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Geothermal Direct Heat Use: Market Potential/Penetration Analysis for Federal Region IX

(Arizona, California, Hawaii, Nevada)

Edited by
William Powell
Kenneth Tang

May 1980

Prepared for

U.S. Department of Energy
Office of the Regional Representative, Region IX
and the San Francisco Operations Office

Through an agreement with
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ABSTRACT

A preliminary study was made of the potential for geothermal direct heat use in Arizona, California, Hawaii, and Nevada (Federal Region IX). The analysis for each state was performed by a different team, located in that state. For each state, the study team was asked to:

(1) Define the resource, based on the latest available data.

(2) Assess the potential market growth for geothermal energy.

(3) Estimate the market penetration, projected to 2020.

Each of the four states of interest in this study is unique in its own way. Rather than impose the same assumptions as to growth rates, capture rates, etc. on all of the study teams, each team was asked to use the most appropriate set of assumptions for its state. The results, therefore, should reflect the currently accepted views within each state.

The four state reports comprise the main portion of this document. A brief regional overview section was prepared by the Jet Propulsion Laboratory, following completion of the state reports.

FOREWORD

The work documented by this report was performed by a team of analysts from each of the four states in Region IX. The principal contributors are listed below, as well as the agencies which provided much of the data. The work was coordinated by the Energy Systems Analysis Group, Jet Propulsion Laboratory, California Institute of Technology, for the Office of the Regional Representative, Region IX, and the San Francisco Operations Office, Department of Energy. Overall direction of the work was the responsibility of Sharon Sellars of the Department of Energy. The regional summary section was prepared by William Powell and Ken Tang of the Jet Propulsion Laboratory.

ACKNOWLEDGEMENT

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Major Sources of Information

U.S. Geological Survey

California Energy Commission

Solar Energy Research Institute

Lawrence Berkeley Laboratory

Department of Planning and Economic Development, Hawaii

New Mexico Energy Institute

Nevada Department of Energy

California Division of Mines and Geology

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SECTION I

EXECUTIVE SUMMARY

A preliminary study was made of the potential for geothermal direct heat use in Arizona, California, Hawaii, and Nevada (Federal Region IX). The analysis for each state was performed by a different team, located in that state. For each state, the study team was asked to:

(1) Define the resource, based on the latest available data.

(2) Assess the potential market growth for geothermal energy.

(3) Estimate the market penetration, projected to 2020.

Each of the four states of interest in this study is unique in its own way. Rather than impose the same assumptions as to growth rates, capture rates, etc. on all of the study teams, each team was asked to use the most appropriate set of assumptions for its state. The results, therefore, should reflect the currently accepted views within each state.

The four state reports comprise the main portion of this document. A brief regional overview section was prepared by the Jet Propulsion Laboratory, following completion of the state reports.

At DOE's direction, the document entitled Regional Hydrothermal Market Penetration Analysis - Rocky Mountain, and Basin and Range Region, by EG&G Idaho, Inc., was used as a baseline for this work.

The findings of this preliminary study are summarized below:

(1) Potentially economical hydrothermal resources exist in all four states of the Region; however, the resource database is largely incomplete, particularly for low-to-moderate temperature resources.

(2) Existing industrial and population concentrations are co-located with identified hydrothermal resources only in some cases, such as Maricopa and Pima Counties in Arizona, San Diego and Imperial Counties in California, Clark and

Washoe Counties in Nevada, and Honolulu and Hawaii Counties in Hawaii, for example.

(3) Where co-location does not occur at present, future market penetration will depend upon economic and other factors which may motivate redistribution of the existing concentrations of industry and population. If this occurs, the impact on geothermal market penetration may be very significant.

(4) In terms of beneficial heat, the total hydrothermal resource identified so far for the four states is on the order of 43 Quads, including an estimated 34 Quads of high temperature ($T > 150^{o}C$) resources which are suitable for direct as well as electrical applications.

(5) Based on assumptions which are unique to each state report, the estimated market penetration (or capture) of direct applications of geothermal energy in the Region may be on the order of 0.02 Quad in 1985, 0.19 Quad in 2000, and 0.45 Quad in 2020.*

(6) In California, Hawaii, and Nevada, the industrial market sector has somewhat greater potential for penetration than the residential/commercial sector. In Arizona, however, the situation is reversed, due to the colocation of two major metropolitan areas (Phoenix and Tucson) with potential geothermal resources.

The role of the Jet Propulsion Laboratory in this preliminary study was that of coordination and compilation. Responsibility for the projections contained in this report rests with the state study teams. It is recommended that a more comprehensive treatment be given to the method and assumptions to be used in any future regional market penetration study.

*As a point of reference, the total industrial, residential, and commercial energy use in 1975 for Arizona was 0.402 Quad.

SECTION II

INTRODUCTION

The development of domestic energy sources to decrease dependence on foreign gas and petroleum is a current American policy goal. Geothermal energy resources are an attractive alternative because they are readily available in many parts of the country, their application can efficiently replace fuel consumption, their development appears less environmentally objectionable than other energy sources, and the current state of technology is sufficient for development. As a part of its effort toward the national goal, the Division of the Geothermal Resource Manager (DGRM) of the U.S. Department of Energy has undertaken a program to stimulate commercial development of geothermal energy. This report presents an assessment of the market for direct heat (nonelectric) applications of geothermal energy in DOE Region IX, consisting of Arizona, California, Hawaii, and Nevada. This work supports the DOE commercialization program by identifiying the market sectors best suited to geothermal direct heat use and by providing a baseline for more detailed or site-specific market studies to follow.

SCOPE

The purpose of this preliminary study is to indicate the potential of geothermal direct heat applications in DOE Region IX for regional planning purposes and to provide a current assessment of resources and markets for direct heat applications. Independent teams were responsible for the analysis within each of the states. The scope of the state efforts differed somewhat because the Arizona and Nevada studies basically updated previous work published by the New Mexico Energy Institute and EG&G Idaho, while the work in Hawaii and California was more of an initial effort.

This study encompasses the following tasks:

(1) Resource Definition: Identification of resource sites suitable for geothermal direct heat applications and estimation of the beneficial heat available, where possible.

(2) Market Potential: The amount of energy used as heat rather than mechanical work which could be supplied by geothermal resources, assuming suitable resource temperatures. The consumers of this thermal energy — industries with process heat requirements and heated or cooled buildings — constitute a market where geothermal energy can be sold. The consumption of thermal energy is expected to increase with time, as with population, so the growth of the potential market is projected to the year 2020.

(3) Market Penetration: The amount of energy which will be supplied to the potential market of thermal energy consumers from the geothermal resource base. This is also projected to the year 2020. Penetration estimates are intended to reflect which energy consumers are likely to use geothermal heat in the near term, which in the long term, and which are unlikely to use geothermal heat. Penetration depends on the prices and stability of supply of competing energy sources such as fuels, and on the costs of developing geothermal systems.

The market of heat consumers is divided into two sectors — the residential/commercial sector which requires heat for space conditioning and hot water, and the industrial sector which uses process heat. The contribution of individual industries within the sector is also included. Agricultural heat use was included as a separate sector in the California study. It was originally proposed to include military reservations, with their space conditioning and water heating needs, as a sector. Data on the thermal energy consumption at military facilities was not readily available, however. For reference, military facilities which are located near prospective geothermal sites are listed in Table 2-1. The four state reports are included in the present document for ease of reference.

Table 2-1. Military Facilities Near Possible Resource Sites

Arizona	Davis-Monthan Air Force Base
	Luke Air Force Base
	Willcox Bombing Range
	Williams Air Force Base
	Yuma Proving Ground
California	China Lake Naval Weapons Center
	El Centro Naval Air Station
	Marine Corps Air Station (Imperial County)
	Fort Bidwell
	National Parachute Test Range
	Norton Air Force Base
	Twenty-nine Palms Marine Corps Base
Hawaii	Pearl Harbor facilities
Nevada	Fallon Naval Air Station
	Nellis Air Force Base
	Naval Ammunition Depot at Babbitt
	Mercury, Nevada Test Site

SECTION III

REGIONAL OVERVIEW

A. RESOURCE OVERVIEW

The latest USGS national summary (Circular 790) of hydrothermal convection systems with temperatures greater than 90°C shows a total identified resource of approximately 400 ± 60 Quads. When converted to beneficial heat,* the total would be about 92 ± 20 Quads (50 ± 7 Quads from hot water over 150°C and 42 ± 13 Quads from hot water between 90°C and 150°C). For the four states in Region IX, Table 3-1 shows a total beneficial heat of approximately 38 Quads, based on the same data source.

The results of this preliminary study are shown in Table 3-2, based on the individual state reports. The total beneficial heat is approximately 43 Quads, or 5 Quads higher than the previous table. Higher values reported for Arizona and Nevada account for the difference. A significant amount of energy from the under-90°C resources was reported for these two states, whereas no quantitative data for this temperature range was available from USGS Circular 790. As noted, the estimates for Arizona could be increased by another 5 to 6 Quads if the assumption regarding zero recharge were to be modified (see discussion in Arizona Report, Part A).

Table 3-1. Beneficial Heat* - Based on USGS Circular 790 Data (1978) (1 Quad = 10^{15} Btu)

°C	AZ	CA	HI	NV	Σ Region
T > 150	0.06	26.53	0.45	6.48	33.52
90 - 150	0.21	1.92	-	2.03	4.16
T < 90	-	-	-	-	-
Total Quads	0.27	28.45	0.45	8.51	37.68

*Beneficial heat = energy at wellhead x utilization factor (0.24) (Ref. USGS Circular 790)

Table 3-2. Beneficial Heat - Based on State Reports

°C	AZ*	CA	HI	NV	Σ Region
T > 150	0.05	26.53	0.45	6.97	34.00
90 - 150	0.49	2.11	-	3.77	6.37
T < 90	0.97	-	-	1.38	2.35
Total Quads	1.51	28.64	0.45	12.12	42.72

*Estimates for Arizona based on zero recharge. With recharge, total for Arizona could be increased to approximately 7 Quads.

Since no data was reported for under-90°C resources in California and Hawaii, and also for 90-150°C resources in Hawaii, it seems reasonable to expect that the total for Region IX could be even higher than shown, as more data become available.

Resources in the over-150°C range are usually considered only for electrical generation. However, we have included such resources in the above tabulations because they are also suitable for direct heat applications.

B. MARKET OVERVIEW

A summary of the estimated market penetration in each of the four states is given in Table 3-3 for 1985, 2000, and 2020. Market sectors consist of residential/commercial (space conditioning and water heating) and industrial (process heat). The agricultural sector was included for California only.

Within each state, a few key counties have the major share of the total estimated market capture. Table 3-4 shows the estimates for three key counties in each state. These 12 counties represent some (but not all) of the most likely areas for the commercial development of hydrothermal energy in the Region, based on the matching of resource and demand projections.

Table 3-3. Region IX Hydrothermal Forecast By State - Estimated Market Capture in Btu x 10^{12}/Year

State	1985	2000	2020
Arizona			
Resid./Comm.	16.0	104.3	253.0
Industrial	0.6	3.1	8.7
Total	16.6	107.4	261.7
California			
Resid./Comm.	1.4	18.8	34.6
Industrial	1.6	23.4	63.5
Agricultural	0.1	0.9	2.2
Total	3.1	43.1	100.3
Hawaii			
Resid./Comm.	0	5.3	19.3
Industrial	1.5	14.2	21.6
Total	1.5	19.5	40.9
Nevada			
Resid./Comm.	0.4	2.6	25.6
Industrial	1.5	18.9	25.5
Total	1.9	21.5	51.1
Regional			
Resid./Comm.	17.8	131.0	332.5
Industrial	5.3	60.5	121.5
Total	23.1	191.5	454.0

Table 3-4. Estimated Hydrothermal Market Capture In 12 Counties Of Region IX (Btu x 10^{12}/Year)

		1985		2000		2020	
State	County	R/C	Total	R/C	Total	R/C	Total
Arizona	Maricopa	8.8	9.1	[illegible]	58.9	138.4	143.7
	Pima	3.2	3.3	21.0	21.4	50.9	52.2
	Pinal	0.6	0.7	4.0	4.7	9.6	11.6
California	San Diego	0.42	0.54	11.1	16.1	19.4	39.5
	Imperial	0.08	0.54	0.61	6.5	1.36	15.7
	San Bernardino	0.07	0.44	0.52	4.6	1.02	9.7
Hawaii	Honolulu	0	0	4.2	7.8	14.8	22.9
	Hawaii	0	1.51	0.54	7.2	2.0	9.3
	Maui	0	0	0.56	4.5	1.6	5.8
Nevada	Clark	0.13	0.56	0.82	6.2	8.1	15.4
	Washoe	0.20	0.50	1.33	5.1	13.2	18.2
	Carson City	0.03	0.09	0.20	1.06	2.1	3.3

The estimates contained in Tables 3-3 and 3-4 were taken directly from the state reports. The values for Arizona shown in Table 3-4 were computed by the study team. It may be noted that the Arizona estimates for the residential/commercial (R/C) sector are considerably larger than the other states. The explanation for this is that Arizona is the only western state where two major metropolitan areas and two potential geothermal resources are contiguous. Key assumptions for Arizona include a 4 percent per year compounded growth rate for population as well as for energy use in the residential/commercial sector. Market penetration for process heat is assumed to be 30 percent of new growth, and for the residential/commercial market, 20 percent of new growth. Excluded from the industrial energy demand are the mining industry's process energy requirements and industrial demand for space conditioning.

Potential agricultural and aquacultural applications were also omitted. It was assumed that space cooling is feasible with moderate temperature geothermal heat. Retrofit of existing industrial facilities for process heat was assumed to occur at a rate of one percent per year beginning in 1980, not to exceed 25 percent of the 1980 market. For the space conditioning market, retrofit was assumed to occur at a rate of one percent per year beginning in 1983, not to exceed 25 percent of the 1983 market.

In contrast to Arizona, the industrial sectors in the other three states generally exceed the residential/commercial sectors in terms of the total estimated market capture, as is shown in Table 3-3. Some of the more important assumptions made for the other states are highlighted below.

1. California - Residential/Commercial Sector

Three major factors affect the rate and timing of market penetration within the residential and commercial sectors:

(1) Temperature of resource.

(2) Dependency on LPG.

(3) Density of the population.

The temperature of a resource within a county was used as proxy for estimating the start of commercialization. That is, if a county has any high- or medium-temperature (i.e., greater than 90°C), penetration was assumed to begin in 1980 because this date reflects existing exploration, development, and production activities that are normally associated with these resources and that can effect a higher probability of early commercialization. If a county has low-temperature resources (i.e., less than 90°C) only, commercialization and penetration were assumed not to begin until 1985.

One quarter of the counties with geothermal-resource potential have no natural gas service and must depend on LPG. If the residential and commercial establishments within a county depend on LPG, it was assumed that geothermal energy would not replace these existing energy sources because the use of LPG implies population density insufficient to support an economic steam-distribution system. Consequently, geothermal energy will probably not be competitive in the residential/commercial sector in these counties.

The density of population in a county was used to determine the near-term possibilities for district heating and the speed which knowledge, acceptance, and use of the geothermal energy would occur.* It was assumed that counties having high population densities will experience a development phase lasting 5 years and a rapid-growth phase lasting 10 years. Contrastingly, counties having low-population densities will experience a development phase lasting 8 years and a rapid-growth period lasting 15 years. The remaining years until 2020 will be in the mature-growth phase. Annual penetration rates were the same for all counties: one percent per year for the development phase, two percent per year for the rapid-growth phase, and one percent per year for the remaining period.**

2. California - Industrial Sector

Penetration of the industrial sector was assumed to begin in either 1980 or 1985, depending on the temperature characteristics of the resources in a county. The development phase for industry was assumed to be 8 years, a duration of time reflecting the concerns of industry executives about the technical and economic feasibility of using geothermal energy. For example, uncertainties over the purity and reliability of the fluid will need to be clarified.

The annual penetration rates during this time period was assumed to be two percent. Annual penetration rates during an estimated 15-year rapid-growth phase will be 4 percent, an assumption which reflects

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* Average population density of the 20 counties (i.e., 54.4 people per square mile) was used as the determining factor.

**In forecasting demand, major gas and electric utilities use one percent per year as the average projected growth in housing stock during the 1976-1998 time period.

estimates of the percentage of annual turnover of capital equipment used for fuel-burning equipment and of the percentage of retrofit applications. Penetration during the mature-growth phase will be two percent per year.

3. Nevada - Residential/Commercial Sector

To obtain the estimates of the amount of energy captured by geothermal development in the various communities, a "Capture Fraction" was used. The numerical values assigned to these fractions were developed logicallly, but not without a considerable amount of considered judgement applied to insure reasonable results. The fractions used are shown in Table 3-5.

To develop these fractions, optimistic but realistic values for 1985 were estimated. The 1985 fractions where then used to compute the fractions for 2000 and 2020 by assuming 10 percent annual growth in the capture rates through 2020.

The capture fractions were used as multipliers to convert the estimates of potential geothermal space and water heating (Table III of the Nevada Report) into estimates of expected geothermal energy use.

Table 3-5. Capture Fractions (%) For Nevada

Geothermal Potential	1975[a]	1985	2000	2020
Nil	0	0	0	0
Low	0	0.50	2.09	14.05
Moderate	0	1.00	4.18	28.10
High	0	1.50	6.27	42.43

[a] In 1975, very little geothermal energy was utilized outside of the Truckee Meadows (Reno/Sparks) which had a captive fraction of approximately 1/8 of 1 percent (for Reno).

