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REGULATORY, LAND OWNERSHIP, AND WATER
AVAILABILITY FACTORS FOR A MAGMA WELL:
LONG VALLEY CALDERA AND
COSO HOT SPRINGS, CALIFORNIA

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1.0 INTRODUCTION

The U.S. Department of Energy is currently engaged in a program to demonstrate the engineering feasibility of extracting thermal energy from high-level molten magma bodies. The program is being carried out under the direction of Sandia National Laboratories where a number of individual projects support the overall program. The existing program elements include (1) high-temperature materials compatibility testing; (2) studies of properties of melts of various compositions; and (3) the investigation of the economics of a magma energy extraction system. Another element of the program is being conducted with the cooperation of the U.S. Geological Survey, and involves locating and outlining magma bodies at selected sites using various geophysical techniques. The ultimate goal here will be to define the limits of a magma body as a drilling target.

During an earlier phase of the program, more than twenty candidate study sites considered were evaluated based upon:

- 1) the likelihood of the presence of a shallow magma chamber,
- 2) the accessibility of the site, and
- 3) physical and institutional constraints associated with each site with respect to performing long-term experiments.

From these early phase activities, the number of candidate sites were eventually narrowed to just 2. The sites currently under consideration are Coso Hot Springs and the Long Valley caldera (Figure 1).

This report describes certain attributes of these sites in order to help identify potential problems related to: (1) state and federal regulations pertaining to geothermal development; (2) land ownership; and (3) water resource availability. The information sources used in this study were mainly maps, publications, and informative documents gathered from the California Division of Oil and Gas and the U.S. Department of the Interior. Environmental studies

Figure 1: Location Map

completed for the entire Long Valley caldera study area, and for portions of the Coso Hot Springs study area were also used for reference.

2.0 STUDY AREAS

2.1 LONG VALLEY CALDERA

2.2.1 Location, Access and Physiography

The Long Valley Caldera study area is situated in southern Mono County, California, along the eastward facing escarpment of the Sierra Nevada Mountains. The study area includes all of the caldera floor (Figure 2) which is principally part of the Inyo National Forest. The study area can be broadly placed into a topographically enclosed basin bounded on the north by Bald Mountain and Glass Mountain, on the east by Round Mountain and the Benton Range, and on the southwest by the high Sierra Nevada Mountains. A large reservoir, Lake Crowley, occupies the southeast part of the study area along the Owens River drainage.

A major route serving the area is U.S. highway 395 which crosses the central part of the caldera. The route winds far northward to Carson City, Nevada (approximately 120 miles), and southeastward to the town of Bishop, California (40 miles). Access to other parts of the study area is by secondary hard surface roads and improved trails.

The Long Valley caldera is an elliptical depression approximately 32 km along its east-west axis and 17 km along its north-south axis, with a total floor area of approximately 450 km². The east half of the caldera is comprised of a broad grass and sage covered lowland that has an average elevation of 2070 m (6800 feet). The western portion of the caldera, which is termed the "Mammoth embayment" because of the prominent reentrant into the Sierra Nevada Range, is a high forested area with an average elevation of 2440 m (8000 ft) (Bailey, 1976, p. 725). Dissected hills rise from the west central part and form an "annular moat" between the hills and the topographic margin of the caldera.

2.1.2 Geologic Setting

Basement rocks in the vicinity are principally pre-Tertiary intrusives

of the Sierra Nevada batholith. Late-Tertiary basalt, andesite, and rhyodacite volcanic units nonconformably overlies the pre-Tertiary basement. The oldest volcanic rocks have been dated between 3.2 and 2.6 M.Y. old (Bailey, 1976, p. 727).

Volcanic units associated with the major "caldera forming" eruptive event include: (1) Glass Mountain rhyolites (1.9 to 0.9 M.Y.); (2) the Bishop Tuff (0.7 M.Y.); and (3) post-caldera rhyolites and rhyodacites (0.68 to 0.1 M.Y.). Glass Mountain rhyolites consist of a thick accumulation of domes, flows, and tuffs along the northeast rim of the caldera. The Bishop Tuff is a regional ash-flow sheet deposited during the caldera's last major eruptive cycle. It is not exposed within the caldera, but is extensively exposed northward and eastward from the caldera's topographic margin. Post-caldera rhyolites and rhyodacites that are confined within the margin consist of three separate rock groups that were extruded (1) synchronously onto the caldera floor during resurgence, (2) after resurgence within the caldera moat, and (3) along the caldera rim.

The caldera is crosscut by one of the main NW-SE trending frontal faults of the Sierra Nevada known as the Hilton Creek fault. Evidence indicates that this structure has been active over the last 3 M.Y.

2.1.3 Water Resource Availability

2.1.3.1 Surface Water

The Long Valley study area can be considered as a single drainage basin which includes the headwaters of the Owens River. The drainage is a major source of water entering the aqueduct system of the city of Los Angeles. Precipitation in the area ranges from nearly 60 inches per year along the nearby crests of the Sierra Nevada to slightly more than 10 inches per year at Lake Crowley. Variations in precipitation from year to year are wide and can fluctuate as much as 50% from one yearly cycle to the next (Sorey, et al.,

1978).

Table 1 presents a water budget for the Long Valley drainage basin measured during the 11 year period from 1964 to 1974. The difference (9,140 acre-ft/year) may be due to ungaged ground-water flow into the Owens River and into Lake Crowley below gaging points. The thermal water discharge into the ground-water system has been estimated at approximately 3,070 acre-feet per year. Warm water (50°C) is thought to move southeastward across the caldera boundary and into southwestern Lake Crowley. The imbalance of the total inflow versus total outflow of 3.2 percent is described by Sorey (et al., 1978) as being in good agreement and well within the error limits of the measurements. Part of the imbalance may be due to unmeasured ground-water underflow in Lake Crowley.

2.1.3.2 Subsurface Water

Ground-water resources in the Long Valley study area are divided into two major components: 1) a shallow subsystem with near-ambient temperature and low salinity; and 2) a deeper subsystem with much higher temperatures and higher salinity.

In the shallow subsystem, the ground-water flow paths are generally short and direct from areas of recharge to areas of discharge. This system is in general contained within the fill above the densely welded Bishop (ash-flow) Tuff. The fill material largely consists of "intercalated lava flows and tuffs in the western part and chiefly of tuffs and fluvio-lacustrine sediments in the eastern part" (Sorey, et al., 1978).

Recharge to the shallow ground-water system is from infiltration of precipitation and runoff from the Sierra Nevada Mountains. Depth to water measured in wells and test holes drilled into alluvium ranges from 0.3 m to about 8 m.

	<u>ACRE-FT/YR</u>
<u>INFLOW</u>	
Owens River below east portal plus water imported from Mono Lake Basin	131,400
Hot Creek at the gorge	46,270
McGee Creek	23,770
Convict Creek	20,580
Hilton Creek	8,790
Rock Creek diversion	7,490
Laurel Creek	4,290
Crooked Creek	2,890
precipitation on Lake Crowley	4,290
ungaged inflow	<u>27,860</u>
TOTAL	277,630
<u>OUTFLOW</u>	
main venturi at Long Valley dam	247,200
evaporation of shallow ground water	12,990
evaporation from irrigated grassland	10,990
evaporation from Lake Crowley	11,990
Owens River Gorge, main wier	3,090
ground-water loss to regional system	2,810
change in reservoir storage, 1964-1974	<u>-2,300</u>
TOTAL	286,770
DIFFERENCE	9,140

Table 1: Water Budget For the Long Valley Drainage
Basin for Water Years 1964-1974
(after Sorey et al, 1978)

A thin (5 to 24 m) layer of fine-grained ash apparently acts as a confining unit to underlying caldera fill. The ash unit is not well defined, but appears to be distributed over the north-central and north-east parts of the caldera. Wells that penetrate through this layer and into the underlying fill either flow at the surface or have high potentiometric heads. The ash unit may be the result of air-fall deposition into the Pleistocene Long Valley Lake.

Deeper aquifers in the shallow systems are not adequately understood due to the general lack of well data. Nine core holes drilled to depths ranging from 52 m to 325 m as part of a USGS evaluation at Long Valley reportedly encountered permeable zones, but did not establish the lateral limits of any one horizon. Figure 3 illustrates the potentiometric surface of shallow groundwater in the Long Valley Caldera. Data points have a much wider distribution in the west, resulting in poor control on the water level in that area, particularly around the resurgent dome. Based upon these data, however, the following generalizations can be made:

- 1) hydraulic gradient in the western part of the caldera is much steeper (0.02) than the gradient in the eastern portion (0.01);
- 2) a broad, gentle gradient exists in the south-central part of the caldera; and
- 3) a steep gradient is present near the intersection of U.S. 395 and the south "rim" of the caldera and can be related to ponding against a northwest trending fault.

The shallow ground-water system of the caldera is contained within near-surface weathered volcanic flows and tuffs in the west and unconsolidated sediments in the east. These units are underlain by post-caldera rhyolites, rhyodacites, and basalts that combine to form an average thickness of about 1 km. Hydraulic properties of these units are not well understood, and are likely to be complicated by local faulting. Faulting is more pervasive in the western part of the caldera.

Laboratory analysis of cores taken from test holes have shown that porosities of rocks of the shallow system are high, sometimes greater than 35 percent, while thermal conductivities are low. The net result is that the rocks of the shallow system provide a thermal insulating blanket for the deeper system. Measured vertical permeabilities have shown high variability with respect to degree of hydrothermal alteration and clay mineral content (Sorey, et al., 1978).

The deeper ground-water system is comprised of the hydrothermal system of the Long Valley caldera. The densely welded Bishop Tuff occupies the lower 1.4 km of what has been designated as the caldera fill and, along with pre-caldera rocks, is the reservoir of the main hydrothermal system. The hydrothermal system model developed by the USGS (Figure 4) is a gross interpretation based upon limited drilling data and interpretation of seismic velocities. Post-caldera fill above the Bishop Tuff probably acts as an impermeable cap to fluids contained below except around the caldera margin where recharge to both systems takes place, and in the Hot Creek Gorge area where thermal water discharges along faults which penetrate into the deep system.

2.1.4 Land Ownership

2.1.4.1 Surface Rights

The Long Valley study area is located principally within Inyo National Forest, and lies adjacent to lands on the west that are included in the Sierra National Forest and Yosemite National Park (Figure 5). The designated Mono-Long Valley KGRA extends across an area of more than 460,000 acres, of which approximately one half (the southern half) lies within the national forest boundary.

The Long Valley caldera is situated near the southern boundary of the KGRA, and spans across lands of both private and public ownership. Private lands primarily cover the eastern part of the caldera around Long Valley and

Figure 4: Conceptual model of the Long Valley hydrothermal system. Model consists of 5 horizontal layers. Layer 1 represents shallow sedimentary and volcanic rocks which contain the shallow ground-water system, and form an impermeable cap to the hydrothermal reservoir. Layers 2 and 3 represent the hydrothermal reservoir in fractured densely welded Bishop Tuff. Recharge to the reservoir is by way of caldera ring fault in the west and northeast. Discharge is by way of faults and fractures to springs in Hot Creek gorge. Straight arrows indicate ground-water flow, wavy arrows indicate heat flow (after Sorey et al, 1978).

Figure 5: Land Ownership Map of the Long Valley Study Area

Lake Crowley. Privately held lands are also present along the Owens River near the north rim and also along the Mammoth Creek drainage near the south rim. Lands administered by the Bureau of Land Management lie adjacent to private tracts in Long Valley. The western two thirds of the caldera is within Inyo National Forest. The proposed magma study site will, in all likelihood, be located on national forest lands.

2.1.4.2 Geothermal Rights

Geothermal leases issued in the Mono-Long Valley KGRA by the BLM through 1983 cover a total surface area of nearly 29,000 acres (Table 2). All leased lands within the KGRA are located within or adjacent to the Long Valley caldera. The majority of leases issued are in the vicinity of the resurgent dome. A summary of drilling activity is also shown on Table 3.

2.1.4.3 Native Lands and Restricted Use Areas

Indian lands in the vicinity of the study area are restricted to small tracts generally less than 160 acres in size. Native lands include the following tracts:

- o T.3S., R.29E., Section 19
 - S 1/2 of NE 1/4 and NW 1/4 of SE 1/4
- o T.2S., R.31E., Section 7
 - S 1/2 of SW 1/4 and SW 1/4 of SE 1/4
- o T.2S., R.31E., Section 11
 - NE 1/4

(Source: Bureau of Land Management, 1976)

Other restricted use areas include protective withdrawals, power withdrawals, and classified lands that occur as scattered tracts near the perimeter of the study area. Lands in these categories are:

<u>LEASE NUMBER</u>	<u>LEASE HOLDER</u>	<u>LOCATION</u>	<u>ACREAGE*</u>	<u>DATE OF ISSUE</u>	<u>SURFACE ADMINISTRATION</u>
CA961	Geo Operator	T3S;R29E	1815	3/1/75	BLM
CA962	Geo Operator	T3S;R29E	1895	3/1/75	BLM
CA11657	Phillips Petroleum Co.	T2,3S;R28E	2445	1/1/82	USFS
CA11658	Phillips Petroleum Co.	T2,3S;R28E	1920	1/1/82	USFS
CA11659	Santa Fe Geothermal	T3S;R28E	2000	3/1/82	USFS
CA11660	Magma Power Co.	T3S;R27E	1920	1/1/82	USFS
CA11661	Geo Operator	T3S;R28E	960	1/1/82	USFS
CA11662	Union Oil Co.	T3S;R27,28E	2464	2/1/82	USFS
CA11663	Union Oil Co.	T3S;R28E	880	3/1/82	USFS
CA11664	Union Oil Co.	T3S;R28E	1960	3/1/82	USFS
CA11665	Santa Fe Geothermal	T3S;R28E	1800	3/1/82	USFS
CA11666	Union Oil Co.	T3S;R28E	390	2/1/82	USFS
CA11667	Union Oil Co.	T3S;R28E	1590	3/1/82	USFS
CA11668	Union Oil Co.	T3S;R28E	2000	3/1/82	USFS
CA11669	Santa Fe Geothermal	T3S;R28E	2480	3/1/82	USFS
CA11670	Mono Power Co.	T4S;R28E	800	1/1/82	USFS
CA11671	Union Oil Co.	T2S;R27E	880	1/1/82	USFS
CA11672	Union Oil Co.	T3S;R27,28E	800	1/1/82	USFS
TOTAL			28,999		

(Source: Bureau of Land Management)

*Acreage by leaseholder: Union - 10,964; Santa Fe - 6280; Geo Operator - 4670;
Phillips Petroleum - 4365; Magma Power - 1920; Mono Power - 800

TABLE 2: Summary of Geothermal Leases in the Mono-Long Valley KGRA

WELL NAME	COMPANY	LOCATION			TD (feet)
		(SECTION, TOWNSHIP, RANGE)			
#LV-19	Chevron	10,	T3S,	R29E	2220
#1 MBP	Mammoth Pacific	32,	T3S,	R28E	650
#2 MBP	Mammoth Pacific	32,	T3S,	R28E	650
#1 Clay Pit	Union Oil	15,	T3S,	R28E	6058
#1 Mammoth	Union Oil	32,	T3S,	R28E	5265
#1 Bathrick	Magma Power	32,	T3S,	R28E	800
#1 Water Well	Magma Energy	32,	T3S,	R28E	327
#1 Endogenous	Magma Energy	32,	T3S,	R28E	670
#5 Endogenous	Magma Power	32,	T3S,	R28E	405
#4 Endogenous	Magma Power	32,	T3S,	R28E	513
#3 Endogenous	Magma Energy	32,	T3S,	R28E	570
#2 Endogenous	Magma Energy	32,	T3S,	R28E	810
#1 Casa Diablo	Magma Energy	32,	T3S,	R28E	386
#1 Mammoth	Magma Energy	32,	T3S,	R28E	1063
#1 Chance	Magma Energy	35,	T3S,	R28E	805
#6 Endogenous	Magma Energy	32,	T3S,	R28E	756
#66-29CA	Republic Geothermal	29,	T3S,	R29E	6920

*Note: Shallow temperature-gradient wells less than 300' deep are not shown.

