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ENVIRONMENTAL STATEMENT

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CORONADO PROJECT

Prepared by

DEPARTMENT OF THE INTERIOR

Bureau of Reclamation
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U.S. Forest Service

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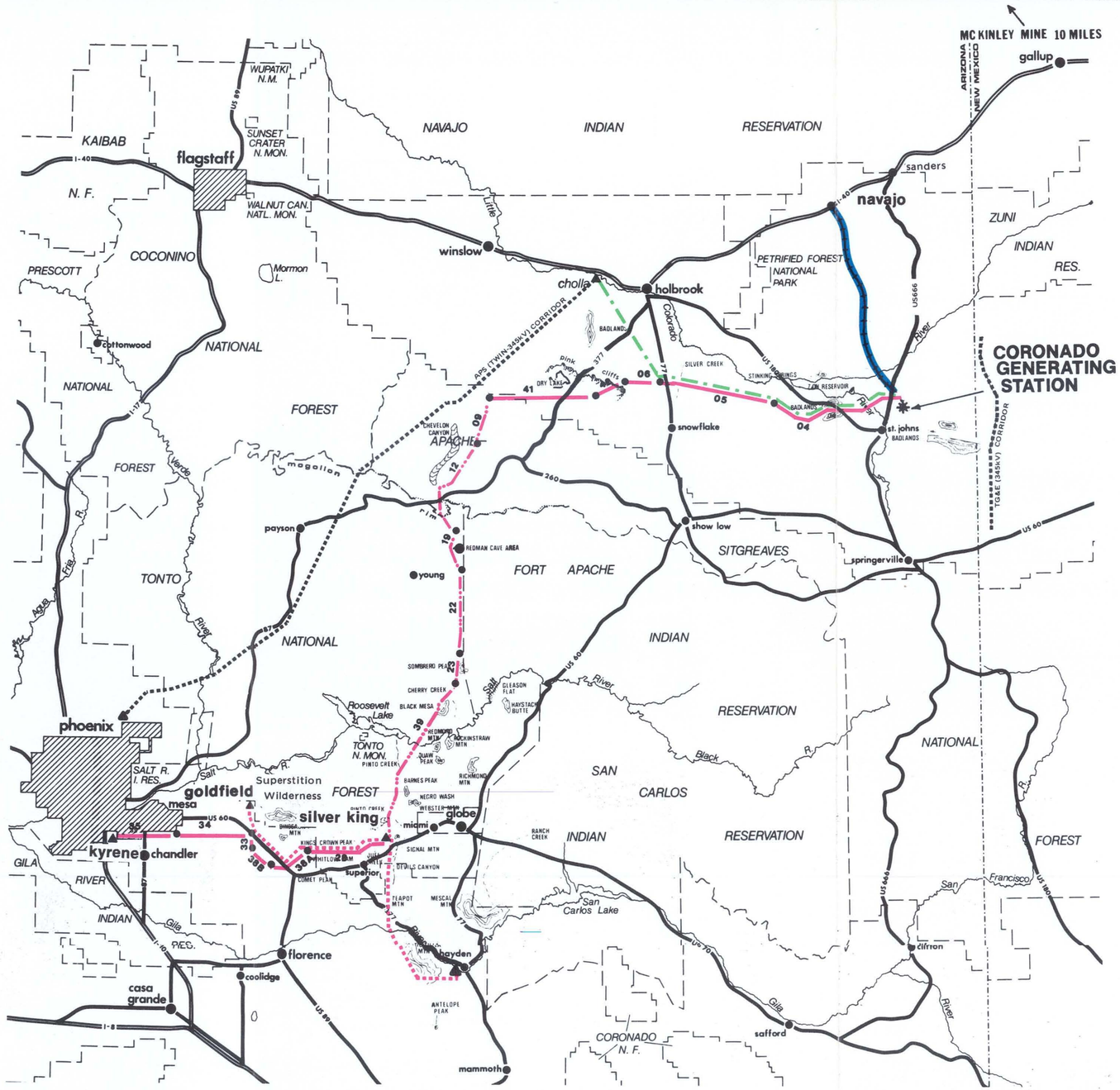

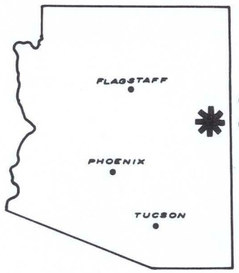

Coronado Generating Station

Proposed 500kV Transmission System

Proposed 500kV Backup System

APS/SRP Common Corridor

Proposed 230kV Transmission Lines

Substation ▲

Proposed Railroad

N

CORONADO PROJECT

LOCATION MAP

Detailed Map of Transmission System Alternates Is Located In The Pocket Attached To The Back of This Statement

Figure I-1

SUMMARY

( ) Draft (x) Final Environmental Statement

Department of the Interior, Bureau of Reclamation, Lower Colorado Region

1. Type of Action:

(X) Administrative ( ) Legislative

2. Brief Description of Action:

This statement describes the environmental impacts associated with the Salt River Project's proposed electrical generating plant at St. John's, Arizona, and associated facilities. The purpose of the project is to provide for a portion of the future electrical energy needs of the Phoenix Metropolitan area in Maricopa County, and for the increased electrical demands of the "Eastern Mining Area." Major facilities consist of a 1050 MW coal-fired electric generating station, associated 500 kV and 230 kV transmission lines, a railroad spur for carrying coal, wellfields and pipelines to transport cooling water, service and process to the generating station, and a limestone source to provide limestone to the Air Quality Control System. The coal from the McKinley mine in northwestern New Mexico will be shipped down the AT&SF line to Navajo, Arizona, where it will be carried 42.5 miles south on the project spur line to the generating plant. The wellfields are north and west of St. Johns and water will be pumped and carried to the plant in underground pipes. The limestone is from a source 4 miles south of the plant. The transmission lines consist of one 500 kV line from the plant southwest 240 miles to the Kyrene Substation, south of Phoenix. It will share a common corridor with the Cholla-Saguaro 500 kV line through the Sitgreaves and Tonto National Forests. A 76 mile 500 kV backup transmission line is proposed to run from the Coronado Station to the APS Cholla plant near Holbrook, Arizona. A Silver King Substation, 60 miles east of Phoenix, is proposed to distribute power along two 230 kV lines - one going to Goldfield Substation just east of Phoenix, and the other going to the Hayden Substation in Hayden, Arizona. The first unit of the generating station is scheduled to be in operation in April, 1979.

3. Summary of Environmental Impacts and Adverse Environmental Effects:

The generating plant, wellfields, pipelines, limestone source, and railroad would occupy 3,516 acres of land. The transmission line would occupy 526 acres.

The generating plant will emit an estimated maximum of 29,400 tons of sulfur oxides, 25,800 tons of nitrogen oxides, and 3,000 tons of particulates each year. These emission rates will comply with state and Federal standards for these types of emissions. Visibility at the plant site would be reduced from an average of 80 miles to an average of 79 miles. Depending on atmospheric conditions, the cooling stacks may produce a plume from 500 to 10,000 feet downwind and may cause ground fog in the plant area. The transmission line will cause adverse aesthetic impacts over its entire length, and particularly where it is not in a common corridor with other lines.

The generating plant would consume 13,424 acre feet of water a year pumped from the Kaibab-Coconino aquifer underlying the St. Johns area. This could result in a lowering of the hydraulic gradient from 21 to 70 feet in the deeper aquifers, from which the water will be pumped. This will not affect vegetation in the area. No significant impacts on other wells in the area are expected. Salt deposition varies with the distance from the cooling stacks; the maximum deposition would be 7.9 pounds per acre per month. This will have no effect on vegetation or animal life in the area.

The major impacts of the transmission lines will be the impact of access roads, tower sites and staging areas on the soils, forage, vegetation, archaeological resources and the impact of the transmission lines themselves on aesthetic resources.

A small portion of wildlife in the project area would be affected by the elimination or disturbance of 5520 acres of habitat for project facilities and by the barrier effect on migratory species caused by the railroad and transmission line.

The population of St. Johns will double after the completion of the project. Surrounding communities will also experience a population growth. This population growth will result in increased urbanization and the need for additional housing, school facilities, and municipal services.

4. Alternatives Considered:

A. Conservation of present energy
B. Purchasing of necessary power from a neighboring utility
C. Alternative energy systems
D. Alternatives to the powerplant
E. Alternate water supply sources
F. Alternate limestone sources
G. Alternate coal delivery methods
H. Alternative methods of power transmission
I. Alternative methods of line construction
J. Alternate route locations
K. Alternative of no action.

5. Comments have been requested from the following

Attached is a list of Federal, state, and non-government agencies which have received copies of the draft statement.

6. Date draft statement made available to council on Environmental Quality and the public: January 14, 1977

7. Date final statement made available to Council on Environmental Quality and the public: AUG 25 1977

CORONADO PROJECT

LISTING OF FEDERAL, STATE, AND LOCAL AGENCIES AND PRIVATE ENTITIES TO WHOM COPIES OF THE DRAFT STATEMENT HAVE BEEN SENT WITH THOSE RESPONDING INDICATED BY "*"

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Department of the Interior, Washington, D.C.
- Commissioner, Bureau of Indian Affairs
- Director, Bureau of Land Management
- *Director, Bureau of Mines
- *Director, Bureau of Outdoor Recreation
- *Director, Fish and Wildlife Service
- *Director, Geological Survey
- *Director, National Park Service

*Advisory Council on Historic Preservation, Denver, Colorado
*Department of Agriculture, Rural Electrification Administration, Washington, D.C.
*Department of Health, Education, and Welfare, Washington, D.C.
Department of Housing and Urban Development, San Francisco, California
Environmental Protection Agency, San Francisco, California
*Federal Power Commission, Washington, D.C.
Department of Army, Corps of Engineers, Washington, D.C.
*Department of Transportation, San Francisco, California
Federal Energy Administration, Washington, D.C.
*Interstate Commerce Commission, Washington, D.D.

Copies distributed by Lower Colorado Regional Office, Boulder City, Nevada

Federal Agencies (Information copies only; responses are anticipated from Washington Offices.)

Department of the Interior
- Special Assistant to the Secretary, Pacific Southwest Region, San Francisco, California
- Staff Assistant to the Secretary, Pacific Southwest Region, San Francisco, California
- Bureau of Indian Affairs, Phoenix, Arizona
  - Superintendent, Hopi Indian Agency, Keams Canyon, Arizona
- Bureau of Land Management, Arizona State Office, Phoenix, Arizona
  - Phoenix District Office, Phoenix, Arizona
- Regional Director, Southwest Region, Fish and Wildlife Service, Albuquerque, New Mexico
  - Field Supervisor, Division of Ecological Services, Phoenix, Arizona
- Bureau of Mines, Intermountain Field Operation Center, Denver, Colorado
- Geological Survey, Water Resources Division, Tucson, Arizona
- National Park Service, Western Region, San Francisco, California

National Park Service, Southwestern Region, Santa Fe, New Mexico
Southern Arizona Group, Phoenix, Arizona
Western Archeological Center, University of Arizona, Tucson, Arizona
Interagency Archeological Services, San Francisco, California
Bureau of Outdoor Recreation, Pacific Southwest Region, San Francisco, California
Department of Army
Corps of Engineers, Phoenix, Arizona
*Corps of Engineers, Los Angeles, California
Department of Agriculture
Soil Conservation Service, River Basin and Watershed Planning Staff, Phoenix, Arizona
*Soil Conservation Service, State Conservationist, Phoenix, Arizona
Regional Forester, Forest Service, Region 3, Albuquerque, New Mexico
Tonto National Forest, Phoenix, Arizona
Apache/Sitgreaves National Forest, Springerville, Arizona
Department of Transportation
Public Highway Administration, Bureau of Public Roads, Phoenix, Arizona
Department of Justice
U.S. Attorney, Phoenix, Arizona
Small Business Administration, District Office, Phoenix, Arizona
Department of Housing and Urban Development, Phoenix, Arizona

State Agencies

Governors of Arizona, California, Colorado, Nevada, *New Mexico, Utah and *Wyoming
Clearinghouses of *Arizona, California, Colorado, *Nevada, *New Mexico, Utah and *Wyoming

Environmental Planning Commission, State of Arizona, Phoenix, Arizona
*Director, Arizona Game and Fish Department, Phoenix, Arizona
Chief, Bureau of Air Quality, Division of Environmental Health, Arizona Department of Health Serivces, Phoenix, Arizona
Chief, Bureau of Water Pollution Control, Division of Environmental Health, Arizona Department of Health Services, Phoenix, Arizona
Chairman, Governor's Commission on Arizona Environment, Phoenix, Arizona
*State Land Commissioner, Arizona State Land Department, Phoenix, Arizona
State Liaison Officer, Arizona Outdoor Recreation Coordinating Commission, Phoenix, Arizona
State Historic Preservation Officer, Arizona State Parks Board, Phoenix, Arizona
Arizona State Soil Conservation Service, Phoenix, Arizona
*Manager, Environmental Planning Services, Arizona Highway Division, Arizona Department of Transportation, Phoenix, Arizona
Executive Director, Arizona Water Commission, Phoenix, Arizona
Staff Economist, Arizona Water Commission, Phoenix, Arizona
Arizona Corporation Commission, Phoenix, Arizona
Economic Security Department, Phoenix, Arizona
Arizona Commission of Indian Affairs, Phoenix, Arizona
State Engineer, Santa Fe, New Mexico

*Director, Environmental Improvement Agency, Santa Fe, New Mexico
*Director, New Mexico Department of Game and Fish, Santa Fe, New Mexico
*State Department of Health, Environmental Services Division, Santa Fe, New Mexico
*Health and Social Services Department, Santa Fe, New Mexico
Secretary, New Mexico Interstate Stream Commission, Santa Fe, New Mexico
State Archeologist, Museum of New Mexico, Santa Fe, New Mexico
Liaison Officer for Historic Preservation, State Planning Office, Santa Fe, New Mexico
*Deputy Director, Division of Natural Resources, State Planning Office, Santa Fe, New Mexico
*Administrator, Energy Resources Board, Santa Fe, New Mexico

Local Agencies

Arizona Atomic Energy Commission, Phoenix, Arizona
Arizona Conservation Council, Phoenix, Arizona
Arizona State Reclamation Association, Phoenix, Arizona
Arizona Water Sports Council, Phoenix, Arizona
Arizona Commission of Agriculture and Horticulture, Phoenix, Arizona
Department of Military Affairs and Emergency, State Division of Emergency Services, Disaster Preparedness Officer, Phoenix, Arizona
Arizona Farm Bureau Federation, Phoenix, Arizona
Colorado Plateau Environmental Advisory Council, Museum of Northern Arizona, Flagstaff, Arizona
Arizona Historical Society, Tucson, Arizona
Environmental Quality Commission, City of Phoenix
City Manager, City of Phoenix
City Engineer, City of Phoenix
Water and Sewers Department, City of Phoenix
Parks and Recreation Department, City of Phoenix
Phoenix Historical Society, Phoenix, Arizona
Phoenix Chamber of Commerce
City Manager, Scottsdale, Arizona
Public Works Department, Tempe, Arizona
Mesa Planning Department, Mesa, Arizona
San Carlos Community Council, San Carlos, Arizona
City of Gilbert, Planning and Zoning Department, Gilbert, Arizona
City of St. Johns, St. Johns, Arizona
Cooperative Extension Service, St. Johns, Arizona
Mayor of Springerville, Springerville, Arizona
Mayor of Show Low, Show Low, Arizona
Town of Snowflake, Snowflake, Arizona
Mayor of Holbrook, Holbrook, Arizona
Mayor of Coolidge, Coolidge, Arizona
Mayor of Florence, Florence, Arizona
Coconino Planning and Zoning, Flagstaff, Arizona
Gila County Board of Supervisors, Globe, Arizona
Gila County Planning and Zoning Department, Globe, Arizona
Maricopa Association of Governments, Phoenix, Arizona
*Maricopa County Planning Department, Phoenix, Arizona
Maricopa County Board of Supervisors, Phoenix, Arizona

*Maricopa County Highway Department, Phoenix, Arizona
Maricopa County Parks and Recreation Department, Phoenix, Arizona
Navajo County Board of Supervisors, Holbrook, Arizona
Navajo Planning and Zoning Department, Holbrook, Arizona
Navajo County Assessor's Office, Holbrook, Arizona
Pinal County Board of Supervisors, Tucson, Arizona
Pinal County Planning and Zoning Commission, Florence, Arizona
Apache County Board of Supervisors, Springerville, Arizona
Apache County Planning and Zoning Department, Springerville, Arizona
Catron County Board of Supervisors, Reserve, New Mexico
Gila River Community Council, Sacaton, Arizona
Hopi Tribal Council, Oraibi, Arizona
Navajo Tribal Council, Window Rock, Arizona
Salt River Pima-Maricopa Community Council, Scottsdale, Arizona
Attorney for Salt River Indian Community, Marks & Marks, Phoenix, Arizona
White Mountain Apache Community Council, Whiteriver, Arizona
Zuni Tribal Council, Zuni, New Mexico
Navapache Electrical Cooperative, Lakeside, Arizona
Central Arizona Water Conservation District, Mesa, Arizona
Central Arizona Water Conservation District, Coolidge, Arizona
Central Arizona Water Conservation District, Phoenix, Arizona
Central Arizona Water Conservation District, University of Arizona, Tucson, Arizona
*Flood Control District of Maricopa County, Phoenix, Arizona
Irrigation and Electrical Districts of Arizona, c/o Rawlins, Ellis, Burrus & Kiewit, Phoenix, Arizona
San Tan Irrigation District, Chandler Heights, Arizona
Roosevelt Water Conservation District, Higley, Arizona
Roosevelt Irrigation District, Buckeye, Arizona
Queen Creek Irrigation District, Queen Creek, Arizona
Maricopa County Municipal Water Conservation District No. 1, Peoria, Arizona
East Maricopa County Natural Resource Conservation District, Chandler, Arizona
New Magma Irrigation and Drainage District, Phoenix, Arizona
Chandler Heights Citrus Irrigation District, Chandler Heights, Arizona
Buckeye Water Conservation and Drainage District, Buckeye, Arizona
Arizona Environmental Health Association, Scottsdale, Arizona
Environmental Conscience, Inc., Phoenix, Arizona
Arizonans in Defense of the Environment, Tempe, Arizona
Arizonans for Quality Environment, Tucson, Arizona
Maricopa Audubon Society, Phoenix, Arizona
Tucson Audubon Society, Tucson, Arizona
Northern Arizona Audubon Society, Sedona, Arizona
National Audubon Society, Boulder, Colorado
Sierra Club, Palo Verde Group, Paradise Valley, Arizona
Sierra Club, Southwest Representative, Tucson, Arizona
Sierra Club, Natural Resources Committee, Santa Fe, New Mexico

Arizona Wildlife Federation, Phoenix, Arizona
The Wildlife Society, Arizona Chapter, Chandler, Arizona
Arizona Lung Association, Southern Branch, Phoenix, Arizona
Native American Rights Fund, Boulder, Colorado
Black Mesa Defense, Santa Fe, New Mexico
Four Corners Regional Commission, Farmington, New Mexico
Municipal Water Users Association, Phoenix, Arizona
National Parks and Conservation Association, Tucson, Arizona
Arizona State Horseman's Association, Phoenix, Arizona
Sportsman's Rod and Gun Club, Phoenix, Arizona
Valley Forward Association, Phoenix, Arizona
Arizona Consulting Engineers Association, Phoenix, Arizona
Arizona Society of Architects, Tucson, Arizona
American Society of Civil Engineers, Arizona Chapter, Phoenix, Arizona
American Society of Civil Engineers, Mesa, Arizona
American Association of Landscape Architects, Phoenix, Arizona
Arizona State AFL-CIO, Phoenix, Arizona
Phoenix OIC, Phoenix, Arizona
NAACP, Phoenix, Arizona
Phoenix Urban League, Phoenix, Arizona
Associated General Contractors of America, Arizona Chapter, Phoenix, Arizona
Phoenix Building and Construction Trades Council, Phoenix, Arizona
University of Arizona, College of Earth Sciences, Department of Hydrology and Water Resources, Tucson, Arizona
Arizona State University, Geography Department, Tempe, Arizona
New Mexico State University, John Muir Institute, Albuquerque, New Mexico
New Mexico State University, Department of Agricultural Economics, Las Cruces, New Mexico
Arizona Electrical Power Cooperative, Benson, Arizona
Arizona Public Service Company, Environmental Management Department, Phoenix, Arizona
Tucson Gas and Electric Company, Environmental Department, Phoenix, Arizona
Frank Lloyd Wright Foundation, Taliesin West, Scottsdale, Arizona
DNA - Legal Services Program, Chinle, Arizona
Peabody Coal Company, Phoenix, Arizona
The Arizona Bank, Phoenix, Arizona
Valley National Bank, Phoenix, Arizona
The Arizona Republic, Phoenix, Arizona
Phoenix Gazetter, Phoenix, Arizona
Tempe Daily News, Tempe, Arizona
Mesa Tribune, Mesa, Arizona
Arizona State University, State Press, Tempe, Arizona
Arizona Farmer-Ranchman, Phoenix, Arizona
Scottsdale Daily Progress, Scottsdale, Arizona

*Valley Bank, St. Johns, Arizona
*Kiwanis Club of St. Johns, St. Johns, Arizona
*St. Johns Chamber of Commerce, St. Johns, Arizona
*Apache Title Company, St. Johns, Arizona
*St. Johns School District No. 1, St. Johns, Arizona
*County Assessor, St. Johns, Arizona
*County Extension Agent, St. Johns, Arizona
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County Library
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Librarian
Scottsdale Public Library
Maricopa County System
3839 Civic Center Plaza
Scottsdale, Arizona 85251

Librarian
Sedona Public Library
Coconino County System
Jordan Road
Sedona, Arizona 86336

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Sierra Vista City Library
Tombstone Regional Branch
Sierra Vista, Arizona 85635

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Springerville, Arizona 85938

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University Library
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Library
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Appendices

The following are appendices containing supplemental information in reference to the environmental statement. The appendices are listed as follows:

No.	Title
A-1	Meteorological Monitoring and Analysis in the St. Johns Area
A-2	Air Quality Monitoring in the St. Johns Area -- Instrumentation and Data Collection Methods
B-1	Air Quality Tracer Studies in the St. Johns Area
B-2	Air Quality Impacts - Ambient SO_2 Modeling Techniques and Procedures
C	Concentration (ppm) of Nine Trace Elements in Soils, Plants, and Animal Tissue On and Within 12 miles of the St. Johns Site
D	Vegetation Representative of the Colorado Plateau in the St. Johns Area
E-1	Bird Communities Near St. Johns, Arizona
E-2	Reptiles and Amphibians Inhabiting the Vicinity of St. Johns, Arizona
E-3	Mammals Present in the Plateau Area that Includes St. Johns, Arizona
E-4	Anthropods Common in Plateau Areas
F	Archeological Sites Recorded Along the Proposed Railroad Alinement
G	Analysis of Natural Beauty - 500 kV Transmission System
H-1	Transmission Line Stipulations -- 500 kV System Joint Corridor
H-2	Easement for Transmission Line -- 500 Kilovolts -- U.S. Forest Service
J	Final Report for Archeological Survey of Four Proposed Substations and Access Roads
K	Correspondence Concerning the Beginning of Construction of the 500 kV lines

Appendices - Volume II

No.	Title
L	Written Comments Received During Review of the Draft Environmental Statement and Responses.
M	Summary of Comments and Replies Presented Orally or in Writing for Inclusion in the Official Proceedings of the February 23, 1977, Public Hearing on the Coronado Project Draft Environmental Statement at St. Johns, Arizona.
N	Summary of Comments and Replies Presented Orally and in Writing for Inclusion in the Official Proceedings of the February 24, 1977, Public Hearing on the Coronado Project Draft Environmental Statement at Kearny, Arizona.
P	Summary of Comments and Replies Presented Orally or in Writing for Inclusion in the Official Proceedings at the February 25, 1977, Public Hearing on the Coronado Project Draft Environmental Statement at Phoenix, Arizona.

I. Description of the Proposal

A. Introduction

This environmental statement describes the Coronado Project or undertaking proposed for construction by the Salt River Agricultural Improvement and Power District (Salt River Project, SRP), a utility providing water and power services to central and east-central Arizona. The Coronado Project includes the construction of a 1050 MW coal-fired generating station near St. Johns, Arizona; a development of three wellfields west of the plant site to provide water for operating the plant; development of a limestone source to service the air quality control system; and construction of 500 kV transmission system; and construction of a coal haul spur railroad from the Navajo siding on the Atchison, Topeka and Santa Fe mainline to the plant site.

The Federal government is not a financial participator in the Coronado Project. The entire project is being financed by the Salt River Project. However, certain project facilities, i.e. the transmission line and the coal-haul spur railroad, will cross lands administered by either the Bureau of Land Management, Department of the Interior, or the U. S. Forest Service, Department of Agriculture. Consequently it is the responsibility of these agencies to assess the environmental impacts of granting rights-of-way for the proposed facilities. Therefore, this environmental statement is being prepared as a joint effort between the Bureau of Reclamation, Bureau of Land Management, both of the Department of the Interior, and the U. S. Forest Service, Department of Agriculture.

The Salt River Project has kept the federal agencies that would be affected by the Project advised of its status since early 1973. Coordination was maintained through a series of meetings (see Chapter IV) and letters in November 1974, after completing the procedures for the State's Powerplant and Transmission Line Siting Committee, SRP formally advised the Department of Interior and the Department of Agriculture of its intentions and requested those agencies begin their procedures to process right-of-way applications. The initial step in these procedures was the preparation of an environmental statement. It was agreed that only one environmental statement should be prepared describing all federal actions that will take place as a result of the Project. The Department of the Interior assumed the lead role in the preparation of the EIS and in December 1974 delegated the lead agency responsibility to the Bureau of Reclamation. The first interagency meeting to establish a federal EIS study team was held in February 1975. Consequently, the team evolved consisting of representation from the Bureau of Reclamation (lead agency) and the Bureau of Land Management, both from the Department of the Interior, and the U. S. Forest Service, Department of Agriculture.

This environmental statement is submitted in compliance with the National Environmental Policy Act of 1969 (83 stat. 852, 42 U.S.C. 4321 et seq.), the Council on Environmental Quality Guidelines (38 F.R. 20550, August 1, 1973), Department of the Interior Regulations (36 F.R. 19343, October 2, 1971) and Bureau of Reclamation Directives (37 F. R. 24910, November 23, 1972).

Construction of the Coronado Generating Station began in 1974 and work on Unit no. 1 (350MW) has proceeded since. As of August 1976 work on Unit 1 was approximately 11 percent complete. Unit no. 1 is scheduled for completion and commercial operation in April 1979. Salt River Project began construction in 1974 because of the long lead times required to meet inservice dates. There were no Federal permits required to allow the start of construction. Unit no. 2 (350MW) is scheduled for completion in April 1980 while the completion date for Unit no. 3 (350MW) will depend upon forecasted demands in the service area.

Construction of the first 30 miles of 500 kV primary and backup transmission lines was started in early October 1976. Construction is planned for both the primary and backup interconnection along Salt River Project's proposed line 4 from the generating station west to the Navajo Apache County line before January 1, 1977. Primary and backup 500 kV transmission line construction is planned to be in progress on links 4 and 5 before the Final Statement for the Coronado Station Project is filed with the President's Council on Environmental Quality.

The federal study team has negotiated a cessation of the transmission line construction at the Navajo County line, a distance of 30 miles west from the plant site. The company agreed to not proceed with transmission line construction on state and private lands until such time as the Final Environmental Impact Statement has been filed.

B. Background and History

In 1973 the Salt River Agricultural Improvement and Power District (Salt River Project; SRP) made known its plans to construct, operate and maintain the Coronado Generating Station (a 1050 MW Generating Station formerly called Arizona Station) and attendant transmission and coal facilities. The powerplant, along with its associated facilities, has come to be known as the Coronado Project.

A comprehensive site selection and environmental impact study was performed pursuant to the intent of the Arizona Power Plant and Transmission Line Siting Act, ARS 40-360, et seq., and the National Environmental Policy Act (NEPA) P.L. 91-190. The goal of the site selection study was to first locate potential environmentally compatible alternative sites and then to provide a basis for the selection of a suitable site on which to build the Coronado Generating Station. The entire process was geared to narrow the 113,909 square miles of land in Arizona down to one preferred site, requiring approximately four square miles.

The Salt River Agricultural Improvement and Power District (Salt River Project) has determined that a 1050 MW Generating Station will be required to meet the growing demand for electrical energy in their service area.

After considering the amount and availability of the fuel required and the time in which a portion of the generating station would have to be in operation, a coal fired, three unit station was selected. Each unit would be constructed to provide 350 MW with the first unit scheduled to be in operation in 1979.

The site selection process spanned a 15-month time frame, starting in April, 1973. The goal of the study was to locate environmentally compatible sites and provide a basis for the selection of a suitable site on which to build the generating station. Of prime concern to the Salt River Project was the availability of water for operation of the powerplant, transportation of coal, a limestone source, and suitable transmission of energy to the Phoenix, Arizona service area and the mining area east of Phoenix.

Nine possible sites were identified within the state of Arizona for locating the generating station. Of these sites, the one located approximately six miles northeast of St. Johns, Arizona was selected. The area would provide the necessary water from three wellfields to be located from one to 15 miles west of the generating site and a suitable limestone source located east of St. Johns. Regardless of the coal

source it was determined that a spur railroad would be required from the Atchison, Topeka & Santa Fe (AT & SF) main line at Navajo, Arizona to the plant sites as coal would be transported by rail. Prior to selecting the St. John's site, Salt River Project contacted individuals, county officials and state offices, expressing their intent of constructing the generating station and requested their comments. With generally favorable replies Salt River Project announced their intentions and selection of the site.

Federal agencies and state offices were advised of their selection of the sites as Rights-of-Way would be required for the transmission line and railroad that would traverse state lands, national forests and public lands within the state of Arizona.

On July 29, 1974, an Application for Certificate of Environmental Compatibility together with exhibit B, volumes 2 and 3 for the Arizona Station Project, (Case No. 16), was filed with the State of Arizona Power Plant and Transmission Line Siting Committee. The Committee held public hearings on the proposed project on September 9-13, and 16, 1974, and granted Certificates of Environmental Compatibility for the generating station and the alignment of the proposed 500 kV transmission system on November 12, 1974. The Certificate for the transmission line alignment was subsequently modified on February 28, 1975 and amended on August 6, 1975 to accommodate revisions requested by SRP.

In November 1974, SRP requested rights-of-way from the U.S. Department of Agriculture and U.S. Department of Interior for transmission lines.

The Proposed Coronado Station Project generally envisions a 500kV transmission line running westerly from the Coronado Station Generating site to an intersection with the Arizona Public Service, Cholla Project, 500 kV line, currently under construction. The 211 mile-long transmission line between the Cholla and Saguaro powerplants will share a joint transmission line corridor through the Apache-Sitgreaves National Forests and the Tonto National Forest up to a substation site, immediately north of the Oak Flat Campground and U. S. Highway 60, on the Tonto National Forest. From this "Silver King substation" SRP's Coronado Station line turns west, passes north of the town of Superior and a residential subdivision in the vicinity of the Whitlow flood control reservoir. From this point, the proposed line crosses U. S. 60 parallels Highway 60 (at some distance) to the previously proposed Dinosaur substation, then turns and heads due west to the Kyrene substation, located in south Tempe. A "backup" interconnection (500 kV) is also proposed between the Coronado Generating Station and the Arizona Public Service Company (APS) Cholla Generating Station.

On June 8, 1976, SRP submitted a tentative 230 kV transmission network as an addendum to the 500 kV transmission line proposal. The 230 kV transmission network was termed the "Eastern Mining Area Proposal". The proposed addendum was a result of new load projections received from SRP's mining customers in November, 1974. The Eastern Mining Area Proposal envisions the 230 kV transmission network to consist of the following components:

Construction of a new 230/115 kV substation near Hayden, Arizona.

Construction of a new 230 kV transmission line connecting the proposed Silver King substation to the proposed Hayden substation.

Construction of a 230 kV transmission line and the upgrading of a portion of a 115 kV transmission line from the proposed Silver King substation to the existing Goldfield substation.

Interconnection of two 115 kV transmission lines with the proposed Silver King Substation.

A Final Environmental Statement on the Cholla Project (filed with the Council on Environmental Quality on 4/9/75) covered construction of the Salt River Project 500 kV line in the same corridor along with the APS 500 kV Cholla line; therefore, no portion of the Coronado Station line lying within the joint corridor will be studied in this statement.

Two environmental assessments of the Coronado Station Project (including proposed transmission line routes) were conducted by an independent, multidisciplinary consultant group, under the direction of Wirth Associates (consultant). This group documented their conclusions in an "Environmental Report, Arizona Station Project (now known as the Coronado Station), Volume III, Transmission System" and "Coronado Project Transmission System, Environmental Report, Addendum A."

Participating organizations and their areas of expertise or responsibility are as follows:

Project management and technical direction - Wirth Assoc.

Climate, physiography, and drainage - Wirth Assoc.

Ecology - Dames and Moore; Dr. Linwood Smith, Arizona State University; and Dr. Roy Johnson, Northern Arizona Museum

Scenic and Visual - Wirth Assoc.

Archeology - Museum of Northern Arizona

Historic - Western Interpretive Services

Land Use - Bruce Howlett, Inc.

Socio-Economic Impacts - John T. Wenders, University of Arizona, Department of Economics

The methodology for the selection of a preferred transmission routing for the Coronado Station Project consisted of both a Regional scale (Phase I) study effort to identify corridor alternatives and a corridor scale (Phase II) environmental, engineering, and right-of-way evaluation.

Corridor Inventory and Analysis

An intensive inventory (including maps) was generated by each consultant for his respective environmental subject area. Any area or structure felt to be significantly affected, either positively or negatively, by the introduction of the 500 kV transmission line was identified. Mapping was done on topographic maps at a scale of one inch equal to two miles. Inventories of physically sensitive data were mapped in a two mile wide corridor while visually sensitive subject areas were mapped two miles on each side of the projected alignment, or within a total corridor width of four miles.

Joint corridors with both the USBR's 345 kV Flaggstaff-Pinnacle Peak line, and the APS twin 345 kV lines from Cholla to Pinnacle Peak were both eliminated by SRP after consultation with the U.S. Forest Service (USFS) as the USFS considers that portions of these lines need to be rerouted. The Cholla transmission line study team indicated to SRP, and its consultant (Wirth Associates) that the Cholla-Saguaro corridor provided a much better alternative environmentally than either of the two previously mentioned corridors. Additionally, corridor alternatives were identified south of the Mogollan Rim by SRP's consultant, by integrating updated information from the Cholla to Saguaro Transmission Location and Import Evaluation Study; and the Palo Verde Nuclear Generating Station Transmission System Environmental Study, and working with personnel from the Tonto National Forest. As a result of this process, a series of alternative line locations were identified.

The following environmental subjects were inventoried and evaluated in the Phase II study:

1. Road access - broken down by the number of miles in good, fair, poor, and no access levels:

2. Physiography - classified by geographic features and land forms;

3. Geology and Soils - classified by geologic formations and soil erosion potentials, i.e., high, medium, low;

4. Ecology - Biotic communities within the two mile corridors along the alternative transmission alignments, including all vertebrate and invertebrate species, and threatened or endangered species;

5. Visual Landscape Character - considering five levels of of natural scenic quality (high, above average, average, modified, and highly modified) as well as three levels of spatial enclosure (enclosed, semi-enclosed, open);

6. Highway Influence - evaluation of the major road systems as they would be visually affected or impacted by a crossing or paralleling of the planned transmission line alternatives;

7. Historic/Cultural Resources - comprehensive listing of historic sites and structures generated in Phase I, including Cholla-Saguaro and PVNGS studies followed by a rating of the historical significance of each inventory item potentially affected by the alternative corridors;

8. Archeology - projection of archeological sensitivities and impacts by corridor links including identification of five levels of sensitivity (extreme, high +, high, moderate, and low) based primarily on projected site density within the alternative corridors;

9. Current Land Use - broken into five area categories (open rangeland, mining, agriculture, U.S.F.S. land use, and residential housing); and,

10. Planned Land Use - includes planned and potential state and county parks, special managment areas, developing and potential recreation sites, county recreation resources. The Buttes Reservior Recreation area, the CAP Aqueduct and Butte Reservior, as well as the Mogollon Rim Land Use Plan (USFS) were also mapped and considered.

To summarize, potential or predictive impacts were identified and assessed for each of the above named subject areas by each consultant based on the following information and considerations:

1. A thorough inventory and mapping of all environmental features;

2. The extent of existing and planned access into the areas adjacent to each routing alternative, and the amount of additional impact caused by road construction and access;

3. A determination of the value, conditions and extent of areas and features potentially affected by construction and operation activities along each routing alternative; and,

4. A knowledge of SRP standard construction and operation practices for an EHV line.

An impact scale was developed for use in describing impact levels as they occur along each line alternative. This scale was "Qualified" into 6 qualitative impact levels; Extreme, Unacceptable or qualified, High plus, High, Moderate, Low and Low minus. These impact levels were then quantified on a 1-10 numerical scale as follows: Low-impact=0.1-1, Low impact level=1-2, Moderate impact level=3-7, High impact level=8-10, and a High+ impact level=Above 10. These impact level scales were applied to each link of each alternative corridor or segment by each consultant in the 10 above named subject areas.

The total impact levels identified for each link were then described in both graphic and tabular form. Impact level maps for each of the above mentioned 10 subject areas are found in the consultants report which is available from SRP or the USFS regional office in Albuquerque.

Following the identification of primary routes and alternatives by Salt River Project and the consultants, the U.S. Bureau of Reclamation, in its role as lead agency in the formulation of the Draft and Final Environmental Statements for the Coronado Station Project, requested the Arizona State Office of the Bureau of Land Management and Regional Recreation Staff Unit of the U.S. Forest Service (Region 3) to evaluate the transmission system (both primary and backup) portion of the statements. As the major portion of the Coronado Station transmission line will be across the Apache-Sitgreaves National Forests and the Tonto National Forest (via the dual corridor with the Cholla line), the Forest Service assumed the responsibility of formulating a study team and evaluating the proposed transmission backup systems and their alternatives as presented by Salt River Project and their consultants.

Study of the proposed 500 kV transmission system and alternatives was well under way when the Eastern Mining Area Proposal (230 kV EMA) was submitted by SRP as an additional part of the Coronado Project. A Study Team was selected to assist in making the 230 kV EMA route selections and to review the environmental assessment of the 230 kV EMA transmission network. Wirth Associates and other parties provided the environmental assessment. This particular study was confined to the study of the various selected routes from the proposed Silver King substation to the proposed new 230/115 kV substation near Hayden. As soon as a preferred route has been selected, SRP will submit an application to the Arizona Power Plant and Transmission Line Siting Committee for approval of the routing and request a Certificate of Environmental Compatibility.

After filing the final Environmental Statement for the Cholla Project with C.E.Q., the Forest Service granted rights-of-way for both lines (APS Cholla and SRP Coronado) through selected segments on Federal lands under Forest Service jurisdiction and joint construction is currently underway by a common contractor.

The Generating Station, wellfields and the water pipeline to the station are currently under construction due to the fact that they are located on private (purchased) properties in which Federal action is not required and to provide energy in accordance with the scheduled date.

A long term coal supply for the Coronado Project has not been established; however, Salt River Project has contracted for interim coal through December 31, 1979 to provide for operation of unit one.

C. Federal Agency Responsibilities

It became immediately apparent that the construction of the Coronado Project required certain approvals by Federal agencies. Table I-1 summarizes these permits and approvals. As the generating station site is on private lands, no Federal approval was needed to locate there. Hence Salt River Project acquired the lands necessary for construction of the powerplant , its access road, and the evaporative pond area. Construction of the generating station was begun in late 1974 in order to meet projected in service date of April 1979 for the first unit.

TABLE I-1

GOVERNMENTAL PERMITS REQUIRED FOR CONSTRUCTION OF THE CORONADO PROJECT

Federal Requirements	Approval, Certificate or Permit
Department of Agriculture	Approval of rights-of-way and use permits. Archaeological permits and clearance.
Department of Interior	Approval of rights-of-way. Archaeological permits and clearance. Power marketing clearance.
Federal Communication Commission	License to operate microwave and two-way radio communication equipment.

State Requirements	Approval, Certificate or Permit
Department of Health Services	Approval to construct water supply and sanitary waste treatment facilities. Installation and operating permits for air pollution control systems.
Land Department	Approval of rights-of-way.
Power Plant and Transmission Line Siting Committee	Certificate of Environmental Compatability (issued November 12, 1974)

The Coronado Generating Station will be required to meet National Ambient Air Quality Standards as well as State of Arizona Air Quality Standards. These standards were promulgated by the Clean Air Act of 1970. Administration of this Act has been delegated to the States by the Environmental Protection Agency. Thus, SRP must demonstrate to the State of Arizona that operation of the generating station will not degrade the air quality beyond what the standards allow.

Construction of the 500 kV and 230 kV transmission systems requires right-of-way across lands administered by the Federal government. The agency most affected by the routing of the transmission lines is the U.S. Forest Service, Department of Agriculture. The other Federal agency affected is the U.S. Bureau of Land Management, Department of the Interior. There are private holdings and state owned lands where right-of-way will have to be acquired, but no Federal action is necessary for their acquisition. Table 1-2 shows the land ownership and right-of-way requirements along the 500 kV and 230 kV systems. A more detailed discussion of these systems is included in Chapter III.

TABLE I-2

CORONADO PROJECT

LAND OWNERSHIP STATUS
500 KV AND 230 KV TRANSMISSION SYSTEMS

(Miles of Line)

	Federal Land (USFS)	Federal Land (BLM)	State Land	Private Land	Total
500 KV System					
Common Corridor with APS Cholla-Saguaro Line	98	0	0	0	98
Balance of Primary Line	20.5	3.28	42.62	75.3	141.7
Coronado-Cholla Backup Line	0	4.70	19.84	49.87	74.41
230 KV System					
Silver King-Goldfield Line	13.5	0.5	17.0	0	31.0
Silver King-Hayden Line	6.2 - 11.9	3.2 - 13.5 1/	2.2-12.9 1/	.8-15.5 1/	26.6-37.6 1/

1/ Mileages shown are the lowest and highest that are most likely to be selected.

Construction of the water well field system will not require federal approval. The well fields are on private lands purchased by Salt River Project. Table I-3 shows the land ownership status. A more detailed discussion of the wellfield system is included in Chapter II.

TABLE I-3

CORONADO PROJECT

LAND OWNERSHIP STATUS
WATER WELLFIELD DISTRIBUTION LINES

(Miles of Pipeline)

	Federal Land	State Land	Private Land	Total
Concho Pipeline	0	8.88	10.48	19.36
Middle Wellfield Pipeline	0	5.79	3.95	9.74

Construction of the 43 mile coal-haul railroad from Navajo, Arizona, to the generating station will require granting of certain rights-of-way by the Bureau of Land Management. Table I-4 shows the status of land ownership for the coal-haul railroad. A more detailed description of this railroad is included in Chapter II.

TABLE I-4

CORONADO PROJECT

LAND OWNERSHIP STATUS - COAL HAUL RAILROAD

	Federal Land (BLM)	State Land	Private Land	Total
Plant Spur Railroad	5.5	13.25	24.75	43.50

D. Institutional Arrangements

Since more than one Federal agency would be affected by the construction, operation, and maintenance of the Coronado Project, the need for a multi-agency environmental statement became evident. The primary actions will be taken by the Department of the Interior and the Department of Agriculture in either granting or disallowing rights-of-way across federally owned lands. As the U.S. Forest Service with the participation of the Department of the Interior, was involved in preparing an environmental statement for the Cholla Project, an expansion of Arizona Public Service Company's Cholla Power Plant, it was agreed that the Department of the Interior assume the responsibility as lead agency in the preparation of the Coronado Project environmental statement.

In December 1974 the Department of the Interior designated the Bureau of Reclamation as lead agency for field preparation of the statement and requested that other Department of the Interior Bureaus lend appropriate assistance in the areas of their jurisdiction and expertise. Subsequent field coordination meetings with the U.S. Forest Service resulted in that Agency, working closely with the Bureau of Land Management, developing the transmission system portion (Chapter III) of this environmental statement.

This environmental statement has been prepared jointly by the Bureau of Reclamation (lead agency), the Bureau of Land Management, and the U.S. Forest Service. In addition, through field coordination meetings and through review of working drafts of the statement, the U.S. Fish and Wildlife Service, the National Park Service, and the U.S. Geological Survey have contributed to the development of the statement.

E. Relationship of the Coronado Project to other Proposed Generation Transmission Networks

1. Planned Power Generation Facilities

To meet the power and energy needs of the future, the Salt River Project is developing several power sources. In addition to Coronado Station, the other sources of power are the Navajo Project, Hayden No. 2, Craig Station, and the Palo Verde Nuclear Generating Station. In order to properly evaluate the need for the Coronado Station, it is important to consider SRP's total resource plans. Table I-5 lists SRP generating resource additions between 1975 and 1985.

TABLE I-5

SRP GENERATING RESOURCE ADDITIONS: 1975-1985

UNIT	SRP CAPACITY (megawatts)	YEAR-ON-LINE
Navajo #3	163	1976
Hayden #2	200 (75 MW recaptured 1982)	1976
Craig #1	110	1978
Craig #2	110	1979
Coronado #1	350	1979
Coronado #2	350	1980
Palo Verde #1	359	1982
Palo Verde #2	359	1984

a. Navajo Project

Salt River Project is the Project Manager and Operating Agent of this 2,250 megawatt coal fired station at Page, Arizona. All three 750 MW units are in commercial operation, with the last unit going on line in April 1976. SRP's share is 163 MW from each unit, or 489 MW from the Project. Other participants in the Project include Arizona Public Service Co., Department of Water and Power - City of Los Angeles, Nevada Power Co., Tucson Gas and Electric Co., and U.S. Bureau of Reclamation.

b. Hayden No. 2

SRP and Colorado-Ute Electric Association Incorporated are adding a second 250 MW coal fired generating unit for operation in 1976 at Hayden, Colorado. SRP will own 80% or 200 MW of this unit until 1982, at which time 75 MW will revert to Colorado-Ute so that both participants will hold 50%.

c. Craig Station

SRP is one of four participants in the Craig Station, also referred to as the "Yampa Project", to be located near Craig, Colorado. The station will consist of two 380 MW coal fired generating units to be operational in 1978 and 1979. SRP will be entitled to 110 MW from each unit. Other participants: Colorado-Ute Electric Association Inc., Platte River Power Authority, and Tri-State Generator and Transmission Association Inc.

d. Palo Verde Nuclear Generating Station

The Palo Verde Nuclear Generating Station is a participation project which will be located 50 miles west of Phoenix. SRP is one of the participants and will receive 359 MW from each of the three 1235 MW units. The units are expected to be on line in 1982, 1984 and 1986.

2. Future Transmission Network

In addition to the Coronado Project transmission line, a number of other plans for transmission of electric power are known. Those plans which could affect the Coronado Station Project Transmission System are discussed below.

a. APS Cholla Plant

A 500 kV transmission system for transferring electric power from the Cholla Plant to the APS Saguaro Plant has been approved by the Arizona Power Plant and Transmission Line Siting Committee. The final Federal Environmental Statement on the Cholla Project, including the transmission system, was filed by the U.S. Forest Service in April 1975. APS will utilize its existing 345 kV lines between the Cholla Plant and the Pinnacle Peak Receiving Station to further support expansion of the Cholla Plant.

b. Navajo Generating Station

All three units of this coal fired generating plant are in production and are owned by six participating utilities including SRP. Two 500 kV transmission lines aligned in a single corridor have recently been constructed. These lines, the Navajo Project Southern Transmission System, transfer power from the Navajo Plant to the Westwing Receiving Station located near Phoenix. Tucson Gas & Electric has plans to construct a single 345 kV line from Westwing Receiving Station to South Substation, to transfer power from the Navajo Plant to the Tucson load center.

c. Palo Verde Nuclear Generating Station (PVNGS)

Three nuclear-powered electric generating units, to be located approximately 50 miles west of Phoenix, have been planned as a joint venture by five utilities. The utility companies included are Arizona Public Service Company, Southern California Edison Company, SRP, El Paso Electric Company and Public Service Company of New Mexico. Construction of the first unit (1,235 MW) began in 1976 and is scheduled to be completed by 1982. The second and third units are scheduled to be on line in 1984 and 1986. The configuration of the transmission system has not been finally determined but will transfer energy from the plant to the Phoenix area to New Mexico and Southern California.

d. San Juan Power Plant

This generating complex, located in northwestern New Mexico, presently has one plant on line with three additional units to be constructed by 1982. The co-owners are Public Service of New Mexico and TG&E. TG&E has completed a 345 kV transmission line from San Juan to the Vail Receiving Station. Construction of another EHV line using the same corridor, is planned to be in service in 1980. This may include a substation at Springerville by 1981.

e. Springerville Power Plant

The Springerville Power Plant is a proposed generating complex, to be located in eastern Arizona, near Springerville, Arizona. The plant will consist of three 350 MW units and will be owned by TG&E. The first two units are tentatively scheduled for 1984 and 1986. TG&E plans to construct a 345 kV line connecting the Coronado and Springerville plants. This line is tentatively scheduled for a late 1980 in-service date.

F. Purpose of the Project

The Salt River Project Agricultural Improvement and Power District (SRP) is a municipality as defined in the Arizona Constitution. SRP has two principal functions, provision of electric power and supplying of water to lands within the district. In the future, the service demands in the Salt River Project territory are expected to increase tremendously. To obtain an accurate picture of SRP's future service obligations, both power demand requirements, and energy requirements must be analyzed.

1. Power Requirements

The Salt River Project must be prepared each year to meet the highest power demand of its customers. Historically, this "peak" has occurred on a hot summer workday afternoon when residential air conditioning usage is highest. Using 1976 as a base year, the peak demand requirements of the Salt River Project are expected to increase from 1732 megawatts to 2393 megawatts by 1980, a 38.2% increase. By 1985, the peak demand requirements are expected to be 3237 megawatts, an 86.9% increase over the 1976 peak demand. Although large, this expected growth is far below SRP's average annual increase (compounded) of 11.7% from 1965 through 1975. Table I-6 shows SRP's forecast peak demands from 1976 through 1985. Foremost among the reasons why the Salt River Project anticipates a large increase in future peak power demands are an increase in the number of residential, commercial and industrial customers.

TABLE I-6

SALT RIVER PROJECT
ESTIMATED ELECTRICAL PEAK DEMAND
1976 - 1985

YEAR	Peak Demand (megawatts)	YEAR	Peak Demand (megawatts)
1976	1732 (actual)	1981	2547
1977	1850	1982	2718
1978	1995	1983	2910
1979	2202	1984	3087
1980	2393	1985	3237

In December 1965, Salt River Project served 119,359 residential customers. While Maricopa County population increased 43% from 1965 1975, by December 1975, SRP was serving 230,712 residential customers, a 94.3% increase. Projections by Valley National Bank indicate that by 1985 the population of Maricopa County will jump from the current population of 1,218,000 people (1976) to 1,900,000 people--a 56% increase. By 1985 SRP expects to be serving 433,000 residential customers, an increase of 202,228 customers or 87.7% above the 1975 figure. The reason SRP's

growth rate is greater than the area average is due to the fact that the bulk of the population growth will be directed toward the suburbs, which are served by SRP. Arizona Public Service Company serves the balance of the metropolitan area.

Increased commercial and small industrial loads are predicted to result from an influx of businesses into central Arizona. Most customers included in commercial and small industrial are service oriented organizations. Their growth is linked directly to the growth of the residential customer class. In 1975 SRP serviced 16,889 commercial and small industrial customers. By 1985 that number is expected to rise to 28,351 a 67.9% increase.

These figures are lower than those projected at the early stages of planning for the Coronado Project. The economic recession that has occurred during the past several years has slowed growth in the Salt River Project service area. As a consequence of this change in the rate of growth, Salt River Project is projecting some excess generating capacity during the period 1978-1983.

In order to reduce the economic impact on its customers of financing facilities earlier than needed, Salt River Project recently began a review to identify several alternatives, including a one-year delay of each of the first two units at Coronado, a short-term sale of 200 to 400 megawatts, a disposition of an ownership interest in generating resources on a recapturable or permanent basis, or some combination of these alternatives.

A preliminary analysis of these alternatives indicates that a delay of the Coronado units is not the most beneficial alternative from an economic viewpoint.

In June 1977, the SRP board of directors approved the temporary sale of 30 percent of Coronado Units 1 and 2 to the City of Los Angeles Department of Water and Power (LADWP). This power will revert back to SRP after Unit 1 of the Palo Verde Nuclear Generating Station goes into operation. At that time LADWP will receive 5.7 percent of Palo Verde Unit 1 in place of the Coronado power.

2. Energy Requirements

SRP's annual energy production has increased by 170% between 1965 and 1975, equivalent to a 10.5% average annual growth (compounded). By 1985, energy production is projected to be 16,050,157,000 KWH --a 73.3% increase over 1976 production.

As in the case of "peak" demand growth, energy increase is due primarily to future growth in SRP customers, but also to greater usage per customer. For example, in 1965 the average usage by SRP's residential customers was 7,287 kilowatt-hours/year. By 1975 the average had grown 76.3% to 12,843 kilowatt-hours/year. SRP is forecasting a continued increase in residential customer usage. By 1985, the average usage/residential customer is projected to be 14,647 kilowatt-hours/year, 14.1% above the 1975 usage.

In 1985, residential energy sales are projected to constitute about 1/3 of total SRP energy sales. The other large users are expected to be commercial and small industrial customers, mine operations, and large industries. Between 1975 and 1985 commercial and small industrial energy usage is expected to climb 159.5%, due to a large increase in the number of establishments. Over the same period, mining energy usage should rise 152.1%, primarily due to expansion. Energy usage of large industries is projected to increase by 70.2%. Table I-7 shows SRP's projected annual energy production between 1976 and 1985.

A dependable oil supply sufficient to provide the projected energy needs is not available. Furthermore, that oil which is available is substantially more expensive than coal for a given energy output. The Arab oil embargo of 1974, and continuing political instability of Middle-East oil producing nations, suggest that a policy of energy self-sufficiency is in our best national interest. Future generation plans involving oil would be inconsistent with this policy.

Consequently, for additional near-term generation needs, SRP plans that base-load capacity will come from coal-fired plants; and existing gas- and oil-fired plants will be utilized mostly for peaking power during heavy energy demands. Percent of energy generated by coal on the SRP system increase by 26% from 1976 to 1980, while oil use will drop from 12% to 2%. Table 1-8 shows SRP's forecasted fuel use for energy production to 1981.

TABLE I-7

SALT RIVER PROJECT
TOTAL ENERGY REQUIREMENTS (INCLUDING
ENERGY PURCHASED, INTERCHANGED & GENERATED)

YEAR	ENERGY (megawatt hours)	YEAR	ENERGY (megawatt hours)
1976	9,260,530 (actual)	1981	12,779,227
1977	10,323,600	1982	13,648,187
1978	10,351,156	1983	14,276,540
1979	11,154,886	1984	15,065,008
1980	11,576,161	1985	16,050,157

TABLE I-8

ESTIMATED FUEL SOURCES

Year	Hydro	Gas	Oil	Coal	Misc. Purchases
1976	13%	3%	12%	60%	12%
1977	12	2	17	64	5
1978	12	-	17	70	1
1979	12	-	7	81	-
1980	12	-	2	86	-
1981	11	-	2	87	-

Salt River Project proposes to build the Coronado Project to meet part of the future power requirement in the service area assigned to the Company by the Arizona Corporation Commission. Major features of the proposed Coronado Project are shown on Figure I-1 (Frontispiece).

G. Description of the Proposed Powerplant

1. Introduction

The Coronado Generating Station will be a 1050 MW coal fired powerplant that will consist of three 350 MW steam electric generating units. Major features of the station will be the main plant, switchyard cooling towers, wellfields, solid waste disposal area, coal storage area, emission stacks, air pollution abatement system, and access road.

The 3840 acre site selected for the Coronado Generating Station is located in the northeast portion of Arizona, approximately six miles northeast of St. Johns, at an elevation of approximately 6000 feet (see Figure I-2). Coal to be used as fuel will be transported by rail to the plant site. Water will be drawn from wellfields that are currently under development and transported to the station by underground pipelines. Mechanical draft cooling towers will perform the function of heat dissipation. The station waste water system will be designed to reuse a maximum amount of waste water with excess waste water discharged to evaporation ponds within the plant site. Solid wastes, bottom and fly ash will also be disposed of within the plant site.

2. Powerplant Site Selection Methodology

The site selection process spanned 15-months, starting in April 1973. The potential transmission corridors and coal transportation systems were considered in the plant site selection study. The goal of the study was to locate environmentally compatible sites and to provide a basis for the selection of a suitable site on which to build the generating station.

The specific criteria originally used as the basis for this study were as follows:

a. The plant site will be located in Arizona.

b. The generating station will be coal fired.

c. The first 350 MW unit must be in service by mid-1979.

d. The planned size of the generating station will be 3 units of 350 MW or 1050 MW total.

e. Service will be to the Phoenix, Arizona area with one of the transmission tiepoints located east of Phoenix.

f. Indian lands will be excluded from consideration for the plant site.

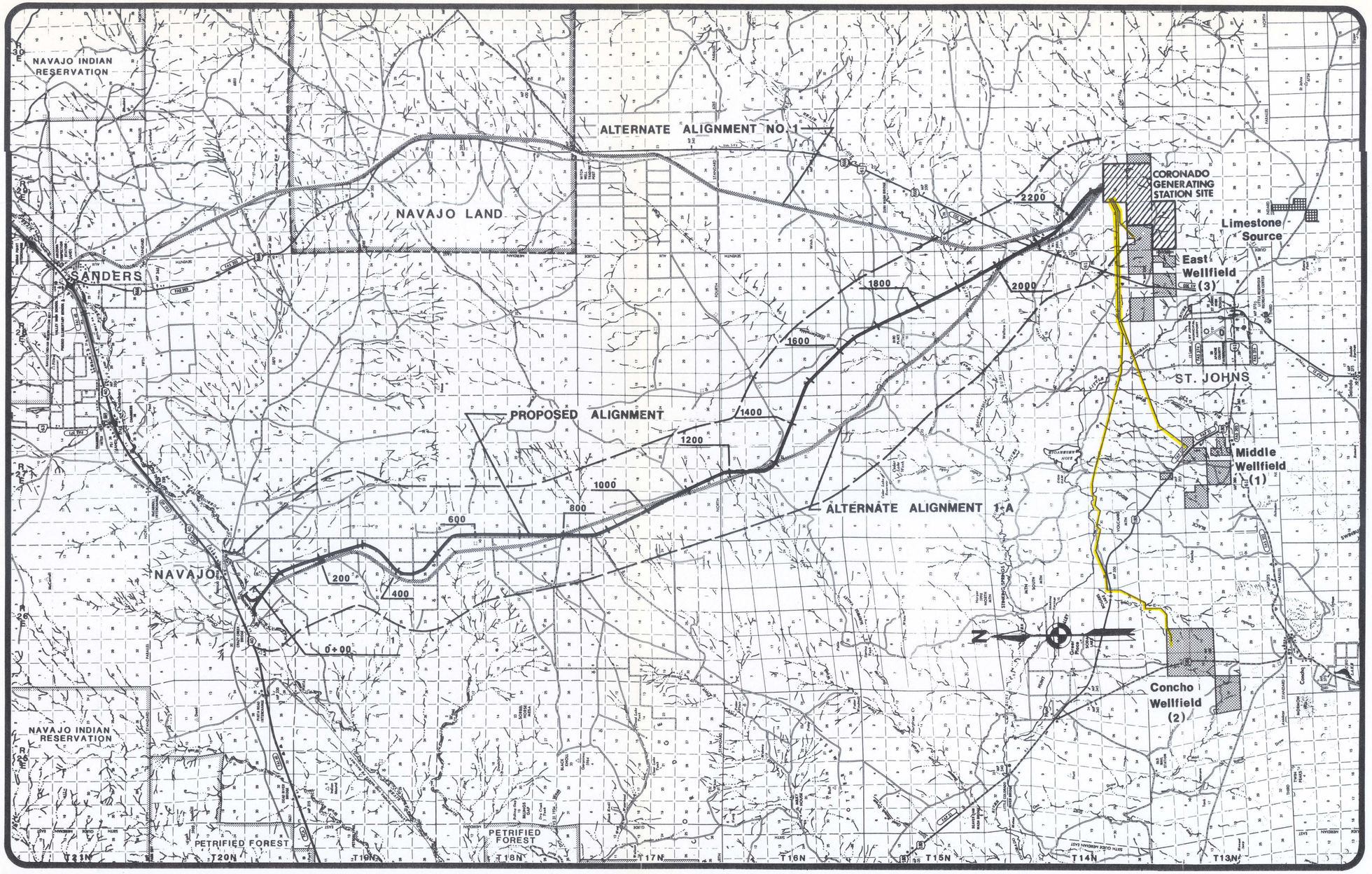
The last exception was considered necessary by Salt River Project in order to assure the completion of the project within the available time period. Past experience has indicated that simultaneous negotiations with the Department of the Interior, the Bureau of Indian Affairs, tribal councils, and traditional groups could not be accomplished within the time schedule.

In order to compare the site ultimately selected to the entire region of interest, without subjecting the large area to the same high degree of detail, a disciplined site selection process was devised. This process is shown on Figure I-3. The process began with a broad survey of the entire region and ended with a highly detailed study of the proposed sites. The program was subdivided into three phases: IA, IB, and II.

Environmental aspects were dominant in Phase IA. A broad survey of the entire state was performed by environmental consulting specialists in the fields of air quality, ecology, and land utilization. In addition, water availability was considered. Each consultant, using the best information available and including factors each believed to be most important, devised a relative ranking of different portions of the State. The goal was to locate all zones within the State with a high likelihood of containing potential environmentally compatible sites. The results of their input were synthesized to describe the zones of greatest overall environmental compatibility with respect to the specific criteria.

The last step in the process of finding suitable zones involved factoring in the criterion of water availability. The potential candidate zones, as described above, were examined to determine whether water was available within the zone and whether site location in any part of the zone would require the transportation of ground water out of a "basin." The latter situation resulted in elimination of some, and boundary adjustments in the other zones.

Only after the determination of the boundaries of these zones, were engineering factors considered. These along with environmental factors, were considered in the Phase IB evaluation of many potential candidate sites. This included a search for feasible sites within the acceptable zones and the review and adjustment by the consultants of selected sites. As a result of field investigations and further studies, two of these sites were selected for final evaluation on the basis of environmental, engineering, and economic considerations.



GENERATING STATION

WELLFIELD

LIMESTONE SOURCE

WATER PIPELINES

PROPOSED RAILROAD ALIGNMENT

BASE MAP: ARIZONA HIGHWAY DEPT.

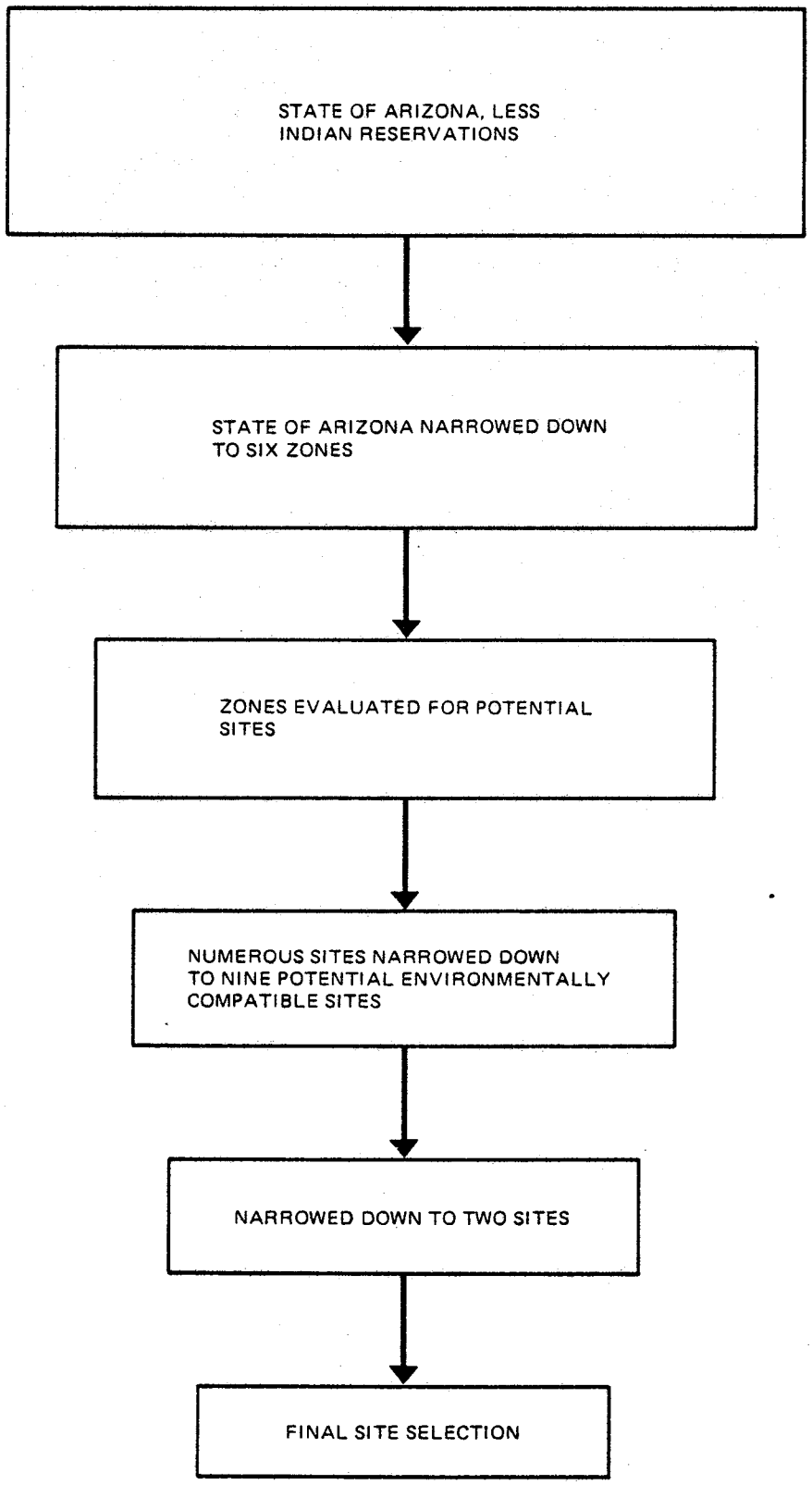
0 1 2 3 4 5 MILES

CORONADO PROJECT

Coronado Generating Station

PLANT SITE AND VICINITY

Figure I-2



NARROWING DOWN PROCESS

Figure I-3

Phase II consisted of detailed studies of both sites. The goal of the Phase II investigation was to provide information in sufficient detail to confirm environmental compatibility, such that either site could become the basis of an application to the appropriate State and Federal regulatory bodies.

It is important to consider the character of sites outside the candidate zones indicated in this study. There is no justification for assuming that specific sites outside the zones are necessarily environmentally unacceptable. Two factors must be kept in mind. First, the procedure for locating the zones was designed purely as a rational process for increasing the likelihood of finding the most desirable sites for a coal burning powerplant within a reasonable budget and time frame. Second, deeply interwoven in the selection process are the characteristics of the particular project under consideration. Different types of projects, different industries, even a different type of powerplant, would have significantly different environmental impact criteria, and hence, would likely result in different zone boundaries and locations.

3. Generating Facilities

A description of the Coronado Station is presented in the following section. Included is a description of the main plant features and the preliminary site arrangement.

a. Major Plant Features

The Coronado Generating Station will be a semi-enclosed, coal-fueled, thermal plant with a portion of the boiler, turbine-generators and major auxiliary equipment contained within two main power buildings.

The plant will consist of three 350 MW identical pulverized coal-fired, steam electric generating units designed to produce a total of 1050 MW net output. In addition to the main power buildings, coal and ash handling facilities, water storage reservoirs, evaporation ponds, mechanically induced draft cooling towers, administration building, 500 kV switchyard, and satellite water wellfields will be included in the plant complex.

The boilers will be the natural circulation drum type design, with balanced draft firing and single level front-rear opposed burner arrangement. The chimneys will be of reinforced concrete, 500 feet above grade level. The flue gases from Units 1 and 2 will be combined in one stack with separate liners. Unit 3 will have a separate stack.

Electrostatic precipitators will be provided to remove particulate matter from the boiler flue gas. Sulfur dioxide (SO_2) control systems will be provided to reduce SO_2 emissions from the flue gas to the atmosphere, in compliance with Arizona air pollution laws (Arizona Revised Statutes 36-770 et seq, and 36-1700 et seq.), Federal laws (including the Federal Clean Air Act, 42 United States Code 1857 et seq.) and other State and Federal regulations.

The coal is to be delivered to the site by rail and the ash trucked to an onsite disposal area. Mechanically induced draft cooling towers will be utilized to remove heat from the main condenser circulating water system for each unit.

The output of the three generators will be transmitted at 500 kV from the main step up transformer into an on-site switchyard which will be provided for transmission of the plant output of electrical energy. One 69 kV transmission line will run from the plant site to a Navopache Electric Cooperative station in the vicinity of St. Johns, Arizona.

Figure I-4 is an artist's conception of Units one and two, power blocks and administration building complex, and Figure I-5 shows Units 1 and 2 under construction.

b. Site Arrangement

The Coronado Station will be a new design and construction project with all new site development work. The plant arrangement for the St. Johns site is shown in Figure I-6. Figure I-7 is a location and vicinity plan. The power building enclosure will house the turbine generators, steam generators, coal silos, generating plant auxiliary equipment, and the auxiliary boiler.

The switchyard will be located adjacent to the power building to facilitate connection of the main transformers to the 500 kV transmission lines. A schematic diagram of the 500 kV switchyard is shown in Figure I-8. A 69 kV substation, located in a corner of the 500 kV switchyard, will provide electrical energy to Arizona Public Service Company to supply Navopache Electric Cooperative in the St. Johns region. The administration shop, and warehouse buildings will be attached to the power building.

Cooling towers will be provided for the generating units. Meteorological data favor location of the cooling towers north and south of the power block area. The towers for units one and two will be north of the power block area and the tower for unit three, south of the power block area. Onsite water storage reserviors, located adjacent to the cooling tower area, will be provided to ensure continuous plant operation in the event of short-term outages of the offsite wellfield water supply.

UNITS 1 AND 2

CORONADO GENERATING STATION

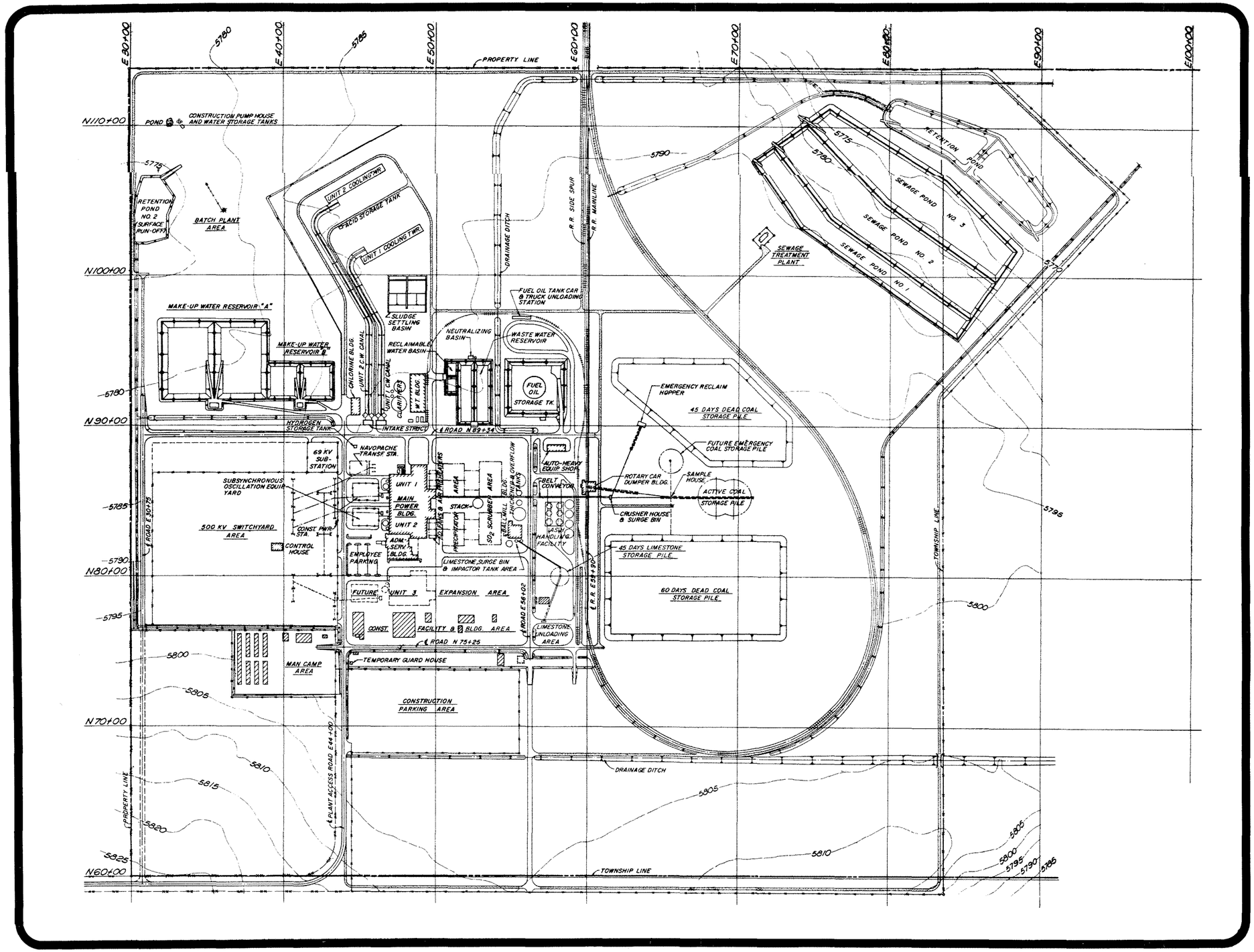
Figure I-4

(a) Units I and 2 - Turbine pedestal under construction. May 1976.

(b) Caissons and foundations for Units I and 2 - Boiler and electrostatic precipitators under construction. May 1976.

CORONADO GENERATING STATION UNDER CONSTRUCTION

Figure I-5



GRAVEL ROAD
ASPHALT CONC. ROAD
RAILROAD

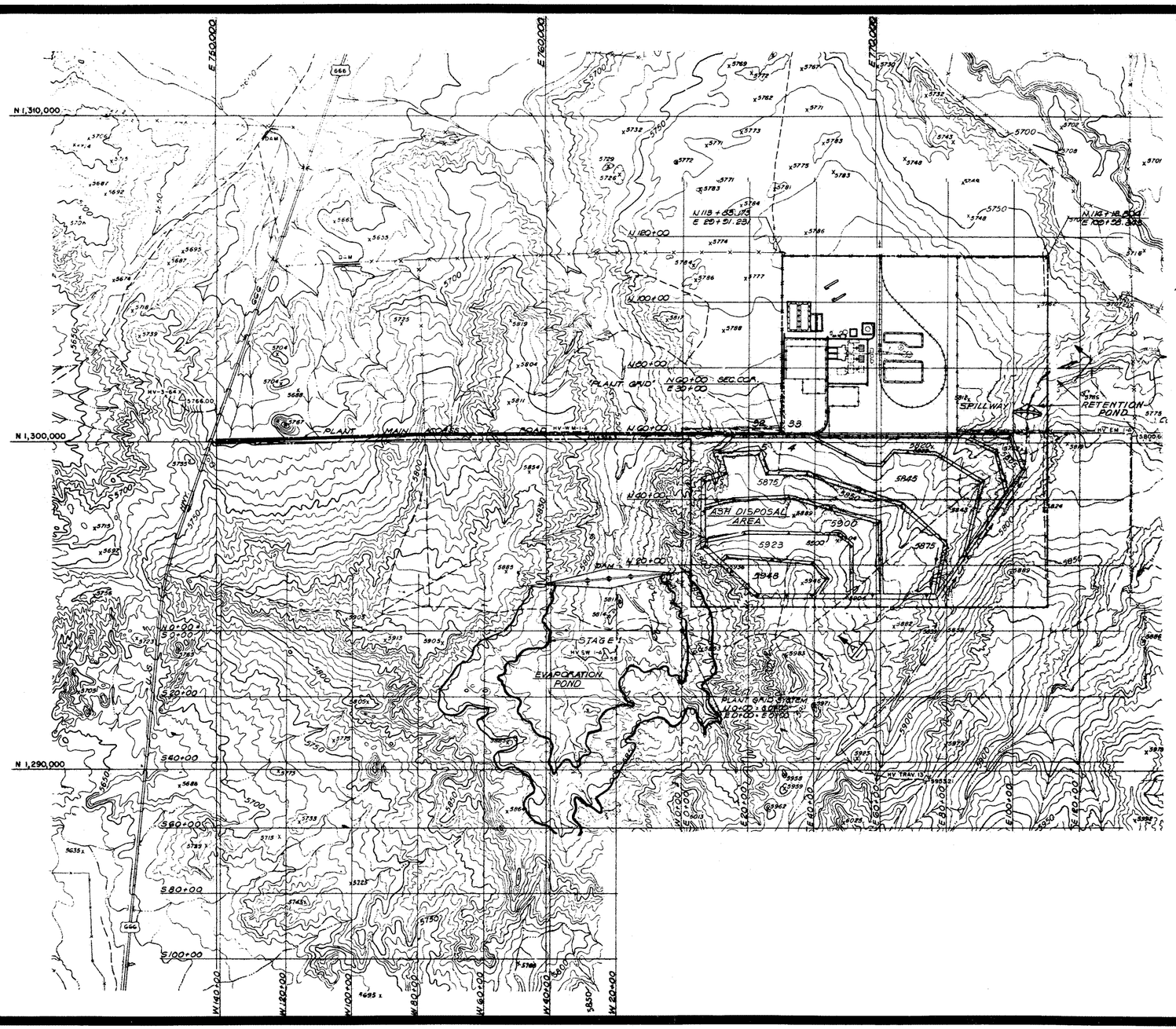
N

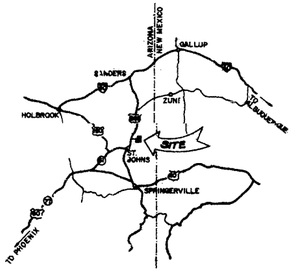
200 0 200 400 feet

CORONADO PROJECT

ON-SITE RAILROAD AND PLANT LAYOUT

Figure I-6





VICINITY MAP

10 5 0 10 20 30 40 50
GRAPHIC SCALE IN MILES

N

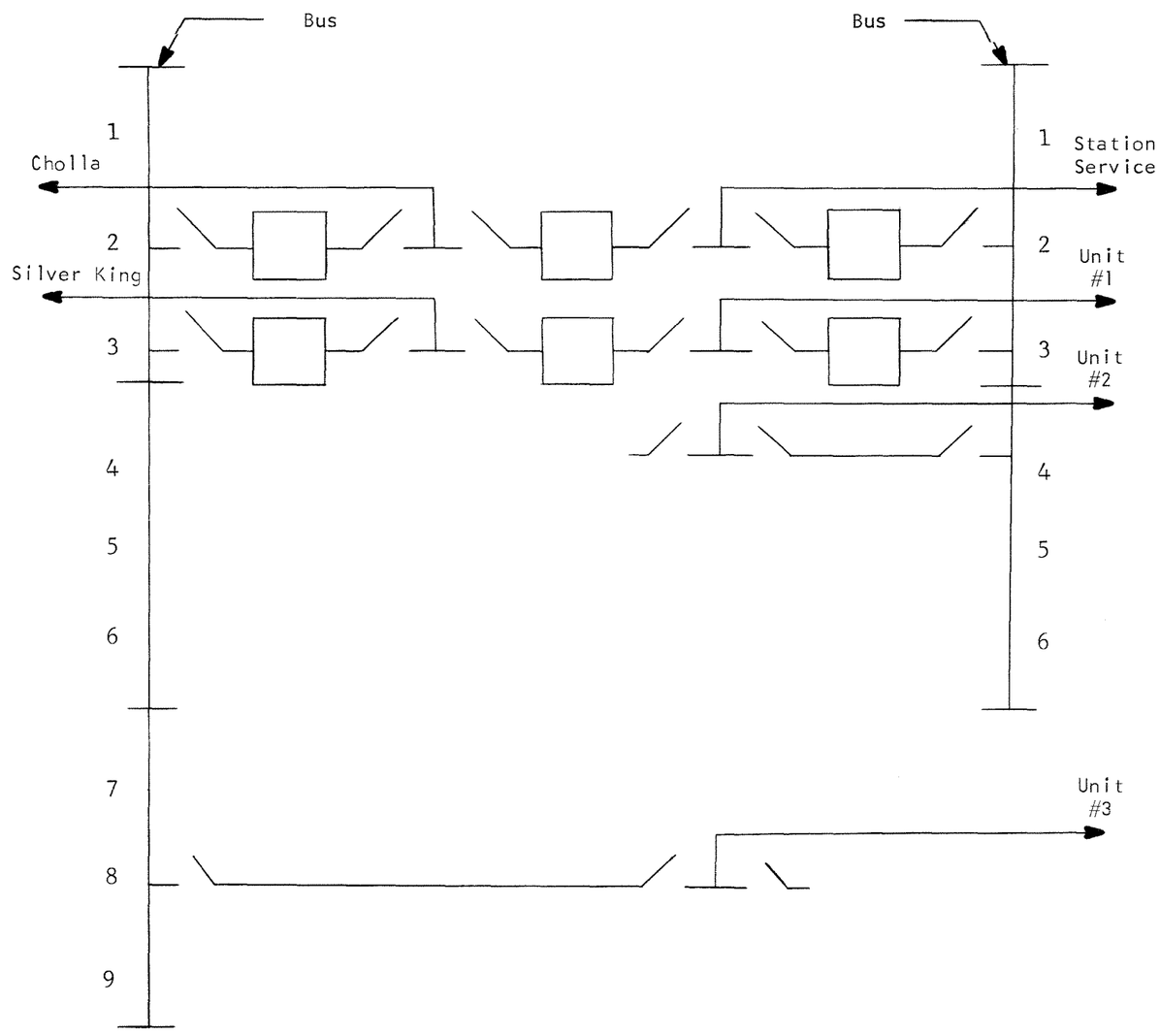
1000 0 1000 2000 feet

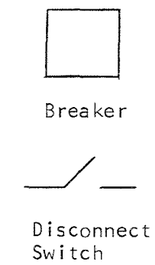
CORONADO PROJECT

Coronado Generating Station

LOCATION AND VICINITY PLAN

Figure I-7





CORONADO PROJECT

Coronado Generating Station

CORONADO STATION 500kV SWITCHYARD

ONE-LINE DIAGRAM

Figure I-8

Onsite evaporation pond areas are proposed for disposal of sanitary waste water and coal storage area runoff. Unreclaimable station waste water will be stored in an onsite retention basin for use in the SO_2 removal, ash handling and coal dust suppression systems. The boiler bottom ash and ash from the fly ash recovery systems will be trucked to an onsite disposal area. Excess waste water will be evaporated in the evaporation ponds which may also be used for disposal of scrubber sludge.

Several months supply of coal will be stored onsite to allow for delays in coal delivery. A fuel oil storage tank will be provided for the auxiliary boiler and the main boiler ignitors. The tank will be located adjacent to the rail spur line for tank car unloading if rail delivery is provided. Earthen dikes having a storage capacity of 100% will be constructed around the tank.

Plant service roads will be provided for ready access to all parts of the plant. Other service roads to the solid and liquid waste disposal area will also be provided. Figure I-9 is a schematic of the major plant systems for the Coronado Generating Station.

4. Buildings and Structures

Administration and plant services will be integrated to form a single, three-level building complex attached to the Units 1 and 2 main power building. The main power building for Units 1 and 2 will be approximately 200 feet high, 400 feet long and 125 feet wide. The service building will contain a machine shop, warehouse, repair shop and personnel facilities. The main power building for Unit 3 will be 200 feet high and will occupy an area of approximately 25,000 square feet. The chimney for Units 1 and 2 will be a combined stack design 500 feet high; the diameter at its base will be 60 feet, and the diameter at the top will be 47 feet. In addition, there will be a separate water treatment building, a ball mill building (for limestone grinding) and an automotive shop.

5. Coal Handling and Storage

a. Quantities

For the three units of the Coronado Generating Station operating at maximum load, the estimated coal requirements are 16,000 tons per day (ton/d) for average grade coal based on an anticipated input and coal heating value as follows:

Moisture	19.0%
Ash	14.8%
Sulfur	0.6%
BTU - 9,130 per pound	

However, these characteristics may vary considerably, depending upon the coal sources used through the life of the plant.

b. Coal Delivery

Coal crushed to three inches maximum size will be delivered by rail. Two unit trains will be required to deliver enough coal to satisfy the daily needs of the plant at full operation. Each unit train would consist of about 100 cars and carry approximately 10,000 tons of coal.

c. Unloading

Rail cars will be unloaded one at a time, by a rotary car unloader. An enclosure to minimize dust emissions will be provided at the dump point. Coal dumped from the cars will fall into a hopper beneath the unloader building. From the hopper the coal will be fed to a belt conveyor and transported to the active storage pile. Coal will be sampled enroute to the pile to monitor moisture, ash, sulfur and heat content, and trace elements (as required). The conveyor will discharge coal to the pile via two vertical, concrete pipes, 12 feet in diameter with holes in the sides to attain uniform distribution of the coal. These pipes, called lowering wells, will minimize dust and wind pick up.

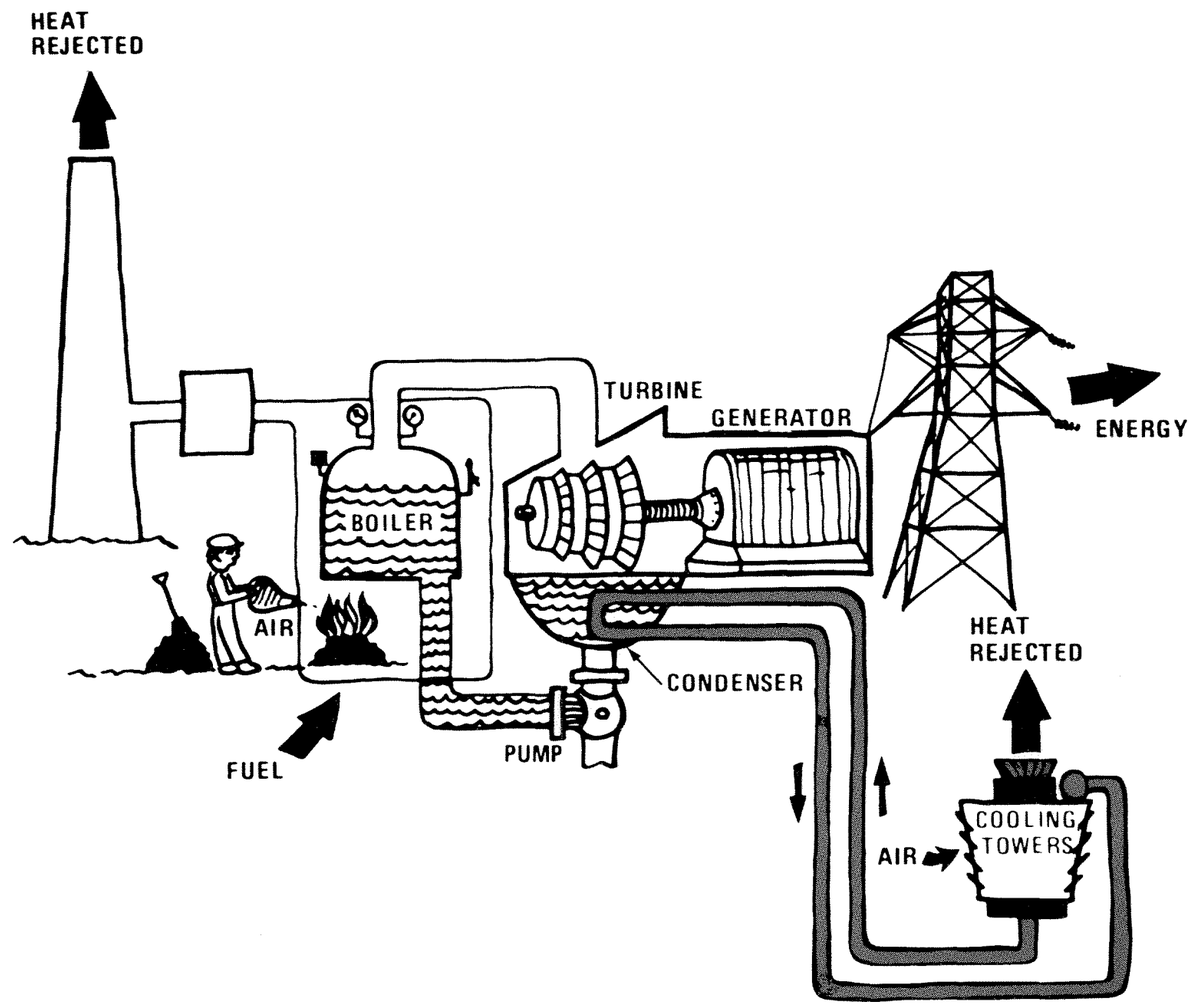
d. Coal Conveying System

Figure I-10 is a schematic diagram of the coal handling system to be constructed on the plant site. Coal will be transported from the active storage by means of a plow feeder and conveyed to the crushing station, where any oversized material will be reduced in size. Crushers will discharge into either of two conveyors leading to the plant. The conveyors leading to the main plant structure will discharge onto either of two reversing conveyors, which in turn will feed additional conveyors to fill the pulverizer feed silos. Normally, one conveyor line will be used, the other will be held as standby. In an emergency, both conveyor lines could be used at the same time.

All conveyors will run in fully enclosed galleries to minimize dust. To control dust within the galleries and buildings, all transfer points will be further enclosed with hoods and skirt boards. Additional dust control will be provided by a dust suppression system and dust collectors. The coal crushers will also be enclosed. The dust suppression system will spray water containing wetting agents on the coal to reduce the tendency of dust to escape and, if necessary, will be used at all transfer points from one belt to another and at interim storage areas.

Dust collectors will be used on the crushers and silos to:

1/ Vent any gases generated when coal is stored and eliminate possible fire hazard; 2/ Maintain a slight vacuum on the bins and thereby control dust emissions from conveyors discharging into bins;, and, 3/ Control dust from nearby transfer points.

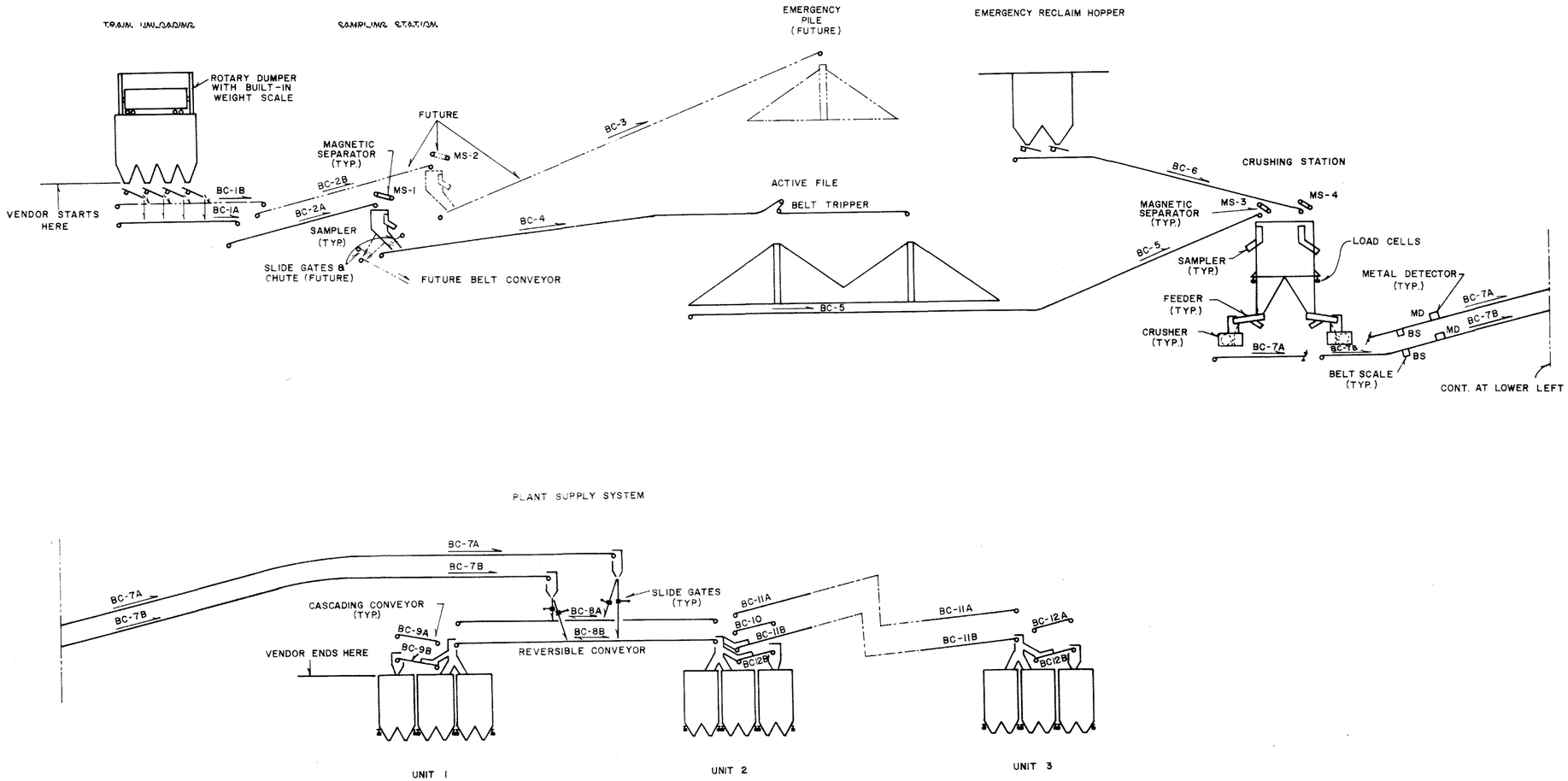


CORONADO PROJECT

Coronado Generating Station

SCHEMATIC DIAGRAM

Figure I-9



BC BELT CONVEYOR

MS MAGNETIC SEPARATOR

CORONADO PROJECT

Coronado Generating Station

COAL HANDLING FLOW DIAGRAM

Figure I-10

e. Active and Inactive Coal Storage

Active, inactive (reserve) and seasonal storage piles will be provided for onsite coal storage. Inactive storage is designed to provide coal for plant operation in case of major disruption of coal deliveries or equipment problems. Active storage is designed to supply the plant between normal coal deliveries and for the weekend (approximately a three day supply). A seasonal pile may also be required to meet peak load conditions if uniform deliveries are scheduled for rail hauls.

Based on preliminary engineering estimates, active coal storage may have a total capacity of approximately 54,000 tons. Two conical piles are proposed, each of which will be approximately 85 feet high. Coal will be rotated in the active storage to eliminate the hazards of spontaneous combustion and emission of gases and smoke.

Based on preliminary estimates, the inactive or reserve coal would consist of approximately one million tons of coal and would be approximately 40 feet high. The surface of the inactive coal storage pile will be compacted to eliminate diffusion of air into the pile and dusting due to wind. The seasonal storage pile, if provided, would be an extension of the active pile. Water will be used to minimize dusting in the immediate area.

f. Coal Storage Area Runoff

Water runoff from the coal storage area will be directed to an onsite evaporation pond northeast of the main power building that will be sized to retain the runoff. Coal dust present in the runoff water would be deposited in the evaporation pond.

6. Fuel Oil and Lubricating Oil Storage

Fuel oil will be delivered to the plant by railroad tank cars via railroad. The fuel oil storage tank shown on the layout plan (Figure I-6) will be 66 feet in diameter and 40 feet high, with a storage capacity of 24,000 barrels. Fuel oil will be used in the main boilers up to 12.5 percent of full load. The auxiliary boiler (for start-up steam production and auxiliary heating) will burn fuel oil up to full load. A diked area with sufficient capacity to contain a spill and sufficiently impermeable to ground leaching will be provided around the fuel oil storage tank. Concrete sumps and curbs will be provided around equipment with significant oil storage capacity such as transformers, lubricating oil storage tanks, and lubricating oil purification units.

Oil discharge from equipment in the plant will be directed through floor drain systems to oily water separators for collection of the waste oil in sumps, pending removal by a commercial disposal company via tank truck. Fuel oil and lubricating oil system design will be in accordance with applicable EPA Oil Pollution Prevention Regulations, NFPA flammable liquid storage requirements and API storage and handling standards.

7. Highways and Railroads

a. Major Highway Transportation Routes

Road service to the St. Johns site is provided by U. S. Highway 666, the primary two-lane paved road, running north and south approximately three miles west of the site. U. S. Highway 666 intersects Interstate Highway 40, approximately 47 miles north of the site, and 7 miles south of the site passes through St. Johns. U.S. Highway 60 intersects U.S. Highway 666 approximately 25 miles south of St. Johns near Springerville and continues in a southwesterly direction through Show Low to Phoenix, approximately 225 miles from the site.

b. Access Road to the Generating Station

Access to the site required a new access road which was constructed in 1974/75 entering the site from the west. It is designed to meet heavy truck wheel loads that will be imposed during construction and transportation of materials and equipment, since a rail spur line will not be available at the beginning of plant construction. The road has been paved with asphaltic concrete material. The access road passes over gently rolling terrain with no grade greater than 4%. Water drainages are provided with culverts, as required.

c. Plantsite Access Roads

On-site plant service and work roads are to be provided as required, including a service road to the ash disposal area. The access road and on-site roads shall be paved with three inches of asphalt concrete over ten inches of base coarse material (unless physical constraints dictate a different design). A prime coat of liquid asphalt shall be applied to all surfaces to be paved with asphalt concrete. An emulsion and cover aggregrate seal coat shall be applied to the finished surface of asphalt concrete.

d. Railroad Facilities on Site

The coal haul railroad which will be constructed from the Santa Fe mainline is described in Section I-1. The railroad enters the generating station on the north side of the yard as shown on Figure I-6. The railroad makes a loop around the coal storage yard, and passes through the coal handling building where its payload is removed. Track design and appurtenant features are described in Section I-3.

8. Water Systems

a. Water Management System

(1) Design Plan

Studies will be made during the pre-construction phase of the design to develop a program that will satisfy the following requirements:

(a) Minimize station make-up water usage by maximizing recovery and recycling of station process waste waters.

(b) Provide a make-up water supply system that will meet long range environmental goals to minimize effect on ground water tables and effect on other possible future users in the St. Johns area.

(c) Monitor all station waste waters to verify that methods of disposal are in accordance with Federal and state regulatory requirements.

(d) Review alternate designs for methods of chemical treatment, where required, to provide economic use of the available water supply.

Several methods will be investigated to provide the most economic use of the water supply which is to be obtained from underground wells in the general area. Methods for economic pre-treatment of water to meet boiler make-up requirements may include de-ionization by use of demineralizers, reverse osmosis, electrodiolysis and zeolite softening prior to distillation by submerged tube evaporators. The degree of chemical treatment and method of operation will be studied for all other process system water uses to minimize waste water quantities. Consideration will be given to lime-soda ash pre-treatment of cooling tower make-up water to reduce total dissolved solids and thereby minimize tower blowdown waste quantities. Other considerations will also be given to: (1) mixing of acidic and alkaline process liquid wastes to provide neutral pH mixtures which can then be reclaimed as cooling tower make-up; (2) treatment of floor drains and cooling tower blowdown for recycle and re-use.

(2) Implementation of the Water Management Plan

Curves showing predicted make-up water and waste water flow quantities will be developed for use during initial operation as a guide for controlling water usage quantities. Complete station make-up and waste water balances will be prepared for operational guides. Flows will be measured to verify the accuracy of the design and to

control water usage. Evaporation ponds will be monitored for controlled seepage. Well water analyses and underground water tables in the general area will be monitored to verify acceptability to regulatory requirements. Adequate records will be maintained of water usage such that alternate long range programs can be initiated if required.

b. Circulating Water System

Heat generated in the plant interfaces with the environment in three ways: (1) heat from the boiler/turbine-generator system is converted into electrical power; (2) heat is discharged to the atmosphere as thermal energy in the flue gases which issue from the stacks; and, (3) heat is transferred in the main condensers and auxiliary equipment coolers to the circulating water system which, in turn, transfers the heat to the atmosphere through the cooling towers.

Secondary interfaces that account for a smaller portion of the heat losses are the ash disposal system, evaporation pond, and radiation and convection from equipment. Some additional heat losses might also occur from flue gas SO_2 removal systems.

The circulating water system for each of the three generating units is to be a separate closed loop. Water will be pumped from the associated cooling tower canal and intake structures, through the tubes of the unit's main condenser, and back to the cooling tower. The circulating water requirement is 179,000 gpm to be supplied by two circulating water pumps per unit each sized from 90,000 gpm. The circulating water will pick up the heat rejected by condensation of the turbine-generator exhaust steam in the main condenser. This heat will then be transferred by the circulating water to the atmosphere via the cooling towers. As the water falls into the air draft from the upper elevation of the towers into the basin, it will be cooled both by evaporation and convection. Then the cooled circulating water will again be pumped to the main condenser. Water will be lost from the circulating water system in three ways: (1) evaporation in the cooling towers; (2) drift loss as liquid droplets entrained in the exhaust air, (independent of water lost by evaporation); and, (3) cooling tower blowdown to limit excessive dissolved-solid buildup in the main condenser and auxiliary equipment coolers.

These water losses will be continually replenished by pumping from the station makeup water reservoir which will, in turn, be replenished with water obtained from the underground well fields.

(1) Cooling Towers

In the wet type evaporative cooling tower system, heat exchange between the air and the warm circulating water is derived from both the evaporative cooling of water and the convective heating of air. Heat is rejected to the atmosphere as saturated air from the cooling tower fan stacks. Heat will not be discharged to any bodies of water external to the station.

There will be one cooling tower per generating unit. Each tower will be approximately 65 feet high. The design parameters for the wet cooling towers are as follows:

Parameter	Temperature (^{o}F)
Wet-Bulb	66
Approach	14.6
Range	22.3

(2) Cooling Tower Blowdown

Cooling tower blowdown is defined as that fraction of cooling tower water which is removed from the circulating water system to control or reduce the concentration of salts and other impurities in the circulating water system. Excessive concentration of salts will cause fouling of main condenser and auxiliary equipment heat transfer surfaces. Since this blowdown water is of satisfactory quality for limited re-use, it will be directed to the waste water reservoir for storage use as makeup to the SO^2 removal system and solid waste handling systems. Cooling tower blowdown, in excess of that required for the above systems, will be directed to the evaporation pond area.

c. Water Supply System

Each well pump will be provided with a gate valve for positive shutoff and a check valve to prevent back flow. Where necessary, air relief valves and total flow meters will be provided.

Tank reservoir and booster pumps will be provided in selected areas. They will require a separate transmission pipeline to the site reservoir. During periods of low power output from the generating station only a part of the wellfield systems will be in service. Adequate system redundancy will be provided to allow for maintenance and repairs on one or more of the wellfield systems without interfering with normal plant operation. The onsite reservoir receiving water from the wellfields will be sized for several days storage capacity at full load. This capacity will allow for scheduled or emergency repairs on the wellfield supply systems. Water analyses indicate that some of the well water will require pretreatment on-site to reduce the dissolved solids prior to use in the various plant process systems.

The reservoirs shown in Figure I-6 will be open. The capacities of the reservoirs are:

Make-up water reservoir A	3.70×10^6 ft^3
Make-up water reservoir B	0.53×10^6 ft^3
Reclaimable water reservoir	150,000 ft^3
Sludge settling basin for water softener sludge from clarifiers	2 basins, each 5 acres
Waste water reservoirs	300,000 ft^3

d. Chlorination Treatment Facilities

To control growth of algae, chlorination systems will be provided for the cooling towers and the make-up water reservoirs. It is planned to provide one system for the reservoir and another for the cooling towers. Unit 3 cooling tower may have a separate chlorination system depending on its location.

Each chlorination system will consist of a chlorinator, chlorine evaporator, program control panel, chlorine injector, liquid chlorine manifold and chlorine storage. Liquid chlorine will be delivered and stored in one ton cylinders which will be connected to a supply feed manifold. Approximately 16 one ton cylinders will be stored on site. Anticipated chlorine usage is 300 lbs/hr per unit, with treatment frequency of approximately one hour per day.

The chlorination equipment will be housed indoors in a separate heated building and the cylinders will be stored in an adjacent semi-outdoor area protected from exposure to the sun and solar heating. The injection of chlorine for the applicable system will be automatically controlled by a timer. Chlorine is metered, evaporated and dissolved in water which carries it to the point of application. The chlorine solution will be pumped through underground rubber-lined piping with minimum possible piping runs. The chlorination building will be equipped with chlorine detection equipment, and leaks will be alarmed to alert station personnel.

9. Air Quality Control System

Engineering details of applicable sub systems will be contained in the application for installation/operating permit filed with, and subject to approval by, the State of Arizona Dept. of Health Services.

a. Sulfur Dioxide Control

The SO_2 control system for the Coronado Generating Station is being designed to meet all applicable Federal and State air pollution laws, rules, and regulations.

Preliminary analysis of coal core data shows that sulfur dioxide removal equipment will be required to meet the existing Arizona SO_2 emission regulation.

Thus, SRP has selected a non-regenerative limestone wet scrubbing process for flue gas desulfurization at Coronado. The system, being designed for installation, will consist of two parallel scrubbers, each designed to treat up to a maximum 40 percent of the flue gas. In effect, 80 percent of the flue gas in each unit will be treated. The scrubbers selected for Coronado are horizontal scrubbers manufactured by Pullman-Kellogg. A contract for the scrubber system was awarded to Pullman-Kellogg in June, 1976.

Bechtel Power Corporation, the engineer-constructor, is engineering the total systems based on the successful demonstrations of the Mohave Power plant SO_2 Horizontal Scrubber Module.

The preliminary design proposes the use of cooling tower blowdown for preparation of the limestone slurry and for make-up to the scrubber system. Waste product buildup (scrubber sludge) resulting from reaction of the slurry and SO_2 in the flue gas will be minimized by continuous purge to dewatering equipment. Details of the disposal system for the scrubber sludge have not been finalized.

The existing scrubbed flue gas will be reheated by an indirect reheat method using by-passed flue gas. The design details are now under evaluation.

b. Particulate Removal

The particulate removal system for the Coronado Generating Station will utilize electrostatic precipators.

Electrostatic precipitators ionize gas molecules by passing the flue gas between a high-voltage electrode and a grounded electrode. The suspended solid particles are charged by bombardment by the gaseous ions or electrons. The existing electrostatic field causes the charged particles to migrate and adhere to the grounded electrode, where the charge is neutralized. Periodically, the collecting electrodes are cleaned by rapping and the collected particles drop into hoppers for removal to the ash handling facility and subsequent disposal.

Each unit will have a separate hot side electrostatic precipitator constructed by Joy-Western. The guaranteed efficiency at 105 percent maximum air flow is 99.875 percent. Higher removal is expected at lower air flows.

c. Nitrogen Oxide Control

Turbo-fired boilers have been selected for the Coronado Generating Station that will meet Federal and Arizona standards for NO_x emissions. The boilers will be designed with overfire air ports and special burner configuration to meet these standards.

10. Stack Emissions and Height

a. Boiler Emissions and Related Standards

The Coronado Generating Station will burn a sub-bituminous, high ash, low sulfur, and low heating value coal. The heating value, ash, sulfur, and moisture contents are presented in Table I-9. The State and Federal emission standards for pollutants were used for analysis of

long-term effects on the environment. To provide maximum operation flexibility and capacity, the reject-grade coal that could be expected to be burned for short durations is used as design criteria for the station equipment. Since there is no correlation between coal heating value and sulfur content, reject-grade coal is assumed to have the lowest heating value and the highest ash and sulfur contents.

With an estimated requirement of 12,000 x 10^6 Btu/h heat input for the three units of the Coronado Generating Station operating at maximum load, coal burn rates are estimated at 650 ton/h for average-grade coal based on the heating values given in Table I-9.

Table I-9

COAL HEATING VALUE AND PROXIMATE ANALYSIS

Coal Value and Content	Average-Grade Coal
Heating value, Btu/lb	9130
Sulfur content, %	0.60
Ash content, %	14.8
Moisture content, %	19.0

Preliminary calculations of the output of boiler emissions without flue-gas treatment for the first unit are presented in Table I-10 for average-grade coal. These rates when three units are in operation are calculated and reported in Table I-11. The allowable emission rates for the applicable Federal and Arizona emission standards are also included in the tables.

TABLE I-10

SUMMARY OF BOILER EMISSIONS FOR 1 UNIT

(4000 x 10^6 Btu/h Heat Input)

Effluent	Boiler Emission Average-Grade Coal (ton/h)	Applicable Standard and Allowable Emission Rate for New Sources ton/h (lbs/10^6 Btu)	
SO_2	2.6	Federal 2.4	(1.2)
		Arizona 1.6	(0.8)
NO_x	1.4	Federal 1.4	(0.7)
		Arizona 1.4	(0.7)
Particulates	22.7	Federal 0.200	(0.1)
		Arizona 0.306	(0.153)

TABLE I-11

SUMMARY OF BOILER EMISSIONS FOR 3 UNITS

($12,000 \times 10^6$ Btu/h Heat Input)

Effluent	Boiler Emission Average-Grade Coal (ton/h)	Applicable Standard and Allowable Emission Rate for New Sources ton/h (lbs/10^6 Btu)	
SO_2	7.9	Federal 7.2	(1.2)
		Arizona 4.8	(0.8)
NO_x	4.2	Federal 4.2	(0.7)
		Arizona 4.2	(0.7)
Particulates	68.1	Federal 0.60	(0.1)
		Arizona 0.492	(0.082)

Based on standard boiler design considerations, it is conservatively assumed that 20% of the coal ash will be collected as bottom-ash and rear pass ash, and 80% of the ash will leave the boiler as fly ash. It is also assumed that 100% of the sulfur in the coal reacts to form SO_2 that is then emitted from the boiler. The estimated emission rates (in ton/day) without flue-gas treatment and concentrations of the components of the flue gases are shown in Table I-12 for three units at maximum load, burning average-grade coal. Also shown are the total daily coal burn rates and the volumetric flue gas flowrate.

b. Stack Height

It was determined that a minimum stack height of 500 feet will be required to prevent downwash of the plume into the boilers. Once the particulate, sulphur oxide, and nitrogen oxide emission requirements have been satisfied, it becomes a function of the stack height to provide sufficient dispersion to satisfy Federal and state ambient air quality standards. It was found that stacks 500 feet high will meet the standards.

TABLE I-12

ESTIMATED BOILER EMISSIONS FOR 3 UNITS

Basis: 12,000 x 10^6 Btu/h Heat Input

Average-Grade Coal

(Coal Burn Rate, 15,800 Tons/Day)

Boiler Emissions	Ton/Day	ppm (Volume)
CO_2	25,800	140,000
H_2O	7,600	101,000
O_2	4,000	29,000
N_2	85,400	729,000
SO_2	115	430
SO_3	3	9
NO_x (as NO_2)	100	520
Total flue gases (4.55 million ft^3/min at 250F, 0.81 atm)	123,000	
Fly Ash Emissions		
*with no control	1,634	
**as controlled	11.8	

11. Limestone Source and System

a. Source

(1) Limestone Requirement

It has been estimated that the Coronado Generating Station will require approximately 96,000 tons of high quality limestone per year, for a total requirement, over the 35-year estimated operating life of the plant, of 2.1 million tons. This quality may vary, depending upon the quality of the coal over the life of the plant. At the maximum mining rate it would be necessary to deliver 342 tons of limestone per day to the Coronado Plant. Quality specifications require that

this limestone must contain 95% or more calcium carbonate ($CaCO_3$) and less than 2% magnesium carbonate ($MgCO_3$). It is to be used in the process of scrubbing the plant's flue gasses for removal of sulphur dioxide. The specific quantity of limestone required will depend upon the quality of the fuel supply over the 35 year plant life.

Combined operation of the Cholla (Arizona Public Service Company) and Coronado (Salt River Project) generating stations would require a total plant-life reserve of 3.8 million tons of limestone. If both of their limestone requirements were to be supplied from the Welch claim (as discussed in the following sections), for which an average limestone thickness of 10 feet was assumed (based upon core-drilling data), a total of about 112 acres would be strip-mined, for an average increase in surface disturbance of about 3.2 acres per year. It was additionally estimated that the total limestone requirement for both plants would be approximately 40% of the 9.6 million ton reserve estimated to be in the southern portion of the Welch claim.

(2) Location

Two different types of high quality limestone occur within approximately six miles of the community of St. Johns. The available limestone deposits were found to be either Pleistocene travertine or Permian Kaibab limestone. The travertine is in a surface deposit covering some five to ten square miles in total surface area, while the Kaibab forms an extensive subsurface deposit throughout the area with surface outcrops in only a few places.

The most promising travertine deposit covers nearly two square miles of Apache County land that is controlled by two individuals. Mr. Del Fisher owns 160 acres of land that is currently being used for grazing. Mr. M. H. Welch has mining claims on two areas adjacent to the Fisher deposit, a 317 acre parcel of Federal (BLM) land to the east and a 160 acre parcel of State land immediately to the south. It appears that the continuous limestone deposit underlying this area is from 30 to 50 feet thick and of fairly uniform high quality. The Project would, however, only mine the top 10 feet of the deposit. Both the Welch and Fisher limestone sources are surface deposits that should require minimal removal of overburden prior to stripping. Test borings indicated approximately 1.5 to 2 feet of overburden as a maximum in most areas.

The limestone deposit that is being given primary consideration is contained within the 317 acres of M. H. Welch travertine limestone claims located on BLM lands (Section 4, T12N, R29E) approximately five miles east-southeast of the community of St. Johns. Other limestone sources being considered include the 160 acre Welch claim (Section 8, T12N, R28E), the Del Fisher travertine deposit (Section 5, T12N, R29E) adjacent to the Welch prospect, and several other occurrences of travertine and Kaibab limestone in the vicinity of St. Johns.

The M. H. Welch limestone claim consists of Calcium Claims No. 1 through 16, recorded by Mr. Welch on July 19, 1973, located approximately six miles south of the Coronado plant site, five miles east-southeast of the community of St. Johns, and approximately 4.5 miles from the nearest paved road. The distance to the Coronado Generating Plant, utilizing existing roads, is approximately 12 miles. This deposit of travertine limestone averages 30 to 50 feet thick (with extremes of 0 to 143 feet) and is of high quality, with analysis indicating that a major part of it is 97.5% $CaCO_3$ and less than 0.7% $MgCO_3$. Studies indicate, however, that the lower few (five to ten) feet of the limestone is not of acceptable quality.

The claim area is open, sparsely covered grassland that is utilized for grazing. A garbage dump exists between the proposed mining area and St. Johns. Access to the site is provided by Salt Lake County Road, a dirt road that crosses roughly west to east between the Fisher land and the southern (160 acre) Welch claim. This road connects with U. S. Highway 666 (State 61) at the community of St. Johns to the northwest and with the community of Salt Lake, New Mexico, to the east.

(3) Arizona Public Service Company Participation

The Welch claim, which is being considered for this mining operation, is on land managed by the Bureau of Land Management. Mr. Welch has the right to mine valuable minerals, but the Federal government controls the surface estate. The grazing rights on the parcel are leased by Ms. Ellen Davis. Arizona Public Service Company obtained an option for development of the limestone deposit from Mr. Welch and entered into an agreement with Salt River Project to share the costs of development on a 50-50 basis, and to also share the limestone in an unspecified manner. The original intent was for APS to take the lead in obtaining the required limestone for both the APS Cholla Generating Station and the SRP Coronado Generating Station from this source. Since that time the Cholla plant has been delayed, thus placing SRP in the position of needing to develop the limestone source first.

b. Mining Methods

Of the 18.4 million tons of limestone estimated in the Welch prospect, approximately 17.5 million tons are considered to be mineable reserves. This quantity appears to be more than sufficient for the plant-life needs of both the Cholla and Coronado generating stations combined. Utilizing standard strip-mining equipment and techniques it has been estimated that the total cost of this limestone to the Coronado Plant would be $3.35 per ton.

Mining would be done by drilling and blasting to loosen the rock, loading, probably by means of one front-loader, onto trucks, and hauling to the crushing and/or calcining facilities at the plant site. It is possible that an on-site crushing and screening facility would serve as an intermediate operation in order to provide sized limestone to the plant site. There is an existing low-voltage distribution line along the south side of Salt Lake Road which will probably be tapped to provide minimal service to the mine area.

At the current stage of project planning many of the details of the mining operation are not known, such as the number or size of the trucks to be used, the location of the crushing facilities, the number of on-site personnel required, the number of shifts to be worked per day, the blasting schedule, etc. Thus, no firm assessment of these aspects of the mining operation is possible at this time.

c. Transportation

Crushed limestone would probably be hauled to the Coronado plant site by a fleet of diesel-powered highway tractors equipped with bottom-dump trailers. It is estimated that normal plant operation would require approximately]63 tons of limestone per day (with a maximum of 342 tons per day). Since the tonnage capacity of the trucks normally used for this type of operation (if equipped with lightweight trailers) is about 25 tons, there would be about seven round trips per day between the limestone source and the generating station, seven days a week, or approximately nine trips for a five-day week, for normal operation. If the maximum amount of limestone were required at the plant, hauling would increase to about]4 trips per day for seven days or]9 trips per day for a five-day week.

There is no existing road from the Welch limestone claim directly to the Coronado plant site, and none is planned. Existing dirt roads cross the proposed mining area and run to the community of St. Johns. Truck transportation of the limestone from the mining area to the plant site, on existing roads, would utilize approximately 4.5 miles of dirt road (from the mining area to St. Johns), and 3.5 miles of paved access road from U. S. 666 to the generating station.

While the existing Salt Lake Road appears to be of adequate design and condition to withstand use by the assumed number of heavy truck trips per day, it is possible that it will require upgrading. It may also be necessary to upgrade existing dirt roads near the quarry area to handle the truck traffic. Preliminary considerations suggest that a 30-foot wide roadway, plus ten feet on either side, would be required for the quarry access road, with an assitional right-of-way width of about 25 feet for the powerline. Thus the quarry operation would require a minimum access right-of-way of approximately 75 feet. It may be necessary to construct additional bridges or culverts along Salt Lake Road and additional road maintenance is likely due to the heavy truck traffic. It may be necessary, in order to meet the requirements of State and County regulations concerning control of fugitive dust, to surface this road, particularly if local development should continue.

U. S. Highway 666 (State 6]) is a major north-south corridor between Sanders and St. Johns. This highway has a very light volume of traffic, with 1972 daily traffic levels of 385 vehicles projected to increase to 452 vehicles per day in 1990.

d. Processing

As presently envisioned the limestone mining operation will be primarily limited to quarrying and hauling. While it is probable that a sizing or crushing operation will be necessary prior to use of the limestone, any such process would most likely be carried out at the plant site. Significant impurities that may be included in the limestone deposit, as discussed in the following section, would not be included in the material transported to the plant.

Current estimates are that normal plant operation would require 163 tons of limestone with a projected maximum daily requirement of 342 tons.

There will be plant-site storage of limestone, as required, sufficient for at least 30 days of normal operation. This will require one acre of surface area.

e. Waste Disposal

Disposal of mining wastes could become a problem at the mining site. The limestone to be quartered contains layers of other, unusable materials. For instance, thin, discontinuous beds of sand and clay occur within it, with most test drill holes intercepting such layers. Most beds ranged from a fraction of an inch to about six inches, with an average thickness of about one to three inches. In one hole silty clays of up to about two feet thick were encountered. It appears that these layers are discontinuous and localized. Near the bottom of the travertine deposits the sand and clay content increases. In areas where the sands and clays become significant constituents of the limestone it was not considered to be economically suitable for mining. It was estimated that the sand and clay content of the limestone should amount to less than one percent. The proposed method of disposal of this waste material (which could ultimately amount to some 21,000 tons) has not been specified.

It is most likely, however, that this material will be avoided, where possible, in the loading operation and simply left among the mining debris. In this case disposal would be no problem. Should a crushing facility be constructed at the quarry site a mass of waste material could accumulate in its vicinity and thus pose a problem. At this point in the planning process it is not known whether such waste material will be generated.

12. Waste Disposal Systems

a. Liquid Wastes

(1) Evaporation Ponds

A maximum of approximately 600 acres of Sections 7 and 8, T13N, R29E, may be required for the waste water evaporation pond. This acreage was determined using an evaporation rate of 33.6 inches per

year. This area was selected as the disposal site because of the clay-shale Chinle Formation which underlies the site. This formation is 150 to 200 feet thick and essentially impervious. The coefficient of permeability for this formation is less than 0.1 foot per year. A sketch of the piping plan to the evaporation pond area is shown in Figure I-11. Disposal of sanitary waste will be provided by a separate evaporation pond.

(2) Sewage Treatment Plant and Sanitary Waste Water Plan

The sewage treatment plant will be an aerobic waste treatment plant. Treating capacity of this system will be about 40,000 gal/d for the construction period and nominally an average of 10,000 gal/d for the station after completion of construction. The clear effluent will be discharged to the sanitary waste evaporation pond and evaporated.

(3) Plant Process Waste Water

(a) Introduction

Plant process waste water includes all water used in any way by the generating station; it does not include storm water runoff. The station waste water system will be designed to economically reuse a maximum amount of process water with a minimum discharge of waste water to evaporation ponds or other waste handling equipment. Processed waste water from one system will be used as makeup to another system if the latter system can accept the quantity and quality of the waste stream. Excess waste water not usable by the station will be disposed of by evaporation in the ash and evaporation ponds. These ponds will be designed to prevent seepage.

Figure I-12 shows the estimated water balance and quantities for three units at average and maximum load. The following systems would recieve reused water as makeup.

(b) SO_2 Removal System

This system normally will not produce waste water other than moisture contained in the alkaline scrubber solid wastes. It will consume cooling tower blowdown, primary water treatment sludge (if plant make-up pretreatment is required), and service water, to make up the water rejected with the sludge and evaporated in the scrubbers when hot flue gases contact the alkali slurry. It is anticipated that normally, no waste water will be discharged from the SO_2 removal system. However, should dissolved solids in the scrubber water exceed an allowable concentration limit of approximately 15%, a blowdown stream will be used to control the dissolved solids concentration. This blowdown would be directed to the evaporation pond.

(c) Ash Handling System

This system will accept cooling tower blowdown.

(d) Cooling Tower/Circulating Water

This system will require reasonable water quality with a total dissolved solids concentration less than 2000 parts per million for wastewater recovered as makeup water. Waste streams of this quality (such as boiler blowdown, sand-filter backwash, and condensate makeup demineralizer rinses) will be collected in a reclaimable water retention basin and fed to the cooling tower basins via the primary water softener.

(e) Coal Dust Suppression System

This system will use cooling tower blowdown as a primary source of supply, backed up by service water.

(f) Cooling Tower Blowdown System

Blowdown water from the cooling tower/ circulating water systems of each generating unit will be discharged to the waste water reservoir as required to control the solid concentration of the circulating water. From this reservoir, this water would be pumped for reuse in the SO_2 removal systems, as described above.

(g) Steam Generator Blowdown

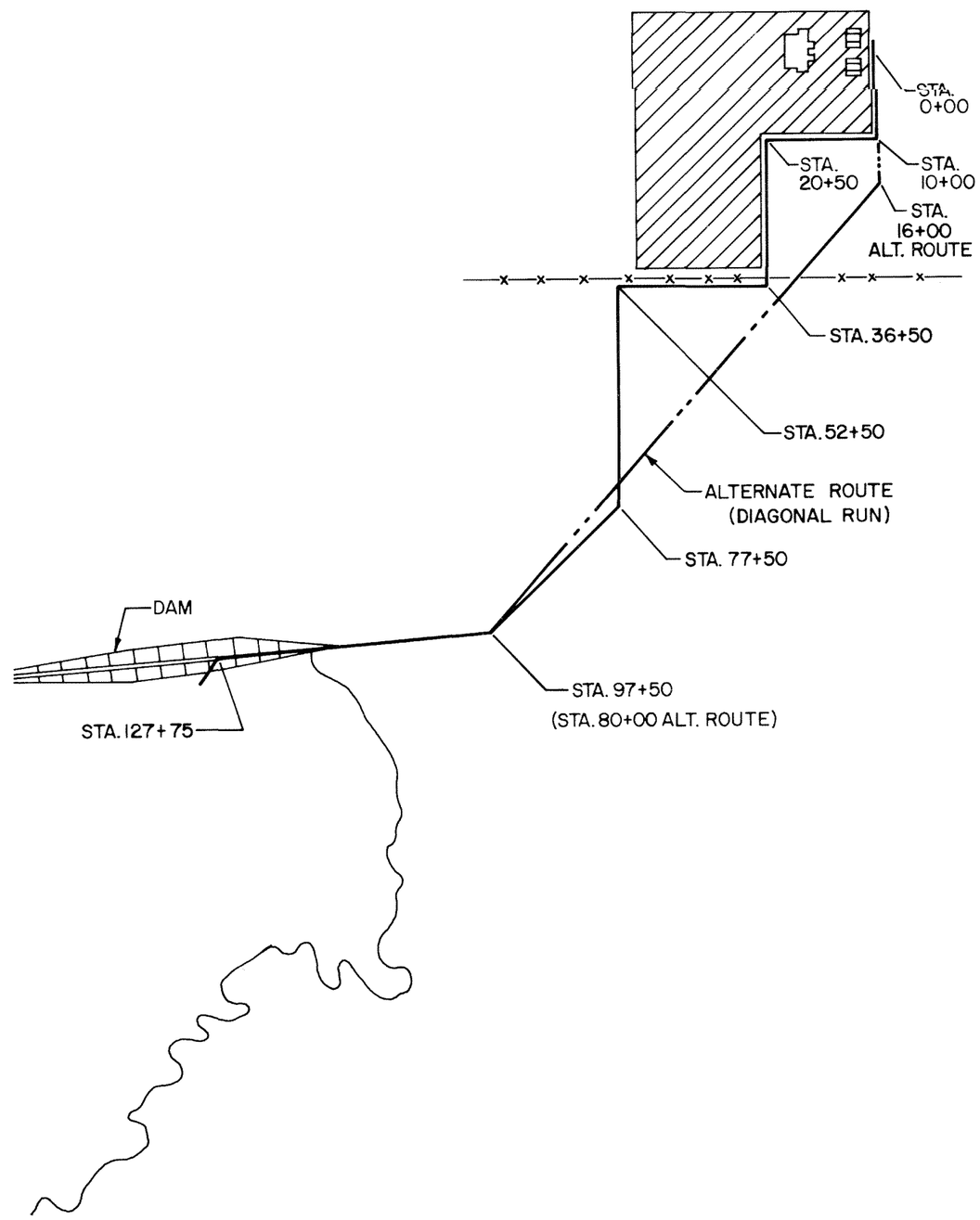
Water will be bled from the steam generator drums to control dissolved solids buildup. This blowdown stream is introduced into a pressurized flash tank. The flash steam is recovered to the turbine cycle, and the water drains are directed to the reclaimable water retention basin for reuse in the cooling towers.

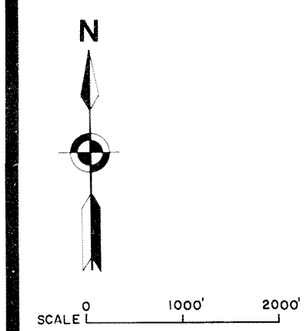
(h) Turbine Generator Cycle Makeup Water Waste

Waste waters in this system will consist of filter backwash, demineralizer regenerant wastes and rinses. Regenerant wastes with high dissolved solids content, will be directed to a neutralizing basin. After adequate pH control, these wastes will be sent to the evaporation pond. Filter backwash and demineralizer final-rinses will be reclaimed in the reclaimable water retention basin and sent to the primary water treatment for reuse.

(i) Sanitary Waste Water

Sanitary wastes will be drained to the sewage treatment plant, and the effluent from this plant will be pumped directly to the sanitary waste evaporation pond. Pond number 1 (see Figure I-6) will be lined on the bottom and side slopes with bentonite clays. Ponds 2 and 3, which are designed for the maximum demand during construction, will be lined with bentonite on the sides of the interior dikes. Sludge from the sewage treatment plant aeration tank settling chamber will be removed by a private tank truck service to a commercial disposal area.



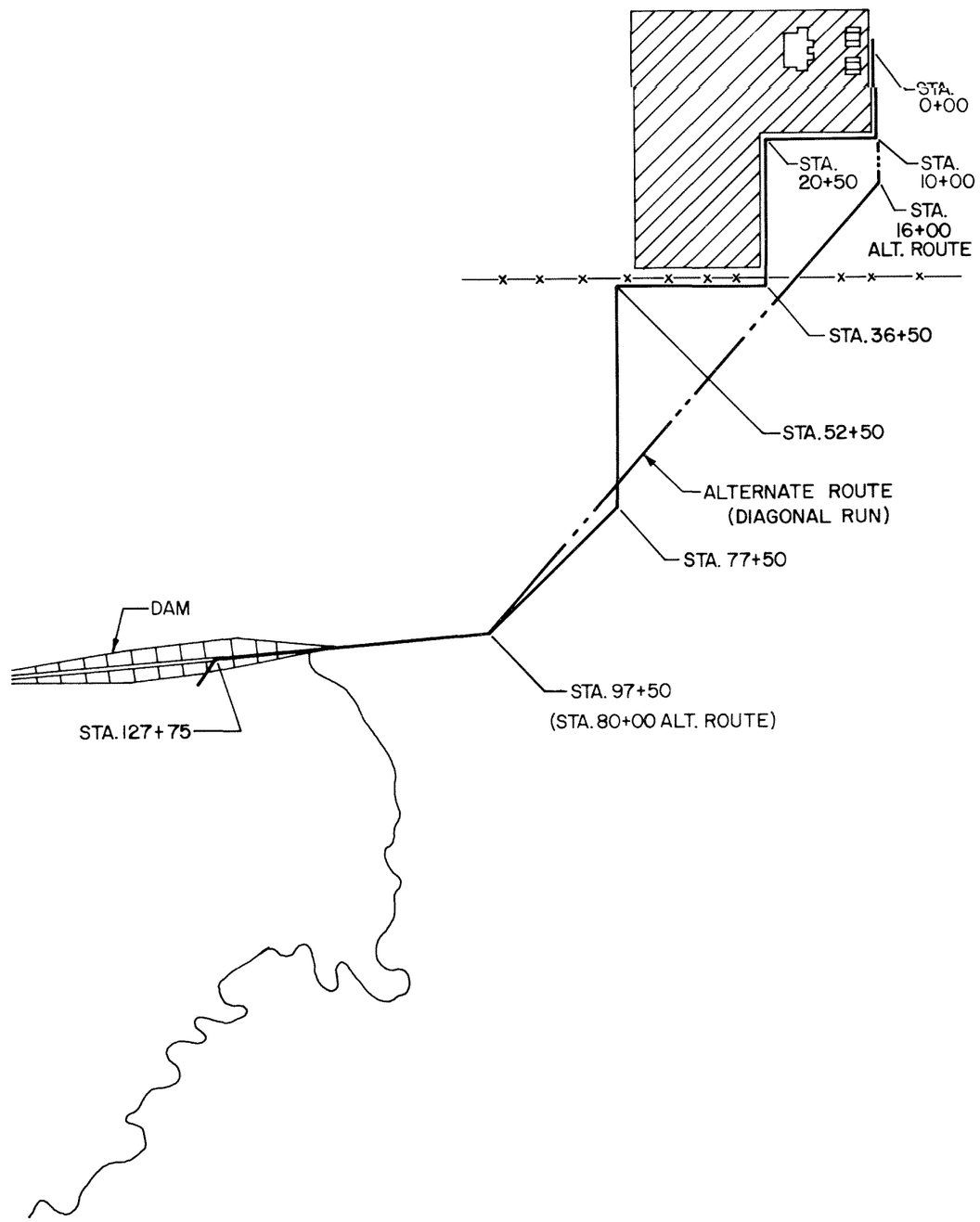


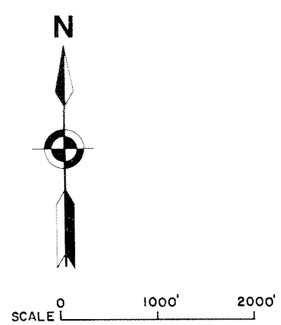
CORONADO PROJECT

Coronado Generating Station

EVAPORATION POND PIPING PLAN

Figure I-11



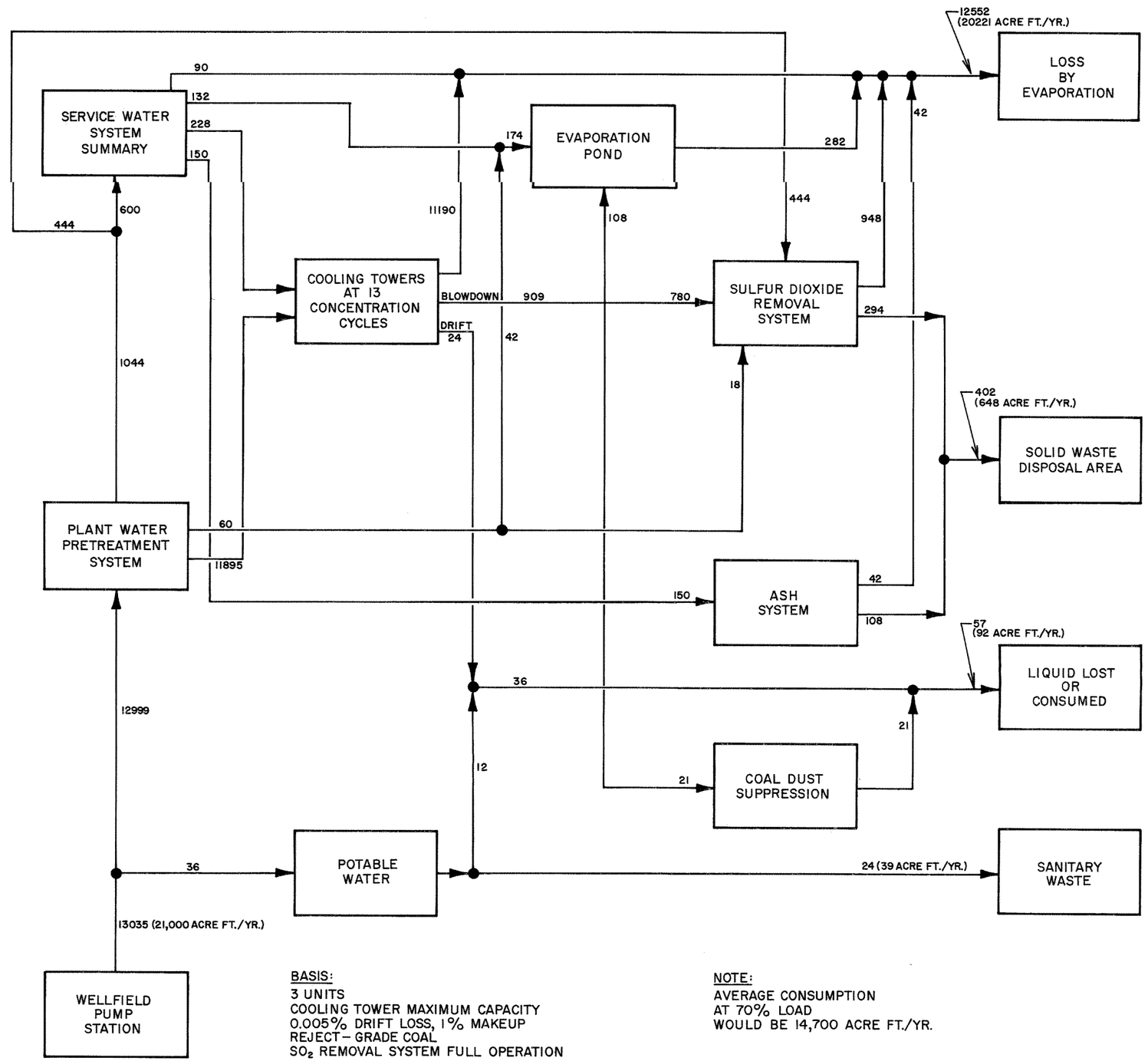


CORONADO PROJECT

Coronado Generating Station

EVAPORATION POND PIPING PLAN

Figure I-11



CORONADO PROJECT

Coronado Generating Station

PLANT WATER BALANCE FOR THREE UNITS WITH SO_2 SCRUBBERS

Figure I-12

(j) Process Waste Evaporation Ponds

Unusable contaminated water and excess cooling tower blowdown will be pumped via a pipeline to the evaporation pond.

(k) Balance of Plant

Wastes from pretreatment of the wellfield water supply, if pretreatment is required, would consist mainly of calcium carbonate, and could be recycled as part of the makeup to the SO_2 removal system.

Liquid collected at floor drains will be directed to oil separators and after oil removal will be used as part of plant makeup to the primary water treatment system. Safety valve steam-water discharge from process equipment is directed to an atmospheric stand pipe, where flash steam is vented to the atmosphere and residual water drains are recycled to the reclaimable water retention basin for reuse as plant makeup.

During startup of each generating unit, operations are performed which produce chemical waste water such as preboiler cleaning, boiler cleaning, pipeline flushing, cooling tower wood treatment leaching, and boiler feed water purification. These wastes are produced only once during the initial startup of each unit, except in the case of boiler cleaning which may occur occasionally during the life of the unit. These wastes will be disposed of either in the reclaimable water retention basin or the waste water reservoir for reuse.

b. Solid Waste Disposal

The solid wastes produced by the plant consist primarily of fly ash and bottom ash, plus the solids discharged from the SO_2 scrubbers (if used). The SO_2 scrubber wastes would consist of a sludge of sulphates and sulphites of variable water content.

(1) Ash System

Ash removal systems are being designed to meet all applicable Federal, State and local air quality laws, rules and regulations. Engineering details of applicable sub-systems will be contained in the application for installation/operating permit filed with, and subject to approval by, the State of Arizona Dept. of Health Services.

The Coronado Generating Station will use coal with an estimated average as-received heat content of 9130 Btu/lb. This results in a coal burning rate of 650 tons/hr with all three units operating at maximum continuous rating (MCR) conditions. The average ash content is estimated at approximately 15 percent, resulting in a total ash production rate of 97 tons/hr for three units. It is assumed that bottom ash and rear-pass ash constitute 20% of the total ash production, with fly ash making up the remainder.

Ash production rates for three units are as follows:

Item	Average Coal
Ash Content (percent)	15
Bottom and Rear-Pass Ash (ton/hr)	19
Fly Ash (tons/hr)	77
Stack Emissions (tons/hr)	0.5

The above production rates are upper design limits based upon continuous operation at MCR conditions. Average ash production rates are expected to be approximately 70% of the above values based on average plant capacity factors.

The furnace-bottom ash and rear-pass ash will be collected and transported in slurry form to dewatering bins. Bottom ash will be collected and stored in a multi-compartmented, water-impounded, gravity-feed type furnace ash hopper. Periodically, approximately once each 8-hour shift, the sequential removal of bottom ash will be initiated by the operator. The ash-water slurry will be passed through crushers and pumped via pipeline to the dewatering bin complex.

The dewatering bins will be equipped with decanting elements to remove any residual water in the ash before offloading the ash for transport to the ash disposal area. The decanted water will drain by gravity to settling tanks, where solids will be removed and pumped back to the dewatering bins. The effluent from the settling tanks will flow by gravity to the ash surge tanks from whence it will be recirculated in the closed-loop system. Makeup water will replenish the losses due to evaporation in the water-impounded furnace ash hopper and residual moisture in the solids. The system will discharge no waste water as it will be designed as a closed circuit system.

The fly ash collected will be removed by a pneumatic system to storage silos. Dust collectors will be provided at the storage silos for separating the fly ash from the transport air. Ash will be removed from the silos by air slides with water added to the ash to obtain the proper moisture content for compaction in the disposal area. The addition of water at the fly ash unloader will minimize the dust problems associated with such operations.

The ash collected from both the bottom ash collection system and the fly ash collection system will be trucked to an onsite storage area south of the power block. The fly ash will be sold for commercial applications if possible. Fly ash is used as a pozzalan in the manufacture of concrete.

(2) Solid Wastes from Sulfur Dioxide Absorption System

Limestone will be used as the primary scrubbing reagent for the SO_2 emission absorption system. The principal waste products produced by the reagent reacting with SO_2 will consist of calcium sulfates and calcium sulfites. Removal of these waste products will be achieved by a continuous flow of a small portion of the scrubber recirculating slurry. Dewatering of this purge stream will be accomplished by thickeners/clarifiers concentrating the suspended solids to 30% at the underflow discharge. The quantities and compositions of thickener underflow for lime and limestone processes, are shown in Tables I-13 and I-14 respectively. The values are calculated for three units when burning average-grade (0.60% sulfur) coal, at a 100% load factor and an overall SO_2 removal efficiency of 70%. There are two alternative methods of disposal under consideration. They involve pumping the thickener underflow either to the waste water evaporation pond area or to secondary dewatering for disposal in the ash storage area south of the main power block.

13. Construction Activities

a. Temporary Construction Facilities

The following buildings are planned for use during construction; construction office, construction warehouse, carpenter shop, pipe fabrication shop, welders test shop, change house, timekeeping buildings, and miscellaneous area buildings and shops. A labor camp (bachelor) planned for location on the construction site will accommodate 150 persons at the peak of construction. This is the size facility determined to be needed to balance the deficit of living facilities expected in St. Johns. Included in the accomodations will be a full service cafeteria. All of these structures will be constructed of non-combustible materials, and in conformance with applicable codes.

b. Temporary Concrete Mixing Plant

A temporary concrete plant will be located on the northwest corner of the site with sufficient area for storage of material and access for transportation equipment. Waste water from the plant or from trucks carrying concrete will be discharged into a settlement basin to control seepage. Waste concrete that has been batched but not placed, will be utilized as site fill material. Sand and gravel piles at the mixing plant site will be sprayed with water to suppress dust. The sand and gravel used for the production of concrete comes from a commercial pit near the town of Taylor, Arizona about 70 miles to the north and west of the jobsite.

c. Storage Areas

Approximately 250 acres are planned for material laydown, located in areas to the east, south, and west of the power block.

TABLE I-13

ESTIMATED THICKENER UNDERFLOW QUANTITIES - LIME PROCESS

BASIS: 3 UNITS AT MAXIMUM LOAD

70% SO_2 REMOVAL

Component	Average Grade Coal Ton/day
$Ca(OH)_2$	10
$CaSO_3 \cdot 5H_2O/CaSO_4 \cdot 2H_2O$	352
Dissolved Solids	52
Fly-Ash	6
H_2O	980
TOTAL	1,400

TABLE I-14

ESTIMATED THICKENER UNDERFLOW QUANTITIES - LIMESTONE PROCESS

BASIS: 3 UNITS AT MAXIMUM LOAD

70% SO_2 REMOVAL

Component	Average Grade Coal Ton/day
$CaCO_3$	21
$CaSO_3 \cdot 5H_2O/CaSO_4 \cdot 2H_2O$	352
Dissolved Solids	64
Fly-Ash	6
H_2O	1,034
TOTAL	1,477

d. Removal of Temporary Facilities

After completion of construction, some of the buildings used during construction will be retained for use as warehouse facilities. All temporary facilities will be removed. The buildings will be taken from the site and the areas around the power block and administration building will be graded to final area grade, paved, seeded or planted.

e. Construction Schedule

The construction schedule for Unit 1 is shown in Figure I-13. It shows a commercial in service date of April 1979. Unit No. 2 is scheduled to be in service one year later in April 1980. A schedule for Unit 3 has not been developed as the exact date of commercial operation has not yet been established.

f. Costs

The cost of the generating station with units 1, 2 and 3 commercial operation dates of 1979, 1980 and 1981, respectively would be $903 million based on 1975 costs. It is possible, that Unit 3 may be delayed several years, in which case the total cost would be greater. A detailed cost estimate for this possibility has not yet been completed. A breakdown of the $903 million estimate is shown in Table I-15.

TABLE I-15

CORONADO GENERATING STATION
ESTIMATED CONSTRUCTION COST*

Item	Cost**
Property	$ 4,000,000
Engineer-Constructor Engineering, Home office and Burden	61,000,000
Boilers & Turbine Generator	118,000,000
Permanent Plant Equipment Material & Subcontrators	293,000,000
Labor (Manual & Non-Manual)	236,000,000
Sulfur Dioxide Controls	91,000,000
Project Management Costs	100,000,000
TOTAL	$903,000,000

* Based on a Unit 3 commercial operation date of 1981
** Based on 1975 prices

14. Pre-Operational Testing

A nine month pre-operational testing period will begin one year before firm power operation and complete at turbine roll. A three month performance testing period will begin at turbine roll and complete at firm power.

During pre-operational testing, each plant system will be thoroughly checked and tested. The fire, service and cooling water systems will be cleaned by flushing with service water. The condensate and boiler feedwater systems will be cleaned by high velocity flushing with service water, hot alkaline flushing using a tri-sodium phosphate solution, and acid cleaned using the hydroxyacetic-formic acid solution followed by a hot condensate rinse. The boilers will be cleaned by flushing with clear water, boiling out with an alkaline solution and acid cleaning followed by a neutralizing boilout and condensate rinse. The boiler superheaters and steam lines are cleaned by firing the boilers and blowing steam through the superheaters and steam lines to the atmosphere. During the performance testing period, the units will be operated at loads from zero to maximum as the various tests are completed. The flue gas treatment systems (electrostatic precipitators and sulphur dioxide removal) will be in operation during the initial startup and operation of each unit.

15. Operation of Powerplant

The three units of the Coronado Generating Station will require 325 operating personnel. The general labor skills included in this total are listed below.

a. Technical/Administrative Staff
    - Supervisor personnel
    - Engineering personnel
    - Clerical personnel
    - Computer operators
    - Instrument technicians

b. Operations Staff
    - Supervisor personnel
    - Plant operators
    - Chemists

c. Maintenance
    - Supervisory personnel
    - Machinists
    - Electricians
    - Maintenance Mechanics
    - Laborers
    - Custodians
    - Auto Mechanics

CORONADO PROJECT SCHEDULE

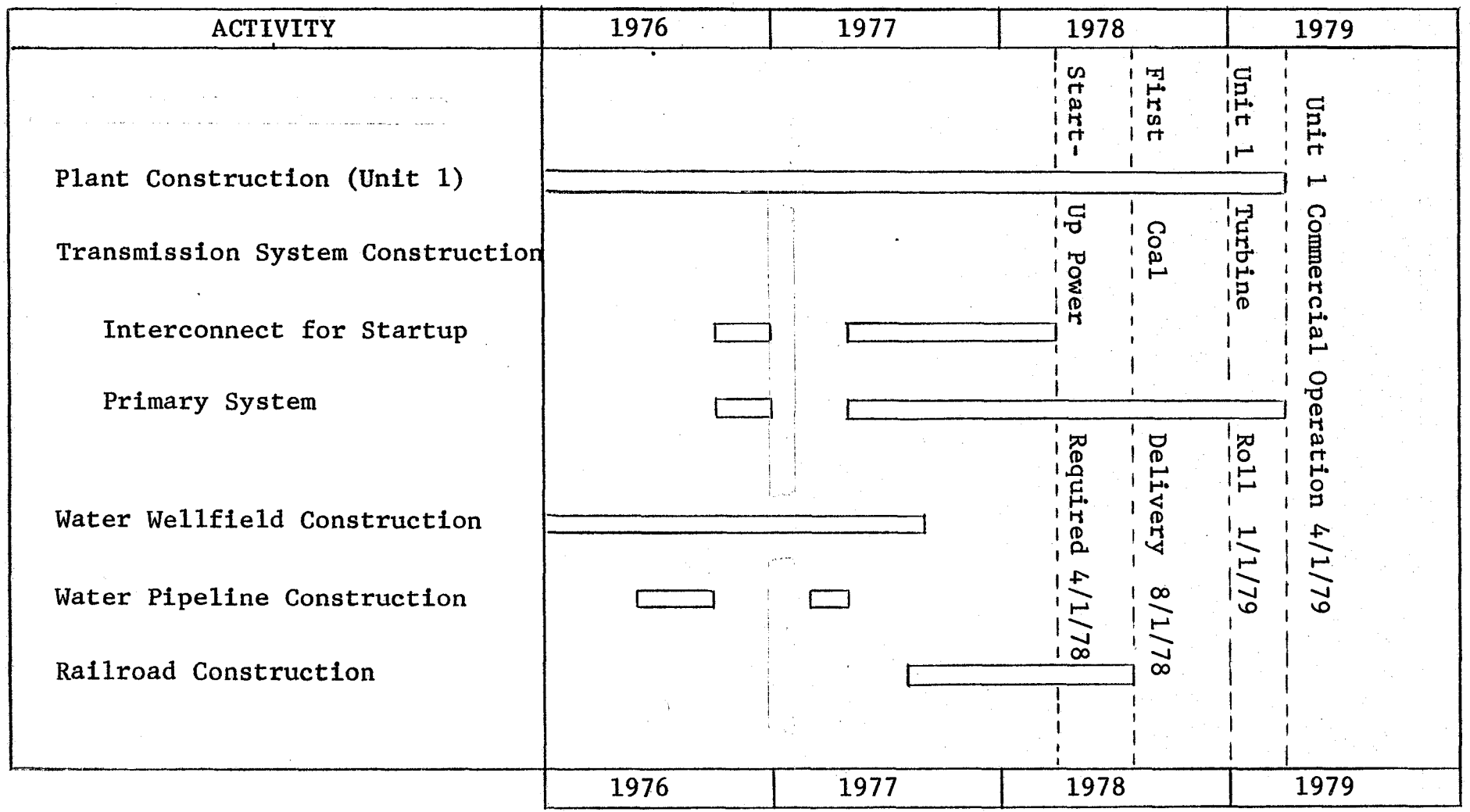


FIGURE I-13

d. Miscellaneous

Security Guards
Warehouse personnel
Truck drivers
Heavy equipment operators

Each unit at the Coronado Generating Station will receive a two week minor overhaul of the first two years, then every third year a six week major overhaul will be undertaken. These overhauls will occur during the off-peak winter season.

H. Description of the Water Supply Wellfields

1. Introduction

The source of water for the plant requirements will come from groundwater resources in the vicinity of the site. An intensive field exploration and testing program was conducted in the St. Johns area to determine the most feasible locations for wells to fullfill the powerplant water requirements of 13,424 acre-feet/year and at a maximum rate of 22,608 acre-feet/year. The production wells will penetrate the entire Kaibab-Coconino aquifer to maximize well efficiency and minimize drawdown coning effects. The formations that overlay the Kaibab- Coconino aquifer will be cement grouted off during the production well drilling phase of the project. This well construction technique will minimize withdrawals from those overlying formations that support domestic and stock wells. The general locations of the wellfields were initially established after compiling a well inventory in the St. Johns area and conducting pumping tests on test wells. As a result, it was determined that three wellfields would be required to assure an adequate water supply for powerplant operations.

2. Location

a. Concho Wellfield (No. 2)

The Concho Wellfield is located approximately four miles north of Concho, Arizona and approximately 14 miles west of St. Johns. (See Figure I-14). The area of the wellfield is approximately 5 square miles.

b. Middle Wellfield (No. 1)

The Middle Wellfield is located near the junction of Highways 180 and 61, or about five miles west of St. Johns. It is approximately three square miles in area.

c. East Wellfield (No. 3)

The East Wellfield is located approximately one mile west of the Coronado Generating Station site and is approximately five square miles in area.

3. Construction

a. Design Criteria

Each wellfield will have five production wells. Turbine pumps will be installed to produce a minimum of 1,050 gpm each.

b. Spacing of Production Wells

The production wells for each wellfield will be spaced one mile apart so that a uniform water level may be maintained in the area.

c. Collection and Storage

Each wellfield will have a collection system whereby water from each production well will be received at the wellfield reservoir and pumped, if required, to the storage reservoir located at the plant site.

d. Water Supply to the Generating Station

Water from the wellfields will be transported to the plant site storage reservoir by means of a single pipeline for each wellfield. The pipeline will be sized to provide sufficient capacity when all productive wells are operating at full capacity. Each pipeline will join the electrical transmission line corridor as soon as practicable and remain in it to the powerplant site.

e. Power Supply and Transmission System

Electric power for each wellfield will be supplied by local power sources at 24 kV with lower voltage distribution lines serving the pumps at each production well.

f. Access Roads

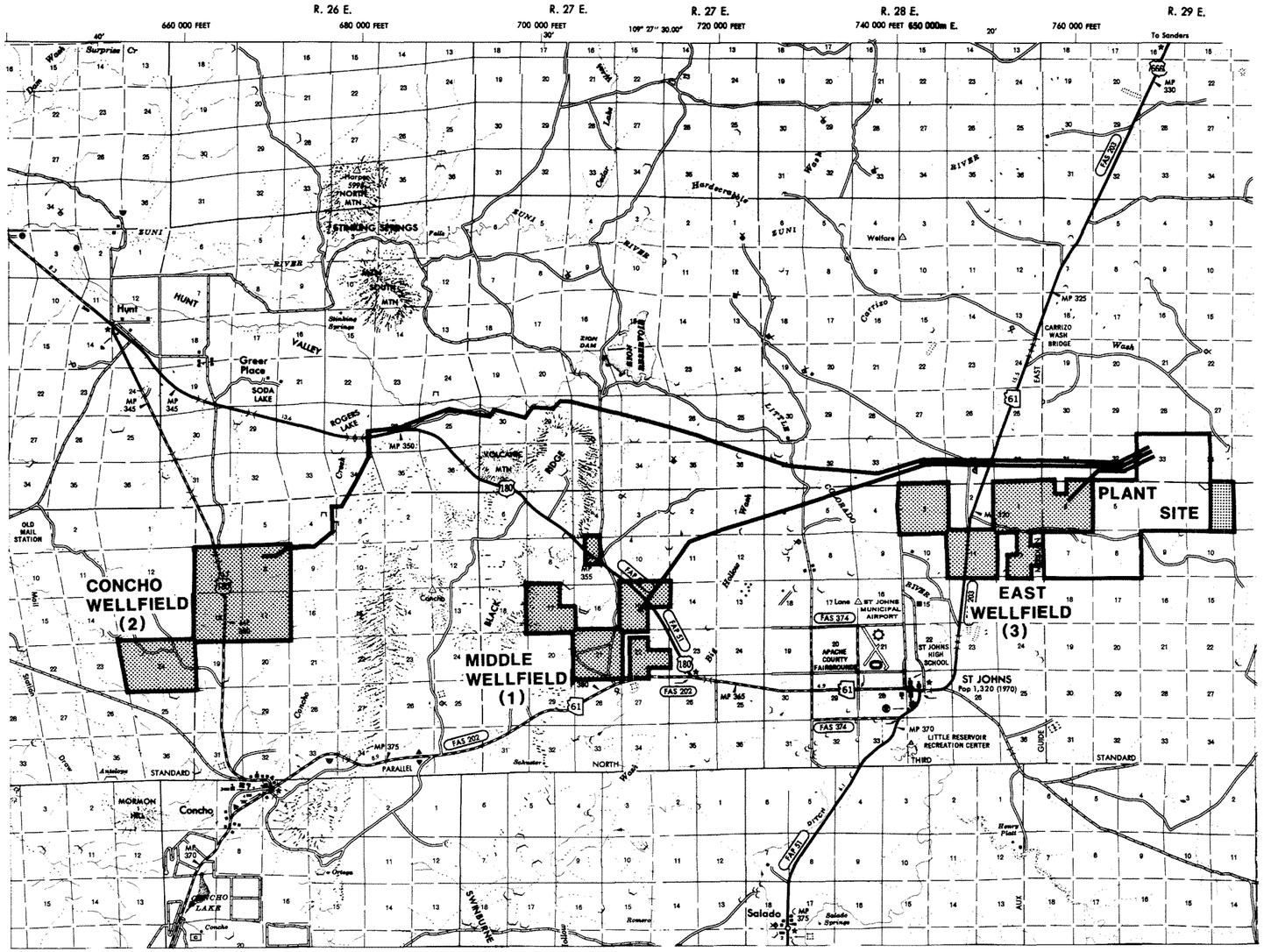
Each production well, reservoir and booster station will require an access road for pump service and maintenance. Existing roads will be utilized to the greatest extent possible.

4. Operation

a. Anticipated Life of Wells

The majority of the production wells will be pumped at about 40 percent of maximum design capacity. These reduced pumping rates will minimize the lateral extent of the cone of depression beyond the Salt River Project wellfield boundaries during production, and will minimize the magnitude of drawdown caused by well-borehole head losses.

It is expected that the life of the wells will coincide with the 35-year life of the powerplant. It is conceivable that some of the wells may go dry during the life of the project due to inadequate groundwater replenishment or other unforeseen conditions. If this occurs to the point where the water supply is deficient, another source would have to be obtained.



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1 0 1 2 3 4 MILES

CORONADO PROJECT

Coronado Generating Station

OFFSITE WELL WATER SUPPLY SYSTEM

Figure I-14

b. Energy Requirements

The wells will be pumped by pumps ranging in size from 150 to 300 horsepower. For 24 hours of continuous pumping, each pump would consume from 2,688 KW-hours of energy (for 150 hp) to 5,376 KW-hours (for 300 hp).

c. Drawdown Effects Caused by Planned Pumping

The Water Management Plan is designed to react in the event adverse water level drawdown (actual drawdown exceeding projected drawdown by more than 50%) should occur. The Salt River Project will consider a number of alternate plans including development of an additional wellfield or wellfields to enlarge the area from which water would be pumped.

d. Additional Water Requirements and Moderate Effects

In the event the Coronado Generating Station's water projection is in error, the three-unit generating plant may need more water to operate economically. Assuming pumping has not created adverse water level decline effects and the quantitative aquifer projection analysis indicates only a moderate increase of effects on the system, Salt River Project will undertake one or more of the following courses of action:

(1) Increase the discharge rate at the existing wells within the three satellite wellfields;

(2) Increase the total amount of pumpage from each of the existing wellfields;

(3) Purchase additional land surrounding one or more of the existing wellfields for the purpose of drilling additional production wells and expand one or more of the existing wellfields;

or (4) Purchase additional land for development of a fourth wellfield to expand the area for withdrawal of groundwater to accommodate the larger water requirement.

e. Additional Water Requirements and Adverse Drawdown Effects

In the event the Coronado Generating Station needs additional water, and adverse drawdown effects have been documented by the monitoring program throughout the area as having been caused by Salt River Project pumping, then the following action will be considered: (1) Purchase additional land and develop additional wellfields; and, (2) Plant water consumption would be re-analyzed to determine a more economical method, if possible, for reducing the water consumption and action would be taken to limit water level decline with the existing wellfields.

I. Description of the Coal-Haul Spur Railroad

1. Introduction

The Coronado Generating Station will use bituminous coal as a fuel source. While a long term supply of coal has not been selected delivery to the generating station will be by railroad.

Salt River Project proposes to build a coal-haul railroad from the Coronado Generating Station north to the main line of the Atchison, Topeka and Santa Fe Railroad. Studies have been performed on a number of alinements and location work is continuing. The alinement discussed in this section of the environmental statement represents the preferred route. Alternate routes are discussed in Section IIH-5 of this Statement.

The proposed alinement of the railroad spur has been changed since the completion of the Draft Environmental Statement. After the filing of the Draft Statement, a thorough evaluation of alternate alinement No. 2 was completed. This evaluation revealed that alternate No. 2 would require less earthwork and shorter bridges than the proposed route. In addition, it was learned that the soil conditons of alternate No. 2 were better than those of the proposed route. Therefore, in this Final Statement, the former Draft Alternate No. 2 has become the proposed route, and the former Draft proposed route has become Alternate No. 1A.

2. Location

The proposed spur railroad will be located in Apache County in northeastern Arizona, and will extend from the Gallup-Holbrook segment of the Atchison, Topeka and Santa Fe (AT&SF) mainline to the proposed Coronado Station site northeast of St. Johns. The railroad will depart the AT&SF mainline near the Navajo interchange on Interstate I-40 just south of the Puerco River (See Figure I-15). The railroad will run generally south from this point, approximately nine miles east of the boundary of the Petrified Forest National Park, and will angle generally away from the Park. The railroad will cross Milky Wash, Hardscrabble Wash, the Zuni River and Carrizon Wash.

3. Project Description

a. Construction

Anticipated construction of the railroad includes initial route selection, railroad design, and physical construction of the roadbed, track, bridges, etc.

(1) Engineering Requirements

The characteristices of the proposed coal-delivery are shown in Table I-16. The primary engineering requirement placed upon the railroad is that the grade shall not exceed 1.5% for a loaded train. The minimum right-of-way width is 100 feet; this will be increased to accommodate earth cuts and embankments, and allowances for borrow areas and contractor work spaces.

The design criteria used to develop engineering quantities herein are:

Rail - 119 RE continuously welded.

Cross ties - 7" x 9" x 9'-0" coastal Douglas Fir and Hemlock
3,250 per mile

Ballast - 8" under tie, 12" shoulders,
2:1 slopes, 2,788 cubic yards
per mile

Turnouts - No. 20 AT&SF Railway standard (described by
AT&SF railway drawings).

Two ballast sources have been investigated; first, imported via the railway, and second, the opening of a local basalt quarry on the assumption that local basalt will prove to be a suitable ballast material.

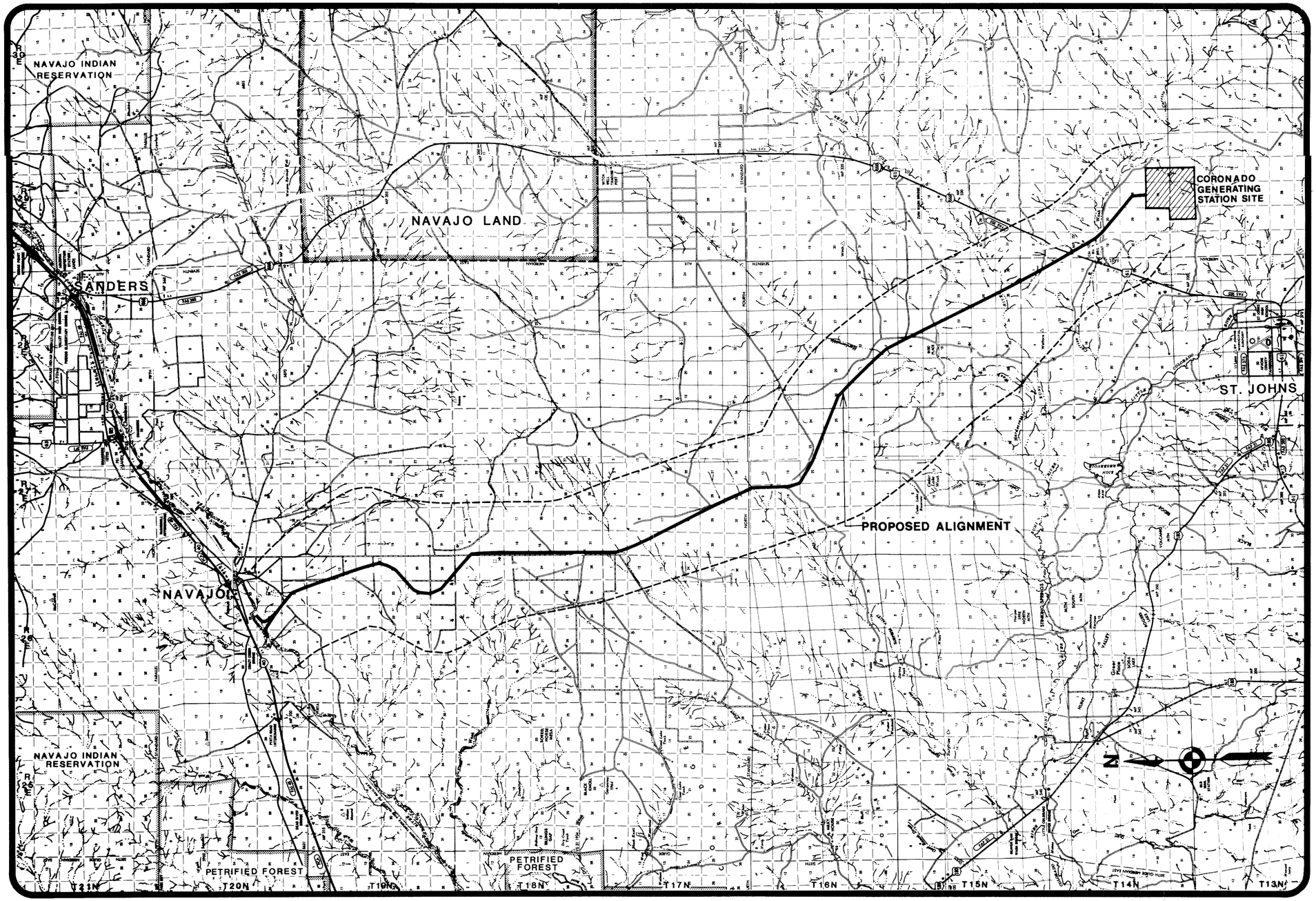
(2) Access Roads and Clearing

The initial phases of construction will include access road construction, initial clearing, and geologic exploration of foundation conditions. Access road locations have not been determined. Assembly and storage areas will be established, and arrangements made for construction water which will be used in the compaction and dust control on the railroad.

(3) Bridges and Culverts

Bridge and culvert design is based upon an assumption of a 100-year design flood and a 35 year project life, with a resulting 29 percent chance that the 100-year flood will be equalled or exceeded during the project life. This conclusion was made using standard statistical and probabilistic methods. A detailed hydrologic study has not yet been undertaken, but the bridges and culverts discussed herein are based upon the preliminary designs available. Bridge crossings along the proposed alignment would be located over Hardscrabble Wash, Zuni River, and Carrizo Wash.

All bridges are designed as concrete ballast deck structures conforming to American Railway Engineering Association Bridge Specifications, and AT&SF Standard high speed mainline loading. Bridge sub-structures are steel H piles with concrete, poured-in-place pile extensions and caps. Superstructure for all bridges will be AT&SF standard pre-cast, pre-stressed two-cell girder units, 7 feet wide by 24 feet long. All bridge superstructures provide for 8 inches of ballast under the cross ties, and 3 foot-wide walkways with hand-rails on each side. Bridge specification are contained in Table I-17.



BASE MAP: ARIZONA HIGHWAY DEPT.

0 1 2 3 4 5 MILES

CORONADO PROJECT

Power Plant Spur
Coal Haul Railroad

LOCATION OF COAL HAUL RAILROAD

Figure I-15

TABLE I-16

CHARACTERISTICS OF THE

PROPOSED COAL-DELIVERY RAILROAD

ITEM	DESCRIPTION
Project Length	43 miles
Track Length (including sidings)	47.8 miles
Right-of-Way Required (minimum)	940 acres
Beginning Elevation	5,600
Highest Elevation	6,155
Lowest Elevation	5,598
Ending Elevation	5,790
Cumulative rise w/load	925 feet
Cumulative fall w/load	735 feet
Maximum Grade w/load (North to South)	+1.5%
Maximum Grade w/o load (South to North)	+1.8%
No. of Curves	13
Maximum Degree Curve	3° 25'
Percent Curved Track	22%
Maximum depth of Cut	60 feet
Maximum height of Fill	70 feet
Number of Bridges	2
Linear ft of Bridge	1,290
Trackwork	
- Track Length, track-ft.	252,400
- Ballast, cu. yds.	137,600
Highway Crossings-	
Signalized	1

Table I-17

COAL HAUL RAILROAD
BRIDGE SPECIFICATIONS

Bridge	Length Feet	Skew Degrees	Channel Width Feet	Height of Bridge * Feet	Number of Spans	Channel Definition
Zuni River	429	0	200	20	13	Poor
Carrizo Wash	627	30	515	20	16	Poor

*Track profile to stream flow line

Bridge lengths were designed to avoid restriction of the existing defined water channels. Bridge lengths over poorly defined channels were determined to pass the estimated peak discharge. The construction of bridges will require access for the necessary pile-driving machinery and cranes required to place and drive the steel piles, and to erect the bridge spans. Culverts will also be placed by cranes. Work on these structures will be proceeding simultaneously.

(4) Grading and Trackwork

The topography of the area will require cutting and filling in order to maintain the 1.5 percent grade for a loaded train. The volumes of excavation and embankment earthwork are based on preliminary horizontal and vertical alignments, and typical cut and fill cross sections which also conform to AT&SF recommendations. These cross sections are shown in Figure I-16.

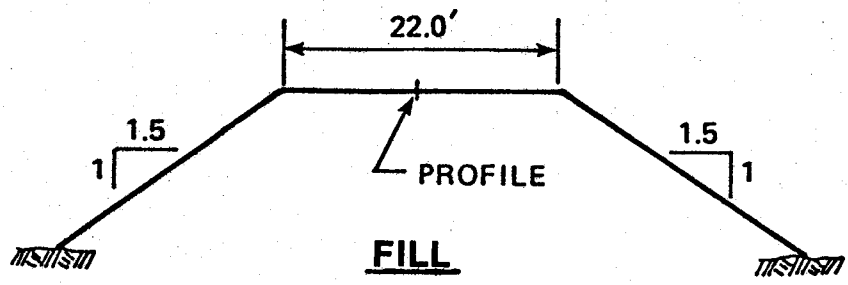
Earthwork estimates are as shown below:

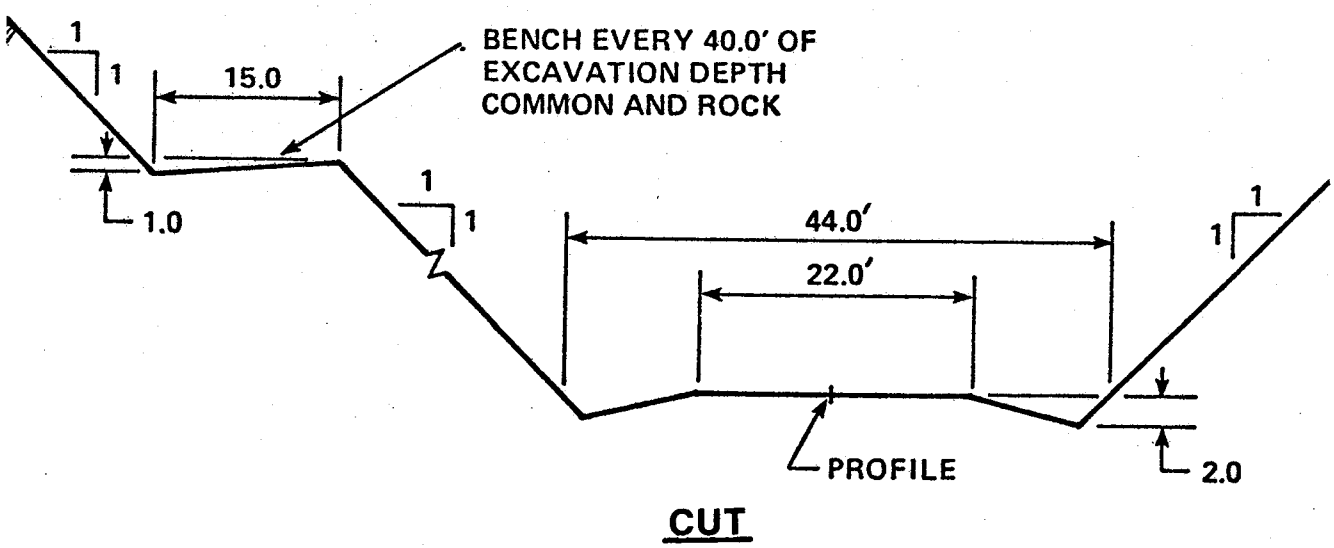
Table I-18

COAL HAUL RAILROAD

EARTHWORK ESTIMATES FOR PROPOSED ALIGNMENT

Item	Proposed Alignment
Route Length	43 miles
Maximum Depth of Cut	60 feet
Maximum Height of Fill	70 feet
Route Length in Chinle Cut	5.2 miles
Compaction Water	330 million gallons





CORONADO RAILROAD SPUR EARTHWORK TYPICAL SECTIONS

Figure I-16

It is anticipated that most of the rock can be fractured by ripping; however, a small amount of blasting may be necessary in the Sonsela sandstone overlie the Chinle clayshales, so extra attention will be given to slopes in these areas. Crawler tractors will be used to rip the harder formations. Scrapers will load the ripped material and transport it from the cuts to the fills. The scrapers will be assisted in loading by pusher tractors where necessary. Water will be applied for dust control in the excavation fill areas. Conventional graders will be used for establishing final grade.

Fill material will be obtained from cuts, where cuts are located within economically feasible haul distances from fills. Once at the fill site the material will be placed with a bulldozer, then wetted and compacted. It is estimated that approximately 60 gallons of water will be required to compact one cubic yard of soil. This water will be sprayed from water trucks. The soil is assumed to undergo a shrinkage of 15 percent when placed in the embankments. Thus, one cubic yard of excavation material measured in its natural state before excavation, will equal 0.85 cubic yards of embankment, when compacted in place.

In construction of the access road at the generating station, a sheepfoot roller was used to compact 8-inch lifts, with three passes at a speed of approximately six miles per hour, and produced 95 percent compaction. This compaction would be satisfactory for the railroad subgrade, and a similar or equivalent operation can be anticipated on the railroad.

After the grading is complete, the roadbed will be sub-ballasted and ties will be laid on the sub-ballast. The tie-laying may be accomplished by a mechanical tie layer or by work crews. After the ties are laid, a rail train will be moved to the construction site. The rail train transports 1,440 foot-strings of shop-welded rail. These rails will be pulled simultaneously from the rail train. The rail is spiked at intervals to allow the rail train to move ahead another half mile to distribute another half mile of the shop-welded strips. The rails will then be anchored to the ties to maintain track alignment. After the rail is laid, the primary ballast will be added to the roadbed, tamped in place by a ballast tamper, than shaped and dressed.

(5) Borrow Areas

It has been estimated that 290,000 cubic yards of borrow material will be required. The amount excavated from cuts will be utilized to the maximum extent economically feasible to provide materials for the fills. Excess material will be wasted. In some cases, fill will be excavated from borrow bits located within an economic haul distance from where the fill will actually be used. Tentative borrow pit locations are shown on Figure I-17.

(6) Fencing

The need for right-of-way fencing has not been established at the present time and along with the type of fencing to be used, will be determined by consulting with the landowners involved.

Since right-of-way fencing tends to inhibit wildlife migration, it may not be provided where the density of domestic animals is low. However, the landowners will specify the need and types of fencing. Thus, the areas which might interfere with wildlife migration cannot be defined until these are identified.

b. Operation

Present plans call for a unit train to be used to haul coal from the source to the proposed generating station. The unit-train will consist of eight diesel electric locomotives, one caboose and 100 cars to be used for hauling coal and other project supplies. Each coal car will carry 100 tons. Four locomotives will pull from the front of the train and four slave (remote control) locomotives will be located either approximately two-thirds of the train length back from the head or at the rear of the train. Train speed will range to 45 miles per hour for loaded trains and 49 miles per hour for empty trains. A 100 car train with eight locomotives will consume 2000 gallons of diesel fuel in the 85 mile roundtrip between the AT&SF main line and the Coronado Generating Station.

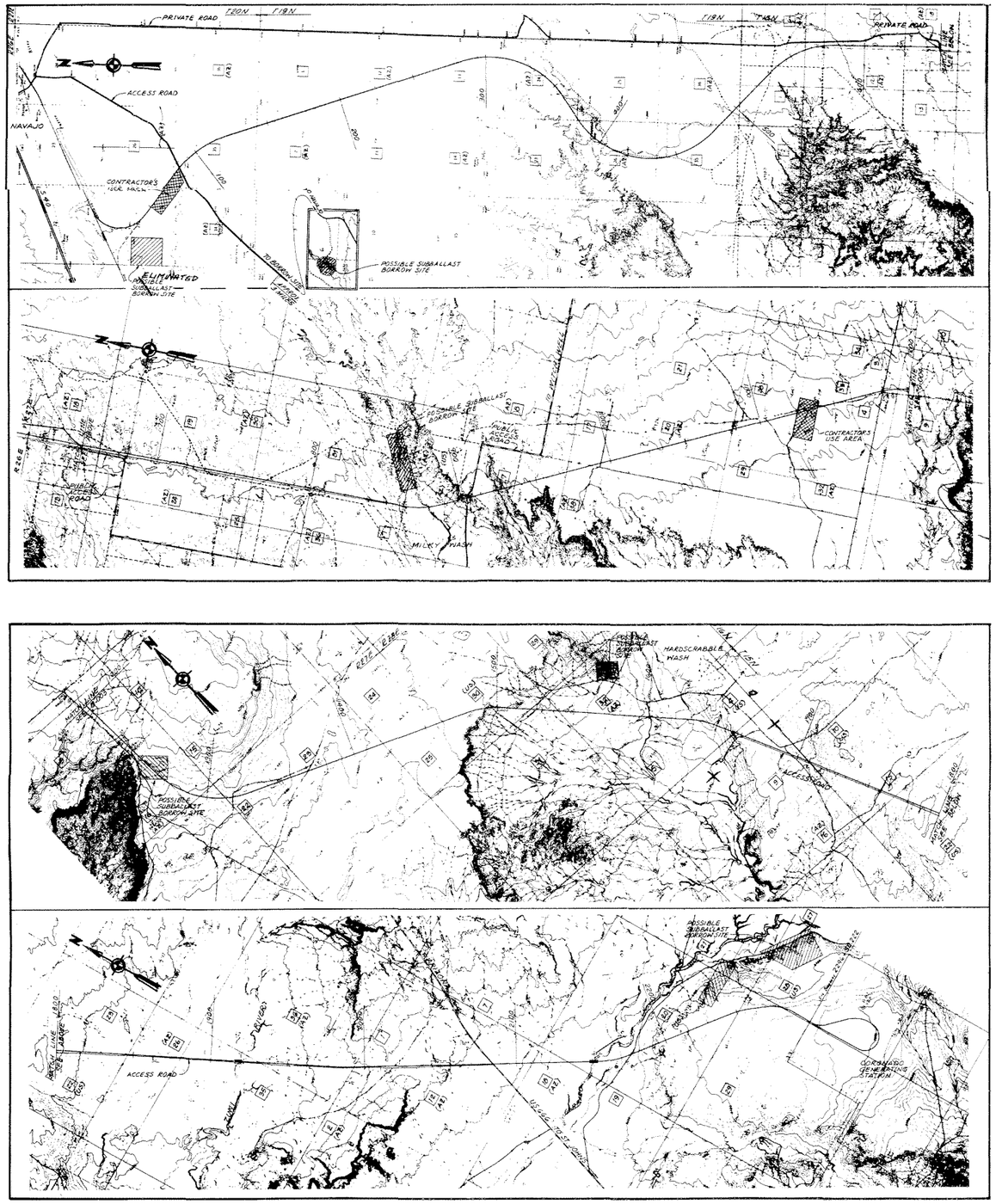
Coal shipments will begin in 1978 with one unit train operating over the spur every 31 hours. When additional units are built at the generating station, the frequency of operation will increase, and two unit-trains will be required to supply the necessary tonnage of coal.

It is anticipated that maintenance will be similar to that on the AT&SF mainline and throughout the state.

c. Rehabilitation or Disposition

Present plans envision the railroad spur to be used exlusively for the Coronado Generating Station throughout the economic life of the plant (about 35 years). The Salt River Project does not intend to operate the railroad or become a common carrier. The Coronado Generating Station spur railroad will be designed and constructed to standards which would physically allow it to be used for other purposes. Thus, there would be no physical reason why the railroad could not be later utilized for some economic purpose, and hence may have a residual value after the station has surpassed its economic life.

In the event that the railroad has no residual economic value in the future, the rails, ties, signals fences and cattle guards would be removed. Cuts, fills, drainage structures, bridges, culvert, and ballast will probably be left in place after abandonment. Wherever possible the surface rights would be sold or transferred.



CORONADO PROJECT

Power Plant Spur Coal Haul Railroad

CONSTRUCTION SITE PLAN

Figure I-17

J. Description of the Proposed Transmission System

1. Coronado Transmission System

Several configurations of the Coronado Station Project Transmission System were designed or studied utilizing computer simulations to model each of the alternative systems. The system selected provides a "primary path" for electric power and energy from the Coronado Station to the Phoenix load area as well as a "backup path" which provides that necessary system reliability (see map enclosed at back of this report). SRP's basic system design criteria provides for a system of reliability sufficient to maintain continuity of service to loads. Through its member systems and their participation, the WSSC, a regional, electric reliability council, has published "Reliability Criteria for System Design." In addition to accepting the philosophy and application of the WSCC criteria, SRP incorporated its criteria for transmission systems capacity, as well as the criteria for dynamic performance of interconnected "Power systems." When evaluating such factors such as reliability, technical performance, and service continuity, SRP advocates that no more than two EHV transmission lines be constructed within the same corridor when such lines are key transmission lines or interconnections.1/ On this basis, specific system criteria were selected.

The first of these criteria was that the method of transmission system required will be:

a. One 500 kV direct line from the Coronado Station to the Phoenix area, and 500 kV interconnections from the Coronado Station to other EHV systems (Cholla Generating Station or San Juan to Vail (TG&E); and,

b. The alternative of rebuilding existing lower voltage (345 kV) lines must result in equivalent capacity and reliability as in (1) above; the rebuilding and reconstruction schedules must not interrupt service.

The second of these criteria was that the Phoenix area 500 kV termination (500 kV substation) will be at the east side of the 230 kV SRP network, where the greatest future demand for electric energy was predicted. Thus, the Silver King substation was proposed for a location east of Superior.

The transmission facilities proposed for the EHV system are overhead three phase, 500 kV lines. Each phase will consist of bundled conductors in parallel to achieve the best electrical noise characteristics. In addition, lightning protection will be provided by static wires supported at the peak of the towers and/or steel poles.

1/ Existing or proposed EHV transmission corridors may be paralleled so long as the WSCC reliability criteria for system design are met. System simulation studies will verify and quantify the effect of various corridor outages.

High-strength, self-supporting lattice towers are proposed to be used for long spans in the grasslands, forested areas, and desert terrain. This will result in the least number of towers per mile, therefore, the least impact to the environment. In the valley urban areas near Mesa, Gilbert, Chandler, and Tempe, steel poles will be used with shorter spans along roadway and/or along existing canal rights-of-way. (See Figures I-18, I-19 and I-20).

Tower heights, location, and the distance between towers (span length) will be determined by the type of terrain being crossed. A minimum clearance between conductors and the ground of 32.5 feet will be maintained. Clearance will be increased when crossing highways and railroads.

The conductors will be suspended from the 500 kV towers by "V" string insulators. Each "V" string will weigh approximately 800 pounds and consist of 54 insulators, 27 on each side of the "V".

On the average 500 kV self-supporting steel towers will be 129 feet high. Tower width at the bridge is 96 feet. Tower height, tower location, and distance between towers (span length) will be governed by the type of terrain being crossed. The average span length is approximately 1,650 feet or approximately 3.2 towers per mile.

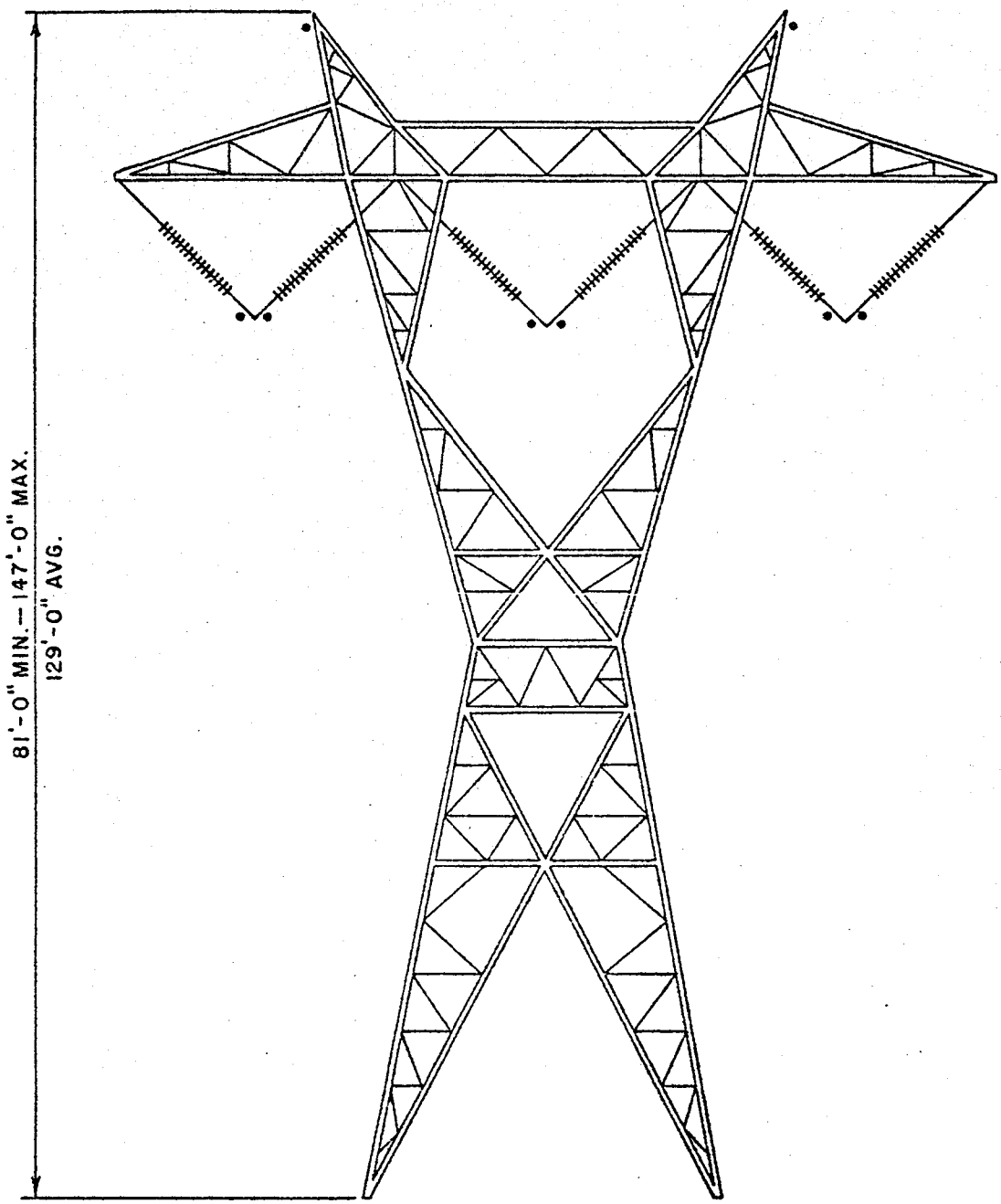
Depending on the type tower, lightning protection for the lines will be provided by either one or two "statics" installed at the top of the structures. The outer diameter of each static will be less than one inch.