A subjective judgement was made to determine which communities could expect high, moderate, low or negligible geothermal development. The factors considered in arriving at this determination include: the temperature, size and depth to resource and proximity to the resource. Thus, a city such as Reno received a high rating because of its proximity to a hot, large, shallow geothermal resource (Steamboat-Huffaker and Moana). A town such as Searchlight in southern Nevada, which is 14 kilometers from a well with 31°C water, was assigned a negligible (Zero) captive fraction.

Table VIII of the Nevada Report lists the estimated geothermal penetration of the residential and commercial sectors for the counties and communities.

4. Nevada - Industrial Sector

Residential and commercial growth are projected to be largely in existing communities. On the other hand, industrial growth will be in communities where existing (1975) industry is located, and secondly, where significant savings can be realized right at a geothermal resource site.

The basic assumptions for the estimates of the industrial market penetration analysis are:

- The bulk of the new high energy-use industry, between 1985 and 2020, will be attracted by, and locate in close proximity to, high and intermediate temperature geothermal resources.
- Light industry will continue to locate near population centers, but will favor those communities offering geothermal energy.

Specifically, it was assumed for this study that:

(1) Geothermal energy use penetration was nil in 1975 for all counties, but statewide it is projected to be:

Year	Percentage Penetration	10^{12} Btu
1985	5%	1.533
2000	20%	18.857
2020	50%	25.517

(2) Fifty percent of the geothermal capture is assumed to be in the cities and larger communities presently existing, regardless of geothermal use potential. Estimated capture by county is assumed to be in proportion to population.

(3) Fifty percent of the geothermal capture is assumed to be in those counties where the geothermal resources presently exhibit the greatest potential. The geothermal resource potential is based on the weighted potential of the high, intermediate and low temperature resources in each county.

5. Hawaii - Industrial Sector

Potential market growth was derived through a combination of forecasting projection based on the state of Hawaii's Department of Planning and Economic Development projections for energy demands, population, and tourism and industry surveys.

Industrial growth rates were developed for each of the SIC categories from company interviews, industry projections, and state projections. Growth projections were made on an annual compounded rate for the periods 1985-2000 and 2000-2020. These figures were not adjusted for efficiencies that might occur due to rapidly rising energy costs.

The sugar factories were not expected to show growth Foreign competition has depressed the price of sugar and many companies are looking for alternative uses of the land. Historical data indicates that the industry is consolidating and that a number of smaller inefficient factories have been shut down. Countering these trends is the increasing value of sugar by-products such as electricity generation.

The other two large energy SIC categories, refinery and cement, were given growth rates based on company projections. Food processors and agriculture processors, other than sugar, were given growth rates equal to population projections. In construction related industries, growth rates were based on projected construction activity in the housing and tourism industries.

The potential geothermal market growth was projected to be lower than the general growth for industry. This reflects the no-growth trend of the sugar factories' energy consumption. Where the sugar factories were subtracted out of the data, the potential geothermal growth rate is higher than the growth rate for industry in general. This can be expected as new industries locate near geothermal resources. It was assumed that in-place industries would not relocate to geothermal resources. Also assumed was a continuation of Hawaii's pattern of attracting smaller scale industrial processes rather than large manufacturers.

It should be noted that if the State is successful in attracting an energy intensive process such as manganese nodules or aluminum refinery that the industrial energy growth rates and geothermal growth rates would change dramatically. For example, a three product manganese nodule plant requires 150 MW capacity and a four product plant or aluminum refinery requires a 300 MW capability. However, as previously stated, it was assumed that these industries would not locate in Hawaii for a number of non-energy reasons.

The market capture potential estimates were developed on a county basis. Present plans indicate that the earliest possible direct application of geothermal to be 1983. All co-located sugar plants are projected to convert to geothermal by year 2000. Other major retrofit applications were projected to start in 1985 in Honolulu at the Campbell Industrial Park. By the year 2000, a 20 percent retrofit is estimated. All other retrofit is projected at a rate of 1 percent per year until the year 2020. Kauai County's retrofit is not projected to start until year 2000, because of the current size of its population and commercial/industrial base. However, for Hawaii, Honolulu, and Maui, geothermal is projected to capture 50 percent of new growth beginning in the year 1985 and starting in 2000 for Kauai. These rates were assumed constant through year 2020.

6. Hawaii - Residential/Commercial Sector

Growth rates for R/C were based on energy use projections by the State Department of Planning and Economic Development based on per capita consumption, population growth, and tourism growth. Over time, these rates decline. Population growth for the State declines from a high of 1.87 average annual percentage growth in the 1977 to 1980 period to a low of 1.05 percent in the 2000 to 2005 period. This growth rate was assumed to continue through year 2020. These forecasts assume a middle fertility level of 2.1 births per woman. The State's economy, growth rate, and commercial activity is very dependent on the tourism industry. State projections for tourism growth starting at 7 percent per annum in the 1977 to 1979 time frame and declining to 1 percent in the 1996 to 2000 period.

The State's projections assume a constant growth rate of 4 percent for electricity generation. This rate includes a growth in per capita energy consumption. The projections also assumed a continuing dependence on petroleum products and did not consider the importance of alternative energy sources.

New discovery factors were not applied to potential geothermal growth since all major population, commercial, and industrial areas of the State are located within potential geothermal market areas. Several sugar factories are not in these areas and new discoveries within this area (which cannot be predicted at this time) would increase the potential growth.

Potential capture for R/C was based on an assumed 1 percent per year retrofit rate for all counties beginning in 1990 for Hawaii, Honolulu, and Maui, and 2005 for Kauai. Starting in 1985, step increases for new growth in Hawaii, Honolulu, and Maui were estimated to a maximum of 30 percent of the new growth by 2000, Kauai's capture of new growth is assumed to start in 2000 up to a maximum of 30 percent by 2015.

C. PREVIOUS WORK

This section describes previous geothermal resource and market assessment studies. Included are studies which have influenced the current effort or which address related topics. The section is organized into the following subsections: Regional Market Assessment, Resource Assessment, and Direct Heat Applications and Development.

No attempt has been made to present a comprehensive bibliography. Studies of geothermal energy have been undertaken by Federal, State, local, and private entities, but the resulting information is often not widely distributed nor easily available. Undoubtedly, reports and research projects related to the work at hand have not been included; however, a thorough search of the available information was beyond the scope of this project.

1. Regional Market Assessment

Two studies have estimated the geothermal resource and market potential for multi-state regions which include two DOE Region IX states: Arizona and Nevada. An overview of the market potential in a 10 state region was prepared by EG&G Idaho, Inc. and the Earth Science Laboratory of the University of Utah Research Institute (UURI). More detailed market and resource assessments for parts of the region have been produced from the continuing Regional Geothermal Operations Research Program of the New Mexico Energy Institute (NMEI) of the New Mexico State University. The EG&G Idaho/UURI work served as a starting point and a pattern for the present effort.

The EG&G/UURI report, titled Rocky Mountain, Basin and Range Regional Hydrothermal Market Penetration Analysis, included both electric and direct heat applications but treated each distinctly. Two heat-consuming sectors were considered: the residential/commercial sector with heat used primarily for space conditioning and water heating, and the industrial sector, with requirements for process heat. The growth in heat consumption by these two sectors was projected to the year 2020. Finally, the quantity of heat expected to be supplied by commercial geothermal development was computed for the period from the present to 2020, based on several regional assumptions.

Some of the assumptions and methods used in the R.M.B.R. Analysis are worth mention here because they profoundly affect the results of that study. Information was presented at the county level of detail, but the R.M.B.R. report did not consider individual sites and markets; colocation was assumed in any county having both resources and heat consumers. State directories of manufacturers were cited as the source for identifying heat-consuming industries, but such directories are often far from complete. Energy use by heat consuming industries was computed from a set of coefficients derived by Rocket Research, Inc. These coefficients, however, were developed from studies of facilities in the Northwest, and may not accurately reflect energy use by industries in Southwestern states Arizona and Nevada. The market projections for both consumer sectors include a 3 percent annual increase in energy consumption by each consumer, and the market growth in the industrial sector includes an increase of 5 percent of the market per year which is assumed to represent growth stimulation due to geothermal development. A single set of assumptions was used to estimate market penetration by geothermal energy, so differences in the availability of various energy sources within each state were not considered.

The assumptions used in the R.M.B.R. Analysis are described here for reference. A maximum of 25 percent of the initial market was assumed to retrofit to geothermal energy at a rate of 1 percent per year for a period of 25 years. A constant fraction (80 percent for industrial, 70 percent for residential and commercial) of new facilities constructed after 1985 is assumed to use geothermal heat. These fractions are assumed to increase from zero linearly with time during the period 1980 to 1985.

The Regional Geothermal Operations Research Program of the New Mexico Energy Institute is an ongoing effort of several years duration.

The NMEI work is therefore somewhat more refined and thorough than the EG&G Idaho/UURI report. The program includes technical, economic, legal, and institutional analysis of geothermal development. The NMEI maintains a database with resource sites and characteristics, population centers, industries, fuel prices and growth rates, and the NMEI has developed computer algorithms for estimating the internal rate of return of geothermal developments, identifying colocated resources and population centers, and projecting future market size. For an overview of the organization and scope of the program, see the Final Technical Report of the Regional Operations Research Program (January 1979).

The resource database is described in a report by Patrick O'Dea and others (February 1979, NMEI 10-3), listing sites, locations, and reservoir volumes and temperatures. The information in this report is not as current as that in USGS Circular 790 (described in the next section). An NMEI presentation on geothermal energy (May 1979, NMEI 10-4) includes estimates of beneficial heat available at temperatures greater than 60°C for counties in the region. For Arizona, the estimate is 5.23 Quad and for Nevada, 46.50 Quad.

The population center database is described in a report by O'Dea and others (May 1979, NMEI 10-5), listing towns, locations, populations, and space heating requirements. Colocated resource sites and towns in the region, and the energy used for space heating in those towns are listed in a report by R.A. Cunniff and others (June 1979, NMEI 10-6). Detailed energy consumption and population growth projections are within the capabilities of the existing NMEI system, but were not available at the time of this writing.[1]

A study by W.V. Toth and F.C. Paddison, of the Johns Hopkins University Applied Physics Laboratory, estimates the market potential for geothermal direct heat in parts of several Atlantic Coast States. A significant result of this study is the identification of military facilities as a major market for direct heat applications. This might also be the case in DOE Region IX because of the large number of military reservations in the region.

[1] Space cooling requirements are not included in the NMEI database, however.

2. Resource Assessment

The best overall assessment of geothermal resources in the region is U.S. Geological Survey Circular 790, Assessment of Geothermal Resources of the United States -- 1978. This circular completely documents the USGS methods and assumptions for estimating reservoir volumes and the beneficial heat which could actually be used in direct applications. With exceptions as noted, the USGS method has generally been followed by the present work.

Circular 790 tabulates information on specific resource sites in the western U.S. For reservoirs with temperatures higher than 90°C, reservoir volumes are estimated and the available thermal energy is computed. Excluding resources within National Parks, the beneficial heat from resources with temperatures higher than 90°C is shown in Table 3-1. A list of sites with potential for resources with temperatures below 90°C is included, but no estimates of volume and beneficial heat are made.

The status of resource definition in Region IX is outlined below. The four states form a fairly diverse region, both in the nature of the resource base and in the level of assessment work undertaken.

a. Arizona. Most of the resource in Arizona appears to be low temperature. A preliminary identification of favorable prospects based on chemical geothermometry was reported by Swanberg and others (1977, NMEI 6-1). This information and other data were collected and compiled into a preliminary map of Arizona's geothermal prospects by W.R. Hahman, Sr., and others (1978) for planning purposes. The Geothermal Group of the Arizona Bureau of Geology and Mineral Tecynology is currently engaged in an exploration program to locate and characterize the geothermal resources of the state (e.g., W.R. Hahman, Sr., March 1979). To date, this work has concentrated in southern Arizona.

b. California. California is rich in hydrothermal resources and commercial exploration and development activities have been extensive. However, this activity has stressed electricity generation, and the sites suitable for it. These sites are well described in USCS

Circular 790. Many low temperature sites have been identified, but little exploration to define their nature or extent has occurred so far.

c. Hawaii. The geothermal resource base of the state of Hawaii is somewhat mysterious. The big island of Hawaii, notable for its active volcanism, has been the subject of some geophysical exploration by the University of Hawaii (J. W. Shupe and others, 1975) and is the location of the high temperature Puna geothermal test well. A more recent University of Hawaii appraisal study indicated sites with favorable indications of undiscovered geothermal resources, but exploration and resource assessment have been limited.

d. Nevada. The situation in Nevada is much like that in California. Resources are widespread, and commercial exploration has concentrated on high temperature resources suited to power generation.

3. Direct Heat Applications and Development

One source of information on potential applications of geothermal direct heat worth special mention is the rapidly growing literature on solar thermal energy. Applications for heated fluids are the same whether the initial source of heat is solar or geothermal. The EG&G Idaho/UURI regional market study cited a solar thermal study by Intertechnology Corp. as the source of data on industrial process heat. For the California section of the present report, information on agricultural process heat was obtained from a solar thermal study of California (JPL, 1978).

Site-specific studies of geothermal direct heat applications in Region IX are described below. Some applications which have been widely examined throughout the nation are as follows: district space heating or cooling, greenhouse heating, crop or lumber drying, livestock pen heating and livestock processing, dairy operations, aquaculture (fish farming), solution mining, and generator or boiler preheating.

a. Arizona. Virtually all the applications listed above have been included in scenarios for Arizona development (Arizona Solar

Energy Research Commission, January 1979). Space cooling is a particularly large energy consuming activity in southern Arizona, and could be a large user of geothermal heat if sufficient moderate-temperature resources are available. Williams Air Force Base, located in an area with indications of moderate temperature waters, might economically use up to 10^{11} Btu/year of geothermal heat for space cooling (Gertsch and others, June 1979). Copper mining by leaching is also a large potential market for geothermal heat. Existing mines in Pima County could use 0.05 quad/year of low temperature resources (Arizona Solar Energy Commission, June 1979) and copper deposits elsewhere in the state could also be amenable to this application.

b. California. Potential applications studied include a sugar plant in the Imperial Valley and meat processing or greenhouse operations in Susanville. Potential low temperature applications, such as aquaculture, car washes, district heating, greenhouse heating, etc. were analyzed for Desert Hot Springs by Christiansen (1978).

c. Hawaii. A study by Science Applications, Inc. (January 1979) indicates that the largest potential users of geothermal heat in Hawaii are existing sugar mills and aquaculture farms. Amfac, Inc. has studied the possibility of using geothermal steam at its sugar mill and generator in the Puna area.

d. Nevada. There are two existing manufacturers using geothermal process heat. Mendive (1976) mentions an explosives plant in Washoe County, and a food dehydration plant was recently built in Church County.

D. DIRECT HEAT APPLICATIONS

Direct heat applications employ the geothermal fluid as a source of useful heat rather than for conversion to electrical or mechanical work. Such uses include space heating, space cooling, water heating, and various industrial and agricultural processes. Development of resources for geothermal direct heat has not occurred to any significant extent in the United States. Aside from natural spas and hot mineral baths, the only direct heat geothermal developments in DOE Region IX are spaceheating in Nevada, greenhouse heat in Nevada and northern California, an explosives manufacturer in Nevada, and a food processing plant in Nevada which was constructed recently with financing through the Geothermal Loan Guarantee Program. Although most commercial interest in geothermal energy has been directed toward the generation of electricity, an analysis by E.F. Wahl (1977, pp. 247-8, 278-93) indicates that direct heat applications are the most thermodynamically and economically efficient use of geothermal fluids and that even the waste heat from a geothermal power plant can be a valuable resource.

Exploration efforts to date have emphasized the geothermal resources suited to power generation. Unfortunately, since power generation requires fluid temperatures higher than 150°C, suitable resources are rare and often occur in geologically unique settings (e.g., the Geysers, CA, or the Puna area, HI). Depending upon the specific application, temperature requirements for direct heat are more flexible. Very high temperature resources can be used for process steam or absorption chilling, but some heating applications can use fluids with temperatures just a few degrees above the ambient air temperature. Lower temperature resources are believed to be more widely distributed than high temperature resources; low enthalpy geothermal systems may represent a substantial energy resource.

Two major factors determine whether a heat consumer has potential for geothermal direct heat application: temperature and location of resource. Many processes require that heat be supplied at a specific temperature; to be applicable to such a process, a geothermal resource must generally produce a higher temperature. Transmission of geothermal fluids over long distances is technically feasible, but is economically possible only when the energy use is quite high.* It is unlikely that a market exists for geothermal energy large enough to merit long-distance

*The Reykjavik Municipal District Heating System currently incorporates a 16 km pipeline carrying fluid at 86°C. However, the energy consumed and the duty cycle of the system are both high because spaceheating in Iceland occurs year round.

transmission, so colocation of users and resources will be a primary constraint on development in the near term. The decision by a heat consumer to actually use geothermal energy will be based on economic considerations - the costs of special equipment or a plant relocation to use a geothermal resource, and the perceived reliability of the geothermal energy supply, will be compared with the costs and perceived reliability of other energy sources.

Given a market for heat and a technically and economically suitable resource, the two must be connected by a developer who installs the wells and pipeworks. In the parlance of microeconomics, the developer is a producer, using land, labor, and capital to produce an output (in this case, heated fluid). The producer may take several forms: a private firm may lease land and sell fluid to consumers in a competitive market, as at the Geysers; a government or utility may produce the fluid to sell in a competitive or a captive market, as in Reykjavik, Iceland; or the producer and consumer may be within a single firm - for example, a factory may use its own on-site geothermal wells. In any form, the producer must choose whether or not to invest in the production of geothermal fluid. The decision will be based upon a comparison of the capital costs and expected return of a geothermal development with those of other investment opportunities, and upon the producer's perceptions of resource reliability and the market for his product.