(Source: Petroleum Information)

TABLE 3: Summary of Geothermal Drilling Activity
in the Long Valley Study Area

- o T.4S., R.28E.
 - Convict Creek Drainage (1720 ac.)
- o T.4S., R.30E.
 - Lower Owens River Drainage (scattered tracts totalling 2,380 ac.)
- o T.2S., R.28E.
 - Indiana Summit Natural Area (approximately 1250 ac.)
- o T.2S., R.27E.
 - Glass Creek Campground (160 ac.)

A study performed as part of an environmental overview (Strojan and Romney, 1979) included a brief description of archaeological and cultural resources in the study area. This indicated that a relatively high density of archaeological sites occur in the KGRA, including many of recent origin. It was recommended at the time that a more detailed archaeological study be performed to more fully identify the cultural resource prior to large scale geothermal development.

2.1.5 Implications to the Magma Energy Program

A detailed land status evaluation will be required in the Long Valley study area prior to selecting a project site. The accurate outlining of existing geothermal leases will be necessary in order to define current leaseholds with regard to a proposed drill site. Based upon present geologic information, a drill site would presumably be selected somewhere within the western half of the caldera where the majority of lands are administered by the U.S. Forest Service. Ideally, the drill site would be positioned on "open-Federal" lands thereby eliminating negotiations with leaseholders. In this case, special arrangements, permits, etc. would be required by the U.S. Forest Service (surface manager) and the Bureau of Land Management (resource manager).

The availability of water for drilling and production remains a question. Surface water rights would almost certainly need to be acquired from an existing water user. In all likelihood this would be the City of Los Angeles. Development of ground-water resources could prove to be the most viable option at Long Valley as there appears to be significant potential for ground-water development.

2.2 COSO HOT SPRINGS

2.2.1 Location, Access and Physiography

The Coso Hot Springs study area is situated in south-western Inyo County, California. The Coso Known Geothermal Resource Area (KGRA) covers nearly 106,000 acres of land consisting of public lands, lands under the jurisdiction of the China Lake Naval Weapons Center, state owned lands and private tracts. The area known as the Indian Wells Valley, which lies south of the KGRA, is also under consideration as part of the Magma Energy study.

The study area is situated at the eastern front of the Sierra Nevada Mountains, along the transition zone between the Sierra Nevada province and the Basin and Range province. The Basin and Range physiographic province is comprised of numerous north-south trending valleys and intervening mountain ranges extending from Oregon to Mexico and from eastern California to central Utah.

Topographic relief varies from a maximum of 8160 feet near Coso Peak in the north to a minimum of 2500 feet in Indian Wells Valley to the south. The terrain is generally uneven, irregular, and sparsely covered. The arid climate is considered a high desert steppe which, due to the Sierra Nevada rain shadow, receives less than 6 inches per year of precipitation. Most precipitation falls during the winter months.

Vegetative cover consists of merged plant communities typical of both the Mojave Desert and the Great Basin. Dominant plant associations are short brush such as Creosotebush and Saltbrush Scrub intermixed with Joshua Tree woodland.

Major routes that service the area are U.S. highway 395 to San Bernardino, and State Route 14 to Los Angeles. A rail spur of the Southern Pacific Railroad runs subparallel to highway 395 through the western part of the KGRA southward through the Indian Wells Valley.

2.2.2 Geologic Setting

The Basin and Range province is characterized by many deep alluvial basins separated by generally north-south trending mountain ranges or structural blocks that are the result of active extensional tectonics. The Coso study area lies near the boundary, or transition zone, between the Basin and Range to the east and the southern Sierra Nevada province to the west.

The oldest rocks exposed in the area are folded Precambrian through early Mesozoic marine sedimentary and volcanic rocks, which have undergone varying degrees of regional metamorphism. These older rocks were later intruded by Jurassic to late Cretaceous granitic stocks and plugs (predominantly quartz monzonite and granodiorite), which are likely satellites to the Sierra Nevada batholith. Late Cenozoic volcanic rocks were later extruded onto the pre-Tertiary complex and consist of rhyolite domes, basaltic to rhyolitic flows, and pyroclastics (Hulen, 1978, p. 5-6).

Major faults present in the study area include the Sierra Nevada frontal fault along the eastward escarpment, and the Garlock Fault to the south which forms the boundary between the Basin and Range and Mojave Desert provinces.

The southern Sierra Nevada Front is one of the most seismically active areas in California. Seismicity is mainly related to movement along the southern Sierra Nevada, Panamint Valley, Furnace Creek - Death Valley, and Garlock fault zones (Bureau of Land Management, 1980, p. 2-41).

Late Cenozoic volcanic rocks exposed in the study area consist of (1) late Pliocene and Pleistocene basalt flows; and (2) rhyolite domes, flows, and pyroclastic deposits associated with the Coso rhyolite dome field (Hulen, 1978, p. 11).

2.2.3 Water Resource Availability

2.2.3.1 Surface Water

The surface watershed in the Coso Study Area is divided into the Owens River Basin, the Rose Valley Basin (89,640 acres), the upper and lower Coso Basin (132,750 acres), and the Indian Wells Valley Basin. The areas of principal runoff are within the Sierra Nevada and within the Coso Range, which comprises part of the Coso Basins (Bureau of Land Management, 1980, p. 2-49).

There are no perennial streams within the study area. Ephemeral surface runoff occurs primarily in response to low frequency precipitation (<10 in/yr.). Perennial stream flow exists as a result of snow melt at higher elevations in the Sierra Nevada. All surface water that originates in the Sierras and within the Coso Range drains toward Rose Valley. Only during unusually wet years will water reach the valley floor for the major part of the year. Otherwise, surface water infiltrates into alluvial fans or becomes impounded in small desert playas. Little Lake, located in the lower Rose Valley, is the only perennial body of water occupying any of the basins. Little Lake is spring fed, and occupies a remnant of the former Owens River channel. It has a maximum depth of about five (5) feet, and covers an area of approximately 100 acres (Bureau of Land Management, 1980, p. 2-51).

The upper and lower Coso basins drain southward into Airport Lake. The majority of water in Airport Lake, a desert playa, is the result of heavy rainfall and is lost to evaporation, although a minor amount may serve as recharge to ground water. Small enclosed basins within the Coso Range have internal drainage.

Surface water runoff in the region is largely a factor of the intensity and duration of individual storms. Low-intensity, long-duration events usually result in minor runoff as precipitation is generally retained by soil infiltration and by vegetation. High intensity, short-duration events are usually localized

and result in large amounts of local runoff due to their intensity exceeding soil moisture capacity. Tropical storms can produce high-intensity, long-duration events that result in severe runoff.

Because surface water flow occurs with rarity, surface hydrology is monitored on an event basis as well as on an annual basis. As a result of this type of monitoring, it has been determined that approximately 70 percent of the average annual precipitation occurs between the months of November and March.

The only significant surface water resources in the area, the Haiwee Reservoir and the Los Angeles Aqueduct, are considered to be one system. This large water system, owned by the Los Angeles Department of Water and Power, moves surface water at the rate of 300,000 acre-feet per year from the Owens Valley, in the north, to Haiwee Reservoir and then southward below ground to Los Angeles. Waste overflow from the L.A. Aqueduct is typically 2000 acre-feet per year, and is received by Owens Lake (dry) to the north.

2.2.3.2 Subsurface Water

Lithologic units in the Coso study area (Figure 6) include Quarternary alluvium, pre-Tertiary crystalline basement composed of granitic and metamorphic rocks, and Tertiary and Quarternary volcanic units. All, except unconsolidated alluvial deposits, are considered to be non-water bearing for all practical purposes. The maximum thickness of alluvial deposits (from gravity data) in Rose Valley was estimated by Healy and Press (1964) to reach 5600 feet in the north-central portion. The thickness of alluvium in Indian Wells Valley may reach similar depths. Transmissivities of saturated alluvial deposits have been determined by Dutcher and Moyle (1973) to reach a maximum of 300,000 gallons per day per foot.

Ground-water flow in the study area has been, due to a lack of adequate data, hypothesized to move from the various source areas into the alluvial

Figure 6: Geohydrologic Map of the Coso Study Area

valley fill and interact with the hydrothermal system at Coso Hot Springs. One component of ground-water flow may move from the Sierra Nevada and into the adjacent Rose and Indian Wells Valleys. Another component is thought to originate in the Coso Range and move into the adjacent Coso Basin (Bureau of Land Management, 1980).

Ground water in the Coso Range maintains a level at an elevation of 3460 feet. This level is higher than the ground-water level in Rose Valley suggesting that recharge in the Coso Range and within the geothermal system is not from the Sierra Nevada. If this is the case, then recharge to the Coso Range would need to be from the north. Another possible source of recharge to the geothermal system may be from the movement of water deep within crystalline basement along east-west fracture zones from the Sierra Nevada and then to the discharge area at Coso Hot Springs.

Estimations of the water budget, or hydrologic balance, for Rose Valley, based largely upon empirical relationships and analogies to similar areas, indicate that total recharge for surface water and ground-water systems is approximately equal to discharge (60,000 acre-feet per year).

The estimated ground-water budget for Rose Valley is shown in Table 4. Rate of recharge versus rate of discharge appears to be within relative equilibrium (within the apparent accuracy of the estimates). One point of disagreement is that Hanford Engineering Development Laboratory (Sonnichsen, 1980, p. 43) estimates that the only major source of ground-water recharge in the vicinity of the Coso KGRA is derived from Haiwee Reservoir. Recharge from the reservoir was estimated to be 11,000 acre-ft. per year. Pumpage rates (of ground water) in 1980, according to Hanford, exceeded 15,000 acre-feet per year. The ground-water table in the vicinity of the Coso study area is reportedly falling.

Sonnichsen (1980, p. 43) has estimated the amount of ground water in storage

<u>Recharge</u>	<u>ANNUAL VALUE</u> <u>(acre-feet per year)</u>
Haiwee Reservoir	600*
West Alluvial Fans	?
Sierra Mtns. Precipitation	1900-3000
Coso Range Precipitation	0
Valley Floor Precipitation	0
Imported Water	100
Irrigation Infiltration	<u>900</u>
	3500-4600
 <u>Discharge</u>	
Irrigation Withdrawal	3100
Evaporation from Little Lake	830
Evapotranspiration	40
Underflow to Indian Wells Valley	200-500
Domestic and Stock Watering Withdrawal	30
Springs	<u>30-190</u>
	4100-4700

*Hanford Engineering Development Laboratory (Sonnichsen, 1980) has estimated recharge from Haiwee Reservoir at 11,000 acre-feet per year.

Table 4: Estimated Ground-Water Balance for Rose Valley
(After Bureau of Land Management, 1980)

within the area containing less than 1000 ppm total dissolved solids (TDS), is approximately 1.9 million acre-feet, and 2.1 million acre-feet in storage with a TDS value of 4000 ppm or less.

The Coso Study Area is situated within Water Resource Subregion ASA 1807. The month of critical surface supply is October. Competition for ground water in the study area is mainly between the community of China Lake and the nearby Naval Weapons Center.

2.2.4 Land Ownership

2.2.4.1 Surface Rights

The general description of surface ownership in the Coso Study Area is illustrated on Figure 7. The major portion of the study area falls within the boundaries of the China Lake Naval Weapons Center (NWC) reserve. Within the NWC border is contained more than half of the designated KGRA, the known geothermal system at Coso Hot Springs, and many of the ground-water basins. Private lands are distributed mainly along the south-east perimeter of the NWC in central Indian Wells Valley and to a lesser degree in and along Rose Valley. State lands are scattered around the northern and eastern perimeters of the NWC, mostly as isolated "school" sections. The remainder of lands in the study area are public domain, administered by the Bureau of Land Management.

2.2.4.2 Geothermal Rights

Table 5 presents a summary of Federal geothermal competitive leasing activity in the Coso Study Area through 1983. A summary of drilling activity is shown in Table 6. All leases are relatively recent with the oldest issued in January of 1982. The land position is held by Grace Geothermal with 14,579 acres under lease, followed by the Coso Land Company (10,873 acres), Grant S. Lyddon (8,401 acres), the City of Los Angeles (4,985 acres), Crownite Corporation (3,840 acres), and the California Energy Company (1,440 acres). In certain

Figure 7: Land Ownership Map of the Coso Study Area

<u>LEASE NUMBER</u>	<u>LEASE HOLDER</u>	<u>LOCATION</u>	<u>ACREAGE*</u>	<u>DATE OF ISSUE</u>	<u>SURFACE ADMINISTRATION</u>
CA11383	City of Los Angeles	T21,22S;R39E	1839	11/1/83	BLM
CA11384	City of Los Angeles	T22S;R38,39E	2555	2/1/82	BLM
CA11385	City of Los Angeles	T21,22S;R38,39E	2430	2/1/82	BLM
CA11387	Grace Geothermal	T22S;R38E	2698	4/1/82	BLM
CA11388	Grace Geothermal	T21,22S;R38E	1921	4/1/82	BLM
CA11390	Grace Geothermal	T22S;R38E	2274	4/1/82	BLM
CA11391	Grace Geothermal	T22S;R38E	2560	4/1/82	BLM
CA11392	Grant S. Lyddon	T22S;R38E	2560	4/1/82	BLM
CA11393	Grant S. Lyddon	T22,23S;R38E	1835	4/1/82	BLM
CA11394	Grace Geothermal	T22,23S;R38E	2564	4/1/82	BLM
CA11395	Grace Geothermal	T22,23S;R38E	2562	6/1/82	BLM
CA11396	Grant S. Lyddon	T22,23S;R38,39E	2566	6/1/82	BLM
CA11397	Grant S. Lyddon	T22,23S;R39E	1440	6/1/82	BLM
CA11400	Coso Land Co.	T22S;R39E	2553	1/1/82	BLM
CA11401	California Energy Co.	T21S;R39E	1440	1/1/82	BLM
CA11403	Coso Land Co.	T22S;R39E	1920	1/1/82	BLM
CA12754	Coso Land Co.	T21S;R39E	1920	9/1/82	BLM
CA12936	Coso Land Co.	T21,22S;R38E	1920	9/1/82	BLM
CA12937	Coso Land Co.	T21,22S;R38E	2560	9/1/82	BLM
CA13568	Crownite Corp.	T21S;R38E	2560	6/1/83	BLM
CA13569	Crownite Corp.	T21S;R38E	<u>1280</u>	6/1/83	BLM
TOTAL			44118		

*Acreage by Leaseholder: Grace - 14,579; Coso Land Co. - 10,873; Grant Lyddon - 8,401; City of L.A. - 4,985; Crownite Corp. - 3840; Cal Energy - 1,440.