Transmission line losses are substantial and must be considered in route selection. Every foot of electric circuit has energy losses, depending on the amount of current flowing in the system. When considering the amount of bulk power a transmission line must supply to load centers, line losses are significant and are minimized when possible.

When all three generating units are operating at full capacity, 668,000 kilowatt hours of energy will be consumed annually in line losses for every mile of 500 kV line in the Coronado Station Project Transmission System. This would result in a total line loss over the entire transmission system of approximately 2 percent of the total productive capacity transmitted over the line. Roughly 380 tons of coal must be burned annually to generate the energy consumed by these losses for each mile of transmission line.

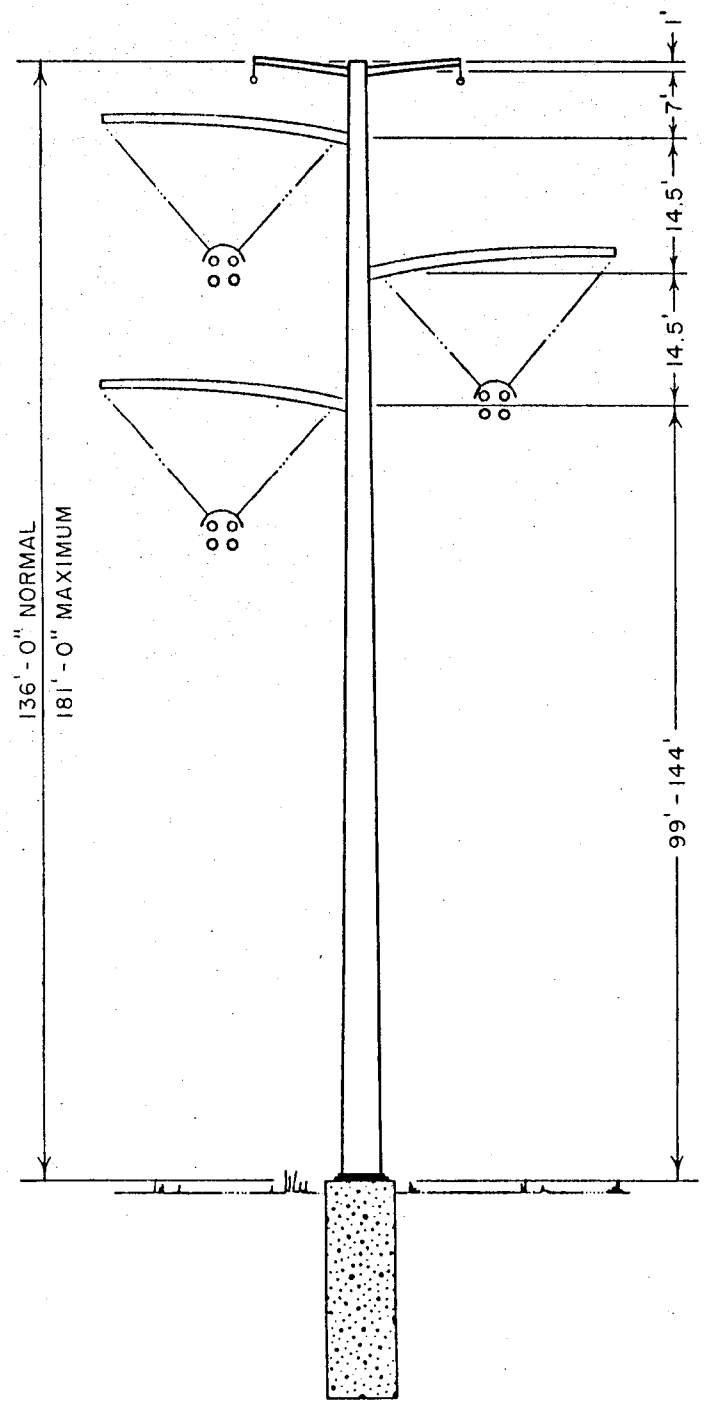
2. Eastern Mining Area

As a result of increasing load growth in SRP's central Arizona service area, several new transmission lines are contemplated over the next few years. These lines would interconnect with the proposed Silver King substation, and would serve SRP's Eastern Mining Area (EMA). Four Transmission lines will be constructed, upgraded, or interconnected with the proposed 500 kV Silver King substation. These lines are described in more detail below.



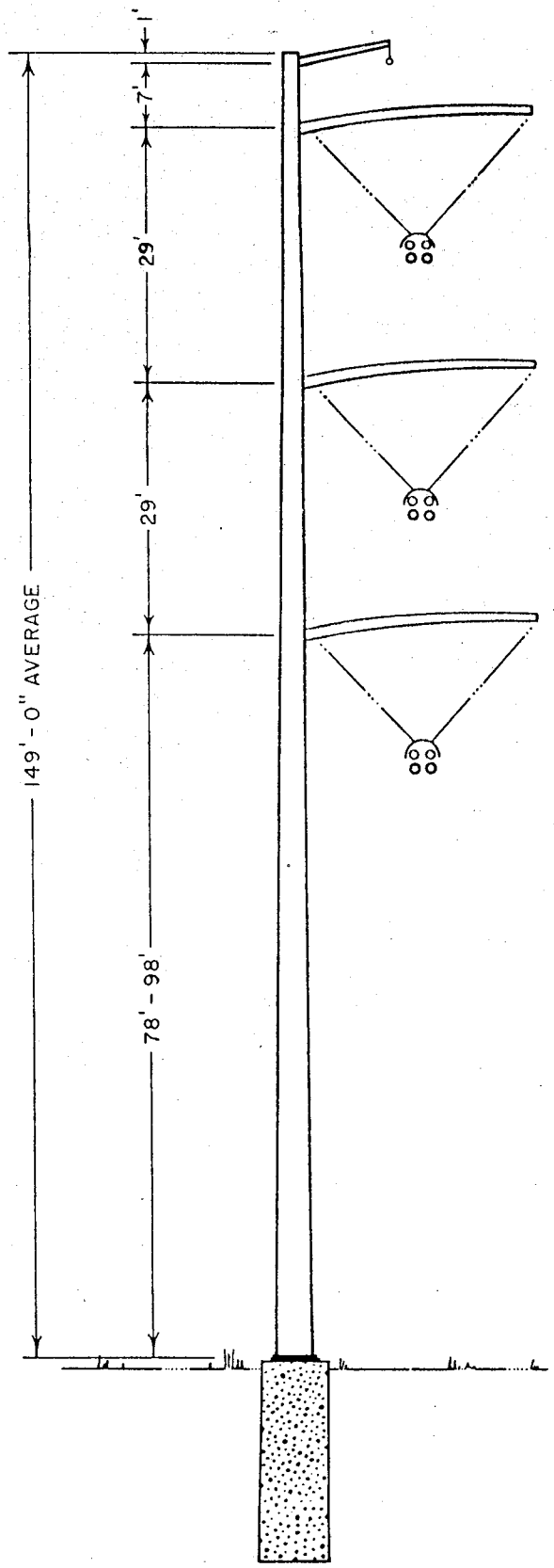
500kV TRANSMISSION STRUCTURE
RURAL CONSTRUCTION

Figure I-18



DELTA 500kV STRUCTURE

Figure I-19



VERTICAL 500kV STRUCTURE

Figure I-20

a. Silver King-to-Goldfield 230 kV Transmission Line

The Silver King-to-Goldfield 230 kV transmission line will be constructed on 230 kV double-circuit steel lattice towers which will exit Silver King receiving station due west in a common corridor with the 500 kV Silver King-to-Kyrene transmission line (Figure I-21).

The corridor will cross Queen Creek Canyon at mile 1.0, Happy Camp Canyon at mile 6.7, Potts Canyon at mile 8.1, Hewett Canyon at mile 12.3 and Whitlow Canyon at mile 17, joining the existing Superior-to-Goldfield 115 kV corridor at the mouth of Whitlow Canyon. At this point the new construction will end and the transmission line structures on the existing 115 kV line will be removed from this point back to the town of Superior.

The existing Superior-to-Goldfield transmission line is constructed on wooden poles with an "H frame" design. The existing conductors can be operated at 230 kV as soon as new 230 kV insulators are installed.

New structures will be added in the immediate vicinity of the Goldfield receiving station in order to enable the existing line to reach the 230 kV section of the receiving station.

b. Interconnection Between Silver King Substation and Existing 115 kV Oak Flat-to-Pinal Transmission Line

The existing 115 kV Oak Flat-to-Pinal transmission line passes approximately 0.6 mile south of the proposed Silver King receiving station site. Two alternate routes are proposed to interconnect the existing 115 kV transmission line with the Silver King substation (Figure I-22).

Alternate interconnection #1 would exit from the west end of Silver King receiving station and proceed south along the east side of Silver King-to-Hayden 230 kV corridor. At the point where the Silver King-to-Hayden 230 kV corridor joins the APS 500 kV corridor, Alternate #1 would cross under the APS 500 kV line and enter the existing 115 kV Oak Flat-to-Pinal transmission line at nearly a right angle. It is anticipated that this will be accomplished by tapping the existing transmission line and interconnecting the existing line with the Silver King receiving station.

Alternate interconnection #2 would proceed from the west end of Silver King receiving station and cross the Silver King-Hayden 230 kV corridor, turning south to the existing 115 kV transmission line. Thus, Alternate #2 would parallel the Silver King-to-Hayden 230 kV transmission line on the west side.

c. Interconnection of the Existing 115 kV Superior-to-Pinto Valley Transmission Line with Silver King Substation

The existing 115 kV transmission line passes across or adjacent to the Silver King receiving station site. It is anticipated that the 115 kV transmission line would be tapped at the Silver King site and interconnect directly with the Silver King substation, without building additional 115 kV transmission lines.

d. Silver King-to-Hayden 230 kV EMA Transmission Line

A new 230 kV transmission line is proposed from the proposed Silver King substation to the Hayden area (Figure I-23).

A new substation is proposed in Section 1, T5S, R14E, near the crossing of the existing Hayden-to-Coolidge 115 kV transmission line on the north bank of the Gila River. The substation will interconnect the proposed Silver King-to-Hayden 230 kV transmission line with the existing Kearny-to-Hayden 115 kV transmission lines. After construction of the new substation, the existing 115 kV transmission lines will remain in service and be operated at their present 115 kV level. A new 230 kV transmission line is proposed from the Silver King substation to the Hayden substation.

The transmission facilities proposed are overhead, three phase 230 kV lines. Lightning protection will be provided by static wires supported at the peaks of the towers and/or steel poles.

Double-circuit, high-strength lattice towers will be used for long spans, resulting in the fewest towers per mile. In urban areas steel poles will be used. Typical tangent tower and conductor arrangements are shown in Figures I-24, I-25, and I-26.

Tower height, location and distance between towers (span length) are the result of the type of terrain being crossed. A 25 foot minimum clearance will be maintained between conductors and the ground. Clearance will be increased when crossing highways and railroads.

Each type of tower has design variations to provide additional strength to certain locations where stronger towers are required. The towers used on straight portions of the transmission line support the conductor vertically and restrain other loads such as the forces of the wind and ice loads. This type of tower is called a tangent tower.

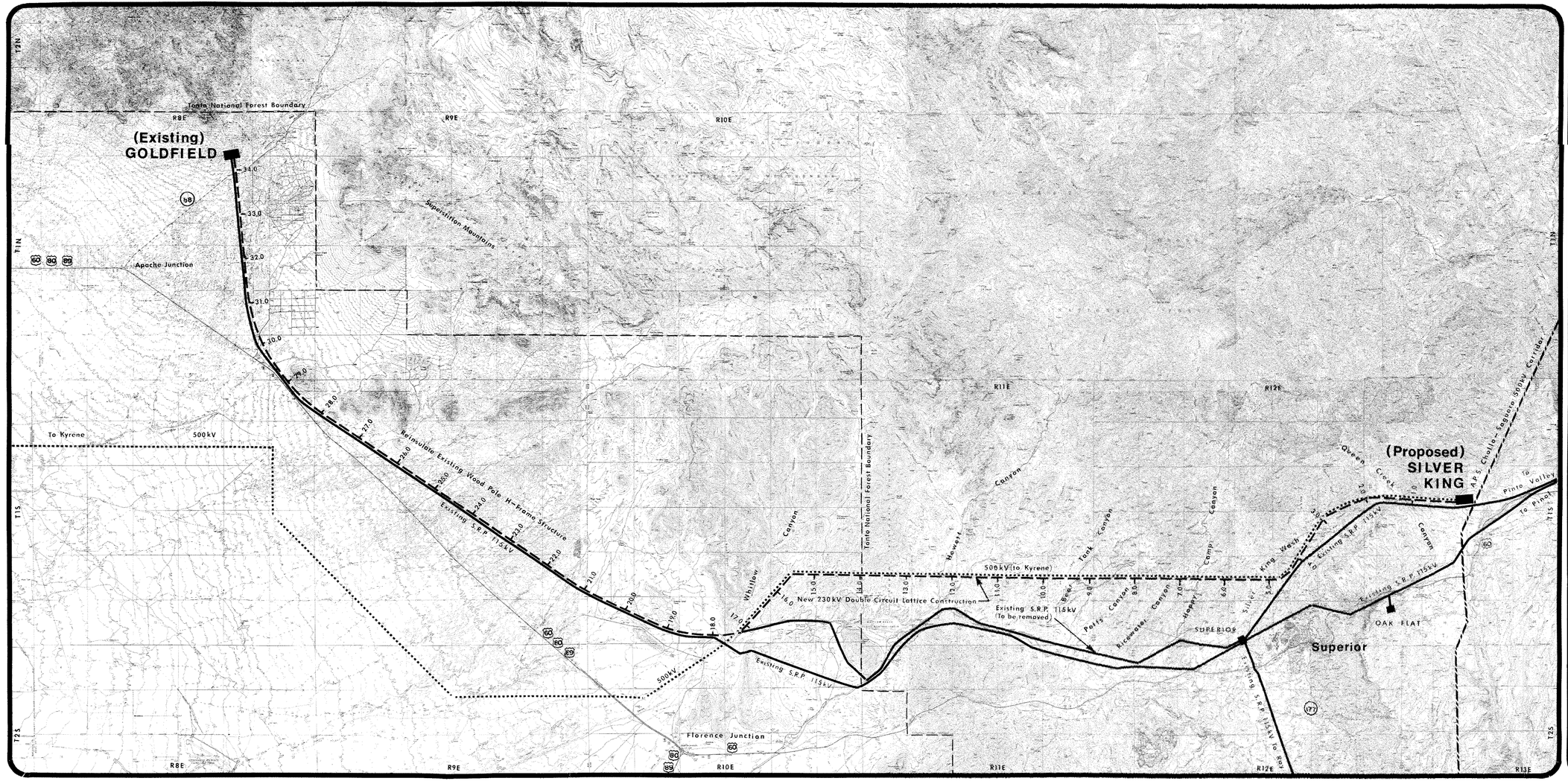
Where towers must support an exceptionally long span of conductors, a stronger type of tower will be used to provide the extra strength necessary for this particular application. Examples are the crossing of rivers, canyons, highways, and the points along the route where the line changes direction sharply.

On the average, 230 kV steel lattice towers will be 117 feet high and 230 kV steel poles will be 109 feet high.

Conductors will be suspended from the 230 kV towers by a single string of insulators, each weighing approximately 190 pounds.

3. Construction Requirements for 500 kV and 230 kV Transmission Lines

Construction requirements for both the 500 kV transmission line and the 230 kV transmission lines are similar. Where construction requirements differ, they are discussed separately.



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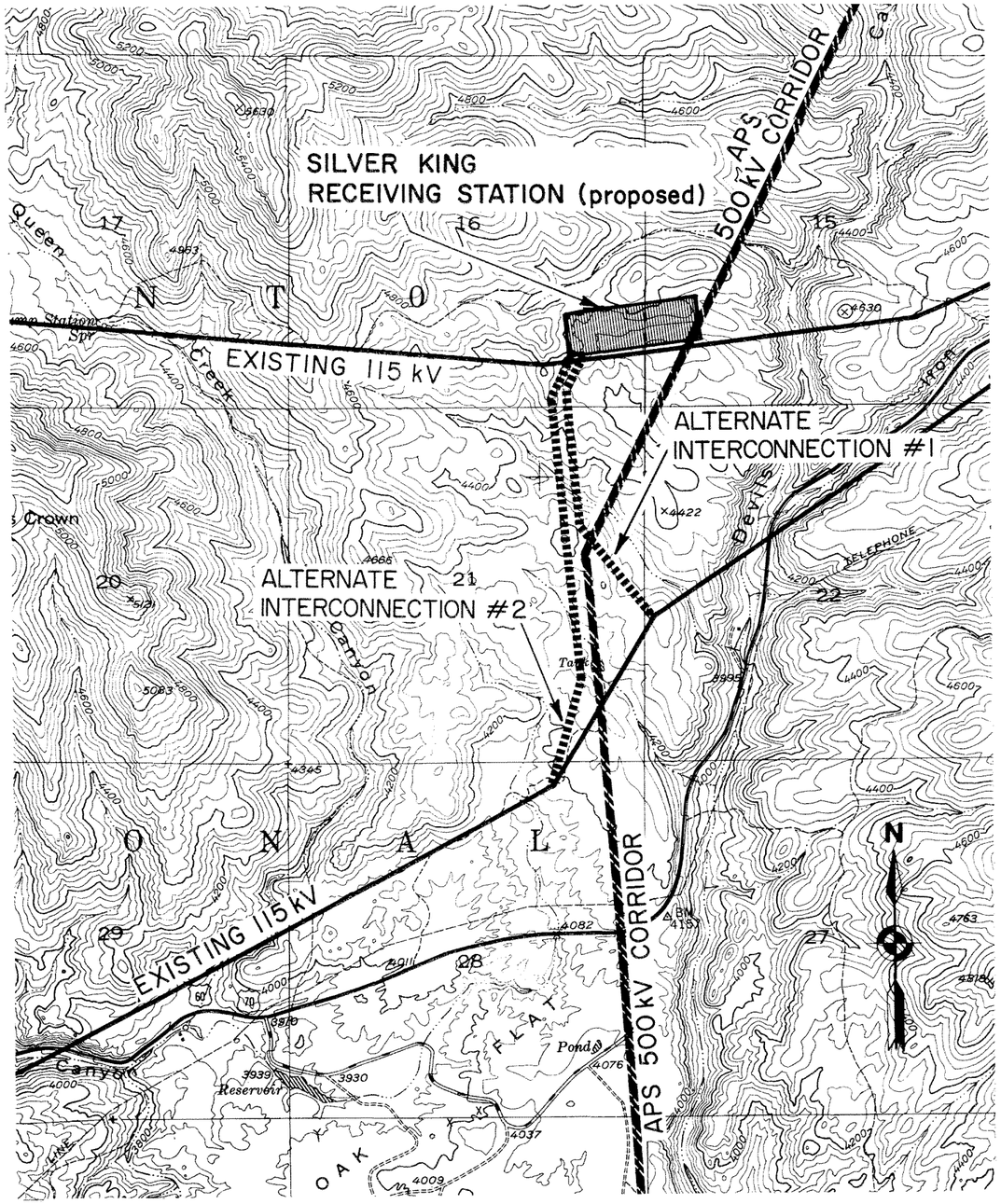
CORONADO PROJECT

Transmission System

SILVER KING to GOLDFIELD TRANSMISSION LINE

Figure I-21



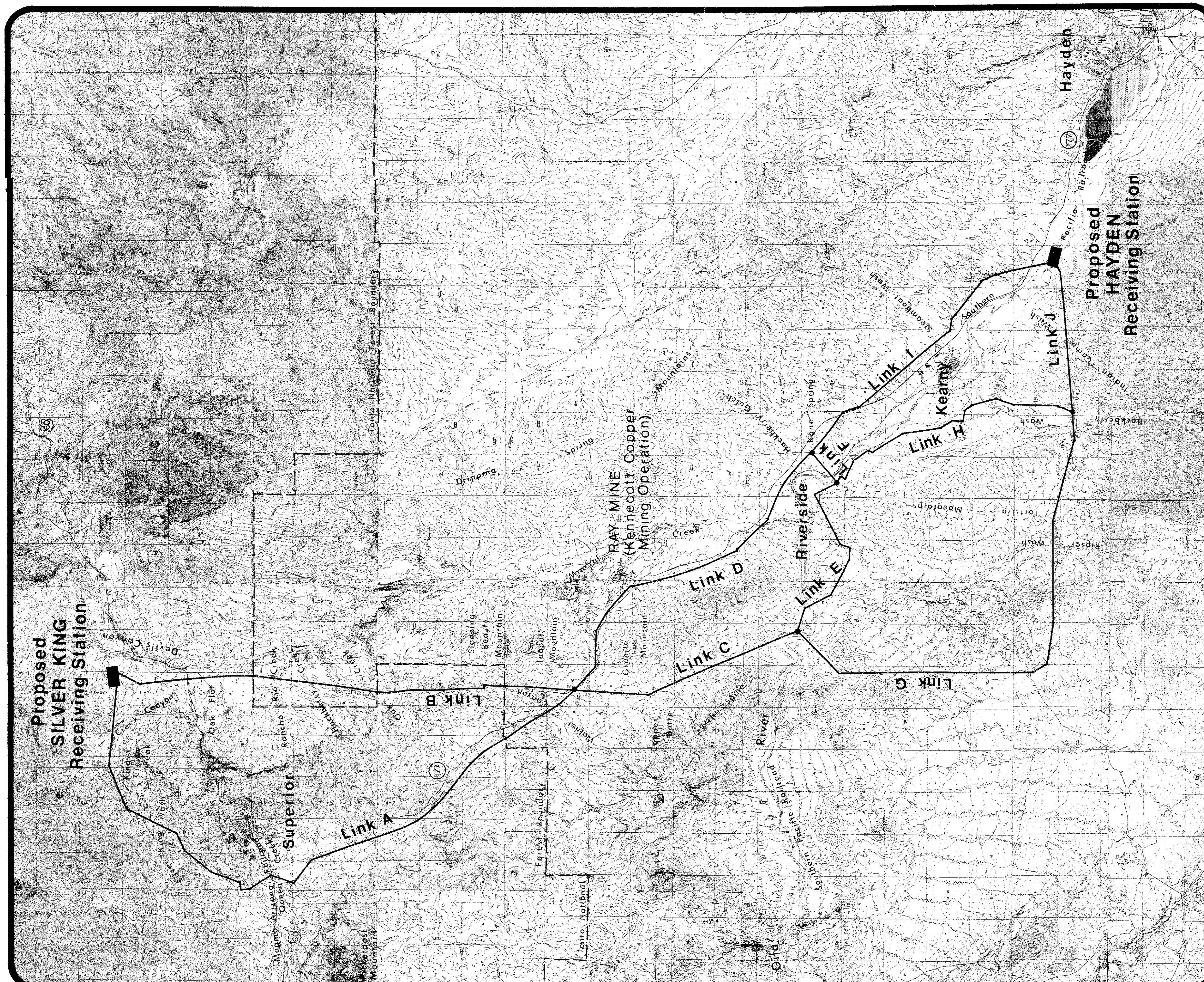
0 1/2 1 MILE

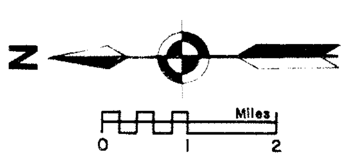
CORONADO PROJECT

Transmission System

INTERCONNECTION BETWEEN PROPOSED SILVER KING RECEIVING STATION AND EXISTING 115kV OAK FLAT-TO-PINAL TRANSMISSION LINE

Figure I-22



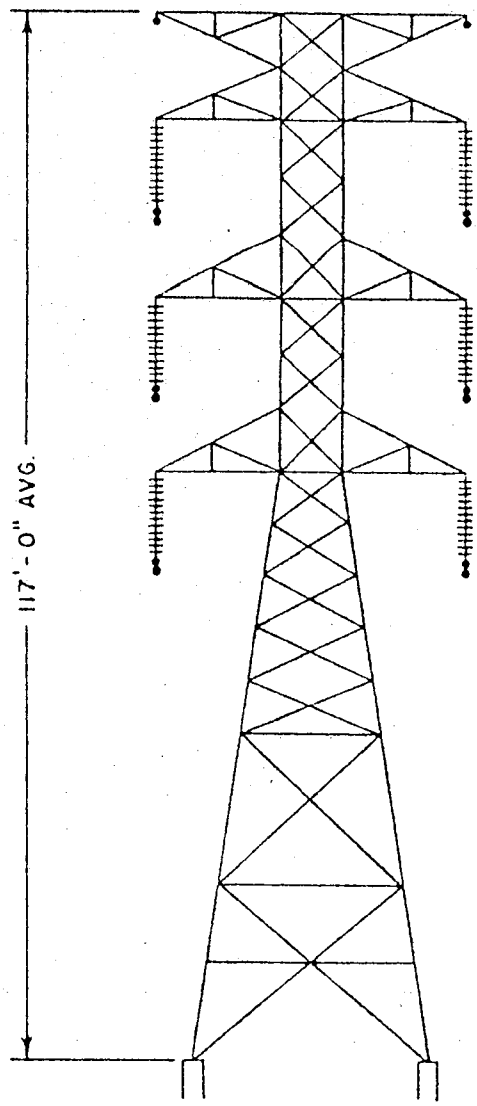


CORONADO PROJECT

Transmission System

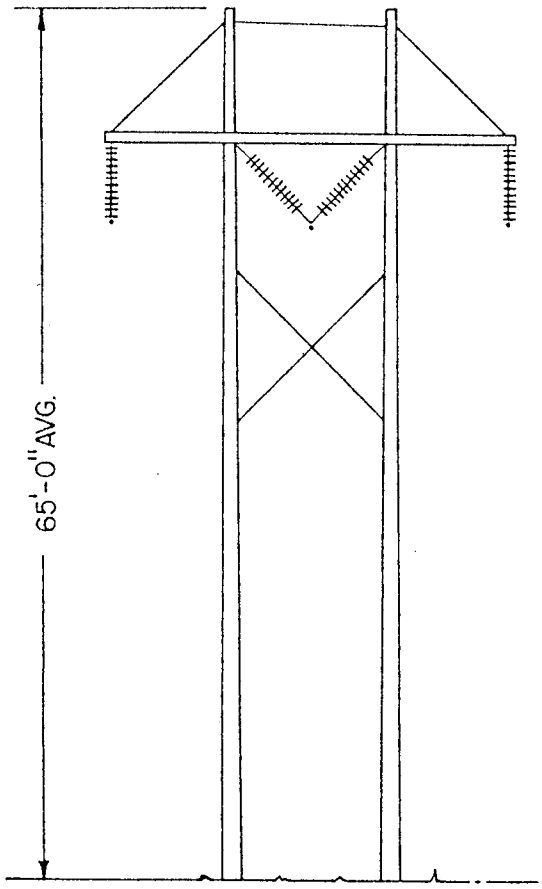
SILVER KING to HAYDEN TRANSMISSION LINE

Figure I-23



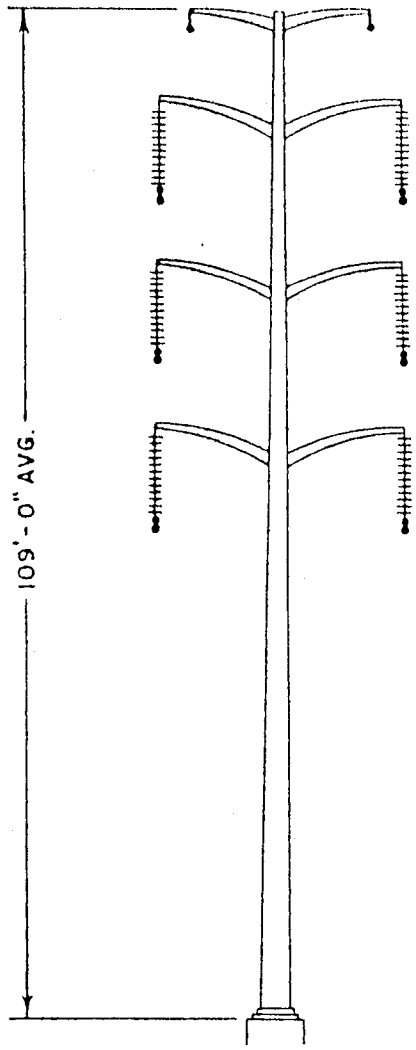
230kV DOUBLE CIRCUIT
STEEL LATTICE TOWER STRUCTURE

Figure I-24



230kV SINGLE CIRCUIT WOOD POLE H-FRAME STRUCTURE

Figure I-25



230kV DOUBLE CIRCUIT STEEL POLE STRUCTURE

Figure I-26

Right-of-way width for the Coronado Station Project 500 kV transmission lines will be 200 feet for a single line and 330 feet for the two-line corridor located within the Cholla corridor.

Where one 500 kV line and one 230 kV line are in the same corridor, 290-foot minimum width is required. Where two 230 kV lines are in the same corridor, 230-foot width is required. Some variations may occur due to difficult terrain or where an existing right-of-way is shared.

A survey of the centerline is necessary before any construction can begin. It is necessary to have a "line-of-site" path, no more than 2' wide, cleared from tower site to tower site.

All angle points will be marked; survey points will be set at all the fence crossings, road crossings, telephone or powerline crossings. The centerline will be referenced to section corners and property corners to establish the point of entry and departure of the centerline from each individually owned parcel of land along the route.

After a centerline land survey has been completed and panels placed for aerial survey, sections of line routes will be photographed, resulting in a plans profile drawing, which will be used for physically locating the towers.

After the plan and profile survey have been completed, line designers will begin locating towers on the profile drawings. The primary concern will be to maintain a conductor to ground clearance of 32.5 feet for all 500 kV transmission lines and 25 feet for all 230 kV transmission lines. The most economical combination of towers will be selected.

Because of varying centerline elevations, different height towers must be used. A tower staking crew will physically locate each tower in the field.

A construction survey will perform tower base layouts and determine the lengths of tower legs. It is essential that the construction survey crew have a cleared centerline to insure accurate base location of each tower; vegetation removal will be kept to a minimum.

Right-of-way clearing will be restricted to the amount necessary for safe construction and operation of the line. Clearing will be restricted as follows:

a. Desert vegetation clearing will be restricted to that required for placement of footings and tower assembly and erection (normally 150'squares); and,

b. Brush clearing will be restricted to that required for footing placement and tower erection (also 150' square). Brush over 15 feet tall will be removed to maintain a 17 foot conductor clearance.

Typically, a road capable of handling construction equipment will be built within the right-of-way of the transmission line, except on Federal lands where BLM or U.S. Forest environmental criteria will be followed. Construction roads will be built to SRP contract specifications which will be in compliance with requirements set forth in applicable governmental or private land permits. Normally, a representative of the contractor will first flag the planned road sites before construction can begin. Existing roads will be used wherever possible. At the conclusion of construction, construction roads will be closed and slash piled, and the area restored unless otherwise required (see Exhibit H in appendix).

The soils at each tower site may vary considerably. Soil borings and soil tests as well as full-scale footing tests will be made, as needed, along the length of the line to determine the engineering properties of the various soils encountered. This information can be used to determine the design of the footings at each tower site.

All foundations will be cast-in-place concrete; soil conditions, type of structure, and loading conditions will dictate the specific type of foundation design to be used. For normal, self-supporting tangent towers, cylindrical footings 7-12 feet in depth (as required by the soil condition) will be used. Larger footings will be required for line angle towers (where the line changes direction), termination towers, and locations where flooding can be expected.

At each tower site, the holes drilled for foundations or footings will be filled with concrete and reinforcing steel, then allowed to cure for 30 days prior to tower erection. Tower steel is delivered by tractor and lowboy trailer to each tower site, and assembled on the site. After the tower is assembled, a truck or tractor mounted crane is brought into the site to erect the tower. Tower sites that are inaccessible by road may have to have "hole drilling equipment," concrete, and tower steel hauled to the tower sites by helicopter.

Concrete batch plants will be required approximately every 20 miles and concrete will be transported to tower sites using large concrete transit mix trucks. Therefore, it will be necessary to build construction roads to each tower foundation site to accommodate digging equipment and concrete trucks. Concrete batch plant sites normally require 3-5 acres of reasonably cleared and level terrain. During operation, the site will be occupied by a portable batch plant, large water trucks, van, a parking area for pre-mix trucks, an aggregate pile, and waste pit. Batch plant "basing" is determined by the travel for ready mix trucks from the batch plant site to the furthest foundation to be poured, which cannot exceed 60 minutes. Batch plant sites may also be used for staging areas, after foundations have been "poured," since the necessary permits have already been obtained and the site already disturbed.

After concrete footings have been allowed to cure tower assembly and construction is commenced. Crews assemble the tower steel pieces into tower sections by hand or by using a light winch line. The erection crews then move into the site with a large crane and erect the tower from previously assembled sections. In the past, tower erection operations have required a 200 foot square area. The crane must be leveled to avoid overturning.

An alternative method of tower placement could be used to assemble the towers either wholly or in part at staging areas placed between 20-30 miles apart along the line, then transport the entire tower or segments thereof to the tower sites by a large helicopter such as Sikorsky S-64 (Skycrane).

Conductor installation (wire pulling) is performed at tensioning and pulling sites, usually located some 15,000 to 20,000 feet apart (3 miles), along the centerline of the transmission line. Road access is necessary at these points.

Conductors and static wires must not be pulled along the ground as this may damage the wire and increase "corona effect." "Tension stringing" is achieved by pulling light lines from tower to tower. This line is usually strung by a light helicopter. This light line is next used to pull a heavier cable (big sock line) through the entire "pull" length. To maintain proper line tension, the tensioner is needed at one end, and heavier pullers or hoists are required at the opposite ends of the pull. The big sock line is then used to pull the conductor into place without dragging or touching the ground. Usually two reels or wires are spliced together by a temporary splice and are used to lengthen the pull length and to reduce the number of pulling sites.

When a tower is located in solid rock or soils having poor conductivity, such as sand and/or gravel, additional grounding connectors from the tower to the ground are required in parallel paths to obtain this low electrical resistance. These additional ground paths are called "counter poise" connections, and are usually installed by driving "rods" into the ground in a suitable pattern, 30-50 feet from the tower, and connecting by a ground wire to the tower legs.

General cleanup will be the final step. This includes completing all unfinished phases of construction, "dressing" soil around tower footings, cleanup of trash and debris, seeding of disturbed areas, complete slash disposal, and drainage closure of roads, if requested by the respective landowners.

Joint construction of the 500 kV and 230 kV transmission lines from Silver King may be possible as far as Whitlow Canyon, i.e., where the two lines separate and the 230 kV line is connected to the upgraded 115 kV transmission line. The portion of the route from Silver King-to-Hayden which is in common with the APS 500 kV corridor will not be subject to joint construction, since construction is already under way on the APS transmission line and will proceed ahead of any feasible schedule for the 230 kV line to be constructed in conjunction with the APS 500 kV line.

4. In Service Dates

The schedule for having various phases of the transmission system constructed and ready for service is listed below:

The backup system, from the Cholla Generating Station to the Coronado Generating Station is scheduled to be in service by April 1978 in order to provide the necessary electrical power for testing the generating equipment.

The Coronado-to-Silver King, the Silver King Substation, and the Silver King-to-Kyrene transmission system is scheduled to be in service by December 1978.

The Silver King-to-Goldfield portion of the proposed system is scheduled to be in service in December 1979. The Silver King-to-Hayden portion of the proposed system will be required by November 1979, including the construction of the new 230 to 115 kV substation near Hayden. The two 115 kV interconnections at Silver King are scheduled to be in service in December 1978.

One of the existing 115 kV transmission lines from Superior-to-Goldfield will be removed from 115 kV service. The portion of this transmission line from Whitlow Canyon to Goldfield will be reinsulated to 230 kV, spliced to the new 230 kV transmission line extending to Silver King and utilized as a 230 kV line. The remaining portion of this existing 115 kV line will be removed, i.e., Whitlow Canyon to the town of Superior.

5. Microwave Communication System

If the Silver King substation is located at Alternative Site C, a passive repeater site for microwave communications with the station will be needed. Its location is the NE 1/4 of the NE 1/4 of Section 17, T1S, R13E.

The proposed repeater site would require less than one acre of land and would consist of three "billboard" type repeaters, one 20' wide and by 16' tall and two 24' wide by 20' high. Each repeater will have four to six concrete footings and will be elevated approximately seven to eight feet above the ground level.

K. Description of Coal-Supply Sources

Salt River Project has contracted to purchase 1.5 million tons of coal from The Pittsburg & Midway Mining Company McKinley Mine located near Gallup, New Mexico during the 17-month period from August 1, 1978 to December 31, 1979. Salt River Project is in the process of negotiating two contracts for coal supply to Coronado after this period. The two sources would be the McKinley Mine for approximately 1,000,000 tons, annually, beginning January 1, 1980, and extending for 25 years. The second contract would be with Coastal States Energy Company for approximately 500,000 tons, annually, between January 1, 1980, and December 31, 1984. Although the agreements are not signed, there appear to be no difficulties in the negotiations. The 1,500,000 tons, annually, will support the expected operation of the Coronado Station between 1980 and 1984. Further negotiations will provide the remaining coal needed after 1984.

The mining operations associated with the coal to be purchased from the McKinley mine was described in the Cholla Project final environmental statement. The impacts of mining up to 5,000,000 tons per year and the associated reclamation plan are discussed in the statement. This 5,000,000 tons per year will include the coal being considered in current negotiations between Salt River Project and The Pittsburg & Midway Mining Company and is covered by a U. S. Geological Survey mining plan.

The coal from Coastal States Energy Company will come from a mine in the Fish Lake National Forest in Utah, 30 miles east of Salina, Utah. The mine has been in operation since 1950. The U. S. Forest Service has performed an environmental analysis of the mine expansion and issued a negative declaration on the impacts of the expansion.

The coal to be supplied from the McKinley Mine will be transported by the Atchison Topeka & Santa Fe Railroad over an existing spur at the mine, the main line of the Santa Fe and the coal-haul spur railroad to be constructed from the main line to the Coronado Generating Station. No track construction is required at the mine.

The coal has the following average quality characteristics as received:

Moisture	19.0%
Ash	14.8%
Sulfur	0.6%
BTU - 9,130 per pound	

With regard to the balance of the long-term coal supply for the Coronado Station, i.e., coal requirements during the period beyond 1984, it is the Salt River Project's objective to acquire a long-term coal supply contract which, when considered with the economics of coal transportation and the quality of the coal involved, would provide the most feasible fuel resource from both economic and enivonmental standpoint. Specific coal sources under consideration include (i) those located in the San Juan Basin in New Mexico, (ii) those located in other portions of New Mexico, (iii) existing mines in Utah, Colorado, Montana, Wyoming, and (iv) mines yet to be developed in the western states.

II. Analysis of the Generating Station, Wellfields Coal-Haul Railroad, and Limestone Source Component

A. Introduction

The following chapter discusses the existing environment of the project area and the environmental impacts of the generating station, wellfields, limestone source and plant spur railroad. In addition, the cumulative impacts of the entire project, including the transmission system, are described in section II.C.2. Alternatives to the project are also presented in this chapter.

B-1 Description of the Environment, Generating Station, Wellfields and Limestone Source

1. Location

The St. Johns plant site is situated in the northeastern part of the State of Arizona, approximately six miles northeast of the town of St. Johns, in Apache County. A system of Federal and State paved highways provides road service to the site area. A paved two-lane road, U.S. Highway 666, passes 3.5 miles to the west of the site. The Atchison, Topeka & Santa Fe (AT&SF) Railroad main line at Sanders is approximately 50 miles north of the site.

2. Physical Environment of the Project Area

a. Climatological Data

The climatology of the St. Johns area has been described by the U.S. National Weather Service based on continuous data obtained from cooperative observers since the turn of the century. The following descriptions of the climate at St. Johns have been extracted from the descriptions published by the National Oceanic and Atmospheric Administration (NOAA).

St. Johns lies near one of the drier sections of Arizona. As a result, it does not receive enough precipitation in an average year to make crop growing profitable without irrigation.

Conditions are aggravated by the seasonal distribution of precipitation. Winter precipitation, which is of greatest benefit to crops, is usually light. The storms that affect Arizona in the cooler months enter the state from the west. By the time they reach St. Johns they are relatively dry, having lost much of their moisture over the Mogollon Plateau to the west and south. Fortunately, spring runoff of melted snow from the White Mountains area, via the Little Colorado River, is normally sufficient to fill the two nearby reservoirs. Snow is common at St. Johns in winter, accounting for better than one half of the total precipitation.

While winter precipitation, when it occurs, is usually widespread and long-lasting, that of summer is spotty and brief. Since summer rains are usually intense, soil moisture levels and surface storage can reach greater peaks during this season. Moderate to heavy afternoon showers and thundershowers develop somewhere in the vicinity almost every day from the middle of July until the end of August. Precipitation is heaviest in the White Mountains area. The source for this moisture is usually the Gulf of Mexico. However, once or twice each summer heavy rains may fall from air that is associated with a tropical storm in the Pacific Ocean.

b. On-Site Meteorology

A one-year study of the meteorology and air quality in the vicinity of the St. Johns site was conducted (see Appendix A-1). Results of this study are summarized as follows:

(1) Winds

Winds in the St. Johns area have a prevailing westerly component which is attributable to the large scale pressure gradient which is the principal driving force of the atmosphere during the daytime at the 100-foot level and during the entire day at the 1000, 2000 and 3000 foot levels. A predominant east wind occurring at the 100 foot level is a drainage wind associated with the higher terrain to the east and the east-west orientation of the Carrizo Wash. Horizontal atmospheric dispersion at the 100-foot level is greatest during summer afternoons, and smallest in the winter mornings.

(2) Layer Stability

The results of the meteorological study showed that: 1) the occurrence of extremely stable conditions is restricted to the early morning; 2) the percent occurrence of very stable conditions decreases with altitude; and, 3) in the afternoon, unstable conditions occur predominantly in the surface layer below 500 feet.

(3) Ground Based Inversion

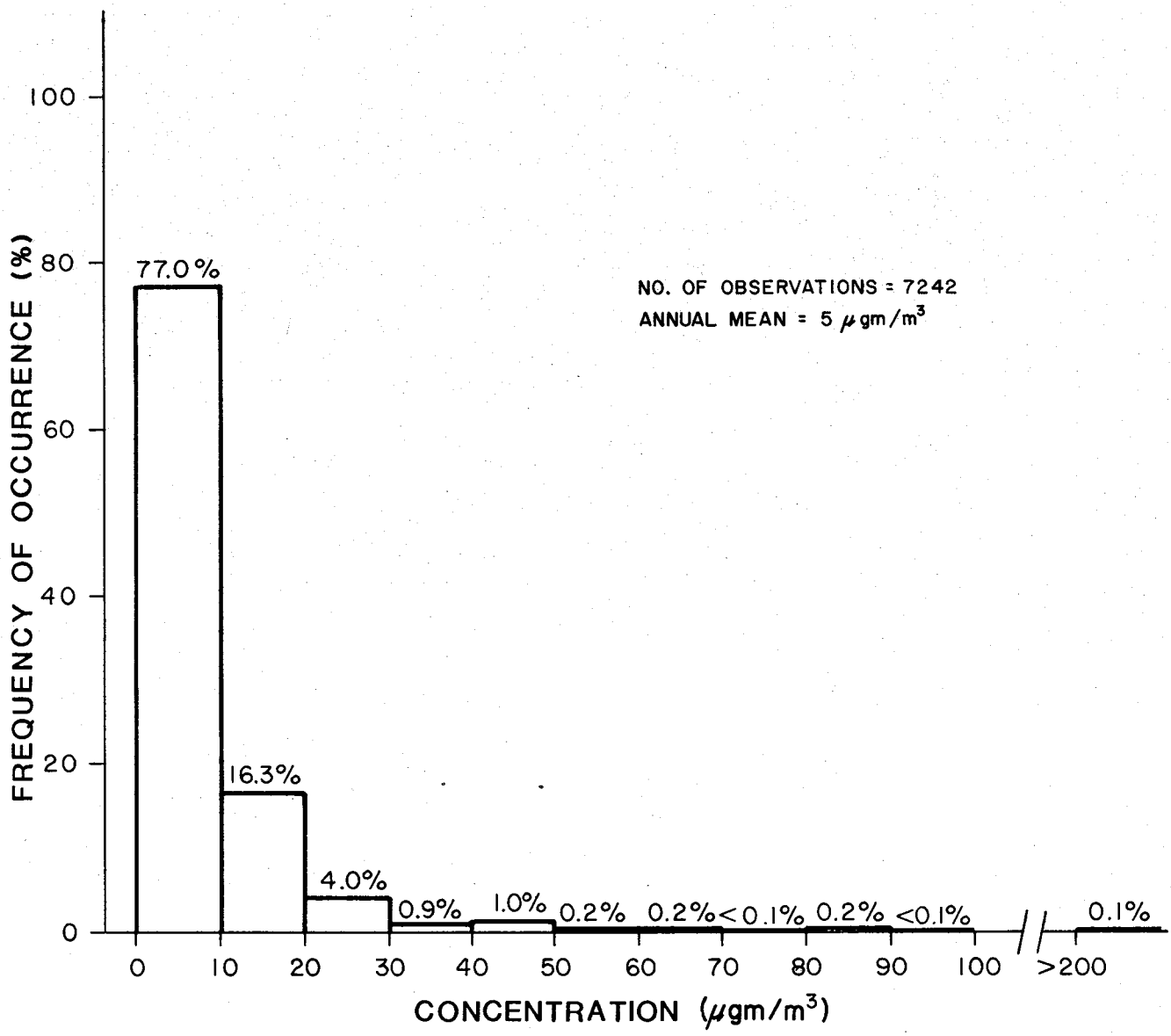
Inversion depths were observed in the St. Johns area between February, 1974 and January, 1975. Ninety-three percent of the observed inversion depths were equal to or less than 1250 feet and 82 percent were equal to or less than 1000 feet. The mean inversion depth in St. Johns during this period was 646 feet.

c. Air Quality

Air Quality monitoring was conducted at St. Johns, Arizona from February, 1974 through February, 1975. Measurements of sulfur dioxide, oxides of nitrogen, suspended particulate matter, and visibility were taken. The results of the monitoring program are summarized below. The instrumentation and data collection methodology is presented in more detail in Appendix A-2.

(1) Sulfur Dioxide

Sulfur dioxide levels were monitored by continuous electro-chemical analysis. These continuous records were averaged on an hourly basis and are presented as 1-hour, 3-hour and 24-hour averages. The distribution of hourly concentrations of SO_2 is illustrated in Figure II-1. This shows that 77 percent of the hourly concentrations were less than 10 $\mu gm/m^3$. Maximum hourly concentrations generally were less than 100 $\mu gm/m^3$, although a single occurrence of unusually high SO_2 (685 $\mu gm/m^3$) was recorded on October 16, 1974. In Table II-1 the maximum and second maximum hourly SO_2 concentrations for each month are listed.



DISTRIBUTION OF HOURLY SO_2 CONCENTRATION ST. JOHNS, ARIZONA FEBRUARY 14, 1974 - FEBRUARY 28, 1975

Figure II-1

TABLE II-1

Maximum and Second Maximum One-Hour Concentrations of SO_2

St. Johns, Arizona

	'74 Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	'75 Jan.	Feb.
Maximum Concentration ($\mu gm/m^3$)	66	49	92	64	41	84	78	34	685	21	41	86	65
Second Maximum Concentration ($\mu gm/m^3$)	66	49	88	53	37	84	20	34	307	21	41	86	65

Annual Mean = 5 $\mu gm/m^3$

State Annual Standard = 50 $\mu gm/m^3$

Average three-hour concentrations of SO_2 were well below the State Standard (1300 $\mu gm/m^3$); concentrations generally were less than 30 $\mu gm/m^3$. Except for one instance (a concentration of 362 $\mu gm/m^3$), maximum three-hour concentrations were less than 90 $\mu gm/m^3$. The single maximum three-hour concentration recorded during the program was associated with the anomalous appearance of SO_2 recorded in October, 1974. Maximum and second maximum three-hour concentrations recorded each month are listed in Table II-2. Average 24-hour concentrations of SO_2 were also below the State Standard (260 $\mu gm/m^3$); concentrations were generally less than 20 $\mu gm/m^3$. Maximum 24-hour concentrations recorded were also small. Maximum and second maximum 24-hour concentrations recorded each month are listed in Table II-3. Except for the anomaly recorded on October 16, 1974, maximum values were less than 40 $\mu gm/m^3$.

TABLE II-2

Maximum and Second Maximum Three-Hour Concentrations of SO_2

St. Johns, Arizona

	'74 Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	'75 Jan.	Feb.
Maximum Concentration ($\mu gm/m^3$)	63	49	64	56	32	84	26	26	362	21	41	86	38
Second Maximum Concentration ($\mu gm/m^3$)	59	46	59	56	32	84	26	23	358	21	41	86	35

State Standard (3-hour) = 1300 $\mu gm/m^3$

TABLE II-3

Maximum and Second Maximum 24-Hour Concentrations of SO_2

St. Johns, Arizona

	'74 Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	'75 Jan.	Feb.
Maximum Concentration ($\mu gm/m^3$)	29	34	23	25	15	26	14	10	90	12	21	37	15
Second Maximum Concentration ($\mu gm/m^3$)	26	11	15	23	13	18	13	6	16	10	19	34	13

State Standard (24-Hour) = 260 $\mu gm/m^3$

(2) Nitrogen Oxides

The oxides of nitrogen were monitored continuously during the period February 22, 1974, to February 28, 1975. Concentration levels of NO and NO_2 during the period were generally less than 10 $\mu gm/m^3$. The distribution of hourly NO concentrations during the monitoring program is illustrated in Figure II-2. More than 90 percent of all occurrences were less than 10 $\mu gm/m^3$; the remaining samples were less than 70 ugm/m^3. The annual average NO concentration was 4 $\mu gm/m^3$, which is near the limit of measurability of the instrument. Maximum and second maximum hourly concentrations of NO during each month are listed in Table II-4. No values are provided for February, 1974 due to the small amount of data acquired during the month. (The instrument was installed in late February.)

TABLE II-4

Maximum and Second Maximum One-Hour Concentrations of NO

St. Johns, Arizona

	'74 Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	'75 Jan.	Feb.
Maximum Concentration ($\mu gm/m^3$)	9	7	10	5	69	25	37	5	7	7	7	7
Second Maximum Concentration ($\mu gm/m^3$)	7	7	10	5	47	25	25	5	7	7	7	5

Annual Mean = 4 $\mu gm/m^3$ (calculated)

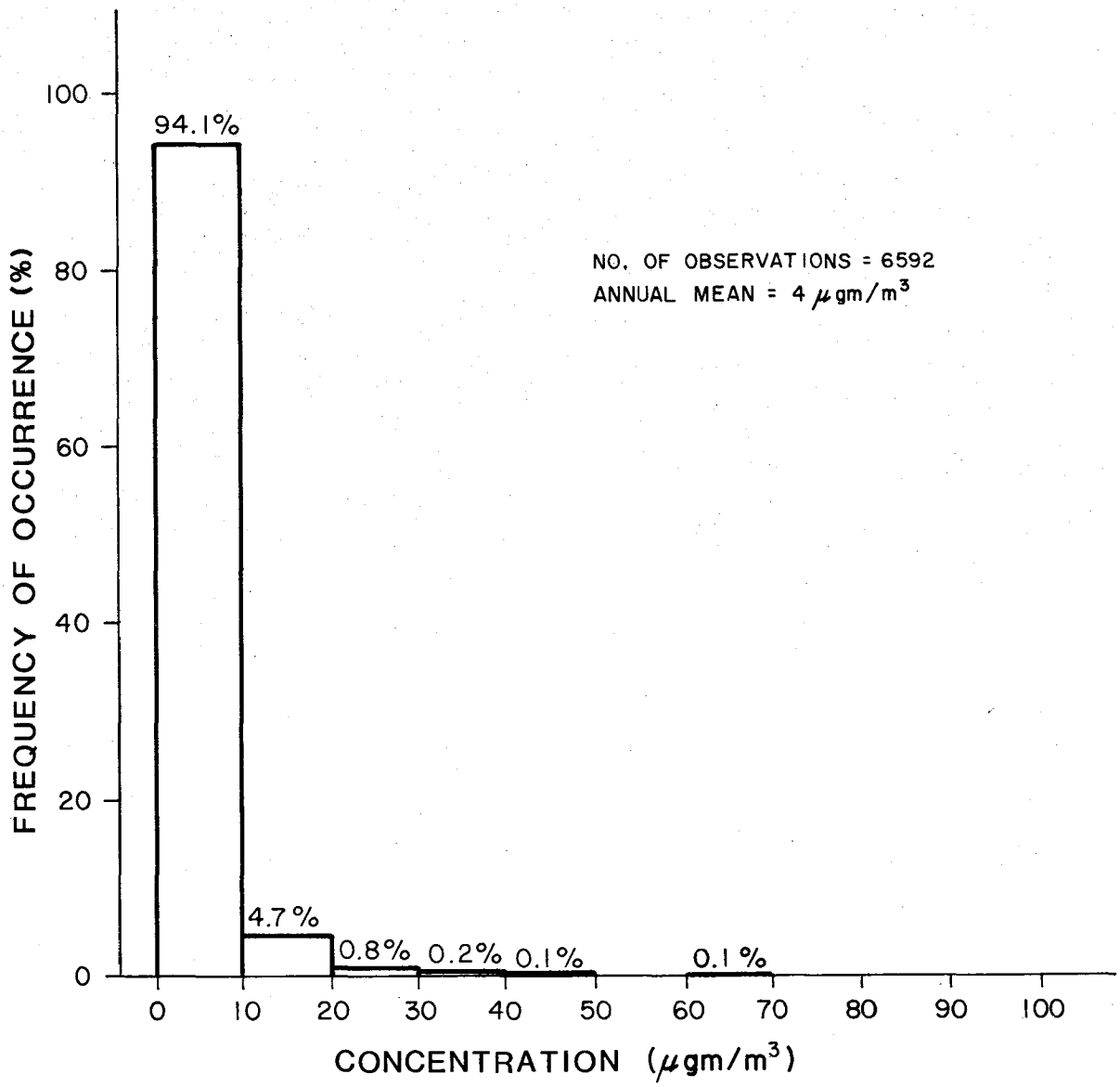
Concentrations of NO_2 at St. Johns were very small. Ninety-nine percent of the hourly averages were less than 10 ugm/m^3; the annual average was 2 ugm/m^3. Distribution of hourly NO_2 values is illustrated in Figure II-3. Hourly values did not exceed or approach the State Annual Standard of 100 ugm/m^3; the maximum hourly NO_2 concentration recorded was 23 ugm/m^3. Maximum and second maximum concentrations of NO_2 during each month are listed in Table II-5. No values are listed for February, 1974, due to the small amount of data acquired during the month.

TABLE II-5

Maximum and Second Maximum One-Hour Concentrations of NO_2

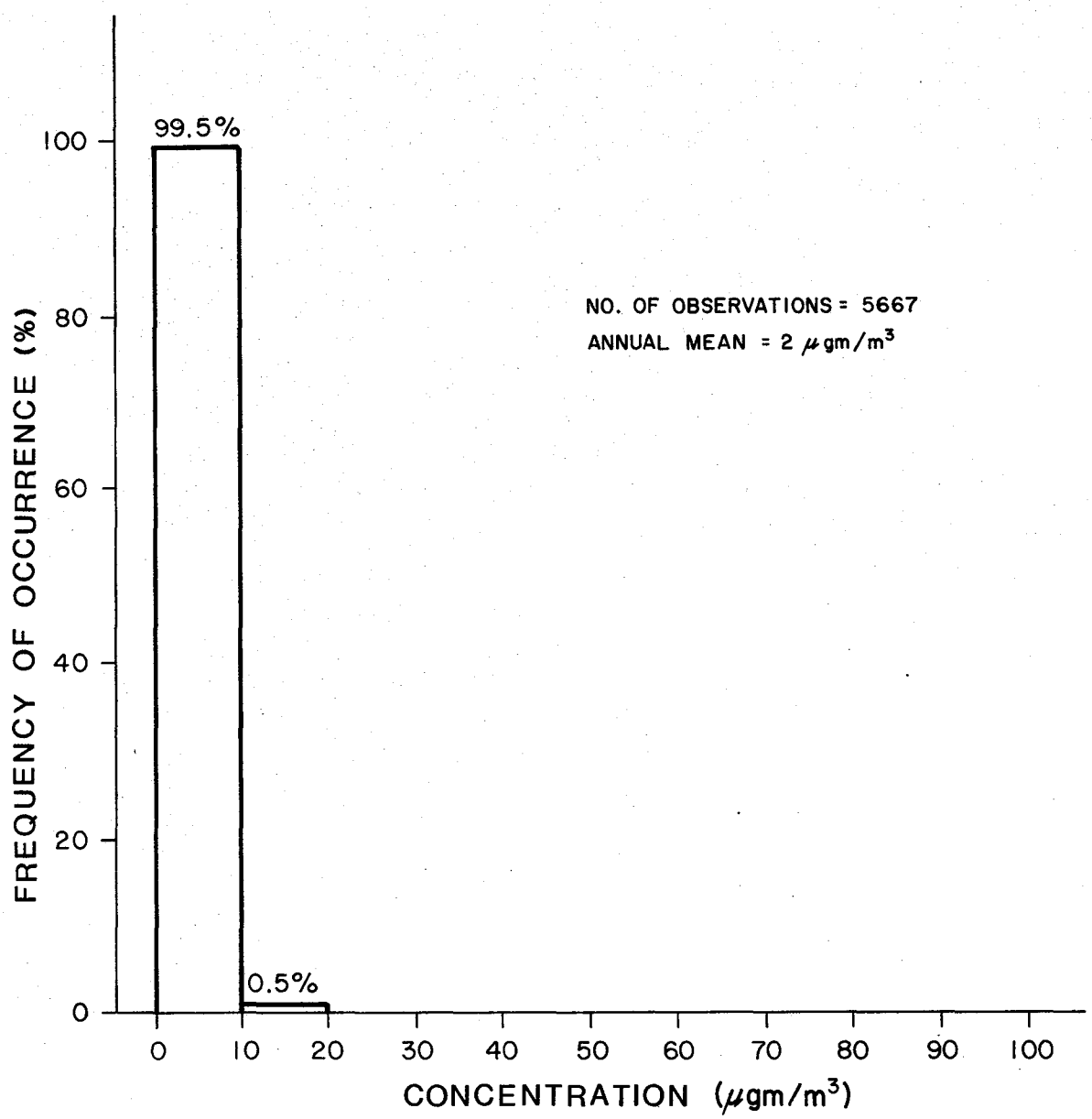
St. Johns, Arizona

	'74 Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	'75 Jan.	Feb.
Maximum Concentration ($\mu gm/m^3$)	15	2	0	0	9	19	9	8	15	15	23	11
Second Maximum Concentration ($\mu gm/m^3$)	15	2	0	0	8	19	9	8	15	11	23	11



DISTRIBUTION OF HOURLY NO CONCENTRATION
ST. JOHNS, ARIZONA
FEBRUARY 22, 1974 - FEBRUARY 28, 1975

Figure II-2



DISTRIBUTION OF HOURLY NO_2 CONCENTRATION
ST. JOHNS, ARIZONA
FEBRUARY 22, 1974 - FEBRUARY 28, 1975

Figure II - 3

(3) Airborne Particulate Matter

Twenty-four hour average concentrations of samples of airborne particulate matter collected during the monitoring program were well below the State Standard (100 $\mu gm/m^3$). Their distribution is illustrated in Figure II-4. Concentrations most often were 10 to 20 μgm^3, although higher values did occur; the maximum concentration recorded was 74 $\mu gm/m^3$. The annual geometric mean obtained at St. Johns was 20 $\mu gm/m^3$, compared with 36 $\mu gm/m^3$ from the Joseph City area during approximately the same period. Maximum, second maximum, and geometric mean concentrations during each month of monitoring at St. Johns are listed in Table II-6. Maximum concentrations were generally less than 50 $\mu gm/m^3$. The annual maximum concentration occurred during June, as did the maximum monthly geometric mean. The majority of particles analyzed consisted of calcium, potassium, sodium, iron, and aluminum silicates and silica. This included calcium, sodium, and potassium feldspars, micas, hornblendes, clays and glass. Calcium-rich minerals such as calcite and gypsum, and iron oxides and hydroxides such as hematite and limonite were also present. Sulfur was found in only a very small fraction of the particles sampled. A few unusual single particles were found, including several that were high in copper, two with vanadium, two high in lead and one with a trace of zirconium. The general composition of particles, however, appeared consistent with the first six months of particulates sampled.

(4) Visibility

Visibility at St. Johns was generally very good during the monitoring program, with maximum values well over 100 miles being recorded. The most common visual range was between 60 and 70 miles. To characterize the visibility at St. Johns during the observation period, the mean visual range from all observations was calculated. This mean value, referred to as the "generalized visibility", was 80 miles. In comparison, a generalized visibility of 70 miles was obtained at the Petrified Forest during another study which used the same photographic technique. The Petrified Forest study was mostly non-concurrent, however, and was based on a monthly study in each of four seasons during parts of 1973 and 1974.

The cumulative percentages of visual ranges that exceeded a given distance during this study are illustrated in Figure II-5. The distribution of measured visual range appears nearly log-normal, with the exception of extremely high values. Note also from Figure II-5 that 50% of all measured values were greater than 78 miles, and 95% were greater than 47 miles.

The visual range varied considerably during this study. Minima near 30 miles and maxima near 160 miles were recorded. Monthly values ranged from 64 miles in September to 109 miles in December. In Figure II-6 monthly mean values are graphed with the maximum

TABLE II-6

Particulate Matter Summary

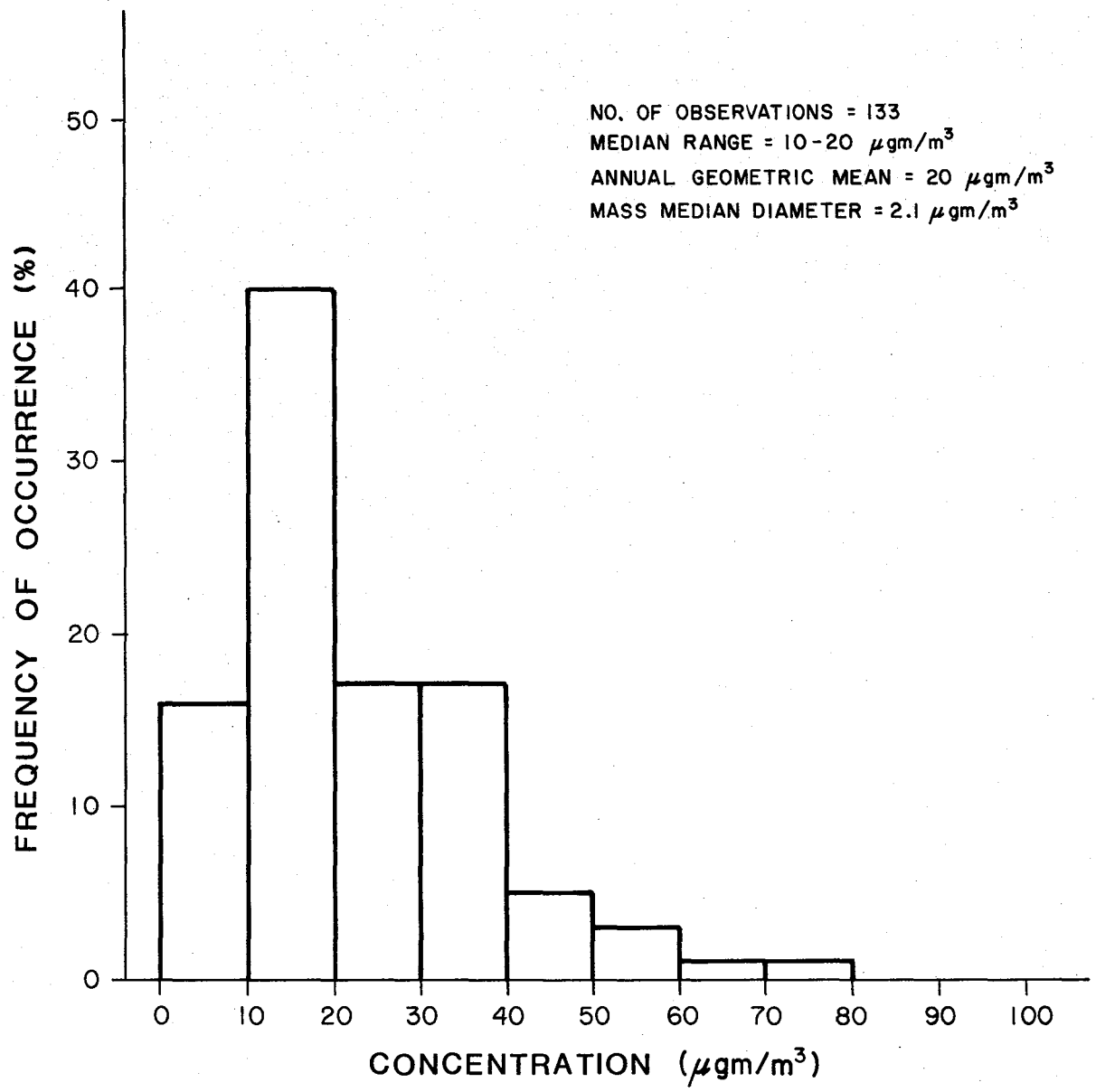
St. Johns, Arizona

	Geometric Mean Concentration, μgm/m^3												
	'74 Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	'75 Jan.	Feb.	Annual
	15	25	36	48	30	17	20	15	17	15	14	11	20

State Annual Standard = 60 μgm/m^3

	Maximum and Second Maximum 24-Hour Concentrations, μgm/m^3												
	'74 Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	'75 Jan.	Feb.	Annual
Maximum Conc.	36	40	49	74	49	29	44	42	25	29	74	23	74
Second Maximum Conc.	28	37	43	62	38	20	37	29	23	22	54	15	74

State 24-Hour Standard = 100 μgm/m^3



DISTRIBUTION OF PARTICULATE CONCENTRATION
ST. JOHNS, ARIZONA
MARCH 1974 - FEBRUARY 1975

Figure II-4

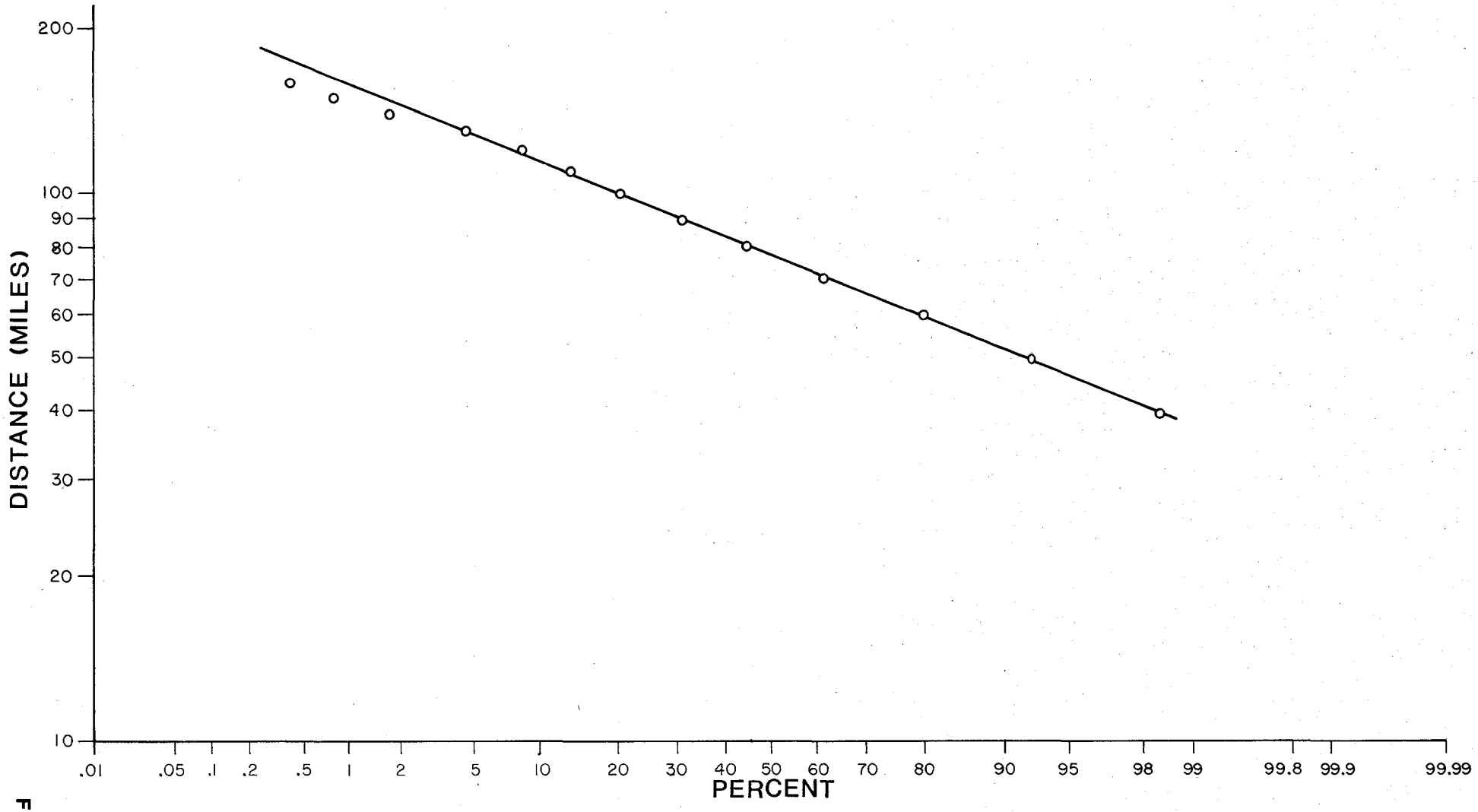
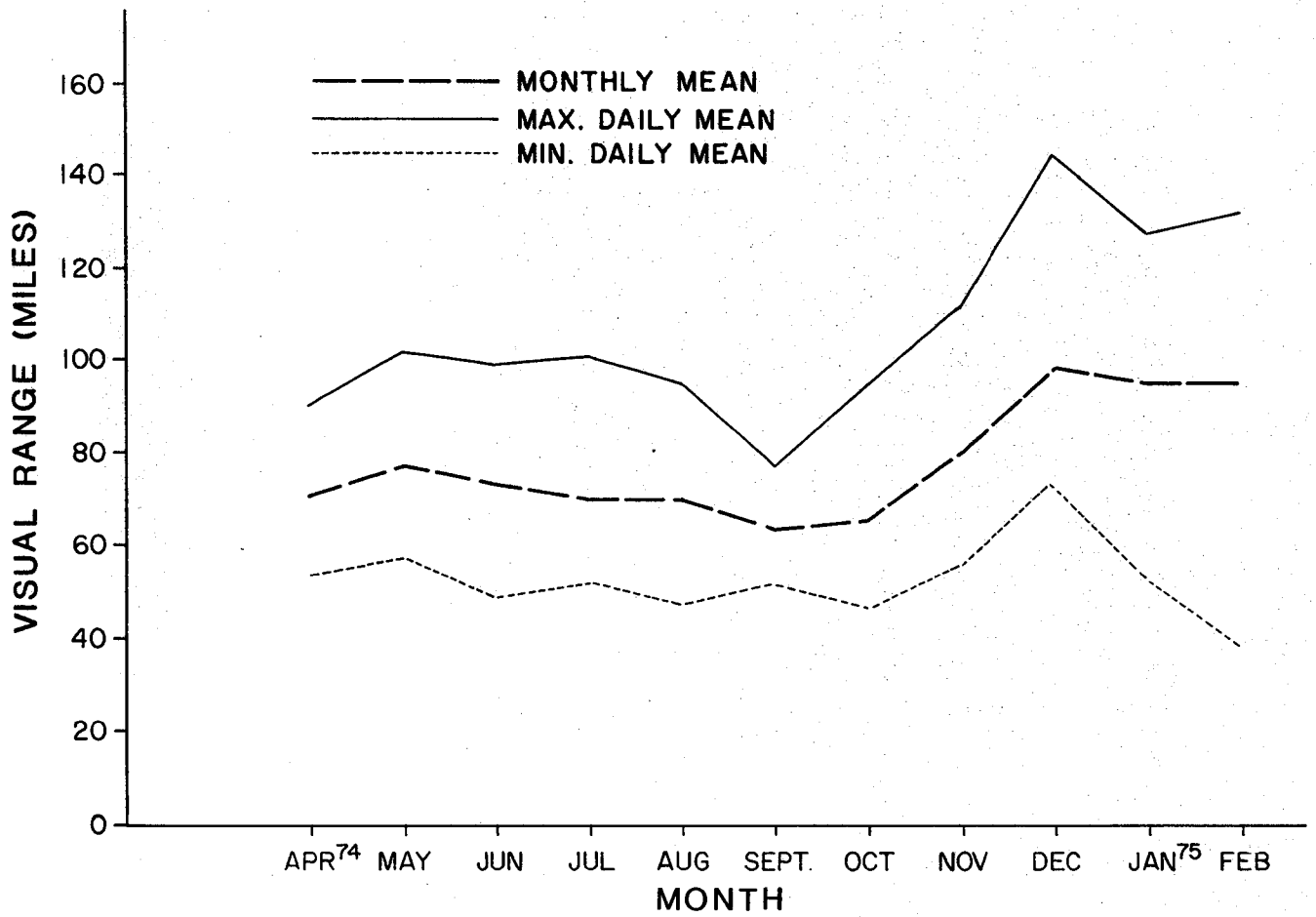


Figure II-5

PERCENT OF VISUAL RANGE OBSERVATIONS WHICH EXCEEDED THE INDICATED DISTANCE, ST. JOHNS, ARIZONA, APRIL 1974 - FEBRUARY 1975



MONTHLY MEAN VISUAL RANGE AND MAXIMUM AND MINIMUM DAILY MEAN FOR EACH MONTH

ST. JOHNS, ARIZONA
APRIL 1974 - FEBRUARY 1975

Figure II-6

and minimum daily mean values for each month. It is interesting to note the change in range of daily mean values during the year. This range was small in September, when the monthly mean was low, and large in February, when the monthly mean was high. Variations in the visual range between the two views were small; a difference of eight miles in the calculated mean values was noted during the period of record. Statistics for each view are listed in Table II-7. Distribution of visual range in each view is illustrated in Figure II-7. Two views were taken from the town of St. Johns, one in a south-southeasterly direction, and another in a south-southwesterly direction.

TABLE II-7

Visual Range Summary

St. Johns, Arizona
April, 1974 - February, 1975
(miles)

View	Mean	Median	Mode	Range	5 Percentile*
1	84	82	60-70	41-160	51
2	76	73	70-80	28-161	42
Combined	80	78	60-70	28-161	47

*Five percent of the calculated visual range values are equal to or less than the indicated value.

Variations in the visual range during the day were calculated based on the values from each view during the entire year. In Table II-8 the annual mean visual range for each view during different times of the day is listed. On an average day, the visual range decreases during the morning hours in both views, but recovers only in View II during the afternoon. However, three measurements per day are probably not sufficient to define a diurnal behavior.

TABLE II-8

Mean Visual Range at Times of Photography

St. Johns, Arizona
April, 1974 - February, 1975
(miles)

View	SR + 1	SR + 3	1400 MST
I	86	82	82
II	77	71	76

d. Topography

As seen in Figure II-8, the site is moderately level in the northwesterly portion with rolling terrain found in the northeast and southeast, and relatively steep hills located in the southwest. The maximum ground elevation at the site is approximately 5945 feet (msl datum) in the southwest section, while the minimum ground elevation at the site is approximately 5740 feet (msl datum) in the north central section near the eastern site boundary.

The terrain in the southeast section of the site slopes towards the two water courses. The terrain on the southwest section of the site generally slopes downward to the north and northeast. The terrain in the vicinity of the southwestern site boundary slopes steeply downward to the west. The terrain in the northeast section of the site slopes moderately downward toward the northeast, while the northwest section is relatively flat with a slight slope downward toward the northwest.

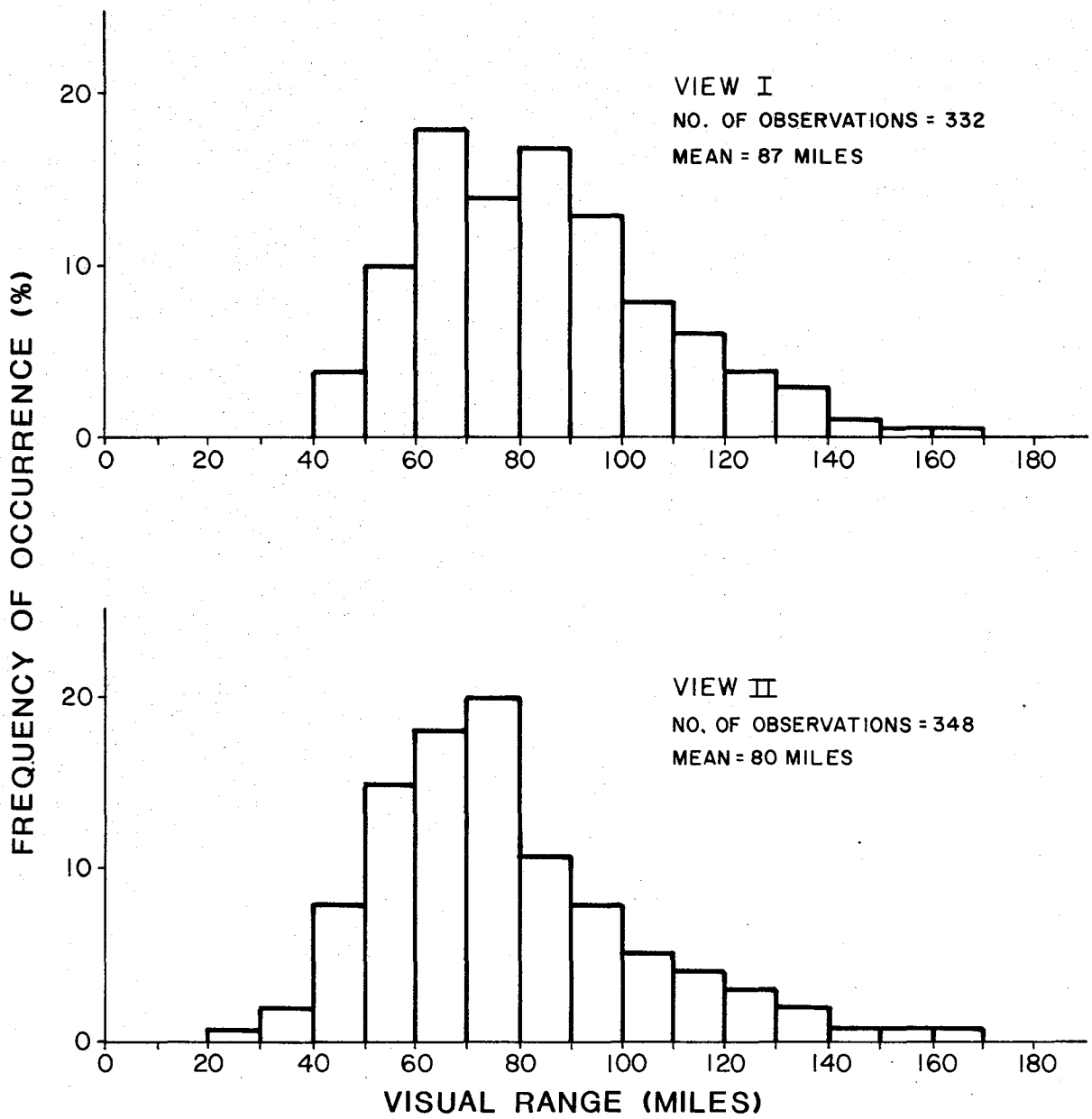
The topography of the Welch limestone claim is typical of the St. Johns area, composed primarily of flat plains to low rolling hills, with occasional flat-topped mesas. The claim site itself is located along the top of a flat-topped mesa with relatively steep sides, with the northern and western sides being steepest, and varies in elevation from approximately 6000 feet at the extreme northern end to 6260 feet near the southwestern corner.

The majority of the area is at approximately 6200 feet elevation. Within a distance of one to two miles from the site the elevation ranges from 5800 to 6300 feet. Just north of the claim a shallow but relatively steep cut is being eroded into the hillside. Near the north end of the site are two large holes that once were the outlets of the springs that deposited the travertine limestone. The larger of the two holes is approximately thirty feet in diameter and forty feet deep; it shows little erosion.

e. Geology and Seismology

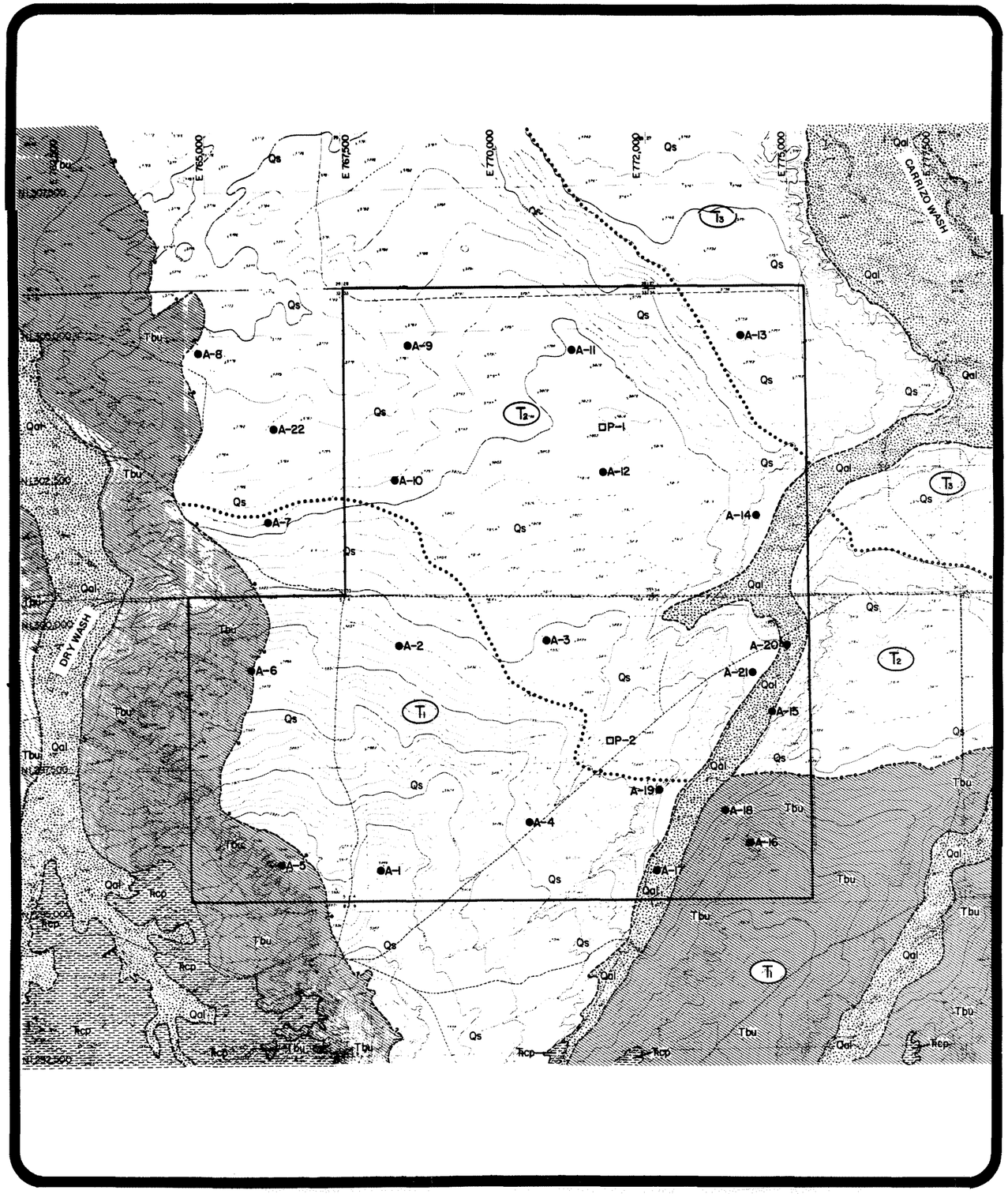
(1) Introduction

This section presents the geologic data derived from site investigations at the St. Johns site. The investigations were made to determine the physical and engineering properties of the soils and rocks for evaluation of their suitability as foundation materials. The site geology was determined from literature search, geologic interpretation of aerial photographs, surface mapping and preliminary subsurface investigation.



DISTRIBUTION OF VISUAL RANGE
ST. JOHNS, ARIZONA
APRIL 1974 - FEBRUARY 1975

Figure II-7



EXPLANATION

Qal — ALLUVIUM: Water deposited sand, silt and gravel (QUATERNARY)

Qs — QUATERNARY SEDIMENTS: Sediments on Black Point surfaces Silty to clayey sand with some gravel and reworked Bidahochi formation material (QUATERNARY)

Tbu — BIDAHOCHI FORMATION: Upper member, consists of weakly cemented, calcareous, fine to medium grained, silty sandstone with gravel layers (TERTIARY)

Rcp — CHINLE FORMATION Petrified Forest member, consists of varicolored clayey and silty shales (TRIASSIC)

●A-22 — Drill hole (Sergent, Hauskins and Beckwith)

□P-2 — Test pit (Sergent, Hauskins and Beckwith)

Geologic contact, dashed where inferred, dotted where concealed, and question marked where doubtful

Thrust or reverse fault, barbs on side of upper plate

Erosional terrace margin

Geologic contact and erosional terrace margin

(T2) — Erosional terrace levels, from oldest (T1) to youngest (T3)

Site boundary

NOTE:

1. Drill hole locations are approximate
2. 2500 ft grid base on Arizona State Coordinate System, East Zone Datum is mean sea level

REFERENCE:

1. Base topography compiled by Stereophotogrammetric methods from photography dated March 4, 1974 by Aero Service
2. Site location: State of Arizona, Apache County, Township 14N, Range 29E, Section 33, East half of Section 32, and West half of Section 34; Township 13N, Range 29E, Section 4, West half of Section 3, and East half of Section 5.

N

0 1/4 1/2 3/4 1

MILES

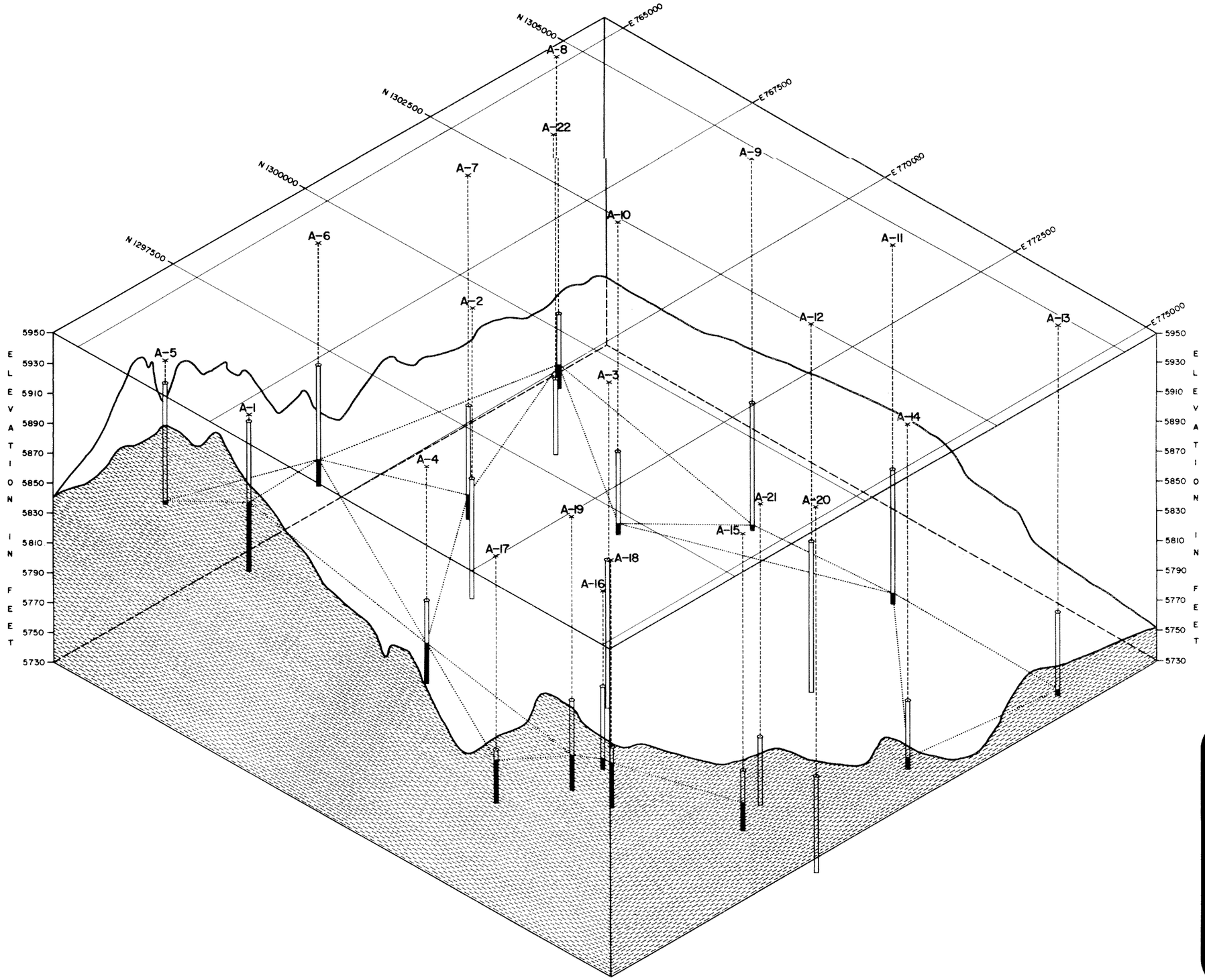
CORONADO PROJECT

Coronado Generating Station

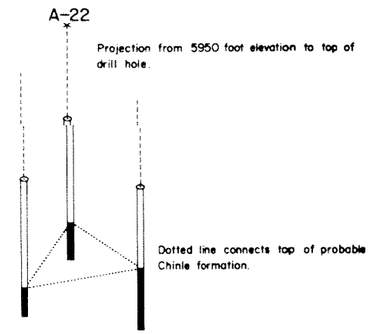
ST. JOHNS GEOLOGIC MAP

SHEET 1 of 2

Figure II-8



EXPLANATION



NOTE:

Dotted line is absent where Chinle formation was not encountered due to insufficient drill depth or possible buried channel.

CORONADO PROJECT

Coronado Generating Station

ST. JOHNS GEOLOGIC MAP

SHEET 2 of 2

Figure II-8

(2) Physiography

The St. Johns site is located within the southern part of the Colorado Plateau Physiographic Province. The Colorado Plateau in this area is characterized by Cenozoic terraces and Mesozoic rocks forming "badlands", volcanic buttes and cinder cones.

The Quaternary is well represented in the area by alluvium, gravelly terraces and basalts. Alluvium occurs in the Carrizo Wash, Little Colorado River and numerous dry washes. Several gravelly terraces occur in the area. Basalts crop out northeast and south of the site. The uppermost formations in the area are the Quaternary terraces consisting of sand, silt, clay and gravels, deposited on the Black Point erosional surface. Six terrace levels were formed representing cycles of erosion and deposition along the Little Colorado River. The terrace deposits are difficult to distinguish from the underlying Bidahochi formation of Pliocene age. In most places the Bidahochi formation is intensely weathered and reworked, and the terrace deposits are partially derived from this formation. This problem is evident on various geologic maps of the area which show conflicts on formations and contacts.

Only the upper member of the Bidahochi formation was deposited in the area. The upper member consists of white to very pale brown, crossbedded, poorly cemented, medium to fine-grained silty sandstone with gravel and rhyolitic ash beds, and a basal travertine. It has a thickness of 200 feet east of St. Johns, but only 50 to 80 feet at the site. The Bidahochi formation is of fluvial origin and was derived by erosion of sediments from the White Pine Mountains to the south and deposited on the Zuni erosional surface. The upper member of the Bidahochi formation is of considerable importance in some areas, because water wells in this formation have produced 10 to 50 gal/min and springs occur in some places at the base of the formation.

Unconformably underlying the Bidahochi formation is the lower member of the Chinle formation of Triassic age. The lower member is also known as the "Petrified Forest" member, or the "C" and "D" members. This member has a thickness of 300 to 350 feet and consists of varicolored shales, marls, mudstone, sand, gravel, and conglomerate, bentonitic clay, volcanic ash, petrified wood and minor gypsum. Uranium, also, has been reported to occur in the middle part of the "C" member in some areas. The Chinle formation weathers into mounds, buttes and mesas with badland expression.

Underlying the Chinle formation is about 60 feet of undifferentiated Shinarump conglomerate and Moenkopi formation that is similar to the Chinle in this area. Underlying the Moenkopi formation is about 240 feet of Kaibab or San Andres limestone consisting of a white to gray, massive or slabby limestone that is partly dolomitic and cherty with some interbedded shale. The nearest outcrops of the Kaibab

limestone occurs about three miles south of St. Johns. Small anticlinal and monoclinal flexures and domical uplifts occur throughout the area, otherwise the regional dip is less than 1° to the north. The major structural features, such as folds, trend northwest and are broad and gentle. An anticline ten miles north of the site and a syncline through Carrizo Wash have 3° to 5° dips on their limbs.

Small-scale structures occur in the Chinle formation, such as anticlinal and synclinal flexures that depart from the regional dip within a distance of 200 to 300 feet, probably as a result of differential compaction, expansive clays, intraformation deformation or deposition over an irregular surface. One of these features, called the "Disturbed Beds" and covering an area over two square miles, occurs three miles east-northeast of St. Johns. A 200 foot zone of very micaceous, cross-laminated siltstones has been squeezed into sharp complex anticlines and synclines that do not continue at depth. The base of this structure is a slip plane along which the overlying beds have been folded resulting in intraformational deformation. The direction of the slip is southwest.

Large-scale landslides have occurred on the sides of many mesas with excessively steep slopes capped by basalt overlying the Chinle formation; this is generally caused by swelling of wet bentonite in the Chinle formation and consequent weakening of the support of the overlying basalt. These slides occur at several locations: 27 miles north-northeast, eight miles east-southeast, and eight miles west of St. Johns. Many joints occur in the consolidated Chinle sandstone lenses with one to four foot spacings. They are vertical and trend $N45^{o}W$ with a minor set $N50^{o}E$. The joints are not believed to be related to uplift but may reflect widespread and varying stresses.

(3) Stratigraphy and Sedimentation

Alluvial fill in dry washes, consisting of sand, silt and gravel with some clay are the youngest deposits in the mapped area. There are three main north draining washes that cut into the Chinle formation; one crosses the site in the southeast corner and the other two are immediately east and west of the site boundaries. The thickness of the alluvial fill is variable, from a few feet at the south end to possibly 70 feet at the north end of the mapped area. Thickest accumulation would be in the alluvial plain in the northeast corner of the mapped area. The alluvium often consists of reworked Chinle material that makes it difficult to determine the fill thickness over the Chinle formation; this was especially true in drill hole A-20 (see Figure II-8).

A thick veneer of dune sand, with a northeast-southwest trend, covers extensive Quaternary sediments. The Quaternary sediments consist of tan, light brown, and yellow brown clean sand, silty sand, and clayey sand with some gravels. The thickness of the sediments increases to the north or northeast and varies from 30 to over 100 feet. Thicknesses over 100 feet may be due to the buried channels in the underlying "badland" topography of the Chinle formation.

Three erosional terrace levels in the Quaternary sediments have been recognized on the site; they are shown as T_1, T_2 and T_3, from oldest to youngest respectively, on Figure II-8. Gravels occur on the northeast and north slopes of terrace T_3 and one such has an abandoned gravel deposit north of the mapped area above the Carrizo Wash. The gravels are rounded and tabular, well graded to three inch sizes, but with some six inch clasts. They consist of chert, quartz, quartzite and some granite fragments, all of which tend to have a caliche rind. Perched water conditions were not found in any of the drill holes in the Quaternary sediments. The next underlying formation is the upper member of the Bidahochi formation consisting of light gray, buff and tan, silty, calcareous, poorly cemented friable sandstone with some gravel layers and scattered travertine. This formation is exposed on the west side and southeast corner of the site and probably has a maximum thickness of 50 to 80 feet. The best exposure of the upper member of the Bidahochi formation is south of the southwest corner of the site. Here it is better cemented and the contact with the underlying Chinle formation can be seen. Further to the north the Bidahochi formation is uncemented and consists of soft sand with loose gravels. The Bidahochi formation below the west rim of the site forms 15 foot near-vertical cliffs in the gullies with badlands expression that weather white, light orange and pink. East of the west rim the contact between the Bidahochi formation and the Quaternary sediments is questionable and generally defined by the "brush line". Vegetation grows better on the silty Bidahochi formation than on the Quaternary sediments. The contact between the Bidahochi formation and the Quaternary sediments could not be determined in the drill holes as the materials are so similar. About 3000 feet east of the southeast corner of the site is a 30 foot thickness of light yellow-brown impure travertine covering 1.6 acres. This deposit is part of the Bidahochi formation. The travertine is flat lying on the north to slightly southwest, dipping at the southwest corner of the deposit.

Perched water conditions were not found in any of the drill holes in the Bidahochi formation or in contact with the underlying Chinle formation. Underlying the Bidahochi formation is the Petrified Forest member of the Chinle formation of Triassic age. The Chinle formation consists of purple, gray, green, brown and reddish brown, generally plastic, silty, clay-shales. In outcrop it resembles a shale, but in drill holes it resembles a clay. The Chinle formation is exposed along the south edge and southwest corner of the mapped area. It underlies the site area at a depth of 30 feet in the south to 100 feet in the north. The Chinle formation has a thickness of 300 to 350 feet, and dips about 100 ft/mi to the northeast. It forms smooth rounded hills where not covered by erosion-resistant cap-rocks; where covered by cap-rock it forms buttes and mesas with badland expression. The same irregular topography on the Chinle formation is reflected in the subsurface investigations. The top of the Chinle formation in drill holes cannot be clearly defined because the top, in many cases, has been reworked and its surface is extremely uneven. Outcrops of the Chinle

formation contain minor scattered 1/4-inch thick slabs of gray aragonite that may be pseudomorphs after gypsum. Near the southeast corner of the site a Chinle outcrop capped by a 5-foot thick ledge of calcareous material contains numerous quartz and chert veins, some of which resemble white porcelain. The rock has the appearance of being baked by basalt. The Chinle has been used in the construction of many dams and ponds in the area with no visible leakage, piping or cracking. Perched water conditions were not found in any of the drill holes in the Chinle formation.

(4) Geologic Structure

Faulting was not found at the site. The fault nearest the site is 1500 feet southwest of the southwest corner of the site in a dry wash cut. It is a minor thrust fault, not traceable on the surface, with 3-foot vertical displacement. The attitude of this fault is N55°E 37°S with the upthrown block on the south side. Joints in the Bidahochi formation have no preferred orientation, but the joints in the travertine are vertical with orientations of N60°E and N40°W.

Two depressions, one in the northwest corner of the mapped area and the other in the northwest quarter of the site appear to be natural, and possibly caused by dune sand blockage of drainages. Both appear dark on aerial photographs because accumulations of reddish-brown silt contrast against the surrounding light brown sand. The depressions are shallow and apparently not caused by solution of underlying materials.

(5) Seismicity

Historical records document the areas of earthquake activity and levels of associated damage for this region. The seismic history data are used to determine design values for these sites. The modified Mercalli Intensity Scale (Table II-9), a measure of earthquake intensity, is referred to in the following discussion.

According to the U.S. Department of Commerce' Earthquake Information Bulletin ("Earthquake History of Arizona", May - June 1970), the earliest documents that describe Arizona's earthquakes were those recorded in the 1800's at Fort Yuma, on the California side of the Colorado River.

Probably the most famous earthquake in this region occurred in 1887 near Bavispe, Mexico, about 190 miles southeast of Tucson (about 250 miles from the site). The tremor caused great destruction near its epicenter, and was probably distinctly felt in the vicinity of the site.

Another significant (intensity V or greater) epicenter located near the site occurred on December 12, 1916. The earthquake, of intensity V, was felt over 70,000 square miles. However, the intensity in the site area was believed to be no greater than IV.

TABLE II-9
MODIFIED MERCALLI INTENSITY SCALE
(ABRIDGED)

I. Not felt except by a very few under especially favorable circumstances. (I Rossi-Forel scale).

II. Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing. (I to II, Rossi-Forel scale).

III. Felt quite noticeably indoors, especially on upper floors of buildings, but many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibration like passing truck. Duration estimated. (III, Rossi-Forel scale).

IV. During the day felt indoors by many, outdoors by a few. At night some awakened. Dishes, windows, doors disturbed; walls made creaking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably. (IV to V, Rossi-Forel scale).

V. Felt by nearly everyone; many awakened. Some dishes, windows, etc., broken; a few instances of cracked plaster; unstable objects overturned. Disturbance of trees, poles, and other tall objects sometimes noticed. Pendulum clocks may stop. (V to VI, Rossi-Forel scale).

VI. Felt by all; many frightened and run outdoors. Some heavy furniture moved; a few instances of fallen plaster or damaged chimneys. Damage slight. (VI to VII, Rossi-Forel scale).

VII. Everybody runs outdoors. Damage negligible in buildings of good structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving motor cars. (VIII, Rossi-Forel scale).

VIII. Damage slight in specially designed structures; considerable in ordinary substantial buildings with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water. Disturbed person driving motor cars. (VIII+ to IX, Rossi-Forel scale).

IX. Damage considerable in specially designed structures; well designed frame structures thrown out of plumb; great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken. (IX+, Rossi-Forel scale).

X. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations, ground badly cracked. Rails bent. Landslides considerable from river banks and steep slopes. Shifted sand and mud. Water splashed (slopped) over banks. (X, Rossi-Forel scale).

XI. Few, if any, (masonry) structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipeline completely out of service. Earth slumps and landslides in soft ground. Rails bent greatly.

XII. Damage total. Waves seen on ground surfaces. Lines of sight and level distorted. Objects thrown upward into the air.

The next closest significant epicenter was located southwest of the site. It occurred on April 17, 1931, and was of intensity V and felt over 3500 square miles.

An intensity VI shock on January 16, 1950, centered about 72 miles from the site produced ground cracks 1/2 inch wide and 12 feet long in Ganado (about 84 miles northeast of the site). The shock was probably not felt in the site area.

A maximum intensity VII shock centered near Flagstaff (about 100 miles from the site), was probably felt with low intensity near the site.

Tremors originating in the vicinity of Flagstaff in 1959 and 1972 were apparently of a local nature, and probably not perceptible in the site area.

On September 23, 1910, an earthquake of epicentral intensity VI centered about 60 miles northeast of Flagstaff (about 112 miles northwest of the site) was felt over a large area and was probably felt with low intensity in the site area.

Several shocks have originated in the vicinity of Socorro, New Mexico. Three of these shocks were of high intensity and were probably felt lightly in the site area. The greatest historical intensity experienced in the site area was certainly no greater than VI and an acceleration of 0.06g has probably never been exceeded.

f. Water Resources

(1) Introduction

The St. Johns site lies in the upper Little Colorado River drainage basin. The major stream in the area is the Little Colorado River which flows northward from its headwaters to St. Johns, then northwestward and toward the Apache-Navajo County line. The main tributaries are Concho Creek and Big Hollow Wash which drain the south flank, and Carrizo Wash which drains the north part of the basin. There is perennial flow upstream from St. Johns in the Little Colorado River; downstream flow is intermittent in the main stem and all the tributaries.

Zion and Lyman Dams are large earthen structures on the Little Colorado River. Concho Dam is a small earthen structure on Concho Creek. The Lyman and Concho reservoirs are functional, but Zion reservoir is no longer usable as it has filled with silt. Lyman reservoir has been dry several times because runoff was low and all the water was released for irrigation.

The average annual discharge of the Little Colorado River above Lyman Dam for a 32-year period of record is 14,420 acre-feet and the median of annual mean discharge is 10,900 acre-feet. The average annual discharge of the Little Colorado River near Hunt for a 32-year period of record is 3740 acre-feet and the median of yearly mean discharge is 2600 acre-feet.

Two water courses traverse the site. The northwesterly water course begins in the southeast quarter of Section 4 and flows northeast. The southeasterly water course flows from the southwest and passes through the southeast corner of Section 4 and continues northeasterly through Section 3. Confluence of the two water courses occurs in the southeast corner of the southwest quarter of Section 34. The water course then flows in a northeasterly direction away from the site and eventually joins the Carrizo Wash, north of the site. Carrizo Wash is one of the main tributaries of the Little Colorado River. Carrizo Wash has a drainage area of approximately 2100 square miles as measured at a point north of the plant site. The on-site streams have a drainage area of approximately 2.5 square miles and a channel length of 3.5 miles as measured from a section at the center of the eastern boundary of the site.

(2) Surface and Groundwater Systems

(a) Stream Flow Characteristics

There are no existing stream flow gauges in the near vicinity of the plant site. Therefore, for the small creeks crossing the site, the rational method was used for peak flood discharge calculations. The basin is very narrow and has relatively steep side slopes. The streams within the site boundaries have an average slope of 0.01%. The 100-year peak discharge is calculated to be 1260 cubic feet per second (ft^3/s). The corresponding water surface elevation is 5756.3 feet for the section, taken at the central eastern boundary. The plant grade is approximately at elevation 5800 feet which is 44 feet above the 100-year flood level. Carrizo Wash is approximately 140 feet below plant grade and is therefore not a source of flooding to the site.

(b) Chemical Quality of Surface Water

Chemical quality data of surface water were not available in the St. Johns region. However, SRP is now monitoring 40 springs for chemical quality as well as rate of flow, three lakes for chemical quality, and four locations on the Little Colorado River for chemical quality. In addition, data on rate of flow at two stations on the Little Colorado River is available from the U.S. Geological Survey.

(c) Hydrogeological Conditions

The Moenkopi formation, Kaibab limestone, Coconino sandstone and Supai formation are the principal rock units pertaining to the occurrence of groundwater. The hydrogeologic cross section of the St. Johns site is shown in Figure II-9. The Coconino sandstone constitutes the principal aquifer, extending over a large area in northern Arizona. The Chinle formation, alluvial deposits and volcanic rocks contain water locally, but are not considered major aquifers.

In the St. Johns area there are several gently dipping anticlinal structures which exhibit a surface expression. The occurrence of these structures is of hydrologic importance, as associated

fractures on the crests and flanks of the anticlines provide groundwater recharge routes, and enhance the permeability of the aquifer. There are no large faults in the St. Johns area; however, the small faults and associated fractures enhance the aquifer permeability. The regional dip of the beds ranges from 1 to 5 degrees in a northerly direction, and is a significant control factor for groundwater movement. The existence of confined and unconfined aquifer conditions is related to the occurrence of the Chinle and Moenkopi formations which comprise the confining rocks overlying the Coconino sandstone and/or Kaibab limestone.

(d) Aquifer Characteristics

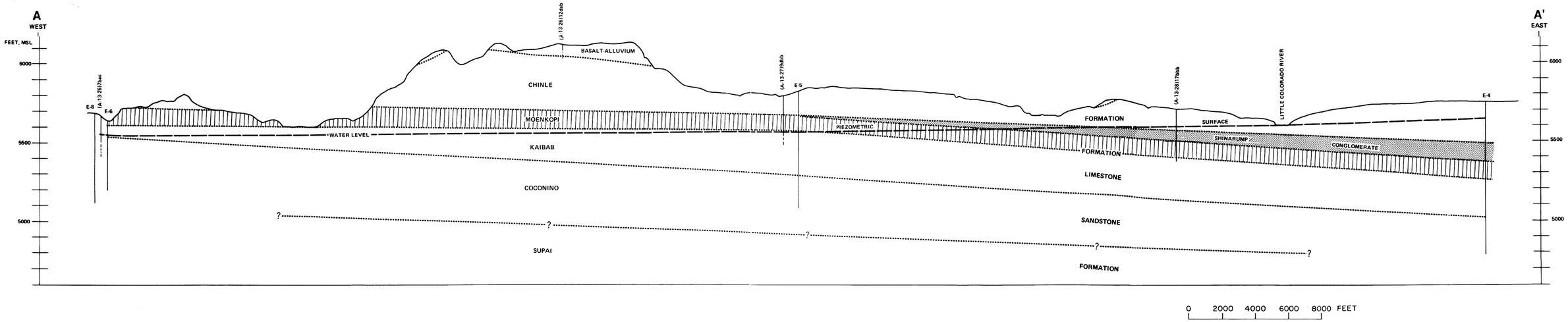
Groundwater occurs mostly in fractures and joints, as the low-permeable and lenticular characteristics of the beds restrict the movement of water. Well depths are generally less than 200 feet and withdrawal is small. Groundwater in the Moenkopi formation contains chloride concentrations that range from 295 to 710 mg/l, and generally a large amount of total dissolved solids.

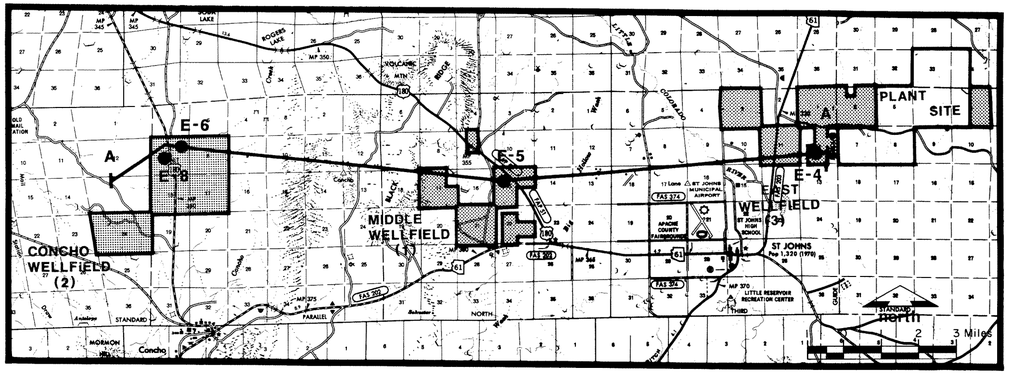
The Kaibab limestone comprises an aquifer in the St. Johns area. The limestone has low permeability, except where fractured. Groundwater normally occurrs in interconnected solution cavities, joints, crevices, and in the sandstone beds contained within the Kaibab. The thickness of the Kaibab ranges from 100 to 300 feet in the St. Johns area. Wells that tap the Kaibab are between 120 to 400 feet deep, and water levels range from 13 to 256 feet below the surface. The specific capacities of these wells range from 3 to 70 gal/min per foot of drawdown. In the early 1960's a pump test was conducted on a well that bottomed in the Kaibab. The data from this test reveal a drawdown of 116 feet for a pumping rate of 830 gal/min for a duration of 46 hours. An analysis of pump-test data made by the U. S. Geological Survey showed a transmissivity of 20,000 gallons per day per foot (gal/d/ft) of aquifer and a specific yield of 0.03.

In the St. Johns area the Kaibab limestone and Coconino sandstone comprise a single aquifer as they are hydraulically connected. The Coconino is the principal component of this aquifer system. Groundwater in the Coconino is under artesian conditions in most of the area north of the Little Colorado River and in places yields water to flowing wells. In most of the area south of the Little Colorado River the water is under water table conditions. The thickness of the Coconino ranges from about 200 to 300 feet. Wells tapping the Kaibab-Coconino aquifer range in depth from 200 to 1000 feet, and the water levels range from flowing at the surface to 800 feet below the surface.

(e) Water Levels

The general direction of groundwater movement is from south to north, and is controlled largely by the regional dip. The recharge areas are along the flanks of the White Mountains and the Mogollon Rim, south of St. Johns. The principal natural and artificial





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HYDROGEOLOGIC CROSS SECTION OF ST. JOHNS SITE

Figure II-9

discharge localities are in the St. Johns area. Recharge to the Kaibab limestone and Coconino sandstone is via downward percolation of water from precipitation through the overlying Quaternary, Tertiary and Cretaceous sedimentary rocks. The downward movement of the water is impeded by the low-permeable beds at the uppermost part of the Supai formation, which underlies the Coconino sandstone. Therefore, water that recharges the Kaibab-Coconino aquifer resides in these formations and moves northward with a downdip toward areas of discharge.

Comparison of available 1974 water level data with earlier recorded water levels indicate that the Kaibab-Coconino aquifer in the St. Johns site area has not been affected by a long-term decline of water levels or depletion of water reserves. Hydrographs of wells (one near Hunt and the other near St. Johns) in Bulletin 7, Arizona Water Commission, 1974, p. 44, show short-term water level fluctuations since the early 1950's, but virtually no change over the long-term period. A decline in the water level generally occurs in the area of heavy pumping near Hunt, Arizona, but recovery during the non-pumping season indicates that the recharge is at least equal to the discharge from wells and springs.

A pilot production well was constructed in the St. Johns site area based on pump test results of exploration wells. The purpose of the pilot production well was to obtain data from a long-term pump test simulating conditions of a plant production well. The long-term test data provided criteria for the design of a well field and the preparation of a projection analysis to estimate the impact on the aquifer system.

(f) Chemical Quality of Groundwater

The total dissolved solids (TDS) concentration of the groundwater in the St. Johns area ranges from 116 to 4314 mg/l. This wide range of chemical quality is indicated by a suite of samples from wells that tap the various rock units in the St. Johns area. Water from the Kaibab limestone and Coconino sandstone aquifer ranges in TDS from 130 to 700 mg/l in the Hunt-Concho area and 1500 to 2000 mg/l near St. Johns. Chemical analysis of water collected at test wells and windmills in the vicinity of St. Johns are shown in Table II-10.

TABLE II-10

CHEMICAL ANALYSES ST. JOHNS SITE AREA - EXPLORATION PROGRAM[a]

Well Location	Date Collected	Temperature (°C)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium and Potassium (Na+K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Hardness (Calcium, Magnesium)	Percent Sodium	Specific Conductance micromhos at 25 C	Total Dissolved Solids
SRP; E-4 (A-13-28) 12cad	5-19-74 (39 h)(b)	21			343	91	324	799	610	450		0		1228		3500	2212
SRP; E-5 (A-13-27) 16abb	5-20-74 (9.7 h)(b)	18			118	22	345	598	360	204		0		384		2225	1343
SRP; E-6 (A-13-26) 7bad	5-09-74 (48 h)(b)	17			38	11	30	177	43	18		0		143		405	228
(A-13-26) 7bac (Windmill)	2-28-74	16			35	9	22	153	32	15		0		125		360	188
(A-13-27) 9dbb (Windmill)	2-26-74	13			177	40	161	409	341	205		0		605		1750	1125

a. Chemical Analyses by Salt River Water Users' Association.
b. Water sample collected after given hours of test pumping.

Note: Analyses are given in ppm (parts per million) except where noted otherwise.

(g) Interrelation of Surface Water and Groundwater

There is a direct relationship between surface water and groundwater in the St. Johns area. Most of the base flow component of the surface water is derived from springs, seeps and flowing wells. Springs and seeps associated with the Quaternary gravel terrace deposits and Tertiary basalt flows are the principal source of the base flow. The discharge of the springs and seeps is related to the amount of annual precipitation.

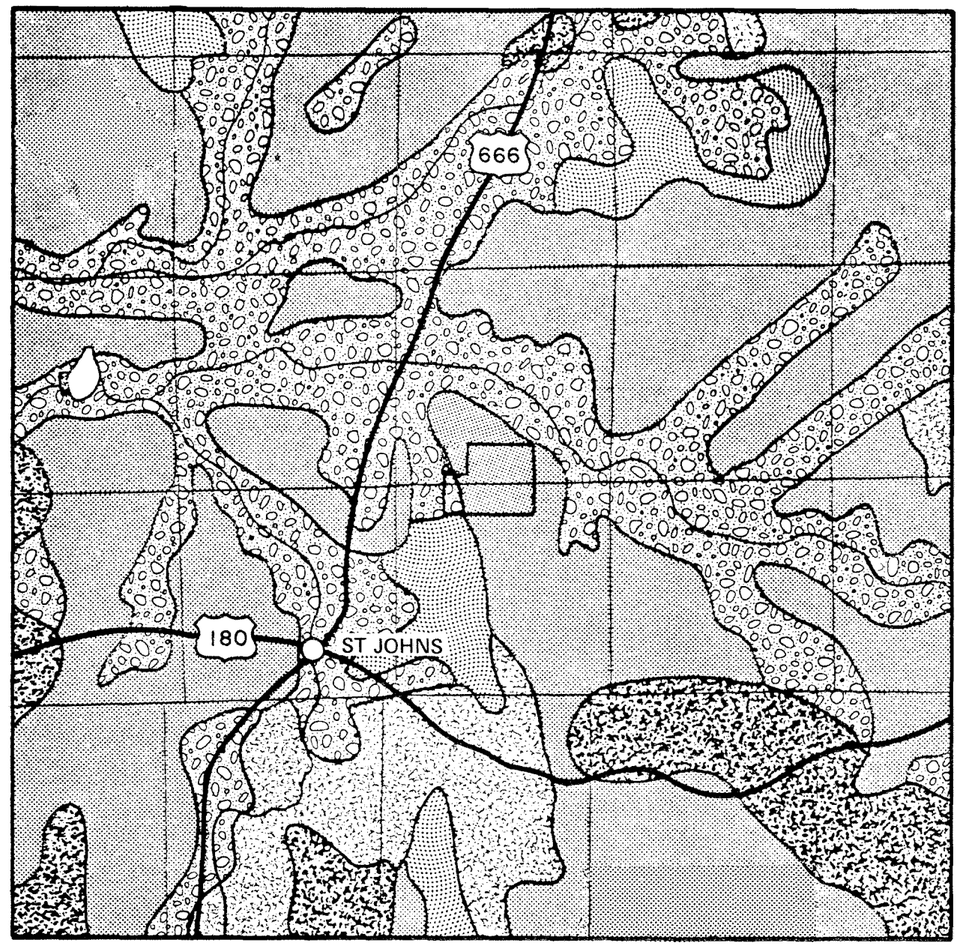
Groundwater from the Kaibab-Coconino aquifer is discharged via large springs along the Little Colorado River between Lyman Reservoir and Hunt, and from flowing wells in the Little Colorado River Valley between Lyman Reservoir and the Navajo County line. In the late 1950's the discharge in this reach fluctuated between four and 10 ft^3/sec. These springs and flowing wells occur where the water in the Kaibab and Coconino is under artesian conditions, mainly at altitudes of less than 6000 feet, and where the overlying Moenkopi formation acts as a confining layer. A flowing well occurs at the southeastern border of the proposed plant site, and contributes to the surface flow in Carrizo Wash. Current (1974) discharge rates of flowing wells and springs are not available.

g. Soils and Trace Elements

(1) Soils

The soils in the area of the plant site and wellfields are medium textured and belong to the Moenkopie, Winona and Palma-Clovis groups. Soils on the St. Johns site belong to the Palma-Clovis group of loamy sands with 0 to 8% slopes. On the ridge immediately adjacent to the north boundary of the site are soils of the Tours-Navajo Association (Figure II-10). Clovis soils are deep, well-drained, moderately fine-textured soils with low permeability, which developed on older alluvium sands, valley filling side slopes and plains. The Palma group of soils are coarser textured and have a higher permeability rate than the Clovis soils. The subsoil in the Clovis group is a sandy-clay loam about 20 inches thick compared to the Palma subsoil which is a sandy loam about 18 inches thick. These soils support principally a range resource with potential annual yield of herbage to 800 pounds of fair forage in years of favorable moisture.

Table II-11 presents results of analysis of soil samples from the St. Johns site. Tests indicate that soils on the site have no sodium salt problems, are well within salt tolerance for most crops and have medium amounts of nitrates and phosphates, both of which are important for crop production. Thus, although the area is used as rangeland, it shows fair to good potential for cropland.



PALMA–CLOVIS

TOURS–NAVAJO–TRAIL

BADLANDS

MOENKOPI–ROCK OUTCROP

RUDD–BANDERA

N

0 1 2 3 4 5 6 MILES

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ST. JOHNS SITE SOIL ASSOCIATIONS

Figure II-10

TABLE II-11

FERTILITY ANALYSIS OF SOILS SAMPLED ON THE ST. JOHNS SITE[a]

Sample No.	pH	Soluble Salts ppm	Na meq(b)	Ca + Mg meq	NO_3 ppm	PO_4 ppm
1.	6.6	203	0.2	0.1	11.5	5.8
2.	7.6	301	1.3	3.0	9.2	8.6
3.	7.1	210	1.0	2.0	10.8	6.7
4.	7.1	203	0.9	2.0	10.8	5.2
5.	7.7	266	0.8	3.0	11.7	8.0

a. Modified from University of Arizona Soils Testing Laboratory's results to clarify estimated Na, Ca, and Mg concentrations.
b. meq = milliequivalent

Basic soils and foundation data for the site were developed by a preliminary program of site reconnaissance, subsurface investigation, laboratory testing and office studies. The purpose of the program was to develop preliminary data for evaluating the onsite soil and foundation conditions for preparation of the environmental study and was, therefore, general in nature. The subsurface investigation program consisted of 22 small-diameter test borings and 2 test pits. The depth of borings ranged from approximately 36 to 100 feet below the surface. Standard penetration tests and open-end drive sampling was performed at five foot intervals in the borings. The test pits extended to a depth of 6.5 to 7.5 feet, and were excavated using a backhoe.

Alluvium is present over most of the site. At the boring locations it extends to depths ranging from 10.5 feet to over 100 feet. In general, the alluvium consists of highly stratified silty sands, clayey sands with some sandy silts, and medium to highly plastic clays. Many of the soils are cemented by calcareous materials and some gravelly zones were encountered in the granular material. The alluvium is underlain by the Chinle formation which is composed of highly plastic hard clays or clay-shales. No evidence of extensive fissuring was observed in the test borings. In many cases it was not possible to determine whether the clays were of the Chinle formation, or reworked Chinle formation. The available boring data indicate that the surface of the Chinle formation is very undulatory and suggests a "badlands" expression. The in-situ moisture content of the alluvium varies from approximately 5 to 10%. The in-situ moisture content of the clay-shales and clays of the Chinle formation varies from approximately 20 to 36%.

Free groundwater was not encountered in any of the test borings. Laboratory tests and field determinations were performed to develop basic information regarding the engineering properties and conditions of the soils encountered at the site. The laboratory tests and field demonstrations included: soil classification; grain-size analysis; Atterberg limits; moisture content of soils; specific gravity of soils; density of soils; consolidation tests; expansion tests; unconfined compression tests; laboratory and field permeability tests; and, standard penetration tests.

(a) Grading and Excavation

It is anticipated that most of the soil materials encountered at the site can be graded and excavated with relative ease. Light ripping, by conventional construction equipment, may be required in some of the more strongly cemented soils and in the Chinle formation. The clay-shale encountered at the site appears to be somewhat friable.

(b) Structural Fill and Backfill Materials

The materials required for the structural fill and backfill for the plant construction can be obtained from onsite sources. It is anticipated that most of the on-site materials will be acceptable for structural fills and backfill, when properly placed and compacted under controlled conditions.

(c) Permeability

Based on data obtained through field and laboratory permeability tests, it is expected that silty and clayey sands of the alluvium encountered at the site may have a relatively high permeability on the order of 10^{-5} to 10^{-4} centimeters per second (cm/sec).

Seepage from evaporation ponds and solid waste disposal areas constructed on the alluvium will be controlled by suitable soil treatment or by a seepage barrier.

The clay-shales or clays of the Chinle formation, generally encountered at greater depths, are believed to be relatively impervious, as indicated by laboratory tests. It is expected that evaporation ponds and solid waste disposal areas constructed entirely within this formation may not require soil treatment or a seepage barrier.

(d) Liquefaction Potential of Granular Soils

The alluvium encountered at this site includes fine sands in a loose condition, in some locations. Under certain conditions, these are generally considered to be the type of soil which may be susceptible to liquefaction. However, the potential for soil liquefaction is dependent upon the groundwater conditions, the initial confining pressure, the intensity and duration of ground motions and other factors. In the absence of groundwater at the site and other

unfavorable conditions, it is believed that soil liquefaction is not likely to be critical.

(2) Trace Elements

Certain chemical substances concentrate at increasing consumer trophic levels in ecosystems, by the process of biogeochemical cycling. This phenomenon is called biological magnification. Trace elements are known to magnify in ecosystems by this process. Trace elements that may be discharged into the environment from mineral resource development may enter biotic communities through biogeochemical cycling. Some of these elements are essential to life within specific limits but in greater amounts may adversely influence species. Some trace elements are physiologically toxic. Because of their biological importance, current levels of certain trace elements in the biotic communities of the proposed mineral development area have been established for comparative purposes.

Heavy metals present in soil and biotic tissue in the area are mainly a function of those characteristic of the parent bedrock, or those intercepted from lateral trans-location and fall-out from industrial activities in areas external to the site. No documentation of the presence and concentration of heavy metals in the area of the various soils is presently available. Samples of soil, plant tissue and animal tissue were taken both on site and in several locations external to the site to determine presence and background of certain heavy metals.

Appendix C shows background concentrations of nine trace elements in soil, producers and primary consumers in, and around the St. Johns site. There were no differences in background concentrations between the biotic and abiotic portions of the environment except for four elements: cadmium, chromium, lead and mercury. Differences in concentrations of cadmium and lead occurred between the total extractable amounts in the soil and the biotic portion of the environment, but not between producers and primary consumers, (Appendix C). Concentrations of cadmium and lead in producers and primary consumers were far less than concentrations that occurred in the soil (Appendix C). Concentrations of chromium and mercury among the soils, producers and primary consumers, for all sites, were somewhat erratic, but analyzed levels are below toxic concentrations.

These data reflect only concentrations present in tissue during the winter sampling period, and the values for plant tissue represent levels for the non-growing season. However, data taken during this time of year do provide background levels than can be used for comparison with future winter samples.

Values for the Botanical Standard Reference Materials (SRM 1571), and Animal Tissue Standard Reference Materials (SRM 1577) guidelines in Appendix C, are sanctioned by the National Bureau of Standards as calibration standards for trace element detection in plant and animal tissues. Comparing the trace element values obtained at St. Johns to the standards, only chromium had detectable levels.

Another set of values obtained from samples taken at the Cholla power plant site are applicable since the Cholla site is only about 70 miles from the St. Johns site. Samples were taken of soils, plants and animal tissues. These values are also given in Appendix C.

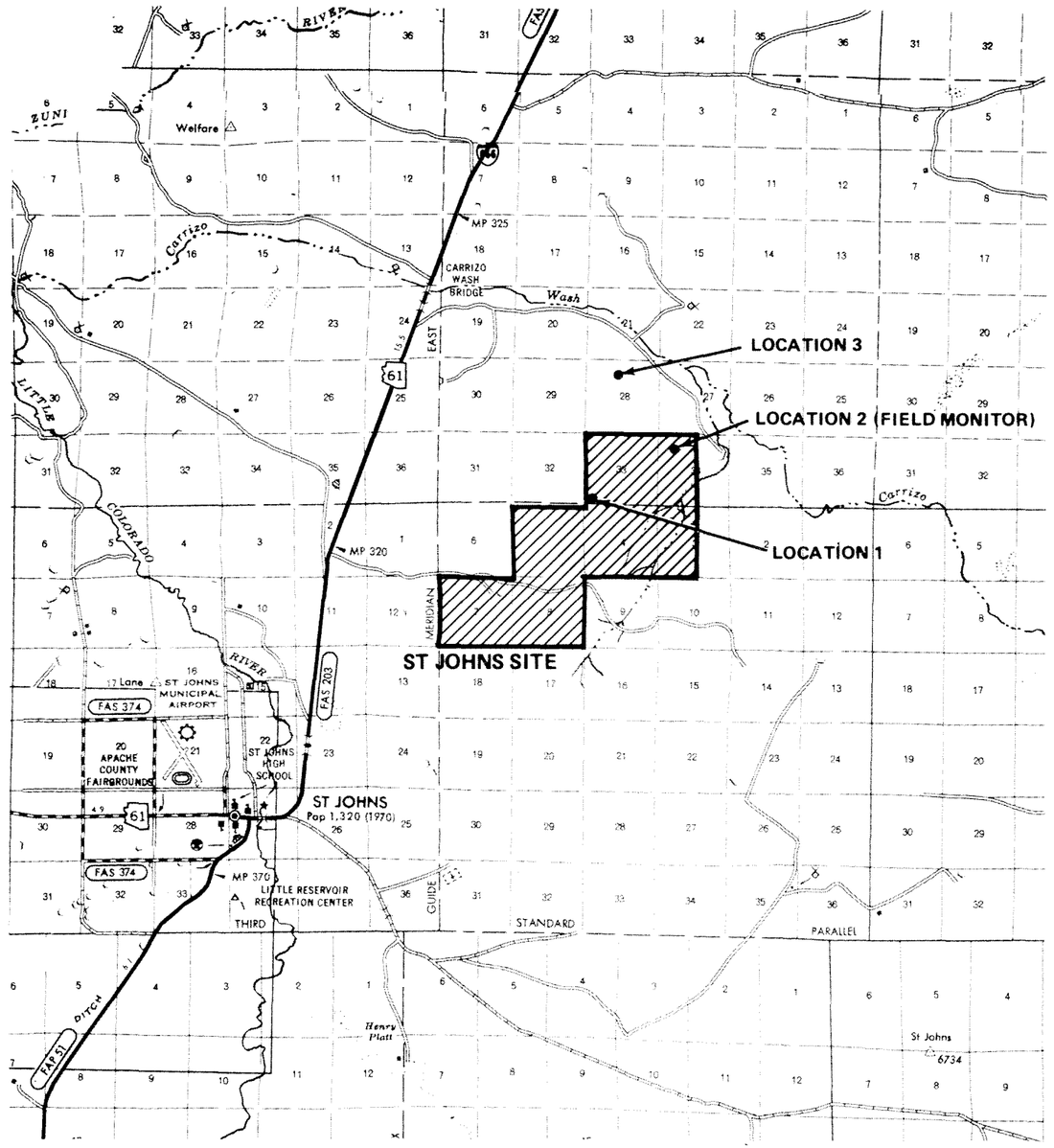
A third set of trace element levels from other sources is also provided for additional comparison. These values represent trace element levels normally occurring in nature, although they may not depict levels occurring at any particular locality. At the St. Johns site chromium exceeded these values for producers, but neither set of values are at toxic levels. No other trace element measured exceeded these levels.

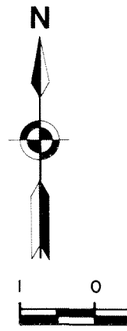
h. Acoustics

A noise survey was conducted at the site to document the present ambient noise levels and to establish a noise baseline to assess the impact of the facility. The ambient noise level measured at the site was less than 30 dB(A) (decibels adjusted to the A-weighted scale) typical of quiet rural areas. Ambient noise is defined as the residual level when no identifiable noise sources are present. The A-weighted noise level exceeded 90% of the time is used to describe the ambient noise level. The logarithmic average of the minimum measured octave bank levels will be used to describe the frequency distribution of the ambient noise.

Noise levels, measured from March 6, 1974 to March 10, 1974, at various locations on and around the site, as shown on Figure II-11, were due mainly to natural sources such as animals, birds, insects and rustling foliage from the wind. During periods of no wind, the noise levels at the site were below 15 dB(A). The cumulative distribution of the ambient noise, recorded with a field monitor system, indicated the L_{90} to be less than 30 dB(A) for the site. Figure II-12 shows the logarithmic average of the ambient noise measured with a sound level meter at the St. Johns site.

For purposes of comparison, some typical noise levels resulting from certain common activities are mentioned below along with the subjective impression generated upon an observer. For example, a jet plane taking off 200 feet from an observer would generate about 120 dB(A), a level considered uncomfortably loud. The same jet making a landing approach from 6000 feet would register about 100 dB(A), a level described as "very loud". Noise levels due to urban ambient sounds, such as those occurring close to a freeway (about 80 dB(A)), are considered moderately loud. A normal conversation indoors would be carried on at about 60 dB(A) while noise levels considered to be "quiet" are below 50 dB(A). Such typical rural sounds as bird calls register around 44dB(A).



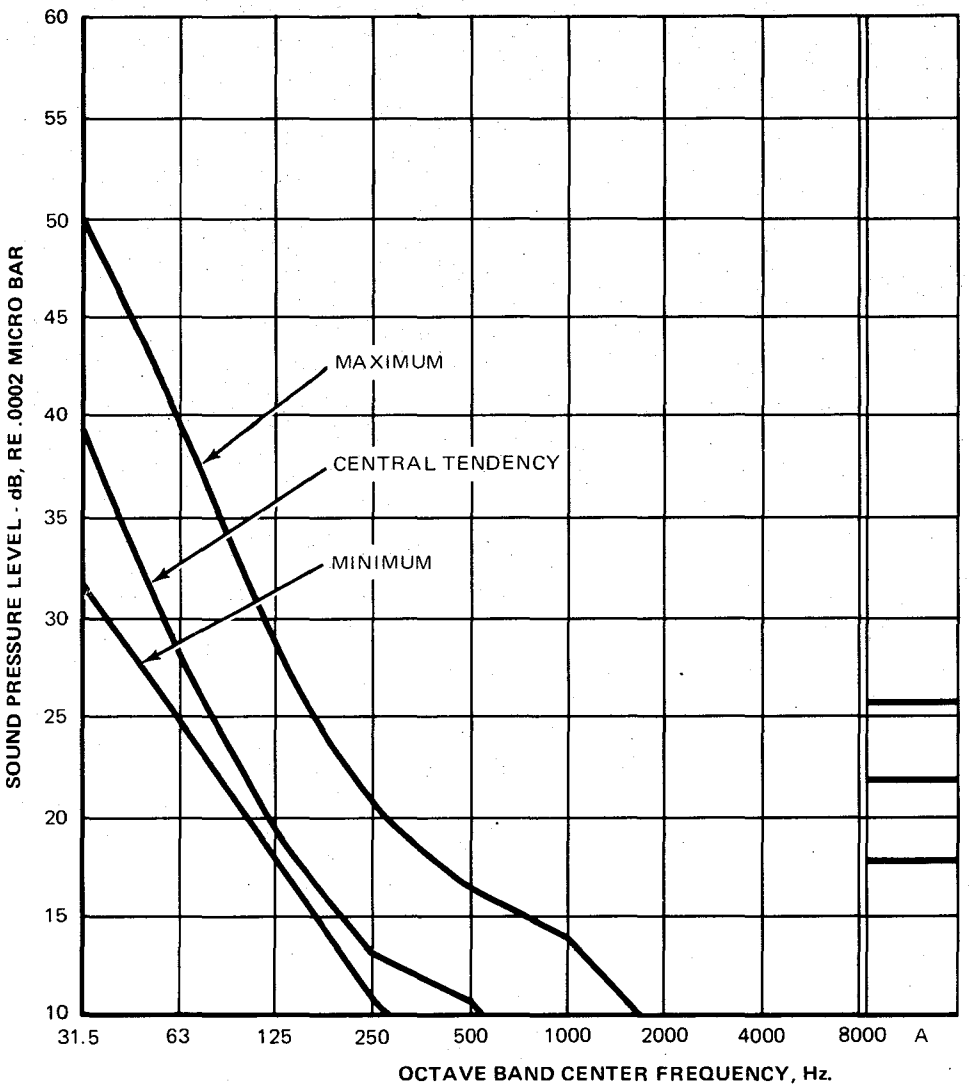


CORONADO PROJECT

Coronado Generating Station

AMBIENT NOISE SURVEY LOCATIONS ST. JOHNS SITE

Figure II-11



LOGARITHMIC AVERAGE OF AMBIENT NOISE ST. JOHNS SITE

Figure II-12

3. Biological Environment of the Project Area

a. Vegetation

(1) Range Vegetation

The general area supports seven species of trees, 46 species of shrubs or cacti, 51 species of perennial grasses and 30 species of perennial forbs (see Appendix D). Riparian areas support the only trees (except for juniper) as well as several species of shrubs not found in the surrounding area. The table in Appendix D does not include a complete list of on-site plants, but includes only those characteristic of the area and those important as food for livestock and as food and cover for wildlife. In many localities, slope, amount of sunlight, moisture conditions and disturbance affect the distribution of plants.

The most common grasses of the area are grama, galleta, and species of muhly grass and drop seed. The more disturbed areas will support perennial three-awns, while in areas not disturbed, three-awns will be uncommon to absent. The 30 perennial forbs in the general area are seasonal, with most occurring after the heavy summer rain or in the spring following winter rains.

The St. Johns area incorporates two range types. Loamy Upland comprises the majority of the area. Sand Upland comprises areas of significant relief with indications of erosion in the northern part of the area. The two range types on the St. Johns site will support 0.17 Animal Unit Months (A.U.Ms) per acre, assuming these sites are in good condition as indicated by the vegetation characteristics sampled. To interpret this, 0.17 A.U.Ms means that a rancher would ideally stock his range with one cow and calf for every six acres of land for one month.

Figures II-13 and II-14 are a series of photographs showing the vegetation in the wellfield areas, principally Juniper /Grassland communities. Figure II-15 shows two photographs of the Welch limestone claim. Vegetation types found on the site include Juniper and Grassland communities.

(2) Vegetation at the Plant Site

(a) Juniper

An average of 10 juniper trees per acre occur on the St. Johns site (Table II-12). The highest density of the trees appears to occur in the southern portion of the area. The southern portion also supports trees which are healthy with few dead limbs, in contrast to the northern portion of the area which supports fewer Junipers, many with large numbers of dead limbs, and many dead trees. Juniper trees have invaded the area at the expense of grassland as they have in many other places in Arizona. The distribition of juniper on the site, while diminishing the expanse of open grassland, has furthered the distribution of Arizona forests and associated cover. These forests are important as deer habitat, and at grassland borders, antelope habitat.

Juniper trees also provide habitat for rodents that serve as food for raptors and carnivores. The burrows of the smaller vertebrates are abundant at the bases of the juniper trees and coyote and fox tracks were common in these areas. Juniper trees are an important source of wildlife food. Their fruit is relished by many songbirds and mammals and their forage is browsed by deer. Most of the junipers in the area are one-seeded juniper, a dioecious plant, and only the female produces fruit. Juniper vegetation is not particularly palatable to livestock, but if cattle are forced to use it, juniper can cause abortion in livestock when downed trees or lobbed branches are available. Root systems of the juniper help retard erosion during high-intensity rainstorms. The dense, fibrous root system of the perennial grass cover is even more effective in erosion control.

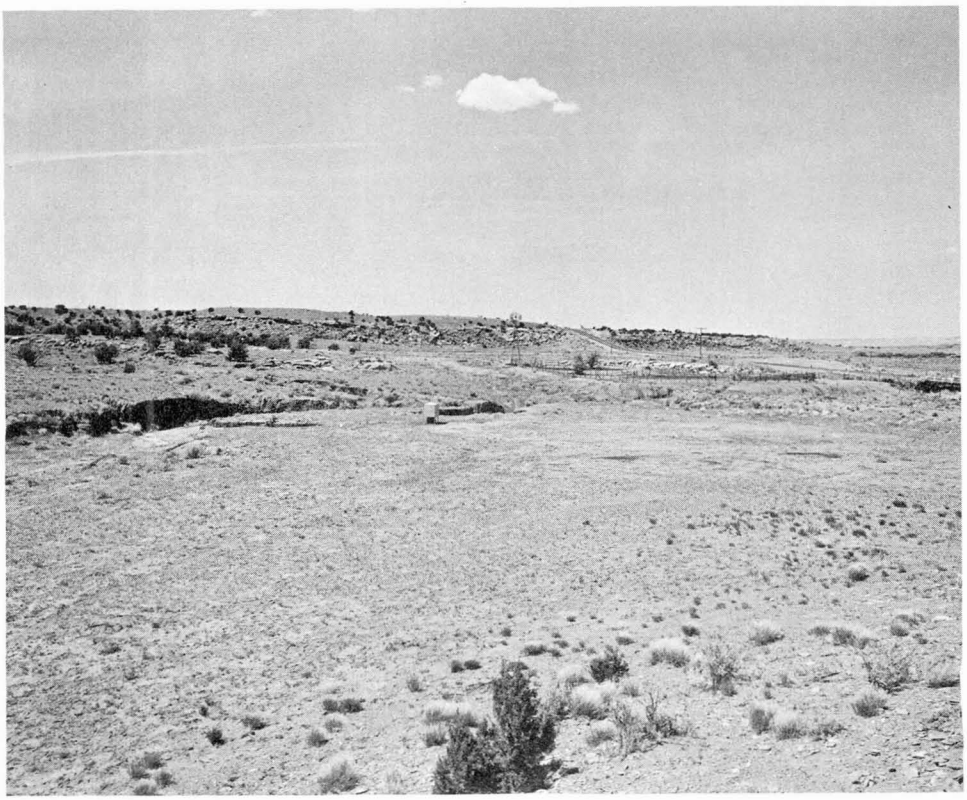
About 4500 shrubs per acre occur in the St. Johns area (Table II-12). Snakeweed and rabbitbrush comprise most of the shrubs and occurred more frequently in the samples than any other shrub species. Snakeweed and rabbitbrush are not particularly palatable to domestic animals or wildlife, although they furnish useful cover in otherwise open areas. Seeds of the tiny-flowered snakeweed can be eaten by many bird and mammal species. Seed-heads and foliage of rabbitbrush can form a significant part of the diet of antelope. Saltbush comprises a moderate portion of the shrub composition (Table II-12), and is particularly valuable as winter feed. Sagebrush is present but does not comprise a very large portion of the shrub composition. The whole sagebrush plant is palatable to antelope and mule deer and often constitutes the principal source of food during seasons when associated vegetation is dormant.

TABLE II-12

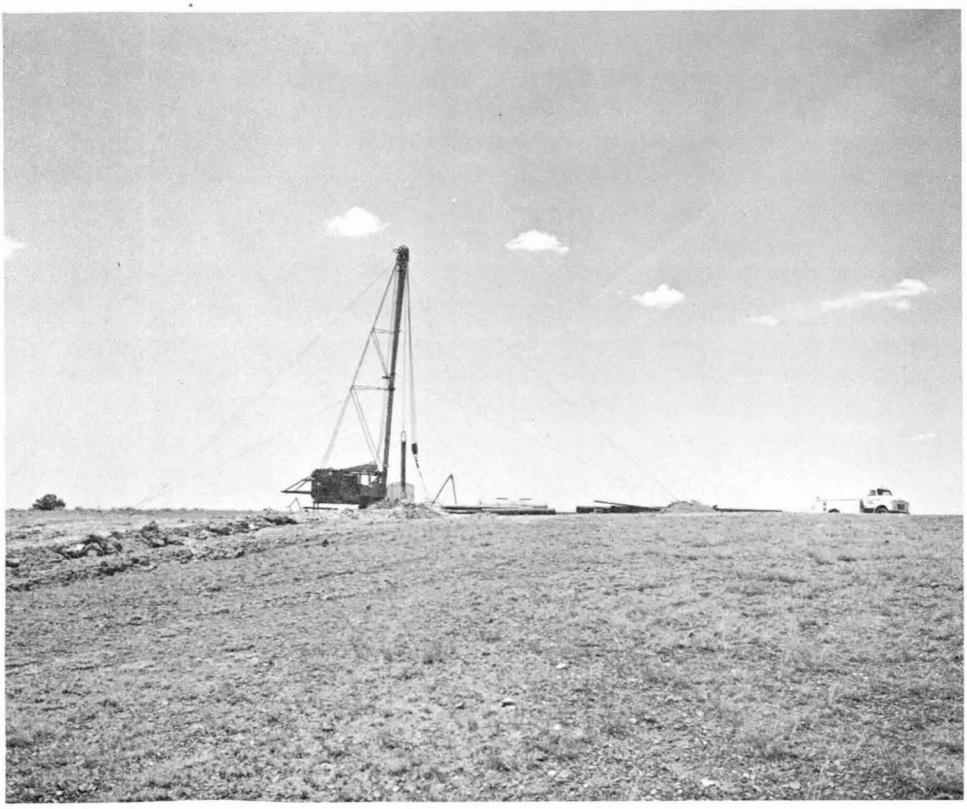
CHARACTERISTICS OF JUNIPER COMMUNITIES ON THE ST. JOHNS SITE

Vegetation Class	Density (%)	Species Composition (%)	Frequency (%)	Basal Cover Grasses (%)
Trees	10 trees/acre ±45 (P <0.10) N = 4	One-seeded juniper N = 4		
Shrubs	4500 shrubs/acre ±45 (P <0.10) N = 40	Snakeweed 54 Rabbitbrush 27 Saltbush 14 Sagebrush 5 N = 40	Snakeweed 12 Rabbitbrush 12 Saltbush 7 Sagebrush 2 N = 40	
Herbs			Blue grama 52 Grama species 25 Unknown grasses 25 Galleta 20 Muhly 17 Black grama 12 Ring muhly 10 Three-awns 5 Indian ricegrass 5 Lovegrass 2 Squirreltail 2 N = 40	
Grasses				13 N = 200

N = Total number of quadrats on points sampled.



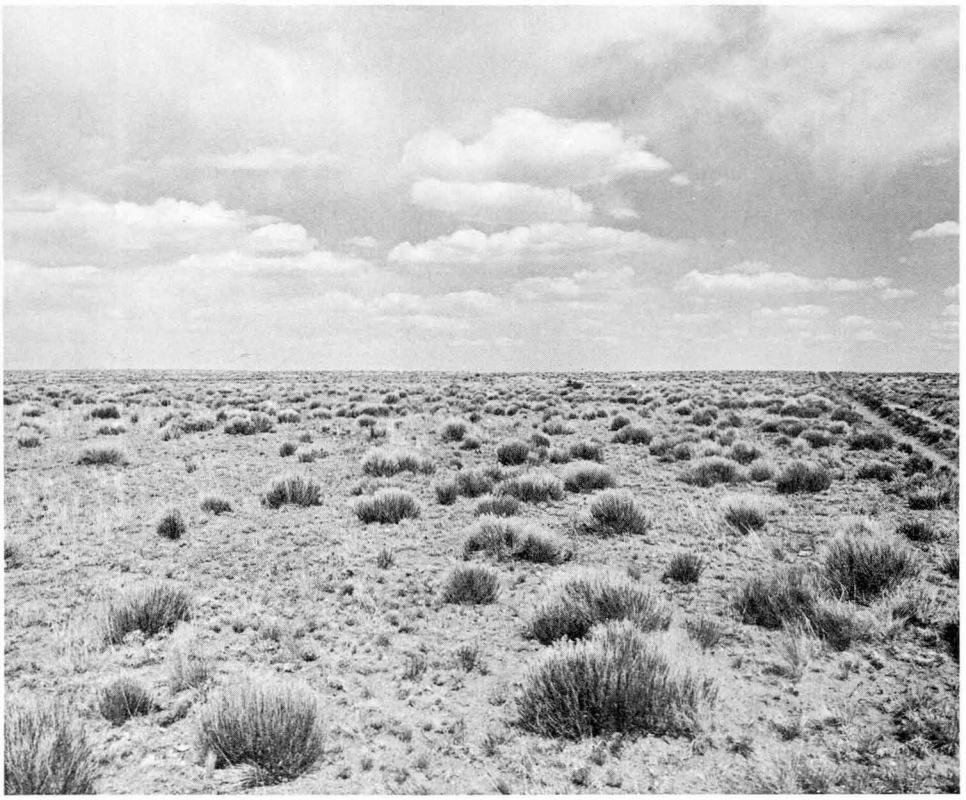
(a) Concho Wellfield - View looking north in center of Section 7, T13N, R26E, showing a typical test well site.



(b) Concho Wellfield - View looking northwest in Section 8, T13N, R26E, showing a cable tool drill rig drilling production well.

CONCHO WELLFIELD

Figure II-13



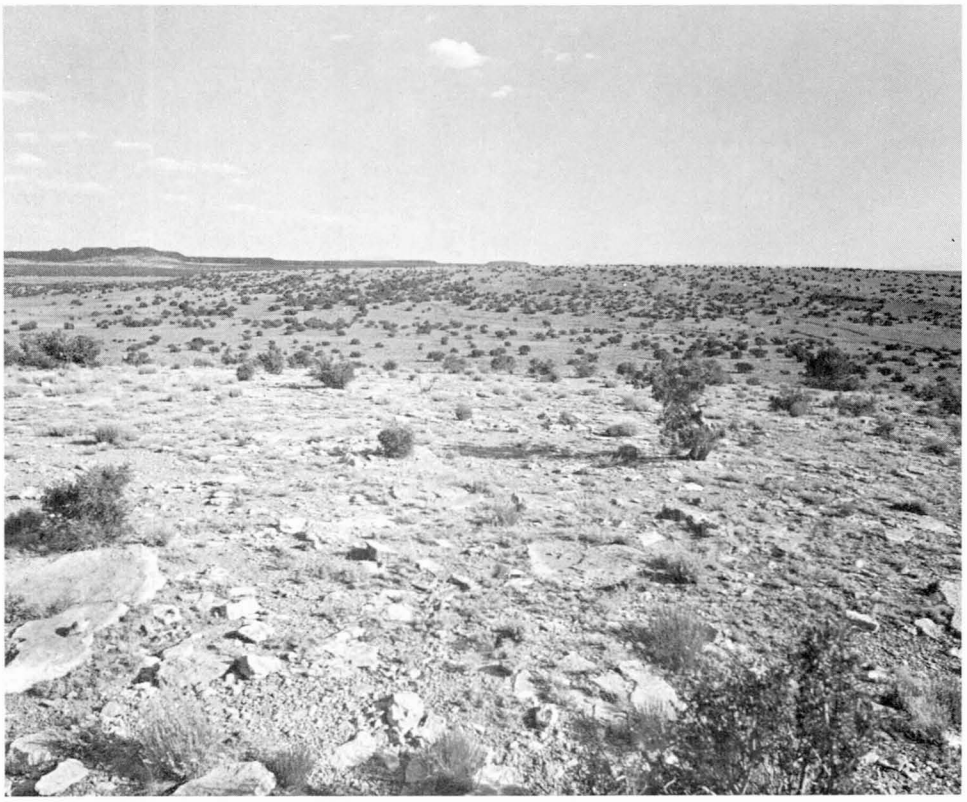
(a) Middle Wellfield - View looking north in Section 21, T13N, R27E, showing area where a well will eventually be developed.

(b) East Wellfield - View looking north in Section 1, T13N, R28E, showing area where future well will eventually be developed.

MIDDLE AND EAST WELLFIELDS

Figure II-14

(a) Limestone Source - View looking north from hill .2 mile south of limestone source. Entire south end of limestone source forms the horizon in the photograph. Photo location Section 8, T12N, R29E.



(b) Limestone Source - View looking south from hill in northern portion of limestone source. Limestone claims extend .8 mile south in photograph. Photo location Section 4, T12N, R29E.

LIMESTONE SOURCE

Figure II-15

The herbaceous class of vegetation on the St. Johns site consisted totally of grasses during the winter sampling. Grama grasses, galleta grass and muhly grass occurred most frequently, but some grasses were unidentified because they are dormant during winter and most of their above-ground portions were missing. Grama grasses and galleta grass are palatable, nutritious forage for domestic livestock. The grama grasses are palatable year-round, even when dormant, but galleta grass is practically worthless for all classes of livestock when it is dry. The individual species of muhly grass could not be identified. The St. Johns area has a low occurrence of unpalatable grass species, such as ring muhly and species of three-awns. The low frequency of unpalatable grasses and the high occurrence of palatable grasses indicate that the St. Johns area supports a fairly good range resource. Black grama is present and occurs more frequently than unpalatable species (Table II-12). Black grama is one of the more palatable grasses and under heavy grazing is one of the first species to disappear from range. Its relatively frequent occurrence supports the contention that the range resource is in good condition.

(b) Grassland

Shrub density in the Grassland community is about equal to that in the Juniper Community (Table II-13). Shrub composition is principally snakeweed and rabbitbrush. Saltbrush and sagebrush did not appear in the grassland samples as they did in the Juniper Community, although a few sagebrush plants were seen in the area. The grassland shrub strata is not as good quality from the standpoint of food as the Juniper shrub strata.

TABLE II-13

CHARACTERISTICS OF THE GRASSLAND COMMUNITY ON THE ST. JOHNS SITE

Vegetation Class	Density (%)	Species Composition (%)	Frequency (%)	Basal Cover Grasses (%)
Shrubs	4450 shrubs/acre ±45 ($P < 0.10$) N = 40	Snakeweed 55 Rabbitbrush 45 N = 40	Snakeweed 20 Rabbitbrush 18 N = 40	
Herbs			Blue grama 72 Galleta 57 Unknown forbs 32 Ring Muhly 27 Aristida 17 Unknown grasses 15 Muhly 7 Eriogonum 2 Hairy grama 2 N = 40	
Grasses				14 N = 200

N = Total number of quadrants or points sampled.

Percent basal cover of grasses is perhaps the most important vegetation characteristic of the herbaceous strata in the plant communities. This is because grasses provide the principal constituent of herbaceous communities in the area and the morphological characteristics of the root systems are best adapted to sustain any erosional tendencies during high-intensity runoff periods. In addition, grass provides food to sustain cattle. Grass basal cover in the Grassland Community is similar to that of the Juniper Community on the St. Johns site. Blue grama and galleta occurred most frequently in the Grassland Community. Ring muhly occurred more frequently in the Grassland Community than in the Juniper Community. This may indicate that the grassland portions are grazed more heavily by domestic livestock than herbaceous strata in the Juniper Communities. This is not surprising since it is possible that grasses in a grassland, with its open aspect and more sunlight, are sweeter and more palatable to livestock than the same species grown in the shade of a juniper tree.

In summary, the Grassland Community on the St. Johns site appears to be of a little lower quality for grazing by domestic livestock and wildlife than the Juniper Plant Community. The Juniper Community excels the Grassland Community in terms of wildlife cover. Basal cover of the herbaceous strata and the density of shrubs are similar on both sites. However, the addition of a tree layer in the Juniper Community provides the additional cover needed to sustain higher populations of rodents and upper level consumers. The Juniper Community consists of several classes of vegetation comprising three principal strata. The upper strata is composed of one-seeded juniper with about ten trees per acre. The trees of the southern portion of the site are of slightly higher density with less above-ground kill than those on the north-facing slope in the northern part of the area. The shrub strata is comprised mainly of palatable shrubs and serves principally as cover in the Juniper Community. The herbaceous layer of vegetation in the Juniper Community provides a good cover consisting principally of palatable grass species.

(3) Riparian Vegetation

The major aquatic-riparian communities of the St. Johns area are located along the Little Colorado River and Carrizon Wash; both areas are outside the site. They were studied by ground reconnaissance, but were not included in the winter sampling since many species were dormant and difficult to identify. The reconnaissance shows that in some areas the communities support three distinct vegetative strata which are primarily comprised of cottonwood and salt cedar. The shrub layer consists principally of small salt cedar and saltbush, and the herbaceous layer supports broomgrass, bluegrass and sacaton grass. Russian thistle and cocklebur are the dominant forbs. Areas along the river provide seasonal wetlands that attract large numbers of migrating water-fowl.

b. Terrestrial Biology

(1) Birds

In northern Arizona, birds are the most diverse class of vertebrates, and their numbers are generally higher than that of any other vertebrate found (Appendix E-1). Most bird species that breed on the northern plateau migrate out of the region during the winter months. Of the few species that remain, their numbers in a given area diminish as the populations tend to disperse over a wide range of habitats. Often there are a few raptorial species, mainly the redtailed hawk, marsh hawk, rough-legged hawk, golden eagle, sparrow hawk and great horned owl remaining as winter residents. Most waterfowl and shorebird species migrate south along with other species of those groups that breed further north.

There are several species of passerine birds that are relatively abundant during the winter months, most notable are the horned lark, common raven, sage thrasher, western bluebird, mountain bluebird, loggerhead shrike, starling, house sparrow, western meadowlark, red-winged blackbird, Cassin's finch, house finch, Oregon junco, grey-headed junco, white-crowned sparrow and chestnut-collared longspur. The horned lark is the most prevalent of the species, and its abundance likely exceeds all the other species mentioned. Both the starling and the house sparrow are introductants and their numbers are quite high around human dwellings. The house finch that is native to North America has also become abundant in the areas of human establishment.

The number of species censused is normal in a winter sample in the northern plateau area (Table II-14). Species composition is low and numbers of birds within populations remain fairly low except for certain of the grassland species, namely horned lark and western meadowlark.

Species diversity tends to increase in late winter and early spring. Because aquatic habitat is available, the number of migratory waterfowl increases considerably as spring approaches. This increase in number is in part due to flocks of ducks and coots concentrating even on small bodies of water such as the farm pond north of the St. Johns airport. On this one-quarter acre pond in early April, 1974, nearly 50 ducks were sighted. Herons and egrets frequent the area in spring. A great blue heron was sighted at the small pond near the airport and an American egret was observed in flight near the plant site in mid-April.

For the remaining bird species, however, the composition is characteristic of the Northern Arizona Plateau area. This includes the large raptorial birds, mainly hawks and eagles, and a few grassland species, namely western meadowlark and horned lark. The Emlen transect plots were located in grassland areas, and represent primarily the grassland species. The other census methods, particularly the 20-mile transect, account for species in the other cover types (Table II-14).

TABLE II-14

BIRD SPECIES OBSERVED AT THE ST. JOHNS SITE

Species	General Reconnaissance (no. sighted)					Emlen Technique (no./acre)		20-Mile Transect (no./mile)		
						Feb. 12-20				
	Oct. 25	Oct. 30-31	Feb. 12-20	Mar. 12-20	Apr. 1-2	Onsite	Offsite	Nov. 1-2	Jan. 17-18	Mar. 12-20
American egret					(a)					
Canada goose				100						
Mallard				500	2					
Pintail				500						
American widgeon					12					
Shoveler					7					
Blue-wing teal				1						
Cinnamon teal					50					
Green-winged teal			x		50					
Redhead			x							
Lesser scaup			x							
Ruddy duck			x							
Turkey vulture					1					
Sharp-shinned hawk			x							
Marsh hawk	1	2	x					0.05		0.15
Rough-legged hawk					1			0.02		
Red-tailed hawk			x	1				0.02		0.05
Swainson's hawk			x							0.05
Golden eagle										0.05
Bald eagle										0.15
Prairie falcon	1									
Sparrow hawk			x	4				0.02		0.4
Great blue heron					1					
American coot					1					
Killdeer				4						
Common snipe				1						
Mourning dove			x		2			0.12		1.6
Flicker			x							0.05
Western kingbird										0.4
Say's phoebe					1					0.2
Horned lark	30	143	x		21	1.36	1.91	2.67		6.75
Common raven	3	2	x			0.04		0.47		0.95
Sage thrasher			x							1.55
Robin			x							
Mountain bluebird			x							0.75
Loggerhead shrike	2	1	x		1	0.04		0.02		1.1
Starling			x	50						
Western meadowlark	25	1	x		7			0.02		0.1
Red-winged blackbird								0.02		
Cassin's finch										2.5
House finch										4.05
Pine siskin			x							
Lesser goldfinch										0.5
Green-tailed towhee			x							
Vesper sparrow										0.2
Sage sparrow			x							
Oregon junco			x							
Gray-headed junco										0.05
White-crowned sparrow		13	x		50			2.22		3.3
Song sparrow				2						
McCown's longspur			x				0.08			
Total	62	162		1159	222	1.44	1.99	5.56		24.90
No. of species	(6)	(6)	(25)	(9)	(17)	(3)	(2)	(11)	(0)	(22)

a. One individual American egret sighted on 23 April 1974.
x = Species sighted but not counted.

The species diversity of riparian zones at the St. Johns site was low. Most species that use the riparian habitat along intermittent streams are members of the Great Basin bird fauna. During winter, many of these species migrate south and the resultant composition is depauperate. Their numbers normally increase in spring.

During the winter census, bald eagles were sighted flying near the St. Johns site. Bald eagles favor aquatic environments because their diet is predominantly fish, and therefore, they probably do not use the habitat of the site. It is likely that the plant site is not critical within the overall territory of these birds because bald eagles, much like the golden eagle, occupy foraging areas as large as perhaps 80 to 100 square miles.

(2) Amphibians and Reptiles

Amphibians are the least diverse of any vertebrate group because aquatic habitats are limited. The reptiles are better represented in the northeastern plateau area, but the species composition does not equal that of the southern Arizona deserts. Nevertheless, reptiles that tolerate xeric sites are widespread and generally common in grassland areas, pinyon-juniper stands and the Great Basin habitats (Appendix E-2). Only a few species remain accessible and can be observed during the colder seasons.

(3) Mammals

Sixty-five species of mammals inhabit the Lower Colorado Plateau in the region of the St. Johns site. Appendix E-3 lists the species, their relative abundance for the region as a whole, and the areas needed for breeding and food requirements.

As to the mammals' food requirements, 34 species rely on insects; 32 feed on plant material other than seeds and fruits; 16 are seed eaters; 15 consume fruits; and 13 are carnivorous on other vertebrates. Species that eat a varied diet are included in more than one category. From the standpoint of food, the mammals rely on all factors of the biotic community. Species distribution and numbers are controlled to a large degree by the food source. Mammals will be absent from areas where food is wanting, and their numbers change as the food supply changes.

Habitat, too, plays a major role in controlling the species distribution and abundance. For example, the Abert's squirrel requires trees, the prairie dog requires grasslands and the muskrat needs a riparian habitat. All mammal species have specific habitat requirements and, with most, the tolerance limits are narrow. In the plateau area, 29 species of mammals occupy more than one habitat type. Habitats of species include the following: grassland, 23 species; brushlands, 25 species; ecotone areas of grasslands and brush or small trees, 28 species; riparian habitats, five species; and areas where trees are the dominant vegetation, seven species. Fourteen species of bats prefer open areas.

Mammals can be categorized into three groups based on their movements or the area needed to support them (Appendix E-3). These include those with small home range (less than five acres), medium home range (up to four sections) and large home ranges (covering many miles). The number of species in each category on the plateau areas are 32, 10 and 23 respectively. The small mammals, including rodents, cottontails and shrews, require only a few acres. Bats have specific needs for roosting and breeding but forage many miles out from the roost area, and in winter, many species migrate out of the area.

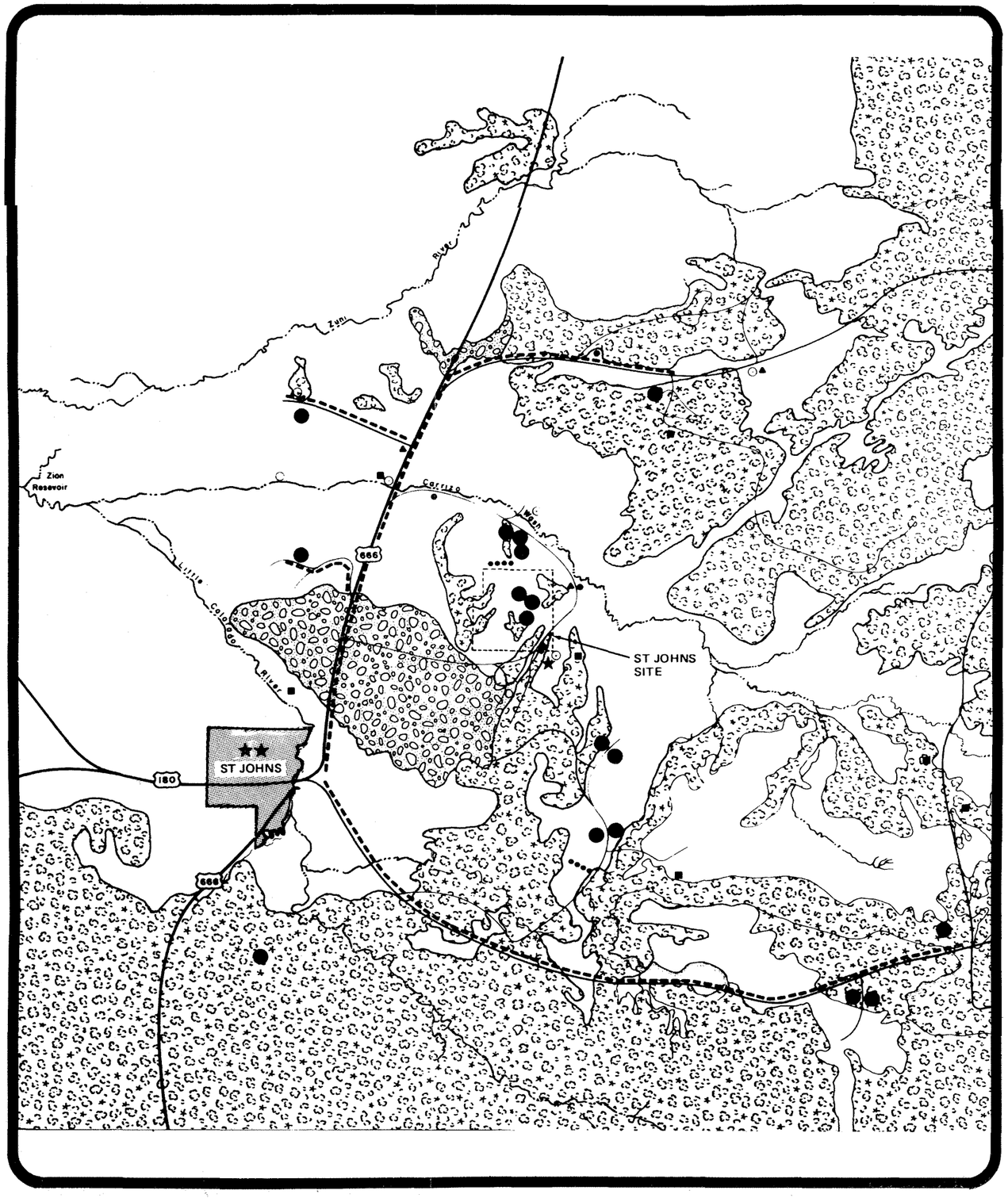
Mammals on the site were studied by trap sample and reconnaissance. Reconnaissance observations were conducted on five separate occasions in November, January, February and March. The reconnaissance covered a large area surrounding the site as well as the site area. Trap samples were conducted during November, February and March. Fourteen trap sites were selected as permanent sample plots. Locations are shown in Figure II-16. A list of all mammals recorded by site records, trap catch or sign (tracks and scats) is included in Table II-15. A total of 19 species of mammals, including 11 families, were recorded in the area. This does not include any of the bats since they are absent or inactive during the winter months. The only mammal with which an attempt was made to get an actual population count was the antelope. Thirteen have been counted on the site and in the study area. Rodent populations were sampled to give data on the species present, species composition and rodent density. The larger mammals were checked for presence and relative abundance. The rodent census (Table II-16) included 25 census lines with a total 2680 trap nights. Two separate trap samples were obtained in February.

(4) Arthropods

No attempt was made to enumerate all the arthropods of the area. Appendix E-4 lists those referred to in the literature reviewed and those with some particular significance in the area. This list includes 56 species representing five classes and 11 orders of insects. It is not a complete listing as there are 250 species of grasshoppers alone listed for Arizona and 20 species of scorpions. Nevertheless, many of the commonly observed invertebrates and many that play dominant roles in the ecosystem are listed.

(5) Game Species

The game, furbearing and huntable non-game species have special status since they include those designated by State law as species that can be reduced from public to private ownership if taken according to the regulations and during the seasons set by the State Game Commission.



SAMPLE LOCATIONS

- Permanent Sample Plot (Soil, plant & mammal)
- Bird Transect (Emlen Technique)
- Bird Transect (20 mile counts)

NATURAL FEATURES

- Badlands
- Juniper-Pinyon Woodland
- Grassland
- Drainage

ARTIFICIAL FEATURES

- Ranch
- Corral
- Windmill
- Water Tower
- Paved Road
- Secondary Road
- Unimproved Road
- Meteorological Monitor Tower
- Air Quality Monitor Site

N

CORONADO PROJECT

Coronado Generating Station

ST. JOHNS STUDY AREA

Figure II-16

c. Threatened and Endangered Species

(1) General

For the past 100 years man has influenced the St. Johns area and brought about considerable changes in the ecology. Cattle numbers have been high since the 1890's and the overstocked ranges were being depleted annually of their grasses. The once almost pure stands of winter fat on the heavy alkaline-free soils have been virtually eliminated and replaced by snakeweed and rabbitbrush. The broad expanse of grass that once covered most of Navajo and Apache Counties has deteriorated under heavy grazing pressure and become overrun with snakeweed and pinque. The decrease of range fires due to modern controls and the lack of dry grass fuel has allowed a steady invasion of juniper into the grasslands.

As a result of man's influence, there are certain changes which have occurred in the fauna of the area. In the late 1880's bands of antelope ranging from 500 to 600 animals roamed the range in the Springerville area. After the Civil War, Lt. Beale recorded elk, antelope, deer, beaver and coyotes in the Cottonwood Wash a few miles east of Winslow. Today only an occasional coyote remains.

(2) Flora

Pursuant to Section 4 of the Endangered Species Act of 1973 the U.S. Fish and Wildlife Service published a list of approximately 1700 U.S native vascular plant taxa in the Federal Register. The Service is proposing these plants as endangered species. Appendix D identifies the vegetation representative of the St. Johns area. *Agave schottii* is listed in this appendix, and is also proposed as an endangered species. Six additional plants listed (*Carex* spp., *Astragalus* spp., *Erigeron* spp., *Mentzelia* spp., *Penstemon* spp. and *Sphaeralcea* spp.) were only classified to the genus level. Certain species within these genera are also contained in the proposed endangered list. The studies performed in the St. Johns area did not locate these species.

(3) Fauna

The U.S. Fish and Wildlife Service's most recent lists of threatened and endangered species are contained in Federal publications dated September 26, 1975, Vol. 48, No. 188, and June 14, 1975, Vol. 41, No. 115. In addition there are other minor lists supplementing these two. Table II-17 is a listing of those species that may be found in the plateau area and includes an indication of their status.

TABLE II-15

MAMMALS OBSERVED AT THE ST. JOHNS SITE

Mammal	Relative Abundance[a]	Preferred Habitat[b]	Preferred Foods[c]
Antelope	U	G-J	P
Antelope ground squirrel	C	G-J-R	S-F-P
Badger[d]	C	G-J	V
Black-tailed jackrabbit	A	G-J-R	P
Bobcat	C	G-J-R	V
Coyote	A	G-J-R	V-I-F
Deer Mouse	C	J	S
Desert cottontail	C	G-J-R	P
Gray fox[d]	C	G-J-R	V-I-F
Mexican wood rat	U	J-G	P-S
Mountain lion[d]	R	J	V
Muskrat	U	R	P
Northern grasshopper mouse	A	G	I-V
Ord's kangaroo rat	C	G	S
Pinyon mouse	A	J	S
Porcupine	R	J-R	P
Raccoon[d]	R	R	F-I
Silky pocket mouse	U	G	S
Valley pocket gopher	C	G-J	P

a. A-Abundant; C-Common; U-Uncommon; R-Rare
b. G-Grassland; J-Juniper woodlands; R-Riparian
c. V-Vertebrates; I-Invertebrates; F-Fruits; S-Seeds; P-Plant Material
d. Presence indicated by signs

TABLE II-16

RODENT CENSUS AT THE ST. JOHNS SITE

	November		February		February		March		Total	
No. census lines	8		6		6		5		25	
Trap nights	640		720		720		600		2680	
No. species	3		3		2		4		7	
Total catch	5		22		8		50		85	
Trap nights per capture	128		33		90		12		32	
Number per acre	0.14		0.44		0.16		1.20		0.48	
Species	No.	Composition (%)	No.	Composition (%)	No.	Composition (%)	No.	Composition (%)	No.	Composition (%)
Pinyon mouse	3	60	12	60	5	71	29	62	41	52
Deer mouse			7	35			15	32	30	38
Mexican wood rat							2	4	2	2
Bushy-tailed wood rat							1	2	1	1
Ord's kangaroo rat	1	20	1	5					2	2
Grasshopper mouse	1	20			2	29			3	4
Catch destroyed			2		1		3			
Total	5		22		8		50		79	

TABLE II-17

Special Status Wildlife in the Plateau Area

Species	Range in Study Area	Status[1/]
Black-footed ferret	Colorado Plateau	E
Brown pelican	Lakes	E
Mexican wolf	Southern portions	E
Peregrine falcon	Throughout State	E
Southern bald eagle	Throughout State	E

1/ T = Threatened
E = Endangered

4. Social and Cultural Environment of the Project Area

a. Attitudes and Lifestyles

The primary cultural components of the St. Johns and surrounding area population consist of the Anglo/Mormon and the Spanish American/Catholic sectors. These two cultures have existed side by side for decades with a remarkable lack of cultural mixing. Separate social, religious, occupational, recreational, residential and economic criteria and institutions characterize each of these groups.

In 1970, the ethnic breakdown of St. Johns was 71.7 percent Anglo, 23.1 percent Spanish American and 5.2 percent other, mostly American Indian. The Anglo majority was almost totally of the Mormon faith, while the Spanish American minority was almost totally of the Catholic faith. In general, the Anglos occupied the city and county political leadership positions as well as business leadership positions. As would be expected, there was a certain amount of distrust and suspicion between these two groups. However, there was little evidence of overt problems rather, the situation could better be characterized as a lack of interaction between the groups.

Prior to the beginning of construction of the Coronado plant, there were two Mormon wards and one Catholic parish which provided for the religious needs of the population of the greater St. Johns area. In addition to the town of St. Johns, these religious institutions served Concho and the surrounding areas. The Catholic parish was directed by a full-time priest, while each of the Mormon wards was directed by a part-time bishop, chosen from among the congregation. Both Mormon wards utilized the same church building, with services held at different times both on Sunday and during the week. Ward membership was determined on the basis of geographical location. The Catholic parish maintained a church plus ancillary structures which included residential facilities for church personnel.

Much of the cultural life of the St. Johns area was centered around the churches. Both maintained active youth and other religiously oriented social organizations. Two major cultural events celebrated each year were San Juan Day, which commemorated the founding of St. Johns by the Spanish Americans, and Pioneer Day, which commemorated the arrival of the Mormons into the Salt Lake Valley of Utah. Both these celebrations, as well as family reunions, funerals, fiestas and other holidays, drew significant numbers of people who were not residents, but who had strong cultural ties to the area. Most of these people came from the Phoenix and Tucson areas, but Anglo cultural ties extended into Utah, Nevada, and California and Spanish American ties extended into California, New Mexico, and the Midwest. In general, these returnees were persons who had close family ties with local people. A substantial number were people who left town after high school because of lack of local employment opportunities. Some of these people owned homes in the St. Johns area, and planned to return upon retirement.

It is thus apparent, that while the actual population of St. Johns has remained static for many years, the number of people with cultural ties to the area continues to grow. Many of these people might return to the area if suitable economic opportunity were available This factor is significant because an expanded future population would likely consist to some extent of people who were already part of the St. Johns area cultural community.

Many of the high school graduates from the St. Johns area go to Mesa Community College in Mesa, Arizona. Apache County had a tuition reimbursement agreement with Mesa College whereby the county paid the tuition for all county residents who attended the college. Many of the students of the Mormon faith also attended Brigham Young University in Provo, Utah.

While the character of St. Johns was shaped to a great extent by the cultural heritage of its citizens, it was also shaped by the dominance of government and retail and service activities in the occupations of the town population. Since the operation and management of the several thousand acres of irrigated land surrounding St. Johns is conducted largely by town residents, and since county administration is also conducted largely by town residents, the cultural character and lifestyles of the town residents are shaped to a large extent by these activities. These functions have caused the town to assume an importance out of proportion to its size. The increasing political power, may cause some future alterations in the role of St. Johns in county politics.

Recreational facilities in St. Johns included a park with picnic facilities and a swimming pool, little league ball park, tennis courts, the Apache County Fair Grounds and the Apache County Community Center. The St. Johns Historical Society operated a historical museum. High school football, basketball, and baseball provided the primary spectator sports in St. Johns. Nearby were several recreational areas: Little Reservoir Recreation Area, Lyman Lake State Park, and the Concho

Lake Recreation Complex. These areas offered water skiing, fishing, golfing, and picnicing. Hunting was a significant recreational activity for both local people and visitors. Animals hunted in the area included ducks, geese, rabbit, deer, and antelope. Skiing and winter sports were available in the White Mountain area to the south, and many St. Johns area people traveled to Show Low regularly to bowl. Rockhounding, four wheel drive and horseback riding were important off-road activities in the area. Local recreational clubs included a gun club and a C. B. radio club.

b. Demography

The population of St. Johns in 1970 was 1320 persons, only 10 greater than the 1960 figure. At that time, St. Johns had a relatively young population. Forty-eight percent were under 18 years of age (compared to 36% statewide); 44.5% were between 18 and 65 (compared to 55% statewide); and 7.5% were over 65 years of age (compared to 9.0% statewide). The St. Johns population was 51.6% female and 48.4% male. Nearly 80% of all households were classified as nuclear families, composed of husband and wife, with or without dependents (compared to 73.6% statewide). The lower than statewide percentages in the 18-65 category indicates that young adults had migrated from the community. The lower than statewide percentages in the over 65 group indicated St. Johns was not primarily a retirement community.

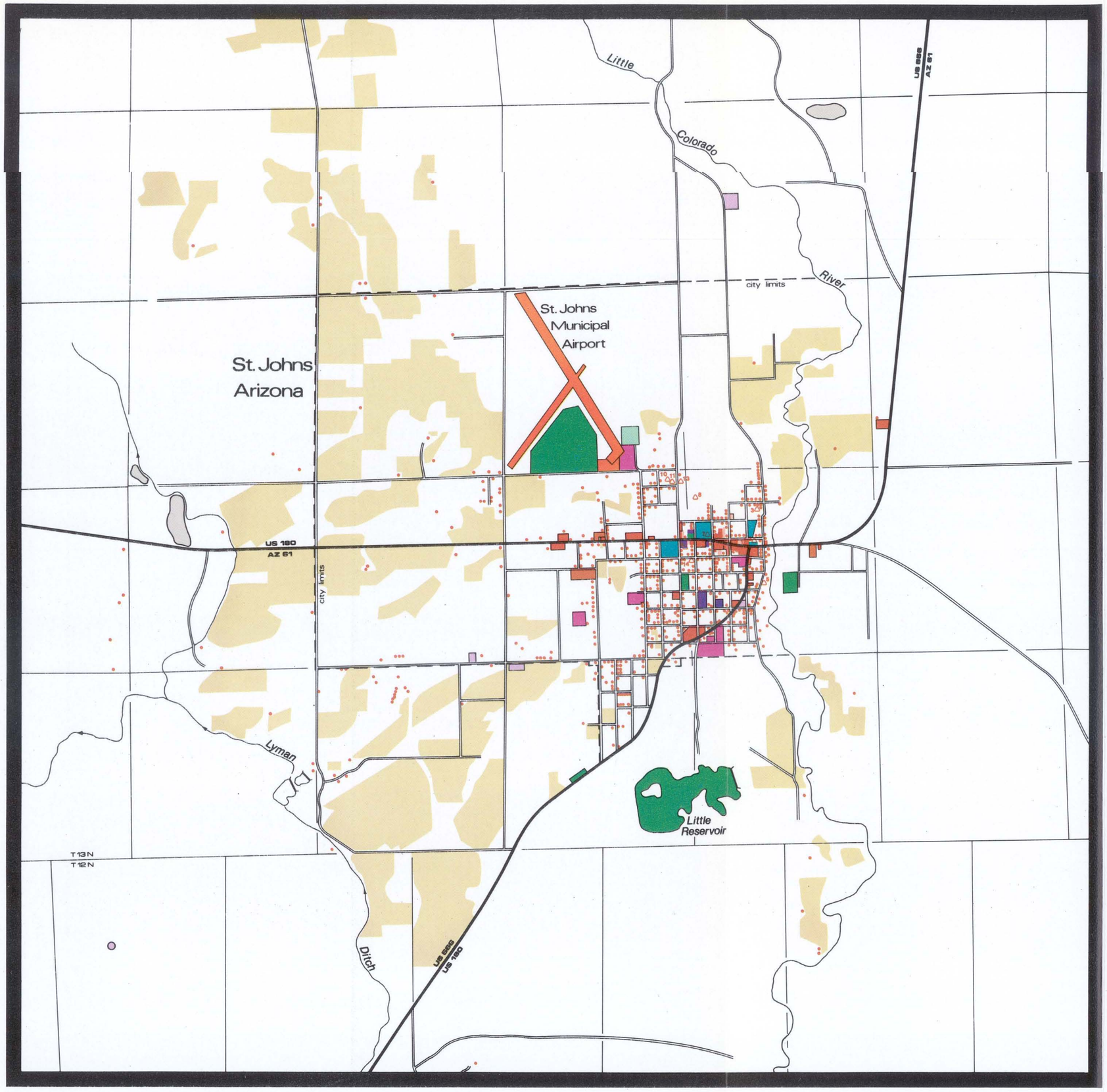
c. Employment

In 1974, the FTE (Full-time equivalent) number of employees in St. Johns was 334. This figure includes full time, part-time, and seasonal employees and is rounded to the nearest whole number. The major employer was local government, including public schools, which had 181 employees. The next highest category was general retail trade, with 49 employees. Other categories were restaurants, bars, and service stations, 27; manufacturing, 25; wholesale trade, 19; finance, insurance and real estate, 18; other services, 10; transportation, utilities, and communication, 3; and hotels and motels, 1.

d. Housing and Land Use

Figures II-17 and II-18 show current and planned land use, respectively, for St. Johns. The land within the city limits of St. Johns totaled 3520 acres. Prior to the inception of Coronado construction, only 340 acres, approximately 9 percent, were developed (Table II-18). In terms of total acreage, 56 percent of this developed land was devoted to residences. Between 1960 and 1970, the housing supply in St. Johns was essentially static. Although several new homes were constructed during that time, these structures were usually built to replace old housing.

The condition of housing within St. Johns ranged from excellent to extremely dilapidated. A special survey of housing conditions conducted in 1975 for a Community Development Block Grant Application showed that 34 percent of the houses within the city limits were either "deteriorating" or dilapidated."



RESIDENTIAL
- Individual Dwellings
- Trailer Parks

COMMERCIAL
- Retail, Trade, and Services
- Professional Services

PUBLIC & SEMI-PUBLIC
- Parks and Recreation
- Institutional
- Cemeteries
- Governmental

INDUSTRIAL
- Airport
- Utility Operations
- Maintenance and Storage

EXTRACTIVE
- Sand and Gravel

AGRICULTURE
- Field Crops

HISTORIC
- Investigated Sites

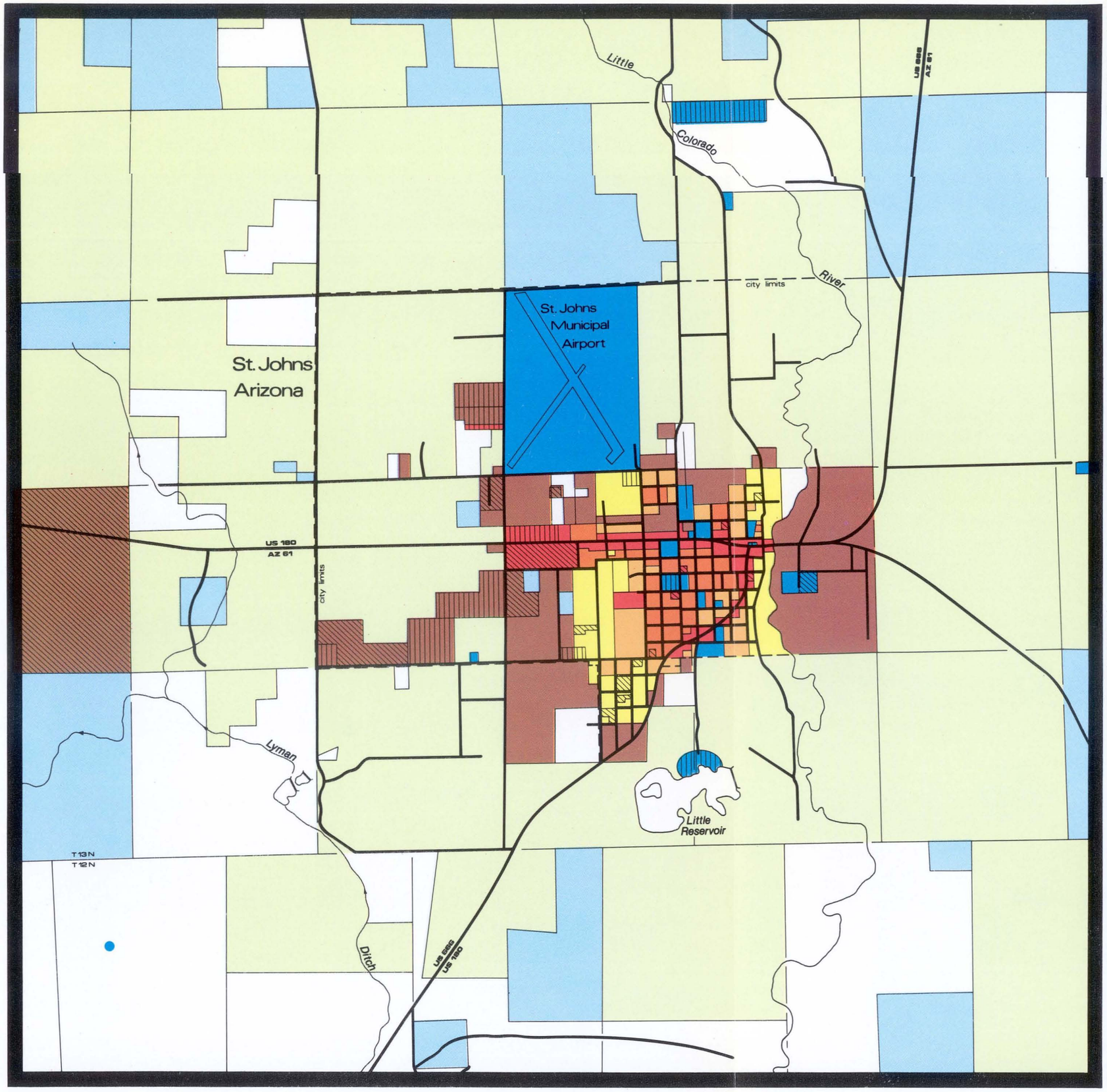
North 0 1/2 1 miles

CORONADO PROJECT

CORONADO GENERATING STATION

CURRENT LAND USE

Figure II-17



ZONING PLAN

- Residential 1
- Residential 2
- Residential 3
- Commercial
- Public

TAX CODE

- Residential
- Farm and Ranch Property
- Undeveloped Public Lands

SPECIFIC PLANS

- Developing
- Proposed

North

0 1/2 1
miles

CORONADO PROJECT

CORONADO GENERATING STATION

PLANNED LAND USE

Figure II-18

TABLE II-18

St. Johns Land Use

Type Of Use	Acres	Percent of Developed Area
Residential	191	56
Retail & Service	9	3
Heavy Commercial & Industrial	7	2
Public & Semi-Public (except airport)	19	6
Roadways	113	33
Total Developed	340	100
		Percent of City Total
Agricultural	200	6
Vacant	2,980	85
Total Land Area	3,520	100

Source: St. Johns Comprehensive Plan, 1971.