The consumer's or developer's cost and risk are the factors to be manipulated in the DGRM program to stimulate commercial geothermal development. The costs incurred by a firm undertaking geothermal development can be reduced by tax incentives or credits and by direct aid such as the Geothermal Loan Guarantee Program or shared-cost development. The developer's risk can be reduced by increasing knowledge of the resource characteristics and by identifying the potential consumers of geothermal fluids. Owing to variations in the characteristics of different reservoirs and the dependence on reservoir characteristics of the cost and risk of development, only very detailed, site-specific resource and market studies can significantly affect a geothermal investment decision by a developer. The degree of detail necessary for a specific development decision lies beyond the scope of this regional study, but this study may help to highlight areas which deserve further scrutiny.

SECTION IV

RECOMMENDATIONS

Based on the results of this preliminary effort, the following recommendations are offered for consideration:

(1) Resource definition work, particularly in the moderate to low temperature resource areas of the Region, needs to be expanded. As shown by the Arizona and Nevada data on hydrothermal resources below 90°C, significant amounts of beneficial heat may be expected to exist at the lower, but still useful, temperatures. Such resources would be particularly valuable if they are found in proximity to existing concentrations of population or industries.

(2) The use of geothermal fluids with temperatures above 150°C for applications other than pure electrical generation should be encouraged. Future studies should focus on the feasibility of combined electric/nonelectric, as well as all nonelectric, utilization of high temperature resources where appropriate. Over 75 percent of the available beneficial heat in identified resources in the Region is in the 150°C or higher range.

(3) Further work is clearly needed in the market penetration analysis area. The lack of time and resources in this effort made it necessary for the four state study groups to resort to many simplifying assumptions. The net result was a lack of consistency in the various penetration analyses. It is recommended that a more comprehensive treatment be given to the method and assumptions to be used in any future regional market penetration study.

(4) Several market areas were not analyzed in this preliminary study. These include the copper mining industry and industrial space conditioning in Arizona, the high temperature resource applications in California, the potential aluminum and manganese industries in Hawaii, and agriculture/aquaculture in all the states except California. These and other market segments such as military reservations should be examined in future studies in Region IX.

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STATE REPORTS

ARIZONA REPORT - PART A

PROVEN, POTENTIAL AND INFERRED GEOTHERMAL RESOURCES OF ARIZONA AND THEIR HEAT CONTENTS

J. C. Witcher

September, 1979

BUREAU OF GEOLOGY AND MINERAL TECHNOLOGY
GEOLOGICAL SURVEY BRANCH
GEOTHERMAL GROUP

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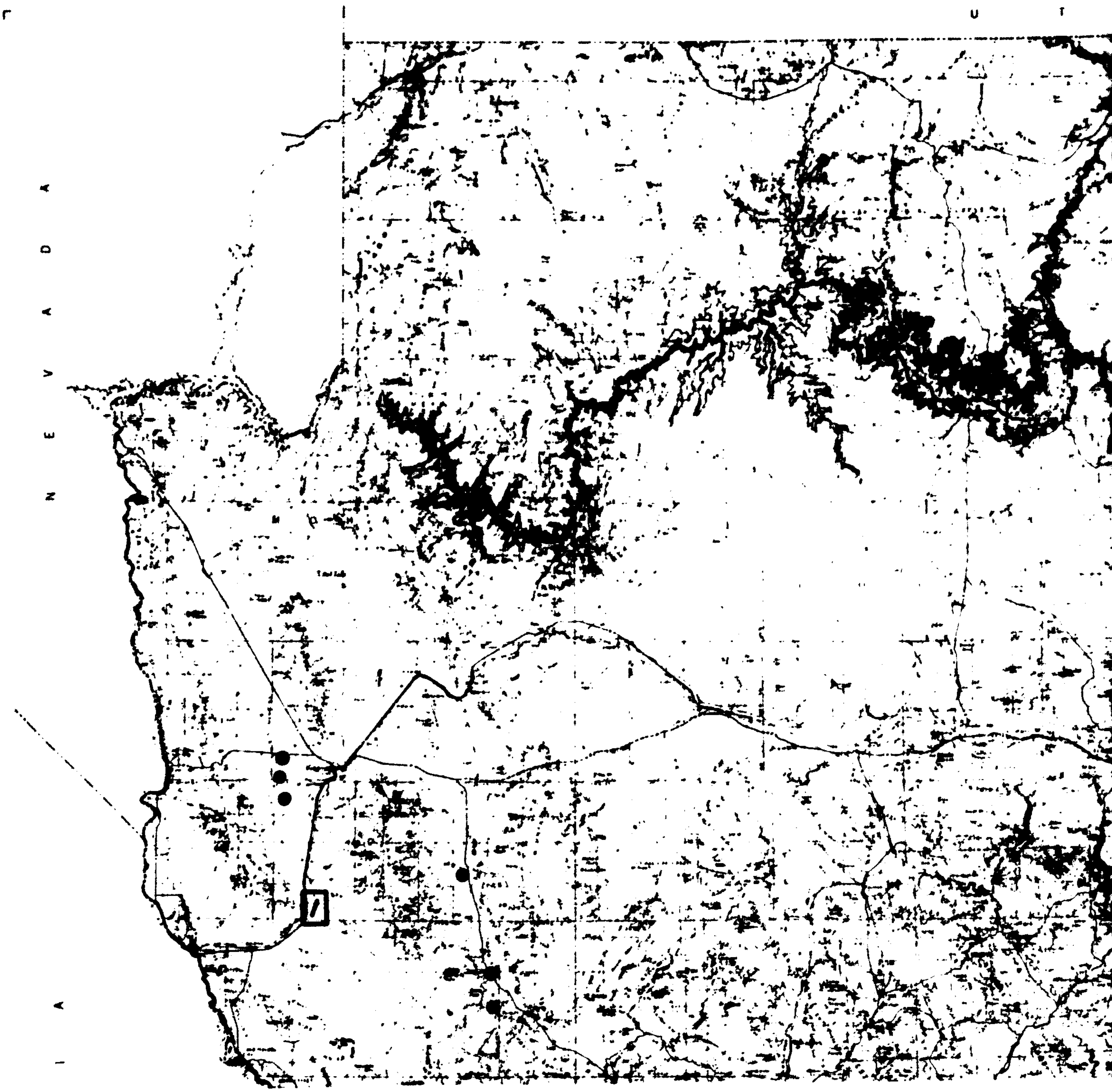

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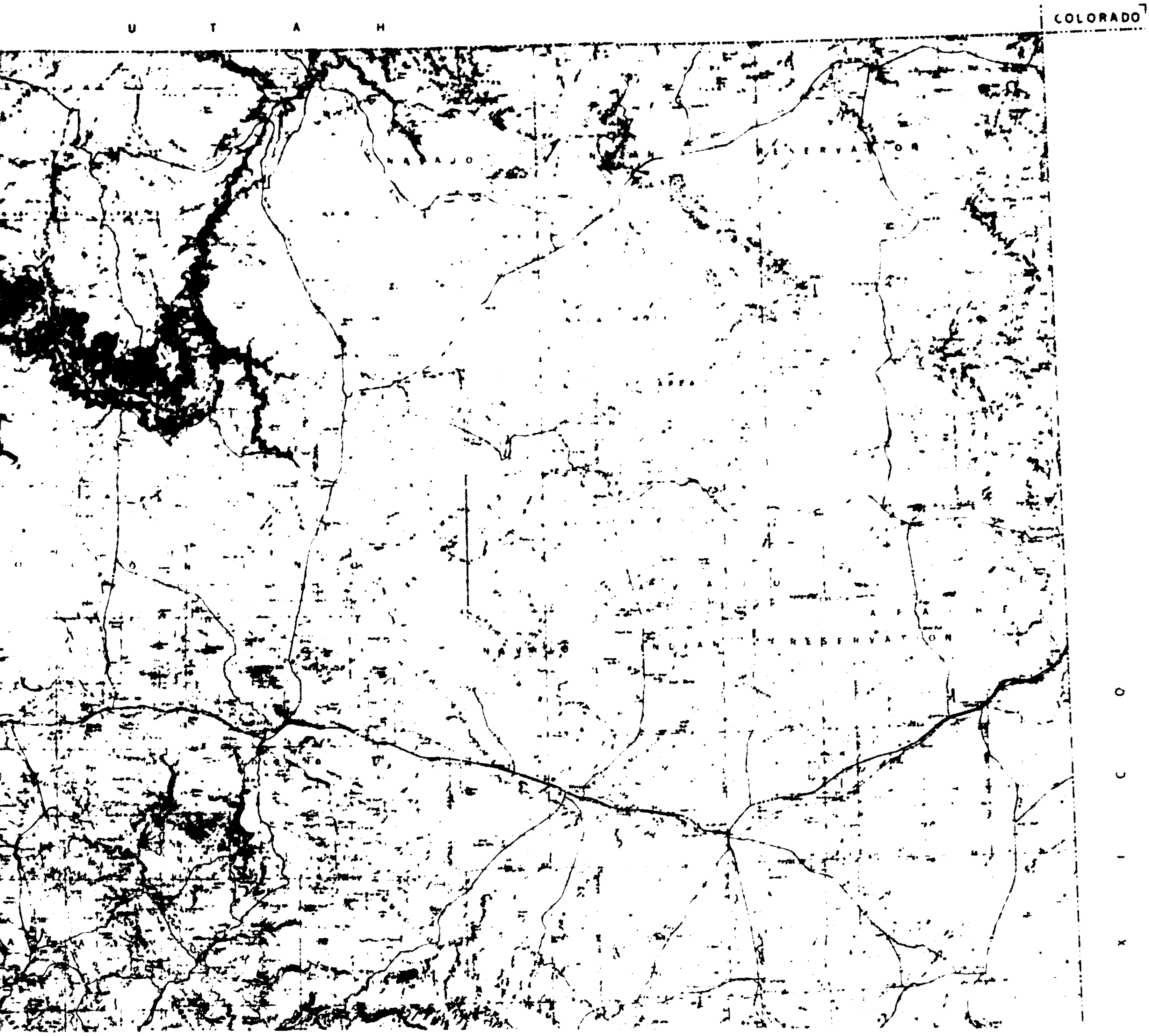

Map of Proven and Potential Low Temperature (<90°C) Geothermal Resources of Arizona - Northern Portion

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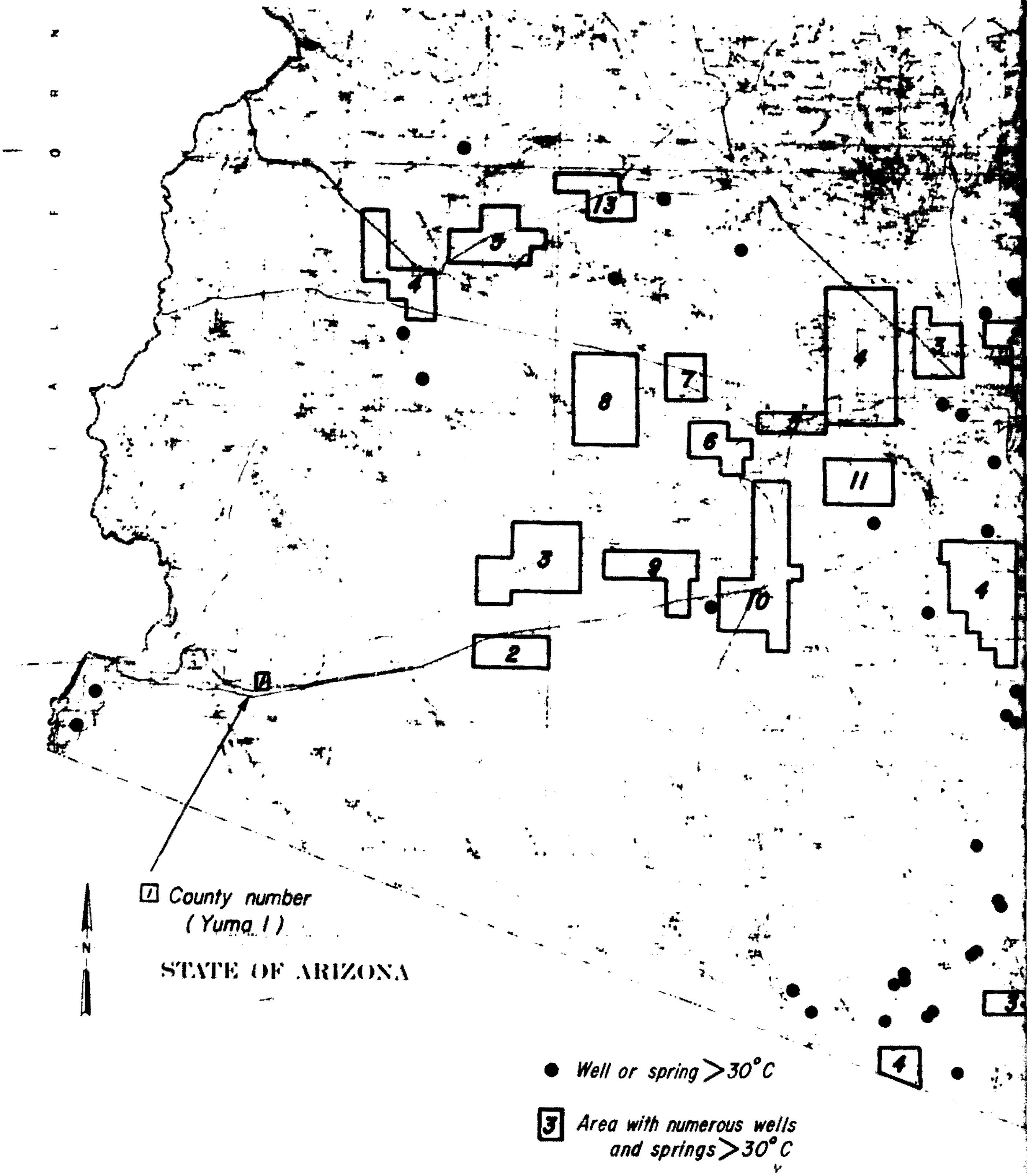

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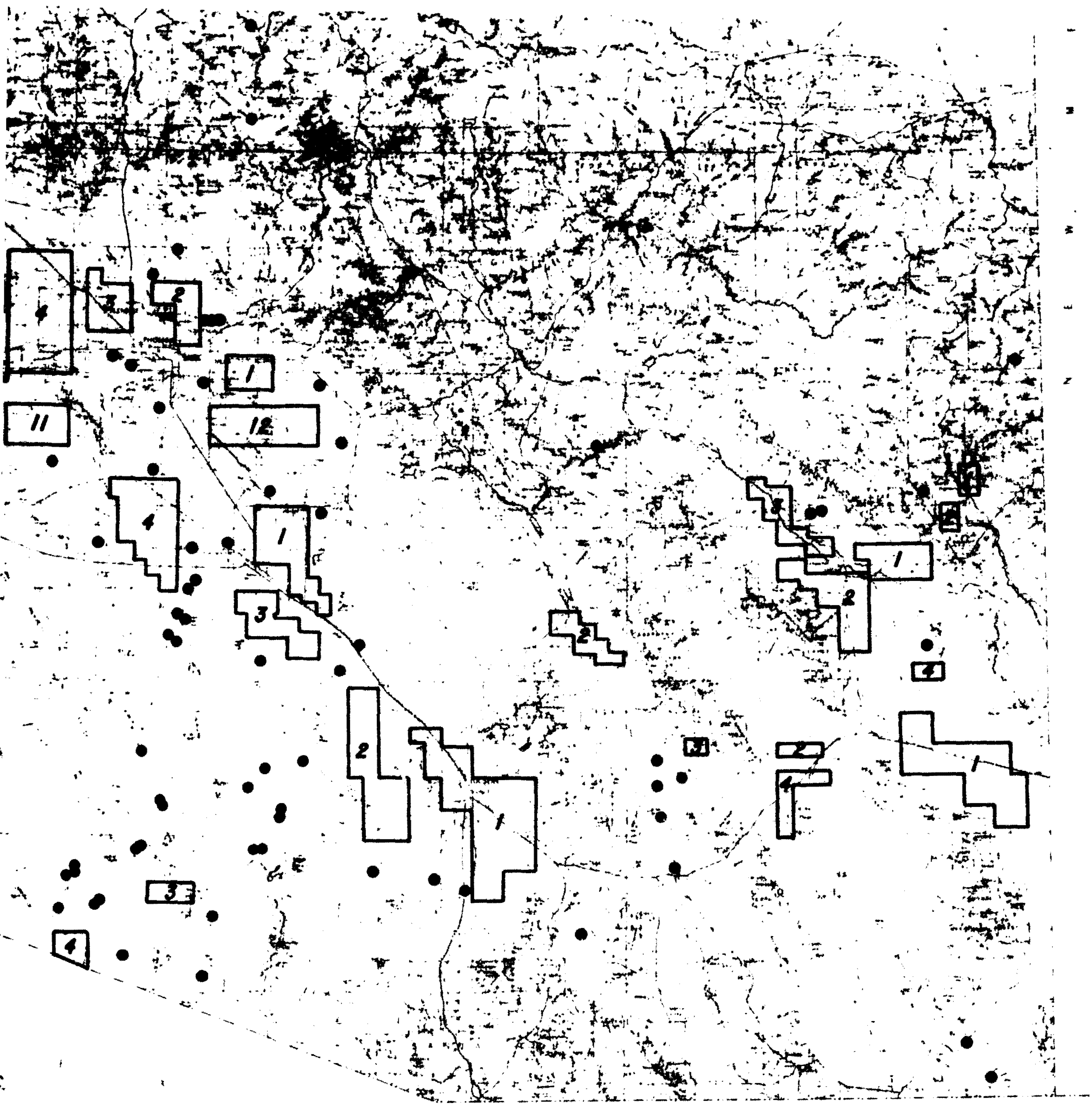

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Map of Proven and Potential Low Temperature (<90°C) Geothermal Resources of Arizona - Southern Portion

Proven and potential geothermal resources are shown by the outlined areas on the 1:1,000,000 map of Arizona. The areas are numbered by county. They outline known hot wells and springs and appropriate geologic setting. Approximately 85% to 90% of the known geothermal occurrences are listed in the computer printout. All of the areas except Greenlee 1 occur in sediment-filled basins. Isolated single occurrences of hot water (>30^{o}C) are shown on the map as dots.

