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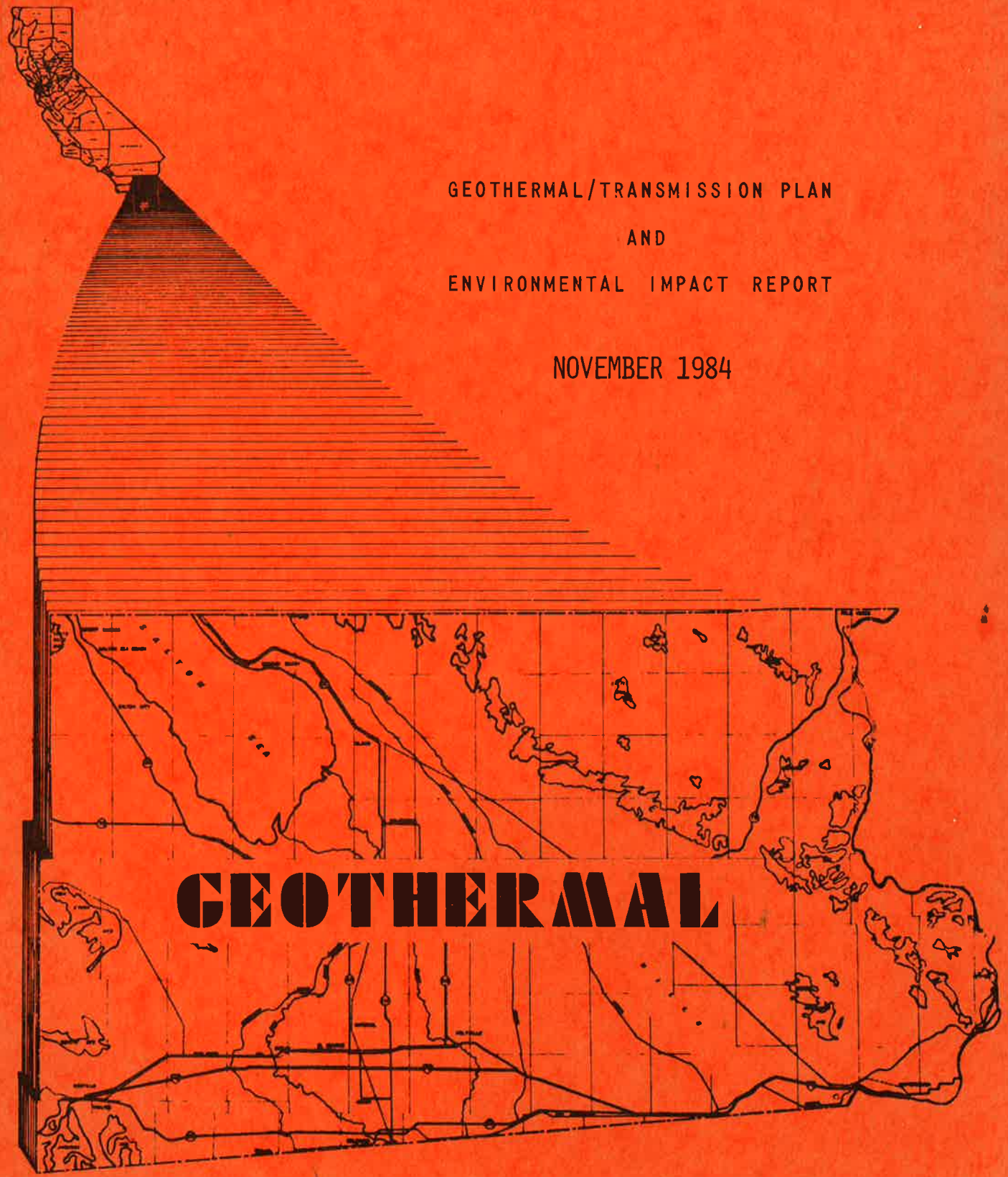
IMPERIAL COUNTY GENERAL PLAN



GEOTHERMAL/TRANSMISSION PLAN

AND

ENVIRONMENTAL IMPACT REPORT

NOVEMBER 1984

GEOTHERMAL

SCH #84032111

ENVIRONMENTAL IMPACT REPORT INDEX

EIR NAME	Imp. Co. Gen. Plan Geo/Transmission Elem.		
EIR TOPIC	Geothermal		
SCH. #	84032111	DATE NOV. 84	I.D. #
PROJECT NAME	Imp. Co. Gen Plan Geo/Transmission Elem		
PROJECT TYPE			
PROJECT LOCATION	Throughout Imp County		
SUP. DIST.		AREA	APN
CONSULTANT NAME	County of Imperial Planning Dept.		

This Plan is an integral part of the Imperial County General Plan. Basic data relative to the County is presented in a separate document entitled Imperial County General Plan: County Overview. The Overview document should be consulted for additional information.

Este Plan es una parte integra del Plan General del Condado de Imperial. Informacion mas detallada relativa al Condado se encuentra en un documento separado con titulo Plan General del Condado de Imperial: Perspectiva del Condado. Este documento debe ser consultado para mas informacion.

ACKNOWLEDGMENTS

We would like to take this opportunity to thank the many individuals who took the time to provide the Planning Department with technical information and review for this revision of the Geothermal Plan. We are particularly grateful for those who attended and participated in the Geothermal Plan Citizens Advisory Committee, the Industrial Advisory Committee, those attending the Scoping Meeting and various other meetings held for providing input for this update. Both federal and state agency staffers also provided their input and help.

Staff members involved in the support and preparation of this document are outlined in a later section. Without such support, the revising of the document would have been much more difficult. Finally, we would like to thank the various Department Heads of Imperial County that reviewed and had their staff comment on sections of this plan for their guidance and support.

DISCLAIMER

DRAFT

IMPERIAL COUNTY GENERAL PLAN

GEOTHERMAL/TRANSMISSION PLAN AND ENVIRONMENTAL IMPACT REPORT

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EXECUTIVE SUMMARY

Adoption of this geothermal portion of the County General Plan demonstrates the long term commitment by the County of Imperial for the promotion of management, use and development of its geothermal resource. The plan guides County staff activities, informs current and prospective developers of the resource and serves as a source of general information and reference for local residents as to the objectives, policies and goals of the County.

The geothermal plan includes in one document both the plan itself and the environmental impacts related to geothermal development in Imperial County thereby satisfying the California Environmental Quality Act.

The current projection is 3000 megawatts of geothermal development over a 30-year development period -- 1985 to 2015.

Policy Statements. A brief summary of the relevant policies are as follows:

> Preserve agricultural lands; conserve water; prevent subsidence; provide for transmission lines; maximize the resource; prepare environmental impact reports; promote and facilitate direct heat development; plan for economic, fiscal and social impact; provide appropriate zoning; inform the public; and monitor seismicity.

Please refer to Section III for a complete discussion of the policies relating to geothermal development.

Section VIII is a "Glossary of Terms."

I. INTRODUCTION

Introduction and Background

This revision of the 1977 geothermal plan is prepared in response to new state guidelines, modified projections, and is being amended in the "public interest" (Government Code Section 65356.1) This revision will also reflect new data and needs of the geothermal industry in Imperial County and provide an updated look at geothermal development since the previous plan was prepared.

The County of Imperial supports and encourages the development of geothermal resources in a manner compatible with the protection of agriculture and the environment. The County implements this goal by providing leadership, staff, liaison with other regulatory and permitting agencies and an effective set of plans, regulations and standards which facilitate the development process.

The objective of this revision is to provide a comprehensive document which contains the latest knowledge about the resource, workable development technology, requirements of law, and policies of other federal and state agencies.

The geothermal plan does not zone, regulate, provide staff, or tax. It does provide a data base, projections, county goals, policies, and implementation measures.

Imperial County is a national leader in the development of its geothermal resources. The County contains what may be the largest geothermal liquid-dominated resource in the world. It is the hottest, and at relatively shallow depths. Due to a variety of factors, geothermal development in the County has not progressed as rapidly as projected in 1977. However, when considering the significant impacts that other energy sources have

on the environment and mankind, the energy captured in the "Liquid-dominated" geothermal reservoirs can provide a relatively clean source of power.

Proposed Development

The analysis in this plan is based on the assumption that up to three thousand megawatts of electrical generation capacity is projected to be developed in Imperial County by the year 2015 (see Figure No. 2). An unknown number of direct heat uses are expected to be developed during this thirty year period. Most direct heat uses will probably be agriculturally-related and labor-intensive.

Authority for the Plan

Assembly Bill 2644, effective January 1, 1979, provides the legal basis and process for approving geothermal development in the State of California. The law defines three stages: exploratory, field development, and power plant. A geothermal plan or "element" is defined as follows:

> "Geothermal Element" means an element of a county general plan consisting of a statement of geothermal development policies, including a diagram or diagrams and text setting forth objectives, principles, standards, and plan proposals, including a discussion of environmental damages and identification of sensitive environmental areas, including unique wildlife habitat, scenic, residential and recreational areas.

The Imperial County geothermal plan is intended to meet the above definition and also satisfy the requirements for environmental documentation under the California Environmental Quality Act (CEQA).

Relationships of the Geothermal Plan

To Other Plans. State law mandates nine plans or "elements" for local government general plans. Although the geothermal plan is not mandatory, it must comply with requirements that are requisite to all plans within a general plan. Legislative intent must be fulfilled as set forth in Government Code, Section 65300.5:

". . . the General Plan and the parts thereof comprise an integrated, internally consistent and compatible statement of policies for the adopting agency."

To Other Factors. CEQA requires environmental documentation to be prepared for all general plans and elements in order to assess the impacts that might result from the policies adopted, and to suggest mitigation measures for those impacts. Section V contains the environmental documentation for this plan.

Social Factors: The plan demonstrates to County residents that County staff has analyzed applicable data, reviewed basic issues, developed specific goals and objectives, made reasonable assumptions, prepared policies which are clear and unambiguous and presented feasible implementation measures that have considered all environmental implications of local geothermal activities. This process must afford the fullest possible protection of the environment and public health and safety within the reasonable scope of the County's authority. Thus, the plan can increase public awareness of both positive and negative effects geothermal development can have in Imperial County.

Economic Factors: The plan discusses at length the potential direct and secondary benefits in Section II.

County Goals and Objectives. In 1977, the aim of the Geothermal Element was to:

(1) Guide "comprehensive long term, physical development." (Government Code Section 54300, et seq.)

(2) Describe a research, planning, and implementation methodology which can be used by areas experiencing comparable development.

(3) Provide a Plan to guide geothermal development in Imperial County.

(4) Provide an adopted plan which must be considered by State and Federal Agencies prior to authorizing development of the geothermal resource in Imperial County.

In 1975, a document entitled, "Imperial County Goals" outlined some goals for the development of the County's geothermal resource:

> "To encourage geothermal exploration and development projects in order to increase the store of knowledge surrounding this useful resource. To increase the store of knowledge of geothermal resources, to encourage and promote the beneficial development of minerals and other uses, and to assure that the development is compatible with agriculture and our environment."

Based on the above, goals, objectives and policies have been developed which are more fully detailed in Section III. The intent of this revised geothermal plan is to ensure that the geothermal resource underlying the County of Imperial is effectively managed, that the uses of today do not preclude the uses of tomorrow, and that the County will regulate and conserve this asset wisely.

II. DATA AND ANALYSIS

Description of the Resource

Geothermal Resources. "Geothermal Resources are the natural heat of the earth, the energy in whatever form, below the surface of the earth present in, resulting from, or created by, or which may be extracted from such products obtained from naturally heated fluids, brines, associated gases, and steam, in whatever form, found below the surface of the earth but excluding oil, hydrocarbon gas, or other hydrocarbon substances." (Public Resources Code, Chapter 1398, Section 6903).

Imperial County is situated in the Salton Trough, a structural depression which extends from the Transverse Ranges on the north to the Gulf of California on the south. The Peninsular Range forms the western border and the Colorado River the eastern border. The Salton Trough area in the County comprising approximately 3100 square miles is designated by the California Division of Mines and Geology as an area ". . . known . . . to be underlain at shallow depths . . . by thermal waters of sufficient temperature for direct heat application." Within this area are separate anomalies (KGRA's) of hotter fluids suitable for electrical generation. The entire County of Imperial is designated by the Division of Mines and Geology as a ". . . region . . . favorable for the discovery. . .of thermal waters. . ."

The Salton Trough represents an active spreading rift valley in which sedimentation has nearly kept pace with natural tectonic subsidence. The formation of the Colorado delta perpendicular to the Trough created a closed basin to the north that contains the Salton Sea and Imperial Valley. Through time, flow of the river has shifted between the north and south of the delta. Even though the river presently empties southward into the Gulf of California, the river has occasionally flowed through the centuries into the Imperial Valley for varying lengths of time.

One general feature consistent throughout the Trough is the thick clay-dominated strata (greater than 75 percent) extending downward from 1000 to about 3000 feet. This relatively impermeable clay along with layers of shale and volcanic rock forms a layer preventing brine from rising to the surface. The hot and hypersaline brine is very corrosive, especially in the Salton Sea resource area, where it exceeds 250,000 parts per million (ppm) of salts. Utilizaition of this brine has represented problems of scaling and corrosion. Large scale development depends on developing cost-effective technology to overcome technical problems in order to make geothermal development economically feasible.

There are currently nine (9) Known Geothermal Resource Areas (KGRA's) in Imperial County. A KGRA is designated by the United States Geological Survey and is defined as follows:

> "An area in which the geology, nearby discoveries, competitive interests, or other indicia would, in the opinion of the Secretary of the Interior, engender a belief in those who are experienced in the subject matter that the prospects for extraction of geothermal steam or associated geothermal resources are good enough to warrant expenditures of money for that purpose." (30 U.S.C. 1001)

The nine KGRA's are located throughout the county and they vary in temperature, pressure, and chemical composition of brine solutions found in each area. Map No. 1 details the KGRA's, the Geothermal Overlay Zones, and location of existing and proposed power plants.

The nine KGRA's:

> Salton Sea, Westmorland, North Brawley, South Brawley, East Brawley, Heber, East Mesa, Dunes, Glamis.
>
> These KGRA's total 347,941 acres in the County of Imperial, or almost 12 percent of the total County land area.

Map No. 2 provides a detailed overview of the state's known geothermal resource areas and shows where Imperial County is geographically located in relation to the rest of the state.

There are four designated Geothermal Overlay Zones ("G" Zones) in Imperial County. The four zones are Salton Sea, North Brawley, South Brawley, and Heber, totaling 62,000 acres. As development increases and new rezone applications made by developers, other "G" Zones may be designated.

Type of Resource and Temperatures

The chemical content of geothermal brine varies significantly throughout Imperial County. Chemical compositions of brine even from the same well can differ due to drilling through various stratigraphic zones.

The power plant design, type of emission abatement equipment and related facilities may be influenced by the type of resource encountered, the temperature, and chemical content of the brine.

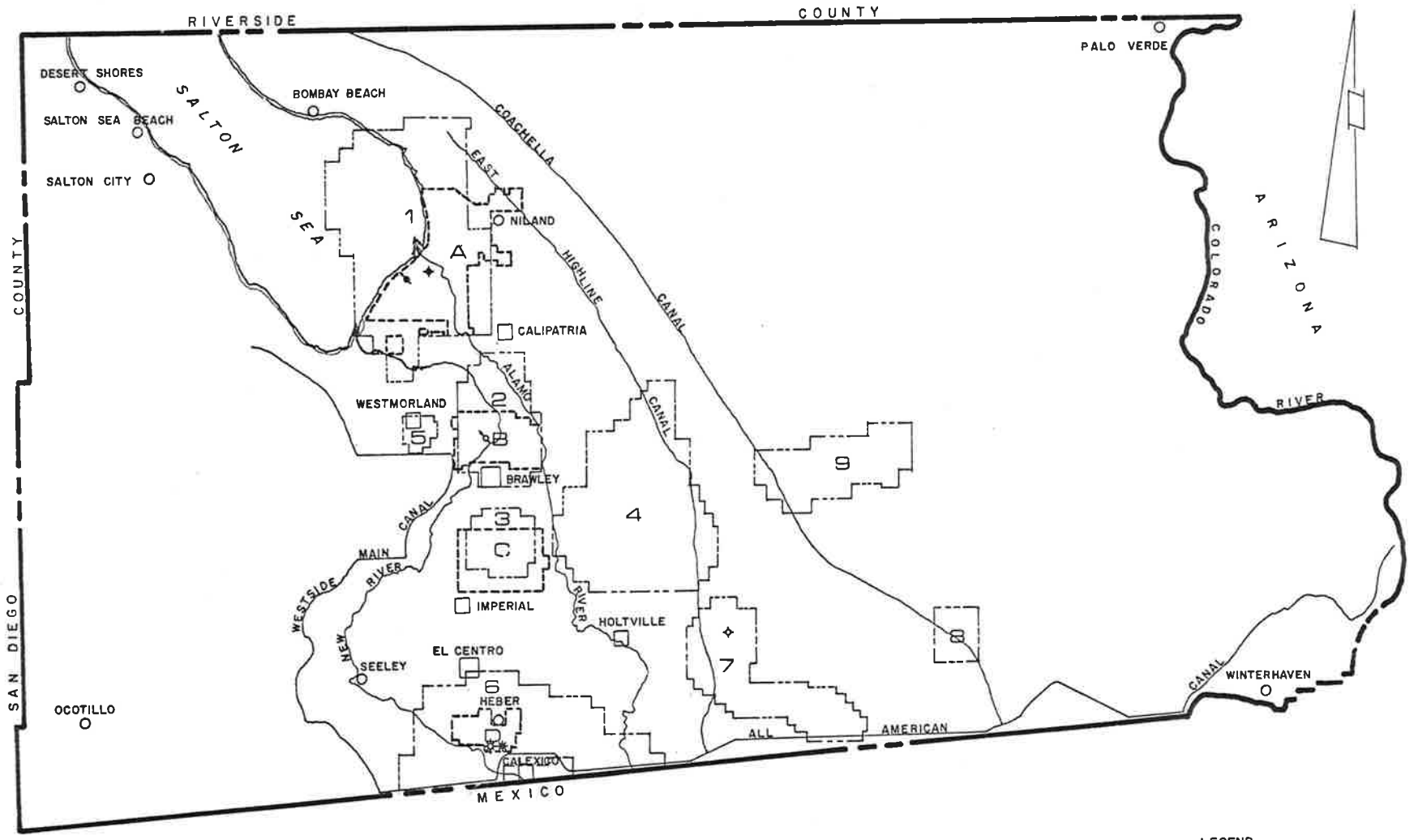
The rate of fluid flow for the production of electrical energy is largely a function of the temperature of the geothermal fluids. The geothermal fluids in the Salton Sea and Brawley "G" zones have a higher temperature and can produce electricity with a lower flow rate than the Heber and East Mesa anomalies.

Figure no. 1 provides a detailed analysis of the typical resource temperature in each of the nine KGRA's. The figure also indicates the various depths at which wells have been drilled and the total dissolved solids (TDS) in parts per million for each area.

Temperatures range from a low of 250°F in the Glāmis and Dunes KGRA's to over 600°F in the Salton Sea KGRA.

Typical brine chemistry is shown on Figure 9.

