

RATIONALE IN DETERMINING  
THE SOUTHERN BOUNDARY OF THE  
KAMAILI GEOTHERMAL RESOURCE SUBZONE

Circular C-117



State of Hawaii  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
Division of Water and Land Development

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## PREFACE

This report has been prepared in response to a request by the Bishop Estate to extend the southern boundary of the Kamaili geothermal resource subzone (GRS) to include all of the Kauaea and Kaueleau land parcels (see Figure 2). This request was formally communicated to the Board of Land and Natural Resources (BLNR) at the public hearing on geothermal subzoning which occurred on September 11, 1984 in Pahoia, Hawaii. Representatives of Bishop Estate and Thermal Power Company presented information at the public hearing in support of their position.

For a complete description of the geothermal subzone assessment process, see DLNR Circulars C-97 to C-108 prepared by the Division of Water and Land Development.



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Introduction

In determining the location of geothermal resource subzones, Act 296, SLH 1983, requires the BLNR to examine factors which include: the area's potential for production of geothermal energy, prospects for utilization, geologic hazards, social and environmental impacts, land use compatibility, and economic benefits.

The assessment below will explain how the Department of Land and Natural Resources (DLNR) applied the subzoning criteria of Act 296 in determining the southern boundary of the Kamaili GRS.

Area's Potential for the Production of Geothermal Energy.

As a source of information and advice, the DLNR selected a committee of technical experts closely associated with geothermal research in Hawaii. The Technical Committee analyzed the State's potential geothermal resource areas during a series of eight meetings from March to June, 1984.

During the fifth meeting (April 19, 1984) all developers were invited to present and submit technical information. On behalf of Thermal Power Company and Bishop Estate, Geologist Joseph Iovenitti presented geophysical data which he interpreted to suggest a rift zone dike complex along the coastline south of the Kamaili GRS. Mr. Iovenitti presented essentially the same information before the BLNR at their September, 1984 public hearing in Pahoa.

The Technical Committee's consensus was that Mr. Iovenitti's interpretation was at strong variance with accepted models of the rift zone and that the data he presented did not adequately support his conclusions regarding a coastal rift zone.

Based on all available geologic, geophysical, and geochemical information, the Technical Committee located a 90% high temperature (greater than 125°C within 3 km depth) probability zone along the Kilauea east and southwest rift zones (see figure 1).

Subsequently, additional technical information has been provided, some at the recent Kahaualea contested case hearing. Interpretation of available geologic and gravity data suggests that the Kilauea east rift has migrated southward to its present active location. Due to this southward migration, it is believed that the geothermal heat source is much broader to the north and declines more sharply to the south than would be indicated by surface expressions alone. Thermal potential of areas to the south of the 90% resource line is believed to diminish rapidly with distance from the rift zone.

In addition to limited heat potential, permeability in areas south of the rift is expected to be low as a result of mineral deposition from salt water intrusion. Therefore, based on all available information, it appears that the geothermal resource potential south of the 90% resource line is significantly diminished.