The definitions of proved, potential and inferred geothermal resources are:

Proven sites are (1) those which are in an advanced stage of development or commercialization by a private company or by government for specific applications, or demonstrations, or (2) those which possess favorable quantitative data on the measured subsurface temperatures, volume and water flows.

Potential sites are (1) those sites on which there is exploration/development activity, or (2) sites possessing some favorable quantitative subsurface data which has been estimated or measured.

Inferred sites or areas are those identified by (1) surface manifestations, such as wells or springs, (2) chemical thermometry, or (3) proximity to potential or proven sites.

The low temperature resources (<$90^{\circ}C$) are assessed for depths less than 4,000 feet (1.2 km). Table (1) contains pertinent information on the low temperature geothermal resources. Drill hole data and gravity data show that most sediment-filled structural basins in southern Arizona are filled with from 2,000 feet (0.6 km) to 4,000 feet (1.2 km) of clastic sediment and/or volcanics. Therefore, the geothermal reservoirs in all areas are asumed to be in clastic sediment and/or volcanics with an average specific yield or storage coefficient of 5%. This is a conservative figure when compared with data presented by Rantz, S. E., and Eakin, T. E., 1971, on p. 76. The data Table is reproduced below:

Material	Specific yield (percent)
Gravel, sand and gravel and related coarse gravelly deposits	25
Sand, medium- to coarse-grained, loose, well-sorted	25
Fine sand, tight sand, tight gravel and related deposits	10
Silt, gravelly clay, sandy clay, sandstone, conglomerate and related deposits	5
Clay and related very fine-grained deposits	3
Crystalline bedrock (fresh)	0

The specific yield or storage coefficient is defined as the percent volume of water to total volume of reservoir that would be obtained if the reservoir were pumped dry without recharge. In all cases, the reservoirs are assumed to be 1,000 feet (.3 km) thick at depths of 2,500 feet (.75 km) to 4,000 feet (1.2 km). Average reservoir temperatures are estimated by chalcedony geothermometers unless otherwise stated. The chalcedony geothermometer appears to be the best for most low temperature reservoirs (<90°C) (Arnorsson, S., 1975). Chalcedony-predicted temperatures in Arizona basins agree very well with temperatures predicted for the assumed reservoir depths using the average temperature gradient. The average temperature gradient of Arizona basins is about 40°C/km. This is a normal gradient in an area with high heat flow (80 m Wm^{-2}) and low heat conductive rocks.

The heat content of the reservoirs is calculated using the following formula:

$$\left[(1-\sigma)\ (Hsr)\rho + (\sigma)\ (Hsw)\right]\gamma \quad V\ (Tr-Tmat) = Qr$$
$$\left[(.85)\ (Hst)\rho + (.15)\ (Hsw)\right]\gamma \quad V\ (Tr-Tmat) = Qr$$
$$\left[(.85)\ (.20)\ (2.69) + (.15)\ (1)\right]\ .05\ V\ (Tr-Tmat) = Qr$$
$$.03\ V\ (Tr-Tmat) = Qr$$

σ = Porosity–.15 (15%)

Hsr = Average specific heat of rock–.20 cal/gm°C

ρ = Average density of rock–2.69 gm/cm^3

Hsw = Specific heat of water–1 cal/cm^3 °C

γ = Average specific yield or storage coefficient–.05 (5%)

V = Volume of geothermal reservoir–$cm^3 \times 10^{15}$

Tr = Average temperature of reservoir–°C

Tmat = Mean annual temperature at the surface–17-21°C

Qr = Extractable heat energy from geothermal reservoir calories–$\times 10^{15}$

The method is similar to the one used in U.S.G.S. Circular 790 except that in these calculations no recharge is assumed. This is because Arizona has an arid climate. Since the heat is transported to the surface by water, it is necessary to calculate the water volume which can be obtained from the reservoir. Therefore, the storage coefficient or specific yield is used in the calculation. These calculations quantify minimum extractable heat contents. Artificial recharge through reinjection may be necessary to prevent subsidence. Also, natural recharge from cooler overlying aquifers is possible; consequently, additional parameters, although not considered in these calculations, may be added to account for the resulting increase in extractable heat.

Table 2 is a list of areas showing inferred intermediate to high temperature (>90^{o}C) reservoirs in Arizona. Wells have not been drilled in these areas. The temperatures, permeability and reservoir size are not known with a great degree of accuracy. In many cases, the subsurface temperatures are the best known quantity. Most of the data on these areas are based on geothermometry, adjacent deep well tests or on geologic structure as determined by geophysical methods like gravity surveys and available heat flow or temperature gradient data. Until more is known of these areas, the reservoir volumes are assumed to be 2.5 km^3. The U. S. Geological Survey WATSTORE water quality file provided a large portion of the data used in this assessment.

Table 1 PROVEN AND POTENTIAL GEOTHERMAL RESERVOIRS LESS THAN 1.2 km DEPTH

County/Area	Area km^2	Location	Volume km^3	Measured °C Temperature	Depth (Feet)	TDS (Mg/l)	Tr °C	Tr-Tmat °C	Calories x 10^{15} Qr
Greenlee 1	61.9	T4S, R30E	18.6	30 - 67	Surface	>8000	80	62	34.59
Greenlee 2	61.9	T5S, R30E	18.6	30 - 83	Surface	<500	80	62	34.59
Graham 1	206.4	T6-7S, R26-28E	61.9	30 - 50	<1000	<1500	75	57	105.85
Graham 2	371.5	T7-9S, R24-26E	111.5	30 - 45	<2000	<5000	70	52	173.94
Graham 3	237.4	T4-6S, R23-25E	71.2	30 - 60	<3500	<1000	60	42	89.71
Graham 4	61.9	T10S, R28-29E	61.9	30 - 40	<2000	<1000	60	42	77.99
Cochise 1	681.1	T12-15S, R28-31E	204.3	30 - 40	<1000	<500	60	42	257.42
Cochise 2	51.6	T13, R24-25E	15.5	30 - 50	<2500	<1500	60	43	19.99
Cochise 3	41.6	T12-13S, R21E	12.4	30 - 50	Surface	<500	60	44	16.37
Cochise 4	268.3	T14-15S, R24-25E	80.5	30 - 40	<1000	<1500	70	53	127.99
Pima 1	959.8	T12-17S, R12-15E	287.9	30 - 50	<2500	<1000	60	41	354.11
Pima 2	526.3	T12-15S, R10-11E	157.9	30 - 45	<2000	<1000	60	41	194.22
Pima 3	103.2	T17S, R3-5E	30.9	35 - 40	<700	<500	55	35	32.45
Pima 4	134.2	T19-20S, R31E	40.3	30 - 45	<1000	<500	65	44	53.20

Area	Geothermometry Temperature °C	Method	Source (See References)
Greenlee 1	130 - 180	Quartz Mixing model, Na-K-Ca/mg corr.	7
Greenlee 2	130 - 140	Quartz, Na-K-Ca	6
Graham 1	70 - 115	Quartz, Na-K-Ca	8
Graham 2	30 - 90	Quartz, Na-K-Ca	8
Graham 3	70 - 90	Chalcedony, Na-K-Ca	8
Graham 4	90 - 110	Quartz, Na-K-Ca	8
Cochise 1	60 - 85	Chalcedony, Na-K-Ca	6, 10
Cochise 2	60 - 70	Chalcedony	3, 10
Cochise 3	50 - 90	Quartz, Na-K-Ca	6
Cochise 4	80 - 110	Quartz, Na-K-Ca	3
Pima 1	50 - 65	Chalcedony, Na-K-Ca	9
Pima 2	30 - 60	Chalcedony	10
Pima 3	50 - 60	Chalcedony	10
Pima 4	50 - 80	Chalcedony	10

Tr - Average temperature of the reservoir

Tmat - Surface mean annual temperature

Qr - Extractable heat content of the reservoir

Table 1 (cont.) PROVEN AND POTENTIAL GEOTHERMAL RESERVOIRS LESS THAN 1.2 km DEPTH

County/Area	Area km^2	Location	Volume km^3	Measured °C Temperature	Depth (Feet)	TDS (mg/l)	Tr-°C	Tr-Tmat°C
Pinal 1	423.1	T5-8S, R7-9E	126.9	30 - 45	<2500	<3000	55	35
Pinal 2	206.4	T8-10S, R16-18E	61.9	30 - 45	<1000	<1000	60	40
Pinal 3	268.3	T8-9S, R6-8E	80.5	30 - 45	<2500	<3000	55	35
Pinal 4	547.0	T4-7S, R2-4E	164.1	30 - 40	<1500	-	55	35
Yuma 1	10.3	T8-9S, R19W	3.1	50 - 60	<50	<3000	60	39
Yuma 2	216.7	T7-8S, R11-12W	65.0	30 - 40	<700	<3000	65	44
Yuma 3	495.4	T4-6S, R10-12W	148.6	30 - 45	<1500	<3000	70	49
Yuma 4	278.6	T3-6N, R14-16W	83.6	30 - 45	<1500	<2000	60	40
Yuma 5	412.8	T5-6N, R11W-13W	123.8	30 - 40	<1500	<1000	50	30
Mohave 1	61.9	T17N, R17W	18.6	30 - 35	-	1500	50	31

County/Area	Qr Calories x 10^{15}	Geothermometry Temperature	Method	Source (See References)
Pinal 1	133.25	40 - 80	Chalcedony	10
Pinal 2	74.28	50 - 70	Chalcedony	10
Pinal 3	84.53	40 - 80	Chalcedony	10
Pinal 4	172.31	-	Reservoir temp. estimated from gradient of 35-40°C/km	
Yuma 1	3.63	60 - 70	Quartz	6
Yuma 2	85.80	40 - 70	Chalcedony	2
Yuma 3	218.44	60 - 80	Chalcedony	10
yuma 4	100.32	40 - 70	Chalcedony	10
Yuma 5	111.42	30 - 40	Chalcedony	10
Mohave 1	17.30	40 - 50	Quartz	6

Tr - Average Temperature of the Reservoir
Tmat - Surface Mean Annual Temperature
Qr - Extractable Heat Content of the Reservoir

Table 1 (cont.) PROVEN AND POTENTIAL GEOTHERMAL RESERVOIRS LESS THAN 1.2 km DEPTH

County/Area	Area km^2	Location	Volume km^3	Measured °C Temperature	Depth (Feet)	TDS mg/l	Tr-°C	Tr-Tmat°C
Maricopa 1	154.8	T1N, T1S, R6-7E	46.4	30 - 40	<500	<1000	60	40
Maricopa 2	227.0	T2-3N, R3-5E	68.1	30 - 45	<1500	<1500	60	40
Maricopa 3	185.8	T2-3N, R1-2E	55.7	30 - 45	<2000	<1000	60	40
Maricopa 4	743.0	T1-4N, R1-2W	222.9	30 - 60	<2000	<5000	60	40
Maricopa 5	123.8	T1N, T1S, R3-4W	37.1	30 - 40	<2000	<2000	55	35
Maricopa 6	275.4	T1-2S, R5-6W	52.6	30 - 35	<1500	<2000	70	50
Maricopa 7	165.1	T1-2N, R6-7W	49.5	30 - 50	<700	<1500	75	55
Maricopa 8	495.4	T1S, T1-2N, R8-10W	148.6	30 - 40	<2000	<1500	65	45
Maricopa 9	247.7	T4-6S, R7-9W	74.3	30 - 40	<1000	<3000	60	40
Maricopa 10	608.9	T2-7S, R3-6W	182.7	30 - 50	<2000	<3000	60	40
Maricopa 11	247.7	T2-3S, R1-2W	74.3	30 - 40	<1500	<2000	60	40
Maricopa 12	412.8	T2-3S, R5-8E	123.8	30 - 40	<1000	<1000	60	40
Maricopa 13	206.4	T6-7N, R8-10W	61.9	30 - 40	<2000	500	55	35

County/Area	Qr Calories x 10^{15}	Geothermometer Temperature °C	Method	Source (See References)
Maricopa 1	55.68	50 - 60	Chalcedony	10
Maricopa 2	81.72	30 - 60	Chalcedony	10
Maricopa 3	66.84	35 - 60	Chalcedony	10
Maricopa 4	267.48	30 - 70	Chalcedony	10
Maricopa 5	38.96	30 - 40	Chalcedony	10
Maricopa 6	78.9	40 - 70	Chalcedony	10
Maricopa 7	81.68	45 - 85	Quartz, Na-K-Ca/mg corr.	Jones, pers., comm.
Maricopa 8	200.61	30 - 110	Chalcedony	10
Maricopa 9	89.16	30 - 80	Chalcedony	10
Maricopa 10	219.24	30 - 65	Chalcedony	10
Maricopa 11	89.16	30 - 70	Chalcedony	10
Maricopa 12	148.56	40 - 60	Chalcedony	10
Maricopa 13	64.99	30 - 40	Chalcedony	10

Tr - Average Temperature of the Reservoir
Tmat - Surface Mean Annual Temperature
Qr - Extractable Heat Content of the Reservoir

Table 2 INFERRED INTERMEDIATE TO HIGH TEMPERATURE (>90°C) GEOTHERMAL RESERVOIRS LESS THEN 2.5 km

Name	County	Location	Depth km	Volume km^3	Tr °C	Inferences based on
Clifton Hot Springs	Greenlee	T4S, R30E	2.0	2.5	170	1, 5
Eagle Creek Hot Springs	Greenlee	T4S, R28E	2.0	2.5	130	1, 5
Gillard Hot Springs	Greenlee	T4S, R30E	2.0	2.5	140	1, 5
Martinez Ranch	Greenlee	T3S, R31E	2.0	2.5	130	1, 5
Cactus Flat-Artesia	Graham	T7-9S, R26E	2.0	2.5	110	1, 3, 5
Buena Vista	Graham	T6-7S, R27-28E	2.0	2.5	120	1, 3, 5
Whitlock Mountains Area	Graham	T8-10S, R28-30E	2.0	2.5	110	1, 3, 5
San Simon	Cochise	T13-14S, R29-30E	2.0	2.5	120	2, 3, 5
Willcox Playa	Cochise	T14-15S, R24E	2.0	2.5	110	1, 3, 5
San Bernadion Area	Cochise	T20-24S, R29, 31E	2.5	2.5	150	1, 3, 4, 5
Tucson Basin	Pima	T14-15S, R14-15E	2.5	2.5	130	2, 3, 5
Power Ranch Area	Maricopa	T1-2S, R6E	2.5	2.5	130	2, 3, 5
Harquahala Plain	Maricopa	T1S, T1N-2N, R8-10W	2.5	2.5	110	1, 3, 5
Luke-Litchfield	Maricopa	T1-4N, R1-2W	2.0	2.5	110	3, 5
Hyder Area	Maricopa	T4-6S, R10-12W	2.0	2.5	110	1, 3, 4, 5
Alpine-Nutrioso	Apache	T5-7N, R30E	2.0	2.5	120	3, 4, 5
Verde Hot Springs	Yavaipai	T11N, R6E	2.0	2.5	130	1, 3, 5

(1) Geothermometry
(2) Deep well tests
(3) Geophysics/Heat flow
(4) Young Volcanism
(5) Structure

Tr - Average Reservoir Temperature

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5. Rantz, S. E., and Eakin, T. E., 1979, A summary of methods for the collection and analysis of basic hydrologic data for arid regions, U. S. Geological Survey Open-File Report, 125 p.

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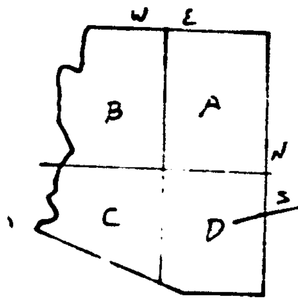
9. Witcher, J. D., 3, 1979, A preliminary study of the geothermal potential of the Tucson metropolitan area in geothermal site evaluation in Arizona, Semi-annual progress report for period July 1978-January 1979, D.O.E. contract EG-77-S-02-4362, p. 73-91.

10. Geological Survey, WATSTORE Water Quality Computer File.

GREENLEE 1 LATITUDE=33.1105 LONGITUDE=109.2983 TOWNSHIP/RANGE=D043000 AREA IN KM**2= 61.9 VOLUME IN KM**3= 18.6

NO.	LATITUDE	LONGITUDE	T/R_LOC	TEMP_(C)	SIO2_(MG/L)	CHALCEDONY	DEPTH_(FT)	TDS_(MG/L)
1	33 3.3140	109 19.0280	D04303C80	48.9	0.0	0.00000	0.0	874.0
2	33 3.3140	109 18.0280	D04303080	40.0	0.0	0.00000	0.0	889.0
3	33 3.3140	109 19.0280	D04303080	37.8	0.0	0.00000	0.0	954.0
4	33 3.3140	109 18.0280	D04303080	40.6	0.0	0.00000	0.0	749.0
5	33 3.3140	109 18.0280	D04303080	43.3	58.0	79.63099	0.0	979.0
6	33 3.3140	109 17.5170	D043030A0	48.9	0.0	0.00000	2.2	8330.0
7	33 3.1000	109 17.7730	D04303008	48.9	58.0	79.63099	0.0	979.0
8	33 4.8000	109 18.1800		56.0	8.0	-0.80417	0.0	0.0



Locates Quadrant in the State.