In the region surrounding St. Johns, there were essentially two types of housing. One was the rural residences of people engaged in agriculture. The other was the rural subdivision type. The rural subdivisions were generally the 40 acre "ranchette" type or the "planned development" type. Land in these rural subdivisions was usually purchased by outsiders for investment, a second home, or a retirement residence. Dwellings on these parcels were generally mobile homes and sometimes small cabins.

As shown in Table II-18, the second major use of land in St. Johns was for roadways. These roadways included U. S. Highways 180 and 666 and State Route 61. These roadways, along with public streets, amounted to approximately 33 percent of the developed land within the City in 1971. This proportion is roughly the same as that found in other communities.

Public and semi-public uses accounted for about six percent of St. Johns' developed land, less than normal for a community of its size. In addition to the two-acre city park in the center of town and the Apache County Fairgrounds at the airport, two recreational areas were on the outskirts of the city: the county-owned ball park to the east and the Little Reservoir to the south. Other public uses included three schools, two churches, two cemetaries, city hall, a community center, the Apache County Courthouse, and the County Museum.

The amount of land used for commercial and industrial purposes in the average community of St. Johns' size normally ranges from about 10 to 20 percent. In St. Johns, this percentage was substantially less. No land was devoted to manufacturing. Some industrial land in the St. Johns study area was used by utilities. The majority of industrial land was used for maintenance and storage. The St. Johns Municipal Airport was a paved, attended, public-use airport which provided gas and hangar services.

Discontinuous areas of field crops existed within the three major irrigation projects in the area. Gardens, orchards, and pasture lands were located within the immediate St. Johns area. Major crops and their approximate acreages are given in Table II-19. In addition, there was intermittent flood irrigation of pasture land, and much of the remaining land was used as low productivity range. Livestock was by far the major agricultural cash export. Much of the irrigated and range land was grazed directly, and most of the crops were fed to livestock. In the early 1970's the St. Johns region was marketing approximately 5000 head of livestock a year.

Within the city limits, approximately 200 acres were used for agriculture. The remaining 2980 acres within the city were vacant.

TABLE II-19

Agricultural Crops in St. Johns Region

Project	Acres in Cultivation	Crops	
Lyman Lake Irrigation Project	4,000	alfalfa	50%
		pasture	20%
		sorghum	20%
		other	10%
St. Johns Irrigation Project	3,000	native grass	80%
		alfalfa	10%
		pasture	10%
Hunt Valley Irrigation Project	1,000	alfalfa	55%
		pasture	20%
		sorghum	25%
St. Johns	100-200	domestic use	
		home gardens, orchards	85%
		pasture	15%

e. Facilities and Services

Prior to the beginning of construction of the Coronado project, recreation areas in St. Johns included a city park with a swimming pool and picnic grounds, tennis courts near city hall, and schools with basketball courts and playgrounds.

Cultural features in the area included the Apache County Museum and the City and County Library. The nearest radio stations were KVSL in Show Low and KDJI in Holbrook. The local newspaper was the White Mountain Independent. Social Services were provided by the Department of Economic Security, the Apache County Guidance Clinic in St. Johns, and by the Mormon and Catholic Churches. The Navajo County Guidance Clinic, Inc., in Show Low also provided social services.

The only bank in the area was the Valley National Bank in St. Johns. Other nearby banks were in Springerville and Show Low. The nearest Savings and Loan Association was Frontier Savings in Show Low. Retail services in St. Johns before construction on Coronado began included grocery and liquor stores, dry goods, nurseries, automotive supplies and service, hardware and building materials, feed stores, barber and beauty shops, TV and radio repair, a laundry, motels, restaurants, gift stores, a drug store, a pool room, and a school of dance. The number and diversity of this list was exceptional for a community of less than 1500 persons. For Apache County as a whole, retail sales in 1974 totaled $30,033,000.

The nearest hospital to St. Johns was at Springerville, approximately 30 miles to the south. This hospital had 25 beds with a 1975 occupancy rate of considerably less than the 85% rate considered to be adequate. The next nearest hospital was at Lakeside, approximately 40-45 miles to the southwest. Other hospitals were located at Holbrook, Flagstaff, and Phoenix-Tucson. The nearest physicians were at Springerville, which had three general practice doctors. The next nearest physicians were at Show Low, Lakeside, and Pinetop, where there were a total of six general practice doctors. Three other doctors were located at Holbrook. St. Johns had a clinic staffed by a nurse practitioner, who worked under the supervision of the Springerville doctors. Other medical services in St. Johns included three pharmacists and an optometrist. Dentists were located at Springerville, Pinetop, Show Low, Holbrook, Snowflake, and Alpine. Other pharmacists were at Springerville, Lakeside, Show Low, and Holbrook. Other optometrists were at Show Low and Holbrook. There were chiropractors at Springerville, Holbrook, Show Low, Taylor, and Pinetop. Emergency medical services for St. Johns were provided by a volunteer unit. This unit was equipped with a modern, well-equipped ambulance. In 1975, funds to operate and maintain this unit were provided by a grant from the State Department of Public Safety. Other funds were needed at that time.

In 1975, St. Johns had no municipal police force. Law enforcement was provided by the Apache County Sheriff's Department. Fire protection was by a volunteer department equipped with a modern truck and an obsolete one. There were no fire hydrants. The underwriters rating of 1967 (still in effect in 1975) rated the department at 10, the lowest possible.

St. Johns received electric power from the Navopache Electric Cooperative. Navopache bought bulk electric power from Arizona Public Service Company and resold it in the St. Johns area. Western States Telephone Company provided telephone service to St. Johns. Domestic sewer and water service was provided by the town of St. Johns. In 1975, the city's supply and distribution system was inadequate to handle anticipated growth. At that time, the city had received a $161,000 Federal grant for construction of a new one million gallon water tank. The sewage plant and trunk lines were expanded and upgraded in 1975 with the help of an $800,000 HUD grant. Solid waste within St. Johns was collected by a private contractor and dipsosed of in the city landfill.

Transportation access to St. Johns was provided by State Highway 61 and U. S. Highway 666 and 180. Freight and package service was provided by Thunderbird Freight Lines and United Parcel Service. The city operated a 4700-foot airport with a paved and lighted runway. There was no railroad service to St. Johns.

f. Education

Prior to Coronado construction, the St. Johns area had four schools under three different jurisdictions. At the elementary level, the St. Johns District #1 had two schools in St. Johns, the small Coronado School which accommodated students in grades 1-3 and the larger, and recently expanded, Pioneer School which accommodated grades K-8. Fourteen miles to the west, the Concho School (District #6) offered instruction to grades K-8. St. Johns High School (Apache County Union High School District #90) accommodated students in grades 9-12.

In 1974, the two elementary schools in St. Johns had a total of 22 faculty and 360 students. The Concho schools had 2 faculty and 39 students. St. Johns High School had 13 faculty and 191 students. Although the high school was closest to capacity, these schools had sufficient physical space to accommodate additional enrollment.

g. Government

Both the Agriculture Stabilization and Conservation Service and the Soil Conservation Service of the U. S. Department of Agriculture maintained offices in St. Johns. The Federal Aviation Agency operated a Vortac Facility at St. Johns Airport. There was also a Headstart office in St. Johns. The University of Arizona operated a Cooperative Extension Service office and the Arizona Department of Transportation maintained a Highway Department and an Engineering Department office. Other Arizona State offices in St. Johns included the Division of Special Education, the Department of Property Valuation, the Department of Economic Security, the Department of Public Welfare and Lyman Lake State Park.

Apache County maintained the Following offices in St. Johns: County Assessor, County Attorney, Board of Supervisors, Civil Defense, Superior Court, County Engineer, Guidance Clinic, Justice of the Peace, Juvenile office, County Maintenance Yard, County Nurse, County Reporter,

Planning and Zoning Office, Probation Officer, County Sanitarian, County Sheriff, Superintendent of Schools and County Treasurer. The City of St. Johns maintained City Hall, Police and Fire Services, and a public library. St. Johns was governed by a mayor-council system. Concho, an unincorporated area 14 miles to the west of St. Johns, was the next nearest population center to the Coronado site.

No Indian tribes will be directly affected or involved with the Coronado Generating Station. The Navajo Indian reservation boundary lies approximately 50 miles to the north of St. Johns, with headquarters in Window Rock, Arizona. The Navajo Tribal Council consists of a chairman, vice-chairman, and councilmen representing one or more of 100 chapters. The Zuni Indian Reservation lies approximately 35 miles to the northeast in New Mexico. The Zuni tribal government consists of a Governor, Lieutenant Governor, and tribal council.

h. Utilities

Electric power was supplied to the St. Johns region by the Navopache Electric Co-operative. Navopache purchased bulk power from Arizona Public Service Company and resold it to local customers. Domestic water service within St. Johns was provided by the city. At the time construction on the Coronado project was begun, the city water supply and distribution system was inadequate to handle the anticipated growth. Sewage disposal within the city was provided by the City of St. Johns. When construction on the Coronado plant began, the city needed to upgrade both the plant and the sewage trunk lines. Solid waste disposal for the City of St. Johns was handled by a private contractor under contract to the city. At the beginning of Coronado construction, this garbage was trucked to the city-owned landfill for disposal. Western States Telephone Company, a member of the Continental Telephone System, served the St. Johns area. Gas service was provided by Liquified Petroleum, which was supplied by local contractors.

i. Historical and Archeological Resources

(1) Historic Sites and Structures

(a) History

The Coronado Project lies within an area which has often been bypassed by major events in the history of Arizona and the region. It was, for example, a region virtually unknown to the Spanish. Estevanico the Black and Fray Marcos de Niza must have crossed near what is presently St. Johns on their trip to the Hopi villages in 1539, and Coronado passed along the same general route in 1540. The routes of both of these parties are very imprecisely known, and the explorers left no known trace of their passage.

For the two hundred years prior to the Anglo period, the area was known primarily to the Apache and Navajo Indians. American exploration of the area took place in the mid 1800's and occurred generally along the Little Colorado. The goal of these explorations was to develop a practical wagon road for emigrant and commercial traffic, and, later, to determine the feasibility of a transcontinental railway. In September and October of 1851, Captain Lorenzo Sitgreaves

of the Corps of Topographical Engineers, with a trained engineering party guided by Antoine Leroux, came down the Zuni River from New Mexico, and followed the Little Colorado through the plant site area. This was the first scientific examination of the study area. The Sitgreaves party moved relatively fast and concentrated on basic mapping of the potential wagon route. Their camps were transitory affairs, and no major incidents occurred to the party while crossing the study area.

Lt. Edward F. Beale brought a wagon road expedition across the study area in 1857, again using Antoin Leroux as guide. This party followed the southside of the Little Colorado River. Beale's 1857 expedition is primarily distinguished for its use of camels as an experiment in western transportation. Beale returned to the area in 1858, making improvements to the trail to make it fit for the use of emigrant wagons.

In the fall of 1875 a party of Mormon explorers led by James Brown came south into Arizona to reconnoiter for possible lands to settle. They examined the country along the Little Colorado River and made a favorable report upon their return to Utah. The St. Johns area became settled in the 1860's and 70's by several Spanish American and Anglo Mormon settlers. Early settlers to the area were William R. Milligan (1866) and Frank Walker (1870). St. Johns, Snowflake and Joseph City formed the commercial centers in the region north of the Rim until the coming of the Atlantic and Pacific Railway (now the Santa Fe) in 1882.

The railroad towns of Holbrook and Winslow soon dominated the trade of the region. Another change brought by the railroad was its use of the public range land, on which the Mormon settlements depended for room to support expansion of their own economy. The railroad sold a substantial portion of key tracts to the Aztec Land and Cattle Company, which soon brought in 40,000 head of cattle to stock this range and the intervening tracts of public land. The Aztec Company maintained offices at Holbrook and a ranch headquarters for their "Hashknife" brand near the river just a short distance south of Joseph City. At the peak of its operations Aztec in effect controlled over 2,000,000 acres of grazing land and was one of the largest ranching operations in the west. Frequent conflict arose between the company and the settlers.

For a long time after the coming of the railroad the level of development within the region remained generally static. The construction of modern roads to the area in the 1930's and 40's brought a major influx of people to the area. This development constituted the last major historical event in the settlement which shaped the area's present-day character.

(b) Historic Places

An inventory performed by Western Interpretive Service of historic resources within the study area revealed one historic site within or immediately adjacent to the plant site property, the wellfield properties or the water pipeline route. In addition, 13 structures which could be described as having local historic importance were located within or near St. Johns. Their primary value is based on the fact that their architecture, and more particularly their external appearances provide St. Johns a visual link with its historical stages of development.

The locations of these sites are contained within Figure II-17, in the land use section of this report, site numbers are indicated on the figures and are cross-indexed to the numerical site-designations which follow:

Site 1 - Barth Hotel - Currently on the National Register of Historic Places, this is one of the older commercial buildings in St. Johns, long noted for its porch columns of petrified wood from the region.

Site 2 - Old St. Johns Jail - This adobe structure, with a frame roof covered with galvanized iron, was built in 1880, and is one of the town's first structures. It served as the first jail for all of Apache County.

Site 3 - Old Gristmill - This structure dates from the early 1890's. It processed most of the grain grown on the irrigated lands around St. Johns.

Site 4 - Armory Hall - This attractive stone masonry building was built in 1893.

Site 5 - "Early Spanish House" - (sometimes called "The Old Frenchman's House.") This adobe house reportedly dates from the early 1880's but local sources differ as to its builder. The Apache County Historical Society's curator states that the building was built by Carlos Anoya.

Site 6 - Lesueur Home - Built around 1884, this house served for many years as a dormitory for the nearby L.D.S. Academy.

Site 7 - L.D.S. Academy - This structure, built in 1900, has served as both a parochial school and as a church for the community's substantial Mormon population.

Site 8 - John Henry Heap Home - Built by Miles Romney in 1881, this house was long occupied by the Romney and Heap families, both prominent in local affairs.

Site 9 - Farr Cabin - This is the Farr Cabin in its new location near the County Museum. This structure is on the State Historic Sites Inventory.

Site 10 - Original site of the Farr Cabin, built in 1881.

Site 11 - Dan Pulsipher Home - Built by Elija Freeman in 1886.

Site 12 - Sorenson Home - Built by the Sorenson family around 1900.

Site 13 - Charles P. Anderson Log Cabin - Built in the fall of 1884.

Site 14 - W. W. Berry Home - The first brick residence built in St. Johns, 1883.

There appears to be a degree of sensitivity for the historic heritage of St. Johns among its citizens. For instance, the Farr Cabin was recently relocated to a site near the County Museum. There is some potential that all of these structures together could be organized to form an Historic District within the town, if the local citizenrydesires to do so.

Two sites exhibiting evidence of human use were recorded during the Museum of Northern Arizona's investigations of the Coronado Generating Station plant site. The sites are both areas of shallow trash. One has been dated to the period between 1955 and 1965, while the other has been roughly dated as contemporaneous. Other isolated pieces of historic material were collected from several of the prehistoric sites and span the period from 1880 to the present.

Three other sites were also located in the evaporation pond area. One consists of a system of small reservoirs which at one time trapped and diverted water from the valley drainage system. Another is a portion of a corral wall, and yet another is a large corral and associated well. The latter corral has remained in use possibly from the early 1930's until the present time. It is constructed of upright juniper posts and is approvimately 80 m. in diameter. Associated with the corral is a shallow well, dug into an arroyo bank. The well is covered with a milled lumber superstructure 1m. square. The former corral is a portion of a juniper-post corral wall about 10 m. in length. The wall is highly weathered and not associated with artifactual material. The main portions of the reservoirs include linear and crescent-shaped earth embankments utilized as dams and for the diversion of water. A series of three cattle ponds have been superimposed on one another in this area and finally two reservoir dams built across the main drainage below the ponds. The drainage has since cut through the second reservoir dam. Paralleling the drainage is a narrow canal running the entire length of the valley from below the modern reservoir in section 7 south through sections 5 and 6.

(2) Archaeological Sites

In all, a total of 130 archaeological sites was recorded during the combined 1974 SRP Arizona Station Plant Site Study/ Coronado Generating Station Project investigations. Of these, 46 apply directly or indirectly to the combined plant site-wellfield aspects of the Coronado Generating Station while, based on present information another ten sites are projected to be directly or indirectly affected by proposed ash disposal and pipeline construction. Archaeological sites recorded during the Coronado Generating Station project range from single petroglyph sites, to pit house communities, to sites of historic affiliation.

(a) Coronado Generating Station Plant Site

Eighteen archaeological sites were recorded either within or immediately adjacent to the 3.5 sq. mi. Coronado Generating Station site. Excavation of sites within the plant site revealed much information about the prehistoric utilization of the

immediate area. Although analysis of the recovered cultural material is not as yet complete, preliminary conclusions can be proffered. Site types can be described in three general categories and the prehistoric temporal range represented by those archaeological resources spans a period of possibly 6000 to 7000 years--6000 B.C. to A.D. 1000.

Lithic Sites: Two lithic sites were found on the plant site and a third is located just beyond it. The first site overlooks a drainage in the southeast corner of the plant site, while the second is on a hill near the plant site's highest point. The latter site has a number of cores from which flakes suitable for the manufacture of tools could have been struck. Flakes, the waste products of stone tool manufacture, are also in evidence as are one complete and several fragmentary tools. Diagnostic projectile points recovered from this site indicate it was utilized during Archaic times, dating sometime between 6000 B.C. and 200 B.C. No cores or complete, diagnostic tools were recovered from the site lying outside of the plant site boundary. The complete lack of ceramic material intimates an age prior to A.D. 500.

Ceramic Sites: A number of ceramic sites were recorded on and just off the plant site. Nine of these sites are located on a ridge overlooking the wash near the plant site. Most of these sites are concentrations of lithic, ceramic, and ground stone material. Three sites yielded pit houses. A total of nine such structures from the three sites have been dated ceramically to late White Mound Phase through late Red Mesa Phase, or from about A.D. 700 to 1000, with all exhibiting at least two occupations during this time span. All three sites yielded extensive trash dumps which suggest permanent occupations over a number of years. Another small site contains a single pit house of late White Mound Phase to early Kiatuthlanna Phase, or about A.D. 700 to 900.

Another group of sites possess a limited amount of artifactual material eroding out of stabilized dune areas. One exhibits numerous features such as firepits, roasting pits and fire-cracked rock which suggest extensive or repeated utilization of the site. Primary activities carried on at this site were probably food collecting and processing. A site located in the northeast portion of the plant site presents a perplexing problem. It yielded ceramics dating from the late Red Mesa Phase through the Wingate Phase, A.D. 950 to 1100, while also yielding projectile points of Archaic age which date to the first few millenia B.C.

(b) Access Road

A total of four archaeological sites were recorded on or adjacent to the Coronado Generating Station plant site access road. Of these, three represent the remains of camp sites while the fourth is a small chipping station. One is located near the junction of the plant site and access road on the west slope of a large ridge. Excavation of this site revealed a temporary utilization sometime during the period A.D. 700 to 1000 with an apparent emphasis on food gathering and processing. Another represents a camp site of probable earlier

tradition, as a complete lack of ceramic material was noted. However, the occurrence of five small firepits and numerous ground stone implements suggests that food processing activities were of importance at this temporary site.

Yet another is a small lithic scatter located about 100 m. south of the second and across a wide drainage from the first. It consists of a concentration of four small firepits with an associated scatter of chipped stone waste flakes atop a small alluvial knoll. Preliminary impressions regarding this site are that it is a small temporary camp where chipped stone tools were fashioned.

The fourth site is a lithic scatter located on a slight rise one mile east of Highway 666. This site is surficial in nature and did not yield a single diagnostic artifact. Waste flakes, cores and one bifacial tool were recovered from the site but no definite date can as yet be assigned to it.

(c) Evaporation Pond Area

The evaporation pond area showed evidence of quarries. These are raw material procurement areas located in naturally occurring gravel deposits dominated by chert and quartzite cobbles and siliceous wood. Some evidence of intentionally worked material is present in almost every naturally occurring deposit and these deposits occur on both east and west valley sides. The valley floor is highly alluviated and does not contain many deposits. All quarry locations are surficial in nature. Artifactual material included bulky cortical flakes weighing more than 20 grams and unutilized debitage of all sizes including cobbles with one or two flakes removed as a test of the quality of the material.

Seasonal and temporary campsites were also found in the evaporation pond area. Archaeological investigations of the evaporation pond, conducted between February and August, 1976, produced records of 33 sites from a 3.25 square mile area. The evaporation pond, located in T13N, R29E, sections 6, 7, 8 and the western 1/2 of section 5 is situated on the upper reaches of an unnamed tributary to Carrizo Wash. The area contains extensive gravel deposits and pieces of petrified wood.

These sites are characterized by the presence of ceramic and/or lithic debris, usually in association with hearths and ground stone. The ceramic material is sparse, and the earliest type of Cibola White Ware represented is Red Mesa B/W. Lithic debris includes the types of material found on quarry locations along with secondary non-cortical flakes, cores and unifacial and bifacial tools.

Topographically the sites are situated along the valley sides between the mesa top and valley floor, usually in areas of stabilized dunes and near naturally occurring gravel outcrops. Chronologically, the sites range from Archaic to Pueblo III. Several sites may have acted as base camp and storage areas as well as tool

manufacturing and food processing locations. These contain featureless pit structures dug into the soft dune sand. Several sites of a surficial nature were also identified.

(d) Wellfields

Parts of the three wellfield areas were surveyed by a team of archaeologists between July 29 and August 7, 1974. Subsequently, selected locations for production, observation and monitoring wells as well as access routes, were intensively surveyed. During the course of these investigations, nine archaeological sites were located within the wellfield boundaries and an additional 15 sites were located adjacent to or just outside these boundaries. In view of the information acquired during this survey, the wellfield north of Concho is the most archaeologically sensitive. The nine archaeological sites located within the proposed wellfield boundaries are all found in this wellfield and include sherd and lithic scatters, petroglyph sites, a rock shelter and concentrations of historic affiliation.

Only one recorded site is purely lithic in cultural material. This site is a small concentration of chert and chalcedony flakes centered around the base of a large juniper tree. One knife base was recovered at this site and a possible rock alignment suggests a hearth may also be present. This site is located on the northern border of a widespread lithic scatter located along a ridgetop overlooking Highway 180A. This entire western ridge area is moderately covered with flakes and bifacial stone tools representative of Concho Complex type sites and is considered a very archaeologically sensitive locality. It is obvious that this locale was an important source for raw lithic material and apparently an important and productive hunting area. The significance of this immediate region is supported by the fact that additional cultural evidence, including at least one habitation site, several camp sites and numerous petroglyph sites, are to be found within one mile of this ridge.

Three sites located within the boundaries of the Concho wellfield yielded ceramics. The first two are characterized as sherd and lithic scatters and each covers an extensive area overlooking the unnamed wash which drains the western sections of the Concho wellfield. Both of these sites have been dated ceramically to Pueblo II-III times (A.D. 1000-2000). The third ceramic site is in a small rock shelter.

The fact that these sites can be placed in a particular time-period affords the opportunity, under controlled conditions, for a study of flaking techniques and stone tool manufacture during a particular developmental stage. These investigations should be compared with other known techniques from different temporal periods for a study of such practices through time in this cultural region. Furthermore, the presence of utilized flakes adds to the research potential of defining specific kinds of activities conducted at each site. Functional differences between the sites or between certain portions of the same

site may provide useful information on the nature of prehistoric exploitive activities.

A small alcove with dry-laid masonry wall remnants is located above a small tributary which drains west into the larger unnamed wash of the western portion of the Concho wellfield. A light amount of ceramic and lithic material is scattered over the site, including the interior of the rock shelter and slope immediately in front of the shelter. A large slab metate is located on this south-facing slope and is evidence of use of the rock shelter as a food processing center. The shelter is dated ceramically to Pueblo III times (A.D. 1100-1300) and is contemporaneous with several other sites in the immediate area, including the two aforementioned sherd and lithic scatters and four other sites.

Two petroglyph sites were located within the Concho wellfield boundaries. Both are located at the base of mesas or ridges where the exposed sandstone bedrock affords numerous large panel faces suitable for pecking. In addition to these two sites, seven other petroglyph sites were recorded just outside the western wellfield boundary. Preliminary studies suggest that all of these sites contain rock art elements stylistically characteristic of the late Pueblo II to late Pueblo III periods. Such a time-period corresponds precisely to that arrived at through ceramic dating of other sites recorded in the area.

It is obvious that the area included in the Concho wellfield was utilized by prehistoric peoples during Pueblo II-III times and probably earlier. The unnamed wash which drains the immediate locale, the availability of raw lithic material and the higher wooded elevations which offer a variety of plant and animal life were features which attracted prehistoric peoples to this particular area. The main habitation sites located to the east in Concho Creek probably served as the base for hunting forays and seasonal food gathering trips into the surrounding regions. The area under consideration exhibits evidence of such subsistence patterns. Additional archaeological investigations in the area would undoubtedly afford a more precise and complete picture of how people of Pueblo II-III times were exploiting their environment and could offer additional information on why they were exploiting these particular areas and how these activities changed through time.

(e) Pipeline Corridor

During the intensive archaeological survey, fifteen sites were identified (12 prehistoric and 3 historic) in the pipeline corridor, and nine were recorded in the joint right-of-way with the transmission line. A ten mile segment of the pipeline corridor coincides with the transmission corridor.

The settlement pattern noted during this survey suggests that sites are occurring in predictable areas. Lithic sites

predominate on the higher ridge locations which contain exposures of gravels that supplied raw lithic material for tool manufacture. Habitation and seasonally-utilized sites occur on the lower ridges and terraces which overlook flat-lying tracts of land and drainages. More precise information about the pipeline corridor archaeological investigations is not available at this time.

(f) Limestone Source

The Museum of Northern Arizona, at the request of the Salt River Project, conducted an archaeological survey of the Welch limestone claim near St. Johns. The study area was systematically surveyed by an archaeologist utilizing a zigzag swathing technique at regular intervals in east-west and west-east directions. The results of the survey were then analyzed by the Museum.

A total of 13 archaeological sites were found on the Welch limestone claims. Three additional sites were found within a few hundred feet of the claim boundaries. These sites consist primarily of prehistoric lithic scatters (seven sites) and historic limestone kilns (five sites). Two of the sites are historic rubbish piles, one site is a structure foundation, and the last is possibly a prehistoric hunting blind.

The museum believes that no reported localities appear to be eligible for nomination to the National Registor of Historic Places. In consultation with that registry, the Museum feels that no sites currently considered for that nomination or actually on file with that curator are within the proposed limestone quarry area.

B-2 Description of the Environment -- Power Plant Spur Coal-Haul Railroad

1. Physical Environment

a. Air Quality and Climatology

(1) General

Air quality and meteorology were studied extensively for the Coronado Generating Station siting studies. This information, which is presented in Section B-1, was used as the data base for the railroad air quality analysis.

(2) Existing Air Quality Conditions

Briefly, the air quality on the Upper Little Colorado Plateau is excellent. Pollutants such as SO_2 and NO_2 are present only in minute concentrations, far below both the National and the State of Arizona Ambient Air Quality Standards.

Particulate matter in the vicinity of St. Johns is also well below the air quality standards. However, measurements made in conjunction with the Cholla Power Project indicate that, in the area of the Upper Little Colorado Plateau near the Petrified Forest, the National and State 24-hour standard for particulates is often exceeded during occasions of high winds. These high levels are due to the action of wind on arid soil producing airborne dust; this is termed wind erosion.

The major climatic causes of wind erosion are high wind velocity and turbulence, low precipitation, high evaporation rate and high temperature. Soil properties which contribute to wind erosion are related to the condition of soil grains (dry, small, loose and low density) and the condition of the surface (roughness, vegetative cover).

For a given soil type, there exists a threshold wind velocity below which the wind will not move the soil. Most soils require a minimum wind speed of 12 miles per hour (mph) for movement to be initiated. The threshold wind speed for fine sand has been reported to be ten mph. Therefore, in order to quantify wind erosion forces, a wind speed-wind direction table is needed.

Two quantities are needed to identify the prevailing direction of wind erosion. First, the force exerted on the soil particles by winds in each direction at all observed speeds is calculated; each speed is weighted with the probability of its occurrence. Second, the preponderance, or the ratio of total forces parallel to each direction, is calculated. The direction of maximum preponderance is the direction which would show maximum wind erosion. Profiles of force and preponderance are shown in Figure II-19. The values of force are in units of wind

speed cubed (mph^3). Preponderance is unitless. Note that the same preponderance is obtained for complementary directions. Consequently only eight directions are shown with preponderance values; these eight directions are the directions for which the magnitude of the erosion forces is greatest.

The directions of prevailing wind erosion are seen to be south-southwest and southwest with almost equal intensity. The prevailing wind directions are, on the other hand, south, east and east-northeast. Thus, the prevailing wind directions are not the same as directions of winds which are predominately responsible for wind erosions. The direction of prevailing wind erosion is generally southwesterly and is visibly evidenced by physiographic characteristics.

From climatological and meterological data of the area it may be concluded that the wind and climatic conditions most conducive to wind erosion are most likely to combine in the spring and summer months. The occurrence of particulate matter in excess of air quality standards is, therefore, concomitant with the arid nature of the land in the vicinity of the Petrified Forest National Park and west and north of that area. Approximately 70 percent of the suspended particulate matter is respirable.

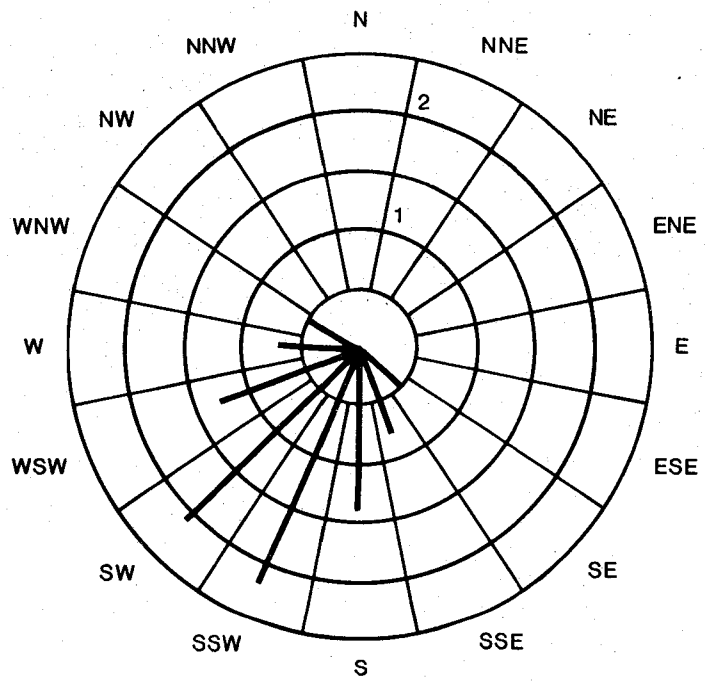
Diffusion is excellent in the area. Poorest diffusion would occur in the evening and early morning hours during which inversions usually occur. Inversions occur almost nightly, but they dissipate by mid-morning. The inversions are generally with easterly to southerly surface winds. At the time of inversion dissipation, the wind direction generally shifts to southwesterly. Inversions are a natural phenomenon common to almost all geographical regions. The significant factor in regional air quality analysis is that these inversions do not generally persist throughout the day.

(3) Existing Climatological Conditions

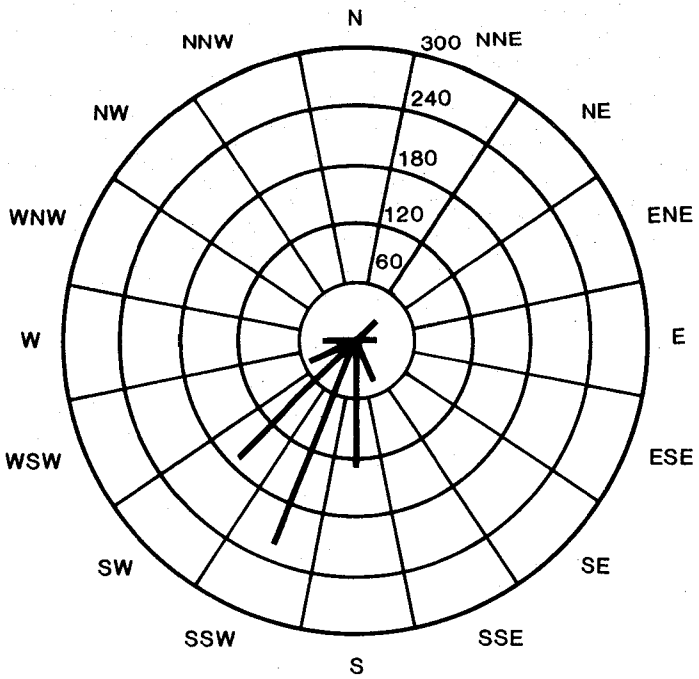
The climate of the area is described in Section II. B-1 of this statement and is applicable to the area encompassing the proposed railroad alignment.

b. Physiography

The proposed alignment lies in the Little Colorado River Basin, which is within the southern part of the Colorado Plateau Physiographic Province. The Colorado Plateau comprises a roughly circular area of approximately 140,000 square miles in Arizona, New Mexico, Colorado and Utah. This part of the Colorado Plateau conforms to the general definition of a plateau in that it is a comparatively flat area of great extent which is considerably elevated above the adjacent province, the Basin and Range Province to the south. The prominent Mogollon Rim, an escarpment that defines the boundary between the two provinces, is located approximately 50 miles southwest of the proposed Coronado Station.



PREPONDERANCE OF
WIND EROSION FORCES



MAGNITUDE OF
WIND EROSION FORCES
BY DIRECTION.

UNITS OF FORCE ARE
MILES PER HOUR CUBED

WIND DATA FROM
CORONADO
GENERATING STATION

CORONADO PROJECT

Power Plant Spur Coal Haul Railroad

WIND EROSION PROFILE

Figure II-19

Sedimentary strata that underlie the area of the proposed alignment have a gentle dip to the northeast. This dip is only slightly modified by small folds and faults. The lack of large-scale, local, structural features contributes to the comparatively flat topography of the area. Existing topographic relief is due largely to downward erosion by surface water and, to a lesser extent, to erosion and deposition by wind. Wind has deposited parallel, northeast oriented, low ridges in the flat highlands area. Closed drainage basins have also been excavated by the wind at several locations.

The topography of the area, which was an important factor used in selection of the proposed alignment, determines the types and magnitudes of potential impacts in several environmental disciplines. Topography is shown on the Topographic Map, Figure II-20. A cross section of the topography and underlying geologic strata along a straight line approximately parallel to the proposed alignment is shown on Figure II-21. Outcrops of the Bidahochi Formation and of the Sonsela Member of the Chinle Formation form escarpments at some locations around the edge of the table-lands. Escarpments are discussed in the Scenic Resources section.

Highland areas of "rolling upland" topography, as seen on the cross section, occupy approximately one-half of the linear distance along the proposed alignment. "Valley plains" topography is present in the flat areas of the two largest stream valleys that cross the alignment - the Carrizo Wash and the Zuni River.

Surface elevations along the alignment range from a low of 5598 feet to a high of 6155 feet: thus total relief is 557 feet. At the north end of the alignment, at the AT&SF Railway, the elevation is 5600 feet, and at the south end, at the proposed Coronado Station, it is 5790 feet. Much of the proposed alignment will be on land surfaces that slope gently downward in a general southwesterly direction.

c. Geology

(1) General

The area of the proposed railroad alignment is underlain by a nearly horizontal series of sedimentary rock strata. These strata are flexed by broad warps and monoclinal folds that are broken by faults at some locations. Volcanic flows have extruded onto the land surface in some areas. The surface distribution of the sedimentary and volcanic rocks that occur in the area are shown on the Geology map, Figure II-22.

(2) Existing Conditions

Existing geologic conditions are described in terms of stratigraphy, structure, formations, geologic resources of economic value, seismicity and paleontology.

(a) Stratigraphy

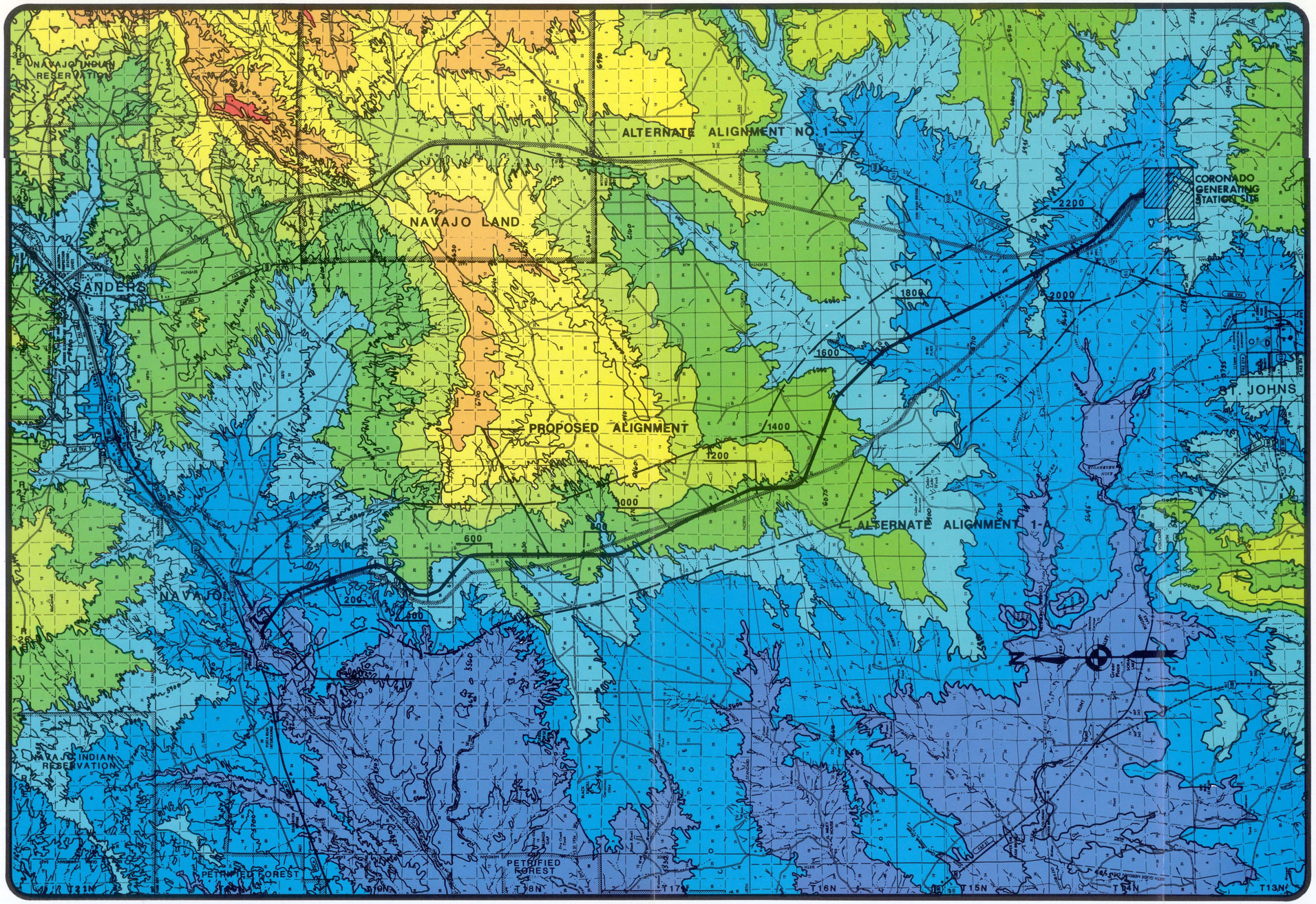
Sedimentary rocks that overlie the Precambrian granitic basement rocks range in age, in ascending order, from Pennsylvanian through Permian, Triassic, Cretaceous, Tertiary to Quaternary. The groups or formations within this stratigraphic column, and in the central Apache County area of the proposed alignment, are shown in Table II-20. The horizontal and vertical distributions of these strata are shown on the northwest-southeast geologic cross section (B-B') in Figure II-21. This cross section is located along a straight line to the west of and nearly parallel to, the proposed alignment. A second cross section (A-A'), transverse to the alignment, is also shown on Figure II-21. Locations of these sections are shown on the Geologic Map, Figure II-22.

The Chinle and Bidahochi formations, the Quaternary sediments, and the valley-fill alluvium are sedimentary formations that crop out along the alignment and which therefore will be subject to potential disturbance by cutting, filling, erosion and possibly other processes that will be associated with the construction and operation of the railroad. The Kaibab Limestone and Coconino Sandstone formations, which together form the principal aquifer in the area, occur below the surface and are not likely to be directly affected by railroad activities. The alignment will cross through a narrow, discontinuous, Quaternary basalt flow approximately 11 miles northwest of the proposed Coronado Station site.

Lithologic and water-bearing characteristics of the various sedimentary rocks that occur along the proposed alignment and in nearby areas of Apache County are described in Table II-20.

(b) Structure

The area of the proposed railroad is in the Mogollon Slope part (general structural and topographic slope away from the Mogollon Rim) of the Colorado Plateau Province. Here, as the result of earth movement during the Laramide orogeny, a major geological event which occurred throughout the west, the early Tertiary and older strata generally dip northeastward at low angles from the Mogollon Rim toward the Defiance Uplift and the Black Mesa Basin. This general, northeastward dip is interrupted locally by small northwest-trending anticlines, synclines and monoclines. These folds are less than six miles long and parallel the broad trough formed between the Mogollon Rim and the Defiance Uplift. Miocene and younger strata show little indication of folding or other disturbances. Thus, as shown on the geologic cross-section (Figure II-21), the Bidahochi and younger Quaternary formations do not exhibit the northeasterly dip that characterizes the older, deeper strata. The Bidahochi and the veneer of overlying Quaternary materials (referred to as "Quaternary sediments" and "Quaternary alluvium" on the geologic cross-sections and map) dip in various directions depending on the slope of the land surface upon which they were deposited by water or wind.



6800′ & UP
6600′ TO 6800′
6400′ TO 6600′
6200′ TO 6400′
6000′ TO 6200′
5800′ TO 6000′
5600′ TO 5800′
5400′ TO 5600′

SOURCE: ARMY MAP SERVICE, 1954

BASE MAP: ARIZONA HIGHWAY DEPT.

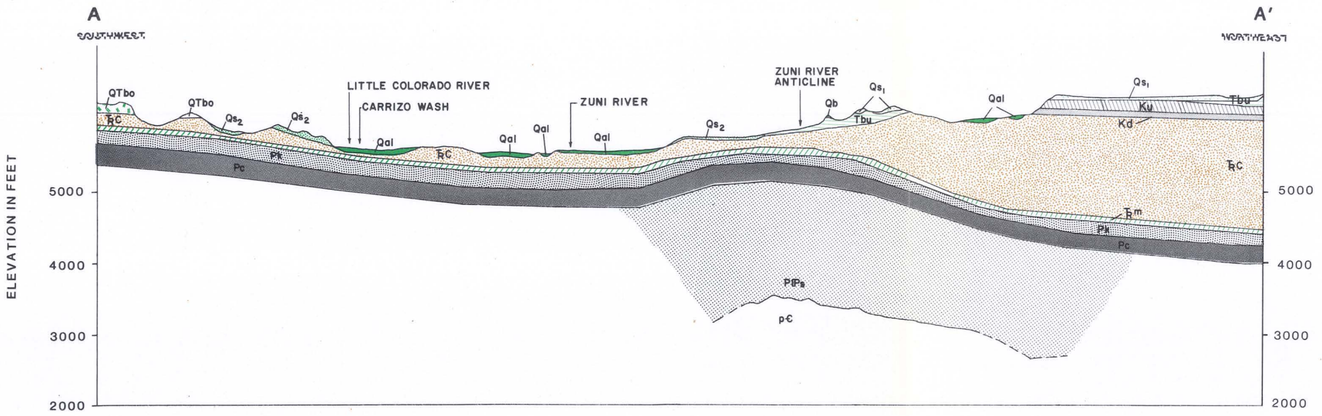
0 1 2 3 4 5 MILES

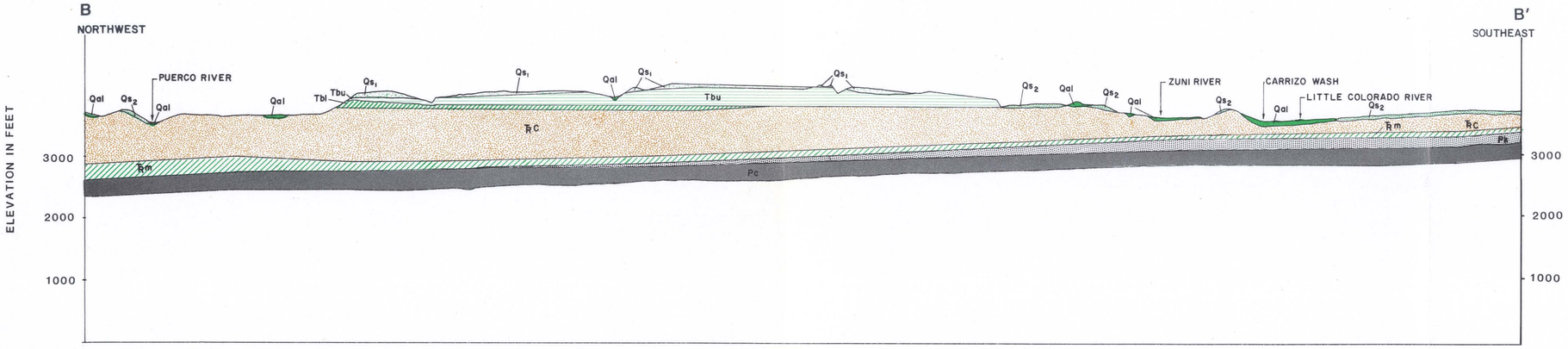
CORONADO PROJECT

Power Plant Spur Coal Haul Railroad

TOPOGRAPHY

Figure II-20





0 1 2 3 4 5 MILES

HORIZONTAL SCALE

Qal ALLUVIUM

Qs2 Qs1 QUATERNARY SEDIMENTS

Qb QUATERNARY VOLCANIC ROCKS

QTbo QUATERNARY OR TERTIARY VOLCANIC ROCKS

Tbu BIDAHOCHI FORMATION

Ku SEDIMENTARY ROCKS UNDIFFERENTIATED

Kd DAKOTA SANDSTONE

TRC CHINLE FORMATION

TRm MOENKOPI FORMATION

Pk KAIBAB LIMESTONE

Pc COCONINO SANDSTONE

PPs SUPAI FORMATION

p€ PRECAMBRIAN ROCKS

NOTE: SEE GEOLOGIC MAP FOR LOCATION OF CROSS SECTIONS

SOURCE: AKERS, 1957

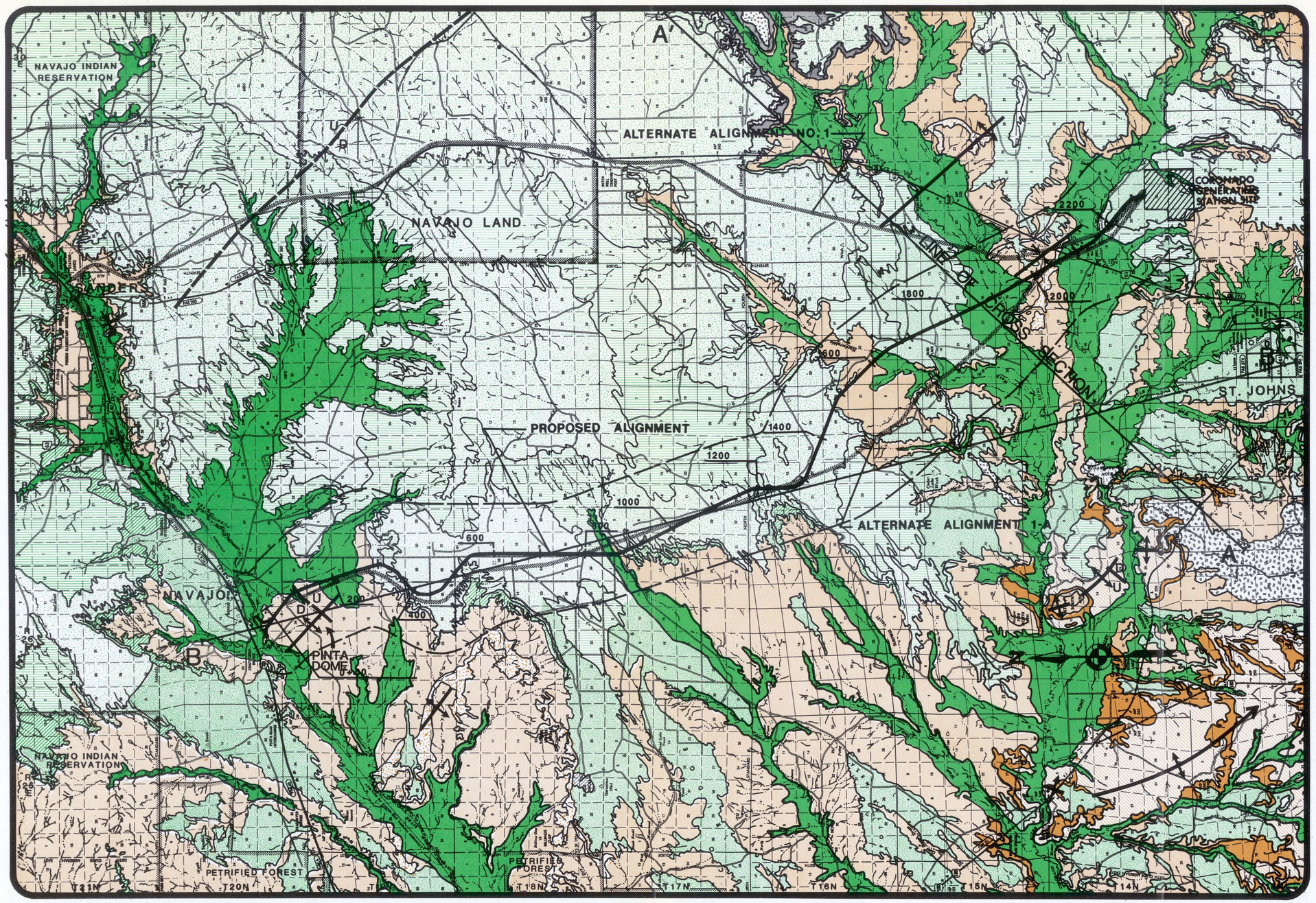
CORONADO PROJECT

Power Plant Spur Coal Haul Railroad

GEOLOGIC CROSS SECTION

IN AREA OF PROPOSED ALIGNMENT

Figure II-21



Qal	ALLUVIUM
Qt	TRAVERTINE DEPOSITS
Qs_2 / Qs_1	QUATERNARY SEDIMENTS
Tbu	BIDAHOCHI FORMATION
Km	MANCOS SHALE
Kd	DAKOTA SANDSTONE
Qb	QUATERNARY VOLCANIC ROCKS
Qtbd	QUATERNARY OR TERTIARY VOLCANIC ROCKS
TRcp / TRcps / TRcs	CHINLE FORMATION
Tb	BASALTIC LAVA
U/D	FAULT
	ANTICLINE
	SYNCLINE

SOURCE: AKERS, 1964
BASE MAP: ARIZONA HIGHWAY DEPT.

0 1 2 3 4 5 MILES

CORONADO PROJECT

Power Plant Spur Coal Haul Railroad

GEOLOGY OF THE AREA

Figure II-22

TABLE II-20

GENERALIZED SECTION OF THE SEDIMENTARY ROCKS OF THE STUDY AREA[1]

System	Series	Group or Formation	Thickness (feet)	Lithologic and Water-Bearing Character
Quaternary	Recent & Pleistocene		0-500	Alluvium, sand, gravel overlying river terraces travertine, cinders, and lava. Contains water.
		Unconformity		
	Pliocene	Bidahochi Formation	0-800	White to light-brown sandstone with minor beds of siltstone and white ash, and light-brown to greenish-gray claystone, mudstone, and siltstone with a few beds of bentonite. Includes lava in the northern part of the area. Contains water.
		Unconformity		
Tertiary	Miocene (?)	Datil Formation	800+	Greenish-gray and reddish-gray mudstone, siltstone, sandstone, and conglomerate composed largely of volcanic fragments. Does not contain water in area of this report.
	Eocene (?)	Sedimentary Rocks	800±	Light-brown to medium-red conglomerate, sandstone, and siltstone. Contains many pebbles and cobbles of quartzite, jasper, granite, gneiss, schist, and limestone. Contains water in Springerville area.
		Unconformity (?)		
Cretaceous	Upper	Undifferentiated: Mesaverde Group	200+	Yellow, light-green and reddish-brown siltstone, sandstone, and conglomerate interbedded with gray siltstone and coal. Some sandstone beds contain water.
		Undifferentiated: Mancos Shale	150+	Yellowish to dark-gray siltstone with minor thin beds of yellow to light-brown fine- to medium-grained sandstone. Does not contain water.
		Undifferentiated: Dakota Sandstone	50-115	Yellowish-gray to light-brown sandstone with lenticular beds of conglomerate, carbonaceous siltstone, and coal. Contains water.
		Unconformity		
Triassic	Upper	Wingate Sandstone	250	Reddish-brown intercalated siltstone and sandstone beds. Does not contain water.
		Unconformity		
		Chinle Formation	0-1,550	Multicolored claystone, mudstone, siltstone, sandstone, conglomerate, and limestone. Some sandstone units contain water, usually of poor quality.
		Unconformity		
	Middle (?) & Lower	Moenkopi Formation	35-250	Brownish-red intercalated siltstone, sandstone, and conglomerate. Contains water of very poor quality in some areas.
		Unconformity		
Permian	Lower	Kaibab Limestone	0-310	Yellowish-gray to dark-gray cherty and silty fossiliferous limestone with a few fine-grained sandstone beds. Contains water where sufficiently fractured.
		Coconino Sandstone	200-400	Light-gray to white, fine- to medium-grained sandstone. Major aquifer in area; contains salty water in some areas.
Pennsylvanian		Supai Formation	1,000-2,000	Red and brown, mudstone, siltstone, sandstone, and limestone interbedded with evaporites. Some units contain salty water.
		Unconformity		
Precambrian		Basement Rocks		Pink coarsely crystalline granite and diorite. Not known to contain water.

[1]Akers, 1964.

In this area of relatively little earth movement, there are no known large faults and only a few small ones. One small northwest-trending fault, located three miles south of Sanders, apparently affects the flow and quality of ground water in the Coconino-Kaibab aquifer. This fault and the few small anticlines and synclines are shown on the geologic map and cross-section. The largest structure is the Zuni River Anticline (Figure II-21).

(c) Description of Formations

The geologic formations that crop out along the alignment are, from younger to older, the Quaternary Eolian dune-sands, alluvial deposits, terrace deposits and volcanic rocks; the Tertiary Bidahochi formation; and the Triassic Chinle formation. The Triassic Moenkopi, Permian Kaibab and Permian Coconino formations occur at depth.

Eolian Dune-Sands (Quaternary)

Longitudinal sand dunes have been deposited on the Quaternary sediments (terrace deposits described below) which are shown on the geologic map and cross-section, Figures II-22 and II-21. Dunes are most widespread on the sediments that overlie the Wupatki erosion surface at higher elevations (Qs_1 on the geologic map and described below). These dunes trend northeast, parallel to the direction of the prevailing wind that formed them, and are separated by intervening troughs. As discussed in the section on Hydrology, the unique "corrugated" topography and high soil permeability limit both the size of streams and the volume of runoff from dune areas.

Alluvial Deposits (Quaternary)

These deposits, which occur along stream valleys in the area, range in thickness from about 30 to 100 feet along the Little Colorado and Zuni Rivers to as much as 120 feet along the Puerco River. The alluvium consists mainly of sand, silty sand and sandy silt. Alluvium has a very limited areal extent along the proposed alignment.

Terrace Deposits (Quaternary)

These terrace deposits are shown as Qs_1 and Qs_2 "Quaternary sediments" deposits on the geologic map and cross sections (Figures II-22 and II-21). The two terrace deposits overlie two ancient erosional surfaces, the Wupatki (Qs_1) and the Black Point (Qs_2) surfaces, respectively. After the deposition of the Bidahochi formation, erosion created the Black Point surfaces in late Pliocene and early Pleistocene time, and the Wupatki surfaces in middle and late Pleistocene time. The terrace deposits (Qs_1) generally occur in the nearly flat highland areas overlying the Wupatki surface that has been eroded on the Bidahochi formation. The terrace deposits (Qs_2) on the Black Point surface generally occur in rolling to nearly flat, lowland areas overlying the Chinle formation. Except for limited areas of gravel, most of the terrace

deposits are composed of silty or gravelly sand. The gentle topography associated with the terrace deposits is generally favorable for railroad construction.

Bidahochi Formation (Tertiary)

The Bidahochi formation, which underlies the thin veneer of dune sand and terrace deposits (Qs_1) forms the bulk of the highlands or tablelands along the proposed alignment. It will supply a considerable portion of the deep cut material to be produced in areas of irregular topography, and especially at erosional escarpments which separate the nearly flat tableland areas from the larger stream valleys. This formation also contains the principal watertable aquifer of the area. Although the Bidahochi consists of three members, only the upper (Tbu) and lower (Tbl) members are present in the vicinity of the proposed alignment.

Upper Member: This upper member, which occurs in most of the area between the Puerco River and Carrizo Wash, is the most widespread of the three members. It consists of poorly cemented, fine-to-coarse-grained sandstone interbedded with claystone, siltstone and travertine. Thickness of this member varies because of widespread, late Cenozic erosion. On the bluffs along the Puerco River Valley it is 50 to 150 feet thick, and north of the Zuni River near State Route 61 it is as much as 400 feet thick.

Middle Volcanic Member: This member crops out at the Painted Desert Lookout but it is not known to be present in the area of the proposed alignment.

Lower Member: As shown on the geologic cross-section (Figure II-21), the northwestern half of the alignment will encounter this lower member. The lower member thins in a southeastward direction, from 160 feet at a location about eight miles south of Navajo to a featheredge 25 miles south of Navajo. Much of the material in this member is reworked material from the underlying Petrified Forest member of the Chinle formation. Thus, the lithology and color of the lower member is similar to that of the Petrified Forest member. The main mass of this lower member of the Bidahochi consists of banded, flat-lying beds of grayish-brown sandstone and of light-greenish-gray, pale-yellowish-brown and dark-reddish-brown mudstone and claystone. Most beds are weakly cemented, but a few are firmly cemented. This member was deposited in a lake during Pliocene time. Following the drainage of this lake in late Pliocene time, fluviatile (stream) sediments were deposited, thereby forming the upper member of the Bidahochi.

Chinle Formation (Triassic)

In the general area of the proposed alignment, the Petrified Forest member of the Chinle formation crops out in the valleys (Puerco River, Zuni River, Carrizo Wash and Hardscrabble Wash). It also crops out in the headwater areas of Milky Wash which have been eroded, from the west, into the highland areas. Although, as seen on the geologic map, only a small portion of the proposed alignment will be constructed on Chinle material, this formation is important in this study because of its unique scenic and engineering characteristics. The formation, consisting of a thick series of colorful, lenticular beds of claystone, siltstone, sandstone and conglomerate, forms the famous Painted Desert in the Petrified Forest National Monument, approximately 12 miles west of the proposed alignment. Many of the claystone units contain bentonite, which swells when wet and can cause disruption of highway surfaces. Well logs show a 1550-foot thickness of the formation in the Zuni River Valley near U.S. Highway 666.

The lower part of the Petrified Forest member which is grayish-blue to grayish-red-purple is more colorful than the upper part which, although of somewhat similar lithology, approaches a reddish-brown. The Soncela sandstone, which separated the upper and lower parts of the Petrified Forest member, is actually several sandstone beds separated by siltstone. The principal occurrence of the Sonsela along the proposed alignment is about 15 miles northeast of St. Johns where it is 70 feet thick and forms a prominent escarpment. Except for the volcanic rocks, the Soncela sandstone may be the hardest rock that occurs in the vicinity of the proposed alignment. The Sonsela, as well as the volcanic rocks, crops out in very limited areas.

The Moenkopi Formation (Triassic)

This formation, located below the Chinle, does not crop out along the proposed alignment. It is comprised of sandstone, mudstone, siltstone and conglomerate. Where present, it and the Chinle serve as a confining aquiclude above the Kaibab-Coconino artesian aquifer.

The Kaibab Limestone and Coconino Sandstone Formations (Permian)

These two formations, which occur at depth, do not crop out in the area. They form the principal aquifer system in the area. These formations are discussed further in the Hydrology section.

(d) Geologic Resources of Economic Value

Geologic resources of present or potential economic value found in the general area include: helium, salt, potash, coal, bentonitic clay, sand, gravel, stone, petroleum and uranium.

Helium

Helium is an inert gas with a wide variety of critical uses. All production of helium in Arizona is from the Pinta Dome, Navajo Springs and East Navajo Springs fields in Central Apache County. The proposed railroad alignment will pass through the northeast corner of the Pinta Dome field in the vicinity of Kerr-McGee wells, Section 35, Township 20 North, Range 26 East. A detailed map showing well locations in the helium fields is presented in Figure II-23. Producing zones are in the Shinarump member, the lower part of the Chinle formation, and in the Coconino sandstone.

Salt and Potash

The Supai salt basin, which covers an area of approximately 2300 square miles in central Navajo and Apache counties, underlies the entire length of the proposed alignment. The potash and salt which occur in the Supai (Permian) formation have been explored extensively by drilling and are of potential economic value as fertilizer or for other chemical uses.

Coal

Outliers of the vast San Juan coal basin of New Mexico extend into Arizona at several locations; the closest outlier, the Gallup-Zuni field, is approximately 20 miles northeast of the proposed Coronado Station. The Cretaceous subbituminous coal in this field is believed to be generally less than 30 inches thick.

Bentonitic Clay

Bentonite, a clay derived from volcanic ash or tuff, is mined in the Sander-Cheto area. This low-swelling bentonite has been mined for use in beauty preparations, refining and decolorizing mineral and edible oils, clay-pack filters, seed coatings, wool cleansers, etc. Approximately 90 percent of Arizona's production of bentonite has been mined from this district.

Other resources

Small deposits of uranium have been found in the Chinle formation at locations in the Little Colorado River Valley, south and west of the proposed Coronado Station. Although petroleum-impregnated rocks have been found at outcrops and in exploratory drill holes that have been drilled in the general area, no economic quantities have been found.

(e) Seismicity

The area of the proposed alignment is within a relatively tectonically stable part of the Colorado Plateau. There have been no earthquake epicenters of historical or instrumental record within a distance of approximately 50 miles. A map showing instrumented seismic occurrences is presented as Figure II-24. The nearest earthquakes had low intensity ratings of "less than 4.0" on the Modified Mercalli scale. An intensity of 4 on the Modified Mercalli Scale is defined as: "Hanging objects swing. Vibration like passing of heavy trucks; or sensation of a jolt like a heavy ball striking. Dishes, doors rattle. Glasses clink. Crockery clashes. In the upper range of 4, wooden walls and frames creak."

The seismic history implies a limited potential for damage to the railroad by seismic action.

(f) Paleontology

Among the several geologic formations which will be traversed by the proposed alignment, all except the Bidahochi and Chinle formations have negligible paleontological resources. These two formations are generally covered by younger formations along most of the alignment. Exposure occurs where erosion is active, for example along escarpments, on other steep slopes and in some valley areas. There are no known paleontological sites along the proposed route. The only known locality for Bidahochi fossils in the general area is at Graywater Wash, 6-½ miles east of Sanders on the south side of the Puerco River. Bidahochi fossil beds have been found north of the alignment on the Navajo Reservation. Important Chinle fossils occur outside of the area of the proposed alignment south of St. Johns in the Petrified Forest National Park and at locations along the Little Colorado River.

d. Water Resources

(1) Introduction

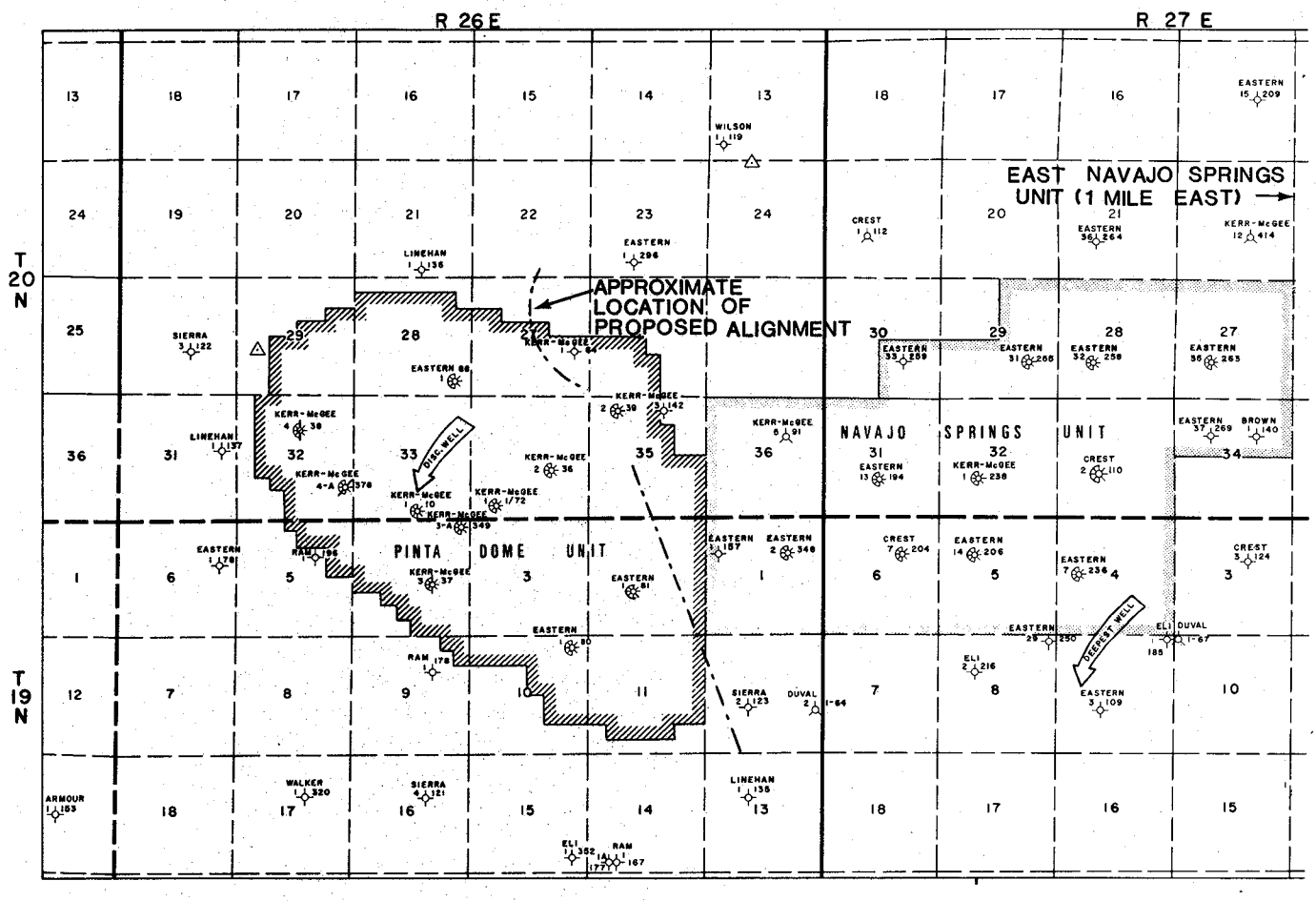
In the semi-arid project area, average annual precipitation is about 11 inches, lake evaporation about 55 inches and annual runoff from the land surface less than 0.1 inch. In such an area, the availability of surface and ground water of good quality exerts much control over the character of the natural environment and limits the extent of social and economic development.

(2) Surface Water

Surface-water conditions are discussed in terms of stream systems, surface-water quantity and surface-water quality.

Stream Systems

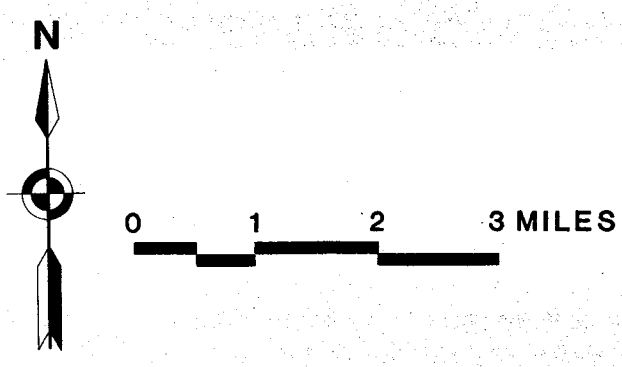
The area of the proposed alignment is in the east-central part of the Little Colorado River Basin. The main stem of the northwesterly flowing Little Colorado passes within five miles southwest of the proposed Coronado Station. Local watersheds are shown on Figure



WELL SYMBOLS

- LOCATION, DRILLING, OR WAITING ON COMPLETION
- HELIUM
- TEMPORARILY ABANDONED
- HELIUM PLUGGED
- DRY HOLE (PETROLEUM OR HELIUM)
- STRATIGRAPHIC OR MINERAL INFORMATION HOLE

OPERATOR'S NUMBER--1 88--IDENTIFICATION NUMBER



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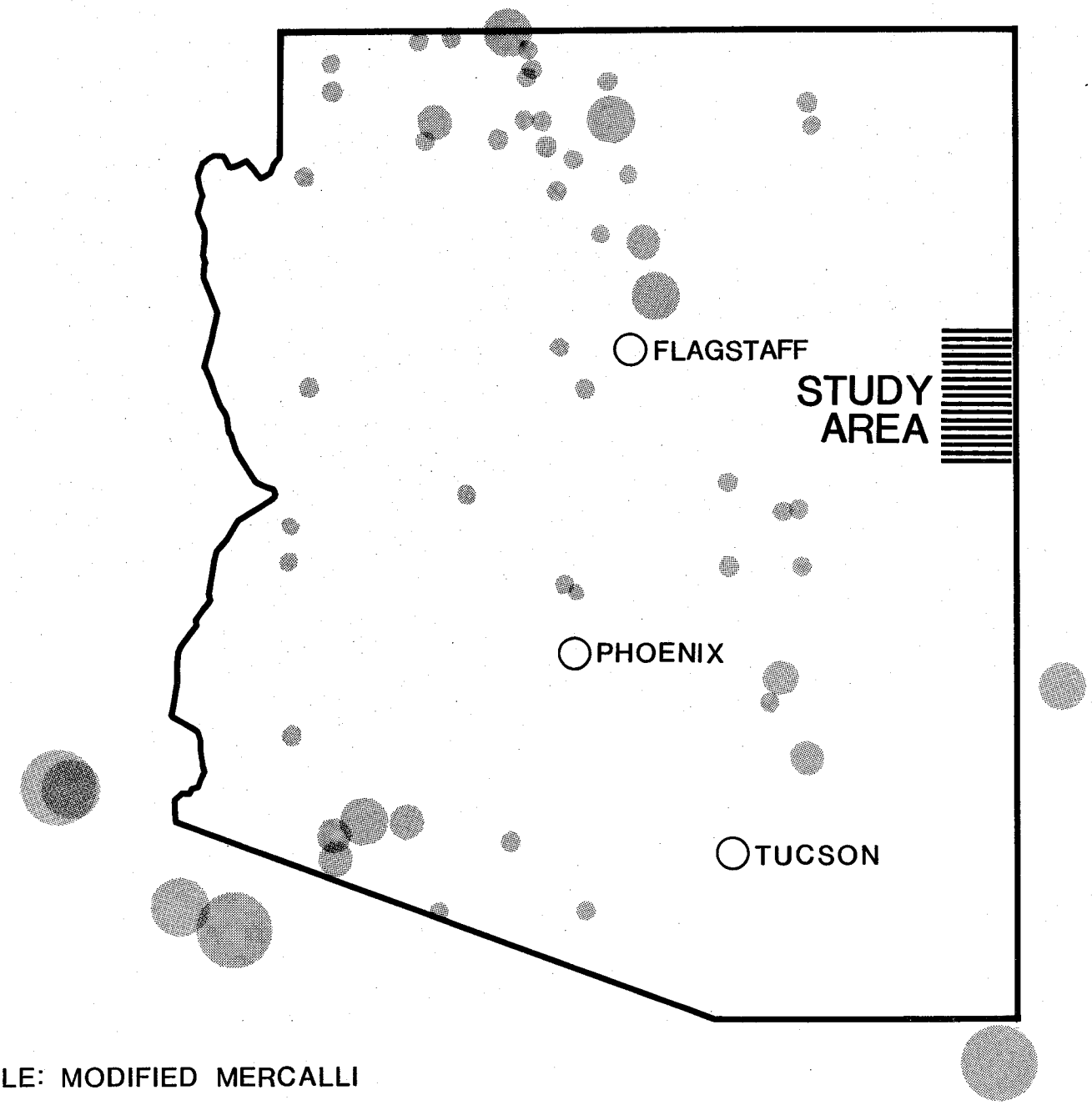
HELIUM GAS POOLS

Figure II-23

SOURCE: ARIZONA OIL & GAS CONSERVATION COMMISSION, 1974



SCALE: MODIFIED MERCALLI

M < 4.0

4.0≤M < 5.0

5.0≤M<6.0

6.0≤M<7.0

7.0≤M

EPICENTER LOCATIONS FROM ESSA, 1927-1973

SOURCE: FUGRO INC.

N

0 50 100 M LES

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INSTRUMENTED SEISMIC EPICENTER LOCATIONS

Figure II-24

II-25. Some of the small watershed areas outlined on Figure II-25 represent composite drainage areas of small streams that the alignment will cross. The principal streams that the proposed alignment will cross are tributaries of the Little Colorado: Carrizo Wash, Zuni River and Hardscrabble Wash, all shown in Figure II-25. Location of the watershed boundaries for these and other streams crossed by the alignment are presented in Table II-21. Table II-21 also includes descriptions of the drainage areas, estimated sediment yield, estimated runoff and flood discharges of these and smaller watersheds that the alignment will cross.

Runoff of the three principal streams flows in a generally southwesterly direction across the southern third of the proposed alignment. All three of these streams, Carrizo, Zuni and Hardscrabble, originate toward the northeast in New Mexico; their drainage areas are approximately 2190, 2270, and 270 square miles, respectively. The total watershed area upstream from the alignment is approximately 4820 square miles of which 4750 square miles are drained by the three principal streams.

As may be seen on Figure II-25 and Table II-21, streams that cross the northern two-thirds of the proposed alignment are small. Except for one of 25 square miles, each composite watershed area is less than five square miles. The majority of the numerous indiviudal streams within such composites have upstream watershed areas of less than one square mile. These streams are sparse, poorly defined and have very little runoff per unit area. There are three "closed basins" within the upstream watershed areas. These basins act as sinks that collect precipitation within their boundaries but contribute none of it to the surrounding watershed areas that drain across the alignment.

Surface-Water Quantity

Surface-water runoff varies with precipitation and with subsequent losses due to infiltration, evaporation and transpiration. Conditions along much of the alignment are particularly conducive to low runoff. Average annual runoff in the area is in the minimum range of less than 0.1 inches.

Estimated average annual runoffs across the proposed alignment at various locations are presented in Table II-21. Hardscrabble Wash, Zuni River and Carrizo Wash have, respectively, average annual runoffs of approximately 1600, 12,000 and 12,000 acre-feet, and 100-year flood discharges of about 17,500, 50,000 and 49,000 cubic feet per second (cfs). Other washes that the alignment will cross are small and have average annual runoffs of less than ten acre-feet. Because of low land-surface gradients and high soil permeability, the peak runoff from most storms for these streams is expected to be very small.

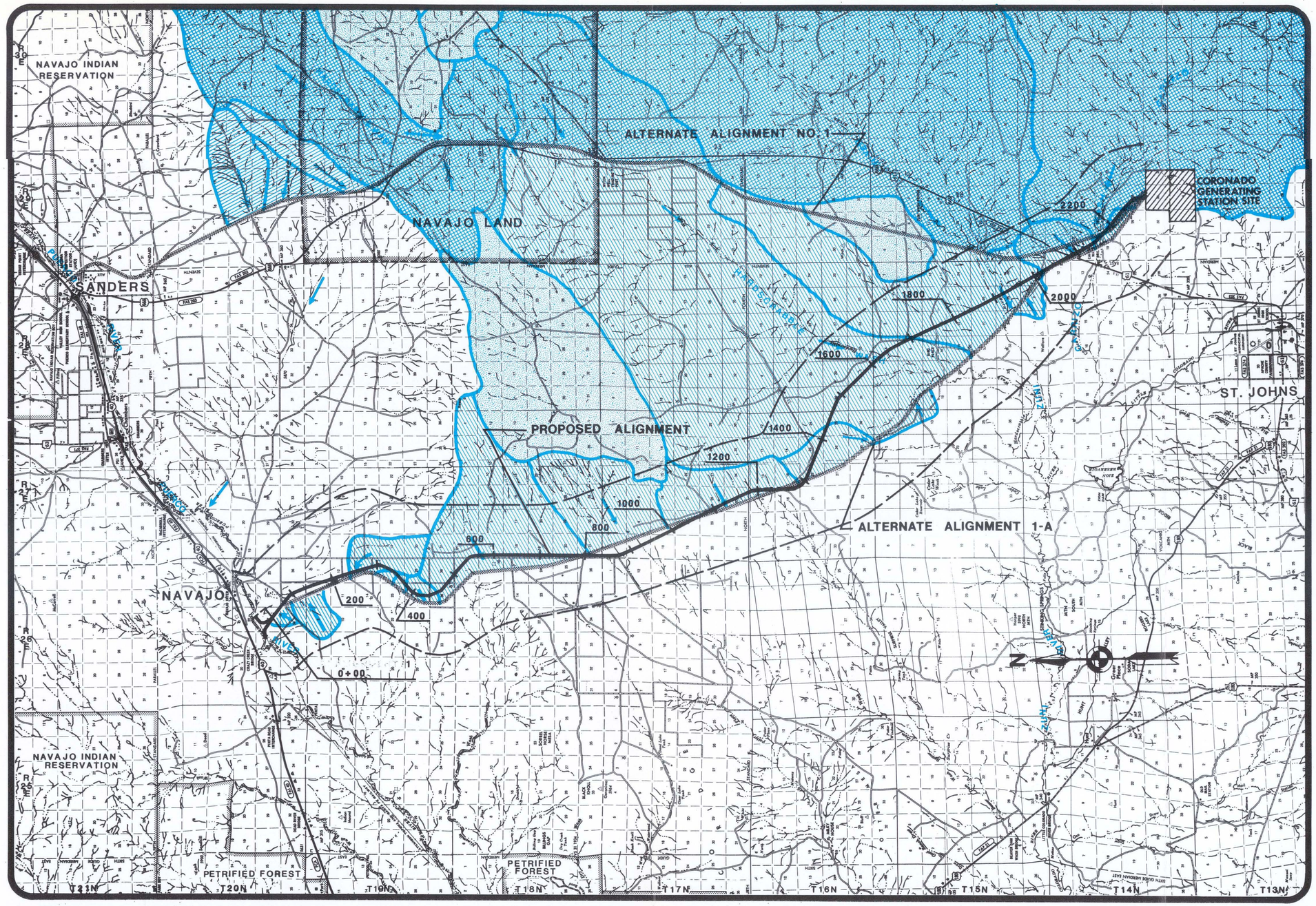
TABLE II-21

CHARACTERISTICS OF STREAMS THAT CROSS THE PROPOSED ALIGNMENT

Location (1000's of feet South of Navajo)	Name of Wash	Description	Drainage Area (mi^2) (Approx.)	Estimated Sediment Yield (af/yr)	Estimated Runoff (af/yr)	100-Year Flood Peak Discharge (cfs)
5		Two small washes cross route.	Distributary Channels			
10		Many small washes, which drain area to west, cross route.	0.4	1	2	-
15		Most of area to west drained by one wash that crosses route.	2.0	4	10	-
25		Flat land with many depressions; insignificant flow across route.	-	-	-	-
30		Most of area to east drained by one wash that crosses route. Slightly less than ½ of area is upstream of stock tank.	5.2	9	29	-
45		Many small washes which drain area to east cross route.	0.0	3	7	-
80		Few washes and some small washes which drain area to east cross route.	23	28	130	-
95		One wash and some smaller washes which drain area to east cross route.	15	18	75	-
125		Many small washes which drain area to east cross route. Very little depression storage in area.	11 (49 mi^2 upstream is a closed basin)	15	58	-
150		Few small washes which drain area to east cross route. Generally an insignificant amount of flow across route between stations 130 and 140. Some depression storage in area.	1.5	8	25*	-
175	Hardscrabble Wash	Most of area drained by Hardscrabble Wash; few small washes crossing route. Many depressions and some stock tanks in area. Hardscrabble Wash is at station 166.	290 (does not include closed basin of 22 mi^2)	200	1600*	17,500
185	Zuni River	Most of area drained by Zuni River and small wash to north. Many depressions & stock tanks in drainage area. Numerous levees in drainage area. Zuni River is at station 184.	2270 (does not include closed basin of 11 mi^2 & 6 mi^2)	190	12000*	50,000
210		Two washes with few small washes which drain area to east cross route.	4.3	7	23	-
210	Carrizo Wash	Area to east and south drained by Carrizo Wash which crosses route at station 210. Few depressions and stock tanks in area. Many levees in area.	2190	870	12000	49,000
225 (Coronada Gen. Station Site Boundary)		Few small washes but generally an insignificant amount of flow across route.	-	-	-	-

*Maximum - without consideration of upstream impoundment of runoff in depression and/or stock tanks.

Note: Values presented are approximate and not meant for use in design calculations.



WATERSHEDS FOR PROPOSED ALIGNMENT

WATERSHEDS FOR ALTERNATE ALIGNMENT

OVERLAPPING WATERSHEDS FOR BOTH ALIGNMENTS

CLOSED BASIN

DIRECTION OF FLOW

BASE MAP: ARIZONA HIGHWAY DEPT.

0 1 2 3 4 5 MILES

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WATERSHED AREAS

Figure II-25

Surface-Water Quality

Relatively little information is available on the surface-water quality of the streams in this area. Most of the individual streams are small and intermittent, with flow only for a short time after rains. The larger streams have been sampled by government water agencies only at infrequent intervals and at widely scattered locations. Chemical concentrations of local streams are generally low but sediment concentrations in some streams may be moderately high during periods of high flow.

Sediment Quality

On a regional basis sediment concentration and channel-deposition are major problems. Sediment concentrations in the Little Colorado River west of Winslow, downstream from the study area, are among the highest in the nation; peak concentrations of 200,000 parts per million have been measured by the U.S. Geological Survey. Sediment deposits tend to choke the river channel and increase flood potential. The Puerco River and the smaller streams that drain areas northwest of Holbrook are major contributors to the high sediment load, concentration and deposition in the Little Colorado River.

Except after larger storms, streams in the tableland areas of sandy soil are likely to have low concentrations of sediment because of low velocities and small discharges which are related to low gradients and high permeabilities. Highest concentrations may be generated in the small headwater areas of Badland soil adjacent to the tablelands where slopes and erosion are greatest.

Chemical Quality

Surface waters in the principal streams that the alignment will cross are generally of the calcium- and magnesium-sulfate and chloride types. These ionic constituents are probably derived from soluble gypsum and salt that are common in the region, especially in the Chinle and Moenkopi formations. Concentrations in all streams are likely to vary, with the highest concentrations in periods of low flow. The Little Colorado near St. Johns has a total dissolved solids concentration of less than 500 milligrams per liter (mg/l). Carrizo, Zuni and Hardscrabble washes are also expected to have low dissolved solids concentrations. No known analyses have been made of the water from the numerous intermittent streams that drain the tablelands. The sandy soils and Quaternary-Tertiary geologic formations of the tableland area appear to have little readily-soluble minerals. Therefore, chemical concentration of tableland streams is probably very low, perhaps a maximum of several hundred milligrams per liter.

(3) Ground Water

Although it may be neither abundant nor of good quality at all locations, ground water is the principal source of water in the general area of the proposed alignment. Ground water occurs under confined, or artesian, conditions in the Coconino-Kaibab formations; it occurs under unconfined, or water-table, conditions in stream-valley

alluvium, the Bidahochi formations, and, to a lesser extent, in other sedimentary strata (Figure II-21). Volcanic surface-rocks and Precambrian-basement rocks are not known to be productive in local areas. Generalized lithologic and water-bearing characteristics of sedimentary rocks within the central Apache County area are presented in Table II-20.

Ground water in the study area is contained, in various quantities and qualities, in the Kaibab-Coconino aquifer, the Moenkopi Formation, the Chinle Formation, Bidahochi Formation and Quaternary Alluvium (Figure II-21).

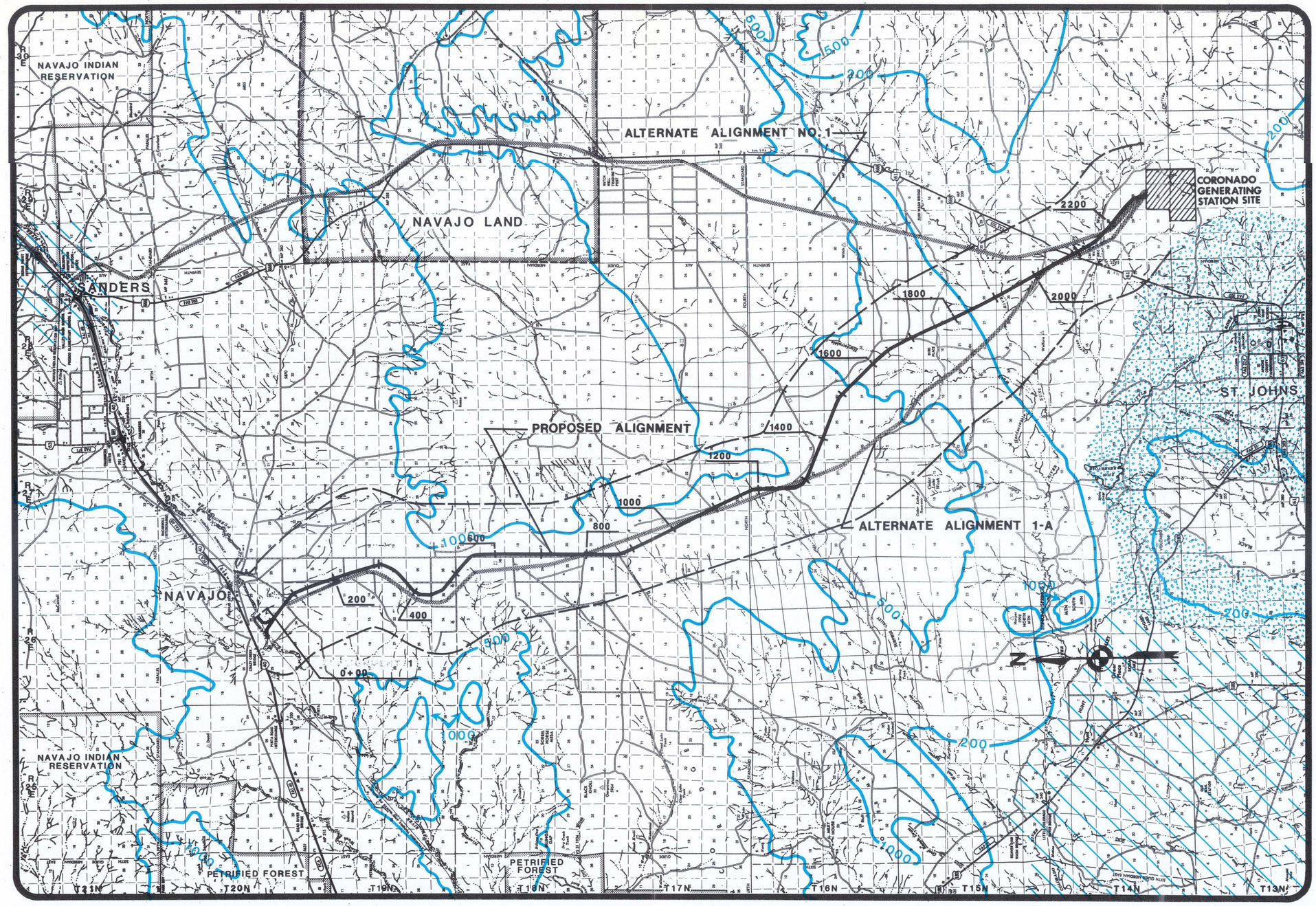
Kaibab-Coconino Aquifer

This aquifer consists of the Coconino Sandstone, which underlies the entire central Apache County area, and the overlying, hydraulically-connected Kaibab Limestone, which thins northwestward to a featheredge along a line that crosses the proposed alignment approximately at midpoint. The aquifer receives discharge in areas of high elevation to the south and southeast of the study area. Approximate depths to the piezometric or watertable pressure surface are shown on Figure II-26, depths generally increase to the northwest in the direction of the hydraulic gradient. Locally, as in the highland area east of the middle of the alignment, the depths are greater due to greater land-surface elevations.

Although the water-quality distribution varies, there is a general water quality deterioration in a down-gradient northwesterly direction. General zones of good, marginal, and poor quality water are shown on Figure II-26. Poor quality water, unsuitable for many uses, may occur along the entire proposed alignment. Wells near Navajo produce water of unusually poor quality with a total dissolved solids concentration of approximately 50,000 mg/l. This water is generally unsuitable in quality for irrigation of most crops and is found at depths that would require excessive pumping lift for most uses. Consequently, there has been little development of well-water supplies from the Coconino-Kaibab aquifer in areas near the proposed alignment. In this area of little development there is a corresponding lack of hydrologic information. Thus the maxium potential yield in this area is not known.

Wells in this aquifer south of the Little Colorado River yield from 400 to 1800 gallons per minute with the largest producers near St. Johns. These larger yields are in areas where fracturing is present or where the sandstone is poorly cemented. On the basis of available information it is questionable whether high yields of good quality would be available at locations along the proposed alignment, except perhaps at the southeast end.

Moenkopi Formation: Generally, only small yields of highly mineralized water have been found in the Moenkopi, which overlies the Coconino.



GOOD TO FAIR QUALITY

MARGINAL QUALITY

POOR QUALITY

-500- DEPTH TO WATER (FT.)

SOURCE: ARIZONA WATER COMMISSION, 1974

BASE MAP: ARIZONA HIGHWAY DEPT.

0 1 2 3 4 5 MILES

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DEPTH & QUALITY OF WATER

COCONINO-KAIBAB AQUIFER

Figure II-26

Chinle Formation: Because it contains claystone, mudstone and siltstone strata, the Chinle is relatively impermeable. It (and the Moenkopi, where present) forms the confining bed that overlies the Coconino-Kaibab aquifer. Only a few lenticular sandstone beds, mainly in the valley of the Puerco River, yield water to wells. These beds are the Shinarump member at the base, the Sonsela sandstone bed, and the upper part of the Petrified Forest member. Water in the Chinle is known to be of poor quality in the study area.

Bidahochi Formation: The Bidahochi, which has been removed by erosion in the principal stream valleys, occurs only in the tableland areas, where it contains water under water-table conditions. The approximate extent of the water-bearing zones and the depth to water in this formation are shown on Figure II-27. Existing wells yield 10 to 50 gallons per minute. The highest yields are from areas where the saturated zone is thickest; such thick saturated zones are present at low points in the topography of the surface upon which the Bidahochi was deposited. Because of the sparsity of wells, the maximum potential yield is not known.

Recharge to the Bidahochi is likely to be largely from downward infiltration of precipitation on the overlying land surfaces. The land surfaces appear to be highly permeable and to have a high infiltration capacity. The large surface areas that have interior drainage, shown as "closed basins" on Figure II-25, collect surface water and may be important areas of recharge to the Bidahochi. Water in the Bidahochi is generally of good quality with a total dissolved solids concentration of less than 500 parts per million.

Quaternary Alluvium: Both the quality and quantity of water in alluvial deposits along the principal streams of the area vary from place to place. Most known wells are less than 100 feet deep and yield from 50 to 200 gallons per minute. Yield varies with the thickness of the gravel and sand aquifer-zones which generally occur below poorly productive zones of finer-grained materials. Much higher than average yields may be available at certain fortuitous locations where permeability, thickness, storage and/or recharge conditions are unusually favorable. Quality of water is generally good. Poorer quality water tends to occur in the finer-grained materials in which circulation and related leaching are limited. Near-surface or shallow zones also may contain poor quality water due to the presence of residual evaporite salts.

e. Soils

Areal distribution of generalized soil types is shown on the Soils Map, Figure II-28. The southern third of the proposed alignment, which is generally in lowlands including the Carrizo, Zuni,

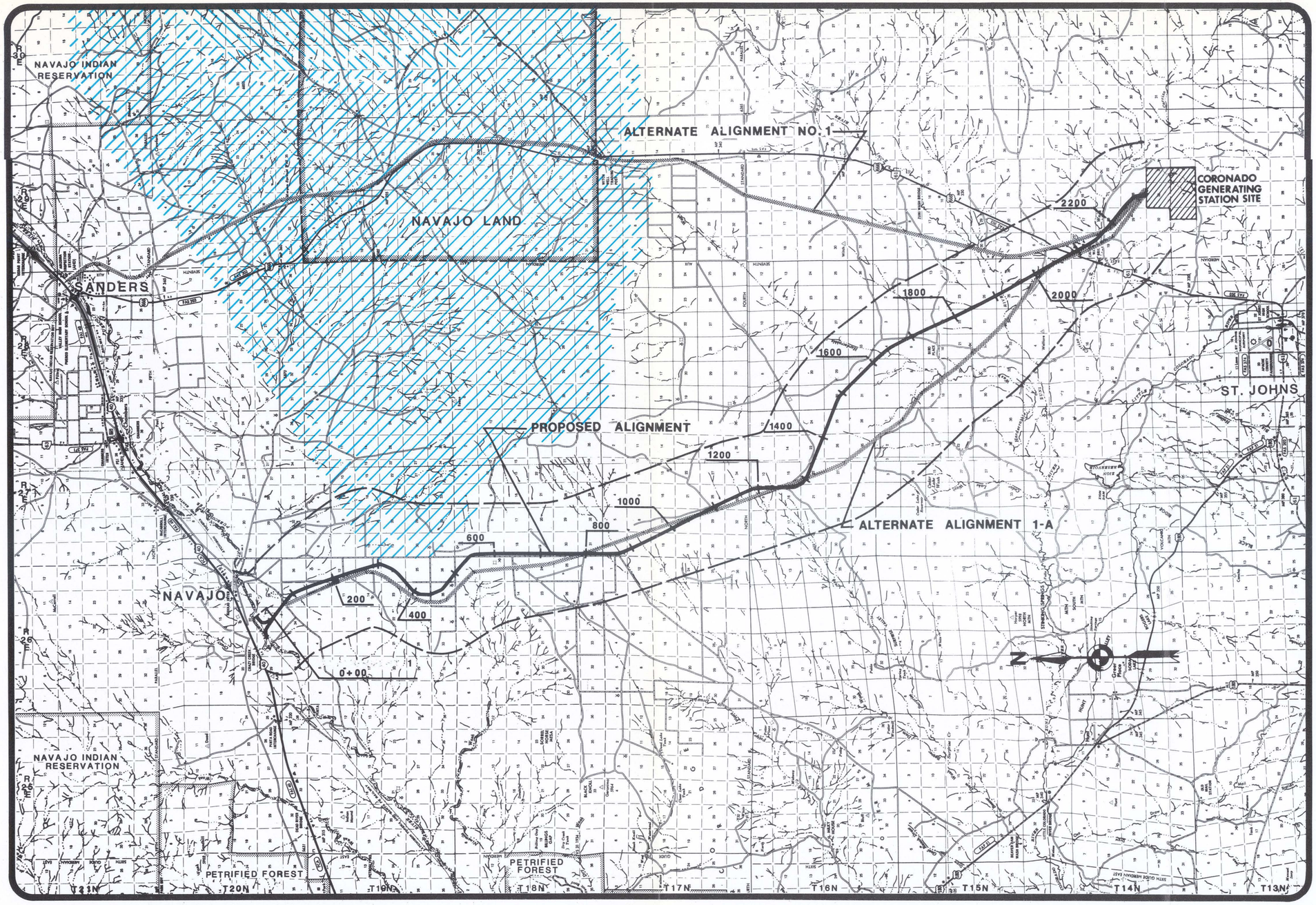
and Hardscrabble Valleys, will encounter soils which are generally finer-grained and more clayey than those which will be encountered along the northern two-thirds of the alignment which is generally in highlands or tablelands. Sandy soils are more prevalent in these northern areas.

There is a general correlation between soils and geology. The valley soils (deep, loamy, clayey or sandy soils on alluvium, Figure II-28), generally correlate with stream-valley alluvium and the Painted Desert member of the Chinle formation. This Painted Desert member, in addition to its scenic characteristics at other locations, is also noted for its tendency to expand when wet, and has caused buckling of highway surfaces. The more sandy tableland soils generally correlate with the Quaternary sediments and the Bidahochi Formation.

The revegetation potential of each of the identified soils types are not precisely known. However, it is believed that each soil has an inherent ability to accept revegetation to at least its native state. The key to successful revegetation usually depends on the availability of moisture.

The proposed alignment will either cross or be very near Badland and Eroded Land soil areas at several locations. In these areas erosion has deeply and irregularly incised the land surface. These Badland soils generally correlate in location with outcrops of the Bidahochi Formation around the edge of the tableland. Soils are subjected to natural erosion by water and wind. It is useful to consider magnitudes of natural erosion as a basis for estimating additional erosion and sediment production that might be induced by the proposed action. Natural erosion, in terms of annual sediment yield per square mile, for different local areas is shown on the Sediment Yield map, Figure II-29. Erosion in this area is largely a function of slope and the permeability and cohesiveness of the soils. Within the Little Colorado River Basin, annual sediment yields range from less than 0.2 to greater than 3.0 acre-feet per square mile. The minimum rates occur in the tableland areas where they typically correlate with the "loamy soils on sandy materials". Although these soils in the tablelands are typically loose (non-cohesive), they are relatively stable because high permeability and low surface gradients minimize volumes and rates of water flow. The maximum rates of sediment yield occur in high slope areas near the edge of the tablelands which typically correlate with the Badland and Eroded Land soils, and with outcrops of the Bidahochi and Chinle formations.

Soil transport by wind has been important through recent geologic time in the local area, as indicated by the presence of elongated sand dunes that parallel the prevailing southwest winds. Bare soil surfaces between grass and small plants are exposed to wind action. Therefore, high winds probably transport considerable quantities of soil particles. However, the principal aeolian features, the elongated dunes, are not mobile but have been arrested by vegetation.



< 500 FEET

> 500 FEET

ARIZONA WATER COMMISSION, 1974

BASE MAP: ARIZONA HIGHWAY DEPT.

0 1 2 3 4 5 MILES

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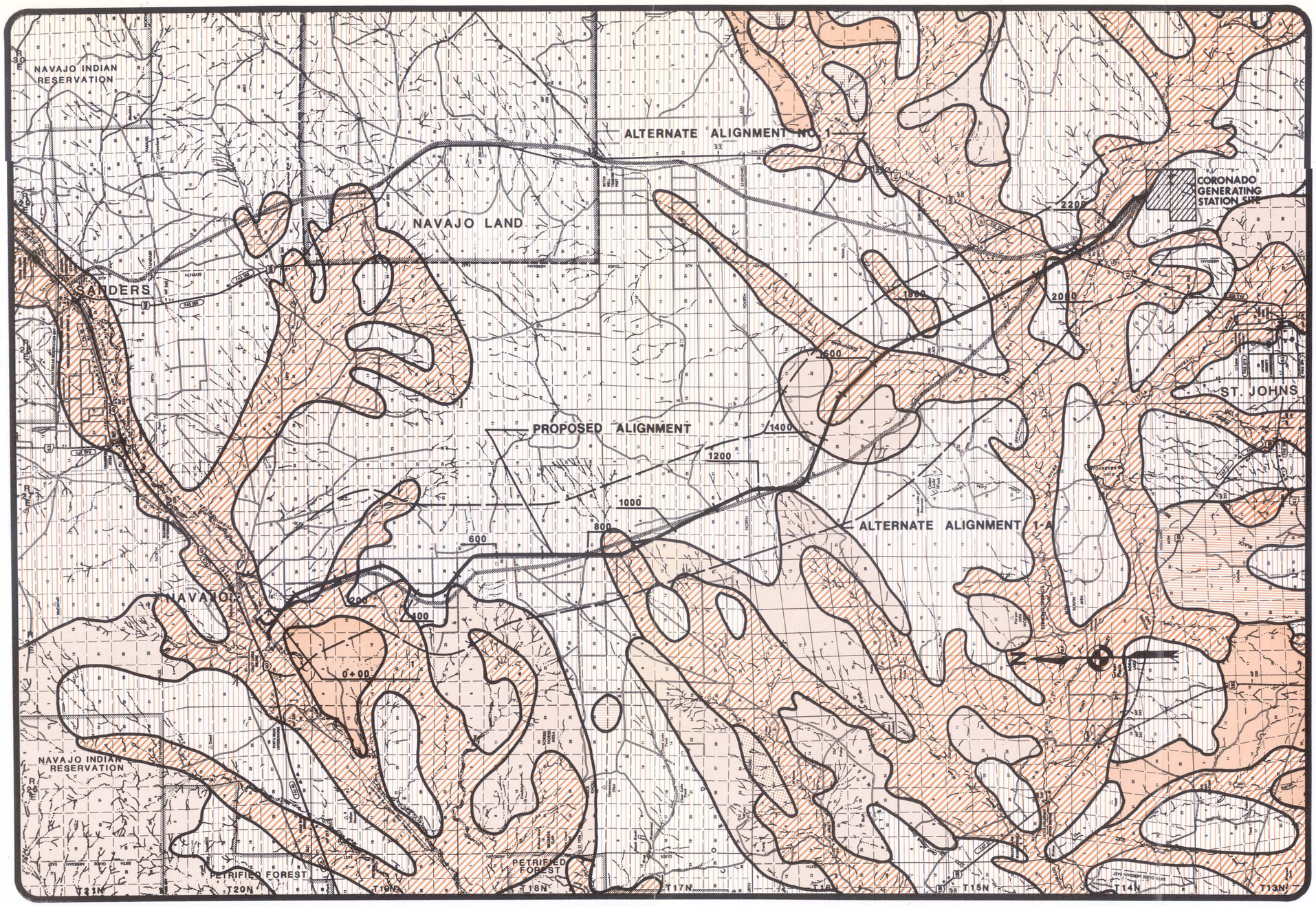
DEPTH OF WATER IN BIDAHOCHI FORMATION

Figure II-27



LOAMY SOILS ON SANDY MATERIALS

DEEP LOAMY, CLAYEY OR SANDY SOILS ON ALLUVIUM

SHALLOW LOAMY SOILS

VERY SHALLOW REDDISH SOILS

BADLAND

SAND SOILS AND ROCK OUTCROP

SOURCE: U.S. SOIL CONSERVATION SERVICE

BASE MAP: ARIZONA HIGHWAY DEPT.

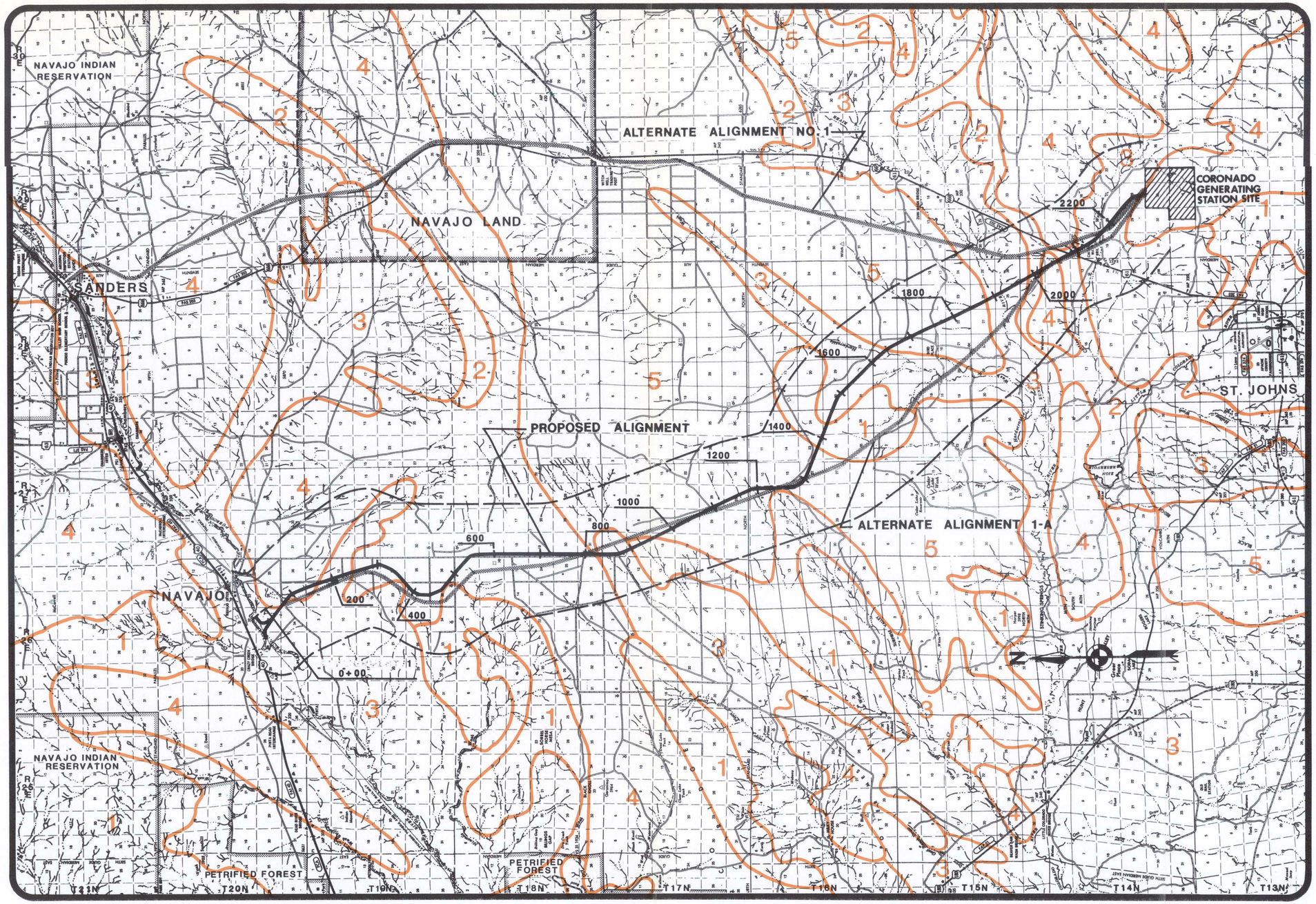
0 1 2 3 4 5 MILES

CORONADO PROJECT

Power Plant Spur Coal Haul Railroad

SOILS OF THE AREA

Figure II-28



1 > 3.0 ACRE-FEET/MI^2/YR
2 1-3
3 0.5-1.0
4 0.2-0.5
5 < 0-2

BASE MAP: ARIZONA HIGHWAY DEPT.

0 1 2 3 4 5 MILES

CORONADO PROJECT

Power Plant Spur Coal Haul Railroad

SEDIMENT YIELD

Figure II-29

Several closed basins with interior drainage, as shown on the map of watershed areas (Figure II-25), are among the more unusual topographic features of the area. These basins have interior drainage areas of as much as 49 square miles. They are generally oriented parallel to the direction of southwesterly prevailing wind, which indicates that they are probably caused by wind erosion and transport.

Surface water tends to transport eroded soils toward the southwest, whereas wind tends to transport them in the opposite direction, toward the northeast.

f. Acoustics

(1) General

The methodology used to quantify the impact due to railroad-induced noise consisted of first evaluating several aspects of sound, both separately and in combination. These aspects are the sound climate prior to railroad construction, contribution to the ambient sound by the construction and operation of the railroad, the population near the railroad, and, finally, the impact of the railroad-associated sounds on the population. The computation results in an equivalent population, P_{eq}, that represents the equivalent number of people that might be impacted by the sound emitted from railroad construction and operation. The population impact model which is used here was developed by the United States Environmental Protection Agency for evaluating the effect on public health and welfare of various noise-producing activities.

(2) Data Acquisition

Construction and operation of the proposed railroad will contribute to the existing sound levels in the area. In order to adequately describe the pre-construction and pre-operational sound levels along the proposed alignment, and assess impact, an ambient sound survey was conducted at the six locations shown in Figure II-30. Four of these locations, labeled 1, 2, 4 and 6, were selected to reflect the present sound climates in noise-sensitive land-use areas along the proposed alignment and alternate Alignment No. 1. Locations labeled 1, 2, 3 and 5 were selected as representative of alternate alignment No. 2.

DESCRIPTION OF ACOUSTICAL MEASUREMENT LOCATIONS

PROPOSED ALIGNMENT

Location	Description
1	Approximately two miles northeast of St. Johns, near a cemetery.

2 Approximately eight miles northwest of Coronado Generation Station.

4 Approximately 1.5 miles south of Navajo interchange.

6 At Blue Mesa Look-Out Point, Petrified Forest National Park.

Ambient sound level measurements were made at the above four locations on September 29th and 30th, and October 1, 1975, during the daytime (0700-1800 MST), evening (1800-2200 MST) and night-time (2200-0700 MST) hours.

(3) Existing Conditions

The results of analysis of measurements taken along the proposed alignment are described using the following nomenclature:

L_{90} - This is the sound level exceeded 90 percent of the time during the measurement period and is often used to represent the "residual" sound level.

L_{50} - This is the sound level exceeded 50 percent of the time during the measurement period and is used to represent the "median" sound level.

L_{10} - This is the sound level exceeded 10 percent of the time during the measurement period and is often used to represent the "intrusive". sound level.

L_{eq} - This is the equivalent steady sound level which provides an equal amount of acoustic energy as the time varying sound.

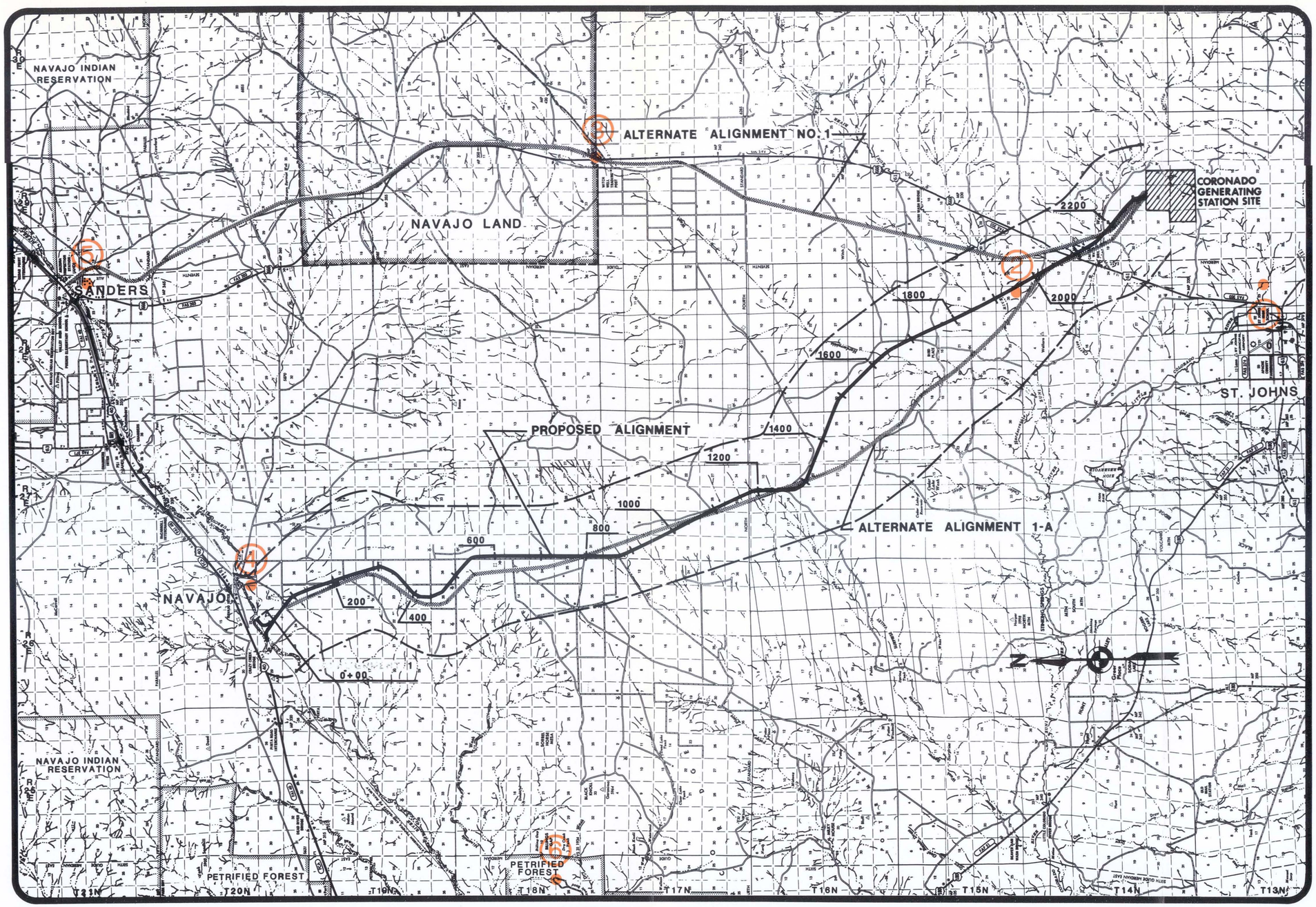
L_d - Equivalent sound level L_{eq}, for the daytime period (1700-2200) only. Time is Local Standard Time.

L_n - Equivalent sound level, L_{eq}, for the nighttime period (2200-0700) only. Time is Local Standard Time.

L_{dn} - Day/night equivalent sound level. Nighttime sound levels are increased by 10 db.

The observed data were used to calculate the equivalent sound levels for the daytime (0700-2200 MST) and nighttime (2200-0700 MST) periods. From these values of L_d and L_n, the daytime/ nighttime equivalent sound level (L_{dn}) was computed.

A summary of the statistical A-weighted sound levels, L_{90}, L_{10}, and L_{eq} for the measurement periods and L_d, L_n and L_{dn} at each location is presented in Table II-22. These data represent the background ambient sound levels along the proposed alignment and will be used in conjunction with sound levels of project activities to evaluate the effect on the acoustical environment.



	L_d	L_n	L_{dn}
1	32.4	23.5	32.8
2	33.4	21.7	32.8
3	53.7	52.0	58.7
4	42.9	34.7	43.7
5	47.7	33.5	46.6
6	48.4	-	-

● MEASUREMENT LOCATION

BASE MAP: ARIZONA HIGHWAY DEPT.

0 1 2 3 4 5 MILES

CORONADO PROJECT

Power Plant Spur Coal Haul Railroad

ACOUSTICAL MEASUREMENT LOCATIONS AND AMBIENT SOUND LEVEL SUMMARY (dBA)

Figure II-30

TABLE II-22

AMBIENT SOUND LEVEL SUMMARY
PROPOSED ALIGNMENT

	Location	Date	Time (MST)	L_{90}	L_{50}	L_{10}	L_{eq}
Daytime (0700-1800 MST)							
	1	9/30/75	0835	24	27	32	28.3
	2	9/30/75	1030	21	23	36	33.4
	4	9/30/75	1430	29	31	35	43.6
	6	9/30/75	1630	32	38	53	48.4
Evening (1800-2200MST)							
	1	9/29/75	2045	22	26	41	36.7
	2	-					
	4	9/30/75	2000	35	40	43	40.2
	6	-					
Nighttime (2200-0700MST)							
	1	9/29/75	2315	22	23	25	23.5
	2	10/01/75	0200	21	21	23	21.7
	4	9/30/75	2300	31	33	37	34.7
	6	-					
Equivalent Sound Levels			L_d	L_n	L_{dn}		
	1		32.4	23.5	32.8		
	2		33.4	21.7	32.8		
	4		42.9	34.7	43.7		
	6		48.4	-	-		

The sound level summary, L_d, L_n and L_{dn}, is also presented on Figure II-30 for each measurement location selected as representative of both the proposed alignment and the alternative alignment. Measurements made at Location 1 may be considered representative of the existing climate at the nearest potential residence to the southern termination point of the alignment. Ambient sound levels at this location were low during both the daytime and nighttime periods and were influenced mainly by vehicular traffic along highway 666; the L_{dn} for this location was 32.8 dB, well below the Federal Housing and Urban Development criteria (guideline) level of 45-65dB (L_{dn}) normally acceptable noise level for eight hour exposure.

Ambient sound levels at Location 2, which may be considered representative of an off-road rural environment, were also low. Major contributors to the existing sound levels include local cattle herds, infrequent vehicular traffic and occasional aircraft. The L_{dn} for this location was 32.8 dB. The sound levels at Locations 4 and 6 were higher than those recorded at 1 and 2. Location 4, which is south of the Navajo interchange approximately 1½ miles, had an L_{dn} of 43.7 dB, approximately 10 dB higher than either Location 1 or 2. Sound levels at these locations were generally attributed to local traffic and trains passing to the north on the AT&SF railroad. Day-night variation in the L_{eq} was approximately 8 dB. Location 6, which is situated on the eastern extremity of the public access at the Petrified Forest National Park, had the highest daytime L_{eq} of the four sites. No L_n or L_{dn} were obtained for this location since the Park is closed to the public after 6 pm. The L_d, however, was 48.4 dB.

Background ambient sound levels at locations along the proposed alignment were generally low; no location had sound levels which exceeded EPA guideline criteria. Daytime-nighttime sound levels varied by 8 to 10 dB; the maximum L_{dn} along the alignment was 43.7 dB and occurred at Location 4. The observed sound levels may be placed in perspective by referring to Table II-23 which lists typical sound levels encountered under various circumstances. For example, the greatest L_{50} observed was 40 dB at Location 4 in the evening hour. This corresponds approximately to the sound level heard in an average residence.

2. Biological Environment

a. Introduction

This discussion deals with existing biological communities and changes that have occurred in them over the recent past. Man's activities in the region have had considerable impact on the changing environment that the railroad will pass through. Implicit in the composition and distribution of biological communities are the community structure and the existing level of disturbance. Community distribution not only provides an inventory of the study area but allows a regional and historic evaluation of the dimensions of the community.

The community is a complex, dynamic, functioning unit composed of many diverse species populations with unique, interdependent niche requirements. Since a major part of the energy stored in a community involves only a small percentage of the populations, these major populations serve as controlling dominants in the community. Their obvious abundance and influence aid in assessing the ecological conditions and in determining community structure, function, and range. Since communities are composed of thousands of species, only key species are identified. The key species include the dominant vegetation (used in recognition and deletion of communities) and species whose niche requirements could possibly be affected by the proposed action. The species and habitats with special status presented include those with precarious futures in the area. The

TABLE II-23

TYPICAL A-WEIGHTED SOUND LEVELS
MEASURED WITH A SOUND-LEVEL METER

At a Given Distance From Noise Source	Decibels RE $20\mu N/m^2$	Environmental
	140	
50 HP Siren (100')		
	130	
Jet Takeoff (200')		
	120	
Riveting Machine Cutoff Saw Pneumatic Peen Hammer	110	Casting Shakeout Area
	100	Electric Furnace Area
Textile Weaving Plant Subway Train (20')	90	Boiler Room Printing Press Plant
Pneumatic Drill (50')		
	80	Tabulating Room Inside Sport Car (50 MPH)
Freight Train (100') Vacuum Cleaner (10') Speech (1')	70	
		Near Freeway (Auto Traffic)
	60	Large Store Accounting Office
Large Transformer (200')		Private Business Office
	50	Light Traffic (100') Average Residence
	40	Min Levels-Residential Areas In Chicago at Night
Soft Whisper (5')		
	30	Studio (Speech)
	20	Studio for Sound Pictures
	10	
Threshold for Hearing youths 1000-4000 HZ	0	

Source: Peterson and Gross, 1974.

ecological conditions of the communities were evaluated using biotic indicators, i.e., plant increasors (those that increase as ecological competition decreases) and plant invaders (those that invade areas reduced to lower successional stages).

b. Vegetation

The dominant vegetation used in delineating and naming the biotic communities (biomes) is represented by five distinct types: grasslands, juniper, sand sagebrush, badlands and riparian (woodlands). The grasslands occur on the deep sandy soils and give way to juniper on the shallower soils of steeper terrain and mesa tops. Sand sagebrush, on the loose alkali-free soils, is represented by finger-like projections and discontinuous islands that represent the southernmost extension of the Great Basin desert scrub (sagebrush) biome. The riparian communities are restricted to the drainageways where increased moisture produces a more mesic growing condition that supports ribbons of deciduous trees across the other communities.

Under pristine conditions the grasslands, dominated by blue grama and galleta grass, occupied the largest portion of the region and represents the subdominants and codominants of the sagebrush and juniper communities. The juniper was essentially limited to the rougher, shallow soil topography and the sand sagebrush was an ecotone (over-lapping community) of sand sage and grass. The major drainages supported an intermittent band of deciduous cottonwood trees that provided niche requirements for many resident or migrant species of animals.

For the past hundred years, man has impacted the area and brought about considerable change in the ecology. Cattle numbers have been high since the 1890's, and past over grazing by livestock has resulted in a deterioration of the ranges. The once almost pure stands of winterfat on the heavy alkaline-free soils have been virtually eliminated and replaced by snakeweed and rabbitbrush. The broad expanse of grass that once covered most of Navajo and Apache counties has become overrun with snakeweed and pinque. The decrease of range fires, due to modern controls and the depletion of dry grass fuel due to overgrazing, has allowed a steady invasion of juniper into the grasslands.

Overgrazing and drought in the sand sagebrush community has decreased the natural competition between sage and grass resulting in enlarging areas of almost pure stands of the unpalatable sand sage. Wood cutting, overgrazing, and the invasion of the exotic salt cedar have drastically reduced the quality and quantity of the riparian communities along the major drainages.

The general region is liberally supplied with state, county and private roads that make almost all areas accessible for public and private use, and, recently, land developers have established scattered "developments" with bulldozed grids.

The major biotic communities found in the general area and those occupying the corridor include juniper, grasslands, sagebrush, badlands and riparian. The distributions of these along the corridor are graphically depicted in Figure II-34. There are ecotone areas where communities overlay one another but these areas are included as portions of the community representing the dominant vegetation, i.e., grasslands with scattered or widely spaced juniper trees are considered grasslands. In the discussions of all communities, areas exhibiting several stages are not named as separate communities if they represent successional stages of the community. Figures II-31 to II-33 are a series of photographs showing different vegetation types along the proposed alignment.

(1) Juniper Community

The juniper community is characterized by the dominance of Utah juniper with an understory of blue grama, Arizona fesque, snakeweed and rabbitbrush. The juniper community is wide-ranging throughout the southwestern states and occupies approximately 25 percent of the corridor area (Figure II-34). Juniper stands in much of the corridor are typical of open savannahs and have an understory of grasses and shrubs. In the central portion of the corridor and on the rocky soil of the steep slopes, tree densities are greater and form a loose canopy. The juniper community in the plateau region is expanding its range into the grassland and sagebrush sites. The spread of this community is largely a result of land use.

(2) Grassland Community

The grassland community of this area is characteristically a short-grass prairie and is the southwesternmost extension of the grassland biome of the Great Plains. This community occupies a large part of northeastern Arizona and represents approximately 60 percent of the corridor area. The dominant vegetation includes blue grama, galleta, Indian rice grass, snakeweed and rabbitbrush. The grassland community in northeastern Arizona is diminishing in size due to the encroachment of juniper and the invasion of low-growing shrubs.

(3) Sagebrush Community

The dominant vegetation of the sagebrush community of the corridor area is sand sagebrush which is located on the level and rolling alkali-free deep sandy soils. The distinctive flora of this community include sand sagebrush, rabbitbrush and blue grama. Sand sagebrush is unpalatable to livestock, hence heavy grazing and drought that kill some of the associated grasses result in an increase in the density of the sand sagebrush and therefore an increase in size of the community.

(4) Riparian Community

The riparian community is a discontinuous ribbon of deciduous trees growing along the major drainageways (Figure II-34). The dominant vegetation includes cottonwood, salt cedar and seep willow (desert broom). This community crosses the other communities following the meanders of the Puerco River, Zuni River, Carrizo Wash and Hardscrabble Wash. It represents a vegetative life form with higher relief and denser understory than the communities it crosses, thus providing habitats (including migratory routes) for species that would not otherwise be present.

Riparian communities in arid and semi-arid regions represent only a small portion of the total land area yet play a vital ecological role in the floral and faunal diversity of the region. In Arizona it is a rapidly diminishing community that cannot be replaced. The decrease is attributed to several causes such as wood gatherers, overgrazing, channelization of drainages, phreatophite control, etc. In the area of the corridor much of the original cottonwood cover has been replaced by salt cedar and cottonwoods are now represented by isolated second growth stands.

c. Terrestial Biology

Animal life in the region has undergone considerable change in recent history as a result of man's influence in the area. Lieutenant Beale, after the Civil War, recorded elk, antelope, deer, beaver and coyotes in Cottonwood Wash in Navajo County. Today only an occassional coyote remains in this area which is now barren landscape with drifting sand. In the late 1880's bands of antelope ranging from 500 to 600 animals roamed the range in the Springerville area, and wolves, prairie dogs and eagles were common in the grassland of Apache County. The region once supported grizzly bear, wolves and black-footed ferrets that are now absent from the area. Antelope, prairie dogs and burrowing owls are still present but in greatly reduced numbers. The more dominant fauna, identified on a community basis, are:

(1) Juniper Community

Distinctive faunal species of this community include the mule deer, pinyon mouse, scrub jay and black-throated gray warbler.

(2) Grassland Community

Distinctive faunal species characteristic of this community include the horned lark, eastern and western meadowlark, savannah sparrow, spotted ground squirrel, antelope, pocket gopher and prairie rattlesnake.

(3) Sagebrush Community

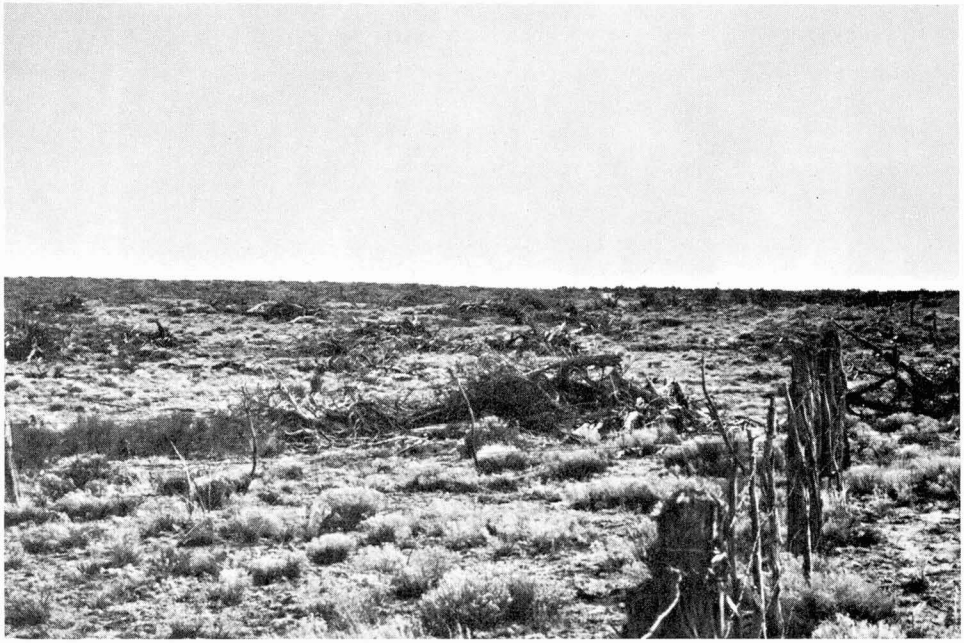
Distinctive fauna of this community include the sage thrasher, antelope, kangaroo rat and pocket mice.

(a) Railroad - View looking southerly across grassland at approach to Coronado Generating Station. Crane booms on horizon are at plant site.

(b) Railroad - View looking southeasterly at crossing of U.S. 666 and Railroad. Drainage in distance is Carrizo Wash.

RAILROAD ALIGNMENT - NEAR PLANT SITE

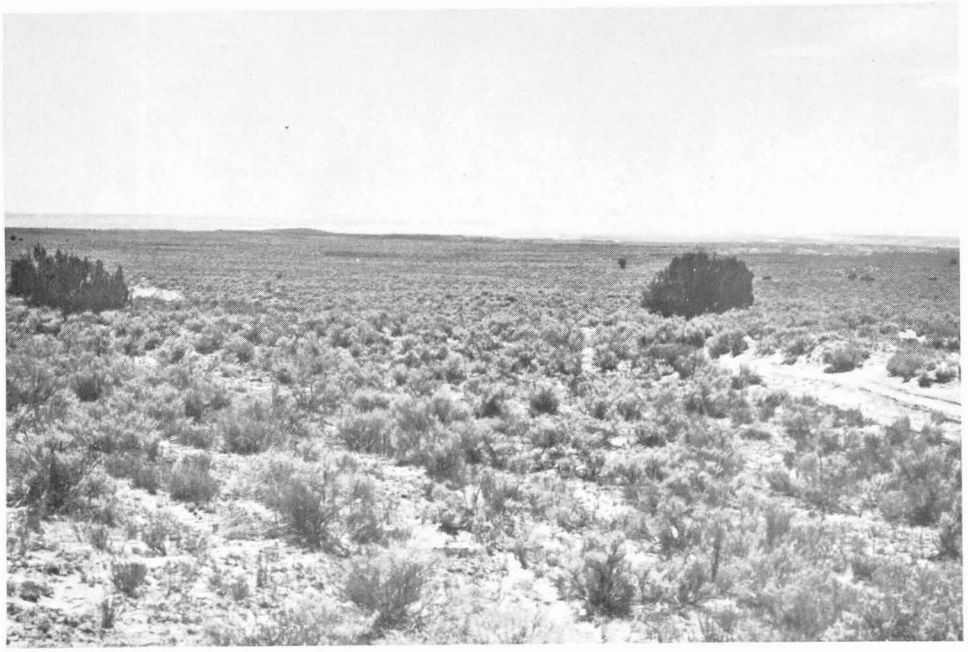
Figure II-31



Railroad - View looking southeasterly, south of Milky Wash. The Juniper has been chained down to improve range conditions.

RAILROAD ALIGNMENT - MILKY WASH

Figure II-32

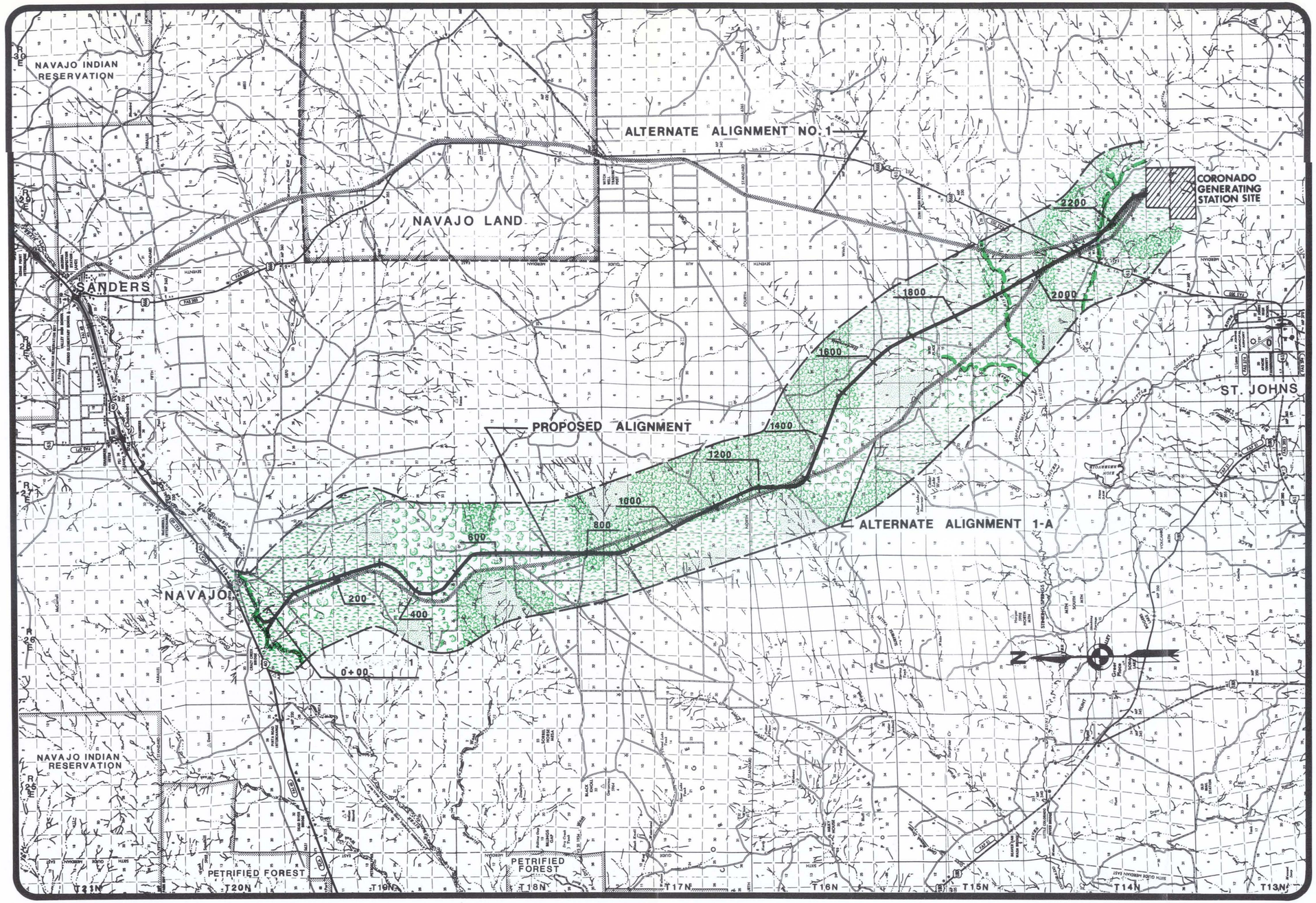


(a) Railroad - View looking southeasterly, south of Cottonwood Spring. Sand Sage in foreground.

(b) Railroad - View looking northerly near Cottonwood Spring. Sand Sage in foreground, Badlands beyond. Navajo faintly visible in distance in center of photo.

RAILROAD ALIGNMENT - NORTH END

Figure II-33



JUNIPER WOODLANDS

GRASSLANDS

SAGEBRUSH

BADLANDS

RIPARIAN

BASE MAP: ARIZONA HIGHWAY DEPT.

0 1 2 3 4 5 MILES

CORONADO PROJECT

Power Plant Spur Coal Haul Railroad

BIOTIC COMMUNITIES

Figure II-34

(4) Badlands Community

Characteristic fauna consist of low densities of horned larks, deer mice and northern grasshopper mice.

(5) Riparian Community

Distinctive fauna include the leopard frog, yellow-billed cuckoo, western flycatcher and phainopepla.

d. Threatened and Endangered Species

(1) Flora

Section II.B-1.3.C identified one species and seven genera of plants that are included on the U.S. Fish and Wildlife Service's proposed list of endangered plants and may also be found in the Colorado Plateau area. Two additional species, *Allonia cristata* (Four-o-clock Family) and *Pediocactus peeblesianus* variety *pleeblesianus* (Cactus family) are known to exist in the Joseph City and Holbrook area. There are no records of these species occuring in Apache County and it is doubtful that they appear in the corridor area.

(2) Fauna

Section II.B-1.3.C identified those endangered or threatened species known to exist in the Colorado Plateau area. The southern bald eagle was sighted during studies conducted for the generating station. This bird is also known to inhabit the nearby White Mountains. No sightings were made of the peregrine falcon during studies made for the railroad, but the falcon nests occasionally on cliffs throughout the state and is found statewide during migration.

The black-footed ferret and the grizzly bear are the only endangered mammals whose original range included the area of the corridor. The grizzly bear, formerly a statewide resident, is now believed to be extinct in Arizona. It is doubtful that the black-footed ferret presently occurs in Arizona. The last known siting of the species in the state was in 1929. It is normally associated with the prairie dog and, although no prairie dog towns were recorded in the corridor area, scattered colonies are known to occur in the general region. Though no ferrets have been sighted recently in Arizona, the Fish and Wildlife Service does not discount the possibility that they may still occur.

3. Social and Cultural Environment

a. Population and Socio-economic

The area for the proposed railroad contains little population. There are nineteen single family dwelling units within one-half to two miles of the proposed centerline. The area which could be impacted by railroad construction is the Navajo-Houck region, which is a sparsely inhabited area along Interstate 40. The population of the immediate area is estimated to be 500-600; the total population of the region estimated to be 1,100-1,200. The economic base of the region is primarily highway businesses and providing goods and services to the large Indian population nearby. Navajo has seven establishments including a motel with campgrounds, a cafe with a small grocery, a service station, and a post office. The estimated full-time employment is 37.

The area west of Navajo is virtually uninhabited for the 15 miles to the Petrified Forest National Park. The first settlement east of Navajo is Chambers, six miles away. Chambers has an estimated 54 employees in 13 establishments. Employers include a cafe, a motel, a service station, a post office, the U.S. Department of Public Health Dental Clinic, the County Highway Department, a trading post, a grocery store, and a beauty shop. Six miles east of Chambers is Sanders, the largest of the four settlements in this area. Establishments in Sanders are largely devoted to serving the needs of a local population. There are 26 establishments and an estimated 240 full-time employees. Ninety-one percent of the full-time employment is in three areas: wholesale trade (8%, Indian jewelry); general retail trade (12%, mostly groceries and gift shop items); and government (71%). Though there are seven governmental establishments, the biggest employers are the Puerco Schools, Valley High School, and two State of Arizona agencies--agricultural inspection and motor vehicles. Houck is 10 miles east of Sanders and has eight establishments with an estimated 50 full-time employees. Of the four communities, Houck is the only one on the Navajo Reservation. Except for the Arizona Silica Sand Company which has 11 full-time employees, establishments are service stations and trading posts which cater both to tourists and to the resident Indian population.

The Navajo-Houck area offers only the most basic goods and services to area residents. Therefore, the population is relatively mobile and must travel long distances to work and shop. Approximately one quarter of the Navajo-Houck area employees live more than 10 miles from their place of employment; a few live as far away as Holbrook and Gallup. Holbrook and Gallup also have the nearest shopping centers for area residents.

The Navajo-Sanders area is served by the Puerco District #18 which offers grade K8 on its Sanders campus and the Apache County Unified Union High School District #90 which accommodates grades 9-12 in its Valley High School in Sanders. The Puerco district staff has grown since 1973, not so much because of student increases but because of new programs and increased service. Student enrollment fluctuates widely and has actually declined from a high of 795 in the fall of 1975 to a

low of 705 in the fall of 1976. This fluctuation illustrates the movement of families in and out of the district. This fluctuation is also due to the large size of the district and the fact that a large portion of the student body lives on the Navajo Reservation. The annual Navajo Fair, the number of family and social occasions, and the hard-to-travel rural roads discourage regular attendance. The Puerco school does not have the classroom space to add teachers, but by increasing class size, up to 95 new students could be accommodated. This is the maximum increase and assumes students will be spread through Grades K-8.

Valley High School has added three new teachers since 1972 to accommodate an increase of 44 students between the fall of 1972 and October of 1976. As of the fall of 1974, Valley High School has been filled to capacity. The design capacity of this school was 200; however, the addition of metal buildings and temporary classrooms has brought the school up to its present capacity of 260 students.

b. Land Ownership and Use

(1) General

The proposed alignment originates at the Atcheson, Topeka & Santa Fe Railroad approximately 1.5 miles west of the town of Navajo, Arizona. The alignment is located entirely within Apache County and extends in a generally south to southeasterly direction for 43 miles to the Coronado Generating Station site. The dominant land use along the route is cattle grazing.

(2) Land Status

Major land ownership categories are shown on the Land Status Map (Figure II-35).

(a) U.S. Bureau of Land Management

National resource lands are managed by the Bureau of Land Management, U.S. Department of the Interior. Decisions regarding either present or future uses within these lands are made by, and the responsibility of, the BLM consistent with Federal laws, regulations and guidelines.

(b) State of Arizona

State Lands are jointly owned by all residents of the State of Arizona and managed by the Arizona State Land Department. Decisions regarding either present or future use of these lands are made by, and the responsibility of, the Arizona State Land Department subject to state laws, regulations and guidelines.

(c) Private Lands/Ranching

These are lands which are owned by private citizens, and presently used for cattle grazing and ranching activities.

(d) Private Lands/Ranching-LDS Church

These lands are owned by the Church of Jesus Christ of Latter-day Saints, and are primarily used for cattle grazing and ranching activities.

(e) Private Lands/Recorded Subdivisions

Three lands are under private ownership, the intended or actual use of which is their sale as subdivided parcels. Such properties are recorded as subdivision properties within Apache County and are presently for sale in parcels which generally average 40-80 acres in size.

(f) Private/Undeveloped Rural Lands

Lands which are privately owned but are not presently utilized for income-producing purposes. This is an Apache County land classification and such lands are taxed at the lowest rate based upon their lack of a designated use.

(3) Land Utilization

Existing land use in and adjacent to the proposed railroad corridor is presented in graphic (Land Utilization Map, Figure II-36) and tabular form (Land Use Inventory, Table II-24).

(a) Residential Facilities

Those residential structures which appear to be occupied or are capable of being occupied are included in this classification. Residential structures in remote locations often appear to receive seasonal rather than permanent use. Such homes, based on their capability for occupation, are included in this land-use classification. Corrals, hay storage buildings, or similar structures are therefore excluded.

(b) Helium Wells and Pipelines

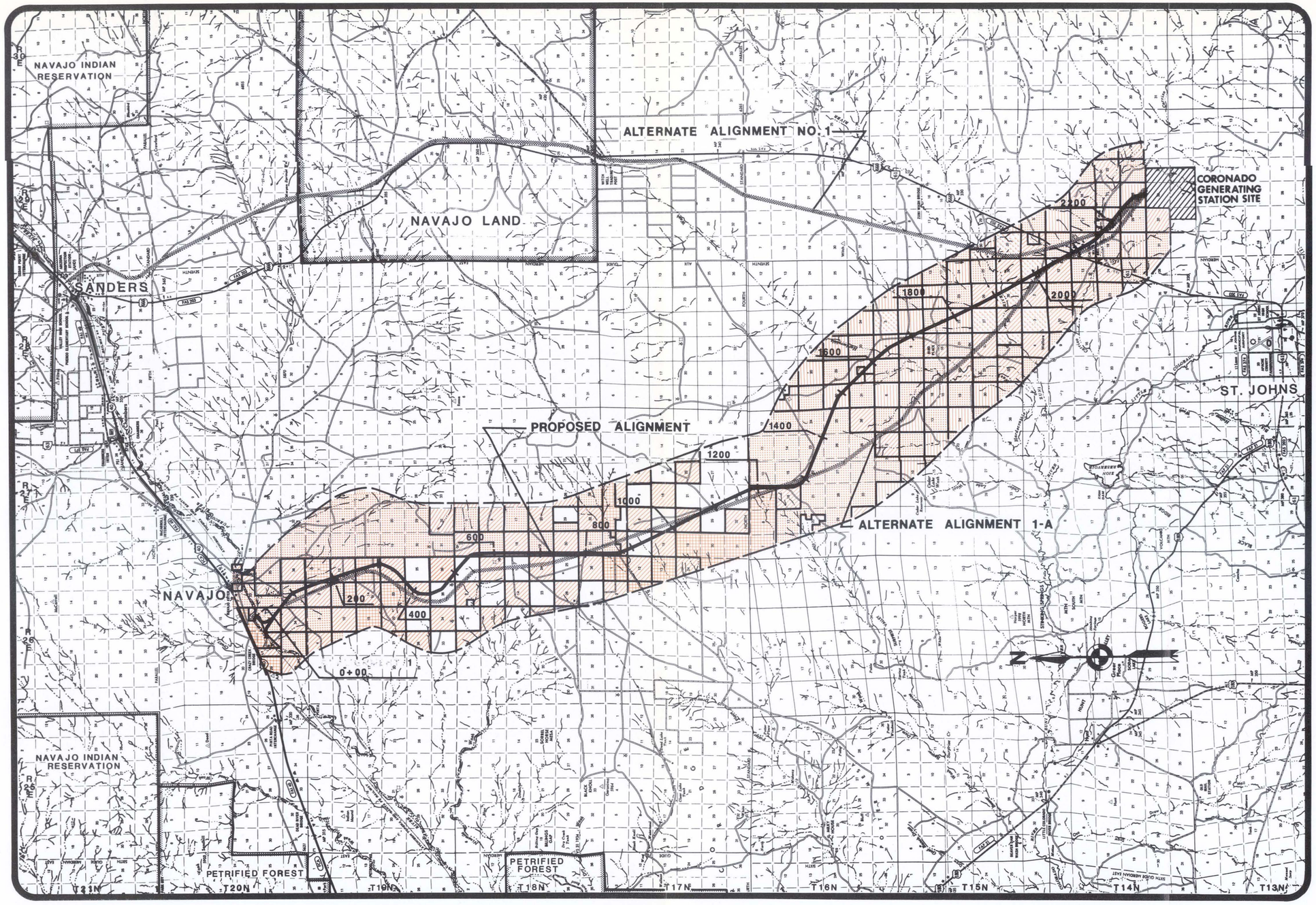
Several wells and pipelines in connection with a Kerr-McGee helium plant occur within the corridor.

(c) Access

Roads within the study area were classified in two categories: major thoroughfares, both Federal and state, were classified as "Highways", and those roads which provide local access (generally unpaved) were classified as "Secondary" or "Unimproved".

(4) Existing Conditions

Land status along the alignment exhibits a checkerboard pattern as alternate sections commonly vary in ownership. Of the approximately 43 miles of railroad route, 12.3 miles are located across state lands, 15.1 miles cross private ranching properties, seven miles are on recorded subdivision property, 1.7 miles of LDS church property is traversed, seven miles cross BLM lands, and one mile of undeveloped rural land is crossed.



U.S. BUREAU OF LAND MANAGEMENT

STATE OF ARIZONA

PRIVATE

RANCHING

RANCHING - L.D.S. CHURCH

UNDEVELOPED RURAL

RECORDED SUBDIVISION

BASE MAP: ARIZONA HIGHWAY DEPT.

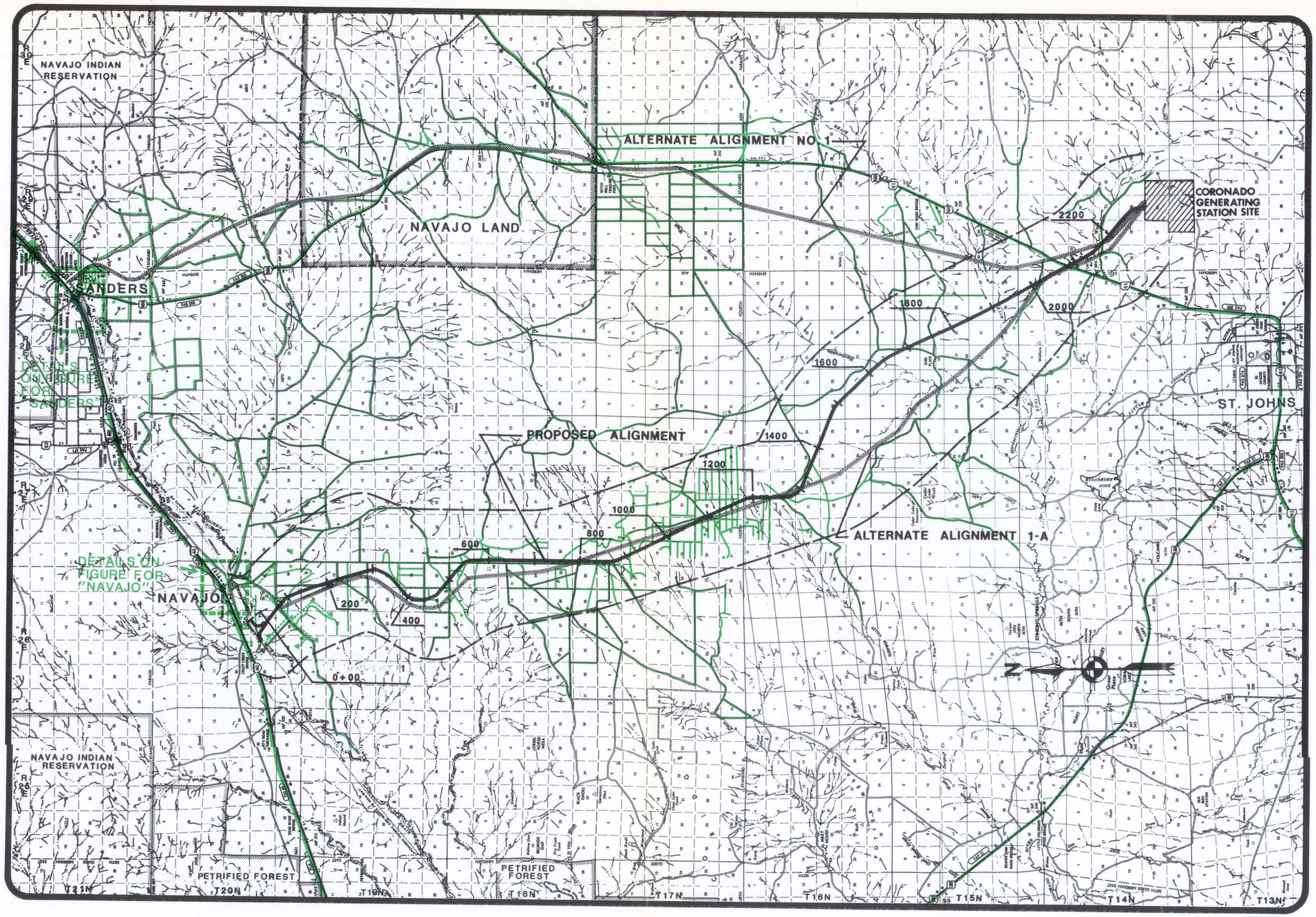
0 1 2 3 4 5 MILES

CORONADO PROJECT

Power Plant Spur Coal Haul Railroad

LAND STATUS

Figure II-35



FACILITIES

- RESIDENTIAL
- COMMERCIAL
- ROADSIDE REST AREAS
- HELIUM WELL
- HELIUM PIPELINE

ACCESS

- HIGHWAYS
- SECONDARY OR UNIMPROVED ROADS

BASE MAP: ARIZONA HIGHWAY DEPT.

0 1 2 3 4 5 MILES

CORONADO PROJECT

Power Plant Spur Coal Haul Railroad

LAND UTILIZATION

Figure II-36

NO TEXT ON THIS PAGE

NO TEXT ON THIS PAGE

Land-use development within the 4-mile wide corridor consists of: 20 single family dwellings, 11 helium wells and associated pipelines, one highway crossing and numerous dirt roads.

Navajo Area: Navajo is a small unincorporated town approximately 12 miles west of Sanders on Interstate Highway 40 (Figure II-36). The AT&SF Railroad is located along the southern edge of town. The proposed alignment extends south from the AT&SF Railroad at a point approximately 1.5 miles west of Navajo. Development south of the railroad at this point is sparse, and consists of a helium wellfield utilized by the Kerr-McGee Plant located in Navajo and two single family dwellings (Figure II-37).

Helium Wells and Pipelines: A Kerr-McGee helium plant is located within the town of Navajo. The northernmost three miles of the proposed alignment passes through a wellfield which supplies helium to the plant. Approximately ten helium wells and several gas-collection pipelines are within the railroad corridor. The helium wells are about 1000 feet deep, producing a non-flammable and odorless gas. The alignment will cross a collector pipeline at a point requiring excavation.

Big Valley Subdivision: The proposed alignment traverses approximately seven miles of recorded subdivision property. This property, Big Valley Ranches, consists of parcels with an average size of 40 acres. These subdivided lands are distributed in a checker-board pattern of mile-square parcels between Stations 40 and 115, mid-way in the corridor (Figure II-35). The majority of the single family residences within the corridor are in this subdivision. No electric or telephone service exists within the subdivision so each property owner must either drill a well or transport water. Future land sales and development within these subdivided areas is expected to be slow and of a seasonal, recreational-home nature.

Petrified Forest National Park: At its closest boundary, the National Park is slightly more than ten miles from the proposed alignment. It is not expected that the railroad will be visible from within the park. The area of the alignment closest to the park possesses an abundance of petrified wood on the ground. Arizona State Land Department personnel have pointed out that commercial removal of petrified wood would possibly become a matter of concern if access into the area is significantly upgraded.

Mining Exploration: A potential exists for commercial mining of potash along the proposed alignment. Mineral leases have been granted within State lands near Station 60 and several other locations.

Due to sparse development along the corridor, and the selection of a routing which avoids existing structures, no physical removal of residential dwellings or other facilities will occur.

TABLE II-24

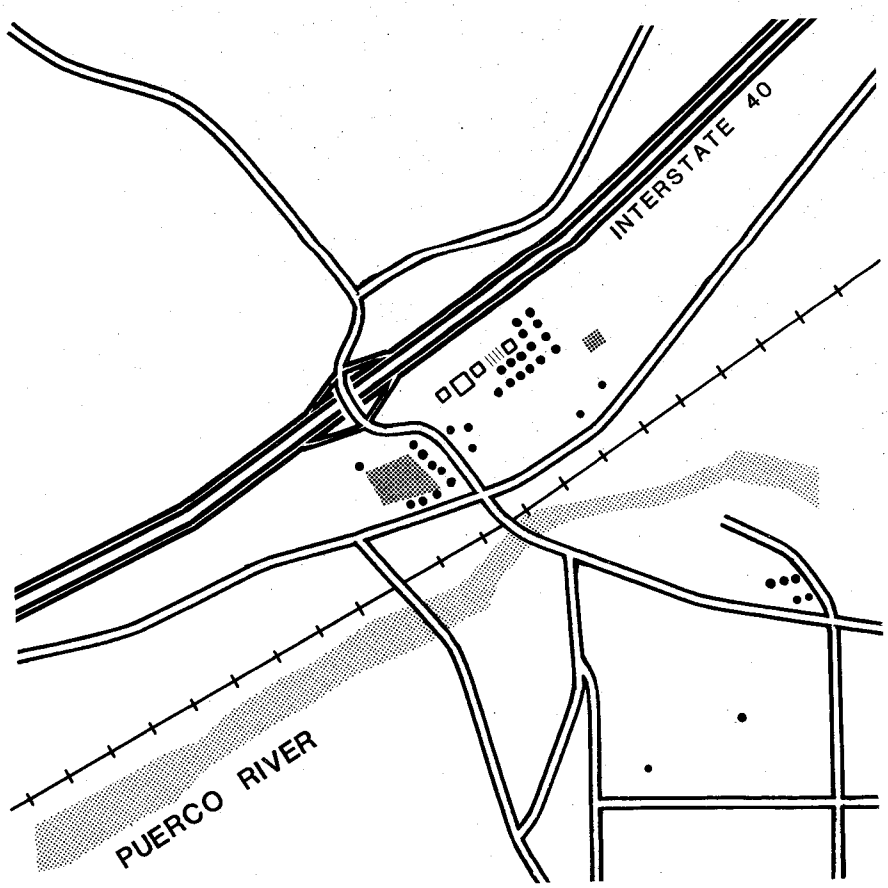
LAND USE INVENTORY SUMMARY - ALONG PROPOSED ALIGNMENT

Station[1]	Segment[2]	WEST 1-2 Miles	WEST ½-1 Mile	CENTERLINE 0-½ Mile	CENTERLINE 0-½ Mile	EAST ½-1 Mile	EAST 1-2 Miles
00-50	0-5(000)*		1 HW				
	5-10				1 HP 1 HW		2 SFD
	10-15	3 HW	1 HW		1 HW		
	15-20		1 HW	1 HW			1 HW
200-250	20-25						
	25-30						
	30-35						
	35-40	1 SFD					
400-450	40-45				(S)		
	45-50						
	50-55	1 SFD			(S)		
	55-60						
600-650	60-65		1 SFD				
	65-70						
	70-75		1 SFD				
	75-80	2 SFD					
800-850	80-85						
	85-90	2 SFD			(S) 1 SFD	1 SFD	
	90-95			1 SFD		1 SFD	
	95-100				(S)		2 SFD
1000-1050	100-105						
	105-110	1 SFD			(S)		
	110-115	1 SFD					
	115-120						
1200-1250	120-125						
	125-130			1 SFD			
	130-135						
	135-140						
1400-1450	140-145						
	145-150						
	150-155						
	155-160						
1600-1650	160-165						
	165-170						
	170-175						
	175-180						
1800-1850	180-185						
	185-190						
	190-195	1 SFD			H		
	195-200						
2000-2050	200-205						
	205-210						
	210-215						
	215-220						
2200-2250	220-225						
	225-230						
	TOTALS	3 HW 9 SFD	3 HW 2 SFD	1 HW 2 SFD	1 HP 2 HW 1 H 1 SFD (S)=32,000'	2 SFD	1 HW 4 SFD

Legend

H	Highway	HP	Helium Pipeline
SFD	Single Family Dwellings	HW	Helium Well
		(S)	Subdivision crossed

[1]Stations (Engineering Stations) in hundreds of feet starting from the junction of the easterly branch of the wye with the AT&SF main line at Navajo siding.
[2]Segments, as used for the Environmental Studies, are 5000-foot lengths (final three zeros omitted) starting at the junction of the easterly branch of the wye with the AT&SF main line at Navajo siding.



● RESIDENTIAL
□ COMMERCIAL
PUBLIC OR INSTITUTIONAL
INDUSTRIAL
= ACCESS

N

CORONADO PROJECT

Power Plant Spur Coal Haul Railroad

LAND UTILIZATION NAVAJO

Figure II-37

Those impacts which will occur relate most directly to cattle ranching activity. Grading which will be required in construction of the railroad bed is expected to physically disturb approximately 550 acres of vegetation presently utilized as cattle forage. This disturbance will occur in a linear pattern along the entire alignment and can be translated into a physical reduction in available forage sufficient for seven to eight head of cattle. This impact would be mitigated by revegetation of disturbed areas with appropriate forage grasses upon completion of construction. Another impact which could occur would be the collision of the train with cattle. As it is not known at present whether the right-of-way will be fenced, no assessment was made of this potential impact.

Several types of disruptive impacts are expected to result from construction of the railroad along alternate 1A as follows:

Access Disruption: Interruption of existing access may occur where the railroad crosses U.S. Highway 666 and where rural dirt roads will be crossed in areas of railroad excavation or earth fills. Interruption of rural dirt roads was considered to have a disruptive impact on ranching as they provide access for such activities as hauling winter feed to remote grazing areas, checking water facilities (such as windmills) and checking on the status of the stock in general. Where such existing roads are located in areas designated for excavation or earth filling, access would be cut off. This impact will be mitigated through the construction of revised road routings which will accommodate continued access. Similar disruptive impacts on existing access are expected where the alignment crosses roads presently used in connection with subdivided lands.

Property Severance: Construction of this alternate will result in division of ranch properties and subdivided lands. The disruptive impacts were not felt to be high in areas of recorded subdivision where no roads are crossed, but are somewhat higher where roads or existing residences would be altered.

Disruption of Kerr-McGee Helium Pipeline: A helium gas line will be crossed during construction of the northern portion of the alignment. It will be necessary to either reroute or otherwise accommodate the crossing of this facility.

Visual Impacts: Limitation/modification impacts would occur where construction of a railroad within the alternate I would alter scenic conditions on which existing or planned land uses depend. Those land uses along the alignment which were considered to be subject to visual impact were: Interstate Highway 40, U.S. Highway 666, existing residences within the corridor and, to some extent, subdivided lands. In these instances, physical modification of both landforms and vegetation resulting from construction of the railroad bed would detract from the scenic setting or views associated with the uses and therefore constitute a change in or impact to, the environmental condition.

Highways: The primary consideration of visual impact on highway views involved the anticipated level of adverse effect that a railroad could potentially have. It is felt that a railroad is not, in itself, a feature that conflicts with highway views. This is especially true within the study area because of its essentially flat character within which extensive alteration of land forms to accommodate a railroad would not be required. Furthermore, a railroad is a facility much like a highway in that both respect topographic limitations, and therefore where both facilities traverse an area their routes tend to follow a similar course. The significance of this similarity results from the fact that most viewed from the highway toward areas of railroad disturbance are from an equal visual plane (which limits visibility); such disturbances are generally no more visually disruptive than is the highway itself.

An exception to this statement occurs where the railroad would cross U.S. Highway 666. In this instance disturbances resulting from construction activity would be viewed from close distances, and some visual impact would result. In the Interstate 40 area the railroad is routed perpendicular to the highway, the effect of which would be similar to that of a highway crossing.

Impacts Due to Visual Discontinuity: Impacts due to visual discontinuity were assigned to each 5000-foot segment along the alignment in which the railroad would be exposed to existing or planned residential structures. Impact values were based upon the number of residences affected and their distance from the alignment. However, as so few residences occur along the alignment, impact assessments normally were made relative to a single residence. In these areas the impact is considered to be long-term in spite of the relatively small number of residences affected. Additionally, subdivided lands were considered to be potentially sensitive to visual impact, however, due to the speculative nature of future development low minus impact values were assigned to these areas.

c. Archeological and Historical Resources

(1) Archeological Resources

(a) General

An archeological research program, including archival and library investigation, field reconnaissance and an intensive survey, was carried out between May, 1976 and September, 1976. Published literature was consulted and site files at the Arizona State Museum and the Museum of Northern Arizona were examined. Reconnaissance surveys were done along segments of this route, and additional sites were recorded during the location of soil test pits and bore holes. An intensive survey was done of the entire route, approximately 42.5 miles in length from the plant site at St. Johns to the AT&SF railroad near Navajo, Arizona. The purpose of this intensive survey was to identify and record all archeological sites located within the proposed right-of-way.

(b) Existing Conditions

The cultural history of the study areas, from prehistoric to historic times, is depicted graphically in figure II-38. This information is provided as an identification of cultures that have been associated with occupation and use of the area.

Archeologists from the Museum of Northern Arizona conducted an intensive survey of the entire 48 miles of the preferred railroad route. A total of 55 archeological sites were recorded, 47 of which are located wholly or partially within the right-of-way. In addition to descriptions of each of these sites, recommendations concerning further mitigation -- avoidance, protection or recovery -- were made.

Most of the sites located along the railroad route range in age from the Basketmaker II to the Pueblo III period of the Cibola Anasazi tradition, and in type from small surficial scatters to large habitation complexes. Several of the sites found along the northern end of the route appear to be associated with the Kayenta Anasazi tradition.

Several of the sites along the proposed railroad are light artifact scatters which are surficial in nature. They are characterized by scattered sherds and/or chipped stone and occasionally ground stone. They may represent locations of tool manufacture, food processing, or camp sites. These sites are reflective of an important element in an over-all subsistence system, the hunting and gathering of wild biotic resources. Study of these sites can provide data on scheduling of seasonal activities, techniques used in food collecting and preparation, or types of wild food utilized. They are also important within the larger context of the interpretation of regional patterning of sites through time.

Many of the sites in the northern portion of the railroad consist of scatters of artifacts associated with small masonry structures or pit houses. These probably represent temporarily occupied sites associated with agricultural activities. These sites range in age from Pueblo I to the Pueblo III period and could provide data about the agricultural potential and utilization of the area with associated information about agricultural technology.

A fairly large number of habitation sites were recorded along the proposed railroad. These sites are characterized by a heavy concentration of artifacts and some evidence of structures such as pit houses or masonry units. Some sites appear to be fairly small with evidence of only a few structures while others are quite extensive with numberous separate room blocks, depressions, and heavy trash deposits. A few are possible habitation sites, even though no structures are surficially evident. These conditions are due to a heavy artifact concentration or location within a sand dune where much of the site could be buried.

Through contacts with the State of Arizona Historic Preservation Officer it was determined that no sites located along the preferred route are listed on or nominated to the National or State Registers of Historic Places.

One area, the Cottonwood Seep Archeological District, located on state and private land, has been recommended for consideration for nomination to the National Register of Historic Places. This District, composed of about eight sites, is very extensive in size and quantity of material. One site extends along a ridge for about 0.25 mile. A large number of masonry units, circular depressions, and a very heavy concentration of artifactual material indicate a relatively lengthy occupation, primarily in the Pueblo I period. The site is located above a highly eroded badlands area along with numerous, somewhat smaller sites which are centered around a spring. The sites of the area generally date from the Basketmaker III to Pueblo III periods. This area appears to have been very intensively occupied during this time, since large sites are very closely spaced for a good distance around the spring. Although this one large site is eroding around the periphery, it is, at present, generally undisturbed and appears to have the least erosional damage of all the sites observed in the immediate area. This district is believed to represent an important source of information concerning the prehistory of this area and will therefore be suggested for nomination to the National Register of Historic Places.

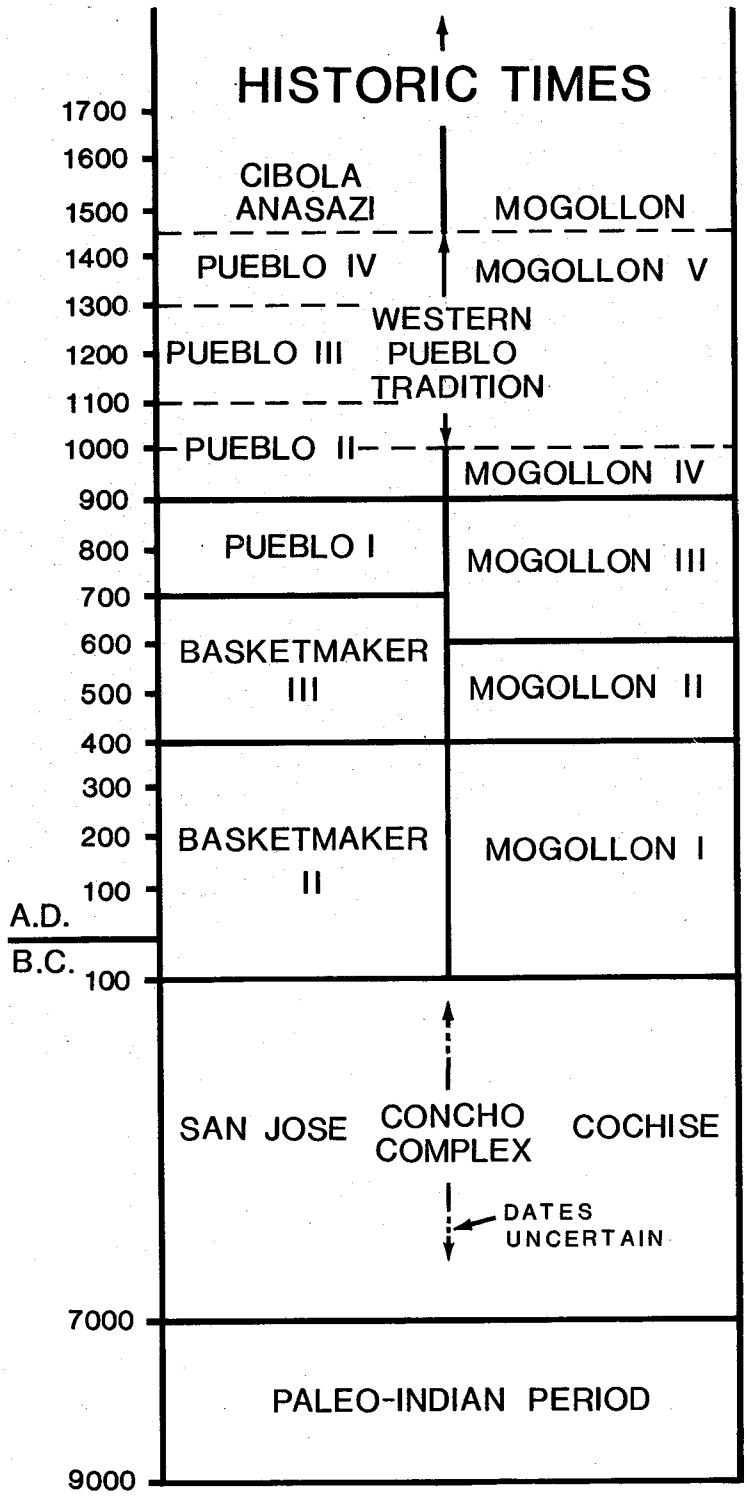
(2) Historic Resources

(a) General

Earlier studies by Salt River Project in connection with the siting of the Coronado Generating Station have identified the region's major historic events and sites. These are discussed in Section II.B-1.4.f. of this environmental statement. This section concentrates in detail on the proposed alignment for manifestations of occupancy during the historic period, and on evaluation of the significance of these sites.

Inventory of the alignment was accomplished through literature and archival research, site reconnaissance and interviews with local inhabitants. Information was obtained from the Arizona Historical Society's library and collections, the General Land Office records of the Bureau of Land Management, the County Land Records in St. Johns, the Apache County Historical Society in St. Johns and from the general records on Arizona history. The literature and archival research resulted in overviews of the history of the region and of the study area.

A site reconnaissance was conducted within the corridor, and examinations of the most promising sites were made for signs of historic occupancy. Each site was checked against land records and other sources. In addition, local interviews were made, and the resulting information checked against the record materials.



CORONADO PROJECT

Power Plant Spur Coal Haul Railroad

GENERALIZED CULTURAL HISTORY OF STUDY AREA

Figure II-38

(b) Existing Conditions

Historic Sites: Five sites were identified in the inventory of the proposed alignment. It is the policy of the Bureau of Reclamation not to make public the location of these sites, in order to discourage vandalism and destruction by souvenir seekers. Exact locations of these sites will be made to appropriate State and Federal authorities who are mandated to protect them.

Cedar Post House: This small house of jacal construction is reported to have been built by squatters around 1900, but it has been unoccupied for many years and no local informants know of its precise origin or use.

The "Bird Place": This consists of a standing house built of stucco over adobe with a sheet-iron roof, plus frame outhouses. The well here is in current use for stock water. The house was built around 1925 by Charlie Bird.

Navajo Springs: This site was a well known camping place on the old Whipple Trail, a seldom used wagon road out of New Mexico. It possesses particular historic significance through one event that occured here. In a camp here on December 29, 1863, Arizona's newly-appointed territorial officers took their oaths of office. A few days later they proceeded on to Prescott to set up territorial offices. This spot, however, is the place where Arizona's first territorial government officially took shape. For this reason, the area is carried on the State Inventory of Historic Properties. There were no structures there when the territorial officials made camp, but by 1881 there was a ranch on the site operated by a Maes Konig. Buildings here consist of a house, stable, and corrals. It is possible this was a sort of "road ranch" (rest stop, source of provisions, etc.) since this was the junction of the old stage road with the "Road to Zuni", a minor, local travel route. With the coming of the railway the following year, business activity moved to the railroad's "Navajo Station" some three miles away, which had a post office from 1883 to 1911. The site of the old ranch is marked by foundations and an extensive deposit of surface trash of 1800's vintage.

Z-Bar and Owens Sites: These sites are discussed together as there is a possible interrelationship in their use, and as they would be located close (within 1/4 to 1/2 mile) to construction for the proposed railroad. The Z-Bar Ranch occupied this site during the 1880-1915 period. Most of the structural remains at this site date from that period, but one cabin of cedar jacal construction (walls made of upright poles or sticks covered and chinked with mud or clay with a thatched roof) appears to be much older.

Of greater historic significance was the homestead of Commodore Perry Owens. Owens is a nationally-known figure in Arizona history. He came to Arizona with the cattle industry, was elected sheriff of Apache County in 1886, and has been credited with

virtually ending the general outlawry that prevailed in the region when he took office. His best known feat was his single-handed shoot out with the desperado Andy Cooper and the Blevins gang at Holbrook in 1887. Owens had a reputation for markmanship under fire. Field examination of the site indicates this was probably true, for he appears to have practiced a lot, as evidenced by plentiful surface deposits of .44-40 and .45-70 cartridges of the 1880's type littering the site. There are no standing buildings here, but it is possible to discern the outline of a cabin site and a corral on the ground.

The Owens association probably gives these sites sufficient significance to raise the question of eligibility for the State Inventory or even the National Register. Remains at the sites from the early period are so scant as to make one question the feasibility of long range work beyond marking the site.

Of the five historic sites identified along the proposed alignment, only Navajo Springs is currently listed in the State Inventory of Historic Sites and no sites are currently in the National Register. It is felt that Navajo Springs is almost certainly eligible for National Register status and that the Owens and Z-Bar Ranch sites, due to their proximity and their association with an important personage, could qualify for State or even National Register status. The remaining sites are not considered to possess sufficient associations with historic personages or events, or to be of sufficient architectural interest, to qualify for Federal or State designation and/or protection.

d. Aesthetics and Scenic Resources

(1) General

The principles and criteria for conducting scenic or visual studies are somewhat limited due to lack of time tested precedent. Research efforts to date have been largely directed at landscape feature identification, classification and assessment techniques. Based upon this work some qualitative knowledge regarding visual quality and scenic classification exists. However, very little quantified knowledge exists regarding how man's mental impression is affected by landscape features, or what psychological effects occur when a landscape is visually altered. The field of visual analysis is therefore in an early stage of evolution and is presently a qualitative discipline.

The scenic resources of an area are those components of the natural environment which comprise the landscape and which render a visual impression. The term "scenic resource", as used in this study, refers to the collective, intrinsic, visual character of a landscape. The resource is further defined through the presence (or absence) of land forms and vegetative and/or water features, how they visually interact with one another to create interest and the extent to which they occur in a natural or unaltered condition.

The perspective from which scenic resources along the proposed alignment were evaluated was one of regionalism. Inherent in this regional concept is acknowledgement that environmental judgments made about a particular site must reflect the regional significance of the site if such judgments are to be considered accurate appraisals of overall environmental concern. The concept of regionalism is felt to be particularly important in respect to assessment of the effects of actions that involve large areas of the environment (such as a railroad). For purposes of evaluation, five categories of scenic resource quality were established based upon degrees of potential scenic interest, scenic integrity, and regional uniqueness. These categories are:

Outstanding Natural Scenic Resource Quality: An area classified as possessing high levels of visual interest based upon its scenic amenities, the particular qualities of which are essentially natural or unaltered in condition and are either scarce or unique within the region.

Above Average Scenic Resource Quality: An area classified as possessing high levels of visual interest based upon its scenic amenities, the particular qualities of which are substantially natural or unaltered in condition, but relatively common throughout the region.

Average Scenic Resource Quality: An area classified as possessing moderate levels of visual interest based upon its scenic amenities, the particular qualities of which are substantially natural or unaltered in condition and common in occurrence throughout the region.

Modified Scenic Resource Quality: An area classified as possessing moderate to high levels of visual interest, but which has been visually altered from a natural condition through man's uses or activities.

Highly Modified Scenic Resource Quality: An area classified as possessing an essentially non-natural visual condition, the natural scenic amenities of which are absent due to modification of the natural landscape.

(2) Existing Conditions

Region: Within the area through which the proposed alignment passes, the topography is generally flat to rolling, providing an open and panoramic visual character typical of the Colorado River Plateau Physiographic Province. Physiographic characteristics were judged to provide a moderate level of scenic interest.

Vegetative communities within the area consist of grasslands/juniper-pinyon woodlands. The communities were judged to provide moderate levels of scenic interest. With the exception of the Little Colorado River, located southwest of the alignment, drainages and lakes are ephemeral. Water features were not, therefore, considered to be major contributors to the scenic character and interest of the area.

The area through which the proposed alignment passes is sparsely developed. With the exception of several highways (Interstate 40, U.S. Highway 666 and Arizona State Highway 61) and the small

communities of Sanders and Navajo, the landscape retains an essentially natural character and therefore scenic integrity was judged to be generally high.

The alignment is located approximately ten miles east of the Petrified Forest National Park, portions of which are referred to as the Painted Desert. The Painted Desert is a recreational area indicative of scenic resource occurrence. Because of its location relatively distant from the alignment, the Painted Desert was considered to indicate the presence of notable scenic qualities in the region, rather than their actual occurrence along the alignment.

In considering the above scenic features and characteristics reltive to the scenic resource quality definitions, the region of the proposed alignment was judged to possess generally Average Scenic Resource Quality with moderate levels of scenic interest and generally high scenic integrity.

In contrast to the alignment area and its Average Scenic Quality classification, areas to the southwest (within 40 miles) were judged to possess Above Average Scenic Quality. This is based upon a much greater variety of topographic, vegetative and water features. Examples of recreational developments that occupy the same area and which verify this judgement are: the resort towns of McNary, Pinetop, Lakeside and Show Low; the camping, boating and snow skiing facilities within the Fort Apache Indian Reservation; and similar facilities within the Apache National Forest.

In summary, the alignment traverses areas possessing generally moderate levels of scenic interest. Areas of greater scenic variety and interest occur in relative proximity. The Painted Desert, which is located west of the alignment, indicates that scenic conditions are somewhat more significant to the west of the alignment.

Proposed Alignment: The discussion of scenic conditions along the alignment is presented in terms of 5000-foot segments along the alignment, and summarized in Table II-25.

The establishment of scenic inventory categories, which serve as descriptors of the dominant landforms and vegetative characteristics found along the proposed alignment, was a direct result of both map studies and field reconnaissance. These categories, flat to rolling, escarpment, intermittent stream, grassland, juniper and grassland/juniper, are defined on Figures II-39 through II-44.

The alignment traverses areas that are flat to rolling in topographic character (Figure II-39), however it is located along the periphery of several broad drainage basins along which are escarpments (Figure II-40). These escarpments are important elements in the scenic composition of the study area as they are the only significant vertical elements within an otherwise flat and open landscape. The alignment crosses or passes quite close to seven escarpments (Table II-25) which range generally from 40 to 80 feet in height.

The proposed alignment, in conjunction with its location along the periphery or upper end of several broad drainage basins, encounters seven intermittent drainages (Figure II-4]). Intermittent drainages of scenic significance in the vicinity of the alignment are: Milky Wash, Hardscrabble Wash, Zuni River, Carrizo Wash, and three unnamed intermittent washes (Table II-35). These drainages, somewhat entrenched due to erosion by runoff from the escarpments, are visually striking; consequently they make significant contributions to the scenic character of the proposed alignment area. These, and other drainages approximately five miles west of the route, begin to exhibit a badlands character with colorful exposed sedimentary sidewalls.

Vegetative cover-types which occur along the alignment are predominantly grasslands and juniper woodlands (Figures II-42, II-43 and II-44). The majority of the route, approximately twenty-five miles, or 59 percent of its length, is grasslands. The remainder of the route traverses approximately nine miles of mixed grassland/juniper cover (22 percent of the length) and approximately seven miles of dense juniper shrubland cover (19 percent of the length). The locations of the cover types along the alignment are shown in Table II-35.

The northern one-third of the alignment exhibits a fairly extensive road network and scattered residential and ranching buildings. The remainder of the route, except for the southern end, is rather inaccessible as the road network is less developed. Development along the alignment is limited, so the area is presently considered to be essentially natural or substantially unaltered in scenic condition.

TABLE II-25

SCENIC INVENTORY SUMMARY - ALIGNMENT

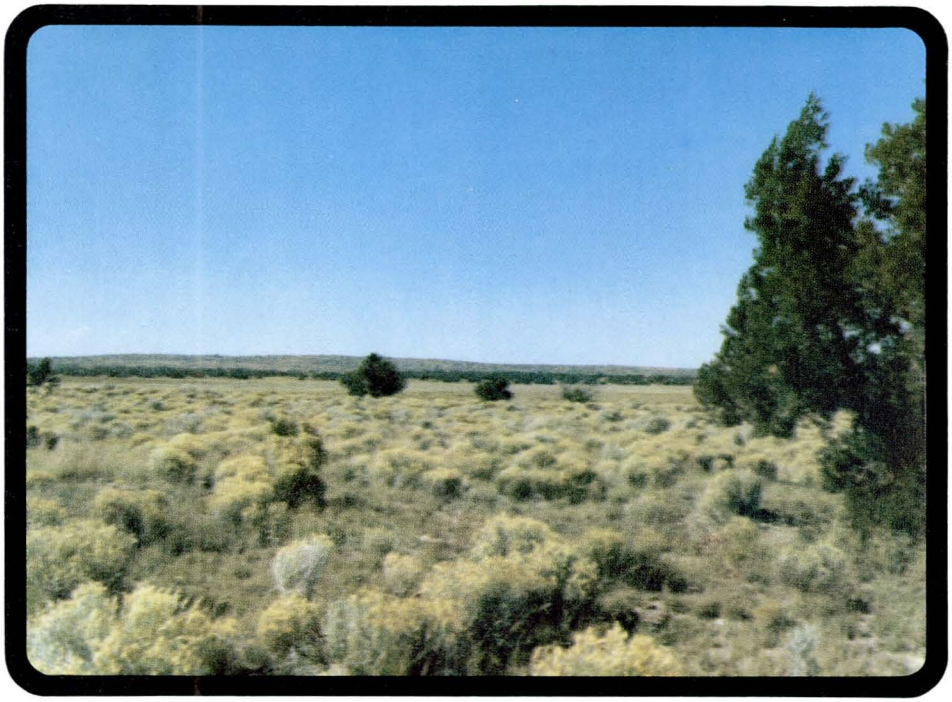
Station[1]	Segment[2]	TOPOGRAPHIC CHARACTER	VEGETATIVE COVER
00 - 50	0-5(000)	Flat to Rolling	
		Puerco Wash	Grassland
	5-10	Flat to Rolling	Grassland
	10-15	Escarpment	Grassland
	15-20	Escarpment	Grassland
200-250	20-25	Flat to Rolling	Grassland
	25-30	Flat to Rolling	Grassland
	30-35	Flat to Rolling	Grassland
	35-40	Escarpment, Intermittent Stream	Grassland
400-450	40-45	Flat to Rolling	Grassland
	45-50	Flat to Rolling	Grassland
	50-55	Flat to Rolling	Grassland
	55-60	Flat to Rolling	Grassland/Juniper
600-650	60-65	Flat to Rolling	Grassland/Juniper
	65-70	Flat to Rolling	Grassland/Juniper
	70-75	Flat to Rolling	Grassland
	75-80	Flat to Rolling	Grassland
800-850	80-85	Escarpment	Juniper
	85-90	Escarpment, Milky Wash	Juniper
	90-95	Flat to Rolling	Juniper
	95-100	Flat to Rolling	Juniper
1000-1050	100-105	Flat to Rolling	Juniper
	105-110	Flat to Rolling	Juniper
	110-115	Flat to Rolling	Juniper
	115-120	Flat to Rolling	Grassland/Juniper
1200-1250	120-125	Flat to Rolling	Grassland/Juniper
	125-130	Flat to Rolling	Grassland/Juniper
	130-135	Flat to Rolling	Grassland/Juniper
	135-140	Flat to Rolling	Grassland/Juniper
1400-1450	140-145	Escarpment	Juniper
	145-150	Flat to Rolling, Intermittent Stream	Juniper
	150-155	Flat to Rolling	Grassland
	155-160	Flat to Rolling, Intermittent Stream	Grassland
1600-1650	160-165	Hardscrabble Wash	Grassland
	165-170	Flat to Rolling	Grassland
	170-175	Flat to Rolling	Grassland
	175-180	Flat to Rolling	Grassland
1800-1850	180-185	Flat to Rolling	Grassland
	185-190	Flat to Rolling	Grassland
	190-195	Zuni River	Grassland
	195-200	Flat to Rolling	Grassland/Juniper
2000-2050	200-205	Flat to Rolling	Grassland/Juniper
	205-210	Escarpment	Grassland
	210-215	Flat to Rolling	Grassland
	215-220	Carrizo Wash	Grassland
2200-2250	220-225	Flat to Rolling	Grassland
	225-230	Flat to Rolling	Grassland

Summary: Length - 43 miles
Topographic Character: Flat to Rolling
(7) Escarpments encountered
(7) Intermittent streams encountered

Vegetative Cover: 25.3 miles grassland - 59% of route
9.5 miles grassland/juniper - 22% of route
8.5 miles juniper - 19% of route

[1]Stations (Engineering Stations) in hundreds of feet starting from the junction of the easterly branch of the wye with the AT&SF main line at Navajo siding.

[2]Segments, as used for the Environmental Studies, are 5000-foot lengths (final three zeros omitted) starting at the junction of the easterly branch of the wye with the AT&SF main line at Navajo siding.



TOPOGRAPHY: FLAT TO ROLLING

With the exception of several escarpments the entire study area possesses a flat to rolling topographic character. Although vegetative communities vary within this topographic setting, visual characteristics are typically open and panoramic in nature as illustrated in the photograph above.

A railroad, in general, is quite well suited to such a visual condition in that it must by design be nearly level. Topographic alteration to accommodate railroad would therefore be minimal, and, few adverse affects on existing topographical characteristics are anticipated.

Figure II- 39

TOPOGRAPHY: ESCARPMENT

Within the study area, topographical transitions between upland plateaus and lowland drainage basins are often abrupt. In many cases these transitions take the form of escarpments, the faces of which are essentially vertical. As is apparent in the above photograph they can be several hundred feet in height and, as a result of the flat to rolling topographic characteristics surrounding them, are dominant visual features.

From the standpoint of scenic resources, escarpments serve as transitions in regard to view sheds, and tend to spacially organize the landscape. A railroad due to slope restrictions would require deep cuts and fills in traversing an escarpment and the resulting visual break in it's profile would be visible for a great distances. A railroad is therefore, considered to be in conflict with the scenic characteristics of escarpments.

Figure II-40

TOPOGRAPHY: INTERMITTENT DRAINAGE

Annual rainfall within the study area is slight therefore water features are generally intermittent. The intermittent drainages of study area tend to be aligned in a northeast to southwest direction and generally originate at the base of an escarpment. The interconnection of these drainages often exhibits a fan like pattern. The bed on which water seasonally flows is typically narrow and possesses a sand and gravel surface. Drainages are occasionally entrenched exposing colorful sedimentary side walls but are more often shallow as illustrated in the photograph.

Drainages which occur in proximity to the railroad alignments were found to be largely perceived as localized scenic features. Although a railroad would to some extent alter the scenic characteristics of an intermittent drainage, the potential for adverse effects on scenic resources in general are considered minor.

Figure II-41

VEGETATIVE COVER: GRASSLAND

The Grassland Vegetative Cover classification was established to distinguish areas possessing broad and uniform coverages or sage of grassland vegetation. Within the study area these communities tend to occur within the broad drainage lowlands. From the photograph above it is apparent that they contribute both color and textural interest to the landscape; however, they tend to be subdominant and are perceived subtly within panoramic landscapes.