MAP NO. 1 IMPERIAL COUNTY GEOTHERMAL RESOURCES



KGRA's PLANNING SCENARIO

1	SALTON SEA	1400 MW's
2	NORTH BRAWLEY	550 MW's
3	SOUTH BRAWLEY	150 MW's
4	EAST BRAWLEY	
5	WESTMORLAND	
6	HEBER	500 MW's
7	EAST MESA	100 MW's
8	DUNES	
9	GLAMIS	

GEOTHERMAL ZONES

A	SALTON SEA
B	NORTH BRAWLEY
C	SOUTH BRAWLEY
D	HEBER

GEOTHERMAL POWER PLANTS

EXISTING

10 MW	SALTON SEA
10 MW	NORTH BRAWLEY
10 MW	EAST MESA

UNDER CONSTRUCTION

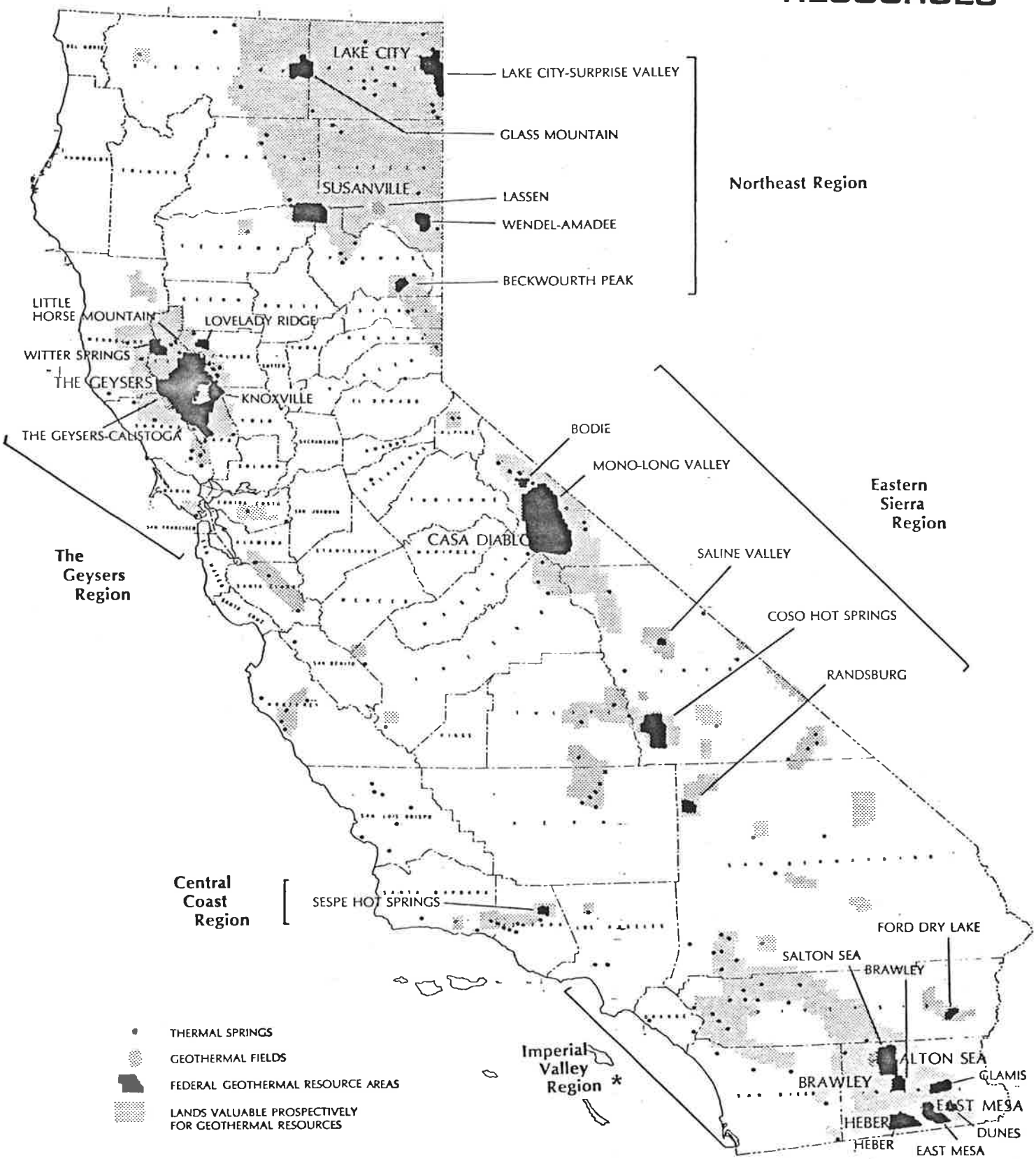
35 MW	SALTON SEA
45 MW	HEBER
47 MW	HEBER

LEGEND

- CITIES
- TOWNSITES
- KGRA's (Known Geothermal Resource Area's)
- GEOTHERMAL ZONES

MAP NO. 2

CALIFORNIA'S KNOWN GEOTHERMAL RESOURCES



California thermal springs, geothermal fields, Geothermal Resource Areas, and lands valuable prospectively for geothermal resources.

Locations for thermal springs from *U.S. Geological Survey Professional Paper 492 (1965).* Locations for Geothermal Resource Areas and lands valuable prospectively for geothermal resources from the Jet Propulsion Laboratory report, *Geothermal Energy Resources in California: Status Report for ERCDC (1976)*

*Since this map was published the East Brawley, South Brawley, and Westmorland KGRA's have been designated. Source: California Division of Oil and Gas, 1983.

Estimate of Resource Magnitude

Heat in the Resource. Total heat in storage is estimated to be 20×10^{19} joules (90×10^{16} BTU's). Fifteen percent of this heat is in the fluid, eighty-five percent is in the rock. Recoverable fluids are estimated at over 250 million acre-feet. Of this amount, 200 million acre-feet have temperatures over 302°F.

The Imperial Valley resource is heated by the earth's core at the rate of 5×10^{16} joules per year. Approximately 3.14×10^{14} joules are required to produce one megawatt of electricity for a year. The 3000 megawatt development scenario will consume 9.4×10^{17} joules per year. The injection and recycling of fluids enhances the recovery of heat stored in the rock, but geothermal energy, like fossil fuels, would be used up faster than it is replaced and should be considered a non-renewable resource.

The 1977 element estimated that 4500 megawatts of electricity could be generated by the year 2020 from four anomalies, i.e. Salton Sea, Heber, Brawley and East Mesa. The 4500 MW's of electricity was estimated then to utilize only 15 to 20 percent of the available resource. The remainder was projected for non-electrical purposes.

However, because of relatively lower costs for other energy sources, geothermal development projections are now significantly lower than those in 1977. An increase in cost of fossil fuel and/or improved technology could accelerate development.

Economics of Production. Some of the factors which limit production are: operating costs remaining high, a slower rate of growth in utility company demand, and relatively lower costs for oil resulting in a temporary surplus of conventional energy supplies. The following production estimates appear now to have been very optimistic.

FIGURE NO. 1

GEOTHERMAL RESOURCE OVERVIEW

The following table provides a current assessment of the various anomalies in Imperial County:

Name of KGRA @	Acreage**		Typical Resource			Production Permits			
	KGRA	"G" Zone	Depth	TDS	Temp.(F)°	Est. MW***	Permitted	Constr.	On-Line
1. Salton Sea	102,887	26,000	4000'	250,000	600°	1400 MW	143	35	10 MW
2. North Brawley	28,885	14,000	7000'	150,000	525°	550 "	10	--	10 MW
3. South Brawley	12,640	15,000	13,500'	250,000	500°	150 "	49	--	---
4. East Brawley	70,211	---	12,000'	150,000	400°	---	--	--	---
5. Heber	58,568	7,000	6,000'	14,000	360°	500 "	92	92	---
6. East Mesa	38,365	---	6,000'	7,500	350°	100 "	79	--	10 MW
7. Westmorland	3,200	---	7,000'	26,000	325°	--	--	--	---
8. Glamis	25,505	---	5,000'	---	250°	---	--	--	---
9. Dunes	7,680	---	4,000'	---	250°	---	--	--	---

***300 MW's not assigned to any specific KGRA.

**Total KGRA acreage is 347,941 with 18% zoned "G" for geothermal development.

@ The California Division of Oil and Gas has designated five geothermal fields in Imperial County: Brawley, Heber, East Mesa, Mesquite, and Salton Sea.

Key:

KGRA - Known Geothermal Resource Area

"G" Zone - Geothermal Overlay Zone

TDS - Total Dissolved Solids

Constr. - Under Construction

MW's - Megawatts

FIGURE NO. 2

PROJECTED GROWTH LEVELS

YEAR	LAWRENCE LIVERMORE (1977)			DR. JEFFERY WEIGAND (1977)	CALIF. ENERGY COMM. (1977)	INTERAGENCY TASK GROUP ESTIMATE (1978)	CURRENT PLANNING ESTIMATE (1984)*
	LOW	MEDIUM	HIGH				
1980			100	150			
1982		100	400				
1985		400	1000	700		500	150
1986	100						
1990				1650	1400	1900	500
1991		1000					600
1994	400						900
1995			3000	4950	3100	3600	1000
2000				6150	6000	4100	1500
2005							2000
2010	1000	3000					2500
2015							3000
2020			8000				

*Two 50 MW plants per year projected by the Planning Department commencing in 1990. The estimates projected do not preclude additional development should economic conditions warrant accelerated development.

Description of Development

History

The usage of California geothermal resources started at many of the hot springs found throughout the state. At these springs, Indians and then later settlers gathered to use and enjoy the warm waters. By the late 1800's, some hot springs were commercialized.

Surface geothermal phenomena has been noted in Imperial County for many years. The famous "mud pots" of the Salton Sea, steam fumaroles, and boiling springs were observed near Mullet Island which is a volcano that erupted about 16,000 years ago.

In 1905, the Colorado River broke through earth closure works in a newly constructed intake channel and waters from the river flowed into Imperial and Coachella Valleys for more than a year. The uncontrolled water formed the Salton Sea. Many of the "mud pots" and other natural phenomena were covered, but their manifestations are visible on the sea's surface in a number of locations.

The initial attempts at utilizing the underground resources of the County commenced when three wells were drilled on Mullet Island in 1927-1928 by the Pioneer Development Company exploring for the Southern Sierra Power Company. The deepest well was drilled to 1,473 feet and reached a maximum temperature of 245°F. All three wells produced steam, hot water, and noncondensible gases; however, steam pressures and volumes were not considered sufficient for commercial use, and the wells were abandoned.

While these wells were being sunk, large quantities of carbon dioxide gas was produced. This led to the formation of the Salton Sea Products Corporation which began exploring for carbon dioxide gas. In 1932,

the discovery well for the Imperial Carbon Dioxide field was drilled about a mile northeast of Mullet Island. The field produced commercial carbon dioxide gas from 1933 to 1954, and the gas was recovered from shallow sands 200 feet to 700 feet deep. Two plants were built in the field to convert the carbon dioxide to dry ice. The field was abandoned in 1954 because of depletion of the producing sands, the rising level of the Salton Sea, and the development of modern refrigerated transport systems.

In 1957, Kent Imperial Corporation drilled "Sinclair" 1 which is considered to be the discovery well for the Salton Sea Geothermal field. This well produced substantial amounts of geothermal fluids. It was drilled as an oil well to 4,725 feet. When it was tested, it produced hot water and steam. A small pilot electrical generation plant was installed at the wellhead in 1959. However, this test facility was shortly abandoned due to the deposition of minerals on the equipment forcing a shutdown.

The first geothermal exploratory well intended to locate a resource was "Sportsman" 1, by Joseph I. O'Neill, Jr. It was drilled in 1961 to 4,729 feet, about 4 miles northeast of "Sinclair" 1. From 1961 to 1964, 10 more geothermal wells were drilled in the vicinity and 8 produced geothermal fluids. The mineral content of these wells was very high occasionally reaching concentrations of over 300,000 ppm total dissolved solids. The brine was slightly caustic, and production was hampered by severe corrosion and scaling.

The Morton Salt Company (Imperial Thermal Products, Inc.) and Union Oil Company erected small pilot plants in an effort to extract minerals from the brine. After a few years of experimentation with brine and electrical production, these ventures were terminated as uneconomical.

From 1965 to 1970, the University of California at Riverside conducted an intensive investigation of the Imperial Valley. The research culminated in a report entitled, "Cooperative Geological-Geophysical-Geochemical Investigations of Geothermal Resources in the Imperial Valley Area of California", dated July 1, 1971. This program was supported by many organizations, including the U.S. Bureau of Reclamation, the National Science Foundation, Standard Oil Company of California, the Chevron Oil Field Research Company, the Imperial Irrigation District and the United States Department of Energy.

Since 1912, when G. Hoyt drilled a 6" well approximately 475 feet deep, Imperial County has had numerous entrepreneurs, oil companies, and private landowners drill wells throughout Imperial Valley searching for viable economic resources such as oil, gas, geothermal resources, and minerals. This search continues today with exploratory applications being made for various purposes in Imperial County.

Numerous studies through the years have been made of the resource and the resource characteristics in the Salton Trough including: temperatures and temperature gradients, ground levels and slopes, seismicity, isotopic studies of groundwater and hydrology of underlying waters, gravity anomalies, magnetic anomalies and stratigraphic geology.

Existing and Proposed Land Use

There are three 10 megawatt plants now producing electricity in Imperial County. Magma Power Company is operating a binary plant on federal land in the East Mesa. Union Oil and Southern California Edison with other investors have two flashed-steam plants operating at North Brawley and at the edge of the Salton Sea. As of July 1984, there are two plants (binary and flash) being constructed in Heber and one plant (flash) at the Salton Sea.

A typical 50 megawatt power plant will require 34 acres, i.e. approximately .68 acres per megawatt. This includes the plant site and associated production and injection well field development.

With a projected megawatt scenario of 60-fifty megawatt plants being built in the next thirty years, approximately 2000 acres of land will be used, most of which will be farm land, but some of which may be desert, reclaimed sea bed, or non-productive farm land.

Non-electric applications and uses may also affect land use in Imperial County, but at this point the extensiveness of these uses are unknown.

Private Land Development

There are numerous governmental entities which monitor and control all aspects of geothermal exploration and development in Imperial County. These entities include federal, state, and local agencies, and they often have similar responsibilities. The agency identification and brief descriptions presented here and in the following sections are intended to clarify the interrelationship of the various governmental levels and entities.

Each of the public agencies having discretionary approval power exercise their discretionary power through the use of permits. For the purpose of implementing their environmental responsibility, the permits issued by such agencies may include:

(1) any condition or stipulations deemed necessary by that agency, including appropriate mitigation measures within the statutory jurisdiction of the agency; and,

(2) a monitoring program capable of assuring the permittee's conformance with all such conditions or stipulations.

Imperial County is the local governmental entity which exercises jurisdiction over geothermal development on private and state lands outside of incorporated cities. The County is lead agency for all exploratory and test projects, and for power plant production projects generating less than 50 megawatts (net capacity). The California Energy Commission (CEC) regulates all power plants over 50 megawatts net.

The County regulates the use of land for geothermal purposes through zoning and conditional use permits (CUP's). The Geothermal Overlay Zone is adopted by ordinance. Exploratory, test, and production projects are approved by conditional use permit. The County acts as the "lead" agency in the preparation of environmental documentation. All projects,

including geothermal, must meet the requirements of the California Environmental Quality Act (CEQA). State law designates the Division of Oil and Gas (DOG) as "lead" agency for CEQA purposes for geothermal exploration projects. Although DOG exercises this authority in other counties, they have designated Imperial County to perform that function for them here.

According to CEQA Guidelines, a lead agency is one which has the "principal responsibility for carrying out or approving a project. . ." The lead agency prepares the environmental document for the project either directly or by contract. A responsible agency is a public agency which also has discretionary approval power over the project, but uses the environmental documentation prepared by the lead agency.

There are three basic types of environmental documentation: Notices of Exemption, Negative Declarations, and Environmental Impact Reports (EIR's). EIR's can be comprehensive Master or Program EIR's or narrowly focused site specific EIR's.

A geothermal permit is a land use permit. The permit does not authorize a person or corporation to drill a well or build a plant, but it does authorize a specific parcel of land to have wells drilled or to have plants built upon it. The permit runs with the land, and the project cannot be moved to another location without a separate application and environmental analysis prepared and approved.

Imperial County has adopted several Master EIR's for the major geothermal anomalies. These are useful base documents and reduce documentation for subsequent projects within that geothermal area. The County must adopt "certification" that a MEIR is adequate for each project. Site specific analysis is also prepared for any new project.

The County exercises authority over all phases of geothermal development on private and state lands and the various permits may be issued on a "project-by-project" basis. All permits require developers to conform with all County regulations as well as regulatory conditions established by other permitting entities.

The Planning Department is responsible for administering the County's General Plan, enforcing zoning ordinances, issuing building permits, and processing geothermal permits. A normal processing time for these permits:

(1)	Notice of Exemption	10 days
(2)	Exploration CUP	1 to 6 months (depends on project)
(3)	Production CUP	12 months
(4)	Rezoning	6 to 18 months
(5)	Building Permits	30 days

Numerous permits are required to bring a project from the first exploratory well to the full field development and power plant phase. A project may not be required to have more than one discretionary permit from the County, but an applicant may sometimes develop a "project" in phases and submit each phase as a separate project. All permits have conditions outlining construction, operation, and monitoring requirements specific to that permit. County permits are not for an unlimited period of time and may expire if not used, or if a specific time limit is included as a condition.

Ministerial permits are those granted without exercise of personal judgement or discretion. These are issued after staff evaluation ensures that a project meets the standards and conditions outlined in the statutes. There are approximately twenty-one ministerial permits from the following: Building Inspection, Fire Department, Road Department, State Department of Industrial Relations, State Department of Transportation, and Federal Communications Commission.

As of July 1984, the County had issued 129 geothermal exploratory permits for 346 wells. In addition, 147 wells had been authorized in connection with power plants, for a total of 493. Of wells permitted, approximately 132 have been drilled and 39 abandoned with the remaining 93 available.

Throughout the County over 1,000 minor geothermal wells to measure temperature gradients have been drilled. Most of these have been abandoned. "Abandoned" means the regulated process for filling in, sealing off, and restoring the site to a permanent and safe condition.

Figure No. 3 provides a detailed assessment of the status of geothermal development in Imperial County.

FIGURE NO. 3

GEOTHERMAL PROJECTS*
IMPERIAL COUNTY

KGRA	MW SIZE	TYPE	OWNER/OPERATOR	STATUS	CUMULATIVE
East Mesa	10	Binary	Magma Power Company	Operating	10
	69	Hybrid	Republic Geothermal, Inc.	Authorized	79
Salton Sea	10	Flash	SCE/Union Oil Company	Operating	89
	35	Flash	Magma Power Company	Construction	124
	49	Flash	Magma Power Company	Authorized	173
	49	Flash	Niland Geothermal Inc.	Authorized	222
Heber	45	Binary	SDG&E/IID/Others	Construction	267
	47	Flash	Heber Geothermal Company	Construction	314
North Brawley	10	Flash	SCE/Union Oil Company	Operating	324
South Brawley	49	Flash	MCR Geothermal Corporation	Authorized	373

SCE - Southern California Edison
IID - Imperial Irrigation District
SDG&E - San Diego Gas and Electric

*There are other projects which are direct heat applications pending approval and are not listed above. The projects above are those which generate electricity, and may or may not become involved in direct heat uses.

Source: Richard D. Mitchell, Planning Director
Presentation to Annual Geothermal
Conference, May 3, 1984.

State Land Development/Agency Involvement

o The State Lands Commission (SLC) has jurisdiction over the development of mineral resources beneath state lands including those lands owned by other agencies. There are approximately 40,000 acres of state-owned lands in the County of Imperial (about 1.3 percent of all lands in the County). It is estimated that at least 5000 acres may have commercially valuable amounts of geothermal resources.

The type of ownership ranges from lands where the state owns both the surface and mineral rights to lands where the state has sold the surface rights but retained the mineral rights.

The State Lands Commission does not preempt the County in permitting geothermal activities on state lands. A proposed developer on state lands must obtain permits from and comply with all regulations of the County of Imperial.

Issuance of geothermal permits and leases are handled from the SLC's Sacramento office, i.e. applications for permits, issuance of leases and on-going lease management activities.

There are four methods of using state land for geothermal activities:

(1) Nonexclusive Geothermal Exploration Permit. This permit is issued for preliminary geotechnical information gathering. Activities may include geophysical, geological and geochemical exploration including the drilling of temperature gradient holes. The permit is for a period of 18 months and does not give the permittee any future production or lease rights. This permit does not normally require any environmental documentation since it is for information gathering, without major environmental impacts.

(2) Geothermal Prospecting Permit. This permit gives the developer the exclusive right to explore the permit area for a period of two years

with a possible two year extension. If a geothermal resource is discovered in commercial quantities the permittee may have a preferential right to a lease under terms agreed to before issuance of the permit. The permit allows drilling of deep exploratory wells and requires environmental impact documentation. This may range from a negative declaration to an EIR depending on the nature, scope and severity of the impacts of the project. The permit requires the drilling of at least one well during the term of the permit and provides for an escalating annual rental of $1.00 per acre the first year, $5.00 the second year and $25.00 per acre during any extension until a well has been drilled. This permit is generally issued in areas where the existence and nature of the resource is less well known.

(3) Leasing by Competitive Bidding. Generally, these leases are issued in areas where the existence and nature of the resource is well established. Royalty may range from ten percent to sixteen and two-thirds percent of gross revenue from the sale of steam and bidding may be on the basis of cash bonus, net profits, or other factors. The lease requires that a well be drilled within three years of the effective date. This method of leasing has not taken place in Imperial County as of June 1984.