(Source: U.S. Department of Interior - BLM)

TABLE 5: Summary of Geothermal Leases in the Coso KGRA

<u>WELL NAME</u>	<u>COMPANY</u>	<u>LOCATION</u> (<u>SECTION, TOWNSHIP, RANGE</u>)			<u>TOTAL DEPTH</u> (<u>in feet</u>)
#31-8 China Lake	California Energy	8,	T22S,	R39E	---
#71-1 China Lake	California Energy	7,	T22S,	R39E	2000
#75-7 China Lake	California Energy	7,	T22S,	R39E	---
#71-7A China Lake	California Energy	7,	T22S,	R39E	2100
#75-7A China Lake	California Energy	7,	T22S,	R39E	1526
#75-7B China Lake	California Energy	7,	T22S,	R39E	1715
#1 CGEH	CER Corp.	6,	T22S,	R39E	4848
1 Slim Hole	Battelle PNL	6,	T22S,	R39E	1342

* Note: Shallow temperature-gradient wells are not shown.

(Source: Petroleum Information)

Table 6: Summary of Drilling Activity in the
Coso Study Area

cases, the indicated leaseholder may be a subleasee, or an assignee to the lease.

2.2.4.3 Native Lands and Restricted Use Areas

Native American reserved lands nearest to the Coso Study area are restricted to one tract covering an area of 580 acres which lies eastward from the Argus Range in Townships 20 and 21 South, Range 44 East. However, areas covered by archaeological sites in the Coso study area as defined in the BLM's draft environmental impact statement (1980, p. 2-153) are estimated to cover nearly 50 percent of the total surface. Sites have been shown to range in size from isolated (point) finds to over 600 acres.

Large tracts of land throughout the Rose Valley area, including the western part of the Naval Reservation, have been included in a Federal Agency Protective Withdrawal (Bureau of Land Management, 1976). Restrictions pertaining to the withdrawal would need to be investigated prior to development in these areas.

2.2.5 Implications to the Magma Energy Program

The availability of adequate water resources in the Coso study area may be the most significant limitation when considering a geothermal project. Available surface water is likely to be already appropriated thereby limiting new sources to the development of ground water.

The portion of the study area which is under consideration for the drill site is in the Indian Wells Valley. This area is outside of the Coso KGRA and away from existing geothermal leases.

Much of the Indian Wells Valley is either privately owned or within the China Lake Naval Weapons Center. The land position would have to be considered early in order to achieve a working agreement between a private land owner or the NWC.

3.0 PERMITTING REQUIREMENTS

Environmental control guidelines established at the state level have been based largely upon federal/state interaction. The federal statutes with the greatest impact on exploration and development of geothermal resources include:

- o Clean Air Act (CAA), P.L. 95-95, as amended by P.L. 95-190.
- o Clean Water Act (CWA), P.L. 92-500, as amended by P.L. 95-217.
- o Safe Drinking Water Act (SDWA), P.L. 93-523, as amended by P.L. 96-482.
- o Resource Conservation and Recovery Act (RCRA), P.L. 94-580, as amended by P.L. 96-482.

3.1 CALIFORNIA STATE REQUIREMENTS

California has adopted state statutes analogous to the National Environmental Policy Act. The guidelines implemented within the context of the California Environmental Quality Act (CEQA) of 1970 are probably the most comprehensive of any state. The guidelines for environmental compliance are primarily directed at protecting surface and ground-water resources, and to regulate the amount of H₂S emissions. Whenever a geothermal project is proposed on private or state land the California Division of Oil and Gas (CDOG) coordinates a review process whereby environmental, social, and economic issues are raised. The CDOG is responsible for preparing an environmental document and must reach a decision on the project within a statutory 135 day time limit (California Dept. of Conservation, 1983, p. 85).

The CEQA was amended in 1978 to provide for environmental permitting requirements. Under this amendment, the designated lead agency changes hands depending upon the stage of the project. At the exploration stage, the California Division of Oil and Gas is the lead agency involved in the environmental review process. The individual county assumes the lead during field development.

The California Energy Commission is responsible for power plant permitting for plants of 50 MW capacity or greater.

The State Oil and Gas Supervisor in the Division of Oil and Gas, Department of Conservation is the responsible party for all phases of geothermal development in California. The Supervisor: 1) designates geothermal resource areas; and 2) supervises the drilling, operation, maintenance, and abandonment of wells.

In counties where a "geothermal element" has not been adopted as part of the general plan, the Division of Oil and Gas is the designated lead agency for the purposes of administering the CEQA. These responsibilities include the public and agency review of the project and the approval or disapproval within the 135 day limit.

The State of California has been divided into three geothermal districts by the authority of the Division of Oil and Gas. The districts and addresses of each district office are outlined in Appendix A of this report. The District Deputy of each office is responsible for working with geothermal operators to protect, to the greatest extent possible, surface and ground-water resources in the area.

Within 30 days of acquiring the well, owners or operators of geothermal wells must file an individual indemnity bond (for a single well) in the sum of \$25,000. A blanket indemnity bond of \$100,000 is required for any number of multiple wells.

A "notice of intent" (NOI) to drill, with an appropriate fee, must be filed with the supervisor or district deputy prior to the commencement of drilling. Drilling can commence upon either written receipt of approval or after 10 working days if no written approval is received by the operator. The content of the notice is outlined in section 3724 of Appendix A.

Shallow, temperature observation well programs that include the well designation numbers and locations of wells, and geologic data must also be

submitted to the supervisor for approval. The number of observation wells in a single program shall not exceed 25 and the depth of each well must not be greater than 250 feet. The filing fee for each program is \$25 per well, or \$200 per program. Depending on the types of shallow wells, the supervisor may impose additional restrictions and require an NOI to be filed for certain wells.

The supervisor shall establish an annual well fee to provide for the supervision of the development. The annual fee is to be paid to the state treasurer.

3.2 FEDERAL REQUIREMENTS

Federal requirements pertaining to geothermal energy have been built around the concept of leasing of federal lands for geothermal development. In making final site selection for the Magma Energy Project, the optimal choice will be a site that is located on "open-Federal" lands. In this manner, potential conflicts with private developments of existing Federal leases and private geothermal lands can be avoided. If the project site selected is located on an existing lease, then a modification to the original "Plan of Operations" would be made and submitted to the Bureau of Land Management for approval. The BLM would in turn prepare an "Environmental Analysis" of the proposed plan, and an Environmental Impact Statement would be undertaken if necessary. A summary of Federal leasing and permitting requirements is presented in Appendix B.

4.0 DISCUSSION AND RECOMMENDATIONS

This preliminary overview of certain factors that will ultimately have a bearing upon the Magma Energy Program has indicated that more detailed work will be necessary once an area (either Long Valley or Coso) has been designated for the project. Although the primary consideration is the presence of a magma body at a shallow level, the factors described in this report will have to be addressed in order to help ensure success.

A detailed land status determination should be made in order to identify land owners and the distribution of individual tracts. Because the test well will be sited largely based upon the results of geophysical surveys, it is recommended that an "area of significant interest" be outlined from existing data and a detailed land status study performed within that area prior to site selection. This may help eliminate unforeseeable difficulties related to surface and subsurface rights and could aid in site selection if the drilling target underlies a broad area.

A detailed study of water appropriations should be made, and the advantages/disadvantages of development of new water sources vs acquiring existing sources. To acquire surface water rights in the State of California, one files an "application to appropriate" through the State Water Resources Control Board. The application is then advertised and opponents are given an opportunity to file a protest. If a protest is filed, the Board goes through an administrative process to satisfy the protest, if possible, through some stipulation in the permit. The Board then will make a determination to accept or reject the application. The land where the use is to occur must be located adjacent to the water course and be non-federal.

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APPENDIX A: CALIFORNIA LAWS FOR CONSERVATION OF GEOTHERMAL RESOURCES
Chapter 4, Division 3, Public Resources Code.

CALIFORNIA LAWS FOR CONSERVATION OF GEOTHERMAL RESOURCES

*An act to add Chapter 4 (commencing with Section 3700),
Division 3, Public Resources Code,
relating to geothermal resources*

The people of the State of California do enact as follows:

Chapter 4. Geothermal Resources

3700. It is hereby found and determined that the people of the State of California have a direct and primary interest in the development of geothermal resources, and that the State of California, through the authority vested in the State Oil and Gas Supervisor, should 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 economic recovery.

3701. For the purposes of this chapter, "geothermal resources" shall mean geothermal resources as defined in Section 6903 of this code.*

* Section 6903. For the purposes of this chapter, "geothermal resources" shall mean 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 natural heat, and all minerals in solution or other 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.

3702. For the purposes of this chapter, "geothermal resources area" means the same general surface area which is underlaid, or reasonably appears to be underlaid, by geothermal resources.

3703. "Well" means any well for the discovery of geothermal resources or any well on lands producing geothermal resources or reasonably presumed to contain geothermal resources, or any

special well, converted producing well or reactivated or converted abandoned well employed for reinjecting geothermal resources or the residue thereof.

Low -
Temperature
Well

3703.1. "Low-temperature geothermal well" means a well drilled for the purpose of producing geothermal resources, as defined in Section 6903, from which fluids can be produced which have value by virtue of the heat contained therein and have a temperature that is not more than the boiling point of water at the altitude of occurrence.

3704. "Department", in reference to the government of this state, means the Department of Conservation.

3705. "Division", in reference to the government of this state, means the Division of Oil and Gas in the Department of Conservation.

3706. "Director" means the Director of Conservation.

3707. "Supervisor" means the State Oil and Gas Supervisor.

3708. "Person" includes any individual, firm, association, corporation, or any other group or combination acting as a unit.

3709. "Operator" means any person drilling, maintaining, operating, pumping, or in control of any well.

3710. "Owner" includes "operator" when any well is operated or has been operated or is about to be operated by any person other than the owner.

3711. "Operator" includes "owner" when any well is or has been or is about to be operated by or under the direction of the owner.

Broad
Powers

3712. This chapter shall be liberally construed to meet its purposes, and the director and the supervisor shall have all power which may be necessary to carry out the purposes of this chapter.

3713. (Repealed. Effective January 1, 1984.)

Duties of
Supervisor

3714. The State Oil and Gas Supervisor shall so supervise the drilling, operation, maintenance and abandonment of geothermal resources wells as to encourage the greatest ultimate economic recovery of geothermal resources, to prevent damage to life, health, property, and natural resources, and to prevent damage to, and waste from, the underground geothermal deposits, and to prevent damage to underground and surface waters suitable for irrigation or domestic purposes by reason of the drilling, operation, maintenance, and abandonment of geothermal resources wells.

Designation of
Geothermal
Resources
Areas

3714.5 The supervisor, pursuant to regulation, shall designate geothermal resources areas and may exclude from the operation of this chapter certain wells within such geothermal resources area when there is no probability of encountering geothermal resources.

Additional
Duties of
Supervisor

3715. The supervisor shall also supervise the drilling, operation, maintenance, and abandonment of wells so as to permit the owners or operators of such wells to utilize all methods and

practices known to the industry for the purpose of increasing the ultimate recovery of geothermal resources and which, in the opinion of the supervisor, are suitable for such purpose in each proposed case. In order to further the elimination of waste by increasing the recovery of geothermal resources it is hereby declared as a policy of this state that the grant in geothermal resources lease or contract to a lessee or operator of the right or power, in substance, to explore for and remove all geothermal resources from any lands in the State of California, in the absence of an express provision to the contrary contained in such lease or contract, is deemed to allow the lessee or contractor or his successors or assigns, to do what a prudent operator using reasonable diligence would do, having in mind the best interests of the lessor, lessee and the state, in producing and removing geothermal resources; provided, however, nothing contained in this section imposes a legal duty upon such lessee or contractor, his successors or assigns, to conduct such operations.

3715.5. For the purposes of the California Environmental Quality Act (commencing with Section 21000), the division shall be the lead agency as defined in Section 21067 for all geothermal exploratory projects as defined in Section 21065.5. The division shall complete all its responsibilities pursuant to the California Environmental Quality Act, including public and agency review and approval or disapproval of the project, within 135 days of the receipt of the application for such project. The division may delegate its lead agency responsibility under this section to a county which has adopted a geothermal element, as defined in Section 25133, for its general plan. Any such delegation shall provide that the county complete its lead agency responsibility under this section within 135 days of the receipt of the application for such project. The provisions of this section shall not apply to geothermal exploratory projects as defined in Section 21065.5 where, prior to January 1, 1979, preparation of an environmental impact report for such project has begun or an application for such project which will require preparation of an environmental impact report has been filed.

3716. The district deputy in each district shall collect all information regarding the wells in the district necessary for the proper supervision of such wells. He shall prepare maps and other accessories necessary to determine the underground conditions in a geothermal area and the location and extent of strata bearing water suitable for irrigation or domestic purposes or surface water suitable for such purposes. This work shall be done with the view to advising the operators as to the best means of protecting the geothermal resource deposits and the water-bearing strata and surface water, and with a view to aiding the supervisor in ordering tests or repair work at wells. All such data shall be kept on file in the office of the district deputy of the respective district, and copies thereof shall be forwarded to the Director of Water Resources, the State Geologist, and the appropriate regional water quality control board located in the area involved, subject to the provisions of Section 3752.

Lead
Agency -
Exploratory
Projects

Lead
Agency
Delegation

(See
Excerpt for
Definition)

Well Data

Duties of
District
Deputy

Notification

3717. The supervisor shall notify the Department of Fish and Game, the Department of Water Resources and the regional water quality control board in the area affected of the location, operation, maintenance, and abandonment of all wells.

3718. Nothing in this chapter shall be construed as superseding any of the provisions of Division 7 (commencing with Section 13000) of the Water Code or Division 6 (commencing with Section 5650) of the Fish and Game Code.