Given the panoramic views that are characteristic of grassland areas, ground disturbances within tend to be visible for extended distances. Also, given their homogeneous character, disturbance areas tend to become points of visual focus due to their contrasting characteristics. Consequently, a railroad located within grasslands is considered to be in conflict with scenic characteristics, where extensive ground disturbance occurs.

Figure II-42

VEGETATIVE COVER: JUNIPER

The Juniper Vegetative Cover classification was established to distinguish areas possessing both a uniform and dense juniper shrubland coverage. Within the study area these communities tend to occupy the elevated plateau which extends through approximately the center of the railroad alignments.

Juniper height would to some extent screen certain views to the railroad, however this effect is not considered a significant aspect of compatibility. Within areas of rolling topography as occurs within portions of the study area, views from positions elevated above the railroad will be provided. In these circumstances the railroads linear clearing swath would be visually emphasized within juniper communities. As lineal vegetative clearings characteristically do not occur in juniper communities railroads located within are considered to be in conflict with their natural scenic characteristics.

Figure II-43

VEGETATIVE COVER: GRASSLAND/JUNIPER

Areas in which grasslands and juniper shrublands integrate were distinguished by the establishment of the Grassland/Juniper Vegetative Cover classification. As illustrated in the above photograph such areas possess a mottled visual character through the occurrence of irregular vegetative edges and an open vegetative canopy. They occur most commonly in areas of gently sloping topography located between elevated plateaus and drainage lowlands.

This scenic condition is considered to possess opportunities for the visual concealment of railroad effects, in that vegetation removal would tend not to be perceived, based upon similarities with existing vegetative patterns; and consideration that juniper vegetation would to some extent screen views to the railroad.

Figure II-44

C. Environmental Impacts of the Proposed Action

1. Introduction

The first part of this impact section presents a discussion of the cumulative impacts of the total Coronado Project, from the generating plant and spur railroad north of St. Johns along the transmission system to the Kyrene substation in the greater Phoenix metropolitan area. This section is included because the Coronado Project covers such a wide region. The cumulative impacts are grouped by environmental parameters such as impacts on air quality, vegetation, wildlife, etc., as they relate to the physical environment, the biological environment and the socio-economic environment.

The second part of this section gives the specific environmental impacts of the generating station, wellfields, pipelines, disposal area, limestone source and railroad. This second part is site-specific in nature and goes into the details of the impacts. The site-specific impacts of the transmission lines are found in Section III-C.

2. Cumulative Impacts of the Entire Coronado Project

a. Impacts on the Physical Environment

(1) Impacts on Air Quality

There will be a temporary decrease in air quality as a result of construction activities throughout the region. Fugitive dust will be released into the atmosphere, as well as carbon monoxide and hydrocarbons, by the operation of trucks and heavy construction equipment. There should not be any significant impact on anyone resulting from these activities, although construction workers at the plant site will be aware of its presence. Fugitive dust should only be a problem or inconvenience to workers during periods of high winds.

There will be a permanent decrease in air quality by the operation of the project, the effects of which will be most noticeable in an area approximately 20 miles radially from the plant. The Coronado Generating Station is designed to meet both Federal and state primary and secondary ambient air quality standards and allowable emission rates for new sources. Hence, it is expected that the plant will emit 4.8 tons/hr of SO_2, 4.2 tons/hr or NO_x and 0.492 ton/hr of particulates. Correspondingly, the stack height is designed to disperse these pollutants so that general correlations will not create health problems (satisfying primary standards) or cause significant deterioration in the quality of life (satisfying secondary standards). Air quality will also be affected by the corona from the 500 kV transmission line going from the generating station to the Kyrene substation. This corona involves the emission of ozone which will cause a slight deterioration of air quality in the near vicinity of the conductors. There has been much debate on the effects of corona on surrounding wildlife, vegetation and humans from a health and/or social standpoint. The corona effects from the 500 kV system is not expected to have an adverse effect on any of these factors.

(2) Impacts on Soils

There will be increased soil erosion throughout the project region as a result of clearing vegetative cover for project facilities. The generating plant area will be cleared, as well as the pipeline rights-of-way, parts of the wellfields, and the railroad right-of-way. In addition, the construction of new roads and upgrading of old roads along the transmission lines will cause increased erosion. The cross-country travel during excavation for tower and pulling sites will expose additional acreage to erosion. Soil erosion will occur as a result of the construction of the proposed substation on the 500kV transmission system. The amounts of excavation for the various sites vary. This area involved for both the environmental, preferred site (Dinosaur) and the second preferred site (Silver King "C") are each about 30 acres. Silver King "C" will require considerably more excavation due to existing terrain and access roads. Of the facilities to be constructed, the feature having the greatest effect on erosion is the coal haul railroad. Some 28,100 tons per year of increased erosion is expected as a result of local precipitation in the early years of the project. This value may decrease in time but cannot be quantified. The other facilities, including the transmission system, have been designed to avoid erosion problems. There should only be a few thousand tons of sediment erosion occurring from all other facilities. This total contribution is not considered significant when compared to the total sediment yield of the Little Colorado River, which is estimated at 10 million tons per year at Cameron, Arizona.

(3) Hydrology

Surface water quality will be reduced by construction activities. This impact will mainly be caused by increased sedimentation due to the increased erosion. The impact along the transmission lines and substation sites will be temporary. There are areas around St. Johns, though, that will be permanently subject to erosion, such as the cut and fill areas of the railroad and the cleared areas in the plant site and wellfields. The increase in suspended particles in surface water runoff resulting from project caused erosion will not be detectable.

(4) Impacts on Aesthetics

The region will experience a permanent alteration in natural appearance as a result of project operation. The generating station, the railroad and the transmission lines will be visible and will intrude on the natural scenery. Topographical changes will result from project features, especially at the ash and waste disposal areas where waste materials will accumulate, and at the limestone source where limestone will be quarried. Overhead transmission lines and substation sites will detract from the view. However, the visual impact of a substation is not considered significant when compared to the view of the open pit copper wires at Pinto Creek and Ray which are both within sight of highway traffic using U.S. Highway 160 and State Highway 177. In addition, the emissions from the generating plant, and the coal dust and particulate matter produced by coal handling, will reduce visibility in the St. Johns area. Aesthetic impacts will be felt by mostly local people. The volume of tourists in the area is not known accurately but is not considered significant.

(5) Noise Impacts

There will be an increase of noise throughout the project region due to construction activities. Permanent operations of the project will involve noise from the railroad, noise from the trucks carrying waste materials and noise from the corona discharge of the transmission lines. The noise level will not be high enough or sustained enough to cause health problems. The noise will be more of a nuisance to those experiencing it. Noise levels will probably not be significant at a distance of a few hundred yards from any of these facilities.

b. Impacts on the Biological Environment

(1) Impacts on Vegetation

Table II-26 shows the number of acrea of habitat, by type, that will be permanently lost through construction activities. Also shown are the numbers of acres of vegetation temporarily lost during construction activities. It is expected that some of these acreages would be re-vegetated.

TABLE II-26

ACRES OF VEGETATION PERMANENTLY DESTROYED DUE TO THE CORONADO PROJECT

COMPONENT	Grassland	Pinyon/Juniper	Conifer	Oak Woodland	Chaparral	Sagebrush	Desert Shrub	Badlands	Palo Verde	Agriculture	Riparian	Total
Generating Station	1250	1250	----	----	----	----	----	----	----	----	----	2500
Well Sites	10	----	----	----	----	----	----	----	----	----	----	10
Water Lines	6 (64)	----	----	----	----	----	----	----	----	----	----	6
Transmission System	118 (432)	125 (456)	61 (224)	72 (264)	39 (144)	----	68 (248)	----	29 (104)	11 (40)	3 (8)	526
Limestone Source	237	237	----	----	----	----	----	----	----	----	----	474
Spur Railroad	316	131	----	----	----	53	----	21	----	----	5	526
Total	1937	1743	61	72	39	53	68	21	29	11	8	4042

Note: Numbers in parenthesis indicate acres of land that will be temporarily lost during construction activities. Revegetation will occur over time except for those acres permanently lost.

The table shows that some 4,042 acres of land will be permanently lost.

(2) Impacts on Wildlife

The noise and tumult of construction activities will disturb wildlife throughout the project area. This impact will be temporary in nature and is not considered significant to any species so affected.

The generating plant, wellfields, pipeline, limestone source and disposal areas will eliminate or damage about 3,500 acres of habitat. The transmission line will eliminate or damage some 526 acres of wildlife habitat. This elimination of habitat will cause wildlife to compete with their neighbors for remaining habitat and breeding areas. The clearing of vegetation may result in invasion by different vegetative types that may be incompatible with wildlife species existing in the area.

The project facilities will result in a barrier effect on such species as antelope and smaller species as rodents. Trenching for the water pipeline will cause a temporary barrier to the movement of wildlife. Its impact will be greatest on amphibians. The transmission line may inhibit the free movement of migrating birds. These birds may collide with conductors, towers and static lines.

Man's increased presence in the area due to better access roads and increased population will result in increased littering, noise, poaching, and habitat destruction - all of which will have an impact on the wildlife.

(3) Impacts on Forage

A total of 474 acres of grazing lands will be lost in the limestone source area. Grazing lands will also be lost in the wellfields, generating plant area and railroad area. An estimated 1,920 acres of vegetation will be destroyed by construction of the transmission lines. The forage lost to the transmission line will support ten mature cattle or 50 mature deer or antelope.

c. Impacts on the Socio-Cultural Environment

(1) Social Impacts

There will be both short-term and long-term social impacts of the Coronado Project. The short-term impacts will be caused by the influx of construction workers to build the generating plant, pipelines, railroad, and transmission lines. The generating station and railroad construction crew will peak at a maximum of 2,058 workers and the transmission line crew will peak at somewhere between 100 and 180 workers. This added population will place a temporary strain on housing, school facilities, and municipal services of the small communities where these workers will stay.

The long-term impacts will be limited to the area around the generating station, where 336 permanent employees will operate and maintain the plant. Additional jobs will also be created in the St. Johns supporting economy. It is estimated that the population of St. Johns will double after completion of the plant. The small communities of Springerville, Eager, Show Low, Snowflake, Taylor, and Holbrook will also experience increased population. Estimates show that St. Johns will gain approximately 3,893 temporary residents and approximately 1,579 permanent residents. These persons will require a peak need of 1,144 dwelling units and a permanent need of 448 dwelling units. A peak of 1,251 students will have to be accommodated by the St. Johns-Concho area schools.

(2) Cultural Resources

Other sections of this environmental statement identify cultural resources that will be lost due to construction of various project features. Construction stipulations on Federal lands and state law on state lands require that archaeological clearance be obtained before construction is initiated. Regardless of the intensity of archaeological inventory and the thoroughness of enforcement of construction stipulations and state antiquities laws, some archaeological sites may be damaged. The area most prone to this type of damage is the railroad line right-of-way in the vicinity of the major drainages. Inventory and recovery of artifacts will remove these cultural resources from their original context, and make them available only through reports and museum collections. However, in comparison with the quantity of significant archaeological resources located in this area will be preserved, this loss of contextual information will not be significant.

(3) Impact on Land Values

The value of land in the St. Johns area and the land along the transmission line will both be affected, but in opposite ways. Land values in the St. Johns area are rising. Raw land in or near St. Johns, which sold for $1,500 to $4,500 per acre in 1974, was selling for up to $6,000 per acre in 1976. Typical building lots for single family homes sold for $2,000 to $3,800 in 1974; these lots are now selling for $4,500 or more.

Land values are falling in those areas adjacent to transmission lines. This is especially true where the transmission line crosses residential areas and other private lands. Construction of the transmission line will definitely affect land values and land use in those areas adjacent to the right-of-way.

3. Impacts on the Physical Environment from the Generating Station, Wellfields, Pipelines, Railroad and Disposal Areas

a. Air Quality

(1) Introduction

Impacts on air quality can occur from construction and operation, even though reasonable precautions such as wetting, etc. are employed in accord with applicable rules and regulations for air pollution control. In the construction phase, fugitive dust could be significant, especially during grading activities. Most of the airborne particulate matter caused by construction will be in the larger particle-size range that will settle to the surface within a few kilometers of the site. Fugitive dust will, for the most part, remain within the construction area. The potential for airborne fugitive dust is greatest during spring and summer months and during the afternoon hours when the wind is from the southwest quadrant.

During construction activity emissions of carbon monoxide, hydrocarbons, oxides of nitrogen and particulate matter will be released from construction equipment and vehicles, primarily from diesel engines. The impact will be minor because the construction equipment will be dispersed. Construction activity will be primarily during the daylight hours when surface heating by the sun causes low level atmospheric instability and greater dispersion of pollutants.

The impacts of plant operation on ambient ground level concentrations of SO_2, NO_x and suspended particulate matter, while significant, are well below ambient standard levels. These standards are established to protect the public health with an adequate margin of safety and protect the public welfare from any known adverse effects of a pollutant.

(2) Ambient Air Quality Standards

Federal primary and secondary ambient air quality standards are presented in Table II-27. The individual states have the option of adopting more, but not less, stringent ambient air quality standards than the Federal standards. The standards adopted by Arizona are shown in Table II-28.

TABLE II-27

FEDERAL PRIMARY AND SECONDARY AMBIENT AIR QUALITY STANDARDS

Air Pollutant	National Standard (a)	Maximum Allowable Annual Mean Concentrations ($\mu g/m^3$)	Maximum Allowable Short-Period Concentrations and Averaging Times (b) Concentration	Avg. Time (hours)
Oxidant(c) (Ozone-O_3)	Primary		160 $\mu g/m^3$	1
	Secondary		160 $\mu g/m^3$	1
Carbon Monoxide (CO)	Primary		10 mg/m^3	8
			40 mg/m^3	1
	Secondary		10 mg/m^3	8
			40 mg/m^3	1
Nitrogen Dioxide (NO_2)	Primary	100 AAM(d)		
	Secondary	100 AAM		
Sulfur Dioxide (SO_2)	Primary	80 AAM	365 $\mu g/m^3$	24
	Secondary		1300 $\mu g/m^3$	3
Non-methane(e) Hydro-carbons	Primary		160 $\mu g/m^3$	3 (6 - 9 a.m.)
	Secondary		160 $\mu g/m^3$	3 (6 - 9 a.m.)
Particulate Matter	Primary	75 AGM(f)	260 $\mu g/m^3$	24
	Secondary	60 AGM	150 $\mu g/m^3$	24

(a) Title 40, Code of Federal Regulations, Part 50.
Primary Standard - necessary to protect the public health.
Secondary Standard - necessary to protect the public welfare and the ecology from known or anticipated adverse effects of a pollutant.

(b) Not to be exceeded more than once per year.

(c) Photochemical oxidants - measured concentrations must be corrected for interferences due to nitrogen oxides and sulfur dioxide before comparing to standards.

(d) AAM = Annual arithmetic mean.

(e) Total hydrocarbons corrected for methane; i.e., total hydrocarbons minus methane.

(f) AGM = Annual geometric mean.

TABLE II-28

ARIZONA AMBIENT AIR QUALITY STANDARDS(a)

Air Pollutant	Maximum Allowable Annual Mean Concentration	Maximum Allowable Short-Period Concentrations and Averaging Times Concentrations	Averaging Time (b)
Non-specific particulate matter	60 AGM(b)	150 ug/m^3	24
Sulfur dioxide	80 AAM(c)	365 ug/m^3	24
		1300 ug/m^3	3
Nitrogen dioxide	100 AAM(c)	-	
Non-methane Hydro-carbons	-	160 ug/m^3	3
Photochemical oxidants	-	160 ug/m^3	1
Carbon monoxide	-	40 mg/m^3	1
		10 mg/m^3	8

(a) Arizona State Department of Health Services, Rules and Regulations for Air Pollution Control, Title 9, Chapter 3, Article 2.

(b) AGM - Annual geometric mean.

(c) AAM - Annual arithmetic mean.

(3) Impacts on Ground Level Concentrations

(a) Introduction

The impact of plant emissions on air quality can be evaluated by computing ground level concentrations and comparing these values with air quality standards for protecting public health and welfare.

The evaluation presented in this section is for sulfur dioxide (SO_2) only. This is not to imply that this was the only factor considered. However, it can be shown that when the SO_2 ground level standards are met, the other standards are also met.

From Table I-10 we see that the maximum allowable emission rates for each pollutant are:

SO_2 - 4.8 tons per hour
NO_x - 4.2 tons per hour
Particulates - 0.492 tons per hour

From Table II-30 and II-33 we see that the calculated maximum ambient SO_2 concentrations are:

3-Hr. average - 445 ug/m^3
24-Hr. average - 89 ug/m^3
annual average - 5 ug/m^3

Assuming that all pollutants disperse through the atmosphere in virtually the same fashion, that all NO_x is converted to NO_2 and that no chemical decomposition takes place, then by simple proportioning, the maximum ambient NO_2 and particulate concentrations caused by the plant may be calculated as shown in Table II-29.

Table II-29

Maximum NO_2 Levels			Maximum Particulate Levels		
3-Hr. average	=	$445 \frac{\mu g}{m^3} \times \frac{4.2 \text{ tons/hr } (NO_2)}{4.8 \text{ tons/hr } (SO_2)}$	3-Hr. average	=	$445 \frac{\mu g}{m^3} \times \frac{0.492 \text{ tons/hr (Particulate)}}{4.8 \text{ tons/hr } (SO_2)}$
3-Hr. average	=	389 $\mu g/m^3$	3-Hr. average	=	46 $\mu g/m^3$
24-Hr. average	=	$89 \frac{\mu g}{m^3} \times \frac{4.2 \text{ tons/hr } (NO_2)}{4.8 \text{ tons/hr } (SO_2)}$	24-Hr. average	=	$89 \frac{\mu g}{m^3} \times \frac{0.492 \text{ tons/hr (Particulate)}}{4.8 \text{ tons/hr } (SO_2)}$
24-Hr. average	=	78 $\mu g/m^3$	24-Hr. average	=	9 $\mu g/m^3$
Annual mean	=	$5 \frac{\mu g}{m^3} \times \frac{4.2 \text{ tons/hr } (NO_2)}{4.8 \text{ tons/hr } (SO_2)}$	Annual mean	=	$5 \frac{\mu g}{m^3} \times \frac{0.492 \text{ tons/hr (Particulate)}}{4.8 \text{ tons/hr } (SO_2)}$
Annual mean	=	4 $\mu g/m^3$	Annual mean	=	0.5 $\mu g/m^3$

Thus, if it can be demonstrated that SO_2 concentrations do not exceed the maximum allowable concentrations, then particulate and NO_2 concentrations will not exceed their respective ambient standards. Predicted concentrations of SO_2 will therefore afford a sufficient evaluation of ground level concentrations due to the impact of the power plant.

(b) Extreme Values Versus Average Values

The maximum computed ground level concentrations are extreme values that occur only rarely. The long-term SO_2 concentrations range from less than 1 to 5 $\mu g/m^3$. Since the long-term averages are derived from a large data sample of which the values in Table II-30 are the largest, it is clear that the extremes are in fact very rare.

However, this point requires greater emphasis. It is more realistic to examine frequency distributions of concentrations that illustrate the impact on air quality at key locations about the plant as discussed in the following paragraph. Such distributions can be computed if several observations of meteorological data per day are used.

(c) Approaches to Impact Evaluation

Several approaches have been taken to evaluate the impact of the Coronado Station operation on air quality. The approaches differ in the meteorological data used to effect the evaluation. Three sets of meteorological data were used: On-site upper air data (five soundings per day over one year); Winslow upper air data (two soundings per day over 10 years): modified to simulate more accurately the Coronado Station area; and, Zuni, New Mexico, surface data (hourly over 10 years) supplemented by on-site stability data.

(d) Impact Analysis Based on On-Site Data

Calculations were made using the on-site data during the period from March, 1974, to January, 1975, at St. Johns and Snowflake, Arizona. The calculations were made using site-specific data and the combined data sets for St. Johns and Snowflake (see Appendix B-2). The data set made little difference in the results; consequently, the ground level concentrations around St. Johns are presented based on the combined data from both sites.

TABLE II-30

Maximum 3-Hour and 24-Hour SO_2 Concentrations
For Two Stacks 500 Feet High at St. Johns
(one year period)

Maximum 3-Hour SO_2 Concentration (Micro Grams/Cubic Meter)

SECTOR	DISTANCE (KM)									
	5	10	15	20	25	30	35	40	45	50
SSW	0	3	9	45	357	311	322	270	231	201
SW	1	10	34	50	169	306	264	219	186	161
WSW	103	38	29	45	149	53	270	247	238	207
W	97	37	22	20	18	14	14	12	12	19
WNW	169	65	42	32	51	31	20	30	20	23
NW	289	115	67	53	92	74	52	27	37	21
NNW	1	19	92	99	105	212	225	187	159	74
N	3	17	40	86	129	165	264	221	189	155
NNE	1	11	24	59	131	209	170	142	122	106
NE	13	23	25	93	237	176	135	125	107	93
ENE	22	42	81	363	266	206	167	138	117	101
E	389	139	76	123	219	216	174	145	123	106
ESE	12	15	36	58	58	153	213	256	246	212
SE	10	36	37	122	89	69	56	46	39	34
SSE	24	60	371	445	329	257	209	174	148	129
S	6	51	38	97	101	78	63	53	45	39

Maximum 24-Hour SO_2 Concentration (Micro Grams/Cubic Meter)

SECTOR	DISTANCE (KM)									
	5	10	15	20	25	30	35	40	45	50
SSW	0	1	2	9	71	62	64	54	46	40
SW	0	2	7	10	34	61	53	44	37	32
WSW	0	1	5	8	30	11	54	49	48	41
W	0	0	1	3	3	3	3	2	2	4
WNW	0	3	5	6	10	6	4	6	4	5
NW	0	2	6	11	18	15	10	5	7	4
NNW	0	4	18	20	21	42	45	37	32	15
N	1	3	8	17	26	33	53	44	38	31
NNE	0	2	5	12	26	42	34	28	24	21
NE	3	5	5	19	47	35	27	25	21	19
ENE	4	8	16	73	53	41	33	28	23	20
E	1	8	15	25	44	43	35	29	25	21
ESE	0	3	7	12	12	31	43	51	49	42
SE	2	7	7	24	18	14	11	9	8	7
SSE	5	12	74	89	66	51	42	35	30	26
S	1	10	8	19	20	16	13	11	9	8

The results for St. Johns using the combined data from both sites are shown in Table II-30. The maximum three-hour SO_2 concentrations and maximum 24-hour SO_2 concentrations for the 16 principal directions are shown for distances out to 50 kilometers in increments of five kilometers. The calculations were based on two stacks 500 feet high, gas temperature of 170°F and flow rate of 467 M^3/sec/unit. In addition, the stacks are assumed to be located at a common point; but the two plumes are assumed to act independently (without mutual entrainment).

The maximum three-hour concentration was 445 $\mu gm/m^3$, and it occured at 20 kilometers south-southeast of the site. This value may be compared with the maximum three-hour concentration over a ten year period of 449 obtained at the same location with Winslow data, adjusted to account for observed differences between the two locations.

At close distances the adjusted Winslow ten-year data and the on-site one-year data give comparable results. The maximum concentrations at the closest distances (five kilometers) are due to the limited mixing condition. At greater distances the on-site data resulted in generally lower concentrations.

The distribution of three-hour concentrations gives a more complete description of the impact on air quality. An example of such a distribution is shown in Table II-31 for the location 20 kilometers south-southeast of the plant site representing the location of the maximum calculated concentration. From these tables it is easily understood that the air quality will not be significantly affected (as compared to air quality standards).

TABLE II-31

Cumulative Distribution of 3-Hour SO_2 Concentrations at the Location Representing Point of First Maximum Concentration (Calculated) For a One Year Period.

20 Kilometers South-southeast

Concentration	Percent Less Than Indicated Concentration
30	97.93
60	99.59
90	99.79
445 (maximum)	100.00

These calculations are without regard to stack separation or stack orientation. The actual plant will have the two stacks separated by 600 feet and oriented along a specific direction. Incorporation of stack separation and orientation into the calculations would result in slightly lower estimated concentrations.

During the review of the draft Environmental Statement, it was pointed out that the Statement did not address the issue of prevention of significant deterioration (PSD) regulations (40 CFR Part 52). The impact analysis in the draft Statement for the Coronado Generating Station was done under the assumption that the station was exempt from PSD regulation based on a letter from the U.S. Environmental Protection Agency to Salt River Project, dated February 3, 1976 (see response to letter no. 14 dated February 28, 1977 from New Mexico Environmental Improvement Agency). Recently the EPA has requested that Salt River Project submit justifying data showing that Unit No. 3 of the generating station is, in fact, exempt. EPA has indicated that Unit Nos. 1 and 2 of the generating station are exempt but that Unit No. 3 is still in question. As of June 30, 1977, the issue of exemption of Unit No. 3 had not been resolved.

Of particular concern to the reviewers was whether or not the plant would violate Class I standards for the Petrified Forest National Park (PFNP) should that park be so classified. As of June 21, 1977 the PFNP is classified as Class II Lands. If one were to assume that the PFNP were, in fact, Class I Lands and if one assumed that Unit No. 3 of the Coronado Project were no longer exempted from 40 CFR 52, then the following analysis would result.

The distance from the closest point in the Petrified Forest National Park to the Coronado Generating Station is approximately 52.5 kilometers and lies on a vector between West-Northwest and Northwest. The data in Table II-30 show maximum 3-hour and 24-hour SO_2 concentrations for the three units of the Coronado Generating Station. One can reasonably assume that the incremental contribution of one unit is equal to one third of the values shown in the table. It can, therefore, be seen that the 3-hour and 24-hour concentration of SO_2 resulting from Unit No. 3 alone will be less than 7 ug/m^3 and 2 ug/m^3 respectively. The incremental increases allowable under PSD for 3-hour and 24-hour concentrations of SO_2 and 25 ug/cm and 5 ug/cm respectively. Therefore, it appears that the Coronado Generating Station would not violate Class I standards for SO_2 emission even if it were subject to them.

(e) Impact Analysis Based On Winslow Upper Air Data

The analysis here is limited only to a prediction of maximum 3-hour concentration of SO_2 over a ten year period. Distribution of concentrations are not presented because the radiosonde data includes only two soundings per day. The method by which the results were obtained are presented in Appendix B-2. The maximum concentration using a data record of ten years would be no more than 716 ugm/m^3, at a location 20 kilometers southeast of the site. This value would be no more than 688 ugm/m^3 if stack separation and orientation were accounted for. Results, if adjusted to a one year period, would be comparable to the on-site results.

(f) Impact Analysis Based on Long-term Zuni Surface Data

Meteorological observations from surface based instruments and by observers are taken every three hours. Upper air

data at Winslow, while more appropriate for computing the behavior of elevated plumes, are available only as twice-daily observations. Thus use of surface data has the statistical advantage of more observations per record day. A ten-year record of surface data taken every three hours consists of approximately 29,200 observations. A ten-year record of upper air data taken every 12 hours would consist of 7300 observations.

Experience has shown that the use of surface data is often more conservative than the use of upper air data. That is, surface data tends to give larger concentrations more often than upper air data. This conservatism is due in part to the excessively high estimate of very stable (Pasquill F and G) atmospheres from surface data alone. As indicated in Appendix A-1, the great preponderance of stable atmospheres aloft are of the D class.

To effect a thorough analysis of the impact of plant emissions on air quality, surface data were utilized to compute frequency distributions in each direction at points near maximum ground level concentrations.

The Coronado Generating Station is at an elevation of approximately 5800 feet above mean sea level. Zuni meteorological data is the most applicable of the available long-term data. Surface data covering the period of 1962 to 1971 were analyzed.

The method of analyzing the surface data was adpated to conform with finding regarding the diffusion meteorology (see Appendix B-2). Specifically, the excessively high frequency of stable to very stable atmospheres (Pasquill F and G) predicted from surface observations was modified in the following manner: if the stability, as predicted from the surface data, was F or G, the plume rise was calculated according to such stability. If the plume, calculated according to such stability, rose above a predetermined altitude marking the upper limit of F stability, it was assumed that the plume was transported in a layer of E stability. If the plume did not rise, by calculation, above the predetermined altitude, the plume was assumed to be transported in an F layer. A predetermined altitude of 1000 feet was selected in accordance with the results presented in Appendix A-1.

There are no significant sources near St. Johns. Sources such as the Cholla Plant and the Snowflake paper mill are too remote to interact with the proposed plant in any significant manner.

The overall estimated maximum impact on air quality by the proposed 1050 MW Coronado Generating Station is presented in Table II-32. The Table shows the percent frequency of predicted concentrations which are less than successive concentration limits. The results presented in Table II-32 are cumulative percentage distributions of concentrations expected at the distance of maximum concentration for each direction. For example, at the location 20 km (12 miles) east-northeast of the site, the predicted three-hour concentrations for a ten-year period would be less than 300 ugm/m^3 with a frequency of 98.593%; less than 450 ugm/m^3 by 98.95.%, etc. Other locations in the

east-northeast direction would have lower concentrations at the corresponding percentile levels.

TABLE II-32

PERCENT FREQUENCY OF 3-HOUR SO_2 CONCENTRATIONS

LESS THAN INDICATED CONCENTRATION

CORONADO GENERATING STATION

Based on Ten Years of Data

Points of Maximum Concentration		INDICATED CONCENTRATION ($\mu gm/M^3$)					
Direction	Km	150	300	450	600	750	900
S	25	99.492	99.614	99.772	99.999		
SSE	20	99.691	99.817	99.867	99.935	99.999	
SE	20	99.675	99.813	99.845	99.919	99.996	99.999
ESE	40	99.707	99.894	99.999			
E	30	98.995	99.357	99.845	99.999		
ENE	20	97.596	98.593	98.951	99.557	99.996	99.999
NE	25	99.089	99.406	99.756	99.999		
NNE	30	99.764	99.935	99.999			
N	35	99.837	99.923	99.999			
NNW	35	99.829	99.947	99.999			
NW	25	99.999					
WNW	25	99.999					
W	15	99.999					
WSW	45	97.198	99.996	99.999			
SW	35	99.199	99.524	99.992	99.999		
SSW	35	99.642	99.776	99.999			

Example

At location 25 Km south of plant the predicted SO_2 concentrations are less than 300 $\mu gm/M^3$ with a frequency of 99.614%, less 450 $\mu gm/M^3$ by 99.772%, etc. Other locations south of the plant will have lower concentrations at corresponding percentile levels.

Estimated impact on air quality at points of maximum three-hour SO_2 concentrations due to emissions from 1050 MW plant at St. Johns, Arizona.

In the computation of the results, a finite number (approximately 26,000) of meteorological observations was analyzed. Consequently, a maximum value was obtained for each location. It might appear that the percentile entered into the table for the appropriate upper class boundary would be 100 percent. But such apparent certainty is based on the fact that finite sample size was considered. To avoid the implication that the upper limit to the concentration at any point is known with certainty, the percentile was set at 99.999 percent in the greatest upper class boundary.

The results show that concentrations beyond approximately 750 ug/m^3 are extremely rare. Indeed, the 99.966 percent level marks the probability of occurrence one time per year. For the east-northeast sector it is seen that is is approximately 700 ug/m^3. Any concentration greater than 700 ug/m^3 is expected to occur less than once per year at all locations about the St. Johns site.

As further indication of the predominance of low concentrations at all points, the annual average is presented in Table II-33. To have such low values for the annual average, very low one- and three-hourly concentrations must occur for a very great percentage of the time. Also, it may be noted that extreme short-term values have little to do with determining long-term averages.

TABLE II-33

AVERAGE ANNUAL SO_2 CONCENTRATION (ug/m^3)
CORONADO GENERATING STATION

Sector	Distance (km)									
	5	10	15	20	25	30	35	40	45	50
SSW	1	1	1	1	1	1	1	1	1	1
SW	1	1	1	1	1	1	1	1	1	1
WSW	1	1	1	3	4	3	4	4	4	3
W	1	1	1	2	2	1	2	1	1	1
WNW	1	1	1	1	1	1	1	1	1	1
NW	1	1	1	1	1	1	1	1	1	1
NNW	1	1	1	1	1	1	1	1	1	1
N	1	1	1	1	1	1	1	1	1	1
NNE	1	1	1	1	1	1	1	1	1	1
NE	1	2	1	1	2	1	1	1	1	1
ENE	3	2	3	5	4	3	3	2	2	2
E	2	1	1	2	2	2	2	1	1	1
ESE	1	1	1	1	1	1	1	1	1	1
SE	1	1	1	1	1	1	1	1	1	1
SSE	1	1	1	1	1	1	1	1	1	1
S	1	1	1	1	1	1	1	1	1	1

Federal Air Quality Standard: 80 ug/m^3

Arizona Air Quality Standard: 50 ug/m^3

Average annual SO_2 concentrations for 1050 MW power plant located at St. Johns site. Stack height is 500 feet; orientation is N to S.

(4) Conclusion

Using the three approaches outlined above and the subsequent results discussed, it is apparent that the impact on air quality will be well below State and Federal standards. The maximum expected three-hour SO_2 concentration will be approximately one-third the Arizona State standard. This maximum value will occur only rarely and then only in small isolated areas well removed from populated areas.

(5) Tracer Studies

During January through March, 1974, plume simulation tracer studies were conducted at the St. Johns site. The purpose of this program was to provide quantitative evaluation of the potential SO_2 impact upon the ambient air quality from the proposed 1050 MW power plant under adverse meteorological dispersion conditions. The field expedition at St. Johns covered the period

January 21 through February 2 and March 2 through March 4, 1974. Appendix B-1 summarizes the methodology used in the plume simulation tracer program and the results from this study.

The highest fluorescent particle (FP) and tracer material plume values observed within the ground sampling network occurred under plume looping and fumigation conditions. The maximum equivalent SO_2 concentration value, X_3 hr, measured at the St. Johns site for each condition is presented in Table II-34. It is seen that the maximum observed impact value at St. Johns was 30% (390 ug/m^3) of the State and Federal ambient SO_2 air quality standards; the maximum value occurred during intense looping conditions. The maximum effect measured during fumigation conditions was equivalent to 10% of ambient SO_2 air quality standards (130 ug/m^3) and occurred 20 km from the St. Johns site.

TABLE II-34

MAXIMUM EQUIVALENT 3-HOUR AVERAGE SO_2 CONCENTRATIONS FROM THE PLUME SIMULATION TRACER STUDY DURING JANUARY - MARCH 1974

Site	Plume Type	Maximum X_3 hr.	Distance
St. Johns	Intense looping	390 ug/m^3	1 km
St. Johns	Fumigation	130 ug/m^3	10 km

The results of the plume simulation studies have been compared with long-term dispersion climatological records and also with air quality computational values presented in Table II-31. To compare the meteorological conditions encountered during the field program with the climatological records on hand, the Winslow 0400 MST radiosonde data for the days of tracer releases at St. Johns (W-SJ) have been compared with the annual data for Winslow during 1973 (W-73). Table II-35 summarizes the comparative results of a Pasquill stability category analysis for the 500 to 1000 feet and 1000 to 1500 foot layers based on the three sets of data. The annual average distribution for the 500 to 1000 foot layer shows a predominant occurrence of E stability (65.6%) but also a significant appearance of F stability (15.1%) during the early morning hours. However, at the 1000 to 1500 foot layers the latter all but disappeared (1.2%).

The distribution of the same stability categories in the two layers during the St. Johns field program is similar. This pattern is verified by the actual field data, which indicates that at St. Johns the air mass stability categories at plume altitude never went beyond a slightly stable E category.

TABLE II-35

PERCENT FREQUENCY OF OCCURRENCE
OF PASQUILL CATEGORIES IN THE 500-1000 FT
AND 1000-1500 FT LAYERS FOR WINSLOW RADIOSONDE DATA
ST JOHNS TRACER PROGRAM (W-SJ)

Layers	Soundings	Stability Categories		
		E	F	G
500 - 1000 feet	W - 73	65.6	15.1	0.3
	W - SJ	57.1	14.3	0
1000 - 1500 feet	W - 73	59.2	1.2	0
	W - SJ	57.1	0	0

A comparison has also been made between the measured plume impact values from the tracer program in Table II-34 and the estimated maximum SO_2 concentration values based on computer modeling which are presented in Table II-31. The latter concerns SO_2 impact values beyond five km from the sites and does not include the effect of plume looping conditions which accounted for the maximum values measured during the tracer program. It should be noted that this condition tends to be transitory in nature and is not usually associated with any preferred wind direction. Hence the impact areas of the short duration looping effects are likely to be randomly distributed around the plant site within the nearest two to three km.

However, the fumigation conditions are included in the computer results in Table II-31. During the St. Johns tracer program the maximum measured value during fumigation was 130 ug/m^3 in the sector of 10 km to the NW where the corresponding computer value is 149 ug/m^3. The results show that there is a general agreement between the observed and predicted values at distances out of 20 km in the specific directions of observed plume travel.

b. Visibility

While ground-level concentrations are important with regard to health and welfare, changes in visibility are the effects most readily noticed by the public. They can occur noticeably for situations in which air quality standards are being met. Standards for visibility have not been promulgated by the Federal Government or the State of Arizona.

In an urban area, a major source of aerosol matter is the automobile, which emits hydrocarbons and nitrogen dioxide. Through photochemical reactions, hydrocarbons combine with the nitrogen dioxide

to form aerosols that reduce visibility. A power plant, on the other hand, emits small particles of fly ash, SO_2 and nitrogen oxides. The fly ash is already in a form that scatters light, although the efficiency with which it does so depends on the distribution of particle sizes.

The SO_2, after release into the atmosphere, becomes partially converted to particulate matter through oxidation. The conversion of SO_2 reduces visibility, and is a very complicated and little understood phenomenon. It is often assumed that SO_2 reacts according to a first-order chemical process, one of the simplest encountered in chemical kinetics. (It is an attractive process to consider in connection with diffusion calculations when attempting to account for the reaction of SO_2 because it may be taken into account with a minimum of mathematical difficulty.) It is unlikely that oxidation of SO_2 is first order. More complicated processes in which the reaction depends non-linearly on amounts of material present are very difficult to incorporate in diffusion estimates. An examination of the literature concerning the reactions of SO_2 within the atmosphere reveals widely differing estimates of the reaction rate. An extensive literature survey has been prepared by Bufalini of the Environmental Protection Agency (EPA). The Department of Health, Education and Welfare has also done some work in this area. The wide range of results quoted in these studies is summarized below.

The photo-oxidation of SO_2 has been reported for various concentrations of SO_2 and relative humidities. The rates vary from 0.05 percent per hour to 0.68 percent per hour. This corresponds to halflives of 1380 hours and 101 hours respectively. On a quantum yield basis the results vary by a factor of 100. There have been indications in the literature that heterogeneous reactions of SO_2 with airborne particulates could be much more rapid than homogeneous gaseous reactions of SO_2 in air. It has been observed that oxides of aluminum, calcium, iron, lead, chromium, and vanadium are very efficient in reacting with SO_2, even in the absence of ultraviolet light. These discrepancies in reaction rate of SO_2 are not unexpected. This is especially true for SO_2 in plumes from various sources. Rather than assuming a one to one corresondence between sources, it is reasonable to recognize the possibility that power plants burning coal of various compositions provide environments for SO_2 reaction significantly different from those environments provided by ore smelters and refineries. Reactions within large urban environments are also significantly different because of the types of nucleating species which arise from such sources as automobiles.

Emissions from diesel locomotives delivering coal to the plant may have a localized effect on visibility. During initial operation, it was assumed that the train will make one round trip every 31 hours. Later, when successive units are operating, the frequency will increase to two every 31 hours. It was assumed that each train would consist of eight diesel locomotives. A comparison of emissions from a typical diesel locomotive to a typical passenger automobile is given in Table II-36. The total emissions expected from a train with eight engines is roughly equivalent to two additional automobiles traveling along Highway 666 between Sanders and St. Johns. With this comparison it is readily concluded that operation of the train will have little impact on the air quality along the route.

TABLE II-36

EMISSIONS FROM TYPICAL AUTOMOBILES AND DIESEL LOCOMOTIVES[1]
(grams per vehicle mile)

Pollutant	Auto	Diesel Bus	Rail
CO	85.0	20.4	6.4
Hydrocarbon	9.5	3.4	4.5
NO_x	6.2	33.6	6.8
SO_2	0.2	2.4	5.9
Particulates	0.3	1.2	2.3
Total	101.2	61.0	25.9

[1]Data from Environmental Protection Agency, 1973, Compilation of air pollutant emission factors: Pub. No. Ap-42

Visual range, the greatest distance at which one can see a black object, may be calculated through the use of photometric techniques. The impact of a pollutant source on the visual range may be estimated from calculated background visual ranges, pollutant emission rates, atmospheric dispersion conditions and pollutant chemical reaction rates.

Neutral (Pasquill D) stability gives the minimum visual range. All values of the visual range reported here were computed for the neutral stability. The daylight hours, during which visibility is of most concern, constitute that portion of the day during which neutral stability is likely to occur. Therefore the atmospheric stability most representative of minimum visual range is the neutral stability. A stable atmosphere would result in little change in visual range. Unstable atmospheres do occur during daylight hours, but they would be associated with larger values of visual range than would neutral atmospheres.

The visual range during fumigation cannot be computed reliably because the spatial distribution of pollutants is not reliably known. Fumigation is a transient phenomenon lasting approximately 1/2 hour. Before fumigation, the atmosphere is stable and the visual range would be high; after fumigation the atmosphere is unstable or neutral, at which times the calculated values apply.

The expected maximum decrease in visual range was computed by calculating the visual range for mean wind speed under neutral stability, assuming several values of background visual range. The expected minimum visual range calculated in this manner closely approximates the minimum values found for wind speeds less than eight to ten m/s. Winds greater than ten m/s can cause a significant amount of arid soil particles to become airborne, thus causing a natural decrease in visibility. Therefore wind speeds greater than ten m/s were not used in the calculations which were made for conditions of light variable winds.

The maximum decrease in visual range was calculated for a steady state situation that becomes established after a sufficiently long period of light variable winds under a mixing depth of 2500 feet. Such situations that result in trapping of the suspended particulates might possibly persist for a few days, but the frequency with which such conditions occur is not known. The choice of 2500 feet as the mixing depth is consistent with the mean minimum mixing depths observed at the site.

As seen from the results of the visibility study sponsored by APS at Petrified Forest National Park, the condition of visibility can vary considerably from hour to hour, day to day and from season to season. The existence and magnitude of these fluctuations must be recognized in the evaluations of the impact of the proposed power plant on visibility. In order to perform such an evaluation the change in the annual distribution of visual range was calculated. The best available information on visibility is the data collected from the Petrified Forest National Park. It is therefore of interest to compute the effect of the Coronado Station on visibility at Petrified Forest if the power plant were located at St. Johns. It is estimated that with the advent of either the Cholla expansion or the Coronado Station, but not both, the median visual range will be reduced from the present average of 70 miles to 68 miles (rounded to the nearest mile). With the advent of both power facilities, it is calculated that the median visual range would be 67 miles. For an observer located at the power plant, the median visual range would be reduced from the present average of 80 miles to 79 miles. Similarly, an observer located a few miles from the plant and looking through the plume would suffer reduced visibility of a few miles due to the synergistic interaction of NO_x, SO_2 and particulates in the immediate vicinity of the plant. The predicted degree of impact of the Coronado Generating Station on visibility is quite small compared to fluctuations in visibility which have been documented to occur hourly, daily and seasonally. Consequently, only decrease in the visual esthetics of the area would be hidden in these normal fluctuations. Because the study area is relatively uniform, no distinction can be made between impacts on air quality as a function of location along an alignment. Impact will be uniformly very low during operation.

During the review of the draft Environmental Statement, an issue was raised concerning the synergistic effects of NO_x (nitrogen oxides), SO_2 (sulfur dioxide) and particulate matter as it relates to visibility impacts. Much discussion has been generated in recent years in the scientific community on this subject and there is still considerable disagreement. A report dated August 2, 1973 prepared for the Committee on Public Works of the United States Senate (Serial No. 94-4) entitled "Air Quality and Stationary Source Emission Control" stated, that based on a study in the St. Louis area, various sulfates were the predominant constituants of the fine particulate aerosols which form visible, light scattering haze in eastern Missouri. Other work done in 1975 for the National Park Service in an analyses of the Kaiparowits Project pointed towards the emission of NO_x from the proposed plant as being the cause of visible pollution.

While the singular effect of particulate matter on visibility is reasonably well understood, the singular effects of SO_2 and NO_x are not well understood at all, primarily because the rate of oxidation to sulfate and nitrate particles large enough to effect visibility

is so variable and dependent on such things as sunlight, humidity, temperature and the presence of ambient ozone, ammonia, metallic salts, etc.

The synergistic effects then of SO_2, NO_x and particulate matter remains highly speculative. As indicated in the September, 1975 "Position Paper on Regulation of Atmospheric Sulfates" by the Environmental Protection Agency and elsewhere, the synergistic events in a power plant plume appear to be as follows:

1. Fly ash particles and SO_2 and NO gas is emitted.

2. The gases absorb onto fly ash particles diminishing the gaseous concentrations, adding minutely to fly ash particle size with little or no effect on visibility. Fly ash particles settle more rapidly.

3. NO, reacts with entrained ambient ozone to form NO_2, a brownish gas which may be visible depending upon ambient ozone concentrations, mixing rate, plume dispersion rate and the ability of the human eye to distinguish contrast (usually 2 to 5 percent). Very stable atmospheric conditions with light winds are usually necessary to produce visible NO_2 in a power plant plume and even then the event is highly localized in the immediate vicinity of the plant.

4. SO_2 and NO_2 react with ozone (when all NO is consumed), oxygen and other elements to form sulfates and nitrates of sufficient size to scatter light and thus effect visibility. The rate of oxidization is highly dependent upon humidity and on the presence of ammonium or metallic salt catalysts usually not found in power plant emissions. Thus the rate of accumulation of sulfate and nitrate particles of sufficient size as to effect visibility is much lower in the arid southwest than is the natural rate of plume dispersion and the combined effect is negligible.

5. Because under sunlight, NO_2 tends to photochemically revert back to NO, the rate of accumulation of sulfate particles exceeds that of nitrate and becomes the dominant factor. The Environmental Statement speaks to the additive effects of fly ash particles and formed sulfate particles on visibility of the plume.

Applying these interrelationships to the Coronado Generating Station, it can be postulated that at certain times of the year when meteorological conditions are right there will be a yellow or brown haze visible in the vicinity of the plant that will be formed by the interaction of nitric oxide and ozone to form nitrogen dioxide. The extent of the visibility of this plume will vary but should not exceed 20-25 miles. The principal cause of reduced visibility in the area though will be a function of the oxidizing of sulfur dioxide to various sulfates. The presence of particulate matter, either from plant emissions or naturally occurring will enhance this oxidation somewhat. The presence of particulate matter will in itself have an adverse effect on visibility in the immediate vicinity of the station especially in the early morning or early evening when the sun is low in the sky which tends to illuminate the particles.

c. Cooling Tower

The waste heat dissipation systems for the Coronado Station will be mechanical draft cooling towers. Because of the large amount of warm moist air emitted from such towers, the possibility exists of large visible plumes extending downwind from several hundred to several thousand feet. There is the additional possibility that the plume will produce ground fog. If this occurs during low temperatures, it may produce icing of surfaces exposed to the plume. Another potential problem is dissolved salts that are expelled from the towers in the form of drift. Results of studies indicate that there would be only short periods of time during the year when predicted plume-induced fog and icing would occur beyond natural fogging and icing conditions. The salt deposition from cooling tower drift was predicted to be very small beyond the site boundaries with little or no noticeable effect on vegetation. Plume length results are shown in Table II-37. Plume lengths greater than 500 feet can be expected to occur 65.4% of the time, while plume lengths greater than 10,000 feet can be expected to occur 7.8% of the time. Plume lengths greater than one mile can be expected to occur about 18% of the time. The directions exhibiting the greatest number of visible plumes of lengths greater than two miles are the west and west-southwest. This is due to the prevalence of easterly winds at Zuni (and St. Johns).

TABLE II-37

CALCULATED FREQUENCY OF OCCURRENCE OF CORONADO GENERATING STATION COOLING TOWER PLUME LENGTHS GREATER THAN INDICATED VALUE

(%)

	Plume Length (ft)											
Sector	0	500	1500	2500	3500	4500	5500	6500	7500	8500	9500	10,000
N	1.2	0.7	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1
NNE	1.4	0.8	0.4	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.0
NE	5.4	3.1	1.8	1.3	1.1	1.0	0.8	0.7	0.6	0.5	0.5	0.4
ENE	13.6	8.0	4.6	3.3	2.8	2.4	2.0	1.8	1.6	1.4	1.3	1.2
E	9.9	6.3	3.2	2.3	1.8	1.4	1.2	1.1	0.9	0.8	0.7	0.7
ESE	4.1	2.9	1.2	0.9	0.6	0.5	0.4	0.4	0.3	0.2	0.2	0.2
SE	2.2	1.4	0.5	0.4	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.0
SSE	1.5	0.9	0.4	0.2	0.2	0.1	0.1	0.1	0.0	0.0	0.0	0.0
S	1.8	1.2	0.7	0.5	0.4	0.3	0.2	0.2	0.2	0.1	0.1	0.1
SSW	1.2	0.9	0.6	0.5	0.4	0.3	0.2	0.2	0.2	0.1	0.1	0.1
SW	2.6	2.2	1.4	1.0	0.8	0.6	0.5	0.4	0.3	0.3	0.2	0.2
WSW	11.5	11.1	8.6	6.5	5.1	4.1	3.4	2.8	2.3	1.9	1.5	1.4
W	21.8	21.3	18.4	14.9	12.2	9.7	7.8	6.1	4.7	3.8	3.1	2.8
WNW	2.4	2.2	1.6	1.2	1.0	0.8	0.6	0.5	0.4	0.3	0.3	0.2
NW	1.8	1.4	0.9	0.6	0.5	0.4	0.3	0.2	0.2	0.2	0.2	0.2
NNW	1.3	0.9	0.5	0.4	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1
Calm	16.0											
Total	100.0	65.4	45.1	34.5	27.7	22.3	18.4	14.8	12.2	10.2	8.6	7.8

Fog, induced at the surface by plume moisture, is predicted to occur about 2.8% of the time, or 247.8 hours during an average year. Of these hours, 156.6 would be associated with simultaneous conditions of natural fog. During the year, 36.6 hours of plume-induced fog would occur beyond two miles in the absence of natural fog. To the west of the proposed plant site is U. S. Highway 666. Traffic is light on Highway 666 and there is no indication of how many drivers would be affected by the fogging. The number is not expected to be significant. The impact of fog on this highway is estimated to be about 78 hours per year, of which only 12 hours would be due to the plume without simultaneous occurrences of natural fog. The occurrences of plume-induced fog are summarized in Table II-38.

Plume icing is predicted to occur about 2.1% of the time, or 183.6 hours per average year. Of these, 84.0 hours would be associated with natural icing conditions. The impact of plume icing on U. S. Highway 666 is estimated to occur about 29.4 hours per year, in the absence of naturally occurring icing conditions. It is not known how many drivers would be affected by this ice. Icing data are summarized in Table II-39. Because of a trend toward lower relative humidity from east to west in this area of the plateau, the total percentage of plume fogging and icing at St. Johns may be slightly overestimated using Zuni data. A better, but as yet unknown, estimate would be intermediate to the results obtained for St. Johns using Zuni data and the results obtained for Snowflake using Winslow data.

Salt deposition rates from cooling tower drift are shown in Table II-40. The calculations were made assuming a total dissolved solids content of 14,000 ppm in the cooling water. The detailed composition of the water is not known. For any given direction, the deposition rate decreases as distance from the tower increases. The largest concentration shown in the table is 888.03 kg/km^2/mo. In more familiar terms, this is equivalent to 7.9 lb/acre/mo. This occurs 1.5 km (.93 mi) to the east-northeast of the towers which may be taken as a nominal distance to the plant site boundary. Neglecting subsequent dissolution by rainwater, a salt deposit of 7.9 pounds per acre per month, or 94.8 pounds per acre per year, would be a very small quantity with little or no noticeable effect on vegetation. The deposition rate decreases rapidly with distance from the towers and is calculated at 10.2 pounds per acre per year at two miles.

TABLE II-38

CALCULATED CGS COOLING TOWER FOG

Sector	Plume Fog (h)	Distance (mi) 1	Distance (mi) 2	Simultaneous Natural Fog (h)
N	1.2	1.2	1.2	0.6
NNE	0.6	0.6	0.6	0.6
NE	21.0	21.0	18.6	12.6
ENE	67.2	67.2	56.4	46.8
E	30.6	30.6	26.4	19.2
ESE	6.0	6.0	4.8	3.6
SE	2.4	2.4	1.8	1.8
SSE	0.6	0.6	0.0	0.6
S	0.6	0.6	0.6	0.6
SSW	0.0	0.0	0.0	0.0
SW	1.8	1.8	1.8	1.2
WSW	28.2	28.2	18.6	15.0
W	81.6	81.6	57.0	48.6
WNW	3.6	3.6	3.0	3.0
NW	1.8	1.8	1.8	1.8
NNW	0.6	0.6	0.6	0.6
Total	247.8	247.8	193.2	156.6

Hours/year of plume fog at distances greater than one and two miles

TABLE II-39

CALCULATED CGS COOLING TOWER ICING

Sector	Plume Icing (h)	Distance (mi) 1	Distance (mi) 2	Simultaneous Natural Ice (h)
N	0.6	0.6	0.6	0.0
NNE	0.6	0.6	0.6	0.6
NE	10.8	10.8	9.6	4.2
ENE	37.8	37.8	30.6	20.4
E	21.6	21.6	18.6	10.8
ESE	3.0	3.0	2.4	1.2
SE	1.8	1.8	1.2	0.6
SSE	0.0	0.0	0.0	0.0
S	0.0	0.0	0.0	0.0
SSW	0.0	0.0	0.0	0.0
SW	1.8	1.8	1.8	1.2
WSW	24.6	24.6	16.2	13.2
W	77.4	77.4	55.2	28.8
WNW	2.4	2.4	1.8	1.8
NW	0.6	0.6	0.6	0.6
NNW	0.6	0.6	0.6	0.6
Total	183.6	183.6	139.8	84.0

Hours/year of plume icing at distances greater than one and two miles

TABLE II-40

CALCULATED CGS SALT DEPOSITION RATES

($kg/km^2/month$)

Sector	Distances, km						
	1.5	2.0	2.5	3.0	3.5	4.0	5.0
S	84.93	29.91	13.91	8.29	6.32	4.82	2.28
SSW	58.73	19.70	9.18	5.38	4.14	3.19	1.45
SW	92.71	35.45	16.75	9.86	7.19	5.36	2.61
WSW	348.41	128.31	59.13	34.95	25.94	19.58	9.65
W	577.68	207.59	95.00	56.23	42.38	32.35	16.04
WNW	106.99	36.73	16.72	9.83	7.56	5.82	2.71
NW	95.83	34.17	15.64	9.11	6.86	5.24	2.54
NNW	89.53	27.18	12.17	7.34	5.95	4.68	2.09
N	90.97	33.20	15.85	9.29	6.85	5.15	2.49
NNE	97.99	38.11	18.33	10.72	7.58	5.56	2.79
NE	380.66	144.11	68.65	40.07	28.06	20.44	10.21
ENE	888.03	348.26	166.69	95.84	64.65	46.01	23.23
E	607.53	234.52	112.47	65.11	44.70	32.20	16.33
ESE	239.74	96.38	46.32	26.68	17.89	12.73	6.67
SE	132.67	49.91	23.88	14.06	9.90	7.24	3.64
SSE	81.83	34.39	16.72	9.66	6.58	4.72	2.47

Values correspond to a TDS content of 14,000 ppm in the cooling water.

d. Fugitive Dust

Airborne particulate matter emitted from any source other than a flue or stack is termed "fugitive dust". Two possible sources at the Coronado Station are the coal storage piles and ash from the solid waste disposal site.

A qualitative inspection of the climatic parameters shows that there is a high potential for ash dust erosion at the plant site during the relatively dry windy period of March through June. The location of the ash disposal area as well as the method of placing and controlling the ash are part of the detailed engineering design necessary to satisfy Arizona Air Pollution Control Regulation R9-3-302.

e. Physiography and Topography

Physiographic and topographic changes resulting from the proposed action will be primarily from excavation, cutting and filling, land clearing and waste disposal.

Ash and scrubber solids will be disposed of in a diked area designated for this purpose. This waste material will be transported from bins and silos to the diked disposal site and then spread over the area and compacted. There will be a change in the topography of the area and an area of approximately 800 acres will be taken out of grazing and used for ash disposal. The actual size of the ash disposal area is represented on Figure I-7.

Railroad and plant access road construction will require cutting, filling and grading to achieve the desired road bed configuration. The topographic changes resulting from the project construction will cause subsequent, or secondary, impacts on land use, scenic resources, hydrology and archaeology which are discussed in the appropriate sections of this report.

f. Geology and Seismology

The geology and seismology of project-affected areas were extensively considered in project planning. These studies revealed no potential effects of the project on either geology or seismology. The effect in minerals will be most significant with respect to the mining of 96,000 tons of limestone per year and four million tons of coal per year.

g. Hydrology

(1) Surface Water

The impacts on surface water occurring as a result of construction of the railroad are more substantial. The flow characteristics of streams that cross the proposed alignment were outlined in Table II-30 and the areas of drainage basins were shown on Figure II-25. Areas of drainage basins exert large controls on runoff and peak discharges; the runoff and peak discharges of only three of the

streams in the area are of magnitudes that might be subject to impact by the proposed action. Bridges are planned at crossings of these three streams, Hardscrabble Wash, Zuni River and Carrizo Wash. The other smaller streams that the alignment will cross have very small drainage areas, generally less than five square miles, with probable runoffs of less than ten acre-feet/year. The alignment will cross several headwater areas at the western edge of the tableland. In these areas numerous small channels are present on steep slopes.

Assessment of potential impacts on surface-water hydrology is divided into surface-water hydraulics, surface-water quantity and surface-water quality.

(a) Surface Water Hydraulics

Impacts on hydraulics will manifest themselves in the study area as disturbances in stream flow. The impacts will consist of changes in direction, turbulence, elevation, gradient or rates of flow. Such disturbances could result in flooding, ponding or secondary impacts such as erosion and sedimentation. The greatest potential for impact probably lies in the several headwater areas that will be crossed by the alignment. Here gradients and numbers of small washes are greater than those in the nearly-level areas that lie along much of the route. Because of the adequate number and favorable design characteristics of culverts and bridges and, to a lesser extent, the generally low volumes and rates of runoff that are likely to occur in most channels, the potential hydraulic impact on stream flow by the proposed alignment will be insignificant.

(b) Surface Water Quantity

Blocking some of the very small drainage ways which might not be culverted can result in minor ponding or minor diversion of flow to a nearby culverted channel. This ponding or diversion would reduce flow in the dammed channel and would increase flow in the receiving channel. The ponding also may cause minor environmental benefits, including reductions in sediment transport, to increases in recharge to the Bidahochi aquifer or increases in intermittent water availability to wildlife. Due to a decrease in the flushing action of periodic stream flow, a build-up of sediment in the channel (aggradation) may be expected. However, except for possible capture in sparsely scattered stock-watering tanks, much of any surface-water runoff probably would have infiltrated or evapotranspired without being used. Since only the smallest of channels will be blocked, the potential impact on surface-water quantity will be negligible.

(c) Surface Water Quality

The principal impacts on surface-water quality will be changes in concentration and load of suspended sediment. Such changes would be caused by both erosion and damming of channels.

Reduction in sediment discharge due to damming will be outweighed by the increase in sediment discharge due to erosion of cuts, fills and roads. Compared to other parts of the Little Colorado Basin, natural sediment yield per unit area (an indication of stream load and concentration) from the study area is relatively low. The conditions that limit natural sediment runoff here may also tend to minimize runoff of soil particles that are loosened artificially by railroad-related activity.

The railroad-related activities cannot appreciably impact the suspended sediment quality of the water in downstream reaches of the Little Colorado River. During flood-phase, the Little Colorado has maximum concentrations of as high as 200,000 parts per million, measured at Winslow, with an average annual sediment load of ten million tons per year farther downstream at Cameron. Even if the entire estimated annual railroad-related sediment were to be carried to the Little Colorado, its relative contribution to the existing load would be equal to approximately 28,000 tons annually.

Soil disturbance caused by the railroad in areas of sandy soil will contribute small amounts of dissolved solids to stream runoff. These will be caused by disturbances of the Chinle formation which crops out in several small areas along the alignment in the Carrizo, Zuni and Puerco valleys.

Potential direct contributions of contaminants to surface water or ground water by operations of the railroad might include small amounts of dissolved solids, oil-fuel residues and toxic substances. Such contaminations might result from: loss of cooling water that contains additives; leakage or losses during draining; spillage of fuel during refueling; runoff and discharge from shops and facilities; spillage of hazardous cargoes and chemicals used on right-of-way, such as defoliants, herbicides and wooden-tie preservatives. None of these are considered to be an appreciable hazard to water quality as in general, no shops or refueling facilities are planned and the coal cargo is essentially non-contaminating (when stockpiled, precipitation leaking through the coal may pollute surface and ground water.) The use of chemicals along the alignment will be limited and special precautions will be taken to minimize potential water quality degradation. Therefore, the project's impacts on water quantity, quality, and flow of surface streams, will be insigificant.

(2) Groundwater

Three tentative wellfields have been selected in the vicinity to provide water for the plant's requirements. An annual average requirement of 13,424 acre-feet was used to determine the impacts of these wellfields. Estimates are that Field No. 1 could yield 3,000 gpm, Field No. 2 could yield 4,500 gpm and Field No. 3 could yield 2,000 gpm. The projected interference drawdown would be less than five feet

between Wellfields No. 1 and 2; and could be about ten feet between Nos. 2 and 3. This drawdown will be from the Kaibab-Coconino aquifer. Vegetation is supported by the perched water table near the surface. The drawdown of the Kaibab-Coconino aquifer will not affect this upper water table. These wellfields would have a moderate impact on the water level; estimates show that drawdowns would range from 20 to 70 feet within the fields. Thus, the project would not have a significant impact on other water users, and there would be no land subsidence caused by the project.

The magnitude of the groundwater underflow in the Kaibab-Coconino aquifer has been estimated to be about 2,000 acre-feet per year per mile. A preliminary flownet analysis indicates that after several years of pumping, each wellfield would intercept a portion of the groundwater underflow of the Kaibab-Coconino aquifer, and water levels would attain a new state of equilibrium. Thus, the annual decline would be very small after the initial one to three year pumping period.

Well yields ranging from 1,000 to 2,000 gpm are common and have not resulted in large water level declines. The groundwater reservoir beneath the wellfield lands, about 14 sections, could yield a volume of approximately 250,000 acre-feet of water from storage in the aquifer system. However, the regional groundwater underflow of approximately 2,000 acre-feet per year per mile of aquifer indicates that the total groundwater underflow beneath the wellfield lands exceeds the estimated 13,424 AF/yr withdrawal. Thus, only a small portion of the groundwater pumped from the proposed wellfields would be released from storage. There would, however, be a reduction of recharge to this groundwater aquifer.

Impacts on the quantity or quality of the groundwater due to the proposed railroad will probably relate to some disturbance of surface-water flow, storage, or quality, and to the possible temporary pumpage that may be needed to provide water for construction needs. A probable effect of railroad drainage interruption is some slight increase in recharge to the Bidahochi water-table aquifer. Such recharge would probably be beneficial because it would tend to improve the quantity and quality of ground water. The magnitude of recharge would be small and might later discharge as seeps or springs from nearby outcrops of the Bidahochi on the slopes of the tableland area.

Because of the relatively small anticipated recharge and estimated small concentrations and loads of dissolved solids, oil or toxic substances that will be in surface water due to railroad action, there will be correspondingly little impact on the quality of ground water in the Bidahochi. Furthermore, even if the surface water were contaminated, some contaminants would be removed by filtration, ion exchange, chemical reaction and other physical-chemical processes during downward percolation to the water-table. In particular, suspended sediments, because of their large size, are susceptible to filtration

and therefore are not likely to penetrate downward more than a few feet. Downward percolation of water and any contaminants from the surface, through the Bidahochi and the relatively impermeable Chinle and Moenkopi formations, into the Kaibab and Coconino formations is not likely to occur. Therefore, except by means of pumpage, the railroad is not expected to affect either the quantity or quality of water in the deeper, confined Coconino-Kaibab aquifer.

According to construction plans, 60 gallons of water will be required to achieve proper compaction of one cubic yard of fill. For the railroad, it is estimated that a total of approximately 33,000,000 gallons (equivalent to approximately 1000 acre-feet or 230 gallons per minute for 100 days) will be needed for compaction over a period of 18 months. Additional water will be needed for dust control. Sources for this water are yet to be determined. Little, if any, of this water would return to streams or aquifers. Thus the volume used is a measure of potential impact on the sources of supply. If a ground water source is utilized there probably would be a considerable draw down around the well or wellfield depending on rates or duration of pumpage, transmissivity of the aquifer, number and distribution of wells and other factors. Due to mobility of groundwater, this drawdown would recover after pumpage ceased, with probably little, if any, permanent impact on local water supplies. If a saline water supply could be found and used for these purposes there would be essentially no impact on the groundwater supply of the area.

The impacts on the quality and quantity of both surface and ground water will be almost insignificant. Although impacts on hydraulics will be largely eliminated by the use of adequately designed culverts and bridges, the potential for impacts on hydraulics is considered to be greater than those on the water quantity and quality conditions. The greatest impacts on hydrology will be at the Zuni River and Carrizo Wash crossings, which will require bridges. Because of their larger magnitudes of runoff, the Zuni River and Carrizo Wash crossings will, during periods of high flow, cause restriction of the water, and some resulting turbulence. Hardscrabble Wash will suffer little impact because of its correspondingly small discharge.

h. Soils and Trace Elements

(1) Soils

The more important potential impacts on soils, which are discussed here, are: 1) erosion by surface runoff, 2) erosion by streams, 3) sedimentation, and 4) cutting and filling.

Erosion by Surface Runoff: The construction of the project facilities will cause increased erosion. Portions of sites of the generating plant, pipelines, wellfields, limestone source, railroad and transmission lines will be cleared of vegetation. Clearing these areas will increase the erosion potential. Though some of the area is expected to revegetate, parts of other areas such as the generating plant site, will remain permanently devoid of vegetation and hence open to increased erosion.

It may be expected that, as a result of the proposed action the weight of soil that may erode as the result of local precipitation along the approximately 226,000-foot length of the proposed alignment will average about 28,100 tons per year (an average of 124 tons per year per 1000 feet of alignment). This total includes approximately 8300 tons of erosion from cuts, 19,300 tons from fills and 500 tons from roads. These magnitudes of erosion by local precipitation occur in other areas of greater topographic relief. Also, the erosion rates should decrease as vegetative cover increases, as residual surface materials become coarser and as more highly cemented materials are exposed.

In Table II-41 erosion from the three sources - cuts, fills and roads, for each incremental 5000-foot length of the alignment, is shown. Here erosion is expressed as average annual weight of material in tons per acre per year and as tons per year. Although the total volumes for proposed cuts and fills are nearly the same (3.8 versus 4.1 million cubic yards, respectively) the volume of annual erosion for cuts is approximately one-half that for fills (8300 versus 19,300 tons/year). Road erosion (450 tons/year) is almost negligible. This predominance of erosion from fill surfaces is related to the higher erodability index applied to the disturbed material in the fills as compared to the undisturbed (in-situ) material in the walls of the cuts, and to the proposed installation of protective benches at 40-foot elevation intervals on the cut surfaces.

Percentage distribution of potential erosion among cuts, fills and roads within each 5000-foot incremental length or segment, is shown in Table II-42. Percentage for roads is generally less than five and percentage for both cuts and fills ranges from 0 to nearly 100. The percentage value for cuts relative to fills varies with the relative sizes of cuts in the segment and, as discussed above, the difference in erodibility and benching. Values for total erosion by precipitation on cuts, fill and roads in each 5000-foot segment along the alignment are shown graphically in Figure II-45. (A discussion of the significance of silt loads on the Little Colorado River is found in Section II.C.3.g.

Because of the close relationship between the anticipated railroad-induced erosion and the amount of required cutting and filling, the potential impact due to erosion by precipitation along the proposed alignment is rated as low. This is in comparison to potential erosion along other possible alignments that would traverse topography of greater relief, and therefore would require greater amounts of cutting and filling; this in turn would result in greater erosion.

TABLE II-41

POTENTIAL EROSION FROM CUTS, FILLS AND ROADS ALONG PROPOSED ALIGNMENT (BY WEIGHT)[1,2]

Location (1000 Feet of Navajo)	Cuts[3]			Fills		Roads		Total
	SOIL (tons/ acre/year)	GEOLOGY (tons/ acre/year)	GEOLOGY & SOILS (tons/year)	(tons/ acre/year)	(tons/year)	(tons/ acre/year)	(tons/year)	(tons/year)
5	42	157	69	440	433	23	7	510
10	169	629	563	131	64	27	8	636
15	115	438	472	507	814	25	12	1299
20	127	617	628	223	122	12	5	756
25	0	0	0	322	184	4	2	187
30	31	0	2	491	571	10	6	580
35	315	737	878	115	143	39	24	1046
40	209	473	294	787	1791	78	45	2131
45	260	184	293	90	7	13	7	309
50	63	0	5	192	106	5	3	115
55	0	0	0	597	973	11	5	979
60	156	62	289	372	606	39	27	922
65	235	115	402	265	260	32	11	675
70	0	0	0	367	252	<1	<1	252
75	173	32	62	59	22	7	4	89
80	206	0	34	101	34	3	1	70
85	277	341	258	408	1308	17	11	1578
90	266	190	473	422	1609	29	29	2113
95	396	162	251	125	24	58	22	298
100	156	50	67	220	103	14	3	175
105	225	42	82	101	37	11	7	126
110	0	0	0	374	240	<1	<1	240
115	201	47	54	179	69	17	3	127
120	93	77	45	490	420	25	10	476
125	263	180	95	341	156	39	16	268
130	192	8	34	122	11	11	5	51
135	0	0	0	296	144	11	8	152
140	309	74	125	43	5	15	7	137
145	43	0	1	500	516	45	14	532
150	323	517	808	236	55	71	33	897
155	118	163	23	493	429	24	12	465
160	266	337	217	287	265	29	12	495
165	343	209	322	0	0	20	9	331
170	31	0	<1	411	295	11	6	302
175	169	140	134	117	17	10	6	158
180	42	157	81	558	785	13	8	874
185	0	0	0	370	223	2	1	224
190	0	0	0	321	185	8	3	189
195	0	0	0	456	422	21	12	435
200	518	785	1008	0	0	50	25	1034
205	207	335	243	264	153	10	8	405
210	0	0	0	445	550	4	2	553
215	0	0	0	1133	4351	25	15	4367
220	31	0	6	276	150	9	3	160
225	0	0	0	397	332	1	1	333
Estimated Totals (Tons/Year)			8300		19300		450	28000

[1]Weight of eroded material calculated for proposed design of cuts and fills (IECO) using Universal Boil Loss Equation. Parallel roadway having 25-feet width assumed to represent access roads.

[2]Tons/acre/year is the calculated annual weight of material eroded from 1 acre is the tons/acre/year value times the acreage exposed to erosion within the 5000-foot segment.

[3]Cuts are considered to be in "soil" to a depth of 5 feet, and in "geology" at greater depths; each soil and geology type has its individual erosion index. All decimal values omitted and totals rounded off.

TABLE II-42

POTENTIAL EROSION FROM CUTS, FILLS, AND ROADS
ALONG PROPOSED ALIGNMENT (BY PERCENT)

Location (1000 Feet of Navajo)	Total	% Cuts	% Fills	% Road
5	510	14	85	1
10	637	89	10	1
15	1300	36	63	1
20	756	83	16	1
25	187	0	99	1
30	580	1	99	1
35	1046	84	14	2
40	2132	14	84	2
45	309	95	2	3
50	115	5	92	3
55	980	0	99	1
60	923	31	66	3
65	675	60	38	2
70	252	0	99	1
75	89	70	24	4
80	71	49	49	2
85	1578	16	83	1
90	2113	22	76	1
95	298	84	8	8
100	175	38	60	2
105	127	65	29	6
110	240	0	99	1
115	128	43	54	3
120	477	10	88	2
125	268	36	58	6
130	51	67	22	11
135	153	0	95	5
140	138	91	4	5
145	532	<1	97	3
150	897	90	6	4
155	466	5	92	3
160	496	44	53	3
165	332	97	0	3
170	302	<1	98	2
175	158	85	11	4
180	875	9	90	1
185	225	0	100	<1
190	189	0	98	2
195	435	0	97	3
200	1034	98	0	2
205	405	60	38	2
210	554	0	100	<1
215	4367	0	100	<1
220	160	4	94	2
225	333	0	100	<1
Total (tons/yr)	28,000			

All decimal values omitted.

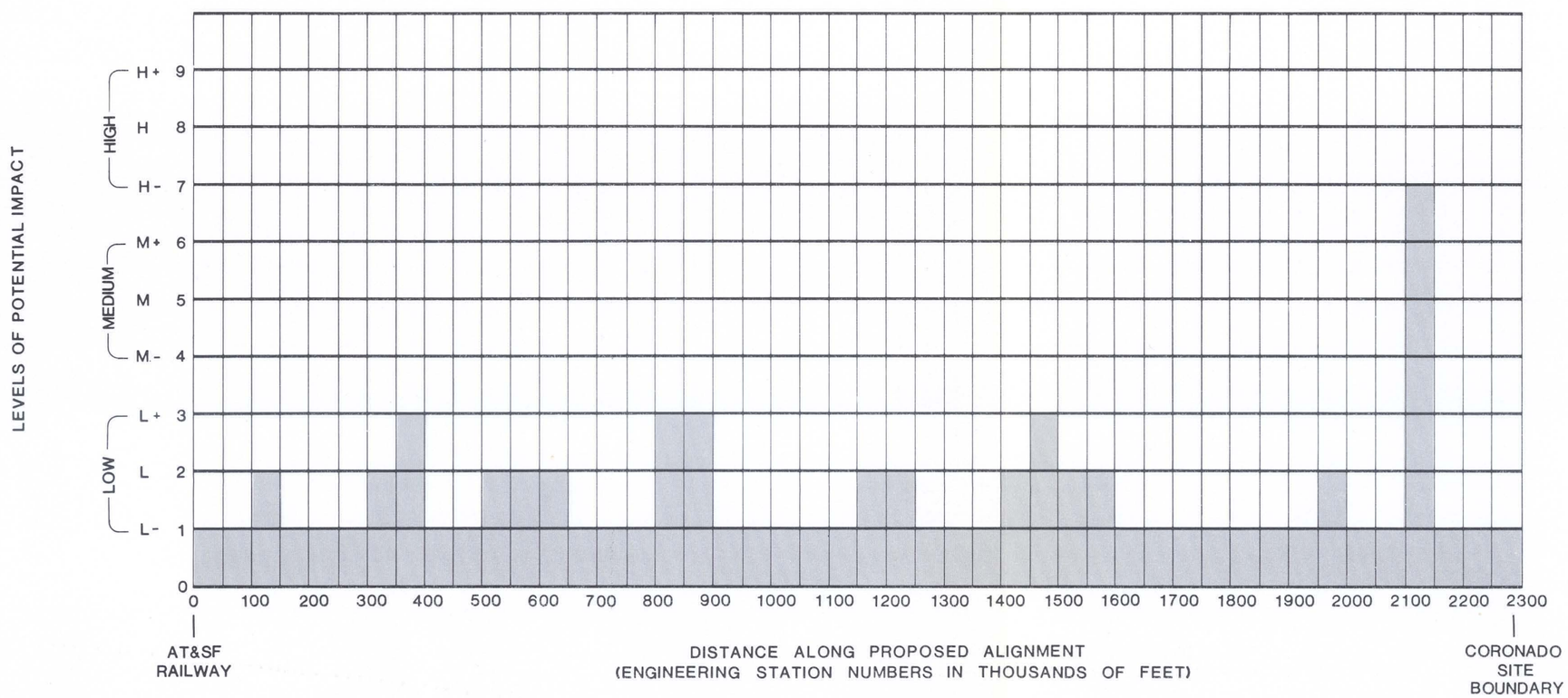
Because the location, volume, size and shape of borrow sources and waste sites have not been defined, it is not practical to estimate magnitudes of erosion from surfaces of borrow and waste sites. However, using the relatively small magnitudes of presently estimated need for borrow material provides some indication that erosion from borrow and waste surfaces will be considerably smaller than that from cut and fill surfaces. The slope gradient along the pipeline right-of-way is most pronounced near Black Ridge and in the badlands. Trenching the pipelines through these areas will create an erosion potential. The coarser upland soils and grass cover near Black Ridge should maintain a fair degree of stability with respect to runoff, but the badlands will erode easily due to the slopes, soil texture and lack of vegetative cover. Gully erosion should be minimal in upland areas, but more severe in badlands.

Erosion by Streams: The alluvial soils along the Little Colorado River are subject to severe erosion during flooding but are otherwise relatively stable due to vegetation cover and flat terrain. Some increase in erosion can be expected to occur along the Concho and Middle Field pipeline crossings as well as along the Concho Field line where it approaches the river in Section 30.

The alteration of flow hydraulics by railroad bridges or culverts across the typical intermittent stream of the area might tend to cause erosion in the vicinity of the structure and for some distance downstream; for an additional distance downstream, deposition would become the dominant, but diminishing, process until finally it becomes undetectable. Damming would cause ponding (unless diversion ditches along the embankment to the next culverted channel are present) and sediment deposition would occur in the pond. Such damming might be classified as beneficial, as are "conservation ponds" that are used to store water for local wildlife, stock, infiltration to the groundwater zone, and to reduce downstream erosion, sedimentation and flooding. Ponding also would tend to cause aggradation of sediment in the beheaded, downstream portion of the channel, which would no longer be subject to periodic flushing during times of high flow.

The opportunities for stream erosion and transport are greater along the several short segments of the alignment that cross the headwater areas of several small watersheds. Here surface slopes are relatively high, small, incised stream channels are numerous and existing natural erosion is moderately high.

The headwater areas that are most susceptible are located approximately between Stations 30 and 40, 53 and 55, 83 and 87 (Milky Wash), 115 and 125 (Beaver Dam Wash and Surprise Creek), and 140 and 160 (tributaries of Hardscrabble Wash, in Badland soils on or near Chinle formation). These locations of higher-than-average susceptibility to erosion and transport of sediment are components of "highs" shown on the impact graph, Figure II-46. There are no streams of appreciable size that flow parallel or adjacent to the proposed alignment which might



CORONADO PROJECT

Power Plant Spur
Coal Haul Railroad

LEVELS OF POTENTIAL IMPACT
ON GEOLOGY AND SOILS

Figure II-46

cause significant lateral erosion of the railroad's embankment. Because of the adequacy of proposed bridge and culvert designs and the self-stabilizing tendencies of the local conditions of hydrology, soils and geology, the potential for erosional impacts by railroad-influenced stream action is considered insignificant.

Sedimentation: Effects on sedimentation, as discussed here, include railroad-related transport or deposition of sediments upstream or downstream from the embankment. The volume of sediment that will be deposited in downstream channels and reservoirs as the result of railroad construction along the proposed alignment will probably be low for reasons similar to those related to erosion; it cannot exceed the volume of the upstream railroad-related erosion, which has been judged to be small. Furthermore, because of the very low runoff in some of the nearly flat areas of highly permeable, sandy soils that are common along much of the alignment, it is believed that, except for the finest-grained materials, much of the eroded material will become part of the typical sandy soils in the local area. This soil, in general, is classified by the U.S. Soil Conservation Service as having relatively low sediment yield to downstream area.

Long-term records, collected by the U.S. Geological Survey, show an average sediment discharge down the Little Colorado (Cameron) of ten million tons per year; a maximum concentration of 200,000 parts per million was recorded in 1966 (Winslow). Because of the small tonnage of expected railroad-related sediment production and sediment runoff, and the very high sediment concentrations and loads in the downstream Little Colorado and Puerco Rivers, the potential for downstream sedimentation impact is rated as low.

Impacts of Cutting and Filling: Cutting and filling along the railroad have been discussed as causes of erosional disturbances of land surfaces. Here the cutting and filling are considered to be direct effects, or impacts, on geology and soil due to railroad construction. Detailed calculations of the volumes and dimensions of cuts and fills that will be required along the alignment are being made by Bechtel Corporation.

Length of the railroad and topography were used as important criteria in selecting a location for the proposed alignment. The alignment was situated where the volumes of cuts and fills required would be minimal. Because of the resulting relatively low volumes of required cuts and fills, the impact on geology and soils, due to translocation of earth materials by cutting and filling, is considered to be low in comparison to that which would occur along other possible alignments in the area. Based on incomplete studies at the Navajo Generating Station, trace element emission from coal-fired power plants, especially from those with highly efficient fly ash control systems, is not a problem at the Navajo Station and is not expected to present a problem at the Coronado Station.

(2) Trace Elements

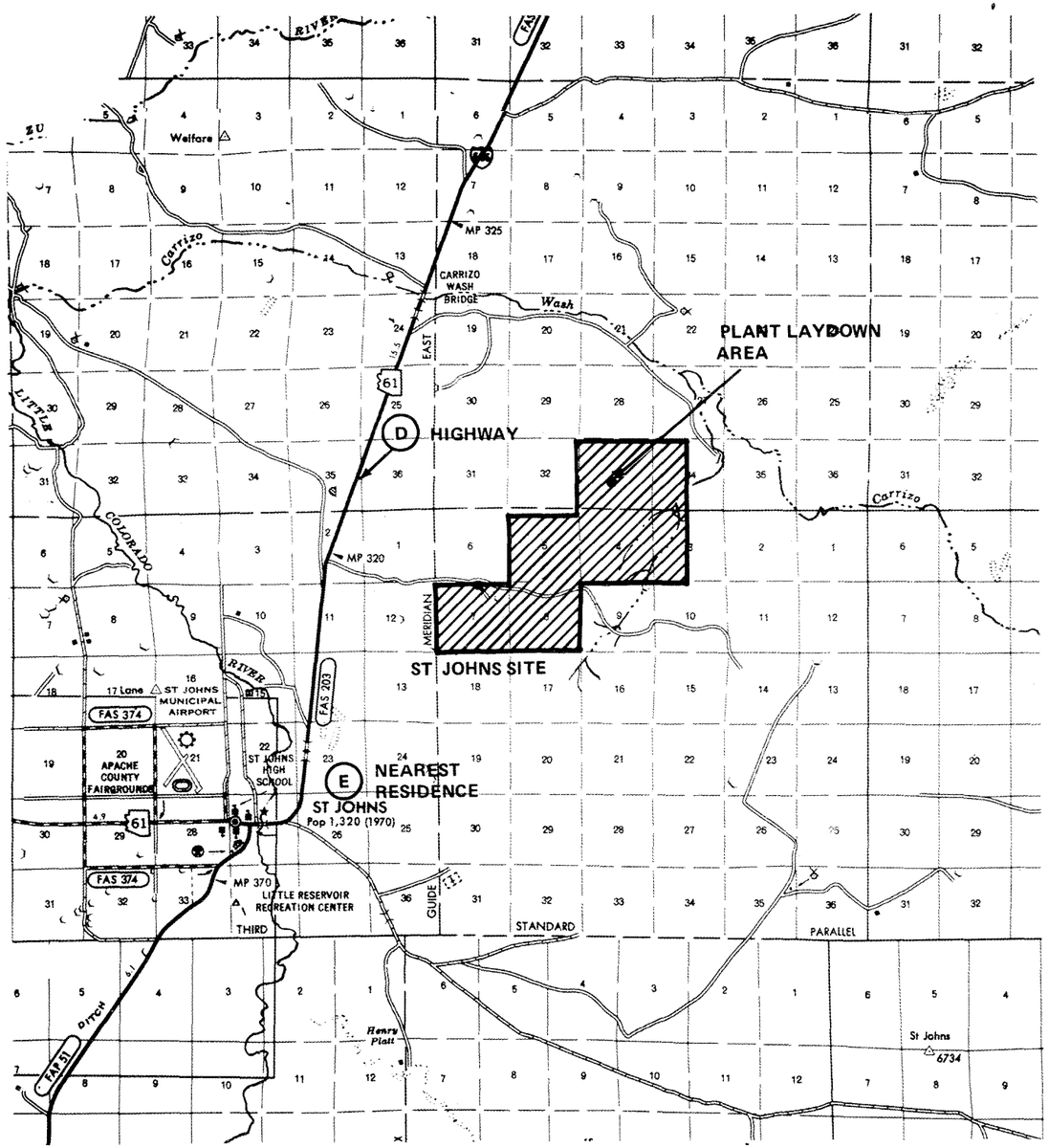
Based on incomplete studies at the Navajo Generating Station, trace element emission from coal-fired power plants, especially from those with highly efficient fly ash control systems, is not a problem at the Navajo Station and is not expected to present a problem at the Coronado Station, provided the coal furnished to the Coronado Station is similar in chemical composition to the coal at Navajo.

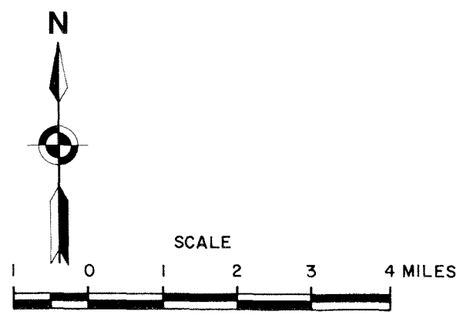
i. Acoustics

Noise from plant construction will vary throughout the construction period for Units 1, 2, and 3. Variables such as phase of construction, number and type of equipment, actual equipment location, equipment operating loads and weather conditions will affect the noise level. To assess the impact, worst case noise levels were established for various construction phases. The noise impact will be negligible due to the remoteness of the plant from populated areas and public roads (Figure II-47). In general, construction can be broken into four phases of activity, some occurring simultaneously: site preparation and excavation; concrete placement and building erection; equipment installation and testing; and, site cleanup.

The site preparation and excavation phase is expected to be the noisiest. Heavy construction equipment such as bulldozers, scrapers, loaders, trucks, rock drills and miscellaneous diesel-powered equipment will be used to grade and excavate the site. Pile driving and blasting will also occur during this phase. Worst-case noise levels for this phase are presented as a basis for assessing the impact of construction noise. The noise levels from other phases of construction will be approximately five to ten decibels (dB) lower, except for steam-blow operations which occur during the equipment testing phase. Steam-blow generally involves one to 12 periods of steam venting per day, lasting 15 to 30 minutes over a period of less than four weeks, as compared to site preparation and excavation activities lasting 22 months. Steam blow will be repeated for each unit.

Worst-case noise levels were developed for the St. Johns site. The continuous noise from site preparation and excavation will be quite similar for each plant site except for periods when blasting and pile driving occur. The St. Johns site will require pile driving before concrete placement and building erection begins. The pile driving and steam-blow were assumed to take place at the proposed laydown area of the plant. The resulting worst-case noise levels from construction activities at the St. Johns site are shown in Table II-43. Correcting for attenuation due to distance and atmospheric absorption, noise levels from on-site construction activities were estimated at the property boundary, at U.S. Highway 666, and in the town of St. Johns over six miles from the site center. These levels represent the contribution from construction activities only. Ambient noise levels along the highway or in the town of St. Johns may be in excess of these levels.





CORONADO PROJECT

Coronado Generating Station

ST. JOHNS CONSTRUCTION NOISE PREDICTION LOCATIONS

Figure II-47

TABLE II-43

CONSTRUCTION NOISE FROM ST. JOHNS SITE

Description*	Sound Levels re 0.0002 microbar in decibels adjusted to the A-weighted scale dB(A)		
	Continuous Noise Sources	Driving	Steam Blow
Site Boundary	55	56	76 to 108
D U.S. Highway 666	34	30	66
E St. Johns (nearest residence)	21	12	49

* Refer to Figure II-47

An effective, well accepted prediction technique for estimating the effect of noise is not available. However, some indication of the significance may be obtained by comparing the levels presented in Table II-43, with typical residual noise levels found in populated areas as shown in Table II-44. Excluding steam-blow, the continuous noise levels at the nearest residences, due to on-site construction, are less than typical quiet suburban residential areas, indicating that very little annoyance may be expected. In addition, the Department of Housing and Urban Development (HUD) criteria for noise are presented in Table II-45 as a guide for estimating the effect of construction noise from continuous noise sources and from steam-blow. For the St. Johns site the steam-blow noise falls within the HUD normally acceptable range at the nearest residences. The noise from continuous sources falls within the HUD acceptable range at the nearest residence to each site.

TABLE II-44

APPROXIMATE DAYTIME RESIDUAL NOISE LEVELS (L_{90}) FOR URBAN AND SUBURBAN DETACHED HOUSING RESIDENTIAL AREAS

Residential Noise Classification	Daytime Residual Noise Level in decibels adjusted to the A-weighted scale- dB(A)	
	Typical Range	Average
Quiet suburban residential	36 to 40 inclusive	38
Normal suburban residential	41 to 45 inclusive	43
Urban residential	46 to 50 inclusive	48
Noisy urban residential	51 to 55 inclusive	53
Very noisy urban residential	56 to 60 inclusive	58

TABLE II-45

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT (HUD)
CRITERIA FOR NOISE

HUD Range	Noise Level for 8 Hour Exposure in decibels adjusted to the A-weighted scale-dB(A)
Unacceptable	75
Normally Unacceptable	65 to 75
Normally Acceptable	45 to 65
Acceptable	45

The noise produced by blasting is typically very low frequency and is felt as well as heard. Because of the nature of the sound, the eight-hour HUD criteria is not applicable to blasting noise. However, blasting noise levels between 70 to 80 dBa may be estimated to result in little annoyance and are described as normally acceptable.

Sound levels that will be produced by the construction and operation of the proposed railroad have been estimated and used to evaluate the potential impacts on the public health and welfare of existing populations near the proposed alignment. Railroad noise contributes to a change in the local environment in two ways. First, construction of the rail line, subgrade and bridges are distinct activities which will produce short-term impacts on sound levels. Secondly, the operation of the railroad will produce a long-term impact of noise along the route.

Table II-46 lists most of the equipment that will be used to construct the coal haul railroad. Most acoustical impacts will be from the operation of the equipment. Impacts may also be expected in areas where drilling and blasting are required in the cuts. Analysis indicates that no people will be exposed to sound levels in excess of 75 dB for 8 hours or more at a distance of 500 feet from construction activities. Hearing damage risk occurs above 75 dB.

TABLE II-46

EQUIPMENT TO BE USED DURING CONSTRUCTION
OF THE COAL-DELIVERY RAILROAD

EQUIPMENT TO BE USED	
Number of Pieces	Type
40	Scrapers
10	Bulldozers
10	Water Trucks
6	Compactor
6	Concrete Truck
2	Service Trucks
1	Rail Train
1	Locomotive
1	Ballast Train
1	Pile Driver, rail tamping and alignment equipment

Train passby noise will be the principal source of noise during the operational phase. Although noise periods will be of relatively short duration, this is considered a long-term impact due to the long-term operation of the line.

The fractional impact and equivalent population impacted at various distances from the right-of-way are listed in Table II-47. The equivalent population impacted along the proposed alignment is nine. That is, of the 22 people along the right-of-way, an equivalent of nine people will be impacted to some degree. It is estimated that four residents could be highly annoyed by the railroad operation.

TABLE II-47

EQUIVALENT POPULATION IMPACTS
DURING OPERATIONAL PHASE ALONG PROPOSED ALIGNMENT

General Location		Equiv. Day/Night Sound Levels, L_{dn}			Impact Assessment	
Area Represented By	Distance X (feet) from Centerline	Background Only (dB)	Operation w/ Background (dB)	Fractional Impact FI (%)	Increment of Population P_I	Equivalent Population Impacted P_{eq}
Zone I	X=75	43	70	100	0	0
	75≤X<145	43	65	75	0	0
	145≤X<280	41	58	50	0	0
	280≤X<680	40	51	25	0	0
	680≤X	39	44	0	0	0
Zone II	75≤X<85	40	67	100	0	0
	85≤X<160	40	63	75	0	0
	160≤X<280	40	58	50	8	4
	280≤X<760	40	52	25	10	3
	760≤X	38	43	0	0	0
Zone III	75≤X<160	33	62	100	0	0
	160≤X<290	33	57	75	0	0
	290≤X<630	33	51	50	4	2
	630≤X<1350	33	45	25	0	0
	1350≤X	33	38	0	0	0
				Totals	22	9

Notes:
1. Data shown in Column (2) are the distances from the center of the right-of-way to the boundaries separating the areas of average Fractional Impact listed in Column (5).
2. The L_{dn} values in Column (4) are the averages for these areas.

4. Impact on Biological Environment

The biological impact of construction will be harsh in the immediate area of the plant site and pipelines, with a lesser impact on the wellfields. Because the area used for plant facilities will be cleared and graded, there will be a total loss of habitat. The impact decreases in intensity as the distance from the plant increases. There are no indications that any major biotic feature will be destroyed or disrupted beyond the general area of the plant. The impact will be localized and not affect any specific biotic factors through a broad area of the biotic community.

a. Aquatic Biology

The proposed plant construction activities will have little effect on the aquatic biology of the study area. However, the pipelines will cross the Little Colorado River north of St. Johns. By trenching these pipelines across this stream, portions of that habitat used by waterfowl and other marsh dwellers will be temporarily eliminated. These impacts will be primarily short-term though, because it is assumed that the riparian vegetation will recover in time. Trenches and access roads will not interfere with the strands of riparian community in the area of the Concho Creek crossing because the riparian woodland does not form a continuous belt along the pipeline crossing.

b. Terrestrial Biology

(1) Range Vegetation

Wellfields: The combined acreage of the wellfields is 8,080 acres of primarily grassland. Only a small portion of the vegetation will be removed at each well site. The combined total of the gathering reservoir, service roads to the well sites, and the electrical facilities is estimated to be ten acres. The undisturbed areas will still be available for grazing purposes. In addition, trenching the water pipelines will cause the temporary loss of vegetation along the pipeline right-of-way. The total vegetation eliminated amounts to about two acres per mile of pipeline, or about 64 acres. It is expected that this vegetation will recover in two to three years.

Limestone Source: A total of 474 acres of grazing land, some of which is sparsely vegetated, will be removed in the mined area.

Vegetation at the Plantsite: Approximately 2,500 acres of grassland, shrubs, pinyon and juniper in the powerplant site will be removed for the power block, evaporative ponds, sanitary disposal ponds, ash disposal area, permanent and temporary buildings and facilities and access roads.

Railroad: Potential impacts on the ecology along the proposed alignment can be described as both short-term and long-term.

Short-Term Impacts: Short-term impacts will be local and will have relatively little effect on the balance of broad biotic communities. Short-term impacts on the habitat will be limited to cut and fill areas during construction, and similar areas for the railroad beds after construction. These areas represent approximately 550 acres that will be devoid of vegetative cover. Such areas have potential for developing habitats but, until plants become established on their surfaces, they will contribute nothing in the way of energy flow to the ecosystem.

Even though succession in this semi-arid region is relatively slow, the first stages of succession (encroaching annuals) will undoubtedly become established on much of the bare soil during the first year. Perennial establishment will depend largely on soil types and slope, rainfall pattern, seed source and size of the bare area. This could take several years but will eventually occur. The time required can be shortened by planting.

Long-Term Impacts: Most of the actions of construction and operation will produce long-term impacts on the ecosystem. The major long-term impacts will be associated with habitat disruption or removal.

Habitat Removal: As shown in Table II-48, approximately 526 acres of existing surface habitat on the railroad beds and cut and fill areas will be destroyed. In the case of cuts, surface removal will alter productivity on 236 acres. With the roadbed and fills, the existing surface and its habitat will be covered, rendering the land unproductive as long as the railroad remains.

TABLE II-48

HABITAT DESTROYED IN THE RAILROAD BED

Vegetation Community	Percentage	Acres
Juniper	25	131
Grassland	60	316
Sagebrush	10	53
Badlands	4	21
Riparian	1	5
TOTAL	100	526

Habitat Disturbance: Much of the habitat disruption is discussed under short-term impacts because the disrupted area will become productive again. It is, however, possible that the railroad will indirectly affect the surrounding habitat and change the plant growth.

Although the roadbed and fill areas will be designed so that runoff water is not impounded, there will be temporary impounding in some areas. This will increase the time available for the soil to absorb water. The resulting increased soil moisture will tend to cause the border areas to produce a more lush vegetation than that produced in surrounding areas.

The channeling of water through culverts will have a negligible effect on the arroyo vegetation because most of the surface area of the alignment is loose sand that does not support riparian or pseudo-riparian vegetation.

(2) Wildlife

Disruption of Habitat: Animal habitat will be thoroughly disrupted within the powerplant, wellfield, limestone source and much of the railroad alignment area. Construction will remove habitats that support short-ranging mammals, chiefly rodents, now occupying the area. It will also affect, but not eliminate, mammals that range up to five miles, such as rabbits, badgers, foxes, skunks and porcupines. The site alteration will destroy some of this habitat and force the residing mammals to migrate to the territories of their neighbors. The habitat removal will have little effect on the wide ranging mammals except to eliminate a portion of their range, thus causing a change in their daily or seasonal movements. Bird species maintaining small breeding territories within the site area will be affected by the habitat disruption, since that part of their territory will be unavailable for nesting and feeding. This will result in a lessening of community productivity since many breeding birds are territorial. The displaced individuals will be forced to crowd into the surrounding territories. Most reptiles living on the sites will probably not survive the site alteration due to their typically small range. The impact of habitat disruption will not be limited to the immediate site. Shock waves will move outward and affect the surrounding community. For instance, those animals uprooted from their habitat and forced to move will have to compete with their neighbors in the surrounding areas for the available food supply. Those not successful in this competition will perish. In general, though, the effects will be limited to a small area around the sites.

The water pipeline from the Middle Wellfield will run adjacent to a white-tailed prairie dog colony along a road north of St. Johns on the Section 5-6 boundary. The pipeline, access road and 500 kV line will pass along the south edge of the colony.

Some of the burrows will likely be destroyed and the loss may interfere with the territorial behavior of the entire colony of about 100 prairie dogs. This could result in reduction or even elimination of the colony.

Dust: Dust could interfere with the feeding and breeding behavior of many species of birds and mammals that live a distance away from the actual construction sites, causing them to avoid these areas. These adjacent areas that are avoided would result in a decrease of productivity compounding that decrease caused by disruption of the actual site.

Erosion: Erosion could cause plants in lower areas to be covered with silt. This would affect the plants and also the animals dependent on these plants.

Human Interference: Man's increased presence will have both direct and indirect effects on some of the fauna of the general area. Some raptors (hawks, eagles and owls) are sensitive to man's presence. Antelope, though tolerant of some human encroachment, generally shy away from areas where people concentrate.

Emissions: Emissions from the plant operation will be within the Federal and state standards. Since these standards are based on the best available knowledge of safe limits, no damaging effects to animals are anticipated from emissions.

Barrier Effect: The long-term barrier effect applies to two types of animals: the large wide-ranging ungulates and the small migrating amphibians. The movements of deer and antelope will be affected by railroad construction only in areas where cuts exceed five feet. Movements of antelope will be affected in areas where the fills exceed 3.5 feet. The length of the cut or fill also will affect the degree of disruption of movement; short cuts or fills can easily be negotiated in suitable terrain by skirting the ends. The fills that cross wide valleys and are higher than the 41-inch eye-height of the antelope will block the vision of antelope. Fills of 41 inches will not prevent antelope from actually crossing the tracks, but since sight is important in antelope behavior, obstacles to their normal view can result in a change in their use of the range. Very high fills that cross valleys, will serve as restricting obstacles essentially dividing valleys into two separate ranges. In general, the deep cuts and high fills will not be of sufficient length to be more than a minor obstacle to the daily or seasonal movements of deer and antelope. It is possible that the barrier effect created by the railroad will have a greater impact on small migrating amphibians than it will on deer or antelope. The small land-dwelling migrants in this area include five species of amphibians. These amphibians, in their migrations from upland habitats to breeding areas, could be stopped by the railroad tracks. The

size and structure of these animals is such that they will be unable to get over the rail. In most instances, the railroad bed materials will impede their movement and prevent their passing under the rail. This effect will be minimized in areas with culverts and bridges. In very few cases would the barrier effect be absolute.

The construction of the water pipelines may produce a barrier effect similar to that caused by the railroad. The pipeline will extend over some 34 miles and will, at least during the construction phase, form an ecological barrier to the small and less mobile animals.

Wildlife Road Kills: Moving trains will undoubtedly kill some wildlife, but how many is unknown. The number generally depends on population density. The species most likely to be killed are mule deer, antelope, rabbit (cottontail and jackrabbit) and carnivores (coyote, fox, skunk and badger). The two big game species, deer and antelope, have relatively low densities in this area and the road kills should be few. The killing of rabbits and carnivores will tend to fluctuate with the population. It is doubtful that road kills will destroy a significant number of the animals.

Poaching-Littering-Vandalism: Human entry into undeveloped areas depends on the availability of roads. Littering, vandalism and poaching are related to access. Only slight changes in access will result from the railroad construction. In the corridor there now exists approximately 205 miles of roads. Road systems were recorded in 39 of the 42 segments of the corridor. Since access is presently open to the corridor, it is unlikely that construction of the railroad will substantially alter the human impact on the area.

Fences: The impact analysis assumed that if fences were constructed, they would be designed so no barrier effect on wildlife would occur. The type of fencing, if any, used on Federal land would be subject to approval by the BLM, and wildlife requirements would be taken into consideration. Fencing on private land would be at the option of the landowner.

The effects of fences on pronghorn antelope movement and survival has been the focus of much research. Artificial barriers such as woven wire fences, seven strand barbed-wire fences and highway fences are definite obstructions to pronghorn movement. The types of fence that present the most serious obstructions to the pronghorns were right-of-way fences near railroads and highways, and woven-wire fences that extended for long distances across the open range.

Pronghorns, under normal circumstances, are reluctant to pass through any fence unless there is an opening between the ground and the bottom wire. Open range fences are no problem to antelope; they simply dive through or under the strands of wire. However, right-of-way fences of paige-wire construction are apparently impassable for the majority of antelope. Antelope losses in Arizona have been caused by restraining fences that impede antelope movement. It is generally agreed among wildlife managers that many types of fences serve as absolute barriers to antelope and that whole herds can be lost if their movements are restrained by such fences.

In light of present knowledge, the construction of antelope-proof fences along the right-of-way of the proposed railroad would be a destructive action and would produce an unacceptable impact, in that the action could cause a permanent alteration of the biotic community in the loss of one of its species members.

(3) Threatened or Endangered Species

There are five endangered and two threatened species whose range could possibly include portions of the project area. The endangered species are the Southern Bald Eagle, the Peregrine falcon, the Brown pelican, the Mexican wolf and the Black-footed ferret. Only two of these species - the Southern Bald Eagle and the Prairie falcon have been reported as sighted within the St. John's area.

Three Southern Bald Eagles were observed in the study area in marshlands near Zion Reservoir during the March bird census. Two sightings of this bird have been made in the St. Johns area. One bird was seen at Conchos Lake, which is about 15 miles southwest of the study area. These eagles are known to inhabit the White Mountains.

The study area is within the original breeding and wintering range of the Peregrine Falcon. During migration, this bird is found throughout the state. However, no sightings have been made during the course of this study, or during the course of previous studies. Its presence in the study area is doubtful, though, because it prefers to nest in cliffs.

The Brown pelican may possibly frequent the lakes in the study area. No sightings have ever been reported in the St. Johns area. No records of the Mexican wolf in the project area have been documented. But since this wolf is so wide ranging, it could possibly occur in the area. The last sighting of the Black-footed ferret in Arizona was made in 1929. This ferret is known to prey on prairie dogs and there are colonies of prairie dogs spread throughout the study area. Although it is possible that the ferret may occur in the project area, it is extremely doubtful.

The Prairie falcon has been frequently sighted in the study area. A road-killed falcon was recorded on Highway 61, ten miles west of St. Johns. This bird nests in bluff areas over wide areas of the plains.

The Spotted bat could possibly occur in the project area. It is doubtful, though, because this bat prefers wooded areas to open plains. No sightings have been recorded.

The Coronado Project is not expected to have any impact on these threatened or endangered species.

5. Impacts on Social and Cultural Environment

a. Attitudes and Lifestyles

Beginning in 1975, changes resulting from the Coronado plant became obvious. The traditional Spanish American/Anglo dichotomy was diluted by newcomers who did not fit all the criteria of either group. For example, there were Catholics who were not Spanish Americans, Anglos who were not Mormon, and construction workers with social, cultural and economic backgrounds new to the area. This group of construction workers, for example, included eight Negroes, a racial group new to the area. Inevitably, all elements of the population suffered a certain amount of cultural shock. Probably the most significant cultural dichotomy was between the construction workers and the established area residents. The temporary status of most construction workers and their families added to this problem. Such problems were anticipated by city and county business and political leaders and SRP and Bechtel Managers.

By late 1976, the Mormon and Catholic Churches in St. Johns had been supplemented by a small Methodist congregation which was meeting in the Catholic Church and a Southern Baptist congregation which was meeting in a mobile home on a site obtained with the assistance of Mormon leaders. The Catholic Church had grown by approximately 60 families. Several professionals had moved to the area including an attorney, chiropractor, optometrist, and a dentist. These people generally had cultural ties to the area. Others with cultural ties were training with SRP for future positions or were planning moves when employment conditions were right.

Recreational activities in the area were supplemented by the opening of a movie theatre, several restaurants and bars, and a citizens band radio shop. Increased use of off-road vehicles was noted by several local observers.

In general, the changes taking place in the St. Johns area are similar to the changes which occur in any small community impacted by a new, large industry. St. Johns is handling the changes with a minimum of dislocation; most people are emphasizing the positive aspects of change and working to meet the new challenges.

b. Demography

In 1960, the city of St. Johns had a population of 1,310. In 1970, the population was 1,320. On November 18, 1975, the U.S. Bureau of the Census reported a total population in St. Johns of 1,838. The 1975 figure reflects only the early stages of the Coronado Plant development, yet it represents a 39 percent increase over the 1970 population figure.

Table II-49 describes the characteristics of the 1975 population. The net difference of 518 persons over the 1970 population had resulted in the following changes: the percentage of persons under 18 years of age had decreased from 47.6% to 42.6%; the percentage of persons between 18 and 64 was 50.1%, as compared to 44.5% in 1970; and the percentage of persons over 66 was 7.9, compared to 7.3 in 1970. The median age had risen from 19.7 to 23.8 and the number of males had grown by 46.3% while the number of females had grown by 32.6%. These figures represent the situation in November of 1975 at the beginning of demographic change induced by Coronado construction. It is likely that subsequent changes will continue the trend toward normalization of the age structure of the population.

Table II-49

ST. JOHNS, ARIZONA: AGE, RACE, AND SEX OF POPULATION, NOVEMBER 18, 1975

	All Races			
Age:	Total	Male	Female	Total Non-white
Under 18 years	783	388	395	8
18-29 years	253	132	121	2
30-39 years	246	125	121	3
40-49 years	185	100	85	1
50-59 years	169	78	91	0
60-64 years	67	37	30	0
65-79 years	109	60	49	0
80 years or more	26	15	11	0
Total	1,838	935	903	14
Median Age	23.8	24.6	23.1	--

Source: United States Bureau of the Census, 1975 Special Census.

The change in employment patterns for St. Johns between 1974 and 1976 has been substantial. The number of full-time employees increased over three times the 1974 figure. (Table II-50) Although almost 80 percent of the increase was in construction, trade, service,

TABLE II-50

St. Johns, Arizona: Business Increases Between November, 1974 and November, 1976 -- Number of Employees Added by Sector

Sector	Total Employees Added	Full-Time Male	Full-Time Female	Part-Time Male	Part-Time Female
Agriculture and Agricultural Services	--	--	--	--	--
Contract Construction	542	512	26	1	3
Manufacturing	6	3	2	0	1
Mining	--	--	--	--	--
Restaurants and Bars, Service Stations	40	10	13	3	14
Hotels, Motels	4	2	2	0	0
Other Services	25	9	6	1	9
General Retail Trade	40	17	10	6	7
Wholesale Trade	0	0	0	0	0
Finance, Insurance, Real Estate	13	4	8	0	1
Transportation, Utilities and Communication	7	6	1	0	0
Local Government and Public Schools	35	22	11	0	2
TOTAL	712	585	79	11	37

Source: by survey, November, 1976.

and government-schools also registered impressive gains. Similarly, growth of part-time employees was especially strong in the trade and service sectors. The decline of part-time employees in the government-schools sector is in part due to the fact that some part-timers were upgraded to full-time status in anticipation of increases in activity. In November, 1976, approximately three-fourths of St. Johns' employees were supported by revenues coming into the community from the outside and about an equal number are supported by sales not to private households but to firms and governmental organizations. This indicates the economic life of St. Johns is largely dependent on the revenues generated by both public and private sector firms outside the city. The total number of FTE (full-time equivalent) employees found in St. Johns is 1041 (Table II-51). Incommuters are defined as those who live more than 10 miles from town. The number in each sector varies widely - the leader is construction with 39 percent. Next are manufacturing (17 percent), retail trade (14 percent), and government and schools (11 percent). The adjusted FTE employment figures were used to estimate the economic base multiplier. The multiplier is used to estimate the role that basic employees (those supported by customers located outside the region) play in supporting workers who serve the local population. Table II-52 shows the estimated number of employees required to serve both local and non-local customers and the methodology by which the multiplier was calculated. The multiplier is 1.47, i.e., every basic worker resident in St. Johns supports 0.47 additional employees.

The transactions of St. Johns employers are described in Table II-53. The bulk of the to-from matrix describes sales between St. Johns firms and agencies. Relatively little employment is supported by local transactions between firms. Sales to (or revenues from) private households provide a moderately important source of income for local firms and governmental agencies. Outside income is the most important source of support for five of the 12 sectors and for by far the largest number of St. Johns employees.

A significant portion of Coronado employees live in the region surrounding St. Johns. Over one-third come from the Springerville-Eager area, next in importance is Concho-Concho Valley (27 percent) followed by Show Low (9 percent) and Lakeside-Pinetop, Snowflake-Taylor, and Holbrook-Joseph City, each with 6-7 percent. The relatively large number of in-commuters suggests that a substantial amount of potential revenue is lost by St. Johns merchants. This is balanced by the fact that St. Johns has been spared the full impact that has come with the Coronado Plant - outlying communities are receiving the benefits of modest growth but, with the possible exception of Springerville-Eager, growth has not been so great or so rapid as to cause major dislocations in these outlying communities.

Table II-54 gives the origin of employees added to the work force between November, 1974 and November, 1975 and it gives the place of residence for "local hires" -- established residents of the region who were hired by St. Johns employers since 1974. The first column

TABLE II-51

St. Johns, Arizona: Estimated FTE Employment, by Sector

Sector	Total FTE Employment (unadjusted FTE)	In-Commuters	Total FTE Employment less In-Commuters (Adjusted FTE)
Agriculture & Agricultural Services	--	--	--
Contract Construction	545.25	215.02	330.23*
Manufacturing	28.42	4.70	23.72
Mining	0	0	0
Restaurants & Bars, Service Stations	52.92	3.00	49.92
Hotels, Motels	12.31	1.00	11.31
Other Services	44.23	.47	43.76
General Retail Trade	84.94	11.50	73.44
Wholesale Trade	3.23	0	3.23
Finance, Insurance, Real Estate	35.09	2.71	32.28
Transportation, Utilities & Communication	33.00	1.00	32.00
Local Government & Public Schools	201.25	23.00	178.25
TOTAL	1,040.64	262.40	778.24

Source: by survey, November, 1976.

*This figure includes construction workers who are a) local hires, b) weekly commuters, c) relocated households, and d) construction camp residents. Estimate is based on Bechtel survey of 9-13-76.

TABLE II-52

St. Johns, Arizona: Source of Support of

FTE Employment (adjusted) and Economic Base Analysis

Sector	FTE Employment Supported by Sales		
	Local Customers	Non-Local Customers	Total
Agriculture & Agricultural Services	--	--	--
Contract Construction	5.04	325.19	330.23
Manufacturing	13.96	9.76	23.72
Mining	0	0	0
Restaurants & Bars, Service Stations	40.70	9.22	49.92
Hotels, Motels	2.10	9.21	11.31
Other Services	34.00	9.76	43.76
General Retail Trade	61.18	12.26	73.44
Wholesale Trade	2.52	0.71	3.23
Finance, Insurance, Real Estate	24.79	7.59	32.38
Transportation, Utilities & Communication	7.66	24.34	32.00
Local Government & Public Schools	61.92	116.33	178.25
TOTAL	253.87	524.37	778.24

Total FTE resident in St. Johns = 778.24
Plus Out-commuters 12.00
790.24

Total Basic FTE resident in St. Johns = 524.37
Plus Out-commuters 12.00
536.37

$$\text{Multiplier} = \frac{\text{Total adjusted FTE}}{\text{Total adjusted Basic FTE}}$$

$$= \frac{790.24}{536.37}$$

$$= 1.47$$

Source: by survey, November, 1976.

TABLE II-53

TO-FROM MATRIX

FROM (Sales by) / TO (Sales to)	Agri-culture	Con-struction	Manufac-turing	Mining	Restaurants, Bars and Service Stations	Hotels, Motels	Other Services	General Retail Trade	Whole-sale Trade	Finance, Insurance, Real Estate	Transpor-tation, Utilities and Communi-cation	Govern-ment
Agriculture and Agricul-tural Services	N/A	.39	.29	0	.08	.05	.62	.44	0	3.18	.13	6.00
Contract Construction	N/A	1.41	3.29	0	.75	1.59	1.33	6.63	.41	2.21	1.00	.36
Manufacturing	N/A	0	.60	0	0	0	0	0	0	0	0	.07
Mining	N/A	0	0	0	0	0	0	.04	0	0	0	0
Resaurants and Bars, Service Stations	N/A	.10	.57	0	.04	0	.38	.26	.10	.18	.24	1.18
Hotels, Motels	N/A	.06	.02	0	0	0	.01	.03	.04	.07	.07	.58
Other Services	N/A	0	.04	0	0	.02	2.48	.31	.10	.22	.06	.08
General Retail Trade	N/A	.21	.73	0	.08	.02	.40	.25	.51	.57	.19	6.59
Wholesale Trade	N/A	0	.03	0	0	.02	0	0	0	.02	0	.09
Finance, Insurance, Real Estate	N/A	.28	.03	0	0	.02	.05	.07	.02	.36	.12	.06
Transportation, Utilities and Communication	N/A	.01	.01	0	.35	.04	.01	.20	.04	.20	.06	32.28
Local Government and Public Schools	N/A	.06	.82	0	.86	0	2.00	2.16	.81	1.62	.63	3.72
	N/A	(2.52)	(6.43)	0	(2.16)	(1.76)	(7.28)	(10.39)	(2.03)	(8.63)	(2.50)	(51.81)
Households	N/A	2.69	7.80	0	38.56	.48	26.89	52.36	.49	16.62	5.15	15.65
Export	N/A	539.93	11.52	0	10.42	10.03	9.92	14.82	.71	8.28	25.34	132.59
Total Employment	N/A	545.25	28.42	0	52.92	12.31	44.23	84.94	3.23	35.09	33.00	201.25
Number of Firms	N/A	3	5	0	16	1	21	28	1	8	3	12

TABLE II-54

St. Johns, Arizona: Source of Employees Added

Between November, 1974 and November, 1976, by Sector

Sector	Returning Former St. Johns Resident	Established St. Johns Resident	New Arrival	Daily Commuter From: Springer-ville-Eagar	Pinetop-Lakeside	Show Low	Concho	Snow-flake-Taylor	Winslow	Saldo	Holbrook-Joseph City	Witch Well
Agriculture and Agricultural Services	--	--	--	--	--	--	--	--	--	--	--	--
Contract Construction*	N/A	43	430	17	5	11	5	7	5	5	11	--
Manufacturing	--	2	3	--	--	1	--	--	--	--	--	--
Mining	--	--	--	--	--	--	--	--	--	--	--	--
Restaurants and Bars, Service Stations	--	26	9	--	--	1	--	--	--	--	--	--
Hotels, Motels	--	2	2	--	--	--	--	--	--	--	--	--
Other Services	2	6	5	--	--	--	--	--	--	--	--	--
General Retail Trade	--	20	14	--	--	--	2	--	--	--	--	1
Wholesale Trade	--	--	--	--	--	--	--	--	--	--	--	--
Finance, Insurance, Real Estate	--	3	8	1	--	1	--	--	--	--	--	--
Transportation, Utilities and Communication	--	3	28	--	1	--	--	--	--	--	--	--
Local Government and Public Schools	6	13	12	1	--	--	1	--	--	--	--	--
TOTAL	8	118	511	19	6	14	8	7	5	5	11	1

Source: by survey, November, 1976.

*Estimated from data provided by Bechtel survey of 9/13/76.

indicates that few former residents have yet to return to St. Johns. It is expected that this number will increase as the local employment situation begins to stabilize and as the Coronado project shifts from the construction phase to a more stable operating phase. The second and third columns indicate that large numbers of both established residents and new arrivals have been integrated into the economic structure of the community. With the exception of the construction sector, most expansion of employment in the St. Johns area has come by hiring established residents or new arrivals -- very few of the new hires are established residents of surrounding communities.

Based on the information generated thus far, it is possible to estimate future impacts. Table II-55 shows the expected employment at the end of the first quarter of the year indicated. These figures assume that unit #2 will become operational in late 1980 or early 1981. The railroad construction is assumed to begin in June 1977 and continue for approximately 15 months (Table II-56). Initially, more workers will be located at the Navajo end of the railroad with emphasis switching to the St. Johns end toward the end of the construction period. Water wellfield and pipeline construction will be carried out by regular SRP employees working on a weekly basis from early 1977 through late 1979. Total employment will peak during early 1978 at a level of 2248.

In order to determine the make-up of the construction employees, an investigation was made into the experience of Bechtel Power Corporation at both their Cholla and Coronado construction sites. Characteristics of the workers at these sites have been used in predicting the population, housing demand, and students resulting from the relocated construction work force. Table II-57 indicates the impact of the Coronado work force on the town of St. Johns.

Table II-55

TOTAL CONSTRUCTION AND OPERATING WORK FORCE

IQ Year	Plant Construction	RR Construction	Wellfield and Pipeline Construction **	Operating
1976	400	0	0	0
1977	981	0	45	0
1978	1,853	205*	30	160
1979	1,281	0	15	283
1980	293	0	0	420
1981	0	0	0	420

Data given are for end of first quarter of year indicated.

*Estimate for March, 1978; 120 of these workers are in St. Johns, and 85 are in the Navajo area.

**All assumed to be weekly commuters.

Sources: Bechtel Power Corporation, Community Impact St. Johns, October, 1976, Salt River Project.

Table II-56

RAILROAD CONSTRUCTION

Year/Month	Number of Employees Based in St. Johns	Number of Employees Based in Navajo
1977		
July	20	120
August	41	169
September	59	181
October	68	162
November	85	160
December	103	157
1978		
January	112	138
February	117.5	117.5
March	120	85
April	53	27
May	52	18
June	54	11
July	37	3
August	5	0

Source: Derived from estimates by Bechtel Corporation, March, 1977.

In order to determine the make-up of the construction employees, an investigation was made into the experience of Bechtel Power Corporation at both their Cholla and Coronado construction sites. Characteristics of the workers at these sites have been used in predicting the population, housing demand, and students resulting from the relocated construction work force. Table II-57 indicates the impact of the Coronado work force on the town of St. Johns.

TABLE II-57

Work Force Impact on St. Johns

Year	Operating Work Force	Local Construction	Relocated Construction	Total Full Impact	Reduced Impact	Reduced Impact Adj.	Full Impact Equivalent
1976	0	35	146	181	120	24	205
1977	0	87	358	445	338	68	513
1978	128	172	705	1005	608	122	1127
1979	226	114	468	808	398	80	888
1980	336	26	107	469	88	18	487
1981	336	0	0	336	0	0	336

Table II-58 shows the expected addition to St. Johns non-weekly population. The implications of Coronado Plant growth for the area which surrounds St. Johns are based on the existing geographic distribution of construction workers. During the last quarter of 1976, the vast majority of weekly and relocated workers were located in the St. Johns area. When weighted in terms of full impact equivalents 71 percent of the impact was falling on St. Johns and 29 percent was falling on other communities in the region.

Table II-58

NON-WEEKLY POPULATION ADDED TO ST. JOHNS

Year	Supporting Population	Locally Hired Population	Relocated Population	Operating Population	Total Population
1976	210	117	390	0	717
1977	571	285	956	0	1,812
1978	1,040	557	1,882	414	3,893
1979	838	364	1,249	721	3,172
1980	650	82	286	1,055	2,073
1981	524	0	0	1,055	1,579

The impacts of both construction and operation of the plant on the region outside of the immediate St. Johns area will be widely dispersed, so the impact on any particular community will not be excessive. There will also be leakage of shopping out of St. Johns to other communities in the region. This may be especially true during the peak construction period when local suppliers are reluctant to expand their operations for what they view as only a temporary increase in sales. It is expected that this leakage will primarily flow to the Show Low area, which is presently taking on the characteristic of a regional shopping chenter.

It is estimated that railroad construction crews will be working out of the Navajo area for 13 months starting in July, 1977. Employment estimates range from a low of 3 in July, 1978 to a high of 181 in September, 1977; monthly average is 104. Resulting impacts on the Navajo-Houck area will likely be minor and will require no formal mitigation programs. Some construction workers can be expected to commute from distant centers such as Holbrook whereas others will be weekly commuters who will make only modest demands on local establishments. Workers who do relocate to this area will likely be scattered along the 12 miles of Interstate 40 that separates Navajo from Sanders. This relatively small group of short-term residents can be expected to purchase a few basic items locally and, like long-time residents, journey to Holbrook, Gallup, or some larger center for most goods and services.

Construction of the third unit at the Coronado Generating Station was originally planned for an in-service date of 1981, but is presently scheduled for the mid-1980's. The schedule will depend upon load growth in the Salt River Project's service area over the next few years. Because no firm estimates of the construction curve and schedule are available, the impacts of third unit construction cannot be definitively assessed. Preliminary analysis indicates that impacts will be much less severe than those associated with construction of units one and two. The labor force required to "add-on" one unit will certainly be less than that which is needed to prepare a new site and then construct two generating units and auxiliary facilities. The St. Johns' public and private sector infrastructure will be better developed than it was at the time of initial impact and, therefore, better able to accommodate new population. Once the St. Johns infrastructure has stabilized, probably in the early 1980's, it will be possible to define a new and meaningful baseline for predictions of additional growth-related impacts. Perhaps most important is the fact that the third unit will be built in a community that has grown accustomed to change. The original Coronado Project was introduced into a stagnant and inward-facing community that had changed relatively little in decades.

c. Housing and Land Use

The provision of housing for construction workers, the permanent plant operators and supporting population has been a prime concern of both Salt River Project and Bechtel Corporation. The number of housing units needed was estimated by using population figures from counties and towns in the region and experience at the Cholla Generating Station. Table II-59 shows the projections of both non-weekly and weekly housing demand for the Coronado Generating Station. To begin meeting this demand, Salt River Project prior to the beginning of construction, purchased lots and placed mobile homes on these lots for lease to project personnel. In October of 1976, there was a total of 40 of these mobile homes occupied, two were available for occupancy and five were under construction or procurred. In addition, Bechtel established a construction camp which contained 44 men in October of 1976, with space for an additional 272. The major thrust of the SRP housing program was directed toward stimulation of housing production by the private sector. A housing office was established in St. Johns through which a housing subsidy program was administered. This program to date has primarily taken two forms, direct subsidy of the development of two mobile home parks in St. Johns and a rental subsidy for any unit rented to a project employee. Within St. Johns the rental subsidy amounts to $65.00 per month per unit to the landlord with an additional $35.00 per month per unit going to the city to assist with provision of services. Outside St. Johns, the total subsidy is paid to the landlord. According to local officials, this subsidy program has had a significant effect on the production of housing in St. Johns and the surrounding area.

Table II-59

HOUSING DEMAND IN ST. JOHNS

Year	Weekly	Relocates	Supporting	Local	Operating	Total Non-Weekly
1976	114	125	55	31	0	211
1977	325	305	150	75	0	530
1978	581	601	274	274	122	1,144
1979	380	399	221	96	212	928
1980	84	91	171	22	310	594
1981	0	0	138	0	310	448

As of October of 1976, within mobile home parks, there was a total of 139 mobile home/camper units occupied in the St. Johns/Concho area. At that time, there were 7 vacant units, 172 mobile home spaces available, with an additional 38 under construction. Outside of organized developments in the St. Johns/Concho area there were 202 occupied mobile home/camper units, four vacant, one space available and four spaces under construction. At the same time, there were a total of 34 single family homes under construction in the St. Johns/Concho area. Occupied apartment units in the same area totaled 14, with an additional two vacant units and three under construction. In addition, there were a total of 19 project workers renting motel rooms in the St. Johns/Concho area.

As of the beginning of 1977, the vast majority of project related housing was of a temporary nature, primarily mobile homes. This type of housing is ideally suited to the flexible demand caused by the temporary construction population. The permanent plant operating population, however, will generally prefer single family homes and to a lesser extent, apartment and mobile home housing. To meet this demand, developers in St. Johns were planning several single family and apartment projects in addition to the 34 single family and three apartment units under construction which were mentioned above. In January of 1977, St. Johns city had approved development plans for over 200 single family lots plus a 24-unit duplex project. At that time, local realtors reported that demand for single family lots equalled demand for mobile home lots. Previous demand had been primarily for mobile lots. In general, it appears that demand for local housing will exceed the supply on a temporary basis through about 1980. This demand will, however, stimulate local developers to provide the needed housing. Thus housing supply will be a problem, although a temporary one.

In late 1976, and early 1977, the pattern of new development was beginning to emerge. While new housing construction was taking place on an infill basis within the developed section of the city, new residential areas were beginning to emerge in the west, southwest and northwest sections of the city. For the most part, this new housing was occuring in new subdivisions, requiring new roads and utilities. Commercial development was occuring along the major highways, primarily on the west side of town, where plenty of land was available and on the northeast, toward the Coronado site.

Because the absolute number of railroad construction employees expected in the Navajo-Houck area is not great and the period of construction is relatively short and because many workers will probable be single and will live in a diverse number of locales, the overall expected impact will be modest. It is anticipated that approximately 50 percent of the railroad workforce will live in motel rooms or in mobile homes at the Painted Desert Inn in Navajo or in mobile homes or vacant housing at the Kerr-McGee plant in Navajo. Of those not living in these accommodations, some will undoubtedly live along the 12 mile Navajo-Sanders corridor whereas others will elect the longer commute to the construction site from Holbrook or some other large center.

d. Facilities and Services

The city of St. Johns in 1976 received a $70,875.00 grant from the Bureau of Outdoor Recreation, Department of the Interior, to add 4-5 acres to the present city park. This park, when complete, will include four lighted tennis courts, a storage building, picnic ramadas, restrooms, and a sprinkler system. Salt River Project and Bechtel Corporation have provided volunteer labor, equipment, and materials to assist the city in meeting the matching requirements for this grant. In January, 1977, this project was 85% complete.

No new cultural or media facilities had located in the St. Johns area by January of 1977. However, the population base to support the existing facilities had begun to expand. The Department of Economic Security in St. Johns has noted an increase in their workload since construction began on the Coronado plant. This is consistent with events in other similarily impacted areas. As communities grow, people tend to rely less on friends and neighbors and more on institutions.

Retail businesses established in St. Johns since Coronado construction began include an auto supply, a cafe, a real estate office, a drive-in restaurant, a gift shop, an aircraft repair service, a catalog store, a propane gas service, a title and escrow service, a welcome wagon, a barber shop, and a radio and TV shop. Medical services which have located in St. Johns since construction began on Coronado include two dentists, a health clinic, and a chiropractic clinic.

The St. Johns city government in cooperation with Salt River Project has recently (1976) obtained assurances that the Springerville medical group is willing to obtain the services of a full-time physician for the St. Johns Clinic. This voluntary agreement provides that St. Johns and Salt River Project will continue to provide financial support for the clinic itself. In 1975, a dentist and an optometrist opened offices in St. Johns. In 1976, a chiropractic clinic opened.

St. Johns has a city marshall and deputy marshall. The Apache County Sheriff's Department provides radio and dispatch services to these officers, along with dispatching sheriff's patrol cars. Recent improvements have been made to the St. Johns municipal airport. These include additional tie-down and establishment of flight clearance zones to assure that development does not encroach into areas which might conflict with flight operations. The city of St. Johns, in 1976, hired a

consultant to prepare an improvement plan for the airport. The recommended improvements will be financed by a grant from the Federal government which will pay 90% of the costs. In addition, State funds will pay another 45%, so the cost to the city will be minimal.

A survey of St. Johns area employers, conducted in November, 1976, shows that significant structural changes have occurred in the recent past. An earlier study completed in May, 1975, described the pre-impact situation in St. Johns (actually limited impact had already been felt). At that time Bechtel and Salt River Project employment levels were still low and only a handful of businesses had opened or expanded in anticipation of an economic boom. Eighteen months later, (Table II-60) the most responsive sector was general retail trade. The service sector was the next most responsive, and the only sector to show a decrease was wholesale trade which lost its only establishment. The three growth sectors are those with relatively low conditions of entry, at least when compared with the six sectors which registered no change.

Most firms in the St. Johns area have experienced an increase in business although the increase has been variable. These business increases are not always attributable to the Coronado project. However, a large share of respondants indicated that business increases were felt during the first year of Bechtel's and Salt River Project's presence in the St. Johns area. It appears that anticipation on long-term increases may be a stronger and more important motivator of business change than the actual short-term impacts. An estimated two-thirds of all St. Johns employers were judged to be operating at below capacity, i.e., they could accommodate increases in business without adding employees. More often than not, the firms that have unused capacity are the ones that have recently added employees, presumably in anticipation of long-term increases.

In general terms, public agencies and private firms have responded quickly to increases in local demand; the 1976 survey indicated that about 40 percent of all establishments had been under their present management for less than two years. This by itself is significant for a community with a history of stagnation. Changes to date can be characterized as follows: 1) Employment increases have been substantial but the fact that the system has unused capacity indicates that expansion of labor force has been accomplished with the long-term in mind; 2) The service base has been expanded by the addition of new firms and by changes in management of several existing firms; 3) There has been relatively little expansion in the types of goods and services offered, i.e., many of the new establishments offer the same goods and services as older establishments.

As of January, 1977, it cannot be said that St. Johns has grown to the point where new and higher support levels have been reached. What is certain is that the established service base has been expanded to accommodate recent growth of population.

TABLE II-60

St. Johns, Arizona: Number of Firms

by Sector, in May, 1975, and November, 1976

Sector	In Business in both May, 1975 and November, 1976	In Business May, 1975 only	In Business November, 1976, only	Increase or Decrease (net)
Agriculture & Agricultural Services	--	--	--	--
Contract Construction	3	0	0	0
Manufacturing	5	0	0	0
Mining	--	--	--	--
Restaurants & Bars, Service Stations	13	0	4	+4
Hotels, Motels	2	0	0	0
Other Services	14	2	0	+7
General Retail Trade	18	2	11	+9
Wholesale Trade	1	1	0	-1
Finance, Insurance, Real Estate	8	0	0	0
Transportation, Utilities & Communication	3	0	0	0
Local Government & Public Schools	12	0	0	0

Source: by survey, May, 1975 and November, 1976.

e. Education

Until 1975 the situation in St. Johns area schools was relatively stable. The Concho School had only two teachers in 1973 and 1974; total enrollment was 37 and 39 students respectively. Student numbers took a sharp jump in 1975 when one teacher was added; the 1976 figure is slightly higher than the 1975 figure and a fourth teacher was added for this school year. The increases in the St. Johsn elementary schools have been much more dramatic. For the school years 1973-74 through 1975-76 the number of teachers and administrators (there is only one administrator) held firm at 22 even when the student population jumped by 20 or 25 percent between the fall of 1974 and the fall of 1975. By the fall of 1976 the number of teachers and administrators had increased to 31 (almost a 50 percent increase), partly in response to an actual increase of 125 students and partly in anticipation of even greater student populations in the years through 1980. Increases in high school students were also substantial - almost 100 students have been added to the fall 1973 figure of 170. Because the high school has been over-staffed in the past, this increase has been accommodated by the addition of only two new teachers.

Impacts through the fall of 1976 have been substantial but not so severe as to be unmanageable. The Concho school's growth is not conspicuous in absolute terms but in relative terms growth has been dramatic - this small, rural school has doubled both the number of teachers and its student population. Students have been accommodated in the existing physical plant; the most significant adjustments as of January, 1977, were the addition of certified and classified personnel. It is estimated that the Concho School could accommodate an additional 23 students in the existing plant although this figure will be lower if new students are not fairly evenly distributed between the various grade levels. To accommodate the growth that is expected within the district, plans are underway to initiate a bond issue to provide funds for the expansion of the physical plant. Three (mitigation) projects are now being discussed: 1) the conversion of the existing gym to two classrooms; 2) the purchase of two temporary classrooms; 3) the construction of a multipurpose building which would hold a gym, a cafeteria, an auditorium, and a reading resource room. New classrooms would hold an additional 100-120 students and increase the school's personnel changes, which would accompany physical plant expansion, are the addition of 1) five new teachers; 2) a full-time administrator and 3) a cafeteria worker.

In absolute terms, the St. Johns elementary schools have received the bulk of the region's student population impact. In addition to adding personnel to accommodate increased numbers of students, the larger Pioneer School's physical plant was expanded by 50 percent. The maximum combined capacity of the Pioneer and Coronado schools is estimated to be 800 students, or about 225 students more than were enrolled in January of 1977. To accommodate even higher enrollments during the peak construction period and to accommodate the separation of grade levels in the long-term, present plans call for the purchase of the St. Johns High School building for use as a junior high school (with a capacity of approximately 260 students). If this plan cannot be implemented, the favored alternative involves bonding for construction of a new junior high school.

Until the recent enrollment increases, high school personnel were under-utilized. The physical capacity of the school has not been reached and the high school, like the Concho and St. Johns elementary schools, does not have the unassigned classroom space that would be required to accommodate new classes and teachers. Current plans call for the construction of a new high school but these plans are pending because the U. S. Attorney's office is now judging the legality of a recent bond election. Even if the bond election is ruled valid, as of January, 1977, it was too late to have a new physical plant ready for use for fall of 1977. School administrators are considering two methods of handling the student increase which is expected in 1977: 1) the purchase of temporary classroom buildings or 2) scheduling double sessions to better utilize the existing physical plant.

The exact number of students who will be added to the school system as a result of the increased population during the period 1977-1980 depends on the proportion of the population which is of school age. The ratio of total students to total population for the towns in the region, and for the relocated construction employees, was used to project the demands on the St. Johns-Concho Schools. These figures are shown in Table II-61.

Table II-61

ST. JOHNS-CONCHO AREA STUDENTS ADDED

Year	Relocated Students	Supporting & Local Students	Operating Students	Total Students
1976	117	114	0	231
1977	289	300	0	589
1978	568	559	124	1,251
1979	377	421	216	1,014
1980	86	256	317	659
1981	0	183	317	500

No permanent impact on schools in the Navajo-Houck area is anticipated, as railroad construction personnel will be temporary. Many are expected to be either daily or weekly commuters, and will have no effect on the school situation. There is no doubt, however, that railroad construction will cause an increase in the number of students attending school in the Navajo-Houck area, since many construction workers will temporarily relocate to the area. There appears to be adequate capacity to handle a substantive increase in elementary students (K-8), but the high school is presently over capacity. Any substantial increase in high school students would likely require addition to temporary classrooms, or institution of double sessions. The recent history of enrollment fluctuations in these schools could be either a positive or a negative factor, depending on whether or not the peaks coincide with construction activity peaks.

f. Government

Since governmental activity was a significant part of the employment base in St. Johns prior to the beginning of Coronado construction, the construction of the project will not add an unfamiliar component to the area. The project will directly cause an increase in both the type and amount of governmental activity. While this increase will be felt on all levels, the largest increase will be on the local level.

Since St. Johns experienced virtually no growth in the decade immediately preceeding the beginning of Coronado construction, the town government mainly functioned to maintain the status quo and conduct routine business. With the advent of Coronado, this same government suddenly had to interact with a new industry, provide an increased level of municipal services, provide planning and zoning functions, deal with Federal grant applications to assist in facilities expansion, maintain utility and other expansion activities, handle a large increase in subdivision and building activity, handle increased expenditures as well as devise means to finance the increased activity. Needless to say, not all of these functions have been handled to the satisfaction of all persons involved. Viewed from the perspective of similar events in other impacted communities, St. Johns must be counted among those who have met or are meeting the challenge. The prevailing attitude of the town government has been one of independence and self-reliance. Through 1976, the city had begun an update of the city water supply system, expanded the sewer system, provided for participation in the new county landfill for solid waste disposal, started its own police force, upgraded and expanded city recreational facilities, updated and improved the city airport, and instituted a housing subsidy program financed by Salt River Project. SRP and Bechtel had also assisted with park and recreation facility construction, providing labor, equipment, and materials. Federal grants were obtained to assist with airport and park improvements.

The proposed budget for the City of St. Johns for the 1976-77 fiscal year calls for total appropriations of $1,549,845. This sum includes $613,825 in Federal grants (except revenue sharing). Not all of the Federal grants are a product of impacts associated with the Coronado Generating Station - several came well before the St. Johns site was selected - but all projects supported by Federal grants play an important role in meeting the demand for public services that the Coronado project has brought to St. Johns.

While much more will need to be done to meet future needs and to upgrade present services, it is obvious much has been accomplished. Studies of other similarly impacted communities have concluded that the key to effective local governmental response is the ability to obtain outside financial assistance to supplement local funds. The primary sources of these funds are Federal, State, and regional agencies, as well as the industry causing the impacts. St. Johns has utilized all these resources.

g. Utilities

The provisions of utilities to meet population increases has two critical parameters, (1) total capacity and (2) timing. The special problems of utility provision in response to the Coronado plant is that there will be a large influx of temporary construction workers who will create a demand which must be met for a short time, followed by a permanent population increase of smaller volume than the peak.

No unusual problems are anticipated in the supplying of electric power to either the temporary or permanent population components by the Navopache Electric Co-operative. Additional lines and facilities will be required to provide the increased level of service.

The City of St. Johns is presently improving the water supply and distribution system. Construction of the new one million gallon water tank was completed in 1976. Money for this tank was obtained via a $161,000 grant from the Federal Department of Housing and Urban Development. Additional water will be obtained from a well which was being drilled in early 1977. The well is being developed with funds from an Economic Development Administration grant which consists of two phases, (1) Drilling and proving the well and (2) upgrading water mains within the town. The terms of the grant require that the well be proven before the town water lines can be upgraded. This situation is slowing the overall development of the water supply and may result in some dislocation in meeting water needs as they occur. Once the proposed system is completed, city officials anticipate no unusual problems in meeting the needs generated by the expected growth.

In response to long and short term demands resulting from the expected population increase, the City of St. Johns with the aid of an $800,000 Federal grant has updated the entire sewage disposal system. This included the addition of numerous trunk lines within the city, and an additional lagoon, tanks, and holding ponds. The treated effluent is being pumped across the Little Colorado River where it will be spread over farmland as fertilizer. City officials feel this updating, comleted in 1976, will be adequate to serve the population peaks expected.

Solid waste disposal needs generated by anticipated expansion will be handled both by disposal at the city landfill and by participation in the new county landfill approximately 5 miles north of town. This facility, which was completed in September of 1976, is financed jointly by the City, which pays 75 percent of the costs and the county, which pays the remaining 25 percent. With this facility in operation, the city anticipates no problems in handling the anticipated garbage disposal volumes.

Western States Telephone will need to expand lines and facilities, but no unusual problems are anticipated in order to meet anticipated needs. The provision of LP gas to meet the expanded needs does not presently appear to be a problem, although national energy supply could be a problem which would affect the St. Johns area along with the rest of the nation.

h. Historical and Archaeological

(1) Historical

Construction of the Coronado Project will place strong development pressures on St. Johns in respect to housing, commercial, and service needs of the plant construction and operation personnel. This development pressure could conceivably create an atmosphere of haste, with historic resources being either physically replaced or visually modified in accommodating these needs.

If historic preservation of the inventoried structures is considered to be important to the citizenry of St. Johns, the community should be made aware of the opportunities for historic preservation which exist through the Department of Housing and Urban Development and Historic Preservation Act funding programs. These site areas, however, are of local significance only, and, therefore, historic preservation interest within the community will become the measure of secondary impact on these historic resources.

The inventory of the plant site revealed two historic sites (shallow trash areas). Three historic sites were identified in the evaporation pond area, a small reservoir system, a portion of corral wall and a large corral and associated well.

The sites in the plant and evaporation pond area were subject to a mitigation program conducted by the Musuem of Northern Arizona.

The inventory phase of the study revealed 5 historic sites in the area of the proposed railroad corridor. As the exact alignment of this route was not accurately known at the time of inventory studies, information within a corridor four miles on either side of an assumed alignment was inventoried. Upon refinement of the route, the five sites proved to be located sufficiently close to the alignment, or of sufficient importance, to be subject to impact. These sites are: Navajo Springs; Commodore Perry Owens Homestead; Z-Bar Ranch; "Cedar Post House"; and "The Bird Place."

Navajo Springs, presently on the State Inventory and almost certainly eligible for National Register status, is located approximately three miles east of the proposed alignment. The railroad, if built no closer than this, would have only a minor aesthetic effect on the site.

The Commodore Perry Owens Homestead and the Z-Bar Ranch are located close to each other as well as to the proposed railroad alignment. These sites do not appear as though they would be physically altered by the railroad, however, considering that they are felt to be eligible for State and/or Federal designation, the proximity of the railroad could cause an adverse effect on the aesthetic qualities of the sites. Therefore, a moderate impact value was assigned to the 5000-foot segment opposite these sites.

A very low impact value was assigned to each 5000-foot segment along which the remaining sites occur. Although these sites are not of historic importance, this value was assigned largely as a precaution against later discovery that they possess some significance. None of these sites are located such that they would be physically altered by the railroad. The Zuni migratory route involves no known sites that would conflict with railroad construction. The only potential problem would occur if the route is fenced. Should this be the case, provision for crossing will be provided after further consultation with the Zuni Tribe and traditional leaders.

(2) Archaeological

The impact of construction on the archaeological resources of an area can be categorized as direct or indirect. Construction of the Coronado plant, access road, wellfield and pipeline, ash disposal area, limestone quarry and railroad will cause the major impacts. These activities may result in either total or partial loss of the archaeological sites.

Direct impacts are the immediate effects that construction will have on environmental resources. This includes the destruction of archaeological sites by earth moving, plowing, flooding or building construction. Development of the Coronado Project will involve earth moving, plowing and building construction.

Indirect effects are defined as the effects on the environment which are not an immediate or direct result of an action, but which would probably not occur without it. Indirect impacts result from such actions as accelerated erosion, construction of private homes or commercial buildings, road building or increased vandalism.

As a result of construction, the plant site and associated facilities will be subject to increased work and recreational use. Thus the potential for damage to the archaeological resources increases even though the areas may not be directly affected by construction.

Increased human use of the area will cause more land to be developed, altered, or opened to the public.

Increased population and improved accessibility to the land will facilitate vandalism of archaeological sites. For instance, site NA12,689 (a large, multi-room pueblo in the Concho area) was in pristine condition when recorded by the Museum in 1974, as part of the 1978 Salt River Project Arizona Station Plant Site Study. Since that time, this site has been the object of thoughtless, highly destructive pot hunting activities.

With the growth of the project, development in addition to what was originally planned becomes likely. This increased construction will set in motion the same process of direct and indirect impacts upon the cultural resources.

As the result of increased population, people will be seeking new recreational activities. One of the activities most likely to occur is off-road vehicle operation. This type of activity will probably impinge upon areas of archaeological significance and damage such fragile archaeological sites as small lithic scatters and food processing stations.

Increased land use and off-road vehicle use will destroy vegetation which in turn will cause increased erosion. Such erosion can, and often does, damage archaeological sites.

Archaeologists can predict with a fair amount of certainty the direct impacts of construction. Predictions of indirect impacts can also be made, but these are often just educated guesses. The reason is that improved access to an area causes the multiplier effect to come into play. Human traffic increases, and new roads are blazed. As development increases, one can sometimes follow the roads to find many of the more impressive sites. Even though development may occur at a slow rate, an archaeological site can be totally destroyed by these indirect impacts.

Impacts can be both positive and negative. Positive impacts are those that contribute to the conservation and protection of the archaeological resource. Negative impacts are those that destroy or erode the resource base.

Evaluation of impact can be made only when the existing resource base is accurately defined. A preliminary survey made of the study area helped to characterize the region, but it did not provide a base for an accurate determination of the archaeological resources of the area. An intensive survey, aimed at locating all sites within the project area, is now being performed. Only an intensive survey such as the one being conducted can possibly provide for the proper assessment of resources and furnish the basis for an interpretation of the adverse impacts of the proposed action.

i. Land Use

Table II-62 indicates the land requirements in acres of private land, Federal land and state land for each feature of the project. The land for the generating station, limestone source and spur railroad will be utilized exclusively for producing power, whereas only a portion of the wellfield lands will be altered for the wells, access roads and electrical facilities. The undisturbed lands may still be used for grazing or other uses.

Impacts which will occur within the proposed alignment of the railroad will include division of both ranch properties and subdivided lands. Division of ranch properties is felt to pose a disruptive impact as a result of several considerations: The first relates to cattle movement and the efficient practice of ranching activity. Ranches traversed by the alignment are very large in size and movement

of cattle within these large ranches appears to be generally unrestricted by fences, with facilities for water and winter feed relatively infrequent. The railroad will include areas of steep excavation and earth fills which in themselves pose a degree of operational impact on cattle movement. However, if fences are constructed along the railroad right-of-way and no crossings provided, cattle movement to established water and feeding facilities will, in many cases, be cut off. In these instances the rancher would be required to construct additional watering and feeding facilities within cut-off portions of this property. Accommodations to assure continued cattle movement throughout a ranch property will be accomplished through negotiations with individual landowners.

TABLE II-62

Coronado Generating Station
LAND REQUIREMENTS
(Acres)

	Private Land	Federal Land	State Land	Total
Generating Station Site	3840	--	--	3840
Railroad Spur	300	66.7	160.6	527.3[1]
Wellfield No. 1	2000	--	--	2000
Wellfield No. 2	3200	--	--	3200
Wellfield No. 3	2880	--	--	2880
Limestone Source (Available area)	--	314	160	474

[1]Based upon the minimum right-of-way width of 100 feet.

Where subdivided properties are transected, the full impact of the railroad is somewhat difficult to assess. It can be expected to impair access to parcels when roads are crossed; and those parcels (40 acres) which occur along the alignment, depending upon the development intentions of future buyers, may be less saleable. Also, existing and future residences would be subjected to such effects as railroad noise, exhaust from the diesel engines and dust. The railroad will preclude or alter future development plans.

As would be expected, land values are rising in the areas in which residential land is being developed to provide project-related housing. Raw land in or near St. Johns which sold for $1500 to $4500 per acre in 1974 was selling for up to $6000 per acre in 1976. Typical building lots in St. Johns, suitable for single family homes, which sold for $2000 to $3800 in 1974, sell for $4500 or more in 1976.

j. Aesthetics

Aesthetic values will be modified by the presence of man made structures associated with the Coronado project. Some slight reduction in visibility will occur due to the powerplant plume and cooling tower fog. Light from the powerplant and operating train will also be noticeable where they did not exist before construction. The generating plant smokestack, cooling tower and general plant profile will be visible and change the aesthetics of the area. The limestone source will slowly be changed in appearance as the limestone is quarried. The ash disposal areas and evaporation ponds will change the natural appearance of the area through the accumulation of waste materials. In addition, the operation of the plant will slightly reduce visibility in the area. For assessment of potential impacts on scenic resources along the proposed alignment of the railroad the following design and construction parameters were assumed:

(1) The railroad spur, at the interconnection with the AT&SF railroad, will not contain a siding for the storage of railroad cars.

(2) The railroad will be diesel/electric powered.

(3) In areas where excess cut or fill material is required, disposal or acquisition of this material will be, to the extent possible, within or from other portions of the railroad bed, through end-hauling. No incremental disturbance was assessed due to material acquisition or disposal at sites not previously altered in environmental conditions.

(4) Microwave rather than pole mounted wire communication facilities are to be used.

(5) Bridge designs will incorporate materials and finishes that will be harmonious with indigenous landscape colors.

(6) The movement of construction equipment will be confined to areas of the railroad right-of-way on which cut and fill operations are to occur. No incremental disturbance due to denial of vehicular access along the route was assessed.

Within the context of this scenic impact assessment process, levels of anticipated impacts were assigned for each 5000-foot segment along the alignment. These were based upon the extent of changes expected and on the quality of scenic resources occurring within that segment. Using this information, evaluations of the expected impacts along the proposed alignment were made. The results of the impact assessment procedure are summarized in the impact assessment graph (Figure II-48) and are discussed in the following paragraphs.

The proposed alignment traverses eight escarpments and such features, as discussed previously, were judged to be visually incompatible with the railroad. Earth cuts and fills would be necessary in such areas; the visual contrasts created by such excavations were judged to be sufficient to result in a localized reduction in scenic quality and a Medium level of scenic impact.

Seven intermittent drainages were encountered along the proposed alignment. As discussed previously, it was judged that the railroad would cause minor visual discontinuity within the physical characteristics of these features. Considering the tendency to perceive the drainage as localized scenic elements, visual modifications based upon physical disturbances would pose a low level of scenic impact.

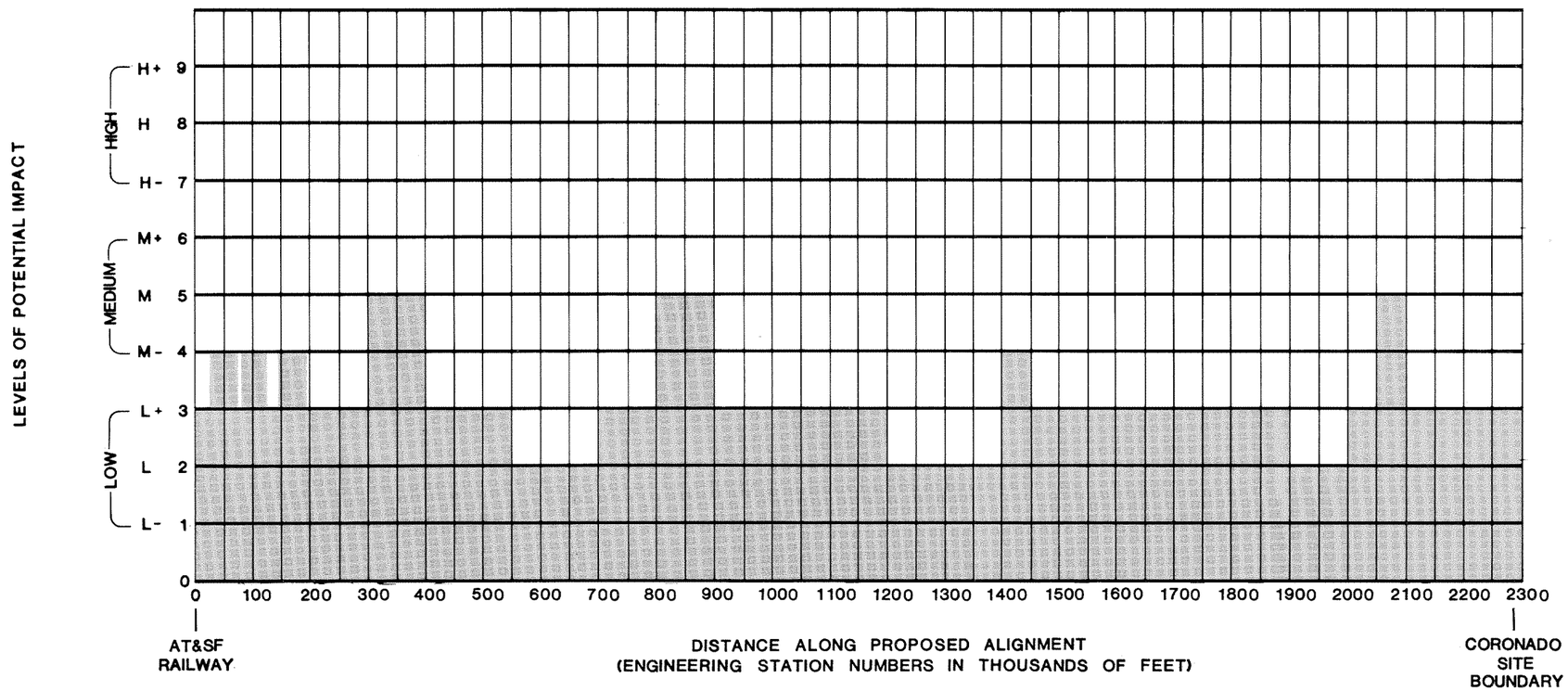
The proposed alignment would require construction of railroad bridges at the Zuni River and at Carrizo Wash. These bridges will constitute man made elements within the landscape. If materials and colors indigenous to the area are utilized, conflict with visual characteristics can be minimized and scenic impacts confined to a low level.

The majority of the route traverses areas of grassland vegetative cover (56 percent) and dense juniper woodland cover (15 percent). Lineal removal of vegetation in these areas would result in visual discontinuity and would reduce the natural scenic character or integrity of the landscape. The scenic impact of the railroad in such areas was assessed to be slight.

Mixed stands of grassland and juniper occupy 29 percent of the route and, due to the difficulty of perceiving lineal clearing within the irregular vegetative patterns of such areas, scenic impacts would be localized in effect and of a lesser magnitude. Scenic impacts in such areas were classified as low.

The railroad bed, rails and train, as introduced landscape elements, were assessed to have only minor effects on existing scenic conditions. This judgment reflects the consideration that visibility and, therefore, visual discontinuity would be minor due to the railroad's horizontal orientation. Within a flat to rolling area the railroad would not significantly detract from existing scenic characteristics and would more probably go unnoticed except during the relatively infrequent periods of actual train activity. Scenic impacts resulting from the introduction of the railroad into the landscape were considered to be relatively insignificant and characterized as very low.

In summary, impact levels are predominately low; however, within the low range of scenic impact, a low-plus level of impact would occur more frequently due to predominance of grasslands or dense juniper woodlands. Moderate levels of impact would occur in eight instances where the visual impacts resulting from escarpment alteration would constitute localized modifications of scenic characteristics and quality.



CORONADO PROJECT

Power Plant Spur Coal Haul Railroad

Levels of Potential Impact on Scenic Resources

Figure II-48

D. Mitigation and Enhancement Measures

1. Introduction

The impacts related to the construction and operation of the Coronado Generating Station, the Coal-haul Railroad and the well-fields have been discussed in Section II.C. While many of these impacts are characteristic of construction of coal-fired generating stations, others are more specifically related to this particular project. In order to reduce the intensity of impacts expected, changes or mitigation measures are to be applied. This section describes those measures.

2. Mitigating Measures to be Implemented for the Generating Station

a. Air Quality Control System

The Coronado Generating Station will utilize turbo-fired boilers that are expected to meet Federal and state standards for NO_x emissions, but present indications are that SO_2 removal equipment will be necessary. A number of systems were considered and a non-regenerative limestone wet scrubbing process was selected. In any event the system will be designed to meet existing Federal and state standards for SO_2 removal.

The air quality control system will include electrostatic precipitators for removal of particulate matter in the exhaust gases.

A more detailed description of the generating station air quality control system is contained in Section I.G.9 of this environmental statement.

b. Stack Height

Stacks for the release of emissions from Coronado Station have been designed to provide the necessary dispersion to satisfy Federal and state ambient air quality standards. Indications are that stacks 500 feet high will satisfy those standards, and these stacks are to be at least 500 feet high but may be higher. A more detailed discussion on stack emissions and height is contained in Section II.A-1.10 of this environmental statement.

c. Waste Disposal

During construction, trash and debris containers will be located throughout the construction areas as necessary. Combustible trash will be burned according to applicable regulations, while non-combustible construction trash will be disposed of by landfill methods or hauled offsite to approved disposal areas. Organic wastes will be collected in chemical toilets and processed in a sewage treatment plant.

The solid waste disposal pile, the coal piles and the evaporation ponds will be designed to control seepage. Storm runoff from the solid waste disposal pile and the coal piles will be in conformance with applicable laws and regulations.

All waste water associated with Coronado Station will be handled in conformance with applicable laws and regulations. Process system waste water will be reused to the maximum extent practicable. Excess from waste water will be discharged to onsite evaporation ponds, which will be designed to control seepage. Seepage from evaporation ponds and solid waste disposal areas constructed on the alluvium will be controlled by suitable soil treatment or by a seepage barrier.

The solid waste disposal area will also be designed to control seepage of waste water, and storm water runoff from it will be directed to temporary pondage within the disposal area for evaporation. Storm waters from the coal storage area and from yard and roof drainage will be directed to evaporation ponds.

d. Dust Control

Dust control measures will be implemented at the beginning of construction and will continue during all phases of construction. Watering trucks will be used to control dust during site preparation, excavation and construction, as required. Temporary means of soil stabilization, such as chemical treatment or the application of light bitumen, will be employed in storage areas and on roads. To prevent dust and particulate emissions, the coal handling system will be a completely enclosed system similar to the one presently in use at the Navajo Generating Station in Page, Arizona. This system is described in Section I. The ash disposal area will be sprinkled and compacted to control dust. Long range plans are considering covering the ash disposal area with a soil cover.

e. Socio-cultural

(1) Housing

Salt River Project began in 1974 to develop a program to meet the anticipated housing demands; through 1976, this program has involved financial assistance in three major areas. Two mobile home parks, which are being developed by local private operators, are being subsidized by SRP. When complete, they will provide a total of 262 mobile home spaces. In addition, one of the operators is planning another park with 296 spaces. SRP has also purchased 50 building lots within St. Johns, 42 of which contain mobile homes which are rented to SRP non-manual employees. The second aspect of the present assistance program involves a $100 per month subsidy paid for each rental unit which accomodates a project employee, of which the landlord receives $65 and St. Johns receives $35. The city's portion is used for upgrading city services, such as water and sewers. Outside St. Johns, the $65 fee to the landlord is paid, but the city portion is not. The third aspect of the program involves exploration of any other means to provide housing with SRP assistance. Private firms and individuals are being encouraged to submit proposals for SRP approval.

(2) Community Services

Salt River Project has participated with St. Johns' community leaders in upgrading and maintaining medical and emergency services. The volunteer ambulance service has been subsidized financially, including sharing the cost of replacing an ambulance which was demolished in an accident. Salt River Project has provided financial and logistic support to the St. Johns Clinic and has participated in negotiations to obtain the services of a full-time doctor for the community.

(3) Recreation

Salt River Project and Bechtel employees have donated time to work on upgrading city recreational facilities. Equipment and materials have been donated to provide lighting for the baseball and Little League fields and grading and design services have been provided to improve both city parks. The value of these materials and donated labor will form a substantial portion of the in-kind requirements of the $70,875.00 park expansion grant from the Bureau of Outdoor Recreation.

f. Archaeological and Historic Sites

Before rights-of-way are granted across federal lands detailed archaeological surveys will be conducted on these lands. In the event significant archaeological or historic resources are encountered the land management agencies will conduct a "106" procedure under the guidelines contained in 36 CFR 800. This procedure involves consultation with the Arizona State Historic Preservation Office and the Advisory Council on Historic Preservation. Determinations of eligibility for inclusion in the National Register of Historic Places will be made as will determinations of effect. In the event of adverse effect on archaeological resources mitigation plans will be developed in consultation and coordination with the Arizona State Historic Preservation Office and the Advisory Council on Historic Preservation.

g. Scenic Resources

The generating station and attendant facilities will be architectually designed to be esthetically pleasing. Figure I-4 is an artist's concept of the generating station, units 1 and 2. Emphasis will be placed on color schemes and selection of building materials to arrive at the most pleasing appearance possible for the station. At present these color selections have not been made. Other major plant structures and buildings that will also be considered in the overall architectural framework to provide a pleasing environmental appearance are the water treatment building, the yard conveyors, and individual boiler stacks. Miscellaneous small structures for housing fire fighting or other equipment will also be enclosed and architecturally treated with masonry or metal siding to blend in with the overall station complex.

h. Fuel Oil and Lubricating Oil Storage Systems

Oil storage facilities will be designed such that spills, should they occur, will be contained onsite in the immediate area of the spill. Small oil spills from yard or in-plant equipment will be mopped up.

i. Limestone Source

The Welch limestone claim will be mined from east to west, beginning with the southern deposit. This deposit is the larger of the two included in the overall claim and is the nearest to the existing Salt Lake Road. This procedure will result in removal of essentially the entire depth of the limestone, with the cut-face progressing steadily toward the west. In addition to providing an established road from the quarrying site to an on-site processing facility (if necessary) or to Salt Lake Road, this procedure would appear to provide a physical barrier, in the form of the un-stripped limestone itself, between the mining activity and the St. Johns area and, in particular, to the closest portion of the recently subdivided St. Johns Ranches development. This procedure should serve to reduce the visual impact of the scarred hillside and probably help to reduce the noise impact of blasting and heavy equipment operation. If necessary access roads will be surfaced to avoid fugitive dust problems.

j. Monitoring Programs

The State of Arizona Department of Health Services is given air and water quality monitoring responsibility under the Arizona Revised Statutes. The ambient monitoring programs described in this statement are voluntary programs accomplished by the owner/operator and are supplementary to any that might be accomplished by the Deparrment of Health Services. Monitoring will be in accord with Federal and State reference or equivelant methods at intervals prescribed by the regulatory agency. All data will be made available to the Department of Health Services.

Engineering details of in-stack monitoring locations will be contained in the application for installation/operation permit filed with, and subject to the approval of, the State of Arizona Department of Health Services.

Although ambient air quality monitoring is not required of the operator, background or pre-operation ambient measurements of atmospheric concentrations of particulate matter, sulfur dioxide and nitrogen oxides were accomplished at the St. Johns airport in 1974 and 1975. Measurements will be resumed at the same or a nearby location when plant operation commences in order to establish the plant impact there. Additionally, measurements will be initiated where maximum short-period ambient concentrations of sulfur dioxide are expected to occur near 20 Km SSE of the station (see Table II-39) in order to verify the maximum expected impact there. All voluntary ambient measurements will be made available to the Arizona Bureau of Air Quality Control.

In-stack emission monitoring of particulate matter (opacity), sulfur dioxide, and nitrogen oxides will be accomplished and the results reported in accord with applicable Federal and State regulations.

The current design calls for construction of a grating at the 249' level of the stack to allow access to the four sampling ports in each liner. The ports are at 90 degree intervals around each liner. The distance between the liners and concrete shell has been designed to allow ease of sampling.

Measurements of meteorological parameters of wind speed, wind direction, direction variability (association with low level atmospheric stability), and temperature have been accomplished at an on-site 100 foot tower and will continue through the program. These voluntary measurements, in conjunction with upper-air wind and temperature data from the nearby Winslow National Weather Service Station, should be sufficient to characterize plume-level winds and atmospheric dispersion.

Baseline visibility measurements using photometric techniques were accomplished in 1974 and 1975. These will be repeated in 1978 and again when all three units are in operation to satisfy visibility monitoring requirements established by the Arizona Power Plant and Transmission Line Siting Committee.

(1) Air Quality Monitoring

Background or pre-operation ambient measurements of atmospheric concentrations of particulate matter, sulfur dioxide and nitrogen oxides were accomplished at the St. Johns airport in 1974 and 1975. Measurements will be resumed at the same location when plant operation commences in order to establish plant impact there. In addition, measurements will be initiated where maximum short-period concentrations of sulfur dioxide are expected to occur, near 20 Km SSE of the station (see Table II-39) in order to verify the maximum impact on the area. Measurements of meteorological parameters of wind speed, wind direction, direction variability (associated with low level atmospheric stability), temperature and relative humidity are being accomplished at an on-site 100 foot tower and will continue through the program. These measurements, in conjunction with upper-air wind and temperature data from the nearby Winslow National Weather Service Station, will be sufficient to characterize plume-level winds and atmospheric dispersion.

Baseline visibility measurements using photometric techniques were accomplished in 1974 and 1975; these will be repeated in 1978 and again when all three units are in operation to satisfy visibility monitoring requirements established by the Arizona Power Plant and Transmission Line Siting Committee.

In stack emission monitoring of particulate matter (opacity), sulfur dioxide, and nitrogen oxides will be accomplished and the results reported in accord with applicable Federal and State regulations.

(2) Water Quality Monitoring

The disposal of the solid wastes and waste water generated by the station will take place during the entire operating life of the plant. The Coronado Station will retain liquid and solid wastes in ponds or other impoundments during construction, as well as

during plant operation. A monitoring program in accordance with applicable laws, rules and regulations will be provided to assure that no adverse environmental effects are realized. As part of the monitoring program, periodic field tests will be made which will include flow measurements or water depth recording at observation wells to verify that seepage control methods are effective.

As part of the monitoring program the chemical quality of surface water and groundwater will be monitored.

Periodic sampling of the water in the Little Colorado River for chemical quality analysis will be made by the Salt River Project at the stream gaging stations maintained by the U. S. Geological Survey. These stations are located at Lyman Reservoir, above the Zuni River confluence near Hunt, Arizona; and a new station to be constructed on the Little Colorado River above Zion Reservoir.

The Arizona State Power Plant and Transmission Line Siting Committee imposed a condition that a water management plan of reasonable practicability, designed to minimize impacts on the resource, be developed by the Salt River Project and acceptable to the Arizona Water Commission. This water management plan was accepted by the Arizona Water Commission on February 3, 1976.

This plan embodies provisions to collect water samples from twelve wells and to analyze these samples for chemical quality. The plan also required reporting the data from the chemical quality monitor programs annually. Significant changes and/or trends in the chemical quality data will be discussed. This required annual report will provide a means to assess the effectiveness of the monitor program. Limiting standards as parameters being monitored have not been set. Until the existing water quality baselind and trends are actually measured, any standards set at the present time would be without factual basis and would therefore, be somewhat arbitrary. Periodic water samples will be collected and analyzed on a semi-annual basis prior to the operation of the Coronado Generating Station to establish baseline data. Water samples of groundwater from the Coronado Station production wells will also be collected for chemical analysis. During the initial two years unless water quality trends indicate a more or less frequent sampling period should be established.

The proposed list of constituents for chemical analysis of surface water and groundwater is given in Table II-63.

Table II-63

LIST OF CONSTITUENTS FOR WHICH WATER SAMPLES ARE TO BE ANALYZED IN THE CORONADO GENERATING STATION SITE AREA

Chemical Constituents	
Silica	(SiO_2)
Iron	(Fe)
Arsenic	(As)

(continued)

TABLE II-63 (cont.)

Calcium	(Ca)
Magnesium	(Mg)
Sodium	(Na)
Potassium	(k)
Bicarbonate	(HCO_3)
Carbonate	(CO_3)
Sulfate	(SO4)
Chloride	(Cl)
Fluoride	(F)
Phosphate	(PO_4)
Nitrate	(NO_3)
Boron	(B)
Total Dissolved Solids	TDS
Hardness as	$CaCO_3$
Non Carbonate Hardness as	$CaCO_3$
Percent Sodium	
Specific Conductance (micromhos at 25°	
ph	
Alkalinity as $CaCO_3$	

3. Mitigating Measures to be Implemented for the Development of the Wellfields

The water supply for the Coronado Generating Station will be drawn from local groundwater supplies. The impacts on the ecology of the area and on other users will be minimal, as described in the Water Management Plan developed with the Arizona Water Commission and as discussed in Section I.H.4.c.

In order to assure that operation of the wellfield over the life of the generating station does not cause any unforeseen impacts, a series of monitoring programs are being implemented by Salt River Project as described below:

a. Streamflow Monitoring Program

The U.S. Geological Survey maintains a series of water level recording stations at Lyman Reservoir which monitor the inflow and outflow of the reservoir, the outflow to diversion canals and outflow to the Little Colorado River. This series of stations provides the baseline record of surface water flow into the Coronado Station site area. The period of record for these stations is more than 20 years, and records are available to the public. Another continuous-height water level recording station maintained by the U.S. Geological Survey is located on the Little Colorado River above the Zuni River confluence, near Hunt, Arizona. Records are available from this station for more than 30 years of outflow data from the Coronado Station area. A U.S.G.S.-Salt River Project contract has been approved to construct a gaging station on the Little Colorado River above Zion Reservoir. This station is being constructed on the recommendation of the cooperating parties as a point source to monitor base flow and stream flow. Records from these gaging stations provide baseline data for the surface water inflow-outflow conditions at the Coronado Station site area which will be compared with post plant construction streamflow records for the evaluation of the impact the plant operations might have on local streamflow.

b. Chemical Quality of Streamflow Monitoring Program

There are no U.S. Geological Survey water quality monitoring stations on the Little Colorado River in the Coronado Station area. Periodic sampling of the water in the Little Colorado River for quality analyses will be made by Salt River Project at the stream gaging stations maintained by the U.S.G.S., as previously discussed. Water samples and chemical analyses will be obtained prior to plant construction to establish baseline data. Water samples will be collected on a quarterly basis until water quality trends indicate a less frequent sampling program would suffice. The recommended chemical constituents to be analyzed are the same as those listed in II-79. Trace elements for which analyses are warranted will be dependent upon the trace elements characteristically found in effluent from a coal-fired generating station.

c. Groundwater

The long-term impact of the expected average withdrawal of 13,424 AF/yr. on the water levels and chemical quality of the groundwater will be determined from the water level and water quality monitoring program data.

d. Water Well and Pumpage Inventory

A water well inventory has been made by Salt River Project of existing wells that tap the Kaibab-Coconino aquifer system in the Coronado Station site area. A field survey was undertaken to determine, where practical, the following: location of well (within ten-acre parcel), altitude of land surface, type of well and pump equipment, well depth, depth of water, well yield and annual pumpage. A water pumpage inventory of all present groundwater users in the plant site area will be made by Salt River Project in cooperation with the U.S.G.S. to provide annual pumpage data prior to operation of the plant.

e. Water Level Monitoring Program

Water level monitor wells are to be selected from existing wells based upon their areal distribution within the groundwater flow system and the proximity of the wells to the Coronado Station wellfields. Drilling of additional wells may be required, depending on availablility of existing wells, costs, sophistication of monitoring program and legal implications. Additional exploration wells will be incorporated into the monitoring well system. Periodic measurements of water levels in selected monitor wells will be obtained on a semi-annual basis prior to plant operation. Water level measurements will be obtained on a quarterly basis during the initial several years of plant operation, then semi-annually until water level trends indicate a less frequent measurement period would suffice. Coronado Station's water production wells will be equipped with access tubes so that water level measurements can be obtained readily, on a monthly basis. Each well will be equipped with a means for measuring flow rate and determining total flow. Pumpage will be recorded on a monthly basis.

f. Chemical Quality of Groundwater Monitoring Program

A suite of wells will be selected from the list of water level monitoring wells to serve for water-quality monitoring. Water samples will be collected and analyzed semi-annually prior to Coronado Station operation to establish baseline data. Samples of groundwater from the production wells will also be collected for chemical analyses. During the initial two years of plant operation, water samples will be collected semi-annually, unless water quality trends suggest changes in the sampling period. All samples taken for analyses will be from pumping wells in order to assure that a representative sample is obtained. A recommended list of constituents for chemical analysis is given in Table II-79.

4. Mitigating Measures to be Implemented for the Construction and Operation of the Coal-Haul Railroad

a. Dust Suppression

Normal compaction and wetting during construction of the railroad will minimize dust, however special additional precautions can be taken. The guidelines provided in Regulation R9-3-302 of the State of Arizona Administrative Rules and Regulations concerning fugitive dust emissions will be utilized to mitigate impacts along the proposed alignment.

b. Rehabilitation

The temporary disturbance caused by construction will be mitigated by extensive cleanup and waste disposal activities at the completion of railroad construction. Slopes in borrow pits and soil disposal areas will be stabilized as required. Unneeded roads will be closed and graded to conform to local topography as necessary and suitable drainage will be provided to prevent ponding in borrow pit areas and upstream from temporary construction roads. Fences will be repaired, gates or cattle guards installed, and road crossings will be established.

c. Wildlife Crossings

Wildlife crossings will be provided for big game animals and smaller vertebrates. Specific measures which can be utilized in particular situations are detailed in the following subsections.

(1) Union of High Cuts and Fills

In areas where high cuts and fills are contiguous, the junction between the two can be made into an acceptable passageway for animals. Such crossing areas would minimize the barrier effect of a long, continuous obstacle.

(2) Long High Fills

Underpasses can be provided for animal movement in areas where the fills exceed ten feet in height and extend over one

mile, or in areas where canyons are blocked. In such extensive areas, if under-passages are to be provided they should be constructed so that animals can freely pass through them. Although the sizes and types of structures that are most effective for deer and antelope use are largely unknown, it has been reported that 61 percent of the local Colorado migrant deer population successfully passed through a 10 x 10 foot underpass under Interstate Highway 70. An on-site evaluation of the large fill areas will be conducted by competent range and wildlife managers for recommendations on the local need and location of underpasses that meet the requirements of both livestock and game. Figure II-49 illustrates several types of underpasses that can mitigate the barrier effects of fills.

(3) Bridges and Culverts

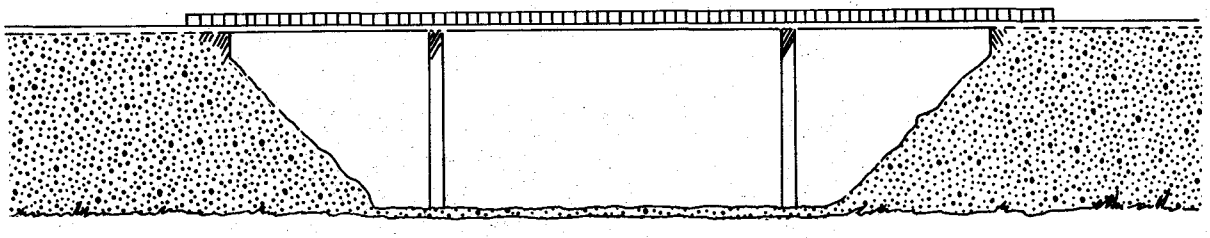
The preliminary design of the railroad includes provisions for bridges over the three largest streams, Puerco and Zuni Rivers and Carrizo Wash, and for culverts on the alignment. These bridges will be designed so that there is minimal constriction or diversion of flow. If culverts are placed under the roadbed and fill areas to provide surface drainage, they would also provide passageways for small vertebrates and would essentially be the only passageways for the migrant amphibians in the area. The culverts can be provided with protective spillways or riprap to prevent erosion of deep holes at the end of the culverts due to scouring. Culverts will be designed with the same objectives as the bridges, to minimize the constriction or diversion of flow.

d. Watering Devices

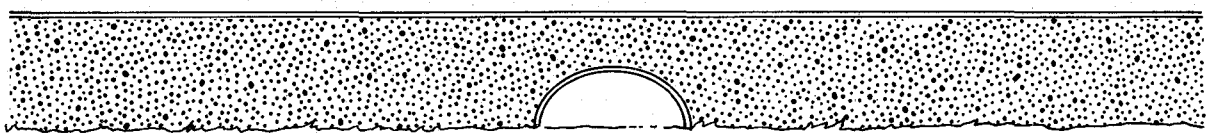
Livestock and wildlife will be provided with crossings at intervals to allow usage of present watering locations. In some cases, construction of the railroad will interfere with water flow in small intermittent washes. If such washes presently contain watering impoundments downstream from the railroad, and it is determined that the presence of the railroad would significantly interfere with such existing impoundments, alternate means to ensure the availability of the same or equivalent water supplies would be provided.

e. Fences

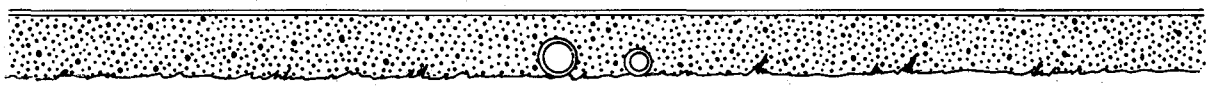
As no decision has been made to fence the railroad right-of-way, no fence specifications have been developed. However, as all fences are obstacles to antelope movement and some types become absolute barriers, should it be decided that the area will be fenced, careful selection of the types of fences is imperative. Fence designs that have proven adequate for holding livestock but allow passage by antelope have been recommended by the Interstate Antelope Conference. Fencing on private lands will be at the request of the landholder. Any fencing on public lands will be subject to approval by the Bureau of Land Management or the State Land Department. Before any decisions to fence are formalized, both the Bureau of Land Management and the Arizona Department of Game and Fish will be contacted for information on fence construction.



Bridge



Underpass



Culvert

RAILROAD UNDERPASSES

Figure II-49

f. Geology and Soils

Rates of erosion on cuts, fills, roads and other bared surfaces should diminish naturally as vegetative cover increases, as residual surface materials become coarser, and as more highly-cemented materials become exposed. Runoff and related erosion will also be impeded by benches placed on slopes of cuts.

The extent of borrow and waste areas can be minimized by utilizing, to the maximum extent feasible, cuts rather than borrow areas as a source of fill material. Furthermore, borrow and waste sites can be located and operated to assure minimal environmental impact. Any quarry sites required to provide rock, gravel or sand will be similarly located and operated. The location, size and shape of any required borrow and waste sites will be carefully selected to minimize impact on geology, soils and related resources.

The potential for erosion and sedimentation by stream action and blockage of flows to downstream areas can be minimized by adequate design and a sufficient number of bridges and culverts. In deciding the final alignment, consideration can be given to the feasibility of making lateral movements of the roadbed to avoid headwater areas that are susceptible to erosion and hydraulic impact.

g. Land Use

The majority of anticipated impacts on land use will be mitigated through planning and right-of-way negotiations, but additional specific measures can also be taken. Disruption of existing traffic flow over highways and rural roads in areas of construction activity can be partially minimized by providing crossings and detours. Adverse effects due to dividing property can be reduced by the installation of cattle crossings to assure continued cattle movement throughout the rangeland. Any potential disturbance to the helium pipeline can be mitigated either by rerouting or otherwise accomodating the facility through design.

h. Scenic Resources

Though some degradation of scenic resources is inevitable, measures can be taken to reduce losses of visual integrity. Scenic resources will be affected by means of excavations at escarpments, introduction of bridges at drainages and by removal of vegetation. The impacts of cuts and fills can be mitigated by grading. By using appropriate materials and colors, the visual impact of bridges can be minimized. Slope rounding is another technique that will help mitigate the scenic resources of an impacted area.

i. Acoustics

To reduce the impact due to the increased sound levels that will result from railroad construction and operation, these factors can be considered:

(a) Quieted construction equipment and other noise control procedures can be used and would have a considerable effect on the magnitude of noise emitted from the construction activity.

(b) Railroad noise can be reduced by utilization of locomotives and freight cars manufactured in response to Federal Environmental Protection Agency regulations.

(c) Careful maintenance of rails and railroad bed can minimize wheel/rail interaction noise.

(d) The duration of exposure to construction noise at any location can be reduced by swift completion of construction.

(e) Nighttime activity can be minimized near inhabited areas.

(f) Population growth can be directed away from the railroad right-of-way by appropriate zoning regulations.

(g) The location of the construction material stockpile contributes to noise impact due to truck activity. If the planned stockpile is located in an unpopulated area the impact due to this traffic will be limited.

j. Archaeological Resources

Mitigating measures will be taken to minimize loss of, or damage to, archaeological sites, artifacts and information inherent in these resources. A qualified archaeologist will be retained to further inventory sites in the area of the proposed action, as necessary to fulfill the requirements of Executive Order 11593 as well as part of the Bureau of Land Management and State of Arizona Antiquities directives. During construction, measures will be taken to avoid archaeological sites wherever possible. When such avoidance is not practical, the archaeologist can make recommendations concerning the protection of the archaeological resources.

k. Historical Resources

Though no direct physical impacts on historic resources are expected, the State Historic Preservation Officer will be advised of the proposed action and will then be given the opportunity to provide suggestions for maximum protection of resources in the area.

Any uncertainties concerning the potential state inventory eligibility of these sites could be resolved through a field visit by the Historic Preservation Officer who can recommend procedures appropriate to the minimization of impact on these sites. It is not presently anticipated that mitigation will be required.

E. Unavoidable Adverse Environmental Impacts

1. Introduction

Section II.C. identified the environmental impacts that could be expected from construction of the Coronado Generating Station, the coal-haul railroad, the three wellfields for supplying the station's water needs, the limestone quarry as well as the cumulative impacts of the entire project. Section III.C. identifies in detail those impacts that could be expected from construction of the transmission system.

This section of the environmental statement identifies those impacts that would still occur as a result of the generating station, railroad, wellfields and limestone quarry even after the application of mitigation measures described in Section II.D. This section also describes those cumulative unavoidable adverse environmental impacts that could be expected on the environment as a result of construction of all project features, including the transmission system.

2. Cumulative Unavoidable Adverse Impacts of the Coronado Project

a. On the Physical Environment

(1) Air Quality

The quality of the existing atmosphere will be affected throughout the area of the Coronado Project. During construction there will be increases in airborne particulate matter, emissions from construction equipment and possible burning of slash accumulated during clearing operations. These impacts will be spread out over distance and time and are expected to be intermittent and of short duration.

During operation of the generating station approximately 0.492 tons/hr. of particulates, 4.2 tons/hr. of NO_x and 4.8 tons per hour of SO_2 will be emitted to the atmosphere. These emissions are within the allowable limits established by the Environmental Protection Agency and the State of Arizona to protect public health and will not appreciably effect social well-being, or adversely affect vegetation or wildlife.

Operation of the transmission system will also result in ozone production through the corona phenomenon. The degree of ozone production will vary over the length of the line and will be dependent, to an extent, on the climatic conditions at any given moment.

As a secondary impact, the supplying of electrical energy to the Phoenix area and eastern mining area will accomodate increasing industrial and residential growth thereby adding to the air pollution loads of those respective areas. The greater Phoenix area is already experiencing air pollution problems with certain standards being exceeded at times throughout the year. Increased growth will compound this problem.

(2) Noise

Construction activity on all features of the project will increase local noise levels to a point that may be objectional to humans and wildlife. These impacts should be short term and intermittent. After operations commence there will probably be a low humming noise noticeable inside the generating station that might be objectionable upon first exposure. Along the transmission line a crackling sound will probably be heard, especially when climate conditions are right. Coal-haul trains will be heard approximately twice every 31 hours making deliveries to the generating station. Their effects should be short term. The impacts resulting from increased noise will be of a nuisance nature and should not cause any adverse health effects.

(3) Visibility

Visibility in the vicinity of the generating station could be reduced on an annual average of 1 mile due to plant operation, from 80 miles to 79 miles. At the Petrified Forest National Park the visibility may be reduced by two or three miles. Visibility in the plant area will be reduced due to light scattering resulting from photo chemical oxidents. There may be times which a change will appear around the power plant particularly during the winter months when temperature inversions occur. It is recognized that the presence of the generating station and transmission lines in a "natural" setting may be objectionable to some people, particularly where the transmission line becomes sky-lined or traverses areas of scenic quality.

(4) Soils

Soils will be disturbed during all phases of construction. Erosion is expected to occur in some of the washes that cross the alignment of the railroad and increased silt loading during flooding could be expected. Erosion impacts on soils from construction of the other facilities are not expected to be severe.

b. On the Biological Environment

(1) Vegetation

Vegetation will be disturbed and destroyed over the entire study area as a result of construction of the various project features. Section II.C.2.b, Table II-35A, shows the number of acres of habitat, by type, that will be permanently lost. The vegetation to be lost varies over the length of the project area and includes that of the Sonoran Desert in the southern part of the study area, the coniferous forests of the Tonto and Apache-Sitgreaves National Forests as described in the Cholla Project final environmental statement, and the grasslands and juniper forests of the higher Colorado Plateau area.

Approximately 4042 acres of rangeland will be both temporarily and permanently lost due to construction of project features. Rangeland along the various features has a varying livestock stocking rate of seven to 25 acres per animal unit month (AUM). If 4,042 acres

are permanently lost to production, this would result in a loss of 253 AUM of forage lost (assuming 16 acres/AUM is the average carrying capacity of the range). If an average value of $14.86 per AUM is assumed, then the maximum economic impact would be $3,760 ($14.86 x 253 AUM).

(2) Wildlife

There are various types of wildlife that will be disturbed or destroyed within the study area as a result of construction activities. These species vary with the habitat they occupy and are described in more detail with respect to the features of the project.

c. On the Socio-economic Environment

(1) Sociological

The Coronado Project will have varying effects throughout the study area. The impacts on the St. Johns area from the total project will be the most significant. Work on Units 1 and 2 of the generating station will be spread over a six year period with the construction work force peaking at about 2000 employees during 1978. Construction workers for the coal-haul railroad will probably be based either at Navajo or St. Johns, Arizona. Their contribution to the work force will not be significant when compared with the workers associated with the generating station. The community of St. Johns, although taking steps to alleviate the expected population increase, will probably not be able to avoid social stress. Potential conflicts may arise due to ethnic or age differences between workers and townspeople in the community. There will be increased pressure on existing recreation facilities which will in all likelihood be unable to accomodate the increased load.

Utilities, such as sewer, water and power systems, may not be able to accomodate the increased load over the construction years with their present systems. The governments of St. Johns and Apache County will be faced with decisions on improving these facilities recognizing the need to accomodate an increased population for only a relatively short period.

Sociological impacts resulting from the construction of the transmission lines and coal-haul railroad should be less severe. By the nature of the construction work various crews move continuously along the alignment. Their exposure to any one community will be for only a few months at any one time.

(2) Transportation

During construction of the transmission line and the generating station, travelers may experience delays or other inconveniences at crossings or where construction equipment is also using a roadway. Increased trucking from the limestone source to the generating station may cause a temporary transportation inconvenience around St. Johns.

(3) Cultural Resources

Numerous archaeological and historical sites have been discovered along the rights-of-way for the proposed facilities. When appropriate, these sites will be salvaged. However, there is a feeling that disturbing any archaeological remains disturbs their intrinsic value and creates an impact that cannot be mitigated.

3. Unavoidable Adverse Impacts Resulting from Construction and Operation of the Generating Station

a. On the Socio-economic Environment

The net sociological effects of Coronado Station upon the St. Johns area will be the result of increased urbanization. The economic impact will be focused on the town of St. Johns with significant impacts on surrounding communities. The expected doubling in population of the St. Johns area during the construction period will bring expansion pressure upon both schools and utilities. Both primary and secondary schools will require expansion to accomodate the expected increase in pupils. The water supply system, medical facilities and the sewer system of the town will all need to be upgraded.

The operation of the powerplant will generate greater demands on the services of the local community. The increased urbanization will also change the lifestyle of the community somewhat from a rural, ranching community to an industry-oriented town.