(4) Negotiated Leasing. The Commission may issue negotiated leases in two instances:

(a) If the resource is to be utilized entirely for purposes other than electrical generation.

(b) If the Commission finds:

1. Wells drilled upon private or public lands are draining or may drain geothermal resources from State-owned lands;

2. The lands are determined to be unsuitable for competitive bidding because of such factors as their small size, irregular configuration, or inaccessibility from surface drill sites;

3. The state owns a fractional interest in the lands; or

4. The lease is determined by the Commission to be in the best interests of the state.

The state has issued one such lease in the County of Imperial.

o California Energy Commission (CEC) has the following authority.

Role:

- Policy: To maximize the use of geothermal energy to generate electricity and to promote the use of direct heat.

- Permits: The CEC certifies the construction of power plants with a capacity to produce more than 50 megawatts (net) or greater.

- Environmental: The CEC is lead agency for preparation of the EIR for projects they approve. They comment on EIR'S prepared by other agencies as appropriate.

o The California Division of Oil and Gas (DOG), Department of Conservation, will:

"exercise its power and jurisdiction to require that wells for the discovery and production of geothermal resources be drilled, operated, maintained and abandoned in such manner as to safeguard life, health, property and the public welfare, and to encourage maximum recovery." (Public Resources Code, Section 3700, Chapter 4, Division 3).

DOG preempts local agency surface regulations which might interfere with state subsurface regulations.

- Permits: DOG issues permits for a variety of operations pertaining to wells or well sites - drilling, redrilling, reworking, abandonment, injection well programming, and drill site construction.

- Regulatory: Supervises all wells on non-federal land during all phases - drilling, operation, maintenance and abandonment.

- Environmental: DOG has delegated its environmental review authority to the County of Imperial for exploratory projects. DOG also comments on EIR's prepared by the County.

o Public Utilities Commission (PUC) has no specific policy regarding geothermal energy, but has gone on public record in support of the development of geothermal resources.

Role:

- Permits: The PUC issues a "Certificate of Public Convenience and Necessity" for the construction of thermal power plants with a capacity to produce more than 50 megawatts (net). The PUC is concerned with the rate structure of utilities and therefore bases the certificate on the economic feasibility of the plant.

  Regulatory: The PUC has continuing jurisdiction over the use and operation of power plants certified by it. The PUC has jurisdiction over electrical transmission lines designed to operate in excess of 200 kV.

o State Water Resources Control Board (WRCB) has no specific policy on geothermal energy, but plays the following role.

Role:

- Regulatory: At various stages, the State Water Resources Control Board, through the Regional Water Quality Control Board, is responsible for any discharge or action that could adversely effect the surface or ground water of the State. The WRCB grants water right permits for the use of surface waters or subterranean streams.

- Environmental: The Board will act as either a Lead Agency or Responsible Agency pursuant to CEQA for all projects which involve the granting of appropriative water right permits and petitions.

o Regional Water Quality Control Board (RWQCB), Region 7, has the following role in the permitting and regulatory process.

Role:

- Permits: RWQCB issues permits regulating discharges that could affect water quality. The quality and quantity of any surface discharge of fluid, including the quality and disposal methods of fluids from drilling operations and waste from outside sanitary facilities.

- Regulatory: Administers and regulates all water quality matters within its specific geographic area. The RWQCB enforces the standards set by the state WRCB.

- Environmental: The RWQCB normally acts as a responsible agency on geothermal projects and reviews and comments on environmental documents.

o The Imperial County Air Pollution Control District (APCD) has discretionary authority as follows:

Role:

- Permits: The Air Pollution Control District issues two kinds of permits; 1) a permit to construct based on submission of construction plans showing how emissions are to be controlled; 2) a permit to operate issued following an inspection of the facilities.

- Regulatory: The APCD sets and enforces regulations for achieving and/or maintaining the air quality standards set by the State Air Resources Board and the U.S. Environmental Protection Agency.

- Environmental: Designated as a responsible agency, the APCD must review and approve environmental documents according to its own standards.

o The State Department of Fish and Game has an interest in geothermal development as follows:

Role:

- Regulatory: Has authority over water course alteration and fish and wildlife.

- Environmental: Is designated as a trustee agency and therefore comments on the draft EIR prepared by the lead agency.

o Imperial Irrigation District (IID) plays an important part in the development of geothermal energy in Imperial County as follows:

Role:

- Authorization: IID was organized on July 25, 1911, following a favorable vote at an election held on July 14, 1911 and made effective by resolution by the Board of Supervisors of Imperial County on July 24, 1911. The District was authorized under the California Irrigation Act to acquire the rights and property of certain water companies. IID is a ". . .public corporation for municipal purposes. . ." (Water Code, Division, 11 Section 20500, et seq)

- Coordination: IID has a positive and cooperative working relationship with the developing geothermal industry providing water, electricity for initial operation, and the "wheeling" of power generated to points outside the County.

Federal Land Development

The U.S. Department of Interior, Bureau of Land Management (BLM) office in El Centro has jurisdiction over 1.4 million acres of federal land including portions of San Diego County. Federal law preempts any County regulation over geothermal activities on federal lands. Federal lands comprise approximately 50 percent of all lands in Imperial County.

Geothermal operations on federal lands are governed by the Geothermal Steam Act of December 24, 1970 (Public Law 91-5810). Surface management of all geothermal activities is provided by the Act and the regulations codified under 43 CFR 3200, and seven Geothermal Resource Operations Orders which were issued by the U.S. Geological Survey.

> Policy: To provide management of public lands in a ". . .manner which recognizes the nations's needs for domestic source of minerals (e.g. steam). . .protect the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archaelogical values". (Federal Land Policy and Management Act of 1976).

The local BLM office has leased approximately 98,000 acres of federal land in Imperial County. In the East Mesa KGRA there have been fifteen leases granted.

Prior to geothermal development on any federal lands, the U.S. Department of Interior, Bureau of Land Management, prepares an Environmental Impact Statement (EIS) on the use of these lands for geothermal activities under its California Desert Conservation Area Plan, 1980. This master plan covers approximately 12.3 million acres of land under federal jurisdiction in the California desert area.

Before lease tracts are released for bid and development, an EIS or Environmental Assessment Report (EA or EAR) is prepared. This report more specifically describes potential site-specific environmental concerns and mitigation considerations for the lease tract. The regulations implementing

the Geothermal Act also require that an environmental baseline study be conducted and regular environmental monitoring program must be maintained when operating.

The geothermal developer must prepare a proposed Plan of Operations, which must be approved by the district office of the BLM. This plan is prepared, submitted and reviewed in stages. The plan details the work that will be followed in preparing the well pads, drilling the wells, exploring for a viable steam resource, and utilizing the resource. The BLM reviews the plan and, after making any necessary changes, approves it. When reviewing the plan, the BLM may consider any state or local ordinances which may be pertinent and require that the geothermal developer's plan comply with them.

Within the County's nine KGRA's, the federal government retains the mineral rights to some lands under private surface ownership. These lands could have been acquired under the 1916 Stock Raising and Homestead Act. The court has opined that the acquisition of surface rights does not include ownership of the geothermal steam. The right to explore and develop the steam on these lands is thus subject to the same management and controls as that on other federal lands. The BLM has the same responsibilities with lease revenues and steam royalties subject to a 50:50 split between the federal and state governments. As the direct result of Assembly Bill 1905, passed and adopted in 1980, 40 percent of the state's share of the money collected from leases is returned to the county in which the federal lease is located.

Figure No. 1 on page 12 outlines the federally designated KGRA's which total 347,941 acres in Imperial County. Out of this total acreage, approximately 18 percent is currently zoned "G" for geothermal development.

The East Mesa KGRA is largely under federal jurisdiction and fifty-five wells have been permitted.

As proposals for power plants are submitted, BLM will focus on the same factors as those considered for development on private and state lands such as:

(1) Consistency with the Desert Plan, including designated and proposed planning corridors;
(2) Protection of air quality;
(3) Impact on adjacent wilderness and sensitive resources;
(4) Visual quality;
(5) Fuel sources and delivery systems;
(6) Cooling-water source(s);
(7) Waste disposal;
(8) Seismic hazards; and,
(9) Regional equity.

Military Use of County Lands. The Department of the Navy operates the Naval Air Facility which was established in the mid-1940's. Disposition and leasing of lands for geothermal development falls under the provisions of the Military Construction Act of 1979 which grants each military department the right to use and benefit from geothermal resources.

Range lands, used by the Navy for aerial weapons training activities, are controlled through a number of land use instruments, some of which allow for geothermal development and compatible use where practical. It does not appear that there are commercially viable geothermal fields on lands in West Mesa. There are no federal KGRA's in that area and BLM's study of the area indicates that potential for geothermal development is relatively low.

Due to uncertainties regarding the economic feasibility of developing the Glamis KGRA and the unknown potential of West Mesa, there may not be any significant impacts on Naval military operations in Imperial County due to geothermal development.

Typical Exploratory Phase

This section provides a generalized view of the different activities which may occur in the search and development of geothermal resources for both power and direct heat uses. There may be many variations, and depending on the success of each previous activity, all or only some of the activities may be conducted.

Initial Exploration Stage. Initial studies and activities are not surface-oriented and have no impact. These studies include literature review, broad geologic studies, aerial photography, and possibly airborne magnetic surveys. Geological mapping provides for an understanding of local geology and may be done by foot or off-road vehicle (ORV). Collections of soil, rock, or water samples from various points in the region may be taken for analysis.

Geochemical studies include water sampling to determine fluid chemistry and temperatures and soil/rock analysis regarding geochemical make-up with age dating analyses if required. These samples are normally collected in small bottles.

Geophysical surveys attempt to determine information about subsurface temperatures, geologic structures, composition of substratum and other resource data. These surveys can be gravity, magnetic, resistivity, magnetotelluric, radiometric, passive seismic or active seismic studies. In each of these survey methods, a number of vehicles and people are needed and temporary access roads may be necessary.

Shallow temperature holes are drilled to measure thermal gradients. These holes, two to four inches in diameter, are usually no more than 500 feet deep. These are spaced two to five miles apart. Spacing will be reduced as exploration continues. The hole is drilled, a plastic tube

is placed in the hole, filled with water, capped and allowed to remain undisturbed for about a week. A temperature device is then used to gather water temperature readings at various depths. Temporary access roads may be needed and a clearing of about 900 square feet is necessary for the drill site. This type of drilling is normally completed in one day by truck-mounted rigs. After measurements are taken, abandonment of these gradient holes is done according to legal requirements.

Observation holes may be drilled for further information about the subsurface geology. These may be as large and deep as regular production wells (described below). Some may be drilled from truck-mounted rigs. These wells are flow tested to assess the reservoir and brine characteristics. Sumps, tanks and brine handling equipment is installed. One to three acres may be occupied during the drilling and testing period.

Once the preliminary exploration stages are complete, and results encouraging, drilling starts to develop the resource. This involves construction of a road, drill pad, well cellar, and sump. The existing infrastructure of roads in Imperial County is generally adequate, but roads may be improved to carry heavier loads, withstand more constant traffic, and function year-round as necessary. The drill pad area must be leveled and cleared of vegetation large enough to accomodate the drilling rig and accessories, temporary structures, and crew parking. The required space must provide room for service and delivery vehicles. A reserve pit called a "sump", is necessary for waste fluids and drill cuttings with the size of the sump depending on the expected depth of the well. The sump must be designated to provide adequate containment (from 1 to 2 1/2 acre-feet), subject to the requirements of the RWQCB. Large "Baker" tanks are sometimes used instead of a sump.

Drilling Procedures. After the road, drilling pad, cellar and sump are completed, a 26" to 36" hole is drilled with an auger to a depth of 50 to 100 feet and a 20" to 30" conductor pipe is inserted and cemented to the surface.

The drill rig may stand over 100 feet high and may have a variety of accessories generally assembled together on the site. Accessories may include: mud tanks for mixing and/or storing drilling mud, blowout prevention equipment, compressors, pipe rack for storing pipe sections (usually 30 foot segments) mud pumps, engines of up to 1000 horsepower, facilities for cooling drilling mud during later stages of drilling, fuel tanks, and water tanks. Ancillary equipment used periodically include large cement pumping trucks, cement trucks, and mud hauling trucks. Trailers, office and storage buildings may be located in the immediate vicinity. See figures 4 and 5 for a detailed view of a typical rig and accessories.

Personnel requirements include geologists, supervisors, subcontractors and information loggers. Service personnel include delivery and specialized service personnel and may number 10 to 15. A drilling rig crew can total from 17 to 22 with no more than five to ten on-site at any one time. The total rig work force during drilling can range from 27 to 37 people.

Drilling operations proceed 24 hours per day, seven days a week until the required depth is reached. An estimated 12 to 50 days or more may be required to drill each well, depending on work loads, scheduling, depth of well, and any problems encountered. Well drilling operations, including drilling, casing the well, installation of blowout protection equipment, and tests, and abandonment are regulated and inspected by the California Division of Oil and Gas.

A rotary drilling rig is most commonly used with mud as the circulating medium. Drilling mud removes cuttings from the hole, controls subsurface pressure, cools and lubricates the drill bit and pipe, prevents bore hole walls from caving in, releases drill cuttings at surface, prevents formation damage, provides maximum information from formations penetrated, suspends cuttings when circulation stops, and supports weight of drill string and casing.

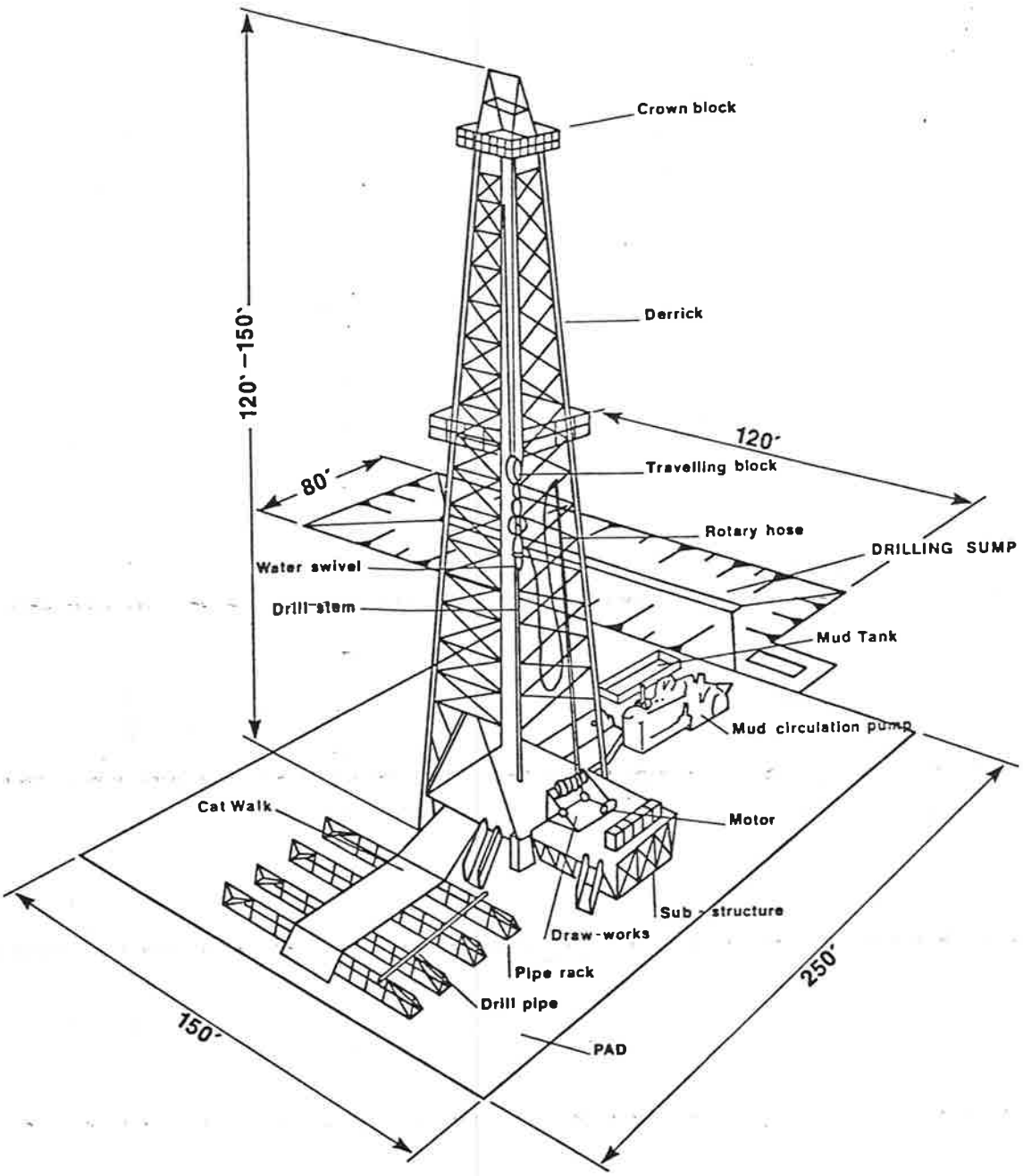
During the drilling process, steel casing is cemented into the hole. The casing diameter decreases with depth. Eight inches is a typical completion depth diameter.

Directional holes can be drilled. These holes cost more and take longer than drilling vertically but permit drilling a number of wells from the same well pad. Directional (or "off set") drilling may be used to reach a "down hole" location with no surface access. A well 8,000' deep might be "off set" as much as 5,000'.

A blowout could occur if subsurface pressures exceed pressures produced by the column of fluid in the bore hole. Various types of blowout prevention equipment can be installed to prevent such an occurrence. Blowout prevention equipment is installed at the surface on top of the casing.

Well cleanout is the process of removing the drilling muds, cuttings, and other material from the hole. After the cleanout is complete and the casing has been set, flow testing commences. Flow is directed to the drilling sump through a series of mufflers, and is composed of fluids, steam and non-condensable gases. The fluids from Imperial Valley wells can include less than 10 to over 30 percent (by weight) of dissolved solids. Noncondensible gases and vapors make up less than three percent of the gaseous volume. If testing produces substances detrimental to

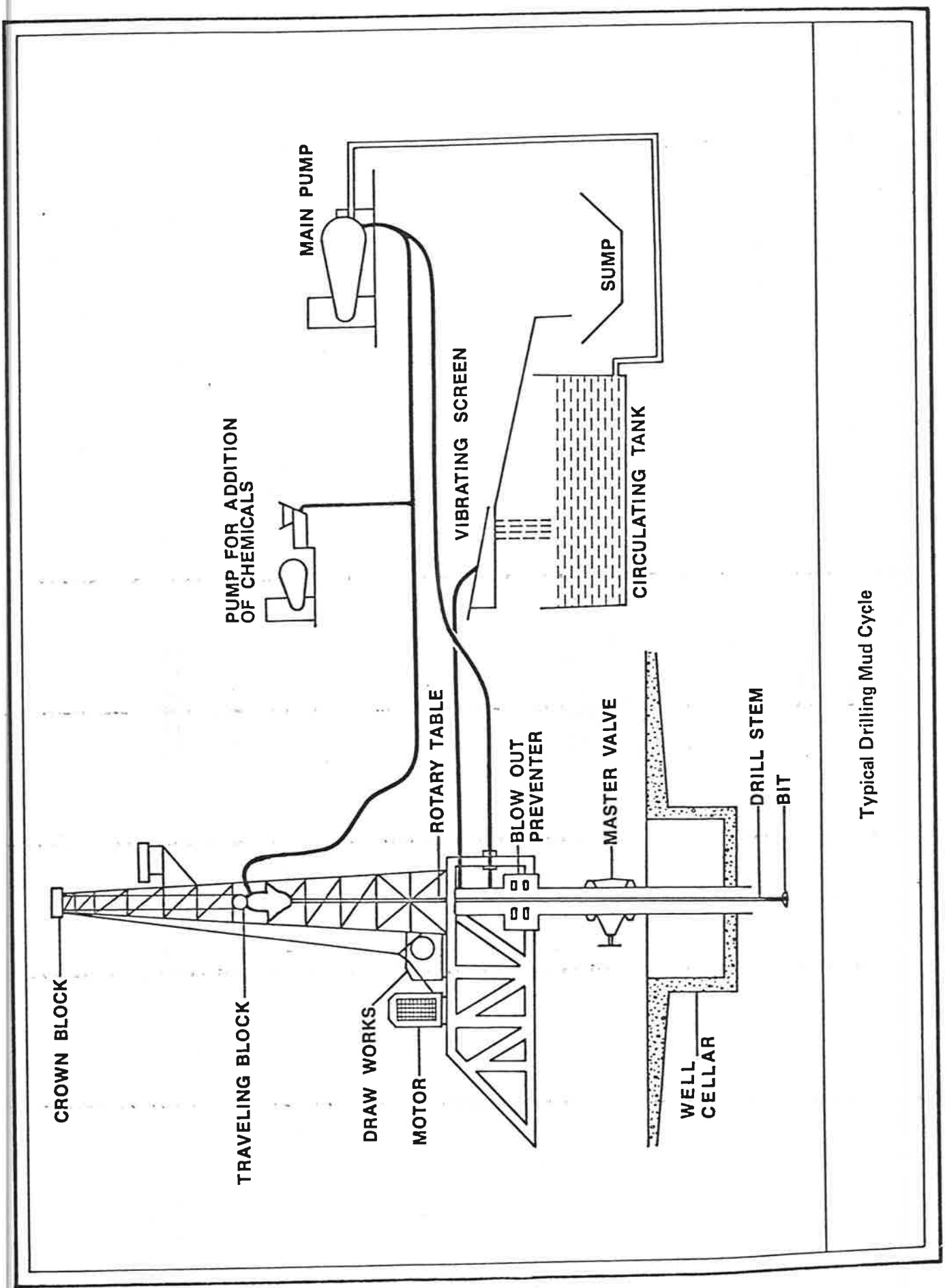
FIGURE NO. 4



Side View - Drilling Rig and Pad

Source: South Brawley EIR

FIGURE NO. 5



Source: South Brawley EIR

the environment, these constituents must be safely detained in the sump or portable tanks. Flow testing may continue for thirty days or more, and may be repeated several times over a number of months. Temperature, fluid flow rates, drawdown, chemistry, etc., are anlayzed.