Township 4 South

Range 30 East

The latitude and longitude locates the northwest corner of the township.

GREENLEE 2 LATITUDE=33.0236 LONGITUDE=109.4083 TOWNSHIP/RANGE=D052900 AREA IN KM**2= 61.9 VOLUME IN KM**3= 18.6

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 58.3200	109 20.7870	D052927AA	82.8	0.0	0.00000	0.0	127.4
2	32 58.3200	109 20.7870	D052927AA	76.7	0.0	0.00000	0.0	125.2
3	32 58.3200	109 20.7870	D052927AA	82.8	0.0	0.00000	0.0	124.2
4	32 58.3200	109 21.6110	D052927BB	30.0	0.0	0.00000	0.0	132.5

GRAHAM 1A LATITUDE=32.9374 LONGITUDE=109.7220 TOWNSHIP/RANGE=0062600 AREA IN KM**2= 6.4 VOLUME IN KM**3= 61.9

(NONE)

GRAHAM 1B LATITUDE=32.9372 LONGITUDE=109.6198 TOWNSHIP/RANGE=0062700

(NONE)

GRAHAM 1C LATITUDE=32.9371 LONGITUDE=109.5165 TOWNSHIP/RANGE=0062800

(NONE)

GRAHAM 1D LATITUDE=32.8506 LONGITUDE=109.7227 TOWNSHIP/RANGE=0072600

(NONE)

GRAHAM 1E LATITUDE=32.8504 LONGITUDE=109.6199 TOWNSHIP/RANGE=0072700

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 51.3450	109 33.4420	0072702BB	35.6	0.0	0.00000	30.0	1025.0
2	32 51.2400	109 32.7600		41.0	65.0	85.69620	0.0	1078.0

GRAHAM 1F LATITUDE=32.8504 LONGITUDE=109.5167 TOWNSHIP/RANGE=0072800

(NONE)

GRAHAM 2A — LATITUDE=32.8514 LONGITUDE=109.9280 TOWNSHIP/RANGE=D072400 AREA IN KM**2= 71.5 VOLUME IN KM**3= 11.5

(NONE)

GRAHAM 2B — LATITUDE=32.8510 LONGITUDE=109.8254 TOWNSHIP/RANGE=D072500

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 50.5180	109 44.2470	D072512AB		0.0	0.00000	0.0	0.0
2	32 49.8700	109 44.7620	D072512CC		0.0	0.00000	9.6	0.0
3	32 49.8700	109 43.9890	D072512DD		0.0	0.00000	10.0	0.0
4	32 49.8700	109 43.9890	D072512DD		0.0	0.00000	0.0	0.0
5	32 50.0860	109 44.7620	D072512C"		0.0	0.00000	0.0	0.0
6	32 47.4930	109 47.0790	D072528DA		0.0	0.00000	0.0	93.7
7	32 49.9800	109 48.9000			0.0	0.00000	0.0	0.0

GRAHAM 2C — LATITUDE=32.8506 LONGITUDE=109.7227 TOWNSHIP/RANGE=D072600

(NONE)

GRAHAM 2D — LATITUDE=32.7648 LONGITUDE=109.9307 TOWNSHIP/RANGE=D082400

(NONE)

GRAHAM 2E — LATITUDE=32.7645 LONGITUDE=109.8256 TOWNSHIP/RANGE=D082500

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 45.3310	109 44.0200	D082512AA		0.0	0.00000	105.0	0.0
2	32 44.8980	109 44.0200	D082512DA		0.0	0.00000	0.0	0.0
3	32 44.8980	109 44.2770	D082512DB		0.0	0.00000	20.0	5120.0
4	32 45.5470	109 44.0200	D082501CD		0.0	0.00000	0.0	0.0

GRAHAM 2F — LATITUDE=32.7640 LONGITUDE=109.7227 TOWNSHIP/RANGE=D082600

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 41.2080	109 42.4650	D082632CD	33.3	0.0	0.00000	0.0	45.6
2	32 41.2080	109 42.4650	D082632CD	33.3	0.0	0.00000	0.0	63.8
3	32 41.2080	109 42.4650	D082632CD	30.0	0.0	0.00000	0.0	64.9

GRAHAM 2G — LATITUDE=32.6809 LONGITUDE=109.9307 TOWNSHIP/RANGE=D092400

(NONE)

GRAHAM 2H — LATITUDE=32.6804 LONGITUDE=109.8287 TOWNSHIP/RANGE=D092500

(NONE)

GRAHAM 2I — LATITUDE=32.6799 LONGITUDE=109.7259 TOWNSHIP/RANGE=D092600

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 41.2080	109 42.4650	D082632CD	33.3	0.0	0.00000	0.0	45.6
2	32 41.2080	109 42.4650	D082632CD	33.3	0.0	0.00000	0.0	63.8
3	32 41.2080	109 42.4650	D082632CD	30.0	0.0	0.00000	0.0	64.9

GRAHAM 3A LATITUDE=33.1120 LONGITUDE=110.0262 TOWNSHIP/RANGE=D042300 AREA IN KM**2= 37.4 VOLUME IN KM**3= 71.2

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 4.8570	110 0.4130	D042317DB	30.0	0.0	0.00000	35.5	2740.0
2	33 4.8570	110 0.4130	D042317CB	30.6	0.0	0.00000	35.5	0.0
3	33 5.0760	110 0.9290	D042317BC	30.0	0.0	0.00000	82.0	0.0
4	33 3.7620	109 59.1220	D042321DD	31.1	0.0	0.00000	0.0	0.0
5	33 4.2000	109 59.6390	D042321BD	34.4	0.0	0.00000	0.0	294.0
6	33 4.2000	109 59.6390	D042321BD	30.0	0.0	0.00000	0.0	0.0
7	33 4.2000	109 59.6390	D042321BD	33.9	0.0	0.00000	0.0	279.0
8	33 4.2000	109 59.1220	D042321AD	36.1	0.0	0.00000	0.0	296.0
9	33 4.2000	109 59.1220	D042321AD	33.8	0.0	0.00000	0.0	301.0
10	33 4.2000	109 59.1220	D042321AD	32.8	0.0	0.00000	0.0	0.0
11	33 4.2000	109 59.1220	D042321AD	35.6	0.0	0.00000	0.0	0.0
12	33 4.2000	109 59.6390	D042321BD	31.7	0.0	0.00000	0.0	0.0
13	33 4.2000	109 59.1220	D042321AD	35.0	0.0	0.00000	0.0	0.0
14	33 4.2000	109 59.1220	D042321AD	33.3	0.0	0.00000	0.0	298.0
15	33 3.9810	109 59.6390	D042321CA	32.8	0.0	0.00000	0.0	0.0
16	33 3.9810	109 59.6390	D042321CA	33.3	0.0	0.00000	0.0	295.0
17	33 3.9810	109 59.6390	D042321CA	32.8	0.0	0.00000	0.0	291.0
18	33 3.9810	109 59.6390	D042321CA	31.7	0.0	0.00000	0.0	0.0
19	33 3.9810	109 59.6390	D042321CA	31.1	0.0	0.00000	0.0	0.0
20	33 3.9810	109 59.6390	D042321CA	32.2	0.0	0.00000	0.0	0.0
21	33 3.9810	109 59.6390	D042321CA	32.8	0.0	0.00000	0.0	0.0
22	33 3.9810	109 59.6390	D042321CA	32.8	0.0	0.00000	0.0	0.0
23	33 3.7620	109 58.8650	D042322CC	33.3	0.0	0.00000	0.0	0.0
24	33 3.7620	109 58.8650	D042322CC	31.1	0.0	0.00000	0.0	272.0
25	33 4.2000	109 58.8650	D042322BC	32.2	0.0	0.00000	0.0	0.0
26	33 4.2000	109 58.8650	D042322BC	30.0	0.0	0.00000	0.0	0.0
27	33 4.2000	109 58.8650	D042322BC	33.9	0.0	0.00000	0.0	0.0
28	33 3.7620	109 58.3480	D042322DC	30.0	0.0	0.00000	0.0	299.0
29	33 3.7620	109 58.3480	D042322DC	30.6	0.0	0.00000	0.0	0.0

GRAHAM 3B LATITUDE=33.1116 LONGITUDE=109.9230 TOWNSHIP/RANGE=D042400

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 3.5360	109 52.6620	D042427BB	33.0	0.0	0.00000	0.0	27.7

GRAHAM 3C LATITUDE=33.1110 LONGITUDE=109.8196 TOWNSHIP/RANGE=D042500

(NONE)

GRAHAM 3D LATITUDE=33.0245 LONGITUDE=110.0262 TOWNSHIP/RANGE=D052300

(NONE)

GRAHAM 3E LATITUDE=33.0247 LONGITUDE=109.9230 TOWNSHIP/RANGE=D052400

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 1.1540	109 55.2490	D052406DC		0.0	0.00000	0.0	452.0
2	33 1.1540	109 55.2490	D052406DC		0.0	0.00000	0.0	0.0
3	33 1.5890	109 55.7670	D052406BC		0.0	0.00000	0.0	0.0
4	33 1.5890	109 55.7670	D052406BC		0.0	0.00000	0.0	378.0
5	33 1.5890	109 55.7670	D052406BC		0.0	0.00000	0.0	0.0
6	33 1.5890	109 55.7670	D052406BC		0.0	0.00000	0.0	478.0
7	33 1.5890	109 55.7670	D052406BC		0.0	0.00000	0.0	0.0

GRAHAM 3E LATITUDE=33.0247 LONGITUDE=109.9230 TOWNSHIP/RANGE=D052400 AREA IN KM**2= 37.4 VOLUME IN KM**3= 21.2

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
8	33 1.5890	109 55.7670	D052406BC		0.0	0.00000	0.0	0.0
9	33 1.5990	109 55.7670	D052406BC		0.0	0.00000	0.0	0.0
10	33 1.1540	109 55.7670	D052406CC		0.0	0.00000	18.7	0.0
11	33 0.2840	109 55.5080	D052407CD		0.0	0.00000	0.0	461.0
12	33 0.2840	109 55.2490	D052407CC		0.0	0.00000	0.0	0.0
13	33 0.2840	109 55.2490	D052407CC		0.0	0.00000	0.0	0.0
14	33 0.2840	109 55.2490	D052407DC		0.0	0.00000	0.0	0.0
15	33 0.2840	109 55.2490	D052407DC		0.0	0.00000	0.0	0.0
16	33 0.2840	109 55.2490	D052407DC		0.0	0.00000	0.0	0.0
17	32 59.6320	109 53.9530	D052417DA		0.0	0.00000	0.0	256.0
18	32 59.6320	109 53.9530	D052417DA		0.0	0.00000	0.0	0.0
19	32 59.6320	109 53.9530	D052417DA		0.0	0.00000	0.0	257.0
20	32 59.6320	109 53.9530	D052417DA		0.0	0.00000	0.0	297.0
21	32 59.6320	109 53.9530	D052417DA		0.0	0.00000	0.0	0.0
22	32 59.6320	109 53.9530	D052417DA		0.0	0.00000	0.0	0.0
23	32 59.6320	109 53.9530	D052417DA		0.0	0.00000	0.0	297.0
24	32 59.6320	109 53.9530	D052417DA		0.0	0.00000	0.0	296.0
25	32 59.6320	109 53.9530	D052417DA		0.0	0.00000	0.0	0.0
26	32 59.6320	109 53.9530	D052417DA		0.0	0.00000	0.0	0.0
27	32 59.6320	109 53.9530	D052417DA		0.0	0.00000	0.0	0.0
28	32 59.9590	109 54.0820	D052417A		0.0	0.00000	0.0	2568.0
29	32 59.9580	109 54.0820	D052417A		0.0	0.00000	0.0	2956.0
30	32 59.9580	109 54.0820	D052417A		0.0	0.00000	0.0	3016.0
31	32 59.9400	109 53.8800		48.3	0.0	0.00000	600.0	2568.0
32	32 59.9400	109 53.8800		48.3	0.0	0.00000	600.0	2580.0
33	32 59.9400	109 53.8800		48.3	0.0	0.00000	600.0	0.0
34	32 59.9400	109 53.8800		47.8	0.0	0.00000	600.0	2570.0
35	32 59.9400	109 53.8800		40.0	0.0	0.00000	0.0	2970.0
36	32 59.9400	109 53.8800		47.8	0.0	0.00000	0.0	0.0
37	32 59.9400	109 53.8800		46.7	0.0	0.00000	0.0	0.0
38	32 59.9400	109 53.8800		44.4	0.0	0.00000	0.0	0.0
39	32 59.9400	109 53.9400		47.8	0.0	0.00000	59.0	2970.0

GRAHAM 3F LATITUDE=33.0242 LONGITUDE=109.8193 TOWNSHIP/RANGE=D052500

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 0.3640	109 46.8380	D052509D	32.2	0.0	0.00000	0.0	28.4
2	33 0.0380	109 48.2560	D0525178A	32.2	0.0	0.00000	0.0	51.0

GRAHAM 3G LATITUDE=32.9382 LONGITUDE=110.0308 TOWNSHIP/RANGE=D062300

(NONE)

GRAHAM 3H LATITUDE=32.9379 LONGITUDE=109.9280 TOWNSHIP/RANGE=D062400

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 54.8660	109 50.6690	D0624138A	58.9	0.0	0.00000	3767.0	3530.0

GRAHAM 3I LATITUDE=32.9376 LONGITUDE=109.8252 TOWNSHIP/RANGE=D062500

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 52.0200	109 44.9490		46.5	0.0	0.00000	2161.0	0.0

GRAHAM 31 LATITUDE=32.9376 LONGITUDE=109.8252 TOWNSHIP/RANGE=0062500 AREA IN KM**2= 37.4 VOLUME IN KM**3= 71.2

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
2	32 52.0200	109 44.9400		44.0	53.0	74.97571	0.0	7950.0

GRAHAM 4A LATITUDE=32.5921 LONGITUDE=109.5209 TOWNSHIP/RANGE=D102800 AREA IN KM**2= 61.9 VOLUME IN KM**3= 18.6

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 31.4030	109 25.8360	D102836AAC	41.1	0.0	C.COCCO	1925.0	0.0

GRAHAM 4B LATITUDE=32.5902 LONGITUDE=109.4188 TOWNSHIP/RANGE=D102900

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 31.3940	109 25.5160	D10293188	41.1	0.0	C.COCOC	192.5	962.0
2	32 31.3800	109 25.5600		41.0	0.0	0.00000	0.0	962.0
3	32 31.3800	109 25.5600		40.5	0.0	0.00000	1925.0	0.0

COCHISE 1A   LATITUDE=32.4169 LONGITUDE=109.5269 TOWNSHIP/RANGE=D122800   AREA IN KM**2= 81.1   VOLUME IN KM**3= 4.3

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 20.4000	109 26.9400		30.0	0.0	0.00000	715.0	0.0
2	32 20.4000	109 26.9400		30.0	0.0	0.00000	715.0	0.0
3	32 22.1400	109 28.6800		30.0	22.0	35.28265	660.0	216.0
4	32 22.1400	109 28.6800		30.5	24.0	38.80237	660.0	247.0
5	32 22.1400	109 28.6800		31.5	0.0	0.00000	660.0	0.0
6	32 22.1400	109 28.6800		31.0	0.0	0.00000	660.0	0.0
7	32 22.1400	109 28.6800		31.5	0.0	0.00000	660.0	0.0

COCHISE 1B   LATITUDE=32.4178 LONGITUDE=109.4227 TOWNSHIP/RANGE=D122900

(NONE)

COCHISE 1C   LATITUDE=32.4164 LONGITUDE=109.3205 TOWNSHIP/RANGE=D123000

(NONE)

COCHISE 1D   LATITUDE=32.4165 LONGITUDE=109.2181 TOWNSHIP/RANGE=D123100

(NONE)

COCHISE 1E   LATITUDE=32.3292 LONGITUDE=109.5268 TOWNSHIP/RANGE=D132800

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 19.4800	109 29.2100	D132804DDB	37.2	32.0	51.03409	830.0	231.0
2	32 19.4800	109 29.2100	D132804DDB	33.3	0.0	0.00000	830.0	0.0
3	32 19.4800	109 29.2100	D132804DDB	36.7	0.0	0.00000	830.0	0.0
4	32 19.4800	109 29.2100	D132804DDB	37.2	0.0	0.00000	830.0	0.0
5	32 19.4800	109 29.2100	D132804DDB	30.6	23.0	37.07077	700.0	382.0
6	32 19.4800	109 29.2100	D132804DDB	31.7	40.0	60.55652	700.0	402.0
7	32 19.0800	109 30.0000		30.6	23.0	37.07077	700.0	256.0
8	32 19.0800	109 30.0000		31.0	0.0	0.00000	700.0	0.0
9	32 19.5000	109 25.9200		31.1	0.0	0.00000	835.0	0.0
10	32 19.6200	109 29.2200		37.2	32.0	51.03409	830.0	231.0
11	32 19.6200	109 29.2200		33.3	0.0	0.00000	830.0	0.0
12	32 19.6200	109 29.2200		36.7	0.0	0.00000	830.0	0.0
13	32 19.6200	109 29.2200		37.2	0.0	0.00000	830.0	0.0