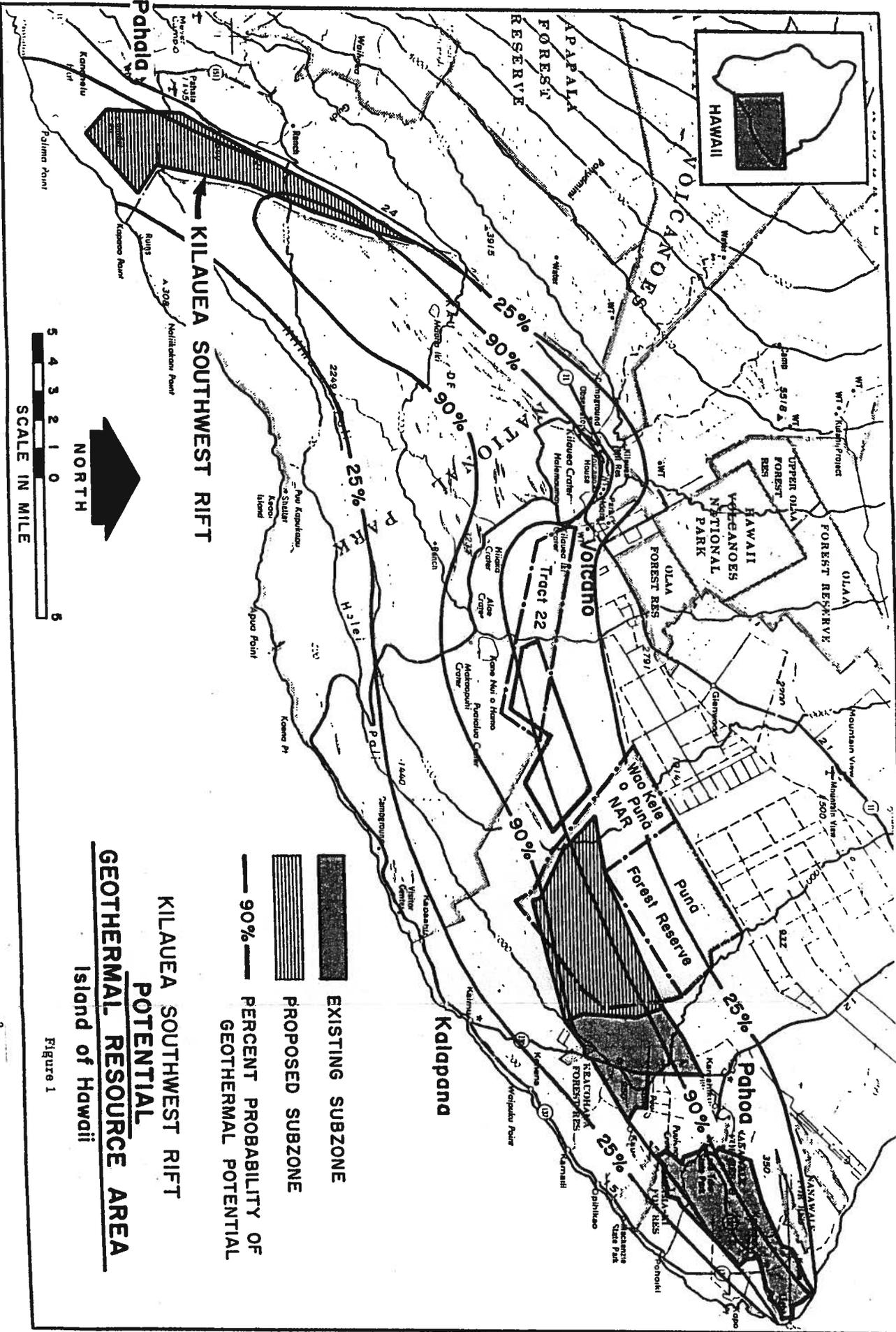
#### Prospects for Utilization of Geothermal Energy

The BLNR approved a direct lease of geothermal resources mining rights to the Bishop Estate in 1977. Subsequently, the BLNR issued the State of Hawaii Geothermal Resources Mining Lease No. R-1 to the Bishop Estate in March, 1981. Prior to subzoning, no developer had requested permission to conduct exploration activities on the leased property.

#### Geologic Hazards

The geologic mapping of Holcomb (1980) shows that hazards from lava flows are greater within and south of the Kilauea east rift zone due to the southward sloping contour of the land. This pattern is typified by the recent 1955 lava which flowed south over the Kaueleau land parcel (Figure 2). Northern east rift GRS boundaries were drawn a reasonable distance north of the rift zone to provide for areas less susceptible to lava flow hazards. It is anticipated that power plants may be sited on locally elevated ground in these safer northern areas.