A completed well, not being tested consists only of the fenced well head, cellar, and piping. It may occupy 200 square feet. Abandonment is the regulated process (by DOG) of plugging the hole with drilling mud and cement. Upon abandonment, all of the equipment, structures, and related materials are removed and the site is restored.

Typical Field and Plant Development Phase

In this phase, the plant is constructed, pipelines are run from each well to the plant, and from the plant to the injection wells. Also at this time electrical transmission lines and poles are constructed as required.

The first step in plant construction is to select the site. The site is more or less fixed by the location of the resource. The typical completed plant site occupies between 12 and 20 acres. During construction another 12 to 15 acres of laydown area for the storage of materials and large vehicle use may be required.

The power plant will consist of office space, parking facilities, tool storage buildings, turbine generator, steam condenser, brine handling equipment, the cooling towers, and flash vessels or heat exchangers. The actual plant size and set up will be determined by which method, flashed-steam or binary, is to be used. If there are noxious gases present that exceed air quality standards, then additional equipment will be necessary to "scrub" these gases out of the plant's emissions.

Pipes from well to plant and to injection wells are installed and must be able to expand and contract. This is normally accomplished by

installation of horizontal or vertical expansion loops. The size of the network will depend on the number of wells required to power the steam turbine, and the number of injection wells necessary. Each well may have a productive capability of three to five megawatts.

The production and injection well sites and pipe networks may range over an area of hundreds of acres, but will actually occupy only from 16 to 19 surface acres depending on the design of the plant and its layout.

Construction. Plant and field construction may last two years with 180 workers at peak. This will be the period of greatest environmental disruption, similar to a large construction site.

Typical Power Plant Production Phase

During this phase all facilities have been erected; no additional impacts should occur from construction activities. Some noise, noxious gases and toxic elements may be produced but can be mitigated through abatement measures. The production rate of the wells may be less than during the testing phase. During the plant production phase, activities will include the operation and maintenance of the power plant and existing wells, the drilling of new replacement production and injection wells, and waste disposal.

Continuing exploration and development can be carried on in other parts of the geothermal field simultaneously with the operational and maintenance activities.

One medium-sized drill rig is needed to drill new wells to maintain generating capacity. As the production gradually diminishes the heat flow from the resource, additional wells must be drilled to allow the plant to operate at full capacity. If brine is to be disposed of by

injection, new injection wells will be drilled. The technique and effects of drilling these replacement wells would be the same as for development wells.

Repair, maintenance, and monitoring of the operating field will require use of access roads to service the equipment. Existing wells will require occasional repair work or cleanout. The frequency of remedial work depends upon resource characteristics and production technology. Scaling and corrosion of the equipment from the geothermal brine may require frequent maintenance.

A flashed-steam power plant in Imperial County can be designed to be water self-sufficient. Condensate from the condenser can be used to supply all the water requirements for the power plant cooling towers. However, when the power plant is operating in this mode, about 20 percent of the geothermal brine is lost due to evaporation of the condensate in the cooling towers. Eighty percent of the brine is then available for injection to replenish reservoir fluid and help prevent land subsidence. Other sources of water for cooling tower needs may be available, such as imported water, agricultural wastewater, river water, the Salton Sea, and ground water. Cooling tower make up water requirements from external sources depend on the temperature of the resource and plant design but ranges from 50 acre feet to 100 acre feet per year per megawatt.

During this phase, the disposal of spent fluids become significant simply because of the volume of wastes requiring disposal. Disposal techniques vary, depending on the quality and quantities of waste involved. Normally, injection of the brines and the blowdown is preferred. Solid wastes can also be generated by the plant's operation, and may require

disposal at proper waste disposal sites. A project may seek permits for on-site disposal of solid and/or hazardous wastes. Processing facilities may require an additional 3 to 5 acres at the plant site.

Utilizing injection, the brine is injected into non-productive zones of the geothermal field. Typical concerns include whether plugging and scaling problems would prevent the reservoir from accepting the fluid, whether fresh water aquifers can be adequately protected from contamination by hot saline brine, and whether the subsurface rock structure would adequately hold the injected fluids.

It may become economically feasible to extract minerals from the geothermal fluids. Desalinization of brines may also become financially feasible for some areas to provide water for irrigation and other uses.

Production closedown phase. This would consist of site abandonment and occur when the geothermal resource is depleted to a non-economical level. Geothermal reservoir knowledge has not advanced to a stage where a reasonable economic limit can be predicted, but for planning purposes, a period of at least 30 years is assumed, which in many cases is the steam plant amortizaioon period.

Plant closeout and abandonment. This includes the removal of all surface facilities, the abandonment or capping of all production and injection wells, and surface restoration to a safe, permanent condition which is as near original condition as possible.

The Master EIR's in each of the four Geothermal Overlay Zones have more detailed information regarding the above procedures.

Geothermal Technologies - Flash and Binary Systems

There are currently two basic energy conversion cycles or systems utilized in Imperial County: flashed-steam and binary fluid cycles. The figure on page 47 shows simplified versions.

In the flashed-steam conversion cycle, electricity is generated as follows:

a. Steam is separated from a liquid-steam mixture produced by a geothermal production well or well field;
b. The separated steam is expanded through a turbine;
c. The turbine turns a generator which produces electricity;
d. Steam exhausted from the turbine is condensed by a condenser; and,
e. The condensate is either sent to an evaporative cooling system (such as a cooling tower) as make-up water or is mixed with the brine and disposed of by injection.

The basic one-stage flash cycle can be modified wherein there are several flash cycles which flash the fluid two or more times and/or a combined flash/binary cycle where, after a flash cycle, the fluid is passed through a heat exchanger (binary) cycle. Below a temperature of 350°F, flash systems generally do not produce adequate steam for economical operations.

In the binary process, the geothermal fluid is used to vaporize a secondary fluid with a lower boiling temperature than water as follows:

a. Geothermal fluid from a production well is passed through a heat exchanger where heat from the brine vaporizes a secondary or working fluid (such as isobutane or propane);
b. The working vapor drives a turbogenerator which produces electricity;

c. The vapor is condensed and returns to the heat exchanger in a closed system; and,

d. After passing through the heat exchanger, all geothermal fluids are injected.

Aside from design differences between the conversion cycles, the amount of fluids extracted for each kwh (kilowatt hour) of electricity produced is primarily a function of resource temperature. More specifically, as the temperature of a geothermal resource rises, the conversion efficiency of a given geothermal power cycle increases, thus reducing the demand.

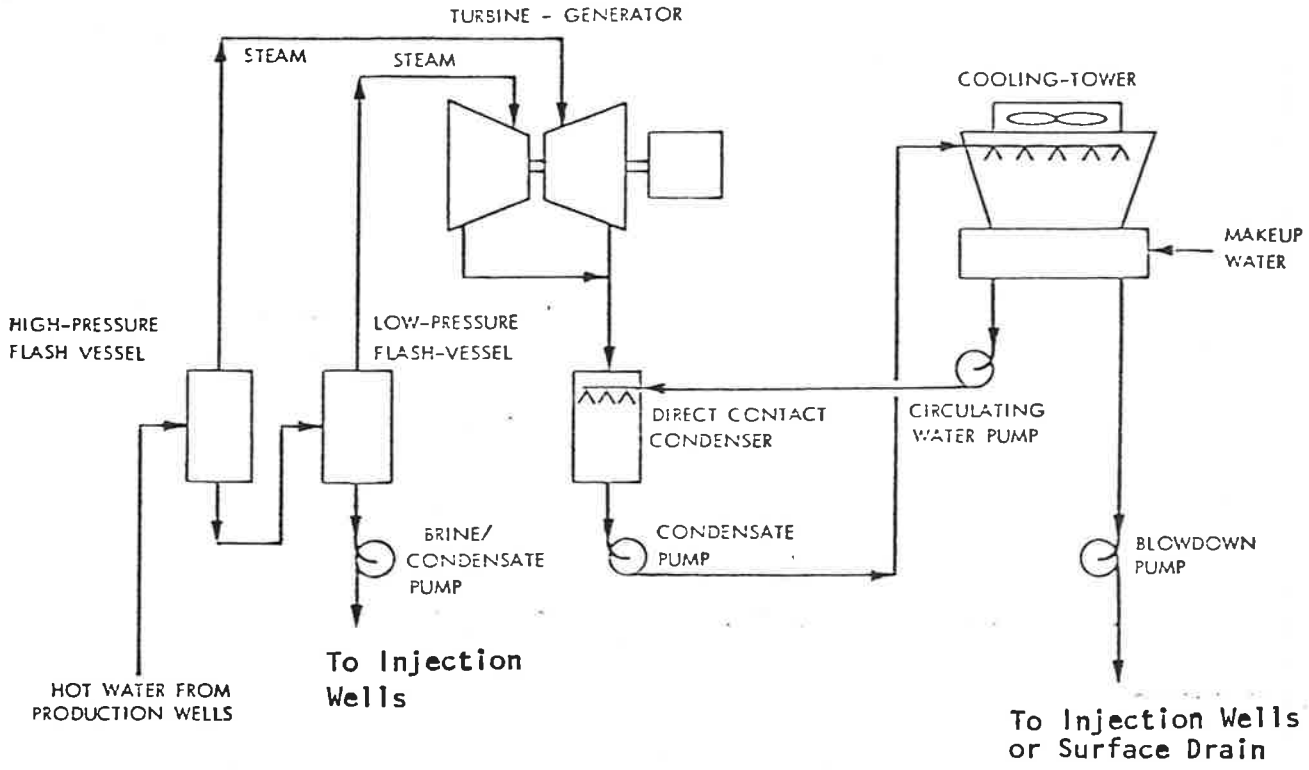
The cooling tower (or pond) efficiency also increases with resource temperature. The most important consequence of this change in fluid requirements is a reduction in the number of wells and the acre-feet of cooling water needed to support power plants. In other words, the higher the brine temperature, the fewer wells and less cooling water necessary per megawatt generated.

The quanity of fluids disposed also varies inversely with the temperature of geothermal brines. With lower resource temperatures, larger amounts of fluids are needed to operate a power plant, and therefore larger quantities of spent fluids must be injected.

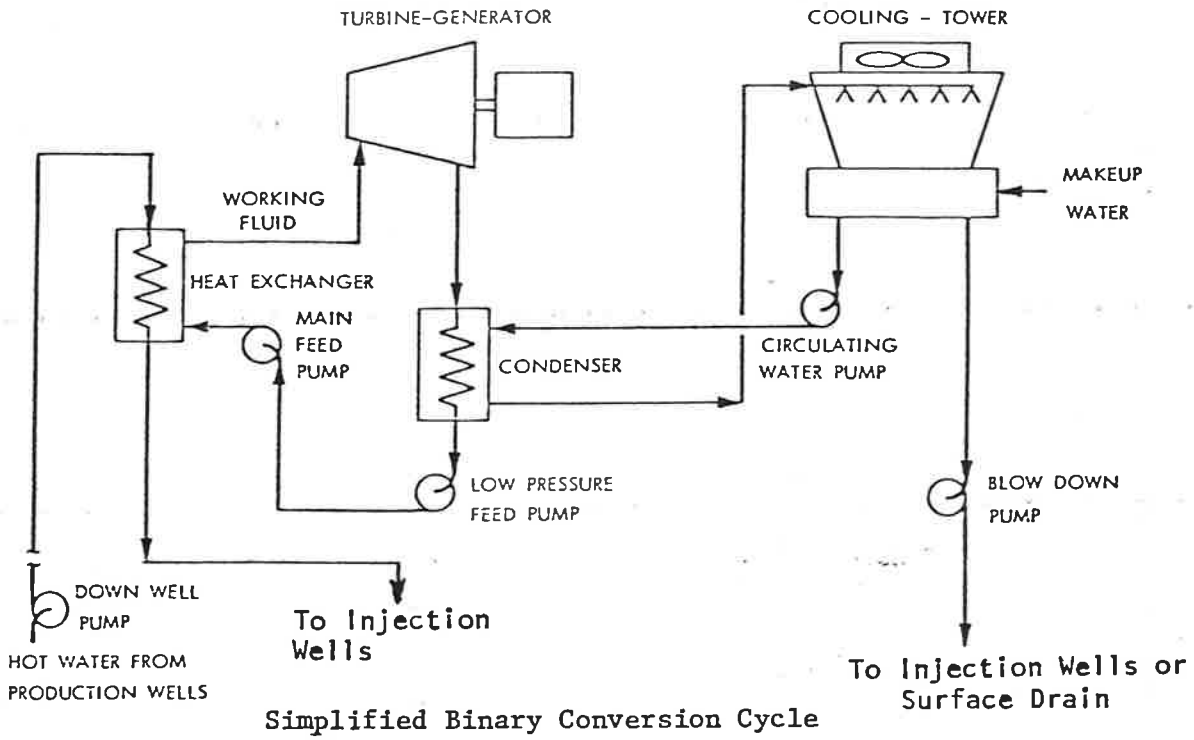
The principal difference or advantage of the binary system is that it allows utilization of moderate temperature resources, and there is no release of non-condensible gases, such as H_2S to affect air quality. From an air quality perspective, binary would be the preferred technology.

If in fact mineral recovery technology advances to the state where it is economically feasible, then the binary system operators may have an incentive to process the brine once it passes through the system.

FIGURE NO. 6



Simplified Flashed-Steam Conversion Cycle



Simplified Binary Conversion Cycle

Water Production

The 1977 Geothermal Element projected that desalinization of water could occur as a by-product of geothermal electrical production.

Congress passed the Colorado River Basin Project Act, Public Law 90-537 (1968), authorizing the Bureau of Reclamation to study the viability of augmenting the water supply of the Colorado River from sources within the Basin.

The University of California, Riverside, was contracted to perform preliminary geophysical investigations. In the summer of 1972 Mesa 6-1 was drilled to 8,015 feet in the East Mesa KGRA. The fluid temperature was 330°F and had a flow rate of about 100 gallons per minute with about 20,000 parts per million, total dissolved solids.

On June 3, 1974, the Bureau of Reclamation awarded a contract to Bechtel Corporation to determine heat transfer, scaling, corrosion, fluid chemistry and flow characteristics.

Systems were employed at East Mesa by the Bureau of Reclamation and Bechtel that are used worldwide for the recovery of potable water from seawater. These systems were the multistage flash, and the vertical evaporator designs. The operators concluded:

> ". . .at least 75 percent of the water content of the geothermal brine entering the plant can be recovered, utilizing the energy of the geothermal brine as a source of heat for the distillation plant. . ." and that, ". . .Recovery of water from geothermal brine is technically feasible through the use of either the multistage flash evaporator concept, or the vertical tube evaporator. . ."

The Bureau of Reclamation estimated in 1972 that as much as 2.5 million acre-feet a year of desalinated water could be produced from geothermal resources in Imperial County. Their 1979 "Geothermal Resources Investigations East Mesa Test Site - Concluding Report,"

found (largely due to reservoir transmissivity limitations) this to be an unreasonably optimistic estimate. On an economic basis, they could support no water production.

H. J. Vaux, Jr., of the University of California, Riverside, prepared a cost analysis for producing fresh water from geothermal resources by a desalinization plant. He estimated that desalinization would cost about 45¢ per 1000 gallons, or $145 per acre-foot.

There does not appear to have been any notable changes in the desalinization technology since these studies were completed, but a rough estimate of cost in 1984, considering inflation and interest rates, might be closer to $1000 per acre-foot. A number of Southern California communities are paying up to $200 per acre-foot. The Imperial Irrigation District delivers water to local industrial users for $45 per acre-foot and to agricultural users at $9 per acre-foot.

The UCR analysis and the Bureau of Reclamation concluded:

> ". . .in the absence of substantial changes in the demand for water and the costs of supplying it, it seems reasonable to conclude that developing fresh water supplies from geothermal brines does not appear especially promising. . ."

Direct Heat Uses

In addition to electrical generation, geothermal resources can be utilized in nearly any process or activity which requires heat. Geothermal fluids can be used directly from a well, or users could obtain "cascaded" heat from other projects (see example of cascaded heat on page 47).

The potential for direct use in Imperial County is extensive. The long-term availability of geothermal resources could serve as a catalyst for local economic development. A study sponsored by the U.S. Department of Energy and the County (May 1983) evaluated potential uses of direct heat in five major categories:

(1) Agriculture: Geothermal energy could be used by farmers, stockmen, ranchers or consortiums of the above; projects could include crop refrigeration and greenhouse and feedlot operations.

(2) Aquaculture: Warm waters can be utilized to grow certain aquatic species, e.g. catfish, prawns, algae, tilapia and for the hydroponic growing of vegetables.

(3) Food Processing: Opportunities for processing of food include refining and cold packing, vegetable canning, dehydration and freeze-dry operations.

(4) Ethanol Process: Imperial County could be a prime location for geothermally-produced ethanol due to the combination of a local supply of feedstock, the geothermal energy resource, and nearby metropolitan markets.

(5) Manufacturing: Certain industrial and manufacturing applications could use geothermal energy to replace fossil fuel and electricity, e.g. process heat, refrigeration and motive steam.

Since the temperature requirements are generally lower for direct heat projects, more flexibility in location of direct heat projects may be possible. However, in order to minimize the cost of fluid transmission, projection locations must be near the geothermal resource.