COCHISE 1F   LATITUDE=32.3301 LONGITUDE=109.4230 TOWNSHIP/RANGE=D132900

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 16.8630	109 20.1560	D132924DC	40.6	0.0	0.00000	96.0	340.0
2	32 19.4250	109 25.8230	D132906CCC	31.1	0.0	0.00000	835.0	0.0
3	32 16.8080	109 20.2190	D132924DCC	40.6	0.0	0.00000	964.0	340.0
4	32 16.8080	109 20.2190	D132924DCC	41.7	0.0	0.00000	964.0	315.0
5	32 16.8000	109 20.3400		40.6	0.0	0.00000	960.0	340.0

COCHISE 1G   LATITUDE=32.3284 LONGITUDE=109.3208 TOWNSHIP/RANGE=D133000

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 18.7170	109 16.8240	D133009DA	33.3	0.0	0.00000	90.0	289.0
2	32 18.7170	109 15.5480	D133011CB	32.2	0.0	0.00000	95.0	268.0

COCHISE 1G   LATITUDE=32.3284 LONGITUDE=109.3208   TOWNSHIP/RANGE=D133000   AREA IN KM**2= 81.1   VOLUME IN KM**3= 4.3

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
3	32 17.6180	109 14.7830	D13301400	32.2	0.0	0.00000	90.0	267.0
4	32 17.8380	109 15.8040	D133015DA	35.0	0.0	0.00000	97.5	285.0
5	32 16.0800	109 14.2730	D133025CA	30.5	0.0	0.00000	88.0	260.0
6	32 16.0800	109 19.6310	D133030CB	40.0	0.0	0.00000	96.0	355.0
7	32 19.7610	109 16.3780	D1330038DC	33.3	62.0	83.15576	860.0	0.0
8	32 18.8820	109 15.6120	D1330118CC	32.2	0.0	0.00000	950.0	268.0
9	32 17.5630	109 15.6120	D133014CCC	32.2	0.0	0.00000	930.0	267.0
10	32 17.8930	109 15.7400	D133015DAA	35.0	0.0	0.00000	975.0	285.0
11	32 17.8930	109 15.7400	D133015DAA	35.0	0.0	0.00000	975.0	289.0
12	32 17.1240	109 15.1020	D133023ACC	30.6	30.0	48.20728	900.0	0.0
13	32 16.3550	109 19.6940	D133030BCB	40.0	0.0	0.00000	960.0	355.0
14	32 16.3800	109 13.9800		30.5	0.0	0.00000	880.0	260.0
15	32 17.2200	109 15.0600		30.6	30.0	48.20728	900.0	0.0
16	32 17.6400	109 14.7600		32.2	0.0	0.00000	930.0	267.0
17	32 18.0600	109 15.7800		35.0	0.0	0.00000	975.0	285.0
18	32 18.9600	109 15.6600		32.2	0.0	0.00000	950.0	268.0
19	32 18.9600	109 16.9800		33.5	0.0	0.00000	900.0	289.0
20	32 19.8000	109 16.3800		33.5	62.0	83.15576	860.0	571.0

COCHISE 1H   LATITUDE=32.3283 LONGITUDE=109.2178   TOWNSHIP/RANGE=D133100

(NONE)

COCHISE 1I   LATITUDE=32.2421 LONGITUDE=109.5265   TOWNSHIP/RANGE=D142800

(NONE)

~~COCHISE 1J~~   LATITUDE=32.2432 LONGITUDE=109.4227   TOWNSHIP/RANGE=D142900

(NONE)

COCHISE 1K   LATITUDE=32.2408 LONGITUDE=109.3209   TOWNSHIP/RANGE=D143000

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 13.7400	109 13.8080	D143012ADB	30.6	97.0	108.76575	0.0	374.0
2	32 13.9200	109 13.8600		30.6	97.0	108.76575	0.0	374.0

~~COCHISE 1L~~   LATITUDE=32.2404 LONGITUDE=109.2181   TOWNSHIP/RANGE=D143100

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 12.4640	109 10.7780	D1431160	31.1	0.0	0.00000	200.0	272.0
2	32 12.3000	109 10.9710	D143116DCC	31.1	0.0	0.00000	2000.0	272.0
3	32 12.3000	109 10.9710	D143116DCC	31.7	37.0	57.57870	2000.0	293.0
4	32 12.3000	109 10.9710	D143116DCC	31.7	0.0	0.00000	2000.0	0.0
5	32 12.3000	109 10.9710	D143116DCC	31.7	0.0	0.00000	2000.0	0.0
6	32 12.3000	109 10.9710	D143116DCC	31.1	0.0	0.00000	2000.0	0.0
7	32 12.3000	109 10.9710	D143116DCC	31.7	0.0	0.00000	2000.0	0.0
8	32 11.8640	109 11.4840	D1431218CC	32.2	51.0	72.58591	711.0	305.0
9	32 12.0000	109 11.5200		32.2	51.0	72.58591	711.0	305.0
10	32 12.4800	109 10.9800		31.7	37.0	57.57870	2000.0	293.0
11	32 12.4800	109 10.9800		31.7	0.0	0.00000	2000.0	0.0

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COCHISE 1M        LATITUDE=32.1561  LONGITUDE=109.5267   TOWNSHIP/RANGE=D152800     AREA IN KM**2= 81.1   VOLUME IN KM**3=  4.3
             (NONE)

COCHISE 1N        LATITUDE=32.1574  LONGITUDE=109.4277   TOWNSHIP/RANGE=D152900
             (NONE)

COCHISE 1P        LATITUDE=32.1536  LONGITUDE=109.3202   TOWNSHIP/RANGE=D153000
             (NONE)

COCHISE 1Q        LATITUDE=32.1532  LONGITUDE=109.2178   TOWNSHIP/RANGE=D153100
             (NONE)
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COCHISE 2A LATITUDE=32.3308 LONGITUDE=109.9350 TOWNSHIP/RANGE=D132400 AREA IN KM**2= 51.6 VOLUME IN KM**3= 15.5

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 20.2260	109 52.3410	D132402BBA	31.7	0.0	0.00000	0.0	0.0

COCHISE 2B LATITUDE=32.3301 LONGITUDE=109.8331 TOWNSHIP/RANGE=D132500

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 19.8090	109 48.9670	D132505	31.1	46.0	67.90433	2500.0	1380.0
2	32 15.4240	109 50.1760	D132531CAB	31.7	0.0	0.00000	800.0	0.0
3	32 15.5400	109 50.1000		31.7	0.0	0.00000	0.0	0.0
4	32 20.1600	109 48.1800		31.1	46.0	67.90433	2500.0	1390.0

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COCHISE 3A        LATITUDE=32.4169  LONGITUDE=110.2421   TOWNSHIP/RANGE=D122100     AREA IN KM**2= 41.3   VOLUME IN KM**3= 12.4
              (NON )

COCHISE 3B        LATITUDE=32.3298  LONGITUDE=110.2427   TOWNSHIP/RANGE=D132100
              (NON )
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COCHISE 4A   LATITUDE=32.2437 LONGITUDE=109.9348 TOWNSHIP/RANGE=D142400   AREA IN KM**2= 68.3 VOLUME IN KM**3= 80.5

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 11.7600	109 55.0800		39.0	0.0	0.00000	0.0	0.0

COCHISE 4B   LATITUDE=32.2433 LONGITUDE=109.8323 TOWNSHIP/RANGE=D142500

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 14.4340	109 59.2580	D142506CBD	35.0	0.0	0.00000	700.0	1370.0
2	32 14.1090	109 46.5510	D142510AAB	30.0	0.0	0.00000	0.0	0.0
3	32 14.2200	109 46.5600		30.0	0.0	0.00000	0.0	0.0
4	32 14.5800	109 50.2800		35.0	0.0	0.00000	0.0	1370.0

COCHISE 4C   LATITUDE=32.1568 LONGITUDE=109.9348 TOWNSHIP/RANGE=D152400

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 9.[illegible]10	109 56.1500	D152406BAD	32.8	0.0	0.00000	0.0	0.0
2	32 7.1710	109 56.1500	D152419BAA	30.0	0.0	0.00000	0.0	0.0
3	32 7.2600	109 56.1600		30.0	0.0	0.00000	0.0	0.0

COCHISE 4D   LATITUDE=32.1563 LONGITUDE=109.8325 TOWNSHIP/RANGE=D152500

(NONE)

PIMA 1A LATITUDE=32.4145 LONGITUDE=111.1561 TOWNSHIP/RANGE=D121200 AREA IN KM**2= 59.8 VOLUME IN KM**3= 87.9

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 22.2600	111 9.8400		35.0	42.0	62.63585	360.0	451.0

PIMA 1B LATITUDE=32.4139 LONGITUDE=111.0518 TOWNSHIP/RANGE=D121300

(NONE)

PIMA 1C LATITUDE=32.4143 LONGITUDE=110.9491 TOWNSHIP/RANGE=D121400

(NONE)

PIMA 1D LATITUDE=32.4142 LONGITUDE=110.8474 TOWNSHIP/RANGE=D121500

(NONE)

PIMA 1E LATITUDE=32.3276 LONGITUDE=111.1572 TOWNSHIP/RANGE=D131200

(NONE)

PIMA 1F LATITUDE=32.3277 LONGITUDE=111.0515 TOWNSHIP/RANGE=D131300

(NONE)

PIMA 1G LATITUDE=32.3276 LONGITUDE=110.9495 TOWNSHIP/RANGE=D131400

(NONE)

PIMA 1H LATITUDE=32.3278 LONGITUDE=110.8465 TOWNSHIP/RANGE=D131500

(NONE)

PIMA 1I LATITUDE=32.2419 LONGITUDE=111.1575 TOWNSHIP/RANGE=D141200

(NONE)

PIMA 1J LATITUDE=32.2400 LONGITUDE=111.0511 TOWNSHIP/RANGE=D141300

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 10.9200	110 57.7200		30.6	29.0	46.16150	500.0	420.0
2	32 10.9800	110 57.7200		33.3	36.0	22.60641	550.0	325.0

PIMA 1K LATITUDE=32.2536 LONGITUDE=110.9642 TOWNSHIP/RANGE=D141400

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 10.9200	110 57.7200		30.6	29.0	46.16150	500.0	420.0
2	32 10.9800	110 57.7200		33.3	36.0	22.60641	550.0	329.0
3	32 12.4800	110 55.5600		30.0	26.0	41.22537	1400.0	339.0
4	32 12.2800	110 55.5000		35.0	26.0	41.14231	1220.0	300.0

PIMA 1L LATITUDE=32.2396 LONGITUDE=110.8461 TOWNSHIP/RANGE=D141500 AREA IN KM**2= 59.8 VOLUME IN KM**3= 87.9

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 10.5000	110 45.2400		30.6	33.0	52.39551	300.0	242.0

PIMA 1M LATITUDE=32.1521 LONGITUDE=111.1571 TOWNSHIP/RANGE=D151200

(NONE)

PIMA 1N LATITUDE=32.1526 LONGITUDE=111.0509 TOWNSHIP/RANGE=D151300

(NONE)

PIMA 1P LATITUDE=32.1531 LONGITUDE=110.9486 TOWNSHIP/RANGE=D151400

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 9.1800	110 53.1600		33.9	0.0	0.00000	2500.0	0.0
2	32 9.1800	110 53.1600		52.2	46.0	45.67504	2500.0	485.0

PIMA 1Q LATITUDE=32.1525 LONGITUDE=110.8461 TOWNSHIP/RANGE=D151500

(NONE)

PIMA 1R LATITUDE=32.0661 LONGITUDE=111.1557 TOWNSHIP/RANGE=D161200

(NONE)

PIMA 1S LATITUDE=32.0661 LONGITUDE=111.0542 TOWNSHIP/RANGE=D161300

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	31 59.9400	110 59.8800		32.2	0.0	0.00000	720.0	370.0
2	31 59.9400	110 59.8800		31.1	43.0	63.81430	500.0	302.0
3	31 59.9400	110 59.8800		32.0	41.0	61.84839	0.0	512.0
4	31 59.9400	110 59.8800		31.0	40.0	60.94993	0.0	566.0

PIMA 1T LATITUDE=32.0665 LONGITUDE=110.9513 TOWNSHIP/RANGE=D161400

(NONE)

PIMA 1U LATITUDE=32.0671 LONGITUDE=110.8496 TOWNSHIP/RANGE=D161500

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 3.2300	110 50.5250	D161507ADD	30.3	0.0	0.00000	1100.0	419.0
2	32 0.2520	110 50.5250	D161530DDD	31.5	0.0	0.00000	100.0	0.0
3	32 0.2520	110 48.4750	D161528DDD	31.8	0.0	0.00000	190.0	0.0
4	32 0.2520	110 46.4250	D161526DDD	30.8	0.0	0.00000	1115.0	1804.0

PIMA 1V LATITUDE=31.9772 LONGITUDE=111.1553 TOWNSHIP/RANGE=D171200

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	31 58.2000	111 4.5000		31.1	44.0	65.74411	600.0	1280.0

PIMA 1W LATITUDE=31.9773 LONGITUDE=111.0539 TOWNSHIP/RANGE=D171300 AREA IN KM**2= 59.8 VOLUME IN KM**3= 87.9

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	31 56.5800	110 58.2600		36.5	29.0	44.67896	1792.0	458.0

PIMA 1X LATITUDE=31.9780 LONGITUDE=110.9518 TOWNSHIP/RANGE=D171400

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	31 59.0620	110 51.6670	D171401AAB	33.5	0.0	0.00000	149.6	0.0
2	31 58.2970	110 53.9710	D171403DCC	31.5	0.0	0.00000	100.0	0.0

PIMA 1Y LATITUDE=31.9818 LONGITUDE=110.8491 TOWNSHIP/RANGE=D171500

(NONE)

PIMA 2A LATITUDE=32.4118 LONGITUDE=111.3632 TOWNSHIP/RANGE=D121000 AREA IN KM**2= 26.3 VOLUME IN KM**3= 57.9

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 21.9600	111 17.4000		30.0	33.0	51.64581	0.0	233.0
2	32 24.9000	111 19.8000		35.5	37.0	56.22058	0.0	232.0

PIMA 2B LATITUDE=32.4140 LONGITUDE=111.2609 TOWNSHIP/RANGE=D121100

(NONE)

PIMA 2C LATITUDE=32.3251 LONGITUDE=111.3633 TOWNSHIP/RANGE=D131000

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 16.2000	111 16.4400		30.5	36.0	55.93678	0.0	219.0
2	32 16.6800	111 18.2400		31.0	34.0	52.96555	0.0	247.0
3	32 17.5200	111 18.2400		30.0	35.0	54.28079	0.0	241.0
4	32 17.5200	111 19.3200		31.0	36.0	55.33749	0.0	220.0
5	32 18.4200	111 19.2600		30.0	37.0	56.56487	0.0	223.0

PIMA 2D LATITUDE=32.3254 LONGITUDE= 11.2610 TOWNSHIP/RANGE=D131100

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 14.8800	111 13.0200		30.5	0.0	0.00000	555.0	0.0

PIMA 2E LATITUDE=32.2379 LONGITUDE=111.3633 TOWNSHIP/RANGE=D141000

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 10.6240	111 16.7260	D141025CAA	32.2	0.0	0.00000	40.0	715.0

PIMA 2F LATITUDE=32.2383 LONGITUDE=111.2608 TOWNSHIP/RANGE=D141100

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 10.6380	111 12.2200	D141127DAC	30.8	0.0	0.00000	1277.0	226.0
2	32 9.5450	111 13.5130	D141133DCC	30.4	0.0	0.00000	654.0	392.0
3	32 10.2010	111 12.9950	D141134BBC	32.1	0.0	0.00000	1260.0	471.0
4	32 9.5450	111 14.0300	D141133CCC	30.6	39.0	59.89243	712.0	222.0
5	32 9.7200	111 13.9800		31.0	35.0	53.80856	0.0	226.0
6	32 11.1600	111 12.1200		30.0	33.0	52.21707	0.0	368.0
7	32 13.1400	111 15.0000		31.0	36.0	55.54153	0.0	231.0
8	32 13.8000	111 15.7200		31.0	35.0	54.55429	0.0	227.0
9	32 14.0400	111 14.8800		30.0	35.0	54.74048	0.0	210.0

PIMA 2G LATITUDE=32.1482 LONGITUDE=111.3630 TOWNSHIP/RANGE=D151000

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 6.3000	111 18.1200		34.0	31.0	31.30786	0.0	216.0

PIMA 2H LATITUDE=32.1509 LONGITUDE=111.2606 TOWNSHIP/RANGE=D151100

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 9.5450	111 13.5130	D141133DCC	30.4	0.0	0.00000	654.0	392.0
2	32 8.5650	111 11.9510	D151111BAB	34.4	0.0	0.00000	1118.0	283.0
3	32 7.8040	111 10.9170	D151112CCC	34.9	0.0	0.00000	147.3	0.0

PIMA 2H LATITUDE=32.1509 LONGITUDE=111.2606 TOWNSHIP/RANGE=D151100 AREA IN KM**2= 26.3 VOLUME IN KM**3= 57.9

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
4	32 9.5450	111 14.0300	D141133CCC	30.6	39.0	59.89243	712.0	222.0
5	32 7.1400	111 12.9000		32.0	0.0	0.00000	1005.0	0.0
6	32 7.1400	111 12.9000		31.5	0.0	0.00000	1005.0	0.0
7	32 7.1400	111 12.9000		30.0	0.0	0.00000	1005.0	0.0
8	32 7.1400	111 12.9000		30.0	0.0	0.00000	1005.0	0.0
9	32 7.8600	111 12.9000		30.0	30.0	45.76552	553.0	200.0
10	32 7.8600	111 12.9600		44.5	0.0	0.00000	2000.0	0.0
11	32 7.8600	111 12.9600		42.0	0.0	0.00000	2000.0	0.0