The visual impact of the plant itself will be limited due to its distance from residences and highways. Visual impacts due to plant operations will range from low to moderate depending upon the opacity and extent of the plume from the stacks. The access roads and railroad will entail relatively minor visual impacts since the traffic volume along adjacent highways will be low and since the rail activity will not be inconsistent with present highway use. The wellfields will constitute a minor feature of the landscape as viewed from adjacent highways and will not significantly degrade the visual quality of the local landscape.

Even with measures to mitigate adverse effects on archaeological and historical resources, there will inevitably be some losses of sites, artifacts and information.

b. On the Physical Environment

Some soil erosion will occur at the start of construction activities although the degree of erosion is not expected to be large. Careful onsite grading and construction of runoff control structures will limit erosion to the immediate site area. Site grading and replanting prior to plant operation will eliminate on-site construction scars. Once the plant is decommissioned, restoration of the site will minimize any long-term effects.

Excluding noise from steam-blow tests performed prior to commercial operation, the continuous construction and operational noise levels at the nearest residences to the site will be less than those levels typical of quiet, suburban residential areas. Thus, very little annoyance is expected at homes closest to the site. At these residences, noise levels predicted for steam-blow tests fall within HUD's normally acceptable category. The short duration of the blows and the relatively short period over which steam-blow operations will occur will reduce the impact to negligible levels.

Plant operation will result in emission to the atmosphere of some pollutants such as sulfur dioxide, oxides of nitrogen and fly ash particulates. However, these emissions will be at or below Federal and State emission standards. Pollutant concentrations at ground level resulting from station emissions will meet ambient air quality standards.

The plume from the stacks will cause a small decrease in visibility in some areas surrounding the plant. This decrease in visibility will fall within the range of normal day-to-day fluctuations due to natural factors.

c. On the Biological Environment

Construction activities will disrupt animal habitats within the site area and will result in the loss of the animals living on the site. Those species having a larger range will be displaced into the territory of the neighbors, resulting in an overall reduction in the number of individuals present. The habitat removal will affect wide-ranging animals by eliminating a portion of their range and possibly by causing a change in their daily or seasonal movements and migration patterns. The general increase in human activities during construction and operation of the plant site will interfere with the use of the area by those species, such as antelope, hawks, eagles and owls, that are sensitive to man's presence.

4. Unavoidable Adverse Impacts Resulting from Construction and Operation of the Water Wellfields

a. On the Physical Environment

Groundwater supplies will provide the water necessary for station operation. Some drawdown of the water table will occur due to withdrawal at the average rate of 13,424 acre-ft/yr, assuming a 70% annual plant capacity factor. In order to minimize the drawdown of the water table, three wellfields wll be developed to supply the necessary water.

b. On the Biological Environment

There will be some local disturbance to vegetation and wildlife at the location of each well and near the access roads that will be constructed to each well. Due to the distances between the wells it is expected that wildlife activity in the wellfield area will return to near its normal levels after construction is completed.

5. Unavoidable Adverse Impacts Resulting from Construction and Operation of the Coal-Haul Railroad

a. On the Socio-economic Environment

Since many impacts on land use will be reduced through planning and right-of-way negotiations, the principal unavoidable residual effects on the land-use resources of the area will result from severance of subdivided lands and the loss of scenic integrity. Where subdivided properties are transsected, the full impact of the railroad is somewhat difficult to assess. It can be expected to impair access to some parcels when roads are crossed. Such parcels, depending upon the development intentions of future buyers, may be less saleable, or less valuable. Also, existing and future residences would be subjected to such effects as railroad noise.

Although the proposed action is expected to cause only minor levels of impact on scenic resources, some degradation from the "natural" state is expected to result from the construction and operation of the railroad.

Even with measures to mitigate adverse effects on archaeological and historical resources, there will inevitably be some losses of sites, artifacts and information.

b. On the Physical Environment

Even though the area of the proposed action is generally of low relief, some topographic irregularities exist which must be modified to meet the gradient requirements of the railroad. Placement of the railroad on the most level route has mitigated, to a great extent, adverse effects on the physiography of the area.

Though various precautions can be taken to minimize adverse effects, some impact due to increased erosion and sediment transport and deposition will occur. The increased erosion will be minor compared to the high natural erosion potential of the Little Colorado River region. Additional silt loading in streams due to construction and operation of the railroad will probably not be measurable. Most of the increased erosion will be confined to the exposed faces of cuts and fills.

The proposed actions will induce some effects on the quantity and quality of surface and ground water in the study area. Despite the use of numerous bridges and culverts designed to transmit water past the railroad without interference, some minor restriction, damming and diversion of surface flow will result. Small increases in sediment concentrations and loads in surface water will occur during period of high flow; however, the resulting downstream impact on the very heavily loaded Little Colorado River is not expected to be measurable.

Although the source of construction water for dust control and compaction is not yet known, it will most likely be pumped from the groundwater sources. Depending on the location of wells with respect to other water users, some local lowering of water levels will occur. While these impacts may be significant locally, the short-term duration of construction will minimize the potential for any long-term impact on water levels or water quality.

The air quality in the area of the proposed action will be unavoidably affected by slight increases in pollutant concentrations during construction and operation. During construction, mitigating actions, such as watering, etc., will keep fugitive dust at a minimum. During operation, the total pollutants added to the air due to train activity will be minor (the total pollutant emissions expected from a train comprised of eight engines is roughly equivalent to two additional autos traveling along Highway 666 between Sanders and St. Johns) and will dissipate rapidly.

Construction and operation of the railroad will cause increased sound levels in the study area. Though mitigation measures can be implemented, some increases in sound levels are unavoidable.

c. On the Biological Environment

The environment of the study area will be unavoidably impacted through loss of habitat, increased potential for road kill and increased accessibility. Within the corridor approximately 526 acres of habitat will be disturbed by construction in the areas of the railroad bed and auxiliary activities (roads, etc.). Of this, 236 acres in the cut area will, in time, provide new habitat. Hence, while there will be an irretrievable loss of approximately 290 acres of habitat along the alignment due to the railroad bed and cuts, this impact is local and should have minimal effect on the functioning of the extensive ecosystems crossed. The type of fencing to be used is optional with each landowner and may in some cases be of the type that antelope cannot cannot penetrate in changing ranges. With improper fencing, the potential for bisection of the antelope range, and thus loss of valuable habitat, could have far-reaching effects on the species. Fencing on Federal Lands will be subject to approval by BLM. Road kill of wildlife on the tracks is an unavoidable impact. It is expected that all locally occuring species will be involved to some degree, but the extent of the kill is expected to be an unimportant factor for any species.

With the opening of the area for construction and operation, increased accessibility to the area may result. It is generally accepted that human ingress into undeveloped areas is proportional to the amount of roads, this in turn may increase littering, vandalizing and poaching in the area.

F. The Relationship Between Local Short-Term Uses of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity

The construction and operation of the Coronado Project will result in both short and long-term uses of the environment. For purposes of this environmental statement environmental gains and losses which will be experienced throughout the life of the project will be included in the definition of short-term uses. Gains and losses whose influence will be felt beyond the project life are considered long-term consequences of the project.

Numerous natural and manmade materials will be utilized in the building and operation of the proposed facility. Most of these, such as cement, steel, glass, etc., will be used in relatively insignificant quantities. Others, such as the coal and limestone to be consumed by the plant, will constitute a significant resource use that will be lost to future generations.

Construction of the Coronado Project will result in a change in land use at the plant site and wellfields. The plant site will be lost to grazing for the life of the plant, but the wellfields may be available for limited grazing after the wells are constructed.

When the plant is decommissioned, restoration methods may be used to return the area to its former state, as nearly as possible.

The economic productivity of the project area, while it is being used to generate electricity, will be large when compared with the productivity from livestock grazing and other likely uses of the surrounding area. A projected boost to the region's economy is expected to result in a corresponding increase in productivity, compared to a smaller effect for uses other than power generation. After the project is decommissioned there will in all probability be a substantial adjustment in the economy of the St. Johns area. Presumably decommissioning will occur over a period of years that will allow the economy to make an orderly transition to its new status.

Most of the water pumped from the wellfields will be lost to evaporation after extensive use and reuse. Since groundwater withdrawal from the wellfields will exceed recharge, water will be "mined" and water levels will decline. Some water quality deterioration is possible. If quality deterioration is serious, future water uses could be limited. At the end of the project life the wellfields will no longer be needed and presuming that no other demands are made on the groundwater reservoir, recharge over a number of years should reestablish the source.

Land in the three wellfields is currently used for grazing and by the limited wildlife that live there. Development of the wellfields will limit other use of the land because it will commit the only available water source. It is therefore anticipated that land use in the wellfield area will not change from present uses.

Construction of the coal-delivery railroad will result in an appreciable change in land use within the right-of-way which is presently rangeland. This area will be lost to grazing for the life of the railroad. After the project has been decommissioned and the railroad is no longer needed to service the powerplant, it is probable that it will be left in place to provide service to the St. Johns area. Such an action would, however, require the railroad to attain common carrier status before it is so used and at this point in time is purely speculative. It is also conceivable that the tracks would be left in place and not used.

Construction and operation of this project will affect scenic and recreational use of the environment in several ways. Most of these effects will be small impacts on the area's visual esthetics. None of the potential actions will preclude any known future uses of the railroad right-of-way.

G. Irreversible and Irretrievable Commitments of Resources

Irreversible commitments generally concern changes set in motion by the proposed action which, at some later time, could not be altered so as to restore the present order of environmental resources. Irretrievable commitments are generally the use or consumption of resources that are neither renewable nor recoverable for subsequent use.

The types of resources of concern in this case can be identified as (1) material resources, including construction materials, and renewable and nonrenewable resources consumed during operation, and, (2) nonmaterial resources, including a range of beneficial uses of the environment.

Resources which may be irreversibly committed by the operation are: (1) biological species that may be destroyed; (2) construction materials that cannot be recovered or recycled with present technology; (3) materials such as the limestone and coal deposits consumed or reduced to unrecoverable forms of waste by plant operations; (4) the atmosphere and water bodies used for disposal of heat and certain waste effluents, to the extent that other beneficial uses are curtailed; and (5) land areas permanently rendered unfit for other uses. Those of importance to this project are discussed in the following sections.

1. Generating Station, Wellfields

The construction of the station will result in the loss or disturbance of up to 4000 acres of native biotic communities and disturbance of some of the biota adjacent to the site. The lands occupied by the station buildings, cooling towers, evaporation ponds and ash disposal area will be permanently altered.

Construction materials are almost entirely of the depletable category of resources. Concrete and steel constitute the bulk of these materials, but numerous other mineral resources are incorporated in the physical plant. No commitments have been made as to whether these materials will be recycled when their present use terminates. It will be a long time before final disposition of construction materials must be decided. At that time, quantities of materials in the categories of precious metals, strategic and critical materials, or resources having small natural reserves must be considered individually, and plans to recover and recycle as much of these valuable depletable resources as is practicable will depend on need.

The principal material resources consumed during the operation of the powerplant will be coal and water. The plant will consume approximately 4,000 tons of coal per unit per day for average grade coal at 70% load factor. A long-term coal supply for the generating station has not been identified yet. Salt River Project has entered into a short-term

5 year agreement with the operators of McKinley Mine in northwest New Mexico to provide 6.5 million tons of coal initially for the station. The impacts of mining coal from the site were described in the Final Environmental Statement for the Cholla Project, filed with the Council on Environmental Quality in April 1975 by the U.S. Forest Service. Water will be consumed at the rate of 13,424 acre-feet per year.

Limestone will be required for operation of the air quality control system. The limestone will be mined from presently undeveloped deposits approximately four miles from the plant site. Some 263 tons/day of limestone will be required for plant operation.

2. Coal-haul Railroad

The construction of the railroad will result in the loss of up to 290 acres of native biotic communities and in the disturbance of up to 526 acres adjacent to the railroad. The lands occupied by the right-of-way will be permanently altered.

Construction materials are almost entirely within the depletable category, with earth, rock, wood, concrete and steel constituting the bulk of these materials. No commitments have been made as to whether these materials will be recycled when their planned use terminates.

H. Alternatives to the Proposed Action

1. Introduction

There are a number of technically feasible alternatives to the proposed project. There are also possible alternatives to features of the project. This chapter discusses alternate types of generating facilities that could be implemented at the St. Johns site, but that would probably be implemented at a site closer to the load center. Also discussed are alternate methods of power generation; alternate designs within the generating station complex; alternate sources of station water needs; alternate sources of limestone and possible alternate alignments for the coal-haul railroad. Chapter III discusses possible alternate routings of the transmission line as well as alternate designs of tower structures.

There are alternative energy systems that are not related to the proposed Coronado Project but which could provide the energy to be produced by the Coronado Project. These alternatives are discussed in this section. Also included is a discussion of the alternative of purchasing power from other sources, a discussion on an active conservation program to reduce power needs and a discussion of the alternative of taking no action.

2. Alternative Energy Sources - Purchased Power

One of the potential alternatives to building new generating facilities is the purchase of necessary power from a neighboring utility. This alternative is dependent upon such a utility having a surplus of generating capacity available to sell. With present difficulties in financing generation facility construction, all electrical utilities are finding it increasingly difficult to supply their own system requirements, and no utilities are planning to install generating resources in excess of their needs. As a result, reliable sources of power for purchase by Salt River Project are not available.

3. Alternative Energy Systems

a. Hydroelectric Energy

Further development of hydroelectric power is limited in this region by the small number of remaining feasible sites both on- and off-stream and by legislative constraints which prohibit development on portions of the Colorado River. Salt River Project is presently evaluating several alternative hydroelectric pumped storage sites for power potential. In the future one or more sites may prove feasible, but the lead-time required does not presently allow any hydroelectric site to be considered as a viable alternative to the Coronado Station.

b. Solar Energy

Research and development work on solar energy conversion has increased in the last few years. One of the goals is the development of solar powered central power stations. Some of the concepts currently being evaluated employ solar collectors which

convert the sun's radiation into a heated fluid from which mechanical energy would be extracted in a conventional manner. Research into the direct conversion of solar energy to electricity, via photovoltaic cells, is also being considered for individual residential installations.

Salt River Project has provided financial sponsorship for solar research in the past and is continuing to do so through its contributions to the Electric Power Research Institute, the research arm of the electric utility industry, and in support of specific solar R&D programs. SRP is currently exchanging technical information with firms conducting research studies to determine the preferred system from a utility point of view. However, even though solar research and development work is receiving considerable attention, current estimates are that electricity from the sun may not be commercially available until after 1990. Thus solar energy is still in a research mode, and it is evident that solar energy development will also incur adverse environmental impacts, particularly with respect to land use, unless substantial advancements in technology are made. Development of solar energy and some of the environmental considerations of this development are described in the publication "Energy Alternatives: A Comparative Analysis". Science and Public Policy Program, University of Oklahoma, May, 1975.

c. Geothermal Energy

Potential energy exists in the earth in the form of steam, hot brine and hot rock. In some areas this supply of thermal energy is located within several hundred feet of the surface and it is feasible to drill wells at these points. Successful utilization of this energy for electrical generation has been made in several areas. However, geothermal steam is a relatively rare and localized resource. Efforts are currently being made by various agencies to develop technology for use of hot brine resources, which are more widespread than steam, but as yet this technology has not been demonstrated.

Salt River Project (along with Arizona Public Service and Tucson Gas & Electric) has helped support exploration for geothermal steam in Arizona. Two test wells were drilled near Chandler, Arizona, with the final evaluation of potential of the area yet to be determined. Even if these wells should prove to be commercially feasible, large-scale utilization of this resource would require an extensive period of time for drilling and hardware development and testing, thereby precluding its use as an alternative to the Coronado Station. Development of geothermal resources and its attendant environmental impacts are discussed in the publication "Energy Alternatives: A Comparative Analysis". Ibid.

d. Fuel Cells

These electrochemical devices convert the chemical energy of conventional fuel oxidation directly into low-voltage, direct current electricity. The oxidation of hydrogen, for example, in such cells would have an electrical conversion efficiency of 60 to 80%, higher than the Carnot efficiency limitation of conventional steam plants. At present, the costs and lack of experience in the use of fuel cells limit their applicability. A utility-funded effort to develop fuel cells is currently under way aimed toward the production of 26 MW capacity modules.

e. Energy Generation by Tidal Action

The technological feasibility of harnessing the tidal flow in a natural coastal basin has been proven, but it is economically viable in only a very few locations. No such location has been identified that could be useful to the SRP system.

Such a facility, in addition to requiring the impoundment of large areas of coastline, could necessitate long transmission lines with consequent impact upon land utilization.

f. Magnetohydrodynamics

Magnetohydrodynamic (MHD) generation of power relies on the same principle as conventional generation. However, instead of a solid conductor, such as a turbine rotor, moving across a magnetic field, a jet of ionized fluid is used. By placing electrodes in this fluid stream, direct current electricity can be produced at a potential of 2000 volts or more.

The higher flame temperature associated with the MHD process means emission of more nitrogen oxides, but the higher energy conversion efficiency of a combined steam-MHD plant would mean less waste heat transmitted to the environment.

Before MHD can be utilized for central power stations, significant technical problems must be solved. A meaningful demonstration of MHD conversion in the United States is not likely before 1980 and the first commercial use is not expected before 1985.

g. Nuclear Fusion

Perfection of devices for confining and heating a plasma of hydrogen isotopes (deuterium and tritium) will make possible a demonstration of principles on which a fusion reactor would be based. Once it is clear how best to confine and heat a plasma in order to sustain a thermonuclear (or fusion) reaction, technological problems associated with providing efficient and economical recovery of the energy released in the plasma can be addressed. The earliest possible date for commercial fusion reactors is expected to be 1995 to 2000.

4. Energy Conservation

The Arab oil embargo provides a tool for investigation of the effects of the alternative of conservation since a strong program of voluntary conservation was instituted during that period. Oil shortages appeared after the imposition of the Arab oil embargo in the latter part of 1973. At that time Salt River Project observed that peak demands and energy consumption were reduced below anticipated levels; in December 1973, the peak demand was reduced below the level

TABLE II-64

Comparison of Monthly Peak Demands and
Energy Requirements for
October, 1972, through May, 1973, and
October, 1973, through May, 1974.

Salt River Project
Agricultural Improvement and Power District

Monthly Peak Demands (Megawatts)

Month	1972-73 Period	1973-74 Period	Increase (Decrease) Over 1972-73	1974-75	Increase (Decrease) Over 1973-74
October	1,004	1,086	8.2%	1,306	20.3
November	740	838	13.2%	872	4.1
December	901	842	(6.6%)	1,012	20.2
January	830	908	9.4%	1,058	16.5
February	787	909	15.5%	993	9.2
March	812	852	4.9%	955	12.1
April	940	975	3.7%	931	(4.5)
May	1,271	1,366	7.5%	1,300	(4.8)

Monthly Energy Requirements
(Millions of Kilowatt-Hours)

October	440.6	508.2	15.3%	582.3	14.6
November	408.2	449.9	10.2%	481.3	7.0
December	467.7	483.8	3.4%	582.2	20.3
January	469.4	494.7	5.4%	603.4	22.0
February	395.1	454.4	15.0%	523.4	15.2
March	448.6	494.4	10.2%	545.2	10.3
April	433.7	497.1	14.8%	619.6	24.6
May	569.7	637.6	11.9%	611.1	(4.2)

established a year earlier for the corresponding period. Table II-64 illustrates this experience by comparing the monthly peak demand and energy requirements for the eight months from October 1973 through May 1974 with the experience in the corresponding months in both the 1972-73 period and the 1974-75 period. It is also seen that peak demand fell below 1972-73 in April of 1975.

The explanation for reduction in electric usage is not fully understood. Conservation measures adopted by SRP customers and some reduction in business activity resulting from gasoline shortages affected electric usage to some extent. However, a very mild winter and an early spring experienced in the southwest, as in other parts of the country, also contributed to the reduction of SRP loads during 1973-74. As can be seen from Table II-64, 1974-75 saw an increase over the 1973-74 oil embargo period in both peak demands and energy consumption for every month of the period except April and May.

Monthly energy conservation is difficult to correlate with the heavily publicized conservation program of 1973-74, since energy usage generally increased during the 1973-74 conservation program and increased again in 1974-75 when compared to 1972-73.

These increases in energy consumption are especially significant when considering conservation as an alternative to increased base-load generation projects, such as Coronado Station. This is because base-load generation produces a relatively large amount of energy per megawatt rating. In other words, if energy use increases when conservation measures are in effect, then the need for base-load capacity, such as Coronado Project, also increases.

Table II-65 shows projected energy sales with the same level of voluntary residential, commercial and small industrial customer energy conservation as was observed by SRP during the 1973-74 Arab Oil Embargo. The effects of weather upon the projections have been removed.

TABLE II-65

Projected Voluntary Energy Conservation
For Residential, Commercial, and Small
Industrial Customers

Year	Projected Sales (Kw-hr)	Projected Sales With Conservation (Kw-hr)	Voluntary Energy Conservation (Kw-hr)
1975	8,072,557,000	7,881,016,000	191,541,000
1976	8,586,014,000	8,385,734,000	200,280,000
1977	8,852,569,000	8,640,481,000	212,088,000
1978	9,473,698,000	9,245,913,000	227,785,000
1979	10,065,432,000	9,819,449,000	245,983,000
1980	10,652,809,000	10,387,657,000	265,152,000
1981	11,491,917,000	11,204,083,000	287,834,000
1982	12,556,025,000	12,242,309,000	313,716,000
1983	13,481,230,000	13,142,120,000	339,110,000
1984	14,478,944,000	14,112,392,000	366,552,000
1985	15,555,943,000	15,159,268,000	396,675,000

Voluntary energy conservation could potentially reduce energy sales by as much as 396,675,000 KW-Hr. in 1985. Assuming that the Coronado Generating Station Unit #1 operates at even a modest 55 percent capacity factor during 1985, it would generate approximately 1,686,300,000 KW-Hr. or over four times the amount conserved. Thus, the amount of conservation would need to be much greater than has been observed in the past to significantly affect the need for the Coronado Project. Voluntary conservation of this magnitude appears unlikely, especially in light of the tremendous national conservation campaign, including Presidential involvement, which was conducted in 1973-74.

There is a shift from oil and gas to electric power for new space heating requirements and to meet other commercial, industrial and agricultural energy needs. This shift is taking place because of the shortage of natural gas in the areas served by SRP, and the increased costs, questions of continued availability and other problems associated with the use of oil and propane. At present, no new gas hookups are being allowed. This shift tends to increase the need for additional base-load generation, even if energy conservation measures are implemented.

Pollution control measures in mine smelters are leading to increased demands for power. These new loads tend to counterbalance any expected reduction in loads due to conservation efforts. A sizable portion of SRP's base-load in the eastern portion of the service area is due to copper mining and smelting activities. In addition, it was pointed out at the public hearing on the draft environmental statement that the Ray Copper Mine could double its present production with available power.

While the current demand for copper and other raw materials reflects the generally depressed levels of economic activity, it is anticipated that the growth in demand for such products will resume; this, together with the increased use of electric smelting processes to reduce pollution in the mining industry, will result in higher mining loads on the SRP system. Since energy usage is already very carefully controlled by the mining customers, further conservation results are more difficult to achieve for these relatively efficient users. Hence, conservation is not expected to have a great influence on these loads.

It must be noted that implementation of any involuntary energy conservation is beyond the authority of an electric utility. Involuntary energy conservation is a major public policy decision, and is therefore not an available alternative to increasing generating capacity, from the standpoint of SRP. Encouraging voluntary energy conservation is, however, an alternative to constructing additional capacity. This alternative is already being utilized by SRP, and has been encouraged since 1972.

Voluntary energy conservation effects, while difficult to separate from other effects, must affect the present SRP loads and have been affecting them for several years. SRP, in forecasting loads, does make use of historic loads, among other factors. Thus, present load projections include the effects of voluntary conservation efforts.

The Salt River Project has actively pursued a public communication and education program designed to encourage energy conservation and efficient energy use by its customers. The scope and nature of this program has been regularly reported to the Federal Power Commission in FPC Docket No. R-454, pursuant to FPC Order No. 495, issued November 13, 1973.

These programs include builder programs to encourage increased insulation, more efficient wiring and more efficient ventilation. Builders are provided brochures showing energy savings and heat gain/heat loss studies on model homes. Commercial and industrial customers are contacted regularly and suggestions in the area of lighting, heating and cooling are offered.

A detailed energy conservation program has been carried out with SRP's 44 largest commercial customers. SRP has worked closely with these customers and a series of plans have been developed that could result in a 10 - 25 percent reduction in power consumption.

A program to develop a pool of contractors that are capable of selling, installing, and servicing heat pumps has been implemented, as well as efforts to increase the efficiencies of name brand heat pumps. SRP has acted as a coordinator between the building industry and suppliers of insulation and/or shade screens in an effort to reduce heat gain and heat loss in buildings.

The general public has been exposed to a broad program of customer communications carried out by many forms of advertising, demonstrations and group presentations. This program is aimed at creating a general knowledge of the need for the average customer to conserve and effectively use energy.

5. Alternatives to the Power Plant

a. Alternative Methods of Power Generation

This sub-section of the environmental statement discusses the alternate methods of power generation that are technically feasible to replace the plant at the St. Johns site. Many of the environmental impacts that will occur with the proposed project would also occur with any given alternative. The following discussion will attempt to point out the impacts that can be expected from the alternatives as compared to the expected impacts of the project as proposed.

(1) Steam Generation with Alternate Fossil Fuels

It would be technically feasible to construct a generating plant that would use other types of fossil fuels, principally oil and gas, as an energy source. Rather than constructing it at the St. Johns site, the plant would probably be constructed near Phoenix, the major load center to be served by the Coronado Porject. There would be

substantial differences in the design and layout of the facilities whether conventional boilers or gas-fired turbines would be used. The yard layout would be similar, but no ash handling facilities or disposal areas would be required. Hence the impacts associated with those facilities would not occur. There would be no coal storage yard but some storage of gas and oil would be needed and, in all probability, a small tank farm would be required.

There would be substantial changes in the impacts of the alternate system on air quality. No particulates would be released to the atmosphere and less emission of nitrous oxides and sulfurous oxides than with a coal-fired plant. Generally, there would be a greater amount of hydrocarbons introduced into the atmosphere.

Since an alternate plan would be built closer to the Phoenix area, there would be no need for the transmission line as proposed. Some transmission facilities would be built to service the eastern mining area around Globe and Miami, Arizona. The transmission system could be built along the same alignment proposed between the Kyrene and Silver King substations. Impacts that are estimated to occur as a result of construction of the transmission line would be reduced accordingly.

There are other concerns with the use of oil and gas for the generation of electric power that do not impact the local environment but involve national policy with respect to using these fuels. Stated briefly, these concerns are:

Natural Gas: The supply of natural gas is low and is decreasing rapidly. Curtailment of deliveries for electrical generation have taken place since 1975 so that existing units can no longer expect to receive an uninterrupted supply of gas. Therefore, natural gas is not considered to be a feasible fuel for a new power plant.

Oil: A dependable oil supply sufficient for the projected energy needs is not available. Additionally, the oil which is available would be much more expensive than coal for a given energy output. The Arab oil embargo of 1974 emphasized the need to reduce dependance on oil as a fuel for electric power generation.

While gas turbine technology is well developed, there are other considerations that preclude the use of gas turbines as a source of base load power. Such units are characterized by low capital cost, but relatively high operating cost, resulting in a high energy cost per kilowatt hour. They require large quantities of fuels that are in short supply--natural gas or high grade distillate fuel. Consequently, gas turbines are designed to be used as peaking units and operate only a few hours per week during periods of maximum demand, as opposed to the high capacity factor of coal units. An additional disadvantage of gas turbines is that during hot weather their power output can be reduced as much as 20%. Extra units would be needed to offset hot weather capacity reduction.

In light of the economic constraints of using oil and gas, as well as the questionable availability of these fuels, Salt River Project does not believe it is in the best interests of the national policy of energy self-sufficiency to further pursue a plan using those alternate fossil fuels.

(2) Combined Cycle Power Generation

It would be technically feasible to substitute a combined cycle generating facility at the St. Johns site in lieu of the proposed power plant, but it would probably be located nearer to Phoenix, Arizona. A combined cycle plant uses a gas turbine to produce electricity in tandem with a turbine driven by steam from a boiler. The heat source for the boiler is the exhaust gasses from the gas turbine. Such plants are being built in the medium-size range, but their operation costs are still relatively high in comparison with a coal-fired plant. Use of such a system would result in essentially the same impacts as would result from generation with alternate fossil fuels.

Similarly, because a combined cycle system uses natural gas and/or oil as a fuel source, the result is energy at a high cost per unit due to the varying costs of petroleum products. Consequently, Salt River Project is not pursuing the combined cycle power generation plan as an alternate to the proposed Coronado Generating Station.

(3) Nuclear Power Generation

It would be technically feasible to replace the Coronado Generating Station with a fission type nuclear powered generating station. In all probability, if such an alternate were chosen, it would be located closer to the Phoenix area than the St. Johns site but further away from populated areas than the gas and oil burning alternate plants would be. Site layout would be substantially different from the proposed plant. The transmission system from the Coronado Station to Kyrene would not be needed, although some lines to the eastern mining area near Globe and Miami, Arizona, would be needed, hence reducing the transmission line impacts. The coal delivery railroad would not be required as fissionable materials would be transported by truck over existing highways. The impacts from the proposed railroad would not occur.

A major consideration in nuclear powered plants is the handling and disposal of radioactive waste materials. Usually these wastes are transported to either Federal storage areas or commercial burial areas. Eventually they are buried to insure that radioactive material does not enter the environment. It generally requires 0.2 acre per year to accommodate waste material from a typical 1000 MW nuclear generating station. The greatest public concern with the construction and operation of nuclear generating stations is safety. The handling of fission-fuel and waste material requires elaborate safety programs to insure that accidents or releases of radioactive contaminants to the environment do not occur, and the radioactive wastes must be safely stored for extremely long periods of time.

Salt River Project recognizes the benefits of nuclear power and is participating in the planned Palo Verde Nuclear Generating Station near Phoenix. Experience indicates that about ten years are required from initiation of a new nuclear project to commercial operation. This period includes more than five years for actual construction. Therefore, at this time, it is not possible to meet the capacity requirement of 1979 with a nuclear power plant.

b. Alternate Plant Site Location

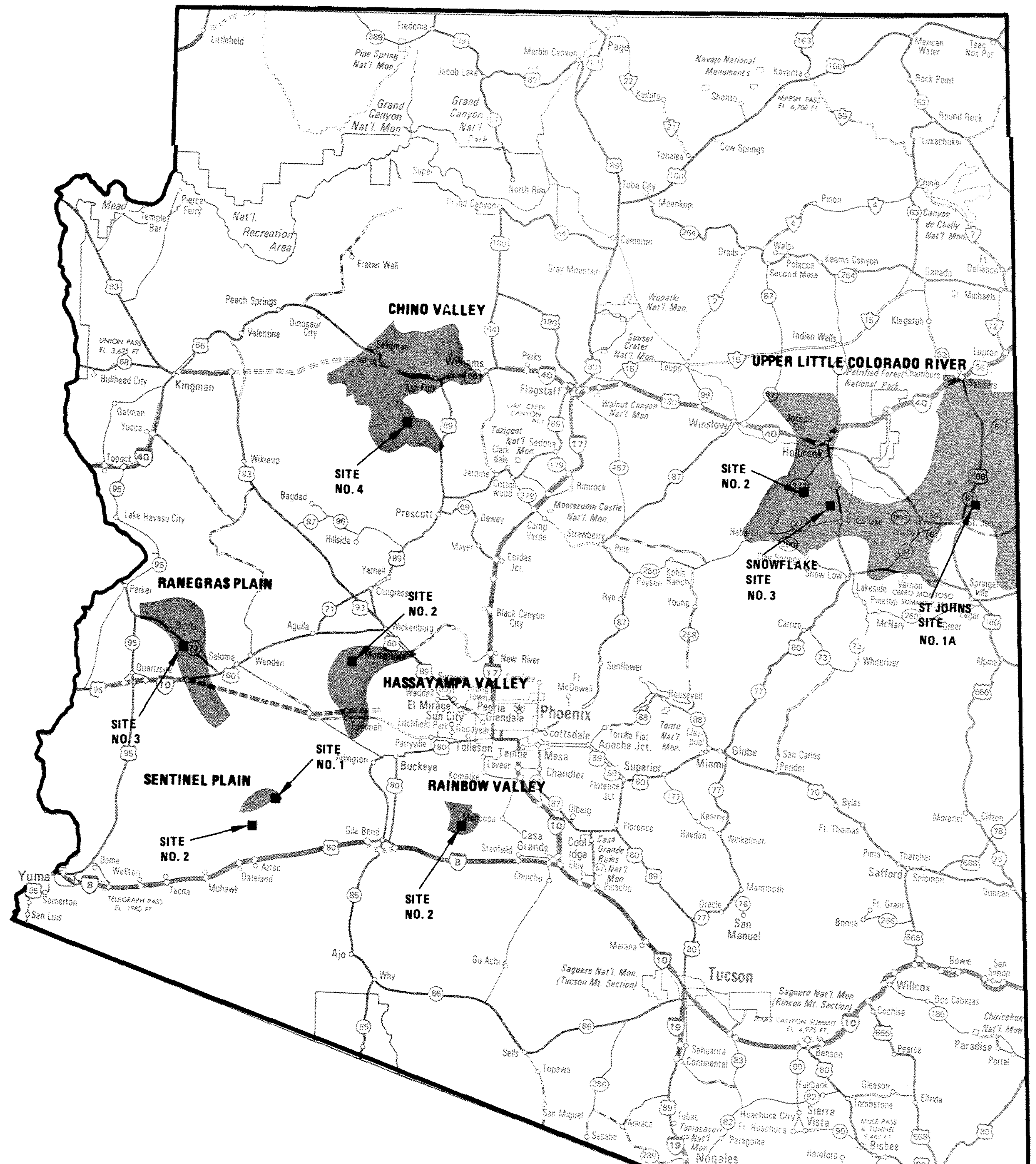
Selection of a plant site came after a detailed site selection study of the entire State of Arizona with the exception of Indian Lands as described in Section I.B. The process of selecting a plant site consisted of three general phases. Phase I-A involved a general survey of the air quality/meteorology, ecology, land use and hydrology of Arizona with the intent of locating acceptable zones within the State. Six zones were located and became the subject of more detailed studies. Environmental consultants and engineers jointly selected several potential plant sites within the acceptable zones. A process of site visitation, investigation, and the application of a set of environmental and engineering criteria resulted in the selection of nine candidate sites (Figure II-50, Location of Candidate Sites).

Phase I-B involved a more thorough investigation of the nine candidate sites. Site visits, literature studies and development of estimated cost differentials at each site led to the selection of two final candidate sites. The two sites, Snowflake and St. Johns, were analyzed in detail in Phase II. Both sites were found to be environmentally compatible at the conclusion of these studies. The principal reason for the selection of the St. Johns site was the greater economic benefit to the community projected for this site over the Snowflake site.

The Arizona Power Plant and Transmission Line Siting Committee has reviewed the studies performed by Salt River Project and has issued a Certificate of Environmental Compatibility for the St. Johns site. The impacts for each of the sites are similar for land and water use, air quality, solid waste disposal and aesthetics. However, impacts would vary on wildlife and vegetation, for delivery of fuel to the sites and tramsmission of energy to the load centers. As of August, 1976, construction of the St. Johns' site was approximately 11 percent complete.

c. Alternate Plant Systems Design

Alternate plant systems considered for the Coronado Station are described in this section. Alternative heat dissipation, waste water disposal, coal handling and storage, air pollution abatement and solid waste handling and disposal systems are included.



CORONADO PROJECT

LOCATION OF CANDIDATE SITES

Figure II-50

(1) Heat Dissipation

In addition to the wet mechanical-draft cooling towers which appear to be the most viable at this time, the following alternate methods of heat dissipation were considered: wet natural draft cooling towers; dry cooling towers; wet/dry cooling towers; and cooling ponds. The following criteria were used in comparing the heat dissipation alternatives: feasibility and engineering experience; environmental effects; economics; and water consumption.

Wet natural-draft towers have proven to be a reliable heat dissipation system for power plants at several installations in the eastern United States and in Europe. Some of the principal advantages are that the plume is discharged at a higher elevation and the tower requires less auxiliary power than the wet mechanical-draft tower for its operation. It is estimated that natural-draft towers would cost at least twice as much as the mechanical-draft towers that are proposed for the station. Another feature which may be considered disadvantageous at the proposed site is the extreme tower height that would be necessary, estimated at over 400 feet. Natural-draft towers also require almost the same amount of make-up water as mechanical-draft towers. Two additional factors which normally tend to favor natural-draft towers, limited space and plume dispersion, are not considered to be critical at the Coronado Station site.

Dry cooling tower systems (either mechanical or natural-draft type) employ finned-tube heat exchangers with atmospheric air on the outside of the exchangers as the cooling medium. The fluid inside the tubes of the exchanger can be either turbine exhaust steam (direct system) or turbine condensate (indirect system). In a dry tower system, the steam or condensate is cooled to the approximate ambient air dry-bulb temperature, as compared to a wet tower which is designed to approach a normally much lower wet-bulb air temperature, especially during summer operation. Numerous dry cooling towers have been installed in Europe, but none on generator units larger than 200 MW. To date, the largest dry cooling tower system in the United States is on a 20 MW unit at Wyodak, Wyoming, owned by the Black Hills Power and Light Company. The principal advantages of dry cooling towers are zero water consumption and no visible plume. However, in addition to the lack of operating data regarding reliability of this type of cooling system in this country, the cost of dry cooling towers is more than twice that of comparable wet towers of either the mechanical-draft or natural-draft types. Another major disadvantage of the dry tower at this specific site is the relatively high summer air temperatures (90° to 100°F) which will increase turbine exhaust backpressures and reduce power generation when system demand is greater than that of wet type towers because of the large amount of air to water heat transfer surface required. The impacts of dry cooling towers as compared to wet cooling towers were presented in the Kaiparowits Final Environmental Impact Statement. As

that statement pointed out, the dry cooling towers would have less impacts in that they would not consume water and would not create a problem of fogging, icing, drift or blowdown, dry cooling towers would, though, decrease turbine-cycle thermal efficiency by four to ten percent, use 10% more fuel, release 18% more heat to the atmosphere and would require a different type of turbine than that suitable for wet cooling towers. Turbine generators suitable for the high back pressure required by a dry cooling tower plant are not in production. Though study of dry cooling towers is continuing, they were not considered suitable for the Coronado Project because of the reasons listed above.

The wet/dry cooling tower utilizes features of both of the previously mentioned tower designs, namely, reduction of water consumption (dry type) and lowest possible turbine exhaust pressure design (wet type) for maximum unit generation. This type of cooling system can be designed to reduce annual water consumption anywhere from five to 50% depending upon the area of dry cooling section installed. A side benefit is the reduction of the visible plume from the tower. Wet/dry towers are not recommended for the Coronado station for the following reasons:

a) The wet/dry tower costs approximately 50% more than the wet tower based on a 10% water saving due to the wet/dry system.

b) Power requirements are higher than for the wet design and net power generation output available during the summer months will be reduced as discussed above for the dry tower, although to a lesser degree.

c) Wet/dry systems achieving greater than 10% water consumption reduction have not yet been proven in large power plant installations. It is estimated that a 10% reduction in cooling tower water loss would save only approximately 14,000 acre feet over a 35 year plant operating life based on an average 60% capacity factor.

d) The advantages of reduction in visible plume length is considered negligible for the Coronado Station site.

The last alternative considered, cooling ponds, requires a large amount of land (approximately one to two acres per MW), or, for the Coronado Station, about 1500 acres for three units. Water consumption for ponds is equivalent to wet cooling towers. There are no significant advantages for the cooling pond over the other alternative systems studied, although the cooling pond does offer a lower operating cost and possible use for public recreation purposes.

(2) Waste Water Disposal

Possible alternate waste disposal methods to supplement the evaporation ponds are various forms of brine concentration to clarify and reclaim water for reuse or reduce the wastes to a solid form which can be readily handled for disposal. These processes include:

a) Multistage evaporator-crystallizers to evaporate liquid wastes to a slurry form and then centrifuge to damp crystals (currently being studies by industry).

b) Evaporate and condense liquid wastes in vertical tube evaporators to reclaim a major portion of the water for reuse.

To date, the above methods have not been proven on a commercial basis. The first commercially-sized evaporator units (vertical tube evaporators) were scheduled for demonstration test in July 1974.

(3) Coal Handling and Storage

Alternate methods of coal handling and storage have been studied, in addition to the open storage method previously described. Alternate methods of open storage are stacker-reclaimer and inclined moving conveyor for kidney pile stack out. Alternates for enclosed storage are conveyors with A-frame building enclosure and concrete silos. The open storage stack out method with lowering wells is the most economical system for the Coronado Station, based on preliminary engineering estimates. In addition, open storage is considered to be safer for maintenance and fire prevention. Should spontaneous combustion occur in an open pile, the coal can be wetted and moved with relatively little hazard to personnel. The major impact of open coal storage would be a certain air quality deterioration due to coal dust. Closed storage methods have the advantage of providing protection from wind to eliminate airborne dust. However there is the possibility of fire hazard due to spontaneous combustion of the stored coal. Western coals are susceptible to this phenomena if stored in place for more than a few weeks.

(4) Air Pollution Abatement

Alternative sulfur dioxide (SO_2) absorption systems and particulate abatement systems are considered in this subsection. The environmental impacts of these alternatives are the same.

(a) Sulfur Dioxide Absorption Systems

Alternate processes have been considered that may be feasible for the Coronado Station. Four of these processes are in a relatively advanced stage of development: double alkali process; Wellman-Lord process; magnesium oxide process; and Monsanto catalytic oxidation process.

The double alkali process is a nonrecovery process which involves absorption of SO_2 with a sodium or ammonium based salt, followed by treatment outside the scrubber loop with lime or limestone. The reaction produces a solid calcium sulfate/sulfite waste

product and the regenerated alkali solution is recycled to the scrubber loop. This process is in the early stages of development, and although it is a potential wet process for this application, a separate lime/limestone treatment of the processed wastes is required.

The Wellman-Lord process utilizes a sodium sulfite/bisulfite solution to absorb SO_2 from the flue gas. The spent absorbent, rich in bisulfite, is processed in a steam-heated evaporator, where active sodium sulfite crystals are regenerated and a gas stream of concentrated SO_2 is sent to further processing. This system requires a tail-end processing plant from which elemental sulfur or high grade sulfuric acid can be produced. There is no present market in the area for such a byproduct. Sodium sulfate must be purged from the system in order to maintain adequate levels of active sulfite in the absorber/evaporator loop, and a liquid waste stream is generated that would pose the same problems of disposal as other schemes discussed herein.

The magnesium oxide (MgO) process utilizes an aqueous slurry of magnesium oxide and recycled magnesium sulfite and sulfate to scrub SO_2 from the flue gas stream. The major reaction involves the formation of magnesium sulfite from SO_2 and MgO. The magnesium sulfite is removed from the scrubber loop to be dried and subsequently calcined to drive off SO_2. The regenerated MgO is then returned to the scrubber loop. The regeneration can be accomplished onsite or at a processing center away from the plant. This system would utilize the SO_2 regenerated in the calcining operation for conversion to high grade sulfuric acid or to elemental sulfur. Unless there is a nearby market for these byproducts, the extra cost of the process system may not be justified.

In the Monsanto catalytic oxidation process, the SO_2 in the flue gas stream is converted to sulfur trioxide (SO_3) for subsequent removal by an SO_3 absorbing tower. The flue gas from the boiler is passed first through a high efficiency particulate removal system and then heated to 850° to 900°F for catalytic oxidation. The strength of sulfuric acid produced in the absorbing tower is approximately 80%, suitable primarily for use in fertilizer production. Again, there must be a nearby market for this byproduct to make the process economically feasible.

(b) Particulate Abatement Systems

Two alternative particulate abatement systems that have been considered are: baghouses and wet scrubbers. Baghouses consist of a structure housing a large number of fabric filter bags, usually woven with relatively large open spaces. The dust-laden flue gases pass through the bags and particles are initially captured and retained on the fibers of the cloth by means of interception, impingement, diffusion, gravitational settling and electrostatic attraction. As the bag lining becomes laden with dust, further collection is accomplished by

sieving as well as by the above mentioned mechanisms. The fabric then serves mainly as a supporting structure for the dust layers responsible for the high removal efficiency. Periodically the accumulated dust is removed for disposal. The dust is recovered in a dry form which may create secondary dust problems during handling. The nature of the fabric is limited by the temperature of the flue gas. The moisture content is also limited because potential cold spot condensation can cake solids and cause corrosion. This collecting system holds promise for ultra-high collection efficiency, particularly for those particles in the smaller size range, but it has not yet been successfully demonstrated for operation on large coal-fired boiler flue gases.

The wet scrubbers utilize a variety of methods for impinging fine dust particles on liquid droplets and subsequently collecting the dust-laden liquid. The solids are recovered as a slurry, thus requiring further processing for waste disposal and partial liquid recovery. The efficiency of the wet scrubber system increases with power input and can extend over a wide range depending on the design, but operating and maintenance costs are high, especially for high efficiencies. Removal of SO_2 may be accomplished in the same device by addition of an alkali reagent to the scrubbing medium. Simultaneous dust and SO_2 removal does not allow use of a regenerative type process and is not generally feasible because dust-free flue gas is required for the recovery of the sulfur.

(5) Solid Waste Handling and Disposal

Alternative methods of solid waste handling and disposal are described in this subsection.

(a) Ash Handling and Disposal

Alternate methods considered for handling bottom and fly ash are: belt conveyors and slurry pumping. Belt conveyors are not suitable for transporting solids to the ash disposal area because of the large area required for the disposal site (approximately 1000 acres). Also, fly ash is a difficult material to handle with belt conveyors and problems such as spills could be expected. With a slurry pumping system, bottom ash slurry would be mixed with fly ash and pumped through a pipeline to a pond in the disposal area. Water from the disposal area would be pumped back for reuse in the plant. Although this method eliminates the possibility of dusting in transit as with solids handling, a stabilizing agent must be added to the fly ash to assist settling out of the slurry and the final storage of the dried ash waste must still be compacted as an engineered fill.

(b) Sulfur Dioxide Abatement System Waste Handling

Two alternate methods for safely transporting SO_2 solid wastes from the emission abatement system to the disposal area are being considered. These alternates are the same as for the ash

handling system: pumping the thickener underflow directly to ponds for solids settling and water evaporation; and pumping the thickener underflow to secondary dewatering equipment (filters or centrifuges) and conveying the resulting cake to the disposal area.

Pumping of thickener underflow directly to the pond may require that the waste material be dried and placed as an engineered fill after transport to the disposal site. Conveying the SO_2 filter or centrifuge cake to the disposal area poses the same problem as handling the solids from the ash storage system. Spreading out the solids via a fixed conveyor system would not be a practical method over such a large area.

Both wet and dry handling systems may require stabilization of the material for placement as an engineered fill. Various methods of producing a stable waste from dry SO_2 removal and ash systems are being investigated. One commercially available process is designed to stabilize the SO_2 sludge from the thickener underflow. A stabilizing agent is added to the thickener underflow being pumped to lined ponds. A structurally stable material forms under water, exhibiting much lower permeability and leaching properties than does the untreated waste product from the scrubber system. After plant decommissioning, the pond could be drained and the material allowed to dry. A layer of native top soil would be applied over the disposal area to prevent dusting of the dry product and to aid in vegetation of the area.

Another commercial process involves mixing dewatered sludge, fly ash and small amounts of other additives such as lime or limestone to produce a final product suitable for engineering fill or for use as a construction material. Tests of the final product produced by this process indicate that the permeability of freshly prepared material usually is in the range of 10^{-5} cm/s and quickly changes during the hardening process to values approximating 10^{-6} to 10^{-7} cm/s. The leaching rates for the final product are close to those for Portland cement.

6. Alternate Water Supply Sources

A thorough investigation of the water resources of Arizona has indicated that locating surface water in quantities capable of accommodating the Coronado Station requirements would be very difficult. In addition to hydrological factors, land acquisition and legal problems in obtaining water rights would have to be resolved.

a. Surface Water Development

The nearest source of surface water for development would be the Little Colorado River. The ephemeral washes that criss-cross the area do not have adequate annual flows to accommodate the project needs. A dam would have to be constructed on the Little Colorado at an acceptable damsite. The reservoir would have to be many times larger than the annual project water demand in order to accommodate the anticipated silt loading over the project life. Appurtenant facilities that would also be needed would be access roads, power lines, pumping plants and a delivery pipeline. It is unknown to what extent treatment of the water would be required. The environmental impacts of implementing this type of alternate appear to be considerably more adverse than those of the proposed wellfield.

b. Groundwater Development

Alternate wellfield locations capable of accommodating the water requirements for plant operation could be developed from the Kaibab-Coconino groundwater reservoir in areas at greater distances from the plant site. The environment of these areas is similar to the proposed fields and hence impacts would be similar. A longer conveyance facility would be needed which would cause greater impacts from pipeline construction as well as more pumping energy to transport the water.

c. Other Sources of Water

Other sources of water, such as treated municipal sewage effluent, are not available in sufficient quantities to meet the requirements of the Coronado Station.

7. Alternate Limestone Sources

Section II. A-1. 11 of this environmental statement discusses two potential sources of limestone located near the St. Johns site. These sources represent the only economical sources available to the project. A decision on which source to use has not yet been made.

8. Alternate Coal Delivery Methods

Alternative routes for potential railroad lines as well as other means of coal transportation were considered for delivering the necessary fuel to the proposed plant. This section describes these alternatives.

a. Alternate Alignments of the Coal-haul Railroad

(1) Alternate Alignment No. 1

Following designation of train transportation for coal delivery, processes to determine routes for the proposed alignment were initiated. Several routes were studied but, principally due to

engineering criteria, only three of the tentative routes were designated as feasible alternatives. These three routes are shown on Figure II-51 as well as the figures found in Section II. B-2; the proposed alignment extends from the AT&SF mainline near the Navajo interchange on Interstate 40 to the proposed Coronado Generating Station at St. Johns, Arizona, and Alternate Alignment No. 1 (A-1) extends from the AT&SF mainline near the Sanders interchange on Interstate 40 to the proposed generating station. Alternate Alignment No. 2 (A-2) represents modifications of the proposed alignment but is in the same general area. The three alignments have been investigated from both engineering and environmental standpoints.

The proposed alignment was initially selected on the basis of economics; it requires 5.3 fewer miles of railroad construction and would cost $6,600,000 less than Alternate 1. Other engineering, environmental and right-of-way factors did not indicate any major disadvantages for either of the routes, so initial construction cost became the deciding factor.

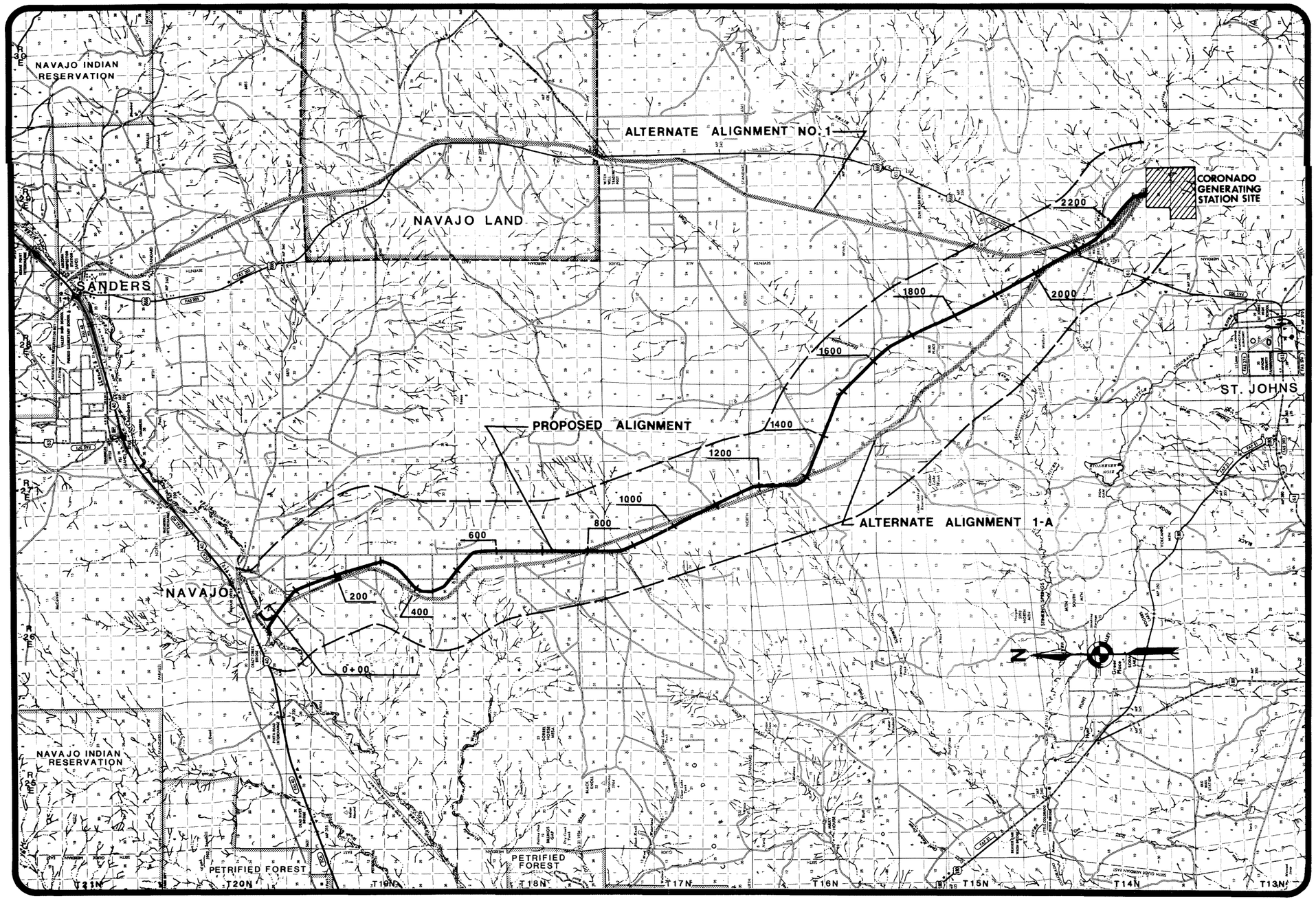
Although A-1 was investigated using the same techniques and in as much depth as the proposed alignment, only a brief summary of the findings for each discipline along the alignment is presented here because of its similarity to the proposed alignment.

(a) Land Ownership and Use

Both existing and planned land uses were inventoried along A-1. Land use information was gathered using the same land status and land utilization categories, techniques and sources of data as that gathered for the proposed alignment. The alternate originates east of the town of Sanders, along the AT&SF Railroad at a position nearly opposite the vehicle inspection station located on I-40. The route extends in a southerly direction along the general alignment of U. S. Highway 666 (within three miles) to the proposed Coronado Station. The alignment is approximately 48 miles in length.

Lands traversed by A-1 are located entirely within Apache County, Arizona, and are, in general, sparsely developed. They are utilized predominantly for cattle ranching. A breakdown of the status of lands crossed is: 18.5 miles of private ranch property, 12 miles of Navajo-owned Ranch property, 1.75 miles of LDS Church ranch property, 5.5 miles of recorded subdivisions, 7.5 miles of State land, 2.0 miles of BLM land and 0.75 miles undeveloped rural land.

Land-use development within the four mile corridor consists of: 62 single family dwellings, four commercial facilities, two industrial facilities, one municipal building, one church, two roadside rest areas, one proposed recreational facility, two highway crossings, 14 miles of highway parallel to A-1 within a distance of one-half mile, and numerous dirt roads. Existing or planned land-use developments of potential significance are summarized briefly as follows:



BASE MAP: ARIZONA HIGHWAY DEPT.

0 1 2 3 4 5 MILES

CORONADO PROJECT

Power Plant Spur Coal Haul Railroad

ROUTE MAP

Figure II-51

Sanders Area: Sanders is a small unincorporated town located at the junction of Interstate Highway 40 and U. S. Highway 666. The A-1 alignment begins at a point approximately one mile east of Sanders and extends in a southerly direction from the AT&SF Railroad which extends through the southern edge of Sanders in an east-west direction. Land-use statistics for A-1 only include those land uses which occur south of the AT&SF railroad.

An existing residential development occurs at the southern edge of Sanders, and is located immediately west of the railroad alignment approximately between Stations 5 and 15. Within this development, 21 residences would be located within one-half mile of the alternate. These residences are generally new, and both single family homes and mobile homes are present. This subdivision contains space for a number of additional homes, and it appears that residential growth will occur.

Highway Crossings and Parallels: The entire length of A-1 is located within about three miles of an existing highway (U. S. Highway 666). Its northernmost end will be viewed from Interstate Highway 40, which the Arizona Department of Transportation indicates received a 1974 Average Daily Traffic Volume of 6,000 vehicles, 3,600 of which were out-of-state passenger cars. U. S. Highway 666, however, is the highway from which the railroad would be most visible. Approximately 14 miles of the alignment are located within one-half mile of Highway 666 and views to the track in these areas would be at close range and largely unrestricted. The remainder of the alignment, particularly the northern and southern ends of the route, would, where visible, be viewed from distances of generally greater than one mile. The alignment crosses this highway twice, once just north of the intersection of U. S. 666 and Arizona Highway 61 at the Witch Well Trading Post and again approximately ten miles north of St. Johns in the Carrizo Wash area. Arizona Department of Transportation 1975 average daily traffic volume figure for Highway 666 was 620 vehicles north of its junction with Arizona 61, of which 60 were out-of-state passenger cars, and 540 vehicles south of this junction, of which 50 were out-of-state passenger cars. The average daily traffic volume along Arizona 61 is 400 vehicles, with 40 being out-of-state passenger cars.

Navajo Lands: The central 12 miles of A-1 would extend through approximately the western one-third of about 180-square-miles of land owned by the Navajo Indians. This land is currently a large cattle ranch. Unlike reservation lands, this property was purchased by the Navajos and taxes are paid to Apache County.

Witch Well Subdivision: The Witch Well subdivision, approximately 25 square miles in size, is traversed as the alignment leaves the Navajo lands. Approximately 5.5 miles of the alignment pass through this subdivision. Roads have been graded within it but at present very little development exists (three single family dwellings).

L.D.S. Church Ranch: Just prior to the southern crossing of U. S. 666 A-1 is routed across lands owned and utilized by the Church of Jesus Christ Latter-Day Saints (LDS) for ranching purposes. Approximately two miles of the alignment are located within this property. These lands are used largely as a winter grazing area for cattle from church ranches located at higher elevations. Intermediate parcels of State lands are leased by the LDS Church for grazing purposes.

(b) Physiography, Geology and Soils

Alternate Alignment No. 1 and the proposed alignment are within 20 miles of each other and are both in a part of the Colorado Plateau Physiographic Province where topography, geology and soils are similar over wide areas. The description of the paleontologic conditions relative to the proposed alignment also applies to those existing along the alternate alignment.

(c) Hydrology

The methods used in the collection of hydrologic baseline information along the alternates were essentially the same as those used for the studies along the proposed alignment. General hydrologic conditions that have been previously described also apply to the alternate alignment. The three largest streams, with drainage areas of more than 300 square miles or average annual runoff of more than 1600 acre-feet/year, that the alignment would cross are Carrizo Wash, Zuni River and Hardscrabble Wash. Principal aquifers along the alignment are the Bidahochi water-table aquifer and the deeper Kaibab-Coconino confined aquifer. Potential impacts on both surface and ground water along A-1 are insignificant.

(d) Vegetation and Wildlife

The baseline ecological conditions along the alternate route are basically the same as those along the proposed alignment. The same biotic communities were encountered in both corridors and the flora and fauna components are similar. There are, however, slight differences in the configurations of communities in the two corridors.

The Biotic Communities map (Figure II-34) indicates that the alternate corridor has a slightly higher percentage of the juniper community and slightly lower percentage of sagebrush and badlands. In the alternate corridor three prairie dog colonies were located whereas none were found in the proposed corridor. The impact values along the alternate alignment are very similar to those along the proposed route.

(e) Archeological Resources

The inventory of archeological sites along A-1 was similar to that conducted for the proposed alignment. Published literature pertinent to the project area was consulted in an effort to identify the nature and scope of the previous work conducted in the area. Site files at Arizona State Museum and the Museum of Northern Arizona were examined to identify any previously recorded sites within the project area. Though the actual anticipated impact along both alignments would be similar, the degrees of sensitivity and levels of impact varied. Specific site descriptions are listed with the Museum of Northern Arizona. The eleven identified sites contained sherds, chipped stone tools and evidence of being used for campgrounds or for food processing. The artifacts were left in place and relatively undisturbed to reduce impacts or loss of values.

(f) Historic Resources

The area of A-1 was investigated for indications of historic occurrence by the same methods utilized during the study of the proposed alignment, and six sites which represent manifestations of historic period activity were identified. None of the sites found are presently listed within either the National Register or Arizona State Inventory of Historic Sites. Also, it is felt that none of these sites possess sufficient association with historic personages or events, nor are they of sufficient architectural interest, to qualify them for future Federal or State designation and/or protection.

(g) Aesthetics and Scenic Resources

The proposed alternate traverses areas which are topographically representative of the Little Colorado Plateau Physiographic Province. The topographical features traversed by the route were observed to be generally flat to rolling, however, a stratification of such areas occurs with respect to both elevation and drainage pattern. For example, the broad drainage basins which are traversed are flat and open in visual character, however, these basins are commonly bordered by vertical escarpments beyond which elevated plateaus of similar topographical characteristics again occur. These escarpments serve as visual transitions and important scenic components within an otherwise uniform and homogeneous landscape. The alternate crosses escarpments in four instances. Three of these escarpments are approximately 100 feet in height and the fourth is considerably smaller. Within each of these areas, deep cuts and fills would be necessary to accommodate the railroad.

Additional features which occur along the alignment, and which contribute to scenic interest, are intermittent drainages. The drainage beds of the streams contain water for a small portion of the year, and tend therefore to be perceived more as topographical rather than water features. The drainages traversed by the alignment are generally entrenched to some extent, exposing sedimentary materials of

varied colors. The depths to which these drainages are entrenched range from less than one foot to approximately ten feet, thus greatly limiting the extent to which these features influence the scenic characteristics of the surrounding landscape. Intermittent drainages of scenic significance are encountered along the alignment in four instances (Puerco River, Zuni River, Carrizo Wash and one unnamed tributary to Hardscrabble Wash).

Vegetative-cover types traversed by the alignment are grasslands and juniper woodlands, which are common within the region and therefore not of particular scenic significance. The grassland communities occur most commonly in the lowland drainage basins with mixtures of both grassland and juniper woodland occurring at both higher elevations and on more sloping lands. Dense juniper woodlands occur largely within the elevated plateau uplands between drainages. The alignment is located within grassland areas for a distance of approximately 14 miles or 29 percent of its length, mixed grassland and juniper for 24.5 miles or 51 percent of its length and within dense juniper shrublands for 9.5 miles or 20 percent of its length.

In considering the value of the scenic amenities along the alignment, the extent to which an area's condition is presently natural or altered is an important factor; therefore the area through which the alignment extends was evaluated with regard to scenic integrity. Although development features such as U. S. Highway 666, dirt roads and ranching structures occur along the route, the sparse distribution of these features has had little effect on scenic characteristics, and it retains an essentially natural or undisturbed scenic character. The exception to this is the northern mile or two of the alignment which is quite close to the town of Sanders. The scenic resources encountered along and adjacent to the alignment were considered along with predicted railroad actions to determine scenic impacts. The existing scenic character within and adjacent to the alignment was assessed to be, in general, moderately compatible with railroad construction. It is believed that the alignment will sustain low levels of impact.

(h) Acoustics

The methodology used in the collection and analysis of the background ambient sound levels along A-1 were similar to those used for the study of the proposed alignment. Four locations, numbered 1, 2, 3 and 5, were used to evaluate background sound levels; Locations 1 and 2 were common to the studies for both alignments. Background sound levels at most locations were generally low and typical of a semi-rural environment; daytime/nighttime sound levels varied by approximately 10 dB. The background sound levels obtained along the alignment were used with sound levels assumed for the construction and operation processes to estimate those sound levels which could be

expected from each activity. The maximum construction noise impact along the alternate alignment would occur during bridge construction at the Puerco River. As many as 20 people within 150 feet of the pile driving activity during bridge construction may be exposed to a day/night equivalent sound level in excess of 75 dB. Department of Housing and Urban Development noise criteria indicate that levels in excess of 75 dBa for an eight hour period are unacceptable.

The Equivalent Population Impacted along the alternate alignment during construction would be 75. Of a total population of 159 people along the right-of-way, the equivalent of 75 would be fully impacted. It is estimated that a maximum of 38 people could be highly annoyed by the construction noise, resulting in some complaints. The equivalent population that would be impacted during rail spur operation would be eight. Of the 159 people along the right-of-way, an equivalent of eight would be fully impacted. It is estimated that four might be highly annoyed by the train operation.

(2) Alternate Alignment 1-A

Alternate Alignment No. 1-A was presented as the proposed alignment in the draft environmental statement subsequent to filing the draft statement, the evaluation of an alternate alignment presented in the draft statement (No. 2) was completed. This evaluation showed that the alternate route would result in less earthwork, shorter bridges, and improved soil conditions over the route originally proposed in the draft statement. Therefore, these alternatives were reversed and the lesser impact route is presented as the proposed route in this document, while the route proposed in the draft is referred to here as Alternate Alignment No. 1-A.

Alignment 1-A would not have the wye connection at the AT&SF mainline that the proposed alignment has. Therefore, train operations would be restricted to an easterly direction.

Following is a description of alignment 1-A and the reasons the proposed route was selected over Alternate 1-A. Locations are identified by engineering status as shown for the proposed alignment.

Station 0 to 50: The proposed alignment provides for both an easterly as well as a westerly connection to the AT&SF mainline. Alternate 1-A only provides an easterly connection. Connections in both directions are desirable because the long-range coal supply has not been determined and this coal may come from either the east or the west.

Station 100 to 600: Alternate Alignment No. 1-A is 1/2 mile west of the proposed route. The proposed route is on higher ground and avoids large embankments. Topography near Station 350 is very rugged and soils are of poor quality, principally Chinle Formation, an expansive clay. Earthwork stability can be improved by increasing excavation, reducing embankments and approaching the better soil formations that appear on higher ground.

Station 600 to 1300; The proposed alignment is shifted up to 1/2 mile to traverse more favorable terrain. Alternate Alignment 1-A requires extensive fills in crossing Milky Wash and the length of embankment can be reduced about 1000 feet by this alignment. In general, the amount of earthwork is reduced.

Station 1300 to 2000: The proposed alignment is shifted up to three miles easterly to place the line on higher ground. Alternate 1-A traverses a lower area of the drainage basin of Hardscrabble Wash, requiring numerous culverts and a 646-foot bridge at Station 1845. The section between stations 1660 and 1845 crosses meadow which is frequently flooded. This soft, marshy soil is not suitable for supporting the railroad embankment. The proposed alignment passes to the east of this area on higher ground that is less subject to flooding from the Zuni River. The river at this point is well defined and the bridge length can be reduced to 430 feet. The 118-foot bridge required at Hardscrabble Wash on the original line can be eliminated.

The proposed alignment also removes the railroad from a particularly good grazing area. It was originally investigated at the suggestion of a major landowner along this section of the railroad in order to reduce the impact upon his ranching operation. Thus, the proposed alignment is more favorable from an environmental standpoint than alignment 1-A in this vicinity.

Station 2000 to Generating Station: The proposed alignment is shifted about 1/2 mile northeasterly to reduce earthwork and to enter the Generating Station in a north-south direction. This shifting allows a crossing of Carrizo Wash at a narrower channel, reducing the bridge length from 526 feet to 262 feet. Both alignments would have the same type of crossing at Highway 666.

(a) Land Ownership and Use

Alternate Alignment No. 1-A originates along the Atchison Topeka & Santa Fe railroad approximately 1.5 miles west of the town of Navajo, Arizona. The alignment is located entirely within Apache County and extends in a generally south to southeasterly direction through sparsely developed lands for 43 miles to the proposed Coronado Generating Station site. Land status along the alignment exhibits a checkerboard pattern. The 43 miles of railroad route is composed of approximately the following: 16 miles located within State lands, 14 miles within private ranching properties, eight miles within recorded subdivision property, one mile of LDS church property, two miles within BLM lands and two miles of undeveloped rural land. The dominant existing land use along the proposed alignment is cattle grazing. Land development within the four-mile wide study corridor consists of: 19 single family dwellings, 11 helium wells and associated pipelines, one highway crossing and numerous dirt roads. Considering the area of a 43-mile corridor, these figures are very small. The areal distribution of these facilities in respect to the proposed alignment is shown on the Land Utilization Map (Figure II-36).

Narrative discussion of each land use occurring along a lineal alignment tends to be awkward and tedious; therefore the Land Use Inventory Summary (Table II-66) for this alternative was prepared as a comprehensive inventory of land use within the corridor. It also indicates the location of various types of land uses along the alignment and their proximity to the centerline. The discussion which is provided summarizes the significant land use developments along the routes, and therefore should be considered together with the chart for a comprehensive understanding of land uses within the corridor.

Navajo Area: Navajo is a small unincorporated town located approximately 12 miles west of Sanders along Interstate Highway 40. The AT&SF Railroad is located along the southern edge of town. The proposed alignment extends south from the AT&SF Railroad at a point approximately 1.5 miles west of Navajo. As they would not be affected by the proposed action, land use features to the north of the existing railroad were not included in statistics for the proposed route. Development south of the railroad in this area is sparse, consisting of a helium wellfield, utilized by the Kerr-McGee Plant located in Navajo, and two single family dwellings.

Helium Wells and Pipelines: A Kerr-McGee helium plant is located within the town of Navajo. The northernmost three miles of the proposed alignment pass through a wellfield which supplies helium to the plant. Approximately ten helium wells and several gas collection pipelines are located within the corridor. It does not appear that the railroad would affect any of the wells as the alignment seems to have avoided them. The helium gas wells were indicated to be about 1000 feet deep and gases supplied are both non-flammable and odorless. It appears that the alignment crosses a collector pipeline and, as construction in this area will require excavating, close attention must be paid to this crossing.

Big Valley Subdivision: As was previously pointed out, Alternate No. 1-A traverses approximately eight miles of recorded subdivision property. This property, referred to as Big Valley Ranches, is being offered in fairly large parcels with 40 acres as the average size. These subdivided lands are distributed in a checkerboard pattern of 1-square-mile parcels between Stations 40 and 120, mid-way within the Corridor. Although relatively few single family residences occur within the corridor, the majority of them occur within the recorded subdivision. At present it appears that no electric or telephone service exists within the subdivision and each property owner must either drill a water well or transport water to his residence. Future land sales and development within these subdivided areas is expected to be slow, and of a seasonal, recreational-home nature.

Petrified Forest National Park: At its closest boundary, the National Park is located at a distance of slightly more than ten miles from Alternate 1-A, and it is not expected that the railroad will be visible from within the Park. However, the area of the

TABLE II-66

ALTERNATE ALIGNMENT 1-A LAND-USE INVENTORY

Location (1000's of feet south of Navajo)	West 1-2 Miles	West ½-1 Mile	Centerline 0-½ Mile	Centerline 0-½ Mile	East ½-1 Mile	East 1-2 Miles
5		1 HW				
10			1 HP	1 HW		2 SFD
15	3 HW	1 HW		1 HW		
20		1 HW	1 HW			1 HW-1 SFD
25						
30						
35						
40	1 SFD					
45						
50				(S)		
55	1 SFD					
60						
65		1 SFD		(S)		
70						
75	1 SFD	1 SFD		(S)		
80						
85					1 SFD	
90	1 SFD		1 SFD	1 SFD		
95				(S)		
100						
105		1 SFD	1 SFD			
110	1 SFD		1 SFD	(S)		
115	1 SFD	1 SFD				
120						
125						
130			1 SFD			
135						
140						
145						
150						
155						
160						
165						
170						
175						
180						
185						
190			1 SFD			
195						
200						
205						
210				H		
215						
220						
225						
TOTALS	3 HW 6 SFD	3 HW 4 SFD	5 SFD 1 HW 1 HP	2 HW 1 SFD 1H (S)=50,000'	1 SFD	1 HW 2 SFD

Legend

H Highway
SFD Single Family Dwellings
HP Helium Pipeline
HW Helium Well
(S) Subdivisions ●●●●●●

alignment closest to the Park possesses an abundance of petrified wood on the surface. Arizona State Lands Department personnel have pointed out that commercial removal of petrified wood would possibly become a matter of concern if access into the area is significantly upgraded.

Mining Exploration: There are no indications that a potential exists for commercial mining of potash deposits along Alternate Alignment No. 1-A. Mineral leases have been granted within State lands at approximately Stations 55 through 70 and several other locations. It is doubtful that the railroad would have any adverse effects on the potential for commercial mining of potash deposits, but might rather assist this development should the railroad line be made available for transport of these deposits.

(b) Physiography, Geology, and Soils

Physiography: The magnitude of impacts on geology, soils and other environmental factors are affected by the physiography, particularly the topography crossed by an alignment. The topography controls the magnitude of required cuts and fills which in turn are reflected in the potential impacts on geology, soils, hydrology, aesthetics and biology. Since Alternate No. 1-A is close to the proposed alignment, only minor differences in topography are apparent. Locally, however, there are areas where the topographic features of the realignments are different from those of the proposed alignment. The proposed alignment typically has a more regular, smoother topography, with less local relief. In several areas it is located east of alignment A-1 and out of the eroded headwater areas of small watersheds on the more level tableland that is present at higher elevations. Segments of the proposed route in which topographic features are more gentle than those of the alternate alignment are described below. The segments are also the ones that are likely to result in the greatest reduction in impacts on soils, geology and hydrology as, compared to corresponding segments on the original alignment. Segment 30 to 40 crosses the escarpment at a point such that a deep canyon is avoided that would have involved a fill of approximately 100 feet in depth. Segment 150 to 156 crosses two washes in a gently rolling tableland area. In the original alignment, the same washes are crossed in gullied areas of higher stream gradient. Segment 83 to 87 crosses Milky Wash approximately 2000 feet west of the alternate alignment. Along both alignments there is appreciable topographic irregularity due to gully erosion on the valley and erosion along the incised meander-channel of the wash. Segment 121 to 124 crosses the Hardscrabble watershed approximately 2 ¼ miles upstream or northeast of the alternate alignment. Here the proposed alignment avoids crossing several headwater washes and a badlands area in the transitional escarpment zone between the tablelands and Hardscrabble Valley. The proposed alignment follows a ramplike ridge across the transitional escarpment zone between the valley and the tableland.

Geology and Soils: The realignment is within 2 ½ miles of the proposed alignment and both are in a part of the Colorado Plateau physiographic province where topography, geology and soils are similar over wide areas. The geology and soils along the proposed alignment, and the realignment, are shown on Figures II-22 and II-28 respectively.

Because of the proximity of the proposed alignment and Alternate No. 1-A, the geology along the two alignments is similar. Locally, the geology traversed by the proposed alignment is generally at slightly higher elevations, representing younger geologic formations at higher positions in the stratigraphic section. This is most apparent where the alternate alignment crosses headwater gullies that are deeply incised both topographically and stratigraphically. Any important potential impacts on geology and soils along Alternate No. 1-A relative to the natural state would be the same for the proposed alignment: 1) increased erosion due to precipitation, 2) increased erosion by streams, 3) increasing sedimentation, 4) disturbance by cutting and filling, and 5) loss of paleontologic resources due to disturbance.

(c) Hydrology

General hydrologic conditions described for the original alignment also apply to Alternate No. 1-A. The several streams and watersheds that the alternate alignment would cross are shown on Figure II-25 with the three largest streams crossed being Carrizo Wash, Zuni River and Hardscrabble Wash. These streams have drainage areas of approximately 2190, 2280 and 300 square miles and average runoff of more than 1600 acre-feet/year. Stream and watershed information for the original alignment is generally applicable to this alignment except that there will be an increase in the individual watershed areas of the realignment, depending on the distance of its downstream displacement from the proposed alignment. The increase in sediment yield, runoff and peak discharge that would result from the increase in watershed area will be at least proportional to the increase in area; in most instances the increases will be more than proportional, because the alternate traverses some of the steep-slope areas that have higher than average runoff and sediment yield.

Principal aquifers along the realignment are the Bidahochi water-table aquifer and the deeper Kaibab-Coconino confined aquifer. Depth of water in Bidahochi is shown in Figure II-27. The potential hydrologic impacts along the alternate will be approximately equal to or slightly more than those along the proposed alignment. Increases in hydrologic impact along the alternate realignment will be most pronounced along segments that are located west of the proposed alignment, i.e., areas of lesser slope and fewer topographic irregularities. Where Alternate Alignment No. 1-A is in areas of poorer topography than that of the proposed alignment, the following comparisons can be made. Hydraulic impacts, or disturbances of stream flow, would be greater because of greater volume and velocity of runoff resulting from a slightly larger watershed area, higher stream gradients and lower rates of infiltration. Water-quantity or supply impacts would be greater because of more channels subject to being blocked.

Water-quality impacts, due to suspended sediments and dissolved solids in runoff from cuts, fills, roads and by stream-channel erosion, would be more because of the generally larger cuts and fills and the greater volume and velocity of stream flow. More dissolved solids would be expected due to erosion from the erodible Chinle formation than from the older, stratigraphically lower, strata.

(d) Vegetation and Wildlife

The baseline ecological conditions along Alternate Alignment No. 1-A are basically the same as those along the proposed alignment. The same biotic communities are encountered and the flora and fauna components are similar. There are, however, slight differences in the configurations of communities along the two alignments (Figure II-34). Alternate No. 1-A has a slightly lower percentage of grassland and juniper communities and slightly higher percentage of sagebrush and badlands than does the proposed alignment. The alternate alignment passes to the west of the proposed segments 85-90 and 210-215 and would result in high cut and fill requirements of these segments that would produce high impact.

From an ecological standpoint, this alternate would produce greater impact on the ecosystem than would the proposed alignment.

(e) Archaeological Resources

The archaeological impact of Alternate Alignment A-1 from the north end of the project to Station 2300 will be very similar to impact levels of the proposed alignment since it follows this alignment closely. In the Hardscrabble Wash area, however, the alternate is expected to have a lower impact value than the proposed alignment, since fewer sites have been documented along the portion of the wash through which the alternate alignment passes.

(f) Historic Resources

The historic resources in the study area were rechecked to see whether or not the alternate alignment of the railroad would affect any additional historic sites and what changes there might be in the impacts on historic sites. It was found that although there were, in some cases, modifications of impacts on the historic sites originally identified, there are no additions or deletions to be made to the original historic resources section of the description of the environment.

The inventory phase of the original study revealed five historic sites in the area of the proposed corridor (see Section II.B-2.3.c(2). The alternate alignment, however, has 14 sites located sufficiently close to or are of sufficient importance to be considered subject to impact.

In addition to the five sites described for the proposed alignment, the following sites were identified within the study area of the alternate alignment.

Small Stone Cabin: This rustic cabin was built about 1925 and has not been occupied for some years. The well is in current use for stock water.

Frame Cabin: This cabin was build by squatters around 1925, but was not occupied for any length of time. A well nearby is in current use for stock water.

"Mail Station Site": Local tradition holds that this was once a "mail station." It is thought that it may have been a change-of-horses station on a branch mail route from Navajo to St. Johns. There are scant remains of wood buildings and corrals. There is no evidence of a well here, so the occupancy could not have been of long duration, or by many persons.

Ruins of Stone House: This structure was built by the O'Dell Ranch about 1915 and remained in use until around 1939.

Tucker Ranch - (Long H Ranch): This ranch was built by the Tucker Land and Cattle Company of Denver, Colorado around 1910. It was abandoned in 1939. Remains consist of the ruin of a stone house and the foundation of another building.

Burr Porter Ranch: These buildings are currently in use. The oldest structures here were built sometime between 1900 and 1914 by Charlie Lamb. The newest structure here is a recently installed trailer.

McCarrol House: This ranch consists of a log segment built in 1906, and a frame addition built in 1913. It is not currently occupied.

McCarrol Cemetery: The McCarroll family cemetery also contains graves of some neighboring ranchers, with a few stones dated before 1900.

Zuni Migratory Route: Indians from the Zuni reservation east of the railroad route in New Mexico conduct a traditional migration to a destination near the Zuni River northwest of St. Johns. This migration takes place every few years and will cross the proposed railroad alignment. Knowledge of this tradition was obtained through Salt River Project consultation and field trips with Zuni tribal and traditional leaders.

Low Rock Wall: A low rock wall and small rock pile were found on the edge of a ridge a short distance south of the Zuni River. It is possible that these remains represent a shrine.

(g) Aesthetics and Scenic Resources

The topography of the study area is generally flat to rolling. Vegetative communities consist of grassland/juniper pinyon woodlands. Both physiographic characteristics and vegetative communities in the study area were judged to provide moderate levels of scenic interest. Water features are generally ephemeral and were not considered to be major contributors to the scenic character and interest of the area. The landscape retains an essentially natural character and therefore scenic integrity was judged to be generally high, but areas of greater scenic variety and interest occur nearby.

Alternate No. 1-A traverses areas that are flat to rolling in character, however it is located along the periphery of several broad drainage basins along which are escarpments. These escarpments are important elements in the scenic composition of the study area as they are the only significant vertical elements within an otherwise flat and open landscape. It crosses or passes quite close to eight escarpments from 40 to 80 feet in height.

The alternate also encounters seven intermittent drainages of scenic significance in the vicinity of the alignment: Nine Mile Wash, Milky Wash, Hardscrabble Wash, Zuni River, Carrizo Wash and two unnamed intermittent washes. These drainages, somewhat entrenched due to erosion by runoff from the escarpments, are visually striking; consequently they make a significant contribution to the scenic character of the proposed alignment area. The locations of physiographic features along the alternate are shown on Table II-67.

Vegetative-cover types which occur along the alternate are predominantly grasslands and juniper woodland. The majority of the route, approximately twenty-four miles or 56 percent of its length, is grassland. The remainder of the route traverses approximately 12 miles of mixed grassland/juniper cover (29 percent of the length) and approximately eight miles of dense juniper shrubland cover (or 15 percent of the length). The locations of the cover types along the alternate are shown in Table II-67.

Alternate No. 1-A passes through a sparsely developed area. The northern one-third has a fairly extensive dirt road network and scattered residential and ranching facilities. The remainder of the route, except for the southern end, is fairly inaccessible, as the dirt road network is less developed. As development along the alternate is limited, the area is presently considered to be essentially natural or substantially unaltered in scenic condition.

Assessment of the overall potential impacts on the scenic resources of the proposed alignment involved identification of the resources along the route, recognition of scenic resources sensitivity and determination of the expected effects of the railroad-induced actions. To predict the actual potential impacts on the scenic resources, it was necessary to make generalizations concerning railroad construction and operation, and to make specific assumptions concerning the particular proposed actions anticipated in the study area. The sources of railroad design data that were utilized in this analysis were the engineering plan and profile drawings for the alignment.

Consideration of the anticipated effects of the railroad upon the existing environment indicates that two types of visual effects will occur. These are the physical alteration of the topography and vegetative cover and the introduction of man-made elements. The two effects are fundamentally different. The degree to which the railroad will affect the scenic resources is determined from the amount of proposed activity (railroad construction, operation and facilities) to be imposed on the resouces along the alignment.

Alternate No. 1-A traverses seven escarpments judged to be visually incompatible with the railroad. Earth cuts and fills would be necessary in such areas; the visual contrasts created by such excavations will be sufficient to result in a localized reduction in scenic quality and a moderate level of scenic impact. Seven intermittent drainages are encountered along the alternate, and the railroad will cause minor visual discontinuity within the physical characteristics of these features. Considering the tendency to see the drainages as localized scenic elements, visual modification based upon physical disturbances would result in minor scenic impact.

The alternate would require construction of railroad bridges at Zuni River and Carrizo Wash which will introduce man-made elements into the landscape. Considering the assumed design and construction details, conflict with visual characteristics can be minimized and scenic impacts confined to a low level.

The majority of the alignment traverses areas of grassland (59 percent) and dense juniper woodland (19 percent) with which lineal removal of vegetation would result in visual discontinuity. Site vegetation removal would reduce the natural scenic character or integrity of the landscape, so the scenic impact of the railroad in such areas was assessed to be low but significant. Mixed stands of grassland and juniper occupy 22 percent of the alternate and, due to the difficulty of perceiving lineal clearing within the irregular vegetative patterns of such areas, scenic impacts would be localized in effect and of a lesser magnitude. The railroad bed, rails and train, as introduced landscape elements, would have only minor effects on existing scenic conditions. This judgment reflects the consideration that visibility, and therefore visual discontinuity, would be minor due to the railroad's horizontal orientation.

(h) Acoustics

The methodology used in the collection and analysis of background ambient sound levels along Alternate Alignment No. 2 were those used for the study of the proposed alignment. Background sound levels at most locations were generally low and typical of a semi-rural environment; daytime/nighttime sound levels varied by approximately 10 dB. It is estimated that, of a total population of 22 people along or near the right-of-way, the equivalent of nine would be impacted in some way and that fewer than four people could be highly annoyed by the construction and operation noise.

(i) Socioeconomics

The socioeconomic impact of the railroad will be due to the presence of personnel during the construction phase. The same number of construction personnel and the same construction schedule would be followed for this alternate as for the proposed alignment. Thus, the socio-economic impact of the construction of the alternate is approximately the same as the socio-economic impact

TABLE II-67

SCENIC INVENTORY SUMMARY - ALTERNATE ALIGNMENT NO. 1A

Location (1000 feet south of Navajo	Topographic Character	Vegetative Cover
5	Flat to Rolling, Puerco River	Grassland
10	Flat to Rolling	Grassland
15	Escarpment	Grassland
20	Escarpment	Grassland
25	Flat to Rolling	Grassland
30	Flat to Rolling	Grassland
35	Flat to Rolling	Grassland
40	Escarpment, Intermittent Stream	Grassland
45	Flat to Rolling	Grassland
50	Flat to Rolling	Grassland
55	Nine-Mile Wash	Grassland
60	Flat to Rolling	Grassland/Juniper
65	Flat to Rolling	Grassland/Juniper
70	Flat to Rolling	Grassland/Juniper
75	Flat to Rolling	Grassland
80	Flat to Rolling	Grassland
85	Escarpment, Milky Wash	Juniper
90	Escarpment	Juniper
95	Flat to Rolling	Juniper
100	Flat to Rolling	Juniper
105	Flat to Rolling	Juniper
110	Flat to Rolling	Juniper
115	Flat to Rolling	Juniper
120	Flat to Rolling	Grassland/Juniper
125	Escarpment, Intermittent Stream	Grassland/Juniper
130	Flat to Rolling	Grassland/Juniper
135	Flat to Rolling	Grassland/Juniper
140	Flat to Rolling	Grassland/Juniper
145	Flat to Rolling	Grassland/Juniper
150	Escarpment	Grassland/Juniper
155	Flat to Rolling	Grassland
160	Flat to Rolling	Grassland
165	Flat to Rolling	Grassland
170	Hardscrabble Wash	Grassland
175	Flat to Rolling	Grassland
180	Flat to Rolling	Grassland
185	Zuni River	Grassland
190	Flat to Rolling	Grassland/Juniper
195	Flat to Rolling	Grassland/Juniper
200	Flat to Rolling	Grassland/Juniper
205	Escarpment	Grassland
210	Flat to Rolling	Grassland
215	Carrizo Wash	Grassland
220	Flat to Rolling	Grassland
225	Flat to Rolling	Grassland

Summary: Length - 43 miles
Topographic Character: Flat to Rolling
(8) Escarpments encountered
(7) Intermittent streams encountered
Vegetative Cover: 24 miles Grassland - 56% of route
12.4 miles Grassland/Juniper - 29% of route
6.6 miles Juniper - 15% of route

of the construction of the proposed alignment as discussed in Section C, Environmental Impacts of the proposed action, Subsection 4; Impacts on Social and Cultural environment.

b. Alternate Methods of Transportation

(1) Introduction

To provide the necessary fuel to the proposed Coronado Station, several alternate methods of coal transportation were considered. All of these alternatives were concerned with transporting coal from Sanders, Arizona to St. Johns, Arizona. This coal would have to be delivered to Sanders on a uniform annual basis by trains using rotary dump type cars.

(2) Use of Trucks

The use of highway-type tractors and trailers having 25-ton net coal capacities using U.S. Highway 666 was considered. This alternate was eliminated as State regulations prohibit such large-scale trucking over public roads on a permanent basis.

Use of off highway-type tractors and trailers having 80-ton net coal capacities and operating on a private, fenced haul road was considered. If this alternative were to be implemented, it was assumed that a unit-train unloading facility consisting of sufficient trackage to handle a 100-car unit-train through a rotary car dumper using a car positioner would be constructed at Sanders. The facilities at Sanders would also include a conveyor system to stack out the entire amount of coal from the unit-train, and a suitable truck-loading station capable of rapid loading of the trucks, including weighing and trimming. This station would be similar to those installed at large rock plants. A private haul road would be constructed between the Sander facilities and the proposed Coronado Station site. At St. Johns, a truck hopper would be installed from which the coal would be moved on a conveyor system to the receiving end of the station's coal handling system.

St. Johns would have the necessary support facilities for operation and maintenance of the trucking system and maintenance of the road right-of-way. Facilities would also be required for maintaining the major unloading equipment at Sanders.

The impacts of construction of a private haul road for trucks would be similar to rail transportation for land use, topography, vegetation and aesthetics. Impacts on wildlife would be much greater during operation, due to the frequency of travel. Use of a private haul road would be much more expensive due to fuel use and labor.

(3) Transportation by Conveyor Belts

Transportation of the coal along a cross-country conveyor system having its own power lines, service road, fire protection, water lines and fenced right-of-way was considered.

In evaluating the conveyor system, it was assumed that the unit-train unloading facility at Sanders would be the same as that for the truck-haul system. A cross county conveyor, with a hooded 36-inch wide belt, would be installed in straight lines with varying distances from 200 to 20,000 feet. An unpaved service road parallel to the conveyor with the necessary power supply line and fire protection system would be constructed. At St. Johns, the coal would be discharged directly into the plant's coal handling system. St. Johns would have the necessary support facilities for maintaining the conveyor system, but maintenance facilities would also be required at Sanders for the major unloading equipment.

The impacts of transportation of coal by conveyor belt would be greater than rail transportation because transmission lines and access roads would be required. More vegetation would be lost and more rights-of-way would be required. Wildlife movement would be restricted as the conveyor system would form a barrier for the larger species of wildlife. Economically the conveyor belt system costs would exceed rail transportation.

(4) Conclusions

As the truck alternate was eliminated due to denial of use of existing facilities, economics became the key factor in the selection of the means of coal transportation. Therefore to aid in determination of the optimum alternative, a study was prepared to compare the present cash requirements of transporting coal via the various means, including a coal-delivery railroad, from a point near Sanders to the site at St. Johns. The study assumed a facility, located east of Sanders, to handle coal that would be delivered on a uniform, annual basis by unit-trains using rotary dump type cars. The facility was not designed to handle the seasonal coal-storage variations. It did include the track loop, rotary car dumper, coal stackout facilities, and equipment required to load the coal onto trucks or a cross-country conveyor system. Maintenance support facilities at St. Johns were also assumed.

The coal-delivery train portion of the study assumed the construction of a railroad capable of handling unit-train operation using rotary dump type cars from a point located east of Sanders to the proposed plant site, with a parallel service road and fenced right-of-way. This estimate also included the track loop, rotary car dumper and associated facilities to dump the coal at St. Johns.

The economic criteria that was used was as follows:

1) Present Worth Costs in 1975 dollars.

2) Coal transportation costs are based upon three generating units.

3) Present Worth Interest Rate - 7¼%

4) Present Worth Demand Charge - $354/kw.

5) Present Worth Energy Charge - $515 x u. f./kw.

6) Use Factor for Coal Transport System - 70.8%. (Same as plant capacity factor, levelized)

7) Escalation rates of equipment and materials - 8%, Labor - 9%, and Fuel - 10%

8) Escalation rates for railroad O&M&R - split between two indexes 60% of the Association of American Railroads (AAR) index - 8% and 40% of the Implicit Price Deflater (IPD) - 5%

9) Year of Operation 1979.

Coal quantities estimated were:

Year	Tons Annually (in thousands)
1979	1,344
1980	2,687
1981-84	4,031
1985-87	4,211
1988-94	4,304
1995-97	4,454
1998-2004	4,557
2005-2007	3,695
2008-2013	3,211

These coal quantities are based upon operating three units and do not reflect delays.

The method of estimating used for each remaining alternate was as follows:

Trucks: Estimated costs for the road, trucks, loading facilities, buildings, etc. were established for 1975 and escalated to 1979. Labor costs, drivers' wages, maintenance crews, fuel, tires, truck replacement, etc. were escalated yearly to show cash flow requirements for the 35-year life of the plant.

Conveyor System: Estimated costs for the conveyor, support facilities, buildings, etc. were established for 1975 and escalated to 1979, Annual O&M costs were established for 1975 and escalated throughout the 35-year life of the plant.

Railroad System: Estimated costs for track, roadbed, rotary car dumper and associated facilities were established for 1976 and escalated to 1979. Annual O&M&R costs were established using the latest rate information from the Santa Fe Railroad, AVO dated 11/21/74, and escalated throughout the 35-year life of the plant.

The following figures represent the results of the Present Worth Study of the coal transportation alternates:

Train System	$125,600,000
Conveyor System	$259,700,000
Truck Haul System	$478,900,000

One reason for the variance in the totals in the comparison is that each of the alternates to the proposed railroad requires two additional handlings of the coal at Sanders. Using rail transportation, the coal would be delivered directly from the mine to St. Johns by a single rail movement. The major cost items in the double handling of the coal at Sanders would be those needed for the required operating and maintenance personnel at the facilities and for the trucks and cross-country conveyor. In addition, one unit-train crew can deliver 10,000 tons of coal whereas it requires a driver for each 80-ton capacity truck.

9. The Alternative of No Action

The Federal actions being considered are the granting of rights-of-way for various facilities of the Coronado Project. Under the alternatives of no action, right-of-way would not be granted to the Salt River Project. As a result, the proposed transmission facilities and the coal-haul railroad would not be constructed. In all probability there is no way that a transmission line could be constructed from the St. Johns site to the load centers at Phoenix and the Eastern Mining Area without crossing Federal lands.

Should right-of-way for the transportation of coal to the proposed Coronado Generating Station not be granted, there will be no supplies of the fuel necessary for the generation of electricity.

Without the granting of right-of-way for those facilities that cross Federal lands, none of the features of the project that are to be constructed on Federal lands would be built. Furthermore, none of the impacts associated with these facilities and described in this environmental statement would occur. In addition, the energy that is to be produced by the Coronado Generating Station would not be available. The generation requirements discussed in Section I.B. indicate that SRP must obtain approximately 2500 MW in new resources by 1983. The Coronado Station is to provide 1050 MW of these resources.

As indicated previously, Salt River Project is constructing the plant facilities now because of the long lead times needed for their completion, and in order to meet scheduled in-service dates. SRP is aware of the risk of not receiving Federal rights-of-way and not being able to construct its proposed transmission system.

SRP, in its capacity as an electric utility, cannot avoid the responsibility to provide for the growing electric needs of its customers. Failure to provide power as needed would have serious social, environmental, and economic effects on the entire area served by SRP.

III. Analysis of the Transmission System Component

A. Introduction

The following chapter is a description of the environmental impacts associated with the proposed primary 500 kV transmission system to be constructed between St. Johns and Phoenix, Arizona, and the proposed 500 kV backup system between the Coronado and Cholla Generating Stations. The actual construction of the system was described in Chapter I. Also addressed in this chapter are the impacts associated with the portion of the 230 kV system from the proposed Silver King Substation to the existing Goldfield Substation and the Eastern Mining Area (EMA) proposal (Silver King-to-Hayden 230 kV Transmission System). Maps delineating the physiography, ecology, land use, natural beauty, etcetera, are contained in the Silver King-to-Hayden 230 kV Transmission System Environmental Study, dated April 1977, and available for review at the Forest Service, Bureau of Land Management, and Salt River Project offices.

Alternative links for the 500 kV and 230 kV transmission system corridors are described in this chapter under part H.

Salt River Project started construction on the 500 kV primary and "backup" interconnection transmission lines in early October 1976 without the knowledge of the Federal Study Team responsible for preparing this Statement. The construction is being done only on private and State lands over which SRP has easements or permits.

The Federal Coronado Station Project Study Team had no prior knowledge of this construction. The study team leader submitted a letter to S.R.P. on November 2, 1976, (see Appendix K) approximately two weeks after construction was discovered advising the company that continued construction would jeopardize the validity of the Environmental Statement as it now exists. This letter further stated that the Federal Study Team had no prior knowledge of the construction activity, and that continued construction would effectively preclude the selection of the T.G.&E. 345 kV "backup" interconnection.

The Federal Study Team held two meetings with representatives of Salt River Project in early November 1976, to discuss the impact of the construction on the validity of the Environmental Statement as it is now written. As a result of these meetings, and as a gesture of good faith, the company agreed to cease construction of the primary and backup transmission lines at the Navajo-Apache County line. SRP responded to the November 2, 1976 letter by letter dated November 24, 1976. This letter is included in Appendix K.

The construction activity will not influence or preclude the choice of any alternative primary or "backup" transmission line alternatives available to the Federal land management agencies.

B. Description of the Environment

Figure III-1 is a map of the study area developed for the transmission system environmental analysis. Figure III-2 shows the alternate 500 kV transmission corridors and substations under consideration for the Coronado Project transmission system with related geographical features.

1. Air Quality

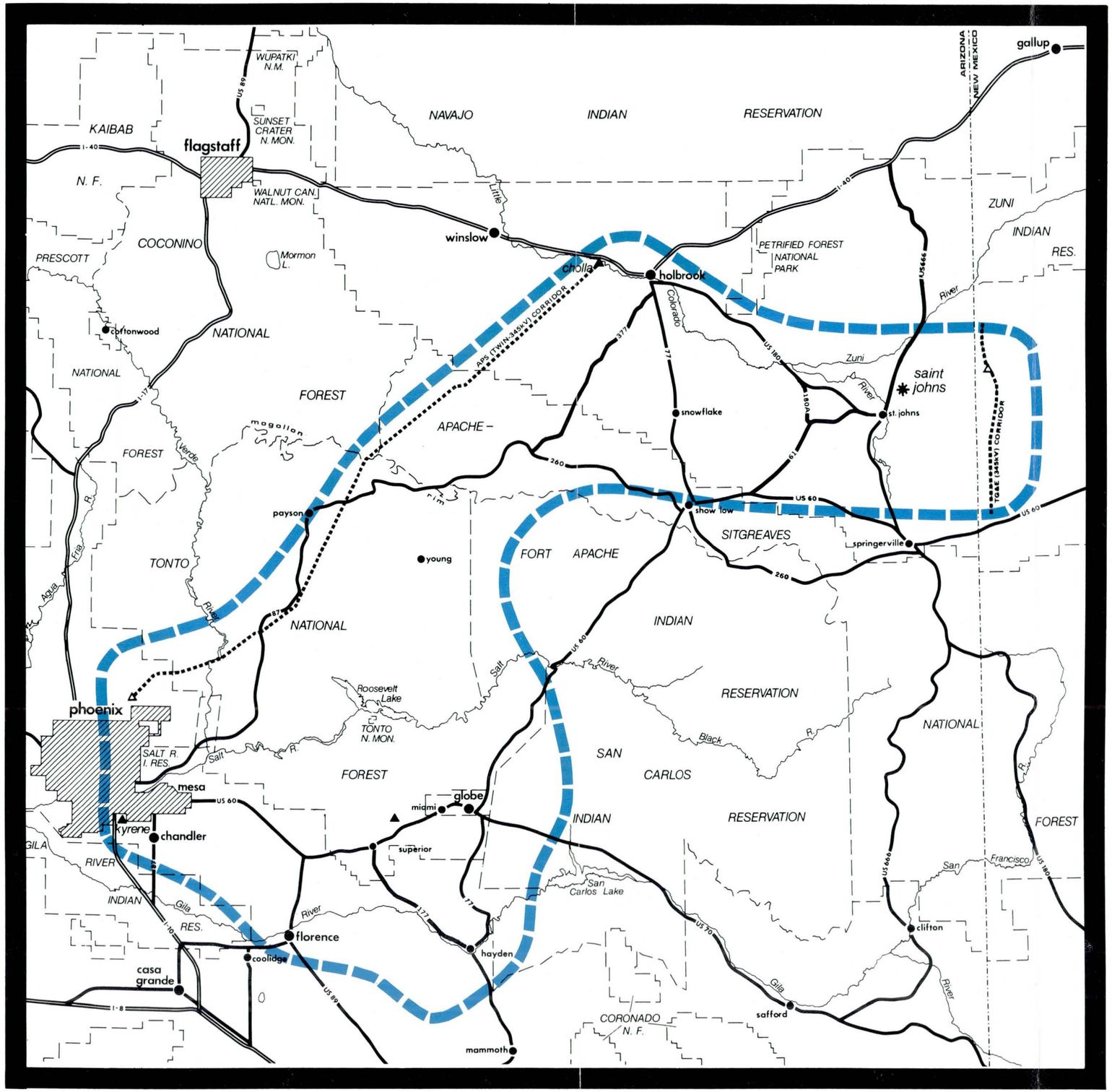
Over that portion of the 500 kV system between the Coronado Generation Plant, westward to its intersection with the Cholla project 500 kV system the air quality is above average for Arizona due to the absence of large cities or activities that may cause air pollution. However, no quantitative studies have been conducted on air qualities. Air quality over the southern portion of the 500 kV system, the Eastern Mining Area (EMA) 230 kV system, and Silver King substation proposal is lower because of smoke from copper smelters and mining operations in the Globe-Miami, Superior, Kearny, Hayden, and Ray areas, dust from storms coming across the desert from the south and west, and emissions from automobiles and industries commonly associated with cities. Corona from existing lines now exist in negligible amounts in the area covered by the transmission systems and substations.

The existing air quality in the 230 kV EMA system is poor because of SO_2 emissions from copper smelters and mining operation in the Hayden, Superior, Kearny and Ray areas, dust caused by winds associated with thunder-storm activity, vehicular traffic on unpaved roads and agricultural activity. Corona from existing lines now exists in negligible amounts in the study area.

Due to the sparsity of automobiles and industry other than copper smelters in the area, concentrations of carbon monoxide, hydrocarbon, nitrogen dioxide and oxidants are so low that they are not routinely monitored by regulatory agencies.

2. Sociological

The proposed 500 kV transmission system crosses through predominately rural areas throughout the northern portion of the system (links 4, 5, 6, 42, and 41) and links 28, 38, 33, and 34 of the southern portion of 500 kV line as well as the proposed 500 kV Silver King Substation. Alternate routes B, C, D, and E of the 230 kV (EMA) proposal and that portion of the 230 kV proposal that parallels the 500 kV proposal also lie in predominately rural areas. However, the line crosses in close proximity to 40 homes on the northern portion of the line and through 13 miles of rural or low density residential areas south of the towns of Mesa and Tempe and north of the town of Gilbert. The principal population centers along the preferred route and those generally within 10 miles of the transmission line are given in Table III-1.



North

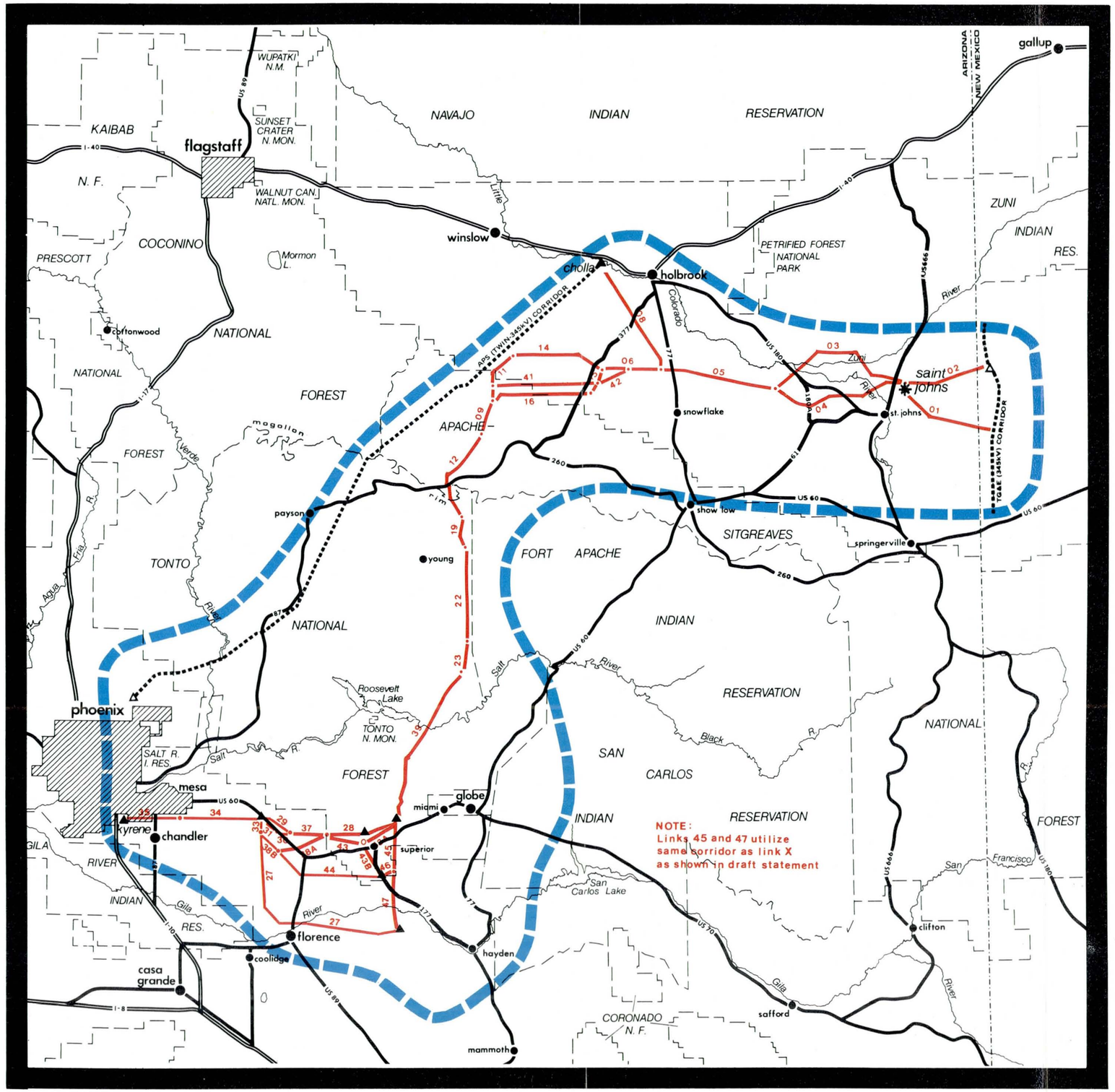
5 10 15 miles

CORONADO PROJECT

TRANSMISSION SYSTEM

STUDY AREA

Figure III-1



500kV line link

▲ 500kV station

230kV EMA System Routes are shown in Figures I-21, I-23, and III-10

North

5 10 15 miles

CORONADO PROJECT

TRANSMISSION SYSTEM

ALTERNATE 500kV CORRIDORS

Figure III-2

TABLE III-1

PROPOSED TRANSMISSION ALTERNATIVES

PROXIMITY TO POPULATION CENTERS

500 KV AND 230 KV SYSTEMS

Population Centers	1970 Population 1/	Approximate Distance From Transmission Line (Miles)
Chandler	13,763	3
Gilbert	1,971	1/2
Holbrook	4,759	10 3/
Joseph City 4/	800	3 3/
Mesa	62,853	4
Miami	3,394	8
Snowflake	1,977	7
St. Johns	1,320	4-1/2
Superior 2/	5,299	2
Tempe	63,500	4
Superior	5,300-5,700 2/	3
Kearny	3,225 2/	3
Hayden	1,375 2/	4
Riverside-Kelvin	1,200 2/	3
Winkleman	1,080 2/	5

1/ 30th Annual Edition - Arizona Statistical Review- dated September, 1974, published by the Valley National Bank of Arizona.

2/ Populations are estimated.

3/ Community not incorporated, 1974 population estimate.

4/ Would be approached by Cholla backup transmission link 08.

The proposed 230 kV transmission system crosses through predominately rural areas. However, portions of the routing alternatives (Routes A, E, F, H and I) are also located in close proximity to Superior, Kelvin-Riverside and Kearny's associated residential areas. The principle population centers along the alternate routes and those generally within 5 miles are included in Table III-1.

3. Natural Beauty

Most of the northern portion of the 500 kV system passes through rolling plains covered with grasses and occasional patches of pinyon-juniper vegetation that is characterized as being of "average" scenic quality.

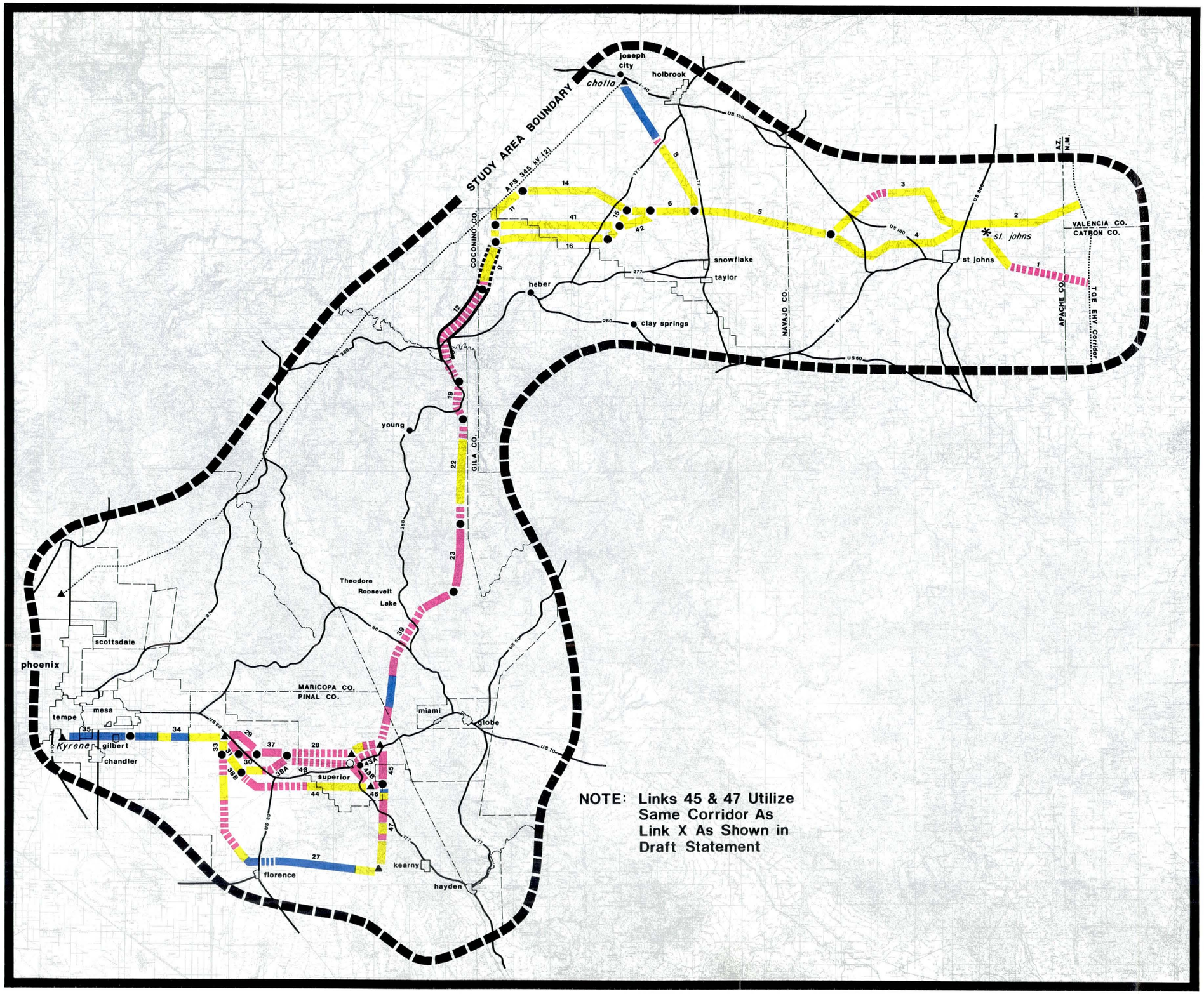
The southern portion of the proposed 500 - 230 kV system from the dual corridor with the Cholla line west towards Kyrene, passes through approximately 5 miles of rugged mountainous topography within the chaparral-juniper pinyon and grassland ecotone then drops in elevation, into what is known as the lower Sonoran desert where the palo verde-saguaro plant community predominates. A transmission line or lines with links 28, 38, 33 of the proposed 500 - 230 kV transmission system would pass near the Superstition Wilderness. Transmission lines within these links will pass near Queen Creek Estates and other residences along Queen Creek Wash west of the town of Superior, Arizona. Figure III-3 is a map of the visual landscape character of the alternate transmission system corridors. See Silver King to Hayden Transmission System Environmental Study (Fig. NB-1) at the places designated in Section III, H.4, for 230 kV EMA map on visual landscape.

Areas of high scenic interest within the 230 kV EMA were identified along portions of Routes A, B, C, and D due to vegetative variety and the lines proximity to the surrounding mountainous topography. Routes crossing or adjacent to the Gila River also have a high scenic interest due to the uniqueness of rivers in Arizona. The remaining routes were generally representative of the areas visual landscape character.

A true natural condition of the landscape was not found along the majority of alternate routes, because of routing alternatives following existing utility rights-of-way. Population centers were generally found to be dominated by man-made features, while a degraded condition was identified adjacent to Route D due to mining operations in this area.

4. Vegetation

Nine principal plant communities exist along the preferred route, all of which are crossed more than once. These include riparian woodland, oak woodland, chaparral, pinyon-juniper, palo verde-saguaro desertscrub, creosote bush-bursage desertscrub, and grassland. Table III-2 identifies the communities traversed by the proposed 500 kV transmission system, including the dual corridor. Table III-3 identifies the communities traversed by the proposed 230 kV EMA transmission system. Significant features of these communities are as follows:



NATURAL SCENIC QUALITY

- HIGH
- ABOVE AVERAGE
- AVERAGE
- MODIFIED
- HIGHLY MODIFIED

SPATIAL ENCLOSURE *

- ENCLOSED
- SEMI-ENCLOSED
- OPEN

* RESTRICTED TO AREAS NORTH OF THE MOGOLLON RIM

North 5 10 15 miles

CORONADO PROJECT

TRANSMISSION SYSTEM

VISUAL LANDSCAPE CHARACTER

Figure III-3

TABLE III-2

Approximate Miles of Vegetation Traversed by the 500 kV Transmission Line
(Company Proposal)

Major Landmarks / Plant Communities	Link 4 Coronado Station to 10 miles east of county line	Link 5 South of Little Colorado River - north of Hunt and Snowflake	Link 6A Ends on east side of Dry Lake	Links 41 and 42 West of Dry Lake to intersection with Cholla powerline corridor	Cholla (joint corridor) Wildcat Canyon C.K.	Link 9	Link 11	Link 12 Mogollan Rim	Link 19	Link 22	Link 23	Link 39	Link 28 - Joint corridor west to Whitlow Dam	Links 38 and 33 north of Queen Creek Estates - line heads south of highway 60 - ends at Dinosaur Substation	Link 34 Dinosaur to Western Canal	Link 35 - Western Canal through Gilbert to Kyrene Powerplant	Acres Distrubed
						← Dual Corridor With Cholla Powerline →											
(Total Miles)	28	24	6.4	33.9	0.2	4	7	24	4	23	9		17	16	16	10	1920
Riparian Woodland (Communities) ea. 1/	12	15	1	4	0.2								5	3	1		8
Grassland	13	4	6	18.8		4					9						436
Pinyon-Juniper Woodland	15	20	1	15.1			7										463
Coniferous Forest								24	4								222
Oak Woodland										23							254
Chaparral													9.5				142
Creosote Bush - Desert Shrub														11	11		174
Paloverde - Saguaro													8	5			103
Agricultural															5	10	118

1/ Total impact on Riparian Woodland communities is estimated to be one mile (linear dimension) or eight acres.

Detailed descriptions of the company proposed links are found in "Environmental Report - Arizona Station Project: Vol III, Transmission System".

TABLE III-3

APPROXIMATE MILES OF VEGETATION TRAVERSED AND ACRES DISTURBED BY PROPOSED 230 kV EMA TRANSMISSION LINES

ROUTES	A		B		C		D		E		F		G		H		I		J	
	mi	ac	mi	ac	mi	ac	mi	ac	mi	ac	mi	ac	mi	ac	mi	ac	mi	ac	mi	ac
Mixed Palverde - Cactus Association	7.9	61.6	1.1	8.6	5.1	39.8	8.1	63.2	3.8	29.6	0.8	6.2	8.3	64.7	4.9	38.2	6.7	52.3	3.4	26.5
Mixed Crucifixion Thorn Association	3.3	25.7	0.5	3.9																
Desert Grassland	0.7	5.5											3.7	28.9						
Transition Sonoran Desert Scrub communities - Chaparral			3.4	26.5																
Chaparral & Oak Woodland	3.3	25.7	4.9	38.2																
Jojoba	0.8	6.2																		
Broadleaf - Oak, Sycamore, etc.	0.1	0.8	0.8	6.2																
Salt Cedar, Mesquite, etc.					0.4	3.1	0.3	2.3	0.8	6.2	0.1	0.8	0.4	3.1	1.6	12.5	0.8	6.2	0.2	1.6
TOTAL	16.1	125.5	10.7	83.4	5.5	42.9	8.4	65.5	4.6	35.8	1.9	7.0	12.4	96.7	6.5	50.7	7.5	58.5	3.6	28.1

Acres Disturbed is based on 230' wide corridor (7.8 ac/mi disturbed)

Riparian Woodland. Riparian woodlands occur along permanent and semipermanent streams and rivers. Where water is readily available, year-round riparian growth may be very dense. Where only intermittent water is available, riparian woodlands tend to be less well developed, often dominated by vegetation more characteristic of surrounding areas.

The species composition of riparian woodlands changes both with altitude and location. On the Colorado Plateau, in the vicinity of the Little Colorado River, Fremont cottonwood and willow are dominant. Riparian communities along the Gila River are dominated by salt cedar, mesquite or a mix of the two species, with common associates being cottonwood and willows.

Riparian communities along intermittent streams at higher elevations (e.g., Devils and Queen Creek canyons) support species such as Emory oak, sycamore, Arizona oak, hackberry and juniper.

Oak Woodland. Oak woodlands are Madrean in origin, being the northern outliner of their more extensive counterparts in the Sierra Madre Occidental of Chihuahua-Sonora. Principal tree species are Emory, Mexican blue, Arizona and gray oaks. Other evergreen species, such as alligator juniper and Arizona rosewood, are common. Principal shrubs are velvetpod mimosa, Mearns sumac, range ratany, manzanita, burroweed, yucca, and agave. Several dry-tropic shrubs and succulents occur in varying degrees in these interior southwest woodlands, which are features of the woodland at its desert grassland edge. Arizona rosewood, coralbean, ocotillo, mesquite, dalea, yucca, and sotol are in this category.

Small stands of Arizona cypress occur occasionally, primarily at mid-elevations in the evergreen woodlands. The post-climax pockets, which often contain cypress trees up to 70 feet in height, are all restricted to north-facing slopes and/or canyon bottoms, where soil moisture is relatively high and the temperatures in both summer and winter are moderate.

Chaparral. Interior chaparral occurs in Arizona in the central part of the State, usually between 4,000 and 6,000 feet elevation. Small stands may occur to as low as 3,500 feet and to as high as 7,000 feet where precipitation ranges from approximately 13 to 23 inches annually.

Dominant plants are generally tough-leaved evergreen shrubs. Shrub live oak is the most common dominant. Several dozen other shrubby plant species are typically found in mature stands of chaparral including manzanita, desert ceanothus, mountain mahogany, silktassel, mimosa, sumac, yucca, and several oak species.

Pinyon-Juniper Woodland. In northern Arizona, where minimum temperatures are markedly cooler than farther south, woodlands are composed predominantly of pinyon and juniper. Annual precipitation in this harsh climate varies from 12 to 20 inches, with a significant portion falling as snow in the winter. This community is primarily found at elevations between 5,500 to 7,000 feet, below the ponderosa pine forest.

Colorado pinyon, Utah and one-seeded juniper are the most common tree species. Rocky Mountain juniper and alligator juniper are found in localized areas. Understory shrubs include cliffrose, serviceberry, rabbitbrush, fourwing saltbush, yucca, and several species of cacti. Grasses are predominantly bluegrama, side-oats grama, western wheat, ring muhly, sand dropseed, and galleta.

The Paloverde-Saguaro Desertscrub climax community is characteristic of the Sonoran Desert. It often contains more than 30 nonriparian species in a standard quadrant (1000 M^2). This figure may be compared to a similar quadrant in the creosote bush or saltbush desert communities where three or four species are typically found.

Mixed Palo Verde-Cactus communities are the most diverse and complex communities in the region. The communities are composed of plants ranging from short-lived spring ephemerals to long-lived saguaro cactus. Palo verdes (yellow and blue) and a variety of cacti comprise the most conspicuous elements of this community, which generally contain numerous less conspicuous drought-resistant shrubby species.

Jojoba is by far the most common shrub within this community, while borroweeed, catclaw, wolfberry, desert hackberry, gray-thorn, hymenclea, Crucifixion thorn and ocotillo are also common contributors to the shrubby vegetation layers. The cacti that occur in the mixed palo verde communities include prickly pear, jumping cholla, Teddy bear cholla and barrel cacti.

Mixed Crucifixion Thorn - Cactus. Two areas were identified along the 230 kV EMA Route A, where Crucifixion thorn essentially replaces palo verde to form a Crucifixion thorn - mixed cactus community. This situation may in part be due to changes in soil texture and/or chemistry, since it is a fairly common situation for Crucifixion thorn to replace palo verde, particularly at the northern and/or the upper elevation limits of the palo verde's range.

Transition Area Between Sonoran Desert Scrub and Chaparral. This ecotonal community is most obvious along the 230 kV EMA Route B. No vegetation sampling was conducted in this habitat because most of the area was destroyed by fire in June of 1976. The area contained numerous plant species, including pinyon pine, juniper, bear grass, scrub oak, sugar summac, prickly pear, staghorn cholla, mesquite, wolfberry, desert broom, mountain mahogany and a variety of grasses. Riparian vegetation in the transition area are somewhat intermediate to riparian communities along the Gila River and those along Devils' Canyon.

The Creosotebush-Bursage Desertscrub community characterizes the lowland desert sites in the Phoenix-Tucson area. Roughly 10 species, including creosote bush, white bursage, and several species of cacti, may be found within this community.

Grasslands. Two distinct grassland communities are traversed by the proposed route. The plains grassland occurs from the Little Colorado River south to the pinyon-juniper woodland. Characteristic species are blue grama, galleta, western wheat, ring muhly, snakeweed, fourwing saltbush, and winterfat. Russian thistle and snakeweed characterize depleted sites along the route. Other common species in such habitats are: banana yucca, catclaw, yellow palo verde, ratany, prickly pear, white-thorn acacia and staghorn cholla. Grasslands identified were traversed by Routes A and G of the 230 kV EMA proposal.

The desert grassland extends from beneath the Rim to the southern edge of the study area. Predominant grasses are sideoats, blue, black, and hairy grama, tabosa, and curly-mesquite. Rabbitbrush and snakeweed are common shrubs. Catclaw and mesquite have invaded much of what was once predominately a grassland community.

A "Report on Endangered and Threatened Plant Species of the United States" developed by the U.S. Fish and Wildlife Service, was published in the Federal Register of June 16, 1976, as directed by the Endangered Species Act of 1973. The following plants are listed in the proposed list as threatened or endangered and may be located within the proposed powerline corridor. These plants are:

Asteraceae

1. Pectis rusbyi - Rusby's Fetid Marigold Reported in the vicinity of Peridot and Camp Creek - it may occur along proposed right-of-way.

2. Perityle gilensis var salensis - Rock Daisy (unnamed) Reported in the vicinity of Tortilla Flat - no record of occurrence along right-of-way.

Cactaceae

1. Echinocereus triglochidiatus var arizonicus - Hedgehog cactus (unnamed) occurs along Highway 60 on both sides of the Pinal-Gila Co. line between Superior and Miami.

2. Pediocactus peeblesianus var peeblesianus - no common name. Reported in the vicinity of Joseph City and Holbrook.

3. Echinocerous acauthodes var eastwoodiae - Barrel Cactus. May occur in desertscrub areas.

4. Mammillaria viridiflora - Pincushion Cactus. May occur in high desert and chaparral areas.

Crassulaceae

1. Echeveria collomae - no common name. Reported in the vicinity of Apache Junction and Globe, etc.

2. Echeveria rusbyi - no common name. Reported in the vicinity of Apache Junction, Florence Junction, and Superior, etc.

Fabaceae

1. Astragalus lentiginosus var maricopae (unnamed) Locoweed. Reported in the vicinity of Tortilla Flat and Saguaro Lake. No record of occurrence along proposed right-of-way.

2. Astragalus xiphoides - Milkvetch (unnamed). Reported in the vicinity of Holbrook, but not from proposed right-of-way.

Nyctaginaceae

1. Allionia cristata - no common name. Reported in the vicinity of Holbrook, but not from proposed right-of-way.

Polygonaceae

1. Eriogonum capillare - wild buckwheat (unnamed). Reported in the vicinity of Winkelmann. Note that this species is confused with E. arizonicum in some manuals. Species identity must be checked.

Note: Information regarding the exact range of these or any other species on the "Endangered" list, is not available at this time.

The plants listed above will be protected under the provisions of the Endangered Species Act of 1973, if they appear on the final approved list of threatened and endangered plants.

In addition to the above plants, the State of Arizona protects certain plants and requires State permits for their removal. (A.R.S. 3-904-E et seq.)

5. Water

Surface water along the proposed 500 and 230 kV transmission system is extremely scarce. With the exception of the Gila River which is crossed by the alternative 500 kV line, and the 230 kV lines for the EMA transmission system proposal, the only water available adjacent to the proposed transmission lines or substations are those wells and stock ponds developed for livestock use. Figure III-4 is a map of the physiography of the study area with drainages and water bodies shown. See Silver King to Hayden Transmission System Environmental Study Figs. P-1 and P-2 at the places designated in Section III, H.4, for 230 kV EMA maps of elevations and drainages.

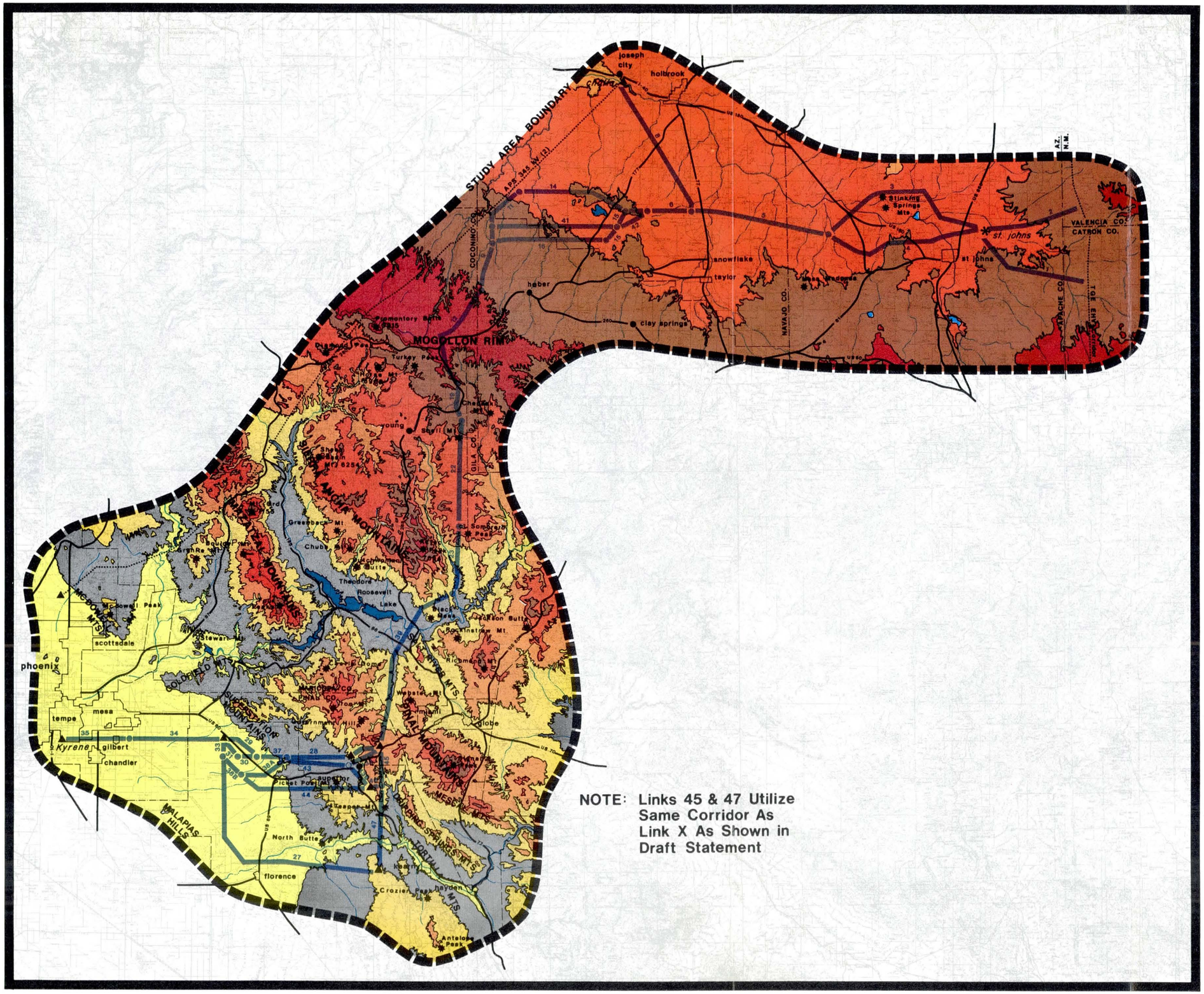
6. Wildlife

Wildlife is not a single unit but a complex interrelating group of living organisms with both similar and differing requirements in varying tolerances to a given point.

Seven plant communities and three major ecotones are crossed by the proposed corridors. The communities include riparian and aquatic, juniper-pinyon, grassland, palo verde-saguaro, creosote-bursage, Great Basin desertscrub and chaparral. The ecotones are 1) chaparral, juniper-pinyon and grassland, 2) juniper-pinyon and ponderosa pine, and 3) juniper pinyon grassland. Ecotones are of special interest in that they are blending areas where communities overlap. They have many flora and fauna characteristics of the respective individual communities.

A total of 485 vertebrate species occupy the study area during different seasons of the year. These include 208 breeding birds; 71 non-breeding birds; 83 mammals; 51 fish; 59 reptiles; and 13 amphibians. These species were listed in a report, "Consultant Report for the Arizona Coronado Station Project Transmission System Environmental Studies" prepared by Wirth Associates. This report is available for inspection at the office of the Regional Forester, U.S. Forest Service, Albuquerque, N.M., and the Forest Supervisors' offices, Tonto National Forest, Phoenix, Arizona or the Apache-Sitgreaves National Forest, Springerville, Arizona. Table III-4 is a list of representative species along the preferred 500 kV transmission line alignment.

Bird species are the most diverse. Birds, because of their role as breeding species, are important ecological indicators in each plant community. However, a majority of bird species use the riparian-aquatic community as winter residents or at least during migration.



ELEVATIONS IN FEET

- 1000-2000
- 2000-3000
- 3000-4000
- 4000-5000
- 5000-6000
- 6000-7000
- 7000-8000

MAJOR DRAINAGES

- PERENNIAL STREAMS
- INTERMITTENT STREAMS
- WATER BODIES

North

5 10 15 miles

CORONADO PROJECT

TRANSMISSION SYSTEM

PHYSIOGRAPHY

Figure III-4

TABLE III-4
500 kV PROPOSAL

GAME, FURBEARING AND HUNTABLE NON-GAME SPECIES OCCURRING IN BIOTIC COMMUNITIES CROSSED BY PROPOSED CORRIDORS

Species	Biotic Communities: Riparian & Aquatic	Juniper-Pinyon	Chaparral	Grassland	Palo Verde-Saguaro	Creosotebush-Bursage	Great Basin Desert
Game Mammals							
Cottontail	X	X	X	X	X	X	X
Albert's squirrel	-	-	-	-	-	-	-
Arizona grey squirrel	X	X	-	-	-	-	-
Red squirrel	-	-	-	-	-	-	-
Big Game							
Javelina	X	X	X	-	X	X	-
Elk	X	-	-	-	-	-	-
Mule deer	X	X	X	X	X	X	X
White-tailed deer	X	X	X	-	-	-	-
Antelope	-	X	-	X	-	-	X
Mountain lion	X	X	X	-	-	-	-
Black bear	X	X	X	-	-	-	-
Buffalo	-	-	-	X	-	-	-
Game Birds							
Gambel's quail	X	-	X	-	X	X	-
Mearn's quail	X	X	X	-	-	-	-
Turkey	X	X	X	-	-	-	-
Mourning dove	X	X	X	X	X	X	X
White-winged dove	X	-	-	-	X	-	-
Band-tailed pigeon	X	X	X	-	-	-	-
Blue grouse	-	-	-	-	-	-	-
Waterfowl*	X	-	-	-	-	-	-
Shorebirds**	X	-	-	-	-	-	-

Species	Biotic Communities: Riparian & Aquatic	Juniper-Pinyon	Chaparral	Grassland	Palo Verde-Saguaro	Creosotebush-Bursage	Great Basin Desert
Non-Game Birds							
English sparrows	X	-	-	-	-	-	-
Starling	X	-	-	-	-	-	-
Crow	X	-	-	-	-	-	-
Furbearers							
Muskrat	X	-	-	-	-	-	-
Ringtail	X	X	X	-	-	-	-
Badger	-	-	X	X	X	X	X
Raccoon	X	-	-	-	-	-	-
Otter	X	-	-	-	-	-	-
Mink	X	-	-	-	-	-	-
Beaver	X	-	-	-	-	-	-
Predators							
Porcupine	X	X	X	-	-	-	-
Wolves	X	X	X	X	X	X	-
Foxes	X	X	X	X	X	X	X
Skunks	X	X	X	X	X	X	X
Coyotes	X	X	X	X	X	X	X
Weasels	X	X	X	-	-	-	-
Bobcats	X	X	X	X	X	X	X

References: Arizona Game and Fish 1973-74 Hunting Regulations
* Ducks, geese and swans (under Federal and State regulations)
**Coots, rails, gallinule, cranes, plovers, snipe under Fed. & State reg.)

A total of 335 vertebrate species occupy the 230 kV EMA study area during different seasons of the year. These include 210 birds; 65 mammals; snakes; 17 lizards; 9 amphibians, 4 turtles; 5 fish. These species were listed in a report entitled "Silver King to Hayden Transmission System Environmental Studies - Baseline Report" prepared by Wirth Associates. This report is available for inspection at the offices of the Regional Forester, U.S. Forest Service, Albuquerque, Mew Mexico, and the Forest Supervisors' Office, Tonto National Forest, Phoenix, Arizona. Table III-5 is a list of representative species along the alternative routes.

The avifauna likely to be encountered in or adjacent to the proposed alternate corridors is very diverse, consisting of representatives from 44 of the 62 families of birds known to occur in Arizona. Many species do not breed in eastern Pinal County but use the riparian aquatic communities only during periods of migration or as winter visitors.

a. Game Species

The game, furbearing, and huntable nongame species, have special status since they include those species of wildlife designated by the State Legislature as species that can be reduced from public to private ownership if taken according to the regulations and during the seasons set by the State Game Commission.

The game and furbearing species have special appeal. Like other wildlife, they play an important biological role in the community because they include some of our most spectacular species such as elk, antelope, deer, mountain lion, black bear, turkey, dove and quail, they are high on the esthetic lists of both sportsmen and nonhunters. Their game status places them in a unique position. They include one of the renewable resources that are managed to produce a harvestable surplus. Their harvest by licensed sportsmen and trappers provide an important source of recreation and revenue in the State.

In the area crossed by the proposed transmission route, 12 species of game mammals and 9 species of game birds are encountered. In addition some 30 species of waterfowl and shore birds are found in the area during their migrations. These bring the total to over 50 game species in the study area. The area also has 8 species of furbearers, 7 species of predators and 3 species of huntable nongame birds.

Game birds that occur within the 230 kV EMA proposed alternate corridors include White-winged Doves, Mourning Doves, Gambel's Quail, a variety of waterfowl (ducks and possibly geese), rails, a number of shorebirds, and wild pigeons. Of these, only doves, quail and ducks are hunted to any great extent and, hence, are the most important game bird species in the area.

White-winged Doves, Mourning Doves and Gambel's Quail are the only game species that breed within alternate corridors to any great extent. White-winged Doves nest commonly in salt cedar and mesquite thickets along the Gila River. Mourning Doves also nest in these riparian habitats but not to the extent that White-winged do. Thus, the value of riparian habitats along the Gila River for nesting by these two species is readily apparent.

Gambel's Quail nest throughout the areas occupied by alternate corridors but are generally more abundant in areas where mesquite is fairly common and water is available to the birds for drinking.

Ducks do not nest in the area to any extent but may occasionally be present at ponds, stock tanks and along the Gila River during the fall and winter months.

Game, furbearing and huntable nongame mammals within the 230 kV EMA area are listed in Table III-5. Big game species known to occur within alternate corridors are: White-tailed Deers, Mule Deer and Javelina. Mountain Lions may be fairly common in the area also but no evidence of their presence was noted during field studies.

TABLE III-5
230 kV EMA PROPOSAL
GAME, FURBEARING AND HUNTABLE NON-GAME SPECIES
OCCURRING IN PLANT COMMUNITIES CROSSED BY PROPOSED ALTERNATE CORRIDORS

Species	Plant Communities					
	Chaparral/ Oak Wood-land	Desert Grass-land	Paloverde Desert-scrub	Riparian Oak-Sycamore	Riparian Salt Cedar-Mesquite& Cotton-wood-Willow	Aquatic Ponds and Trails
Small Game Mammals:						
Desert Cottontail	(may occur almost anywhere)----------					
Big Game Mammals:						
Black Bear	X	-	-	X	-	-
Mountain Lion	(may occur almost anywhere)----------					
Javelina	(may occur almost anywhere)----------					
Mule Deer	(may occur almost anywhere)----------					
White-tailed Deer	(may occur almost anywhere)----------					
Game Birds:						
Gambel's Quail	X	X	X	-	X	-
Mourning Dove	X	X	X	X	X	X
White-winged Dove	-	-	-	-	X	-
Ducks	-	-	-	-	X	X
Coot	-	-	-	-	-	X
Snipe	-	-	-	-	-	X
Non-Game Birds:						
Starling	-	-	X	-	X	-
English Sparrow	-	-	-	-	X	-
Non-Game Mammals:						
Black-tailed Jack Rabbit	-	X	X	-	-	-
Antelope Jack Rabbit	-	X	X	-	-	-
Rock Squirrel	(may occur almost anywhere)----------					
Furbearers:						
Opossum	-	-	-	X	X	-
Beaver	-	-	-	-	X	-
Muskrat	-	-	-	-	X	X
Ringtail	X	-	X	X	X	-
Raccoon	-	-	-	X	X	X
Badger	X	X	X	X	X	-
Coati	x	-	-	X	X	-
Predators:						
Porcupine	(may occur almost anywhere - uncommon)----------					
Coyote	(may occur almost anywhere)----------					
Gray Wolf	(probably extinct in the area----------					
Kit Fox	-	-	X	-	-	-
Gray Fox	(may occur almost anywhere)----------					
Skunks	(may occur almost anywhere)----------					
Bobcat	(may occur almost anywhere)----------					

b. Endangered Wildlife

Species listed as endangered in the United States List of Endangered Fauna (Federal Register Vol 401, No 188, September 26, 1975 and Vol 41, No. 115, June 14, 1976 and others) which occur in habitats similar to those found in the area of the proposed line include black-footed ferret, southern bald eagle, Mexican duck, and American peregrine falcon. The most likely of the above species to occur in the study area would be the peregrine falcon.

Little specific information exists on the precise geographic distribution of endangered wildlife. Many such species are highly transient and, thus, frequently change locations. This is particularly true for carnivorous mammals and raptorial birds which are most often found on lists of endangered and threatened wildlife. Assigning a specific locality to these animals is, therefore, a tenuous task at best.

7. Cultural Resources

The principal cultures identified along the proposed route are Mogollon, Western Pueblo, Anasazi, Hohokam, Cibola, Salado, and Sinagua.

The proposed 500 kV corridor passes near two sites that have been proposed for the addition to the Arizona State National Historic Register. They are Hashknife Ranch Headquarters (link 8) and the Silver King Mine (link 28).

The National Register of Historic Places has been consulted, and no nominated areas are found within the proposed corridor.

The preferred route passes through several areas of prehistoric culture. An analysis of the site density and impacts of archeological resources by proposed links, as determined by the company's consultant in cooperation with the Museum of Northern Arizona, is shown on table III-6.

In additon to 34 sites which were inventoried during the reconnaissance study of the potential routes, 143 archeological sites were recorded during the intensive survey along portions of the preferred route. It appears that 41 of these sites along the preferred route would be directly impacted by construction, and would therefore require further mitigation measures.

The proposed 230 kV EMA Route alternatives pass through several areas of prehistoric culture. Though only the Hohokam culture was identified, a total of 18 archeological sites were inventoried by Arizona State University during their study of potential routes. An analysis of the site area and sensitivity to archeological resources by route, as determined by the company's consultant in cooperation with Arizona State University, is shown on Table III-7.

TABLE III-6

500 kV PROPOSAL
ARCHEOLOGICAL SENSITIVITY LEVELS (MILES) 1/

Links 2/	High	Moderate	Low	Impact	Historic Sites
04		28		moderate	None identified
05		22	2	moderate to low	None identified
06		11	2	moderate to low	Hashknife Ranch Headquarters
41 42	6	22		high to moderate	None identified
28	2	15		high to moderate	Silver King Mine
38 33	7	8		high to moderate	None identified
34	3	1	12	low to moderate	None identified
35			10	low	None identified

1/ Sensitivity levels were determined to be as follows:

High Sensitivity (High predicted possibility of sites). Include areas with a site density of 40 sites per township in well-studied areas, and by at least 20 sites per township in mdoerately well-studied areas.

Moderate Sensitivity (Low predicted possibility of sites). Areas possessing the lowest expected site density in the study area. From the studies that have taken place in the area, sites are known to occur, but the total number of sites is expected to be low in comparison to other parts of the study area. No estimate of site density in these areas is possible on the basis of existing data.

Low Sensitivity (Low predicted possibility of sites). Areas possessing the lowest expected site density in the study area. From the studies that have taken place in the area, sites are known to occur, but the total number of sites is expected to be low in comparison to other parts of the study area. No estimate of site density in these areas is possible on the basis of existing data.

2/ Links 9, 12, 19, 22, 23, and 39. These links are described in the Final Environmental Impact Statement for the Cholla (APS) Project as segments D, D^1, G, J, and Q respectively. These links are "dual corridor" links in which both the APS 500 kV and the SRP Coronado Station 500 kV lines are located.

Detailed descriptions of the company proposed links are found in "Environmental Report - Arizona Station Project: Vol III, Transmission System".

TABLE III-7
230 kV EMA PROPOSAL
ARCHAEOLOGY SENSITIVITY LEVELS (in miles)

Route	Number of Archaeological Sites	Maximum	Major	Moderate	Minimum	Number of Historic Sites
A	4	-	0.6	0.1	15.4	4
B	3	-	0.3	-	10.4	1
C	1	0.6	0.1	-	4.8	6
D	1	-	0.3	1.9	5.5	1
E	1	0.3	-	0.5	3.8	2
F	None identified	-	-	0.9	-	None identified
G	None "	0.3	-	1.0	11.1	3
H	3	0.4	2.6	2.6	0.9	4
I	3	0.2	1.2	6.1	-	None identified
J	1	-	0.9	0.3	2.4	None "
Total	17					21

1. A maximum sensitivity designation is reserved for those areas which contain large and/or unique sites which may yield new and valuable information.

2. Major sensitivity areas include those with small sites, large numbers of isolated loci, or unusual, but by no means unique, material. These areas, however, contain a relatively large quantity of archaeological material.

3. Moderate sensitivity zones contain less archaeological material; no sites are present but isolated loci do occur. There is no unique material in these areas and the potential for new information is generally low.

4. Minimum sensitivity designation is reserved for those areas which contain very little archaeological material which is not unique and has very little potential information.

The National Register of Historic Places has been consulted, and no nominated areas are found within the proposed corridor. A total of 92 historic sites were inventoried, of these only 21 sites were determined to be potentially eligible for nomination to the National Register of Historic Places (see Table III-7). Route A passes near one State Register site, identified as the Silver King Mine, which is currently active and is located on private land.

Geological formations with paleontological significance within the transmission system study area are the Martin limestone, the Escabrosa limestone, the Naco limestone and the Toranado limestone. Exposures of these fossiliferous limestone formations are not extensive within the proposed transmission system alignments, occurring between miles 2.2 to 2.5 and 11.0 to 15.3 (Route A) between miles 6.5 to 10.0 (Route B), and between miles 11.9 to 12.1 (Route G).

8. Minerals

Nonmetallic minerals such as sand, gravel, cinders, gypsum and building stone are the chief mineral resources of the study area. Near Holbrook, sand and gravel are economic resources. Gypsum from the Moenkopie formation is available at Snowflake and Woodrof. Coal is found at Pinedale and may be an important future resource.

Occurrences of minerals including copper, uranium, iron, manganese, silver, lead, and perlite are known to be present over various segments of the proposed 500 kV links as well as in the proposed substation sites. Deposits of copper are known to exist in the vicinity of the Silver King substation and Link 28.

Commercial copper mining now occurs east and west of the present Coronado Cholla-dual 500 kV corridor and the proposed Silver King Substation at Cities Service's Pinto Valley mine and Magma Copper Co.'s number nine shaft. Additional patented copper and other precious minerals such as silver and uranium mining claims are now found within the link 28 corridor. The entire Superior - Oakflat - Ray area through which the 500 kV systems are located appears to be overlying or covered with mineral claims or patents, excepting the Oak Flat area that has been withdrawn from mineral entry.

Nonmetallic minerals, building stone, aggregate and industrial minerals that occur within the 230 kV EMA study area include: perlite, asbestos, limestone, tuff, sand and gravel. Although historically all of the minerals listed above have been mined in the area, only perlite and sand and gravel are currently being produced. Perlite is being mined from open pit operations two miles southwest and west, respectively, of Superior adjacent to Route A. Sand and gravel is produced near Kearny.

Metallic minerals occurring within the study area include sulfides, oxides and carbonates of copper, silver, gold lead and zinc. Copper is the major resource with other metals occurring in minor deposits or as co-products in copper mining.

Major economic mineral deposits occur at two localities within the study area. Currently Magma Copper Company is producing copper from underground operations at Superior (about one mile east of Route A) and the #9 shaft (two miles west of Route B), and Kennecott Copper Company has an open pit operation at Ray (adjacent to Route D). Magma Copper Company removed 1,087,694 tons of ore containing 78,048,000 pounds of copper from the underground mine at Superior during the calendar year of 1975. Kennecott Copper Company removed 11,721,547 tons of ore that contained 175,994,828 pounds of copper and 682,514 pounds of molybdenum from their open pit mine at Ray in 1974. Ray mines is within the 230 kV EMA study area and approximately 12 air miles south of Silver King substation sites A, B, and C, and in the same drainage. The Superior underground mine has a shaft within 2 miles of Silver King substation alternates A, B, or C and 500 kV corridor link 28. This same shaft and its appurtenant access road and buildings are within the travel influence zone of U.S. Highway 60 and the 500 kV alternative link 45. These are the only nonferrous metal mining operations currently in production within the study area, though the entire Superior-Oak Flat-Ray area appears to be overlying or covered with mineral claims or patents. Approximately 700 acres of the Oak Flat area is withdrawn from mineral entry, and no prospecting is allowed in this area.

9. Soils

Soils along the study route show considerable variation in depth and texture especially in these areas of major topographical variation. Localized areas of highly sensitive soil units not described in this phase of analysis, which may be significant to the project, occurred in isolated areas along the route and should be recognized when a more detailed survey of the final centerline is conducted. A brief discussion of the dominant soil units found along the route can be found in the following paragraphs. Terminology used for the 230 kV EMA study is shown in parenthesis.

a. Moenkopie-Rock Outcrop Soil Association

Soils developed on the Moenkopie formation are shallow to very shallow sands and sandy loams which are gravelly in places. The soils occur on nearly level to rolling plateaus diversified by locally steeper slopes on buttes, escarpments, and mesas and canyon walls where bedrock is exposed. Latter areas comprise 30 percent of the total unit. Slopes are gentle (2-15%), except on the canyon walls and in the flanks of buttes, mesas, and escarpments. The Moenkopie soils, on nearly level or gentle slopes, which comprise approximately 70 percent of the unit, have a low erosion hazard if the vegetation is destroyed. In the rock outcrop areas, on steep slopes, the erosion hazard for hill and gully development is moderate to severe especially in shaley areas. Slopes in shales may be unstable. The Moenkopie soils have a low shrink-swell potential. The Moenkopie soils are strongly calcareous.

b. Palma-Clovis Association

This association consists of deep, sandy loams and loamy sand soils developed on old alluvium and aeolian deposits with mantle sandstone and shale bedrock. The soils occur on nearly level to gently rolling terrain with slopes ranging from 0-8 percent. The relief is diversified by occasional steep escarpments and occasional buttes. The water erosion hazard is moderate while the hazard for wind erosion is severe if vegetation is destroyed.

c. Winona-Rock Outcrop Association

This association is composed of gravelly or cobbly loam soils on slopes ranging in gradient from 2-8 percent. Soil depths are shallow, generally between 10 and 18 inches in depth. Water erosion potential is considered to be moderate while wind erosion potential is thought to be low. The shrink-swell potential is rated as low. In general these are shallow, semi-arid, soils commonly occurring on calcareous sedimentary rock outcrops.

d. Tours-Navajo Association

This association is composed of silty clay loam soils located on flood plains. They are typically deep, greater than 60 inches in depth, and arid. They occur generally on slopes less than 3 percent in gradient. Their water and wind erosion potential is moderate to high. The shrink-swell potential is also rated as moderate.

e. Caralampi-White House Association

(Alluvial Fan Deposits)

Dissected rolling fan deposits on 5 to 30 percent slopes, with thin accumulations of silty sand with gravel, gray-tan surface soils which overlie variable composition fan deposits. The surface soil thickness is generally less than 6 inches with low organic contents. The toe of fan slopes and very gently sloping surfaces are often underlain by a red-brown sandy clay with gravel, which have thicknesses on the order of 3 feet. Variable calcium cementation ranging from light to heavy occurs under the red-brown sandy clay soil, gravel and cobble size particles are rounded to angular, permeabilities of the loamy surface soils is moderate to slow with the soils below 24 to 36 inches being moderately slow, available water capacity is low to moderate in the sandier areas and high in gravelly loam areas. The surface soils are moderately erodible with localized fine grained surface soils being highly erodible. The presence of large amounts of gravel and cobble sized particles restricts the soil transport potential. Caralampi soils are gravelly or cobbly sandy clay loam subsoils. Whitehouse soils are gravelly loam surface layers over clay subsoils.

(Old Alluvial Fan Deposits)

Dissected fan deposits with slopes of 10 to 20 percent, gravelly sands with silt, tan, variable calcium cementation, slight to heavily cemented. Surface soil thicknesses are generally less than 12 inches with accumulation of silty sands with clay occurring on the toe of slopes. The fan composition and degree of induration are variable but tend to be both predominantly granular and moderately indurated. Gravel size particles are rounded to subangular, permeability is moderately slow to moderate and the available water capacity is low to moderate. The surface soils are erosive, however, the gravels tend to reduce particle transport.

f. Gunsight - Cavelt - Rillito Association

This association consists of strongly calcareous soils on partially dissected, undulating to hilly fans at the base of the mountains. Slopes range from 5-15 percent. Soils are deep gravelly and shallow gravelly, loamy textured soils that are normally found over silica and carbonate cemented hardpans. Soil erosion potential is moderate, and there is a probability of slumping around excavations.

g. Mohall - Pinant Association

These are deep, nearly level to gently sloping soils found in old mixed alluvium. Slopes range from 0-5 percent. Soils are deep, moderately fine textures and very gravelly, moderate fine textured reddish soils. Soil erosion potential is low to moderate, however, severe slumping may occur around excavation.

h. Gilman - Antho - Pimer Associates

This association consists of deep, medium, moderately coarse, and moderately fine textured soils formed in recent alluvium from mixed sources. These soils are found on nearly level flood plains and lower alluvial fans. Slopes are generally less than one percent. Localized areas may be clay or gravel. Soil erosion is low. Where soils occur in intermittent drainage ways, erosion may be severe.

i. Torrifluents Association

(Flood Plain Soils)

These are recent water laid deposits in and adjacent to the Gila River channel and associated tributaries. The soils consist of gently sloping to nearly level stratified deposits of both coarse and fine grained materials. These soils are subject to seasonal overflow and erosion and redeposition as the active channel shifts. Organic content varies from low to moderate, gravels are rounded to subangular. The soil permeabilities are moderately rapid to rapid and the available water capacity is low. The edges of the river channels contain deep soils with both fine and granular constituents. These sandy-silty loamy soils have slopes less than 3 percent. The permeability of these soils is moderate to low and the available water capacity is high. These river channel soils are moderately erosive and often subjected to scour during high flows.

j. Mohall - Contine Association

This unit consists of deep, loam and clay loam soils on nearly level, old valley plains and alluvial fans. Slopes are usually less than one percent. Moderate shrink-swell potentials may be found in some areas. Soil erosion potential is low to moderate. In general, the soil erosion potential of soils increases as slope increases and vegetation decreases. The revegetation potential of soils along the route is generally low because of the hot, arid climate.

k. Rough Broken Land

(Soil Developed on Old Alluvial Fan Deposits)

Steep to very steep, deeply dissected old terrace deposits with overlying tuff deposits in several areas. Slopes range from 20 to 70 percent. Surface soils are primarily granular gravelly sands although sandy clays with gravels occur as thin units 0 to 2 feet thick in localized areas, calcium cementation is variable ranging from low to moderately cemented. The deeper soils are variable and are generally granular with the percentage of gravel sized particles increasing with depth, gravel and cobble size particles are rounded to subangular. A distinct increase in the degree of cementation and lithification was observed in the direction from Hayden to Kearny through this zone. Soil permeabilities range from slow to rapid with low to moderate available water capacity. Soil organic content is low. The surface soils are moderately erosive. In general, the presence of gravels will restrict gully development and quickly armors an erosional surface.

l. Rock Land

In addition to the previous soil units discussed three different types of thin soils exist over the mountainous portions of the system area. In general these soils are less than several feet thick and the land surface is frequently broken by rock outcrops. Because of the proximity to the source area most of these soils contain a large component of gravel and cobble size particles. The presence of this coarse particle segment tends to reduce the erosion potential of the rock land soils through a process of surface protection or "armoring". For all three of the following rock land soils the erosion potential varies from slight to moderate.

(1) Granite and Schist Rock Land (arid and semi-arid)
Shallow, cobbly soils developed primarily on Granite and Schist rock.

(a) (Thin Granular Soil Over Granite)

Dissected irregular surface with granite outcrops, with slopes less than 5 percent, thin silty sand, tan to red-brown, soils over weathered granite, low organic content, and thickness generally less than 1 to 2 feet. Rock fragments of angular cobble size occur within the soil zone. Permeabilities are moderate to moderately rapid and the available water capacity is low to moderate. The granular soils are very erodible, however, the gentle slopes will tend to restrict soil transport.

(b) (Thin Soils Over Granite)

Dissected, rolling topography with granite outcrops and slopes of 5 to 25 percent, the surface soils are silty sands with gravel, gray-red brown, low organic content. The underlying granite is weathered to considerable depths. At the toe of slopes in localized areas clayey sands with gravel, red-brown, are developing. The thickness of the surface soils is 0 to 6 inches, permeability of the soils is moderate to moderately slow and the available water capacity is low to moderate. These soils are easily eroded. The presence of rock close to the surface restricts the development of arroyos.

(2) Extrusive Igneous Rock Land (arid and semi-arid) Shallow, cobbly soils developed on primarily extrusive igneous rock.

(a) (Thin Granular Soils Over Extrusvie Igneous Rock)

Irregular surface with rock outcrops, slopes 3 to 25 percent, silty sands with gravel, low organic content, 0 to less than 12 inches in thickness, on toe slopes, sandy clays accumulate in some areas to less than 3 feet in thickness. Gravel-cobble particles are subrounded to angular. Permeabilities are slow to moderate to high erosion potential, gravel-cobble particles tend to protect soil as their concentrations increase during the erosion cycle. The close proximity of rock to the surface prevents extensive arroyo cutting.

(b) (Dissected Thin Soils Over Intrusive and Extrusive Igneous Rock)

Dissected irregular topography with slopes of 5 to 10 percent, elevations range from 3,000 to 3,500 feet. Sandy clay with gravel and silty sand with gravel tan to red-brown, overlie igneous intrusive in varying degrees of alteration. The overall soil thickness ranges from 0 to 5 feet, within some areas of tan silty sand loam, 0 to 6 inches in thickness overlying a sandy clay occurs. Permeability is moderate to moderately rapid. In the soil areas available water capacity ranges from low to moderate. Existing transmission lines and roads in this area show moderate to slight erosion. The presence of gravels in the soils tends to restrict the amount of erosion although the near surface soils are very erodible.

(3) Igneous, Metamorphic and Sedimentary Rock (arid and sub-humid) Shallow, cobbly soils developed on igneous, metamorphic, and sedimentary rock.

(a) (Granular Soils on Sedimentary and Igneous Rocks)

Dissected sedimentary and igneous rock with gravelly sand and clay soils, slopes range from 5 to 70 percent, low organic content, thickness generally less than 1 foot

with accumulations of clayey sand with gravel at the toe of slopes and in valleys to three feet. Gravels are subangular to angular, permeabilities are slow to moderate and the available water capacity is low to moderate. Rock outcrops cover 20 to 50 percent of this zone. The surface soils have a moderate to high erosion potential with the gravel size particles restricting soil transport. The underlying rock restricts arroyo development.

(b) (Thin Soils Over Igneous and Metamorphic Rock)

Dissected irregular topography with igneous and metamorphic rock outcrops, slopes vary from 5 to 75 percent, the thin soils are primarily silty sands with gravel, tan-red brown, in localized areas where soils are accumulating clayey sands with gravel, red-brown occur. The soils have low organic contents and the thicknesses are generally 6 inches to 3 feet, the gravel and cobble size fragments are generally angular to subangular, permeability of the soils is moderate to moderately slow, the available water capacity is low to moderate. Rock outcrops cover a significant portion of this soil unit, approximately 20 to 50 percent. The surface soils are very erosive. Rock fragments in the soil and the proximity of rock to the surface restrict the development of arroyos in all but the areas where soils are accumulating at the toe of slopes.

(c) (Fine Grained and Granular Soil on Steep Sedimentary, Metamorphic and Igneous Rock)

Irregular topography with steeply sloping soil surfaces overlying sedimentary, metamorphic, and igneous rock. Slopes range from 10 to 90 percent. Surface soils are generally gravelly sands with silt, tan-gray in color, low to moderate organic content, thicknesses ranges from 0 to less than 12 inches, on the shallowest portions of this zone clayey sands-sandy clays with gravel, red-brown in color, have developed, thicknesses range from 0 to 5 feet. Variable calcium cementation often occurs beneath the surface soils ranging from non to moderately cemented. Gravel size particles are subrounded to angular. Permeabilities are moderate and the available water capacity is low to moderate. The soils are low to moderately erosive with gravels providing increasing protection to the soils as erosion proceeds. Arroyo formation is restricted by the underlying rock.

(d) (Thin Soils Over Steeply Dipping Sedimentary Rocks)

Dissected, irregular topography, with slopes of 20 to 75 percent, with igneous minor intrusive and sedimentary rock outcrops. Thin tan to brown gravelly sands with concentrations of gravel size rock fragments overlie rock in varying degrees of alteration, sand clays with gravel have accumulated in the shallower slope sections of this zone. Organic content is low. Thicknesses

of the surface soils range from 0 to as much as 10 feet with generally the gravelly sand materials less than 6 inches in thickness. The gravel and cobble size particles are angular to subangular. The surface soils are moderately erodible with the exception of some soils over a conglomerate which has primarily a fine grained matrix. Soils developed from this rock type are very erosive. Permeability of the soils ranges from moderately rapid to slow and the available water capacity is low to moderate.

Detailed geologic and soils maps are contained in the following source reports at the Forest Supervisor's Office of the Tonto and Apache-Sitgreaves National Forest at Phoenix and Springerville, Arizona, and at the Salt River Project, Phoenix, Arizona.

> Volume A and B of the Arizona Station Project Transmission System Environmental Study -- Consultant Report.
>
> Silver King to Hayden Transmission System Environmental Studies, Inventory (Baseline) Report and Impact Reports.

10. Wilderness

Proposed alignment for the 500 - 230 kV link proceeding westward from the end of link 28 to the formally proposed Dinosaur Substation, (along links 33, 34, 38, 37 and 29), are visible from some points within the Superstition Wilderness. However, actual contact with wilderness boundaries is avoided by all alternative routes considered. None of the Roadless Areas selected by the Chief of the Forest Service for study as wilderness areas adjoin any of the proposed routes.

11. Forage

Basically, the entire proposed route is available for grazing by both domestic livestock and wildlife. Forage production will be adversely affected temporarily at tower and pulling sites. Access road construction could create impacts of a more long-term nature. The maximum acreage of disturbance to existing vegetation is estimated at 1,920 acres. Current livestock stocking rates along the proposed route vary from 7-25 acres per animal unit month. In addition, much of the land along the route has no grazing capacity due to rough terrain or lack of vegetative cover. An animal unit month of livestock forage has an estimated value of $14.86 to the regional economy. At an average stocking rate of 15 acres per AUM, a maximum annual forage value of $1,190 would be lost. A significant reduction in the land's capacity to support livestock and wildlife grazing is not anticipated due to the minor reduction in forage produced.

Nearly all of the 230 kV EMA proposal routes are available for grazing by both domestic livestock and wildlife. Forage production will be adversely affected temporarily at tower and pulling sites. Access road construction could create impacts of a more long-term nature. The maximum acreage of disturbance to existing vegetation is estimated at 415 acres. Current livestock stocking rates along the proposed route are approximately 7 acres per animal unit month. In addition, much of the land along the route has no grazing capacity

due to rough terrain or lack of a vegetative cover. At an average stocking range of 7 acres per AUM, a maximum annual forage value of $881 would be lost. A significant reduction in the land's capacity to support livestock and wildlife grazing is not anticipated due to the minor reduction in forage produced.

Livestock concentrations trailing along rehabilitated right-of-way and access roads, resulting from the animal seeking highly palatable seeded vegetation, can largely negate rehabilitation efforts.

Increased public access can result in gates being left open and a general disturbance of both livestock and wildlife. Vandalism of range improvements such as water troughs may also increase where access is not controlled.

12. Outdoor Recreation

The proposed route avoids areas of concentrated recreation and scenic drives through most of its length. The entire dual corridor section (in conjunction with the 500 kV Cholla Project) was covered under the Environmental Statement issued for the Cholla Project.

The current recreation uses found along the studied corridors are dispersed outdoor recreation uses such as sightseeing, backpacking, "rockhounding", bird watching, and hunting.

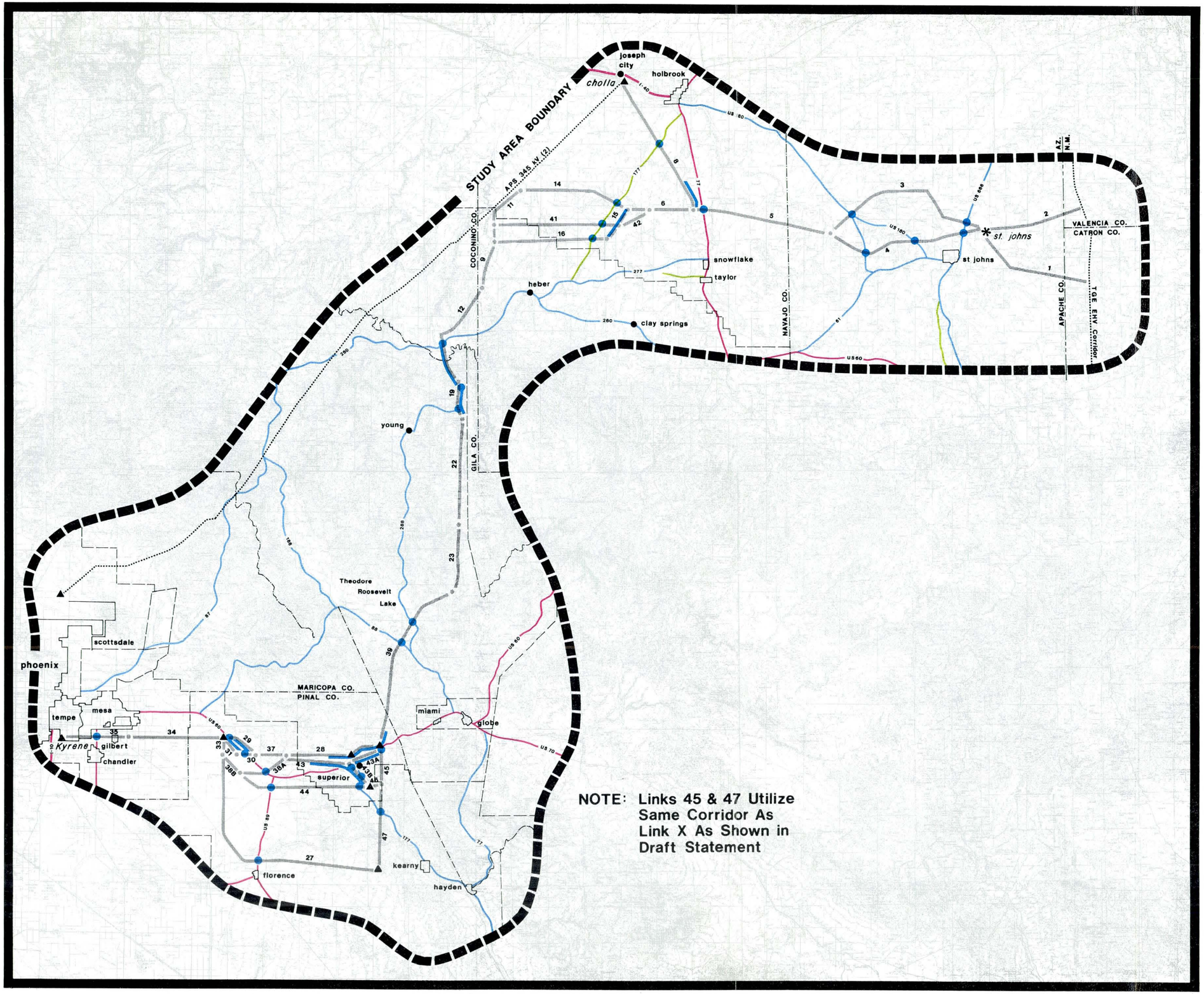
Various Outdoor Recreation categories and activities were identified along the alternate corridors within the 230 kV EMA proposal, including the Tonto National Forest (crossed by Routes A and B), Bureau of Land Management land and state land (generally crossed by all routes). Current recreational uses associated with the study areas include sightseeing, backpacking, "rockhounding", birdwatching and hunting.

The alternative routes generally avoid intensive recreational use areas. The Boyce Thompson Southwest Arboretum is located 2 miles west of Route A. The Oak Flat Campground is crossed by Route B and a county park located in Riverside is located within 1/4 mile of Route E.

13. Transportation

State Highways 377, 77, 177, as well as U.S. Highways 666, 60, and 180 are crossed by the proposed 500 kV transmission system. Figure III-5 shows the network of major highways in the study area. There are no interconnecting secondary roads.

The mainline of the AT&SF railroad parallels I-40 approximately 50 miles west of the plantsite. A spur railroad owned by Southwest Forest Industries, branches south from Holbrook to McNary.



MAJOR HIGHWAYS

- INTERSTATE
- MAJOR THROUGH HIGHWAYS
- OTHER THROUGH HIGHWAYS
- OTHER PAVED ROADS

VISUAL SITES

- CROSSINGS
- PARALLELS

North

5 10 15 miles

CORONADO PROJECT

TRANSMISSION SYSTEM

HIGHWAY INFLUENCE

Figure III-5

A Southern Pacific Railroad line parallels the Gila River from Phoenix to the Hayden portion of the 230 kV EMA. This line is used for industrial purposes only. It would be crossed by the 230 kV EMA Routes E, F, G, and I. See Figure LU-1 contained in the Silver King to Hayden Transmission System Environmental Study that are available in the locations listed in Section III, H. 4, for the 230 kV EMA map on highway influence.

A Magma Copper Company owned railroad parallels U.S. Highway 60 westward from Superior, then crosses U.S. Highway 60 near Florence Junction where it heads south to joint the Sante Fe line near Florence. This line would be crossed by the 230 kV EMA Route A.

A Kennecott Copper Company owned railroad parallels Mineral Creek from the Ray Mine to the Gila River where it joins the Southern Pacific Railroad and would be crossed by Route D.

14. Other Land Uses

Within the 11,000 square mile total study area, a series of four one mile wide corridors were selected by the proponent's consultant, with aggregrate links of approximately 650 miles. Within these corridors, 82 types of land use were inventoried, 44 of which are current or existing uses of land and 38 proposed future uses of the land. Current land uses are specific in type and location, while planned land uses can vary from site to site.

Current land uses - found along the proposed links in the northern portion of the proposed 500 kV transmission line includes recorded subdivisions, grazing land, irrigated agricultural lands, and mobile home residential areas. Current land uses along the southern portion of the proposed 500 - 230 kV lines running westerly from the proposed Silver King Substation include active mining, mobile home residential, irrigated farm land, industrial uses, rural density residential areas, and grazing land.

Planned land use - in some respects impacts on planned land use can be a significant point in determining existing uses while some types of planned land use are explicitly designated and precisely located. In other instances plans can be so vague or general as to be of little value in deciding the location of the future transmission lines. Planned land use in the urbanized portion of the Phoenix metropolitan area was mapped at a more detailed scale than other areas due to its complexity. Planned land uses for the urbanizing area were obtained from the Maricopa Association of Governments' 1973 composite plan and plans from towns within the area. Although these official plans are current at this time, planning is ongoing; and plans will be revised.

Plans of public agencies - Federal, State, County, and local - were also shown on the planned land use map.

The following plans were inventoried and taken into consideration in determining the alternative routes or links for the proposed Coronado Station Project:

a. The 1971 Apache County Comprehensive Plan which systematically shows future urbanization around the existing settlements of St. Johns, Concho, and Hunt.

b. The Navajo County Comprehensive Plan which systematically shows urban expansion and other uses including an environmental reserve category.

c. Apache-Sitgreaves National Forest and Tonto National Forest Multiple Use Plans. Of particular interest is the 1973 draft Mogollon Rim area land use plan and Canyon Creek Management Use Plan.

d. Most lands within Gila County are primarily owned and managed by public agencies. The 1971 Gila County Plan projects further urbanization in the Hayden area.

e. The 1967 Pinal County "1985 Development Plan" shows expansion for the Florence area together with large areas of planned irrigated agriculture. Also identified in this plan are sites designated as recreation resources.

f. The State Parks Board has proposed purchase of the Boyce Thompson Southwestern Aboretum. It has also identified a potential state park area to service the Superstition Wilderness.

g. The Central Arizona Project includes a proposed Buttes reservoir. The C.A.P. canal Salt-Gila (Aqueduct) is also proposed to pass through Pinal County.

h. Within Maricopa County, the following existing plans were consulted:

(1) "A Park Recreation and Open Space Study," Phoenix, Arizona, September 1970.

(2) "A Report Upon a General Land Use Plan for Maricopa County, Arizona," Phoenix, Arizona, August, 1968.

(3) "A Report Upon Future General Land Use for Maricopa County, Arizona," Phoenix, Arizona, April, 1971.

(4) "Subdivision Regulations for the Unincorporated Area of Maricopa County, Arizona," Phoenix, Arizona, November, 1973.

(5) "The 1969 Amended Zoning Ordinance for the Unincorporated Area of Maricopa County," Phoenix, Arizona, 1972.

(6) The Maricopa County Association of Governments 1973 Composite Land Use Plan shows a combined plan of cities in their jurisdiction.

A large area of irrigated agriculture as well as the potential Central Arizona Project Granite Reef Aqueduct is located south of the proposed Dinosaur Substation site. A Maricopa County recreation resource area is also noted in the vicinity of the Queen Creek Estates mobile home park south of the propsed link 28 and immediately adjacent to the existing 115 kV transmission lines belonging to Salt River Project.

A series of four mile wide corridors were selected and studied, totaling 76.2 miles within the 230 kV EMA study area, encompassing 420 square miles. Within these routes, 52 types of land uses were inventoried, 43 of which are current or existing uses of land and 7 proposed or planned uses of the land. Current land uses are specific in type and location, while planned land uses can vary from site to site.

Current Land Uses found along the proposed routing alternates included subdivisions, grazing land, mobile homes, residential areas, industrial uses, active mining and rural density residential areas.

Planned Land Use along the proposed links were so general so as to not be of great value in determining the location of future transmission lines. Planned land uses for Pinal County were obtained from a variety of sources.

Plans of public agencies Federal, State, County and local were shown on the lineal, outdoor recreation and other land use maps.

The following plans were analyzed for the Proposed Silver King to Hayden Transmission System:

a. The 1967 Pinal County "1985 Development Plan" identified areas of possible urban and extractive industry expansion and sites designated as recreation resources.

b. The State Parks Board has proposed purchase of the Boyce Thompson Southwest Aboretum.

c. The Central Arizona Project includes the proposed Buttes Reservoir.

d. The Arizona Department of Transportation identified a consideration to upgrade State Highway 177.

e. The Galbreath Development Corporation plans for private subdivision development in the Kearny area.

15. Economics

The long term economic effect of the transmission line will be substantial. The existing labor force that currently resides within the communities passed by the proposed transmission line, will not support the construction and maintenance of the transmission line because of the lack of construction and maintenance specialists needed to construct and maintain EHV lines.

Construction of the transmission line within the dual corridor section between Heber and Superior will begin during the first quarter of 1977 and will be completed sometime during the first quarter of 1978. Depending on weather conditions and the actual staging of construction, the required construction labor force will vary between 100 and 180 persons with an average of 140. Construction of the northern segment between the Coronado Plant and Heber was started by Irby Construction in the fourth quarter of 1976 with expected completion in June of 1978. Employment will range from 80 to 120 with an average of 100. Construction activities will be centered around Snowflake. It is expected that this will be the residential location for much of the workforce, although during the early stages of construction some workers may live in the St. Johns area and later, some may live in Heber. The shift out of the St. Johns area should occur before peak employment is reached at the Coronado Plant. There are adequate goods and services within communities along the line, to support the transmission line and substation construction activities.

The major purpose of the proposed Silver King to Hayden 230 kV EMA Transmission System is to facilitate the expansion of the Kennecott Ray mines Division operations. Two possible alternative expansions are being investigated: the first would employ about 275 construction workers at construction peak and would add approximately 135 workers at full capacity, and the second possible expansion would employ about 800 construction workers at construction peak and add about 1235 workers at full capacity.

The existing labor force that currently resides in the communities of the study area, will not support the construction and maintenance of the transmission system or mining operation expansion due to lack of construction and maintenance specialist needed.

16. Fire Management

The northern portion of the proposed transmission line, from the Coronado Generating Station west to the Cholla 500 kV corridor, does not now experience destructive wildfires because of a lack of surface vegetation (fuel).

Wildfires (within the Chaparral and palo-verde-saguaro vegetative types) do occur in the mountain ranges that encompass the southern portion of the 500 and 230 kV systems, the 230 kV EMA proposal, and all of the 500 kV substation proposals, with the exception of Dinosaur. Grass and brushfire occurrence from both dry-lightning and man's activities is common at all times of the year when good burning conditions are present.

The Coronado Project transmission lines as well as the 230 kV EMA lines would pass through lands under the jurisdiction of the following Federal and State Agencies: State Land Office, U. S. Bureau of Land Management, Tonto National Forest (Globe and Mesa Ranger Districts), and the Apache-Sitgreaves National Forest. Fire occurrence on State lands within the corridors studied is unknown. On Bureau of Land Management lands man-caused fires have occurred along the Southern Pacific Railroad right-of-way along the Gila River.

Both dry-lightning and man-caused fires occur from the Dripping Springs Mountains, north and westerly through the study area.

Grass and brush fires occurring within the Chapparral vegetative type burn extremely fast and hot. One of the 52 blazes that occurred on the Globe Ranger District of the Tonto National Forest consumed 7,000 acres of brush and grass in one area immediately adjacent to the soon to be constructed Cholla - 500 kV transmission line, 3,600 acres of the 7,000 were consumed the first day of the fire.

Both the Bureau of Land Management and Forest Service engage in the fire suppression activities. Both the Bureau of Land Management Phoenix District Office and the Globe Ranger District of the Tonto National Forest hire from a few up to 40 men annually to carry out fire presuppression and/or suppression activities. The Forest Service actively engages in presuppression activities within their portion of the study area. Both agencies use the Forest Service lookout tower at Signal Peak as a "fixed" fire detection center and aerial reconnaissance (fire patrol) after dry lightning storms as a "supplementary" detection method.

C. Environmental Impacts Of The Proposed Action

1. Air Quality

Air quality would not be significantly affected by the transmission line. During construction, however, vehicles and equipment will be sources of temporary noise, dust, and smoke. Maintenance activities will cause lesser amounts of the same pollutants at infrequent intervals.

Corona loss will cause noise, heat, light, radio interference and ozone. These effects are of low significance during fair weather but are more in evidence during rain. The 500 kV acoustic-radiated noise will remain below 59 decibels it all times. The 230 kV acoustic-radiated noise will remain below 52 decibels at all times. This level of sound is similar to that found in typical business offices or conversation. Light and heat will have no adverse impacts other than the energy loss in producing them. Radio interference will be noticeable within a few hundred feet of the line, particularly at highway crossings. Certain transmission line design measures can mitigate this interference. Ozone is injurious to health at concentrations exceeding 0.08 ppm. Predicted concentration levels of ozone from the proposed transmission lines are much below 0.05 ppm, a level detectable by smell. Acceptable continuous exposure to ozone concentrations specified by the Occupational Safety and Health Act (OSHA) of 1972 is 0.1 ppm for any 8-hour period. It is unlikely that it will be produced in measurable quantities. Whatever amount is produced will be dispersed in the surrounding atmosphere with a resulting very low concentration level.

An increase in air pollution in the form of emissions from copper smelters and mining equipment, plus dust from mining operations will be experienced over all of the southern portion of the transmission study area as a direct result of providing additional power to the Ray-Kearny área. Mr. Kenneth H. Matheson, Jr., General Manager of the Ray Mines Division, Kennecott Copper Corportion, announced on February 24, 1977 at a public hearing on the Coronado Project, that the company was engaged in a long range expansion program which eventually could result in an exploitation rate more than double their present rate. The expansion on the Ray Mine is based on the additional electrical power necessary for any expansion being supplied by SRP.

A portion of the additional power will be used to replace existing fossil fueled smelters with cleaner burning electric furnaces that will tend to help decrease the amount of pollutants in the air at the present time.

2. Sociological

Social and cultural impacts will be associated with the impact of temporary increases in the population (between 160 to 210 construction workers) during the 2 year construction period. Most construction workers will move from town to town as construction progresses. Experience from the recently completed TG&E 345 kV transmission line in western New Mexico indicates that some workers will bring their families to the towns closest to the line that offers schools, hospitals, churches, etc. All of the communities listed in Table III-1 will be temporarily affected by the construction activities.

Adequate energy supplies would likely facilitate urban growth and sprawl in the Phoenix area, and the quality of community life will probably degradate even while per capita income increases. The increasing concern over air pollution, open space preservation, and mass transit may mitigate the expected degradation to some extent.

The proposed route passes through predominantly rural areas and, such, is expected to have a minor effect on human habitation. The greatest degree of impact will be short term, occurring during construction activities due to the amount of people and equipment involved. It is estimated that the line crosses within sight of approximately 40 homes on the north end at least 5 times that number on the southern end as it passes through 13 miles of rural or low density residential areas south of the towns of Mesa and Tempe and north of Gilbert. Impacts upon the inhabitants will be primarily visual over the long run. Any homes adjacent to the transmission line right-of-way will be depreciated in value due to the presence of the 230 kV EHV transmission line.

Specific areas of visual impact upon concentrated rural populations are as follows: the proposed line would be visible from the villages of Concho and Hunt; White Mountain Ranches subdivision; Silver Creek subdivisions; Chevelon Retreat; Queen Creek Estates; the towns of Gilbert, Chandler; and the southern portion of Tempe. The property values within the White Mountain Ranches and Silver Creek subdivisions crossed by the proposed transmission line may be adversely affected by the presence of the line. Urbanizing influence surrounding the towns on the south end of the line negate the effect of the line from Queen Creek Estates west to the Kyrene powerplant.

Social and cultural impacts within the 230 kV EMA proposal, will be associated with the temporary increase in population during the one year construction period of the transmission line (60 to 90 workers) and expansion of Kennecott Ray Mines Division operations (135 to 1235 workers).

Few, if any, workers would be hired locally for construction of the line. It is unlikely that many construction workers will relocate permanently, to any communities in the area, for the one year construction period.

Most workers associated with mining expansion operations will move to towns, in the area, that offer schools, hospitals, churches, etcetera. A number of employees could commute on a daily basis due to the proximity of population centers.

The expansion of mining operations in the area appears to be a positive impact to local and regional economy since the economy of the region is based on the mining industry. Such an expansion will result in more money in the local economy, thus additional housing, services, etcetera,which eventually provides more jobs within the supporting work force.

Most alternatives of the proposed transmission line will pass through predomoninantly rural areas and, is expected to have a minor effect on human habitation. Short term impacts will occur during construction activities due to the number of equipment and people involved. Impacts upon the inhabitants will be primarily visual.

3. Natural Beauty

The natural scenic quality of the landscape is an important resource in the State of Arizona. Power transmission facilities of the proposed project will have a definite impact on the surrounding natural landscape. The magnitude of the impact on scenic quality will vary with the land's capability to absorb the structures, related clearing, and earthwork.

Areas of little topographic relief and minimum vegetative variety, such as the Little Colorado River Plateau Region and the Lower Sonoran Desert Region, offer little opportunity for the absorption of powerline structures and conductors. In contrast, the area around Superior offers numerous ridges and peaks to provide screening and backdrops which lessen the impact of the powerline on the visual potential of the area. Related earthwork and road construction in these rougher areas, however, can present a visual impact.

Several areas of above average or high scenic quality could be affected by either the company proposed route or alternatives studied by the Study Team. They are:

a. Links 45 and 47 (Route B). The 230 kV and 500 kV lines would cross U. S. Highway 60 near Oak Flat Campground, and be within sight of State Highway 177. The same lines would then cross State Highway 177. This would occur for both the Silver King E and Kearny No. 2 substations.

b. Link 38 where it crosses U. S. Highway 60, and Link 44 where it crosses U. S. Highway 89 near Florence Junction.

The proposed 230 kV EMA proposals generally follow existing transmission lines and the impact was determined to be moderate to low. An exception is where Routes C, E, and G cross the Gila River, resulting in a high impact.

A complete description of the methods for inventory and analysis of the 500 kV transmission line is included as Appendix G, and is shown in Figure III-3 and III-5. The analysis of the 230 kV EMA transmission line is included in the Silver King to Hayden Transmission System Environmental Study.

4. Vegetation

The uniqueness of a habitat (or plant community) is directly related to its abundance within a circumscribed area. In Arizona, riparian woodlands are by far the most unique plant community, covering an estimated 0.003 percent of the state.

Thirty-four rare, endangered, or peripheral vertebrate animal are found in association with riparian woodlands in Arizona. This restricted community also has within it more species of vertebrate animals than any other plant assemblage in Arizona and shares with oak woodland the distinction of having the greatest number of game animals.

Because of plant community uniqueness, the presence of a large number of diverse animal species and a large total number of rare endangered, and peripheral wildlife and game animals, riparian woodlands are considered the most sensitive plant community in Arizona. Based on similar reasoning, the other plant communities through which the transmission line must pass were classified, subjectively. The ranking for plant community and associated animal sensitivity is (from most to least sensitive): riparian woodland, Palo Verde-Saguaro Desert-Scrub, Creosote bush-Bursage Desertscrub, Pinyon-Juniper woodland, chaparral and grassland. The initial impact of transmission line construction on plant communities thus depends on the amount and quality of each community through which the line must pass.

Table III-2 shows the amount of each plant community traversed in miles and the total number of riparian communities crossed from the Coronado Station Generating Plant to the Kyrene Receiving Station (Kyrene Steam Plant in Tempe). The right-of-way will be 200 feet wide for the single 500 kV line and 330 feet wide for joint corridor portions of the line (APS-Cholla line); thus, 5,800 acres could be impacted by the line and its right-of-way alone. In the shorter scrub and grassland communities, vegetation will not have to be cleared except for roadways and tower sites. The area of continued or operational impact along the transmission line is estimated at 1,920 acres that are occupied by access roads and tower sites.

Potential impacts on native vegetation resulting from construction of the Silver King to Hayden proposed 230 kV EMA transmission line are generally not severe except where clearings for roads, towers and pulling stations would have to be placed in relatively undisturbed riparian plant communities. Because of plant community uniqueness, the presence of a large number of diverse animal species, riparian communities are considered the most sensitive plant community in Arizona. Based on similar reasoning, the other plant communities through which the transmission lines must pass were classified, subjectively. The ranking for plant community and associated animal sensitivity is (from most to least sensitive): riparian communities, chaparral, saguaro - paloverde, transition between desert scrub and chaparral, mixed crucifixion thorn and grassland. The initial impact of transmission line construction on plant communities thus depends on the amount and quality of each community through which the line must pass.

Table III-3 shows the amount of each plant community traversed in miles, from the proposed Silver King Receiving Station to the proposed Hayden Receiving Station. The right-of-way will be 140 feet wide for single 230 kV line; thus, 1295 acres could

be impacted by the line and the right-of-way alone. In the shorter scrub and grassland communities, vegetation will not have to be cleared except for roadways and tower sites. The area of continued or operational impact along the transmission line is estimated at 415 acres that would be occupied by access roads and tower sites.

Impacts to threatened or endangered species, may occur from construction activities located either inside or outside the right-of-way.