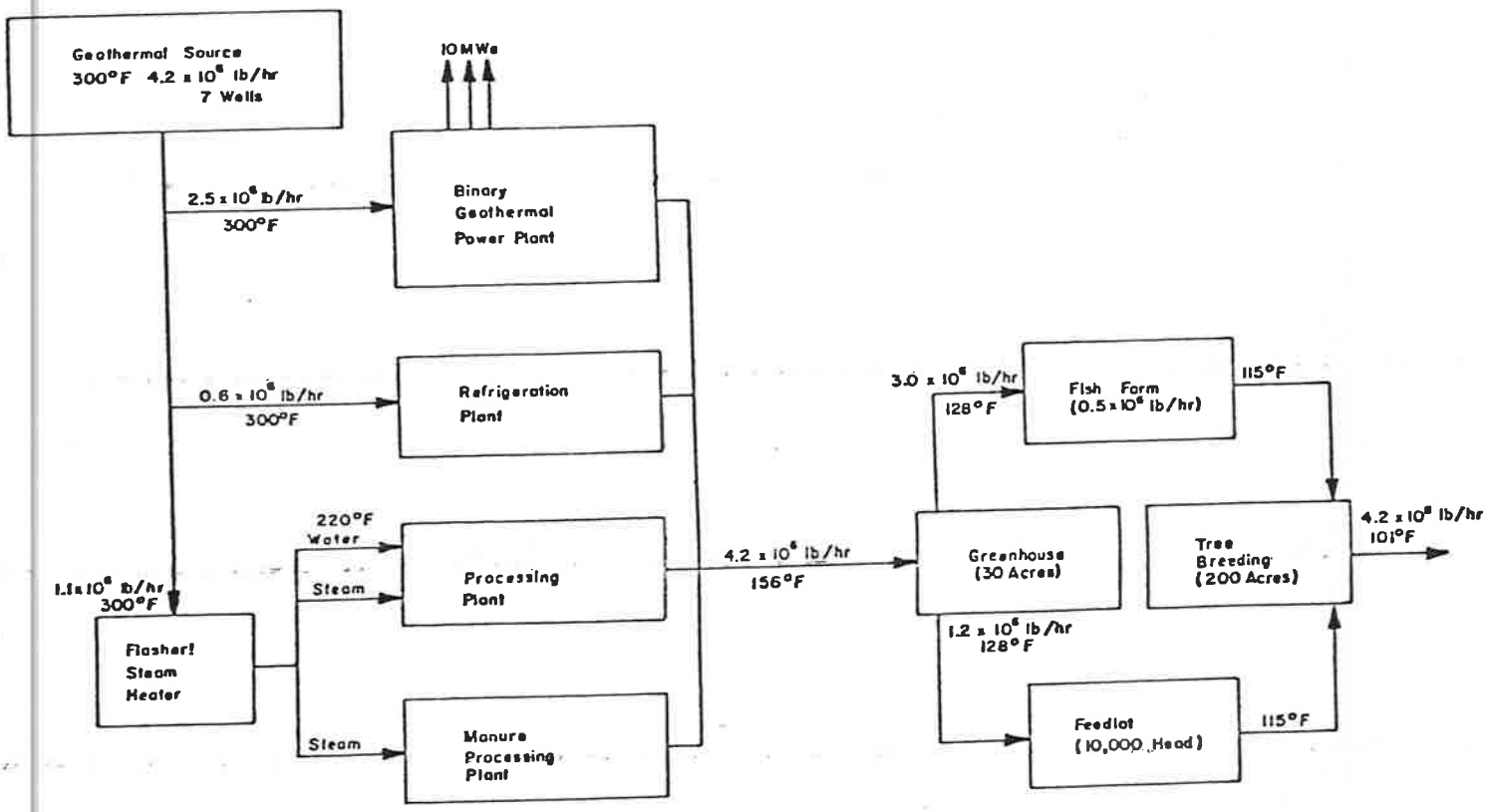
The rate of growth of geothermal direct use projects is unpredictable at present, since development will be influenced by a number of factors including prices for competing energy sources, labor costs, price of land and tax incentives among others. Development of resources for electricity generation could facilitate development of direct applications. Resolution of technical issues and the availability of cascaded heat from power plants may lead to development of direct heat projects. A successful

Figure No. 7

CASCADED HEAT EXAMPLE

The following figure represents an example of a "cascading" heat system from a 300°F geothermal resource with 10 MW's of electricity being generated by a Binary Power Plant.

The example is merely to show how a system might occur in an industrial park complex and does not establish policy on injection temperature requirements.



Source: Geothermal Energy Magazine, Vol. 4, No. 4, pg. 22, 1976.

local application of geothermal resources for an industrial project could stimulate development of other projects.

Several geothermal cascaded heat projects are in preliminary planning stages and successful development of these projects could also stimulate development of other cascaded and direct heat use projects. The geothermal aspects of the proposed industrial projects are expected to be relatively minor in comparison with the non-geothermal aspects of the projects, i.e. capital costs, operating costs and environmental impacts.

The non-geothermal issues of economic development industrial projects are analyzed in other portions of the County General Plan.

Mineral and Gas Extraction

Brines in various parts of the world are being used to produce minerals. However, the recovery of these minerals from geothermal brine is dependent upon both production costs and market price.

In certain KGRA's, particularly the Salton Sea, the brine is very high in minerals such as sodium, potassium, iron, tin, manganese, chlorine, boron, bromine, potash, and zinc, among others. Precious metals--silver, gold and platinum--are present in trace concentrations. Studies of brine in the Salton Sea area have shown substantial differences in the trace element compositions even from relatively close-spaced wells. The total dissolved solids and mineral concentrations in the brine can also change with the well flow rate.

Both the U.S. Bureau of Mines and the Department of Energy have sponsored experimental programs on mineral extraction from Salton Sea brines. However, few detailed reports are available. In 1974, the Bureau of Mines funded Hazen Research to do a study at the Salton Sea. Hazen

Research built and operated a 15 gallon per minute pilot plant which was operated successfully. The process was based on selective precipitation of the hydroxides found in the brine utilizing lime. The results are still being analyzed and a final report is not available.

Another study was performed by SRI International at the San Diego Gas and Electric Geothermal Loop Experimental Facility (GLEF). This study involved precipitation of the more valuable elements in the brine through use of a sulfide. A number of equilibrium calculations were made using aged, spent brine from the GLEF. SRI's goal was to precipitate all of the silver, lead, and zinc, while minimizing the precipitation of iron and manganese and using as little of the sulfide as possible. After a careful study and analysis for silver in the brines, they concluded that the silver content of the brine used was 0.02 parts per million utilizing Magmamax No. 1 brine.

Although the potential for mineral extraction appears favorable, processing methods are still under development. Since the geothermal brines of the Salton Sea KGRA have a greater concentration of valuable minerals, future process design studies will probably focus on this area's resource. Currently, the flashed-steam technical design has the greatest potential for mineral recovery in the Salton Sea area.

Some of the minerals that could be extracted from geothermal brines are of strategic value to our national defense. Manganese and Tin are only two of these metals which may become difficult to import if world conditions control availability. Figure No. 8 lists the percentage of metals of strategic value to the United States which are imported from various countries and which could be extracted from geothermal brines. Figure No. 9 gives typical Imperial Valley brine chemistry.

FIGURE NO. 8

STRATEGIC METALS VITAL TO DEFENSE AND ECONOMY

Metal	Uses	% Imported	Principal Sources
Chromium	Stainless steels, electroplates	90	South Africa, U.S.S.R.
Cobalt	Superalloys, magnets	90	Zaire, Zambia
Manganese	Steels and Steel-making	98	Gabon, South Africa
Platinum metals	Catalysts, glass-making electronic contacts	89	South Africa, U.S.S.R.
Tantalum	Capacitors, superalloys cutting tools	96	Thailand, Malaysia
Tin	Tin plate, bearings, solder	81	Malaysia, Thailand

Source: Lawrence Livermore Laboratories

FIGURE 9

TYPICAL IMPERIAL VALLEY BRINE CHEMISTRY

(Dissolved solids in mg/l; noncondensible gases in mg/kg)

		Salton Sea	Westmorland	Brawley	Heber	East Mesa
Sodium	Na	52000.	10000.	22000.	4200.	2600.
Potassium	K	14000.	1400.	3800.	260.	190.
Calcium	Ca	24000.	690.	8100.	880.	130.
Magnesium	Mg	106.	188.	34.	5.4	3.4
Chloride	Cl	145000.	18000.	46000.	7900.	3900.
Sulfate	SO_4	84.	57.	-	99.	155.
Bicarbonate	HCO_3	140.	2900.	49.	27.	490.
Arsenic	As	11.	-	2.6	0.1	.16
Boron	B	350.	63.	140.0	14.	5.4
Barium	Ba	433.	-	363.	3.8	2.2
Copper	Cu	4.	.07	.11	.53	.03
Fluorine	F	9.	2.24	-	1.6	2.0
Iron	Fe	2300.	.3	65.	22.	2.2
Lithium	Li	211.	48.	100.	9.5	6.3
Manganese	Mn	1200.	2.8	190.	2.7	.42
Nickel	Ni	4.	-	-	-	.03
Lead	Pb	100.	3.6	1.1	1.9	.09
Strontium	Sr	500.	-	340.	53.	38.
Zinc	Zn	660	.04	14.	.83	.07

		SALTON SEA		EAST MESA	
		Range	Mean	Range	Mean
Hydrogen Sulfide	H_2S	1.6 - 6.0	3.2	0.12 - 1.6	0.54
Ammonia	NH_3	20 - 40	35	1.3 - 8.1	4.5
Carbon Dioxide	CO_4	1100 - 3800	1700	270 - 2300	1100
Methane	CH_4	3 - 10	6.0	4.0 - 56	33
Hydrogen	H_2	0.0016 - 0.002	0.0018	0.005 - 0.007	0.0064

Source: Pimental et al. 1978; Ermak et al. 1979

Early extraction of gas occurred in the Niland area from 1933 to 1954 where a large amount of carbon dioxide was produced to make dry ice. The flow of geothermal brine also releases methane, hydrogen sulfide, radon, benzene, and mercury gases in small quantities. With adequate abatement methods these gases are not hazardous.

Solid Waste Disposal

Geothermal energy production creates large volumes of waste, much of it containing some heavy metals and salts. Wastes result from well drilling and testing, and power plant operation. Wastes can include rotary drilling muds, workover and clean out fluids, well testing fluids, geothermal brines and residues, pretreatment sludge from cooling water makeup, and cooling tower and boiler blowdown sludges.

The RWQCB requires that geothermal wastes which contain in excess of 6,000 parts per million (ppm) total dissolved solids be disposed in a Class I or a Class II-1 landfill, wastes with less dissolved solids may go to certain Class II-2 sites. Five sites in Imperial County are authorized for the acceptance of geothermal wastes: IT corporation Class II-1 site, and areas of the County operated Brawley, Calexico, Holtville, and Salton City Class II-2 sites.

The County Solid Waste Management Plan (SWMP) is prepared by the County Department of Public Works, and adopted by the Board of Supervisors and the cities. The SWMP addresses the need for disposal sites to receive geothermal wastes. All waste management activities in the County must be in conformance with the SWMP as adopted.

Transmission Corridors

The Transmission Corridor Element of the County General Plan was adopted on August 12, 1980. This revision of the geothermal plan supercedes by incorporation and revision that Transmission Element and rescinds it.

The development of energy pursuant to this plan will require an improved electrical transmission system. It is the policy of Imperial County:

1) To recognize the necessity for transmission corridors within and through Imperial County.

2) To plan for the least disruptive corridor routing, and

3) To formalize the County's input to the appropriate public and private entities in terms of goals, policies, routing criteria and specific corridor location plans.

The following goals are established and adopted for these policies:

- To protect the health and safety of Imperial County's residents and their communities by assuring that the corridors will be so located as to have the least possible adverse impact upon them.

- To protect the health and well-being of Imperial County's agricultural economy by assuring that the placement of transmission towers and lines will have the least possible adverse impact on agriculture to the extent practicable.

- To protect, as much as possible, the fragile ecological balance of our wetlands and surrounding desert by assuring that natural resources will be considered in the location of transmission corridors.

- To utilize, wherever possible, existing rights of way (such as existing lines, roads, canals and railroads) for the placement of transmission towers and lines so as not to further impact our surrounding environment.

- To minimize, as much as possible,the impact of transmission towers and lines upon our aesthetic environment by encouraging appropriate location and design features.

- To participate in State and Federal licensing procedures for the location of transmission lines, towers and related substations where is is deemed that such participation would serve the best interests of the County.

The following guidelines will be followed regarding transmission routes, except where competent and responsible advice dictates otherwise.

- Transmission rights-of-way, including the towers and lines, be located adjacent to existing roads, canals and property lines. Towers should be sited at the end of fields wherever possible.
- Diagonal alignments of transmission lines and towers through agricultural fields should be avoided.
- The use of H-frame transmission towers or mono poles should be considered in the agricultural area where their placement would minimize the removal of land from production and facilitate the operation of farm equipment.
- When the need arises for a second transmission line, it should be placed within the same right-of-way as the first line, parallel to and alongside existing towers, in order to avoid the staggering of tower placement and further impact agricultural activities.
- Transmission towers near airports or crop duster strips should comply with FAA regulations.
- The operating entity should provide grounding of stationary structures where necessary in order to minimize the build-up of electrical charge and protect avian species.
- Questions concerning payments for rights-of-way, liability in the event of damage to transmission structures and weed clearance at the tower footings are subject to negotiation between the utility company and the land owners.

Due to the direct impacts geothermal development will have on existing and future transmission lines in Imperial County, it was necessary to consult with the Imperial Irrigation District.

The District's position is that it owns and operates all transmission lines within its service area. The current exception to this is the 500-kV transmission line, Southwest Powerlink, through the Valley; however, the District is part owner of this facility as well as the Imperial Valley Substation.

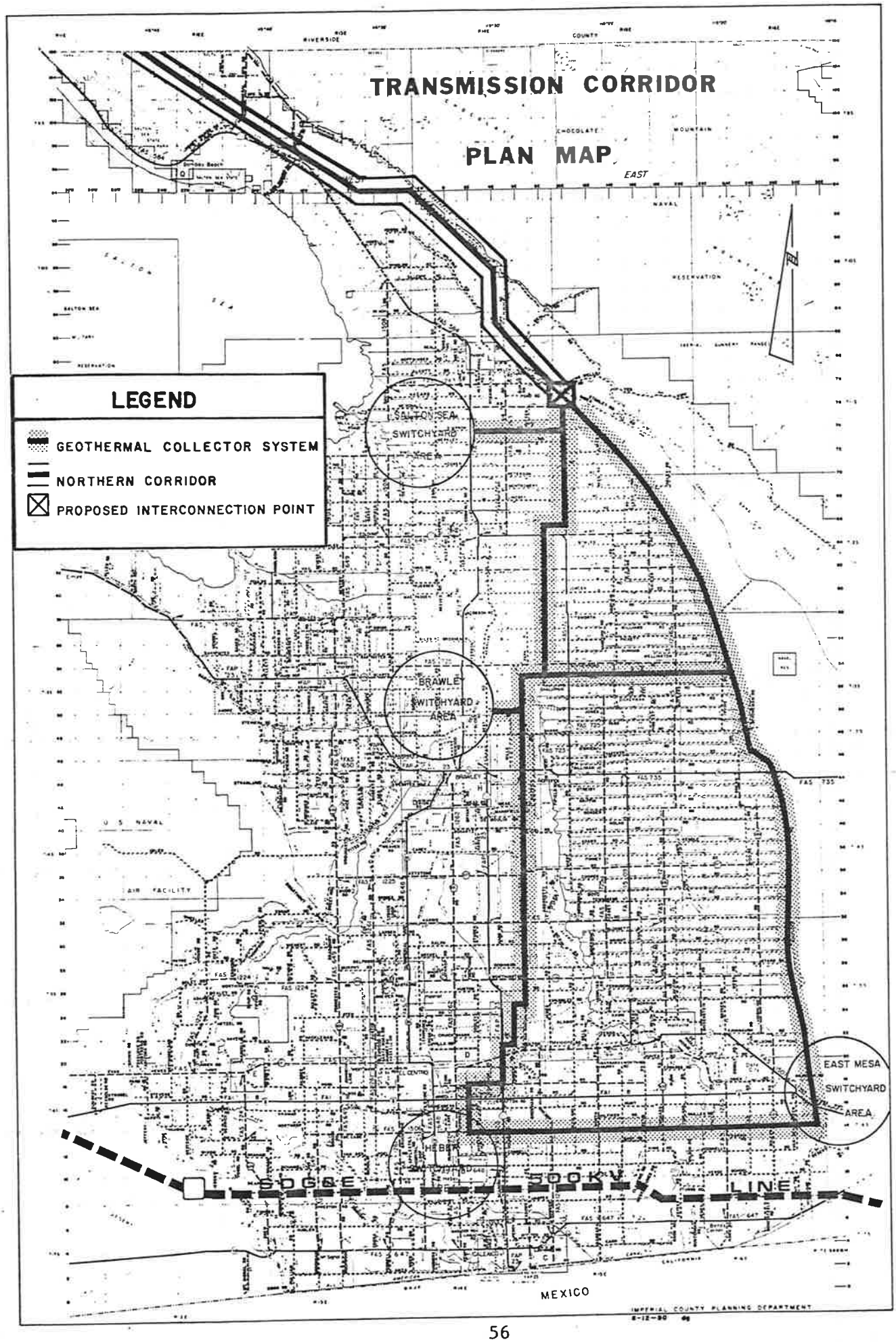
A major problem is the financing of new or upgraded facilities required to "wheel" geothermal power to users.

The following maps are included to provide a general overview of the designated transmission line corridors in Imperial County for geothermal development. Map No. 3 outlines the various switchyard areas for the geothermal collector system and proposed interconnection point for the northern corridor. It also depicts the location of the 500-kV transmission line in relation to the geothermal collector system.

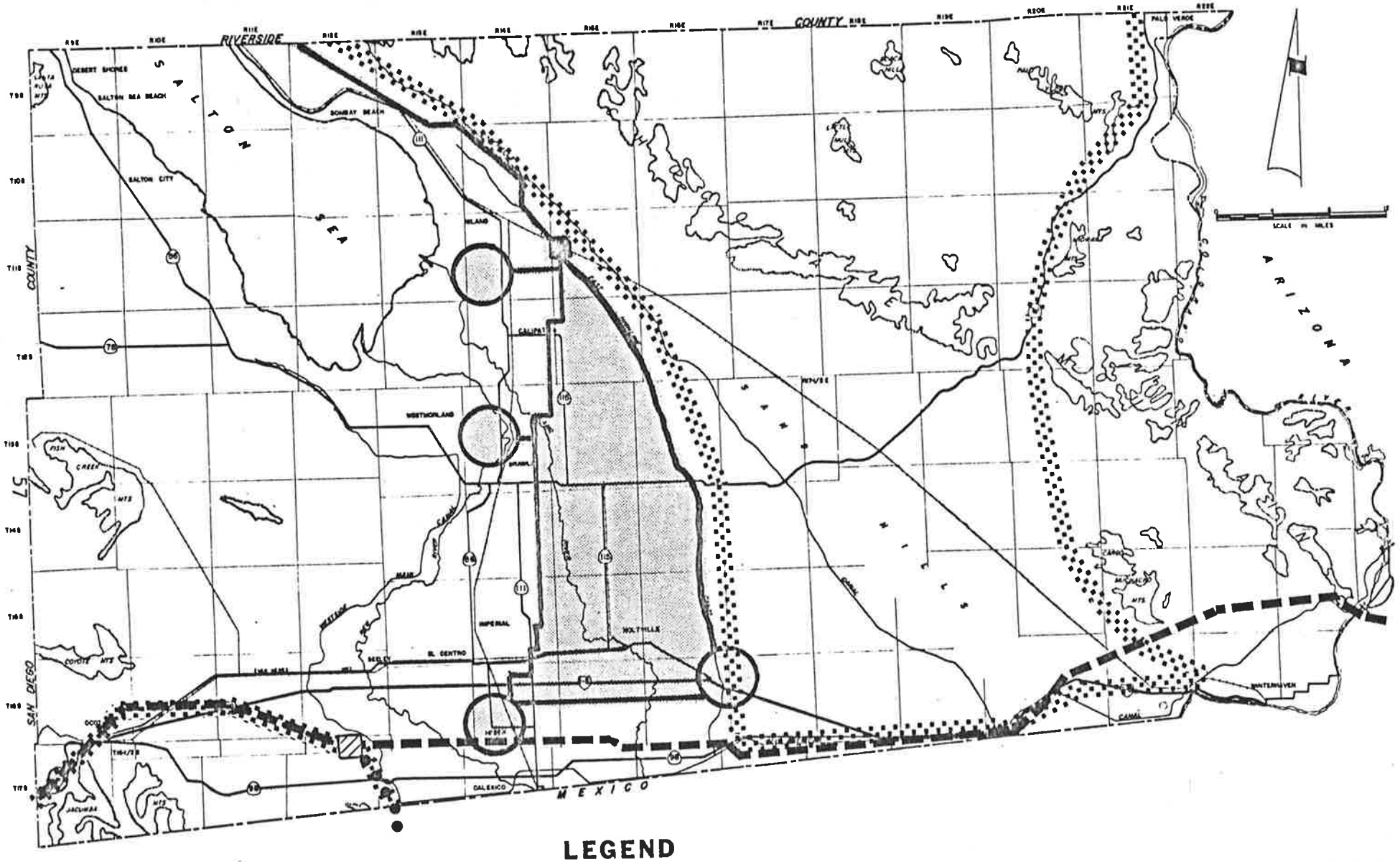
Map No. 4 indicates the four federal planning corridors (J, L, M and N), the CFE-SDG&E 230 k-V line from the La Rosita Substation in Mexico to the Imperial Valley Substation, and the SDG&E 500-kV line stretching from the Arizona border to the San Diego County line.