Publication
and
Proceeds

3719. The supervisor shall publish any publications, reports, maps, statistical data or other printed matter relating to geothermal resources, for which there may be public demand. If these publications, reports, maps, statistical data or other printed matter are sold, they shall be sold at cost, and the proceeds shall be deposited in the General Fund.

Districts

3720. For the purposes of this chapter, the state may be divided into one or more districts, the boundaries of which shall be fixed by the director.

Agent

3721. Every owner or operator of any well shall designate an agent, giving his post office address, who resides in this state, upon whom may be served all orders, notices, and processes of the supervisor, board, or any court of law. Every person so appointing an agent shall, within five days after the termination of any such agency, notify the supervisor, in writing, of such termination, and unless operations are discontinued, shall appoint a new agent.

Transfer
by Seller

3722. The owner or operator of any well shall notify the supervisor or the district deputy, in writing, in such form as the supervisor or the district deputy may direct, of the sale, assignment, transfer, conveyance, or exchange by the owner or operator of such well, and the land, owned or leased, upon which the well is located, within 30 days after such sale, assignment, transfer, conveyance, or exchange. The notice shall contain the following:

(a) The name and address of the person to whom such well was sold, assigned, transferred, conveyed, or exchanged.

(b) The name and location of the well.

(c) The date of the sale, assignment, transfer, conveyance or exchange.

(d) The date when possession was relinquished by the owner or operator.

(e) A description of the land upon which the well is situated.

Acquisition
of Well

3723. Every person who acquires the ownership or operation of any well, whether by purchase, transfer, assignment, conveyance, exchange, or otherwise, shall, within 30 days after acquiring the well and the land, owned or leased, upon which it is located, notify the supervisor or the district deputy, in writing, of his ownership or operation. The notice shall contain the following:

(a) The name and address of the person from whom the well was acquired.

(b) The name and location of the well.

(c) The date of acquisition.

(d) The date when possession was acquired.

(e) A description of the land upon which the well is situated.

3723.5. Any person who acquires the ownership or operation of any well or wells, whether by purchase, transfer, assignment, conveyance, exchange, or otherwise, shall, within 30 days after acquiring the well or wells, file with the supervisor an individual indemnity bond in the sum of twenty-five thousand dollars (\$25,000) for each well acquired, or a blanket indemnity bond in the sum of one hundred thousand dollars (\$100,000) for any number of wells acquired. The bond shall be stated in substantially the language set forth in Section 3725.

3724. The owner or operator of any well, before commencing the original drilling of a well or the redrilling of an abandoned well, shall file with the supervisor or the district deputy a written notice of intention to commence drilling, accompanied by the prescribed fee. Drilling shall not commence until approval is given by the supervisor or the district deputy. If the supervisor or the district deputy fails to give the owner or operator written response to the notice within 10 working days, such failure shall be considered as an approval of the notice and the notice shall, for the purposes and intents of this chapter, be deemed a written report of the supervisor. The notice shall contain the following:

(a) The location and elevation of the floor of the proposed derrick.

(b) The number or other designation by which the well shall be known. Such number or designation shall be subject to the approval of the supervisor.

(c) The owner's or operator's estimate of the depths between which production will be attempted.

(d) Such other pertinent data as the supervisor may require.

After the completion of any well, the provisions of this section, other than the requirement of the payment of the fee, shall also apply, as far as may be, to the deepening or redrilling of the well, or any operation involving the plugging of the well, or any operations permanently altering in any manner the casing of the well. The number or designation by which any well heretofore drilled has been known, and the number or designation specified for any well in a notice filed as required by this section, shall not be changed without first obtaining a written consent of the supervisor.

As set forth by regulation, the appropriate fee to be filed for the drilling of a new well or the redrilling of an abandoned well, shall be twenty-five dollars (\$25), two hundred dollars (\$200), five hundred dollars (\$500), or one thousand dollars (\$1,000).

The fee shall be paid as provided in Section 3724.6.

Program for
Shallow and
Observation
Wells

Indemnity
Bond

Notice of
Intention
to Drill

Drilling Fee

Additional
Requirements

Approval
to Drill

Confiden-
tial Status

Establishment
of Annual
Well Fee

Notice for
Deepening,
Redrilling,
Plugging,
or Altering

Drilling and
Redrilling Fee

3724.1. An owner or operator may submit to the supervisor for approval a written program to drill a shallow well or wells for geothermal observation purposes. In order to qualify under this section, a program shall contain not more than 25 wells and the maximum total depth of each of these wells shall not exceed 250 feet. Each program submitted for approval shall include:

(a) Well numbers.

(b) Well locations and elevations.

(c) Geologic interpretation of the area under investigation, including any known or inferred temperature data.

(d) Such other data as may be required by the supervisor.

The fee required to be filed for the drilling of these shallow wells shall be twenty-five dollars (\$25) per well or two hundred dollars (\$200) per program, whichever is the lesser.

The fee shall be paid as provided in Section 3724.6.

3724.2. If, after study by the supervisor, it is determined that one or all of the wells proposed pursuant to Section 3724.1 require additional supervision, the supervisor may require that a proposal for such well or wells be submitted in compliance with all the provisions of Section 3724.

3724.3. Drilling of program wells, as described in Section 3724.1, shall not commence until approval is given by the supervisor or the district deputy. If the supervisor or the district deputy fails to give the owner or operator written response to the program within 10 working days, such failure shall be considered as an approval of the program and the program shall, for the purposes and intents of this chapter, be deemed a written report of the supervisor.

3724.4. The proposal, and all other data submitted as required by Sections 3724.1, 3724.2, and 3724.3, shall be maintained in a confidential status as provided for in Section 3752.

3724.5. To provide funds for the supervision of geothermal resource wells, the supervisor shall establish an annual well fee to be applied on an equal basis to all wells as provided under this section.

The annual well fee shall be imposed upon each producing, service, and idle well that existed at any time during the calendar year preceding the statewide fee-assessment date. However, the annual well fee shall not apply to wells described in Section 3724.1 and to the wells for which the supervisor has approved suspension. The annual well fee shall be established so that the sum of the annual well fees plus the estimated sum of those well permit fees provided in Sections 3724 and 3724.1 are equal to the appropriation for the supervision of geothermal resource wells as provided in the Governor's Budget. The establishment of the annual well fee shall take into account any budget adjustments for actual expenditures in the current and prior fiscal year. Any budget change proposal for support of the provisions of this chapter shall be submitted by the supervisor to geothermal operators for review and comment. A system for determining the fee and administering the fee collection shall be adopted by the supervisor by regulation after public hearing.

3724.6. The permit application fees established in Sections 3724 and 3724.1 shall be made payable by the operator to the Department of Conservation, and the annual well fee established in accordance with Section 3724.5 shall be made payable to the Treasurer. The proceeds from the permit applications and the annual well fees shall be deposited in the General Fund, and shall be available for appropriation exclusively for the supervision of geothermal resource wells.

Payment of
Permit Fees
and Annual
Well Fees

3725. Every person who engages in the drilling, redrilling, deepening, maintaining, or abandoning of any well, except a low-temperature geothermal well, shall file with the supervisor an individual indemnity bond in the sum of twenty-five thousand dollars (\$25,000) for each well drilled, redrilled, deepened, maintained, or abandoned. The bond shall be filed with the supervisor at the time of the filing of the notice of intention to drill, redrill, deepen, maintain, or abandon, as provided in Section 3724 or 3724.1. The bond shall be executed by such person, as principal, and by an authorized surety company, as surety, conditioned that the principal named in the bond shall faithfully comply with all the provisions of this chapter, in drilling, redrilling, deepening, maintaining, or abandoning any well or wells covered by the bond, and shall secure the state against all losses, charges, and expenses incurred by it to obtain such compliance by the principal named in the bond.

Bonding

Bond
Language

(\$2,000) for each well less than 2,000 feet deep, ten thousand dollars (\$10,000) for each well 2,000 feet deep or deeper, but less than 5,000 feet deep, fifteen thousand dollars (\$15,000) for each well 5,000 but less than 10,000 feet deep, or twenty-five thousand dollars (\$25,000) for each well 10,000 or more feet deep. The bond shall be filed with the supervisor at the time of the filing of the notice of intention to drill, redrill, deepen, maintain, or abandon, as provided in Section 3724 or 3724.1. The bond shall be executed by such person, as principal, and by an authorized surety company, as surety, and shall be in substantially the same language and upon the same conditions as provided in Section 3725, except as to the difference in the amount.

The conditions of the bond shall be stated in substantially the following language:

"If said _____, the above bounden principal, shall well and truly comply with all the provisions of Chapter 4 (commencing with Section 3700) of Division 3 of the Public Resources Code and shall obey all lawful orders of the State Oil and Gas Supervisor, or his district deputy or deputies, if not appealed as provided in that chapter, or upon affirmance thereof by the Geothermal Resources Board, if appealed thereto, and shall pay all charges, costs, and expenses incurred by the supervisor or his district deputy or deputies in respect of such well or wells or the property or properties of said principal, or assessed against such well or wells or the property or properties of such principal, in pursuance of the provisions of said chapter, then this obligation shall be void; otherwise, it shall remain in full force and effect."

Bond
Language

3725.5. Any person who engages in the drilling, redrilling, deepening, maintaining, or abandoning of any low-temperature well, as defined in Section 3703.1, shall file with the supervisor an individual indemnity bond in the sum of two thousand dollars

Bonding:
Low-tem-
perature
Wells

3726. Any person who engages in the drilling, redrilling, deepening, maintaining, or abandoning of one or more wells at any time, may file with the supervisor one bond for one hundred thousand dollars (\$100,000) to cover all his operations in drilling, redrilling, deepening, maintaining, or abandoning of any of his wells in this state in lieu of an individual indemnity bond for each such operation as required by Section 3725 or 3725.5. The bond shall be executed by such person, as principal, and by an authorized surety company, as surety; and shall be in substantially the same language and upon the same conditions as provided in Section 3725, except as to the difference in the amount.

3727. (Repealed. Effective Jan. 1, 1977.)

3728. Any individual or blanket indemnity bond issued in compliance with this chapter may, with the consent of the supervisor, be terminated and canceled and the surety be relieved of all obligations thereunder when the well or wells covered by such bond have been properly abandoned or another valid bond has been substituted therefor. Should the person who has filed a blanket bond properly abandon a portion of his wells covered by the bond, the bond may, with the consent of the supervisor, be terminated and canceled and the surety be relieved of all obligations thereunder upon the filing by such person of an individual bond for each well which he is still engaged in drilling, redrilling, deepening, maintaining, or abandoning. Liability as to individual wells that have been drilled and abandoned under a blanket bond may also be terminated with the consent of the supervisor.

3728.5. In lieu of the bond required by Sections 3723.5, 3725, 3725.5, and 3726, a deposit may, with the written approval of the supervisor, be given pursuant to Article 7 (commencing with Section 995.710) of Chapter 2 of Title 14 of Part 2 of the Code of Civil Procedure, other than a deposit of money or bearer bonds or bearer notes.

Blanket Bond
in Lieu of
Individual
Bond

Termination
and
Cancellation
of Bonds

Deposit in
Lieu of
Bond
See
Pertinent
Excerpt
995.710

Abandonment
Defined

Log, Core
Record,
History

Contents
of Log

Core
Record

History

Filing Copy
of Well
Record

Filing Copy
of Well
Record
on Request

Date of
Completion

3729. For the purposes of Section 3728, a well is properly abandoned when it has been shown to the satisfaction of the supervisor that all proper steps have been taken to protect underground or surface water suitable for irrigation or farm or domestic purposes from the infiltration or addition of any detrimental substance, and to prevent the escape of all fluids to the surface.

3730. The owner or operator of any well shall keep, or cause to be kept, a careful and accurate log, core record, and history of the drilling of the well.

3731. The log shall show the character and depth of the formation passed through or encountered in the drilling of the well, the amount, size and weight of casing used, and particularly the location, depth and temperature of water-bearing strata, together with the temperature, chemical composition, and other chemical and physical characteristics of fluid encountered from time to time, so far as ascertained.

3732. The core record shall show the depth, character, and fluid content of cores obtained, so far as determined.

3733. The history shall show the location and amount of side-tracked casings, tools, or other material, the depth and quantity of cement in cement plugs, the shots of dynamite or other explosives, the results of production and other tests during drilling operations, and completion data.

3734. The log shall be kept in the local office of the owner or operator and, together with the tour reports of the owner or operator, shall be subject, during business hours, to the inspection of the board, the supervisor, or the district deputy.

3735. Upon the completion or abandonment of any well or upon the suspension of operations upon any well, true copies of the log, core records, history, and, if made, true copies of all electrical, physical or chemical logs, tests, or surveys, in duplicate and in such form as the supervisor may direct, shall be filed with the district deputy within 60 days after such completion or abandonment. Like copies shall be filed upon the recompletion of any well.

3736. The owner or operator of any well, or his local agent, shall file with the supervisor a copy of the log, history, and core record, or any portion thereof, at any time after the commencement of the work of drilling any well upon written request of the supervisor, or the district deputy. The request shall be signed by the supervisor, or the district deputy, and served either personally, or by mailing a copy of the request, by registered mail, to the last known post office address of the owner or operator, or his agent.

3737. A well is completed, for the purposes of this chapter, 30

days after it has commenced to produce a geothermal resource unless drilling operations are resumed before the end of the 30-day period.

3738. (Repealed. Effective January 1, 1975.)

3739. Any person engaged in operating any wells wherein high pressures are known to exist, and any person drilling for geothermal resources in any district where the pressures are unknown shall equip the well with casings of sufficient strength, and with such other safety devices as may be necessary, in accordance with methods approved by the supervisor, and shall use every reasonable effort and endeavor effectually to prevent blowouts, explosions, and fires.

3740. The owner or operator of any well on lands producing or reasonably presumed to contain geothermal resources shall properly case it with watertight and adequate casing, in accordance with methods approved by the supervisor or the district deputy. The owner or operator shall also use every reasonable effort and endeavor to prevent damage to life, health, property, and natural resources, to shut out detrimental substances from strata containing water suitable for irrigation or domestic purposes and from surface water suitable for such purposes, and to prevent the infiltration of detrimental substances into such strata and into such surface water.

3741. The supervisor shall require such tests or remedial work as in his judgment are necessary to prevent damage to life, health, property, and natural resources, to protect geothermal resources deposits from damage, or to prevent the infiltration of detrimental substances into underground or surface water suitable for irrigation or domestic purposes, to the best interests of the neighboring property owners and the public.

3742. (Repealed. Effective January 1, 1984.)

3742.1. (Repealed. Effective January 1, 1984.)