An estimated eight acres (of the total 1,920 acres) of the riparian-woodland plant community may be permanently disturbed. An estimated 436 acres of the juniper-pinyon plant community and 142 acres of the chaparral plant community will be disturbed.

The desert plant communities, represented in the project areas by the cresote bush-desert shrub and the paloverde-saguaro plant communities (See Table III-2 and III-3), are the most sensitive to vegetative disturbances, i.e., that revegetation is more difficult because of the arid conditions.

The relative ease with which disturbed soils can be revegetated, either naturally or artifically, is an important consideration. Generally, revegetation becomes more difficult as one descends from the higher, cooler, wetter sites along the Rim to the arid creosote bajadas near Phoenix.

Secondary impacts resulting from vegetation manipulation involve the introduction of exotic plant species through revegetation activities and changes in the microclimate as a result of reduced plant cover. Introduced species are of greatest concern where pristine plant communities still exist, as is the case south of Sombrero Peak, on the dual corridor portion of the line. Modified microclimates are of greatest concern in the more arid regions where temperatures and moisture regimes are already at critical levels for most plant species and sufficient vegetative cover to protect soil resource is seldom achieved.

Livestock grazing pressure on revegetated portions of the right-of-way or access roads can nullify revegetation efforts if not controlled. Conversely, the opportunity for improving both livestock and wildlife forage is also present if the proper plants are seeded and given adequate protection.

Based on the successional patterns of juniper control, removal of junipers, pinyons, and oak from under powerlines may release seedlings of the same species and release growth of understory species such as manzanita, scrub oak, sagebrush, saltbush, cliffrose, winterfat, and sumac as well as grasses and forbs. Successional patterns following the removal of ponderosa pine and associated evergreens from under transmission lines may vary with the occurrence of understory species north or south of the Mogollon Rim. Along the top of the Rim and northward, removal of overstory conifers may release aspen, New Mexico locust, Gambel Oak, alligator juniper, Emory Oak, and understory shrubs and grasses. South of the Rim, commonly released specied include Emory Oak, Alligator juniper, and common chaparral species.

5. Water

Water was probably a significant factor in determining the location of the plant. Surface water quality will be temporarily affected by construction activities. Water for concrete batch plants and other construction activities may be difficult to obtain over the Coronado Station project area. Nearby stock tanks may receive an increase in silt from road and tower construction. Short-term chemical and physical pollution from equipment operation, construction camps, and disposal of waste material is also possible. Ground water will not be affected by the transmission line during construction or after its completion.

6. Wildlife

Impacts to the wildlife resource will come in three different ways:

a. From the actual construction,

b. The completed transmission line, and

c. New or improved access roads into undisturbed areas.

The major problems encountered in making this evaluation are that:

a. "Wildlife" is not a single unit but a complex interrelating group of organisms with both similar and differing requirements and varying tolerance to a given impact.

b. Blanket statements do not apply to all wildlife species found in a particular area.

c. Quantifying impacts or the degree of impact on most populations is virtually impossible within the time framework of the study, expertise, or technical information available.

d. Impacts to the wildlife resource stem from a combination of various uses on even large parcels of land. Serious harm to a wildlife population is generally not from a single project such as the construction of a powerline. The harm to varying ecosystems and local populations comes in increments which sometimes are so small that they go unnoticed until a critical, sometime irreversible, stage is reached. Each project can be analyzed and evaluated showing little impact on the wildlife resource. It is the insidious accumulation of these little impacts that should be given concern as this is where the real problem lies.

Wildlife is important in the State of Arizona for three reasons:

a. Economic reasons. Hunters and fishermen licensed in Arizona in 1972 numbered 370,336. This represents an industry within the State that will approach the $100 million mark in 1975.

b. Esthetic importance, both from actually viewing or listening by people to various species and from the satisfaction experienced by some people just knowing that these species exist.

c. As a barometer of the quality of the environment.

The primary impacts anticipated due to construction of the line are:

a. Removal of vegetation. This varies from complete removal to thinning. This determines what vegetation will be available for food, cover, perches, breeding, etc.

The most productive habitat areas occur within the riparian and aquatic biotic communities. However, the chaparral and juniper-pinyon biotic communities also support a great variety of wildlife. (See Tables III-4 and III-5).

b. Conversion of habitat rather than elimination. This implies that changes are both detrimental and beneficial depending on what species one is talking about, amount of a particular vegetative type, or what areas conversion is taking place in. Since populations are dynamic and interrelating this tends to be a spiraling impact.

c. Corona discharge. There may or may not be an impact on wildlife. Literature on the subject is conflicting. Concern increases with EHV lines 500 kV and above and under a variety of circumstances ranging from age of the line, load on the line, atmospheric conditions, and amounts of pollutants in the atmosphere. The primary villain is the production of ambient ozone which is very toxic. "The National Primary Air Quality Standard for photochemical oxidant prescribed a level of 0.08 parts per million by volume (ppm) as a maximum one hour arthmetic means concentration not to be exceeded more than once a year." (Scherer, Ware, Shih, 1972)

d. Collision of migratory birds with conductors, towers, and static lines. There are numerous instances where this has occurred. To date there is no indication that this has been a chronic problem except on certain types of towers that are taller than 300 feet in height.

Secondary impacts caused by the presence of the line will be:

a. Increased access into relatively remote areas as a result of new road construction or improvement to marginal existing roads. This will have an impact on the effectiveness of law enforcement by increasing the ratio between the number of miles to be covered and the number of law enforcement personnel available. This also opens up new roadside areas for poachers and new areas for professional and casual collectors of lizards, snakes, desert tortoises, etcetera. Areas of relative solitude are opened up to the disturbances of man's activities. It is very difficult to measure this effect, especially on breeding populations.

b. Concentration of livestock in right-of-way clearings. This greatly reduces or eliminates any benefits gained by creating openings in monotypic types, increasing of vegetative type diversity, or increasing edge effect. Such concentrations can eliminate cover in the openings for turkey, quail, lagomorphs, etc.; eliminate food available for wildlife species and, over a period of time, reduce or eliminate the preferred species of vegetation seeded in the rights-of-way.

c. Increase in road kills by creating new roads that the public will use.

There are two additional concerns that have not been documented. One is the possible effect on movement of birds and bats in narrow riparian drainages being spanned with low hanging conductors. The other concern has interested biologists for some time and involves possible magnetic field effects on migrating birds.

At the present time, there is no information on threatened or endangered insects. Therefore, they will not be discussed any further in this statement.

7. Cultural Resources

The preferred route passes through several areas of prehistoric culture. An analysis of the site density and impacts of archeological resources by proposed links, as determined by the company's consultant in cooperation with the Museum of Northern Arizona, is shown on Table III-6.

A total of 34 archaeological sites were inventoried during the reconnaissance study of the potential routes. All sites encountered were recorded on survey forms and plotted on detailed maps. It has been requested that detailed site maps not be included in this document in order to prevent site destruction.

The principal cultures identified along the proposed route are Mogollon, Western Pueblo, Cibola, Anasazi, Hohokam, Salado, and Sinagua.

A detailed archeological survey will be conducted on the approved route prior to construction.

The proposed corridor passes near two sites that have been inventoried for the Arizona State National Historic Register. They are Hashknife Ranch Headquarters (link 8) and the Silver King Mine (link 28). No site degradation is anticipated as the company's proposed alignment does not cross or impede access to either of these sites.

An anlysis of the sensitivity levels of archeological resources for the 230 kV EMA alternative routes is described in Table III-7. Severe and high impacts were generally identified along the Gila River. Moderate to low impacts were identified over the remaining area.

The National Register of Historic Places has been consulted, and no nominated areas are found within the proposed corridor. A total of 92 historic sites were inventoried, of these only 21 sites were determined to be potentially eligible for nomination to the National Register of Historic Places (see Table III-7). Route A passes near one State Register site, identified as the Silver King Mine, which is currently active and is located on private land.

Any archeological and historical sites located on Federal lands within the permitted right-of-way and access roads will be protected as required by the Antiquities Act of 1906, Executive Order 11593, the National Historic Preservation Act of 1966, and the Archeological and Historical Conservation Act of 1974. The company will also be required to report "any archeological, paleontological, or historical sites found during survey, excavation, or construction on State owned lands to the Director of the Arizona State Museum, and take all reasonable steps to secure its preservation; under the provisions of the Arizona Antiquities Act of 1960 (Title 41, Chapter 4, Article 4, ARS Section 41-773 to 41-776, Inclusive)."

8. Minerals

Nonmetallic minerals such as sand, gravel, cinders, gypsum and building stone are the chief mineral resources of the study area. Near Holbrook, sand and gravel are economic resources. Gypsum from the Moenkopie formation is available at Snowflake and Woodruff. Coal is found at Pinedale, and may be an important future resource. The Chinle formation has been productive for uranium north of the study area, and unforeseen economic considerations may make uranium occurrences within the study area exploitable in the future.

Occurrences of metals such as copper, uranium, iron, and manganese are known to be present over various portions of the proposed 500 and 230 kV links as well as the proposed substation sites. Deposits of copper are known to exist in the vicinity of Silver King Substation link 28 and all of the proposed 230 kV EMA proposals.

Commercial copper mining now occurs throughout the Eastern mining Area and within all of the proposed transmission line corridors and substation alternatives, except for Dinosaur. Additional mineral claims (silver and uranium) are presently found within the link 28 corridor.

The known presence of mineralized areas and the subsequent exploration and claiming activities within the proposed transmission system corridors makes it likely that at sometime in the future new or expanded mining operations will be developed. This potential for increased mineral exploitation occurs also within the proposed 230 kV EMA transmission systems. Expanded mining activites within the transmission line corridors will produce only a minor effect on the transmission system. The consequences of the expanded mining activity may be the relocation of affected towers. The impact of the transmission line system on the mineral resources would appear to be favorable, since an expanded power distribution system would result in lower developmental mining costs.

9. Soils

The construction of new roads and upgrading of existing roads will be the major impact on the soil resources in the area. Cross-country travel during construction and excavation for tower and pulling sites will also have an impact. Increased soil erosion and the related decreased site productivity will be of major concern. Soil compaction is probable at staging areas and other locations where heavy equipment will be concentrated.

The construction of the 500 kV and 230 kV substations will require additional earthwork to be done for site preparation. The location of the proposed Silver King 500 kV substation site will necessitate total disturbance over an area approximately 650 feet wide by 2,100 feet long.

Areas most sensitive to damage from conventional construction activities are shallow soils, soils on steep slopes, and unconsolidated alluvial deposits in drainage ways. Revegetation of disturbed areas will be difficult along much of the route because of the hot, arid conditions. Tours-Navajo Association soils along links 41 and 42 and the Flood Plain soils along the Gila River (EMA Routes C, E, F, G, H, I and J) are extremely susceptible to wind and/or water erosion if the surface vegetation is removed.

The more severe and more lasting damage to the soils will result from the following:

a. Soil compaction.

b. The removal of the sand surface layers (A_1 horizon), thereby exposing the clayey subsoils (B_2 horizon) or the subsoils containing higher concentrations of carbonates.

c. Any excavation done in the desert areas, such as near Superior, Arizona, will cause a permanent visual scar.

d. The unique properties of aridic soils needs to be recognized. Depth of soil material over bedrock is significant. The variation in the properties of the different horizons may have even a greater effect on the plant growing environment than the depth to bedrock. The removal of the thin surface horizon (1-5 inches of A_1) may restrict revegetation almost as effectively as exposing bedrock. The formation of the fertile surface layers can take as long as the weathering of soil from bedrock under more moist conditions. The subsoil, in an arid environment, generally contains higher amounts of clay or carbonates, thereby reducing water infiltration, and increasing the potential for erosion.

e. Erosion will be excessive in the areas near Superior, unless mitigating measures are taken.

10. Wilderness

The proposed alignment (along with links 28, 33, 34 and 38) may possibly be seen from some points within the Superstition Wilderness. However, actual contact with wilderness boundaries is avoided by all of the routes considered. None of the Roadless Areas selected by the Chief of the Forest Service for study are near the route.

11. Forage

Basically, the entire proposed route is open to grazing by both domestic livestock and wildlife. The number of acres covered by right-of-way of the line is 24.24 acres for each mile of single 500 kV and 40 acres for each mile of dual corridor 500 kV or 500 and 230 kV. Of this total 24.24 and 40 acre area of encumbered right-of-way an estimated 8 acres and 11 acres respectively, will be lost to future forage production as a result of access roads, tower sites, and substation sites. A total of 1,920 acres maximum, could be permanently encumbered or covered by the access roads, tower sites, and substations for the 500 kV lines and substations.

Basically, all proposed 230 kV EMA routes are open to grazing by both domestic livestock and wildlife. The number of acres covered by the right-of-way of the 230 kV line is 16.96 acres for each mile. Of the 16.96 acre area of encumbered right-of-way an estimated 7 to 11 acres (depending on final alignment), will be lost to future forage production as a result of access roads and tower sites. A total of 415 acres maximum could be permanently encumbered or covered by access roads and tower sites.

The potential of the range to carry (support) commercial livestock (cattle) is termed carrying capacity. Carrying capacity is usually expressed as Animal Unit Months or AUM's. An Animal Unit Month is described in the "Glossary of Terms Used in Range Management," published by the Society for Range Management, as "The amount of feed or forage required by an animal-unit for one month." An animal unit is described in the same Glossary as ". . . one mature cow (1000 lb.) or the equivalent based upon average daily forage consumption of 26 lbs. of dry matter per day." The carrying capacity of the range through which the transmission line passes varies from 7 acres per AUM down to 25 acres per AUM. An average of 16 acres per AUM is estimated for all vegetative types crossed by the powerline. Hence, if the average carrying capacity of range through which the transmission line crosses is 16 acres per AUM, then the indication is that 16 acres or 780 lbs of dry forage is needed to support a 1000 lb. cow or equivalent for one month.

The impact of the 500 kV powerline and substation construction of the forage resource can be:

1920 acres ÷ 16 ac./AUM1/	=	120 mos. of forage for a 1,000 lb. cow or the equivalent = 10 cattle (120 mos. - 12 mos.) permanently lost.

In other words the access roads, substation sites, and tower sites will decrease the forage available for cattle by an estimated 120 AUM's or 10 cattle throughout the entire 200 mile length of the project (does not include Cholla dual portion of project).

1/ 16 Ac./AUM is deemed to be the average carrying capacity of the range through which the transmission line travels.

The impact of the project on forage available for deer or antelope would be calculated as follows:

Deer or antelope consume approximately 1/5 the amount of forage consumed by cattle, hence a ratio of 5 to 1 is approximate, hence 16 acres of forage would support 5 deer or antelope for 1 month.

The number of AUM's of forage lost for deer and/or antelope is therefore:

1920 acres ÷ 3.2 (16 ac./AUM÷5) = 600 months of forage for a mature deer or antelope, or forage for 50 deer or antelope could be lost due to construction of the project.

The impact of the 230 kV EMA proposal powerline construction of the forage resource can be:

415 acres ÷ 7ac./AUM1/ = 60 mos. of forage for a 1000 lb. cow or the equivalent = 5 cattle (60 mos. - 12 mos.)

In other words the access roads and tower sites will decrease the forage availability for cattle by an estimated 60 AUM's or 5 cattle throughout the entire 25 to 40 miles of alternative alignments.

The impact of all proposed alignments on forage available for deer would be calculated as follows:

Deer consume approximately 1/5 the amount of forage consumed by cattle, hence the ratio of 5 to 1 is approximate, thus 7 acres of forage would support 5 deer for one month.

The number of AUM's of forage lost for deer is therefore:

415 acres ÷ 1.4 (7 ac/AUM÷5) = 300 months of forage for a mature deer or forage for 25 deer could be lost due to construction of alternative alignments.

12. Outdoor Recreation

Dispersed outdoor recreation such as sightseeing, backpacking, rock hounding, hunting, and fishing will be affected more so than will recreational activities in developed facilities. Approximately 42 percent of all recreational use in the Mogollan Rim area is of a dispersed nature.

The proposed route avoids areas of concentrated recreation and scenic drives for most of its length. As all of the dual corridor

1/ 7 Ac./AUM is deemed to be the average carrying capacity of the range through which the transmission line travels.

section (in conjunction with the 500 kV Cholla Project) was covered under the Environmental Impact Statement for the Cholla Project, none of the outdoor recreation impacts covered under that statement will be mentioned here.

Construction of the 500 kV line on the northern portion along links 4, 5, 6, 8, 41, and 42 will impact recreation driving or sightseeing where the proposed transmission line crosses State Highways 377 and 77 and U.S. Highways 180 and 666. Other recreation impacts will be increased accessibility for hunters, rock hounds, prospectors, and off-road vehicle enthusiasts. Closure of construction roads will be more difficult because of off-road vehicles that can drive around or over barriers.

Construction of the 230 kV EMA lines along Routes A, B, C, D, E, H, I and J will impact recreation driving or sightseeing where the possible line location crosses or parallels U.S. Highway 60 and 70 and/or State Highway 177. Other recreation impacts will be increased accessibility for hunters, rockhounds, and off-road vehicle enthusiasts. Closure of construction roads will be more difficult because of off-road vehicles that can drive around or over barriers.

New construction access roads can be both beneficial and adverse. More people will visit the area which will in turn cause resource damage, either willfully or unknowingly; e.g. littering, vandalism, animal harassment, and man-cause fires.

Construction of the proposed line west from the southern end of the dual corridor, along links 28, 38, 33, 34, and 35 will increase accessibility for hunters, prospectors, rock hounds, campers and picnickers. The proposed 500 kV transmission line and portions of the Goldfield to Silver King 230 kV transmission line will be back dropped against the base of the Superstition Mountains, west of Florence Junction. Towers and conductors will be viewed by those west bound on U.S. Highway 60, from the vicinity of Florence Junction to the 500 kV crossing of U.S. Highway 60, a travel distance of 1½ miles. Portions of the 500 kV transmission line may also be visible, though two to three miles distant, for west bound motorists using U.S. Highway 60, between Gonzales Pass and the turn off to Queen Creek Estates. This is also the best viewing area of Weavers Needle for travelers on U.S. Highway 60.

The proposed line should not interfere with views from the Superstition Wilderness Area.

13. Transportation

Transportation systems will be affected in the following ways. The temporary adverse effects on existing roads and highways will be due to the interruption of normal traffic. The permanent adverse effects will result from roads not needed after the line is constructed. These will be difficult to obliterate and close

to future use due to use by off-road vehicles. Temporary favorable effects will be due to improved and more frequent maintenance. The permanent favorable effects will be due to the higher standard of roads constructed on those roads that will be left open by consent of the landowners. There will be a better network for fire control, firewood harvest, hunter access, stockman use, and mineral exploration. Also, some existing roads used during construction may be obliterated if they will not be needed for the permanent system. There may be some increase in traffic at all air strips within close proximity to the line, but no adverse effects on air transportation is contemplated. Table III-8 shows the access roads, both new and existing, that will be either constructed or affected by the proposed 500 kV lines.

Road conditions on the proposed 230 kV EMA lines are shown in Table III-9.

TABLE III-8

500 kV SYSTEM PROPOSAL
MILES OF ROAD CONDITION BY LINK

Link No.	Total Link Mi.	Present Access (in Miles)				New Access to be Constructed
		Poor	Fair	Good	Excellent	
4	28.2	28.2	-	-	-	-
5	23.6	21.6	2.0	-	-	-
6A	6.4	3.4	-	-	-	3.0
41 & 42	29.8	9	3	5.8	-	12.0
28	17.5	5.2	3.4	5.0	-	3.9
38 & 33	15.5	-	8.2	-	-	7.3
34	15.8	8.6	-	4.6	-	2.6
35	10.4	-	-	-	-	10.4

Links 9, 12, 19, 22, 23, and 39. These links are described in the Final Environmental Statement for the Cholla (APS) project as segments d, D', G, J, and Q, respectively. These links are dual corridor links in which both the APS 500 kV and the SRP Coronado Station 500 kV line are located.

TABLE III-9

230 kV EMA SYSTEM PROPOSAL
MILES OF ROAD CONDITION BY ROUTE

Route	Total Route Miles	Present Access in Miles				Access to be Constructed
		Poor[1]	Fair[2]	Good[3]	Excellent[4]	
A	16.1	3.5	1.4	11.2	-	3.5
B	10.7	-	-	10.7	-	0.5
C	5.5	0.5	-	5.0	-	0.5
D	8.4	-	-	8.4	-	0.5
E	4.6	1.6	-	3.0	-	1.6
F	0.9	0.9	-	-	-	0.9
G	12.4	1.5	-	10.9	-	1.5
H	6.5	-	-	6.5	-	0.5
I	7.5	6.0	-	1.5	-	6.0
J	3.6	-	1.8	1.8	-	-

1. Poor - parallels no existing roads (high moderate or low level of human activity)

2. Fair - roughly parallels unimproved roads

3. Good - parallels unimproved roads, roughly parallels paved or improved roads, and parallels agricultural roads or crosses agricultural fields

4. Excellent - parallels paved or improved roads

14. Other Land Uses

The proposed route either crosses or parallels various other powerlines, telephone lines, pipelines, railroads, roads, and TV translator "lines-of-sight." Property values adjacent to the powerline right-of-way may be adversely affected by the presence of the transmission line.

The primary concerns associated with the 230 kV EMA proposal alternative routes from the proposed Silver King substation to the proposed Hayden substation are the adverse direct physical and visual impacts within the populated areas of Superior, Kearny and Kelvin-Riverside and the possible indirect impacts upon growth patterns there.

Route A has a severe impact upon the Superior Airport by crossing the associated interference zone. Placement of the proposed 230 kV transmission line here could impair usage of the airport and therefore result in the most severe land use impact identified within the study area. The high impacts of this alignment respond to the physical and visual impact upon the large residential area of Superior and residences in the Walnut Creek area.

Moderate to high impacts were found along Routes D, E, F, H, and I due to the lines visibility to the communities of Kelvin-Riverside and Kearny. Severe impacts along Route I responds to the crossing of two residential areas, located north of Kearny.

No conflicts other than visual were identified with either existing or planned land development. It is likely, however, that a transmission line of this size will have an influence on future development and land use patterns adjacent to it.

15. Economics

The economic effects of the transmission line will be substantial and practically all beneficial. Construction costs of the line, based on 1975 wage and price averages, are $49,860,000 for primary line with a "backup" system interconnected with the Tucson Gas and Electric Company's San Juan-Vail line. The primary line with a "backup" interconnected with Arizona Public Service's Cholla Plant and transmission line is estimated at $60,873,000. The cost of right-of-way easements is estimated at between $5,770,000 to $6,249,000 depending on which "backup" is selected.

Electricity rate increases for Salt River Project power users may be expected in the future due to increased costs for new facilities and materials, added costs of environmental protection, and increased costs of financing. The Coronado Station Project represents a significant portion of this expense.

Taxes, based on the value of this transmission line, that will be paid to the State of Arizona, counties, and school boards range from $1,058,000 to $1,286,000 per year 1/, depending again on the backup route selected.

1/ Based on the route proposed by the Proponent.

The most tangible benefit of line construction, other than the taxes and the direct benefit of power delivery, relate to employment of construction workers. Labor costs are estimated to be 35 to 40 percent of the total cost of transmission line construction, or between $15,100,000 and $18,200,000. The number of men to be employed in construction of the line is estimated to be between 160 and 210 men. The weighted average cost of construction labor is $14 per hour. This equates to 1,078,500 to 1,300,000 manhours of labor or an average of 160 to 210 men per month over the 2-year construction period.

Few, if any, construction workers would be hired locally. It is unlikely that many construction workers will relocate permanently to any community; however, some workers will bring their families to towns located along the proposed transmission line. Construction force benefits will be of significance at the local community as well as the State level.

It is likely that most of the nonlabor expenditures for construction of the line will be made in Phoenix or other supply centers both within and outside of the State.

The annual operating cost for a 500 kV line, 200-400 miles in length is $300 per mile. Payroll costs will represent approximately 40 percent of operating costs. For example, at $300 per mile, the 269-mile line (primary line and double line over link 2 for the TG&E backup which would be the cheapest) would have an annual operating cost of $80,700 of which $32,280 would be payroll.

The total property tax yield of the 500 kV transmission system over its projected 35-year life (primary and TG&E backup) would be $34,900,000. This figure is the least amount of property tax yield; $44,800,000 in taxes would be received if the Cholla backup system is used. This estimate is based upon actual tax rates for each of the school districts. State and Federal income taxes attributed to revenue resulting from operation of the facility will largely be offset by income deductions.

The economic effects of the 230 kV EMA proposal transmission line will be felt primarily in populated areas which serve the copper industry and will be practically all beneficial. Right-of-way acquisition and construction costs have been determined for each route and capitalized in 1976 dollars:

Route	Cost in 1976 Dollars
A	$3,056,150
B	$1,768,785
C	$ 940,146
D	$1,543,366
E	$ 837,806
F	$ 218,430
G	$1,665,977
H	$1,151,890
I	$1,611,126
J	$ 355,088

Taxes, based on the value of the proposed transmission line, that will be paid to the State of Arizona, Pinal County, and school boards range from $170,285 to $237,428 per year, depending on the final route selected.

The most tangible benefit of line construction, other than taxes and direct benefit of power delivery, relate to employment of construction workers. Labor costs are estimated to be 35 to 40 percent of the total cost of transmission line construction, or between $1,700,000 and $2,540,000 depending on final route selection. The number of men to be employed in construction of the proposed line is estimated to be between 60 to 90 men. This equates to 121,000 to 181,000 man hours of labor over the one year construction period.

The major purpose of the proposed Silver King to Hayden Transmission Line is to facilitate the expansion of the Kennecott Ray Mines Divisions operations. This expansion could add from approximately 135 to 1235 workers to the 1765 workers presently employed by the Ray Mines Division. Including family and supporting workers, this expansion could add between 305 and 2794 persons to the regional population. This population increase would amount of a 30 percent increase over the existing area population. Since the present trend in the study area is toward upgrading and improving area facilities, services transportation, education and utilities, it is felt that expansion would be beneficial.

It is likely that most of the nonlabor expenditures for construction of the line will be made in Phoenix or other supply centers both within and outside of the State.

Total property tax of the line over its projected 35-year life would be between $5,960,000 to $8,310,000 depending on final routing alternates. This estimate is based upon actual tax rates for each of the school districts. State and Federal income taxes attributed to revenue resulting from operation of the facility will largely be offset by income deductions.

Right-of-way easements will be a source of revenue to the Federal and State governments and to the affected counties which receive a percentage of the fee collected on Federal lands (25 percent of $13.30 per mile annually on National Forest lands.)

Public Law 94-565, passed October 20, 1976, established a new system of Federal payments in lieu of taxes. Under this new law, the Secretary of Interior is directed to make certain payments to units of local government having Federal "entitlement lands" within their jurisdiction. The new payments under P.L. 95-565 will be in addition to payments under other laws, and will be based on a formula which takes into account local population, Federal acreage, and certain specified Federal payments (including National Forest System 25% payments) during the preceding fiscal year.

Right-of-way easements will be a source of revenue to the Federal and State governments and to the affected counties which receive a percentage of the fee collected on Federal lands (25 percent of $13.30 per mile annually on National Forest lands.)

16. Fire Management

Fire risk will be affected by increased human access. Fire risk may also be increased as a result of construction slash disposal and due to the presence of an energized powerline. Access roads provide for increased recreational use areas, and better access for fire suppression forces. Right-of-way clearing will reduce the volume of fuel present and thereby act somewhat as a fuelbreak, Slash may be chipped rather than burned if necessary to reduce hazard. Helispots needed for powerline construction can be coordinated with suppression and fire planning to insure continuing usefulness.

Fire suppression activities will be affected by the presence of the line. It is hazardous for firefighting personnel to work in the immediate vicinity of a charged powerline since there is a great risk of an electric current arcing between the line and the ground through the medium of dense smoke columns. Helicopter and fixed-wing aircraft operations are also affected by the presence of the powerline, particularly where canyons are spanned.

Transmission lines are subject to extensive damage from high temperatures generated by a wildfire. Flame temperatures ranging from 2500°F. to 3000°F. often occur in the combustion zone of intensely burning fires. The combustion zone extends from the fuel bed upward for approximately 100 feet in the timber type, a zone through which the transmission line passes.

Structural powerline failure begins to occur when aluminum conductor wire is heated to 300°F. to 350°F. Steel towers begin to fail when heated to 800°F. to 900°F. The risk of damage to the proposed 500 kV line and the hazards faced by firefighting personnel indicate that the line should either be located in lighter fuels where the flame temperatures are reduced, or that adjacent fuels be modified to reduce their volume and associated flame temperatures.

17. Favorable Environmental Impacts

a. Social Impacts

The major charter of the Salt River Power District is to provide the electrical energy and water to satisfy needs for a growing population. While the population of Maricopa County grew only 49 percent from 1964 to 1974, residential consumers of electrical energy delivered by the Salt River Project increased from 113,849 in 1964 to 221,792 in 1974, or 95 percent. In 1974, the Project served 15,917 commercial and small industrial customers. The Project's annual energy production had to be increased 170 percent between 1964 and 1974. During the 1964-1974 period, annual customer use increased from 7,109 KW hours to 12,809 KW hours (81 percent).

Prior to 1950, the Phoenix economy was based on agriculture. Stockyards, grain fields, and citrus groves covered the land immediately surrounding the city. At that time, the Phoenix metropolitan area cities were separated by fields and an urban resident could find ample open space for recreation within a few minutes' drive.

Tempe, Glendale, and Mesa, once agricultural cities, became bedroom communities for Phoenix workers. Scottsdale, a small desert town, became a westernized tourist resort in the 1960's. Arizona State College in Tempe achieved university status in the 1950's. Student enrollments increased from about 6,000 in 1950 to approximately 30,000 in 1973. The booming growth of the university added to urbanization of Tempe and the rest of the metropolitan area.

Urbanization of the area reduced the land available for recreational use. During the 1950's as the metropolitan area increased by 311 percent, there was a decline in agricultural activity and a nearly complete filling in of the land in and around the central city.

New factories, new businesses, and thousands of motor vehicles brought an increase in air pollutants to the metropolitan area. In 1951, there were 152,121 motor vehicles registered in Maricopa County; by 1970, 726,709 vehicles were registered. The increase of air travel in the Phoenix area, the decrease is bus travel within the metropolitan area, and the attendant rise in vehicular travel all added to the rise in pollution of the surrounding environment. Airline exhaust accounts for the second highest source of transportation related pollution in the Phoenix metropolitan area. Yearly bus transit patronage declined from 9,309,573 customers in 1960 to 4,091,581 in 1970.

Since Phoenix and western Arizona are in a desert region, there are few natural or manmade bodies of water to be affected by pollution. Those that do exist, such as the system of reservoirs northeast of Phoenix, are used for recreational purposes as well as for human consumption, irrigation, and industry in the metropolitan area. After being treated in area sewage plants, waste water is discharged into the dry Salt River so no effluent mixes with nearby fresh water supplies. Much of the water for western Arizona comes from the Colorado River or from deep water wells near towns and cities. These sources have remained nearly free of mancaused pollution. 1/

1/ Environmental Impact Study for the Bureau of Land Management, "The Kaiparowits Project and Its Impact and Growth in the Arizona and California Service Areas." by Dr. Alan J. Wyner, Dr. Robert Welsh, Dr. John Grehl, University of California at Santa Barbara and Dr. Keith Pearson and Mr. S. Craig Whitney of the Northern Arizona University, September 21, 1974.

Based on projections from mining customers in the eastern portion of SRP's service area, the demand for electricity for copper mining in the Salt River Project's eastern mining area will increase by 48.9 megawatts between 1975 and 1979. With the addition of this projected new load, the capacity of the SRP 115 kV transmission system that presently serves the mining industry in the Hayden area will no longer be adequate. In order to meet the demand for additional energy in this area, SRP is proposing to construct a 230 kV transmission line from the proposed Silver King substation to a proposed receiving station near the town of Hayden.

Power from Salt River Project's Coronado station plant is, therefore, needed to produce copper from existing and new mines. This should mean more jobs for, and possibly a greater variety of ethnic groups in the Hayden-Winkleman area and small mining communities to the north and south. It will also mean much more industrialization of the area.

The social well-being of the economically depressed counties, such as Navajo and Apache, should be improved by the collection of either $34.9 million in property taxes over the 35-year life of the project (if the TG&E backup is used), or $44.8 million (if the APS Cholla backup is used).

An estimated 160 to 210 construction workers will be needed for approximately 2 years for construction of the 500 kV line. An estimated 60 to 90 construction workers will be needed for approximately one year for construction of the 230 kV EMA proposed line. Because construction workers frequently live in small towns closest to the proposed line, it can be assumed that social activities will increase due to the increased number of people, even if they are only temporary.

b. Wildlife

There are several impacts that can be favorable to a wide range of wildlife species. One impact would come from the creation of openings in vegetative types where either trees or brush have dominated. These openings add some vegetative diversity. In chaparral, a second dimension is added which is access into areas of impenetrable growth.

In disturbed areas, reseeding usually consists of a variety of grasses, forbs, and browse species. Benefits are extended if the pattern of openings are irregular in shape, occur on good soils, and are away from access roads. The irregular shape increases the perimeter of the opening. The outer perimeter has to be thinned for a distance of at least half the diameter of the opening, with less thinning in further one gets from the

perimeter. This artificially creates an ecotone, or transition zone between the two biotic communities. It is within this ecotone area that what is referred to as "edge effect" occurs. In this area many species of both communities can be found plus species that may not be present in either community. These benefits can be nullified if roads bisect them or cattle are allowed to concentrate in the right-of-way.

Secondary benefits to a variety of birds will result from erected towers that will be used for perching, especially for rapitorial species. This should increase as the height of surrounding canopy decreases. Construction access roads may also be beneficially used for game management purposes.

c. Cultural Resources

Presidential Executive Order 11593 directs all Federal agencies to inventory and manage all archeological and cultural resources on lands under their direction. Also, under the provision of the Arizona Antiquities Act of 1960 (Title 41, Chapter 4, Article 4, ARS Sections 41-773 to 41-776, inclusive), the company will be required to report "any archeological, or historical sites found during survey, excavation, or construction on State owned lands to the Director of the Arizona State Museum and take all reasonable steps to secure its preservation."

Neither the State nor Federal Government can effectively manage or protect its cultural resources without inventories to identify their location; therefore, inventories of transmission line rights-of-way will aid these agencies in carrying out their responsbilities.

Archeological knowledge will be improved as a result of inventories and surveys conducted prior to project approval. While the proposed route avoids, insofar as possible, all archeological sites, sites presently not on record may be located and catalogued. Where it is not possible to avoid a site, it will be excavated and the cultural values salvaged at the applicant's expense and under the laws and regulations governing cultural resources; i.e., National Historic Preservation Act of 1966 (PL 89-665), Historic Sites Act of 1935 (PL 74-292), Antiquities Act of 1906 (PL 59-202), Executive Order 11593, the Archeological and Historical Conservation Act of 1974 (88 Stat. 174), and the Arizona Antiquities Act of 1960 (as mentioned above).

d. Forage

Resources for both livestock and certain wildlife species will be benefited to some degree. Wildlife species which require green grasses and forbs in the spring and early summer will benefit from the use of appropriate forage plant species.

Turkey can be further benefited by seeding large-seeded grass species. Oak and other sprouting shrubs will provide increased forage in the right-of-way following construction and maintenance activities. From the northern end of the line, specifically, antelope will be benefited by the invasion of new forbs species following construction activities. On the southern portion of the Coronado Station line, javelina, in particular, will be benefited by invasion of new forb species and grass species.

Improved access, if requested to be left open by the landowner, will assist improved livestock distribution into areas currently receiving little use, if water is available in these areas. The stockmen will be able to use those roads left open to assist in the movement of cattle and placement of salt, likewise improving the use of forage resources.

e. Transportation

Access roads will be constructed, and either left open or closed based on the desires of the landowner. Existing "track" or "rut" roads will be improved during the construction phase. Existing National Forest System roads that can be used for construction will be upgraded to current minimum Forest Service standards and retained on the system.

f. Economics

As a result of monetary circulation, short-term economic benefits will accrue to local communities, suppliers of materials, and construction workers during the one year construction period required to construct the 500 kV system and the one year necessary to construct the 230 kV EMA proposal.

Average manpower commitment required for the construction of both parallel line sections during the period is estimated to vary between 160 and 210 men for the 500 kV system and between 60 and 90 men for the 230 kV EMA system.

A construction payroll (based on 1975 labor rates) is estimated to be between $15.1 and $18.2 million for both the independent Salt River Project line and the Salt River portion of the dual corridor (Cholla line).

A construction payroll (based on 1976 labor rates) is estimated to be between $1.7 and $2.54 million for the 230 kV EMA system (depending on final alignment). Total value of the 230 kV system is estimated between $6,663,658 and $4,709,361 (depending on final alignment).

Landowners will receive between $5,770,000 and $6,249,000 for right-of-way easements and purchases. A total value of the Coronado Station Project Transmission System is estimated at between $49,860,000 and $60,873,000 (depending on which backup is used), with the dual corridor portion amounting to $17,334,600 of this total.

Property taxes estimated at between $34.9 to $44.8 million over the 35-year estimated life of the 500 kV line will provide significant and continuing benefits to the tax base of affected counties. This computes to be between one million and $1.3 million per year to be returned to the State, counties, and school districts as a result of the property taxes on the primary transmission line alone. One of the "backup" transmission lines alone, TG&E backup - (link 2), would contribute approximately $80,000 per year in taxes to Apache County in Arizona and Valencia County in New Mexico. The Cholla "backup" transmission system would contribute approximately $360,000 per year to Apache and Navajo Counties as well as the school districts and State of Arizona.

Property taxes, estimated at between $5.96 to $8.31 million over the 35-year estimated life of the 230 kV EMA line, will provide significant and continuing benefits to the tax base of affected counties. This computes to be between $170,285 and $237,428 per year to be returned to the State, counties, and school districts as a result of the property taxes on the proposed transmission line alone.

Increasing the productivity of the mines through increased electrical power from the 230 kV EMA network will result in favorable secondary economic impacts. Increased mining operations, already announced by Ray Mines, will result in an increased tax base and therefore more taxes.

As a whole, the Statewide impact of the construction of the transmission lines can be roughly estimated by assuming a Statewide employment multiplier of 3.and socio-economic characteristics of the work force the same as for the plan construction labor force. Table III-10 presents the impact of transmission line construction on supporting employment and total population, including construction labor force population. Thus, the transmission line construction will support 1661 and 3682 persons in the State of Arizona. 1/

g. Fire Management

The location of access roads and helispots can be coordinated with fire suppression planning efforts to provide preplanned access routes and control lines. The transmission line right-of-way will serve as a partial fuel-break since fuel volumes will be somewhat reduced in timber and brush types.

1/ Report on Coronado Generating Station Socio-Economic Impact. Dr. John T. Wenders, University of Arizona, Department of Economics, July 15, 1975.

TABLE III-10

TRANSMISSION LINE ECONOMIC IMPACTS

4th Quarter Year	Construction Labor Force[3/]	Supporting Employment Generated	Total Population
1976[1/]	225	450	2,021
1977[1/]	410	820	3,682
1978[1/]	185	370	1,661
1979[1/]	185	370	1,661
1979[2/]	80	180	404

1. Transmission line economic impacts for the 500 kV system.

2. Transmission line economic impacts for the 23 kV EMA system.

3. SOURCE: Construction Labor Force: Salt River Project. Report on Coronado Generating Station Socio-Economic Impact, Dr. John T. Wenders - University of Arizona, Department of Economics. July 15, 1975.

D. Mitigating and Enhancement Measures

Since Salt River Project contacted Federal agencies, the State Siting Committee, and private landowners impacted prior to beginning detailed engineering of preferred routes, much routing flexibility resulted. This permitted consideration of a number of routing possibilities before selection of those analyzed here. Once these routes were selected, there was opportunity to make refinements in their locations and alignments to take advantage of topography and existing access; to avoid recreation, residential, scenic, open space values; and to adjust for other environmental factors. Thus, many potential impacts have been avoided which, if the line had been surveyed in advance, would have required mitigation through negotiation and perhaps costly resurvey by the company. Potential impacts that can be mitigated will be relieved through Forest Service and Bureau of Land Management policies and regulations, construction stipulations (issued in conjunction with the Bureau of Land Management and Forest Service easements), State requirements, private landowner requirements, and through liaison and construction stipulation checks between the Federal agencies and Salt River Project. The following list of documents represents Federal requirements associated with transmission line construction. These documents show the degree to which environmental mitigation was accomplished for the Cholla Project which shares a dual corridor with Salt River Project through portions of the Apache-Sitgreaves and Tonto National Forests. All of the following are included in Appendices H-1 and H-2.

Construction stipulations for Cholla Project (Forest Service) based on an Environmental Detailed Coordinating Report that was done after the transmission line centerline was selected following issuance of the Final Environmental Statement.

The easement for right-of-way for electrical power transmission lines - Forest Service.

In addition to the above documents which guarantee that specific mitigation measures will be relieved, the following general measures can reduce potential adverse impacts of the transmission line on the environment.

1. Route Location

In order to obtain the best route possible, the Salt River Project retained Wirth Associates of Billings, Montana, landscape architects, to study and prepare an environmental report on the entire project. Wirth, in turn, utilized the services of consultants for advice on geology, soils, archeology, etcetera. By working with SRP engineers and designers, preferred routes and alternatives acceptable to both SRP and Wirth Associates were proposed. A Federal Study Team reviewed the proposed routes and alternatives. The team, in turn, proposed some alternatives. The following mitigation measures will be helpful in preserving the environment regardless of whether the proposed route or alternatives are selected:

a. Carefully locate this line to obtain compatibility with existing lines and corridors.

b. Maximize utilization of available space.

c. The quantity, type and space requirements for future transmission lines should be considered.

d. Use dual corridors wherever possible.

e. Consider use of helicopters in lieu of road construction on sensitive soils or where the presence of roads will be esthetically offensive.

f. Possible mitigation of the severe impact, associated with crossing of the Superior Airport interference zone, would be to parallel the existing SRP 115 kV line. This would, however, result in severe impacts to 37 residential units, a light industry, an equestrian area and a school.

2. Survey and Staking

a. Provide for the construction of two or more transmission lines in the same corridor wherever possible. This will require a total right-of-way width less than that required if transmission lines are constructed within separate corridors.

b. Conduct an archeological inventory along the selected route and proposed access roads to assure that archeologically valuable sites are avoided, preserved, or salvaged as required.

c. Use long spans and locate towers to avoid impacts on riparian vegetation and farmlands wherever possible.

d. Avoid sidehills, narrow ridges, and small hill-tops for tower sites.

e. Screen tower sites from view if possible.

f. Locate the line behind ridges, out of view from existing routes of travel. Where this cannot be accomplished, keep the towers and conductors beneath the skyline, against a backdrop of hills or ridges. If 230 and 500 kV EHV lines are located in Link 28, the lines should be "back dropper" against a ridge line named "Black Point".

g. Form line, color, and texture of structures (towers and conductors) should blend with the characteristic landscape. Use of non-specular conductor should be encouraged to reduce contrast.

h. Cross roads or highways between high points, at a dip, or on a curve in the road to avoid long views of the transmission line.

i. Pre- and post-location conferences should be held with the applicant to assure that the environment will be protected. All affected interests should be identified and appropriate measures agreed to accomodate these interests.

j. Confine the survey centerline to as narrow a clearing as possible, i.e., two feet, and utilize "offsets" to avoid undue damage to standing vegetation.

3. Access

a. Use existing access roads to the fullest extent possible. Strive to coordinate new access road construction with overall transportation planning.

b. Since roads will have one of the greatest impacts on the areas affected, an overall transportation system plan should be prepared showing:

(1) Existing roads to be used as is.

(2) Existing roads to be upgraded.

(3) Existing roads to be obliterated.

(4) Existing roads to be retained.

(5) New roads to be constructed and retained.

(6) New roads to be constructed and obliterated.

This plan should be approved in advance by the appropriate agency or landowner. It should be made a part of the agreement.

c. All additional access roads should be constructed to preserve natural beauty and minimize erosion, including following the contour of the land with smooth gradual curves to "fit" the terrain so that excessive cutting and filling is avoided and esthetic values protected.

d. Restrict vehicle travel to designated routes, thereby eliminating promiscuous cross-country travel.

e. Retain protective vegetative ground cover on temporary access roads. Where grading is necessary construct roads to a standard that will prevent damage to the soil resource.

f. Restore temporary roads to productive status by restoring the original contour of the land, draining, revegetating, and closing roads to vehicle use.

4. Clearing

a. Restrict the clearing of vegetation to that necessary for assembling and erecting towers and to provide required conductor clearance. Riparian vegetation will be disturbed only if unavoidable, and then only under the direct supervision of the land manager.

b. Trees less than 15 feet in height will not be removed from the right-of-way except as necessary for surveying purposes. Survey clearing will be minimal.

c. Right-of-way clearing in canyons spanned by the line will be minimal--limited to that required to maintain clearance with the conductor.

d. Utilize the services of a landscape architect to feather and undulate right-of-way clearing to achieve a more natural appearance.

e. Consider the opportunity to improve wildlife habitat when laying out tower site clearings.

f. The clearing and disposal of vegetation, including commercial timber, will be as directed by the appropriate agency or the landowners.

g. Require that trees and shrubs be cleared by hand, particularly on steep slopes and rocky areas when it will result in less overall soil disturbance to the site.

h. The Company will be required to notify the Arizona Commission of Agriculture and Horticulture at least 10 days prior to the removal or destruction of protected native plants. This notification is necessary to allow the Commission to arrange the setting aside or salvage of protected plants so they are not destroyed. A list of the protected plants is contained in Sec. 3-901 of the Law.

i. Hold clearing and grading of construction areas such as campsites, storage areas, pulling sites, and tower pads, etcetera to a minimum. When grading is necessary, minimize erosion hazards and retain the natural contour of the land.

j. Limit clearing of vegetation to: (1) within 17 feet of the conductors and only that vegetation needing to be removed for safety of construction personnel during tower erection and conductor tensioning and pulling, (2) cleared "paths" for surveying purposes to a maximum 2-foot width, and (3) that necessary for "pioneer" access roads.

k. After a finalized list of threatened and endangered plant species is published, the company will be required to perform

an inspection to identify threatened and endangered plant species (See Section III. B. 4) by a professional plant taxonomist. This inspection will be necessary on the approved links, access roads, and staging areas prior to construction. As there are no mitigating measures to protect threatened and endangered plants, other than by completely avoiding them, it is important that this inspection be accomplished as quickly as possible after the transmission centerline is established and the list of plants is finalized by the Bureau of Sport Fisheries and Wildlife.

5. Construction

a. Preconstruction conferences should be held following issuance of construction contract to insure guidelines and requirements of land manager are understood and implemented by the applicant.

b. When permitted, locate construction camp, batch plants, staging areas, and borrow pits in suitable areas designated for such use by the landowner or agency representative.

c. Utilize helicopter construction techniques if necessary to prevent the impact of conventional construction methods and increased access on fragile soils and unroaded areas.

d. Require all construction activities be conducted according to the Fire Plan approved by the respective agencies and landowners.

e. Use of nonspecular conductors and treated tower steel can be utilized to reduce the visual impact of the line, where the transmission line will not be a hazard to low flying aircraft.

f. To warn airmen during daylight hours of catenary obstructions more than 200 feet above ground, International orange colored spherical markers will be displayed on overhead wires as per standards described in FAA Advisory Circular 70/7460-2E, 7/5/73.

g. Use techniques that disturb a minimum amount of soil for installing tower footings, snubs, and grounding towers.

h. Use rubber-tired vehicles to transport structures, wire spools, and tensioner equipment to minimize damage along the right-of-way.

i. Provide seasonal drainage and closure of access roads when necessary to protect the soil from spring runoff.

j. Post construction conference should be held following a physical inspection to assure that the agreements have been completed; and, if not, what can be done to rectify any inconsistencies.

6. General

a. All applicable Federal, State, and local rules and regulations will be strictly adhered to.

b. Provide for prompt restoration and revegetation of disturbed soil.

c. Agencies and landowners provide adequate supervision to assure that terms of the various contractual documents are complied with.

d. Give close attention to final alignment, choice of materials, and methods of construction to minimize the impact upon natural beauty and the character of the land.

e. Wildlife habitat. Avoid high impact areas (productive habitat and sensitive vegetative types). Where encroachment is necessary, seed species of grasses, forbs, and browse known to be desirable for many species of wildlife. Avoid meadows and riparian bottoms.

f. Primary Wildlife Impacts and Mitigating Measures

(1) Removal of vegetation (habitat) - keep to an absolute minimum.

(2) Vegetative (habitat) type conversion - avoid critical and sensitive habitat areas. Use species of forbs, grasses, and browse known to be desirable to many species of wildlife when conversion is necessary.

Specific plant species to be used in different type conversion situations cannot be identified until the centerline, access roads, tower sites, batch plant sites, and staging areas are surveyed or located on the ground. Construction stipulations or easements with the respective private landowners will identify the specific reseeded species to be used based on the reseeding environment at each site.

(3) Stream siltation as a result of construction activity - limit amount of clearing in the riparian zone. Allow equipment access into the riparian zone only at "prepared" crossings where access has been provided for through construction of "low-water" crossings or bridging.

g. Secondary Wildlife Impacts and Mitigating Measures

(1) Increased access into areas that were inaccessible to vehicles before the powerline was constructed. This condition can be relieved by closure of construction access roads, if requested by the landowners.

(2) Concentration of livestock as reseeded areas which would reduce amount of feed available for wildlife. Can be mitigated by reseeding less palatable species, herding, and fencing water within 1 mile of the right-of-way.

E. Unavoidable Adverse Environmental Impacts

1. Air Quality

Vehicular traffic and construction equipment will create adverse sensory effects during construction. These will be in the form of noise, dust, and exhaust emissions. If construction slash is burned rather than chipped, smoke will cause degradation to air quality. Ozone will be generated. Dust created by removal of vegetation during construction, will continue to degrade air quality until revegetation has been accomplished.

Transmitting more electricity into the Phoenix and Eastern Mining areas will increase air pollution through accretive urban and industrial growth.

Increased tourism, the building of adult retirement communities around the city, increased freeway development, multiplication of electronics manufacturing plants, and expanded air travel will intensify problems of environmental pollution in Phoenix.

2. Sociological

Unlike new residential communities of the Salt River Valley where water and sewage systems are adequately planned and constructed, the present systems at St. Johns are inadequate to serve an increase in population. School systems in all of the smaller communities are too small to handle any sizeable influx of new students as may be forthcoming with temporary construction workers.

It is possible that potential conflicts may arise due to ethnic or age differences between construction workers and townspeople within the small communities adjacent to the line. Generally speaking, the small towns along the north end of the line (St. Johns, Snowflake, Hunt, and Heber) contain more Anglos and fewer Spanish-Americans than the state as a whole. This same ratio applies to the towns of Tempe, Mesa, Gilbert, and Chandler on the southern end of the line. A reverse ratio of more Spanish-Americans than Anglos occurs in the villages of Concho on the north end of the line and Superior on the south end of the line. Blacks are under-represented in the region's population.

In general, area facilities, service, transportation, education, and utilities within the 230 kV EMA area are capable of expanding to meet the anticipated demands with no unusual problems. Also, no substantive change in demographic characteristics are envisioned as a result of the mine expansion or transmission line construction.

Social inconveniences associated with the construction of the transmission line may occur at brief intervals when lack of water may interrupt dust controls, when erosion occurs before revegetation is successful, or during the brief construction period when production of crops is temporarily suspended from approximately 150 acres of irrigated farm lands in the Phoenix area.

Because of the tremendous rate of growth, Phoenix and its surrounding cities have shared a number of problems: pollution; lack of open space for recreation; and poor transportation. Work on most of these problems has been continuous since the late 1950's. Some success has occurred, but some failure has slowed down ultimate solutions.

Within the Phoenix area, aesthetics vary greatly. In some locales, attention is given to conservation of indigenous vegetation, control of outside advertising, and architectural design standards. In others, standards are nonexistent. The sharp distinction in quality of different neighborhoods increases pollution and transportation problems, because it encourages greater suburbanization. Those who work in Phoenix may have to commute long distances to find quality areas in which to live. 1/

3. Natural Beauty

The primary environmental impact of a transmission line is visual. It presents a major intrusion into otherwise natural landscapes regardless of the number of mitigating measures applied.

"Skylining" the transmission line, encroachment upon scenic drives, the presence of construction access roads on steep sidehills, recreation areas, subdivisions, and areas relatively undisturbed by man, along with required clearing of the right-of-way in forested areas, are severe visual impacts.

The powerline route passes through or adjacent to several sparsely developed subdivisions in the area between St. Johns and Wildcat Canyon and a more fully developed site at Queen Creek Estates below Whitlow Dam. The impact of the transmission line to the people in these developments could be significant because of their desire to be living in the "wide open spaces" free from the impacts of urban reminders such as powerlines.

It is recognized that transmission lines may be somewhat objectionable to the 2,350 residential units within two miles of the selected route through established communities in the Phoenix area.

Short-term visual impacts such as smoke, dust, and heavy equipment will be present during construction activity. Disturbed soil and vegetation will present an impact of somewhat longer duration.

1/ Environmental Impact Study for the Bureau of Land Management, "The Kaiparowits Project and Its Impact and Growth in the Arizona and California Service Areas." by Dr. Alan J. Wyner, Dr. Robert Welsh, Dr. John Grehl, University of California at Santa Barbara and Dr. Keith Pearson and Mr. S. Craig Whitney of the Northern Arizona University, September 21, 1974.

4. Vegetation

Approximately 24 acres of vegetation per mile of 500 kV line will be affected in the pinyon-juniper woodland and oak woodland vegetation types. About three acres per mile of 500 kV line will be disturbed in the lower grassland and shrub types. Between 7 to 11 acres of vegetation per mile will be affected during the 230 kV EMA transmission line construction.

Impacts upon plant communities will be the most detrimental in those few areas where relatively undisturbed climax vegetation still occurs. Changes in microclimate resulting from reduced overstory vegetation will favor plants having a more xeric tolerance, and the present flora. These plants will increase in abundance at the expense of those requiring a cooler, moist environment.

Pinyon-juniper and oak stands crossed by transmission lines and associated access roads will be reduced in size which will result in a smaller net volume of fuel wood available to the public on a sustained yield basis. No commercial timber occurs on the Salt River Project Coronado Station line outside the dual corridor.

5. Water

Water will be polluted during construction activities. Heavy use of dirt roads, staging areas, and "batch" plants will generate thick layers of dust which, in some cases, will be washed into streams, tanks, and lakes when the first heavy rain occurs. Tower sites, to a lesser extent, will produce a similar effect.

Concurrent with deterioration in air quality has been the problem of water supplies and sewage treatment facilities. The Salt River Project is constantly striving to meet water demands of Phoenix area residents; and, to date, the project has been most successful. Sewage treatment facilities have also been expanded to meet increasing needs.

6. Wildlife

Wildlife habitats will be affected by the construction of this line. The only way to avoid any of the impacts listed (see Section III.C.6) for this renewable resource would be to not build the line. There is no way a line can be built for a distance of 175 to 190 miles 1/ through such a diversity of habitats without all the impacts listed occurring. The mitigation measures will lessen the degree of impact, but in no instance completely eliminate them. The preferred route and alternate routes all can be expected to have the listed impacts.

1/ Includes 230 kV EMA proposal.

7. Cultural Resources

Although archeological knowledge may be opened up to new discoveries made possible by surveys due to the construction of the transmission line, some loss of scientific information may result in spite of plans to conduct salvage operation or to avoid disturbance of sites through rerouting the access roads or transmission. This possible loss of scientific information may also result from increased access construction roads, and degradation of the natural setting in which they are located.

8. Minerals

Location of the transmission line or substations on mineral ore bodies will result in some towers or substations having to be moved when the minerals are exploited.

9. Soils

Soils along much of the preferred route have low to moderate erodibility with isolated areas of highly erodible soils, which are usually related to sections of more rugged terrain.

The amount of accelerated soil movement from these soils is directly correlated with the degree of disturbance to protective ground cover and the time frame necessary to revegetate the site, either artificially or naturally.

Road construction involving horizontal cuts into steeply, sloping sidehills has the most severe impact on the soils resource. Improperly drained roads constructed on moderate to steep grades also contribute to significant soil loss.

Use of heavy construction equipment can result in soil compaction. This compaction can be minimized by ripping compacted areas upon completion of construction.

Roads, either existing or constructed, will be necessary every 17,000 feet regardless of construction techniques to provide access for heavy equipment to pull and tension the line. Considerable clearing and leveling will be necessary where tower and pulling sites occur on steep slopes to provide a level working surface to cranes and pulling equipment.

In general, slight to moderate impact is expected on the soil resources in areas of level to gently rolling terrain. Moderate to severe impact can be expected on sensitive units, steep terrain, and areas of unconsolidated alluvium which may be affected by seasonal runoff if conventional construction methods are used to erect self-supporting steel lattice towers.

10. Wilderness

No unavoidable adverse environmental impacts are anticipated.

11. Forage

Forage production will be adversely affected temporarily at tower and pulling sites. Access road construction could create impacts of a more long-term nature. The maximum acreage of disturbance to existing vegetation is estimated at 1,920 acres for the 500 kV line and 415 acres for the 230 kV line. Current livestock stocking rates along the proposed route vary from 7-25 acres per animal unit month. In addition, much of the land along the route has no grazing capacity due to rough terrain or lack of vegetative cover. An animal unit month of livestock forage has an estimated value of $14.86 to the regional economy. At an average stocking rate of 16 acres per AUM, a maximum annual forage value of $1,783 would be lost on the 500 kV line and $881 on the 230 kV EMA line based on 7 acres/AUM acreage stocking route. A significant reduction in the land's capacity to support livestock and wildlife grazing is not anticipated due to the minor reduction in forage produced.

Livestock concentrations trailing along rehabilitated right-of-way and access roads, resulting from the animal seeking highly palatable seeded vegetation, can largely negate rehabilitation efforts.

Increased public access can result in gates being left open and a general disturbance of both livestock and wildlife. Vandalism of the range improvements such as water troughs may also increase where access is not controlled.

12. Outdoor Recreation

Adverse impacts on recreation activities will occur during both construction and operation stages. Construction stage effects are short lived but more intense. During construction, effects on recreation pursuits such as hunting and sight-seeing in the vicinity of the line may be locally considerable but of short duration.

The primary impact of the line on recreation activities will be visual and will occur after the line is in place.

13. Transporation

Travelers on highways and roads near the route will be inconvenienced occasionally by construction equipment. Conflicts between construction equipment, and other traffic are anticipated.

14. Other Land Uses

The westernmost 15 miles of the 500 kV Coronado Station line, prior to reaching the Kyrene Substation crosses irrigated agricultural land. However, much of this line lies within the right-of-way for the Western Canal; therefore, although the line will be highly visible, it will not have a significant effect on other land uses. Further, presently unplanned land uses will undoubtedly be affected by the presence of the line throughout its length.

Route A would cross the Superior Airport interference zone and existing land uses associated with the town of Superior and Route I would cross a number of residential and planned land uses surrounding Kearny, depending on final line location.

15. Economics

No unavoidable adverse environmental impacts are anticipated.

16. Fire Management

The risk of wildfire occurrence will increase during construction activities due to the presence of men and equipment. The presence of a "charged" powerline, when in service, will also add to the fire risk.

Fire suppression activities will be adversely affected in that the line poses a hazard to low flying aircraft. The possibility of electrical arc's endangering firefighters is present.

F. Relationship Between Local Short-Term Uses of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity

A short-term disturbance of the environment during the life of the project will result from construction activities. Temporary disruption of wildlife activities and soil disturbance are primary impacts which will be largely negated soon after construction is complete.

There would be an estimated 567 towers on the 500 kV line (outside of the dual corridor with APS's Cholla line). They will occupy from 15-20 acres of land depending upon the tower design used. Depending on the final route selected, there will be between 90 and 140 towers constructed on the 230 kV EMA proposal, occupying from three to five acres of land depending upon tower design used. Few additional access roads are anticipated, due to the presence of existing roads over much of the route. The alternative of using helicopter construction techniques in presently unroaded areas will also keep land disturbance to a minimum. Road restoration measures provide for returning those road used during construction needed, to productive use.

The effect of the line on water production and water quality will be minimal. Proper construction methods and rehabilitation measures can prevent any significant reduction in water quality.

Long-term productivity of the land will not be appreciably affected during the life of the facility, and no future uses will be excluded. Electrical services to users will be of a long-term economic, social benefit, however, the long term productivity of the visual resources will be appreciably affected during the life of the facilities.

Kennecott Copper Company announced at the public hearing held in Kearny, Arizona, on February 24, 1977, that production from their Ray Mines division could be expected to double as a result of the increased availability of power from the Coronado Project. This increase in production, while providing an increasing stimulant to the economy, will also cause increased deterioration of the air quality over the mining area as well as any areas downwind. Doubling the exploitation rate will cause the mining area of pits, spoil piles and tailing ponds to increase.

G. Irreversible and Irretrievable Commitment of Resources

Other than some loss of cultural resources, no irreversible and irretrievable commitments of resources are anticipated other than those discussed below. While EHV transmission lines require fairly long-term commitments of land, the inherent productivity and usefulness of the land is not beyond retrieval should it be desired at some time in the future.

Impacts upon the natural beauty of the landscape, particularly in the desert, can be long lasting if construction activities are not closely controlled. Areas stripped of soil mantle and excavations in rock outcrops are difficult to restore in arid climates. Further, the natural weathering process is very slow. Even at best, the recovery period necessary for a power corridor to return to its predisturbed condition is in terms of decades.

Resources used in the actual construction of the line are largely retrievable in the form of salvage. Fuel and lubricant consumed by motorized equipment and the energies of man spent constructing the line are lost to any alternative uses.

Electricity only has value while it is being used. However, in some instances electrical energy can be retrieved through such systems as pumped storage. Under the concept of pumped storage, a portion of the electrical energy required to lift the water to the storage area will be lost forever. The remaining energy is recalled during peak use periods making it more valuable thus supporting the economic feasibility of the concept.

Commercial timber land that must be removed from the R/W within the dual corridor portion of the project will be lost to the public as long as the transmission line remains in place.

H. Alternatives to the Proposed Action

1. Power Transmission Alternatives

a. Use of Existing Transmission Lines

The first of three 350 MW generating units (called the Coronado Station Generating Station) is scheduled to begin operation in April of 1979. There are no existing powerlines in the vicinity of the proposed Coronado Station site that are large enough to transmit 1,050 MW of power.

Another alternative might be to build a 500 kV line from the Coronado Station either east to the existing 345 kV San Juan-Vail line (TG&E) or west to either the twin 345 kV Cholla lines or the new 500 kV Cholla line, currently under construction. Once any of these lines were reached, a switching station would be constructed, and Coronado Station power "switched" into the other line. This alternative was rejected after it was determined from the system studied that there is insufficient transmission capacity in the existing transmission systems to carry the full Coronado Station Generating Plant output and meet the Western Systems Coordinating Council reliability criteria. A new transmission line is required from the plant (Coronado Station) to the Phoenix area and use of existing facilities is also required to meet transmission system backup requirements.

b. Alternative System Configurations

Several system alternatives as well as different transmission voltages were considered in the development of the Coronado Station Project Transmission System. The transmission voltage of 500 kV was selected because proposed and future EHV lines in Arizona are presently being planned at 500 kV and the selection of this voltage will accomodate interconnection with other transmission systems. Voltages higher than 500 kV are not economically feasible for a project of this scope, at this point in time. The higher voltages would not eliminate any transmission lines. Lower voltage transmission lines would require more transmission lines resulting in higher environmental impacts.

Five alternative schemes were considered for the 500 kV transmission primary system. Each scheme would provide a means for delivering electric power energy from the Coronado Station to the Phoenix area with a backup system in the event of maintenance or failure of the primary system. The five schemes are described below:

(1) Alternative T-1 (proposed system)

(a) Primary System - One 500 kV transmission line from the Coronado Station to the Kyrene Receiving Station. (Phoenix Load Center)

(b) Backup System - One 500 kV transmission line from the Coronado Station to APS's Cholla 500 kV Switching Station (At the Cholla Generating Plant).

(2) Alternative T-2

(a) Primary System - One 500 kV transmission line from the Coronado Station to the Kyrene Receiving Station.

(b) Backup System - Two 500 kV transmission lines from the Coronado Station to TG&E's San Juan-Vail transmission system resulting in an electrical interconnection between the Coronado Station and the San Juan Generating Station and the Vail Station (Tucson).

(3) Alternative T-3

(a) Primary System - One 500 kV transmission line from the Coronado Station to the Kyrene Receiving Station.

(b) Backup System - One 500 kV transmission line from the Coronado Station to the APS Cholla 500 kV switching Station. Two 500 kV transmission lines from the Coronado Station to the TG&E San Juan-Vail transmission system resulting in an electrical interconnection between the Coronado Station and the San Juan Generating Station and the Vail Station.

(4) Alternative T-4

Primary/Backup System - Two 500 kV transmission lines from the Coronado Station to APS's Cholla 500 kV switching Station. Rebuild the Cholla-Pinnacle Peak 345 kV lines to 500 kV.

(5) Alternative T-5

Primary/Backup System - Two 500 kV transmission lines from the Coronado Station to the Kyrene Receiving Station.

After preliminary study only the first three alternatives were considered as viable options.

Alternative T-4 was not selected due to the impossibility of constructing the lines within the necessary time frame (1979 - in - service date of first 350 MW unit at Coronado Station). Construction time would be approximately four winter seasons. Rebuilding of the Cholla- Pinnacle Peak Twin 345 kV lines would have to begin after the 500 kV ChollaSaguaro line, now under construction, goes into service in 1978. Additionally, the power from Coronado Station is needed to service the loads in Salt River Project's southeastern service area (southeast of the towns of Tempe, Mesa, Chandler, and Gilbert) and the new projected "doubled" load in SRP's eastern mining area. Consequently, bringing all of the Coronado Station power into the Pinnacle Peak Switching Station (northwest of the McDowell Mountains and northeast of metropolitan Phoenix and Paradise Valley) would lead to considerable transmission line construction between Pinnacle Peak and the southeastern part of the Salt River Project's service territory.

Alternative T-5, while technically feasible, was also deleted due to its significantly greater environmental impact than Alternatives T-1, T-2, or T-3. It would also be much more expensive to construct.

The remaining alternatives, T-1, T-2, and T-3 were being studied jointly with Arizona Public Service and the Tucson Gas and Electric. All three options were evaluated in terms of the internal Salt River Project systems standards and those prescribed by Western Systems Coordinating Council. The company contends that T-3 (a combination of T-1 and T-2) is the most desirable option; however, it is also the most expensive. Because of the expense involved, the Company proposed to construct either T-1 or T-2 depending on the outcome of negotiations with Arizona Public Service Company and Tucson Gas and Electric Company.

The Salt River Project has signed a Letter of Intent with Arizona Public Service Co., that states that SRP intends to interconnect as a backup system, the Coronado Station Generating Plant 500 kV system with the Cholla (APS) Generating Plant. This Letter of Intent was signed in advance of the plant and transmission construction as the company had to have a guaranteed backup interconnection before it could proceed with the timely construction of the power plant.

The Company received a Certificate of Environmental Compatibility on November 12, 1974, from the State of Arizona Powerplant and Transmission Line Siting Committee to build either Alternative T-1 or T-2.

Several system alternatives as well as different transmission voltages were considered in the development of the Silver King to Hayden transmission system. The transmission voltage of 230 kV was selected because proposed and future loads in the area are such that a lower voltage transmission line could not economically carry the load. Voltages higher than 230 kV are not economically feasible for a project of this size at this point in time and would not eliminate any lines.

c. Construction of a Direct Current System

The Direct Current System for transmission of power was considered as an alternative to the proposed alternating current system. However, it was learned upon further investigation that Direct Current Systems are not as economical to construct as Alternating Current Systems, for distances under 300 miles, due to the higher costs of constructing converter and inverter stations. If a direct current line were installed, converter and inverter systems would be needed both at the Coronado Generating Station and the proposed Silver King 500 kV substation site near Oak Flat. The cost of terminal facilities (converters and inverters) is extremely expensive. The cost of one 1000 kV D.C. converter presently being planned by the U. S. Bureau of Reclamation, to be placed at Phoenix, Arizona is conservatively estimated at $105 million dollars, a single 1000 kV D. C. line would handle the same voltage as two 500 kV lines. A 1971 study of lower Colorado Region electric power requirements by the Bureau of Reclamation showed that the economics of recent high voltage direct current projects show A.C.- D.C. "break-even" distances as low as 325 miles--roughly 30 percent shorter than break-even distances commonly talked about in 1965.

The Bureau of Reclamation believe this "break-even" distance has not changed since this report was published; therefore, since transmission lines proposed to carry power from the Coronado Generating Station to the Kyrene substation are 240 miles (without backup interconnection), power can be transmitted more economically via A.C. lines rather than D.C.

A direct current system for transmission of power to the EMA was not seriously considered as an alternative to the proposed alternating current system. Direct current systems are not as economically constructed as alternating current systems for distances under 400 miles due to the higher costs of constructing converter and inverter stations. If a direct current line were installed, converter and inverter systems would be needed at the proposed Silver King and Hayden receiving stations. The cost of terminal facilities (converters and inverters) is extremely expensive.

The advantages of a direct current transmission system over an alternating circuit system are:

(1) Less line loss - alternating current-3 phase-direct current-2 poles

(2) Smaller, less expensive towers.

One of the principal disadvantages of D.C. lines is that an economical backup system is not available. Therefore, if the line should ever be disabled, no alternative line is available to transmit the power to the load center.

d. Construction of New Transmission Lines Underground

Although theoretically feasible from a technical standpoint, constructing a line of this voltage and length underground is not considered to be a reasonable alternative. Although there is one short kV underground line currently in the planning stages, presently there are no 500 kV underground lines in this country. It is believed that impacts on the environment will be far greater for an underground system than for an overhead line. An underground line require a cleared right-of-way with a continuous trench for the length of the line. The conductor would then be buried in an oilfilled pipeline. The facility could be compared to several large pipeline installations presently found in the Southwest. It is estimated that the cost of a 500 kV underground line would be from 25 to 28 times the cost of the conventional overhead 500 kV line. The Southwest Energy Study concluded that there is no practical substitute at present for overhead lines in long distance transmission of electrical energy.

It is estimated that the cost of a 230 kV underground line would be 15 to 20 times the cost of the conventional overhead 230 kV line.

e. No Transmission Line Construction

This alternative suggests that power could be supplied by some other means or that the demand could be held at the present level. The power available from this project will be used to meet anticipated electrical demand and is not designed to increase the expected demand. Salt River Project has ceased all advertising which could lead to higher peak demands on the system and, in addition, is advising its customers on the efficient use and conservation of energy. If no new transmission lines were constructed, there would be no way to transmit the power generated at the Coronado Station to the Phoenix load area. Delivering power and energy without use of transmission lines, using theoretical, undeveloped devices such as a laser transmission system or a microware transmission system is not economically or engineeringly feasible at this time.

2. Alternative Method of Conductor Stringing and Tower Placement

a. Company Proposal - Conventional Placement of Self - Supporting Steel Towers

The Company proposes that the Coronado Station Project Transmission System be constructed using self-supporting lattice steel towers in outlying desert and forested areas, and steel pole structures from near the crossing of the U. S. Bureau of Reclamation Mesa-Coolidge 230 kV line east of Mesa to the Kyrene Receiving Station. For the Silver King to Hayden transmission line, the company proposes using self-supporting, double circuit, lattice steel towers in outlying areas. Double circuit steel pole structures will be used if it is necessary to go through the towns of Superior, Kelvin-Riverside and Kearny. Salt River Project also proposes that conventional construction methods be used except where terrain or economy permits; helicopters will be used in specified areas to erect towers or to pull the "sock lines" or light pulling lines into position prior to pulling the heavier conductors. Pulling the sock lines by helicopter will minimize the need to move equipment from tower to tower down the center of each line. Conventional construction methods entail building a road of sufficiently high standard to allow passage of lowboys loaded with tower steel; cranes large enough to erect 11 ton, 130-foot towers (9 ton, 120-foot towers for 230 kV); and cement trucks used to pour tower foundations. This road is generally built within the right-of-way of the powerline between each tower site.

b. Placement of Towers and Conductor Stringing by Helicopter Alternative

During the last decade, a number of utility companies have constructed transmission lines without conventional access roads and with few areas of ingress. Helicopters have been utilized in the skidding of right-of-way clearing debris, transportation of the drill rigs, men, equipment, and concrete to the tower sites. Tower erection and line stringing have also been accomplished with helicopters. The only phase of line construction that has not utilized helicopters extensively is the "tensioning" and "pulling" of the line. The recent development of larger helicopters such as the Sikorsky S-64 Skycrane capable of lifting 11 tons at sea level, has resulted in helicopter construction becoming competitive with conventional line construction techniques. Tower design and types of construction equipment have changed to fit the needs of this type of construction.

At present, the Sikorsky S-64 Skycrane is the largest helicopter available for transmission line construction. It has a payload of 22,000 pounds at sea level and 15,000 pounds at 7,000 feet elevation. When so designed, towers can be transported, assembled, and erected by the Skycrane. Industry is currently working on tower designs involving multi- stage assembly and the use of guide plates which do not require workmen beneath a hovering helicopter during multi-stage assembly--a hazardous procedure.

Aluminum towers have recently come into use by utility companies. While aluminum structures are more expensive than steel for identical design, industry has designed towers specifically for helicopter transit and erection.

Tucson Gas and Electric Company has recently completed a 345 kV powerline from the San Juan Generating Station to Vail (Tucson) using delta "guyed" towers placed on line by the S-64 Skycrane helicopter. This line was constructed in topography that is as rugged as that proposed to be crossed by the Salt River Project Coronado Station line.

Bonneville Power Authority has recently completed a 200 mile double-circuit 500 kV transmission line in Oregon by means of helicopter construction.

The economics and environmental impacts of transmission line construction by helicopter can be evaluated only in its true perspective by comparing not just the construction costs, but environmental damage incurred by constructing access roads into tower sites located in steep topography and on unstable soils. Time and salaries saved by transporting men and equipment to remote portions of the proposed line is another important consideration in determing the feasibility of helicopter construction.

3. Alternative Types of Towers That Could Be Used

a. Wooden or Steel Poles

(1) Single Circuit System - Either 500 or 230 kV or Combination

Section I.J.1 of this statement describes two types of 500 kV steel pole structures that are proposed for portions of the Coronado transmission system. While steel poles occupy less surface area than lattice towers, they must be constructed closer together due to the limitations imposed by conductor ground clearances. This can result in up to twice as many steel poles per mile as lattice towers, making steel pole construction more costly and negating the benefits of the smaller tower base. Thus, steel pole construction is only desirable in areas where they provide a better visual blend than lattice towers, and where surface disturbance and cost are not major factors.

Single circuit 230 kV transmission lines can be constructed on wood pole structures. A separate set of wood pole structures is required for each circuit.

(2) Delta Guyed Tower

The "guyed delta tower" has been used successfully by the Tucson Gas and Electric Company in its 345 kV San Juan-Vail line. Towers of this design require a minimum of four guy wires for support. Guy wire anchors are spaced approximately 125 feet apart on level terrain; guyed towers are limited to terrain with less than 40 percent slope to facilitate anchoring the guy wires. Since portions of all of the routes studied cross steep, mountainous country, some self-supporting towers would be required in addition to guyed towers. Concern has been expressed by some utility companies over the reliability of towers dependent upon guys for support.

The guyed delta tower (Figure III-6) has been used successfully by other utility companies for 500 kV transmission lines.

b. Double-circuit (Metal), Self-supporting Lattice Steel Tower Alternative

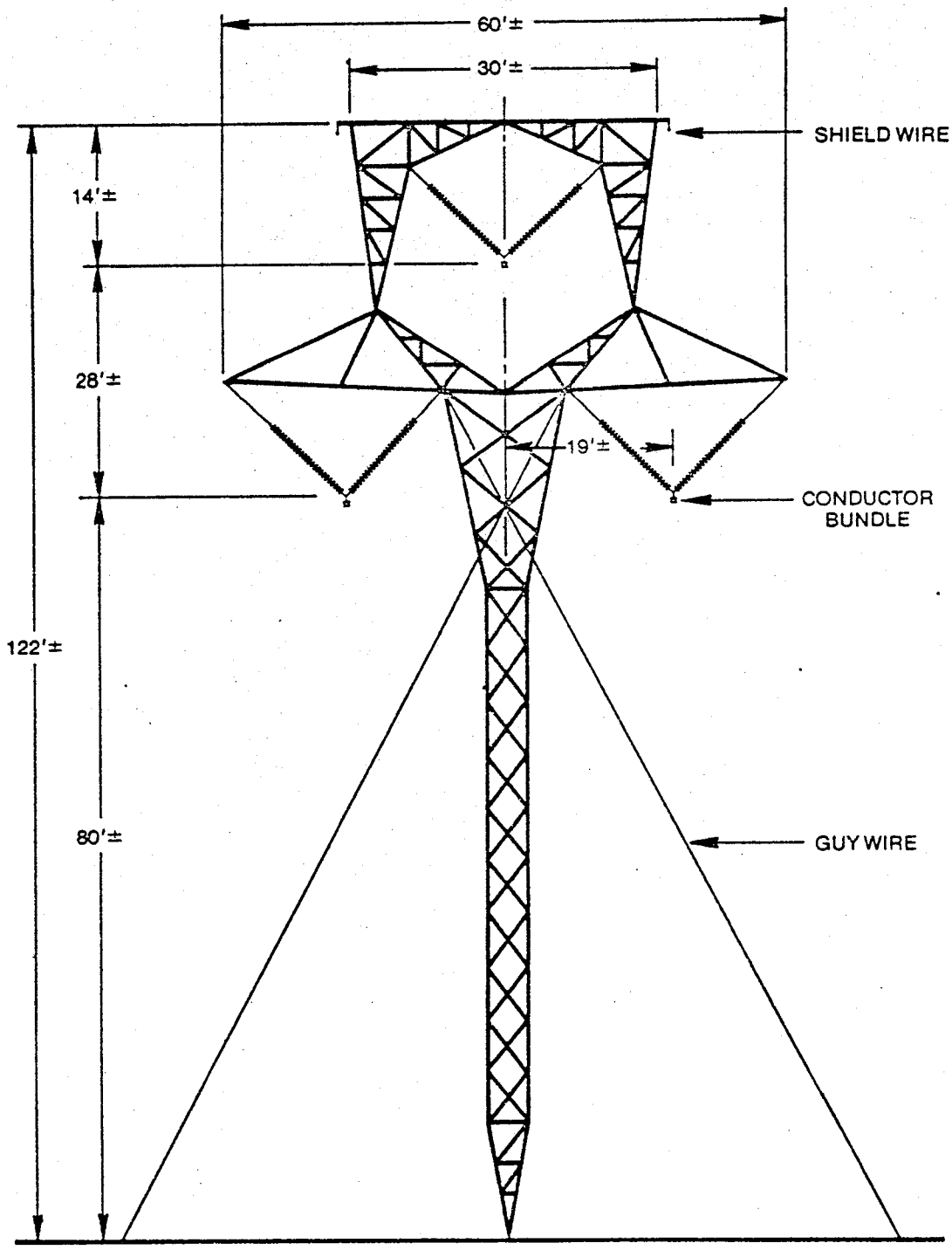
Two double-circuit towers are diagramed in Figure III-7. In addition to the visual and physical impact of towers of this size, construction equipment would have to be considerably larger than required for a 500 kV line, resulting in greater environmental disturbance. System realiability would be significantly reduced over that provided by separate lines in that the loss of two 500 kV lines due to a tower, conductor, or static wire failure would interrupt 1050 MW of capacity or 10 percent of the projected 1984 Arizona load. Construction costs of a double-circuit line would most likely exceed two times the cost of a single-circuit line due to the amount of steel in the towers and the heavy construction equipment needed.

A comparison of tower designs is shown in Table III-11.

TABLE III-11

TOWER DESIGN COMPARISON

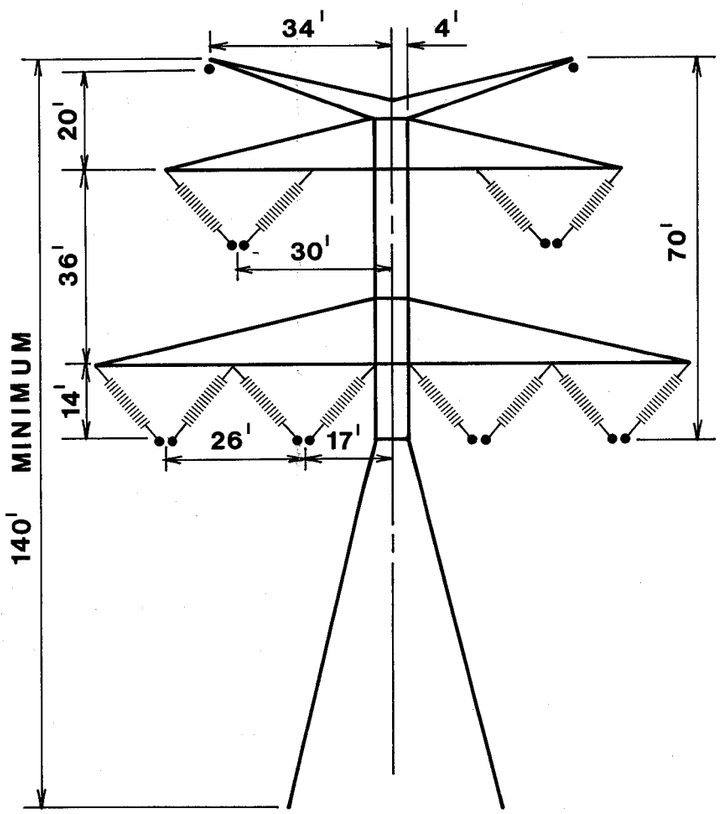
Item	500 kV Self-Supporting	500 kV Guyed Delta	500 kV Double Circuit
Design	On Hand	Needed	Needed
Aug. Height	130'	122'	170'-180'
Aug. Width	96'	60'	80'-120'
Aug. Weight	22,000#	18,000#	58,000#-70,000#
Towers/Mile	3.2	5	3.1-3.5
Tower Base	34'x34' to 39'x39'	3'x3' + guys	40'x40'
Foundation Area	4x9 sq ft = 36 sq ft	10 sq ft incl. anchors	4x16 sq ft = 64 sq ft
Right-of-Way	200'	200'	250'-300'
Visibility	Intermediate Mass	Minimum Mass	Extreme Mass
Est. Cost/Mile	$136,000	$126,000	$250,000+



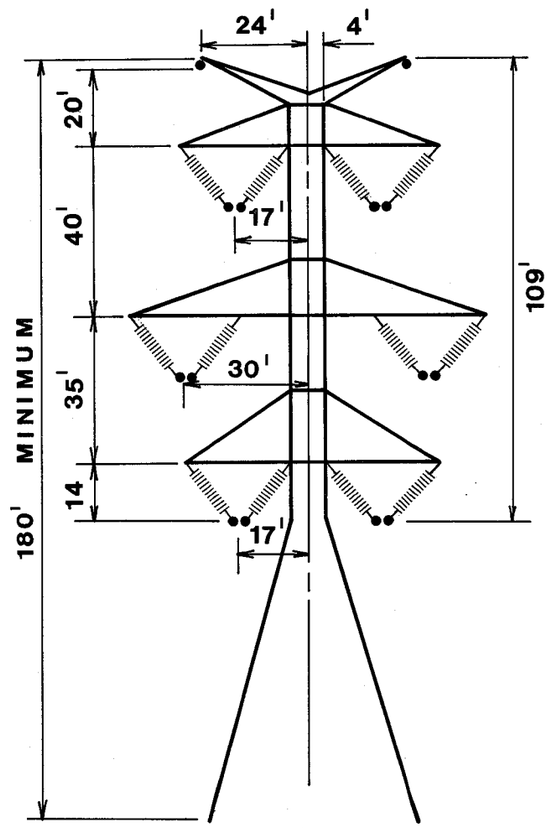
SCHEMATIC OF TYPICAL GUYED DELTA TOWER

Figure III-6

500 kV
DOUBLE-CIRCUIT DESIGNS



DELTA TOWER



VERTICAL TOWER

CORONADO PROJECT

Transmission System

500 kV

STEEL TOWER DESIGNS

Figure III-7

4. Link (Route) Alternatives

The proposed 500 kV transmission system has been discussed in Sections B, C, D, E, F, and G of this chapter (Chapter III). The location of the proposed 500 kV links are indicated in Figure I-1, and the large Coronado Station Project Transmission System map enclosed inside the back cover.

A detailed description of these links is contained in the Wirth Associates Reports entitled: "Environmental Report Arizona Station Project Volume III Transmission System", "Coronado Project Transmission System Environmental Report - Addendum A", and "Volume A and B Coronado Station Background Data". All of the above documents may be examined at the following locations:

Apache-Sitgreaves National Forest
P.O. Box 640
Springerville, Arizona 85938

Bureau of Land Management
2929 West Clarendon
Phoenix, Arizona 85009

Bureau of Reclamation
Lower Colorado Regional Office
P.O. Box 427
Boulder City, Nevada 89005

Salt River Project
Environmental Division
P.O. Box 1980
Phoenix, Arizona 85001

Tonto National Forest
102 S. 28th Street
P.O. Box 13705
Phoenix, Arizona 85002

U.S. Forest Service
Region 3
517 Gold Ave. S.W.
Alburquerque, New Mexico 87102

In the northern portion of the 500 kV system the Federal Study Team identified two systems as being alternatives to the proposed Links 42, 41 and 11B, and Link 03 as an alternative to Link 04. The systems identified by the Federal Study Team are described below and are evaluated with the proponents proposal in Tables III-12 and III-13.

TABLE III-12

Landownership Percentages - Alternative Links

Jurisdiction	Backup System Link 01 %	Backup System Link 02 %	Primary System Links 6B, 14 & 11 %	Primary System Links 6B, 15 & 16 %
Private	70	47	41	40
State	5	35	17	22
Bureau of Land Management	25	18	27	22
National Forest	0	0	15	16
TOTAL MILES	19	17	34	30

TABLE III-13

EVALUATION OF STUDY TEAM ALTERNATIVES TO THE COMPANY PROPOSAL
(PRIMARY TRANSMISSION LINE (NORTHERN) AND BACKUP INTERCONNECTION)

	Primary Transmission Line Northern Alternatives					Backup Interconnection		
	Links 6B, 15 & 16 (Path C)	Study Team Alternative Links 6B,11, & 14 (Path B)	Proposed Links 11B, 41 & 42 (Path A)	Link 03	Link 04	Proposed Links 4,5, & 8(Cholla Plant)	Link 2 (to TG&E Line)	Study Team Alternative Link 1 (to TG&E Line)
1. Total length of line (miles)	30.3	33.9[1/]	29.8	31.2	28.2	76.3	33.8	38.0
2. Present road access Planned (not existing) (mi.)	15.6	10.6	12.0	6.1	-	10.5	31.8	17.8
Road Condition								
Fair	-	-	3	-	-	2.9	-	7.8
Poor	6.2	1.0	9	25.1	28.2	61.8	2.0	12.4
Good	3.2	17.6	3.6	-	-	1.1	-	-
3. Physiography - flat to less than 10% mi.	20.0	27.0	22.6	31.2	28.2	76.3	33.8	38.0
Irregular (broken)	10.3	6.9	7.6	-	-	-	-	-
4. No. of drainages crossed	7	6	10	16	15	38	6	24
5. Soils & Geology Erosion potential	mod.to high	low to mod.	moderate	low to mod.		low	low	low
Reveg. potential	moderate	moderate	moderate	moderate	moderate	low	low	moderate

TABLE III-13 (Con't.)

	Primary Transmission Line Northern Alternatives					Backup Interconnections		
	Links 6B, 15 & 16 (Path C)	Study Team Alternative Links 6B,11, & 14(Path B)	Proposed Links 11B, 41 & 42 (Path A)	Link 03	Link 04	Proposed Links 4,5, & 8 (Cholla Plant)	Link 2 (to TG&E Line)	Study Team Alternative Link 1 (to TG&E Line)
6. Ecology								
Grasslands	12.4	18.8	11	26.0	11.2	41.3	10.0	12.0
Pinyon-Juniper	17.9	15.1	18.8	5.2	15.3	35.0	24.0	26.0
Riparian Community Crossed	5	4	7	9	13	35	4	8
Palo-Verde-Saguaro Cactii	-	-	-	-	-	-	-	-
Chaparral	-	-	-	-	-	-	-	-
7. Visual Landscape Character	average	average	average	above avge.3.0 average 28.2	above avge. 8.0 average 25.2	average 33.8 mi.	above avg. 25 mi. avg. 13 mi.	above avg. 25 mi. average 13 mi.
8. Current Land Use	Undeveloped rangeland, important as elk winter range	Rangeland 2 mi. across undeveloped subdivision	Rangeland 3 mi. adjacent to partially developed subdivision	Rangeland subdivision w/ some development close to airstrip	Rangeland	All undev. range except 10 mi. that pass 20 scattered residences in subdivision	Undeveloped rangeland	Undeveloped rangeland
9. Planned Land Use	10 mi. of Apache-Sitgreaves N.F. Forest Land Use Mgmt. Plan 5-W-4	Within power line corridor along with Cholla line on A-S N.F. Land use Plan	7 mi. of A-S N.F.'s Land Use Plan Mgmt. Unit 5-W-4	Rangeland	Rangeland	2/	Rangeland	Rangeland

TABLE III-13 (Con't.)

	Primary Transmission Line Northern Alternatives					Backup Interconnections		
	Links 6B, 15 & 16 (~~Path C~~)	Study Team Alternative Links 6B,11, & 14 (Path B)	Proposed Links 11B, 41 & 42 (Path A)	Link 03	Link 04	Proposed Links 4,5, & 8 (Cholla Plant)	Link 2 (to TG&E Line)	Study Team Alternative Link 1 (to TG&E Line)
10. Highway Influence	Crosses St. hwy. 377 & parallels it for 5 miles	Crosses St. Hwy. 377 once	Crosses St. Hwy, 377 once.	Crosses U.S. Hwys. 180 & 666 once	Crosses U.S. Hwys. 180 & 666 once	3/	none	none
11. Archeology and Historic	Within 2 miles of Zeniff site							
High Density (Mi)	0	0	0	0	0	Approaches the Hash Knife Ranch Hdqtrs.	2	0
Moderate (mi)	25.1	13.0	16.3	31.2	28.2	72.3	32	38
Low (mi)	5.2	20.9	13.5	-	-	4.0	0	0
12. Vegetation Disturbance	10 mi. of mod.to hvy. density Pinyon-Juniper	4.6 mi. of mod.density Pinyon-Juniper.	14 mi.mod. to lt.density Pinyon Juniper	27 mi.of high to mod. density Pinyon Juniper	18 mi.of hi to mod. density Pinyon Juniper	35 mi. of lt. to mod. density Pinyon-Juniper	32 mi. of lt. to mod. density.Pinyon-Juniper	38 mi of lt. to mod. density Pinyon-Juniper
13. Construction, Right-of-Way Engineering Costs	$5,856,228	$7,490,541	$5,898,569	$6,165,335	$5,572,514	$17,097,320	$10,711,579	$11,600,592
14. Taxes (over 35 years) Present worth	$2,708,233	$3,779,769	$2,975,260	$3,109,817	$2,810,796	$8,623,950	$5,433,223	$5,851,380

1. Includes 10.6 miles of line within the dual corridor with the 500 kV (APS) Cholla Line
2. Encounters a recreation subdivision and Concho Park Estates, crosses Silver Creek environmental reserve area, 3 miles of potential county part at Hieroglyphic Wash. Parallels company transmission line proposal for 52 miles.
3. Crosses U.S. Highways 666 and 180, also State Highways 180, 377, and 77. Parallels State Highway 77 for 1.5 miles.

a. "Primary" 500 kV System - Northern Portion

(1) Links 6B, 14 and 11

Location: The link lies within Navajo County and extends north of the Apache-Sitgreaves National Forest, generally northwest of Dry Lake and east of Chevelon Creek, joining with the westerly alignment of the Cholla-Saguaro routing alternatives. As the northern most route, it begins at the west end of Link 6A, and would then proceed west, making half of a loop, passing through Chevlon Acres and intercepting the APS Cholla line north of the Apache-Sitgreaves and then proceeds south in a common corridor with the Cholla line.

Length: 33.9 miles

Access:
Good - 17.6 miles
Fair - 2.7 miles
Poor - 2.0 miles
None - 11.6 miles

Physiography: The terrain is relatively flat to gently rolling, with an occasional canyon. Slopes are generally 1-10 percent. Eight drainages are crossed.

Soils and Geology: Soil erosion potential is moderate. Soils are sandy loam with rock outcrops for 12.7 miles, and then grading into a gravelly or cobbly loam with limestone outcrops near the end of the link.

Possible karst and solution collapse on Link 14.

Impact: low.

Ecology: The corridor crosses 18.8 miles of grassland and 15.1 miles of juniper pinyon, with four riparian communities crossed.

Impact: low

Visual Landscape Character: The scenic quality is average.

Impact: Moderate to Low.

Highway Influence: There is one crossing of State Route 377 in open country with high visibility.

Impact: Low to Moderate.

Historic: No historic sites were identified.

Archeology: Sensitivity of the archeological resources is moderate for 13 miles and low for 20.9 miles, with one high density area near Chevlon Canyon.

Impact: Moderate to Low.

Current Land Use: Rangeland exists throughout. Two miles pass through Chevlon Acres, a recorded undeveloped subdivision. There are two individual dwelling units. The one dwelling near the west end of Link 14 also has associated corrals and other buildings.

Impact: Low.

Planned Land Use: (Navajo County Plan) Possible planned uses are the undeveloped subdivision and the land use plans on State, Bureau of Land Management, and National Forest lands.

Impact: Low.

(2) Links 6B, 15, and 16

Location: The link extends southwest of Dry Lake to just north of and within the Apache-Sitgreaves National Forest above the Townships 14 N., and 13 N. Boundary. As the southern most of the two alternate routes, it begins at the west end of Link 6A, and then proceeds in a westerly direction crossing the Pink Cliffs and passing south of Dry Lake and intercepts the dual corridor near APS tower 113 on the Cholla line.

Length: 30.3 miles

Access:
Good - 3.2 miles
Fair - 2.7 miles
Poor - 7.2 miles
None - 17.2 miles

Physiography: The area is relatively flat, to hilly, with slopes generally 0-20 percent, except when canyons are crossed. Fourteen drainages are crossed.

Soils and Geology: Soil erosion potential is moderate with the Pink Cliffs and steep canyon slopes having a high erosion potential. Soil erosion by wind and water has occurred along the Pink Cliffs. Possible karst and solution collapse on Link 16.

Impact: Low.

Ecology: Grassland communities extend for 12.4 miles and Juniper-Pinyon for 17.9 miles. Five riparian communities are crossed. The area along Link 16 has been identified by the Forest Service as an Elk calving ground.

Impact: Moderate to High.

Visual Landscape Character: The scenic quality of the natural resource is average.

Impact: Moderate to Low.

Highway Influence: There is a crossing of State Highway 377 where the area is open and flat. Link 15 parallels the highway for 6.4 miles at an average of two miles distance.

Impact: Moderate.

Historic: The link passes approximately two miles from Zeniff site.

Impact: Low.

Archeology: Sensitivity of the archeologic resource is high for 4.2 miles, low for 1 mile and moderate for 25.1 miles.

Impact: Moderate to High.

Current Land Use: Range and undeveloped land exists. One windmill is located along the link. The area is Elk winter range.

Planned Land Use: (Navajo County Plan) The link has State, Bureau of Land Management and National Forest lands with varying degrees of planned use.

Impact: Low to Moderate.

(3) Link 03

Location: This path extends west from the St. Johns Plant Site and north of Zion Reservoir, Stinking Springs Mountains and Hunt, Arizona.

Length: 31.2 miles

Access: Poor - 25.1 miles
None - 6.1 miles

Physiography: The terrain is flat plateau, generally 0-10% slopes - 16 drainages including the Little Colorado River are crossed.

Soils & Geology: Low erosion sensitivity for 13.1 miles. Moderate erosion sensitivity for 16.6 miles. High erosion sensitivity for .6 mile.

Impact: Low to Moderate.

Ecology: This corridor crosses 26 miles of Grassland with 8 riparian communities; and 5.2 miles of Juniper-Pinyon-Grassland. Ecotone with one riparian community.

Impact: Moderate to Low.

Visual Landscape Character: Above average - 3 miles; open broken badlands topography. Average - 28.2 miles; flat plateau, scattered ranch houses and windmills, Highway 180.

Impact: Moderate.

Highway Influence: There are crossings of U.S. Highways 180 and 666. Both crossings are in flat, open areas, with high visibility from either direction.

Impact: Low to Moderate.

Historic: No historic sites identified.

Impact: None.

Archeology: Moderate site density, 2 samples - 1 site recorded.

Impact: Moderate.

Current Land Use: Range land exists throughout. This path passes through Hunt, a small village area which is undergoing some residential development and close to an airstrip in this area.

Impact: Moderate to Low.

Planned Land Use: Lands involved with the Apache County Plan and open range land exist throughout. The corridor passes within one mile of Hunt, Arizona, an urbanizing influence area.

Impact: Low to Moderate.

b. "Primary" 500 kV System - Southern Portion

The Federal Study Team identified four systems as being alternatives to proposed Links 28, 38, and 33. The four systems identified by the Federal Study Team are described below, and are evaluated with the proponents proposal in Table III-14.

(1) Links 43A, 43, 28A, 38, and 33

Location: This route runs, from the proposed Silver King Substation site, west along an existing 115 kV line past the old Silver King Mine, and southwest along the slope of Silver King Wash, then south to an existing 115 kV substation west of Superior. It would then turn to the southwest, following the 115 kV line, a railroad and a water pipeline, to about one mile east of the old Queen's Station siding where it would cross, with the 115 kV line, to the south side of Queen Creek Wash to avoid private land and residential development. About one mile east of Hewitt Station it would turn to the northwest to join Link 28. It would then run approximately 2.4 miles to the west, turn to the southwest for 4.6 miles and then to the west again, crossing U.S. Highway 60/70 about two miles northwest of Florence Junction. After about another 3.5 miles it crosses a major drainage feature, turns to the northwest for 5.7 miles, turns to the north and continues to the Dinosaur Substation.

TABLE III-14

Evaluation of Study Team Alternatives to the Proposed Route
Primary 500 kV Transmission Line (Southern Portion)

Item	Proposed System	Study Team Alternative Systems			
	Links 28, 38, and 33	Links 43A, 43, 28A, 38 and 33	Links 45, 46, 43B, 43, 28A, 38, and 33	Links 45, 46, 44 38B, and 33	Links 45, 47, 27 and 33
1. Total length of Line (miles)	33.0	35.7	55.8	39.2	69.7
2. Road Access (miles)					
Good	5.0	7.7	25.5	7.4	54.5
Fair	11.6	12.6	12.9	10.6	--
Poor	5.2	5.2	6.3	13.0	5.8
None	11.2	10.2	11.1	8.2	9.4
3. Physiography (miles)					
0-10 percent	23.5	24.9	37.5	23.4	59.8
Irregular & Broken	9.5	10.8	18.3	15.8	9.9
4. Drainages Crossed (number)	17	25	32	20	79
5. Soils & Geology					
Erosion Potential					
High	5.0	7.8	13.0	9.4	--
Moderate	21.8	10.0	24.9	13.8	52.4
Low	6.2	17.9	17.9	16.0	17.3
Revegetation Potential	Low to Moderate	Low to Moderate	Low to Moderate	Low to Moderate	Low
6. Ecology (miles)					
Grasslands	--	--	--	--	1.9
Pinyon-Juniper	--	--	--	--	--
Palo Verde-Cactus (Saguaro, Cholla & other cacti)	15.6	19.8	20.0	12.7	27.7
Creosote Bush - Bursage	7.9	7.9	7.9	16.6	12.4
Transition	--	--	3.3	3.3	5.1
Crucifixion Thorn - Cacti	--	--	1.3	2.6	--
Chaparral	9.5	5.0	20.3	4.0	4.0
Agricultural	--	--	--	--	8.0
Riparian Areas crossed (number)	5	9	16	10	21
7. Visual Landscape Character					
High	11.9	19.7	42.5	12.6	
Above Average	13.5	5.7	5.7	8.0	
Averate	7.6	7.6	7.6	18.6	

TABLE III-14 (continued)

Evaluation of Study Team Alternatives to the Proposed Route
Primary 500 kV Transmission Line (Southern Portion)

Item	Proposed System	Study Team Alternative Systems			
	Links 28, 38, and 33	Links 43A, 43, 28A 38 and 33	Links 45, 46, 43B, 43, 28A, 38, and 33	Links 45, 46, 44 38B, and 33	Links 45, 47, 27 and 33
8. Current Land Use	Queen Creek Estates A roadside rest A trailer home area 2.4 mi of 115 kV line U.S. Highway 60/70 Rangeland	14 mi. farms & ranches 3 mi. mining 14 mi Tonto N.F. Queen Creek Estates A roadside rest 2.4 mi of 115 kV line Magma Railroad Pipeline	Range Land 27.6 mi Tonto N.F. Oak Flat Campground U.S. Highway 60/70 A roadside rest State Route 117 6.1 mi. 500 kV line 31.7 mi.115 kV line A trailer home area	Range Land 10 mi. Tonto N.F. Oak Flat Campground State Route 177 U.S. Highway 60/70 Magma Railroad Pipeline Several dwellings Airstrip	Range Land 10 mi. Tonto N.F. Oak Flat Campground U.S. Highway 60/70 State Route 177 17 mi. 115 kV line 23 mi. 115 kV line Pacific Southern RR 2 mi. irrigated land
9. Planned Land Use	21 mi. of mining	Mining	Upgrading St. Rt.177 Queen Creek Estates Mining	Upgrading St. Rt.177 1.5 mi irrigated land Mining	Upgrading St.Rt. 177 Pinal County Park 21.6 mi irrigated land Scenic trail CAP Salt-Gila Aqueduct
10. Highway Influence	Crosses U.S. Highway 60/70	Crosses U.S. Highway 60/70	Crosses U.S. Hwy. 60/70 twice Crosses St. Rt. 177	Crosses U.S. Hwy. 60/70 Crosses St.Rt. 177 Crosses U.S. Hwy. 80/90	Crosses U.S. Hwy. 60/70 Crosses St.Rt. 177 Crosses U.S. Hwy. 80/90 Parallesl St. Rt. 177 for 0.5 mi.
11. Historic	Near Silver King Mine	7 sites of potential historic value Near Silver King Mine Near Pinal Townsite Old Camp Picketpost	10 sites of potential historic value Near Pinal Townsite Old Camp Picketpost	10 sites of potential historic value Near Reymert Mine/ Site Near Reymert townsite	14 sites of potential historic value
Archaeology Sensitivity (mile					
High	7.3	25.1	9.7	0.2	23.9
Moderate	25.7	2.2	33.3	0.1	1.1
Low	--	--	12.7	30.9	44.7
12. Construction Costs (Includes acquisition of right-of-way and engineering costs)	$6,131,320	$6,701,670	$11,268,914 1/	$8,474,330	$13,667,710
13. Taxes (over 35 yrs.) (Present Worth)	$3,092,660	$3,380,346	$ 5,684,081 1/	$4,274,483	$ 6,894,048

1/ The dollar amounts for this system was calculated by projecting an average for Links 43A, 43, 28A, 38, and 33, and Links 45, 46, 44, 38B, and 33.

Length: 35.7 miles

Access:
Good - 7.7 miles
Fair -12.6 miles
Poor - 5.2 miles
None -10.2 miles

Physiography: Slopes are: 0-10% - 24.9 miles. Irregular (Broken) - 10.8 miles. Twenty-five drainages are crossed. Queen Creek is crossed twice and paralleled for about 2.5 miles.

Soils and Geology: Erosion potential is High, 7.8 miles; Moderate, 10.0 miles; and Low, 17.9 miles.

Ecology: This path crosses 5.0 miles of Chaparral, 19.8 miles of Palo Verde-Saguaro and 7.9 miles of Creosote bush-Bursage communities. Nine riparian areas are crossed.

Visual Landscape Character: Scenic quality is rated as High, 19.7 miles; Above Average, 5.7 miles; and Average, 7.6 miles.

Highway Influence: This path would cross U.S. Highway 60/70 in an open area about two miles northwest of Florence Junction and would come within about 0.2 mile of U.S. Highway 60/70 west of Superior.

Historic: Only seven sites with potential historic value were identified within one mile of the corridor centerline, including the Silver King Mine (1/4 mile) and Pinal Townsite (1/2 mile).

Archeology: Two sites were identified. Site density was rated as High, 7.3 miles; High to Moderate, 17.8 miles; Moderate to High, 2.4 miles; and Moderate, 8.2 miles.

Current Land Use: This route crosses 4.0 miles of developing area with 14 farms and ranches, and 31.7 miles of undeveloped land. This includes 3.0 miles of mining area, 6.0 miles with mining claims, 14.0 miles of Tonto National Forest Land, and a few residences. The route parallels 2.4 miles of an existing 115 kV line and passes near Queen Creek Estates, a roadside rest area and a trailer home area.

Planned Land Use: No planned land uses were identified along this 35.7 mile route. It is likely that extensive copper mining activity will occur within about the Eastern nine miles.

(2) Links 45, 46, 43B, 43, 28A, 38, and 33

Location: This route runs to the south from the site of the proposed Silver King substation parallel to the APS Cholla 500 kV line, crossing U. S. Highway 60/70 east of Oak Flat Campground. At mile 6.1, it runs to the southwest to the site of the proposed Kearny No. 1 substation, then turns to the northwest crossing State Route 177 and continuing along an existing 115 kV line to a 115 kV substation west of Superior. It would then turn toward the west parallel to an existing 115 kV line, a railroad and a water pipeline on the northern side of Queen Creek Wash. About one mile east of the old Queen's Station siding, it would cross, along with the 115 kV line, to the south side of the Wash to avoid private land and residential development. About one mile east of Hewitt Station, it would turn to the northwest and, about one mile after crossing Queen Creek again, would turn to the west. After 24 miles, it would turn to the southwest, parallel Queen Creek for about 2 1/2 miles and turn to the west again crossing U.S. Highway 60/70 about two miles northwest of Florence Junction. About 3.5 miles beyond the highway, the route would cross a major drainage feature, turn to the northwest for about 5.7 miles, turns to the north into the Dinosaur substation site.

Length: 55.8 miles

Access:
Good - 25.5 miles
Fair - 12.9 miles
Poor - 6.3 miles
None - 11.1 miles

Physiography: Slopes along this route are 0-10%, 37.5 miles; 10-20%, 3.6 miles; 20-30%, 0.8 miles; 30 % and above, 0.9 miles; and irregular, 13.0 miles. Thirty-two drainages are crossed, including two crossings of Queen Creek.

Soils and Geology: Soil erosion potential is High, 13.0 miles; Moderate, 24.9 miles; and Low, 17.9 miles.

Ecology: Plant communities crossed include Chaparral, 20.3 miles; Transition, 3.3 miles; Crucifixion Thorn-Cactus, 1.1 miles; Palo Verde-Saguaro, 20.0 miles; and Creosote bush-Bursage, 7.9 miles. Sixteen riparian areas are crossed.

Visual Landscape Characteristics: Scenic quality was rated as High, 42.5 miles; Above Average, 5.7 miles; and Average, 7.6 miles.

Highway Influence: This route would cross U.S. Highway 60/70 twice and come within about 0.2 mile of it at another place; it would cross State Route 177 and parallel it for about two miles; and, it would have an open crossing of U.S. Highway 60/70 about two miles northwest of Florence Junction.

Historic: A total of ten sites of potential historical value were identified within two miles of the corridor centerline. Four of these sites are located within one mile of the corridor centerline, one of which is eligible for nomination to the National Register of Historic Sites.

Archeology: Only four archeological sites were identified along this route. Sensitivity was rated as High, 9.7 miles; Major 0.1 mile; Medium, 0.1 mile; moderate, 33.2 miles, Low, 4.3 miles, Minimum, 8.4 miles.

Current Land Uses: The full length of this route is listed as undeveloped. About 27.6 miles cross Tonto National Forest Land. The route crosses near Oak Flat Campground, crosses U.S. Highway 60/70 and a roadside rest area, parallels 6.1 miles of APS 500 kV transmission line and 31.7 miles of 115 kV line, and passes near another roadside rest area, Queen Creek Estates and a trailer home area.

Planned Land Use: No specific plans were identified along this route. Future upgrading of State Route 177 could create a conflict, and about 0.4 mile of the route crosses the area above Queen Creek Estates. Much of the route in the Superior vicinity crosses mining claims that are likely to be developed in the future.

(3) Links 45, 46, 44, 38B, and 33

Location: This route runs to the south from the site of the proposed Silver King Substation, along the APS 500 kV line for 6.1 miles, crossing U.S. Highway 60/70 east of Oak Flat Campground. It then turns to the southwest for 2.5 miles into the proposed Kearny No. 1 Substation Site and to the west, crossing State Route 177, U.S. Highway 80/89, and the Magma Arizona Railroad south of Florence Junction. At the railroad the route turns northwest and then north into the Dinosaur Substation Site.

Length: 39.2 miles

Access:
Good - 7.4 miles
Fair - 10.6 miles
Poor - 13.0 miles
None - 8.2 miles

Physiography: Slopes along this route are 0.10%, 23.4 miles; 10-20%, 9.6 miles; 20-30%, 2.8 miles; 30% and above, 3.4 miles. Drainages crossed include five named streams and washes and 15 unnamed washers.

Soils and Geology: Erosion potential is rated as High, 9.4 miles; Moderate, 13.8 miles; Low, 16.0 miles.

Ecology: Vegetation communities crossed would be Chaparral, 4.0 miles; transition, 3.3 miles; Crucifixion Thorn-Cactus, 2.6 miles; Palo Verde-Saguaro, 9.8 miles; Palo Verde-Cholla, 2.9 miles; and Creosote bush-Bursage, 16.6 miles. Ten riparian areas are crossed.

Visual Landscape Characteristics: Scenic Quality is rated as High, 12.6 miles; Above Average, 8.0 miles; and Average 18.6 miles.

Highway Influence: This route would cross U.S. Highway 60/70 and State Route 177 with the APS 500 kV line. The route would also cross U.S. Highway 80/89 south of Florence Junction. Views to the first two crossings would be from up to about one mile while the U.S. Highway 80/89 crossing would be very open and visible for a greater distance.

Historic: Within two miles of the corridor centerline, a total of 10 sites of possible historic value were identified. Four of these sites are within one mile, one of which is on the State Inventory of Historic Places and one determined to be eligible for nomination to the National Register of Historic Sites. Potential for impact was rated as Moderate, 2.5 miles, and None, 36.7 miles.

Archeology: Sensitivity along this route is rated as Major, 0.1 mile; High, 8.1 miles; Medium, 0.1 mile; Low, 22.5 miles; and Minimum, 8.4 miles. Seven sites were identified within two miles of the centerline, with four of these being within one mile.

Current Land Use: This route crosses near Oak Flat Campground and a roadside rest area. The route crosses Tonto National Forest land for 10.0 miles, State Route 177, U.S. Highways 60/70 and 80/89, and the Magma Arizona Railroad. It parallels the APS 500 kV line for 6.1 miles and crosses miles of undeveloped land. There are several dwellings within 2-1/2 miles of the corridor centerline, mostly at Walnut Spring and Florence Junction, and a landing strip two miles from the centerline at Florence Junction.

Planned Land Use: Planned Land Uses include possible upgrading of State Route 177 north of Walnut Spring and about 1.5 miles of irrigated agriculture. No planned uses were identified on the remaining 37.8 miles. The route crosses 2.5 miles of land administered by the Bureau of Land Management. The Bureau of Land Management does not have a utility corridor designated in their Middle Gila Management Franework Plan for this 2.5 mile portion of the route.

(4) Links 45, 47, 27, and 33

Location: This route runs from the proposed Silver King Substation Site parallel to the APS Cholla 500 kV transmission line, crossing U.S. Highway 60/70, State Route 177 and the Gila River, and entering the proposed Kearny No. 2 substation site. From here it would run to the west along an existing SRP 115 kV line, crossing U.S.Highway 80/89 at Florence, then turning toward the northwest along the Southern Pacific Railroad Line to Magma. It would then turn toward the north and continue into the Dinosaur Substation.

Length: 69.7 miles

Access: Good - 54.5 miles
Poor - 5.8 miles
None - 9.4 miles

Physiography: Slopes: 0-10%, 59.8 miles; 10-20%, 5.3 miles; 20-30%, 2.4 miles; 30% and above, 2.1 miles. The route crosses seven Major (named) drainages and 72 minor (unnamed) drainage features.

Soils and Geology: Geologic structure for the entire route is classified as insensitive. Soil erosion potential is Moderate, 52.4 miles; Low, 17.3 miles.

Ecology: This route crosses six vegetation communities: Grassland, 1.9 miles; Transition 5.1 miles; Palo Verde-Cactus associations, 27.7 miles; Creosote bush-Bursage, 12.4 miles; Chaparral, 4.0 miles; and Agricultural, 8.0 miles. In addition 21 riparian areas are crossed.

Visual Landscape Characteristics: Scenic quality was rated as: High, 12.6 miles; Above Average, 12.8 miles; Average, 15.1 miles; Representative, 9.3 miles; Modified, 16.2 miles; and Highly Modified, 2.5 miles.

Highway Influence: This route would cross U.S. Highway 60/70 and State Route 177 with the APS Cholla 500 kV transmission line and U.S. Highway 80/89 at Florence with an existing SRP 115 kV line. It would also parallel State Route 177 for about 0.5 mile at Walnut Spring.

Historic: A total of fourteen sites with potential historic value were identified within two miles of the route centerline, with ten of these being within one mile. Six of these sites are either on the National Register of Historic Places or considered to be eligible for nomination to it, while one site is on the State Inventory of Historic Sites. Sensitivity levels were rated as Moderate, 1.2 miles; Low, 0.7 mile; and None, 67.8 miles.

Archeology: Sixteen sites have been identified along this route. Sensitivity levels are rated as Maximum, 0.6 mile; High, 23.3 miles; Medium, 1.1 miles; Low, 30.1 miles; and Minimum, 14.6 miles.

Current Land Use: Current land uses include the following: Tonto National Forest, 10.0 miles; Oak Flat Campground, 0.8 mile; roadside rest area, 0.1 mile. Parallel to: 500 kV line, 17.0 miles; 115 kV line, 23.0 miles; railroad, 5.4 miles. Developed, 2.0 miles; irrigated agriculture, 8.5 miles; undeveloped, 46.8 miles.

Planned Land Use: Future upgrading of State Route 177 in the vicinity of Walnut Spring; proposed Pinal County park, recreation and open space area, 2.5 miles; High water line of proposed Buttes Dam, 0.8 mile; planned scenic trail, 0.8 mile; two Gila River (potentially a Wild and Scenic River) crossings; irrigated agriculture, 21.6 miles; and two crossings of the planned Central Arizona Project Salt-Gila Aqueduct.

c. "Primary" 500 kV System - Additional Links Considered (Southern Portion)

Various studies were conducted during the State Siting process where in additional links were identified as alternatives to segments of the proposed routes. Further analysis of the alternatives during the environmental statement process indicated that these alternatives were not as desirable from the aesthetic view point as those proposed as alternatives to the proposal and those alternatives presented by the Federal Study Team. In addition, the State Siting Committee rejected the company's request for permission to construct transmission lines on these segments of proposed routes.

(1) Links 37, 30 and 31

Location: Starting north of the Whitlow Dam area the corridor leads due west and crosses U.S. Highway 60 about six miles northwest of Florence Junction. One mile from the crossing the corridor turns northwest and parallels U.S. Highway 60 one mile distant, then terminates in the proposed Dinosaur substation area.

Length: 12.3 miles

Access: Good - 2.6 miles
Poor - 3.0 miles
None - 6.7 miles

Physiography: The terrain is mountainous for about two miles with varied slopes, generally 30-50% The remaining corridor path is flat. Five drainages are crossed.

Soil and Geology: Moderate soil sensitivity - 4.8 miles,low soil sensitivity - 7.5 miles.

Impact - Low.

Ecology: The path crosses 8.2 miles of Palo Verde-Saguaro with 2 riparian communities and 4.1 miles of Creosote bush-Bursage with 2 riparian communities.

Impact: Low to Moderate.

Visual Landscape Character: High scenic quality - 7.3 miles, Superstition Mountains. Above average scenic quality - 5 miles, Superstition Mountains.

Impact: High to Moderate.

Highway Influence: One very open crossing of U.S.Highway 60/70 south of Superstitions has high visibility. There is a parallel of 3 miles along the west side of U.S. Highway 60/70 that is about one mile distant.

Impact: High.

Historic: No historic sites identified.

Impact: None.

Archeology: High site density - 6.7 miles; moderate site density - 5.6 miles; one sample, no recorded sites.

Impact: Moderate to Low.

Current Land Use: Undeveloped land is crossed, but the path comes near a few residences and a trailer home area.

Impact: Low

Planned Land Use: The line passes by a potential state park with undefined boundaries. There are 7.0 miles of undeveloped land.

Impact: Moderate to Low.

(2) Links 37 and 29

Location: In the vicinity of Whitlow Dam the corridor heads west until it intersects an existing 115 kV corridor. It parallels this corridor to the area near Dinosaur Mountain. Here the corridor crosses U.S. Highway 60/70 and heads west into the Dinosaur Receiving Station area.

Length: 10.5 miles

Access: Good - 5.2 miles
Poor - 3.0 miles
None - 2.3 miles

Physiography: The terrain is mountainous for about 2 miles with varied slopes generally 30-50%. The remaining corridor path is flat. Six drainages are crossed.

Soils and Geology: Moderate sensitivity soils - 5.9 miles; low sensitivity soils - 4.6 miles.

Impact: low

Ecology: The corridor crosses 10.5 miles of Palo Verde-Saguaro with 4 riparian communities.

Impact: Low

Visual Landscape Character: High scenic quality: Open to semi-enclosed Superstition Mountains.

Impact: High

Highway Influence: The path crosses and then parallels U.S. Highway 60/70 for 5.5 miles. South of the Superstition Mountains the parallel is generally 0.5 mile from the road. The crossing can be seen for only 0.5 mile in each direction due to a bend in the road and the topographic screening of Dinosaur Mountain.

Impact: High.

Historic: No historic sites identified.

Impact: None.

Archeology: High site density - 2.3 miles; moderate site density - 8.2 miles; one sample, one site recorded.

Impact: Moderate to Low.

Current Land Use: Undeveloped land is crossed. The path does pass near a few residences and Superstition City, a recorded undeveloped subdivision.

Impact: Low.

Planned Land Use: The line passes by a potential state park with undefined boundaries, and 5.2 miles of undeveloped land.

Impact: Moderate to Low.

d. Link Descriptions

The following links, which are included as segments in the routes described in III. 4.b, were identified during the environmental analysis as alternatives to the proponent's proposed 500 kV transmission system.

(1) Link 27

Location: Beginning at the Kearny No. 2 substation, the route proceeds westerly and parallel to an existing SRP 115 kV transmission line, crossing U.S. Highway 80/89 at mile 20.8 about two miles north of Florence. Three miles west of U.S. Highway 80/89 the route intersects the Southern Pacific Railroad Line which is then paralleled to the northwest for six miles. About one mile before reaching the community of Magma the route turns toward the north, crossing the Magma Arizona Railroad line at mile 30.7, continuing north to the southern end of link 33.

Length: 45.0 miles

Access: Good - 32.3 miles
Poor - 5.8 miles
None - 7.0 miles

Physiography: The route is fairly level for its entire length with slopes of 0-10%. Major drainages are crossed at mile 6.7 (Donnelly Wash), 9.5 (Box 0 Wash), 19.6 (Gila River) and 37.6 (Queen Creek). Forty-seven smaller washes are crossed.

Soils and Geology: Soils sensitivity is as follows: Moderate, 30.1 miles; Low 14.9 miles. Probable impact on soils is rated as Low for the entire link.

Ecology: Vegetation types are as follows: Palo Verde-Saguaro, 17.0 miles; agriculture, 10.8 miles and Creosote bush-Bursage, 10.0 miles. Fifteen riparian communities are crossed.

Visual Landscape Character: Scenic quality along this route is rated as follows: Above Average, 12.8 miles; Average, 13.9 miles; Modified, 15.8 miles; and Highly Modified, 2.5 miles.

Highway Influence: This Link would have an open crossing of U.S. Highway 80/89 at mile 20.8, and would be at the intersection of the highway and the Southern Pacific Railroad line about 0.3 mile from the Federal Prison Camp. The impact would be moderate.

Historic: Only two sites along this route were identified as having possible historic value. Poston Butte, 0.6 mile south of mile 22.6, is included on the State Inventory of Historic Sites. The impact on this site would be moderate at most. The Magma Arizona Railroad, which is crossed at mile 30.7, is of potential value but not on the inventory. Impact here would be low. There will be no impact on historic resources along the remainder of the Link.

Archeology: Sensitivity was rated as High, 20.9 miles; and Low, 24.2 miles. Projected impact levels are Moderate to Low, 20.0; High plus, 2 miles; and Low, 3 miles. This route would cut through the northern edge of a large prehistoric Hohokam occupation area.

Current Land Use: Land uses are: 17.5 miles undeveloped, 3 miles, irrigated agricultures, 2 miles, Florence area, railroad, Prison Camp; 15.5 miles of irrigated agriculture with scattered residential, passes near Magma hunting preserve at mile 31; and 7 miles undeveloped. An existing 115 kV transmission line is paralleled for 23 miles, and a Southern Pacific Railroad line is paralleled for 5.4 miles.

Planned Land Use: Identified planned land uses include: 17.5 miles undeveloped with some possible mining activity; 21.6 miles irrigated agriculture; 3 miles, Florence sphere of urbanizing influence (Pinal County 1985 development plan); and 14.2 miles undeveloped. This link would also cross the Central Arizona Project Salt-Gila Aqueduct Route at about miles 17.7 and 33.5.

(2) Link 28A

Location: This link is the last 2.4 miles of link 28, and was created by the addition of link 43 which joins link 28 at mile 32.0. It runs west from the link 28/43 intersection about 1.5 miles north of Hewitt Station, to the eastern end of link 38.

Length: 2.4 miles

Access: Good due to existing 115 kV transmission line.

Physiography: Generally level with slopes of 0-10%. Three minor drainage features are crossed.

Soils and Geology: The link lies in an insensitive geologic area. The soils have Low erosion potential and the impact level is Low.

Ecology: The route lies entirely within the Palo Verde-Saguaro vegetation community. The potential for biotic impact is Moderate.

Visual Landscape Characteristics: The scenic quality is rated as Above Average for 0.8 mile and High for 1.6 miles. Potential for visual impact is Moderate for 0.8 mile and High, for 1.6 miles.

Highway Influence: None.

Historic: No sites were identified. The potential impact was rated as Moderate for 1.5 miles and None for 0.9 mile.

Archeology: Sensitivity is rated as High, potential for impact is rated as Moderate to High. No specific sites were identified.

Current Land Use: None identified. Impact rating was None for 1.5 miles, and Moderate for 0.9 mile. Mile 2.0 to 2.4 lies within the Queen Creek Development Area. The corridor parallels an existing 115 kV transmission line.

Planned Land Use: None identified, Impacts level was rated as Low, 0.0 mile, and Moderate, 1.6 miles.

(3) Link 33

Location: This link runs from the northwestern end of link 38B northward into the Dinosaur substation site.

Length: 2.4 miles

Access: None 2.4 miles

Physiography: This link crosses level land with all slopes less than 10%. Two small unnamed drainage features are crossed.

Soils and Geology: This link falls within a geologic area that is classed as insensitive. Soils sensitivity is Low, erosion potential is Low and impact level is Low.

Ecology: The route crosses one biotic community (Creosote bush-Bursage) and two riparian communities. The potential for biotic impact is Moderate to Low.

Visual Landscape Characteristics: Scenic quality and visual landscape character are both classified as Average.

Highway Influence: There should be no highway influence or impacts due to this link.

Historic: No historic sites were identified along this link, there should be no impact on historic resources.

Archeology: While no specific archeological sites were identified the sensitivity was classified as High and the potential for impact was rated as Moderate to High.

Current Land Use: The link crosses state land. No current land uses were identified, therefore there should be no impact.

Planned Land Use: No planned land uses were identified, therefore there should be no impact.

(4) Link 38B

Location: Link 38B, which is a segment of Link 38, runs to the northwest from the western end of Link 44 to the southern end of Link 33, about 2.4 miles south of the Dinosaur substation.

Length: 5.7 miles

Access: Fair - 0.8 miles
None - 4.9 miles

Physiography: The terrain is essentially flat for the entire 5.7 miles, with seven significant washes being crossed. Elevation ranges from about 1660 to 1740 feet.

Soils and Geology: Soils have low erosion potential and the geology is characterized as insensitive. In both cases the potential for impact is rated as low to low minus.

Ecology: The corridor centerline crosses a Creosote bush-Bursage plant community for its entire length and two riparian areas at washes. The impact level would be Low.

Visual Landscape Character: The natural scenic quality is rated as Average and the impact level is rated as Moderate.

Highway Influence: This link would not fall within two miles of any paved road and so would have no visual effect due to parallels or crossings. There would be no identifiable impact.

Historic: No historic sites were identified within or adjacent to the link 38B corridor. Thus no impact to historic resources is anticipated.

Archeology: The sensitivity of the archeologic resources along this link is considered to be high. The potential for impact to archeologic resources is considered to be Moderate to High.

Current Land Use: The full length of this link crosses undeveloped land with no identified land uses within two miles. Impact would be None.

Planned Land Use: No planned land uses were identified within or adjacent to this corridor. There would be no identifiable impact.

(5) Link 44

Location: This route would proceed to the west from substation site E (Kearny No. 1) until U.S. Highway 80/89 is crossed at mile 16.4, about 2.5 miles south of Florence Junction. Upon crossing the Magma Arizona Railroad at about mile 17 it would turn toward the northwest, crossing Queen Creek at mile 20.3 and ending at mile 22.5 at the south end of Link 38B.

Length: 22.5 miles

Access:
Good - 1.3 miles
Fair - 9.3 miles
Poor - 11.9 miles

Physiography: The terrain is mountainous from about miles 0 to 5, hilly to rolling to about 12 and relatively flat for the final ten miles. Roughly twelve miles of the corridor centerline crosses slopes of 0 to 10%, eight miles have slopes of 10 to 30%, 1-1/2 miles have slopes of 30 to 50%, and 1/2 mile has slopes of 50% and above. All of the slopes of 30% and above occur in the eastern 10 miles of the route. Six significant drainages are crossed, including Queen Creek. Soil erosion impact would be High 9.4 miles, Moderate for 5.2 miles, and Low for 7.9 miles.

Soils and Geology: The centerline of this corridor would cross five types of geologic structure as follows: Precambrian Apache group (schists, granites and diabase), overlain by thin granular soils for 1.3 miles; Tertiary volcanics and limestone (dacites, rhyolites, dikes and plugs), overlain by thin granular and fine grained soils for 3.4 miles; Paleozoic sedimentary (Limestone, sandstone shale and quartzites), overlain by thin granular and fine grained soils for 0.4 mile; Pinal schists overlain by thin granular soils for 5 miles; Quaternary-Tertiary sediments (sandstone, congomerate, old alluvial fans and soils on pediments), overlain by the Mohall-Pinant Association (medium to moderately course alluvial fans for 3.4 miles; and Gilman-Antho-Pimer Association (moderately fine and gravelly alluvial) for 8.8 miles.

Ecology: The centerline of the corridor would cross Sonoran desert scrub vegetation in four major plant associations: Crucifixion Thorn-Jojoba with some saguaros and other cacti for 1.3 miles;

Palo Verde-Saguaro, with jojoba increasing toward the east for 9.8 miles; Palo-Verde-Chain-Fruit for 2.9 miles and predominately Creosote bush-Bursage associations with good to excellent stands of palo-verde and ironwood trees along drainages for about 8.5 miles.

In addition a microphyllous riparian community occurs throughout the corridor wherever available soil moisture is increased by washes.

Several species of rare and endangered plants or animals are likely to occur within the corridor.

Visual Landscape Character: The visual quality was found to be as follows: Above Average 0.8 mile; High 4 miles; Above Average 7.2 miles; Average 10.5 miles. The potential for impact is Moderate to High.

Highway Influence: There is one crossing of State Route 177 at mile 0.5 that is considered to have Open-Variable visibility, High scenic interest and a Natural Dominance condition. It would also have a very open crossing of U.S. Highway 80/89 at mile 16.4 where visibility would be High. Impact at both crossings is rated as High.

Historic: Several historic or possibly historic sites have been identified within the vicinity of the corridor centerline. One site that is on the State Inventory of Historic Places (Reymert Mine) lies 2.2 miles north of the centerline at mile 8.0, and sites of some possible historic value as follows: Reymert De Noon town site, 1.2 miles north of the centerline at about mile 8.5; Mineral Mountain Archeological Site, 1.5 miles south of mile 11.5; Woodpecker Mine Vicinity, 0.2 mile north of mile 7.7; Ajax Mine vicinity, 0.3 mile south of mile 7.0; and mining area 0.3 mile south of mile 0.3.

Archeology: While no archeological sites were identified during the Reconnaissance inspection of this route, eight sites have been previously identified in this area by Arizona State University. Site density is low.

Current Land Use: The corridor centerline crosses 6.9 miles of Tonto National Forest lands, 12.6 miles of state land, 2.5 miles of Bureau of Land Management land and about 0.5 mile of private land (patented mining claims). Current land uses crossed by the centerline include State Route 177, an SRP 115 kV transmission line and an APS gas line at mile 0.6, and El Paso Natural Gas pipeline at mile 14.3, U.S. Highway 80/89 at mile 16.4, the Magma Arizona

Arizona Railroad at mile 17.0 and an SRP 69 kV transmission line at mile 19.0. An inactive mining area is crossed between miles 7.4 and 8.4.

Within 2-1/2 miles of the corridor centerline (two miles on each side of the one mile study corridor) are a few scattered dwelling units (primarily in the unincorporated community of Walnut Spring along State Route 177, and Florence Junction at the U.S. Highway 60/70 and 80/89 intersections) and a number of mining sites, mostly inactive. A landing strip is located about two miles north of the corridor centerline, adjacent to Florence Junction, north of mile 16.5, and an oil storage tank is located at the intersection of U.S. Highway 80/89 and the Magma Railroad, about 0.6 mile north of mile 16.3. Three sites with possible historic interest that lie within 2-1/2 miles of the corridor centerline are discussed above under the Historic heading. No significant impacts on current land uses are anticipated.

Planned Land Uses: The only planned land use identified is about 4-1/2 square miles of irrigated agriculture southwest of the route from miles 21.0 to the end. It should be noted that the Bureau of Land Management lands that fall within this corridor are not planned to have utility corridors in the Bureau of Land Management's Management Framework Plan that is currently being prepared. In this regard, the Bureau of Land Management has said that "additional corridors should only be considered in the event that future utilities cannot be suitably routed along the above corridor" (referring to an existing corridor).

(6) Link 45

Location: This route would proceed to the south from the proposed Silver King substation site, parallel to the APS Cholla 500 kV transmission line, crossing U.S. Highway 60/70 and along the east side of Oak Flat Campground and continuing south to the north end of Link 46.

Length: 6.1 miles

Access: Good due to construction of the APS line along the route.

Physiography: This link lies from ¼ to one mile west of Devil's Canyon most of its length and one to two miles east of Apache Leap for its southern five miles. It would lie within ½ mile of Oak Creek for 1.1 miles, crossing it at mile 5.6. It would also cross Rancho Rio Creek at mile 3.7, and Hackberry Creek at mile 4.3. Slopes are as follows: 0-10%, 3.0 miles; 10-20%, 1.8 miles; 20-30%, 0.6 mile; 30% and above, 0.7 mile.

Soils and Geology: The geologic structure along the route is classified as tertiary volcanics and intrusives with dacites, rhyolites, dikes and plugs. Soils are listed as thin and granular over extrusive igneous rock for 3.7 miles, and granular on sedimentary and igneous rocks for 2.4 miles. Soil erosion impact would be Moderate.

Ecology: The route passes through 4 miles of chaparral with patches of evergreen oak woodland scattered along the drainages and in low, water-holding basins. Devil's Canyon ½ to one mile to the east, has well developed riparian vegetation. There are 2.1 miles of transition area with some chaparral and desertscrub elements in addition to juniper and pinyon. Three major tributaries leading into Devil's Canyon support lush intermediate riparian vegetation. Sensitivity to impact is rated as Moderate for 2.7 miles; high for 2.6 miles; and severe for 0.8 mile.

Visual Landscape Characteristics: For 1.7 miles visibility is Open-Modified with full or partial tower visibility or possible skylighting. Condition is Natural Dominance due to the presence of U.S. Highway 60/70, transmission lines and jeep trails. Visual interest is High with views of King's Crown Peak, Hutton Peak and Devil's Canyon. Miles 1.7 to 4.3 have Open visibility as the route follows the western ridges of Devil's Canyon without modifying backgrounds. The presence of Oak Flat Campground and a 500 kV transmission line result in a Natural Dominance condition. Visual interest is High. Miles 4.3 to 6.1 have Open-Modified visibility due to topography changes which allow an open or modified view depending on viewer orientation. A Natural Dominance condition exists with only a few jeep trails present. The full length of this link follows the new APS 500 kV transmission line. The impact level was rated as Moderate.

Highway Influence: The line would cross U.S. Highway 60/70 at the eastern end of Oak Flat Campground and would follow the APS 500 kV line. It could be visible for ½ to one mile in each direction to east bound traffic.

Historic: Five sites of possible historic value were located within two miles of the corridor centerline. The only site identified within one mile of the route was determined to be eligible for nomination to the National Register of Historic Sites. This site (54, check Dams and Historic Trash), located between miles 1.8 and 2.8, is reported in the Arizona Public Service 500 kV project archeological survey report. Impact potential was rated as Moderate for 1 mile, and None Identifiable for the balance of the link.

Archeology: The archeologic sensitivity was rated as Minimum with the exception of a small area containing a rockshelter that was rated as Major, and a rock ring that was rated as Medium. Impact rating for these sites is High and Medium, respectively, while the remainder of the link is rated as Low.

Current Land Use: This link is on Tonto National Forest lands for 3.2 miles, and state lands for 2.9 miles. It crosses near Oak Flat Campground and a state roadside rest area. The route crosses U.S. Highway 60/70 at mile 1.7. A SRP 115 kV transmission line is crossed at mile 1.2. The entire 6.1 miles lies adjacent to a new APS 500 kV transmission line. The Oak Flat substation lies about 1.8 miles west of mile 2.3, no other industrial, commercial or residential uses were identified within two miles of the route. Impacts on outdoor recreation were rated as Moderate for 0.8 mile, and Low for the balance of the link. No impacts were identified on other land uses.

Planned Land Use: No planned land uses were identified within two miles of this corridor. No improvements are scheduled for Oak Flat Campground in the next ten years. There are no identifiable impacts on planned land use.

(7) Link 46

Location: Link 46 would proceed generally to the southwest from the southern end of link 45 to the site of the proposed Kearny No. 1 substation

Length: 2.5 miles

Access: Fair - 0.5 mile
Poor - 1.1 mile
None - 0.9 mile

Physiography: This short link would cross relatively flat terrain for 1.7 miles, with the central 0.8 mile crossing steeper areas. It would lie within ½ mile southeast of Oak Creek for its first 1.3 miles. Elevations would range from 4220 feet to 3200 feet at the northern and southern ends, respectively, with a maximum of about 4310 feet along the route. No drainage is crossed.

Soils and Geology: This route would cross three types of geologic structure, as follows: Tertiary volcanics and intrusives with dacites, rhyolites, dikes and plugs, overlain by granular soils for 0.7 miles; paleozoic sedimentary units: limestone, sandstone, shale and quartzite, overlain by fine grained and granular soil, for 0.8; and precambrian rocks: Apache group, schists, granites and diabase, with dissected thin soils, about one mile. Soil erosion impact would be Moderate.

Ecology: The first half of the link lies within a transition area between sonoran desert scrub communities and chaparral with a small area of broadleaf riparian habitat within ½ mile to the northwest along Oak Creek from about mile 0 to 0.8. The southern half of the route crosses mixed Crucifixion Thorn-Cactus associations. Wildlife habitat is rated as Good from about miles 0 to 0.5 and Poor for the final two miles dues to a recent fire in the area. Ecological impacts were rated as Moderate.

Visual Landscape Characteristics: The route was rated as having High scenic quality with a High potential impact. Highway visibility will be Low with Low potential impact.

Highway Influence: The route will not cross or parallel any paved roadway.

Historic: No historic sites were identified within or adjacent to this corridor.

Archeology: While this specific corridor was not surveyed, the adjacent areas of Links 44 and 45 were listed as having a Minimum of archeological resources.

Current Land Use: The first 0.1 mile crosses Bureau of Land Management land, with the remainder crossing Tonto National Forest land. No current land uses were identified.

Planned Land Use: No planned land uses were identified.

(8) Link 47

Location: This link continues along the APS 500 kV transmission corridor from the southern end of Link 45, crosses State Route 177 at mile 4.7 near Walnut Spring, passes between Copper Butte and Granite Mountain at about mile 6.5, crosses the Gila River at mile 10.4 and terminates at the site of the proposed Kearny No. 2 substation about seven miles west southwest of Kearny. This line would follow the APS 500 kV line most of its length.

Length: 16.2 miles

Access: Access will be good due to the construction of the APS 500 kV transmission line.

Physiography: Twenty-three drainages are crossed including the Gila River (mile 10.4), Zellweger Wash (mile 13.8). Slopes are as follows: 0-10%, 9.4 miles; 10-20%, 3.5 miles; 20-30%, 1.8 miles; 30% and above, 1.4 miles.

Soils and Geology: Geologic structure is as follows: Tertiary volcanics and intrusives (dacites, rhyolites, dikes and plugs) for 2.7 miles; Quaternary and Tertiary sediments (sandstone, conglomerates, old fans and soils on pediments) for 3.1 miles; Precambrian rocks (Apache group, schists, granites, diabase) for 8.2 miles; Laramide granitic intrusives (granite and associated crystalline rocks) for 1.6 miles; and recent surficial deposits (flood plain, alluvial fan and soil veneers) for 0.6 miles.

Eight soil types are encountered as follows: granular soils on sedimentary and igneous rock for 0.7 mile; fine grained and granular soil on steep sedimentary, metamorphic and igneous rock for 2.8 miles; thin soils over igneous and metamorphic rock for 3.4 miles; thin soils over granite for 2.1 miles; thin granular soils over granite for 4.8 miles; flood plains soils for 0.6 mile; and old alluvial fan depositions for 2.3 miles.

Ecology: The route crosses 3 miles of a transition area with some chaparral and desertscrub elements in addition to juniper and pinyon. There is mixed Palo Verde-Cactus association for 10.7 miles, with a small area of mixed Crucifixion Thorn-Cactus associations for 0.5 mile. Wildlife habitat is rated as Good for 9.1 miles, and Fair for 4.1 miles, except for 2.3 miles burned in June, 1976. There is a riparian area at the Salt River (0.6 mile) with excellent wildlife habitat quality. There is 1.9 miles of desert grassland. Burroweed-invaded grasslands have Fair wildlife habitat for 0.6 mile.

Visual Landscape Character: Visual interest is Modified for 0.4 mile; Representative for 9.3 miles; and High for 6.5 miles.

Highway Influence: This link crosses State Route 177 at mile 4.6 where it would be parallel to the APS 500 kV transmission line.

Impact: High.

Historic: Several sites with potential historic value have been identified along this link and Zellweger Ranch have been determined to be elgibile for nomination to the National Register. "Buell" home site, is suggested for consideration for nomination. Wolley Mine may be potentially eligible.

Archeology: Archeological sensitivity for the entire link is rated as Minimum with the following exceptions: Medium for 7.9 miles; Maximum for 0.6 mile. Only 13 archeological sites were identified along this 16.2 mile link, thus site density is Low.

Current Land Use: The route crosses 4.5 miles of State lands; 3 miles of Tonto National Forest; and 8.7 miles of Bureau of Land Management lands. It crosses State Route 177, an SRP 155 kV transmission line and an APS gas pipeline at mile 4.6, an APS 21 kV line at mile 4.7, Southern Pacific Railroad at mile 10.4 and the proposed railroad relocation route at mile 11.0, a SCIDD 69 kV line at mile 13.7. The APS 500 kV line is followed for 10.9 miles, and its route is crossed at miles 9.3 and 9.7.

Planned Land Use: Future upgrading of State Route 177 may affect the corridor from miles 4.6 to 4.8. The route crosses a proposed Pinal County Park, recreation and open space area for 2.5 miles, and the high water line of the proposed Buttes Dam for 0.8 mile.These plans have not been coordinated with either the Bureau of Land Management or the Bureau of Reclamation.

e. "Backup Interconnections" 500 kV System - Interconnection with TG&E "Twin" 345 kV San Juan, New Mexico to Vail, Arizona, Transmission Line

Initially Salt River Project studied two alternative backup transmission systems for the Coronado Generating Station. One system would connect the Coronado Station to the Tucson Gas & Electric Company's (TG&E) Extra High Voltage transmission line, from San Juan to Vail, and the second would connect the Coronado Station to the Arizona Public Service Company's (APS) Cholla power plant. This system would also serve as "startup" power for the generating station.

Table III-15 shows the cost of the APS interconnection and two TG&E interconnections, one at 345 kV and one at 500 kV. The current TG&E plan is to construct the second San Juan-Vail transmission line at 345 kV. The cost differential between the APS interconnection and the TG&E interconnection is $3.3 million based on the 345 kV interconnection with TG&E.

TABLE III-15

Alternate Backup System
Coronado Evaluation
1976 Dollars

	Cholla Interconnection	San Juan-Vail 345 kV Interconnection	San Juan-Vail 500 kV Interconnection
Coronado Primary System	82,700,000	82,700,000	82,700,000
Coronado Backup System	19,000,000	13,600,000	8,000,000
Subtotal	101,000,000	96,300,000	90,700,000
Other System Capital Costs*	1,200,000	3,300,000	1,000,000
TOTAL	102,900,000	99,600,000	91,700,000

*Other System Capital Costs represent SRP's expense to uprate other systems to accommodate the interconnection.

As studies of the possible interconnections with both APS and TG&E progressed, it became evident that the planning by TG&E for their second 345 kV San Juan-Vail transmission line was not firm enough for SRP's scheduling of the Coronado Project. Thus, SRP opted to interconnect with the APS Cholla switch yard even though the cost would be greater. On June 24, 1975, a letter of intent was signed by APS and SRP, designating the Cholla Interconnection as the backup system. The Federal Study Team was not informed by SRP of this decision until five months later- November, 1975.

It would appear from the evaluation shown in Table III-15, that the TG&E backup interconnection would have been the most economical if SRP had known what voltage the second TG&E line would have been and by what date it would have been operational. However, SRP stated they had to have long range commitments, contracts, or agreements "in hand" in order to plan the orderly construction of the plant, transmission lines, railroad, and development of the coal fuel source. Salt River Project felt they could not afford to hold up construction pending a decision from TG&E on what size the second line would be and what date it would become operational.

As noted in Section I A. and III A. of this Statement, construction on links 4 and 5 (State and private land) is currently in progress. The Federal Transmission Line Study Team does not condone this action.

At the present time, the second TG&E 345 kV San Juan-Vail transmission line is scheduled to be in service by late 1980. Should completion of the Coronado Generating Station be delayed for any reason, the option of the TG&E interconnection for the backup system would be the most economical and desirable alternative - dependent upon the status of the agreement with APS concerning the Cholla interconnection as the backup system.

The difference in line length, 76 miles for the Cholla Generating Plant as opposed to 38 miles for the Link 01 TG&E alternative (see Table III-13), indicates that the TG&E backup interconnection could have the least environmental impact.

Figure III-8 is a layout drawing of a possible station using the TG&E backup system (See Figure III-9 for potential locations for this station).

Alternative links 1 and 2 were studied by both the consultants and the Federal transmission line study team. One 345 kV EHV line in the San Juan-Vail corridor was completed at the time of the original study. These links are described below.

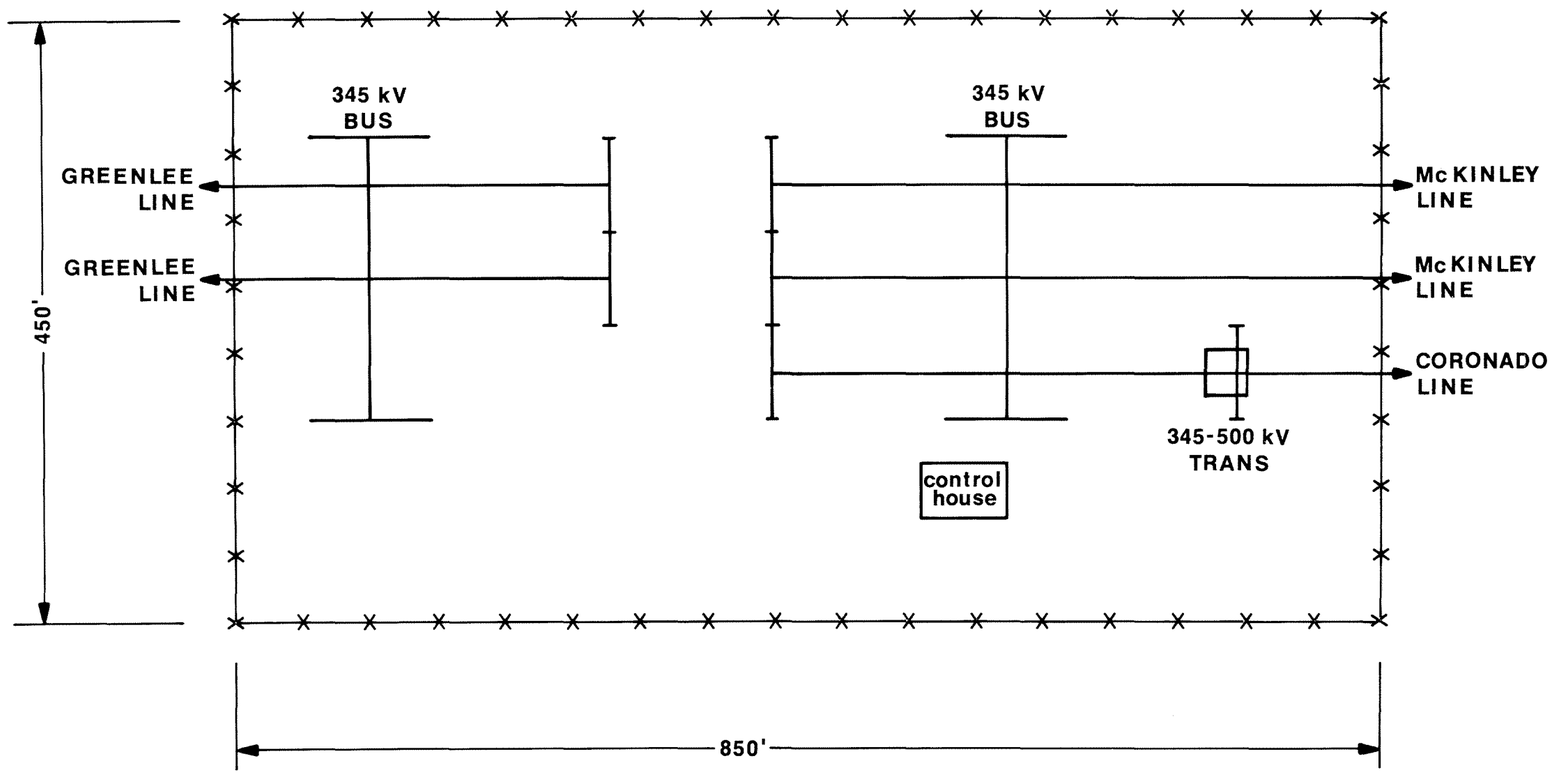
Figure III-9 is a detailed map of the two alternative paths for the TG&E Backup System.

(1) Link 1

Location: The link is routed southeast of the Coronado Station site in Apache County, Arizona, and crosses into Catron County in New Mexico. This link would serve the backup system interconnection to the San Juan-Vail line.

Length: 19.0 miles (Double line = 38.0 miles)

Access: Fair - 3.9 miles
Poor - 6.2 miles
None - 8.9 miles



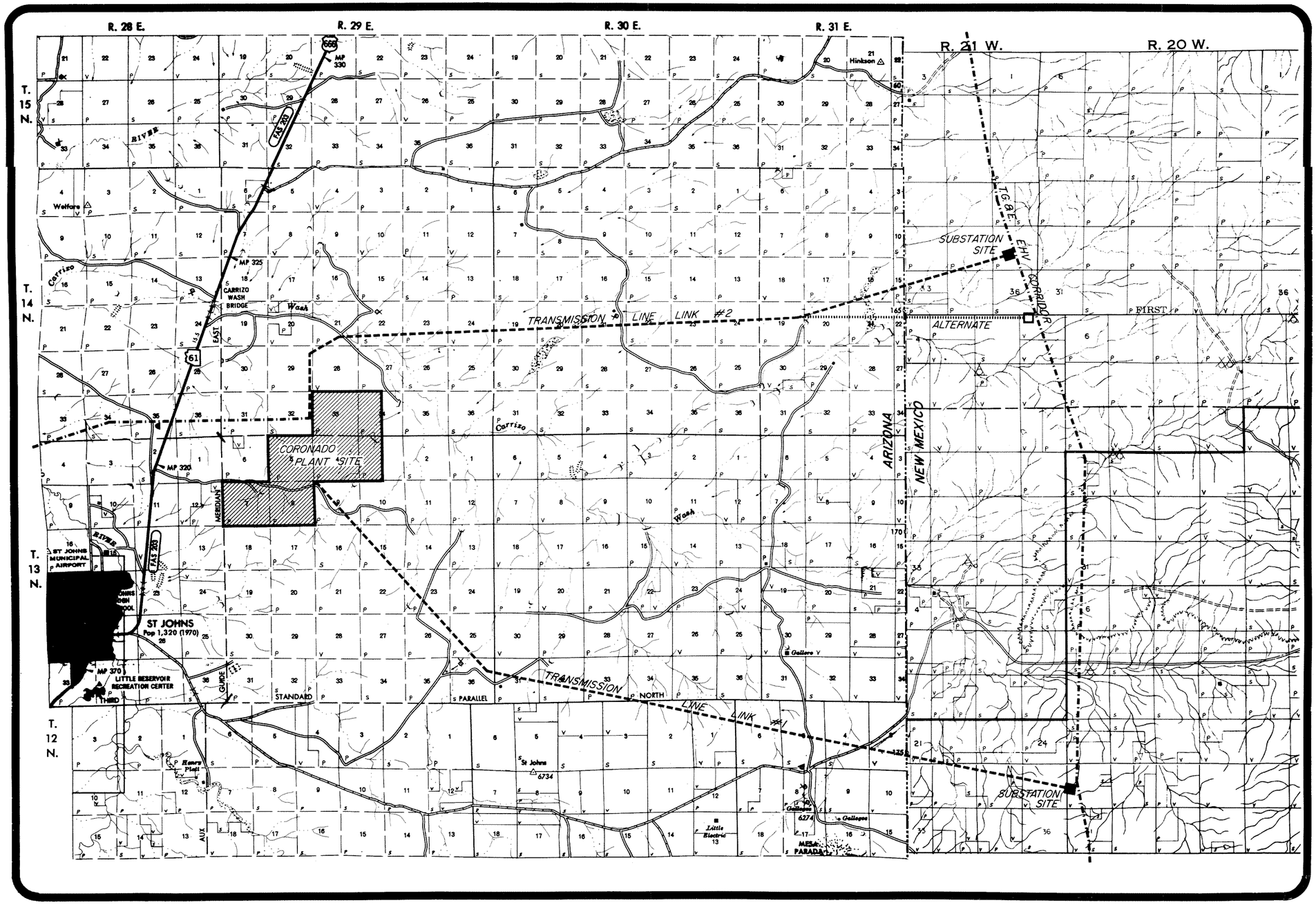
0 50 100
1"=100'

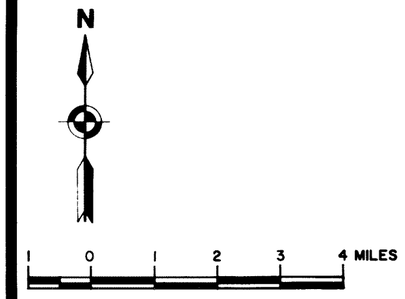
CORONADO PROJECT

Transmission System

T.G.& E. 345 kV TRANSMISSION SUBSTATION DESIGN

Figure III-8





CORONADO PROJECT

Transmission System

T. G. & E. BACKUP SYSTEM

Figure III-9

Physiography: The terrain crossed by the link is flat plateau with slopes generally between 0-10 percent. Twelve drainages are crossed.

Soils and Geology: Soil erosion potential ranges from low to high, depending on the type of terrain crossed. Areas considered to have high soil erosion potential are soils in drainage ways affected by occasional heavy runoff and sections of the western portion crossing steep rocky slopes where construction disturbance would be significant. A ridge having a broad, gently sloping top is found along the eastern portion and may provide a route through an area of steep terrain with relatively low impact to the area.

Impact: Low.

Ecology: The links cross 12.8 miles of juniper-pinyon grassland ecotone within which three riparian communities are crossed, and 6 miles of grasslands within which one riparian community is crossed.

Impact: Moderate to Low.

Visual Landscape Character: Above average scenic quality - 12.6 miles of badlands topography. Average scenic quality - 6.4 miles of flat plateau.

Impact: Moderate to High.

Highway Influence: No highways are crossed.

Impact: None

Archeology: Moderate site density.

Impact: Moderate.

Current Land Use: Range and undeveloped lands exist throughout the link areas.

Impact: None.

Planned Land Use: Rangeland throughout.

Impact: None

(2) Link 2

Location: The link extends northeast of the Coronado Station site in Apache County, Arizona, into Valencia County in New Mexico. This link would serve the backup system interconnection to the San Juan-Vail line.

Length: 16.9 miles (double line = 33.9 miles).

Access: Poor - 1.0 mile
None -15.0 miles

Physiography: The link extends across mostly flat plateau with slopes of 0-10 percent. Six drainages, including Carrizzo Wash, are crossed.

Soils and Geology: Soils resemble those of link 1, although areas considered high for potential erosion are somewhat more frequent. It also appears that less access roads exist along this link.

Impact: Low.

Ecology: The link crosses 10.9 miles of pinyon- grasslands. Ecotone, 5.1 miles of grasslands and two riparian communities.

Impact: Moderate to Low.

Visual Landscape Character: Average scenic quality - flat plateau, open.

Impact: Moderate.

Highway Influence: No highways are crossed.

Impact: None.

Archeology: High plus site density - 1 mile; moderate site density - 16 miles; two samples taken, two recorded sites.

Impact: Moderate to Low.

Current Land Use: Rangeland throughout.

Impact: None.

Subsequent to the issuance of the Draft Statement to the public, TG&E announced their plans to construct a substation and a generating station near Springerville, Arizona. In their announcement, TG&E stated that they plan to have the generating station in operation by the year 1984. Should this occur, it is very likely that TG&E would desire to interconnect their proposed Springerville generating station with the Coronado Station for the backup system. To date, there are no known studies available that show where TG&E would route their backup line from their proposed Springerville Station to SRP's Coronado Station. Likewise, it is not known whether Links 1 or 2 would be useable for such a system.

f. Start Up Power

The Coronado Generating Station will require start-up power in advance of the turbine roll date. The schedule is shown below. (This does not include construction power requirements.)

The most efficient and economical means of providing this start-up power is to complete the backup system interconnection to the APS Cholla Generating Station, and obtain the power from the Cholla Station over the Coronado-Cholla 500 kV line. If this line is not completed by April 3, 1978, the Navopache Electric Cooperative 69 kV system which serves the St. Johns area can be utilized to provide 10 MW (or approximately 10 MVA) of start-up power if SRP provides the 13 mVar of additional 24 kV shunt capacitors at St. Johns on the Navopache system. This will cost SRP approximately $100,000 (in 1976 dollars) which serves no other benefit to SRP other than delaying the need for the Coronado-Cholla backup system interconnection for four months.

Total Start-up Power (Mega Volt-Amperes)	Requirements Added	Date Required
0.343	Lighting/Cranes Elevators	4/3/78
2.703	Sump pumps/Wells/Makeup water	4/24/78
8.551	Service water/Fire pumps/Water treatment/Coal handling	5/29/78
9.938	Aux. boiler/Freeze protection	6/26/78
17.727	Circulating water/Cooling tower Cooling water/Condenser pumps	7/31/78
40.108	Boiler feed pump. Forced draft fan/Induced draft fan/Lube oil pumps	8/28/78
48.431	Ash handling/Fuel oil system Stator cooling/Turning gear	9/25/78
48.441	Transformer cooling	10/30/78
57.721	SO_2 removal/Feed pumps	1/1/79

If SRP has to continue to serve start-up power over the Navopache system beyond the initial four month period, significant transmission system additions to the Navopache system will be required. APS conducted studies of future Navopache electrical system requirements prior to negotiating an interconnection and power source for

the Navopache system at the Coronado Generating Station. These studies indicated that a 230 kV system as well as a 69 kV system would be needed. Based on these studies, it was determined that the peak 57.721 MVA start-up requirement would require a new 69 kV line from Cholla to Show Low to Vernon (72 miles) with associated substation facilities. More shunt capacitors for power factor corrections will also have to be added in the Coronado-St. Johns area. These facilities are estimated to cost $2,164,000 (in 1976 dollars) and will not be needed by SRP, APS, or Navopache once the Coronado-Cholla 500 kV line is completed. The new facilities will also create additional impacts upon the environment in the Cholla-Show Low-St. Johns area.

A second alternative for start-up power would be to build a 69 kV line to the TG&E San Juan-Vail 345 kV line in New Mexico. However, recent experience in ordering the type of equipment required for the substation indiciates that it is highly unlikely that procurement and installation could be accomplished in the required time frame. The cost of such a system would be approximately $2 million (in 1976 dollars). This would include the cost of the 69 kV line, a 345/69 kV transformer, a 345 kV circuit breaker and other substation facilities. Wheeling costs are not included in this figure. Again, these facilities would have no use after the Coronado-Cholla 500 kV line is completed. In addition, due to the special application for which the transformer would be designed, the salvage value of this item would potentially be limited to scrap metal values at the time of retirement.

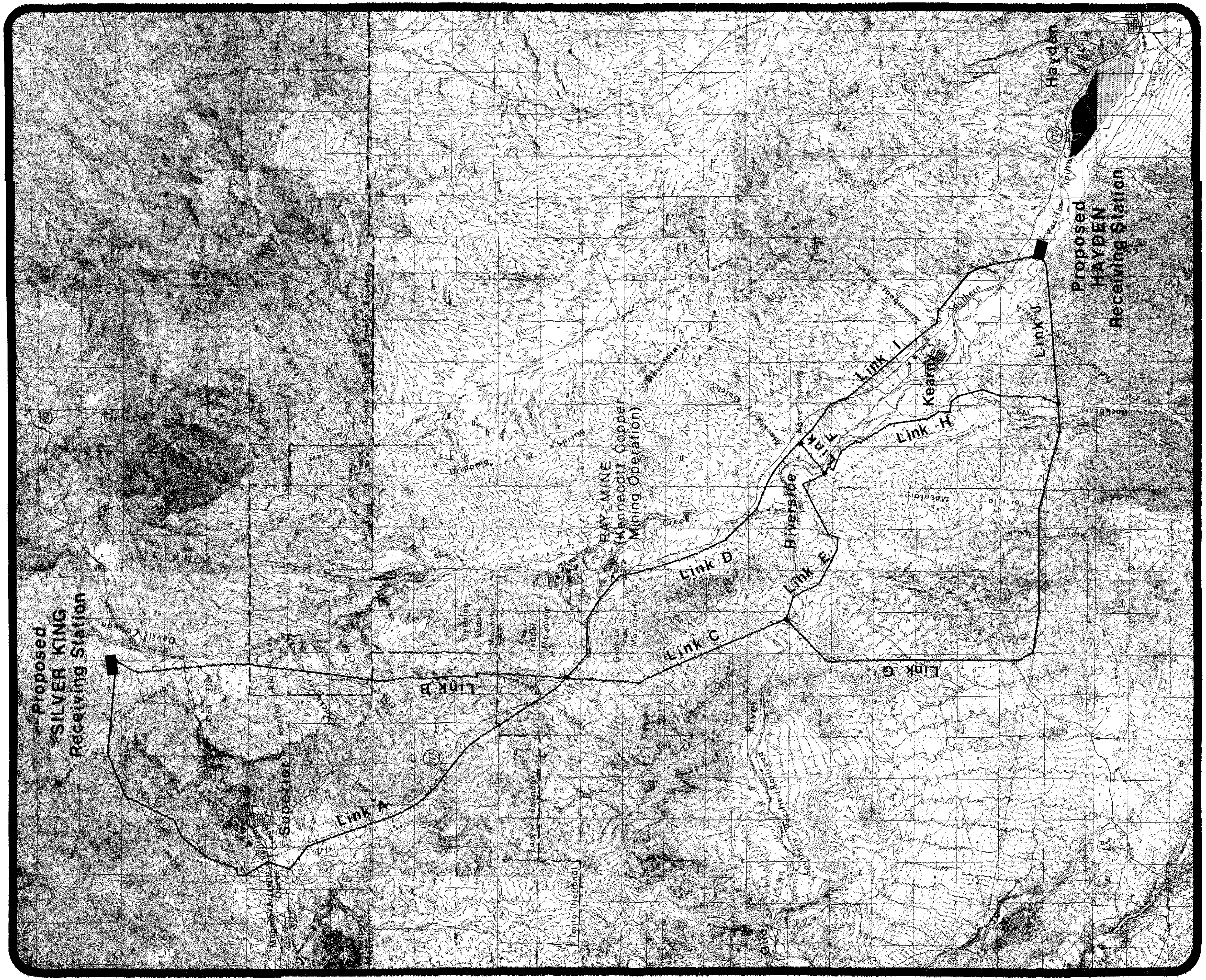
The TG&E interconnection could also serve as a source for start up power, should it be constructed. However, the late schedule (in service by 1980) would cause too long a delay for the start up power needed to test the first unit of the Coronado Generating Station.

g. Route (Link) Alternatives - 230 kV EMA System

The routes studied in connection with the 230 kV EMA system are considered to be alternatives. The proponent has not indicated a preferred route. Thus, all routes, as shown in Figure III-10, are described below as alternatives.

(1) Route A

Location: Route A begins at the proposed Silver King Substation following the proposed SRP 230-500 kV corridor (Link 28) due west, crossing Queen Creek Canyon, and passing north of Kings Crown Peak. The line then angles west southwest and crosses the Silver King Wash. Here Route A proceeds southwest crossing the Silver King Road before leaving the SRP 500 kV corridor and follows the SRP 115 kV alignment, crossing the Silver King Road again, before turning south by southwest. After routing around the existing SRP Superior substation, Route A crosses the Magma Railroad and U.S. Highways 60/70 before turning south. The line then crosses Queen Creek and turns southeast where it parallels an SRP 115 kV line to the end of the route, passing Lime Point.



Z

Miles
0 1 2

CORONADO PROJECT

Transmission System

ROUTE ALTERNATIVES

230kV EMA SYSTEM

Figure III-10

Length: 16.1 miles

Access:
Fair - 1.4 miles
Poor - 3.5 miles
Good - 11.2 miles

Physiography: The terrain is mountainous for approximately the first 5.0 miles and the last 4.0 miles. The area between is relatively flat. Thirteen drainages are crossed. The following shows percent of slopes crossed, in miles, by Route A:

0 - 10% - 11.4 miles
10 - 20% - 2.9 miles
20 - 30% - 0.9 mile
30% or more- 0.9 mile

Soils and Geology: Soil erosion potential ratings for Route A are as follows:

High to Moderate - 0.9 mile
Moderate to High - 7.4 miles
Moderate to Low - 0.9 mile
Low to Moderate - 6.9 miles

The high to moderate soil erosion potential occurs around the Walnut Creek area. Revegetation potential is generally moderate. Soil erosion potential is moderate.

Ecology: The high impact between miles 1.5 and 3.5 is due to the need for new road construction in an area of moderate ecological sensitivity (crossing 12 miles of chaparrel) and good wildlife habitat quality. Moderate impacts were identified for 2.1 miles due to moderate ecological sensitivity, good wildlife habitat quality and good access between miles 0.0 to 1.5, and declining wildlife habitat quality between miles 3.5 and 4.1. Route A crosses approximately 7.9 miles of mixed Palo Verde-Cactus, 3.3 miles of both mixed Crucifixion Thorn and Chaparrel-oak Woodland, 0.8 miles of Jojoba, 0.7 miles of Desert Grassland and 0.1 miles of riparian communities.

Visual Landscape Character: Although scenic interest was high and visibility of the transmission line would generally be modified for the entire length of Route A, the moderate impact rating was due in part to the following of the existing 115 kV transmission line which generally lowered the condition of the landscape. Areas of greatest scenic concern are King Crown Peak, Picketpost Mountain and Apache Leap.

Highway Influence: U.S. Highway 60/70-A moderate impact between highway milepost 1.8 to 2.4 was due to the man-made dominance condition of the landscape, caused in part by the proposed 230 kV line crossing the highway, and a high visual interest of the surrounding topography. State Route 117-A high impact was identified between mileposts 3.7 to 8.2 due in part to the lines close proximity to and paralleling State Route 117.

Historic: The moderate impact, between miles 10.6 and 10.8 was due to a minor increase in visibility and possible disturbances by project personnel, to the Arnett Ranch site.

Archeology: Four small areas, amounting to 0.7 miles of the total distance, constituted a moderate impact based upon the size and quantity of the sites. A high impact of 0.4 miles was a result of the largest site recorded, located outside of the Gila River Valley.

Current Land Use: Within 1/8 mile of the line are two commercial areas, three heavy industry areas, the Superior Airport interference zone, an equestrian area, a stockyard and nine residential units. Route A has 0.3 miles of severe impact, due to the crossing of the Superior Airports' interference zone. The 1.0 mile of high impact is caused by the visible proximity to residential land uses, and 0.3 mile caused by the route crossing the direct physical zone of eight low density residences in the Walnut Creek area, while 0.8 miles of moderate impacts are caused by a lesser degree of visibility of fewer residential units. Route A falls within two miles of the Boyce Thompson Arboretum.

Planned Land Use: Route A crosses an Extractive Industry area (Pinal County 1985 Development Plan) between miles 4.5 and 9.5 and may affect the considered upgrade of State Route 177 between mile 10.6 and 16.1.

(2) Route B

Location: The APS Cholla-Saguaro 500 kV corridor is followed for the entire length of Route B. Route B lies west of Devils Canyon beginning at the proposed Silver King Substation and proceeds south southwest to mile 0.5. At this point, the line would turn south crossing U.S. Highways 60 and 70, Oak Flat, Rancho Rio Creek and Hackberry Creek. Route B parallels and crosses Oak Creek. The line would enter Walnut Canyon passing west of Sleeping Beauty and Teapot Mountains. Route B passes east of the Walnut Creek settlement and crosses State Route 177.

Length: 10.7 miles

Access: Good - 10.7 miles

Physiography: Route B crosses a flat plateau area for the first 3.0 miles before crossing rolling and mountainous terrain for the remaining distance. Nine drainages are crossed. The following percent of slopes are crossed by Route B.

0-10% - 5.9 miles
10-20% - 1.7 miles
20-30% - 1.2 miles
30% or more - 1.9 miles

Soils and Geology: Soil erosion potential ratings for Route B are as follows:

High to Moderate - 1.1 miles
Moderate to High - 6.7 miles
Low to Moderate - 2.9 miles

The high to moderate erosion potential occurs in the southern portion of Route B which has irregular topography with thin soils, (existing transmission lines show vegetation varying from moderate to extensive, depending on slope.) Thin soils for the first 3.9 miles will hamper revegetation while revegetation is generally favorable for the remainder of the route. Route B responds to a moderate impact potential for its entire length.

Ecology: Potentially severe impacts for 0.6 miles, could occur where this route crosses, riparian habitats associated with tributaries of Devil's Canyon. High impact ratings for 2.8 miles result from the area being characterized by good wildlife habitat quality and moderate ecological sensitivity coupled with very rugged terrain that will almost certainly require additional road-building if construction occurs on this route. Moderate ratings at the origin of the route and between miles 6.0 - 8.9 were identified with the assumption that the burned area (miles 7.1 - 8.8) is recovering and will provide good wildlife habitat within a short time. Route B crosses 3.4 miles Sonoran Desert Scrub, 4.9 miles of Chaparrel-oak Woodland, 1.1 miles of Palo Verde Cactus, 0.5 mile of mixed Crucifixion Thorn, and 0.8 mile of riparian communities.

Visual Landscape Character: A moderate impact was given for the first 10.0 miles, due in part to the condition of the landscape and the following of an existing 500 kV transmission line. Devils Canyon was identified as an area of scenic concern.

Highway Influence: U.S. Highway 60-70-A moderate impact between highway milepost 7.0 to 8.0 was caused by Route B crossing the highway in this area. State Route 117-A high visual interest and a mixed condition adjacent to the Mineral Creek area resulted in a moderate impact between highway milepost 8.2 and 9.5.

Historic: Although Route B passes directly through and could destroy portions of a site, which contains a number of CCC check dams, a moderate level of impact was assigned, due to the quantity of dams within the sight area.

Archeology: A moderate impact was identified around an unknown site between miles 8.9 to 9.1. The high impact between miles 5.0 to 5.6 is the result of a high potential for a site to yield information concerning the prehistoric occupation of the region. The remaining 9.9 miles has low site density.

Current Land Use: Route B has no severe or high impacts and has only moderate impacts due to the lines visibility from residential areas in Walnut Creek and in crossing the Oak Flat Campground. The impacts on Route B are lower due to paralleling the APS 500 kV line for its entire length.

Planned Land Use: None were identified along Route B.

(3) Route C

Location: The APS Cholla-Saguaro 500 kV corridor is followed from mile 0.0 to 5.0. Route C begins just south of State Route 177 and proceeds south for 1.7 miles before turning southeast. Copper Butte, a mile to the west, is passed at mile 2.0. West of Route C, the Spine is paralleled and the Gila River is crossed twice.

Length: 5.5 miles

Access: Good - 5.0 miles
Poor - 0.5 miles

Physiography: The first 3.0 miles routes through a flat expansive valley while the remaining area crossed was irregular. Thirteen drainages are crossed. Percent of slope crossed by Route C are as follows:

0-10% - 3.7 miles
10-20% - 1.3 miles
20-30% - 0.2 mile
30% or more - 0.3 mile

Soils and Geology: Soil erosion potential for Route C is as follows:

High to Moderate - 3.2 miles
Moderate - 2.3 miles

Between miles 0.0 to 4.9, moderate soil erosion potential exists and a moderate impact level was given. The remaining 0.6 miles responds to the crossing of the Gila River and associated flood plain soils. Where scouring around tower foundations could be a factor, a high impact rating was assigned. The revegetation potential is generally moderate to good.

Ecology: Between miles 5.0 - 5.3 a severe impact was identified due to the potential removal of highly sensitive riparian vegetation on the Gila River for road and tower construction. The high impact between miles 5.3 and 5.5 is the result of needed road construction in an area of good wildlife habitat quality that is immediately adjacent to an area of excellent wildlife habitat quality. Route C crosses 5.1 miles of mixed Palo Verde Cactus and 0.4 miles of riparian communities.

Visual Landscape Character: The moderate impact between miles 0.7 to 3.0 was the result of a high interest and natural dominance condition. The high impact for 0.5 miles is due to the high scenic interest of the Gila River and the proposed route leaving the APS Cholla 500 kV corridor.

Highway Influence: For description of State Route 177, refer to Route B highway miles 8.2 to 9.5.

Historic: A moderate impact between miles 4.8 to 5.1 was due to increased access and visual intrusion, to Zellweger Ranch site by the proposed 230 kV transmission line.

Archeology: Route C has low site density with only 3 sites identified. A potential severe impact was identified for 0.8 miles (from mile 4.7 to 5.5) based on the presence of one large site of maximum sensitivity. This area has poor access contributing to the severity of potential impact. A moderate impact between miles 4.6 to 4.7 responds to two small loci, adjacent to Route C.

Current Land Uses: There are no severe or high impacts on Route C. The 0.2 miles of moderate impacts are due to the lines visibility to the Walnut Creek residences.

Planned Land Use: Route C crosses the proposed County Park, Recreation and Open Space area for 1.0 mile, the high water level of the proposed Buttes Dam Reservoir for 0.5 mile. Consequently, high to moderate impacts were assigned in these areas. The high impact is the result of no existing transmission lines along the proposed corridor at the Gila River Crossing. The proposed County Park has not been coordinated with the federal agencies with the land management responsibilities.

(4) Route D

Location: Route D crosses State Route 177 and angles south and southeast, paralleling State Route 177 and the 115 kV SRP transmission line, for its entire length, crossing the highway twice. Route D passes north and east of Granite Mountain, west of the Ray Mine, crossing Mineral Creek and the Kennecott Copper Corporation Railroad. Route D then passes northeast of Riverside and the Gila River and finally crosses Hackberry Gulch and Kane Spring.

Length: 8.4 miles

Access: Good - 8.4 miles

Physiography: Route D crosses gentle slopes for its entire length. Eighteen drainages are crossed. The following shows percent of slope crossed by Route D:

0 - 10%	- 8.0 miles
10 - 20%	- 0.4 miles

Soils and Geology: Soil erosion potential for Route D is as follows:

High to Moderate	- 7.1 miles
Moderate	- 1.3 miles

Locally where major stream channels are crossed the erosion potential is high but since streams will be spanned, the entire route was assigned a moderate impact. Revegetation potential is low to moderate.

Ecology: Between miles 6.2 and 6.4 a potentially high impact could occur if towers or pulling stations are placed in the narrow bank of riparian vegetation along Mineral Creek. Route D crosses 8.1 miles of mixed Palo Verde Cactus and 0.3 miles of riparian communities.

Visual Landscape Character: Natural dominance condition between miles 0.0 to 1.4 resulted in a moderate impact. The Dripping Spring Mountains were identified as an area of scenic concern.

Highway Influence: State Route 177-A high impact was identified between miles 0.0 - 1.0 due to high visual interest and a natural dominance condition of the landscape. Between highway mileposts 8.2 to 9.5 and 13.9 to 16.0 a moderate impact resulted from existing transmission lines and a high visual interest.

Historic: Because the Ray site is increasingly being exposed to new adverse impacts, primarily due to the local mining industry, a low impact level was assigned between miles 2.6 to 3.1.

Archeology: The last 2.2 miles of Route D has a moderate impact due to the moderate sensitivity of several isolated loci. The northern portion of Route D has no cultural remains.

Current Land Use: Within 1/8 mile of Route D are 12 mobile homes, two extractive areas and one substation. Between 1/8 and one mile are 178 residential units, three commercial areas, one cemetery, one governmental unit, one extractive area and 2.4 miles of agriculture. Because the direct physical zone of 12 mobile homes are crossed, 0.3 miles resulted in high impacts. A moderate impact was identified for 9.8 miles, caused by the lines visibility to Riverside and numerous mobile homes.

Planned Land Use: None were identified along Route D.

(5) Route E

Location: Route E extends east to mile 0.6, turning south southeast and crossing the Gila River at this point. The Southern Pacific Railroad is crossed before Route E turns southeast, crossing the SCIDD 69 kV line and then paralleling the 69 kV line to mile 4.0. Route E continues northeast to mile 4.0 entering south of the Kelvin-Riverside area and angles southeast at mile 4.0 to 4.6.

Length: 4.6 miles

Access: Poor - 1.6 miles
Good - 3.0 miles

Physiography: Due to the location of Route E, flood plains, foothills and a few steep slopes are encountered. Route E traverses the northern slopes of the Tortilla Mountains and crosses the Gila River and nine unnamed washes. The following percent of slopes are crossed by Route E:

0 - 10%	- 3.5 miles
10 - 20%	- 0.7 mile
20 - 30%	- 0.3 mile
30% or more	- 0.1 mile

Soils and Geology: Soil erosion potential for Route E is as follows:

High to Moderate	- 2.2 miles
Moderate	- 0.5 mile
Low to Moderate	- 1.9 miles

A high erosion impact, between miles 0.0 to 0.9 is assigned to the Gila River flood plain soils where scour around tower foundations could be a factor affecting their integrity. The remaining 3.7 miles responds to a moderate impact with slight revegetation potential.

Ecology: Impact ratings over the first mile of this route are related to the need for constructing new access roads through highly sensitive riparian communities (0.8 miles are crossed) with excellent wildlife habitat quality (resulting in a severe impact) and adjacent to mixed Palo Verde Cactus communities (3.8 miles are crossed) with good wildlife habitat qualities and low sensitivity (resulting in high impact ratings). Other high impact ratings on this route (e.g. miles 4.0 - 4.6) were not given a severe impact rating because of the proximity of the town of Riverside and resultant human activity that detracts from the wildlife habitat quality of the terminus of Route E.

Visual Landscape Character: The high impact between miles 0.0 to 1.0, results from crossing the Gila River where no transmission lines are presently located. The moderate impact between miles 1.0 to 2.7 and 4.0 to 4.6 is due in part to no existing utility corridor and proximity to the Gila River.

Highway Influence: State Route 177-A the moderate impact between highway milepost 14.6 to 16.0 (0.0 to 1.4 milepost) responded to the high interest and natural dominance condition in the Mineral Creek area.

Historic: Historic mining sites between miles 0.4 to 0.8 will be subject to a low level of impact due to increased site access by project personnel.

Archeology: The area between miles 0.3 to 0.6 was given a severe impact because of poor access and large apparently undisturbed site overlooking the Gila River. A moderate impact was identified between miles 0.0 to 0.3 resulting from a single isolated loci. No high or moderate impacts were identified along the route. No archeological resources were identified for the remaining distance of Route E.

Current Land Use: Within the 1/8 mile of Route E are 45 residential units, one extractive area and one heavy industry use. Between 1/8 and one mile are 151 residential units, three commercial areas, one cemetery, one governmental yard. The high impact for 0.1 mile is due to the lines proximity to the residential areas of Riverside. The moderate impact for 0.9 miles is caused by the visibility to the town of Riverside and a county park in Riverside.

Planned Land Use: Route E crosses the proposed Pinal County Parks, Recreation and Open Space area for 0.3 mile, and the high water level of the proposed Buttes Dam Reservoir for 0.7 mile, a planned scenic trail twice and the Gila River. The proposed County Park has not been coordinated with the federal agencies charged with managing the land. The high impact (between miles 0.0 to 0.9) was the result of a number of park, recreation and natural area designations associated with the Gila River influence.

(6) Route F

Location: Route F crosses the Gila River and the Southern Pacific Railroad at mile 0.1, and proceeds northeast for 0.8 miles.

Length: 0.9 miles

Access: Poor - 0.9 miles

Physiography: Route F lies within the Gila River flood plains between the Tortilla Mountains to the west and the Dripping Spring Mountains to the east. Route F crosses the Gila River and two unnamed washes. Route F crosses 0-10 % slopes for its entire length.

Soils and Geology: Moderate soil erosion potential exists for all of Route F since the Gila River Channel soils are often subjected to scour during high flows. The revegetation potential for the fine grained soils is moderate to good. The high impact, between miles 0.2 to 0.7 responds to the crossing of the Gila River and associated flood plain. The remaining 0.4 miles was a moderate impact.

Ecology: Milepost 0.0 - 0.2 of Route F, encounters a high impact due to a high ecological sensitivity and very good wildlife habitat quality. A moderate rating was given the rest of the route because of necessary access road construction. Route F crosses 0.8 miles of mixed Palo Verde Cactus and 0.1 mile of riparian communities.

Visual Landscape Character: A moderate impact was identified for the entire length of Route F due in part to the crossing of the Gila River area.

Highway Influence: Because of the landscapes mixed condition and the transmission lines modified visibility between highway milepost 16.0 to 17.7 the impact is low along State Route 177.

Historic: No historic sites were identified along Route F.

Archeology: The entire route has a moderate sensitivity rating, based on three isolated finds, as well as a poor access rating, thus, a moderate impact was assigned.

Current Land Use: Route F passes within one mile of the unincorporated communities of Kelvin and Riverside. The entire 0.9 mile of Route F has a high impact because of visual disturbance to the town of Riverside.

Planned Land Use: Route F crosses the high water level of the proposed Buttes Dam Reservoir for 0.2 miles and crosses both the Gila River and a planned scenic trail, resulting in a high impact for 0.5 miles, and a moderate impact for the remaining 0.4 miles.

(7) Route G

Location: Route G crosses the Gila River and the Southern Pacific Railroad and continues southwest joining the APS Cholla-Saguaro 500 kV corridor at

mile 1.2 before turning due south. At mile 6.0, Route G turns southeast leaving the 500 kV corridor at mile 6.4, where the line turns east following an existing SRP 115 kV line to the end of the route, crossing Ripsey Wash and Hackberry Wash.

Length: 12.4 miles

Access: Poor - 1.5 miles
Good -10.9 miles

Physiography: After crossing the Gila River, mountainous terrain is encountered for approximately 2.0 miles and again when Route G traverses the Tortilla Mountains between miles 9.1 to 11.9. Route G crosses 18 drainages. Percent of slopes crossed by Route G are as follows:

0 - 10%	- 8.5 miles
10 - 20%	- 2.2 miles
20 - 30%	- 1.3 miles
30% or more	- 0.4 mile

Soils and Geology: Soil erosion potential for Route G is as follows:

High to Moderate	- 8.4 miles
Moderate	- 1.7 miles
Low to Moderate	- 2.3 miles

A high impact, between miles 0.0 to 0.2 and 11.9 to 12.1, responds to the crossing of the Gila River with its associated flood plain and Hackberry Wash respectively. The remaining 12.0 miles has a moderate impact potential. Revegetation potential varies from sparse to moderate along Route G.

Ecology: The severe impact rating (mile 0.0 - 0.3) involves crossing of 0.4 miles of highly sensitive riparian habitats with excellent wildlife habitat qualities. High impact ratings (miles 9.0 - 10.0, 0.3 - 0.5 and 0.0 to 0.1) are all related to the necessity of creating new, access roads to facilitate construction within this route. Miles 10.0 - 12.4 are assigned a moderate impact value because the route, at this point passes through or very near good Mule Deer and Javelina populations that could decline due to increased area access. Route G also crosses 8.3 miles of mixed Palo Verde Cactus and 3.7 miles of Desert Grassland communities.

Visual Landscape Character: The high impact between miles 0.0 to 1.0, responds to the high interest and natural dominance condition of the surrounding landscape. Interest between miles 1.0 to 1.5 becomes

representative and reduced the impact to moderate. The low and moderate impacts between miles 1.5 to 12.4 responds to the following of existing 115 kV and 500 kV transmission lines.

Highway Influence: Route G is located at least 3 miles from State Route 177, consequently the impact is low between highway milepost 19.3 to 25.2.

Historic: A moderate impact due to increased visual disturbance and possible destruction of the Hackberry Mine site, by vandalism, was given between miles 11.8 to 11.9.

Archeology: A severe impact for the first 0.2 miles was based on maximum sensitivity of two major sites and poor access. A moderate impact (between miles 5.3 and 6.4) was the result of several archeological loci present near a minor drainage.

Current Land Use: Between 1/8 and one mile are one residential unit, three stockyards and the "A" Diamond Ranch. From one to two miles away from Route G are a microwave tower and two ranches.

Planned Land Use: Route G crosses 1.4 miles of the proposed County Park, Recreation and Open Space area and the high water level of the proposed Buttes Dam Reservoir for 0.4 mile, resulting in high impact (between miles 0.0 to 0.4) and moderate impact (between miles 0.4 to 1.4). The proposed "county park" has not been coordinated with the federal land management agencies.

(8) Route H

Location: Route H parallels a gas pipeline for its entire length. Proceeding southeast for 1.9 miles, Route H turns south. At mile 2.9 the Route proceeds southwest crossing Hackberry Wash before turning due south to mile 6.1 where the line angles southeast for the remaining distance.

Length: 6.5 miles

Access: Good - 6.5 miles

Physiography: Route H parallels, one mile to the west, the Tortilla Mountains for its entire length, where very few steep slopes are encountered except for drainages. Route H crosses Hackberry Wash parallels the Gila River, and crosses 15 unnamed washes. Percent of slope crossed by Route H are as follows:

0 - 10%	- 6.0 miles
10 - 20%	- 0.5 mile

Soils and Geology: Moderate soil erosion potential exists for Route H. Where the alignment crosses or parallels the Gila River or Hackberry Wash revegetation potential is moderate to good. Revegetation for the remainder of the route is a questionable process. Because of the close proximity of Hackberry Wash, placement of the proposed 230 kV transmission line, between miles 4.0 to 5.0 would result in a high impact. A moderate impact was assigned to the remainder of Route H.

Ecology: This route originates in very good wildlife habitat (miles 0.0 - 0.1) then parallels that habitat for the next 3.5 miles. An impact rating of high is given for the first 3.6 miles of the route to underscore the potential for conflicts with mesquite and other riparian communities on the west bank of the Gila River. The origin of the route is not assigned a severe rating because of existing disturbance related to the proximity of the town of Riverside. Moderate ratings between miles 3.6 and 6.5 underscore the possible impact of construction access roads in areas that were previously inaccessible by vehicle. Route H crosses 4.9 miles of Palo Verde Cactus and 1.6 miles of riparian communities.

Visual Landscape Character: Route H follows a pipeline right-of-way where no overhead structures currently exist. The moderate impact of Route H responds to a natural dominance and mixed condition (Kelvin-Riverside and Kearny) and representative interest throughout.

Highway Influence: Due to modified visibility caused by the Tortilla Mountains the resulting visual impact is low between highway milepost 16.0 to 25.2 and 25.7 to 26.8.

Historic: Moderate impacts were identified for 0.4 miles due to possible site destruction or alternation and probably increased site access by public and project personnel.

Archeology: Although Route H has good access, it also has the heaviest concentration of archeological resources. The severe (between 2.1 to 3.2) and high (between mile 1.0 to 2.1 and 3.2 to 4.0) impacts are based strictly on the size, quality and potential information yield of this area. The area of severe impact is centered on large sherd/lithic scatter and large habitation area. The areas of moderate impact, between miles 0.0 to 1.0 and 4.0 to 5.6, contain fewer resources with no large concentrations but several scattered loci.

Current Land Use: Within 1/8 mile are two residential units, one airstrip interference zone and 7.0 acres of agriculture. Between 1/8 and one mile are 546 residential units, two local parks, one golf course, two schools, two governmental units, two commercial areas, three heavy industry uses, one equestrian area, one airstrip, the Kearny Corporate limit and 55 acres of agriculture. From one to two miles are 292 residential units, two planned subdivisions, two schools, four churches, one cemetery, two governmental units, one hospital, one commercial area, one extractive area and two substations. A High impact for 4.7 miles is due to the visual disturbance to single family dwellings in Riverside and Kearny area and physically crossing the interference zone of the Kearny Airstrip. Various impact levels for the outdoor recreation were assigned due to proximity to the Gila River with the impact levels depending largely on distance from the Gila River and land ownership.