The environmental impacts associated with transmission lines have been addressed in the Final Environmental Impact Report (March 1980) prepared by the County.

MAP NO. 3


TRANSMISSION CORRIDOR
PLAN MAP
LEGEND
GEOTHERMAL COLLECTOR SYSTEM
NORTHERN CORRIDOR
PROPOSED INTERCONNECTION POINT
SALTON SEA SWITCHYARD AREA
BRAWLEY SWITCHYARD AREA
EAST MESA SWITCHYARD AREA
HEBER
SDG&E 500 KV LINE
MEXICO
IMPERIAL COUNTY PLANNING DEPARTMENT

MAP NO. 4 **PLANNING CORRIDORS**



LEGEND

- LA ROSITA 230 KV LINE
- IMPERIAL VALLEY SUBSTATION
- FEDERAL PLANNING CORRIDORS (J,L,M,N)
- S.D.G. & E. 500 KV LINE
- IMPERIAL COUNTY GEOTHERAL COLLECTOR SYSTEM

IMPERIAL COUNTY PLANNING DEPARTMENT

Benefits of Development

The benefits of geothermal development in Imperial County are:

1) Fiscal benefit of expanded property tax revenues.

2) Fiscal benefit of sales tax revenues from purchase of goods and services.

3) Royalty and lease benefits to local landowners.

4) Social and fiscal benefits from increased economic activity and employment opportunities.

5) Improvements in technology reducing costs of electrical generation.

1) Fiscal benefit of expanded property tax revenues. The property tax effects from development of the resource would result in major increases in property tax revenues. Property taxes are levied on both the geothermal resource and the power plant. Property taxes related to the geothermal resource will be assessed by the County. While public utility facilities will be assessed by the State Board of Equalization (SBE).

Property taxes on geothermal-related activities will be affected by Proposition 13, Article XIII A of the California Constitution. Under Article XIII A, property taxes are limited to 1.0% of the full cash value of the property. In addition to this limitation, increases in county-assessed valuation of real property are limited to 2.0% per year, unless there is a change in ownership of the property. This limitation applies to land including geothermal resources, and improvements including any county-assessed power plant. The 1.0% tax rate also applies to state-assessed property, but the limitation on assessed value does not.

Geothermal resources are assessed locally and have two methods of taxation:

- If the resource area is not in production, the assessment is based on the capitalized net present value of the rental payments made by the lessee, but increases in value are limited as described previously.

- Once production commences and geothermal brine is being sold, the method of taxation changes to an "appraised income" approach or the capitalized present value of the future net income derived from the resource. To calculate the property tax assessment under this method, the following date is necessary:

  1. The capitalization rate.

  2. Net income from operations.

  3. Estimate number of years remaining in the life of the field; increases in annual assessments are subject to Proposition 13 limitations. However, an increase in the number of years remaining could be enrolled as "new property".

In addition to the taxes levied on the resource--land, power plant, and transmission lines, facilities will also be taxed. The facilities, when owned by a public utility, are assessed by the State Board of Equalization. The Board uses a unitary value concept to determine the fair market value of the land and improvements owned by the public utility in the state. The following factors are used by the Board to determine fair market value:

- Original/historical cost of land and improvements less depreciation;
- Capitalized earnings; and,
- Market value of stock and debt issues.

The Board determines annually the fair market value of all the assessee's taxable property and then allocates this value to the County tax areas where the property is located.

The Union Oil/Southern California Edison Salton Sea and North Brawley facilities are assessed by the State Board of Equilization and not by the County. However, in the East Mesa KGRA, Magma's 10 megawatt facility is assessed by the County because it is not operated by a public utility.

The County Assessor's Office recently reported that the current value of local geothermal fields, demonstration plants, and equipment

is about $80 million dollars, bringing approximately $800,000 annually into the County Treasury for disbursement to various taxing agencies.

A typical 50 megawatt plant costs approximately $150 million dollars. Using this figure and assuming 60-fifty megawatt plants are built by 2015, the total capital investment would be $9 billion. Depending on the actual assessed value assigned, the tax revenue to Imperial County could be as high as $90 million. Due to the SBE's method of determining fair market value and allocating assessed value of the state-assessed property, the exact amount of Imperial County's share is unpredictable. The SBE staff indicates that the above figure could be significantly less.

2) Fiscal benefit of sales tax revenues from purchase of goods and services. Retail sales and resultant sales tax revenues will increase temporarily during peak construction phases. Geothermal service industries, cascaded heat processes, and direct heat industries will also be established bringing additional demands upon local business for goods and services. A portion of sales tax revenues generated locally by geothermal development will be returned to Imperial County by the State Board of Equalization. The state retains $0.0475 of the $0.06 total retail sales tax per $1.00 of retail sales and the remaining $0.0125 is returned to the place of origin.

During early phases of geothermal development the temporary increases in retail sales, especially during construction, may not create a significant effect among local business. However, if development continues as projected, the cumulative impact will be substantial over the 30-year development period.

3) Royalty and lease benefits to local landowners. Local landowners profit from the development of the geothermal resource in three major ways. Landowners receive annual rental payments for leased land, monthly royalty payments for a percent of gross or net production, and payments for any surface use of land (such as for pipelines and well pads).

Increased revenues to local landowners can provide local benefits through increased expenditures and investments. A secondary benefit to local landowners would be improvements to adjacent roads.

4) Social and fiscal benefits from increased economic activity and employment opportunities.

Based on estimates and experience, a 50 MW plant and facilities could require the following manpower:

Site preparation/drilling	45 workers/average for 9 months
Construction (structure/equipment)	70 to 180+ for minimum 18 months
Operation & Maintenance (once construction is complete)	35 workers (more or less depending on design of plant)

Of the 2,100 local work force (35 workers x 60 plants) who will operate and maintain the 60 electrical plants, about 70 percent are expected to be local residents. Over the 30-year development period, approximately 49 County residents per year could obtain new employment in the geothermal industry.

The non-local labor force of 630 would increase local retail sales through purchases of food, lodging, gasoline, car maintenance, medicine, entertainment, drugstore items, and laundry services. It is assumed that on weekends and scheduled days off, the non-resident work force would return home.

Direct heat employment opportunities are not included in the above analysis. Recent estimates indicate that employment could range from

6 to 75 persons in the related industries such as crop cooling/packing, vegetable dehydration, food processing, greenhouses, and aquaculture.

New geothermal-related jobs will not be seasonal, so the development of geothermal energy could help to stabilize the County's economy.

Local statistics indicate that young adults now tend to leave the County shortly after high school. This emigration might be reduced if geothermal development offers a variety of jobs for those wishing to remain in the County. The employment generated will also produce jobs in other sectors of the local economy, create a greater range of job skills, and new employment opportunities for local unemployed residents.

5) Improvements in technology reducing costs of electrical generation. The Regional Economic Research Study for the SDG&E Binary Plant in Heber pointed out the reduction in costs resulting directly from actual experience of operating an initial plant with a new technological design.

> ". . .Major innovation and learning benefits are expected in two areas:
>
> (1) "learning by doing" and economics of scale associated with experience in operating and maintaining the geothermal well sites, and
>
> (2) efficiency gains over time in the design and establishment of future similar generating plants directly attributable to experience in designing and constructing this first commercial size binary plant system. . ."

Comparable benefits will also result from flashed-steam project operation.

III. ISSUES AND COUNTY POLICIES

Assumptions

Based on current data and new growth scenarios, County staff has made certain assumptions concerning the future. The following assumptions were utilized in the preparation of this plan:

1. It is assumed that electrical demand will increase slowly by the late 1980's in Southern California, and the entire state.

2. It is assumed that electricity developed from geothermal energy will become competitive in cost with electricity developed from other sources as technology advances, costs decrease, and cost of other energy sources increases.

3. It is assummed that an adequate and satisfactory source of cooling water will be available for geothermal development.

4. It is assummed that 3000 megawatts of electrical generation will be developed in Imperial County by 2015.

5. It is assumed that electrical development will take place gradually by construction of two 50 megawatt plants per year on average.

6. It is assumed that a variety in type and size of direct heat uses will be developed, that they will be predominantly agriculturally-related, and will be more labor-intensive than electricity generation.

7. It is assumed that the County of Imperial will retain a leading role in guiding and regulating development of the geothermal resource in Imperial County.

8. It is assumed that geothermal development will be environmentally acceptable with adequate protection of agricultural land uses, wildlife, and other resources.

Issues

Data analysis for the Geothermal Plan discloses that the cumulative effects of local geothermal development will be less than was projected in 1977. At the time of the preparation of the 1977 element, it was projected that 4500 MW would be generated by the year 2020. The resulting document and environmental impact report projected the "worst case" scenario for this development.

The current projection of 3000 MW by the year 2015 through a two-50 megawatt-plant-per-year scenario commencing in 1990, provides a lower level of environmental disturbance, less geothermal waste, and fewer impacts on humans and on wildlife. The County will reduce negative environmental, social agricultural, and/or related impacts through proper planning.

This plan establishes County policies on:

- Preservation of agricultural lands
- Water use and conservation
- Subsidence
- Transmission line siting
- Resource maximization
- Master environmental impact reports
- Direct (non-electrical) heat uses
- Economic, fiscal and social impacts
- Zoning administration
- Flow of information to public
- Seismicity

Goals, Objectives and Policies

Preservation of Agricultural Lands. Production of 3000 MW's of electricity by approximately sixty power plants will remove from agricultural use approximately 2000 acres (less than one percent of present agricultural land) to industrial uses.

With the gradual construction of geothermal plants, overall agricultural production levels should not be adversely affected. However, since some prime farm land will be affected, it is essential than any impacts be minimized. For this reason, the County will require that:

- o Production facilities be sited and designed to lessen impacts on agricultural lands.
- o Directional drilling and "islands" be used in irrigated areas where feasible.
- o Liquid transmission lines utilize existing easements or rights-of-way- and follow field boundaries whenever possible.

Water Use and Conservation. The development of the geothermal resource requires water for cooling and injection. Agricultural production is totally dependent on water. The initial development stages indicate that water usage by geothermal power plants varies with the temperature of the resource but will average 60 acre-feet per year per megawatt. The development of the 3000 MW scenario would thus require 180,000 acre-feet of water per year. The trend would appear to be for water self-sufficiency, through the use of condensate, for about two-thirds of the projects.

The Imperial Irrigation District has in past years maintained a policy of allocating limited quantities of canal (Colorado River) water to pilot geothermal developments. By Resolution 8-84 of January 23, 1984, IID established the goal to reduce flows to the Salton Sea by 100,000 acre-feet per year, and specifically invited the geothermal industry, among others, to make proposals for the beneficial use of such "conserved" water. Thus, water sufficient to serve the needs of geothermal prospects may become available without impinging upon the water usage of agriculture.

The County recognizes that the production, distribution, and sale of water, and the establishment and assignment of water rights lie primarily with other agencies. Since the amount of condensate and/or saved water available for geothermal use may also prove to be less than presently estimated, County decisions will be guided by the following water use policies established to:

- Maintain at least the present level of agricultural production while encouraging efficient water use.

- Provide for geothermal water use of 180,000 acre-feet of water per year; geothermal development will have first priority for use of "saved" and/or excess water over other uses over which the County has jurisdiction.

- Encourage the efficient utilization of water in geothermal operations, and foster the use of non-irrigation water by the geothermal industry.

Subsidence. Agricultural operations within the County depend on gravity-fed irrigation, drainage, and tiling systems. These systems utilize existing land contours and have little tolerance for change. Areas away from the irrigated fields, canals, and drains may be less sensitive to land surface elevation change. Land subsidence, which could be caused by geothermal production, would be a potentially serious impact of development.

Well field programs covering production and injection plans are required by the Division of Oil and Gas for each major geothermal project.

In order to assure that detrimental subsidence is not caused by geothermal development, the County will:

- Require that all geothermal operations be conducted so that subsidence or other surface impacts detrimental to existing land uses will not occur.

- Establish injection standards for each project that are consistent with the requirements of CDOG. Request a CDOG subsidence review, if necessary, for consideration prior to setting injection standards.

- Require permittees to establish and monitor subsidence detection networks in areas that could be affected by permitted project activities.

- Require other monitoring programs, if necessary, for determining the possibility or extent of induced subsidence.

- Require corrective measures, as necessary and in proportion to each developer's activities, if evidence indicates that geothermal operation has caused or will cause surface detriment. In determining monitoring or mitigation requirements, the County may consult with informed parties such as the Division of Oil and Gas, the permittee, other developers, and other experts as appropriate.

- Where fields have been unitized, or developers have established a cooperative agreement for reservoir management, specific production and injection requirements of individually-permitted projects may be modified in accordance with CDOG requirements.

Transmission Line Siting. The collection system and any transmission line exporting power from Imperial County may impact agricultural lands, wildlife, and the natural desert landscape. The planning and design of these lines should take into consideration these factors. The County will require, to the maximum extent possible that:

- All major transmission lines be located in designated corridors.

- Lines be designed for minimum impact on agriculture wildlife, urban areas and recreational activities.

- Transmission lines be constructed in accordance with this plan.

Resource Maximization. The County desires efficient utilization and production of the geothermal resource. The California Division of Oil and Gas has the necessary technical expertise and has a mandate to conserve the resource. Working jointly, the County will seek to develop and extend the resource's productive life. To accomplish this, the County will require each applicant to:

- Provide information concerning the anticipated life of each geothermal facility.

- Insure any proposal for large scale injection of non-geothermal fluids is reviewed by the Division of Oil and Gas and implemented so as to prevent detrimental impacts to geothermal reservoirs.

Master Environmental Impact Reports (MEIR's). The County has approved MEIR's for the Salton Sea, North Brawley, South Brawley, and Heber anomalies. MEIR's consider cumulative environmental impacts for the total anticipated level of development within an anomaly. Major geothermal development in other anomalies on non-federal lands will require a zone change and EIR. At such time the County will:

- o Prepare MEIR's as needed to evaluate potential development and impacts in the anomaly.
- o Seek reimbursement for the costs of the preparation of MEIRs for the area being rezoned from applicant, industry, and governmental sources.

Direct (non-electrical) Heat Uses. The County of Imperial seeks to also stimulate economic development activities through direct heat processes. In a recent study (Geothermal Direct Heat Study, May 1983) potential uses of direct heat were identified. Substantial and important benefits could result from the development of these primarily labor-intensive and agriculturally-related direct heat applications. Benefits would include increased employment, tax revenues from capital improvements, and sales taxes from increased demand for local goods and services. Therefore, the County will:

- o Encourage and facilitate the development of non-electrical uses of geothermal energy for economic development purposes.

Economic, Fiscal and Social Impacts. The County intends to maximize benefits and minimize negative impacts of geothermal development. [The (cont) costs of public facilities and services] monitoring and mitigation programs, and regulation should be paid by the geothermal industry. Thus, the County will:

- o Determine the services needed and related effects of geothermal development.

- Determine the costs incurred by the County in regulating and monitoring geothermal energy development.

- Assure that revenues resulting from geothermal development are sufficient to offset costs to the County of that development.

- Encourage employment of County residents by the geothermal industry wherever and whenever possible.

- Encourage the establishment of necessary applicable geothermal training programs in local school systems in cooperation with the geothermal industry.

Zoning Administration. The County will insure that:

- Efficient permitting and review procedures are appropriate to the various types of geothermal exploratory and development projects.

- Major production activities on non-federal lands are allowed only in a geothermal overlay zone and by a Conditional Use Permit containing appropriate performance standards.

- Geothermal overlay zones are based on data indicating the existence of a viable resource.

- Each zone is established according to good planning practices: properly related to the known resource and proposed developments, recognizing other land uses, avoiding formations of corridors or islands, and following legal lot lines.

Flow of Information to the Public. In order to provide adequate information to the public, the County will:

- Conduct public forums to allow information concerning geothermal development to be circulated between industry, county staff, and the public.

- Provide the public adequate opportunity to inform themselves on the current status of geothermal development and to express their opinions on matters pertaining to the development of the resource.

Seismicity. Imperial County is subject to a high level of natural seismic activity. Events range in magnitude from very small (detectable only by sophisticated monitoring equipment) to larger events capable of causing substantial surface damage. Scientific evidence indicates that human activities can modify natural seismicity, but the occurrence and

seriousness of any induced effects related to geothermal development are unknown. In order to determine the effects of development on natural seismicity, the collection of precise seismic data may be necessary.

Therefore, the County may:

- Require that seismic monitoring be performed in conjunction with major geothermal projects as necessary.
- Request the developer to analyze seismic data to determine effects of geothermal production and injection on seismic activities within the development area.
- Consult with experts, such as Division of Oil and Gas, U.S. Geological Survey, geothermal industry representatives, permittees, and other developers to determine monitoring and mitigation requirements.

IV. IMPLEMENTATION MEASURES

In order to implement the policies set forth in the previous section, the County will:

(1) Maintain an updated Zoning Ordinance including regulations for geothermal projects, a geothermal development zone, and definitions of the resource, wells, facilities and projects.

(2) Require applications for Conditional Use Permits and/or zone changes to include, but not be limited to:

  (a) a comprehensive project description.

  (b) a conceptual scenario for the ultimate development of the anomaly, or how the project will fit into existing scenarios.

  (c) a statement of measures to be taken to preserve and protect agricultural land and the environment.

  (d) a description of any steps the applicant may have taken to cooperatively develop the anomaly with other developers and leaseholders as appropriate.

  (e) a general description of production and injection plans for the project.

  (f) the proposed source of cooling water for the project.

(3) Include new projects into the existing subsidence, seismicity and air quality monitoring networks.

(4) Periodically evaluate the findings of each environmental monitoring program to determine if: (a) mitigation measures are necessary, (b) the monitoring program should be modified, (c) results demonstrate that the monitoring program is unnecessary.

(5) Periodically review insurance and bond requirements to establish appropriate levels of protection.

(6) Coordinate County planning and regulation of geothermal activities with other governmental agencies as necessary.

(7) Develop procedures to assure County input on projects for which other governmental agencies are "lead agency" or the approving authority, and to insure continuity of enforcement in the event of such agency's failure or inability to exercise their authority.

(8) Maintain "master" environmental impact reports and prepare new ones as necessary for areas with substantial anticipated geothermal development.

(9) Periodically review utility transmission corridor plans with the Imperial Irrigation District, other utilities, and geothermal industry representatives to determine if plans are adequate.

(10) Determine the costs of processing applications, and performing inspections and monitoring (including major monitoring projects), passing costs on to geothermal developers through appropriate fees.

(11) Assure that adequate waste disposal facilities are available for materials not injected or recovered for useful purposes.

(12) Facilitate the development of cascaded/direct heat utilization of geothermal energy.

(13) Review and advise on necessary occupational skill levels required for employment in the geothermal industry and encourage educational institutions and industrial companies to offer appropriate courses and training programs.

(14) Keep the public informed on geothermal development in Imperial County with periodic informational programs.

(15) Cooperate and participate in studies, as appropriate, of:

(a) public services and facilities needed as a result of geothermal development.

(b) technical developments and changes in facility operations which might require changes in County policy or regulations.

(c) water resources for geothermal facility use.

(d) means and incentives to develop cascaded or direct heat industries in Imperial County for economic development.

(e) possible legislative incentives to accelerate resource development in Imperial County.

(f) options available for utilization of geothermal revenues for staffing and monitoring purposes.

V. ENVIRONMENTAL IMPACT REPORT

TABLE OF CONTENTS FOR EIR

V. ENVIRONMENTAL IMPACT REPORT

Location. The location of the project is Imperial County California. The major geothermal areas are shown on Map 1. Maps 3-10 further identify individual geothermal projects and study areas.

Description. The project is the revision of the Geothermal Plan for the County. The plan is a planning document (integrated with other documents) for 3000 MW of electrical generation utilizing geothermal brine by the year 2015.

Within this 30 year planning period, approximately 60-fifty megawatt plants (about 15 acres each) and 15 to 40 wells each may be built for the generation of electricity. Also, within this period an indeterminant number of additional direct heat projects may be developed.