3742.2. Any person having drilled a well or wells on state, federal or private lands which are producing or, according to the supervisor, are capable of producing geothermal resources, may, at any time, apply to the supervisor for a certificate of primary purpose. When the supervisor determines that such well or wells are primarily for the purpose of producing geothermal resources and not for the purpose of producing water usable for domestic and irrigation purposes, the supervisor shall issue a certificate of primary purpose to such person. Such certificate shall establish a rebuttable presumption that such person has absolute title to the geothermal resources reduced to his possession from such well or wells. Such presumption may be rebutted only upon a showing that the water content of the geothermal resources is useful for domestic or irrigation purposes without further treatment thereof, but not by virtue of any production of such water as a by-product incident to the production of the geothermal resources.

3743. Whenever the supervisor or a district deputy makes or gives any written direction concerning the drilling, testing, or other operations in any well drilled, in process of drilling, or being abandoned, and the operator, owner, or representative of either,

Blowout
Prevention

Use of
Casing

Tests

Certificate
of Primary
Purpose

Presumption
of Absolute
Title

Supervisor's
Order;
Appeal

shall give written notice, either personally or by mail, addressed to the supervisor, or to the district deputy at his office in the district, requesting that a definite order be made upon such subject, the supervisor or the district deputy shall, within five days after receipt of the notice, deliver a final written order on the subject matter.

3744. Within 30 days after service of an order pursuant to Section 3743, the owner or operator shall commence in good faith the work ordered and continue it until completion. If the work has not been commenced and continued to completion, the supervisor shall appoint necessary agents who shall enter the premises and perform the work. An accurate account of the expenditures shall be kept. Any amount so expended shall constitute a lien against the real or personal property of the owner or operator upon which the work is done and such lien shall have the force, effect, and priority of a judgment lien pursuant to the provisions of Section 3772.

3745. The owner of any well producing geothermal resources shall file with the supervisor, on or before the 30th day of each month, for the last preceding calendar month, a statement of production utilized in such form as the supervisor may designate.

Commencement
of Work

Monthly
Production
Reports

3746. Before abandoning any well in accordance with methods approved by the supervisor or the district deputy, and under his direction, the owner or operator shall use every reasonable effort and endeavor to protect any underground or surface water suitable for irrigation or domestic purposes from the infiltration or addition of any detrimental substances.

3747. Before any work is commenced to abandon any well, the owner or operator shall give written notice to the supervisor or the district deputy of his intention to abandon the well and the date upon which the work of abandonment will begin.

The notice shall be given at least five days before the proposed abandonment, and it shall show the condition of the well and the proposed method of abandonment.

The owner or operator shall furnish the supervisor or the district deputy any additional information that he may request regarding the condition of the well and the proposed method of abandonment, at any time between the filing of the notice of intention to abandon the well and the completion of abandonment.

3748. The supervisor, or the district deputy shall, before the proposed date of commencing work to abandon such well, furnish to the owner or operator either:

(a) A written report of approval of the proposal.

(b) A written report stating that work or tests will be necessary before approval of abandonment will be given.

(c) A written request stating what information will be necessary for the owner or operator to furnish the supervisor or the district deputy before approval to commence work to abandon or before approval of abandonment will be given.

3749. If the supervisor or the district deputy fails to give the owner or operator a written report or request within the specified time, such failure shall be considered as an approval of the proposal to abandon the well, and the proposal shall, for the purposes and intents of this chapter, be deemed a written report of the supervisor or the district deputy.

3750. Within 60 days after the completion of abandonment of any well, the owner or operator of the well shall make, in such form as the supervisor or the district deputy may direct, a written report of all work done in connection with the abandonment. The supervisor or the district deputy shall, within 10 days after the receipt of a written report of completion, furnish the owner or operator with a written final approval of abandonment, or a written disapproval of abandonment, setting forth the conditions upon which the disapproval is based.

Failure to abandon in accordance with the approved method of abandonment, or failure to notify the supervisor or the district deputy of any test required by the final approval of abandonment to be witnessed by the supervisor, the district deputy or his inspector,

Abandonment of Wells

Notice to Abandon

Report before Abandonment Date

Failure to Give Timely Report

Report of Completion of Abandonment

Grounds for Disapproval of Abandonment

Notice to Remove Casing

Report of Work Done

Public Records

Request for Confidential Status

Request for Extension

or failure to furnish the supervisor or the district deputy, at his request, with any information regarding the condition of the well, shall constitute sufficient grounds for disapproval of the abandonment.

3751. No person, whether as principal, agent, servant, employee or otherwise, shall remove the casing or any portion thereof, from any well without first giving written notice to the supervisor or the district deputy of his intention to remove the casing from such well. The notice shall be given at least five days before the proposed removal.

The supervisor or the district deputy shall, before the proposed date of removal, furnish the person with a written report of approval of his proposal, or a written report stating what work shall be done before such approval will be given.

If the supervisor or the district deputy fails to give the person a written report within the specified time, such failure shall be considered an approval of the proposal to remove the casing, and such proposal shall, for the purposes and intents of this chapter, be deemed a written report of the supervisor or the district deputy.

Within five days after the completion of the removal, the person shall make, in such form as the supervisor or district deputy may direct, a written report, in duplicate, of all work done in connection with such removal.

3752. (a) Except as otherwise provided in this section, all the well records, including production records, of any owner or operator which are filed pursuant to this chapter shall be public records for purposes of the California Public Records Act (Chapter 3.5 (commencing with Section 6250) of Division 7 of Title 1 of the Government Code).

Such records shall be public records when filed with the division, unless the owner or operator requests, in writing, the division to retain the well records confidential. The confidential period shall not exceed five years from the date of production or injection for other than testing purposes or abandonment, whichever occurs first. Well records retained confidential by the division shall be open to inspection to those persons authorized in writing by the owner or operator. For the purpose of this section, "date of production for other than testing purposes" means the date on which, in the judgment of the supervisor, sustainable production commenced into a power generating plant, greenhouse, space heating unit, chemical or mineral extraction plant, or other facility dependent wholly or in part upon geothermal resources for its operation. Confidential status shall not apply to state officers charged with regulating well operations, the director, or as provided in subdivision (b).

Upon receipt by the supervisor of a written request documenting extenuating circumstances pertaining to a particular well, the supervisor may extend for six months the period of confidentiality. The total period of confidentiality, including all extensions, shall not ex-

ceed seven years from the date of production or injection for other than testing purposes or abandonment, unless a longer period of time is approved by the director after a public hearing.

(b) Production reports filed pursuant to Section 3745 shall be open to inspection to the State Board of Equalization or its duly appointed representative when making a survey pursuant to Section 1815 of the Revenue and Taxation Code or when valuing state-assessed property pursuant to Section 751 of the Revenue and Taxation Code, and to the assessor of the county in which a well referred to in Section 3745 is located.

(c) For the purposes of this section, "well records" shall not include either experimental logs and tests or interpretive data not generally available to all operators, as defined by the supervisor by regulation.

3752.1. (Repealed, Effective July 1, 1976.)

3753. Upon receipt by the supervisor or by a district deputy of a written complaint, alleging a condition in violation of this chapter, specifically setting forth the condition complained against, signed by the complainant, the supervisor shall make an investigation of the well or wells and make a written report and order, stating the work required to repair the damage complained of, or stating that no work is required.

A copy of the order shall be delivered to the complainant, or if more than one, to each complainant, and, if the supervisor orders the damage repaired a copy of the order shall be delivered to each of the owners, operators, or agents having in charge the well or wells upon which the work is to be done.

The order shall contain a statement of the conditions sought to be remedied or repaired and a statement of the work required by the supervisor to repair the condition. Service shall be made by mailing copies to such persons at the post office address given.

3754. Any owner or operator, or employee thereof, who refuses to permit the supervisor or the district deputy, or his inspector, to inspect a well, or who willfully hinders or delays the enforcement of the provisions of this chapter, and every person, whether as principal, agent, servant, employee, or otherwise, who violates, fails, neglects, or refuses to comply with any of the provisions of this chapter, or who fails or neglects or refuses to furnish any report or record which may be required pursuant to the provisions of this chapter, or who willfully renders a false or fraudulent report, is guilty of a misdemeanor, punishable by a fine of not less than one hundred dollars (\$100), nor more than five hundred dollars (\$500), or by imprisonment for not exceeding six months, or by both such fine and imprisonment, for each such offense.

Exceptions

Written
Complaint

Content of
Order

Refusal of
Access
and Other
Offenses

Penalties

Civil
Penalty

Order of
Abandon-
ment

Coopera-
tive Unit
Operation

Spacing
of Wells

Well Drilling
Proposals

3754.5. (a) Any person who violates any provision of this chapter may be liable, in lieu of the penalty specified in Section 3754, for a civil penalty not to exceed five hundred dollars (\$500) for each violation.

(b) The Attorney General, upon the request of the supervisor, shall bring a civil action to impose and recover those amounts.

(c) Any amount collected under this section shall be deposited in the General Fund.

3755. The supervisor or his deputy may order the abandonment of any well that has been deserted whether or not any damage is occurring or threatened by reason of said well. Suspension of drilling operations and removal of drilling machinery is prima facie evidence of desertion after the elapse of six months unless a request for an extension of time for a period not to exceed an additional six months is theretofore filed. At any time the supervisor may for good cause shown extend this period.

3756. Whenever the supervisor finds that it is in the interest of the protection of geothermal resources from unreasonable waste, the lessors, lessees, operators, or other persons owning or controlling royalty or other interests in the separate properties of the same producing or prospective geothermal resources area, may, with the approval of the supervisor, enter into agreements for the purpose of bringing about the cooperative development and operation of all or a part or parts of the area, or for the purpose of bringing about the development or operation of all or a part or parts of such area as a unit, or for the purpose of fixing the time, location, and manner of drilling and operating of wells for the production of geothermal resources. Any such agreement shall bind the successors and assigns of the parties thereto in land affected thereby and shall be enforceable in an action for specific performance. No such agreement when approved by the supervisor hereunder shall be held to violate any of the statutes of this state prohibiting monopolies or acts, arrangements, agreements, contracts, combinations, or conspiracies in restraint of trade or commerce.

3757. Any well hereafter drilled for the discovery and production of geothermal resources, which is located within 100 feet of an outer boundary of the parcel of land on which the well is situated, or within 100 feet of a public road or street or highway dedicated prior to the commencement of drilling of the well, is a public nuisance.

3757.1. Notwithstanding any other provisions of this chapter, where a parcel of land contains one acre or more and all or substantially all of the surface is unavailable for the location of a geothermal well and directional drilling is found by the supervisor to be necessary, the supervisor may approve proposals to drill wells at whatever locations he deems advisable for the purpose of properly developing

the geothermal resources; provided, that no well shall be drilled or permitted to produce which is located within 25 feet of the outer boundary of the parcel of land on which the well is situated or within 25 feet of a public road, street, or highway dedicated prior to the commencement of drilling. The supervisor may require, at the time he gives approval of the notice of intention to drill, redrill, or deepen such well, that a subsurface directional survey be made, and that the survey be filed with the supervisor within 30 days of cessation of drilling operations.

3757.2. For the purpose of developing low-temperature geothermal resources, the supervisor may approve the exemption of any low-temperature geothermal well from Sections 3721, 3722, 3723, 3723.5, 3724.5, 3725.5, and 3745, if the resource is used domestically or in a noncommercial manner. The supervisor may also approve the drilling of low-temperature geothermal wells at whatever locations he deems advisable, if no well is drilled or permitted to produce which is located within 15 feet of the outer boundary of the parcel of land on which the well is situated or within 15 feet of a public road, street, or highway dedicated prior to the commencement of drilling.

3758. Where several contiguous parcels of land in one or different ownerships are operated as a single geothermal resources lease or operating unit, the term "outer boundary line" means the outer boundary line of the lands included in the lease or unit. In determining the contiguity of any such parcels of land, no street, road or alley lying within the lease or unit shall be deemed to interrupt such contiguity.

3759. For the purpose of this chapter, an alley which intersects or lies within any block or other subdivision unit is not a public street or road.

3760. Each day in which the drilling of any well is carried on, or on which it is permitted to produce geothermal resources in violation of this chapter is a separate nuisance.

3761. The provisions regarding the location of geothermal resources wells do not apply to any wells producing geothermal resources on the effective date of this act. *

3762 The lessor, lessee, or any operator or any well owner, or the owner of any rig, derrick, or other operating structure, or his local agent, shall, within 10 days from the date of the service of any order from the supervisor or a district deputy, either comply with the order or file with the supervisor or the district deputy a written statement that the order is not acceptable, and that appeal from the order is taken to the director under the provisions of this chapter.

The appeal shall operate as a stay of any order issued pursuant to this chapter.

3763. (Repealed. Effective January 1, 1984.)

Notice of
Hearing

Disposition
of Appeal

Exemption
and spacing.
Low-temperature
Wells

Notice of
Decision

Lease
Boundary

Review by
Court

Alley not
a Street
or Road

Each Day
Separate
Nuisance

Applicability

Compliance
with Order
or Appeal

Continuance

Evidence
of Review

3764. Within 10 days from the taking of the appeal, 10 days' notice in writing shall be given to the appellant of the time and place of the hearing. For good cause, the director may postpone the hearing, on the application of the appellant or the supervisor, or the district deputy, for a period not to exceed 10 days.

3765. The director, after hearing, shall affirm, set aside, or modify the order from which the appeal is taken.

Within 10 days after hearing the evidence, the director shall make a written decision with respect to the order appealed from. The decision of the director shall forthwith be filed with the supervisor and upon such filing shall be final. In case the order is affirmed or modified, the director shall retain jurisdiction until such time as the work ordered to be done by the order is finally completed.

The written decision shall be served upon the lessor, lessee, or any operator or any well owner, or the owner of any rig, derrick, or other operating structure, or his local agent, and shall supersede the previous order of the supervisor. In case no written decision is made by the director within 30 days after the date of notice of hearing as provided in Section 3764, the order of the supervisor shall be effective upon the supervisor's notifying any such person that the director has failed to make a decision and subject only to review by writ of certiorari from the superior court as provided in this chapter.

3766. The decision of the director may be reviewed by writ of certiorari from the superior court of the county in which the well, or wells, affected by the order is situated, if taken within 10 days after the service of the decision upon the lessor, lessee, or any operator or any well owner, or the owner of any rig, derrick, or other operating structure, or his local agent, as provided in Section 3765, or within 10 days after the decision upon petition by the supervisor. If no written decision is made by the director as specified in Section 3765, the order of the supervisor may be reviewed by writ of certiorari from the superior court of that county within 10 days after the supervisor notifies any such person of that fact. The writ shall be made returnable not later than 10 days after its issuance and it shall direct the director to certify the director's record in the cause to the court. On the return day the cause shall be heard by the court unless for good cause it is continued, but no continuance shall be permitted for a longer period than 30 days.

3767. No new or additional evidence shall be introduced in the court, but the cause shall be heard upon the record of the director. The review shall not be extended further than to determine whether or not:

(a) The director or supervisor acted without or in excess of jurisdiction.