AREA IN KM**2= 3.2 VOLUME IN KM**3= 38.9

PIMA 3A

LATITUDE=31.9778 LONGITUDE=112.1037 TOWNSHIP/RANGE=D170300

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	31 56.0400	112 0.7800		34.0	0.0	0.00000	250.0	0.0
2	31 56.1000	112 0.9000		41.5	0.0	0.00000	117.0	0.0

PIMA 3B

LATITUDE=31.9779 LONGITUDE=111.9707 TOWNSHIP/RANGE=D170400

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	31 54.9330	111 53.1910	D170425CDA	41.7	0.0	0.00000	117.0	0.0
2	31 55.4750	111 52.6790	D170425AAD	33.9	0.0	0.00000	250.0	0.0
3	31 55.0410	111 58.6900	D170430CBC	35.6	34.0	53.07263	700.0	338.0
4	31 55.0410	111 58.6900	D170430CBC	35.6	34.0	53.31796	700.0	339.0
5	31 55.0410	111 58.6500	D170430CBC	35.0	35.0	54.51831	700.0	340.0
6	31 55.1400	111 58.6800		35.5	34.0	53.31870	700.0	339.0
7	31 55.1400	111 58.6800		35.5	34.0	53.07379	700.0	338.0
8	31 55.1400	111 58.6800		35.0	35.0	54.51831	700.0	340.0

PIMA 3C

LATITUDE=31.9780 LONGITUDE=111.8687 TOWNSHIP/RANGE=D170500

(NONE)

PIMA 4A LATITUDE=31.7988 LONGITUDE=112.3084 TOWNSHIP/RANGE=D190100 AREA IN KM**2= 34.2 VOLUME IN KM**3= 40.3

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	31 48.2020	112 17.6790	D190105BAC	46.6	14.0	18.20691	420.0	327.0
2	31 47.3240	112 18.8230	D190107BBD	45.5	56.0	73.15982	270.0	477.0
3	31 47.3240	112 18.8230	D190107BBD	45.5	0.0	0.00000	350.0	0.0
4	31 47.3240	112 18.8230	D190107BBD	45.5	0.0	0.00000	550.0	0.0
5	31 47.3240	112 18.8230	D190107BBD	45.5	0.0	0.00000	700.0	0.0
6	31 47.3240	112 18.8230	D190107BBD	45.5	64.0	84.11304	715.0	417.0
7	31 47.3240	112 18.8230	D190107BBD	45.5	0.0	0.00000	715.0	0.0
8	31 47.3240	112 18.8230	D190107BBD	45.5	0.0	0.00000	715.0	0.0
9	31 45.6790	112 18.0610	D190119AAA	30.0	43.0	64.51535	950.0	361.0
10	31 45.9000	112 18.1200		30.0	43.0	64.51535	950.0	361.0
11	31 46.5000	112 18.1200		32.0	55.0	76.59064	952.0	350.0
12	31 47.1600	112 18.5400		45.5	56.0	73.15982	0.0	477.0
13	31 47.1600	112 18.5400		45.5	0.0	0.00000	0.0	0.0
14	31 47.1600	112 18.5400		45.5	0.0	0.00000	0.0	0.0
15	31 47.1600	112 18.5400		45.5	0.0	0.00000	0.0	0.0
16	31 47.1600	112 18.5400		45.5	64.0	84.11304	715.0	417.0
17	31 47.1600	112 18.5400		45.5	0.0	0.00000	715.0	0.0
18	31 47.1600	112 18.5400		45.5	0.0	0.00000	715.0	0.0
19	31 47.1600	112 18.5400		44.0	53.0	73.59671	0.0	356.0
20	31 48.0000	112 17.9400		46.5	14.0	18.20691	420.0	327.0
21	31 48.0000	112 17.9400		46.0	37.0	56.93704	0.0	335.0

PIMA 4B LATITUDE=31.7106 LONGITUDE=112.3095 TOWNSHIP/RANGE=D200100

(NONE)

Z TOWNSHIP/RANGE D050700 NOT DIGITIZED
Z TOWNSHIP/RANGE D050800 NOT DIGITIZED
Z TOWNSHIP/RANGE D050900 NOT DIGITIZED
Z TOWNSHIP/RANGE D060700 NOT DIGITIZED
Z TOWNSHIP/RANGE D060800 NOT DIGITIZED
Z TOWNSHIP/RANGE D060900 NOT DIGITIZED

No DATA IN TOWNSHIP

PINAL 1G LATITUDE=32.8349 LONGITUDE=111.6626 TOWNSHIP/RANGE=D070700

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 45.7800	111 39.0600		40.0	0.0	0.00000	1530.0	0.0
2	32 45.8400	111 38.2200		32.0	30.0	44.30942	1585.0	504.0
3	32 48.4200	111 34.0200		30.0	0.0	0.00000	552.0	0.0

Z TOWNSHIP/RANGE D070800 NOT DIGITIZED
Z TOWNSHIP/RANGE D070900 NOT DIGITIZED

PINAL 1J LATITUDE=32.7498 LONGITUDE=111.6621 TOWNSHIP/RANGE=D080700

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 [illegible].5600	111 38.2200		35.5	33.0	51.57248	1300.0	301.0
2	32 44.5200	111 37.2600		43.5	77.0	97.06360	2150.0	2440.0

Z TOWNSHIP/RANGE D080800 NOT DIGITIZED
Z TOWNSHIP/RANGE D080900 NOT DIGITIZED

PINAL 2A LATITUDE=32.7651 LONGITUDE=110.7479 TOWNSHIP/RANGE=D081600 AREA IN KM**2= 6.4 VOLUME IN KM**3= 61.9

(NONE)

PINAL 2B LATITUDE=32.7657 LONGITUDE=110.6464 TOWNSHIP/RANGE=D081700

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 41.5980	110 37.3130	D081732DAA	42.0	38.0	58.80969	148.5	441.0

PINAL 2C LATITUDE=32.7666 LONGITUDE=110.5439 TOWNSHIP/RANGE=D081800

(NONE)

PINAL 2D LATITUDE=32.6792 LONGITUDE=110.7483 TOWNSHIP/RANGE=D091600

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 41.1200	110 40.9740	D091602BAA	38.0	31.0	49.63727	130.0	440.0

PINAL 2E LATITUDE=32.6800 LONGITUDE=110.6454 TOWNSHIP/RANGE=D091700

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 39.6880	110 35.5870	D091710DCB	32.0	0.0	0.00000	8.5	0.0
2	32 38.8410	110 34.8190	D091714CDB	31.0	47.0	68.95541	5.4	590.0
3	32 38.7350	110 34.6910	D091714CDD	31.0	35.0	55.04269	0.0	23.4
4	32 37.8880	110 33.2820	D091724DDC	31.0	0.0	0.00000	87.0	259.0
5	32 37.8890	110 33.2820	D091724DDC	31.0	40.0	61.20349	87.0	0.0
6	32 37.8880	110 33.2820	D091724DDC	31.0	40.0	61.20340	87.0	313.0
7	32 37.8880	110 33.2820	D091724DDC	31.0	0.0	0.00000	87.0	0.0
8	32 37.8880	110 33.2820	D091724DDC	31.0	0.0	0.00000	870.0	0.0
9	32 37.8880	110 33.2870	D091724DDC	31.0	0.0	0.00000	870.0	0.0
10	32 37.8000	110 33.2400		31.0	0.0	0.00000	870.0	0.0
11	32 37.8000	110 33.2400		31.0	0.0	0.00000	870.0	0.0

PINAL 2F LATITUDE=32.6805 LONGITUDE=110.5426 TOWNSHIP/RANGE=D091800

(NONE)

PINAL 2G LATITUDE=32.5945 LONGITUDE=110.7483 TOWNSHIP/RANGE=D101600

(NONE)

PINAL 2H LATITUDE=32.5951 LONGITUDE=110.6454 TOWNSHIP/RANGE=D101700

(NONE)

PINAL 2I LATITUDE=32.5945 LONGITUDE=110.5420 TOWNSHIP/RANGE=D101800

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 35.9370	110 29.4920	D101803BAD	41.0	41.0	62.38804	27.7	454.0

PINAL 3A LATITUDE=32.7481 LONGITUDE=111.7652 TOWNSHIP/RANGE=D080600 AREA IN KM**2= 68.3 VOLUME IN KM**3= 80.5

NO.	LATITUDE	LONGITUDE	T/R_LOC	TEMP_(C)	SIO2_(MG/L)	CHALCEDONY	DEPTH_(FT)	TDS_(MG/L)
1	32 45.3600	111 42.3000		31.0	29.0	46.74203	800.0	299.0
2	32 45.3600	111 41.3400		30.5	0.0	0.00000	322.2	225.0

PINAL 3B LATITUDE=32.7488 LONGITUDE=111.6621 TOWNSHIP/RANGE=D080700

NO.	LATITUDE	LONGITUDE	T/R_LOC	TEMP_(C)	SIO2_(MG/L)	CHALCEDONY	DEPTH_(FT)	TDS_(MG/L)
1	32 40.5600	111 38.2200		35.5	33.0	51.57248	1300.0	301.0
2	32 44.5200	111 37.2600		43.5	77.0	82.06360	2100.0	2440.0

% TOWNSHIP/RANGE D080800 NOT DIGITIZED

PINAL 3D LATITUDE=32.6660 LONGITUDE=111.7821 TOWNSHIP/RANGE=D090600

NO.	LATITUDE	LONGITUDE	T/R_LOC	TEMP_(C)	SIO2_(MG/L)	CHALCEDONY	DEPTH_(FT)	TDS_(MG/L)
1	32 40.0200	111 41.4000		30.0	0.0	0.00000	800.0	0.0

PINAL 3E LATITUDE=32.6616 LONGITUDE=111.6627 TOWNSHIP/RANGE=D090700

(NONE)

% TOWNSHIP/RANGE D090800 NOT DIGITIZED
% TOWNSHIP/RANGE D040200 NOT DIGITIZED
% TOWNSHIP/RANGE D040300 NOT DIGITIZED
% TOWNSHIP/RANGE D040400 NOT DIGITIZED
% TOWNSHIP/RANGE D050200 NOT DIGITIZED
% TOWNSHIP/RANGE D050300 NOT DIGITIZED
% TOWNSHIP/RANGE D050400 NOT DIGITIZED
% TOWNSHIP/RANGE D060200 NOT DIGITIZED
% TOWNSHIP/RANGE D060300 NOT DIGITIZED
% TOWNSHIP/RANGE D060400 NOT DIGITIZED

PINAL 4J LATITUDE=32.8354 LONGITUDE=112.1945 TOWNSHIP/RANGE=D070200

(NONE)

PINAL 4K LATITUDE=32.8359 LONGITUDE=112.0916 TOWNSHIP/RANGE=D070300

(NONE)

PINAL 4L LATITUDE=32.8324 LONGITUDE=111.9879 TOWNSHIP/RANGE=D070400

NO.	LATITUDE	LONGITUDE	T/R_LOC	TEMP_(C)	SIO2_(MG/L)	CHALCEDONY	DEPTH_(FT)	TDS_(MG/L)
1	32 47.4000	111 53.6400		31.0	0.0	0.00000	400.0	0.0
2	32 49.0800	111 58.3200		32.0	0.0	0.00000	1410.0	0.0

% TOWNSHIP/RANGE C081900 NOT DIGITIZED
% TOWNSHIP/RANGE C091900 NOT DIGITIZED

YUMA 2A   LATITUDE=32.8584   LONGITUDE=113.4300   TOWNSHIP/RANGE=C071100   AREA IN KM**2= 16.7   VOLUME IN KM**3= 65.0

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 47.8950	113 22.7620	C071127CDD	31.7	52.0	64.67676	590.0	714.0
2	32 48.1800	113 20.5200		39.0	0.0	0.00000	0.0	0.0
3	32 48.2400	113 25.5000		32.5	0.0	0.00000	0.0	0.0

YUMA 2B   LATITUDE=32.8560   LONGITUDE=113.5325   TOWNSHIP/RANGE=C071200

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 49.9880	113 27.1500	C071213BBD	33.3	27.0	43.63739	658.0	2400.0
2	32 49.3770	113 27.7900	C071214DCC	33.3	31.0	49.63727	507.0	731.0
3	32 48.8690	113 32.0140	C071219CAA	33.3	24.0	38.61978	678.0	924.0
4	32 48.9710	113 26.8940	C071224BCD	32.2	38.0	58.80969	495.0	816.0
5	32 48.0000	113 32.2200		31.5	25.0	40.33960	678.0	926.0
6	32 48.0000	113 32.2200		31.0	0.0	0.00000	678.0	0.0
7	32 48.0000	113 32.2200		33.5	24.0	38.61914	678.0	974.0
8	32 48.3000	113 26.8200		32.0	38.0	58.70850	495.0	814.0
9	32 48.5400	113 27.7200		30.0	36.0	55.71425	0.0	2030.0
10	32 48.6600	113 26.5800		33.5	0.0	0.00000	0.0	0.0
11	32 48.6600	113 27.3600		34.0	0.0	0.00000	0.0	0.0
12	32 48.6600	113 27.7800		32.5	28.0	45.23538	507.0	0.0
13	32 48.6600	113 27.7800		33.5	31.0	49.53903	507.0	731.0
14	32 50.4000	113 32.4000		31.0	0.0	0.00000	0.0	0.0

Z TOWNSHIP/RANGE C081100   NOT DIGITIZED
Z TOWNSHIP/RANGE C081200   NOT DIGITIZED

YUMA 3A   LATITUDE=33.1103 LONGITUDE=113.3315 TOWNSHIP/RANGE=C041000 AREA IN KM**2= 95.4 VOLUME IN KM**3= 48.6

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 6.5660	113 16.3510	C041003DAA	33.3	19.0	25.98459	451.0	590.0
2	33 6.9960	113 20.3390	C041006BBB	35.0	49.0	71.02245	45.0	664.0
3	33 6.1370	113 20.3390	C041007BBB	33.9	0.0	0.00000	50.0	0.0
4	33 6.4800	113 16.2600		33.5	19.0	25.97198	451.0	590.0
5	33 7.0200	113 18.7800		36.0	18.0	27.01287	0.0	617.0
6	33 7.0200	113 19.7800		37.5	0.0	0.00000	0.0	0.0
7	33 7.0200	113 19.3800		33.5	0.0	0.00000	0.0	0.0

YUMA 3B   LATITUDE=33.1049 LONGITUDE=113.4332 TOWNSHIP/RANGE=C041100

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 6.6520	113 22.4150	C041102BBB	38.9	61.0	87.28589	530.0	647.0
2	33 6.6520	113 25.4270	C041105BBB	39.4	50.0	72.03165	465.0	537.0
3	33 5.8390	113 20.9050	C041112ABB	37.8	56.0	67.11060	1229.0	657.0
4	33 5.8390	113 21.4110	C041112BBB	35.0	49.0	70.65518	415.0	1250.0
5	33 5.0260	113 24.4230	C041116BBB	30.0	40.0	59.94562	500.0	680.0
6	33 4.2120	113 23.9210	C041121ABB	32.2	80.0	66.88159	1375.0	569.0
7	33 6.6520	113 25.4270	C041105BBB	40.6	0.0	0.00000	46.5	548.0
8	33 6.6520	113 25.4270	C041105BBB	44.4	51.0	73.02655	46.5	510.0
9	33 6.6520	113 25.6780	C041106AAB	37.8	57.0	78.72324	0.0	47.2
10	33 5.8390	113 21.4110	C041112BBB	44.5	0.0	0.00000	41.5	668.0
11	33 3.9000	113 24.4800		30.5	43.0	62.02731	1302.0	461.0
12	33 4.3200	113 23.7000		32.0	80.0	67.01590	1372.0	569.0
13	33 4.3800	113 24.9600		35.0	0.0	0.00000	0.0	0.0
14	33 5.2800	113 24.4800		30.0	65.0	83.38770	500.0	534.0
15	33 5.2800	113 24.4800		30.0	40.0	59.94562	500.0	680.0
16	33 6.1200	113 25.5000		40.0	46.0	67.12628	0.0	606.0
17	33 6.1200	113 20.8800		38.0	56.0	67.07089	1229.0	657.0
18	33 6.1200	113 21.4200		34.5	0.0	0.00000	415.0	0.0
19	33 6.1200	113 21.4200		35.0	49.0	70.65518	415.0	1250.0

YUMA 3C   LATITUDE=33.1029 LONGITUDE=113.5359 TOWNSHIP/RANGE=C041200

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 1.7400	113 30.9600		32.0	0.0	0.00000	0.0	0.0

YUMA 3D   LATITUDE=33.0243 LONGITUDE=113.3316 TOWNSHIP/RANGE=C051000

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 59.5600	113 18.2860	C051016CBC	40.0	42.0	62.75433	0.0	1610.0
2	32 59.4510	113 18.2860	C051016CCB	39.4	0.0	0.00000	8.4	731.0
3	32 59.1800	113 19.5100	C051019AA	37.2	0.0	0.00000	0.0	63.2
4	32 58.6910	113 18.6730	C051020DDD	33.3	42.0	63.51251	1.4	816.0
5	32 57.6000	113 17.7600		35.0	0.0	0.00000	0.0	0.0
6	32 57.6000	113 17.7600		38.5	0.0	0.00000	0.0	0.0
7	32 57.8450	113 17.3400		35.5	0.0	0.00000	1196.0	0.0
8	32 58.6200	113 15.6000		33.5	71.0	75.87856	0.0	581.0
9	32 58.7400	113 18.3000		32.0	45.0	66.29519	0.0	3080.0
10	32 59.3400	113 19.9200		34.5	42.0	63.51251	0.0	619.0
11	32 59.4600	113 18.3000		32.0	45.0	66.29519	0.0	3080.0
12	33 0.0600	113 18.3000		45.0	0.0	0.00000	0.0	0.0