The plan seeks to establish a meaningful and useful guide for local decision-makers. This long-range and comprehensive guide is necessary to fully develop the County's geothermal resource. Since the project's implementation may have environmental impacts, the preparation of an EIR is necessary.

The primary purpose of the revision of the Geothermal Plan and EIR is to develop policies and implementation measures which reflect advancing technological changes and the streamlining of geothermal permitting. The essence of the updated Plan, beyond promoting safe and efficient development, is to ensure that geothermal development will be beneficial to the Imperial County economy, environment and residents.

The Plan is designed to be flexible, to encourage an on-going assessment of environmental impacts, and to establish required performance standards for operations which may affect the environment.

Sections II - IV discuss the anticipated development in detail.

Intended Use. It is anticipated that this EIR will, in addition to the revised Geothermal Plan, provide environmental documentation for all or most exploratory, test facility, minor and intermediate geothermal projects, and regulating ordinances. Major projects (generally those using over one million pounds of fluid per hour), both power plants and direct heat uses, and "G" zones, will probably require individual EIR's - focused and site specific, if within one of the areas already well documented, comprehensive if in new areas or if involving substantially different technologies or processes. In all events, an initial study or project evaluation will be performed and a decision made, pursuant to CEQA and Imperial County's CEQA implementing procedures, as to the proper environmental documentation needed for each project permitted.

The focus in these pages is on cumulative impacts. A compilation of impacts and mitigation measures (not necessarily applicable to all projects), is included.

In addition to providing primary documentation for the type of projects noted above, this document is intended to serve as a reference guide for the preparation of environmental documentation for subsequent geothermally-related projects. It is intended for use primarily by Imperial County staff and decision-makers.

Upon final adoption of this revised geothermal section to the General Plan and certification of this EIR, then EIR #160 -77 is superceded by this document.

Discussion of CEQA and Incorporation of Existing Documents. The California Environmental Quality Act (CEQA) comprises Chapters 1, 2, 2.5, 2.6, 3, 4, 5, and 6 of Division 13 of the Public Resources Code. Section 21083 directs that Guidelines for implementation of CEQA be prepared. They are contained in Chapter 3, Division 6, Title 14 of the California Administrative Code as Sections 15000-15378. The revision of this geothermal section of the Imperial County General Plan is a project as defined by CEQA Guidelines Section 15371 (1), and Imperial County has determined to prepare an Environmental Impact Report (EIR) in support thereof.

Many geothermal projects have been approved in Imperial County, and many EIR's have been prepared to assess their effects. Section 15150 of CEQA provides for the incorporation by reference of other documents into an EIR. Section 15152 provides for, and encourages, the "tiering" of EIR's ". . .for separate but related projects. . ." to ". . .eliminate repetitive discussions of the same issues and focus the EIR on the actual issues ripe for decision at each level of environmental review." Section 15153 provides for the "use of an EIR from an earlier project."

The original project anticipated 4500 MW's of development and EIR #160 - 77 assessed the impacts thereof. This revised project anticipates 3000 MW's of development in essentially the same locations as previously addressed. The net effect of this revision will be a significant decrease in impacts over that originally anticipated.

No agency other than Imperial County will be making discretionary decisions related to this project. Although a scoping meeting was held, Notices of Preparation sent, and other consultations made with the agencies

which normally are responsible agencies on geothermal projects, there are no responsible agencies for this project (CEQA 15381).

An EIR is not a permit, nor a regulatory document. It is an information document to assist decision-making bodies in identifying the aspects of projects to be permitted that might require restrictive conditions on permits. An EIR is a guide for decision makers, and the public. It neither mandates nor relieves responsibility for the decision to approve or disapprove a project and the conditions to be applied to that approval.

The incorporation of separate documents into this EIR introduces probable inconsistencies in statements of fact, assessments of impact, and suggestions for mitigations. This, in itself, is neither a fault nor an undesirable condition. Because an EIR is not a Plan nor regulatory document, the internal consistency both desired and required for them, is not necessary. Because EIR's involve forecasting, speculation, and varying degrees of specificity and emphasis (CEQA sections 15143-6) we should be suspect if the "separate but related" documents all said the same thing.

The incorporation by reference of other documents into this document is for the EIR portion of this document only, and only for EIR purposes. This geothermal plan is part of the General Plan of Imperial County, and as a legally binding policy document, it is intended to be an integrated, comprehensive and internally consistent portion thereof. The combining of the EIR with the plan is to reduce paper and facilitate review of both documents. Further, the reader should be aware that the incorporation is not casual or for general backup purposes. The incorporated documents representing approximately 7120 pages constitute the major portion of this EIR.

An EIR becomes a legally certified document only in connection with a specific project approval. There is no such thing as a "certified EIR" standing alone. An EIR does stand alone, however, as an information document describing settings, analyzing impacts, and suggesting mitigations and alternatives. Thus, an existing EIR document certified adequate for some previous project may prove to be inadequate for a subsequent project, or one found inadequate earlier may be certified as properly describing some later project.

Each project must be evaluated individually with respect to its scope, location, and timing, and then a determination made as to the adequacy of existing, or need for additional, environmental documentation.

Documents Incorporated. The following twenty-five (25) documents are incorporated into this EIR by reference as if set forth fully herein. All are on file at the Imperial County Library and the El Centro Public Library. United States documents are also on file at the El Centro office of the Bureau of Land Management.

Abbreviations used in the following list:

(I.C. = Imperial County; FEIR = Final Environmental Impact Report; SCH# = State Clearinghouse Number; EA = Environmental Assessment; DLRI = Dry Land Research Institute, I.C. contract C1 75/761, Final Reports, January 1977; LLL = Lawrence Livermore Laboratory - University of California; BLM = Federal Bureau of Land Management)

1. "An Assessment of Geothermal Development in the Imperial Valley of California, Volume 1 - Environment, Health, and Socioeconomics," Layton, LLL, DOE/EV-0092 VC 66e, July 1980.

2. "An Assessment of Geothermal Development in the Imperial Valley of California, Volume 2 - Environmental Control Technology," Morris, LLL, DOE/EV - 0092 VC 66e, July 1980.

3. "A description of Imperial Valley, California for the Assessment of Impacts of Geothermal Energy Development," Layton, LLL, UCRL - 52121, August 1976.

4. "Salton Sea Anomaly Master FEIR," 4 Volumes, I.C., SCH #80102409, December 1981.

5. "North Brawley Ten Megawatt Geothermal Demonstration Facility (and Geothermal Overlay Zone) FEIR," I.C., #198-78, SCH #79020586, April 1979.

6. "South Brawley Prospect Geothermal Overlay Zone Program FEIR," 2 Volumes, I.C., SCH #82082250.

7. "Heber Master FEIR" I.C., #213-79, SCH #79021326.

8. "Westmorland Development Project Geothermal Loan Guarantee EA" DOE/EA 0058, April 1979.

9. "East Mesa Non-Competitive Leases for Geothermal Exploration/ Development - FEA Record," BLM, SCH #80040923, January 1981.

10. "Glamis/Dunes - Leasing for Geothermal Exploration/Development Imperial County, California FEA," BLM, SCH #81040306, November 1981.

11. "North Salton Sea Area, California, Proposed Geothermal Leasing FEA Record," BLM, SCH #78090503, May 1979.

12. "Salton City/Kane Springs Geothermal Resource Prospect, Non-Competitive Leasing and Exploration - FEA," (Phase 1 of a two phase review), BLM, March 1982.

13. "Superstition Hills Geothermal Resource Prospect, Non-Competitive Leasing and Exploration - FEA," (Phase 1 of a two phase review), BLM, March 1982.

14. "West Chocolate Mountains Geothermal Resource Prospect, Non-Competitive Leasing and Exploration - FEA," (Phase 1 of a two phase review), BLM, March 1982.

15. "Yuha Basin/Mt. Signal Non-Competitive Leases for Geothermal Exploration/Development FEA Record," BLM, SCH #79081503, February 1980.

16. "East Brawley Geothermal Exploratory Project FEIR," I.C., #223-79, SCH #79080104, October 1979.

17. "Holly Prospect Geothermal Exploration Project FEIR," I.C., #233-80 SCH #80021321, 1980.

18. "South Westmorland Geothermal Exploration Project FEIR," I.C., #206-78, SCH #78121207, February 1979.

19. "Truckhaven Prospect Geothermal Exploratory Wells FEIR," I.C., SCH #81050106, August 1981.

20. "Geothermal Direct Heat Study Imperial County, California," Sections 1-4, May 1983.

21. "Use of Geothermal Heat for Sugar Refining in Imperial County FEIR," I.C., #229-79, SCH #79090526.

22. "FEIR I.C. General Plan Transmission Corridor Element," with Addenda #1 and #2, I.C., #228-79 (SCH #7909053) March 1980.

23. "APS/SDG&E Interconnection Project (500 kV Transmission Line) Final Environmental Document EIR-EIS," 4 Volumes, BLM and CA PUC (A-59575), SCH #79061204, October 1981.

24. "Imperial Valley to La Rosita 230 kV Transmission Line Inter-Connection with Mexico - Proponent's EA," San Diego Gas & Electric Co. and CA PUC Application (No. 82-09-28).

25. "Superstition Hills Class II-I Disposal Site FEIR," 3 Volumes, I.C., SCH #79090501, March 1980.

The geographic areas covered by documents 4, 5, 6, and 7 are shown on Map No. 1, by document 22 on Map 3, and by documents 8-19 and 24-25 on Maps 5-10. Documents 1, 2, 3, 20, 21, and 23 are county wide.

In addition to the description of the environment and description of typical development projects presented here, all of the incorporated documents include excellent, similar, often more detailed and specific descriptions. Documents 1, 2, and 3 are especially good for the comprehensive overview.

Documents 4, 5, 6, and 7 are the most important. They are the "Master" (or Program) EIR's for the four County-adopted Geothermal Overlay Zones: Salton Sea, North Brawley, South Brawley, and Heber. These areas are where most of the geothermal development is anticipated to occur. These four EIR's assess the impacts of 3445 MW's of development - more than the total now anticipated for all areas.

Document 8 assesses the large area west of the North Brawley, and south of the Salton Sea "G" zones. Its area extends south of Westmorland and west beyond the IT Class II-1 site. It is less comprehensive and detailed than the above four

Documents 9 - 15 were all prepared by BLM for leases of federal lands. Documents 9, 10, 11, and 15 are comprehensive and thorough analyses of both geothermal exploration and development impacts. The EA's prepared under NEPA are generally of the same scope as EIR's under CEQA. The "North Salton Sea EA" has a good discussion of direct heat projects. EA's 12, 13, and 14 are less comprehensive, assessing primarily the impacts of exploration only.

Documents 16, 17, 18, and 19, although only for exploratory projects, are fairly thorough studies and are good base documents. They cover area not included in other EIR's.

Documents 20 and 21 are useful base documents for analyses of direct heat projects. All of the probable impacts of electrical transmission lines are assessed in documents 22, 23, and 24. Each of these has good descriptions of the existing environment. Document 25 deals with hazardous wastes generated by drilling and from geothermal power plants.

In addition to the above incorporated documents, the following EIR's and EA's for specific projects provide valuable material:

26. Magma # 1 (10 MW binary East Mesa) EA #78 #113-9;
27. Magma # 2 (49/28/35 MW, Salton Sea) SCH #79072515 with supplement & addenda;
28. Magma # 3 Salton Sea MEIR; SCH #80102409;
29. Salton Sea Union/SCE (10 MW) SCH #80020623;
30. South Brawley Unit #1 (49 MW) PEIR, SCH #82082250;
31. Republic (48 MW East Mesa) EA #0089;
32. Republic (19 MW East Mesa) EA #99-100 & EA #107-9; and
33. Niland Geothermal Energy Program (49 MW), SCH #82091950
34. Heber-Geothermal Demonstration Project (EIR 170-77) SCH #77120564 (predecessor to Heber-MEIR)

The location of these projects are shown on Maps 1 or 7.

Further, the following EIR's have been prepared for geothermal projects (mostly exploratory). They provide useful site specific information:

	County EIR#	Project	Location by Section, Township and Range
35.	6-72	Chevron, 1 Well	33/16S/14E.
36.	12-73	SDG&E, Test Facility	33/11S/13E
37.	15-73	Magma Geo, 4 Wells	34/16S/16E; 8/17S/13E; 22/15S/14E
38.	17-73	Hills Bros, Mineral Prod.	4,10/12S/13E
39.	20-73	Phillips, Test Facility	4/10/12S/13E
40.	30-73	Chevron, Test Facility	31,32,33,16S/14E
41.	38-73	Magma, Bonaman 1, Sharp 2	22/15S/14E; 34/16S/16E
42.	46-73	Chevron, Jackson Jr., 1	32,33/16S/14E
43.	47-74	Magma, Elmore 2&3	27/11S/14E
44.	54-74	Union, Jiminez 1	15/13S/14E
45.	56-74	Chevron, Hulse 1	50/16S/14E

	County EIR#	Project	Location by Section Township and Range
46.	61-74	Transeeco, Russell 1 & 2	2/12S/13E
47.	74-74	Union, Veysey 1 & 2 Benson 1, Cox 1 Tr	95,97,118,120/13S/14E
48.	85-75	RGI, 4 Wells	28,32,33/16S/15E; 3/17S/15E
49.	86-75	Chevron, 3 Wells, GTW 1,2,3	34/16S/14E
50.	108-75	RGI, 18 Wells	20,21,22,27,28,29/15S/17E
51.	111-75	Union, Kruger	17/13S/14E
52.	116-75	RGI, 9 Wells	20,21,22,27,28,29,15S/17E
53.	118-75	RGI, 6 Wells	20,32,36/12S/13E
54.	122-75	Chevron, 9 Wells	32,33/16S/14E; 3,4/17S/14E
55.	125-75	Magma Power	7/16S/17E
56.	126-75	Union, 10 Wells	3,4/5,6/17S 34,31,20,21,24,27/16S/14E
57.	127-75	Union, 11 Wells	7,9,16,20,13S/14E
58.	131-76	Phillips	4,10/12S/13E
59.	134-76	RGI	17/11S/14E
60.	141-76	Union	3,4,5,7,8,9,10,17,17S/14E
61.	145-76	Chevron, 11 Wells	15,10,22,8,20,17,21,14/13S/14E
62.	148-76	RGI, Jameson #1 & 2 Goin #1	17/11S/14E
63.	149-76	RGI, 10 Wells	5,19,20,28,29,12S/13E
64.	150-76	McCulloch	28/14S/14E
65.	151-76	Imperial Magma	33/11S/13E
66.	153-77	Chevron/Standard Oil Co.	8,10,18,19/13S/14E
67.	162-77	Union, 14 Wells	14,15,16,17,20,21,22/13S/14E

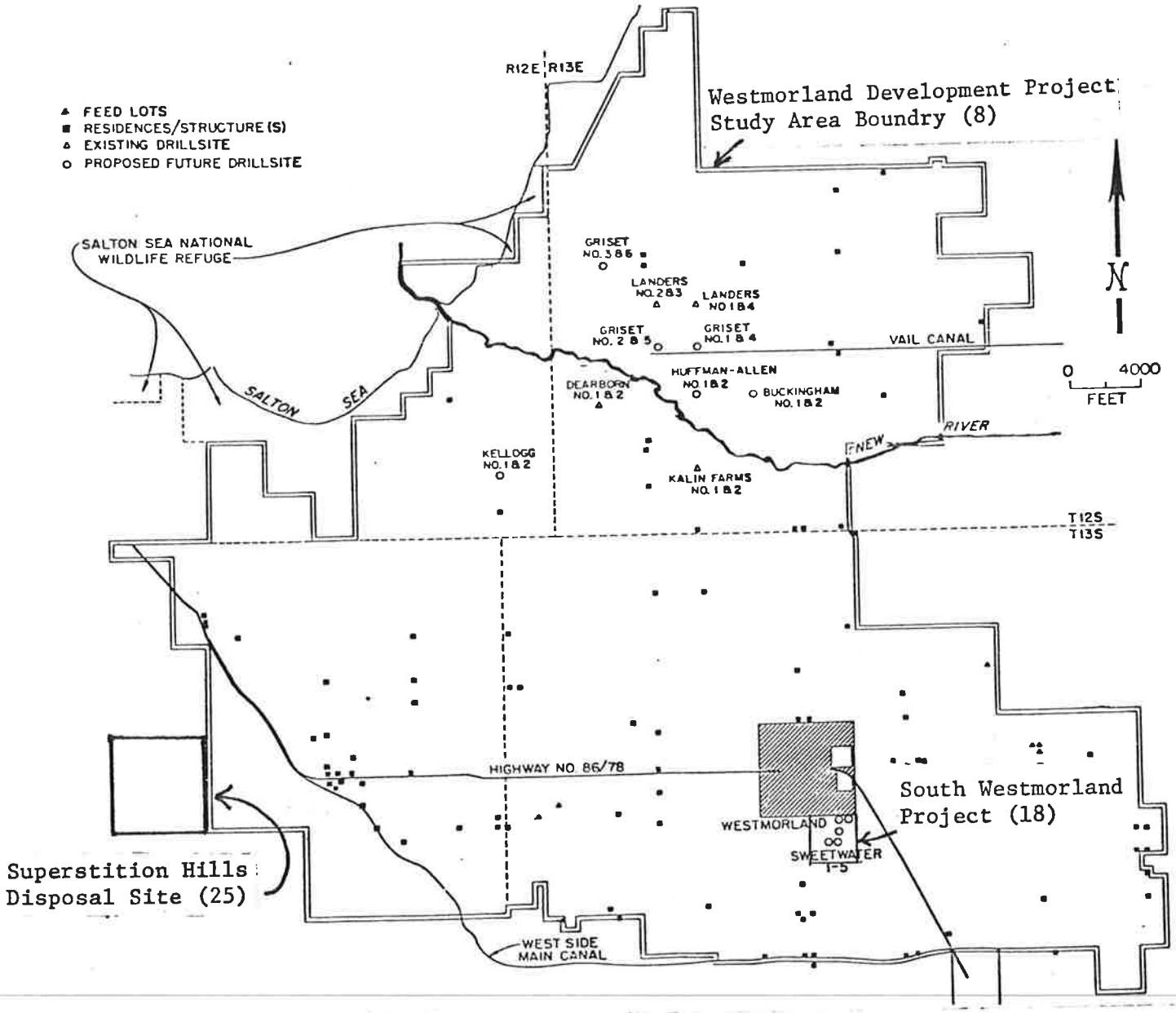
	County EIR#	Project	Location by Section Township and Range
68.	190-78	Union Geothermal Exp. Project Salton Sea 10 Wells	32/11S/13E; 4,5/12S/13E
69.	199-78	McCulloch	15/9S/12E
70.	205-78	RGI 6 Wells	11/12S/13E
71.	230-79	McCulloch 4 Wells	28/14S/14E

The following documents for exploratory projects (less than a full EIR) are useful:

	Project	Location
72.	Bear Creek #3 Wister (CUP 123-83) SCH #83100502	12/11S/13E; 6/11S/14E
73.	RGI 12 Wells (CUP 111-80) SCH #80032606	17,18/11S/14E
74.	KSMG Venture (CUP 112-80) SCH #79020586	3/13S/14E
75.	Phillips 6 Wells (CUP 105-80)	17,18/14S/16E
76.	Emanuelli A. Rutherford (CUP 115-80) SCH #8010702	20/13S/16E
77.	Magma Elmore, 10 Wells (CUP 113-80) SCH #80040213	25,26,27,34, 35/11S/13E
78.	Rutherford Drill Site A & B (CUP 109-80)	13,13S/15E; 19/13S/16E

Finally the following document used primarily by the Imperial County Air Pollution Control District, has been found to accurately predict emissions by geothermal plants:

79. "The Potential Air Quality Impact of Geothermal Power Production in the Imperial Valley," Gudiksen, et al. LLL UCRL - 52797.