(b) The order, decision, or award was procured by fraud.

(c) The order, decision, rule, or regulation is unreasonable.

(d) The order, decision, regulation, or award is clearly unsupported by the evidence.

3768. If a review is not taken within 10 days, or if taken, in case the decision of the director, or, if there is no decision, the order of the supervisor, is affirmed, any charge, including penalty and interest thereon, imposed by the director or supervisor shall constitute a lien which, upon recordation or filing pursuant to Section 7171 of the Government Code, attaches to real or personal property. The lien upon the property shall be enforced in the same manner as are other liens on real property and personal property of the debtor. Upon the request of the supervisor, the Controller shall bring an action for the enforcement of the lien in the manner provided in this chapter.

3769. In any proceeding instituted by the supervisor for the purpose of enforcing or carrying out the provisions of this chapter, or for the purpose of holding an investigation to ascertain the condition of any well or wells complained of, or which in the opinion of the supervisor may reasonably be presumed to be improperly located, drilled, operated, maintained, or conducted, the supervisor shall have the power to administer oaths and may apply to a judge of the superior court of the county in which the proceeding or investigation is pending, for a subpoena for witnesses to attend the proceeding or investigation. Upon the application of the supervisor, the judge of the superior court shall issue a subpoena directing the witness to attend the proceeding or investigation, and such person shall be required to produce, when directed, all records, surveys, documents, books, or accounts in his custody or under his control; except that no person shall be required to attend upon such proceeding, unless he resides within the same county or within 100 miles of the place of attendance.

The supervisor may in such case cause the depositions of witnesses residing within or without the state to be taken in the manner prescribed by law for like depositions in civil actions in superior courts of this state, and may, upon application to a judge of the superior court of the county within which the proceeding or investigation is pending, obtain a subpoena compelling the attendance of witnesses and the production of records, surveys, documents, books, or accounts at such places as the judge may designate within the limits prescribed in this section.

3770. Witnesses shall be entitled to receive the fees and mileage fixed by law in civil cases, payable from the Geothermal Resources Account of the General Fund.

3771. In case of the failure or neglect on the part of any person to comply with any order of the supervisor or chairman of the board, or any subpoena, or upon the refusal of any witness to testify to any matter regarding which he may lawfully be interrogated, or upon refusal or neglect to appear and attend at any proceeding or hearing on the day specified, after having received a written notice of not less than 10 days prior to such proceeding or hearing, or upon

Enforce-
ment of
Lien

Prosecution

Proceedings

State Tax
Lien for
Failure to Pay

Subpoena
of
Witnesses

Warrant for
Collection
of Charges

Fees and
Commissions
for Sheriff

Fees and
Mileage

Offenses

Release
of Lien

his failure, refusal or neglect to produce books, papers, or documents as demanded in the order or subpoena upon such day, such failure, refusal or neglect shall constitute a misdemeanor. Each day's further failure, refusal, or neglect is a separate and distinct offense.

The district attorney of the county in which the proceeding hearing, or investigation is to be held, shall prosecute any person guilty of violating this section by continuous prosecution until the person appears or attends or produces such books, papers, or documents, or complies with the subpoena or order of the supervisor or chairman of the board.

3772. (a) If any person fails to pay any charge or penalty imposed under this chapter at the time that it becomes due and payable, the amount thereof, including penalties and interest, together with an costs in addition thereto, shall thereupon be a perfected and enforceable state tax lien. Such a lien is subject to Chapter 1 (commencing with Section 7150) of Division 7 of Title 1 of the Government Code.

(b) For the purpose of this section only, "due and payable" means the date a return is required to be filed, without regard to an extension of time, without payment of the amount due or the date a determination or assessment made under this chapter becomes final, whichever is applicable.

3772.2. A warrant may be issued by the State Controller or his duly authorized representative for the collection of any charges, interests and penalty and for the enforcement of any such lien directed to the sheriff or constable and shall have the same effect as a writ of execution. It may and shall be levied and sale made pursuant to it in the same manner and with the same effect as a levy of and a sale pursuant to a writ of execution.

3772.4. The sheriff or constable shall receive, upon the completion of his services pursuant to a warrant, and the Controller is authorized to pay to him the same fees and commissions and expenses in connection with services pursuant to said warrant as are provided by law for similar services pursuant to a writ of execution; provided, that fees for publication in a newspaper shall be subject to approval by the Controller rather than by the court; such fees, commissions and expenses shall be an obligation of the person or persons liable for the payment of such charges and may be collected from such person or persons by virtue of the warrant or in any other manner provided in this chapter for the collection of such charges.

3772.6. In the event that the lien of the charges, penalties or interest attaches to real property from which geothermal energy is extracted and more than one parcel of property is included within the lien, the Controller may release by certificate pursuant to Section 7174 of the Government Code from the lien of such charges, interest

and penalties and costs, upon payment by the owner of any parcel or parcels of property of his proportionate share of the charges.

3772.8 (Repealed.)

3773. The Controller shall, on or before the 90th day following the delinquency of any charge, bring an action in the name of the people of the state, in the county in which the property involved in the order is situated, to collect any delinquent charges, together with any penalties or costs, which have not been paid.

3774. The Attorney General, as provided in Section 3102 of the Public Resources Code, shall commence and prosecute any such action to final judgment.

3775. In such actions the record of charges, or a copy of so much thereof as is applicable, duly certified by the Controller, showing unpaid charges against any person, is prima facie evidence of the charges, the delinquency, the amount of charges, penalties, and costs due and unpaid, that the person is indebted to the people of the State of California in the amount of charges and penalties therein appearing unpaid, and that all forms of law in relation to the charges have been complied with.

The provisions of the Code of Civil Procedure relating to service of summons, pleadings, proofs, trials, and appeals are applicable to the proceedings.

3776. Payment of the penalties and charges, or the amount of the judgment recovered in the action, shall be made to the State Treasurer, and shall be returned and credited to the General Fund.

Action to Collect
Delinquent
Charges

Prosecution by
Attorney
General

Certification of
Unpaid Charges

Payment of
Delinquent
Charges

EXCERPT

Excerpts from AB 2751 that affect responsibilities of the California Division of Oil & Gas. Effective date: January 1, 1983

Section 995.710 is added to the California Code of Civil Procedure to read:

See
section
3728.5
for
exceptions

995.710. (a) Except to the extent the statute providing for a bond precludes a deposit in lieu of bond or limits the form of deposit, the principal may, instead of giving a bond, deposit with the officer any of the following:

(1) Lawful money of the United States. The money shall be maintained by the officer in an interest-bearing trust account.

(2) Bearer bonds or bearer notes of the United States or the State of California.

(3) Certificates of deposit payable to the officer, not exceeding the federally insured amount, issued by banks authorized to do business in this state and insured by the Federal Deposit Insurance Corporation or by savings and loan associations authorized to do business in this state and insured by the Federal Savings and Loan Insurance Corporation.

(4) Savings accounts assigned to the officer, not exceeding the federally insured amount, together with evidence of the deposit in the savings accounts with banks authorized to do business in this state and insured by the Federal Deposit Insurance Corporation.

(5) Investment certificates or share accounts assigned to the officer, not exceeding the federally insured amount, issued by savings and loan associations authorized to do business in this state and insured by the Federal Savings and Loan Insurance Corporation.

(6) Certificates for funds or share accounts assigned to the officer, not exceeding the guaranteed amount, issued by a credit union, as defined in Section 14002 of the Financial Code, whose share deposits are guaranteed by the National Credit Union Administration or guaranteed by any other agency approved by the Department of Corporations.

(b) The deposit shall be in an amount or have a face value, or in the case of bearer bonds or bearer notes have a market value, equal to or in excess of the amount that would be required to be secured by the bond if the bond were given by an admitted surety insurer.

(c) The deposit shall be accompanied by an agreement executed by the principal authorizing the officer to collect, sell, or otherwise apply the deposit to enforce the liability of the principal on the deposit. The agreement shall include the address at which the principal may be served with notices, papers, and other documents under this chapter.

EXCERPT

Excerpts from AB 2644 that affect responsibilities of the California Division of Oil and Gas.
Effective date: January 1, 1979.

SECTION 1. Section 65928.5 is added to the Government Code, to read:

65928.5 "Geothermal field development project" means a development project as defined in Section 65928 which is composed of geothermal wells, resource transportation lines, production equipment, roads, and other facilities which are necessary to supply geothermal energy to any particular heat utilization equipment for its productive life, all within an area delineated by the applicant.

SEC. 2 Article 6 (commencing with Section 65960) is added to Chapter 4.5 of Division 1 of Title 7 of the Government Code, to read:

65960 Notwithstanding any other provision of law, if any person applies for approval of a geothermal field development project, then only one permit from the lead agency and one permit from each responsible agency shall be required for all drilling, construction, operation, and maintenance activities required during the course of the productive life of the project, including, but not limited to, the drilling of makeup wells, redrills, well cleanouts, pipeline hookups, or any other activity necessary to the continued supply of geothermal steam to a powerplant. The lead agency and each responsible agency may approve such permits for less than full field development if the applicant submits such an application. Such permits shall include (1) any conditions or stipulations deemed necessary by the lead or responsible agency, including appropriate mitigation measures within the statutory jurisdiction of such agency, and (2) a monitoring program capable of assuring the permittee's conformance with all such conditions or stipulations. This section shall not apply to any permit whose issuance is a ministerial act by the permitting agency.

SEC. 3 Section 3715.5 is added to the Public Resources Code, to read:

3715.5 For the purposes of the California Environmental Quality Act (commencing with Section 21000), the division shall be the lead agency as defined in Section 21067 for all geothermal exploratory projects as defined in Section 21065.5. The division shall complete all its responsibilities pursuant to the California Environmental Quality Act, including public and agency review and approval or disapproval of the project, within 135 days of the receipt of the application for such project. The division may delegate its lead agency responsibility under this section to a county which has adopted a geothermal element, as defined in Section 25133, for its general plan. Any such delegation shall provide that the county complete its lead agency responsibility under this section within 135 days of the receipt of the application for such project. The provisions of this section shall not apply to geothermal exploratory projects as defined in Section 21065.5 where, prior to January 1, 1979, preparation of an environmental impact report for such project has begun or an application for such project which will require preparation of an environmental impact report has been filed.

SEC. 4 Section 21065.5 is added to the Public Resources Code, to read:

21065.5 "Geothermal exploratory project" means a project as defined in Section 21065 composed of not more than six wells and associated drilling and testing equipment, whose chief and original purpose is to evaluate the presence and characteristics of geothermal resources prior to commencement of a geothermal field development project as defined in Section 65928.5 of the Government Code. Wells included within a geothermal exploratory project must be located at least one-half mile from geothermal development wells which are capable of producing geothermal resources in commercial quantities.

SEC. 5 Section 21090.1 is added to the Public Resources Code, to read:

21090.1 For all purposes of this division, a geothermal exploratory project shall be deemed to be separate and distinct from any subsequent geothermal field development project as defined in Section 65928.5 of the Government Code.

GEOHERMAL DISTRICT BOUNDARIES AND DISTRICT OFFICES

PRC02 (1-84-DWRR-1M)

**APPENDIX B: FEDERAL LEASING AND PERMITTING
REQUIREMENTS**

APPENDIX B

FEDERAL LEASING AND PERMITTING REQUIREMENTS

This Appendix describes leasing procedures for federal geothermal lands, and federal environmental compliance regulations.

1.0 Federal Geothermal Leasing and Permitting Procedures

This section presents a set of procedures for performing geothermal operations on federally-controlled lands, including pre-lease exploration, leasing, post-leasing activities, and environmental compliance. The purpose of this section is to provide a stepwise summary of the process leading to the exploration and development of publicly held geothermal lands.

The Federal Geothermal Steam Act of 1970 authorizes the Secretary of the Interior to dispose of federal lands to develop geothermal steam found within public, withdrawn, and acquired lands. As originally conceived, the Department or the Interior assigned leasing responsibility to two of its agencies, the Bureau of Land Management (BLM) and the U.S. Geological Survey (USGS). A later reorganization of responsibility between the two agencies has resulted in the consolidation of leasing and operations responsibility entirely with BLM.

Leasing on federal land is separated into two sets of procedures: 1) competitive, which is used when lease applications are filed in a Known Geothermal Resource Area (KGRA); and 2) non-competitive, which is used for uncontested applications outside of KGRA's. The three major steps in obtaining and operating on a geothermal lease are: 1) pre-lease exploration; 2) leasing; and 3) post-leasing procedures.

1.1 Pre-Lease Exploration

Pre-lease exploration may be conducted upon federal lands after obtaining a permit commonly called an "NOI" or "Notice of Intent to Conduct Geothermal Resource Exploration Operations." Exploratory operations are defined as:

"Any activity relating to the search for evidence of geothermal resources which requires physical presence upon public lands and which may result in damage to public lands or resources thereon. It includes, but is not limited to, geophysical operations, drilling of shallow temperature gradient wells, construction of roads and trails, and cross-country travel by vehicle over public lands."

Slim deep-hole drilling for stratigraphic or temperature testing may be permitted under an NOI on public, acquired, or mineral-reserved lands in those states where the Bureau of Land Management (BLM) feels that the practice is acceptable. Core drilling for geothermal resources, or subsurface geologic information collection is not authorized under the NOI, but rather are activities permitted only under a geothermal lease. Approval or denial of the NOI must come within 30 days of the applications for the permit.

Exploratory activities are then undertaken by the permittee in accordance with terms and conditions set forth in the NOI. After completion of exploratory activities, the BLM sends a notification of compliance to the permittee.

1.2 Leasing

The U.S. Department of the Interior is the principal agency of authority governing leasing activities with regard to geothermal energy resources upon federal lands. BLM is charged with policy making and the administration of leasing activities as well as the task of tracking and controlling the technical operational aspects of the lease.

Geothermal leasing regulations mandate certain environmental actions related to impacts of geothermal production and utilization. Regulations require that prior to leasing, after a significant interest has been shown in a parcel of land, an evaluation of the environmental impact of proposed operations on an

area be done. This first round study is performed and documented by BLM and is referred to as an Environmental Analysis Report (EAR). If, from this study, major or significant adverse ecological impacts are anticipated to the surrounding area, then BLM is required by the National Environmental Protection Act (NEPA) to prepare a formal Environmental Impact Statement (EIS). After issuance of the lease, BLM is charged with the Environmental Analysis (EA) of the operational plan itself and may also, as a result of the operational plan EA, require an EIS.

Those areas that are determined to possess significant value by the surface management agency may be withdrawn from leasing, or require special restrictive conditions assigned to the lease. On federal lands, the preparation of the EAR may take up to 30 months. Approximately 2 to 3 years, including baseline studies, may be necessary for completion of a "full-blown" EIS, should one be required.