Planned Land Use: Route H crosses 0.7 mile of the proposed Buttes Dam Reservoir high water area.

(9) Route I

Location: Route I parallels the SCIDD 69 kV line, the Gila River and State Route 177 for its entire length. Crossing State Route 177 in a southeasterly direction, the line turns south southeast at mile 1.2 and southeasterly again at mile 1.5. The Kearny incorporated boundary is crossed before the line turns due east for 0.2 mile then southeast again. Route I crosses State Route 177 and enters the Proposed Hayden 230 kV Substation at mile 7.5.

Length: 7.5 miles

Access: Good - 1.5 miles
Poor - 6.0 miles

Physiography: Three to four miles to the east of Route I, lie the Dripping Spring Mountains which are paralleled for the entire length of Route I, resulting in gentle slopes overall. Route I crosses Steamboat Wash and 28 unnamed washes.

The following percent of slopes are crossed by Route I:

0-10%	- 7.1 miles
10-20%	- 0.2 mile
20-30%	- 0.2 mile

Soils and Geology: Moderate soil erosion potential exists along the entire length of Route I. Erosion on existing transmission lines which have been constructed in this area has been slight. Sparse vegetation cover and relatively thin surface soil development indicates that vegetation potential is low to moderate. Between miles 0.0 to 7.2, a moderate impact potential was given. The remaining 0.3 miles crosses the Gila River flood plain resulting in a high impact.

Ecology: The entire 7.5 miles of this Route was assigned a low impact due to fair wildlife habitat quality and low ecologic sensitivity. Route I crosses 6.7 miles of mixed Palo Verde Cactus-Desert Scrub vegetation and 0.8 miles of riparian communities.

Visual Landscape Character: Route I follows a 115 kV transmission line, resulting in a low impact for one mile. A change in the landscape condition results in a moderate impact between miles 6.0 and 7.0.

Highway Influence: Along State Route 177 between highway milepost 16.3 to 25.2 a moderate impact was identified due in part to the open-variable visibility of the proposed transmission line.

Historic: No identified historic sites along Route I.

Archeology: Numerous lithic scatters from mile 0.0 to 6.0 resulted in a moderate impact level. The high impacts, from mile 6.0 to 7.1 and 7.3 to 7.5 was the result of the high density of archeological loci in the area and poor access.

A severe impact (between miles 7.1 to 7.3) corresponds to the location to two sites and poor access.

Current Land Use: Within 1/8 mile of the corridor are 89 residential units, two commercial and governmental units, one each substation and church, the Kearny Corporate limit and 8.0 acres of agriculture. Between 1/8 and 1 mile of the corridor are 839 residential units, two local parks, one golf course, two schools, three churches, one cemetery, one hospital, one airstrip, and its interference zones, two governmental areas, one extractive area, one heavy industry area and one equestrain area.

Planned Land Use: Two planned subdivisions, one located with 1/8 mile of the corridor.

(10) Route J

Location: Route J angles east for a distance of 3.4 miles, turning northeast and entering at the Proposed Hayden Substation at mile 3.6. It parallels an existing 115 kV powerline.

Length: 3.6 miles

Access: Good - 1.8 miles
Fair - 1.8 miles

Physiography: Route J begins at the foothills of the Tortilla Mountains and ends at the foothills of the Dripping Spring Mountains.

Route J crosses the Indian Camp Wash, the Gila River and 12 unnamed washes. Percent of slopes crossed are as follows:

0 - 10%	- 2.8 miles
10 - 20%	- 0.4 mile
20 - 30%	- 0.4 mile

Soils and Geology: All 3.6 miles of Route J have a moderate soil erosion potential rating. Existing transmission right-of-way show slight changes in the natural erosion patterns and existing vegetation cover is sparse. The presence of a thin soil horizon makes revegetation of questionable success.

The first 3.3 miles responds to a moderate impact level (see Route A). Due to the crossing of the Gila River and associated flood plain, a high impact was given between miles 3.3 to 3.6.

Ecology: Milepost 0.0 - 3.4 has a moderate impact due to good wildlife habitat quality containing good Javelina and Mule Deer habitat (0.0 - 2.0 mile) and low ecological sensitivity. A high impact occurs between milepost 3.4 - 3.6 responding to high ecologic sensitivity, very good wildlife habitat quality and crossing 0.2 miles of riparian vegetation in the Gila River flood plain. Route J also crosses 3.4 miles of mixed Palo Verde Cactus.

Visual Landscape Character: An overall moderate impact, due in part to paralleling a 115 kV line for the entire length, was identified along Route J.

Highway Influence: The modified visibility and the lines distance from State Route 177 result in a low impact between highway milepost 19.3 to 26.3.

Historic: No historic sites were identified along Route J.

Archeology: Several such levels of impact are present along Route J due to the presence of one site and several smaller loci. A severe impact was identified for 0.2 miles, high impacts for 0.8 mile and a moderate impact for 0.1 mile.

Current Land Use: No real land uses were identified within 1/8 mile of Route J. Between 1/8 and one mile is one residential unit. From one to two miles are 64 residential units, the Kearny corporate limit and 37.6 acres of agriculture.

The low impact for 1.2 miles is due to visibility of a few residential areas in the Gila River Valley. Route J continues to follow the SRP 115 kV line. The moderate impact between miles 3.4 to 3.6 was the result of the Gila River's recreation potential.

Planned Land Use: None identified.

Table III-16 shows the percentages of land by ownership for the 230 kV EMA proposal.

An evaluation of the alternative routes (all routes are considered to be alternates) for the 230 kV EMA proposal is shown in Table III-17.

TABLE III-16

LAND OWNERSHIP PERCENTAGES - ALTERNATIVE ROUTES (EMA)

ROUTES	A	B	C	D	E	F	G	H	I	J
Private	14%			57%	33%	100%		69%	71%	22%
State	1%	36%		19%	43%		73%		21%	
Bureau of Land Management	11%	6%	100%	24%	24%		27%	31%	8%	78%
National Forest	74%	58%								
Total Miles	16.1	10.7	5.5	8.4	4.6	0.9	12.4	6.5	7.5	3.6

TABLE III - 17

EVALUATION OF ALTERNATIVE ROUTES - 230 kV EMA PROPOSAL

Routes	A	B	C	D	E	F	G	H	I	J
1. Total Length of Routes(miles)	16.1	10.7	5.5	8.4	4.6	0.9	12.4	6.5	7.5	3.6
2. New Access Needed	3.5	0.5	0.5	0.5	1.6	0.9	1.5	0.5	6.0	-
Existing Access Condition(miles)										
Fair (see Table III-18)	1.4									1.8
Poor	3.5		0.5		1.6	0.9	1.5		6.0	
Good	11.2	10.7	5.0	8.4	3.0		10.9	6.5	1.5	1.8
3. Physiography (miles per cent of slope crossed 0 - 10%	11.4	5.9	3.7	8.0	3.5	0.9	8.5	6.0	7.1	2.8
10 - 20%	2.9	1.7	1.3	0.4	0.7	-	2.2	0.5	0.2	0.4
20 - 30%	0.9	1.2	0.2	-	0.3	-	1.3	-	0.2	0.4
30% or more	0.9	1.9	0.3	-	0.1	-	0.4	-	-	-
4. Number of Drainages Drossed	13	9	13	18	10	3	18	16	29	14
5. Soil Erosion Potential (miles) High to Moderate	0.9	1.1	3.2	7.1	2.2	-	8.4	-	-	-
Moderate to High	7.4	6.7	-	-	-	-	-	-	-	-
Moderate	-	-	2.3	1.3	0.5	0.9	1.7	6.5	7.5	3.6
Moderate to Low	0.9	-	-	-	-	-	-	--	-	-
Low to Moderate	6.9	2.9	-	-	1.9	-	2.3	-	-	-
Revegetation Potential	Mod.	Mod. to Good	Mod. to Good	Low to Mod.	Low	Mod. to Good	Low to Mod.	Mod. to Good	Low to Mod.	Low

TABLE III - 17 (Con't.)

Routes	A	B	C	D	E	F	G	H	I	J
6. Ecology (miles)										
Mixed Paloverde Cactus Association	7.9	1.1	5.1	8.1	3.8	0.8	8.3	4.9	6.7	3.4
Mixed Crucifixion Thorn Association	3.3	0.5	-	-	-	-	-	-	-	-
Desert Grassland	0.7	-	-	-	-	-	3.7	-	-	-
Transition Sonoran Desertscrub Communities	-	3.4	-	-	-	-	-	-	-	-
Chaparral and Oak woodland	3.3	4.9	-	-	-	-	-	-	-	-
Jojoba	0.8	-	-	-	-	-	-	-	-	-
Broadleaf - Oak Sycamore, etc.	0.1	0.8	-	-	-	-	-	-	-	-
Saltcedar mesquite	-	-	0.4	0.3	0.8	0.1	0.4	1.6	0.8	0.2
7. Visual Landscape Character (in miles)										
Condition (1)										
Natural	-	-	-	-	-	-	-	2.0	-	-
Natural Dominance	12.5	10.0	4.8	1.4	1.7	-	12.4	-	1.0	3.6
Mixed	3.6	0.7	0.7	2.4	2.9	0.9	-	4.5	6.5	-
Man-made Dominance	-	-	-	-	-	-	-	-	-	-
Degraded	-	-	-	4.6	-	-	-	-	-	-
Visability (2)										
Open	1.3	2.6	-	-	-	-	4.5	-	-	-
Modified	7.2	0.7	5.5	6.0	4.6	0.9	6.2	6.5	1.0	-
Open Modified	6.5	6.0	-	2.4	-	-	0.7	-	6.5	3.6
Restricted	1.1	1.4	-	-	-	-	1.0	-	-	-

TABLE III-17 (Con't.)

	A	B	C	D	E	F	G	H	I	J
Interest (3) High	16.1	8.6	3.5	6.0	1.0	-	1.0	-	-	-
Rep.	-	2.1	2.0	2.4	3.6	0.9	11.4	6.5	7.5	3.6
8. Current Land Uses (in units) Residential	1179	23	19	202	191	305	4	840	936	65
Commercial	9	-	-	3	3	3	-	3	3	-
Institutional	13	-	-	2	2	2	-	12	12	-
Agriculture (miles)	-	-	-	-	-	-	-	1.0	0.9	-
Local Parks & Golf Courses	3	-	-	-	-	-	-	3	3	-
Outdoor Recreation Categories	8	6	2	4	3	1	3	2	3	2
9. Planned - (in units) Recreation	-	-	3	-	4	3	4	1	-	1
10. Highway Influence Crossed (number)	1	2	-	2	-	-	-	-	2	-
Parallel (miles)	5.1	0.6	-	8.4	-	-	-	-	0.5	-
11. Archaeology Sensitivity (miles) (see Table III-17) Maximum	-	-	0.6	-	0.3	-	0.3	0.4	0.2	-
Major	0.6	0.3	0.1	-	-	-	-	2.6	1.2	0.9
Medium	0.1	-	-	1.9	0.5	0.9	1.0	2.6	6.1	0.3
Minimum	15.4	10.4	4.8	6.5	3.8	-	11.1	0.9	-	2.4
History Sites - (4)	4	1	6	1	2	-	3	4	-	-
12. Estimated Vegetation Communities Removed(in acres)(5) Chaparral - oak/woodland	20.4	22.0	-	-	-	-	-	-	-	-
Paloverde Desertscrub	49.0	7.0	24.5	43.0	17.0	4.5	56.0	18.0	60.0	26.0
Desert Grassland	3.0	-	-	-	-	-	10.0	-	-	-
Transitional	-	13.0	-	-	-	-	-	-	-	-
Riparian	-	13.0	1.5	2.0	8.0	1.5	2.0	18.0	-	3.0

TABLE III - 17 (Con't.)

	A	B	C	D	E	F	G	H	I	J
13. Construction Right-of-way and Engineering Costs	$3,056,150	$1,768,785	$940,146	$1,543,366	$837,806	$218,430	$1,665,977	$1,151,890	$1,611,126	$335,088
14. Taxes (over 35 years)	$5,110,000	$2,830,000	$930,000	$1,530,000	$830,000	$220,000	$1,650,000	$1,140,000	$1,600,000	$330,000

1. Natural condition includes landscapes with little man-made change or intrusion, as undeveloped lands used for informal recreational purposes. Natural Dominance condition occurs in areas that are predominantly natural, but have been somewhat modified by man-made intrusions such as paved roads, individual rural residences or small transmission lines. Mixed condition refers to areas in which the natural environment and present land uses are about equally dominant, with rural residential developments, numerous transmission lines or major transportation corridors may be interspersed with more natural landscapes. Man-Made Dominance conditions occur in areas that are primarily man-made, such as in dense residential areas or extensive agricultural uses, but some natural elements may remain. Such areas would not usually be substantially visually modified by a transmission line. Degraded conditions would occur in industrial areas with no remaining natural influence.

2. Open visibility refers to areas in which the topography provides little or no potential for visually shielding or absorbing to transmission line and its towers. Under these conditions, the line would be fully visible and often skylighted. Modified visibility includes areas in which large topographic features would form a background to the line. This would tend to visually absorb the line, minimizing skylighting. Open Modified visibility refers to areas in which views to the line could be open and/or modified, depending upon the location of the viewer, and skylighting could result in some areas. Restricted visibility would occur in areas in which the tower would be surrounded by the topography thus limiting the viewshed to a narrow area (around 1/2 mile).

3. High interest refers to landscapes displaying greater scenic amenities than most of the landscapes in the region. Representative interest occurs where the landscape is composed of scenic amenities most often associated with the region.

4. Number of historic sites, occuring within two miles, which may or may not be impacted depending on final alignment.

5. Per cent of vegetation cover for State:
   - Chaparral - oak woodland - 5.5
   - Paloverde - Desert scrub - 29.0
   - Desert Grassland - 20.7
   - Transitional - --
   - Riparian - 0.3

5. Transmission System Substation Alternatives (Southern Portion)

a. System Alternatives

The original proposal for the Coronado Project Transmission System included a 500 kV substation at the junction of Links 33 and 34, and identified it as the Dinosaur substation.

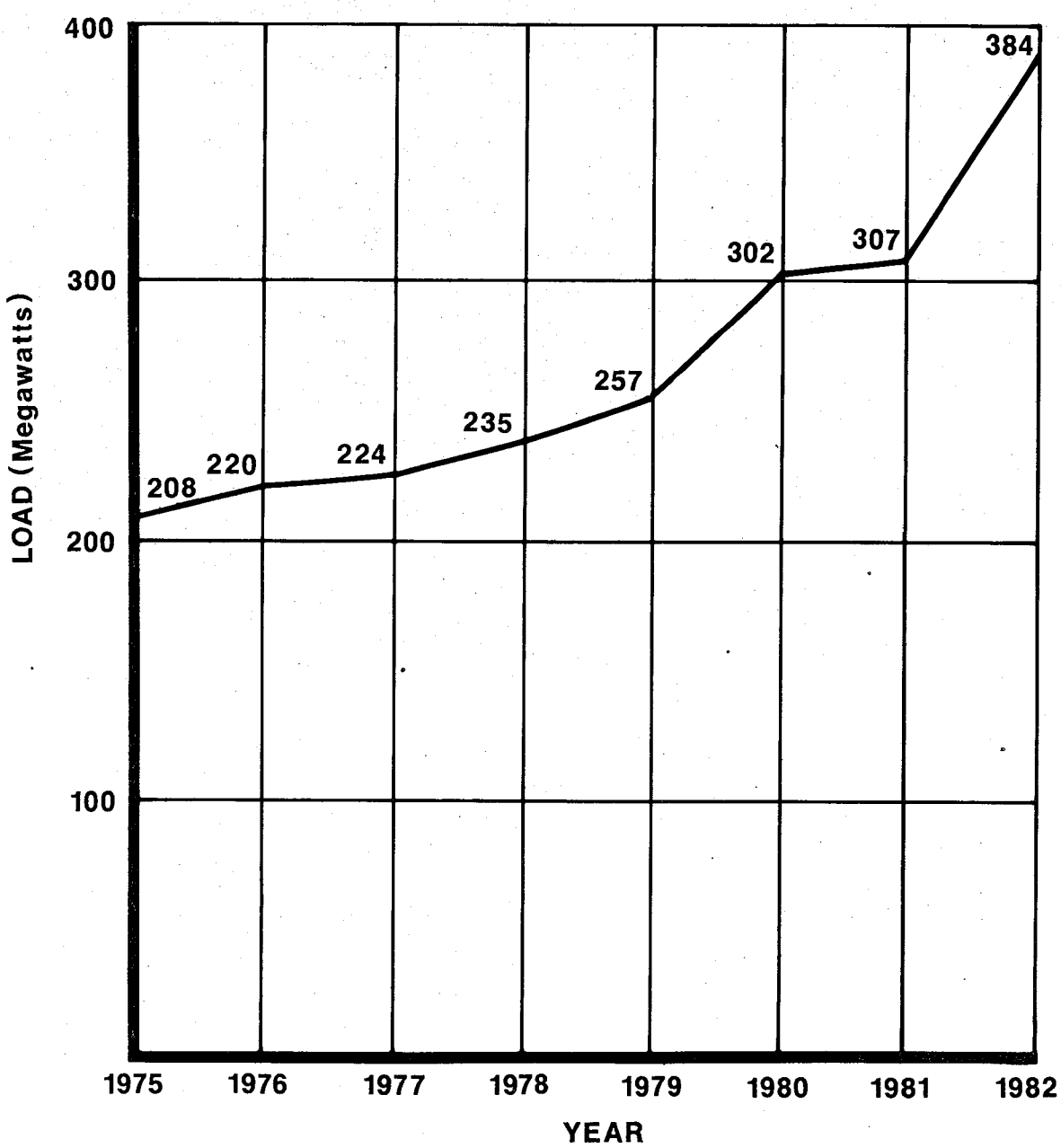
This proposal was dropped in July 1975 and a new substation was proposed where it would be more centrally located to the company's Eastern Mining Area (EMA) customers.

In November 1974 new load projections were received from SRP's mining customers. These loads are tabulated by company in Table III-18, by location in Table III-19, and are shown graphically in Figure III-11 and geographically in Figure III-12. They show that if these projections are realized SRP will increase its load in the EMA by 48.9 MW between 1975 and 1979. With the addition of the projected new loads, the capacity of the existing SRP 115 kV transmission system will be exceeded and additional transmission lines will be required.

As a result of the projected new loads in the mining area and the limited capability of the exisiting transmission system, a substantial amount of planning effort was invested in the Eastern Mining Area. The SRP plans studied, included upgrading the 115 kV system to 230 kV and constructing new 115 kV and/or 230 kV transmission lines from 500 kV stations at Dinosaur, Silver King and a site 20 miles northeast of Globe. Because of the effect upon the Coronado 500 kV transmission system of the Silver King Substation, additional power flow and stability studies were performed upon the Coronado transmission system.

The Dinosaur Plan is shown in Figure III-13 and the Silver King Plan is shown in Figure III-14. The Dinosaur Plan would require the construction of three new substations, a 500/230 kV substation at Dinosaur, a 230/115 kV substation at Superior, and a 230/115 kV substation near Hayden. The Silver King Plan would require only two new substations, a 500/230/115 kV substation at Silver King and a 230/115 kV substation near Hayden. Each plan would require interconnecting facilities as shown on the Figures III-13 and III-14. A comparison of the two plans is summarized below.

(1) The Silver King Plan costs were calculated to be $836,000 less than the Dinosaur Plan based upon cash flow. A present worth analysis was made extending to 1990 which included escalated costs for construction of transmission lines and station facilities plus the costs of taxes and maintenance. The 1975 present worth difference was $916,000, in favor of the Silver King Plan.

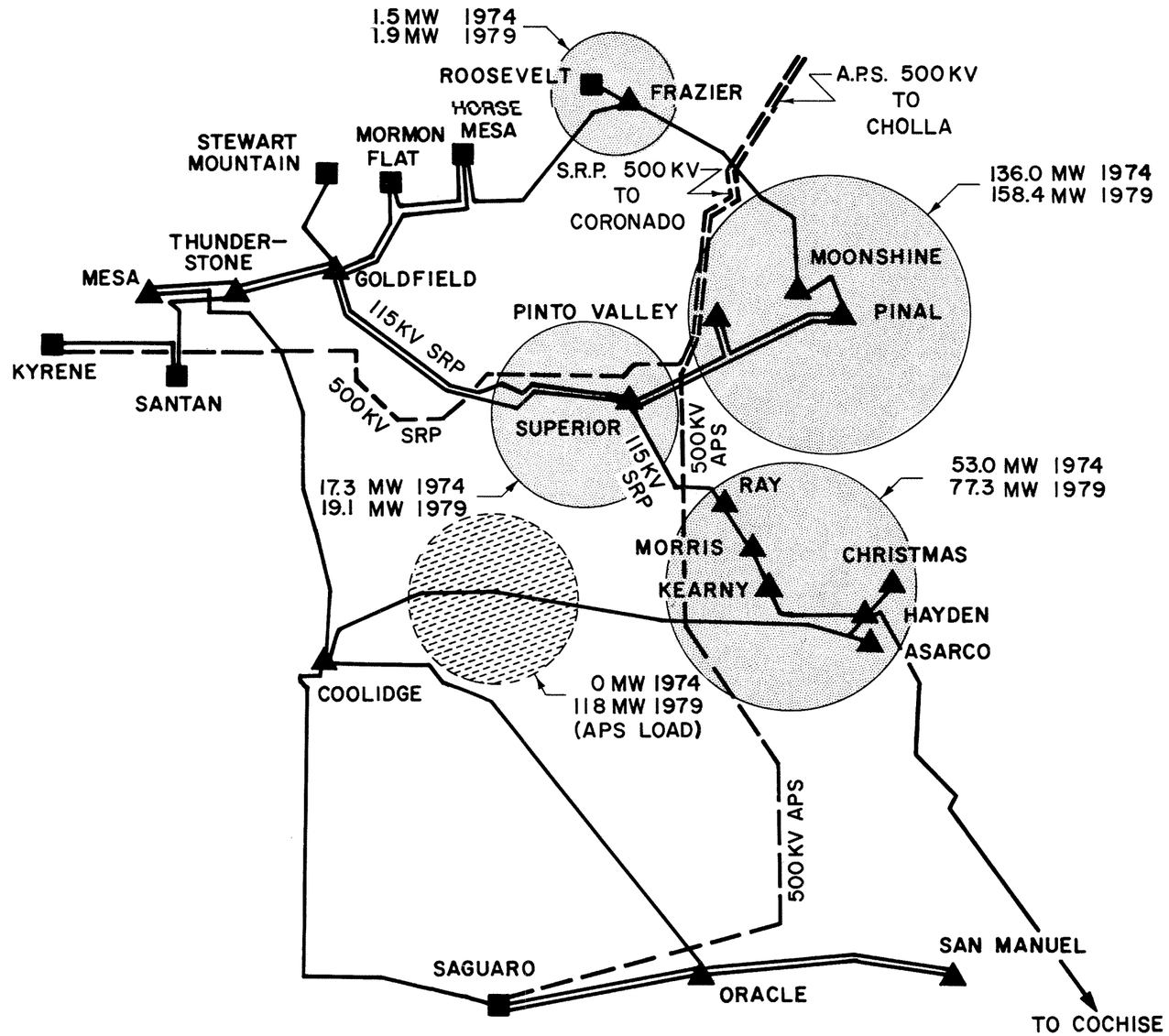


EASTERN MINING AREA NON-COINCIDENT LOADS

1975 ACTUAL

1976 - 1982 (2-4-76 Projection of Loads)

Figure III-11



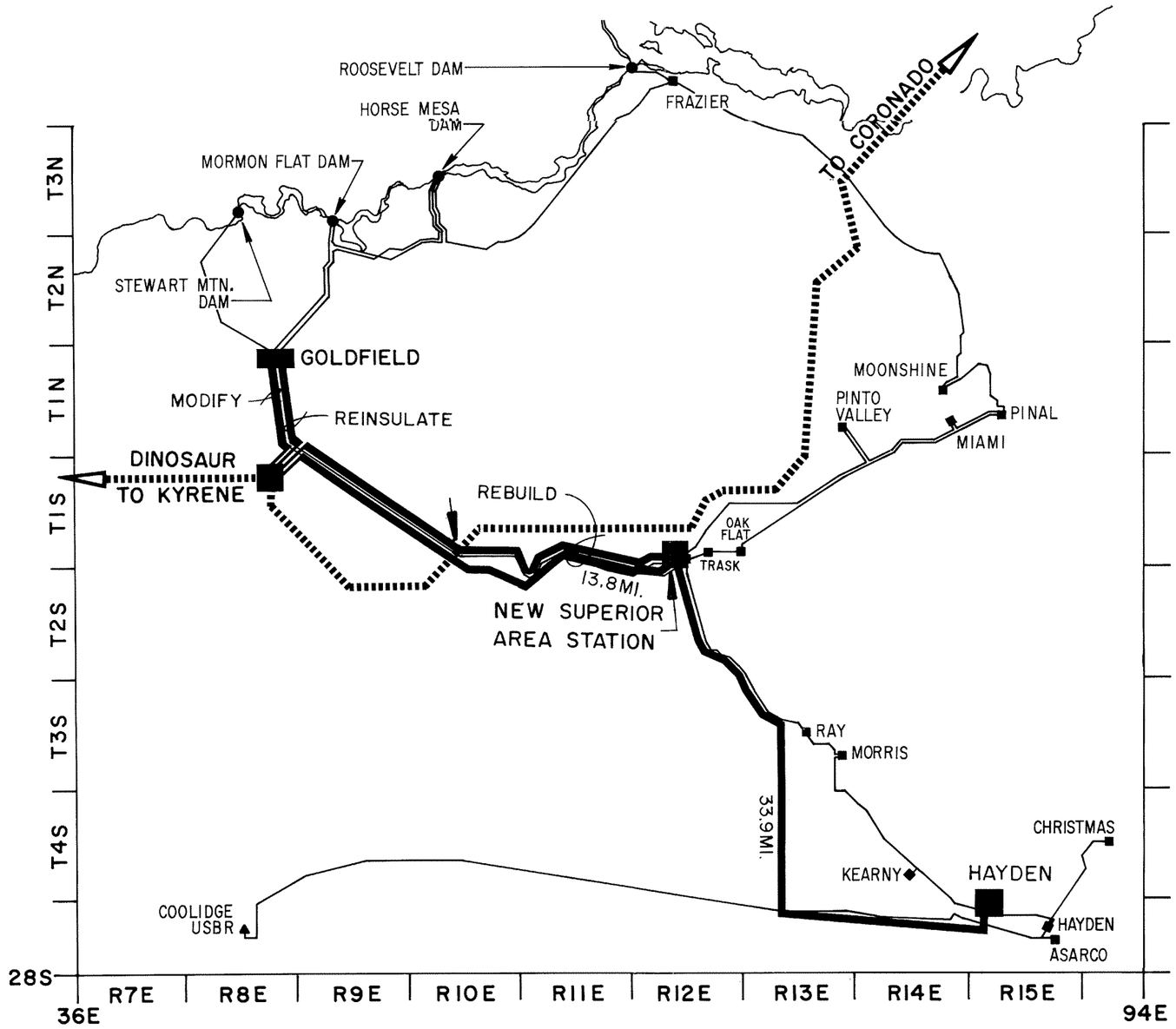
207.8 MW 1975

256.7 MW 1979

CORONADO PROJECT

EASTERN MINING AREA LOCATION NON-COINCIDENT LOADS

Figure III-12



230 kV

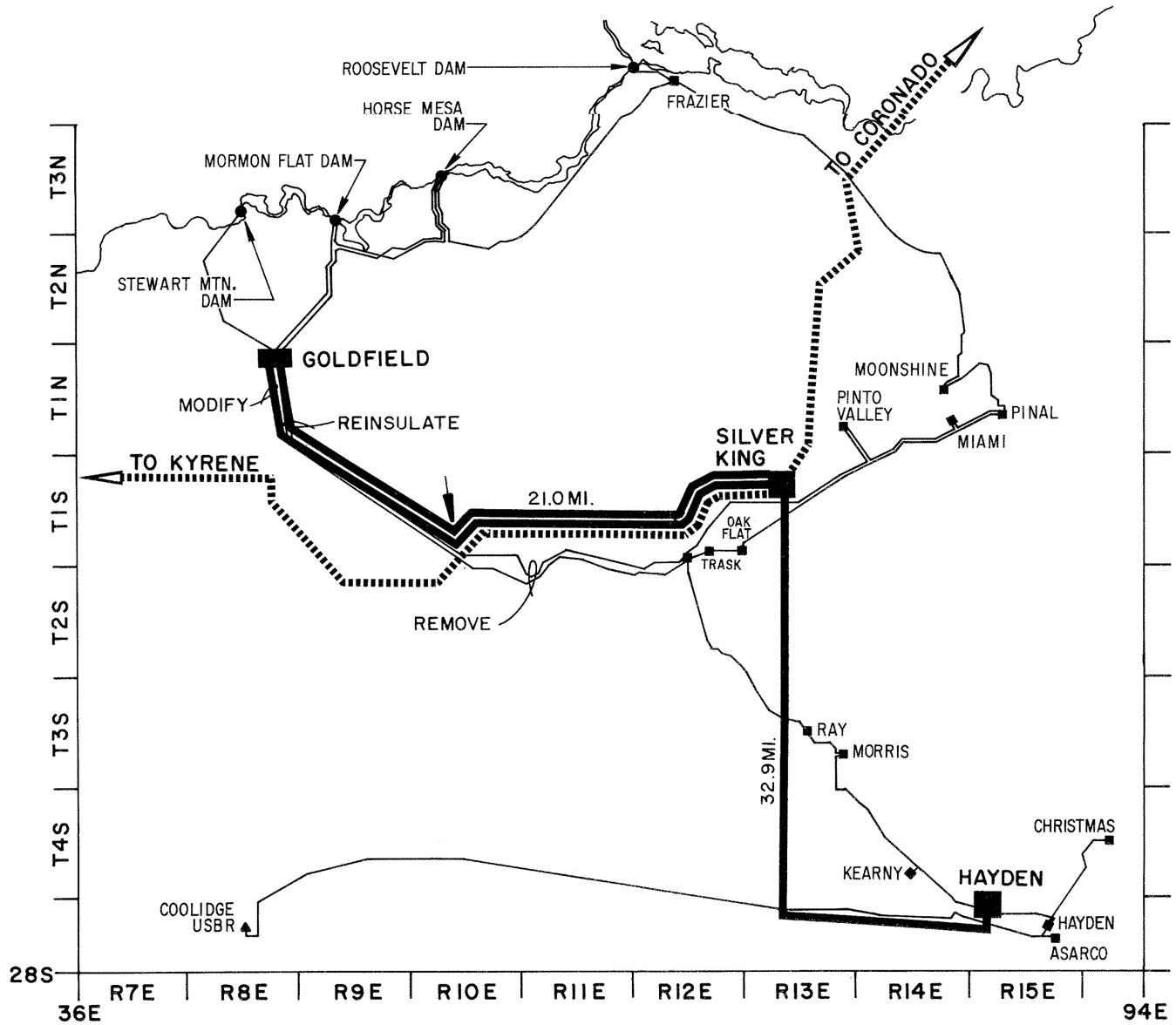
500 kV

CORONADO PROJECT

SUBSTATIONS AND SYSTEMS

DINOSAUR PLAN

Figure III-13



230kV
500kV

CORONADO PROJECT

SUBSTATION AND SYSTEMS

SILVER KING PLAN (SITE C)

Figure III-14

TABLE III-18

EMA NON-COINCIDENT LOAD PROJECTION - LISTED BY COMPANY (MW)

	1975 1/	1976	1977	1978	1979	1980	1981	1982
ASARCO	6.7	6.7	7.0	7.0	9.0	11.0	13.0	13.0
Cities Service								
Pinto Valley	34.4	37.5	38.0	41.0	41.5	42.0	42.5	42.5
Miami	8.0	8.0	9.0	9.0	12.0	14.5	15.0	15.0
TOTAL	42.4	45.5	47.0	50.0	53.5	56.5	57.5	57.5
Inspiration								
Christmas	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Ellison Firm	11.4	10.5	11.0	11.0	11.0	11.0	11.0	11.0
Ellison Inter.	33.5	33.0	33.0	33.0	33.0	33.0	33.0	33.0
Moonshine	16.0	15.0	16.0	23.5	26.0	27.5	28.0	28.8
Moonshine 25 Hz	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Pinal	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
TOTAL	77.4	75.0	76.5	84.0	86.5	88.0	88.5	89.3
Kennecott								
Hayden	18.1	26.0	26.0	26.0	39.0	77.0	77.0	153.0
Morris	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
Ray	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
TOTAL	37.1	45.0	45.0	45.0	58.0	96.0	96.0	172.0
Magma								
Oak Flat	8.6	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Trask	5.5	6.0	6.0	6.0	6.0	6.0	6.0	6.0
TOTAL	14.1	16.0	16.0	16.0	16.0	16.0	16.0	16.0
Ranchers	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
APS Territorial								
Kearny	4.7	5.3	5.5	5.6	5.8	6.0	6.1	6.3
Pinal	16.7	16.9	17.5	18.2	18.9	19.6	20.4	21.1
Superior	3.2	3.1	3.1	3.1	3.1	3.1	3.1	3.1
TOTAL	24.6	25.3	26.1	26.9	27.8	28.7	29.6	30.5
Frazier	1.5	1.8	1.8	1.8	1.9	2.0	2.0	2.1
EMA TOTAL	207.8	219.3	223.4	234.7	256.7	302.2	306.6	384.4

1. The highest month's billing demand for each company. Substation noncoincident loads have been multiplied by a factor so they will add up to the peak billing demand.

TABLE III-19

EMA NON-COINCIDENT LOAD PROJECTION - LISTED BY LOCATION (MW)

	1975[1/]	1976	1977	1978	1979	1980	1981	1982	pf[2/]
Frazier (SRP)	1.5	1.8	1.8	1.8	1.9	2.0	2.0	2.1	.80
Hayden									
ASARCO	6.7	6.7	7.0	7.0	9.0	11.0	13.0	13.0	
Christmas (ICC)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	
Kennecott	18.1	26.0	26.0	26.0	39.0	77.0	77.0	153.0	
TOTAL	29.3	37.2	37.5	37.5	52.5	92.5	94.5	170.5	.95
Kearny (APS)	4.7	5.3	5.5	5.6	5.8	6.0	6.1	6.3	.90
Miami (CS)	8.0	8.0	9.0	9.0	12.0	14.5	15.0	15.0	.90
Moonshine									
Moonshine 25 Hz (ICC)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	
Moonshine (ICC)	16.0	15.0	16.0	23.5	26.0	27.5	28.0	28.8	
Ellison firm (ICC)	11.4	10.5	11.0	11.0	11.0	11.0	11.0	11.0	
Ellison Inter. (ICC)	33.5	33.0	33.0	33.0	33.0	33.0	33.0	33.0	
TOTAL	68.9	66.5	68.0	75.5	78.0	79.5	80.0	80.8	.95
Morris (KCC)	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	.85
Oak Flat (Magma)	8.6	10.0	10.0	10.0	10.0	10.0	10.0	10.0	.80
Pinal									
Inspiration	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Ranchers	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
APS	16.7	16.9	17.5	18.2	18.9	19.6	20.4	21.1	
TOTAL	24.7	24.9	25.5	26.2	26.9	27.6	28.4	29.1	.95
Pinto Valley (CS)	34.4	37.5	38.0	41.0	41.5	42.0	42.5	42.5	.92
Ray (KCC)	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	.88
Superior (APS)	3.2	3.1	3.1	3.1	3.1	3.1	3.1	3.1	.95
Trask (Magma)	5.5	6.0	6.0	6.0	6.0	6.0	6.0	6.0	.85
EMA TOTAL	207.8	219.3	223.4	234.7	256.7	302.2	306.6	384.4	

1. Based upon the highest month's billing demand for each company. Substation noncoincident loads have been multiplied by a factor so they will add up to the peak billing demand.

2. Based upon substation pf @ noncoincident substation peak for 1975.

APS - APS Territorial Load
ICC - Inspiration Copper Company
KCC - Kennecott Copper Company
CS - Cities Service

(2) The system losses were calculated to be 3 to 5 megawatts less with the Silver King Plan. Based upon SRP average energy and demand costs, the present worth of this difference in losses projected over the 35 year life of the Coronado Station was $1,776,000 in 1975 dollars. Taking the value of losses into account increased the difference in the present worth of the two plans to $2,692,000.

(3) The EMA transmission system capacity was determined to be at least 150 MW greater with the Silver King Plan.

(4) The EHV transmission system performance was the same for both plans.

(5) With the Silver King Substation there was the potential for a joint 500 kV Substation with APS after 1983. This would interconnect the APS Cholla-Saguaro 500 kV line and the SRP Coronado-Kyrene 500 kV line, providing improved EHV system reliability.

(6) Transmission lines and station facilities for the Silver King Plan would not all be required in the same year. The Silver King 500 kV, 230 kV and 115 kV station work, the Silver King-Kyrene 230 kV line and uprating of the Goldfield-Superior 115 kV lines to 230 kV would be required in 1979. The Hayden 230 kV and 115 kV station work, and the Hayden-Superior 230 kV lines would be required in 1980.

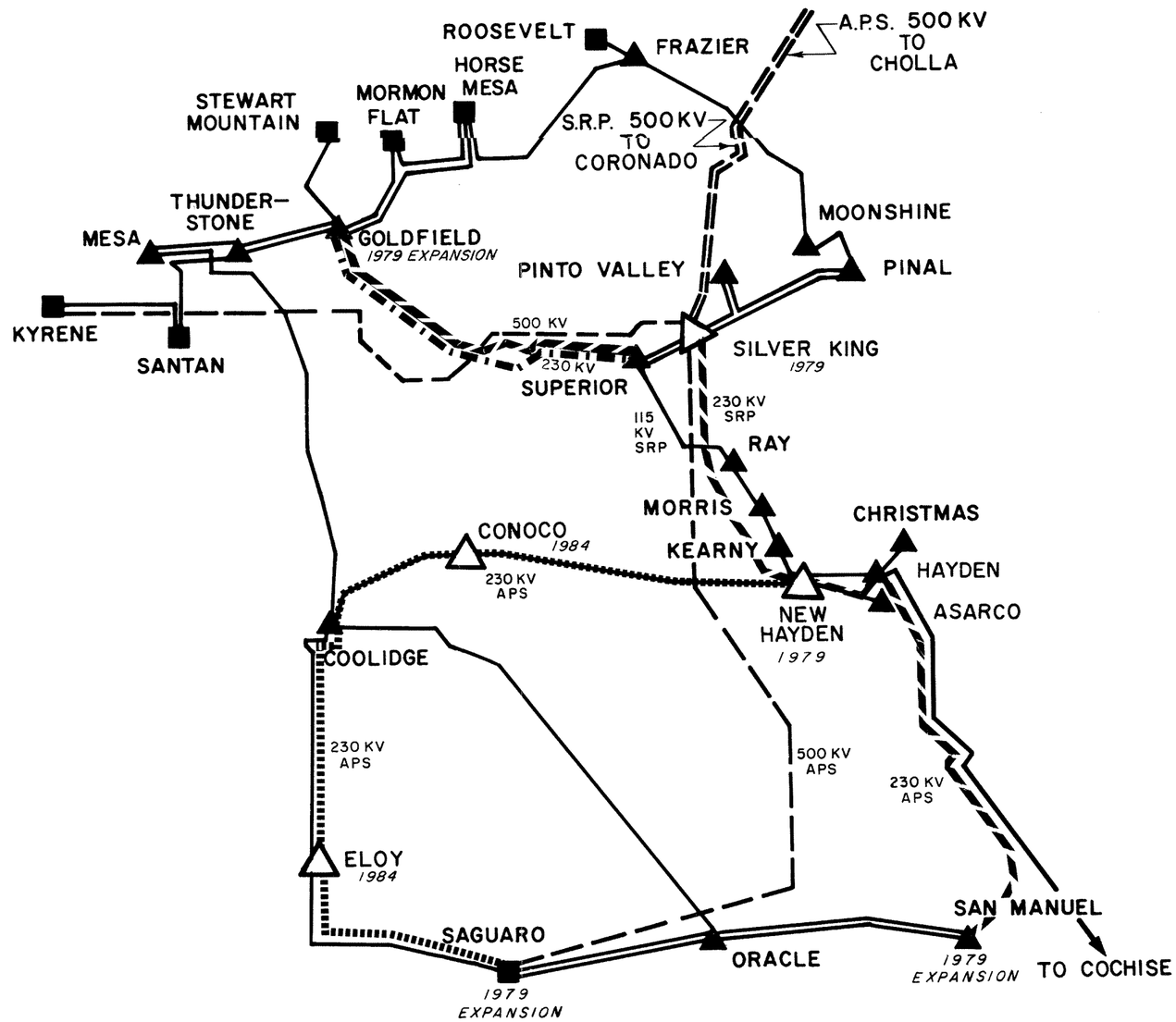
A joint transmission planning study was initiated by APS and SRP in January 1975 to determine if there were mutual benefits to a joint system because both companies were faced with significant new loads projected for the Eastern Mining Area. As a result of this study, APS and SRP have signed a letter of intent to interconnect the APS 500 kV Cholla-Saguaro transmission line with the proposed SRP 500 kV substation in the Superior area.

Arizona Public Service Company (APS) desired to interconnect their Cholla-Saguaro 500 kV with the Coronado Station 500 kV line if it were located in the vicinity of Superior. According to APS engineers, the Hayden site was as desirable as the Silver King site.

Of the four substation sites studied, it was agreed by APS and SRP that the Silver King site and associated transmission system plan (see Figure 15) had the least cost and most benefit for both APS and SRP.

Arizona Public Service has the option of interconnecting their Cholla-Saguaro 500 kV transmission line with the Silver King substation at some future time.

The advantages of a joint APS and SRP Silver King 500 kV sbustation over a SRP only Silver King substation were determined to be as follows:



1979 CONST.
1984 CONST.
FUTURE 230 KV CONST.
FUTURE 500 KV CONST.

CORONADO PROJECT

EASTERN MINING AREA JOINT S.R.P./A.P.S. PLAN

Figure III-15

(1) Better Extra High Voltage (EHV) system performance than was possible with only an SRP substation.

(2) More reliable valley and EMA system with the APS Cholla-Saguaro line tied into the Coronado Station system at Silver King.

(3) The need for a future 500 kV substation on either the Coronado-Kyrene or the Cholla-Saguaro line was eliminated for the forseeable future.

(4) A joint 500 kV substation could be expanded to include power from the Palo Verde Nuclear Generating Station or any other EHV projects in the future.

(5) System capacity and reliability are increased by the underlying 230 kV transmission line system between the Silver King substation and the Saguaro (APS) power plant.

(6) A greater stability margin on the Coronado 500 kV transmission system.

(7) A lower loading on the two APS Cholla-Pinnacle Peak 345 kV transmission lines in the event of a Coronado-Silver King outage or a Cholla-Saguaro outage.

(8) A possible reduction in the series compensation required for the Coronado 500 kV transmission system for the present proposal.

Based upon the above information and in agreement with APS, the Silver King site was proposed for the 500 kV substation location.

b. Silver King 500 kV Substation Alternatives

Six 500 kV substation sites were selected as alternatives for the proposed Silver King (Site C) location. (See pocket map enclosed inside the back cover of this statement). Three of the substations (A, B, and C) are located north of U.S. Highway 60/70 in the vicinity of Oak Flat Campground and Devil's Canyon. All three sites (A, B, and C) are located within an area approximately 1.7 miles long by 1.3 miles wide, and are very near the APS Cholla-Saguaro 500 kV transmission line. Substation Site D is located about two miles north and one mile west of the community of Superior. Kearny No. 1 or Site E is located about eight miles south of the proposed Silver King substation (Site C), and on the east side of State Route 177. The substation site Kearny No. 2 is located near the junction of Links 47 and 27, a distance of 9.7 miles west of Hayden. The Dinosaur site was left in its original location, near the junction of Links 33 and 34.

All the alternative substation sites are located within the area corridors studied, by link, for the 500 kV transmission lines.

c. Discussion of Environmental Impacts Southern Portion Substation Alternatives

The location of a 500/230 kV substation is critical not only because it is a multi-million dollar investment, but because it will become a "hub" from which transmission lines will radiate in all directions. Therefore, the location of a substation will locate the focal point from which 115 kV, 230 kV, and 500 kV powerlines will converge for the life of the project. In other words, the location of the substation will imply tacit approval for future transmission line rights-of-way into and out of the substation.

Figure III-16 is a schematic single-line diagram of the proposed Silver King substation. It shows the potential for eight 500 kV terminations. Two would be for the Coronado Project (one in and one out) and likewise, two for the APS Cholla-Saguaro line. The remaining four terminations would be for two future, as yet undetermined lines. Six 230 kV terminations are shown. The need for five of these terminations (Goldfield, Kyrene and Hayden) would be immediate, or would closely follow the completion of the substation. The remaining termination is for future needs. The 115 kV "yard" or portion of the substation will also have six terminations. Initially only four of these terminations will be used. These terminations are for the existing Superior, Pinto Valley, Pinal, and Oakflat 115 kV lines.

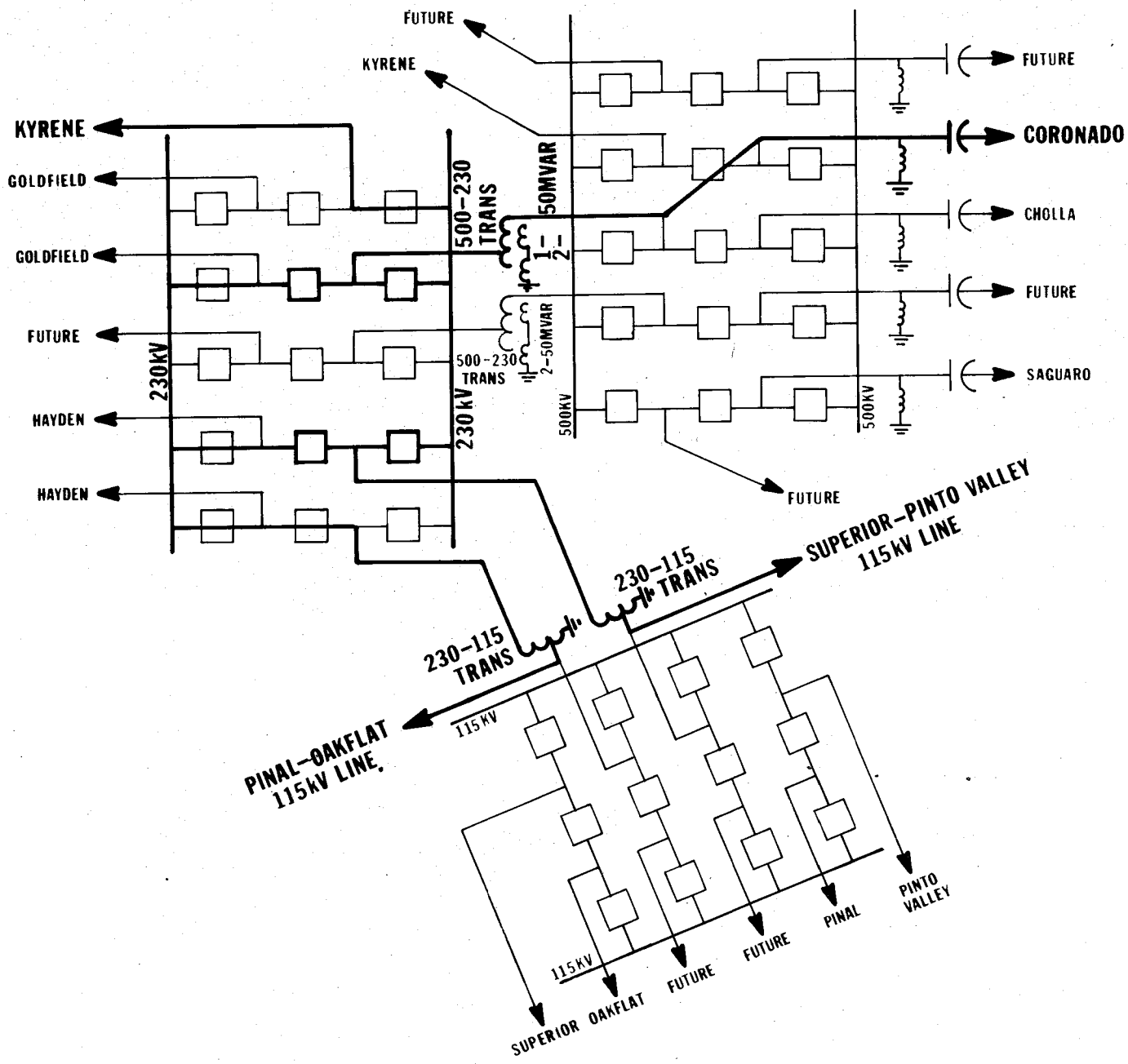
Table III-20 shows the differential costs for the seven sites, with Silver King Site C (the proposed site) as the base.

The site for the 500 kV substation will be approximately 40 acres. The surface will be covered with crushed rock and enclosed by a chainlink fence.

Access to the 500 kV substation site would require a permanent road capable of being traveled by trucks loaded with heavy equipment.

(1) Silver King Site A (Figure III-17) would be located in a drainage that is tributary to Queen Creek Canyon. Slopes are gentle in the area. Soils in the area are Mesic, consisting of a very shallow, loamy soil developed on welded tuff. The soil erosion potential is medium, and the revegetative potential is low. Queen Creek Canyon would be 1,000 feet from the site. Vegetative communities are grass and chaparral. Archeological impact is high. The site would be within 1/4 mile of U.S. Highway 60/70, and within the Travel Influence Zone. The site is within 3/4 mile of Oak Flat Campground.

The site would be adjacent to one 115 kV transmission line and within one mile of another 115 kV transmission line. Both of these 115 kV lines would be interconnected to the 500 kV substation. The site would be less than one mile from the APS Cholla-Saguaro 500 kV transmission line.



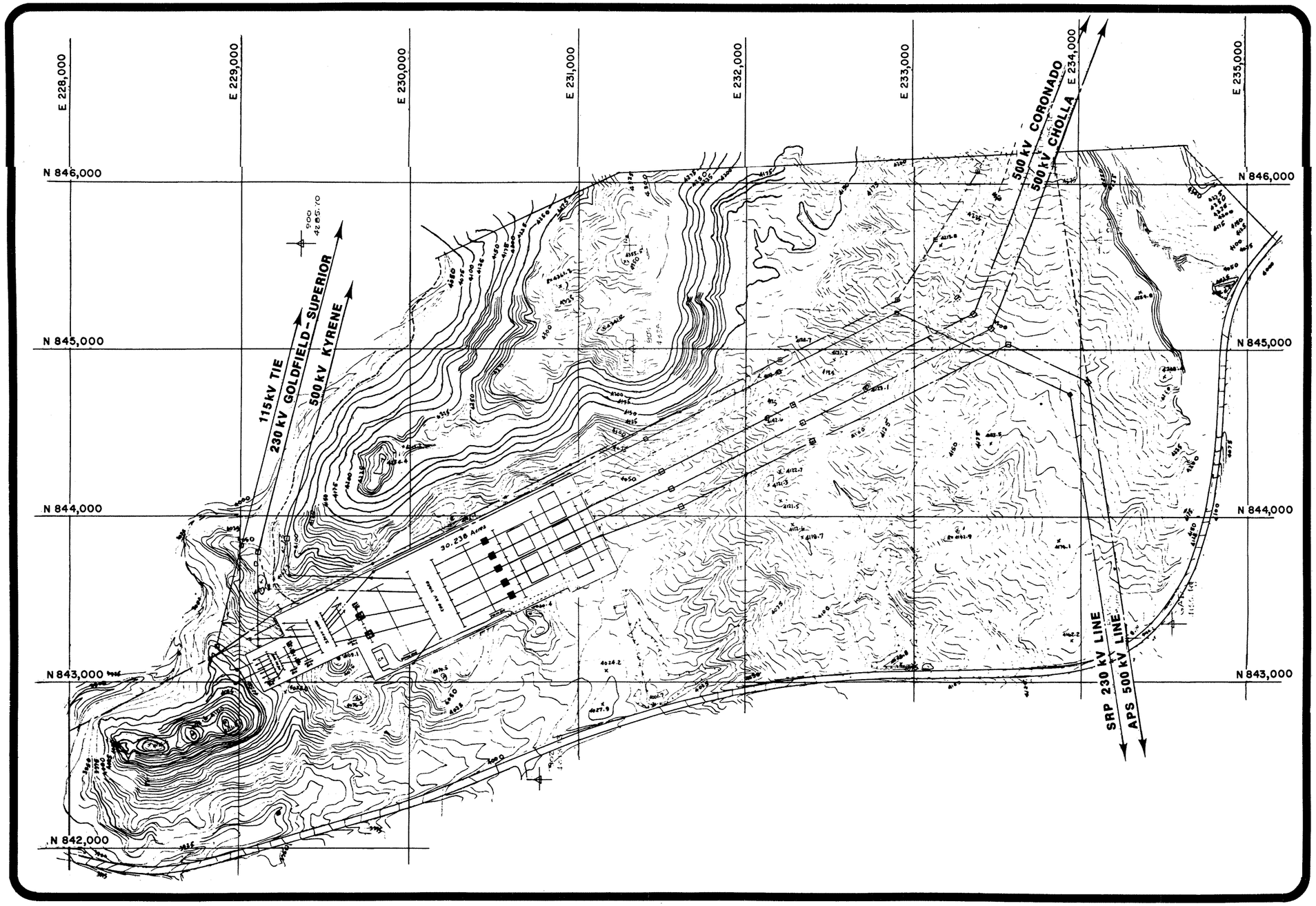
Transmission System

SILVER KING STATION SCHEMATIC

INITIAL CONSTRUCTION

ULTIMATE REQUIREMENTS

Figure III-16



CORONADO PROJECT

Transmission System

SILVER KING STATION
SITE A

Figure III-17

TABLE III - 20

500 kV STATION - DIFFERENTIAL COST ANALYSIS

Substation Alternative	Additional Transmission Construction (Miles) & Cost 500 kV	230 kV	115 kV	Total Miles of Line	Total Line Cost ($)	Const. Costs including Site Prop. & Roads ($)	Present Worth Value of 35 yr Taxes ($)	Present Worth Value of 35 yr Line Loss ($)	Total Costs ($)	Cost W/O PW Values ($)
Silver King A	(3.4 mi) 624,960	(0.9 mi) 170,960	(2.3 mi) 141,450	5.7	937,370	20,000	482,901	-	1,440,271	957,370
Silver King B	(1.2 mi) 220,575	(0.0)	(1.9 mi) 116,850	3.1	337,425	-	170,198	-	507,623	337,425
Silver King C	(0.0) -	(0.85) 161,460	(0.8 mi) 49,200	1.65	210,660	460,000	338,283	-	1,008,943	670,660
Silver King D	(10.6 mi) 1,948,410	(0.7 mi) 132,970	(0.0 mi) -	11.3	2,081,380	10,000	1,054,900	335,000	3,481,280	2,091,380
Silver King E (Kearny #1 Syst.#2)[1]	(8.8 mi) 2,343,010	-	(0.0 mi) -	8.8	2,343,010	1,718,000[3]	2,048,388	275,000	6,384,398	4,061,010
Kearny 2 (System 2)[2]	(40.0 mi) 7,536,390	(6.7 mi) 1,272,702	(0.8 mi) 49,200	47.5	8,858,292	2,034,000[3]	5,494,112	1,200,000	17,586,404	10,892,292
Dinosaur	(0.0 mi) -	(4.2 mi) 797,813	(0.8 mi) 49,200	5.0	847,013	3,122,000 [3]	2,001,985	-	5,970,998	3,969,013

1. Kearny #1 - System 2, features double circuit 230 kV line & towers north out of the Substation along line 43b up to link 28 where it would then follow the company proposed alignment.

2. Kearney #2 - System 2, features double circuit 230 kV line & towers north out of the Substation along links G, C, & A (436) up to link 28 where it would then follow the company proposed alignment.

3. Includes cost for the new 230 kV Superior Area Substation.

(2) Silver King Site B (Figure III-18) would be located on a relatively flat area, with slopes less than 10 percent. The soils in the area are Mesic, consisting of a very shallow, loamy soil developed on welded tuff. The soil erosion potential is medium, and the revegetative potential is low. Archeological impact is low. The site would be within 1/4 mile of U.S. Highway 60/70, and within the Travel Influence Zone. The site is within one mile of Oak Flat Campground. Chaparral is the vegetative community.

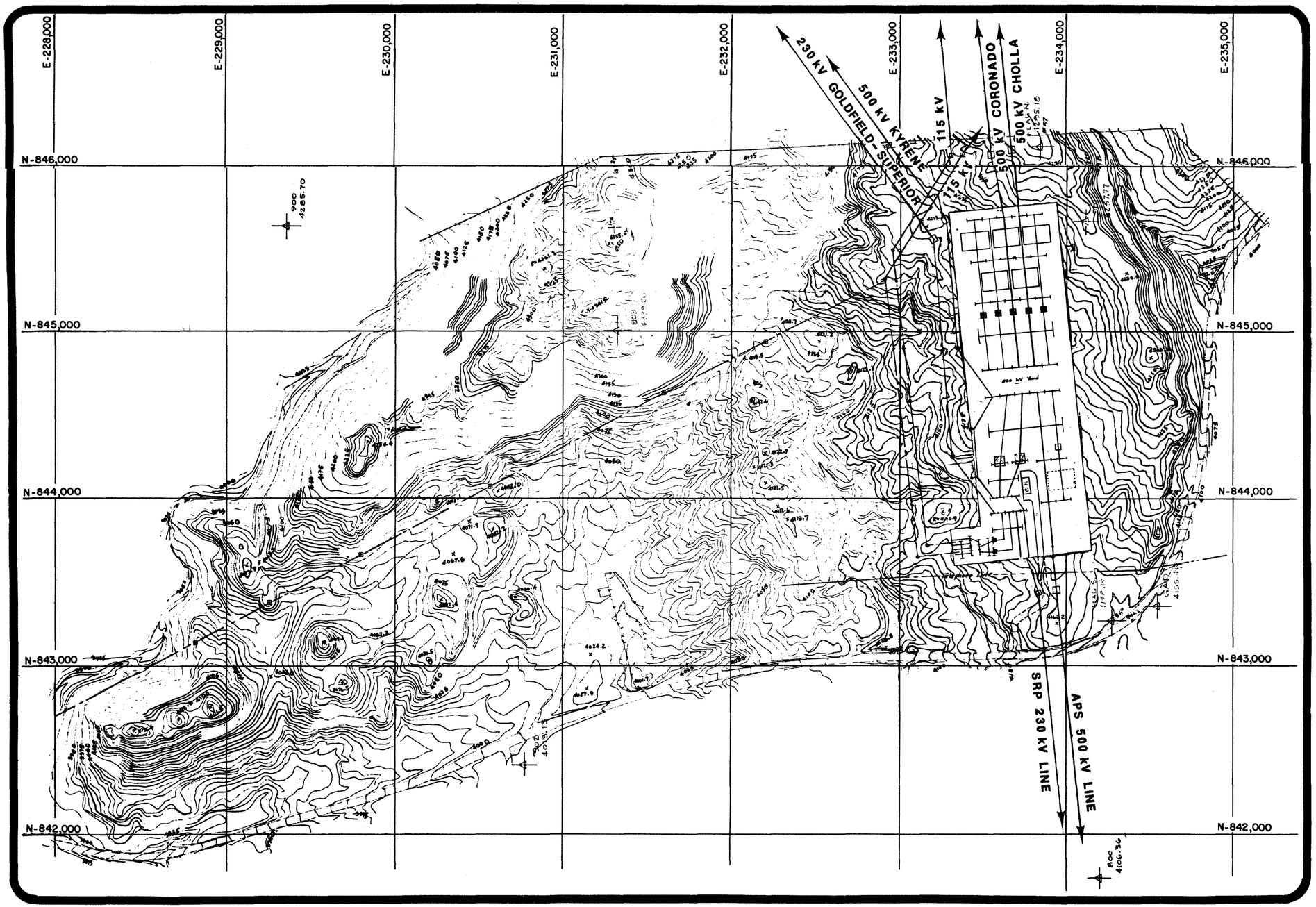
The site would be adjacent to the APS Cholla-Saguaro 500 kV transmission line and the 115 kV transmission line to be interconnected. Another 115 kV transmission line would be within one mile of the site and would be interconnected.

(3) Silver King Site C (proposed site) would be located in an area consisting of a relatively flat grassland, ending abruptly at a drainage (See Figures III-14 and III-19). The site is surrounded on three sides by ridges, with a steep sided drainage on the fourth side. The principal vegetative community is Chaparral with some oak trees. Soils in the area are mesic, having developed from welded tuff. The grassland is located on an area where the soil has accumulated to a greater depth than that on the surrounding slopes. The soil erosion potential is medium and the revegetative potential is low. The archeological site density is considered to be moderately low in the area. The site would be within 3/4 mile of U.S. Highway 60/70, but hidden from view. Devil's Canyon would be within 1/2 mile of the site. The drainage at the east end of the site is tributary to Devil's Canyon.

The site would be adjacent to the APS Cholla-Saguaro 500 kV transmission line and one 115 kV tranmission line to be interconnected. Another 115 kV transmission line to be interconnected would be one mile distant. Three dead-end towers have already been constructed at the site, two for APS, and one for SRP. The two utility companies considered the risk to be economically advantageous, should this site be selected.

(4) Silver King Site D would be located on a dissected alluvial plain bordering Silver King Wash (See figures III-20 and III-21). Ridges are present on both sides of the wash. The erosion potential is medium due to the tendency for gullying. The vegetative community is Chaparral, and the revegetative potential is low. Archeological density is considered to be moderately high in the area.

The site would be five miles from the APS Cholla-Saguaro 500 kV transmission line. A transmission line 1.75 miles long would be required to interconnect the 500 kV substation with the 115 kV substation at Superior.



N

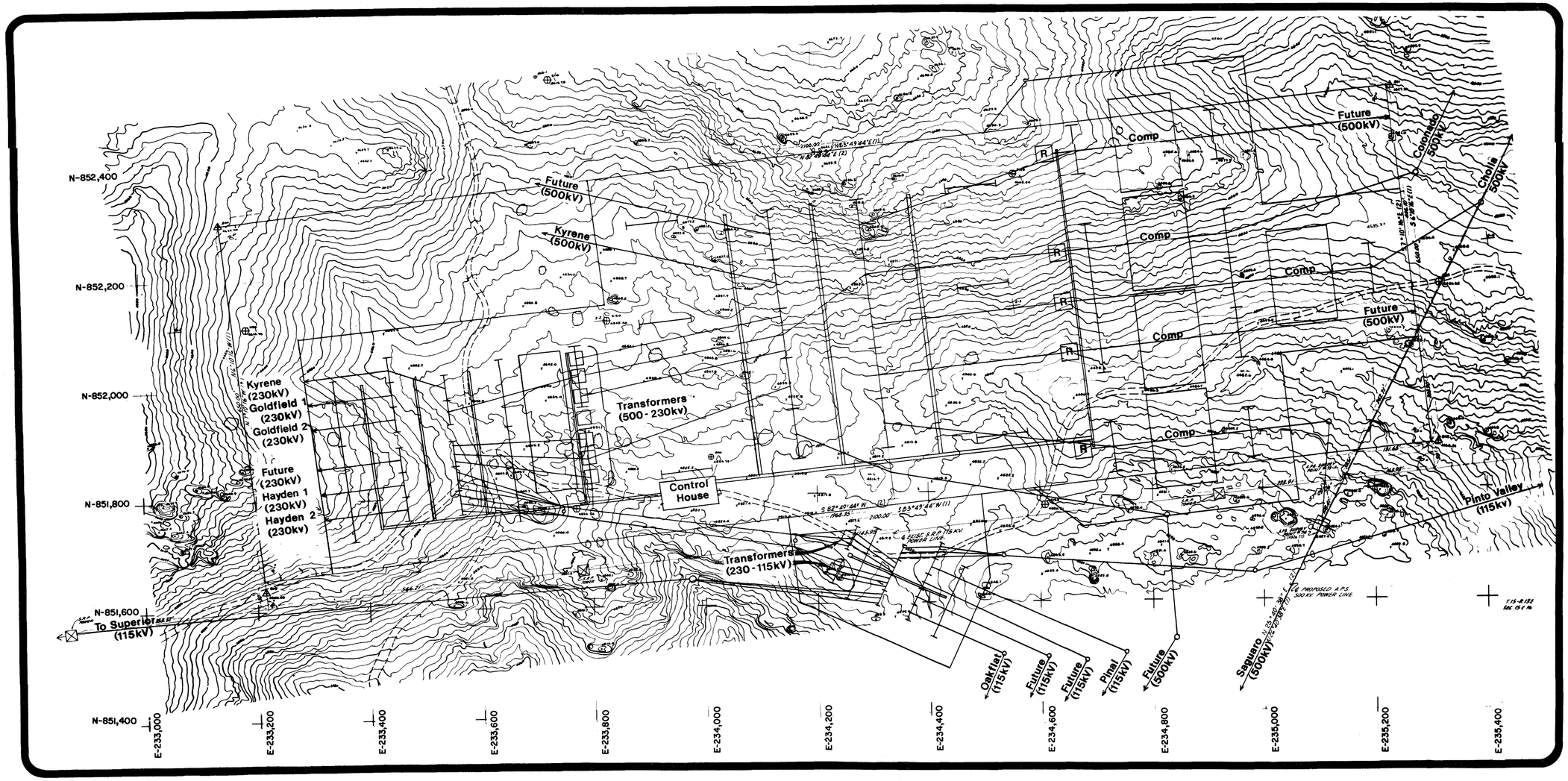
0 1000 FEET

CORONADO PROJECT

Transmission System

SILVER KING STATION
SITE B

Figure III-18



COMP _____ CAPACITOR COMPENSATION

R _____ REACTOR

N

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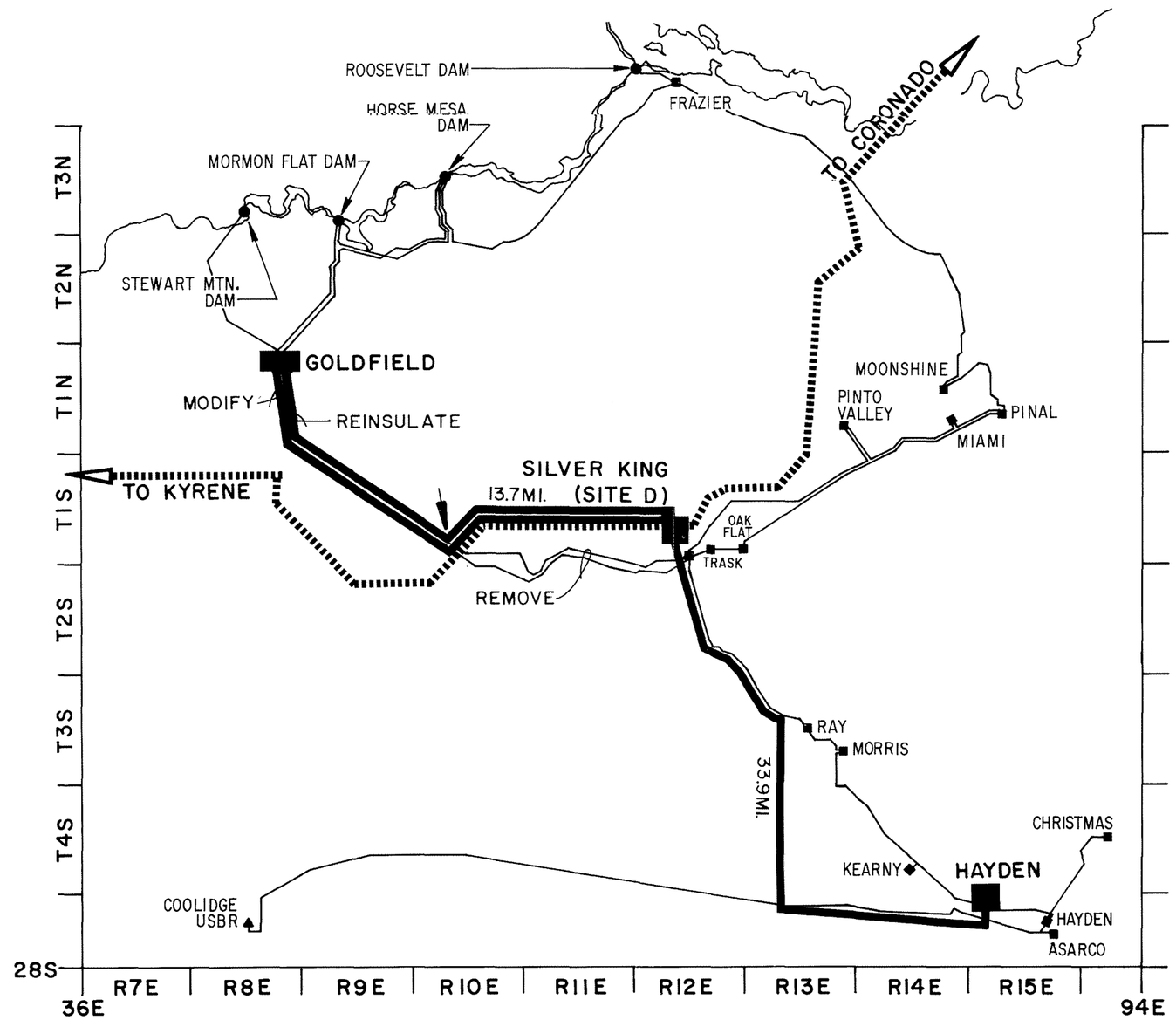
CORONADO PROJECT

Transmission System

SILVER KING STATION

SITE C

Figure III-19



230kV

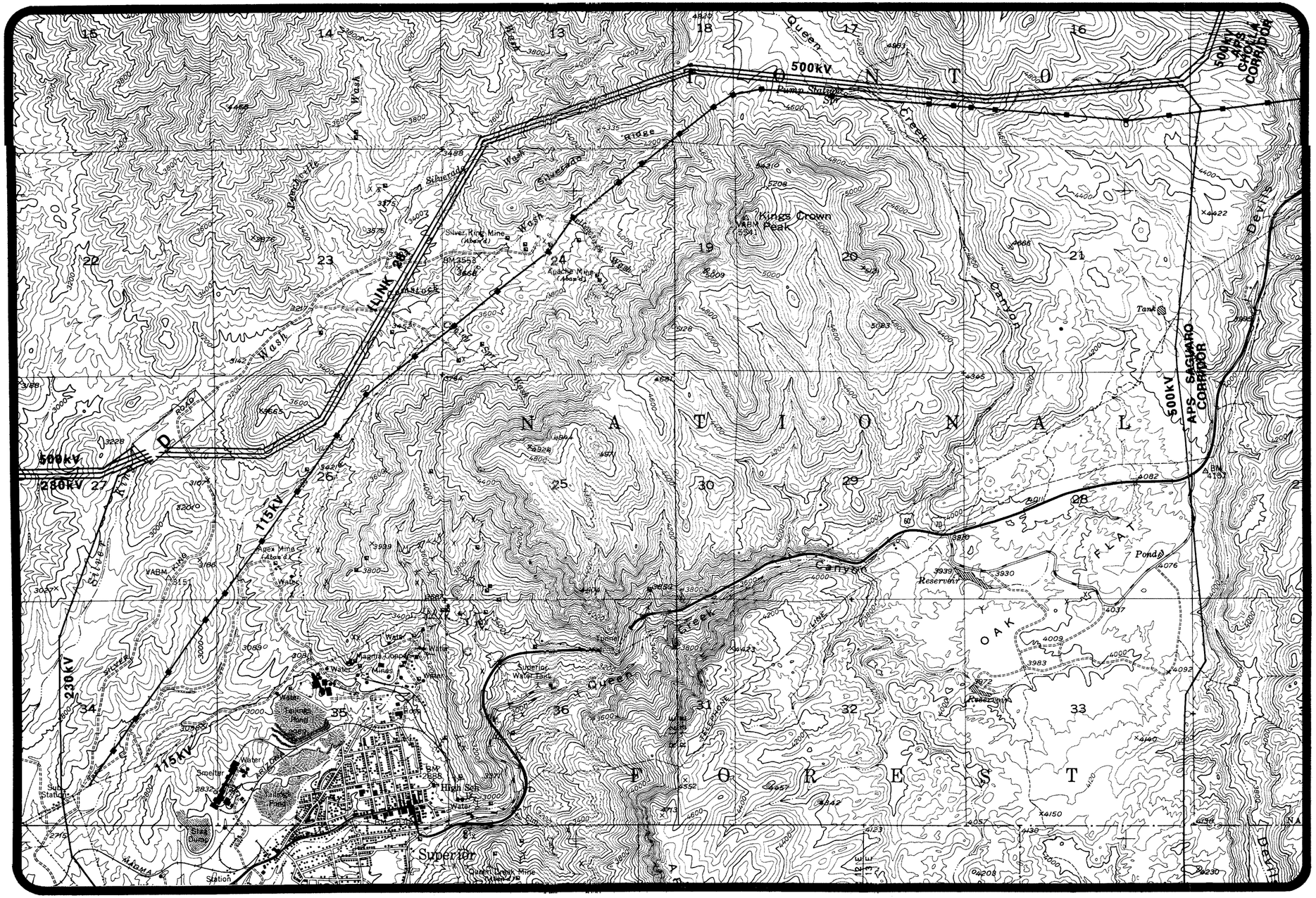
500kV

CORONADO PROJECT

SUBSTATIONS AND SYSTEMS

SILVER KING PLAN (SITE D)

Figure III-20



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0 1 MILE

CORONADO PROJECT

Transmission System

SILVER KING STATION
SITE D

Figure III-21

(5) Kearny No. 1 (Silver King Site E) (See Figures III-22 and III-23) would be located on a flat alluvial plain dissected by drainages. The soil erosion potential is moderate with a tendency for gullies to form in areas of soil disturbance. The vegetative community is a mix of Crucifixion Thorn-Cactus Associations. Revegetation potential is low. The site would be within 1/4 mile of State Route 177, and within a Travel Influence Zone. Archeological site density is considered to be moderate.

The site would be 1.2 miles from the APS Cholla-Saguaro 500 kV transmission line. A 230 kV transmission line would be constructed 7 miles to Superior (See Figure III-22). A new 230 kV substation (New Superior Area Substation) would be required near the existing 115 kV substation in Superior.

(6) The Kearny No. 2 Site (Figure III-24) would be located at the intersect point of Links 47 and 27. A specific site has not been identified for this alternative. Slopes are 0-10 percent where Links 47 and 27 intersect, with the area gently rolling and extending in all directions for one-half mile or further. Soil erosion potential is low to moderate. The vegetative community is a mix of Crucifixion Thorn-Cactus Association. Revegetation potential is low. Archeological site density is moderate. The area is removed from any paved roads, but is near a well traveled and maintained unsurfaced road.

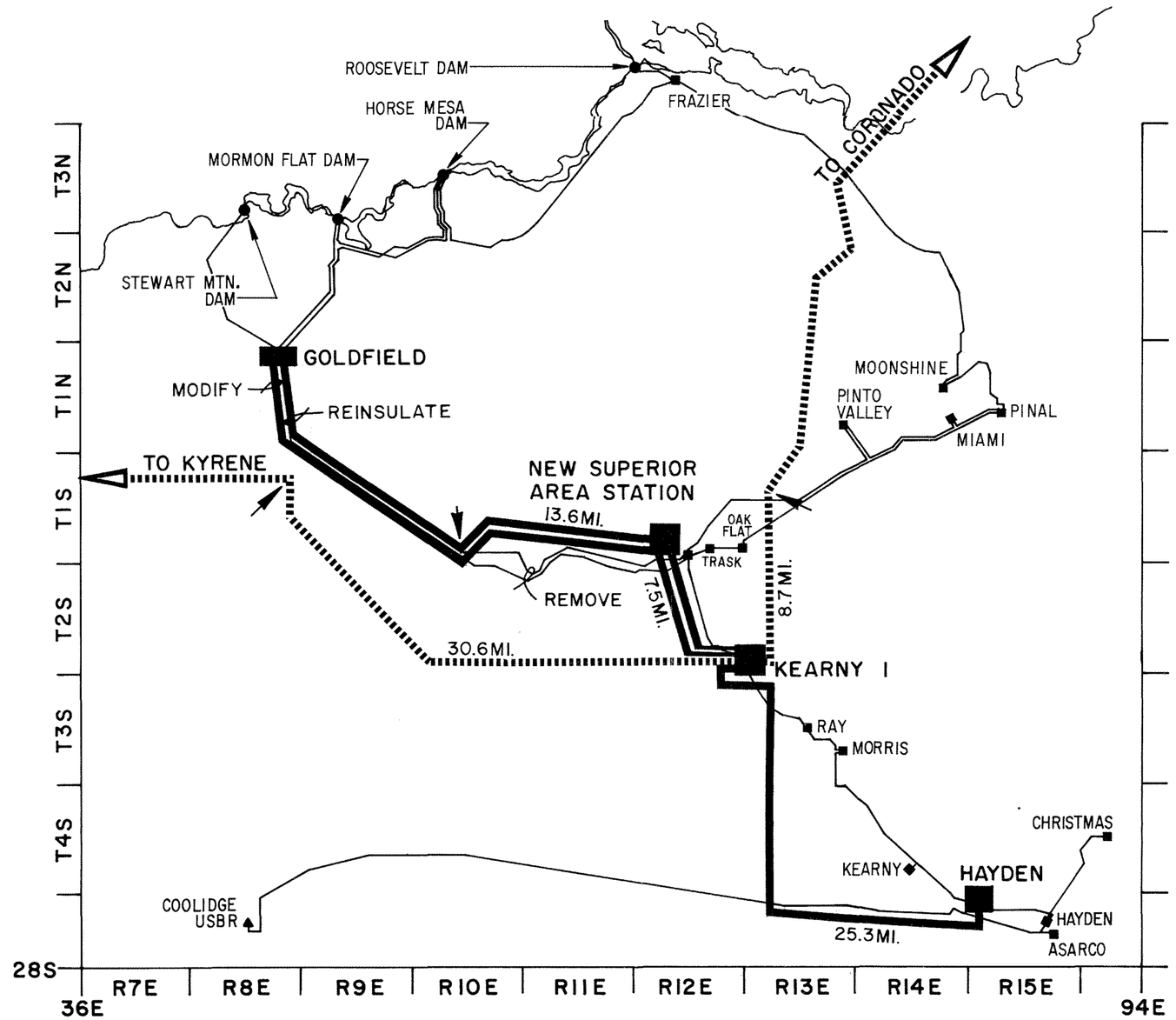
The site would be adjacent to the APS Cholla-Saguaro 500 kV transmission line. A 230 kV transmission line would be constructed 23.4 miles to Superior. A new 230 kV substation (New Superior Area Substation) would be required near the existing 115 kV substation in Superior.

(7) The Dinosaur Site would be located near the junction of Links 33 and 34 (See Figure III-13). The area is flat. The vegetative community is Creosote Bush - Bursage. Revegetation potential is low. Soil erosion potential is low. Archeological site density is moderately low. The site is three miles south of U.S. Highway 60/70.

The site would probably be considered by APS to be too costly to interconnect with their APS Cholla-Saguaro 500 kV transmission line. A 230 kV transmission line would be constructed from the Dinosaur substation to Superior. A new 230 kV substation (New Superior Area Substation) would be required near the existing 115 kV substation in Superior.

d. Comparison of Substation System Alternatives

Table III-18 indicates that a substation at Silver King Site C would require the least total mileage of additional transmission line to interconnect all 115 kV, 230 kV and 500 kV systems.



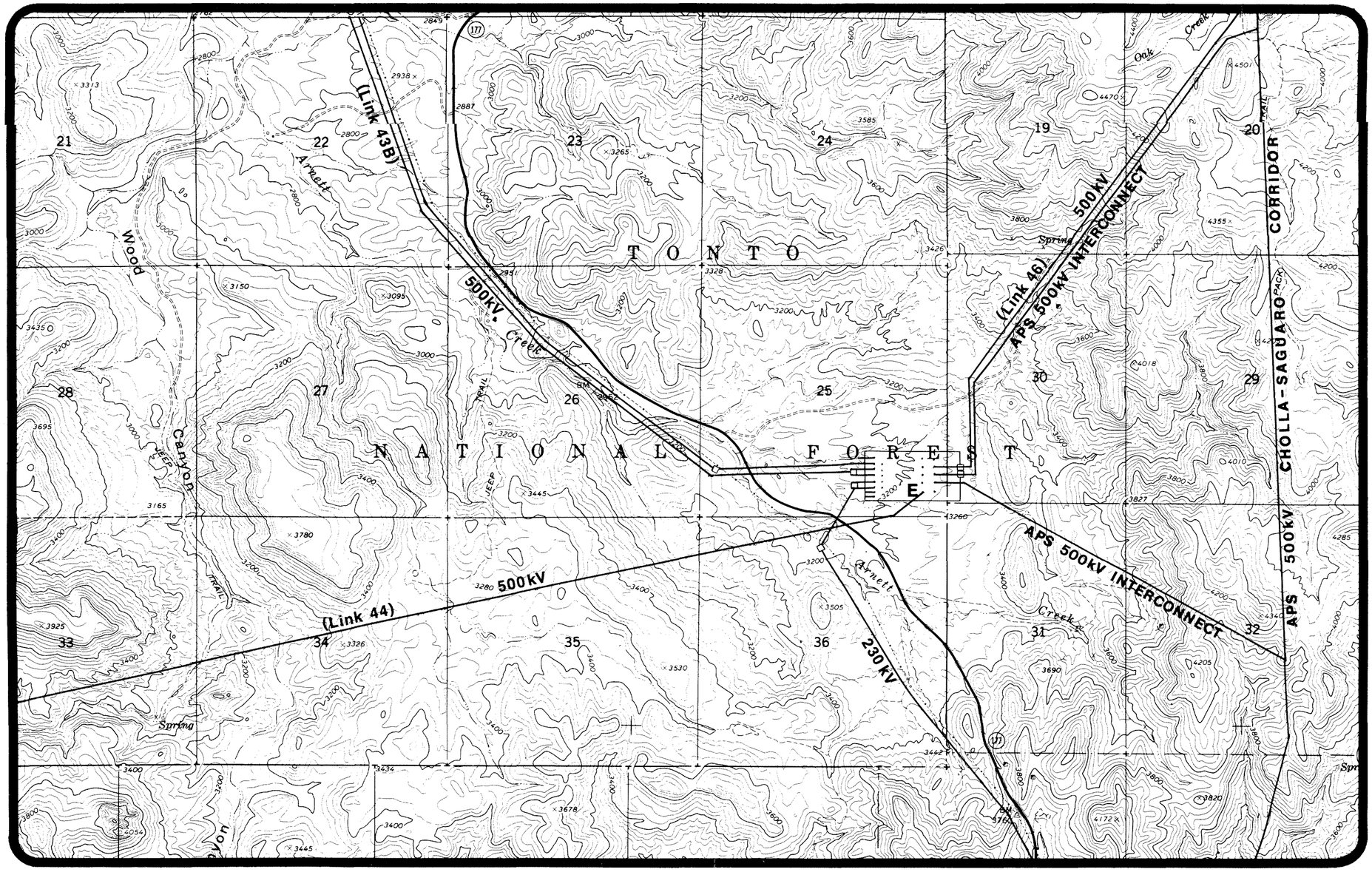
230kV
500kV

CORONADO PROJECT

SUBSTATION AND SYSTEMS

KEARNY NO. I PLAN (SITE E)

Figure III-22

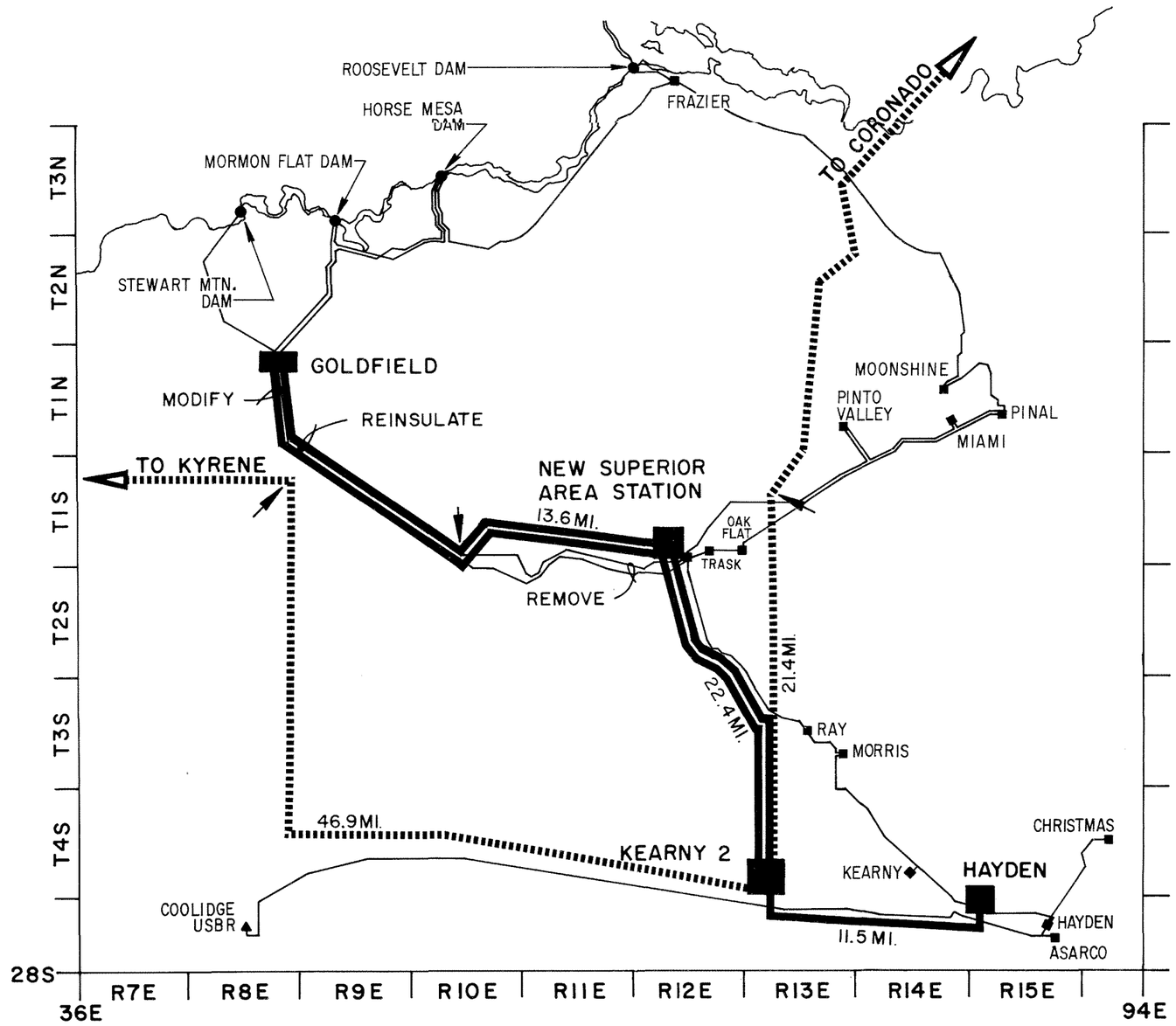


CORONADO PROJECT

Transmission System

KEARNY NO. 1 STATION (SITE E)

Figure III-23



230kV
500kV

CORONADO PROJECT

SUBSTATIONS AND SYSTEMS

KEARNY NO. 2 PLAN

Figure III-24

e. Hayden Area 230/115 kV Substation

SRP proposes no alternative sites for the Hayden 230/115 kV substation for the following reasons:

(1) The present substation is near existing 115 kV lines, thus minimizing the need for additional new 115 kV and 230 kV line construction.

(2) It acts as an electrical load center that permits serving existing and future loads in four directions with minimal revamping of the existing 115 kV lines.

(3) It has an existing access road from State Route 177 and very little upgrading will be required.

6. Environmental Matrices

In order to assist the federal land management agencies on granting easements, permits or rights-of-way, an objective analysis of a number of alternatives was made. As part of a standard procedure for the U.S. Forest Service, environmental matrices were prepared for six of the most viable alternatives of the company's transmission line and substation proposals where the study team identified alternatives to the proposed action. These areas were:

a. Eastern Mining area 230 kV transmission line corridors. Assuming that the 500/230 kV substation was located at Silver King Substation Alternative E (Kearny No. 1), five alternative corridors were identified. No company proposal has been made pending the issuance of the Final Environmental Impact Statement (F.E.I.S.).

b. Eastern Mining area 230 kV transmission line corridors. Assuming that the 500/230 kV substation was located at Silver King substation alternatives A, B, or C, ten alternative corridors were identified. No company proposal has been made pending issuance of the F.E.I.S.

c. Southern portion 500 kV transmission line corridors. Five alternative corridors were identified.

d. Northern portion 500 kV transmission line corridors. Three alternative corridors were identified.

e. Southern portion 500/230 kV substation alternatives. Seven alternative locations were identified.

f. Northern portion 500 kV "backup" interconnection alternatives. One alternative to the company proposal to interconnect with the APS Cholla Generating Station was identified. This alternative interconnection had two alternative corridors to interconnect the Coronado Station with TG&E's 345 kV EHV line east of the Coronado plant site approximately 17 miles.

Eleven environmental factors were given "double-adjective" ratings for each of the above alternatives by Forest Service and Bureau of Land Management officers and representatives from SRP's environmental division. These "double-adjective" ratings ranged from a "low-low" impact rating up through a "high-high" impact rating.

For instance, if Silver King Substation Alternative A was being rated, and the rater felt that the substation would have an insignificant impact on the "air quality" environmental factor, he would rate that factor with a double-adjective rating of "L-L" (low-low). If the rater felt that the "Natural Beauty" environmental factor would be severely impacted he would rate this environmental factor at "high-high". A total of nine double-adjective increments were available to rate each environmental factor.

After completion by the raters, individual matrices were combined into a master matrix for each alternative. Double-adjective ratings were than converted to numerical rankings used in the following table:

Double-Adjective Rating		=	Numerical Rating
LL	(low-low)	=	2
MF	(moderately-low)	=	3
HL	(high-low)	=	4
LM	(low-moderate)	=	5
MM	(moderately-moderate)	=	6
HM	(high-moderate)	=	7
LH	(low-high)	=	8
MH	(moderately-high)	=	9
HH	(high-high)	=	10

The sum total of all numerical ratings for each environmental factor was then divided by the number of responses which yielded an average numerical rating for each contributing agency (Forest Service, BLM, SRP) for each environmental factor of each alternative.

The raters were then asked to assign weighting factors from 1-20 to each environmental factor based on the raters estimate of the relative importance of each environmental factor. Since the "low-low" double adjective impact rating was assigned the lowest numerical rating (2), each rater was told to assign the lowest weighting factor number (1), to the environmental factor or factors that he felt was the least important or significant, and the higher numbers (up to 20 so that a greater "spread" would occur) for those environmental factors that were deemed most important.

The agency weighting factors were then multiplied times the agencies average numerical score to obtain the weighted average numerical rating for each environmental factor for each alternative. The weighted average numerical ratings for each environmental factor were then totaled. A similar procedure was followed in evaluating the engineering matrices, i.e., that double adjective ratings were assigned to the Restoration and Accessibility, R/W difficulty, Reliability and Cost factors. These double adjective ratings were then assigned numbers the same as those applied to the environmental factors.

Each alternative was then given a combined total score for all factors.

The total score from the environmental matrix and the total score from the engineering matrix were normalized to a base of 100 for ease in graphic representation.

Alternatives were ranked for suitability or environmental preference according to the sum of the normalized engineering and environmental weighted average numerical ratings, from the lowest numerical rating to the highest. For example, that alternative with the lowest total weighted "normalized" engineering and environmental score was considered to be the most desirable (suitable) alternative because the lower total numerical ranking would reflect the least environmental impact. Conversely the highest total "normalized" engineering and environmental scores was considered the least desireable or suitable alternative because the higher total numerical rankings would reflect the greatest environmental impact.

7. Engineering Constraints or Matrices

The company was given the same six sets of alternatives that were given the Forest Service, Bureau of Land Management, SRP Environmental Division, and the Environmental Consultant. They were asked to conduct engineering studies to determine the rankings for each of the alternatives based on the following factors:

Reliability

Right-of-way acquisition

Construction costs

These factors are further explained below:

a. Reliability

As envisioned by the Federal Study Team, the system should meet customer demands except for 1 day in 10 years, and that the system could be adjusted to meet all demands with one major transmission line out of service. Reliability is also based on the fact that if a second line was removed from service some service would have to be curtailed, and that if a third line went out of service further curtailment would occur and the likelihood of the entire system collapsing would be high.

(1) Causes of "outages" (Continuity of Service) Variable

(a) Weather - (lightning) should be assigned values from a double-adjective scoring system where a "high-high" rating would reflect the corridor, link, or substation alternative with the heaviest lightning occurrence and "low-low" the lightest occurrence area.

(b) Wildfire - potential fire hazard areas should also be assigned double-adjective rankings as follows: Areas with the heaviest amount of fuel, either under or immediately adjacent to the alternative corridor or substation, should be assigned a "high-high" ranking. Those areas either under or immediately adjacent to the alternate line or substation, with the lightest concentration of fuel,(i.e., Palo Verde or Desert-Scrub vegetative type), should be ranked "low-low".

(c) Vandalism

Transmission corridors where easy vehicle access is available or where they are located near population centers - "high-high" (hazard)

Transmission corridors near public recreation areas "moderate-moderate" impact (hazard)

Transmission corridors in areas open to hunting during hunting seasons - "low-moderate" impact (hazard)

Transmission corridors in rural areas where hunting is not allowed, i.e., within two mile limits of Kearny - "low-low" impact (hazard)

(2) Restoration Variable - refers to the time it would take to restore a line in case of an outage.

(3) Relative Ease of Accessibility - is calculated as follows:

The direct distance from the centerpoint of each link to the closest surfaced highway is added to the distance from the above "point-on-a-surfaced highway" to the closest crew headquarters. The sum of these two mileages is then added to the distance (mileage) from the above crew headquarters to either Phoenix or St. John's, whichever is closer.

The sum of the above mileages (3) are then to be multiplied times the link mileage.

The product of these two figures is then multiplied by a physiographic factor.

Physiographic factors used in previous reports (Cholla F.E.I.S. page IV-70) are described on page 42 of the Wirth and Associates report entitled "A.P.S. Transmission Line Location and Impact Evaluation, Cholla to Saguaro, Phase III" dated May 1973. This report uses following physiographic variables as factors:

Slopes	0 - 1%	- 0.1
"	10 -30%	- 1.0
"	30 -50%	- 6.0
"	50%+	-20.0
Major drainages		- (P) - 10.0
" "		(I) - 5.0
Ridgetops - 3.0		
Major canyons - 40.0		

These factors should be used in this report.

Based on the above numerical ratings for each link, a normalized score should be obtained for each link, e.g., if alternative #4 (links A, C, E, H, J) of the EMA proposal - Silver King Substation Alternative (A, B, C)to Kearny has the highest numerical score of all of the EMA alternatives, it would be rated on the normalized numerical rating scale of "100". This normalized "100" rating should then be converted to a double-adjective impact rating of "high-high."

The normalized score for each alternative would be converted to the double-adjective impact rating as follows:

Normalized Rating	Double-Adjective Rating
90 - 100	High-High (HH)
80 - 90	Moderate-High (MH)
70 - 80	Low-High (LH)
60 - 70	High-Moderate (HM)
50 - 60	Moderate-Moderate (MM)
40 - 50	Low-Moderate (LM)
30 - 40	High-Low (HL)
20 - 30	Moderate-Low (ML)
0 - 20	Low-Low (LL)

b. Right-of-Way Acquisition Variable

The estimated cost of R/W will be included as part of Construction Costs in the matrix. This variable refers to the difficulty in obtaining R/W.

The following factors will be assigned double-adjective ratings the same as was applied to the Restoration Variable.

(1) Number of Cases - individual property owners.

The number of individual R/W needed along each corridor should be counted and a double-adjective score assigned. The "high-high" double-adjective score would indicate that R/W acquisitions within the assigned time frame would be impossible.

(2) Number of Structures Requiring Relocation

Score each corridor with double-adjective ratings as above, where a "high-high" rating would indicate that corridor with the highest number of buildings or structures that would have to be moved.

(3) Amount of Irrigated Cropland to be Crossed 1/

Score each corridor with double-adjective ratings as above with the corridor alternative containing the highest number of leases or number of acres to be crossed by the corridor as "high-high".

c. Construction Costs

The average construction cost for each corridor or alternative should be determined by using the average or typical tower design for each corridor times the mileage, then adjusted by the physiographic factor used in computing the Restoration Variable above. Substation alternative ratings should consist of the cost of construction (adjusted by the physiographic variable if necessary) plus the cost of R/W.

The total cost of each alternative would then be assigned double adjective ratings based on the most expensive alternative being rated as "high-high", the next highest "moderate-high", etcetera.

The seven substation alternatives were evaluated in the same manner as the transmission line corridor alternatives, i.e.:

(1) Reliability

(a) Continuity of Service
(b) Restoration Variable
(c) Relative Ease of Accessibility

1/ Experience has shown that a considerable amount of acreage is mortgaged, and that the consent of all mortgages is required to subordinate the mortgage to the easement. Negotiation, legal problems encountered, and the time required to do both of the above can be compounded making the price to acquire right-of-way easements prohibitive.

(2) R/W Acquisition

(3) Construction

(a) Number of Cases
(b) Number of Structures Requiring Relocation
(c) Amount of Irrigated Cropland to be Crossed

Attached are the 6 final environmental matrices. The environmentally preferred alternatives are shown on each matrix. A table follows each matrix that shows the total normalized scores for the environmental and engineering factors. The lowest total of the engineering and environmental factors is indicated as the preferred alternative, because it should reflect the least environmental damage coupled with the lowest total score for the engineering factors considered.

8. Discussion (Correlation of Transmission System Components)

a. Alternative Routes for 230 kV EMA System Assuming Silver King Substation Sites A, B, or C.

The EMA Study Team were asked to present their opinions as to first and second choice following the team members review of the final environmental report as prepared by Wirth and Associates, Inc. Table III-21 below, shows the results of this survey.

Table III-21

230 kV EMA Route Preference as Stated by Study Team Members

Agency	1st Choice	2nd Choice
Arizona Game & Fish	A-D-I	B-C-G-J
Bureau of Land Management	B-D-I	B-C-G-J
Arizona State Land Dept.	B-D-F- to E-G-J	
Salt River Project Eng. & R/W Divisions	B-C-G-J	B-D-I

The environmental matrices prepared by the Federal Study Team for the 230 kV EMA proposal, indicated route rankings by suitability based on "normalized" engineering and weighted environmental rankings (see Figures III-25, and III-26). Figure III-25 indicates the following 230 kV transmission line corridor environmental rankings if the 500/230 kV Silver King Substation is located at sites A, B, or C:

First Choice	-	Routes B. C, G, J
Second Choice	-	Routes B, C, I
Third Choice	-	Routes B, D, F, H, J

The remaining rankings are shown on Figure III-25.

b. Alternative Routes for 230 kV EMA System Assuming Kearny No. 1 (Silver King E)

Figure III-26 indicates the following 230 kV transmission line corridor weighted environmental rankings if the 500/230 kV Silver King Substation is located at Kearny No. 1 (Silver King E).

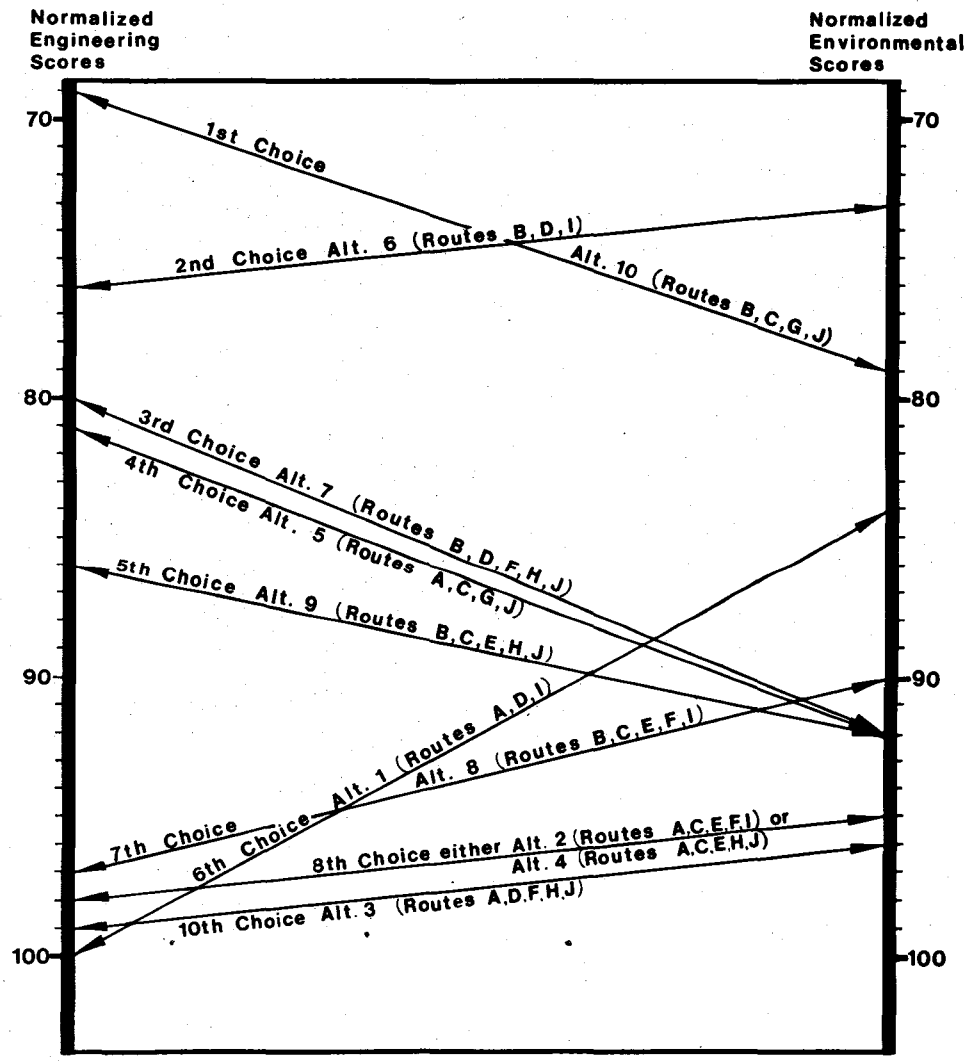
First Choice	-	Routes D, I
Second Choice	-	Routes D, F, H, J or C, G, J
Fourth Choice	-	Routes C, B, H, J

c. Alternative Links for 500 kV Transmission System - Southern Portion

A total of five 500 kV transmission line corridor alternatives were ranked in the southern portion of the 500 kV system. These alternatives represent the five corridors, from the 500 kV Arizona Public Service - Cholla powerline corridor west to the Kyrene Steam Plant in Tempe with the lowest costs.

Figure III-27 indicates the following 500 kV transmission line corridor environmental rankings for the southern portion:

First Choice	-	Links 28, 29, 33
Second Choice	-	Links 43, 43a, 38, 33
Third Choice	-	Links 45, 46, 44, 38B, 33
Fourth Choice	-	Links 45, 46, 43B, 43, 28A, 38A & B, 33
Fifth Choice	-	Links 45, 47, 27, 33

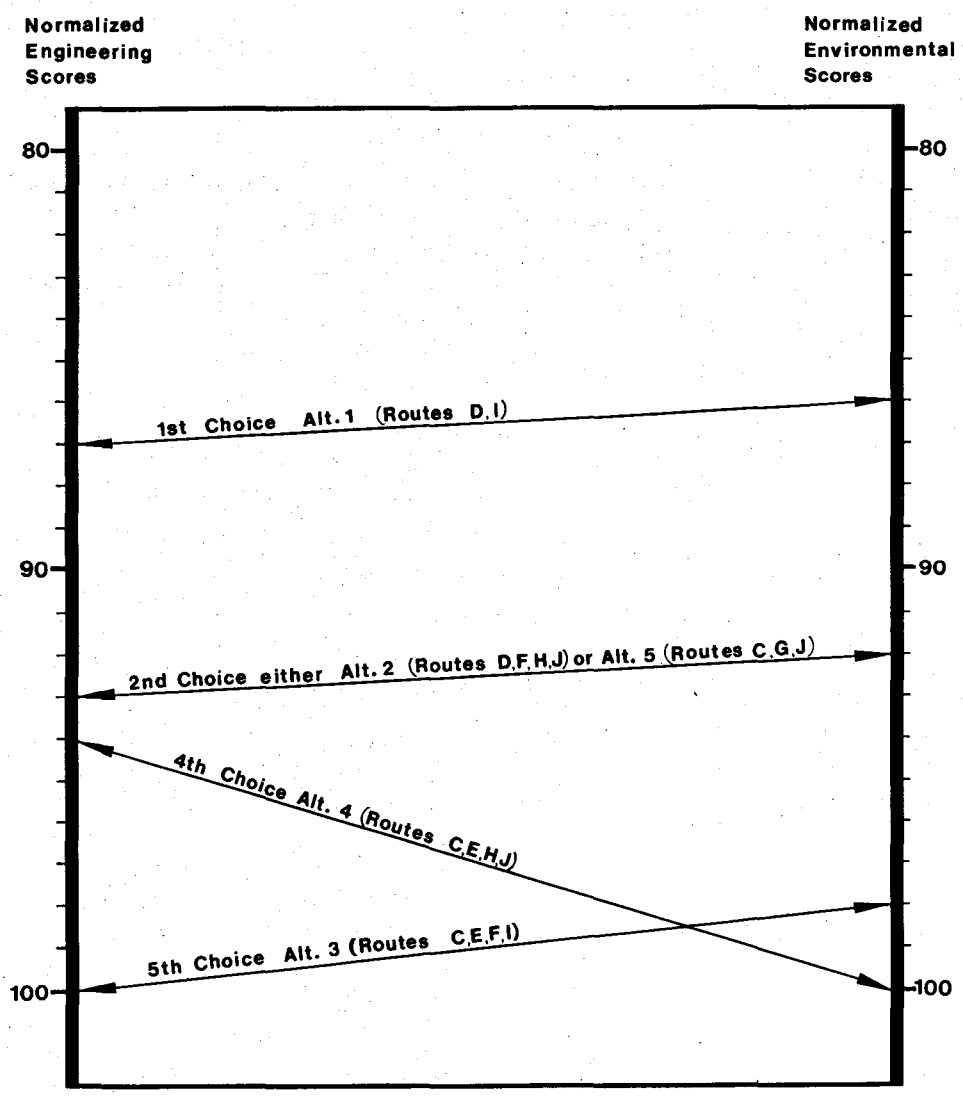


Suitability Route Rankings - EMA Alternatives
Assuming Silver King Substations A, B, or C

Alternate No.	Alternate Routes	Normalized Engineering + Score	Normalized Environmental = Score	Total Normalized Score	Route Suitability Ranking
1	A,D,I	100	84	184	6
2	A,C,E,F,I	98	95	193	8
3	A,D,F,H,J	99	96	195	10
4	A,C,E,H,J	93	100	193	8
5	A,C,G,J	81	92	173	4
6	B,D,I	76	73	149	2
7	B,D,F,H,J	80	92	172	3
8	B,C,E,F,I	97	90	187	7
9	B,C,E,H,J	86	92	178	5
10	B,C,G,J	69	79	148	1

EASTERN MINING AREA ALTERNATIVES
Assuming the Silver King Substations A, B, or C

Figure III-25

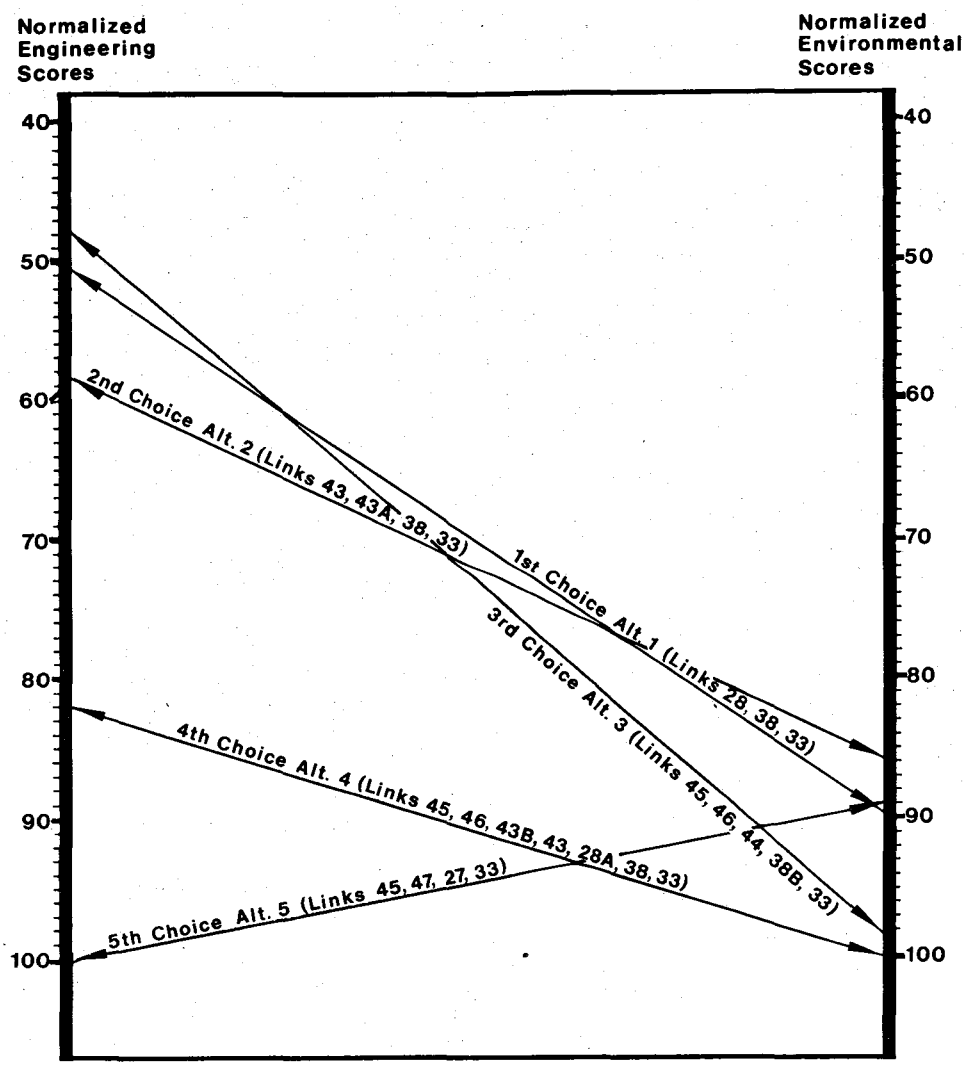


Suitability Route Rankings - EMA Alternatives
Assuming Kearny No. 1 (Silverking E) Substation

Alternate No.	Alternate Routes	Normalized Engineering Score	+	Normalized Environmental Score	=	Total Normalized Score	Route Suitability Ranking
1	D,I	87		86		173	1
2	D,F,H,J	93		92		185	2
3	C,E,F,I	100		98		198	5
4	C,E,H,J	94		100		194	4
5	C,G,J	88		97		185	2

EASTERN MINING AREA ALTERNATIVES
Assuming Kearny No.1 (Silver King E) 500kV Substation

Figure III-26



Suitability Rankings - 500 kV Transmission Line
Southern Portion

Alternate No.	Alternative Links	Normalized Engineering + Score	Normalized Environmental Score	Total Normalized = Score	Route Suitability Ranking
1	28,38,33	139=50	90	140	1
2	43,43B,38,33	160=58	86	144	2
3	45,46,44, 38B,33	131=47	99	146	3
4	45,46,43B,43 28A,38,33	227=82	100	182	4
5	45,47,27,33	278=100	89	189	5

500kV TRANSMISSION SYSTEM ALTERNATIVES (Southern Portion)

Figure III-27

d. Alternatives for 500 kV Substations

A total of seven 500/230 kV substation alternative locations were evaluated in Figure III-28. The weighted environmental rankings for these seven substation locations are:

First Choice	-	Dinosaur
Second Choice	-	Silver King C
Third Choice	-	Silver King B
Fourth Choice	-	Silver King Site A
Fifth Choice	-	Silver King Site D
Sixth Choice	-	Silver King Site E
Seventh Choice	-	Kearny No. 2

The above rankings for both the 500 kV transmission corridors, southern portion, and the substation sites are ranked according to their combined weighted environmental and engineering scores for the transmission system (the combination of the 500/230 kV lines and the location of the 500/230 kV substation) that would result.

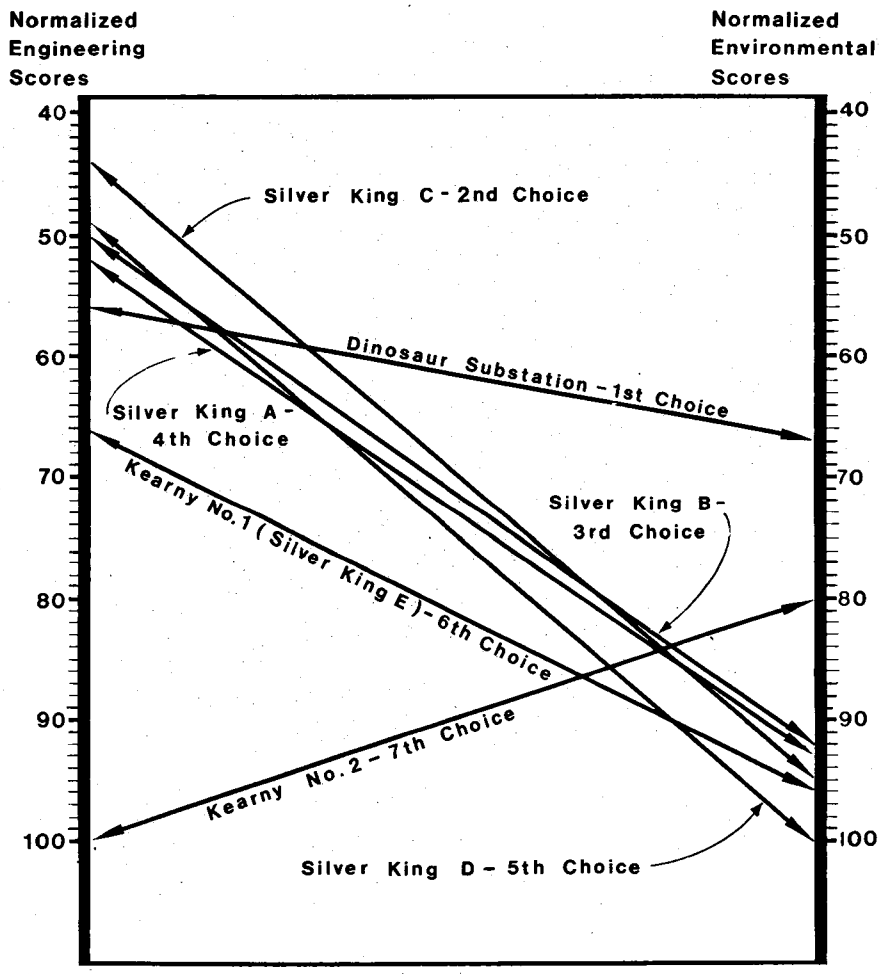
e. Alternative Links for 500 kV Transmission System - Northern Portion

On the northern portion of the proposed 500 kV transmission line system, three alternative 500 kV corridors were identified on the extreme western end of the primary system where the primary 500 kV system would interconnect with the dual 500 kV corridor. The environmental matrices prepared by the Federal Study Team, based on "normalized" engineering rankings and weighted environmental rankings (see Figure III-29), indicate the following rankings:

First Choice	-	Links 6B, 14, 11A, 11B
Second Choice	-	Links 42, 41, 11B
Third Choice	-	Links 42, 15, 16

f. Alternative Links 03 and 04

Another 500 kV transmission corridor alternative to the link 04 corridor was identified by the environmental consultant prior to any study performed by the Federal Study Team. This alternative link was identified as link 03. Link 03 was not studied as an alternative to link 04 even though it was identified in the Phase II Corridor Inventory and Analysis. Since no significant environmental factors could be identified in either link 03 or 04, and since link 03 was three miles longer in length than 04, it was not mentioned in the Draft EIS for this project. Further it was not considered in this Final Statement.

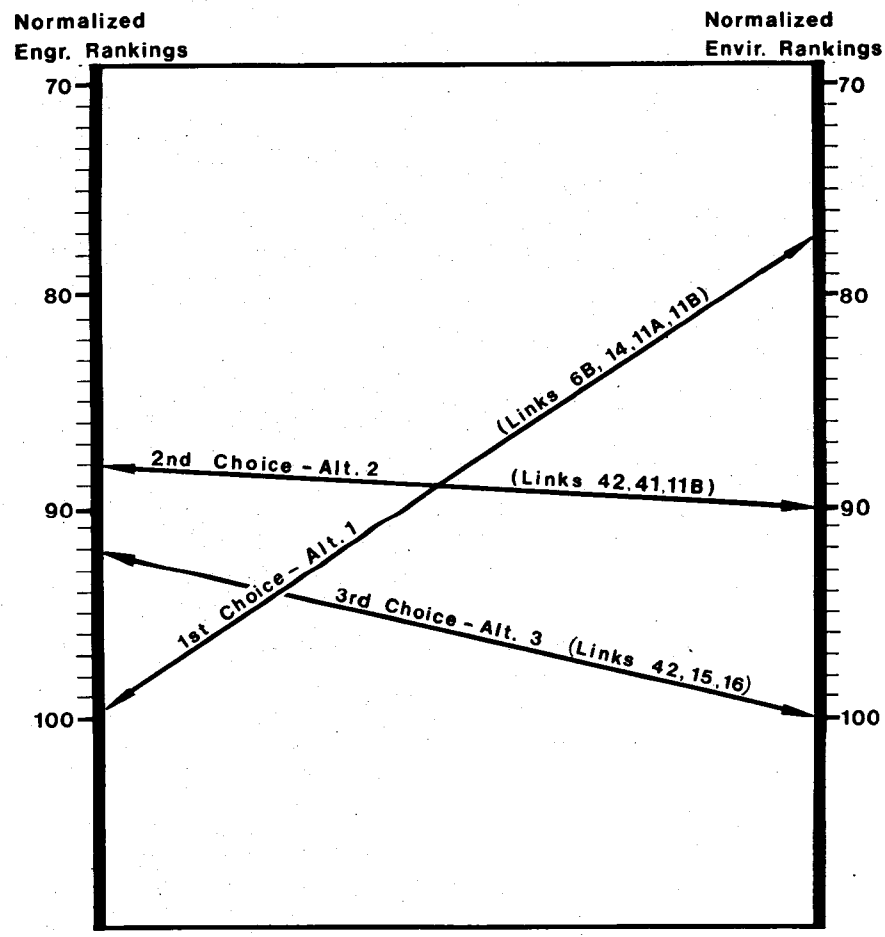


Suitability Rankings - 500 kV Substation Alternatives

Substation Site	Normalized Engineering Score +	Normalized Environmental Score =	Total Normalized Score	Substation Suitability Ranking
Dinosaur	56	67	123	1
Silver king C	44	95	139	2
Silver king B	50	92	142	3
Silver king A	52	93	145	4
Silver king D	49	100	149	5
Kearny No. 1 (Silver king E)	66	96	162	6
Kearny No. 2	100	80	180	7

500KV SUBSTATION ALTERNATIVES

Figure III-28



Suitability Ranking - 500 kV Transmission Line
Northern Portion

Alternate No.	Alternative Links	Normalized Engineering Score	+	Normalized Environmental Score	=	Total Normalized Score	Link Suitability Ranking
1	6B,14,11A,11B	100		77		177	1
2	42,41,11B	88		90		178	2
3	42,15,16	92		100		192	3

SUITABILITY ROUTE RANKINGS
500KV Transmission Line Alternatives
(Northern Portion)

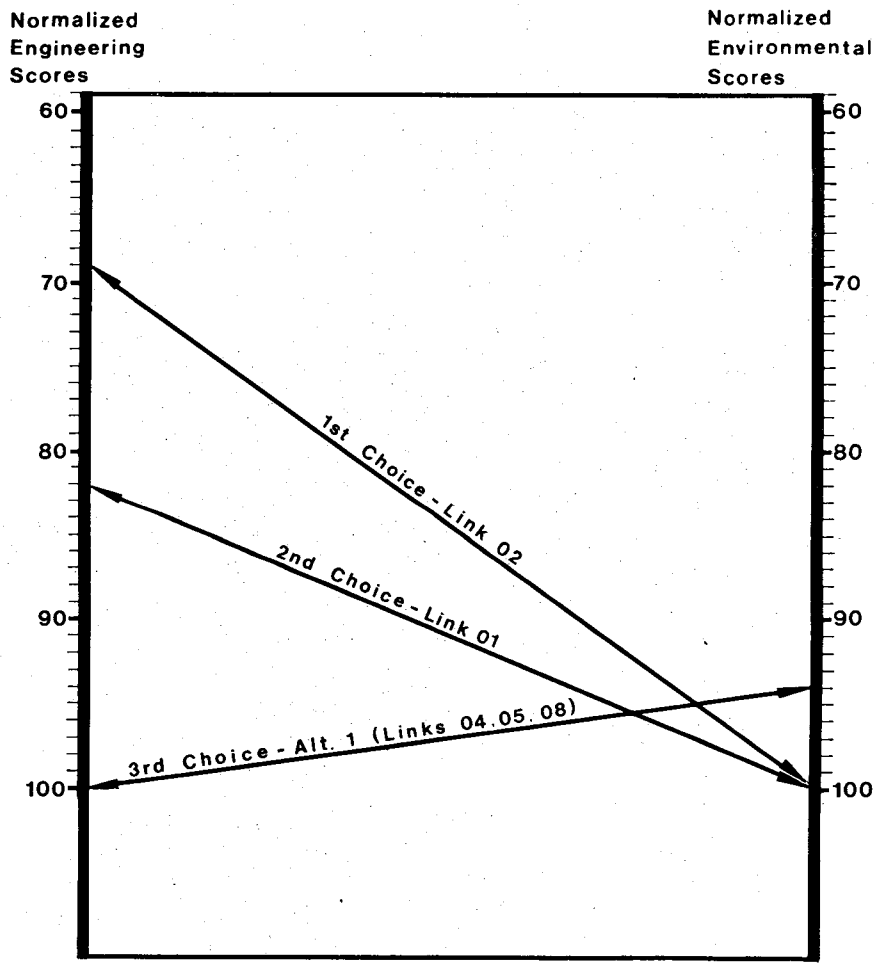
Figure III-29

g. Alternatives for 500 kV "Backup" Interconnection

Three backup interconnections were identified during the study for use as "start-up" and "back-up" power.

The environmental matrices prepared by the Federal Study Team, based on "normalized" engineering rankings and weighted environmental rankings for start-up and back-up power (see Figure III-30), are indicated with the following rankings:

First Choice	-	Link 01 to the TG&E 345 kV line
Second Choice	-	Link 02 to the TG&E 345 kV line
Third Choice	-	Links 04, 05, 08 to the APS Cholla Power Plant



Suitability Ranking - 500 kV Backup Interconnection
Northern Portion

Alternate No.	Alternative Links	Normalized Engineering Score	+	Normalized Environmental Score	=	Total Normalized Score	Link Suitability Ranking
1	04,05,08	100		94		194	3
2	02	69		100		169	1
3	01	82		100		176	2

ALTERNATIVE 500KV "BACKUP" INTERCONNECTIONS

Figure III-30

IV. Consultation and Coordination During Development of the Proposal and During Preparation of the Draft Environmental Statement

A. Consultation and Coordination in the Preparation of the Draft Environmental Statement

The Federal preparation team for development of this Draft Environmental Statement held its first meeting in February 1975. This multiagency team consisted of representatives of the Bureau of Reclamation, the U.S. Forest Service, and the Bureau of Land Management (those agencies preparing the statement) as well as liaison participation from the Fish and Wildlife Service, the National Park Service, the U.S. Geological Survey and the Department of the Interior for informational and advisory purposes. Subsequent team meetings were held in July, September and December 1975 in addition to numerous work group meetings between individual agencies preparing sections of the statement.

Table IV-1

CORONADO PROJECT

Chronology of Activities of Federal Study Team

April 1, 1973 - SRP started environmental studies on the location of the generating station.

January 1974 - Phase I Studies on the transmission line corridors were begun. These were completed the first of March 1974. The studies were aimed at identifying regional environmental features sensitive to an EHV transmission line, and/or minimizing conflict with these features in the location of alternate transmission corridors.

March 1, 1974 - Phase II Studies began; and were completed by mid-May 1974. This was a comprehensive inventory and analysis of environmental features potentially affected by the proposed transmission system.

1974 - Work began on the Coronado Generating Station.

November 1974 - SRP formally requested the Department of Interior and Agriculture to process right-of-way for the Coronado Project triggering the EIS process.

December 26, 1974 - The Secretary of Interior's Office designated the BR as lead agency for the Coronado Project Environmental Statement. The letter stated that substantive participation in preparation of the Statement would be required of BLM, BIA, USGS, and NPS within the Department and the forest Service of the Department of Agriculture.

February 20,1975 - All participating agencies met to set out agency assignments and responsibilities. At the time a Forest Service Team Leader had not been identified. USBR Team Leader set a date of July 15, 1975 to have environmental studies completed and sent in to the BR Team Leader.

April 4, 1975 - The Deputy Regional Forester responded to BR Team Leader's request that studies be completed by July 15, 1975, stating that the Forest Service would complete the job quickly once a Forest Service Study Team member was selected and the applicant's Environmental Report was received.

The three Federal agencies now involved in the Coronado Project Statement were simultaneously involved in the Statement for the APS Cholla Project.

April 9, 1975 - The Cholla Project final Environmental Statement was filed with CEQ. That statement studied a dual corridor (with 2-500 kV lines, one APS and one SRP) through the Apache-Sitgreaves and Tonto National Forests.

May 7, 1975 - The study Team met to organize and agree on how to coordinate efforts. The Team was given Environmental Reports Vol. II (Snowflake and St. Johns Generating Station Site), Vol. III (Transmission Systems), an environmental analysis and study entitled "An Application to Certificate of Environmental Compatibility for the Arizona Station Project" prepared for the State of Arizona Power Plant and Transmission Line Siting Committee and dated July 29, 1974, and "A Consolidated Application for Amendments to Certificates of Environmental Compatibility" also prepared for the State Siting Committee and dated May 1, 1975. There was no Federal agency input into those documents.

June 19, 1975 - Telecon from F. Darmiento, Environmental Analyst for SRP, notifying the Transmission Line Study Team of a desire by the applicant to change the 500-230 kV substation location from the Dinosaur area to the Superior Area (later to become known as Silver King).

June 25, 1975 - SRP signed a Letter of Intent with APS to pursue a backup interconnection with the APS Cholla power plant. The Federal Study Team did not become aware of this action until November 24, 1975.

July 2, 1975 - The preliminary draft of the transmission segment of the Coronado Project DEIS was circulated for internal Forest Service review and to the BLM for comments. Reply due date July 28. Final draft to reach USBR Team Leader by August 15, 1975.

August 21, 1975 - Field review with representatives of Apache-Sitgreaves and Tonto National Forests.

August 27, 1975 - The Forest Service asked for a 30 day extension to evaluate a new substation alternative and to obtain more data from SRP regarding the TG&E backup interconnection. Also requested information on the Silver King Substation future 500 kV terminations, on why it had to be located north of Highway 60 (since 43% of the projected load would be from the mines located in the EMA), and on the TG&E backup interconnection.

October 14, 1975 - Again requested the information listed above.

November 24, 1975 - Federal Study Team was advised that the TG&E backup interconnection alternative was no longer being considered and that discussion of this alternative could therefore be eliminated from the "writeup" - provided a copy of the June 24, 1975 Letter of Intent.

December 1, 1975 - Again requested the information listed above. Pointed out Federal obligation under NEPA to examine all alternatives.

December 12, 1957 - Meeting of FS, SRP, BLM and USBR on need for information on the TG&E backup interconnection.

February 20, 1976 - The SRP Board of Directors voted not to renew Agreement with Santa Fe Industries for development of Star Lake Mine.

March 8, 1976 - SRP wrote to the Forest Service documenting a March 1 telecon with Darmiento. Advised that TG&E backup interconnection information would be sent to FS soon.

June 10, 1976 - Report on meeting of SRP, BLM and Tonto National Forest personnel regarding adding the 230 kV EMA (Eastern Mining Area) proposal transmission lines to the Coronado Project. Decided to include the description of the proposed links in the draft and have the complete environmental study of the various links included in the Final EIS.

July 2, 1976 - Second preliminary draft reviewed internally by Forest Service.

August 6, 1976 - Letter from Tonto National Forest to SRP (B. Babcock) documenting August 5, 1976 field trip. The Forest was not satisfied with the Silver King Substation proposal (Alternate A, B, or C) or with Link 28 (dual 500 and 230 kV transmission line link).

August 21, 1976 - Letter from SRP (Darmiento) to Tonto Forest Supervisor referred to earlier Forest Service recommendation that SRP locate the 500 kV line north of U.S. Highway 60 within Link 28, so that the existing 115 kV lines could eventually be moved up into the Line 28 corridor. Cited May 10, 1974 letter to the Tonto Forest Supervisor

and map of the entire SRP proposal. No comments were received in regard to Link 28. Also referred to a meeting on June 26, 1975 with Tonto National Forest personnel where the EMA proposal and Link 28 were presented. No comments or questions were raised by the Forest. Mentioned that the Study Team viewed all alternate corridors in June of 1975. No other alternatives were offered at that time. In response to the questions raised about the Silver King Substation, the letter mentioned that two field trips had been held at the various Silver King Substation sites during the late summer and fall of 1975. Questions had been asked and answered, no additional request for information had been received.

August 31, 1976 - Memo from the Transmission Line Team Leader to the Tonto Forest Supervisor documenting the preliminary draft EIS review meeting with representatives of the Secretary of Interior's Office of Environmental Program Review. That Office wanted the outline changed as well as the format. This change in format necessitated a major rewrite of the draft statement. The Team Leader stated that the rewrite would take six weeks.

September 23, 1976 - Letter from Tonto Forest Supervisor to SRP (Darmiento) stating that all reasonable alternatives must be portrayed and judged on their merits and that the Forest Service position was that all reasonable alternatives must be studied and arrayed in the same manner and to the same degree of completeness as the "preferred" route.

October 15, 1976 - The Study Team learned that SRP was constructing the 500 kV primary and backup interconnection lines (needed for startup power) westward along Link 04 from the Coronado Generating Station.

November 2, 1976 - Letter from the Regional Director of BR to SRP advising that the Federal Study Team had learned of the premature construction and were concerned about the effect of this action on the integrity of the Statement and the agencies assigned to the Team.

November 4, 1976 - The agencies involved in the Study Team and SRP held a meeting concerning the premature construction. SRP was asked to cease construction. SRP Assistant General Manager, Leroy Michael, told the Team that SRP would study its contract with Irby Construction Company to determine what alternatives were available, then call another meeting when they had arrived at a decision.

November 17, 1976 - SRP requested a meeting, to announce that they would agree to stop construction at the Navajo-Apache County Line, a distance of 30 miles, if the Team would continue to process the Draft EIS. The Forest Service Team member agreed to proceed providing the Environmental Statement reflected:

1. That the Forest Service had no prior knowledge of the premature construction.

2. That the Environmental Statement be revised to state that the premature construction would not affect any decisions on the environmentally preferred corridor alternatives.

November 24, 1976 - Letter from A. J. Pfister of SRP to USBR documenting the two meetings and SRP's commitment to cease construction at the County Line. Stated that in order to meet the commercial service date of June 1979 that startup power must be available by July 1, 1978 at the very latest. The backup interconnection to the Cholla Power Plant would be needed to furnish this power. The letter also warned that if SRP's ability to meet the required date for startup power was jeopardized by delays in the final Statement, that SRP would consider all laternatives that would permit them to obtain startup power on schedule (April 1, 1978).

November 29-30, 1976 - Meeting between Study Team members and SRP to discuss needed changes in the statement due to SRP's premature construction. Changes in the text were agreed to by all agencies. The SRP representative took the changes back to his office to be incorporated into the Draft EIS (SRP was furnishing the typing services).

December 6, 1976 - The Forest Service Transmission Line Team Leader received a call from SRP requesting that the USBR letter of November 2, 1976, be placed in the appendix of the statement in place of the text agreed to the previous week by the Study Team. Team members were contacted and informed of the request, and all stated that they wanted the agreed to wording to remain unchanged. USBR Project Team Leader Frey stated that the suggested wording would have to be reviewed by the Field Solicitors Office and the WO Solicitors Office.

January 5, 1977 - The Forest Service was furnished a copy of the Field Solicitor's Letter of December 17, 1976 to the Regional Director, USBR. The Solicitor felt that Study Team comments on the premature construction were "not appropriate for inclusion in an environmental statement" and that the material would be "appropriate matter to be included in statements on the EIS by an agency including one of the agencies participating in the draft," and further that "the suggested deletions (referring to those statements negotiated by the Study Team) are tantamount to conclusions for law."

January 12, 1977 - Regional Forester's letter to the Regional Director, USBR stating Forest Service concern over deletion of the agreed upon changes in wording regarding SRP's premature construction. Pointed out that Forest Service agreement to proceed with processing the statement was predicated on the inclusion of material. Strongly recommended that the wording be left in the draft, as it was considered necessary in order to fully comply with the intent of NEPA. Letter was received by the Bureau of Reclamation on January 18, 1977.

January 14, 1977 - Draft EIS filed with CEQ and the public.

During preparation of the environmental statement advance draft copies were provided to certain Federal agencies other than the preparing team to gain the benefit of their expertise before filing the statement with the Council on Environmental Quality. Those agencies responding to the advance draft review included the U.S. Fish and Wildlife Service, the U.S. Geological Survey and the U.S. Environmental Protection Agency. This draft environmental statement has attempted to be responsive to those comments and copies of it are being sent to those responding agencies for their future review.

B. Salt River Project Activities throughout the Life of the Project

Salt River Project has maintained a continuous program of informing governmental and public entities of their plans to construct the Coronado Project since 1973. This coordination has included formal presentations and educational meetings throughout Arizona and elsewhere.

During the course of the siting studies approximately 100 presentations were made to governmental, private and environmental entities soliciting comments from these groups. Table IV-2 is a chronology of these presentations. After the studies were completed, these comments were incorporated into the Application for Certificate of Environmental Compatibility that was submitted to the Arizona State Power Plant and Transmission Line Siting Committee. In accordance with the requirements of the Arizona Power Plant and Transmission Line Siting Act the complete application was made available to the public and a public hearing held. Subsequently a Certificate of Environmental Compatibility was issued by the Siting Committee on November 12, 1974, and approved by the State Corporation Commission on January 3, 1975. The siting studies are available to the public at the Hayden Library, Arizona State University.

Table IV-2

CORONADO PROJECT

Agency and Public Organizational Contacts

	DATE	ORGANIZATION	ORGANIZATION ATTENDEES
1.	9/28/73	Colorado Plateau Environmental Advisory Council (CPEAC)	Dr. Eric Walther + 100 Attendees
2.	10/10/73	Arizona Game & Fish Department	Robert Jantzen (Bruce R. Duke on 2.8/74 w/BSFW
3.	10/12/73	Arizona State Museum	Raymond Thompson
4.	10/12/73	Arizona State Highway Department	Forest D. Jennings, et al
5.	10/15/73	State Land Department	Andrew Bettwy Kent Johnson Bill Fish H. K. Doss Joe Melling

	DATE	ORGANIZATION	ORGANIZATION ATTENDEES
6.	10/15/73	Bureau of Land Management (BLM) Phoenix District	Guy E. Baier Reinard Okeson (Arizona State Office) Barry Cushing Bob Archibald Hap Thonhoff Mr. "Pete" Gonzales
7.	10/15/73	Arizona State Parks	Wallace Vegors Charles Eatherly
8.	10/15/73	Office of Economic Planning & Development	Robert Worden Clint Johnson
9.	10/16/73	Arizona Water Commission	Wesley Steiner Phil Briggs Tom Clark
10.	10/16/73	Arizona Dept. of Health Services - Div. of Air Pollution Control	Art Aymar Carl Billings
11.	10/17/73	Environmental Conscience Inc.	Joe Sparks
12.	10/17/73	City of Phoenix Planning Department	John Beatty V. Warner Leipprandt, Jr.
13.	10/19/73	Yavapai County Planning and Zoning Commission	Jerry H. White
14.	10/19/73	Yavapai County Parks & Recreation Department	C. A. Williams
15.	10/19/73	Prescott National Forest	Jim Kimball
16.	10/23/73	Yuma County Planning & Zoning Commission	Robert P. Baldwin
17.	10/23/73	Arizona Public Service	Dr. Raymond Kary Tom Parrish
18.	10/25/73	KOOL TV - (Channel 10, CBS)	Bill Close Jim Murdock Bob Davies
19.	10/25/73	KTAR TV - (Channel 12, NBC)	Tim Hayes Diane Calas Jack Frazier

	DATE	ORGANIZATION	ORGANIZATION ATTENDEES
20.	10/25/73	KTVK TV - (Channel 3, ABC)	Gov. Ernest McFarland Chuck Glance Frank Mouer Stan Block
21.	10/25/73	KPHO TV - (Channel 5)	Tom Sherlock Ken Coy Steve Jensen Frank Donaldson
22.	10/25/73	Republic & Gazette	Republic - Harold Milks Grant Smith Joe Cole Gazette - Alan Moyer Loyal Meek Vic Thornton
23.	10/25/73	Associated Press	Tom Aden
24.	10/29/73	Apache County Planning & Zoning Commission	Arlo B. Lee
25.	10/29/73	Apache County Board of Supervisors	Larry Stradling
26.	10/29/73	St. Johns Mayor and City Council, et al.	Francis Day Jay Patterson Raymond Issacs Al Anderson Tracy Hansen
27.	10/29/73	Navajo County Planning Commission	Eric L. Manola
28.	10/29/73	Navajo County Planning Commission	R. H. Herbert
29.	10/29/73	Navajo County Board of Supervisor, et al.	William Smith Mike O'Haco L. A. "Roy" Palmer
30.	10/29/73	Apache-Sitgreaves National Forest	Harold Harper
31.	11/1/73	National Park Services	Bob Lovegren
32.	11/1/73	Maricopa Association of Governments (MAG)	Art Auerback C. Roger Brady Ronald Ross Tom Buick Tom Ford
33.	11/2/73	Arizona Corporation Commission	A. L. Farron Phil Yale Bob Kircher

	DATE	ORGANIZATION	ORGANIZATION ATTENDEES
34.	11/2/73	Maricopa County Parks & Recreation Department	Tom Wardell R. H. Milne Mike King John White Howard Gilmore
35.	11/2/73	James K. Wheat, Landscape Architect, Member of the Power Plant and Transmission Line Siting Committee	James K. Wheat
36.	11/6/73	Maricopa County Health Department, Air Pollution Division	Robert Taylor Mr. Grant Joseph Weinstein
37.	11/7/73	Maricopa County Planning and Zoning Department	D. W. Hutton
38.	11/7/73	Arizona Outdoor Recreation Coordinating Commission	Ronald Sharer Michael Peterson
39.	11/9/73	Tonto National Forest	Fred J. Wirth Ned Jackson Bruce Lamb
40.	11/26/73	Regional Office, United States Forest Service (Cholla Study Team)	John Chambers (Albuquerque office) Ronald E. Burraychak (Tonto) Jay Fitch (Sitgreaves) Tom Orchard (BLM loan)
41.	12/1/73	Arizona Consulting Engineers Association	J. O. Martin Bill Sawyer
42.	12/1/73	Environmental Conscience, Inc.	Sherman Bendalin
43.	12/1/73	Arizona Society, AIA	Mary Smith
44.	12/1/73	Advisory Commission on Arizona Environment	Robert Durrenberger
45.	12/1/73	Audubon Society	Peggy Spaw
46.	12/1/73	Arizona Friends of the Earth	Bob Sanderson Shelly Vebber Bill Reisland Joe Robbins
47.	12/1/73	Sierra Club - Yavapai Group	Henry Dahlberg Margaret Broh
48.	12/1/73	Arizona Lung Association	Joel Goldenthu

	DATE	ORGANIZATION	ORGANIZATION ATTENDEES
49.	12/1/73	League of Women Voters of Arizona	Muriel Beroza
50.	12/1/73	Arizona Wildlife Federation	Frank Welsh
51.	12/1/73	National Wildlife Federation	Bill Winter
52.	12/11/73	Bureau of Sport Fisheries and Wildlife - Division of Wildlife Services	William Rightmire
53.	12/15/73	Wickenburg Mayor and Citizens	Mayor Arnett, et al.
54.	1/23/74	Snowflake Chamber of Commerce	Larry Brewer
55.	1/23/74	Southwest Forest	R. L. Betts
56.	1/23/74	Silver Creek Irrigation Dist.	Pete Shumway
57.	1/23/74	Snowflake Union High School	Raymond Kellis
58.	1/23/74	Navajo County Assessor's Office	Vincent M. Flake
59.	1/23/74	Realtor-Farmer	Lynn Ellsworth
60.	1/23/74	Snowflake-Mayor of	Gordon Farr
61.	1/23/74	Navajo Cattlemen's Association	Isa Willis
62.	1/23/74	Ranchers and Citizens of Snowflake	Sanford D. Flake Glen L. Flake Eugene Flake Dean Flake Jake Flake Bill Elkins Jay Flake Larry K. Flake
63.	1/23/74	Arizona Public Service	Larry Nelson
64.	12/73	Past Executive Director ROMCOE; Ford Foundation - "Studies for the future"	Mr. and Mrs. Roger Hansen
65.	1/3/74	Arizona Conservation Council	Lynn Keefer and 20 Council Members
66.	1/28/74	The Honorable Senator Fannin and Staff	
67.	1/28/74	The Honorable Congressman Rhodes and Staff	

	DATE	ORGANIZATION	ORGANIZATION ATTENDEES
68.	1/28/74	The Honorable Congressman Colan and Staff	
69.	1/28/74	The Honorable Congressman Steiger and Staff	
70.	1/28/74	Council of Environmental Quality	The Honorable Dr. Beatrice E. Willard
71.	1/25/74	University of Arizona	David Layton T. G. Roefs Dan B. Kimbell L. N. Kurs
72.	1/28/73	U.S. Department of Agriculture - Forest Service, Washington, D.C.	William R. Kinworthy
73.	1/28/74	U.S. Department of Agriculture - Soil Conservation Service, Washington, D.C.	Glen H. Loomis
74.	1/28/74	National Park Service, Washington, D.C.	Richard D. Jacobsen
75.	1/28/74	Bureau of Outdoor Recreation, Washington, D.C.	Russel A. Soulen
76.	1/28/74	U.S. Bureau of Reclamation, Washington, D.C.	E. A. Seaman James A. Braxdale
77.	1/28/74	Department of Interior Office of Environmental Projects Review, Washington, D.C.	Bruce Blanchard Lillian K. Stone Ernest E. Sligh
78.	1/28/74	Bureau of Land Manaement Washington, D.C.	David J. Walter Larry Montross
79.	1/28/74	Bureau of Mines, Washington, DC	Lindsay D. Norman
80.	1/28/74	Bureau of Sport Fisheries & Wildlife, Washington, D.C.	Glenn Kinser
81.	1/28/74	U.S. Geological Survey Washington, D.C.	H. G. Stewart
82.	2/6/74	Citizens of St. Johns, State Representative Jack Brown and State Senator Hubbard	50 Citizens, Mayor Francis W. Day
83.	2/6/74	Citizens of Snowflake	75 Citizens, Mayor Gordon Farr

	DATE	ORGANIZATION	ORGANIZATION ATTENDEES
84.	2/8/74	Bureau of Sport Fisheries & Wildlife - Division of River Basin Studies	Dick Morgas, Martin Kenney, Ronald McKinstry (Bruce R. Duke)
85.	3/5/74	Arizona State University	Noon Seminar of Geography Department - Dr. Durrenburger, Dr. Markus
86.	3/13/74	Arizona State University	Dr. Wagstaff and 20 students Geography of Energy
87.	1972	Arizona Public Service	Staff
88.	1974	Tucson Gas and Electric	Staff
89.	1974	Arizona Electric Power Cooperative	Staff
90.	1974	Navapache Electric Coop., Inc.	(Rep. at St. Johns Mtg. 2/6/74)
91.	3/27/74	Environmental Protection Agency - Region IX San Francisco	Russell Freeman Phil Wondra Larry Bowerman Charles M. Seeley Frank Covington John Wise R. L. O'Connell Paul DeFalco, Adm.
92.	3/27/74	Bureau of Outdoor Recreation	Orin Beckwith Ed Haberlin George W. Webber Robert Von Etten Donald N. Christensen
93.	4/8/74	New Mexico State Planning Office	G. B. Page Maurice Bonal Tom Samuelson
94.	4/8/74	Regional Office, Bureau of Sport Fisheries & Wildlife Albuquerque, New Mexico	W. O. Nelson, Jr. William M. White Milt Borges Jack P. Woolstenhulme
95.	4/17/74	U.S. Bureau of Reclamation, Lower Colorado Region Boulder City, Nevada	E. Phillip Sharpe, Regional Envir. Specialist Elmo Isom, Staff Assistant Christian Anderson, Envir. Specialist Wayne Deason, Supervisory Env. Specialist

DATE	ORGANIZATION	ORGANIZATION ATTENDEES
		Ron Effertz, Water Management Branch Robert D. Austin, Regional Engineer
96. 4/29/74	United States Bureau of Land Management	Gay Baier Ralph J. Korn Mr. E. Gonzales Phillip D. Moreland Bob Archibald
97. 4/29/74	U.S. Bureau of Reclamation - Phoenix	Creighton, USBR APO Mel Persons, USBR Phoenix Fred Weiss, USBR Phoenix APO A.F. Velasquez, USBR Phoenix PD Ed Hallenbeck, USBR Phoenix PD Joe Graul, USBR APO Thomas Burbey, USBR Phoenix M.C. Thomas, USBR Phoenix Andy Dolynick, USBR APO R.E. Shunick, USBR APO
98. 5/1/74	Apache-Sitgreaves National Forest Springerville, Arizona	Hallie Cox Bill Edwards M.E. Richards Arlie Holm James H. McSloy Art Maynard Robert Osthreim
99. 5/1/74	Arizona Game and Fish Department	R.A. Jantzen R.D. Curtis
100. 5/3/74	Bureau of Sport Fisheries and Wildlife - Phoenix, Arizona	William Rightmire Richard L. Morgan Ron McKinstry
101. 5.8.74	Pinal County Planning & Zoning Department	Charles Guinn Terry Smith Ed Rummell
102. 5/8/74	City of Tempe Planning & Zoning Department	Don Hull
103. 5/9/74	City of Mesa Planning & Zoning Department	Howard Godfrey
104. 5/13/74	Gila County Planning & Zoning Department	Nick Ragus
105. 5/13/74	City of Gilbert Planning & Zoning Department	Lynn Stuart

DATE	ORGANIZATION	ORGANIZATION ATTENDEES
106. 5/21/74	Division of Environmental Health Services - Arizona Department of Health Services	James D. Goff Bruce Scott Robert A. Follett Carl Billings Ed Garthe Nils Larson
107. 6/6/74	Tempe City Council	Mayor Shumway and Councilmen
108. 7/24/74	Advisory Commission on Arizona Environment	Natural Resources Committee

C. Coordination and Distribution of the Draft Environmental Statement

The federal study team has, in the development of this environmental statement maintained close liaison with other federal agencies as well as state and local entities to get their input. The draft environmental statement was filed with the Council on Environmental Quality on January 14, 1977. Initially 314 copies of the draft statement were mailed to those entities shown on the distribution list. Notices of availability appeared in the Federal Register on January 18, 1977, and newspaper stories appeared in approximately 100 periodicals in Arizona. In addition the radio and television news media were made aware of the availability of the statement. During the review process an additional 80 statements were made available upon request from the general public. During the review period ___ agencies entitles and/or individuals chose to comment on the draft statement. Their letters of comments and responses to them are included in Appendix ___.

D. Public Hearings on Draft Environmental Statement

Three public hearings were held to give interested persons an opportunity to comment on the Coronado Project Draft Environmental Statement. These hearings were held at 2 p.m. and 6:30 p.m. until all speakers were heard on February 23, 1977, at St. Johns, Arizona; February 24, 1977, at Kearny, Arizona; and on February 25, 1977, at Phoenix, Arizona. Notification of the public hearings as well as of the availability of the draft environmental statements were made through the Federal Register, local radio and television stations as well as other news media such as the White Mountain Independent, Copper Basin News, and the Arizona Republic.

The hearings were presided over by an Attorney Advisor for the Field Solicitor's Office of the Department of the Interior. A panal composed of the Federal government interagency study team consisted of:

Gary Frey, Chief, Physical Sciences Branch, Office of Environment, Lower Colorado Region, Bureau of Reclamation

Robert Archibald, Area Manager, Phoenix Resource Area, Phoenix District Office, Bureau of Land Management

Art Maynard, Forester, Region 3, U. S. Forest Service

John Hart, District Ranger, Apache-Sitgreaves National Forest, U.S. Forest Service (Representing the local National Forest for the St. Johns public hearing)

Walt Taylor, Recreation and Lands Staff, Tonto National Forest, U.S. Forest Service, (Representing the local National Forest for the Kearny and Phoenix public hearings)

The hearing was recorded and a copy of the official hearing transcript for each location is available for public examination at the following locations:

Assistant to the Commissioner - Ecology, Room 7622, Bureau of Reclamation, Department of the Interior, Washington, D. C.

Division of Engineering Support, Technical Services and Publications Branch, Engineering and Research Center, Bureau of Reclamation, Denver, Colorado

Office of the Regional Director, Lower Colorado Region, Bureau of Reclamation, Room C-119, Colorado Street Building, Boulder City, Nevada

There were 38 persons in attendance at the St. Johns hearings other than hearing officials and staff. Eight scheduled and six unscheduled comments were heard at the St. Johns location. At Kearny, 12 persons attended the two meetings other than hearing officials and staff. There was one scheduled speaker and three unscheduled speakers at the Kearny location. Sever persons attended the hearings in Phoenix, at which time there was one scheduled speaker and no unscheduled speakers. No written supplemental comments were received for inclusion in the hearing record during the 10-day period following the hearings.

The relevant comments on the draft statement which were made at the hearings have been considered in the preparation of this final environmental statement. The contents of the transcripts have been abstracted and responded to regarding the Coronado Project and are presented in Appendix __ in the form of a comment and reply section.

E. Consultation and Coordination During Development of Proposals for the Eastern Mining Area Transmission Section

The Draft Environmental Statement described the proposed Eastern Mining Area 230 kV transmission system but indicated that analysis of impacts were underway and not included in that statement. In October 1976 an interagency team consisting of representatives from _____ began developing possible alternative routes for the proposed system and attempted to analyze impacts. Their efforts culminated in a report entitled "Silver King-to-Hayden 230 kV Transmission System Environmental Study." The results of that study and subsequent analyse by the interagency team appear in this final environmental statement.

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Site Selection Study for 1050 MW Power Plant - Meteorology and Ecology: Phase I, Dames & Moore, 1974.

Site Selection Study - Volume I, Salt River Project and Bechtel Power Corporation, January 1974.

Site Selection Study - Volume II, Salt River Project and Bechtel Power Corporation, January 1974.

Appendices

The following are appendices containing supplemental information in reference to the environmental statement. The appendices are listed as follows:

No.	Title
A-1	Meteorological Monitoring and Analysis in the St. Johns Area
A-2	Air Quality Monitoring in the St. Johns Area -- Instrumentation and Data Collection Methods
B-1	Air Quality Tracer Studies in the St. Johns Area
B-2	Air Quality Impacts - Ambient SO_2 Modeling Techniques and Procedures
C	Concentration (ppm) of Nine Trace Elements in Soils, Plants, and Animal Tissue On and Within 12 miles of the St. Johns Site
D	Vegetation Representative of the Colorado Plateau in the St. Johns Area
E-1	Bird Communities Near St. Johns, Arizona
E-2	Reptiles and Amphibians Inhabiting the Vicinity of St. Johns, Arizona
E-3	Mammals Present in the Plateau Area that Includes St. Johns, Arizona
E-4	Anthropods Common in Plateau Areas
F	Archeological Sites Recorded Along the Proposed Railroad Alinement
G	Analysis of Natural Beauty - 500 kV Transmission System
H-1	Transmission Line Stipulations -- 500 kV System Joint Corridor
H-2	Easement for Transmission Line -- 500 Kilovolts -- U.S. Forest Service
J	Final Report for Archeological Survey of Four Proposed Substations and Access Roads
K	Correspondence Concerning the Beginning of Construction of the 500 kV Lines

Appendices - Volume II

No.	Title
L	Written Comments Received During Review of the Draft Environmental Statement and Responses.
M	Summary of Comments and Replies Presented Orally or in Writing for Inclusion in the Official Proceedings of the February 23, 1977, Public Hearing on the Coronado Project Draft Environmental Statement at St. Johns, Arizona.
N	Summary of Comments and Replies Presented Orally and in Writing for Inclusion in the Official Proceedings of the February 24, 1977, Public Hearing on the Coronado Project Draft Environmental Statement at Kearny, Arizona.
P	Summary of Comments and Replies Presented Orally or in Writing for Inclusion in the Official Proceedings of the February 25, 1977, Public Hearing on the Coronado Project Draft Environmental Statement at Phoenix, Arizona.

Appendix A-1

Meteorological Monitoring and Analysis in the St. Johns Area

A one year meteorology monitoring program was established at St. Johns to accomplish the following objectives: 1) Provide actual on-site meteorological inputs for estimating coincident 3-Hr. and 24-Hr. ambient pollutant concentrations which would occur at full plant operation over a representative time period; 2) Provide summarized wind and stability information for comparative analysis with that for Winslow and Zuni for the same period; and, 3) Provide a basis for extrapolating diffusion meteorological conditions through the life of the plant using existing long period climatological records for the area.

(1) Diffusion Meteorology

Diffusion meteorology is a fundamental consideration in the design of a power generating facility, and can be described in the following manner. Although the facility can be designed to comply with federal and state emission regulations, this does not necessarily ensure compliance with ambient air quality standards. For example, if stack emissions which satisfy emission regulations were released at ground level, the ambient air quality standards would be grossly violated although emission regulations would continue to be satisfied. However, a high stack permits the pollutants to be dispersed and diluted to a sufficient degree before reaching ground level to satisfy air quality standards. In the same sense the dilution and dispersion attributable to properties of the atmosphere such as wind, turbulence and stability must be considered in the prediction of air quality given a particular emission source configuration.

Ideally, a complete knowledge of the diffusion characteristics of the atmosphere in the critical areas surrounding a pollution source would require a complete knowledge of all future motions of the atmosphere responsible for diffusion. It is generally accepted that this ideal cannot be achieved. Instead, an alternative approach has been developed which uses observations of synoptic scale horizontal winds and atmospheric stabilities computed from vertical temperature gradients. Diffusion models in current use parameterize the effects of turbulence in terms of wind speed and stability. The diffusion meteorology of the St. Johns site is established in this report through an analysis of on-site wind and temperature data. Whenever appropriate, comparison is made with concurrent off-site data.

(a) On-site Measurements

The on-site measurement program began in February, 1974. Winds aloft were measured by double theodolite tracking of pilot balloons (Pibals); winds were also measured at the 10-foot and 100-foot levels of a 100-foot tower; temperature was measured aloft with an instrumented aircraft and at the 10-foot level of the tower.

The period of record and sampling intensity of this study is shown in Table A-1. The Pibal tracking station, instrumented aircraft and tower are illustrated in Figures A-1, A-2, and A-3 respectively. Although the period of record for upper winds and tower data extends through March 31, 1975, only those data that were obtained through February 28, 1975, were analyzed for this report.

TABLE A-1

Period of Record and Sampling Intensity
For Meteorological Data for Coronado Station
(St. Johns)

Parameter	Period of Record	Sampling Intensity
Upper Wind (Pibal)	3/74 - 8/74	(1) (2) 5/day-5 days/week every other week
	8/74 - 3/75	5 day-5 days/week weekly
Temperature Aloft	2/74 - 8/74	5/day-5 days/week every other week
	10/14/74-11/08/74	5/day for 20 days
	1/06/75-02/01/75	5/day for 20 days
Tower Data		
Wind 100- foot	2/74 - 3/75	Continuous
10-foot	2/74 - 3/75	Continuous
Temperature 10-foot	2/74 - 3/75	Continuous
Sling Psychrometer (Wet-Dry Bulb Temperature)	6/74 - 3/75	3/day(3)

(b) Analysis of On-Site Data

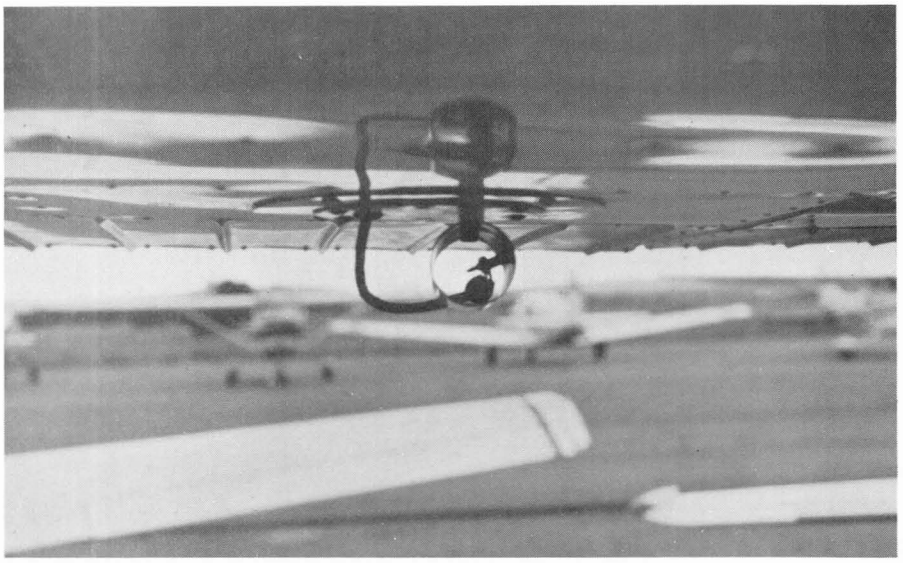
Wind Distributions: In Figures A-4 through A-8 and succeeding paragraphs the distribution of winds observed at St. Johns is illustrated with wind roses. Conditional wind roses

(1) 5/day, i.e., at sunrise, sunrise + 1 hr., sunrise + 3 hrs., noon and 1400 MST.
(2) 5 days/week = Monday through Friday
(3) 3/day, i.e., At Sunrise, Sunrise + 3 hrs., and 1400 MST.

PIBAL TRACKING STATION

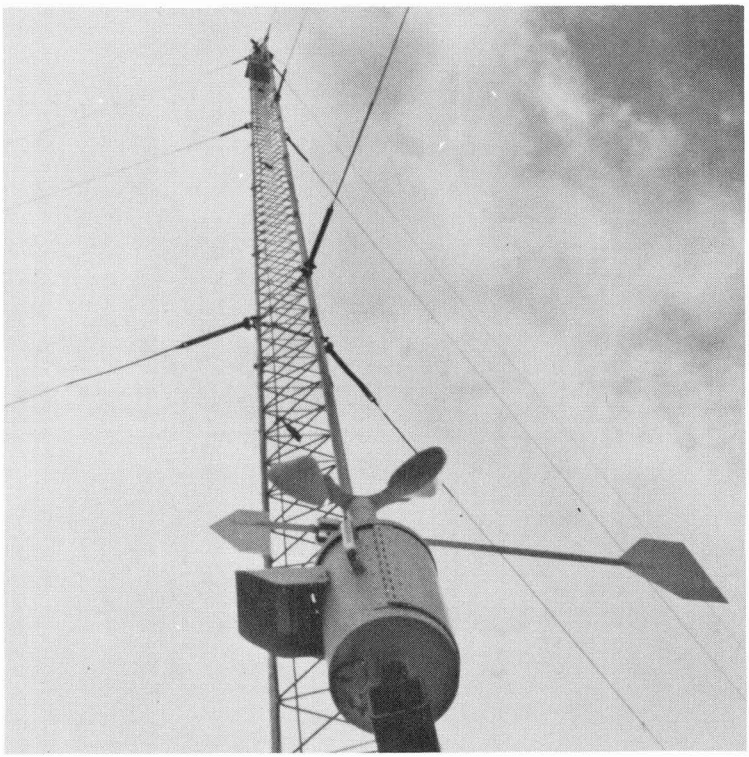
Figure A-1

CESSNA 150 INSTRUMENTED FOR TEMPERATURE SOUNDINGS



TEMPERATURE SENSOR

Figure A-2



100-FOOT TOWER

Figure A-3

with respect to Pasquill class (defined in Table A-2) are presented for the winds aloft. Each wind rose is composed of line and bar segments extending outward from the center for each of sixteen directions; a line-bar extending outward towards the south represents a wind from the south. The combined length of the line and bar segments is proportional to the frequency of occurrence of that particular wind direction. For each direction the various speed classes are represented by the line or bar segments. The percent frequency of occurrency of calms is given in the central circle.

TABLE A-2

AEC Stability Classification Scheme Based

On Vertical Temperature Gradients

Stability Class	$\frac{\Delta T}{\Delta Z}$ (^{o}C/100 m)	Equivalent Pasquill Class
Extremely Unstable	-1.9	A
Moderately Unstable	-1.9 to -1.7	B
Slightly Unstable	-1.7 to -1.5	C
Neutral	-1.5 to -0.5	D
Slightly Stable	-0.5 to 1.5	E
Moderately Stable	1.5 to 4.0	F
Extremely Stable	>4.0	G

Winds aloft are most appropriate to the study of diffusion of an elevated plume. Surface winds are most useful in plant design and for studies of cooling tower plume, salt drift and ash disposal area fugitive dust. Wind roses were calculated from tower data at 100 feet (AGL) and Pibal data at 1,000, 2,000 and 3,000 feet (AGL).

Surface Winds: The surface wind data are based on measurements recorded at the 10- and 100- foot levels of a 100-foot tower from February, 1974 to February, 1975. The 100-foot wind data are summarized in the five wind roses in Figure A-4. These wind roses illustrate the wind distribution for time periods of a whole day (0-24 MST), 0-6, 6-12, 12-18, and 18-24 MST. The periods 0-6 and 12-18 represent the periods of minimum and maximum atmospheric diffusion respectively. For the whole day period (0-24) it is shown that 53% of the winds are from the five sectors, S through W, and 23% are from the two sectors, ENE and E. The six northern sectors (from NE to WNW) contribute a total of 15%, and the three south-east sectors (ESE, SE and SSE) a total of 9%.

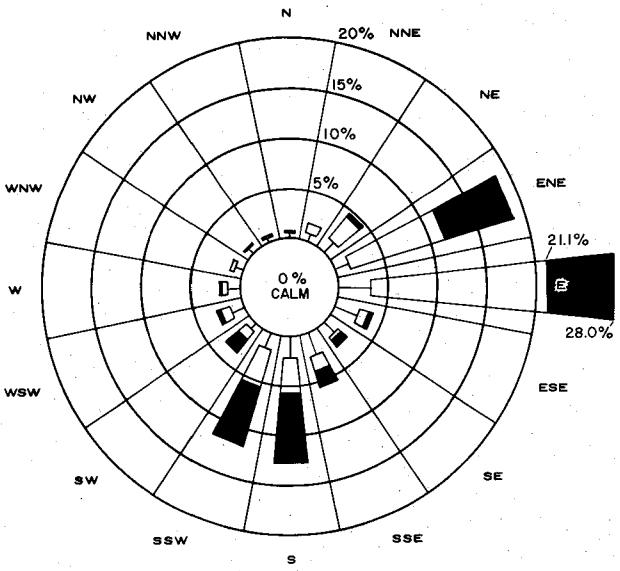
When the wind roses for the four periods of the day are examined together, the diurnal change of the wind at St. Johns is revealed. During the 0-6 period, the occurrence of the winds from the E and ENE is at a maximum while the winds from the WSW and W are at minimum frequency. As the day progresses, the occurrence of the east wind decreases while that for the west wind increases. During the 12-18 period, the winds from WSW reach their maximum frequencies while the winds from E and ENE are at their minimum frequency. The west wind decreases and the east wind increases gradually again during the 18-24 period. The daily variation of the winds from S and SSW, with maximum frequency during the hours 18-24, and minimum frequency during the hours 6-12, seems to be six hours out of phase with that of both the east wind and the west wind. The percentage of wind direction in the four sectors, NNE to NW, and the percentage of the three sectors, ESE to SSE remain small all day.

Upper Winds: Conditional wind roses for winds at 1000, 2000, and 3000 feet (AGL) are illustrated in Figure A-5 for D stability and Figure A-6 for E stability. Stability was obtained from on-site aircraft temperature soundings concurrent with the Pibal observations. The aircraft soundings indicate that stability D and E are associated with more than 95% of the wind observations. Also, the frequency of occurrence of stability D increases from 1000 feet to 2000 feet, but decreases slightly from 2000 feet to 3000 feet; while the frequencies for stabilities E and A through C decrease from 1000 feet all the way up to 3000 feet. It should be pointed out that for stability F, only eleven cases at 1000 feet and one case at 2000 feet was observed. Of these, all but one case was associated with easterly winds. One case of F was observed with a southwest wind at a speed of 4.2 mps. No stability G was observed at St. Johns at the 1000, 2000, and 3000 foot levels. At St. Johns the frequencies for stability D, E, and A-C, are 54.7, 40.5 and 4.8 respectively at the 1000 foot level, and are 71.0, 28.1, and 0.9 respectively at the 3000 foot level.

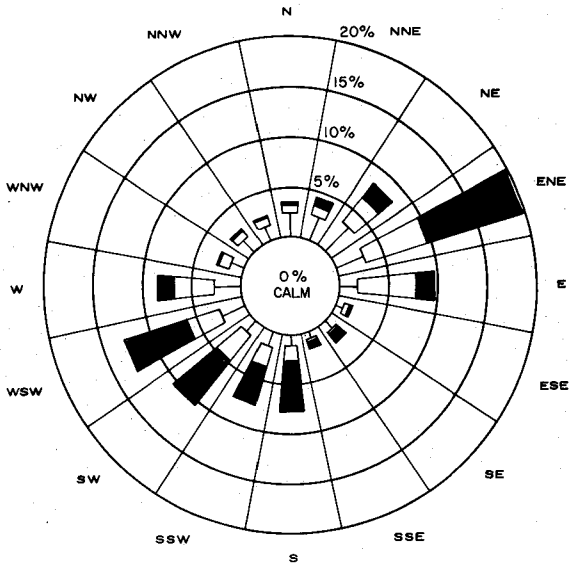
As illustrated In Figure A-5 for neutral conditions (D) more than 50% of the winds are from the four sectors, WSW to NW, at all three levels. The frequency peaks are W at 1000 and 2000 feet and W and WSW at 3000 feet. Figure A-6 shows the wind distribution under slightly stable conditions (E) at levels from 1000 to 3000 feet. The frequency peaks are, W at 1000 feet, WNW at 2000 feet and W and WNW at 3000 feet.

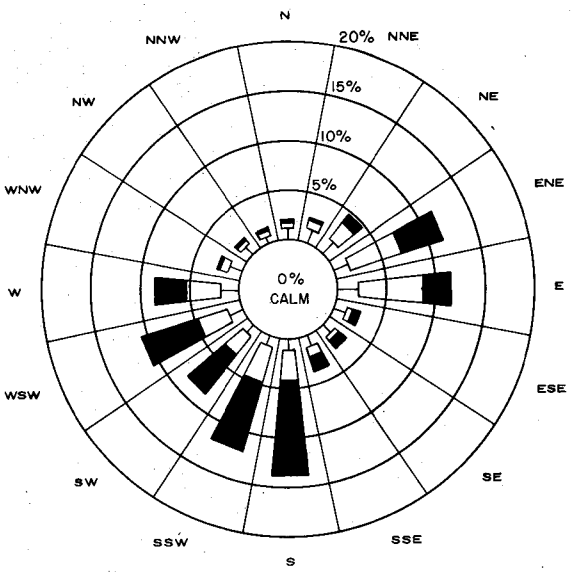
Comparision of Winds at St. Johns And Winslow: The wind roses for the 1000 foot, 2000 foot and 3000 foot levels at St. Johns, based on observations taken at sunrise, are presented at the left side of Figure A-7. Only those observations that have data at all of the three levels are included in the calculations. At the right the corresponding concurrent wind roses at Winslow (at 0400 MST) are presented. The wind roses for the two places at mid-afternoon (1400 MST for St. Johns and 1600 MST for Winslow) are shown in Figure A-8.

0000-0600 MST

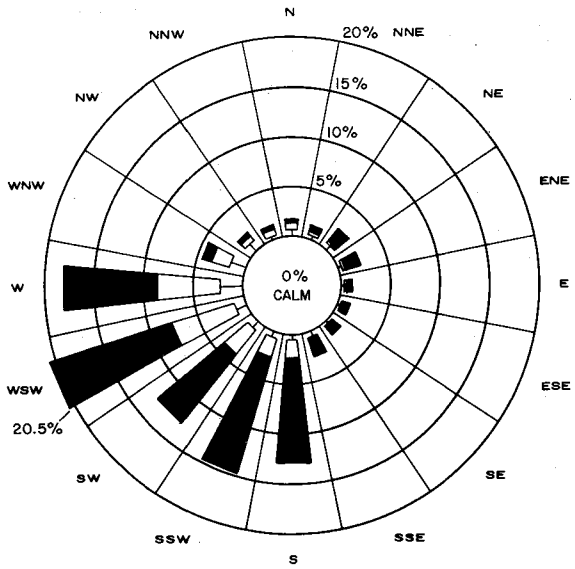


0600-1200 MST

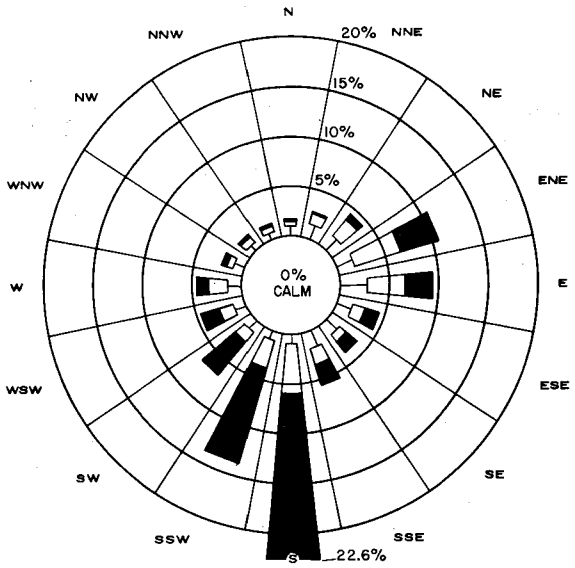




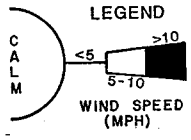
0000-2400 MST



1200-1800 MST

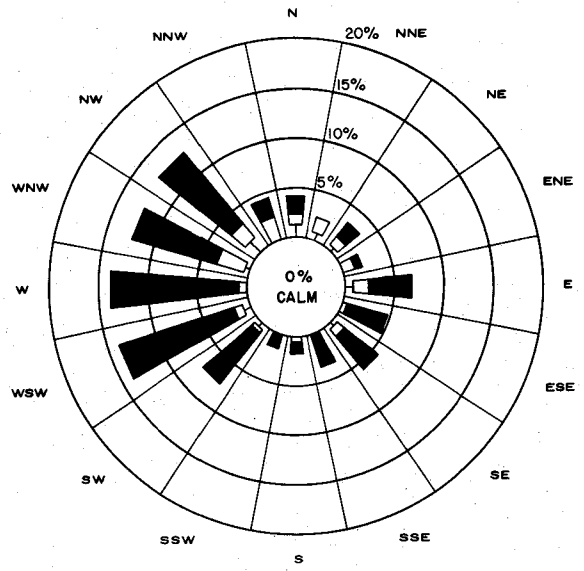


1800-2400 MST

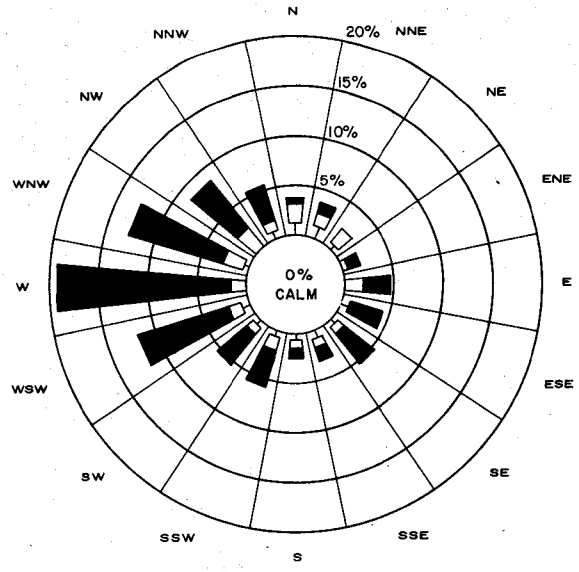


WIND ROSES FOR THE 100-FOOT LEVEL AT THE ST. JOHNS SITE,
FEBRUARY 1974 - FEBRUARY 1975

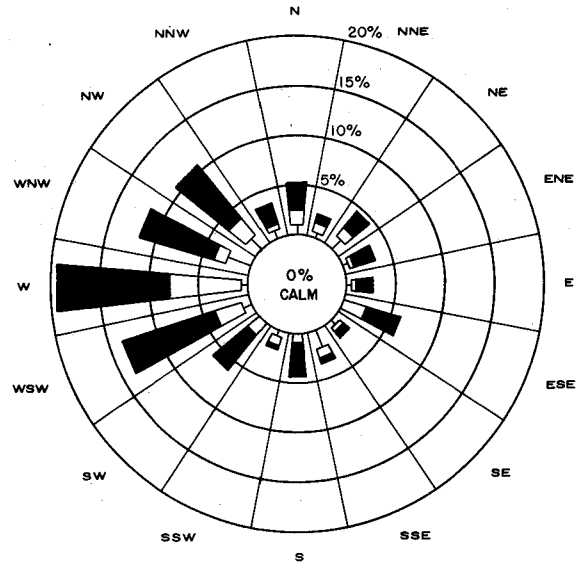
Figure A-4



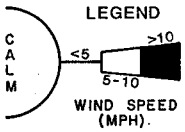
3000 FEET



2000 FEET

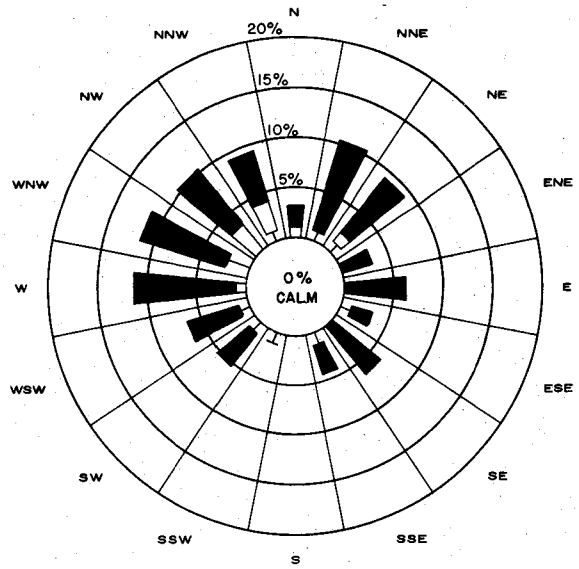


1000 FEET

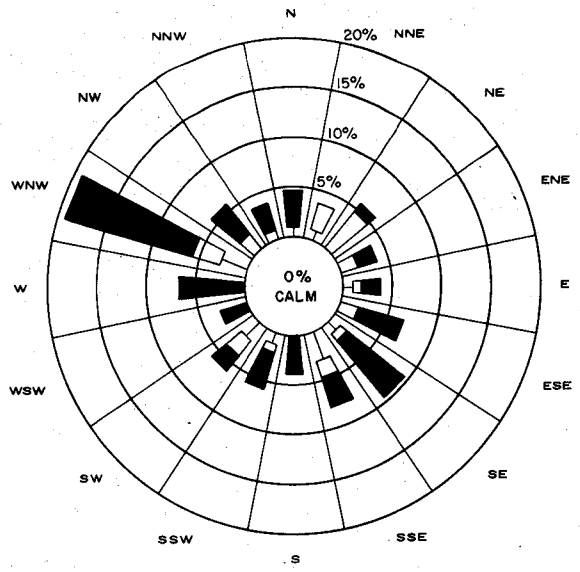


DISTRIBUTION OF WINDS ALOFT
AT ST. JOHNS FOR D STABILITY

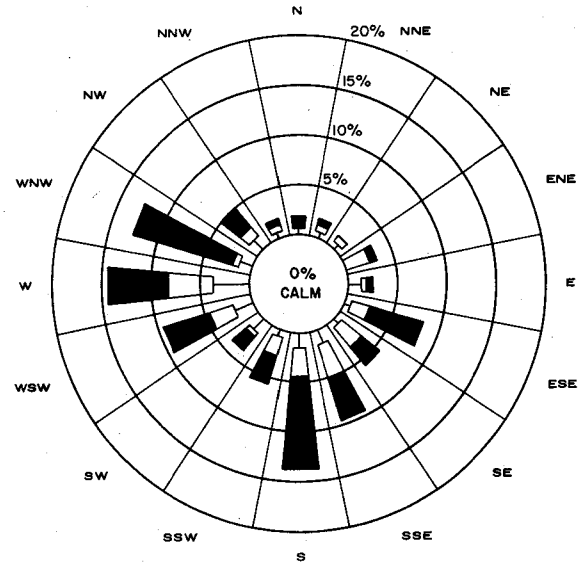
Figure A-5



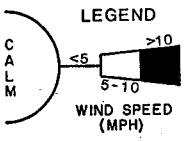
3000 FEET



2000 FEET



1000 FEET



DISTRIBUTION OF WINDS ALOFT
AT ST. JOHNS FOR E STABILITY

Figure A-6

From Figure A-7 and Figure A-8 it is seen that at St. Johns the frequencies of occurrence are fairly concentrated in the five sectors from SW to NW; at all of the three levels the frequency peak is at WNW at sunrise and at W at 1400 MST respectively. At Winslow there are two relative frequency peaks at 0400 MST: they are at WSW and NW at 1000 feet, WSW and double peaks at NNW and N at 2000 feet, and SW and N at 3000 feet. At 1600 MST, a predominant frequency peak is shown at SW at all of the three levels, while the secondary relative peak at the north diminishes considerably. The difference in the frequency distribution between St. Johns and Winslow as shown in the wind roses is attributable to differences in regional topography at the two places.

Conclusion: As illustrated in Figure A-4 through A-6, the winds have a prevailing westerly component; this is attributable to the large scale pressure gradient which is the principal driving force of the atmosphere during the daytime (6-12 and 12-18) at the 100 foot level and during the entire day at the 1000, 2000, and 3000 foot levels. The predominant east wind during the 0-6 period at 100 feet is a drainage wind associated with the higher terrain to the east and the east-west orientation of the Carrizo Wash. The percent occurrence of the most stable conditions (Pasquill F, G) is at a maximum near the ground; Pasquill G was not observed above 1000 feet at St. Johns. Since drainage winds are associated with stable conditions (E, F, G) the occurrence of drainage winds above 1000 feet would be associated with E or F rather than G Stability. Thus, an elevated plume diffusing in a stable layer associated with a drainage wind is expected to move over lower terrain to the west of St. Johns; as the plume moves toward the west the vertical distance between the plume and the ground increases, and as a result the ground level concentrations are minimized. It is apparent from Figure A-6 that the occurrence of E stability at 1000, 2000, and 3000 feet is not strongly related to drainage winds; relatively strong (10 MPH) easterly winds and winds with westerly components are not associated with drainage flow.

Wind Direction Variability; Various investigations have indicated a relation between the standard deviation of wind direction, σ_θ and atmospheric stability. Statistics of σ_θ derived from data obtained at the 100-foot level at St. Johns are summarized in Figure A-9 σ_θ was derived from wind direction data with an analog device* which has an averaging time of 15 minutes. The frequency of occurrence for the four categories of σ_θ (corresponding to Pasquill stability classes A-C, D, E, and F) is depicted in Figure A-9; the hatched single bars represent the frequency in percent at 0-6 MST during the winter months (December through February), and the shaded bars represent the frequency at 12-18 MST during the summer months (June through August). This figure clearly shows that during the early morning in the winter months there is a predominance of small values of σ_θ corresponding to stable conditions. According to the Pasquill classification the percent occurrences of moderately stable conditions (Pasquill class F) was 68.8. During this period, frequency of stabilities A-C is smallest (1.4%). On the other hand, in the summer afternoon, stabilities D and E make

*Meteorology Research Inc., Sigma Meter

the major contributions, together with stability A-C comprising a total of 93%. In summary, horizontal atmospheric dispersion at the 100-foot level is greates during summer afternoons, and smallest in the winter mornings.

Layer Stability

The most convenient index for describing atmospheric stability through a layer several hundred meters deep is the vertical temperature gradient. The more negative the gradient, the more unstable the atmosphere and the more positive the gradient, the more stable the atmosphere. The Energy Research and Development Administration has developed a stability classification based on vertical temperature gradient and has chosen their stability classes to be in correspondence to the Pasquill classification which is based on surface observations of wind speed, sky conditions, and sun angle. Because of the one-to-one correspondence (such correspondence is verified in succeeding paragraphs) the Pasquill terminology has been used in this report interchangeably to describe both classification methods. No confusion should result if it is remembered that assignment of stabilities to the atmosphere aloft was done so using the temperature gradient as an index.

For comparison of layer stabilities, Winslow radiosonde soundings at 0400 and 1600 MST were selected only on those days when aircraft soundings were obtained at St. Johns at sunrise and 1400 MST; thus, the comparison is for nearly concurrent data. The percent occurrences by Pasquill class for eight 500-foot layers from the surface up to 4000 feet are listed in Table A-3 for early morning and afternoon observations.

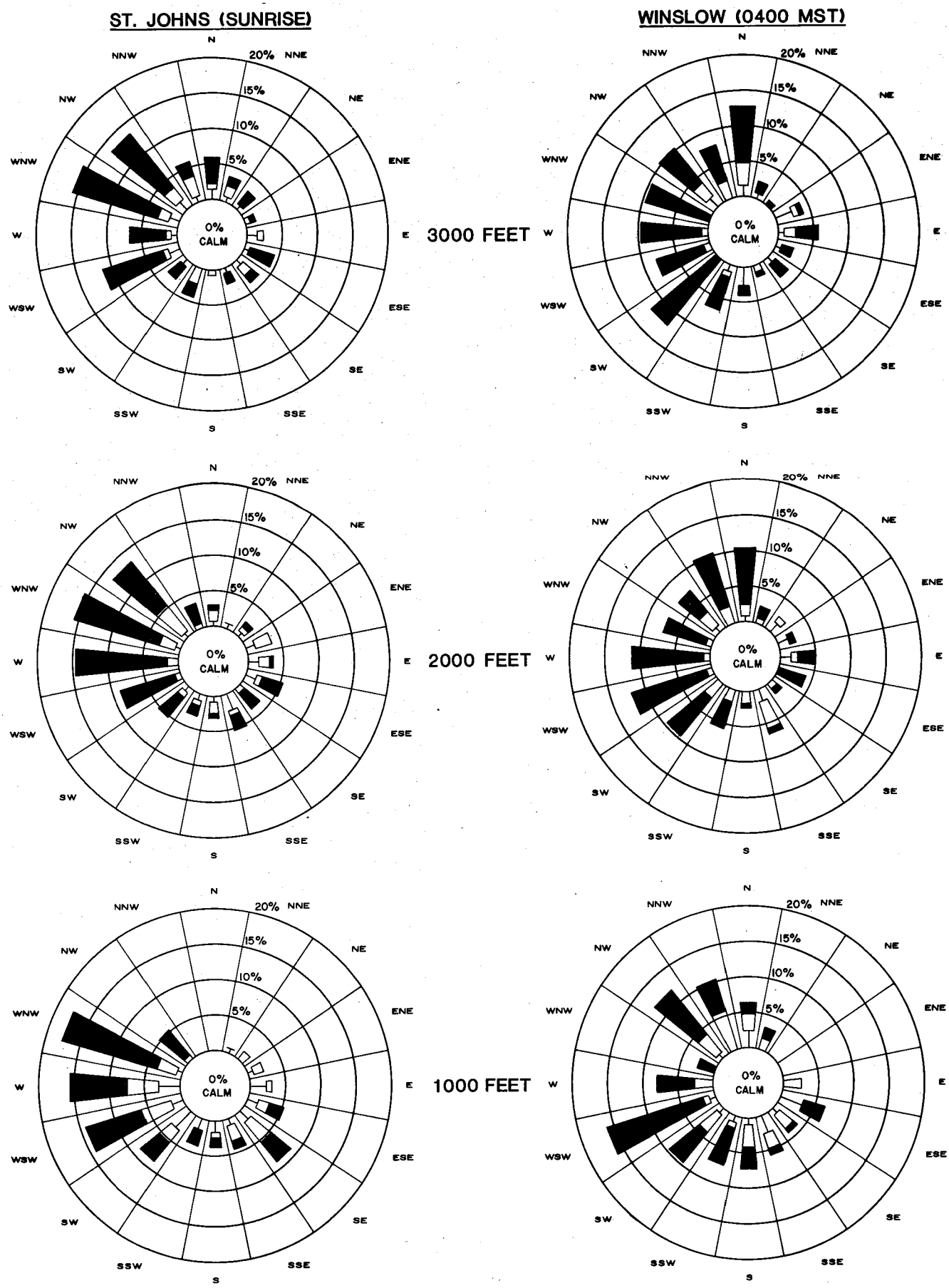
It is indicated that:

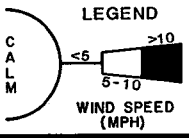
* The occurrence of the extremely stable conditions (Pasquill class G) is restricted to early morning soundings.

* The percent occurrence of very stable conditions (Pasquill classes F and G) decreases with altitude. None were observed above 1500 feet at St. Johns but were observed up to 3000 feet at Winslow. Above 1000 to 1500 feet inversions are of the slightly stable E class.

* The percent occurrence of moderately stable conditions in the 1000-1500 foot altitude band was 2.0 for St. Johns and 4.1 for concurrent Winslow.