Reports from the Hawaiian Volcano Observatory show that tectonic earthquakes, many of significant magnitude, have frequently occurred



**KILAUEA SOUTHWEST RIFT  
GEOHERMAL RESOURCE AREA  
Island of Hawaii**

**EXISTING SUBZONE**  
**PROPOSED SUBZONE**  
**PERCENT PROBABILITY OF  
GEOHERMAL POTENTIAL**

KAMAILI GRS

# BISHOP ESTATE GRML No. R-1

Figure 2

2 1 0 2 4 6  
SCALE IN THOUSAND FEET

Bdry of Bishop Estate GRML

KAPOHO GRS

Ohia Forest

LAVA FLOWS

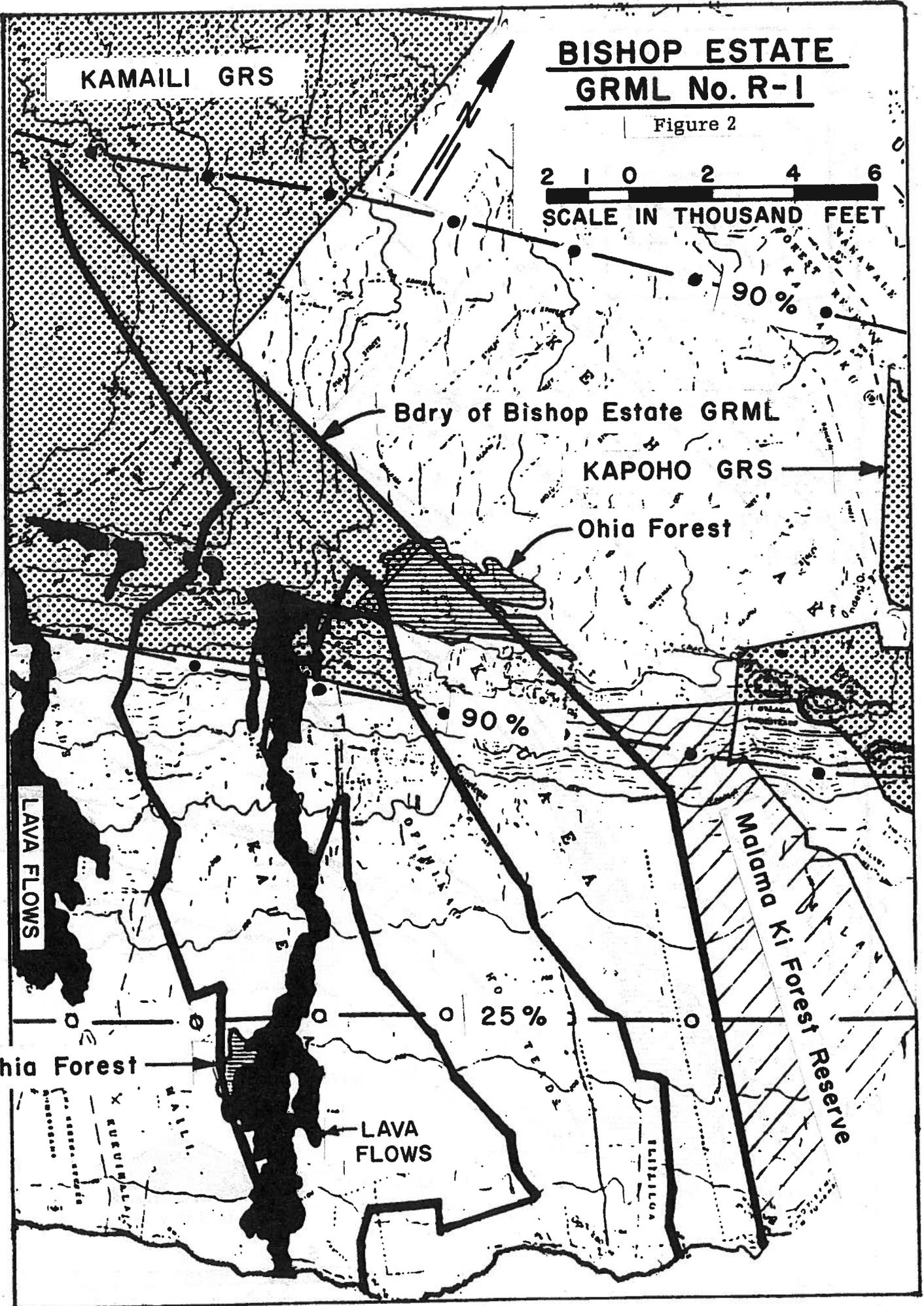
90%

25%

Ohia Forest

LAVA FLOWS

Malama Ki Forest Reserve



south of the east rift zone. The largest recent earthquake (magnitude 7.5) occurred in 1975 about 5 km southwest of Kalapana. Ground cracking and subsidence can be associated with such earthquake activity. These ground movements may pose a danger to geothermal well bores.