1.2.1 Competitive Leasing

Competitive and non-competitive leasing procedures are followed based upon either the tract's location with respect to an existing KGRA, or an overlapping interest outside of a KGRA by several parties. The major steps followed in a competitive leasing situation are outlined as follows:

- 1) BLM initiates the leasing process for a particular tract.
- 2) BLM initiates an EAR in cooperation with other agencies. If an EAR has been completed previously, then BLM may elect to review that report and forego the EAR process.
- 3) After a review and comment period by other agencies BLM prepares a draft EAR including any proposed lease stipulations.
- 4) Review and comment period by DOE, BLM, Fish and Wildlife Service (FWS), and the public.
- 5) BLM then supplies other agencies with the final stipulations. An EIS may be undertaken at this point if it is deemed necessary by BLM.
- 6) EAR/EIS is reviewed and concurrently, BLM prepares a pre-sale economic evaluation.

- 7) BLM district office completes the final EAR/EIS including lease stipulations, and notifies other agencies of the pending lease sale.
- 8) BLM state office gives public notification of the lease sale.
- 9) Applicant prepares bid and files all documentation required for the lease sale. The lease sale is held.
- 10) BLM selects and notifies the successful bidder after a committee evaluation and recommendations.
- 11) BLM sends lease copies to the successful bidder and the bidder executes the lease agreement.
- 12) BLM issues the lease.

1.2.2 Non-competitive Leasing

Leasing procedures conducted for non-competitive leases, in a very general fashion, follow similar steps to the competitive leasing procedures.

Major steps in non-competitive leasing are as follows:

- 1) The lease application is submitted to the BLM state office. The application is reviewed by BLM after the one month filing period, and the serial register pages are prepared.
- 2) A title report is prepared.
- 3) FWS and the surface management agency are consulted with respect to the EAR Schedule. The BLM district office may elect at this point to review an existing EAR if available.
- 4) If an EAR is necessary, BLM initiates the EAR and notifies other agencies whereby review and comments are made.
- 5) BLM prepares a draft EAR with proposed lease stipulations.
- 6) The draft EAR is made available to all concerned parties, including the public, for review and comments.
- 7) The BLM district office completes the EAR, including lease stipulations.
- 8) An EIS is undertaken at this point if deemed necessary.
- 9) BLM supplies other agencies with the final BLM stipulations. The agencies review and concur with the stipulations.
- 10) After receiving the concurrences, BLM forwards the lease forms for the applicant's signature.

- 11) The applicant signs and returns the lease forms.
- 12) BLM approves or rejects the signed lease the according to KGRA Clear List Report.
- 13) BLM issues the lease.

1.3 Post Leasing Procedures

After a lease has been awarded, the lessee must submit a "Plan of Operation" (POO) to BLM for approval. BLM then prepares an "Environmental Analysis" (EA) for each plan, describing the ecological and environmental considerations of proposed operations. The geothermal developer may, at this point, pursue surface and shallow subsurface resource exploration. When a resource target has been selected, the lessee must submit an "Application for Permit to Drill" (APD) to BLM. An EIS may be undertaken after the EA if it is deemed necessary.

When the geothermal operator moves from a phase of exploration to development, a "Plan of Development" (POD) must be submitted to BLM. Another EA is conducted on the POD and an EIS is undertaken if necessary. One year of environmental baseline data may be required if none has been collected at this point. The operator may move into the development phase of the project while simultaneously collecting baseline data.

When development work is completed, the operator will then submit a "Plan of Production" (POP). Another EA is undertaken by BLM and an EIS is performed if required as before.

Table 1 shows a general summary of the functions of the various federal agencies involved in administering federal leasing.

2.0 Federal Environmental Compliance

The Federal Geothermal Steam Act of 1970 prescribes blanket environmental protection for all federal lands exploited for geothermal resources. Geothermal leasing regulations (Title 30 CFR, Parts 270 and 271, and Title 43, Parts 3000

Federal Agencies	Permit or Function	Required Prior to	Estimated Time for Issuance	Notes
Bureau of Land Management	Permit for Pre-Lease Operation	Non-surface disturbing exploratory activities on lands not leased by applicant	30 days	Includes geophysical/geological exploration temperature gradient surveys, etc. 30 day time limit for approval
	Issue lease — BLM Lands	Major exploratory activities	8 months or longer	
	Conducts EAR Conducts KGRA Lease Sales Issues Lease			
	Plant Siting Permit	Plant construction	Not known	
	Post-lease Approval of Plans of Operation	-	-	Site specific
	Administers Terms of Lease	-	-	
	Approves Permit for Exploratory Activities	Non-surface disturbing activities	30 days	Includes geophysical/geological activities, temperature gradient surveys, etc., 30 day time limit for approval
	Conducts Site-Specific Environmental Analysis and approval of Plans of Operation	-	-	Plans of operation are site specific
	Exploration	Surface disturbing activities	About 1 year	
	Environmental Baseline Data	Gathering of required 1 year's environmental baseline data	About 3-5 months	Must be completed at least one year before plan of production is submitted
	Development	Drilling and development of production wells	About 3-5 months	Define extent of field
	Injection	Drilling and development of injection system	About 3-5 months	
	Utilization	Constructing a power plant	About 3-5 months	Sundry notices submitted for each phase. Includes contract and royalty breakdown
	Production	Using the resource for power production	About 3-5 months	Includes production data from wells and target date for completion
	Change of Plans of Operation	Implementing any change of plans in operation	A few months	Sundry notices
U.S. Environmental Protection Agency	Certify Air Discharge Permit	-	About 90 days	Air, water, and solid waste permits are in conjunction with State Department of Health Services
	Issue Water Permit	-	About 90 days	
	Issue Solid Waste Disposal Permit	-	About 90 days	
	Review of EIS	-	-	
U.S. Fish and Wildlife Service	Advisory	-	-	Consults on lease sales (competitive and non-competitive), pre-lease and post-lease environmental analysis
U.S. Forest Service	Special Use Permit for Pre-Lease Operations	Exploratory activities on lands not leased by applicant	30 days	Includes geophysical/geological exploration, temperature gradient surveys, etc., 30 day time limit for approval
	Issue Lease — Forest Service Lands	Major exploratory activities	About 17 months or longer	
	Conducts EAR, KGRA Land Sales			

Table B-1: Federal Agency Permitting and Regulatory Functions.

and 3200) mandate that federal geothermal lessees comply with all applicable federal, state, and local environmental standards. In addition, the lessee is also required to comply with any standards imposed by BLM. This directive includes control of all forms of air, land, water, and noise pollution, including but not limited to the control of erosion and the disposal of solid, liquid, and gaseous wastes.

All federal statutes pertaining to environmental control programs are administered by the Environmental Protection Agency (EPA). Further, geothermal activities are also subject to federal laws designed to guard and preserve endangered species, historic and archaeological sites, wild and scenic rivers, and other aspects. The application of these laws is either direct or through stipulation within a lease.

The EPA administers statutes pertaining to clean air, clean water, resource conservation, and noise pollution. These statutes are applicable to all sources of the type of environmental contamination they are designed to control. Compliance with the statutes is a requirement of all federal geothermal lessees.

2.1 Air Quality

The Clean Air Act (P.L. 95-95, as amended by P.L. 95-190) provides various methods for establishing emission standards. The EPA promulgates such standards for hazardous pollutants and sets performance standards for new sources of pollution. The individual state may set emission standards for pollution from stationary sources. If the state fails to adopt emission standards in response to national ambient air standards, then EPA may elect to enforce its own standards.

Many of the proposed magma study sites are located within or near pristine areas. Geothermal power production from these areas may be subject to prevention of significant deterioration (PSD) regulations which may severely restrict emissions. EPA regulations require that if a facility discharges more than

250 tons of hydrogen sulfide (H_2S) annually, a permit is required and also the addition of pollution control equipment. Under PSD regulations, if after the addition of pollution control equipment, the 250 ton annual limit is exceeded then the plant will become subject to stringent PSD requirements (Beeland, p. 7).

2.2 Water Pollution Control

If water from a geothermal resource is discharged into an existing body of water, a discharge permit required under the National Pollutant Discharge Elimination System (NPDES) must be obtained which incorporates quantitative limitations on effluents. The cost of the permit is \$100 for the first discharge point and an additional \$50 per outlet (Malysa, p. 57). The NPDES permit is a federal permit but is administered by various state agencies. Limitations on the discharge are established on a case by case basis and will be subject largely to state water quality standards that apply to the body of water that receives the discharge. The primary concern is the control of 65 toxic pollutants that include a number of heavy metals known to be associated with geothermal systems.

EPA regulations provide the states with primary enforcement authority relating to the reinjection of geothermal fluids, and are designed primarily to prevent the contamination of potable aquifers. A drinking water aquifer is defined as an aquifer supplying drinking water for human consumption or an aquifer that contains water with less than 10,000 mg/l of total dissolved solids. Aquifers may be "exempt" from this classification if they are: more valuable for geothermal energy production; are severely contaminated; are impractical for water supplies because of their location; or are located over a geothermal well area subject to subsidence (Beeland, p. 7).

Permits that are required for reinjection will be less restrictive if reinjection takes place within an exempt aquifer.

2.3 Noise Control

Primary responsibility for the control of noise has been vested with state and local governments. Regulatory authority, however, is retained by EPA on four categories of low-noise level products (construction and transportation equipment, motors or engines, and electrical or electronic equipment).

Noise levels on federal geothermal leases are restricted to 65 dB(A) at a distance of 201 m (660 ft.)

2.4 Endangered Species

If a proposed geothermal project is planned for an area that serves as habitat for an animal on the endangered species list, then BLM consultation with the U.S. Fish and Wildlife Service (FWS) is required. FWS regulations require that a description of all proposed actions be filed with them. FWS then prepares a biological assessment that requires a maximum of 180 days for completion. Next, BLM issues a biological opinion requiring a minimum of 60 days for completion. The opinion may require modification of the project.

APPENDIX C: MISCELLANEOUS FORMS

RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF CONSERVATION
DIVISION OF OIL AND GAS

A.P.I. No.

WELL SUMMARY REPORT - GEOTHERMAL

Operator				Well name and number							
Field				County				Sec.	T.	R.	B.&M.
Location (property or section corner, or street center lines)								Elevation of ground (meters above sea level)			
Commenced drilling (date)		Total depth (meters)		Plugged depth (meters)		Depth measurements taken from top of:					
Completed drilling (date)		Geologic formation and age at total depth				☐ Derrick floor ☐ Rotary table ☐ Kelly bushing					
Commenced producing (date)						Which is _____ meters above ground.					
Junk				Geologic marker(s)				Depth (meters)			

DATE	STATIC TEST (Shut-in well head)		PRODUCTION TEST DATA										
	Temp °C	Press. bars	Total mass flow data					Separator data					
			kg/hr	Temp °C	Press. bars	Enthalpy	Orifice	Water kg/hr	Steam kg/hr	Press. bars	Temp °C		

CASING RECORD (present hole)									
Size of casing (A.P.I.)	Top of casing (m)	Depth of shoe (m)	Weight of casing (kg)	New or second hand	Seamless or lapweld	Grade of casing	Size of hole drilled (cm)	Volume of cement (m ³)	Depth of cementing if through perforations (m)

PERFORATED CASING (size, top, bottom, perforated intervals, size and spacing of perforation and method)

Was analysis of effluent made? Yes ☐ No ☐		Electric log depths	Temperature depths
--	--	---------------------	--------------------

In compliance with Section 3735 , Chapter 4 , Division 3 of the Public Resources Code, the information given herewith is a complete and correct record of the present condition of the well and all work done thereon, so far as can be determined from all available records.

Name		Title	
Address		City	Zip Code
Telephone Number	Signature		Date

File this report in duplicate with the appropriate geothermal district office.

WELL LOG AND CORE RECORD - GEOTHERMAL

Operator		Well name and number				
Field		County	Sec.	T.	R.	B.&M.

FORMATIONS PENETRATED BY WELL

Depth in meters to:		Thickness (meters)	Drilled or cored	Recovery	Description
Top of formation	Bottom of formation				

In compliance with Section 3735 , Chapter 4 , Division 3 of the Public Resources Code, the information given herewith is complete and correct so far as can be determined from all available records.

Name		Title		
Address		City		Zip Code
Telephone Number	Signature		Date	

File this record in duplicate with the appropriate geothermal district office.

WELL HISTORY - GEOTHERMAL

operator	Well name and number				
field	County	Sec.	T.	R.	B.&M.

is of the greatest importance to have a complete history of the well. Use this form to report a full account of all important operations during drilling and testing of the well or during redrilling, permanently altering casing, plugging, or abandonment, with the dates thereof. Be sure to include such items as hole size (in cm), formation test details, volumes of cement used (in m^3), top and bottom of plugs (in m), perforation details, sidetracked junk, bailing tests, shooting and initial production data (in kg/hr), and zone temperature (in $^{\circ}C$).

DATE	HISTORY

In compliance with Section 3735, Chapter 4, Division 3 of the Public Resources Code, the information given herewith is a complete and correct record of the well and all work done thereon, so far as can be determined from all available records.

Name		Title	
Address		City	Zip Code
Telephone Number	Signature		Date

File this report in duplicate with the appropriate geothermal district office.

RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF CONSERVATION
DIVISION OF OIL AND GAS

Notice of Intention to Drill a Geothermal Resources Well
(SUBMIT IN DUPLICATE)

Operator		Well Designation				
Id		County	Sec.	T.	R.	B & M.
Name (Person submitting report - print or type)		Street Address				
Name (Agent or officer of company)		City	State		Zip Code	

Signature _____ Date _____ Telephone Number _____

The appropriate drilling fee, an indemnity or cash bond, a complete drilling program, and a parcel map showing the operator's surface rights, mineral rights, and the location of the proposed well must accompany this notice.

Location of well: _____ meters _____ along section/property line, and _____ meters _____ at right angles to

_____ line from the _____ corner of section/property _____ or _____

Elevation of prepared site above/below sea level: _____ meters.

Is the surface location or intended productive interval within 100 feet of property boundary? ☐ yes ☐ no

If well is to be directionally drilled, show proposed coordinates (from surface location) at total depth:
_____ meters _____ and _____ meters _____

PROPOSED CASING PROGRAM

Depth measurements taken from top of _____ that is _____ meters above ground.

SIZE OF CASING CM API	WEIGHT (Kg)	GRADE AND TYPE	NEW OR USED	TOP OF CASING (m)	SIZE OF HOLE (cm)	VOLUME OF CEMENT (m³)	CEMENTING DEPTHS	CALCULATED FILL BEHIND CASING

Intended zone(s) of completion: _____ Estimated total depth: _____ meters.