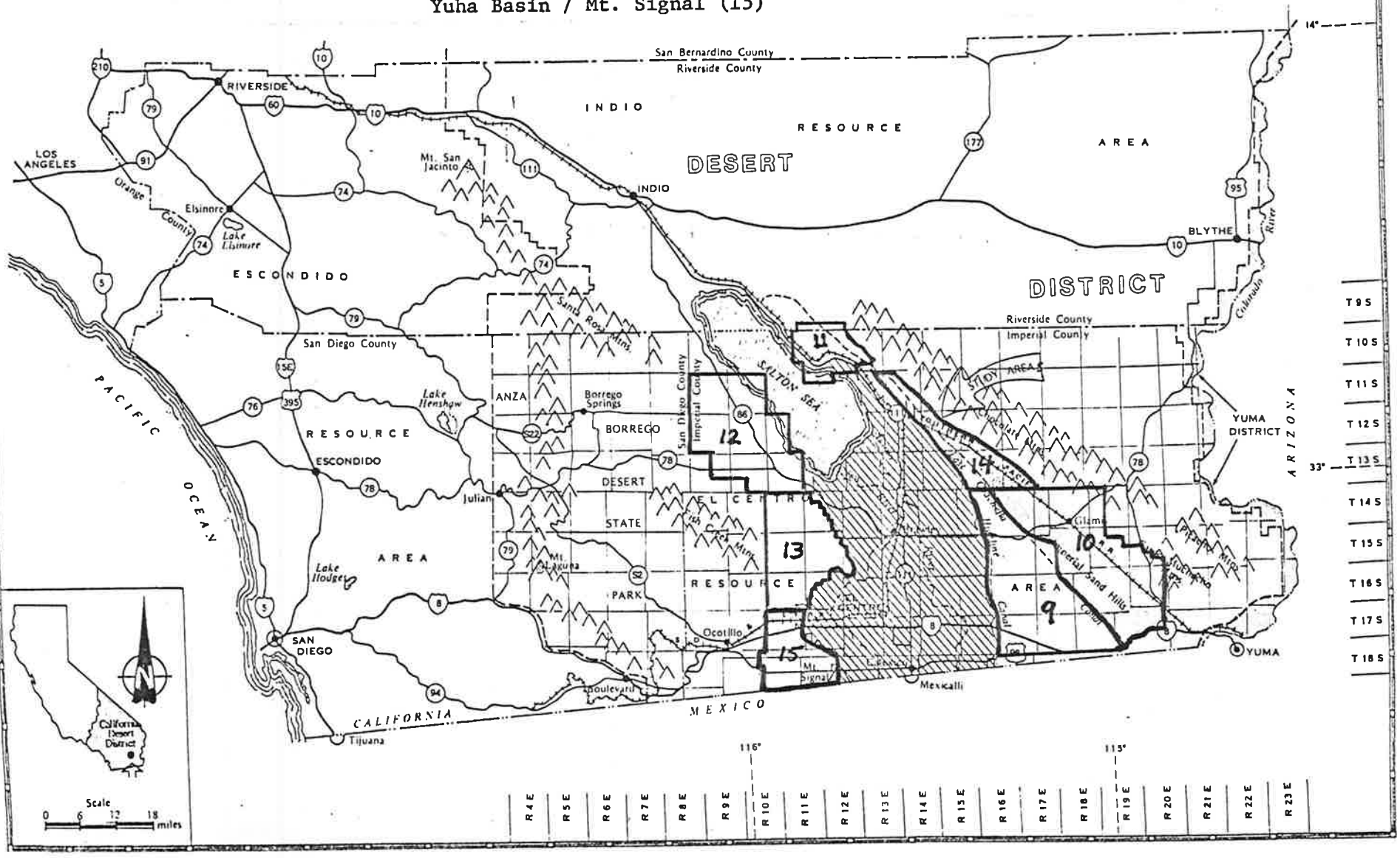
MAP NO. 5 WESTMORLAND AREA SITES

REGIONAL LOCATION MAP

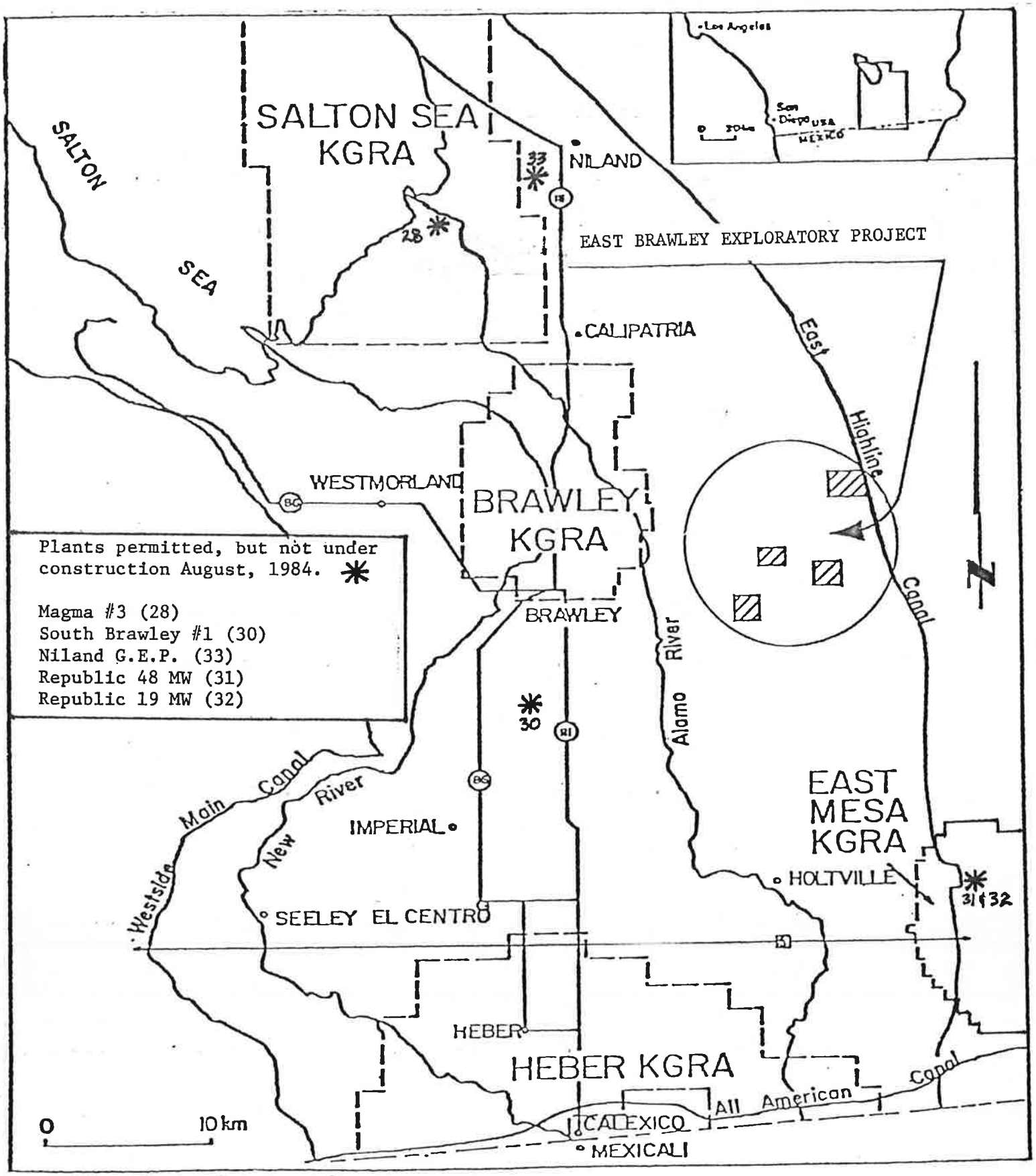
Map 6

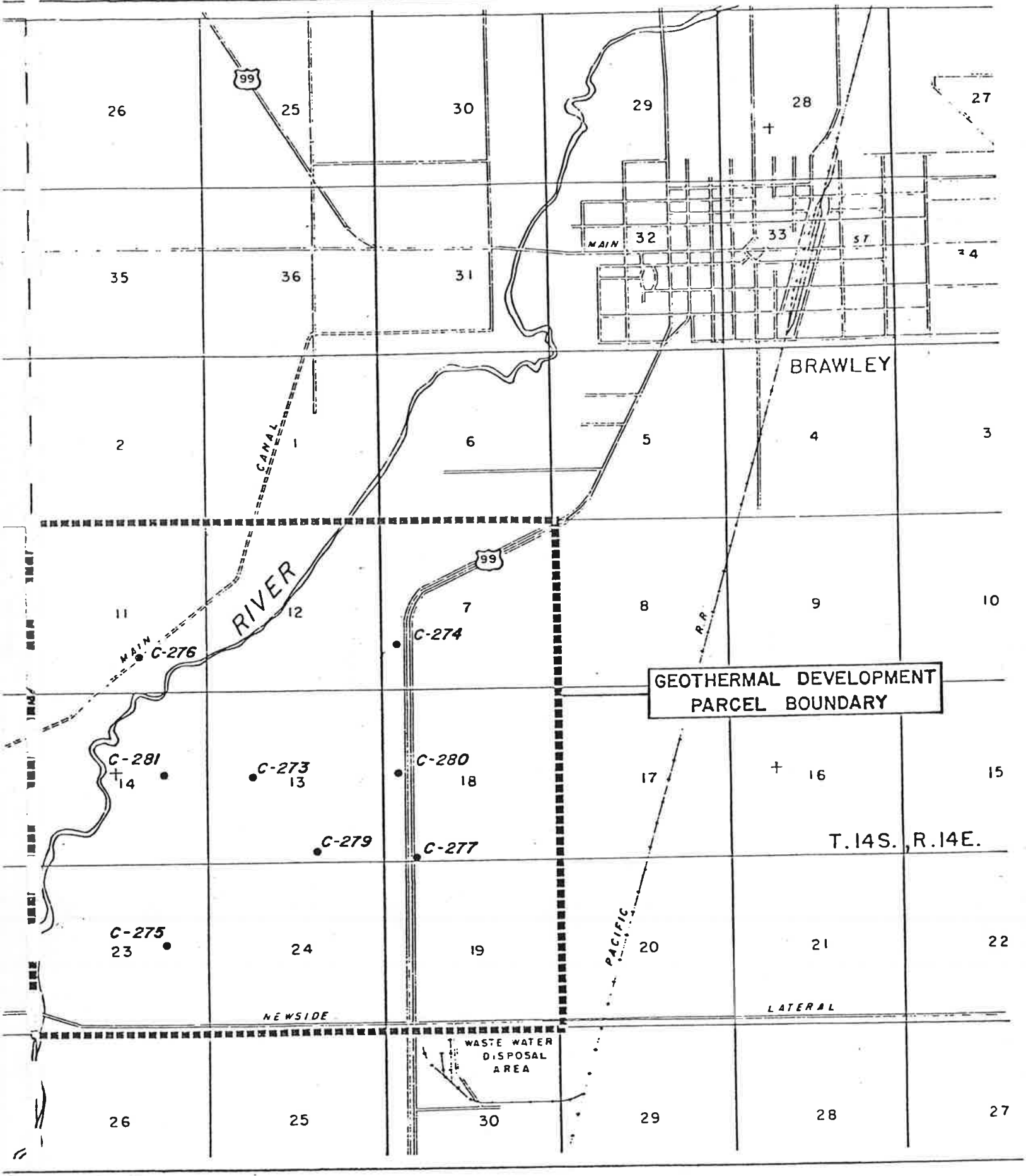
BLM FINAL ENVIRONMENTAL ASSESSMENTS FOR:

East Mesa (9)
Glamis / Dunes (10)
North Salton Sea (11)
Salton City / Kane Springs (12)
Superstition Hills (13)
West Chocolate Mountains (14)
Yuha Basin / Mt. Signal (15)

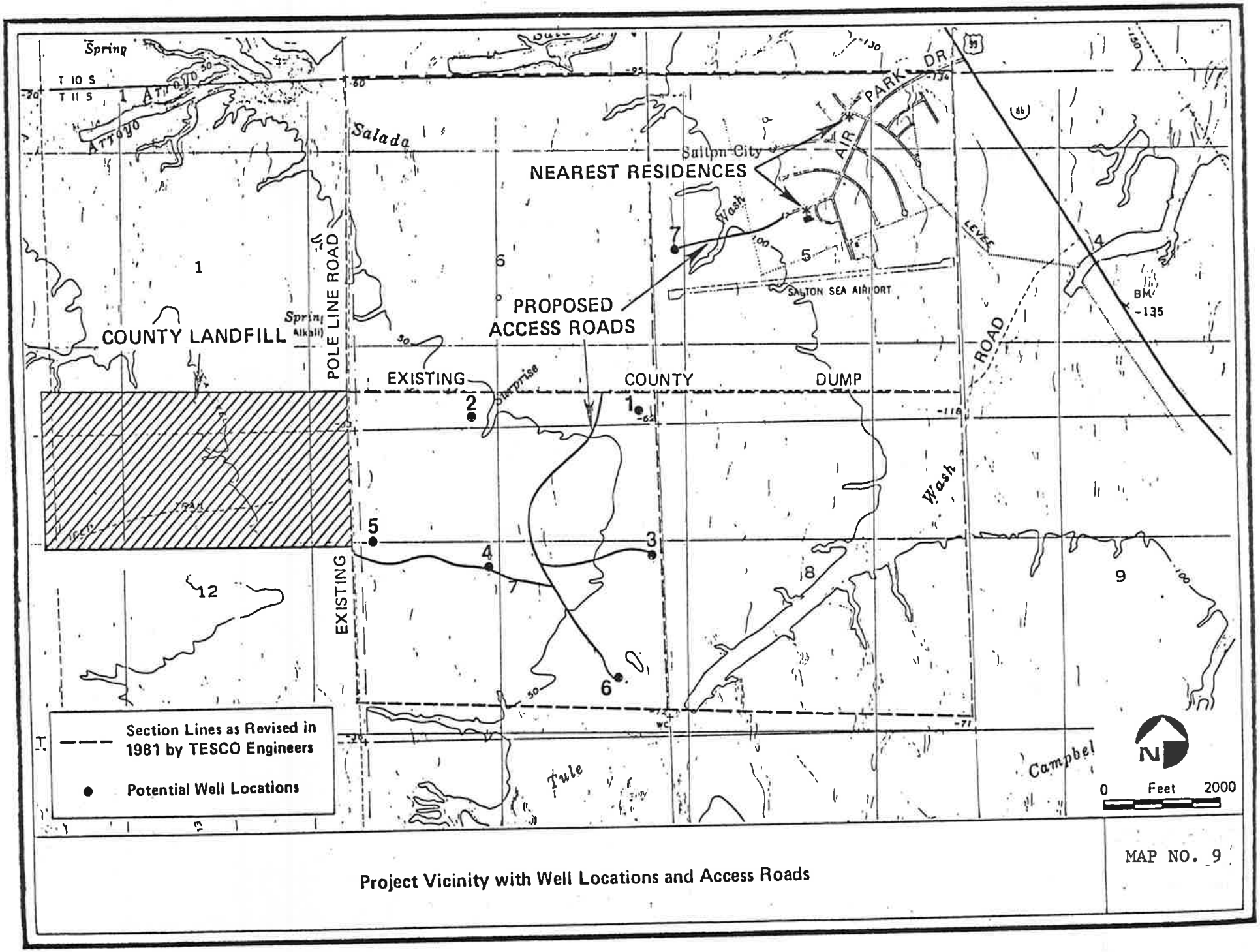


MAP NO. 7 EAST BRAWLEY STUDY AREA AND
PROPOSED POWER PLANT SITES

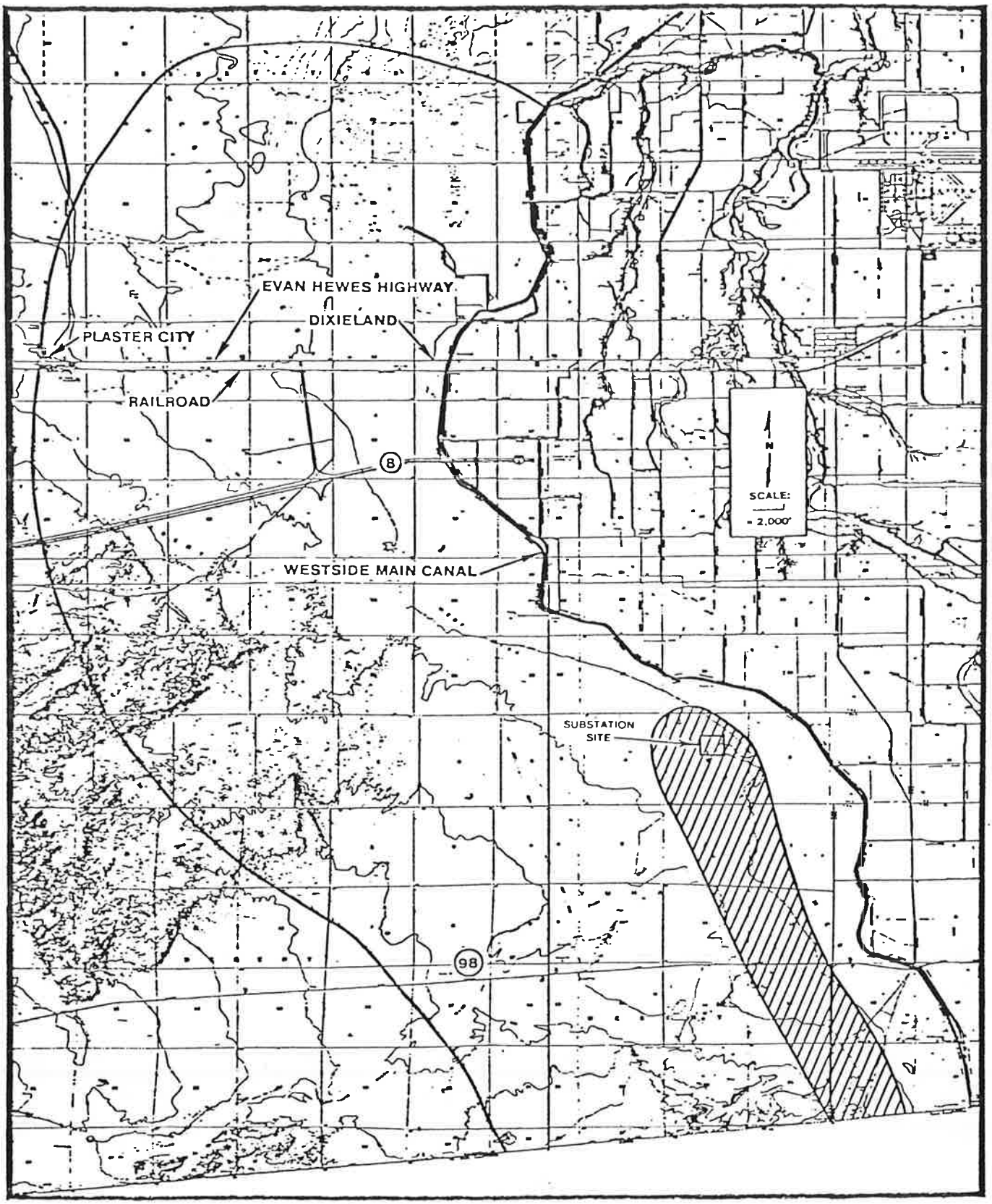




MAP NO. 8 HOLLY PROSPECT STUDY AREA



Project Vicinity with Well Locations and Access Roads



SAN DIEGO GAS AND ELECTRIC

LA ROSITA TRANSMISSION LINE

Study Corridor

PREPARED BY: San Diego Gas & Electric

MAP NO. 10

ENVIRONMENTAL SETTING

The environmental setting and description of existing conditions is contained in the County Overview portion of the General Plan. It was included with the draft of this document circulated for review but is not duplicated in this final document. See also the environmental setting sections of the incorporated documents.

ENVIRONMENTAL IMPACTS AND MITIGATING MEASURES

Summary of Major Categories and Discussion of Cumulative Effects:

Documents 1 and 2, incorporated herein, are devoted largely to the assessment of full field geothermal development, its impacts, and mitigating technologies. Those documents used a 3000 MW development scenario. Documents 4 through 19 assess the impacts of their project's development in their study areas. All of these documents are comprehensive and thorough. They identify the significant impacts likely to occur and suggest mitigating measures and alternatives.

The notable cumulative impacts of Valley-wide full geothermal development are in traffic, land use, air quality, and visual resources. Most notably, the Valley will look and feel more industrial and more urban, especially at night. These impacts are absolutely cumulative. That means the impacts even where small on a site-specific basis, are additive as each plant is built.

Other types of impacts need to be viewed differently when we try to assess their cumulative impacts. For example, are those such as spills, which are not routine, and may never even occur. We can only estimate the probability of them occurring. With Valley-wide development of 50 to 60 plants, the probability of one such occurrence becomes very high but, the chances of two or more occurring at the same time so that their