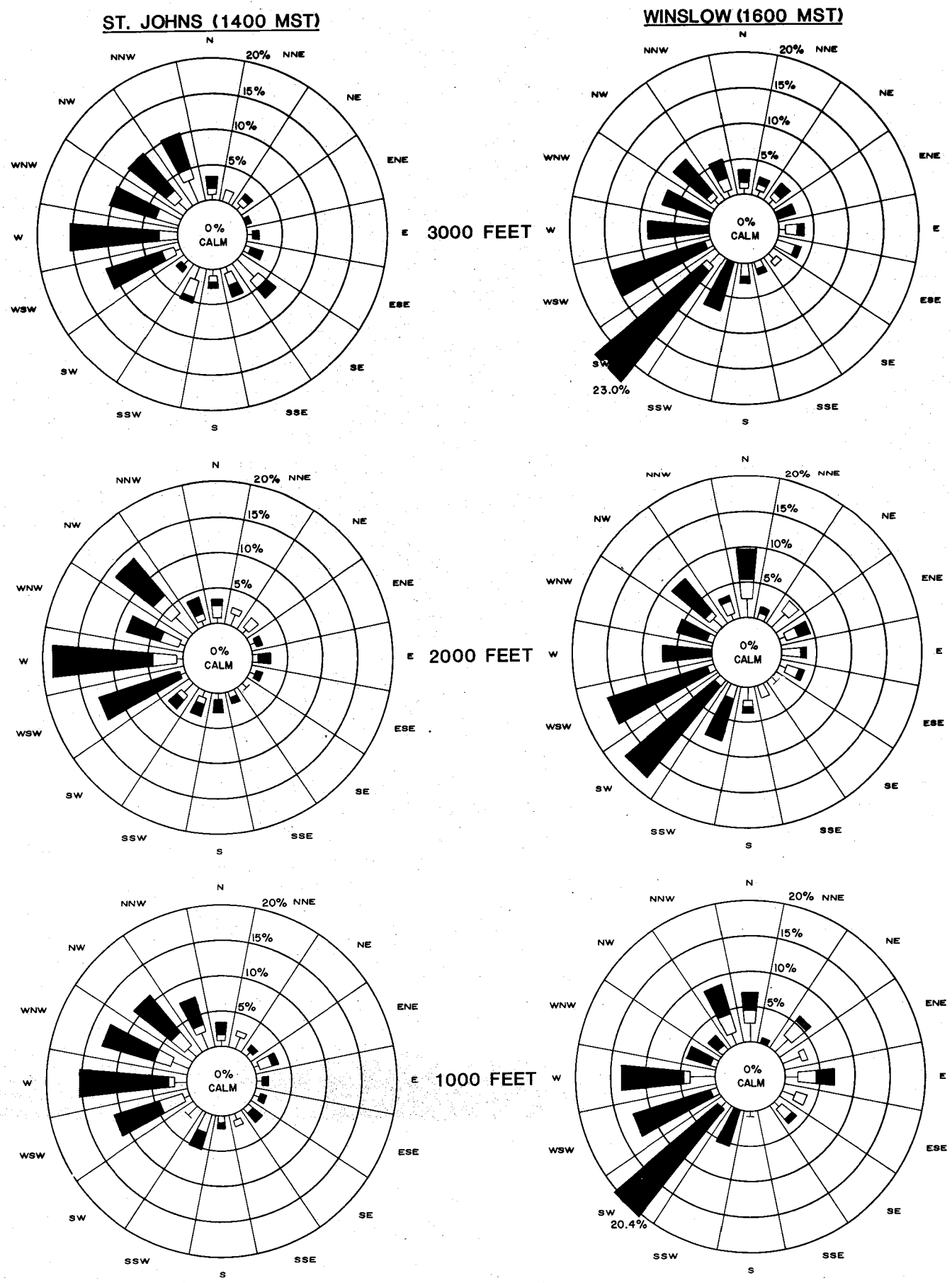
* In the afternoon, unstable conditions (Pasquill class A through C) occur predominantly in the surface layer (below 500 feet). At this time the stability of the air above 500 feet is predominantly neutral (class D).

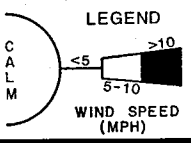




WIND ROSES FOR 1000, 2000 AND 3000 FOOT LEVELS AT ST. JOHNS AT SUNRISE WITH CONCURRENT WIND ROSES AT WINSLOW (0400 MST)

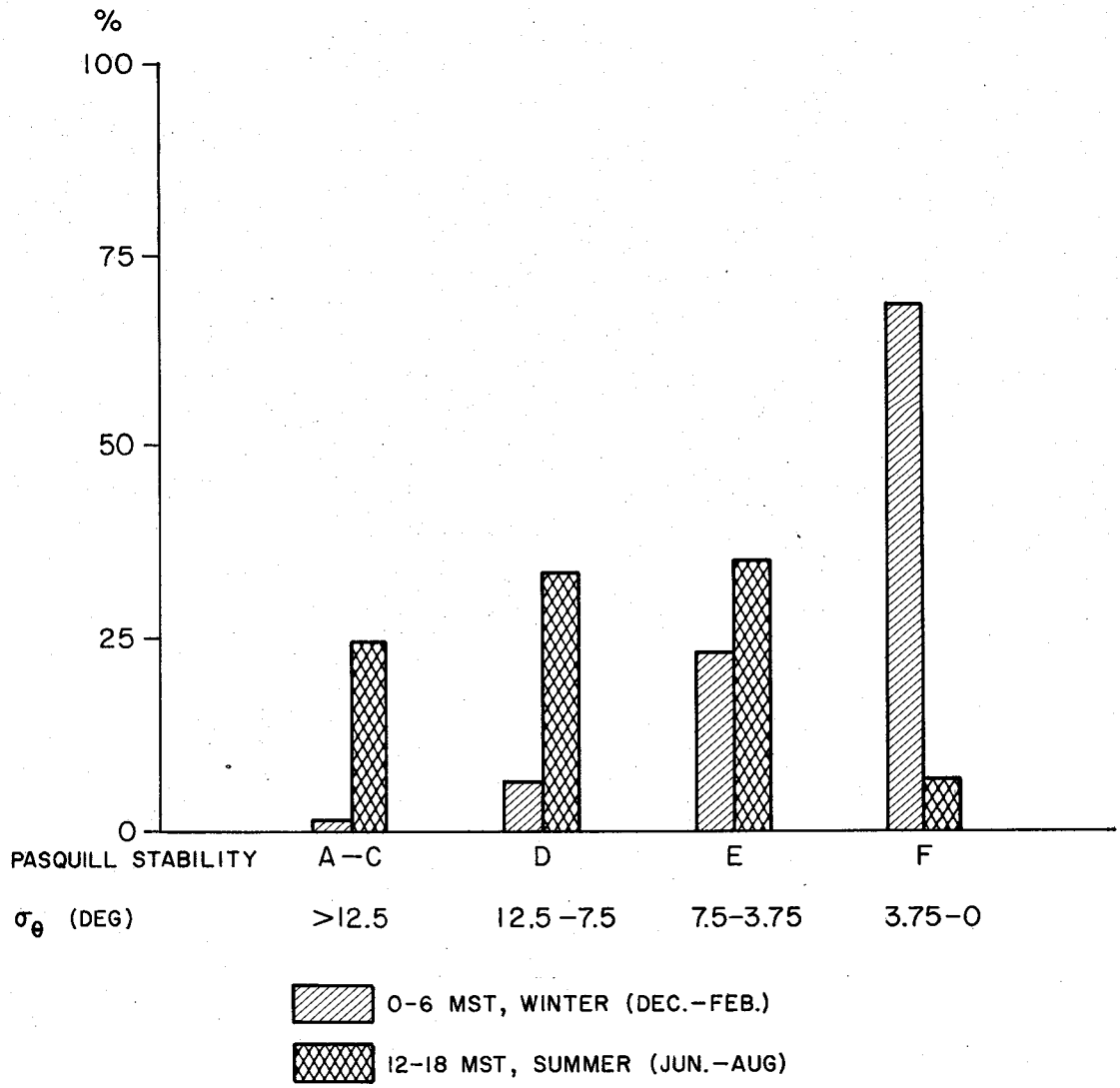
Figure A-7





WIND ROSES FOR 1000, 2000 AND 3000 FOOT LEVELS AT ST. JOHNS AT 1400 MST WITH CONCURRENT WIND ROSES AT WINSLOW (1600 MST)

Figure A-8



DISTRIBUTION OF THE STANDARD DEVIATION OF WIND DIRECTION AT THE 100-FOOT LEVEL AT ST. JOHNS

Figure A-9

TABLE A-3

Percent Occurrence of Layer Stability by Pasquill Class
At St. Johns (SJ) and For Winslow (W)
Concurrent with St. Johns
February, 1974 Through January, 1975

St. Johns at SUNRISE, Winslow at 0400 MST

Layer (Ft.)	A-C		D		E		F		G	
	SJ	W	SJ	W	SJ	W	SJ	W	SJ	W
3500-4000	0.0	0.0	60.8	85.3	39.2	14.7	0.0	0.0	0.0	0.0
3000-3500	1.0	0.0	67.0	77.6	32.0	22.4	0.0	0.0	0.0	0.0
2500-3000	0.0	0.0	70.4	76.5	29.6	22.4	0.0	1.0	0.0	0.0
2000-2500	2.0	0.0	66.3	67.3	31.6	32.7	0.0	0.0	0.0	0.0
1500-2000	1.0	0.0	62.0	56.1	37.0	39.8	0.0	3.1	0.0	1.0
1000-1500	1.0	0.0	43.0	44.9	54.0	51.0	2.0	4.1	0.0	0.0
500-1000	0.0	0.0	26.0	23.5	66.0	61.2	8.0	15.3	0.0	0.0
100 -500	3.0	0.0	16.0	1.0	57.0	26.5	20.0	42.9	4.0	29.6

St. Johns at 1400 MST, Winslow at 1600 MST

Layer (Ft.)	A-C		D		E		F		G	
	SJ	W	SJ	W	SJ	W	SJ	W	SJ	W
3500-4000	4.3	0.0	64.5	94.4	31.2	5.6	0.0	0.0	0.0	0.0
3000-3500	4.4	0.0	81.7	92.2	14.0	7.8	0.0	0.0	0.0	0.0
2500-3000	4.2	0.0	76.6	92.2	19.1	7.8	0.0	0.0	0.0	0.0
2000-2500	1.1	0.0	83.0	91.1	16.0	6.7	0.0	2.2	0.0	0.0
1500-2000	7.5	0.0	79.8	91.1	12.8	5.6	0.0	3.3	0.0	0.0
1000-1500	5.3	0.0	86.2	92.2	8.5	4.4	0.0	3.3	0.0	0.0
500-1000	9.6	0.0	79.8	92.2	7.4	5.6	3.2	2.2	0.0	0.0
100 -500	12.8	56.6	68.1	34.4	19.1	8.9	0.0	0.0	0.0	0.0

Ground Based Inversion

As described in the previous section, stable layers have the highest probability of occurrence at night near the ground. The importance of these ground-based layers is related to the mode of dispersion during inversion breakup. If an effluent plume is initially imbedded in such a stable layer, the ground level concentrations will be low because of poor vertical mixing. After sunrise, surface heating by solar radiation may eliminate the inversion, beginning at the surface and proceeding through the inversion layer. In this manner a layer of air in which there is good mixing increases in depth from the surface. As the new mixing layer envelopes the plume, effluent is mixed to the ground. The ground level concentration of pollutant can be of momentarily high value depending on the height of the plume inversion depth. While inversion breakup is a transient phenomenon, it is recognized as one of the major causes of high, short-term ground level concentrations.

Inversion breakup may be expected at all locations. It can be partially mitigated by the construction of stacks of sufficient height to lift the plume above the inversion. Of course, this cannot be accomplished for all cases, but the more shallow the inversion, the more effective is a tall stack for mitigating inversion breakup.

A summary of inversion depths observed during the period from February, 1974 through January, 1975 over St. Johns and the nearly concurrent values at Winslow is given in Table A-4. Ninety-three percent of the observed inversion depths were equal to or less than 1250 feet and 82 percent were equal to or less than 1000 feet at St. Johns, while the concurrent percents for Winslow are 71 and 65 percent respectively. The mean inversion depths were 646 and 1005 feet at St. Johns and Winslow respectively. As discussed previously, inversions extending above 1000 feet at St. Johns are characterized mostly by Pasquill class E (slightly stable). As indicated in Table A-4, there is a tendency for inversions to be deeper at Winslow in comparison to St. Johns.

TABLE A-4

Percent Occurrence and Mean Inversion* Depth Observed Nearly Concurrently At St. Johns (Sunrise) and Winslow (0400 MST) during February, 1974 Through January, 1975

Inversion Depth (Feet AGL)	Percent Occurrence of Inversion Depth Equal to or Less Than Indicated Value	
	ST.JOHNS	WINSLOW
3750		100%
3500		98
3250		98
3000	100%	97
2750	98	96
2500	98	96
2250	98	92
2000	98	88
1750	98	83
1500	97	81
1250	93	71
1000	82	65
750	71	49
500	56	28
250	39	9

Mean Inversion Depth (feet)

St. Johns	646
Concurrent Winslow	1005

* An inversion is defined by $\frac{\Delta T}{\Delta Z} > 0$

Mixed Layer

It is not uncommon for the atmosphere to be stratified so that a layer aloft is more stable than layers beneath it. Such a situation places a limitation on the vertical mixing of the pollutant and leads to higher concentrations than would occur if the stratification did not exist. The mixing depth is a useful measure for this effect. Mixing depth is defined as the maximum height above ground of a mixed layer characterized by a negative temperature gradient which extends from the ground during the afternoon and from the top of the surface layer inversion during the night and early morning; the limited elevation of mixed layers associated with inversion breakup is not included in this definition. A summary of afternoon mixing depths observed during February, 1974 through January, 1975 over St. Johns and Winslow is given in Table A-5. It is indicated that more than 90 percent of the mixing depths exceeded 4000 feet at Winslow; in comparison, 68 percent exceeded 4000 feet at St. Johns. The tendency

for mixing depths to be smaller over St. Johns in comparison to Winslow indicates that Winslow data may not adequately represent situations involving limited mixing in the vicinity of St. Johns. However, according to the diffusion calculations, using on-site data, this apparent inadequacy is not significant.

TABLE A-5

Percent Occurence of Mixing Depth
Observed Nearly Concurrently at St. Johns
(1400 MST) and Winslow (1600 MST) During
February, 1974 Through January, 1975

Mixing Depth (Feet AGL)	Percent Occurrence of Mixing Depth Greater Than Indicated Value	
	ST. JOHNS	CONCURRENT WINSLOW
4000	68%	93%
3750	-	-
3500	75	94
3250	77	-
3000	80	-
2750	81	-
2500	83	-
2250	85	-
2000	89	-
1750	91	-
1500	92	-
1250	93	-
1000	-	95
750	94	96
500	96	97
250	98	99

Vertical Diffusion Coefficients

In addition to layer stability a measure of the diffusive power of the atmosphere is the vertical heat diffusion coefficient. Larger values of this coefficient indicate more rapid and effective dispersal of pollutants. An average value for the vertical diffusion coefficient for heat due to turbulent mixing has been estimated from temperature sounding data at St. Johns and Winslow. The values obtained are valid for vertical diffusion of any other scalar quantity including stack emissions. The diffusion coefficients are calculated according to the theory of the diurnal temperature variation from an estimate of the daily range of temperature data. Geometric mean values of the vertical diffusion coefficient for heat, k_h(cm^2/sec), are listed in Table A-6 for two altitude intervals (500-1000 feet, 1000-1500 feet). It is indicated that the value of k_h was about the same for

the 500-1000 foot interval at the two locations but was somewhat larger over Winslow for the 1000- 1500 foot interval. It is also indicated that the diffusive power of the atmosphere is larger at the higher layer of 1000-1500 feet than at the lower layer of 500-1000 feet at both places.

TABLE A-6

Geometric Mean Vertical Heat Diffusion Coefficients, k_h (cm^2/sec), Calculated From Aircraft (A) and Radiosonde (R) Temperature Data

	500-1000 Ft.	1000-1500 Ft.
St. Johns (A)	1.87×10^5	2.94×10^5
Winslow (R) Concurrent with St. Johns	1.89×10^5	1.03×10^6

APPENDIX A-2

Air Quality Monitoring in the St. Johns Area - Instrumentation and Data Collection Methods

Air quality monitoring was conducted at St. Johns, Arizona from Februrary, 1974 through February, 1975. Measurements of sulfur dioxide, oxides of nitrogen, suspended particulate matter and visibility were obtained from an instrumentation shelter located at the St. Johns municipal airport. The instruments, data collection methods, and results obtained during the study are discussed in the following sections.

The air quality instruments used at St. Johns were housed in a shelter capable of maintaining an inside temperature of 25°C. This precluded any instrumentation corrections necessary to compensate for temperature variations during the monitoring program. The shelter also provided a platform on which to mount the particulate sampler and served as a storage area for maintenance and meteorological supplies. The air quality shelter is illustrated in Figure A-10. The instruments and sampling periods used for collection of air quality at St. Johns are listed in Table A-7. For a discussion of the findings of the monitoring program refer to Section II B-1.2c of the environmental statement.

TABLE A-7

Air Quality Data Collection Scheme
At The Municipal Airport, St. Johns, Arizona

Parameter	Instrument (model)	Frequency
Sulfur Dioxide (SO_2)	Philips, SO_2 Meter (PW9700)	Continuous
	Philips, Calibrator/timer (PW9700)	Daily
Oxides of Nitrogen (NO, NO_2)	Monitor Labs, NO_x Analyzer (8440)	Continuous
	Monitor Labs, Calibrator (8500)	Monthly
Particulates	RAC, Hi-Vol Sampler (666)	2/wk*
Particle Size	Andersen 2000, Segregator (65-000)	3/wk*
Visibility	Nikon 35 mm Camera (F2) Soligor 800 mm lens	5/wk*

* on alternating weeks, Feb.-Aug., 1974; weekly, Sept. 1974-Feb. 1975.

Suspended particulate matter at St. Johns was collected by a high-volume sampler using standard techniques. Air flow rates were measured at the beginning and end of each 24-hour sampling period, using a calibrated rotameter, and the average flow recorded. Glass fiber filters were brought to constant weight in a desiccator, weighed to $\pm$0.1 mg and placed in individual plastic bags for transportation to and from the monitoring site. The standard sampling method was

replaced by a segregator sampling method on alternate days during the week for a 24-hour size distribution sample. This was not an interruption of data since the segregator also provides a total 24-hour integrated sample. For this reason, no distinction will be made between the methods used when discussing averaged values in this section.

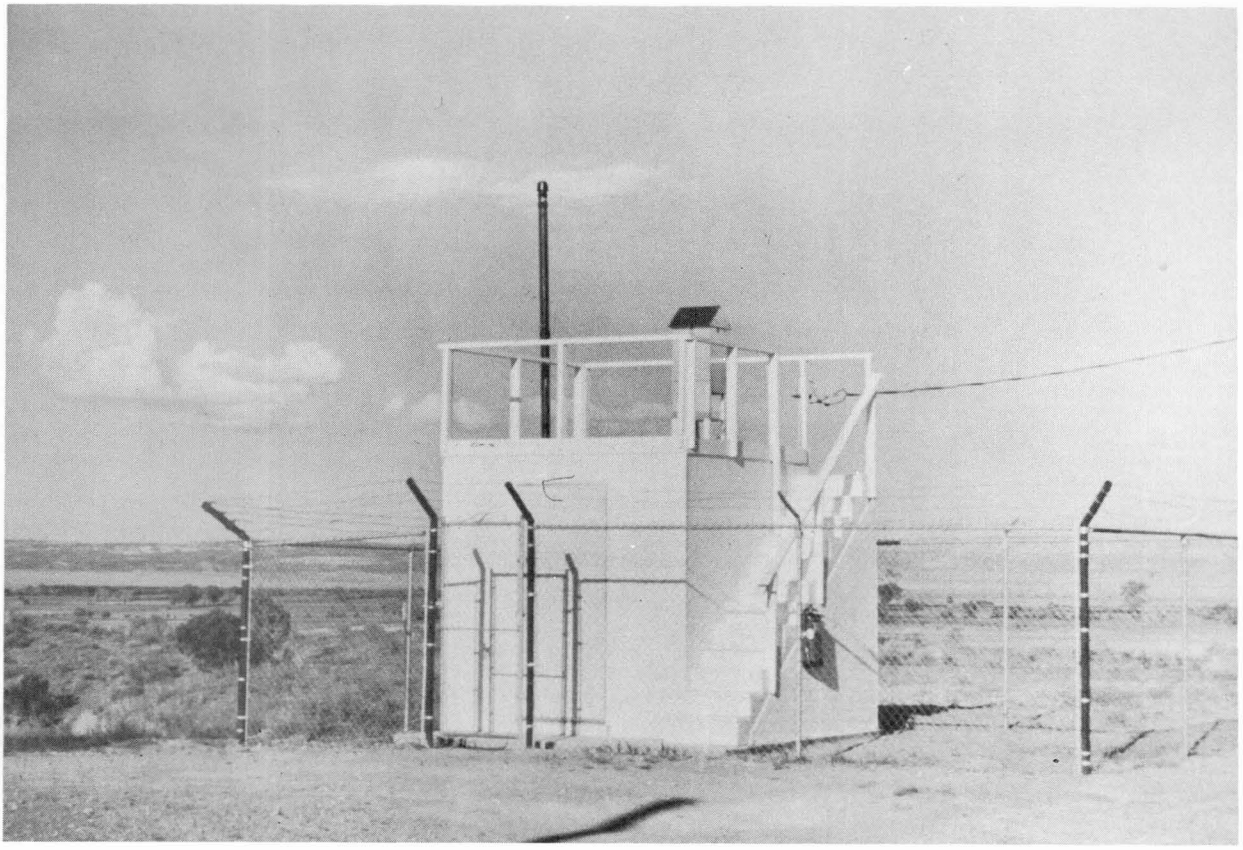
Particle size distribution was measured using an Andersen segregator head. Particles were classified by diameter into five stages and the total mass in each stage was measured. In Figure A-11, the distribution of particulates is shown in terms of weight percent of the total class limit of particle diameter collected on the indicated stage. The distribution is log normal. The combined cumulative size distribution measurements were plotted to obtain an estimate of the mass median diameter. The mass median diameter (MMD) is the medium particle size measured on a mass basis and expressed as the particle diameter below which falls 50% of the sample mass. The MMD was 2.1 micrometers (um) as illustrated in Figure A-12. Respirable dust constituted approximately 70% of the airborne particulate matter collected.

Representative particulate samples collected during the year were submitted to elemental qualitative analysis by electron microprobe X-ray spectroscopy. Six samples, one from each of the last six months, were selected to represent average concentrations on a monthly basis. A seventh sample was selected which represented the maximum concentration obtained during the entire monitoring program. Within the concentration ranges, however, the selection of sample for chemical analysis was random.

The majority of particles analyzed consisted of calcium, potassium, sodium, iron, and aluminum silicates and silica. This included calcium, sodium, and potassium feldspars, micas, hornblendes, clays and glass. Calcium-rich minerals such as calcite and gypsum, and iron oxides and hydroxides such as hematitie and limonite were also present. Sulfur was found in only a very small fraction of the particles sampled.

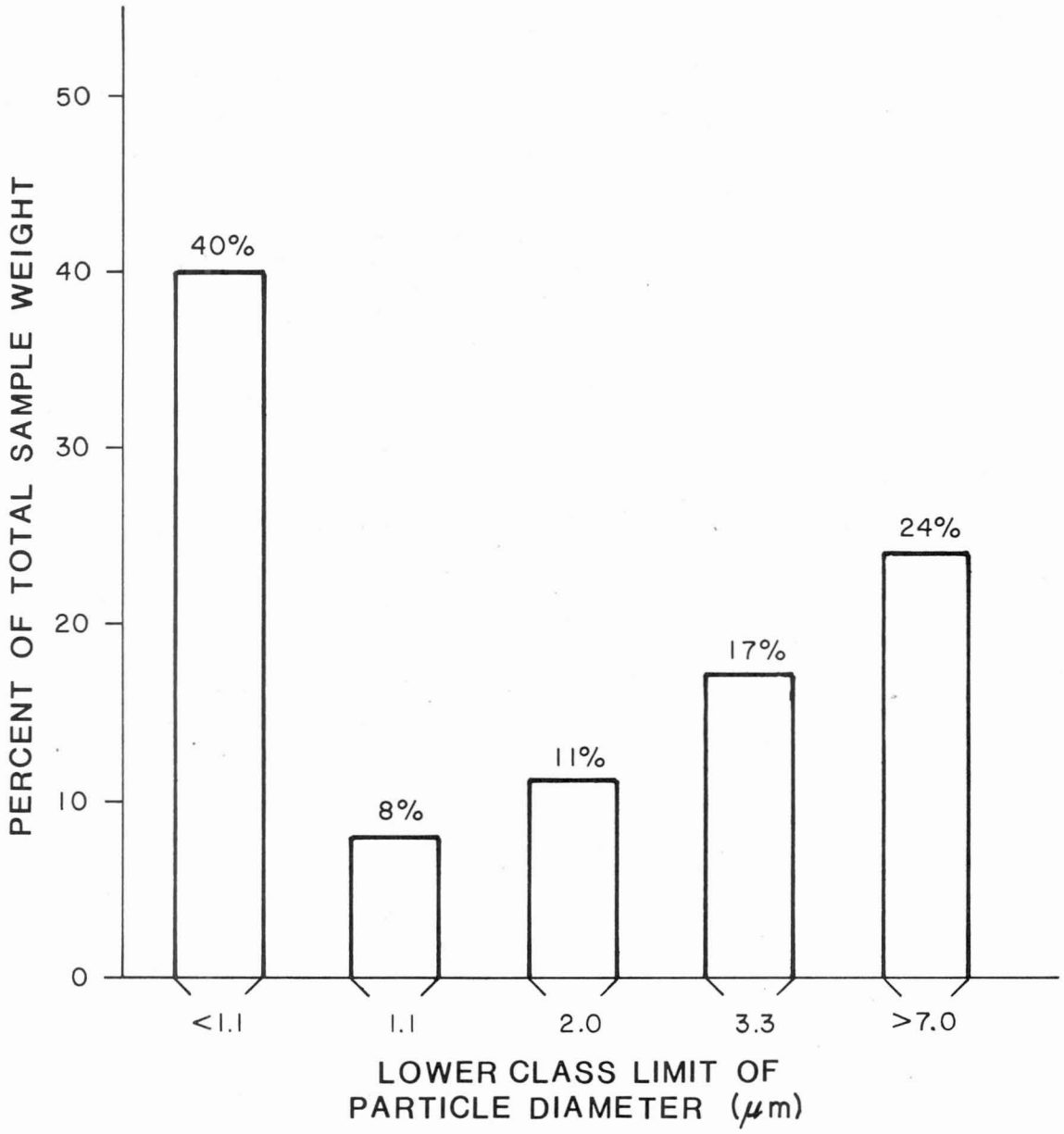
A few unusual single particles were found, including several that were high in copper, two with vanadium, two high in lead and one with a trace of zirconium. The general composition of particles, however, appeared consistent with the first six months of particulate sampled.

In general terms, air quality in the vicinity of St. Johns was very good over the period of record. The average visibility was 80 miles. Sulfur dioxide and nitrogen dioxide levels generally were near the lower measuring limits of the methods involved; frequently the measurements were below instrument limits, where the accuracy has not been validated. Hourly concentrations of SO_2 and NO_2 generally were



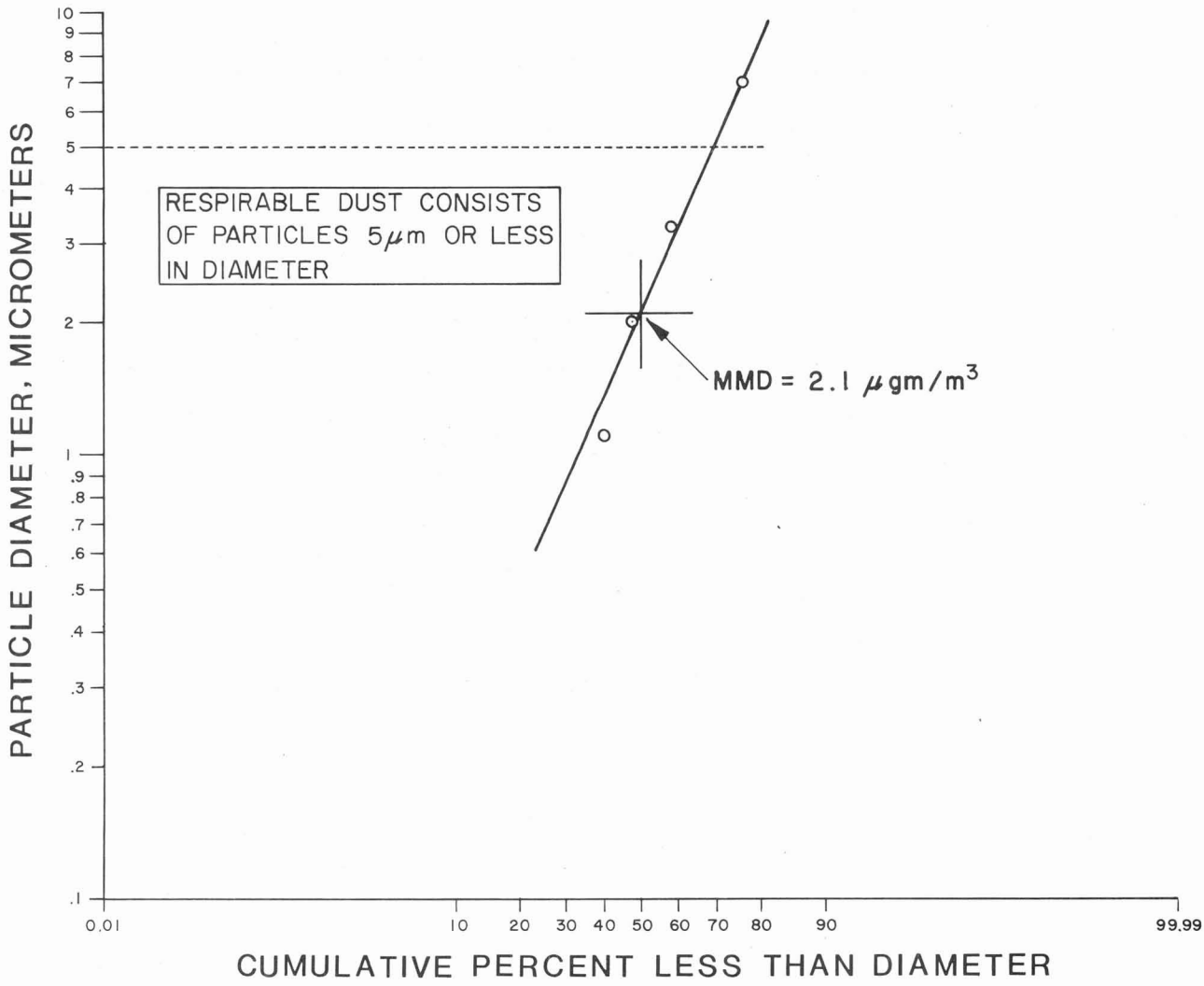
AIR QUALITY SHELTER
MUNICIPAL AIRPORT
ST. JOHNS, ARIZONA

Figure A-10



PARTICLE SIZE DISTRIBUTION BY MASS
ST. JOHNS, ARIZONA
MARCH 1974 - FEBRUARY 1975

Figure A-11



CUMULATIVE DISTRIBUTION OF PARTICLE MASS
ST. JOHNS, ARIZONA
MARCH 1974 - FEBRUARY 1975

Figure A-12

less than 10 ugm/m^3. Twenty-four hour concentrations of airborne particulate matter most often occurred between 10 and 20 ugm/m^3. The maximum particulate concentration recorded was 74 ugm/m^3, well below the State Standard (100 ugm/m^3). Data obtained at St. Johns during 1974 and 1975 are presented in this section as averaged values. Monthly and yearly averages were calculated in most cases; maximum and second maximum values have been pointed out.

Appendix B-1

Air Quality Tracer Studies in the St. Johns Area

A plume simulation tracer program was conducted in the St. Johns area to provide a first approximation of expected ambient pollutant concentrations under plant operating conditions.

The methods employed in conducting the plume simulation study consist of the following:

* A known amount of fluorescent particle (FP) tracer material and visible oil fog tracer is released over the sites from aircraft flying in concentric circles at the prevailing calculated effective stack height level. For the purpose of this study a physical stack height of 500 feet (152m) was used at both sites, and the prevailing effective stack height level was determined with Briggs plume rise equations and meteorological parameters collected at the sites.

* Aerial measurements were made in the FP and oil fog plumes with a specially instrumented aircraft. The instrumentation included an automatic FP counter, an integrating nephelometer to measure equivalent smoke density, a Universal Indicated Turbulence System (UITS) for turbulence measurements and an airborne meteorological system to measure temperature and relative humidity.

* Ground measurements of FP material were made using an extensive network of Rotorods with H-shaped collector rods. The FP dosages collected on the rods are expressed in terms of equivalent SO_2 concentration values by scaling the known quantity of FP tracer material released to the expected quantity of SO_2 to be emitted from the power plant. The rotorod collection time extends for about 4 to 5 hours, commencing about 1 hour before release time; however, the equivalent SO_2 concentration values are maximized to an averaging period equal to the dispensing time, namely 1 hour. Hence the resultant 1 hour average equivalent SO_2 concentration value (X_1 hr) is a conservative estimate. It is converted to a 3-hour average concentration value (X_3 hr) by means of the following relationship proposed by Hino

$$X_3 \text{ hr} = 0.58\ X_1 \text{ hr}$$

The lower threshold value of the FP rotorod system employed in this study is 26 ug/m^3 (0.01 ppm).

* The visible oil fog plumes were photographed extensively from an aircraft and also from selected vantage points on the ground. The aircraft flight paths were selected relative to the plume for maximum plume contrast and optimum viewing. Observers provided detailed descriptions of the plume behavior and also assisted in vectoring the tracer aircraft into optimum plume tracking positions.

A total of 14 tracer releases were made at St. Johns, for atmospheric conditions ranging between very stable to unstable air masses and covering a range in wind speeds from 1 to 10 m/sec.

Appendix B-2

Air Quality Impacts - Ambient SO_2 Modeling Techniques and Procedures

On-site Calculations

Maximum on-site 3-hr and 24-hr ambient SO_2 concentrations were calculated from on-site meteorological measurements for corresponding 3-hr and 24-hr periods using the "technique for the computation of ground-level contaminant concentrations utilizing upper air data" described later in this appendix.

Winslow Calculations

Winslow upper air data were compared with on-site upper air measurements for the same one year period. It was found that because of pooling of colder air in the lower reaches of the valley that where an "F" category of stability occurred on rare occasions at Winslow, the most stable condition that ever occurred at St. Johns was an "E" category. The tendency for Winslow data to over estimate the depth and degree of stability above St. Johns was corrected by convertion layers of air from stability F to layers of air of E stability if those layers are above 1000 feet. Calculations of maximum 3-hr ambient concentrations were then done using the same technique as with on-site data but for a 10 year period of record. Estimates reflect actual meteorological conditions which occurred during the 10 year period rather than those which might occur under assumed limits placed on wind speed or mixing heights.

Zuni Calculations

Zuni, N. M. surface weather observations taken once each 3-hrs over a 10 year period were used to calculate maximum ambient concentrations using the "technique for the computation of ground level contaminant concentrations utilizing surface data" described later in this appendix.

Vertical Heat Diffusion Coefficients

The vertical diffusion coefficient for heat, K_h due to turbulent mixing is valid for turbulent mixing of any other scalar quantity including stack emissions. K_h is calculated from estimates of the daily temperature range at two altitudes near the ground; at these altitudes the temperature of the air is strongly related to the temperature at the ground. Various research investigations[1] have shown that during aperiod

of clear weather within a particular air mass the diurnal temperature variation can be represented by a simple cosing wave of the form

$$T = A \text{ EXP } (-aZ) \cos \left[\frac{2\pi t}{24} - aZ \right] \qquad (1)$$

where,

$$a = \left[\frac{\pi}{24K_h} \right]^{\frac{1}{2}} \qquad (2)$$

and A is the amplitude of the ground surface temperature variation defined as $(T_{max}-T_{min})/2$, t is the time elapsed, in hours, beyond the time of maximum surface temperature. The symbol Z represents the height above ground in centimeters, and K_h is the vertical diffusion coefficient for heat. The diurnal temperature wave at any level z has a phase lag, θ, and an amplitude A(A) given by

$$\theta = \frac{12\ az}{\pi} \qquad (3)$$

$$A(Z) = Ae^{-aZ} \qquad (4)$$

If A(Z) is estimated at two levels from temperature sounding data, then EQ 4 can be used to solve for "a" such that

$$a = \frac{\ln \frac{A(1)}{A(Z)}}{Z_1 - Z_2} \qquad (5)$$

According to equation (2) K_h can be calculated if "a" is known.

$$K_h \ (cm^2/sec) = \frac{3.636 \times 10^{-5}}{a^2} \qquad (6)$$

Average values of A(1) at 500 feet and A(2) at 1,000 feet were estimated from the average difference between the temperatures measured at 0400 and 1600 MST at Winslow and Sunrise and 1400 MST at Snowflake and St. Johns; similar estimates were also made from Joseph City data at 280 and 780 feet at 0600 and 1400 MST. the results are presented in Section 2.2.3.3.

Technique for the Computation of Ground-Level Contaminant Concentrations Utilizing Upper Air Data

Introduction

A computerized model has been developed to compute the ground-level concentrations of a contaminant that is emitted from a vent stack. This

computer model requires inputs that are derived from the design parameters of the plant, meteorologic data and topographic data.

The facility design parameters that are provided as input for the computation are:

a. Velocity of stack effluent (V_s)
b. Stack diameter (D_s)
c. Temperature of stack effluent (T_s)
d. Quantity of effluent emitted (Q)
e. Stack height (hs)
f. Average stack separation (XST)
g. Stack orientation (ORI)

The meteorologic and topographic parameters for input to the computer model are:

a. Wind direction and wind speed (u)
b. Ambient temperature (T_a)
c. Vertical (σ_z) and horizontal (σ_y) dispersion coefficients of plumes as a function of distance from vent stack.(EL)

A more complete glossary of symbols is given at the end of this appendix.

There are three distinct meteorological situations that are treated in the model: (1) normal or coning-plume dispersion, (2) inversion breakup (fumigation), and (3) the limited mixing situation. First, a general discussion of each of these conditions will be presented followed by the actual treatment used in the analysis.

Coning-Plume Dispersion

This model is based upon the Pasquill-Gifford diffusion equation,[2] the Briggs plume rise equation[3] and representative data. It is the procedure followed by the Southwest Energy Study (SWES).[4] The following equations are applicable:

$$C = 10^6 \times Q \exp\left[-\left(h_e^2/2\,{}_z^2\right)\right] \Big/ \pi \sigma_y \sigma_z \bar{U}$$

$$\Delta h = 1.6F^{1/3}\,(10hs)^{2/3}/\bar{U}$$ for Pasquill stability A, B, C, D.

$$\Delta h = 2.9\,(F/Us)^{1/3}$$ for Pasquill stability E, F.

$$F = gV_s\,(D_s/2)^2 \quad \frac{(T_s - T_a)}{T_s}$$

$$s = g/T_a \quad (\Delta\theta/\Delta Z)$$

For all stabilities the effective stack height is calculated from:

$$h_e = h_s + \Delta h - EL$$

Inversion Breakup (Fumigation)

This model is the same as the one used in the SWES[4] with one exception. The computation of XMAX, the point of initial plume breakup, is based upon the Tennessee Valley Authority [5] (TVA) approach. Both methods give similar results, but the TVA method was more easily adapted to the daily computational method. The following equations are applicable:

$$C = \frac{10^6 \cdot Q}{\sqrt{2\pi}\ \bar{U}\ (\sigma_y + Z_F/8)\ Z_F}$$

$$XMAX = \bar{U}\ C_p\ \left[(h_e + 2.15\sigma_z)^2 - h_s^2\right] /4K$$

The inversion breakup situation causes momentary, high ground-level concentrations of contaminants downwind of the vent stack. Whereas, the normal temperature structure (lapse rate) of the lower atmosphere is a decrease with height, the atmospheric process that produces the inversion breakup situation is an alteration of this structure.

The normal atmospheric lapse rate of temperature is altered by nightime radiational cooling of the earth's surface. This is common on cloudless nights when outgoing terrestrial radiation is not reflected back to earth. Since the earth cools more rapidly than the air, the temperature increases with altitude (or becomes "inverted" from normal). This resulting surface-based nocturnal inversion will persist and deepen until sunrise. After sunrise, the earth's surface heats, causing the lower atmosphere to warm and mix to a neutral lapse rate. By mid-morning, the lapse rate becomes unstable through a thicker layer, but the upper portion of the nocturnal inversion still exists and acts as a cap over the lower unstable (well-mixed) layer.

When the top of the surface-based mixing layer reaches the height of the bottom of the vent stack plume, the plume effluent mixes to the ground, fumigation results.

Limited Mixing

This model is the same as the one used in the SWES.[4] The following equation is used to compute concentrations under limited mixing:

$$C = \frac{10^6 \cdot Q}{\sqrt{2\pi}\ \bar{U}\ \sigma_y Z_m}$$

Usually, by mid-day the top of the surface-based mixing layer will have reached the height of the top of the inversion layer, and the effluent will mix with the upper air. If, however, the large-scale (synoptic-scale) meteorological conditions are such that a "deep" inversion exists and the surface-based mixing layer does not reach the top of the inversion layer, a limited-mixing situation occurs. The layer of stratified air that remains aloft throughout the afternoon "limits" the effluent's mixing with the upper air, resulting in high ground-level concentrations of contaminants. This limited-mixing situation lasts for one to four hours during some afternoons and, for emissions from tall stacks, is often the special situation during which the highest ground-level concentrations are measured.

For the "deep inversion" (necessary for this type of limited-mixing situation to occur) to exist, radiational cooling of the earth's surface is usually not sufficient. An additional warming of the upper air is usually necessary. This warming of the upper air occurs when it is experiencing subsidence (downward vertical motion) and the consequent compressional heating. The deep inversion is, therefore, a combination of a nocturnal inversion and a subsidence inversion (aloft).

Since subsiding air is usually cloudless, the synoptic-scale meteorological condition (a high pressure area) that produces the subsidence inversion aloft could also produce the nocturnal inversion. The optimum condition for the creation of a limited-mixing situation is for a high pressure area to cover the vicinity throughout the night and the following day. During the afternoon of this following day, the limited-mixing situation is most likely to occur.

Due to the nature of the conditions that produce the limited-mixing situation, the maximum ground-level concentrations occur about five to ten kilometers from the stack and have a width of about fifteen azimuthal degrees. The maximum concentrations are not directly dependent upon the height of the stack but upon the height of the maximum mixing depth. (The height of the stack affects the frequency of occurrence, however, because a plume from a very tall stack will have a greater chance of penetrating into the stratified air).

The term z_m, represents the thickness of the layer in which the effluent is mixed, the so-called mixing depth. Maximum concentrations will be calculated when this term has its minimum "climatologically realistic" value above effective stack height.

Specific Points

1. Peak to Mean Ratio - Since the wind direction varies considerably over any time period greater than about one hour, the calculated centerline concentration will consistently overestimate the actual downwind concentration at any point for longer time periods. Thus, appropriate peak-to-mean ratios were applied to the calculations. The choice of these ratios are discussed at the end of this appendix.

2. Apparent Distance Corrections - The Coronado Station will have two stacks of equal height with a separation of 600 feet. Adding the concentration from each stack individually will overestimate the concentration. To compensate for this, an "apparent distance" correction is made. For example, take the worst case from an additive viewpoint where the wind direction is parallel to stack orientation. PHI is zero, the change in σ_y is thus zero, but the change to σ_z is a maximum, as is the adjustment factor for the plume rise. At the other extreme, for winds perpendicular to the stack alignment, there is no change in plume rise or σ_z, but the change in σ_y is a maximum.

3. Vanishing Effective Stack Height - Without considering terrain, a minimum value for effective stack height (h_e) is h_s. However, due to the nature of the terrain in northern Arizona, there are occasions where h_e may approach zero or become negative if the conservative assumption is made of wholly subtracting terrain elevation from h_s. In these calculations the effective stack height was allowed to vanish. In cases of small effective stack height, the concentration during coning and fumigation was bounded above by the centerline concentration of an elevated plume with a Gaussian distribution moving in the layer of the given stability.

4. Stability - The AEC stability classification was applied utilizing the equivalent Pasquill classes to compute the diffusion coefficients. The diffusion coefficients were computed from the formulas as follows.

5. Diffusion Coefficients

$$\sigma_z = 1000.0\ ax^b$$

$$\sigma_y = 1000.0\ cx^d$$

Where a, b, c and d are stability dependent:

Stability	Coefficients and Exponents a	b	c	d
A	0.45	2.1	0.20	0.88
B	0.11	1.1	0.16	0.88
C	0.061	0.92	0.10	0.88
D	0.033	0.60	0.070	0.88
E	0.023	0.51	0.052	0.88
F	0.015	0.45	0.035	0.88

6. Potential Temperature Lapse Rate (DPDZ) - DPDZ is defined as the change in potential temperature (0) with height and is used in computing plume rise for stability classes E and F.

   Theta is the temperature a parcel of air would have if brought to a pressure on 1000 mb, dry adiabatically (temperature decrease of $5.5^{o}F$ per 1,000 feet of height).

7. Mixing Height (RIXG) - The following procedure was used in logging RIXG:

   a. If the surface stability is not neutral or unstable, RIXG is zero.

   b. RIXG is zero unless there exists a significant layer of isothermal or greater stability capping the surface layer of well-mixed air. The bottom of this layer is at an elevation of RIXG above ground.

Meteorological Interpretations

The special interpretation of the individual and successive meteorological observations is as follows:

1. Inversion Breakup - The following criteria were used to check for the occurrence of fumigation:

   a. The morning stability from surface through a layer equal in depth to that between 850 and 800 mb must be Pasquill D, E, or F (neutral or stable).

   b. The afternoon mixing depth must be greater than stack height.

   c. At distances less than XMAX, the point of initial plume breakup, C = 0.

2. Limited Mixing - The criteria for determining the occurrence of limited mixing are as follows:

   a. A mixing depth exists as defined under Section A, above, and is less than 2,571 meters (upper limit placed for practical reasons).

   b. The mixing depth is greater than the effective stack height, terrain not included, i.e., $z_m > h_e$. Otherwise, the plume is prohibited from mixing downward by the stratified layer.

c. The average wind speed for the layer from 850 to 800 mb must be between 2.5 and 8.0 meters per second. These wind speeds are believed to be the realistic limits under which the meteorological condition of limited mixing will occur.

d. Limited mixing is not computed before a critical distance is reached. This distance is defined as the point where Gaussian diffusion in the vertical ceases and uniform vertical mixing takes effect. Mathematically, it is the point where $2.15\sigma_z = z_m(2)$. Since for larger power plants, the plume rise is usually almost equal to z_m, this distance has been modified to $2.15\ \sigma_z = 0.75\ z_m(4)$, where σ_z is based on neutral stability.

Time Averaging Peak-To-Mean Ratios

The standard diffusion equation is

$$C_p = \frac{Q}{\pi \sigma_y \sigma_z \bar{U}} \left[\exp\ -1/2 \left(\frac{H_e}{\sigma_z} \right)^2 \right]$$

where the parameters are as defined in Appendix 2. The values of σ_y and σ_z used here are for sampling times of 10 minutes. For larger sampling times, the plume is assumed to meander over a sector of width to be determined by additional considerations. The so called "sector spread formula" is given by

$$C_m = \frac{\sqrt{2}\ Q}{\pi \sigma_z \bar{U} L} \qquad \exp \left[-1/2 \left(\frac{H_e}{\sigma_z} \right)^2 \right]$$

Often L is the width of the sector over which the concentration is averaged.

The peak concentration and mean concentration are related by

$$C_m = \left[\frac{\sqrt{2\pi}\ \sigma_y}{L} \right] C_p$$

Thus the mean peak to mean ratio is

$$(P/M) = \frac{L}{\sqrt{2\pi}\ \sigma_y}$$

The problem reduces to one of selecting an appropriate value for L.

The following theory is one of several possibilities. It is chosen because it is logical and intuitively credible. In addition

it leads to results comparable to the peak-to-mean ratios used by EPA and results obtained from actual field studies.

At a distance, x, from the source, the sector width is related to the angular measure, $\sigma\theta$, of the sector by $L = X\sigma\theta$ where $\sigma\theta$ is dependent on the averaging time.

It is assumed here that the wind direction fluctuates according to a random walk probability model. Such a model does not take into account definite tendencies for the wind direction to change in either a clockwise or counterclockwise manner. Rather the direction is supposed to move with equal probability in either direction around the clock. For this reason the model is conservative, especially for the longer time periods such as 24 hours.

It is further assumed that the wind direction changes in discrete steps by an amount $\pm\sigma\theta$ on either side of the mean wind direction. Here $\sigma\theta$ is the appropriate standard deviation of the wind direction averaged over 10 minutes. According to the theory of random walk

$$L = \sigma_\theta \sqrt{\nu t} \quad x$$

where ν is the frequency of changes in wind direction and t is the time over which the random process occurs. Here ν is 6 hour - 1 and t is 3 hours or 24 hours, etc. Slade (6) has given several exponents of the time ranging from 125 to 15 depending on stability.

Now $\sigma\theta$ depends on stability. For the Pasquill stability classes $\sigma\theta$ is as follows:

TABLE A3 - 1

Pasquill Class	σ_θ (degrees)
A	25.0
B	20.0
C	15.0
D	10.0
E	5.0
F	2.5

To be conservative and to avoid the risk of applying the random walk model to fluctuations inordinately large, the value of 0 for the D class is applied to the stability classes A, B, C, and D.

This theory leads to a very slight dependence of (P/M) on distance. This dependence is too slight to be meaningful and is averaged out in the values reported below. The peak-to-mean ratios are given in the following table:

Stability	3-Hour (P/M)	24-Hour (P/M)
A, B, C, D	5.9	16.9
E	4.0	11.2
F	2.9	8.3

EPA uses a peak-to-mean ratio of 3 appropriate to 3-hour averages and 15 as a ratio for 24-hour averages. From the above table it may be seen that the value of the 3-hour (P/M) is 2.9 for an F stability. Since F stability is the adverse stability, there is agreement with this model and the assumptions made by EPA. The value of 2.9 is used in this report for all stabilities. For a peak-to-mean value appropriate to a 24-hour sampling time an average over the stabilities would be appropriate. For example, it could be argued that a typical day might be composed of 8 hours of F stability, 4 hours of E stability and 12 hours of A, B, C, D stabilities leading to a peak-to-mean ratio of 13.1 for a 24-hour period. This is close to the EPA choice of 15 and is ued in the calculation of this report.

A one-hour peak-to-mean ratio, supposing the correct 3-hour value is 3, would be obtained by dividing the latter by $\sqrt{3}$. Thus the appropriate 1-hour value for the random walk model is approximately $\sqrt{3}$ or 1.73.

These considerations have experimental verification in Hino's (7) extensive study on the effect of sampling time on maximum concentration.

GLOSSARY OF SYMBOLS

X	-	Surface SO_2 centerline concentration (ugm/M^3)
Q	-	SO_2 emission rate (grams/second)
h_s	-	Stack height (meters)
h_e	-	Effective stack height, $h_s = h$ (meters)
Δh	-	Plume rise (meters)
D_s	-	Inside stack diameter (meters)
V_s	-	Stack gas exit velocity (meters/second)
T_s	-	Stack gas exit temperature (^oKelvin)
g	-	Gravitational acceleration (meters/second^2)
F	-	Initial flux due to buoyancy and momentum (m^4/s^3)
T_a	-	Ambient temperature (^oKelvin)
s	-	Restoring acceleration (sec^{-2})
$\frac{\Delta\theta}{\Delta Z}$	-	Vertical potential temperature gradient (^oK/meter)
$\bar{U}$	-	Average wind speed of layer (meters/second)
σ_y	-	Horizontal dispersion coefficient (meters)
σ_z	-	Vertical dispersion coefficient (meters)
Z_F	-	Effective stack height less differential terrain (meters)
Z_m	-	Mixing depth (meters)
XMAX	-	Initial plume breakup distance (meters)
P	-	Ambient air density (grams/cubic meter)
C_p	-	Specific heat capacity of air at constant pressure (cal./g.^oK)

TECHNIQUE FOR THE COMPUTATION OF GROUND LEVEL CONTAMINANT CONCENTRATIONS UTILIZING SURFACE DATA

INTRODUCTION

The model used to compute ground level concentration using surface data is similar in many respects to the model which utilizes upper air data. Its outline is presented here in less detail than the outline for the upper air model. The modifications applied to surface data for the purpose of simulating upper air features are discussed.

The following is a descriptive or verbal flow diagram of the calculating procedure.

DISPERSION MODEL

A. DATA INPUT

Meteorological

T = ambient temperature (converted to ^{o}K) corrected to stack height

D = Wind direction

U = Wind speed (converted to m/sec)

S = Stability

Plant Parameters

H = Stack height (m)

V = Exit velocity (cubic meters/sec)

Q = Emission rate (g/sec)

T_s = Average temperature of emitted effluent (^{o}K)

B. PROGRAM COMPUTATIONS

1. Modification of ambient surface temperature to stack height

$$T_h = T + \Delta T$$

where ΔT is dependent on stability as the following:

Stability	$T(^{o}K/100m)$
A	-1.90
B	-1.80
C	-1.60
D	-1.00
E	0.50
F	2.75

2. Calculate Plume Rise

a. For stabilities A, B, C, and D:

$$\Delta h = 1.6F^{1/3} \quad (10H)^{2/3}$$

where

$$F = (1-T/T_s)\ (3.12)\ (V)$$

The distance at which this is calculated (x) is greater than 10 times the stack height.

b. For Stabilities E and F:

$$\Delta h = 2.9 \left(\frac{F}{US}\right)^{1/3}$$

where

$$S = \left(\frac{9.8}{T}\right) \left(\frac{\partial \theta}{\partial z}\right) = \frac{9.8}{T} \quad (.03)$$

g = acceleration of gravity (m/sec^2)

The distance for which this is calculated (x) are greater than

$$\frac{2.4U}{S^{1/2}}$$

3. Modification for stack orientation and separation:

Input values are

ϕ = angle between stack orientation and sector considered

XST = average stack separation

SN = number of stacks

a. Diffusion Coefficient Modification

$$\Delta\sigma_z = \frac{XST}{4.0} \quad \frac{SN-1}{4.28} \cos \phi$$

$$\Delta\sigma_y = \frac{SN-1}{4.28} XST \sin \phi$$

The diffusion coefficients become:

$$\sigma_z = \sigma_z + \Delta\sigma_z$$

$$\sigma_y = \sigma_y + \Delta\sigma_y$$

b. Plume Rise Modification

$$BQ = 0.22\ (XST)^{-0.19}\ (SN-1) \cos \phi$$

The plume rise becomes,

$$\Delta h = \Delta h + (BQ)\ (\Delta h)$$

4. Time Constant for Fumigation Calculation

ρ = atmospheric density

C_p = specific heat at constant pressure (0.24)

$$\frac{\partial \theta}{\partial Z} = 0.03\ ^{o}K/m$$

R = net rate of sensible heating of air column by solar radiation

This constant is the heating time of the mixing layer needed to break the inversion divided by the solar radiation (the source of this heating).

$$T_M = \frac{PC_p}{R} \frac{\partial \theta}{\partial Z} \left[\Delta h + BQ\Delta h + 2\sigma_{z_{20}}\right] \left[\frac{\Delta h + BQ\Delta h}{2} + \sigma_{z_{20}} + H\right]$$

Where $\sigma_{z_{20}}$ is the value of the diffusion coefficient at 20 kilometers.

This value times the ambient wind speed will give the distance at which the maximum fumigation concentration should exist.

5. "DO" Loop for the Various Distances Downwind Starts Here

Compute Effective Plume Height

For all stabilities use:

$$DH = DH - TQPQ\ (ID,I)$$

where TQPQ (ID,I) is the topography of the section. This array is dimensioned by direction and distance.

6. Calculate Diffusion Coefficient

$$\sigma_z = 1000.0\ a\ X^b$$

$$\sigma_y = 1000.0\ c\ X^d$$

Where a, b, c and d are stability dependent:

Stability	Coefficients and Exponents			
	a	b	c	d
A	0.45	2.1	0.20	0.88
B	0.11	1.1	0.16	0.88
C	0.061	0.92	0.10	0.88
D	0.033	0.60	0.070	0.88
E	0.023	0.51	0.052	0.88
F	0.015	0.45	0.035	0.88

The correction factors of σ_z and σ_y for the orientation and the stack separation are included in σ_y and σ_z.

$$\sigma_z = \sigma_z + \sigma_z$$

$$\sigma_y = \sigma_y + \sigma_y$$

7. Standard Calculation of Concentrations

This is computed for each distance that is less than the distance the plume will travel in 12 hours.

$$X_{ST} = \frac{Q}{\pi u \sigma_y \sigma_z} \exp\left[-\frac{DH^2}{2\sigma_z}\ 2\right]$$

These values are stored for future comparison with other calculations.

8. Mixing Concentrations

This concentration is computed for stabilities A, B, C and D only. It is the concentration resulting from uniform vertical mixing through a layer of constant thickness above the terrain (Z_m).

The mixing depth is stability dependent. In the list below Z min is the mixing depth averaged over remainder of the year. The mixing depths were computed from long-term Winslow data and subsequent comparison with recent on-site data at Snowflake and St. Johns.

Winslow	St. Johns	Z min = 810 meters;	S = D
Data:	Snowflake	Z max = 3296 ;	S = A,B,C

a. Determine the distance to compute the mixing concentrations

The critical distance, X_m, is distance at which vertical mixing begins. X_m is the point where 2.15 o_z = 0.75 Z_m or

$$X_m(km) = \left[\frac{0.75Z_m/2.15}{1000A}\right]^{1/B}$$

The mixing concentration equation is applied at $2X_m$ and beyond. For distances of X_m and less, the standard equation is used to calculate the concentration.

For disntance greater or equal to X_m and less than $2X_m$, the values of concentration are computed by straight line log - log interpolation between the standard calculation at X_m and the mixing concentration at $2X_m$.

b. The mixing concentration calculation

$$X_{mix} = \frac{Q}{\sqrt{2\pi}\,\bar{U}o_y Z_m}$$

x_{mix} = 0 for stabilities E and F

9. Fumigation Calculation

This is calculated for stabilities of E and F, only when the next observation shows stability D or more.

a. Distance Criteria

(1) Compute the distance, X_F, of maximum concentration by $X_F = U\ T_m$.

(2) If the distance at which the concentration is to be calculated is less than ½ X_F, use the standard calculation.

(3) From distance of ½ X_F to distance where $o_z = Z_F/5$ (Z_F = DH), use the equation:

$$X = \left[\frac{\sigma_z}{1000A} \right]^{1/B}$$

to calculate the distances at various values of σ_z.

(4) From distance at which $\sigma_z = Z_F/5$ to distance where $Z_F = \sigma_z$, ½ the calculated fumigation concentration is assumed to apply.

Distances greater than the value where $Z_f = \sigma_z$, the standard equation concentration is used.

b. The equation used to calculate the fumigation is:

$$X_F = \frac{Q}{2\pi U \ (\sigma_y + Z_F/8) \ Z_F}$$

c. For the three-hour maximum value, 1/6 of the fumigation concentration is added to 5/6 of the standard calculated concentration. For the 24-hour maximum, 1/48 of the fumigation concentration is added to 47/48 of the standard 24-hour concentration.

C. SPECIFIC POINTS

1. Vanishing Effective Plume Height

In case the plume height above ground is computed to be negative or zero the effective stack height is set equal to zero in steps 7 and 9. For these cases and for effective stack heights less than 1.18 o_z the computed concentration in steps 7 and 9 are limited above by the centerline concentration of an elevated plume. This upper bound is:

$$\frac{Q}{2\pi \sigma_y \sigma_z U}$$

2. Strong Inversions

Stabilities are determined by the STAR program. If the stability is F, the plume rise is computed accordingly. If the plume rise plus stack height exceeds a predetermined, site dependent strong inversion depth above which F stability does not apply, the plume is supposed imbedded in a layer of E stability. If the plume does not rise above the F layer, then F stability applies.

3. Peak-to-Mean Ratios

To calculate the three-hour maximum values, the instantaneous maximum concentrations are divided by the Peak-to-Mean ratio appropriate

for three-hour averaging period. The Peak-to-Mean ratios were 3.0 for standard concentrations for all stability classes; 1.0 for fumigation and 2.0 for limited mixing.

4. Wind Adjustment for Stack Height

Because the surface wind speed is not a true representation of the wind speed at stack height, especially for high stacks, an adjustment is made based on the magnitude of the difference anticipated. The following adjustment is used:

$$U = U_o \left(\frac{hs}{Z_o} \right)^{0.14}$$

where hs is the stack height, Z_0 is the height of the surface base wind instrument and Uo is the surface wind speed. The exponent 0.14 is based on experiments reported in the literature for neutral stability. For a stack of 500' and a Z_0 of 30', U_0 is multiplied by a factor of 1.49. This is conservative in stable atmospheres where a greater wind shear is expected.

5. Lapse Rate of Temperature

The ambient surface temperature is corrected to produce temperature at stack height. For this purpose the lapse rates associated with the stability class is used.

$$T = T_o + \frac{\Delta T}{\Delta Z} H_s$$

6. Determination of Maximum Value

The values of concentration calculated by the three modes 7, 8, and 9 are compared and the maximum values at each distance downwind for each direction sector is stored at that location for each 3-hourly observation. Therefore, the final array of maximum concentrations have the largest values at each sector and distance regardless of the method of calculation. The results are obtained as frequency of concentrations for each grid point.

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Appendix C

CONCENTRATIONS (ppm) OF NINE TRACE ELEMENTS IN SOILS, PLANTS, AND ANIMAL TISSUE ON, AND WITHIN 12 MILES OF ST JOHN SITE (Sheet 1 of 3)

Elements	Sample Type	Onsite	4 Miles NE	6 Miles NE	12 Miles NE	SRM 1577	CPP Joseph City	Other Levels
Arsenic	Soil (water extractable)	<0.8	<0.8	<0.8	<0.8		≦2.51	6.0 ppm
	Soil (total extractable)	<0.8	<0.8	<0.8	<0.8			
	Producers	<0.8	<0.8	<0.8	<0.8	14±2		0.2 ppm
	Primary Consumers	<0.8	<0.8	<0.8	<0.8	0.0555		≦0.2 ppm
Boron	Soil (water extractable)	<40.0	<40.0	<40.0	<40.0		≦2.0	2-100 ppm
	Soil (total extractable)	<40.0	<40.0	<40.0	<40.0			
	Producers	<40.0	<40.0	<40.0	<40.0	33±3		50 ppm
	Primary Consumers	<40.0	<40.0	<40.0	<40.0			0.5 ppm
Cadmium	Soil (water extractable)	.001	<.001	<.001	<.001		≦0.35	0.06 ppm
	Soil (total extractable)	1.5	1.3	1.7	0.8			
	Producers	<0.001	<0.001	<0.001	<0.001	0.11±.02		0.6 ppm
	Primary Consumers	<0.001	<0.001	<0.001	<0.001	0.27±.04		≦0.5 ppm

a. G - Grass
b. S - Shrub
c. J - Juniper

Appendix C

CONCENTRATIONS (ppm) OF NINE TRACE ELEMENTS IN SOILS, PLANTS, AND ANIMAL TISSUE ON, AND WITHIN 12 MILES OF ST JOHN SITE (Sheet 2 of 3)

Elements	Sample Type	Onsite	4 Miles NE	6 Miles NE	12 Miles NE	SRM 1577	CPP Joseph City	Other Levels
Chromium	Soil (water extractable)	<0.003	<0.003	<0.003	<0.003		0.18-0.9	5-3000 ppm
	Soil (total extractable)	30.0	40.0	16.0	41.0			
	Producers	20.0[a] 8.0[b] 1.0[c]	19.0[a] 2.5[b] 0.8[c]	27.0[a] 3.0[c]	16.0[a] 1.2[c]	2.3		0.23 ppm
	Primary Consumers	< 0.003	< 0.003	< 0.003	< 0.003			0.075 ppm
Lead	Soil (water extractable)	< 0.002	<0.002	< 0.002	< 0.002		1.26-12.6	100 ppm
	Soil (total extractable)	26.0	48.0	39.0	39.0			
	Producers	< 0.002	< 0.002	< 0.002	< 0.002	45±3		
	Primary Consumers	< 0.002	< 0.002	< 0.002	< 0.002	0.34±.08		
Mercury	Soil (water extractable)	0.002	0.003	0.002	0.004		≤0.15	0.003-0.8 ppm
	Soil (total extractable)	0.003	0.004	0.006	0.004			
	Producers	0.001[a] 0.0003[b] 0.0002[c]	<0.0001	0.0006[a] 0.0004[b]	<0.0001	0.155±.015		0.015 ppm
	Primary Consumers	<0.0001	<0.0001	<0.0001	<0.0001	0.016±.002		0.046 ppm

Appendix C

CONCENTRATIONS (ppm) OF NINE TRACE ELEMENTS IN SOILS, PLANTS, AND ANIMAL TISSUE ON, AND WITHIN 12 MILES OF ST JOHNS SITE (Sheet 3 of 3)

Elements	Sample Type	Onsite	4 Miles NE	6 Miles NE	12 Miles NE	SRM 1577	CPP Joseph City	Other Levels
Molybdenum	Soil (water extractable)	<0.01	<0.01	<0.01	<0.01			2.0 ppm
	Soil (total extractable)	<0.01	<0.01	<0.01	<0.01			
	Producers	<0.01	<0.01	<0.01	<0.01			0.9 ppm
	Primary Consumers	<0.01	<0.01	<0.01	<0.01	3.2		0.2 ppm
Selenium	Soil (water extractable)	<0.5	<0.5	<0.5	<0.5		T	0.2 ppm
	Soil (total extractable)	<0.5	<0.5	<0.5	<0.5			
	Producers	<0.5	<0.5	<0.5	<0.5	0.08-0.01		0.2 ppm
	Primary Consumers	<0.5	<0.5	<0.5	<0.5	1.1±0.1		1.7 ppm
Vanadium	Soil (water extractable)	<0.1	<0.1	<0.1	<0.1		T-27.8	100 ppm
	Soil (total extractable)	<0.1	<0.1	<0.1	<0.1			
	Producers	<0.1	<0.1	<0.1	<0.1			1.6 ppm
	Primary Consumers	<0.1	<0.1	<0.1	<0.1			0.15 ppm

Appendix D

VEGETATION REPRESENTATIVE OF THE COLORADO PLATEAU IN THE

ST. JOHNS AREA (Sheet 1 of 6)

Vegetation		Biotic Communities		
Scientific Name	Common Name	Riparian	Juniper Pinyon	Grassland
Trees				
Acer negundo	Box Elder	x		
Alnus oblongifolia	Arizona elder	x		
Juniperus monosperma	One-seeded juniper	x	x	
Juniperus osteosperma	Utah juniper	x	x	
Juniperus scopulorum	Rocky Mountain juniper	x	x	
Pinus edulis	Colorado pinyon		x	
Populus fremontii	Cottonwood	x		
Shrubs and Cacti				
Agave schottii	Amole			x
Amelanchier alnifolia	Serviceberry	x	x	
Aplopappus spinulosus	Burroweed			x
Artemisia filifolia	Sand sagebrush			x
Artemisia nova	Black sagebrush		x	x
Artemisia tridentata	Big sagebrush			x
Atriplex canescens	Four-wing saltbrush			x
Atriplex confertifolia	Shad seale		x	x
Baccaris sarothroides	Desert broom	x		x
Berberis fremontii	Fremont barberry	x	x	

a. Annual observed on St Johns or Snowflake site

Appendix D (cont.)

VEGETATION REPRESENTATIVE OF THE COLORADO PLATEAU IN THE

ST JOHNS AREA (Sheet 2 of 6)

Vegetation		Biotic Communities		
Scientific Name	Common Name	Riparian	Juniper Pinyon	Grassland
Brickellia californica	Brickellbush	x	x	
Celtis reticulata	Netleaf hackberry	x		
Chamaebatiaria millefolium	Fernbush		x	
Chrysothamnus depressus	Rabbitbrush		x	x
Chrysothamnus nauseosus	Rabbitbrush		x	x
Chrysothamnus viscidiflorus	Rabbitbrush			x
Cowania mexicana	Cliff-rose		x	
Echinocereus fendleri	Hedgehog cactus			x
Ephedra viridis	Mormon tea		x	x
Eurotia lanata	Winterfat		x	x
Fallugia paradoxa	Apache plume	x	x	
Forestiera phillyreoides	Desert olive	x		
Garrya wrightii	Silk tassel		x	
Gutierrezia lucida	Snakeweed			x
Gutierrezia sarothrae	Snakeweed		x	x
Hymenoclea monogyra	Burrobush			x
Mamillaria spp.	Fishhook cactus		x	x
Nolina microcarpa	Beargrass			x
Opuntia engelmannii	Prickly pear		x	x
Opuntia fragilis	Fragile cholla		x	
Opuntia phaeacantha	Engelman prickly pear		x	x
Opuntia polyacantha	Prickly pear		x	x
Opuntia whipplei	Whipple cholla		x	
Prosopis juliflora	Mesquite	x		x
Quercus turbinella	Scrub oak	x		
Rhus choriophylla	Woodland sumac		x	

Appendix D (cont.)

VEGETATION REPRESENTATIVE OF THE COLORADO PLATEAU IN THE

ST JOHNS AREA (Sheet 3 of 6)

Vegetation		Biotic Communities		
Scientific Name	Common Name	Riparian	Juniper Pinyon	Grassland
Rhus trilobata	Squawbush		x	
Salix supp.	Willow	x		
Tamarix gallica	Salt cedar	x		
Yucca baccata	Thornber yucca		x	x
Yucca elata	Palmilla			x
Grasses				
Agropyron smithii	Wheatgrass		x	
Agrostis scabra	Bentgrass		x	
Andropogon babinodis	Cone beardgrass			x
Andropogon cirratus	Texas beardgrass			x
Andropogon hallii	Sand bluestem			x
Andropogon scoparius	Little bluestem			x
Aristida adscensionis	Six weeks three-awn			x
Aristida divaricata	Poverty three-awn			x
Aristida glabrata	Santa Rita three-awn			x
Aristida hamulosa	Three-awn			x
Aristida longiseta	Red three-awn			x
Aristida purpurea	Purple three-awn			x
Aristida ternipes	Spider grass			x
Avena fatua	Oats			x
Blepharoneuron tricholepis	Pine dropseed		x	
Bouteloua aristidoides	Six weeks grama			x
Bouteloua barbata	Six weeks grama			x
Bouteloua chondrosioides	Sprucetop grama			x
Bouteloua curtipendula	Sideoats grama		x	x
Bouteloua eriopoda	Black grama			x
Bouteloua filiformis	Slender grama			x

Appendix D (cont.)

VEGETATION REPRESENTATIVE OF THE COLORADO PLATEAU IN THE

ST JOHNS AREA (Sheet 4 of 6)

Vegetation		Biotic Communities		
Scientific Name	Common Name	Riparian	Juniper Pinyon	Grassland
Bouteloua gracilis	Blue grama		x	x
Bouteloua hirsuta	Hairy grama		x	x
Bouteloua rothrockii	Rothrock grama			x
Bromux rubens	Red brome			x
Carex spp.	Sedge	x		
Elymus Canadensis	Canadian wild-rye	x	x	
Elymus glaucus	Blue wild rye		x	
Eragrostis intermedia	Plains lovegrass		x	x
Festuca arizonica	Arizona fescue		x	x
Festuca octaflora	Six weeks fescue		x	
Heteropogon contortus	Tanglehead			x
Hilaria belangeri	Curly mesquite			x
Hilaria jamesii	Galleta		x	x
Hilaria mutica	Tobosa			x
Leptochloa dubia	Green spangletop			x
Muhlenbergia microsperma	Desert muhly			x
Muhlenbergia montana	Mountain muhly		x	
Muhlenbergia porteri	Bush muhly			x
Muhlenbergia torreyo	Ring muhly		x	x
Oryzopsis hymenoides	Indian rice grass		x	x
Scirpus spp.	Rushes	x		
Setaria macrostachya	Plains bristlegrass			x
Sitanion hystrix	Squirreltail			x
Sporobolus airoides	Alkali sacaton	x		
Sporobolus cryptandrus	Sand dropseed		x	
Sporobolus wrightii	Sacaton	x		

Appendix D (cont.)

VEGETATION REPRESENTATIVE OF THE COLORADO PLATEAU IN THE

ST JOHNS AREA (Sheet 5 of 6)

Vegetation		Biotic Communities		
Scientific Name	Common Name	Riparian	Juniper Pinyon	Grassland
Trichachne californica	Cottongrass			x
Tridens muticus	Slim tridens			x
Tridens pulchellus	Desert fluffgrass			x
Typha spp.	Cattail	x		
Forbs				
Ambrosia psilostachya	Ragweed			x
Arabis perennans	Rock cress	x	x	
Asclepias spp.	Milkweed			x
Aster tephrodes	Aster		x	x
Astragalus spp.	Locoweed[a]		x	x
Boerhaavia spp.	Spiderling			x
Cassia bauhinioides	Senna			x
Cirsium neomexicanum	Thistle			x
Descurainia spp.	Tansy mustard		x	x
Dichelostemma pulchellum	Brodiaea			x
Eriastrum diffusm	Eriastrum			x
Erigeron spp.	Fleabone			x
Erodium circutarium	Fillaree			x
Eschscholtzia mexicana	Gold poppy			x
Eurotia lanata	Winterfat		x	x
Gnaphalium spp.	Cudweed			x
Helianthus spp.	Sunflower			x
Lotus spp.	Vetch			x
Lupinus spp.	Lupine			x

Appendix D (cont.)

VEGETATION REPRESENTATIVE OF THE COLORADO PLATEAU IN THE

ST JOHNS AREA (Sheet 6 of 6)

Vegetation		Biotic Communities		
Scientific Name	Common Name	Riparian	Juniper Pinyon	Grassland
Mentzelia spp.	Stickleaf		x	x
Orthocarpus purpurascens	Owl clover		x	x
Penstemon spp.(a)	Beardtongue		x	x
Phlox spp.	Phlox		x	x
Plantago spp.	Indianwheat			x
Salsola kali	Russian thistle			x
Sisymbrium linearifolium	Mustard	x		
Sphaeralcea spp.	Globemallow			x
Stephanomeria pauciflora	Stickweed			x
Thalictrum Fendleri	Meadow rue	x		
Verbena bipinnatifida	Vervain	x		
Verbena spp.	Verbena	x		
Vicia americana	Vetch			x
Viola spp.(a)	Violet	x		
Xanthium spp.(a)	Cockleburr			x
Zinna spp.	Zinnia			x

APPENDIX E-1

BIRD COMMUNITIES NEAR ST. JOHNS, ARIZONA

Species	Common Name	(a) Territory	(b) Abundance	(c) Riparian & Aquatic	(c) Juniper Pinyon	(c) Grassland	(c) Great Basin Desert	(d) Trophic Level C_1	C_2	C_3	(e) Food Type
Grebes											
Podiceps Caspicus	Eared grebe		C	T					a	a	I
Podilymbus podiceps	Pied-billed grebe		C	R					a	a	I,A
Acchmophorus occidentalis	Western grebe		C	T					a	a	I,A
Herons and Bitterns											
Ardea herodias	Great blue heron	M	C	R					b	a	A
A. virescens	Green heron		U	T					b	a	A
A. alba	Common egret		U	T					b	a	A
A. thula	Snowy egret		C	N					b	a	A
Nycticoraz nycticorax	Black-crowned night heron		R	T					b	a	A
Botaurus lentiginosus	American bittern		R	T					b	a	A
Ixobrychus exilis	Least bittern		U	B					b	a	A
Geese and Ducks											
Branta canadensis	Canada goose		C	M				a			P
Anser albifrons	White-fronted goose		R	T				a			P
A. caerulescens	Snow goose		U	M				a			P
Anas platyrhynchos	Mallard	S	C	X				b	a	c	P,I
A. strepera	Gadwall		C	M				b	a	c	P,I
A. acuta	Pintail		C	M				b	a	c	P,I
A. americana	Baldpate		C	M				b	a	c	P,I
A. carolinensis	Green-winged teal	S	C	R				b	a	c	P,I
A. discors	Blue-winged teal		U	T				b	a	c	P,I
A. cyanoptera	Cinnamon teal		C	M				b	a	c	P,I
A. clypeata	Shoveler		C	N				a	a	b	P,I
Aythya valiscineria	Canvasback		U	M					a	b	I,A
A. americana	Redhead		C	T					a	b	I,A
A. collaris	Ring-necked duck		U	T					a	b	I,A

APPENDIX E-1

BIRD COMMUNITIES NEAR ST. JOHNS, ARIZONA

Species	Common Name	Territory (a)	Abundance (b)	Riparian & Aquatic (c)	Juniper Pinyon (c)	Grassland (c)	Great Basin Desert (c)	Trophic Level C_1	C_2	C_3 (d)	Food Type (e)
A. affinis	Lesser scaup		C	M					a	b	I,A
Buecephala clangula	Common goldeneye		R	T					a	b	I,A
B. albeola	Bufflehead		C	T					a	b	I,A
Mergus merganser	American merganser		C	N					b	a	A
M. Serrator	Red-breasted merganser		R	T					b	a	A
Oxyura jamaicensis	Ruddy duck		C	M					a	b	I,A
Vultures, Hawks and Falcons											
Cathartes aura	Turkey vulture	L	C	B	B	x	x		b	a	C
Accipiter striatus	Sharp-shinned hawk	M	U	R	B	x			a	a	T
A. gentilis	Goshawk		R	N					a	a	T
A. cooperii	Cooper's hawk	M	U	B	B				a	a	T
Buteo jamaicensis	Red-tailed hawk	L	C	B	B	x	x		a	a	T
B. swainsoni	Swainson's hawk	L	U	B	B	x			a	a	T
B. lagopus	Rough-legged hawk		R	N	N	N	N		a	a	T
B. albonotatus	Zone-tailed hawk	L	U	B					a	a	T
B. regalis	Ferruginous hawk	L	R	B	B	R			a	a	T
Aquila chrysaetos	Golden eagle	L	R	B	B	x			a	a	T
Haliaectus leucocephalus	Bald eagle	L	R	B	x	x			a	a	T
Pandion haliaetus	Osprey	M	U	R	x				a	a	T
Circus cyaneus	Marsh hawk		C	N	N	N	N		a	a	T
Falco mexicanus	Prairie falcon	L	R	x	x	R	R		a	a	T
F. peregrinus	Peregrine falcon	L	R	x	x	R	R		a	a	T
F. columbarius	Pigeon hawk		U	N	N	N	N		a	a	T
F. sparverius	Sparrow hawk	L	C	R	x	R	R		a	a	I,T
Quail and Turkey											
Callipepla squamata	Scaled quail		U	x		R		a			F,S

APPENDIX E-1

BIRD COMMUNITIES NEAR ST. JOHNS, ARIZONA

Species	Common Name	(a) Territory	(b) Abundance	(c) Riparian & Aquatic	(c) Juniper Pinyon	(c) Grassland	(c) Great Basin Desert	(d) Trophic Level C_1	C_2	C_3	(e) Food Type
C. gambelii	Gambel's quail	M	U	R	R	R	x	a			F,S
Cyrtonyx montezumae	Mearn's quail	M	U		R			a			F,S
Meleagris gallopavo	Turkey	M	U		R			a			F,S
Rails, Coots and Gallinules											
Grus canadensis	Sandhill crane		U	T					a	a	I,P,A
Rallus limicola	Virginia rail	S	R	B				b	a	a	A,P
Porzana carolina	Sora rail	S	C	B				b	a	a	A,P
Fulica americana	American coot	S	C	B				b	a	a	A,P
Shorebirds											
Charadrius vociferus	Killdeer	S	C	B	x	x	x		a	b	I
Capella gallinago	Common snipe		U	M					a	b	I
Actitis macularia	Spotted sandpiper	S	C	R					a	a	I
Catoptrophorus semipalmatus	Willet		C	M					a	a	I
Tringa solitaria	Solitary sandpiper		C	M					a	a	I
Numenius americanus	Long-billed curlew		U	M					a	a	I
Totanus melanoleucus	Greater yellowlegs		C	M					a	a	I
T. flavipes	Lesser yellowlegs		U	T					a	a	I
Erolia minutilla	Least sandpiper		C	T					a	a	I
E. melanotos	Pectoral sandpiper		U	M					a	a	I
E. bairdii	Bairds sandpiper		C	T					a	a	I
E. alpina	Dunlin		U	T					a	a	I
Limnodromus scolopaccus	Long-billed dowitcher		C	M					a	a	I
Ercunetes mauri	Western sandpiper		C	T					a	a	I
Limosa fedoa	Marbled godwit		R	T					a	a	I
Recurvirostra americana	American avocet		C	M					a	a	I

APPENDIX E-1

BIRD COMMUNITIES NEAR ST. JOHNS, ARIZONA

Species	Common Name	(a) Territory	(b) Abundance	Riparian & (c) Aquatic	Juniper Pinyon(c)	(c) Grassland	Great Basin Desert (c)	Trophic Level C_1	C_2	C_3 (d)	(e) Food Type
Steganopus tricolor	Wilson's phalarope		U	T					a	a	I
Hinantopus mexicanus	Black-necked stilt		U	M					a	a	I
Larus delawarensis	Ring-billed gull		C	T					a	a	I,A
Sterna forsteri	Forster's tern		U	T					a	a	I,A
Chelidonias niger	Black tern		C	T					a	a	I
Pigeons and Doves											
Zenaida macroura	Mourning dove	S C	x	x	x	x	x	a			F,S
Cuckoos											
Coccyzus americanus	Yellow-billed cuckoo		U	T					a	a	I
Geococcys californianus	Roadrunner	M	U	R	R	R	x		a	a	I,T
Owls											
Tyto alba	Barn owl	M	C	R	R	R	R		a	b	T
Otus asio	Common screech-owl	M	C	R	R	x	x		a	b	T
O. flammeolus	Flammulated screech-owl	M	U	R	R				a	b	T
Bulo virginianus	Great horned owl	L	C	R	R	x	x		a	a	T
Glaucidium gnoma	Mountain pygmy owl	M	U	R	R				a	a	I,T
Speotyto cunicularia	Burrowing owl	M	R			B			a	a	I,T
Asio otus	Long-eared owl		R	N	N	x			a	b	T
A. flammeus	Short-eared owl		R	N		N	x		a	b	T
Aegolius acadicus	Saw-whet owl	M	R	x	R				a	b	T
Goatsuckers											
Phalaenoptilus nuttallii	Poor-will	M	C	B	B				a	a	I
Chordeiles minor	Common night-hawk	M	C	x	B	B	x		a	b	I

APPENDIX E-1

BIRD COMMUNITIES NEAR ST. JOHNS, ARIZONA

Species	Common Name	(a) Territory	(b) Abundance	(c) Riparian & Aquatic	(c) Juniper Pinyon	(c) Grassland	(c) Great Basin Desert	(d) Trophic Level C_1	C_2	C_3	(e) Food Type
Swifts and Hummingbirds											
Aeronautes saxatalis	White-throated swift	M	C	x	B	B	x		a	a	I
Archilochus alexandri	Black-chinned hummingbird	S	U	B	x			a	b	b	P,I
A. anna	Anna's hummingbird		U	M				a	b	b	P,I
Sclasphorus platycercus	Broad-tailed hummingbird	S	C	B	x			a	b	b	P,I
Kingfishers and Woodpeckers											
Megaceryle alcyon	Belted kingfisher		C	T					b	a	A
Colaptes auratus	Flicker	S	C	R	R		x		a	a	I
Melanerpes formicivorus	Acorn woodpecker	S	C	T	B			a	b	b	F,S,I
Asyndosmus lewis	Lewis' woodpecker		U	T					a	a	I
Sphyrapicus varius	Yellow-bellied sapsucker	S	C	N	T			a	b	b	I,P
Dendrocopos villosus	Hairy woodpecker		C	N	N				a	a	I
D. pubescens	Downy woodpecker		R	T					a	a	I
Flycatchers											
Tyrannus verticalis	Western kingbird	S	C	B	x	B	B		a	a	I
T. vociferans	Cassin's kingbird	S	C	B	B	x			a	a	I
Myiarchus cincrascens	Ash-throated flycatcher	S	C	B	B				a	a	I
Sayornis nigricans	Black phoebe	x	U	B	M	x	x		a	a	I
S. saya	Say's phoebe	S	C	B	B				a	a	I
Empidonax wrightii	Gray flycatcher	S	C	B	B				a	a	I
E. traillii	Traill's flycatcher	S	U	B					a	a	I
Contopus mesoleucus	Olive-sided flycatcher		U	M	M				a	a	I
C. sordidulus	Western wood-peewee	S	C	x	B				a	a	I
Larks and Sparrows											
Eremophila alpestris	Horned lark	S	C			B		a	a	a	S,I
Progne subis	Purple martin		U	T	T				a	a	I

APPENDIX E-1

BIRD COMMUNITIES NEAR ST. JOHNS, ARIZONA

Species	Common Name	Territory (a)	Abundance (b)	Riparian & Aquatic (c)	Juniper Pinyon (c)	Grassland (c)	Great Basin Desert (c)	Trophic Level C_1	C_2	C_3 (d)	Food Type (e)
Tachycineta thalassina	Violet-green sparrow		U		T				a	a	I
Riparia ruficollis	Rough-winged swallow	S	C	B					a	a	I
Hirundo pyrrhonota	Cliff swallow	S	C	B					a	a	I
H. rustica	Barn swallow	S	C	B		x			a	a	I
Jays											
Perisoreus canadensis	Gray jay		R		T			a	a	a	S,F,T
Cyanocitta stelleri	Steller's jay		C		T			a	a	a	S,F,T
"Aphelocoma" coerulesens	Scrub jay	S	C		R			a	a	a	S,F,T
Gymnorhinus cyanocephalus	Pinyon jay	S	C		R			a	b	b	S,I
Corvus corax	Common raven	S	C	x	R	R		b	a	a	S,T,C
C. brachyrhynchos	Common crow	S	U	x	R	R		a	a	a	S,T,C
Nucifraga columbiana	Clark's nutcracker		U		T			a	a	a	S,I
Tits and Verdins											
Parus gambeli	Mountain chickadee	S	C	T	B			a	b	b	S,F,I
P. wollweberi	Bridled titmouse	S	U	x	B	x		a	b	b	S,F,I
P. inornatus	Plain titmouse	S	C	x	R			a	b	b	S,F,I
Psaltriparus minimus	Bushtit	S	C	x	B	x		b	a	a	S,F,I
Nuthatches and Creepers											
Sitta carolinensis	White-breasted nuthatch	S	U	M	R			a	a	a	S,F,I
S. canadensis	Red-breasted nuthatch		U	T	N			a	a	a	S,F,I
S. pygmaea	Pygmy nuthatch	S	C	x	R			a	a	a	S,F,I
Certhis familiaris	Brown creeper		U	N	N				a	a	I
Wrens											
Troglodytes aedon	House wren		C	M	x				a	a	I
T. troglodytes	Winter wren		R	T					a	a	I
Thryomanes bewickii	Bewick's wren	S	U	B	B				a	a	I
Catherpes mexicanus	Canyon wren	S	U	B	B				a	a	I
Salpinctes obseletus	Rock wren	S	C	B	B				a	a	I

APPENDIX E-1

BIRD COMMUNITIES NEAR ST. JOHNS, ARIZONA

Species	Common Name	Territory (a)	Abundance (b)	Riparian & Aquatic (c)	Juniper Pinyon (c)	Grassland (c)	Great Basin Desert (c)	Trophic Level C_1	C_2	C_3 (d)	Food Type (e)
Mockingbirds and Thrashers											
Mimus polyglottus	Mockingbird	S	C	B	x	x			a	a	I
Dumetella carolinensis	Catbird	S	U	B	x				a	a	I
Oreoscoptes montanus	Sage thrasher	S	C	B	B	x	B		a	a	I
Thrushes and Bluebirds											
Turdus migratorius	American robin	S	C	B	M				a	a	I
Catharus guttatus	Hermit thrush		C	M					a	a	I
Stalia mexicana	Western bluebird	S	C	N	R	x	x		a	a	I
S. currucoides	Mountain bluebird	S	C	M	B	x	x		a	a	I
Myadestea townsendi	Townsend's solitaire		C		N				a	a	I
Gnatcatchers, Kinglets, Silky Flycatchers, Pipits and Waxwings											
Polioptila caerulea	Blue-gray gnatcatcher	S	C	B	B				a	a	I
Regulus calendula	Ruby-crowned kinglet		U	M					a	a	I
R. satrapa	Golden-crowned kinglet		R	T					a	a	I
Anthus spinoletta	Water pipit		C	M	T	M			a	a	I
Phainopepia nitens	Phainopepia		U	B	x				a	a	I
Pombycilla garrulus	Bohemian waxwing		R	T				a			F,S
B. cedrorum	Cedar waxwing		U	M				a			F,S
Shrikes and Starlings											
Lanius ludovicianus	Loggerhead shrike	S	C	R	R	R	R		a	a	T,I
Sturnus vulgaris	Starling	S	C	R					a	a	I
Vireos											
Vireo vicinior	Gray vireo	S	U		B				a	a	I
V. solitarius	Solitary vireo	S	C	M	B				a	a	I

APPENDIX E-1

BIRD COMMUNITIES NEAR ST. JOHNS, ARIZONA

Species	Common Name	Territory (a)	Abundance (b)	Riparian & Aquatic (c)	Juniper Pinyon (c)	Grassland (c)	Great Basin Desert (c)	Trophic Level C_1	C_2	C_3 (d)	Food Type (e)
Warblers											
Helminthophila celata	Orange-crowned warbler		U	M					a	a	I
H. ruficapilla	Virginia warbler		C	M	T				a	a	I
Dendroica petechia	Yellow warbler	S	C	B			x		a	a	I
D. coronata	Yellow-rumped warbler		C	M	M				a	a	I
D. nigrescens	Black-throated gray warbler	S	C	M	B				a	a	I
D. occidentalis	Hermit warbler		C	T	T				a	a	I
D. townsendi	Townsend warbler		C	M	M				a	a	I
D. graciae	Grace's warbler		U	M					a	a	I
Oporornis tolmiei	McGillivray's warbler		C	M					a	a	I
Geothlypis trichas	Common Yellow-throat		U	M					a	a	I
Cardellina rubrifrons	Red-faced warbler		U		M				a	a	I
Icteria virens	Yellow-breasted chat	S	U	B					a	a	I
Weaver Finch											
Passer domesticus	House sparrow	S	C	R					a	a	I
Meadowlarks, Blackbirds and Orioles											
Sturnella magna	Eastern meadowlark	S	U			B			a	a	I
S. neglecta	Western meadowlark	S	C			B	x		a	a	I
Xanthocephalus xanthocephalus	Yellow-headed blackbird		U	N			x		a	a	I
Agelaius phoeniceus	Red-winged blackbird	S	C	R					a	a	I
Ictorus galbula	Bullock's oriole	S	C	B			x		a	a	I
Euphagus cyanocephalus	Brewer's blackbird	S	C	R			x		a	a	I
Cassidix mexicanus	Boat-tailed grackle		U	T					a	a	I
Molothrus ater	Brown-headed cowbird	S	C	B	x				b	a	I
Tanagers											
Piranga ludoviciana	Western tanager		C	T	T				a	a	I

APPENDIX E-1

BIRD COMMUNITIES NEAR ST. JOHNS, ARIZONA

Species	Common Name	Territory (a)	Abundance (b)	Riparian & Aquatic (c)	Juniper Pinyon (c)	Grassland (c)	Great Basin Desert (c)	Trophic Level C_1	C_2	C_3 (d)	Food Type (e)
Grosbeaks and Buntings											
Pheucticus ludovicianus	Black-headed grosbeak		C	R	T			a	b	b	S,F,I
Passerina caerulea	Blue grosbeak	S	C	B				a	b	b	S,F,I
P. cyanea	Lazuli bunting	S	U	B				a	b	b	S,F,I
Hesperiphona vespertinus	Evening grosbeak		U		T			a	b	b	S,F,I
Loxia curvirostra	Red crossbill		U		T			a			S
Finches and sparrows											
Carpodacus cassinii	Cassin's finch	S	U		R			a	b	b	S,F,I
C. mexicanus	House finch	S	C	B	x	x		a	b	b	S,F,I
Pinicola enucleator	Pine grosbeak		U		T			a	b	b	S,F,I
Spinus tristis	American Goldfinch		C	N				a	b	b	S,F,I
S. psaltria	Lesser goldfinch	S	C	B				a	b	b	S,F,I
S. pinus	Pine siskin		C	M	T			a	b	b	S,F,I
Pipilo chlorurus	Green-tailed towhee		C	T	T		x	a	b	b	S,F,I
P. erythrophthalmus	Rufous-sided towhee	S	C	M	R		x	a	b	b	S,F,I
P. fuscus	Brown towhee	S	R	T				a	b	b	S,F,I
Calamospiza melanocorys	Lark bunting		C	x	x	T		a	b	b	S,F, I
Ammodramus sanwichensis	Savannah sparrow	S	C	B				a	a	a	S,F,I
Pooecetes gramineus	Vesper sparrow	S	C			B	B	a	a	a	S,F,I
Chandestes grammacus	Lark sparrow	S	C			B	B	a	a	a	S,F,I
Spizella arborea	Tree sparrow		U	N				a	a	a	S,F,I
S. passerina	Chipping sparrow	S	C	T	B	T	x	a	a	a	S,F,I
S. breweri	Brewer's sparrow	S	C	M	B	M	B	a	a	a	S,F,I
S. atrogularis	Black-chinned sparrow	S	C	B	B			a	a	a	S,F,I
Aimophila belli	Sage sparrow	S	C	T	T	T	B	a	a	a	S,F,I
A. bilineata	Black-throated sparrow		C	B	x	x	B	a	a	a	S,F,I
Junco oregonus	Oregon junco		C	N	N			a	a	a	S,F,I
Zonotrichia leucophrys	White-crowned sparrow		C	N	N		x	a	a	a	S,F,I
Junco hyemalis	Gray-headed junco	S	C	T	R			a	a	a	S,F,I
Melospiza melodia	Song sparrow	S	C	R			x	a	a	a	S,F,I
M. lincolnii	Lincoln sparrow		U	M				a	a	a	S,F,I
Calcarius mccownii	McCown's longspur		R	x		N	x	a	a	a	S,F,I
C. ornatus	Chestnut-collared long-spur		C	x		N	x	a	a	a	S,F,I

KEY

a. S< 100 acres, M>100≤ 640 acres, L >640 acres

b. C - common, U - uncommon, R - rare

c. R - year-round resident, B - breeding resident, N - nonbreeding resident, M - migrant, T - transient, x - occurrence superficial

d. C_1 - herbivore, C_2 - primary consumer, C_3 - tertiary consumer

Diet: a - most important, b - intermediate importance, c - least importance; replication means equal importance.

e. I - invertebrate, A - aquatic vertebrate, T - terrestial vertebrates, C - carrion, P - plant material, F - fruits, S - seeds

APPENDIX E-2

REPTILES AND AMPHIBIANS INHABITING THE VICINITY OF ST. JOHNS, ARIZONA

Species	Common Name	Abundance (a)	Riparian & Aquatic (b)	Juniper Pinyon (b)	Grassland (b)	Great Basin Desert (b)	Trophic Level C_1	C_2	C_3 (c)	Food Types (d)
Amphibians										
Salamanders										
Ambystomidae										
Ambystoma tigrinum	Tiger salamander	C	R	x	x	R	a	b		I
Frogs and Toads										
Pelobatidae										
Scaphiopus bombifrons	Plains spadefoot	C	R	x	R	R	a	b		I
Scaphiopus hammondi	Western spadefoot	C	R	x	x	x	a	b		I
Bufonidae										
Bufo woodhousei	Woodhouse's toad	C	R	x		x	a	b		I
B. punctatus	Red-spotted toad	C	R	x	x	x	a	b		I
B. cognatus	Great plains toad	C	R	x	x	x	a	b		I
Hylidae										
Hyla wrightorum	Arizona treefrog	U	R	x	x		a	b		I
H. arenicolor	Canyon treefrog	U	R				a	b		I
Pseudacris nigrita	Chorus frog	C	R				a	b		I
Ranidae										
Rana pipiens	Leopard frog	C	R				a	b		I
Reptiles										
Lizards										
Iguanidae										
Crotaphytus collaris	Collared lizard	C	x	R	R	R	a	b		I
C. wislizeni	Leopard lizard	U		x	R	x	a	b		I,T

APPENDIX E-2

REPTILES AND AMPHIBIANS INHABITING THE VICINITY OF ST. JOHNS, ARIZONA

Species	Common Name	Abundance (a)	Riparian & Aquatic (b)	Juniper Pinyon (b)	Grassland (b)	Great Basin Desert (b)	Trophic Level C_1	C_2	C_3 (c)	Food Type (d)
Holbrookia maculata	Lesser-earless lizard	C			R	R		a	b	I
Phyrnosoma douglassi	Short-horned lizard	C	x	R	R	R		a	b	I
Sceloporus undulatus	Eastern fence lizard	C	R	R	R	R		a	b	I
S. clarki	Sonoran spiny lizard	U	R					a	b	I
S. graciosus	Sagebrush lizard	C		R	R	R		a	b	I
Urosaurus ornatus	Tree lizard	C	R	R	R			a	b	I
Uta stansburiana	Side-blotched lizard	C	x	R	R	R		a	b	I
Xantusidae										
Xantusia arizonae	Arizona night lizard	R	R	x				a	b	I
Scincidae										
Eumeces multivirgatus	Many-lined skink	R	R	R	R	x		a	b	I
E. obsoletus	Great plains skink	U	R	R				a	b	I
Teidae										
Cnemidophorus velox	Plateau whiptail	C	R	R	x	R		a	b	I
C. escanguis	Spotted whiptail	C	R	R	R			a	b	I
C. tigris	Western whiptail	C	R	x	R	R		a	b	I
Anguidae										
Gerrhonotus kingi	Arizona alligator lizard	C	R	R	x			a	b	I
Snakes										
Colubridae										
Arizona elegans	Glossy snake	C	R	R	R	R		a	b	T
Diadophus punctatus	Ringneck snake	U	R		R			a	b	I
Hypsiglena torquata	Night snake	C	R	R	R	R		a	b	T
Lampropeltis pyromelana	Sonoran mountain king snake	U	R	R				a	b	T

APPENDIX E-2

REPTILES AND AMPHIBIANS INHABITING THE VICINITY OF ST. JOHNS, ARIZONA

Species	Common Name	Abundance (a)	Riparian & Aquatic (b)	Juniper Pinyon (b)	Grassland (b)	Great Basin Desert (b)	Trophic Levels C_1	C_2	C_3 (c)	Food Type (d)
Masticophis flagellum	Coach whipsnake	C		x	R	R		a	b	I,T
M. taeniatus	Striped whipsnake	C		R	R	R		a	b	T
Natrix rufipunctatus	Narrow-headed water snake	U	R	x				a	b	I,A
Pituophis melanoleucus	Gopher snake	C	R	R	R	R		a	a	T
Thamnophis cyrtopsia	Black-necked garter snake	C	R	R	R	x		a	a	A
T. elegans	Western garter snake	C	R	R	R	R		a	a	I,A
Crotalidae										
Crotalus atrox	Western diamondback rattlesnake	C	R	R	R			b	a	T
C. molossus	Black-tailed rattlesnake	C	R	R				b	a	T
C. viridis	Western rattlesnake	C	R	R	R	R		b	a	T

KEY

a. C - Common, U - Uncommon, R - Rare

b. R - year-round resident, B - breeding resident, N - nonbreeding resident, M - migrant, T - transient, x - occurrence superficial

c. C_1 - herbivore, C_2 - primary consumer, C_3 - tertiary consumer
Diet: a - most important, b - intermediate importance, c - least importance; replication means equal importance

d. I - invertebrates, A - aquatic vertebrates, T -terrestrial vertebrates, C - carrion, P - plant material, F - fruits, S - seeds

APPENDIX E-3

MAMMALS PRESENT IN THE PLATEAU AREA THAT INCLUDES ST. JOHNS, ARIZONA

Species	Common Name	Abundance	Plant Material	Seeds	Fruits	Insects	Vertebrates	Habitat (a)	Home Range (b)
Ursidae									
Euarctos americanus	Black bear	U	x		x	x	x	T-B	L
Felidae									
Felis concolor	Mountain lion	U					x	T-B-Ec	L
Lynx rufus	Bobcat	C					x	O-G-B-T-Ec-R	
Procyonidae									
Eassariscus astutus	Ringtail	U			x		x	T-B-Ec	M
Procyon lotor	Raccoon	U	x		x	x	x	R	M
Ungulates									
Antilocapridae									
Antilocapra a. americana	Pronghorn	C	x					G-Ec	L
Cervidae									
Odocoileus hemionus	Mule deer	C	x					T-Br-Ec	L

a. O - Open areas; G - Grasslands; B - Brushlands; T - Trees; Ec - Grassland with Brush or small trees; R - Riparian

b. S - Less than 5 acres; M - Less than 4 sections; L - Wide ranging over several miles

APPENDIX E-3

MAMMALS PRESENT IN THE PLATEAU AREA THAT INCLUDES ST. JOHNS, ARIZONA

Species	Common Name	Abundance	Plant Material	Seeds	Fruits	Insects	Vertebrates	Habitat (a)	Home Range (b)
Peromyscus leucopus	White-footed mouse	C			x			B-Ec	S
Peromyscus maniculatus	Deer mouse	C			x			B-Ec	S
Peromyscus nasutus	Rock mouse	U			x			B-Ec	S
Peromyscus truei	Pinyon mouse	C			x			B-Ec	S
Reithrodontomys megalotis	Western harvest mouse	C		x				G	S
Sigmodon minimus	Least cotton rat	U	x	x				G	S
Muridae									
Mus musculus	House mouse	C		x				R	S
Erethizontidae									
Erethizon dorsatum	Porcupine	C	x					T-Ec	M
Geomyidae									
Thomomys bottae	Valley pocket gopher	C	x					G	S
Carnivores									
Mustelidae									
Mephitis mephitis	Striped skunk	C				x	x	G-B-Ec	M
Mustela frenata	Long-tailed weasel	U					x	R-Br-Ec	M
Mustela nigripes	Black-footed ferret	R					x	G	M
Spilogale putorius	Spotted skunk	U				x	x	G	M
Taxidea taxus	Badger	C					x	G-Ec	M
Canidae									
Canis latrans	Coyote	C			x	x	x	G-B-Ec-T-R	L
Canis lupus	Gray wolf	R			x	x	x	G	L
Urocyon cinereoargenteus	Gray fox	C			x	x	x	G-B-Ec	M

APPENDIX E-3

MAMMALS PRESENT IN THE PLATEAU AREA THAT INCLUDES ST. JOHNS, ARIZONA

Species	Common Name	Abundance	Plant Material	Seeds	Fruits	Insects	Vertebrates	Habitat (a)	Home Range (b)
Sylvilagus audubonii	Desert cottontail	C	x					G-Ec	S
Sylvilagus nuttalli	Nuttal's cottontail	U	x					B	S
Rodents									
Sciuridae									
Citellus leucurus	White-tailed antelope ground squirrel	C	x	x		x		Ec-B	S
Citellus tridecemlineatus	Thirteen-lined ground squirrel	U	x	x		x		G	S
Citellus variegatus	Rock squirrel	U	x	x		x		Ec	S
Cynomys gunnisoni	White-tailed prairie dog	U	x					G	S
Eutamias cinericollis	Gray-collared chipmunk	C	x	x	x	x		Ec-B	S
Eutamias dorsalis	Cliff chipmunk	C	x	x	x	x		B-Ec	S
Sciurus aberti	Abert's squirrel	U	x	x	x			T	S
Heteromyidae									
Dipodomys spectablis	Banner-tailed kangaroo rat	U		x				G	S
Dipodomys ordii	Ord's kangaroo rat	C		x				G	S
Perognathus flavus	Silky pocket mouse	C			x			G	S
Cricetidae									
Neotoma albigula	White-throated wood rat	C	x	x				B-Ec	S
Neotoma cinerea	Bushy-tailed wood rat	U	x	x				B-Ec	S
Neotoma mexicana	Mexican wood rat	C	x	x				B-Ec	S
Neotoma stephensi	Stephen's wood rat	C	x	x				B-Ec	S
Ondatra zibethicus	Muskrat	U	x					R	S
Onychomys leucogaster	Northern grasshopper mouse	C				x		G	S
Peromyscus boylei	Brush mouse	C			x			B-Ec	S
Peromyscus crinitus	Canyon mouse	C			x			B-Ec	S

APPENDIX E-3

MAMMALS PRESENT IN THE PLATEAU AREA THAT INCLUDES ST. JOHNS, ARIZONA

Species	Common Name	Abundance	Plant Material	Seeds	Fruits	Insects	Vertebrates	Habitat (a)	Home Range (b)
Insectivores									
Soricidae									
Notiosorex crawfordi	Desert shrew	R				x		G-B	S
Sorex merriami	Merriam's shrew	U				x		G-B	S
Sorex vagrans	Vagrant shrew	C				x		G-B	S
Bats									
Vespertilionidae									
Antrozous pallidus	Pallid bat	C				x		O	L
Corynorhinus townsendii	Townsend's big-eared bat	U				x		O	L
Eptesicus fuscus	Big brown bat	C				x		O	L
Euderma maculata	Spotted bat	R				x		Ec	L
Lasionycteris noctivagans	Silver-haired bat	U				x		O-Ec	L
Lasiurus cinereus	Hoary bat	U				x		Ec	L
Lasiurus borealis	Red bat	U				x		Ec	L
Myotis californicus	California myotis	C				x		O	L
Myotis evotis	Long-eared myotis	U				x		O	L
Myotis subulatus	Small-footed myotis	U				x		O	L
Myotis occultus	Arizona myotis	U				x		O	L
Myotis thysanodes	Fringed myotis	U				x		O	L
Myotis volans	Long-legged myotis	U				x		O	L
Myotis yumanensis	Yuma myotis	U				x		O	L
Pipistrellus hesperus	Western pipistrell	C				x		O	L
Molossidae									
Tadarida brasiliensis	Brazilian freetail	C				x		O	L
Rabbits									
Leporidae									
Lepus californicus	Black-tailed jack rabbit	C	x					G	M

Appendix E-4

ARTHROPODS COMMON IN PLATEAU AREAS (Sheet 1 of 4)

Species	Common Name	Activity Time		Food	Habitat
		Day	Night		
Class Arachnoidea					
Subclass Arachnida					
Aphonopelma sp.	Tarantula	X	X	Insects	Burrow
Avicalaria sp.	Tarantula	X	X	Insects	Burrow
Latrodectus mactans	Black Widow Spider	X	X	Insects	Holes and crevices
Phalangida (order)	Daddy long-legs		X	Decaying veg.	Ground
Order Pedipalpi					
Magtigoproctas sp.	Whip scorpion		X	Insects	Under objects
Solpugida (order)	Solpugid		X	Insects	Ground
Class Chilopoda					
Scolopendra Heros	Centipede		X	Insects	Ground
Class Crustacea					
Order Isopoda					
Oniscus sp.	Sow bugs		X	Decaying veg.	Under objects
Class Diplopoda					
Julus sp.	Millipede	X	X	Decaying veg.	Under objects

Appendix E-4

ARTHROPODS COMMON IN PLATEAU AREAS (Sheet 2 of 4)

Species	Common Name	Activity Time		Food	Habitat
		Day	Night		
Class Insecta					
Order Coleoptera					
Adalia bipunctata	Lady Bug	X		Insects	Plants
Cystodemus armatus	Inflated beetle	X		Pollen	Plants and ground
Eleodes armata	Circus (dunking) beetle	X	X	Decaying veg.	Ground
Lytta magister	Blister beetle	X		Pollen	Plants and ground
Polyphylla sp.	Green June bug	X	X	Plants	Ground
Scyphophorus yuccae	Yucca borer	X		Yucca	Yucca
Tegrodera erosa	Soldier beetle	X		Plants	Plants and ground
Order Dermaptera					
Forficula auricularia	European earwig		X	Decaying veg.	Under objects
Order Diptera					
Cochliomyia americana	Screw worm	X		Blood	Animals
Cuterebra sp.	Bot fly	X	X	Vertebrates	Animals
Diarthronomyia artemisiae	Sage gall midge	X	X	Stems	Big sage
Tabanus punctifer	Horsefly	X		Blood	Mud
Theobaldia sp.	Mosquito		X	Blood	Plants
Order Hemiptera					
Blissus sp.	Chinch bugs	X		Plant sap	Plants
Iriatoma sp.	Cone-nosed bug	X		Plant sap	Plants

Appendix E-4

ARTHROPODS COMMON IN PLATEAU AREAS (Sheet 3 of 4)

Species	Common Name	Activity Time		Food	Habitat
		Day	Night		
Order Homoptera					
Cerococcus quercus	Oak scales	X	X	Plants	Trees
Diceroprocta sp.	Cicada	X		Plants	Trees
Order Hymenoptera					
Andricus sp.	Oak gallfly	X	X	Plants	Trees
Apis sp.	Honeybee	X		Pollen	Plants
Bombus sp.	Bumblebee	X		Pollen-nectar	Plants
Cremastogaster sp.	Harvester ant (red)	X		Seeds	Ground
Dasymutilla satanus	Velvet ant	X		Insects	Ground
Lasioptera ephedra	Fusiform gallfly	X	X	Stems	Mormon tea
Pepis thisbe	Tarantula hawk	X		Tarantulas	Ground
Progonomyrmex sp.	Harvester ant (black)	X		Seeds	Ground
Xylocopa arizonensis	Wood cutting bee	X		Plant stems	Agave
Order Isoptera					
Gnathamitermes perplexans	Termite		X	Wood	Ground
Order Lepidoptera					
Apodemia motmo	Buckwheat butterfly	X		Buckwheat	Stem
Celerio linata	Sphinx moth	X	X	Plants	Plants
Chlosyne lacinia	Rufescent patch butterfly	X		Sunflower	Sunflower
Colias eurytheme	Alfalfa butterfly	X		Alfalfa	Alfalfa
Danaus menippe	Milkweed butterfly	X		Nectar	Milkweed
Danaus plexippus	Monarch butterfly	X		Nectar	Plants
Ecuterva variaria	White-winged moth		X	Desert willow	Branches

Appendix E-4

ARTHROPODS COMMON IN PLATEAU AREAS (Sheet 4 of 4)

Species	Common Name	Activity Time		Food	Habitat
		Day	Night		
Malacosma fragilis	Tent Caterpillar	X	X	Plants	Tree
Megathymus stephensi	Stephen's skipper butterfly	X		Agave	Leaves
Melittia gloriosa	Clear-winged moth	X		Gourd	Roots
Papilio zolicaon	Swallowtail butterfly	X		Citrus	Plants
Tegeticula alba	Yucca moth		X	Yucca	Yucca
Vanessa cardui	Painted-lady thistle butterfly	X		Thistle	Plants
Order Neuroptera					
Myrmeleonidae	Ant lion	X	X	Insects	(Larvae) ground
Order Odonata					
Amomaloagrion hastatum	Damsel fly	X		Insects	Open
Celithemis sp.	Dragon fly	X		Insects	Open
Order Orthroptera					
Arenivaga erractica	Wingless cockroach		X	Plants	Rat den
Bootettis punctatus	Silver-spotted grasshopper	X		Vegetation	Creosote bush
Mantidae (family)	Praying mantis	X		Insects	Plants
Nemobius mexicanus	Cricket		X	Vegetation	Vegetation
Parabacillus arizonicas	Walking stick	X		Vegetation	Plants

Appendix F

Archeological Sites Recorded Along the Proposed Railroad Alignment

Site D-1

Location: Township 14 North, Range 29 East

Land Status: Private

Site Description: Situated near the base of a ridge, this site consists of a moderate concentration of chipped stone scattered among alluvial gravels. The site represents tool-making activities. Although a knife fragment and several utilized flakes were recorded, the scatter is composed primarily of waste flakes from the manufacture of tools. The site appears to qualify for the National Register.

Site D-2

Location: Township 15 North, Range 28 East

Land Status: Private

Site Description: Located in the valley of the Hardscrabble Wash, this site is a light scatter of sherds, chipped stone, and ground stone. The site is approximately 5 meters in diameter, and may represent a food processing station. Although sherds noted at the site are known to occur over a wide time range, it is estimated that the site dates to the Pueblo II period. The site appears to qualify for the National Register.

Site D-3

Location: Township 15 North, Range 28 East

Land Status: Private

Site Description: This site consists of a circular structure 3 meters in diameter, located on a terrace of a basalt outcrop. The walls of the structure average 1 to 2 feet in height. No artifacts were noted in the immediate vicinity of the structure, although isolated artifacts were scattered at the base of the outcrop near the wash. The site may represent a field house, a structure generally associated with agricultural activities. This site appears to qualify for the National Register.

Site D-4

Location: Township 17 North, Range 27 East

Land Status: State

Site Description: Located to the south of Milky Wash, this habitation site is extensive in size and amount of surface material. A heavy concentration of sherds, and chipped and ground stone are scattered down the slope of a ridge which rises above the wash. Much of the site has been extensively eroded. A date in the late Basketmaker III to early Pueblo I period is indicated by sherds collected at the site. The site appears to qualify for the National Register.

Site D-5

Location: Township 17 North, Range 27 East

Land Status: State

Site Description: This possible habitation site is located on the top of a fairly steep hill to the south of Milky Wash. A moderately heavy scatter of sherds and chipped and ground stone were recorded in the site area. Material was scattered over an area approximately 15 meters in diameter. Sherds from the site suggest a date in the Pueblo I period. The site appears to qualify for the National Register.

Site D-6

Location: Township 17 North, Range 27 East

Land Status: Private

Site Description: This site is located above Milky Wash. Surface indications include only a light scatter of chipped stone, several upright sandstone slabs, and a small amount of sandstone rubble representing a wall. Some material from the surface of the site appears to have eroded down the slope of the hill, since various isolated artifacts were noted downhill from the site. The site appears to qualify for the National Register.

Site D-7

Location: Township 18 North, Range 26 East

Land Status: Private

Site Description: This habitation site consists of a light scatter of sherds and lithics, a masonry lined pit house, and sandstone rubble, possibly representing a wall, situated near the base of a low dune area. These features are only partially exposed, and it appears that most of the site is buried in sand. The site is located north of Milky Wash in an area of northeast--southwest oriented sand dunes. Preliminary examination of sherds collected from the site indicates a date in the Pueblo II period. The site appears to qualify for the National Register.

Site D-8

Location: Township 19 North, Range 26 East

Land Status: State

Site Description: This site is very extenisve in size, measuring up to 166 meters in diameter. Located in a hilly area above a broad floodplain south of the Puerco River, the site consists of a heavy concentration of sherds, and a moderate concentration of chipped stone and ground stone. Several hearth areas were also noted. Sherds from the site suggest a date in the Pueblo II period. The site appears to qualify for the National Register.

Site D-9

Location: Township 20 North, Range 26 East

Land Status: Private

Site Description: This site is very extensive in size, scattered down the slope of a hill above the Puerco River. The site consists primarily of chipped stone with a light concentration of sherds scattered among alluvial gravel deposits composed of material commonly used in chipped stone tool manufacture. The site represents a chipping station similar to Site D-1, but much larger in size. The site appears to qualify for the National Register.

Site D-10

Location: Township 20 North, Range 26 East

Land Status: Private

Site Description: Situated on a sand dune, south of the Puerco River, this site consists of a light scatter of sherds and lithics. In addition, several hearths were noted. The site is fairly eroded and much of the surface material has been washed from the site area. The site probably represents a campsite. The site appears to qualify for the National Register.

Appendix G

Analysis of Natural Beauty

500 kV Transmission System

Inventory and Analysis

The visual analysis of the proposed corridor considers five levels of natural scenic quality (High, Above Average, Average, Modified, and Highly Modified), as well as three levels of spatial enclosure (Enclosed, Semienclosed, and Open).

Scenic Quality

Levels of scenic quality established within the corridor relate to the degree of interest and natural character with the visual influence of the corridor.

Scenic levels were determined from both extensive ground and air surveys and map studies of physiography, drainage, and vegetation. The following are definitions of scenic quality as used in this study.

High Scenic Quality: Areas with outstanding natural landscape character and interest (topographic relief, landforms, vegetation, water features) and little or no evidence of human encroachment or disturbance.

Above Average Scenic Quality: Areas with little encroachment from development or disturbance due to manmade modification to the landscape with interesting, but not necessarily outstanding, natural landscape interest.

Average Scenic Quality: Areas of flat to rolling topography and relatively homogeneous vegetation lacking interesting drainage patterns with little human encroachment.

Modified Scenic Quality: Areas characterized by human encroachment from rural communities, subdivisions, and agricultural development.

Highly Modified Scenic Quality: Areas which have been considerably changed by man and have little or no redeeming natural topographic, vegetative, or drainage interest.

In determining scenic quality levels, the following landforms were inventoried and evaluated as they visually affected the corridor:

Topographic Features

- Escarpments
- Canyons
- Valleys
- Ridges
- Peaks

Topographic Features (cont.)

Buttes
Mesas
Badlands
Outcroppings
Rolling Topography
Flat Topography

Water Features

Rivers
Streams
Lakes
Washes

Vegetation Features

Paloverde-Saguaro
Ponderosa Pine
Riparian Woodland
Pinyon-Juniper
Creosotebush-Bursage
Plains and Desert Grassland

Human Encroachment Features

Mining
Urbanization
Transmission Lines
Agriculture

Enclosure

Degrees of vegetational enclosure were also established from ground and air surveys as well as map studies of vegetation. Enclosure is an important aspect in potential screening of transmission lines from distant views. Vegetation on flat terrain within the corridor was evaluated in terms of the degree of enclosure it would afford. The following is a list of features which would provide varying degrees of enclosures:

Enclosed:	Dense Ponderosa Pine Forest
Semi-Enclosed:	Scattered Ponderosa Pine Forest Dense Ponderosa Pine-Pinyon-Juniper Forest
Open:	Low Vegetation--Chaparral, Creosotebush, Pinyon-Juniper, Grassland

Impact Evaluation

Visual impact levels were based on the relationship of natural scenic quality to enclosure. That is, the higher the scenic quality and lesser the enclosure, the higher the potential impact. Conversely, the lower the scenic quality and greater the enclosure, the lesser the potential impact level. Impact levels identified through evaluating these relationships were additionally modified depending upon what type of utility corridor, if any, was being paralleled by the Coronado Station Project Transmission System line.

Highway Influence

The highway influence study evaluated the major road systems as they would be visually affected or impacted by a crossing or paralleling of the planned transmission line alternatives.

In this regard, the study identified a viewer and impact relationship to the number of viewers affected; unlike the Visual Landscape Character Study which considered impact on the inherent scenic quality of an area regardless of who, if anyone, presently views the lines.

While the primary road system in Arizona basically serves an origin-destination function, it also provides the means for viewing the natural scenery within the state. Many people do not have the time or proper vehicle to leave main roads to view Arizona's landscape closely and must rely on the primary roads as scenic recreational experience. This consideration is particularly important within short driving distances from population centers as good existing roads possessing natural scenic amenities for this type of driving experience are limited.

Thirty-five major road crossings and parallelings were evaluated within the alternative corridors with respect to the quality of the visual experience, potential filtering of the lines, paralleling of other lines, and traffic volume. Impact levels were determined for each crossing or paralleling based on this evaluation.

Inventory and Analysis

In determining levels of potential visual impact associated with each crossing or parallel, consideration was given to the following highway related aspects: (See Table G-1)

Visual Quality

Natural Character

Topography
Vegetation
Water

Effects of Man

Extent
Quality

Numerical values representing Visual Quality were generated by considering in total the topographic, vegetative, and water interest of the site, and how the natural character of the landscape had been modified by man. The highest visual quality observed was Site 4C (208 points) and the lowest, Site 1C, (24 points).

Visibility

Distance of Exposure

Background (over 2 miles)
Middle Ground (distant - 1 to 2 miles)
Middle Ground (near - 0.5 to 1 mile)
Foreground (1 to 0.5 mile)

Duration of Exposures

Expressed in miles, the line would be visible from both directions.

Visual Absorption (based on extent of topography or vegetation)

Open
Filtered
Enclosed
Background Influence

A percent of visibility was determined by assessing the above considerations in relation to one another. Site 23P represents an open and uninterrupted view of the line for a distance of several miles. Zero percent (6P, 34P) represents the line paralleling road segments which were evaluated but from which the line would not be seen.

Traffic (Vehicles per day)

Average daily traffic counts were used to estimate the magnitude of effect on people at each highway crossing or paralleling site.

All of the above considerations were combined in the evaluation and determinations of potential impact levels per highway site. Exhibit F shows the highway crossing and parallels evaluated in this study.

TABLE G-1

Highway Influence

Site No.	Highway No.	Visual Quality	Visibility	Vehicles Per Day
1C*	State 93	24	54%	13,447
2C	US 60/70	153	18	7,733
3P+	US 60/70	193	52	7,733
4C	US 60/70	208	60	7,733
5C	US 80/89	36	65	2,096
6P	US 60/70	141	0	6,697
21C	State 377	102	65	301
22C	State 377	92	52	301
23P	State 377	114	100	301
24C	State 377	97	52	301
25C	State 377	68	65	301
26P	State 77	76	9	1,176
27C	State 77	99	65	1,176
28C	US 180	94	65	162
29C	US 180	56	41	408
30C	US 180	128	18	325
31C	State 61/US 666	58	65	393
32C	State 61/US 666	58	65	393
33C	US 60/70	148	33	7,733
35P	US 60/70	133	25	7,733

(Excludes common corridor portion)

*C = Crossing

+P = Parallel

TRANSMISSION LINE STIPULATIONS
(Cholla Project - Common Corridor Segment)

This Stipulation, made this 28th day of April 1976, by and between Arizona Public Service Company and Salt River Project Agricultural Improvement and Power District, hereinafter referred to as the Grantees, and the Forest Service, United States Department of Agriculture, acting herein by and through the Regional Forester, hereinafter referred to as the Regional Forester.

WHEREAS, the Arizona Public Service Company is engaged in the surveys, laying out, construction, operation, and maintenance of a 500KV transmission line as a part of their Cholla Project, and

WHEREAS, Salt River Project Agricultural Improvement and Power District has authorized Arizona Public Service Company to survey, lay out, and construct a portion of a 500 KV transmission line as a part of their proposed Coronado Project, and

WHEREAS, Salt River Project Agricultural Improvement and Power District will accept control, operation and maintenance of their 500 KV transmission line upon completion of construction, and

WHEREAS, the two 500 KV transmission lines will be constructed within a common corridor with adjoining and overlapping rights-of-way, and

WHEREAS, the Grantees and the Regional Forester desire to cooperate in the location, alignment, and construction of two transmission lines

that will adequately protect the resources for which the lands are being administered.

NOW, THEREFORE, supplementary to the terms and conditions of the extra high voltage transmission line easement deeds between the United States and the Grantees, the parties hereto agree to carry out the following provisions during the construction stage (construction stage will begin when construction activities commence on lands administered by the Forest Service and end when the Regional Forester and the Grantees mutually agree that any work done thereafter will be considered as maintenance, EXCEPT, that the Regional Forester reserves the right to reinstate the provisions of this stipulation if either of the Grantees subsequently submit plans for reconstruction or alteration of their transmission line) with all costs related to the construction of the proposed transmission lines to be borne by that project;

The Regional Forester will:

1. Before any clearing of the right-of-way or construction of the transmission lines is commenced:

    a. Prepare, in cooperation with the Grantees, a fire protection plan which will set forth, in detail, the fire prevention, pre-suppression, and suppression measures which will be taken by the Grantees, their contractors, and subcontractors, and their employees in all operations during the construction stage.

b. Prepare, in cooperation with the Grantees, a clearing plan which will set forth, in detail, the procedures and standards which will apply to (1) all clearing and disposal of merchantable timber and young growth in the right-of-way, and (2) construction generated debris disposal, including construction generated debris removal from all streams. Such plan shall include provision for payment by the Grantees or its contractors for the merchantable timber on lands of the United States to be cut, used, or destroyed in the construction of the transmission lines or in clearing of said right-of-way. Payment for merchantable timber will be at appraised value as determined by the Regional Forester.

c. Prepare in cooperation with the Grantees a revegetation and erosion control plan with the objectives of protecting, and restoring or enhancing the landscape, protecting soil, protecting or reestablishing vegetative cover. Such plan shall, when appropriate, provide for vegetating cuts, fills, and other areas damaged as a result of transmission line construction, maintenance or operation; and for terraces, drainage, waste disposal areas, soil replacement, and other related requirements necessary to achieve the objective. Such plan shall include measures necessary to close all temporary roads.

d. Prepare, in cooperation with the Grantees, a transportation plan which will provide specifications for construction, reconstruction and maintenance of all roads used in connection with the construction of the transmission lines. Such plan shall, when appropriate, designate any roads to be incorporated into the Forest Service Transportation system, and all construction access roads.

e. Prepare, in cooperation with the Grantees a flagging plan which will indicate the different colors of plastic flagging to be used to mark, delineate, and identify types of proposed activity.

2. Delegate responsibility for all phases of easement and permit administration and construction liaison to the Forest Supervisors, whomever. The Forest Supervisors will in turn designate field representatives for the Forest Service, who shall hereinafter be referred to as the Liaison Officer.

The Liaison Officer will:

1. Prepare, in cooperation with the Grantees a tower site prescription (tower site to include the actual site for the tower plus temporary access road), prior to clearing each tower site.

Each tower site prescription shall be considered to contain as a part, the Flagging Plan, Clearing Plan, Transportation Plan, Fire Protection Plan, and Revegetation and Erosion Control Plan as prepared in cooperation with the Grantees. Each tower site prescription shall also be considered to contain the stipulations supplementary to the terms and conditions of the transmission easement deeds as agreed to for the construction stage. Each tower site prescription shall, when appropriate, contain additional stipulations deemed necessary to protect, preserve, or to mitigate irreversible damage to the resources.

2. Hold a pre-work conference with the Grantees, his Contractors, and the Forest Service before commencing clearing of any right-of-way or other construction work.

The Grantees will:

1. Hold a pre-work conference with the Liaison Officer, his Contractors, and the Forest Service before clearing of any right-of-way or other construction work commences.

2. Designate a representative for field operations. Said representative shall be empowered on behalf of the Grantees and his contractor to communicate, and to receive and comply with all messages and decisions of the Liaison Officer.

The Liaison Officer shall be immediately informed in writing of any changes in the Grantees' field representative.

3. Suspend construction, in whole or part, when, in the judgment of the Liaison Officer, such suspension is necessary to prevent environmental damage, to obtain compliance with the terms of this agreement, the easement, or other such facilitating documents. Such suspensions will be given in writing by the Liaison Officer.

4. Cause its contractors to comply with all provisions of the Fire Protection Plan and of all burning permits issued for disposal of flammable materials.

5. Request through the Liaison Officer, at least four weeks before needed, permits for:

   a. Construction access roads
   b. Borrow areas
   c. Staging areas
   d. Heliports
   e. Construction camps
   f. Batch plants
   g. Parking lots.

6. Direct survey and inventory to be made by an agency which meets the approval of the Forest Service of archeological, paleontological, and historical sites within the area to be occupied

by the right-of-way and access roads. The results of this survey will be provided to the Forest Service. If, during construction, Grantees encounter any archeological, paleontological, or historical sites, construction will be suspended at such site and a report made to the Liaison Officer. The Forest Supervisor may require the Grantees to relocate the proposed transmission lines facilities in order to avoid destruction of archeological, paleontological, or historical values or to delay construction until salvage operations are completed.

All costs of inventory, survey, and salvage operations will be borne by the Grantees. All salvage shall remain the property of the United States and shall be surrendered to the Forest Service.

In addition, the Grantees will:

a. Provide a project archeologist, as needed, to monitor construction activities in regard to the archeological resource during all phases of construction.

b. Flag the perimeters of archeological sites which are to be avoided. Flagging will be done just prior to the construction period and removed as soon as construction activity has moved on.

c. Determine, through the project archeologist and in consultation with the Liaison Officer, what protection should be afforded individual archeological sites.

d. Identify and protect, through the project archeologist, archeological sites encountered in other construction activities such as road building, prior to construction activities.

e. Arrange systematic surface collection and/or salvage if essential for archeological sites which cannot be avoided.

f. Require employees or contractor and subcontractors to strictly observe laws regarding antiquities, including surface collection.

g. Restrict the availability of all plans, profiles, and the archeological inventory report to individuals directly connected with the construction in order to reduce the risk to the archeological resource.

h. Promptly report "pot hunter" or vandal activity to the Liaison Officer.

7. Establish a means of communication with the Forest Service, FAA, and military to provide for safe air operations during the fire season at the following telephone numbers:

   Arizona Public Service Company - Day, 271-2766 and Night, 942-0126

8. Require any project aircraft to monitor frequency 122.9 on all aircraft radios in order to provide for instant communications.

9. Mark the landing strip near Cherry Creek and Forest Road 203, in Section 3, T.4N., R.15E., as abandoned in accordance with FAA regulations as a visual signal to pilots that the landing strip is no longer operable.

10. Relieve the Forest Service of all responsibility with regards to the final disposition of the airstrip located near the Rock House in Section 22, T.7N., R.15E.

11. Pay the Forest Service for all timber cut, injured or destroyed in the construction of the transmission line.

    a. Payment for merchantable sawtimber size trees will be at the market value based on transaction evidence of adjacent or nearby timber sales under contract of comparable timber quality, but not less than the applicable minimum prices established by the Regional Forester.

b. Payment for pulpwood will be at the market value based on the Colorado Plateau Pulpwood Sale.

c. Payment for young-growth timber below merchantable size will be at damage - appraisal value based on transaction evidence.

d. Payment for fuelwood will be at current prices charged commercial wood cutters.

12. Pay the Forest Service for all cacti, ocotillo, and other species protected under the Arizona Native Plant Law, and are of commercial value, that will be salvaged or destroyed during construction of the transmission lines. Payment will be at market value based on transaction evidence.

13. Agree that the effective day for valuation of forest products in stipulations numbers 11 and 12 shall be the date of execution of the Easement Deed by the Regional Forester.

14. Use other than conventional logging equipment acceptable to the Liaison Officer while logging sensitive areas, such as meadows, steep slopes, sink holes, and aspen.

15. Restrict clearing of tower sites in desert vegetation to that required for the tower footings, and for the assembly of towers, and obtain approval of the Liaison Officer before any of this clearing shall begin.

16. Remove riparian vegetation from sides and bottoms of canyons, streams, and washes, as approved by the Liaison Officer.

17. Comply with the following recommendations of the State Game and Fish Department and Forest Service for wildlife and fish management:

    a. Take all necessary precautions to avoid damage to fish habitat and exercise every reasonable precaution to prevent muddying or silting live streams. For the purpose of these stipulations Cherry Creek, Coon Creek, Pinto Creek, Devil's Canyon and the Salt River shall be considered live streams.

    b. Minimize harassment of wildlife, particularly protected species during nesting or breeding periods, by helicopters or other equipment.

    c. Leave selected slash piles for wildlife purposes adjacent to the right-of-way in the Intermediate Zone.

18. Remove, repair, replace, and/or construct improvements which are damaged, destroyed, or made necessary by the exercise of the rights granted herein and according to specifications approved by the Regional Forester as follows:

a. Protect, box, and pipe water outside of right-of-way for any spring encountered during construction.

b. Reconstruct that portion of Forest Road 202, from the junction with Forest Highway 12 to the vicinity of the "Q" Ranch, as shown on the plans furnished by the Forest Service.

c. Reconstruct that portion of Forest Road 101, from the junction with Forest Highway 12 to the Reservation Boundary, as shown on plans furnished by the Forest Service.

d. Reconstruct or install new culverts on the Cherry Creek Road, from State Highway 288 to the junction with Forest Road 202, as agreed with the Forest Service.

e. Provide permanent cattleguards and a 16 foot steel gate on all fences crossed, as required in the Special Use Permit for the road. Cattleguards and gates to meet specifications included in the Transportation Plan:

f. Provide permanent or temporary cattle guards, and/or a 16 foot steel gate on all fences crossed with temporary roads.

g. Use colored concrete for tower footings to more closely blend with the forest setting as approved by the Liaison Officer.

19. Replace or restore immediately, to at least original condition, any Forest Service improvement, such as fences, pipelines, corrals, gates, and cattleguards damaged by project activities.

20. Replace signs accidentally destroyed, and promptly replace signs that are removed to avoid damage. Such replacement will be to the standards of the "Manual of Uniform Traffic Control Devices".

21. Refrain from using trees to anchor ropes, cables, or guys.

22. Prune or trim limbs from trees, flush with the trunk of the tree, using shears or saws.

23. Restrict travel to established routes.

24. Apply dust abatement at the following locations, in accordance with the Transportation Plan.

    a. Charlie Armer's Ranch

    b. Cook Ranch

    c. Rock House

    d. "Q" Ranch

    e. Gentry Place

25. Locate the two lines of towers opposite each other in the following locations, if possible:

    a. Forest Road 504

    b. Forest Road 99

    c. Forest Road 170

d. State Highway 260

e. Canyon Creek

f. Salt River

g. State Highway 88

h. U.S. Highway 60

26. Use the optimum span possible for all road crossings, with the towers located to utilize maximum vegetation screening available.

27. Locate tower sites so towers will be least obtrusive from the following critical areas, and obtain approval of Liaison Officer.

a. State Fish Hatchery and Canyon Creek Campground (Canyon Creek Crossing).

b. Canyon Point (Campground - State Highway 260 Crossing)

c. Devil's Canyon (U.S. Highway 60 Crossing)

28. Locate tower sites behind the foothills at the base of the Salt River Mountains wherever possible.

29. Locate no tower sites between State Highway 288 and the Salt River.

30. Observe the following general environmental protection measures:

a. Confine construction activities to designated areas.

b. Restore disturbances from temporary construction facilities such as haul roads, work areas, structures,

foundations of temporary structures, stockpiles of excess waste materials, or any other vestiges of construction, and revegetate in accordance with the Revegetation and Erosion Control Plan.

c. Prevent the operation of equipment in perennial streams.

d. Obtain water for contractor use from other than stock tanks, springs, and creeks, except Cherry Creek. The location of any diversions and quantity of water removed from Cherry Creek will be approved by the Liaison Officer.

e. Abide by all federal, state, or local laws in securing water for construction purposes.

31. Pay for all round-up costs resulting from cattle straying through gates left open on the access roads, and for transmission line construction.

32. Keep all gates closed as directed by the Liaison Officer.

33. Brace all fences before cutting in accordance with specifications included in the Transportation Plan.

34. Refrain from using unsurfaced roads during or immediately after a rainstorm unless permitted by the Liaison Officer.

35. Consider wet and poorly drained roads unusable if deep rutting - in excess of 3 inches - will occur, unless permitted by the Liaison Officer.

36. Store and handle explosives and flammable materials in conformance with all Federal, State, and County rules, laws, and regulations.

37. Install non-specular conductor in the following locations:

    a. Forest Road 504. From the centerline of Forest Road 504 in Section 12, T.13N., R.15E., a distance of about 3,500 feet north and a distance of about 4,500 feet south of the centerline for a total of 8,000 feet, as approved by the Liaison Officer.

    b. Wildcat Canyon. From the north section line of Section 9, T.12N., R.15E., south a total of 16,000 feet, as approved by the Liaison Officer.

    c. Wagon Draw Road - Ryan Ranch. From 2,500 feet north of Section corner common to Sections 25, 26, 35, and 36, T.12N., R.14E., southwest to the angle towers immediately north of the Ryan Ranch, a total of approximately 8,070 feet, as approved by the Liaison Officer.

d. State Highway 260 - Mogollon Rim - Naegelin Rim. From the angle towers in Section 15, T.11N., R.14E., south to the angle towers at the base of the Mogollon Rim in Section 31, T.10½N., R.15E.; and from the angle towers at the base of the Mogollon Rim in Section 31, T.10½N., R.15E., south to the angle towers in the NW¼ of Section 33, T.10N., R.15E., a total of 64,000 feet, as approved by the Liaison Officer.

e. Young-Heber Road Crossing. From the angle towers in Section 33, T.10N., R.15E., south, a total of 8,000 feet, as approved by the Liaison Officer.

f. Sombrero Peak - Cherry Creek. From 5,000 feet north of the angle towers in Section 34, T.6N., R.15E., south to near the center of Section 27, T.5N., R.15E., a total of 32,000 feet, as approved by the Liaison Officer.

g. Tonto Basin. From 1,500 feet south of the angle towers in the NE¼ of Section 24, T.4N., R.14E., to the angle towers in Section 15, T.2N., R.14E., a total of 64,000 feet, as approved by the Liaison Officer.

h. Pinto Creek. From the angle towers near the north boundary line of Section 35, T.1N., R.13E., north across Pinto Creek, a total of 8,000 feet, as approved by the Liaison Officer.

i. U.S. Highway 60 Crossing. From the angle towers in Section 21, T.1S., R.13E., north about 2,300 feet, and south about 13,700 feet to the Forest Boundary and the south boundary line of Section 34, T.1S., R.13E., a total of 16,000 feet, as approved by the Liaison Officer.

j. Last three miles. From the north boundary line of Section 20, to the south boundary line of Section 32, all in T.2S., R.13E., a total of 16,000 feet, as approved by the Liaison Officer.

38. Install darkened or dulled towers to support non-specular conductor in the following locations:

a. On all of the Heber District, Apache-Sitgreaves National Forest

b. From the north boundary of the Pleasant Valley District, Tonto National Forest to and including the last tower supporting non-specular conductor in Section 3, T.9N., R.15E.

39. Agree to be bound by Forest Service decisions regarding critical areas where access roads may or may not be allowed to a tower site, but reserve the right of appeal. Such decisions will be made on a site by site basis and written up in the tower site prescriptions.

a. South one-half of Section 31, T.10½ N., R.15E., and Sections 5 and 6, T.10N. and R.15E.

b. Sections 22, 27, and 34, T.5N., R.15E.

c. South one-half of Section 3, and Sections 9, 10, and 16, T.4N., R.15E.

d. Southwest one-fourth of Section 24, and Sections 25, 26, 34, and 35, T.4N., R.14E; Sections 3 and 4, and NE ¼ of Section 9, T.3N., R.14E.

e. Sections 28 and 33, T.3N., R.14E., and Sections 4 and 9, T.2N., R.14E.

f. South one-fourth of Section 32, T.2N., R.14E., Section 5 and NE ¼ of Section 6, T.1N., R.14E.

g. Southeast one-fourth of the NE¼ and the Southeast one-fourth of Section 23, and the North one-half of Section 26, T.1N., R.13E.

h. Sections 10, 11, and 15, T.1S., R.13E.

40. String the "sock line", as planned, by helicopter.

41. Install counterpoise in accordance with Tower Site Prescriptions.

42. Ground all metal fences to eliminate possible shock hazard.

a. Any fence that parallels the transmission line within

200 feet of the centerline of the towers for more than ¼ mile shall be grounded at points not more than ¼ mile apart, with ground rods.

b. At each point where the transmission line crosses a fence, ground rods shall be installed on the fence at the centerline of the right-of-way, and at the right-of-way lines.

43. Restore all temporary access roads to near natural contour, establish erosion control structures as required, and re-vegetate so they are in conformance with the Revegetation and Erosion Control Plan.

44. Rip all roads before returning to near natural contours.

45. Provide for safety in accordance with the Occupational Safety and Health Act of 1970, and as follows:

a. Construct the transmission lines to conform with all applicable federal regulations regarding aircraft safety.

b. Provide and place appropriate temporary guards, signs, bridges, lights and other signals as necessary for public safety, where requested by the Liaison Officer.

c. Place signs in the center of temporary roadways when they are closed. These signs will be worded: "Road Closed To Protect Watershed and Wildlife", and "Secretary of Agriculture Regulation 36 CFR 251.25 36 CFR 212.7 (A) (3)", and shall be on a 24" x 24" square shape, with black letters and border on a yellow background. Also furnish the Forest Service with 50 additional signs for replacement as the signs are vandalized.

46. Observe the following sanitation measures:

a. Remove or dispose all construction generated waste off Forest Service land. The term "waste" as used herein means all discarded matters, including but not limited to human waste, trash, garbage, refuse, oil drums, petroleum products, and equipment. If any waste material is dumped on Forest Service land, the material shall be removed and the area restored. If necessary, contaminated ground shall be excavated, disposed of as directed by the Liaison Officer, and replaced with suitable fill material, compacted and finished with top soil.

b. All used oil or other petroleum products shall be hauled away. There shall be no release of crank-case oil, etc., into streams or the soil.

c. Water used in embankment material processing, aggregate processing, concrete curing, foundation and concrete lift cleanup, and other waste waters shall not be allowed to contaminate surface waters.

d. Wasted concrete and washout from concrete trucks shall be disposed of at the batch plant site in a place satisfactory to the Liaison Officer.

e. All non-combustible wastes such as conductor, ceramic or metal scraps shall be hauled away.

f. Discharge sanitary waste only in approved sewage treatment plants and solid waste in approved sanitary landfills.

g. Follow a litter policing schedule on all roads associated with the project, as approved by the Liaison Officer.

h. Keep the construction site free from accumulation of waste materials and rubbish resulting from operations, as required for safety, appearance, and avoidance of fire hazards. All waste material and rubbish shall be removed at the end of each working day.

47. Re-establish or restore public land monuments disturbed or destroyed by construction, reconstruction, or maintenance

in accordance with (1) procedures outlined in the "Manual of Instructions for the Survey of the Public Land of the States", (2) the specifications of the county surveyor, or (3) the specifications of the Forest Service.

To cut witness trees (those that must be cleared) four and one-half feet above the ground or 18 inches above the blaze, whichever is higher.

Further, the Grantees will cause official survey records as are affected to be amended as provided by law, and furnish copies of all such survey data to the Forest Service.

48. Preserve and protect all known mining claim corner monuments.

49. Provide maps to the Forest Service that show all temporary roads used for construction of the transmission lines within and outside the easement. Such maps will be provided prior to completion of the "construction stage".

50. Provide as planned, surveyed ground ties between the centerline for the transmission line and the nearest section corner or quarter corner for each section line crossed. No surveyed ground ties will be required where the nearest section corner or quarter corner is more than one mile distance from the centerline.

51. Provide a performance bond as follows:

Before issuance of the easement grant, furnish the United States a surety bond or other security (hereinafter called "bond") of such type and on such terms and conditions as are acceptable to the Secretary of Agriculture, in the principal amount of $100,000. Said bond will at all times, be maintained in force and effect in the full principal amount until construction of the lines is completed and until the bond is released in writing by the Forest Service.

Said bond will have the purpose of: (1) ensuring the performance by Grantee of each and every obligation of Grantee under terms and conditions of this grant and any permit issued to Grantee by the United States in connection with the lines; (2) providing for immediate payment to the United States of any cost or obligation incurred by the United States in performing any said obligation of Grantee which in the judgment of the Forest Service, Grantee has not performed satisfactorily; and (3) ensuring the payment, within the amount of said bond, of any final judgment.

These bonding requirements will be in addition to, and not intended to affect, all other requirements of law, nor will they be intended to limit in anyway Grantee's liability under any provision of law.

52. Require its contractors and their employees to comply with all provisions of the easement, facilitating permits, project plans, timber sale contract, and these stipulations.

IN WITNESS WHEREOF, the parties hereto have caused this stipulation to be executed on the day and year first above written.

ARIZONA PUBLIC SERVICE COMPANY

By: [signature]

Title: Manager F.H. Contracts

SALT RIVER PROJECT

AGRICULTURAL IMPROVEMENT

AND POWER DISTRICT

By: [signature]

Title: Secretary

UNITED STATES

DEPARTMENT OF AGRICULTURE

FOREST SERVICE

Date: 4/28/76

for [signature]
WM. D. HURST
Regional Forester

United States Department of Agriculture
Forest Service

EASEMENT FOR TRANSMISSION LINE - 500 KILOVOLTS
On Publicly Owned Lands Administered by the Forest Service

GRANTED UNDER PROVISIONS OF:

Act of March 4, 1911, 36 Stat. 1253, as amended May 27, 1952 (Public Law 367, 82nd Congress; 66 Stat. 95)

NAME OF GRANTEE: Salt River Project Agricultural Improvement and Power District

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Pursuant to the provisions of the above referenced Act, I, Wm. D. Hurst, Regional Forester, Southwestern Region of the Forest Service, (hereinafter referred to as the grantor) hereby grant to Salt River Project Agricultural Improvement and Power District (hereinafter referred to as the grantee), an easement for right-of-way for the construction, operation, and maintenance of an extra high voltage transmission line as hereinafter described and located upon lands of the United States within the Apache-Sitgreaves National Forests or other lands under Forest Service jurisdiction in the State of Arizona, subject to the rules and regulations of the Secretary of Agriculture and to the conditions, provisions, and requirements set forth hereinafter and in the Act.

In consideration of this grant and the benefits and advantages accruing hereunder to the grantee, the grantee hereby stipulates and agrees and binds himself as follows:

Article 1. This grant is for a period of approximately 50 years ending December 22, 2025. The right of the grantee and his transferees and successors to use or occupy the lands covered by this grant for the purpose of maintaining the project works or otherwise, shall absolutely cease at the end of the period hereof, unless a new easement shall be granted pursuant to then existing laws and regulations.

Article 2. The project covered by and subject to this grant consists of the right-of-way and all structures, equipment, or facilities used or useful in the operation and maintenance of the transmission line as follows:

Width of right-of-way: 100 feet on each side of the centerline.

Location of right-of-way: Counties of Coconino and Navajo, State of Arizona.

On National Forest and other land under Forest Service jurisdiction in:

Gila and Salt River Base and Meridian

Township 10½ North - Range 15 East

Section 19	-	E½E½
Section 20	-	W½W½W½
Section 30	-	NE¼, N½SE¼

Township 11 North - Range 14 East

Section 2	-	NW¼, W½SW¼
Section 3	-	SE¼SE¼SE¼
Section 10	-	E½NE¼, SE¼
Section 11	-	NW¼NW¼NW¼
Section 15	-	E½, E½E½SW¼
Section 22	-	E½
Section 27	-	E½
Section 34	-	NE¼, S½

Township 12 North - Range 14 East

Section 24	-	SE¼SE¼SE¼
Section 25	-	All
Section 35	-	All
Section 36	-	NW¼NW¼NW¼

Township 12 North - Range 15 East

Section 4	-	All
Section 8	-	SE¼SE¼
Section 9	-	N½, SW¼
Section 17	-	All
Section 18	-	SE¼SE¼SE¼
Section 19	-	All
Section 20	-	NW¼NW¼NW¼

Township 13 North Range 15 East

Section 1	-	NE¼, S½
Section 11	-	SE¼SE¼SE¼
Section 12	-	W½
Section 13	-	NW¼NW¼NW¼
Section 14	-	E½NE¼, SE¼
Section 23	-	All
Section 26	-	NW¼, W½SW¼
Section 27	-	E½SE¼
Section 34	-	NE¼, S½

Township 14 North - Range 15 East

Section 1	-	E½E½
Section 12	-	E½E½
Section 13	-	E½E½
Section 24	-	E½E½
Section 25	-	E½E½
Section 36	-	E½NE¼, SE¼

All as approximately shown upon certain maps and described in certain field notes and made a part of this easement.

Total acreage of National Forest land in this grant is 659.17 acres.

Total length of line from point of entrance on National Forest or other land under Forest Service jurisdiction to point of leaving is 27.191 miles, of which 27.191 miles are on National Forest or other lands under Forest Service jurisdiction and project works are more specifically shown and described by certain exhibits which form a part of the application for easement and which are designated and described as:

Exhibit A - Right-of-way map across the Apache-Sitgreaves National Forests, designated Coronado - Kyrene 500 KV transmission line, drawing #A-675-430.14 and signed by F. E. Smith, Secretary on October 7, 1975.

Exhibit E - Transmission Line Stipulations dated April 28, 1976.

Exhibit F - Clearing Plan dated April 28, 1976.

Exhibit G - Transportation Plan dated April 28, 1976.

Exhibit H - Fire Protection Plan dated April 28, 1976.

Exhibit K - Revegetation and Erosion Control Plan dated April 28, 1976.

In consideration of this grant and the benefits and advantages accruing hereunder to the grantee, it is expressly agreed by the grantee that the entire project area and project works, as above designated and described, shall be subject to all the terms and conditions hereof.

Article 3. The stipulations executed on Form 2700-12, Stipulations, and submitted with the application as required by 36 CFR, Part 251, as amended March 23, 1963, (28 FR 2903) are made a part hereof.

Article 4. The map, specifications, written stipulations and plans designated as exhibits in Article 2 hereof are made a part of this grant, and no substantial change or alteration in the design, location, construction, voltage or capacity of the line shall hereafter be made until such change is approved by the grantor: Provided, That if the grantee deems it necessary or desirable that said exhibits of any of

them be changed, there shall be submitted for the approval of the grantor corrected, amended, supplemental, or additional exhibits covering the proposed changes, which upon approval shall become a part of this grant and shall supersede, in whole or in part, such exhibits theretofore made a part of this grant, as may be specified by the grantor.

Article 5. The grantee shall begin the construction of the aforesaid line or lines within 90 days from the date hereof, shall thereafter prosecute such construction in good faith and with due diligence, and shall complete the same and begin operation within 36 months from the date hereof. The periods specified for the beginning and completion of construction will be extended only on the written approval of the grantor after a showing by the grantee satisfactory to said officer that such beginning or completion of construction has been prevented by difficulties that could not reasonably have been foreseen or by other special and peculiar cause beyond the control of the grantee.

Article 6. The grantee shall, after the completion of construction as required in Article 5 hereof, operate in good faith and as continuously as may be possible under prevailing market requirements, or users' demands, the line or lines constructed, and/or maintained in whole or in part under the grant; and that if there is discontinuance of operation, or reduction in amount of power transmitted for a continuous period of more than thirty (30) days or for an aggregate period of more than ninety (90) days in any calendar year, the grantee shall notify the grantor of the fact of such discontinuance or reduction and of the reasons therefore.

Article 7. The grantee shall pay to the Forest Service, U. S. Department of Agriculture, the sum of eight hundred and eighty dollars ($880.00) for the period from May 1, 1976 to December 31, 1976, and thereafter on January 1, annually in advance one thousand three hundred and twenty dollars ($1320.00); Provided, however, charges for this use may be readjusted whenever necessary to place this grant on a basis consistent with charges to other users for like privileges; and, Provided further That a general readjustment will be made on January 1, 1980, and at 5-year intervals thereafter.

Article 8. The grantee shall immediately notify the Forest Supervisor of any change of address.

Article 9. The grantee, in exercising the privileges of this grant shall comply with the regulations of the Department of Agriculture and all Federal, State, county, and municipal laws, ordinances, or regulations which are applicable to the area or operations covered by this grant and shall maintain the improvements and premises to standards of repair, orderliness, neatness, sanitation, and safety acceptable to the grantor.

Article 10. This grant is subject to all valid claims.

Article 11. The grantee, if engaged in business, shall conduct same in an orderly manner and in accordance with the requirements of the laws of the State of Arizona, as well as the laws of the United States.

Article 12. The land herein described is subject to certain rights reserved by or outstanding in parties other than the United States, and nothing herein shall abridge said rights or authorize prevention or obstruction of the reasonable exercise thereof.

Article 13. This grant confers no rights upon the grantee to use this right-of-way for purposes other than for the constructing, maintaining, and operating a transmission line thereon.

Article 14. The grantee will pay the United States for all damage to Federal property or resources and for all Federal fire suppression costs resulting directly or indirectly from the grantee's use and occupancy of the area covered under this grant, regardless of whether the grantee is negligent or otherwise at fault.

Article 15. The grantee shall be liable for injury to, or destruction of, any buildings, bridges, roads, trails, lands, or other property of the United States, occasioned by the construction, operation, or maintenance of the project works, or of the works appurtenant or necessary thereto. Arrangements to meet such liability, either by compensation for such injury or destruction, reconstruction or repair of damaged property, or otherwise, shall be made with the appropriate department or agency of the United States.

Article 16. The grantee shall allow officers and employees of the United States free and unrestricted access in, through, and across the said project and project works in the performance of their official duties, and shall allow the Forest Service, without charge, to construct or permit to be constructed in, through, and across the said project, railroads, chutes, roads, trails, conduits, and other means of transportation not inconsistent with the enjoyment of said project by the grantee for the purpose herein set forth.

Article 17. No timber shall be cut or destroyed without first obtaining a permit from the Forest Supervisor.

Article 18. The grantee shall pay the United States for all National Forest timber cut, injured, or destroyed in the construction and maintenance of the transmission line. Payment for merchantable timber will be at current stumpage rates for similar timber in the National Forest. Young-growth timber below merchantable size will be paid for at current damage-appraisal value. All slash and debris resulting from the cutting or destruction of such timber shall be disposed of as the Forest Supervisor suggests.

Article 19. The grantee shall clear designated portions of the transmission line right-of-way, and keep them clear as approved by the Forest Officer in charge; shall trim all branches of trees in contact or near contact with the line; and on or adjacent to the right-of-way shall remove all dead snags and all trees leaning toward the line, which are deemed hazardous or might fall in contact with the line, and shall observe such other precautions against fire as may be required by the Forest Officer in charge; but no burning of such waste material shall be done, except with the prior written consent of the Forest Officer in charge as to time and place. The clearing width shall be restricted to that necessary for safe transmission unless the specific permission of the Forest Supervisor for a greater clearing width is obtained: EXCEPT a "feathered effect" will be maintained by the Grantee even though this may require work outside this grant. Such work will be done as directed by the Forest Supervisor and all timber, slash, and other waste material, resulting from maintenance of the feathered effect, shall be disposed of to the satisfaction of the Forest Supervisor.

Article 20. The grantee shall do everything reasonably within its power and shall require its employees, contractors, and employees of contractors to do everything reasonably within their power, both independently and upon request of officers of the Forest Service, or other agents of the United States, to prevent and suppress fires on or near the lands to be occupied under this grant.

Article 21. The grantee shall notify the Forest Supervisor, Apache-Sitgreaves National Forests whenever a tower failure or conductor failure occurs.

Article 22. The grantee shall make provision or bear the reasonable cost of making provision for avoiding inductive or conductive interference between any transmission facility or other works constructed, operated, or maintained by it on the easement authorized under the grant and any radio installaion, telephone line, or other communication facilities existing when the easement is authorized or any such installation, line or facility thereafter constructed or operated by the United States or any agency thereof. This provision shall not relieve the applicant from any responsibility or requirement which may be imposed by other lawful authority for avoiding or eliminating inductive or conductive interference.

Article 23. The grantee shall place and maintain suitable structures and devices to reduce to a reasonable degree the liability of contact between its powerline and telegraph, telephone, signal or other powerlines heretofore constructed and not owned by the grantee, and shall also place and maintain suitable structures and devices to reduce to a reasonable degree the liability of any structures or wires falling and obstructing traffic or endangering life on highways or roads, in a manner satisfactory to the Forest Service. The transmission line shall be designed and constructed in accordance with accepted standards (National Electrical Safety Code) and specifications for transmission lines of similar voltage, capacity, and purpose.

Article 24. The grantee shall protect all Government and other telephone, telegraph, and power transmission lines at crossings of and at all places in proximity to the grantee's power transmission line or lines in a work-man like manner, according to standards of safety satisfactory to the Forest Service for construction, operation, and maintenance in such cases; and shall maintain said power transmission line or lines in such a manner as not to menace life or property.

Article 25. The grantee shall protect the scenic and esthetic values of the right-of-way and the adjacent land as far as possible consistent with the authorized use, during the construction, operation, and maintenance of the facility.

Article 26. No value whatsoever shall at any time be assigned to or claimed for the easement, or for the occupancy or use of National Forest and other lands under Forest Service jurisdiction granted thereunder, nor shall the approval of such occupancy and use ever be estimated or considered as property upon which the grantee shall be entitled to earn or receive any return, income, price, or compensation whatsoever, in the regulation by any competent public authority of the service to be rendered by the grantee or of the price to be charged therefore, and in any purchase or taking over the properties or business of the grantee, or any part thereof, by the United States or by any State within which such properties are situated or business carried on in whole or in part, or by any municipal corporation of such State.

Article 27. The grantee agrees to abide by such reasonable regulation of the service rendered and to be rendered, in the furnishing or transmitting of power and of rates of payment therefore, as may from time to time be prescribed by the State or by any duly constituted agency of the Federal Government or of the State in which the service is rendered.

Article 28. The grantee agrees that the transmission line or lines authorized by this grant, or any part thereof, whether constructed or unconstructed, may be abandoned or surrendered by the grantee upon the written approval of the grantor after a finding by the Forest Officer that such abandonment or surrender will not be contrary to the public interest, and after the fulfillment by the grantee of such obligation under this easement as the grantor may prescribe in respect to rental payment or otherwise if the transmission line authorized by this grant has been constructed in whole or in part, then upon such conditions with respect to the disposition of the transmission line as may be prescribed by the grantor. If the abandonment, termination, or revocation of this easement is approved and in the absence of a requirement to the contrary, the grantee may, within a period of 12 months, remove all structures which have been placed on the premises by him, except where the material was furnished by the Forest Service, but upon failure to remove the structures within that period they shall become the property of the United States, but that will not relieve the grantee of liability for the cost of their removal and restoration of the site.

Article 29. The grantee agrees that upon breach by the grantee of any of the terms or conditions set forth in the grant or in the regulations for carrying out the provisions of the act the United States may enforce appropriate remedy therefore by injunction, action for damages, or otherwise; and if any such breach shall be continued or repeated after thirty (30) days notice thereof, given to the grantee by the Regional Forester, the easement granted, together with all rights thereunder and all rental charges and other moneys paid thereon, may be forfeited to the United States by a suit for that purpose in any court or competent jurisdiction.

Article 30. The grantee agrees that he will not voluntarily assign or transfer to any person or corporation whatsoever the right-of-way granted, except with the approval in writing first obtained from the grantor, and upon terms and conditions prescribed in said written approval by said grantor: Provided, That a transfer by mortgage or trust deed or judicial sales made thereunder or under tax sales shall not be deemed a voluntary transfer within the meaning of this article.

Article 31. If the grantee shall cause or suffer essential project property to be removed or destroyed or to become unfit for use, without replacement, or shall abandon or discontinue good faith operation of the project for a period of 2 years, or refuse or neglect to comply with the terms of the grant and the regulations, the grantor will deem it to be the intent of the grantee to surrender the easement, and after 30 days written notice may, in his descretion declare this grant forfeited or annulled.

Article 32. The right-of-way granted shall be subject to the express covenant that it may be modified, adapted, or discontinued by the issuing office, without liability or expense to the United States, so as not to conflict with the use and occupancy of the land for any authorized use which may be hereafter required under the authority of the United States.

In Witness Whereof, I hereunto set my hand this 28th day of April, 1976.

for M Hassell
Wm. D. Hurst
Regional Forester

County of Bernalillo)

State of New Mexico)

Before, Ann Bordenave, a Notary Public in and for the County of Bernalillo, State of New Mexico, on this 28th day of June, 19 76, personally appeared M. J. Hassell, the Acting Regional Forester for Wm. D. Hurst, Regional Forester to me known to be the identical person who executed the foregoing instrument and acknowledged to me that he executed the same as a free and voluntary act and deed for the uses and purposes set forth therein.

Ann Bordenave
Notary Public

My commission expires My commission expires 2/15/79

In Testimony of Acceptance of all the provisions and conditions of the Act of March 4, 1911, 36 Stat. 1253, as amended May 27, 1952, and the regulations thereunder, and the further conditions imposed in this grant, the grantee, this 28th day of APRIL, 1976, has caused its corporation name to be signed hereto by JOHN R. LASSEN, its Vice President, and its corporate seal to be affixed hereto and attested by Paul D. Rice, the Secretary, pursuant to a resolution of its board of directors duly adopted on the 1st day of March, 1971, a certified copy of the record of which is attached hereto.

IN WITNESS WHEREOF, SALT RIVER PROJECT AGRICULTURAL IMPROVEMENT AND POWER DISTRICT has caused its name to be signed and its seal to be affixed by the undersigned officers thereunto duly authorized, this 28th day of April 19 76.

John R. Lassen
President

STATE OF ARIZONA) ss.
County of Maricopa)

ATTEST AND COUNTERSIGN: Paul D. Rice
Secretary

The foregoing instrument was acknowledged before me this 28th day of April 1976, by JOHN R. LASSEN ~~Karl F. Abel~~ and Paul D. Rice as Vice President and _____ Secretary of Salt River Project Agricultural Improvement and Power District.

In witness whereof I have hereunto set my hand and official seal.

Don Smith
Notary Public

My Commission expires: May 3, 1979

X86-600

RESOLUTION

RESOLVED, That this Board hereby authorizes the Secretary or Assistant Secretary of the Salt River Project Agricultural Improvement and Power District to apply for leases, rights of way, easements, permits and licenses over public, reserved and Indian lands and to execute the standard form lease, right of way, easement, permit or license agreements and appurtenant documents thereto.

CERTIFICATE

I, Paul D. Rice, the duly appointed, qualified and acting Secretary of the Salt River Project Agricultural Improvement and Power District, HEREBY CERTIFY that the foregoing is a true and complete copy of a resolution adopted by the Board of Directors of said District at a meeting thereof duly held on the first day of March, 1971, at which meeting a quorum was present and voted.

WITNESS my hand and seal of Salt River Project Agricultural Improvement and Power District this 28th day of April, 19 76.

Paul D. Rice, Secretary

Appendix J

MUSEUM OF NORTHERN ARIZONA
DEPARTMENT OF ANTHROPOLOGY

SALT RIVER PROJECT

CHOLLA-DINOSAUR TRANSMISSION LINE

TONTO NATIONAL FOREST

PINAL COUNTY, ARIZONA

Final Report

for

Archaeological Survey of Four Proposed Substations and

Access Roads

Prepared by:

Paul R. Fish
Senior Archaelogist

Submitted by:

Alexander J. Lindsay, Jr.
Coordinator of Archaelogical Research

September 30, 1975

ABSTRACT: At the request of Salt River Project, four potential substation sites for the Cholla-Dinosaur transmission line were intensively surveyed by the Museum of Northern Arizona. The four alternative substation locations are in the Tonto National Forest near Superior, Arizona. Two of the substation localities contained archaeological remains. Reconnaissance level survey of access roads leading to the substations was also undertaken.

INTRODUCTION

Between September 22 and 24, 1975, Museum of Northern Arizona archaeologist Paul R. Fish intensively surveyed four proposed substation sites on the Cholla to Dinosaur transmission line. Reconnaissance level survey of access roads to the substation localities was also performed during this time period. The substations and access roads are in the Tonto Forest near Superior, Arizona. This work was accomplished at the request of Salt River Project and under Federal Antiquities Permit 72-Az-040 and a permit from the United States Department of Agriculture to survey on Tonto National Forest lands.

SUBSTATION AND ACCESS ROAD SURVEYS

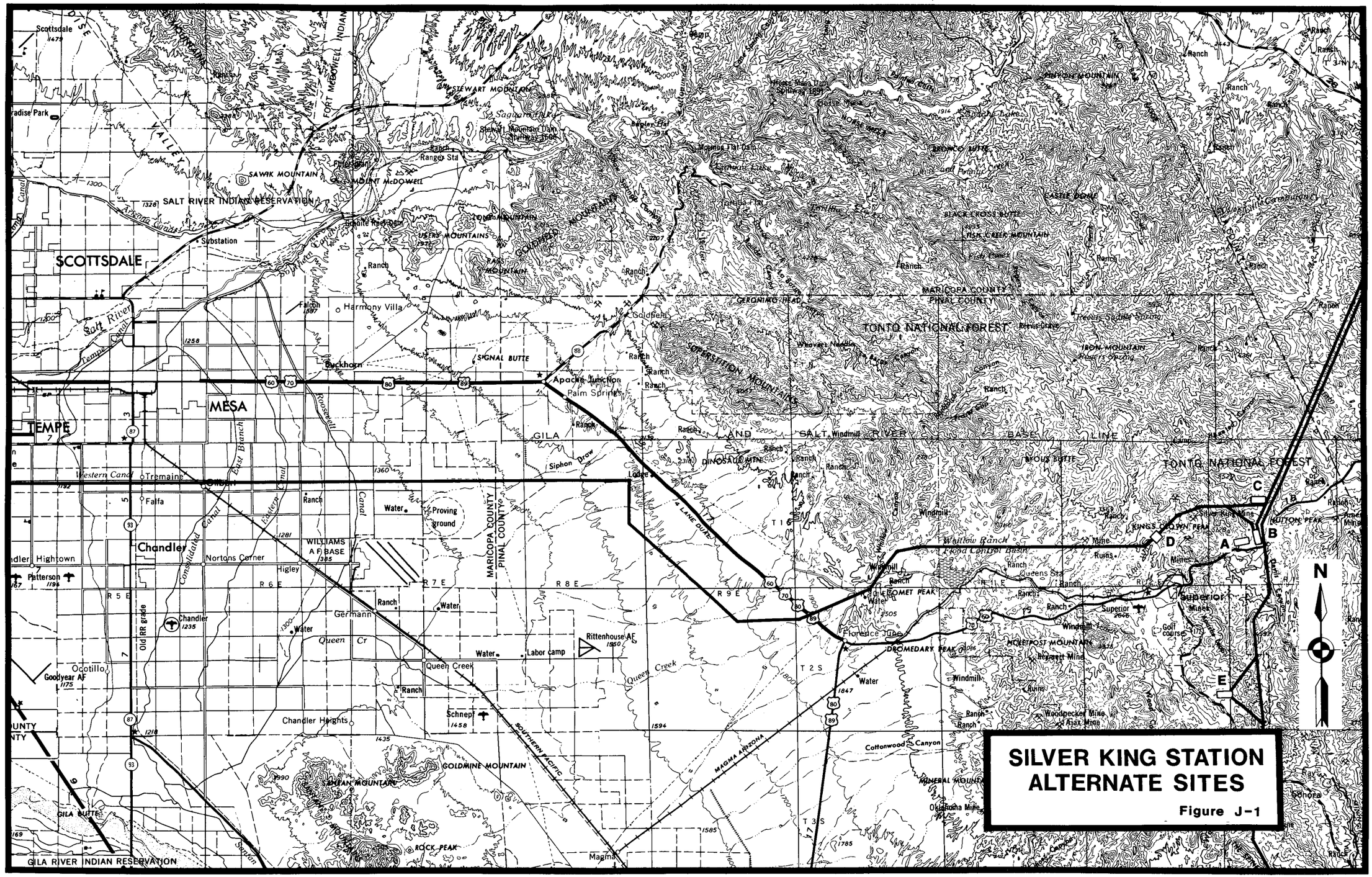
Survey Method

Since substation perimeters were not flagged prior to the survey, boundaries were approximated in the field from good quality maps provided by Salt River Project. A buffer zone approximately 200 yds. wide surrounding each substation site was also included as part of the survey area. Each substation was intensively surveyed by means of parallel transects spaced 20 yds. apart. When archaeological remains were encountered, they were recorded by means of notes, standardized Museum site survey forms and photographs. Archaeological sites were also plotted on project maps. Collections were limited to stylistically and temporally diagnostic ceramics.

Access roads currently being considered for each substation follow existing roads. The reconnaissance level survey undertaken for this aspect of the project consisted of the selection of the most environmentally favorable situations for sites along the existing roads. These survey localities were selected from the vehicle while traveling to or from a substation site. Upon selection, the locality was inspected on foot for archaeological remains.

Substation A

A large and complex Salado site exhibiting architectural features and artifacts related to habitation, wild food processing and agriculture cover the entire western half of the proposed substaion. This site extends from 50 to 125 yds. beyond the proposed substation boundaries on the north, south and west.


SILVER KING STATION
ALTERNATE SITES
Figure J-1
A
B
C
D
E
N
SCOTTSDALE
TEMPE
MESA
Chandler
Superior
TONTO NATIONAL FOREST
SALT RIVER INDIAN RESERVATION
GILA RIVER INDIAN RESERVATION
MARICOPA COUNTY
PINAL COUNTY
GILA AND SALT RIVER BASE LINE
Apache Junction
Palm Springs
Harmony Villa
Goldfield
Whitlow Ranch
Flood Control Basin
Queens Sta
Queen Creek
Queen Cr
Germann
Chandler Heights
Ocotillo
Goodyear AF
Rittenhouse AF
Magma
Florence Jct
Proving ground
WILLIAMS A F BASE
Superior Mines
Golf course
Silver King Mine
KINGS CROWN PEAK
KITTOM PEAK
DROMEDARY PEAK
COMET PEAK
MOGHTPOST MOUNTAIN
IRON MOUNTAIN
GOLDMINE MOUNTAIN
ROCK PEAK
SAWIK MOUNTAIN
MOUNT McDOWELL
STEWART MOUNTAIN
Stewart Mountain Dam
Mormon Flat Dam
Roosevelt Dam
Granite Reef Dam
Cottonwood Canyon
Cactus Canyon
Oklahoma Mine
Woodpecker Mine
Ajax Mine
Hayden Mine
Mines
Ruins
Windmill
Ranch
Water
Labor camp
Substation
Range Sta
Tremaine
Falfa
Hightown
Nortons Corner
Higley
Patterson
Old RR grade
Consolidated Canal
Eastern Canal
Western Canal
Tempe Canal
Arizona Canal
Salt River
Siphon Draw
Lodge
Buckhorn
SIGNAL BUTTE
GILA BUTTE
Paradise Park
Scottsdale
Falcon
Lane Dune
SOUTHERN PACIFIC
MAGMA ARIZONA
T 1 S
T 2 S
T 3 S
R 5 E
R 6 E
R 7 E
R 8 E
R 9 E

If Substation A is selected as the preferable site, it is estimated that approximately five weeks of additional field investigations would be required. Excavation would be the primary and most costly aspect of these investigations. At least 50 man/days of supervisory time and 400 man/days of labor would be necessary to adequately study this locality.

Two large lithic sites were found along the access road to Substation A. At both sites, the existing road cuts through approximately the center of the site with archaeological remains extending approximately 50 yds. on either side. The sites have a high density of chipped and ground stone remains. No cultural features were observed on the surface. Although no stylistically diagnostic artifiacts were found, the absence of ceramics, presence of one hand manos and grinding slabs, and the diversity in the flaked stone tool assemblage suggests that the site might represent an Archaic manifestation. If this is the case, the significance of these sites would be great in terms of understanding local culture history.

Substation B

With an exception of a single piece of flaked stone, an intensive survey of Substation B revealed that this locality is completely free of archaeological remains. A reconnaissance survey of the access road to Substation B provided no evidence of archaeological sites. On the basis of this survey, archaeological clearance could be recommended at this time. However, if Substation B is the selected site, an intensive archaeological survey of the access road is still necessary.

Substation C

A small site consisting of a diffuse scatter of chipped stone artifacts and a dry laid masonry wall. The wall extends from a boulder overhang in circular fashion. The overhang and wall enclose an area approximately 10 ft. in diameter. The wall averages five courses (ca. three ft.) in height, and is in good condition. Condition of this architectural feature and the presence of numerous tin cans within the enclosure suggest that it is of historic construction. The scatter of lithic artifacts extends downslope from the overhang for a distance of approximately 25 yds. Additional study involving five days for a supervisory archaelogist and one laborer will be necessary before archaeological clearance could be recommended for this locality.

Although no archaeological remains were located during the reconnaissance survey of the access road, an intensive survey will be necessary before a clearance recommendation can be made.

Substation D

At the request of Salt River Project, no archaeological survey was made at this proposed substation site.

Substation E

An intensive survey of Substation E revealed no archaeological remains. Also, a reconnaissance survey of the access road provided no evidence of an archaeological site. Since an intensive archaeological survey of this substation site has been completed, archaeological clearance can be recommended at this time. However, if Substation E is selected, an intensive survey of the access road is still necessary.

RECOMMENDATIONS AND CONCLUSIONS

The most recent listings of the National Register of Historic Places has been consulted and no sites in the immediate vicinity of the proposed project areas would be affected. Likewise, the State Historic Preservation Officer has been contacted and no sites that are on the State Register of Historic Places or are nominated to the National Register would be affected by the proposed project.

On the basis of information derived from the field investigations described in this report, Substation Sites B and E would have least impact on archaeological remains. Since no archaeological remains were found at either Substation B and E, an archeological clearance recommendation for both localities could be made at this time. Both Substation Sites A and C contain archaeological sites. Costs for adequate study of the archaeological site located within Substation A would be extremely high. On the other hand, costs for necessary field investigations at Substation C would be low.

In no case was an intensive survey of access roads accomplished. Present information suggests that a low density of archaeological sites exists in areas affected by roads to Substations B, C, and E. A high density of archaeological remains has been shown to exist in areas which would be impacted by the access road to Substation A. Of course, an intensive archaeological survey of the access road for whichever substation site is selected will be necessary before a clearance recommendation can be made.

Appendix K

CORRESPONDENCE CONCERNING THE BEGINNING OF CONSTRUCTION OF THE 500 kV LINES

United States Department of the Interior
BUREAU OF RECLAMATION
LOWER COLORADO REGIONAL OFFICE
P.O. BOX 427
BOULDER CITY, NEVADA 89005

IN REPLY REFER TO: LC-150
651.

NOV 2 1976

RECEIVED
NOV 4 1976
A. J. Pfister, Gen. Mgr.

Mr. A. J. Pfister
General Manager
Salt River Project
P. O. Box 1980
Phoenix, Arizona 85001

Dear Mr. Pfister:

On October 15, 1976 the interagency federal study team, of which the Bureau of Reclamation is the lead agency, that is preparing an environmental statement for your proposed Coronado Project, learned that you have begun construction of the northern section of the 500-kV transmission system. After further discussions with various members of your staff we were advised that work had, in fact, begun on approximately the first 30 miles of the primary 500-kV transmission line to Kyrene Substation and the 500-kV backup line to the Cholla Generating Station, near Joseph City, Arizona. We were further advised that construction is proceeding in a dual corridor along the route identified as Link 4 in the alinement evaluations that have been made to date. You indicated that all construction of this segment is on privately owned or state owned lands for which you have already obtained rights-of-way.

The Bureau of Reclamation as lead agency for the study team is concerned about this action and how it affects the integrity of the environmental statement and the agencies participating on the team. As you are aware we are just now finalizing work on the draft statement in anticipation of filing it with the Council on Environmental Quality very shortly. As the study team had no prior knowledge of your plans the draft environmental statement does not reflect the start of construction. Hence, there is concern that your action may jeopardize the validity and integrity of the document, as it now exists. Your unilateral action is not consistent with the spirit or letter of the National Environmental Policy Act, nor is it consistent with the team approach to the development of a full disclosure draft environmental statement.

In addition to Reclamation's concern, there is further concern among the other land management agencies represented on the study team that your actions may also jeopardize their ability to make an objective analysis

of the entire system which they believe is essential prior to granting of easements or rights-of-way across federal lands. Your action appears to preclude consideration of certain alternate alinements of both the primary and backup systems that are described in the proposed environmental statement and is in conflict with the intent of the NEPA of 1969.

We cannot overemphasize the seriousness of these concerns, and, as we are sure you will agree, it is to our mutual benefit to meet and discuss them. Therefore, we request that you meet with us on Thursday, November 4, 1976 to discuss these issues. Arrangements have been made to conduct the meeting in the office of the Field Solicitor, Department of the Interior, Room 2080, Valley Center, 210 North Central Avenue, Phoenix, Arizona beginning at 1:30 p.m. If you have any further questions concerning the details of the meeting please contact Mr. Gary W. Frey of this office, telephone number 702-293-8464.

Sincerely,

Manuel Lopez, Jr.
Regional Director

cc:
Mr. M. Jean Hassell, Regional Forester, U.S. Forest Service, 517 Gold Avenue, S.W., Albuquerque, New Mexico 87102
Mr. William K. Barker, District Manager, Phoenix District Office, Bureau of Land Management, 2929 West Clarendon Avenue, Phoenix, Arizona 80917

SALT RIVER PROJECT
P.O.BOX 1980
PHOENIX, ARIZONA 85001

November 24, 1976

TELEPHONE 273-5900

Mr. Manuel Lopez, Jr.
Regional Director
Lower Colorado Regional Office
U. S. Bureau of Reclamation
P. O. Box 427
Boulder City, Nevada 89005

Dear Mr. Lopez:

Re: Coronado Project Environmental Impact Statement

By letter dated November 2, 1976 (your reference LC-150651), you set forth the Bureau of Reclamation's concern, as lead agency for the interagency federal study team preparing an environmental impact statement for the Coronado Project, upon learning that Salt River Project has begun construction of a portion of the northern section of the 500 KV transmission system located on private and state lands.

Salt River Project shares the Bureau of Reclamation's concern, as lead agency, over the integrity of the environmental statement. It is in our best interests to cooperate with the study team to insure the integrity of the final statement. Salt River Project has no intent to violate either the spirit or the letter of the National Environmental Policy Act, or the study team's approach to development of a full disclosure document.

I wish to personally assure you that we will provide the study team with any and all information necessary for the preparation of the environmental statement. In this regard, Salt River Project is supplying the study team with material necessary to update the environmental statement to reflect construction work on a portion of the northern section of the 500 KV transmission line.

Our construction activities on private and state lands are not intended to conflict with the intent of NEPA in any way. We understand that no easements or rights-of-way can be granted prior to the filing of the final environmental

statement and we assume all risks for construction on private and state lands prior to filing of the final environmental statement.

Your letter stated members of the study team are concerned that Salt River Project's actions jeopardize an objective analysis of the entire transmission system because construction of certain alternate alignments of both the primary and backup systems are precluded. The only viable option for the backup system is interconnection to the Arizona Public Service Company (APS) Cholla Generating Station. On June 24, 1975, an agreement with APS was entered into for the interconnection at Cholla. It was impossible to make arrangements with Tucson Gas & Electric Company (TG&E) for a backup interconnection needed in April 1978 by the time this decision was required. The backup system is also required to provide startup power.

With regard to transmission line construction activities on non-federal lands, Salt River Project's present plans are to cease construction work at the Apache/Navajo county line, approximately 30 miles west of the Coronado Generating Station. However, it is critical to meeting the commercial service date of June 1979, that startup power be available at the very latest by July 1, 1978. The July 1, 1978 date assumes certain arrangements can be made with Navopache Electric Cooperative to provide startup power beginning April 1, 1978 to July 1, 1978 at which time the requirement exceeds Navopache's capability. If the arrangements with Navopache cannot be worked out the backup system must be in service by April 1978. If our ability to meet the required date for startup power is jeopardized by delays in the preparation and filing of the final environmental statement, we will consider all alternatives which may permit us to obtain startup power on schedule. Before undertaking work on an alternative, we would discuss this option with your team leader and the other federal agencies involved.

Insofar as the primary system is concerned, it is our position that the halting of construction, at the point referred to above, does not preclude selection of any practical alternate transmission line alignment over federal lands concerned.

At the meeting held on Thursday, November 4, 1976, attended by the federal interagency study team, other representatives

of land management agencies represented on the study team, and representatives of Salt River Project to discuss the issues raised in your November 2 letter, Leroy Michael, Jr., Assistant General Manager for Salt River Project, presented our formal apology to the study team for the failure in communication concerning the start of construction, and a commitment to assure the team it will not happen again. I add my own commitment to you, and to the team, that this unintentional oversight will not re-occur.

At a second meeting held on Wednesday, November 17, agreement was reached with the USBR study team leader, representatives of the land management agencies and Salt River Project representatives to resume processing the draft environmental statement. This agreement was contingent on the U. S. Forest Service Apache-Sitgraves and Tonto Forest supervisor's approval of Salt River Project's commitment to stop construction at the Apache/Navajo county line, as noted previously. On November 18, 1976, Art Maynard of U. S. Forest Service Regional Office in Albuquerque confirmed by phone to Al Colton of the Salt River Project that both supervisors had agreed to resume processing the draft environmental statement.

Please contact me should you have any further questions. It is my sincere wish that we may now proceed to completion and filing of the final environmental statement by the spring of 1977.

Very truly yours,

A. J. Pfister

cc: M. Jean Hassell
William K. Barker

Region 3
517 Gold Avenue, SW
Albuquerque, New Mexico 87102

2750
JAN 12 1977

Mr. Manuel Lopez, Jr.
Regional Director
U. S. Bureau of Reclamation
P. O. Box 427
Boulder City, Nevada 89005

Dear Mr. Lopez:

The Forest Service, as a member of the Coronado Station Project Federal Study Team, would like to document some of its concerns regarding Salt River Project's premature transmission line construction along links 4 and 5 and our subsequent failure to get a clear statement of position inserted into the environmental impact statement.

The Secretary of the Interior requested that the Forest Service become a member of the Federal Study Team in his letter of December 26, 1974. The Forest Service agreed to this and was assigned responsibility for the transmission line portion of the environmental statement. It was assumed that along with the responsibility for the preparation would come substantial control over the content and format. It did not work — out that way. We are very concerned over the deletion of certain wording in the draft statement dealing with SRP's early construction.

All members of the Federal Study Team agreed on the wording that was to be placed in the draft to explain the sequence of actions taken by the Study Team following our discovery of the premature transmission line construction. This wording also included the probable consequences — of the Company's actions. To us the deletion of this material seems inconsistent with the intent of the National Environmental Policy Act and the Secretary's request for us to participate in formulating the statement.

Mr. Leroy Michael, Assistant General Manager of Salt River Project, assured the Federal Study Team that Salt River Project would accept full responsibility for their action. The Forest Service agreement to proceed with the processing of the environmental statement was, therefore, contingent upon certain disclaimers being placed in the statement.

It is our present understanding that those portions of Chapter 1 and Chapter 3 that explain the probable consequences of SRP's premature construction have been deleted even though our agreement to proceed was

based on the inclusion of that material. We are entirely aware that the deletion was substantially predicated on the advice of your field solicitor and his feeling that its inclusion might heighten the chances of litigation and that it improperly drew a conclusion. However, we were also proceeding on the advice of our attorney who felt there was considerable value to be derived from a full disclosure of the facts and in a clear statement of the probable outcome. It was also our feeling that SRP probably made its own assessment of the legal implications before proceeding and the professed fear of opening the door to litigation came a little late.

We still strongly recommend that those passages be left in the draft statement as they reflect the situation as we see it, i.e., that Salt River Project's premature construction activity has the following consequences:

1. Precluded the opportunity for the public or other Governmental agencies to comment on the transmission line proposal and also for any alternatives, thereby appearing to circumvent the purpose of the National Environmental Policy Act.

2. Eliminated the Tucson Gas and Electric alternative "backup" interconnection as described in Chapter 3, H., 4.c.

Even though the early construction was all on non-Federal lands, it is felt that failure to point out the consequences of Salt River Project's actions may be interpreted as providing tacit approval for an easement across Federal lands prior to issuance of the Final Environmental Impact Statement. This could then be interpreted as a failure on our part to fully comply with the intent of the National Environmental Policy Act.

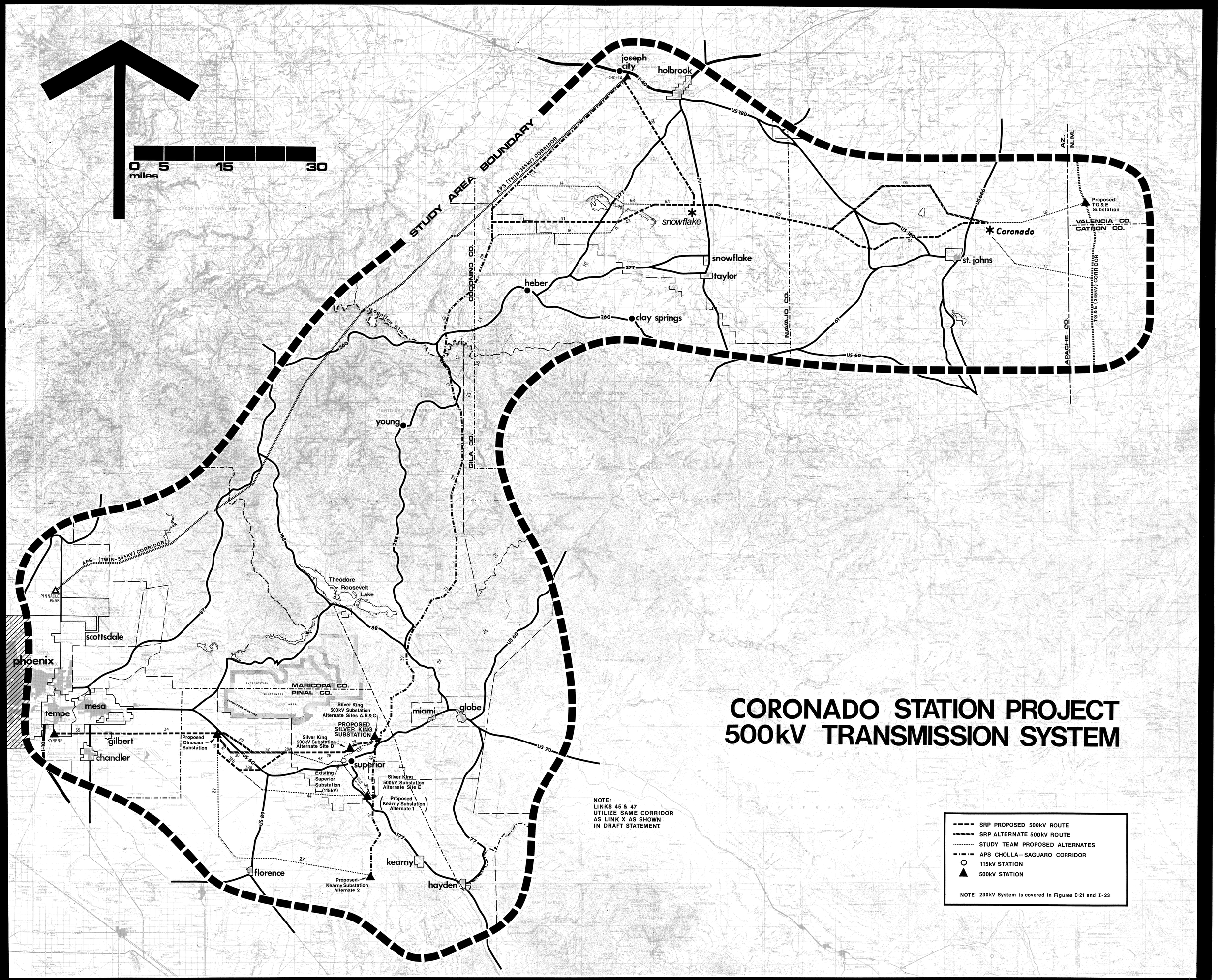
We request that you reconsider your decision to delete the above material from the statement, as we feel that this omission is not consistent with the team approach to the development of a full disclosure draft environmental statement.

Sincerely,

Thomas G. Schmeckpeper

M. J. HASSELL
Regional Forester

cc: Tonto
A/S
SRP, Attn: A. Colton



CORONADO STATION PROJECT 500kV TRANSMISSION SYSTEM