ENVIRONMENTAL INFORMATION
(SEE REVERSE SIDE)

If a governmental agency has prepared an environmental document, please submit a copy of the document with this notice or supply the following information:

Government Agency: _____ Contact Person: _____
Address: _____ Phone: () _____
Document title: _____ S.C.H. No.: _____

**REWORK/SUPPLEMENTARY NOTICE
GEOTHERMAL WELL**

Submitted in compliance with Section 3724, Division 3, Chapter 4, Public Resources Code

Operator		Well Designation				
Field or GRA		County	Sec.	T.	R.	B.&M.
Name (Person submitting report - print or type)		Street Address				
Title (Agent or officer of company)	City	State			Zip Code	

Signature _____ Date _____ Telephone Number _____

The present condition of the well is as follows:

- 1. Total depth: _____ meters.
- 2. Complete casing record, including plugs:
- 3. Last produced: _____, 19_____

(Production in kg/hr. or gal. /min.)

The proposed work is as follows:

RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF CONSERVATION
DIVISION OF OIL AND GAS

API No. _____

**NOTICE OF INTENTION TO ABANDON
GEOTHERMAL WELL**

Submitted in Compliance with Section 3724, Division 3, Chapter 4, Public Resources Code

Operator		Well Designation			
Field/GRA	County	Sec.	T.	R.	B. & M.
Name (Person submitting report - print or type)		Street Address			
Title (Agent or officer of company)	City	State		Zip Code	

Signature: _____ Date: _____ Telephone Number: _____

The present condition of the well is as follows:

1. Total depth: _____ meters
2. Base of fresh water aquifer: _____ meters
3. Last produced: _____, 19 ____

(Production in kg/hr., gal./min.)
4. Results of initial production test: (includes fluid analysis)
_____ (Kg/hr., gal./min.) rate
_____ (Bars, psi) pressure
5. Bottom hole temperature: _____ ° C
6. Maximum temperature: _____ ° C, depth: _____
(meters)

7. Stratigraphic markers and depths (in meters):

8. Formation and age at total depth: _____

Complete casing record, including plugs:

To fulfill the abandonment requirements of the division, the following work is proposed:

[illegible]

SEE DIVISION MANUAL M11 FOR INSTRUCTIONS
TO COMPLETE THIS FORM.

[illegible]

*PERCENTAGES SHOULD BE GIVEN AS DECIMAL FRACTIONS. (eg. 23.1% SHOULD BE SHOWN AS .231).

STATE OF CALIFORNIA
DEPARTMENT OF CONSERVATION
DIVISION OF OIL AND GAS
1416 NINTH STREET, ROOM 1310, SACRAMENTO 95814

DESIGNATION OF AGENT FOR CORPORATION

In compliance with Section 3721, Division 3, Public Resources Code, notice is hereby given and we hereby certify that _____

a corporation organized and existing under and by virtue of the laws of the _____

of _____ by resolution of its board of directors, has appointed, authorized and empowered _____

whose address is _____
(Postal Address) (City) (Zip Code)

State of California, as its agent for the State of California * _____

upon whom all orders, notices and processes under the provisions of said act may be served.

This notice revokes all former appointments made for said purpose.

IN WITNESS WHEREOF the corporation has caused this certificate to be signed by its President and attested by its

Secretary this _____ day of _____ 19____

_____, President
(Name)

(Signature of President)

Attest:

(Signature of Secretary)

CORPORATE SEAL

Sec. 3721. Every owner or operator of any well shall designate an agent, giving his post office address, who resides in this State, upon whom may be served all orders, notices, and processes of the supervisor, a board, or any court of law. Every person so appointing an agent shall, within five days after the termination of any such agency, notify the supervisor, in writing, of such termination, and unless operations are discontinued, shall appoint a new agent.

* Should the owner or operator filing this form choose to appoint more than one agent, the phrase, "the State of California," should be deleted and the exact area for which the agent is to be appointed should be inserted. A separate form must be filed for each agent.

STATE OF CALIFORNIA
DEPARTMENT OF CONSERVATION
DIVISION OF OIL AND GAS
1416 NINTH STREET, ROOM 1316. SACRAMENTO 95814

DESIGNATION OF AGENT FOR INDIVIDUAL OR PARTNERSHIP

In compliance with Section 3721, Division 3, Public Resources Code, notice is hereby given and.....
(I, we)

hereby certify that.....
(I, we)

of....., State of....., have appointed, authorized and
empowered.....

whose address is.....
(Postal Address) (City) (Zip Code)

State of California, as..... agent for the State of California*.....
(my, our)

upon whom all orders, notices and processes under the provisions of said act may be served.

This notice revokes all former appointments made for said purpose.

IN WITNESS WHEREOF..... have signed this certificate this..... day of..... 19.....
(I, we)

(Name and Title)

(Signature)

Witness:

(Signature)

Agents acceptance:

Accepted.....
(Signature)

Sec. 3721. Every owner or operator of any well shall designate an agent, giving his post office address, who resides in this State, upon whom may be served all orders, notices, and processes of the supervisor, a board, or any court of law. Every person so appointing an agent shall, within five days after the termination of any such agency, notify the supervisor, in writing, of such termination, and unless operations are discontinued, shall appoint a new agent.

NOTE: An operator may appoint himself as agent.

* Should the owner or operator filing this form choose to appoint more than one agent, the phrase, "the State of California," should be deleted and the exact area for which the agent is to be appointed should be inserted. A separate form must be filed for each agent.

INDIVIDUAL GEOTHERMAL RESOURCES WELL INDEMNITY BOND

(SEE INSTRUCTIONS ON REVERSE SIDE FOR APPLICABLE AMOUNT)

Know All Men by These Presents:

WE

That I,

as principal, and

a corporation

organized and existing under and by virtue of the laws of the STATE OF
and authorized to transact surety business in the STATE OF CALIFORNIA, as surety, are held and firmly bound
unto the STATE OF CALIFORNIA in the sum of THOUSAND AND NO/100 DOLLARS
(\$.....,000.00) lawful money of the United States of America, to be paid to the said State of California, for which
payment, well and truly to be made, we bind ourselves, our heirs, executors and successors, jointly and severally,
firmly by these presents.

THE CONDITION OF THE ABOVE OBLIGATION IS SUCH THAT,

WHEREAS, said principal is about to acquire ownership or operation, drill, redrill, deepen, maintain, or abandon a

.....-temperature geothermal resources well designated as, Sec.,
(high or low)

T. R. B. & M., and is required to file this bond in connection therewith in accordance with
Sections 3723.5 and 3725 to 3729, inclusive, of Chapter 4 of Division 3 of the Public Resources Code of the State
of California.

NOW, THEREFORE, if said

the above bounden principal, shall well and truly comply with all the provisions of Chapter 4 (commencing with
Section 3700) of Division 3 of the Public Resources Code and shall obey all lawful orders of the State Oil and Gas
Supervisor, or his district deputy or deputies, if not appealed as provided in that chapter, or upon affirmance thereof
by the Geothermal Resources Board, if appealed thereto, and shall pay all charges, costs, and expenses incurred
by the supervisor or his district deputy or deputies in respect of such well or the property of said principal, or
assessed against such well or the property of such principal, in pursuance of the provisions of said chapter, then
this obligation shall be void; otherwise, it shall remain in full force and effect.

IN WITNESS WHEREOF, the seal and signature of the said principal is hereto affixed and the corporate seal and
name of the said surety is hereto affixed and attested by its duly authorized at

California, this day of , 19

(SEAL OF PRINCIPAL)

[Principal]

By

(SEAL OF SURETY)

[Surety]

By

Office of surety to which correspondence relating to this bond should be
addressed:

.....

.....

\$100,000 BLANKET GEOTHERMAL RESOURCES WELL INDEMNITY BOND

Know All Men by These Presents:

WE

That I,

as principal, and

a corporation

organized and existing under and by virtue of the laws of the STATE OF
and authorized to transact surety business in the STATE OF CALIFORNIA, as surety, are held and firmly bound
unto the STATE OF CALIFORNIA in the sum of ONE HUNDRED THOUSAND AND NO/100 DOLLARS(\$100,000.00)
lawful money of the United States of America, to be paid to the said State of California, for which payment, well
and truly to be made, we bind ourselves, our heirs, executors and successors, jointly and severally, firmly by these
presents.

THE CONDITION OF THE ABOVE OBLIGATION IS SUCH THAT,

WHEREAS, said principal is about to acquire ownership or operation, drill, redrill, deepen, maintain, or abandon
geothermal resources wells in CALIFORNIA and is required to file this bond in connection therewith in accordance
with Sections 3723.5 and 3725 to 3729, inclusive, of Chapter 4 of Division 3 of the Public Resources Code of the
State of California.

NOW, THEREFORE, if said

the above bounden principal, shall well and truly comply with all the provisions of Chapter 4 (commencing with
Section 3700) of Division 3 of the Public Resources Code and shall obey all lawful orders of the State Oil and Gas
Supervisor, or his district deputy or deputies, if not appealed as provided in that chapter, or upon affirmance thereof
by the Geothermal Resources Board, if appealed thereto, and shall pay all charges, costs, and expenses incurred
by the supervisor or his district deputy or deputies in respect of such wells or the properties of said principal, or
assessed against such wells or the properties of such principal, in pursuance of the provisions of said chapter,
then this obligation shall be void; otherwise, it shall remain in full force and effect.

IN WITNESS WHEREOF, the seal and signature of the said principal is hereto affixed and the corporate seal and
name of the said surety is hereto affixed and attested by its duly authorized at

California, this day of , 19

(SEAL OF PRINCIPAL)

[Principal]

By

(SEAL OF SURETY)

[Surety]

By

Office of surety to which correspondence relating to this bond should be
addressed:

.....

.....

INDIVIDUAL GEOTHERMAL RESOURCES WELL CASH BOND

(SEE INSTRUCTIONS ON REVERSE SIDE FOR APPLICABLE AMOUNT)

Know All Men by These Presents:

WE

That I,

as principal, present a total cash deposit of THOUSAND AND NO/100 DOLLARS
 (\$.....,000.00) in the form of:

Cashiers Check No., in the amount of \$, and/or
 Certified Check No., in the amount of \$, and/or
 Certificate of Deposit No., in the amount of \$, and/or
 Passbook Account No., in the amount of \$
 accompanied by a properly executed assignment form; or

a total deposit of THOUSAND HUNDRED AND NO/100 DOLLARS (\$.....,000.00) in the
 form of bearer bonds listed by number on the reverse side of this form, issued by the:

United States Government in the amount of \$, and/or
 State of California in the amount of \$

all made payable solely to the State Division of Oil and Gas.

THE CONDITION OF THE ABOVE OBLIGATION IS SUCH THAT,

WHEREAS, said principal is about to acquire ownership or operation, drill, redrill, deepen, maintain, or abandon a
-temperature geothermal resources well designated as....., Sec.....,
 (high or low)

T....., R..... B. & M., and is required to file this bond in connection therewith in
 accordance with Section 3728.5, of Chapter 4 of Division 3 of the Public Resources Code of the State of California.

NOW, THEREFORE, if said

the above bounden principal, shall well and truly comply with all the provisions of Chapter 4 (commencing with
 Section 3700) of Division 3 of the Public Resources Code and shall obey all lawful orders of the State Oil and Gas
 Supervisor, or his district deputy or deputies, if not appealed as provided in that chapter, or upon affirmance thereof
 by the Geothermal Resources Board, if appealed thereto, and shall pay all charges, costs, and expenses incurred
 by the supervisor or his district deputy or deputies in respect of such well or the property of said principal, or
 assessed against such well or the property of such principal, in pursuance of the provisions of said chapter, then
 this obligation shall be void; otherwise, it shall remain in full force and effect.

If the principal fails to comply with all of the provisions of Chapter 4 (commencing with Section 3700), Division 3
 of the Public Resources Code and to obey all lawful orders of the State Oil and Gas Supervisor or his deputies, then
 the supervisor may draw upon this bond to pay all costs and expenses incurred by the supervisor or his deputy in
 respect to such well or property.

This bond shall be subject to all conditions set forth in Sections 3723.5 and 3725 to 3729, inclusive, P.R.C.
 IN WITNESS WHEREOF, the seal and signature of the said principal is hereto affixed.

at California, this day of, 19

This is to certify under penalty of perjury that the above cash deposit and/or bearer bond is free of all liens
 including tax liens by the U.S. Revenue Service or the State of California Franchise Tax Board, Board of Equalization
 or Department of Employment.

(SEAL OF PRINCIPAL)

[Principal]

By

APPROVED BY State Oil and
 Gas Supervisor

By , Deputy

DATE , 19

BLANKET GEOTHERMAL RESOURCES WELL CASH BOND**\$100,000 CASH**

Know All Men by These Presents:

WE

That I,

as principal, present a total cash deposit of ONE HUNDRED THOUSAND AND NO/100 DOLLARS (\$100,000.00) in the form of:

Cashiers Check No., in the amount of \$, and/or

Certified Check No., in the amount of \$, and/or

Certificate of Deposit No., in the amount of \$, and/or

Passbook Account No., in the amount of \$

accompanied by a properly executed assignment form, all made payable solely to the State Division of Oil and Gas.

THE CONDITION OF THE ABOVE OBLIGATION IS SUCH THAT,

WHEREAS, said principal is about to acquire ownership or operation, drill, redrill, deepen, maintain, or abandon geothermal resources wells in CALIFORNIA and is required to file this bond in connection therewith in accordance with Section 3728.5, of Chapter 4 of Division 3 of the Public Resources Code of the State of California.

NOW, THEREFORE, if said

the above bounden principal, shall well and truly comply with all the provisions of Chapter 4 (commencing with Section 3700) of Division 3 of the Public Resources Code and shall obey all lawful orders of the State Oil and Gas Supervisor, or his district deputy or deputies, if not appealed as provided in that chapter, or upon affirmance thereof by the Geothermal Resources Board, if appealed thereto, and shall pay all charges, costs, and expenses incurred by the supervisor or his district deputy or deputies in respect of such wells or the properties of said principal, or assessed against such wells or the properties of such principal, in pursuance of the provisions of said chapter, then this obligation shall be void; otherwise, it shall remain in full force and effect.

If the principal fails to comply with all of the provisions of Chapter 4 (commencing with Section 3700), Division 3 of the Public Resources Code and to obey all lawful orders of the State Oil and Gas Supervisor or his deputies, then the supervisor may draw upon this bond to pay all costs and expenses incurred by the supervisor or his deputy in respect to such wells or properties.

This bond shall be subject to all conditions set forth in Sections 3723.5 and 3725 to 3729, inclusive, P.R.C. IN WITNESS WHEREOF, the seal and signature of the said principal is hereto affixed.

at California, this day of, 19

This is to certify under penalty of perjury that the above cash deposit is free of all liens including tax liens by the U. S. Revenue Service of the State of California Franchise Tax Board, Board of Equalization or Department of Employment.

(SEAL OF PRINCIPAL)

[Principal]

By

APPROVED BY, State Oil and Gas Supervisor

By, Deputy

DATE, 19