A potential tsunami hazard may be localized to an area of land approximately two km from the coast and at elevations below 75 feet.

Thus, the southern portion of the Bishop properties are at relatively high risk from lava flows, tectonic earthquakes, and tsunamis.

### Social Impacts

Existing subzones have been situated a reasonable distance away from communities. If the Kauaea land parcel were entirely subzoned it would not provide any buffer between the subzone and the village of Kaueleau.

### Environmental Impacts

Two areas of predominantly native ohia forest exist on the Kauaea and Kaueleau parcels (see figure 2). This was a prime consideration in limiting the southeast boundary of the Kamaili subzone.

The Malama-ki Forest Reserve is immediately adjacent to the northeast boundary of the Kauaea land parcel. When geothermal subzone areas are adjacent to Forest Reserve areas, the DLNR has sought to mitigate any possible impacts by providing a 2000-foot buffer between the forest and geothermal subzone areas. When this 2000-foot criteria is applied, it removes almost the entire southern portion of the Kauaea land parcel from subzone consideration. (The Malama-ki Forest Reserve is adjacent to the Kapoho GRS. However, that portion of the GRS was grandfathered by the legislature by Act 151, SLH 1984.)

### Economic Benefits

In addition to jobs created by construction and operation of power plant facilities, some economic benefits could be derived from direct use

application of geothermal energy. Much of the Kauaea and Kaueleau land parcels are used for agricultural purposes. Some direct uses of geothermal energy include food processing, soil and fruit sterilization, and production of livestock feed from fodder.

### Compatibility

Since sections of the Bishop properties contain or are immediately adjacent to native ohia forest, Forest Reserve areas, coastline, and communities; questions as to compatibility might have arisen if the entire Bishop lands were subzoned.

### Conclusion

In summary, the reasons for not subzoning the southern portion of Bishop Estate's land are as follows:

- o The lands were south of the 90% geothermal resource probability line where the resource potential is significantly diminished. Thermal potential of areas to the south of the 90% resource line is believed to diminish rapidly with distance from the rift zone. Additionally, the permeability in areas south of rift zone is expected to be low as a result of mineral deposition from salt water intrusion.
- o The lands are at relatively high risk from geologic hazards of lava flows, tectonic earthquakes and tsunami.
- o The land contains some native ohia forest and is immediately adjacent to the Malama-ki Forest Reserve.
- o The village of Kaueleau is on the boundary of the Kauaea land parcel.

## REFERENCES

### State of Hawaii Department of Land and Natural Resources Publications:

- Plan of Study for Designating Geothermal Resource Subzones,  
State of Hawaii. Circular C-97, September 1983.
- Assessment of Available Information Relating to Geothermal  
Resources in Hawaii. Circular C-98, January 1984.
- Public Participation and Information Program for Designating  
Geothermal Resource Subzones, State of Hawaii. Circular C-99,  
March 1984.
- Geothermal Resource Developments, State of Hawaii. Circular C-100,  
March 1984.
- Statewide Geothermal Resource Assessment. Circular C-103,  
September 1984.
- Social Impact Analysis of Potential Geothermal Resource Areas.  
Circular C-104, September 1984.
- Economic Impact Analysis of Potential Geothermal Resource Areas.  
Circular C-105, September 1984.
- Environmental Impact Analysis of Potential Geothermal Resource  
Areas. Circular C-106, October 1984.
- Geologic Hazards Impact Analysis of Potential Geothermal Resource  
Areas. Circular C-107, September 1984.
- Geothermal Technology. Circular C-108, September 1984.
- Rules on Leasing and Drilling of Geothermal Resources,  
Chapter 183 of Title 13, Administrative Rules.

### Personal Communication:

- Dr. Donald M. Thomas, Hawaii Institute of Geophysics, University of  
Hawaii, 1985.