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YUMA 3E   LATITUDE=33.0233 LONGITUDE=113.4332 TOWNSHIP/RANGE=C051100 AREA IN KM**2= 95.4 VOLUME IN KM**3= 48.6

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 1.1410	113 20.8980	C051101DCB	31.7	36.0	56.32343	900.0	608.0
2	33 0.5230	113 22.1550	C051111CAB	36.7	44.0	58.10031	1000.0	599.0
3	33 0.5230	113 21.2750	C051112CBA	31.1	0.0	0.00000	10.0	711.0
4	33 0.0600	113 22.9200		35.5	0.0	0.00000	0.0	0.0
5	33 0.0600	113 22.9200		35.5	0.0	0.00000	0.0	0.0
6	33 0.4200	113 22.0800		36.5	44.0	58.12830	0.0	599.0
7	33 1.7400	113 22.4400		39.0	36.0	56.14487	1000.0	1470.0

YUMA 3F   LATITUDE=33.0211 LONGITUDE=113.5363 TOWNSHIP/RANGE=C051200

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 59.4730	113 29.2700	C051215CAC	33.9	46.0	67.46353	475.0	1400.0
2	32 59.9850	113 29.7870	C051216AAB	32.2	45.0	66.66351	625.0	699.0
3	32 59.1650	113 30.5630	C051221BBB	33.9	47.0	68.95541	445.0	716.0
4	32 56.9170	113 30.1750	C051233CDA	31.1	39.0	56.76791	247.0	503.0
5	32 59.9850	113 29.7870	C051216AAB	32.8	0.0	0.00000	40.0	465.0
6	32 59.9850	113 29.9170	C051216ABA	32.5	0.0	0.00000	42.6	565.0
7	32 59.6780	113 30.0460	C051216ACC	33.1	43.0	64.63760	92.5	438.0
8	32 59.9850	113 30.5630	C051216BBB	37.2	0.0	0.00000	32.9	518.0
9	32 59.0630	113 30.4340	C051221BBD	33.3	55.0	76.87350	26.0	566.0
10	32 59.0630	113 29.5290	C051222BBC	34.4	52.0	74.00775	57.0	653.0
11	32 58.3460	113 29.6580	C051229AAA	33.9	48.0	65.99560	71.5	767.0
12	32 57.5260	113 28.4950	C051235BBB	30.6	39.0	60.01761	48.6	566.0
13	32 58.9200	113 30.4200		33.5	55.0	76.87350	260.0	566.0
14	32 59.1600	113 30.5400		34.0	47.0	67.83783	612.0	715.0
15	32 59.4600	113 29.2800		34.0	46.0	67.46277	475.0	1400.0
16	33 0.0000	113 29.7600		33.5	0.0	0.00000	400.0	0.0
17	33 0.0000	113 29.7600		32.0	0.0	0.00000	0.0	0.0
18	33 0.0000	113 30.1200		35.5	0.0	0.00000	0.0	0.0
19	33 0.0000	113 30.5400		37.0	0.0	0.00000	329.0	0.0
20	33 0.0000	113 30.5400		35.5	0.0	0.00000	0.0	0.0
21	33 0.1800	113 30.2400		42.5	47.0	67.66055	0.0	533.0
22	33 0.1800	113 30.3600		41.0	0.0	0.00000	0.0	0.0
23	33 0.3000	113 30.5400		42.5	47.0	67.66055	0.0	533.0
24	33 0.9000	113 30.5400		31.5	0.0	0.00000	0.0	0.0
25	33 0.9600	113 30.1200		36.0	0.0	0.00000	0.0	0.0
26	33 1.1400	113 30.1800		35.0	0.0	0.00000	0.0	0.0
27	33 1.2000	113 30.5400		30.0	48.0	69.16571	0.0	817.0
28	33 1.4400	113 30.5400		30.0	58.0	79.63098	370.0	550.0
29	33 1.6200	113 30.6600		31.0	0.0	0.00000	0.0	0.0
30	33 1.7400	113 30.9600		32.0	0.0	0.00000	0.0	0.0

YUMA 3G   LATITUDE=32.9374 LONGITUDE=113.3262 TOWNSHIP/RANGE=C061000

(NONE)

YUMA 3H   LATITUDE=32.9408 LONGITUDE=113.4308 TOWNSHIP/RANGE=C061100

(NONE)

YUMA 3I   LATITUDE=32.9390 LONGITUDE=113.5329 TOWNSHIP/RANGE=C061200

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)

YUMA 31 LATITUDE=32.9390 LONGITUDE=113.5329 TOWNSHIP/RANGE=C061200 AREA IN KM**2= 95.4 VOLUME IN KM**3= 48.6

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 56.7000	113 30.1800		31.0	39.0	56.77390	247.0	503.0

YUMA 4A   LATITUDE=33.6292 LONGITUDE=113.7405   TOWNSHIP/RANGE=8031400   AREA IN KM**2= 78.6   VOLUME IN KM**3= 83.6

(NONE)

YUMA 4B   LATITUDE=33.6294 LONGITUDE=113.8443   TOWNSHIP/RANGE=8031500

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 35.4000	113 46.7400		32.0	15.0	20.69003	0.0	463.0

YUMA 4C   LATITUDE=33.6293 LONGITUDE=113.9485   TOWNSHIP/RANGE=8031600

(NONE)

YUMA 4D   LATITUDE=33.7160 LONGITUDE=113.7402   TOWNSHIP/RANGE=8041400

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 39.2400	113 44.8200		31.0	16.0	23.05148	0.0	735.0
2	33 43.3200	113 42.1200		33.0	16.0	19.67563	0.0	280.0

YUMA 4E   LATITUDE=33.7160 LONGITUDE=113.8441   TOWNSHIP/RANGE=8041500

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 42.3600	113 48.1200		30.0	26.0	42.11194	0.0	1500.0
2	33 47.6600	113 47.8200		33.5	0.0	0.00000	0.0	0.0
3	33 43.3800	113 46.3200		34.0	0.0	0.00000	0.0	0.0

YUMA 4F   LATITUDE=33.7153 LONGITUDE=113.9487   TOWNSHIP/RANGE=8041600

(NONE)

YUMA 4G   LATITUDE=33.8027 LONGITUDE=113.7562   TOWNSHIP/RANGE=8051400

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 44.5800	113 45.1200		32.5	0.0	0.00000	0.0	0.0
2	33 44.5800	113 45.1200		33.5	26.0	42.11194	0.0	609.0

YUMA 4H   LATITUDE=33.8029 LONGITUDE=113.8608   TOWNSHIP/RANGE=8051500

(NONE)

YUMA 4I   LATITUDE=33.8025 LONGITUDE=113.9658   TOWNSHIP/RANGE=8051600

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 44.3400	113 52.6800		32.5	26.0	42.11194	1452.0	1270.0

YUMA 4J   LATITUDE=33.8905 LONGITUDE=113.7565   TOWNSHIP/RANGE=8061400

(NONE)

YUMA 4K LATITUDE=33.8906 LONGITUDE=113.8607 TOWNSHIP/RANGE=8061500 AREA IN KM**2= 78.6 VOLUME IN KM**3= 83.6

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 52.9200	113 52.0800		30.0	52.0	72.93295	0.0	0.0

YUMA 4L LATITUDE=33.8904 LONGITUDE=113.9660 TOWNSHIP/RANGE=8061600

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 50.4600	113 53.3400		30.0	32.0	50.58746	1100.0	0.0

YUMA 5A LATITUDE=33.8031 LONGITUDE=113.4438 TOWNSHIP/RANGE=B051100 AREA IN KM**2= 12.8 VOLUME IN KM**3= 23.4

(NONE)

YUMA 5B LATITUDE=33.8028 LONGITUDE=113.5482 TOWNSHIP/RANGE=B051200

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 44.3400	113 32.4600		33.0	22.0	32.39219	0.0	357.0

YUMA 5C LATITUDE=33.8033 LONGITUDE=113.6532 TOWNSHIP/RANGE=B051300

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 47.4000	113 37.6800		30.0	0.0	0.00000	0.0	0.0
2	33 47.8200	113 37.9800		30.0	0.0	0.00000	0.0	0.0
3	33 48.2400	113 34.2600		30.0	0.0	0.00000	0.0	0.0
4	33 48.3000	113 35.5200		30.0	0.0	0.00000	0.0	0.0

YUMA 5D LATITUDE=33.8902 LONGITUDE=113.4435 TOWNSHIP/RANGE=B061100

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 50.8200	113 22.9200		30.4	26.0	42.11194	1000.0	667.0

YUMA 5E LATITUDE=33.8902 LONGITUDE=113.5483 TOWNSHIP/RANGE=B061200

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 51.2870	113 27.2100	B061213DDD	37.0	0.0	0.00000	119.6	0.0
2	33 51.2870	113 27.2100	B061213DDD	37.0	0.0	0.00000	119.6	0.0
3	33 51.2870	113 27.2100	B061213DDD	36.0	0.0	0.00000	119.6	0.0
4	33 49.5600	113 33.3600		36.0	0.0	0.00000	0.0	0.0
5	33 49.6800	113 32.5800		35.0	0.0	0.00000	0.0	0.0
6	33 50.8800	113 32.3400		35.0	0.0	0.00000	0.0	0.0
7	33 50.9400	113 29.2800		30.0	16.0	23.05148	943.0	792.0
8	33 50.9400	113 29.2800		30.0	25.0	40.48151	943.0	306.0
9	33 50.9400	113 29.2800		34.0	0.0	0.00000	0.0	0.0
10	33 51.3000	113 32.5800		34.0	0.0	0.00000	0.0	0.0
11	33 51.3000	113 33.1800		33.0	0.0	0.00000	0.0	0.0
12	33 51.3600	113 27.5400		35.0	0.0	0.00000	0.0	0.0
13	33 51.4200	113 27.1800		35.0	0.0	0.00000	0.0	0.0
14	33 51.4800	113 27.1800		36.0	22.0	31.41685	0.0	350.0
15	33 51.4800	113 27.1800		37.8	21.0	33.43326	1196.0	354.0
16	33 51.4800	113 27.1800		34.0	21.0	31.14035	0.0	362.0

YUMA 5F LATITUDE=33.8905 LONGITUDE=113.6529 TOWNSHIP/RANGE=B061300

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 48.6600	113 33.6000		31.0	23.0	36.52087	0.0	332.0
2	33 48.7200	113 35.1600		31.0	0.0	0.00000	0.0	0.0
3	33 49.0800	113 35.5200		30.0	0.0	0.00000	0.0	0.0
4	33 49.3800	113 34.5000		33.0	21.0	31.18170	0.0	394.0
5	33 49.5600	113 34.9800		33.0	0.0	0.00000	0.0	0.0
6	33 49.5600	113 33.9600		34.0	0.0	0.00000	0.0	0.0
7	33 49.5600	113 35.4600		30.0	0.0	0.00000	0.0	0.0
8	33 49.8000	113 34.4400		35.0	0.0	0.00000	0.0	0.0
9	33 49.9800	113 35.5200		30.0	0.0	0.00000	0.0	0.0
10	33 50.2400	113 33.9600		36.0	0.0	0.00000	0.0	0.0

MOHAVE 1 LATITUDE=34.8639 LONGITUDE=114.1272 TOWNSHIP/RANGE=B171700 AREA IN KM**2= 61.9 VOLUME IN KM**3= 18.6

(NONE)

MARICOPA 1A   LATITUDE=33.4670 LONGITUDE=111.7806   TOWNSHIP/RANGE=A010600   AREA IN KM**2= 54.8   VOLUME IN KM**3= 46.4

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 24.1200	111 42.5400		37.0	43.0	64.63760	357.0	566.0
2	33 24.5400	111 44.8200		34.5	0.0	0.00000	218.0	902.0
3	33 26.2200	111 42.0600		40.0	0.0	0.00000	0.0	0.0

MARICOPA 1B   LATITUDE=33.4674 LONGITUDE=111.6772   TOWNSHIP/RANGE=A010700

(NONE)

MARICOPA 1C   LATITUDE=33.3808 LONGITUDE=111.7831   TOWNSHIP/RANGE=D010600

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 22.3200	111 41.7600		32.0	0.0	0.00000	0.0	0.0
2	33 22.5600	111 41.5800		31.1	34.0	53.73520	510.0	390.0
3	33 22.8000	111 44.0400		30.0	0.0	0.00000	217.0	823.0
4	33 22.8000	111 44.0400		30.0	0.0	0.00000	217.0	823.0
5	33 22.8000	111 44.0400		30.0	0.0	0.00000	217.0	838.0

MARICOPA 1D   LATITUDE=33.3814 LONGITUDE=111.6803   TOWNSHIP/RANGE=D010700

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 21.4800	111 40.2000		32.0	0.0	0.00000	0.0	0.0
2	33 21.9000	111 40.2000		34.0	0.0	0.00000	0.0	0.0
3	33 22.3200	111 38.6400		34.0	0.0	0.00000	0.0	0.0
4	33 22.7400	111 40.1400		34.0	0.0	0.00000	0.0	0.0
5	33 22.7400	111 40.7400		33.0	0.0	0.00000	0.0	0.0

MARICOPA 2A LATITUDE=33.5514 LONGITUDE=112.0919 TOWNSHIP/RANGE=A020300 AREA IN KM**2= 27.0 VOLUME IN KM**3= 69.1

MARICOPA 2B LATITUDE=33.5524 LONGITUDE=111.9776 TOWNSHIP/RANGE=A020400

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 32.1070	111 55.5900	A020411CBC	31.0	37.0	57.26620	518.0	231.0
2	33 31.8890	111 55.0760	A020411DCC	30.0	34.0	53.25937	1003.0	294.0
3	33 31.3440	111 54.1750	A020413CAA	30.0	23.0	36.80078	1020.0	480.0
4	33 30.1450	111 56.1050	A020422CCC	30.0	41.0	61.10153	630.0	1180.0
5	33 30.1450	111 54.6900	A020423CDD	30.0	0.0	0.00000	1200.0	454.0
6	33 30.1450	111 54.6900	A020423DDD	30.0	0.0	0.00000	1200.0	435.0
7	33 30.0360	111 53.6610	A020425AAA	34.0	0.0	0.00000	1200.0	441.0
8	33 30.0360	111 53.6610	A020425AAA	32.0	0.0	0.00000	1200.0	482.0
9	33 30.0360	111 53.7900	A020425AAB	32.0	0.0	0.00000	1325.0	452.0
10	33 30.0360	111 54.0470	A020425ABB	32.0	0.0	0.00000	1200.0	333.0
11	33 30.0360	111 54.0470	A020425ABB	33.0	0.0	0.00000	1200.0	317.0
12	33 29.2730	111 54.1750	A020425CDD	30.0	0.0	0.00000	1200.0	383.0
13	33 29.3820	111 53.9190	A020425DCA	32.0	0.0	0.00000	1205.0	434.0
14	33 29.3820	111 53.9190	A020425DCA	32.0	0.0	0.00000	1205.0	443.0
15	33 29.1640	111 54.8190	A020435AAB	31.0	0.0	0.00000	985.0	739.0
16	33 29.1640	111 54.8190	A020435AAB	31.0	0.0	0.00000	985.0	805.0
17	33 28.8000	111 54.7200		30.0	0.0	0.00000	992.0	0.0
18	33 28.8000	111 54.7200		30.6	0.0	0.00000	985.0	0.0
19	33 28.9200	111 54.0000		30.0	0.0	0.00000	1200.0	0.0
20	33 29.0400	111 53.7600		31.7	0.0	0.00000	500.0	0.0
21	33 29.0400	111 53.7600		32.2	0.0	0.00000	500.0	0.0
22	33 29.2800	111 54.2400		36.7	34.0	52.02444	550.0	703.0
23	33 29.6400	111 53.7000		31.7	0.0	0.00000	1325.0	0.0
24	33 29.6400	111 53.9400		32.8	0.0	0.00000	1200.0	0.0
25	33 29.7000	111 55.9800		30.0	41.0	61.10153	630.0	1180.0
26	33 29.7600	111 54.5400		30.0	0.0	0.00000	1200.0	0.0
27	33 29.7600	111 54.5400		30.0	0.0	0.00000	1200.0	0.0
28	33 30.6600	111 57.0000		30.0	21.0	32.76831	0.0	266.0
29	33 31.0200	111 53.9400		34.4	32.0	51.03409	1020.0	311.0
30	33 31.0200	111 53.9400		30.0	23.0	36.80078	1020.0	480.0
31	33 31.4400	111 54.7800		30.0	34.0	53.25537	1003.0	294.0
32	33 31.7400	111 55.3800		30.6	37.0	57.26946	0.0	231.0
33	33 31.9200	111 54.0600		33.3	0.0	0.00000	1000.0	336.0

MARICOPA 2C LATITUDE=33.5524 LONGITUDE=111.8843 TOWNSHIP/RANGE=A020500

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 30.9160	111 52.8650	A020519ABA	31.0	30.0	48.02130	1106.0	616.0
2	33 29.7000	111 53.4600		33.9	0.0	0.00000	1200.0	0.0
3	33 29.7000	111 53.4600		31.7	0.0	0.00000	1200.0	0.0
4	33 30.4800	111 52.7400		30.6	30.0	48.02261	0.0	616.0
5	33 31.5600	111 52.5000		31.0	0.0	0.00000	0.0	0.0
6	33 32.2800	111 49.3200		32.0	0.0	0.00000	0.0	0.0
7	33 32.2800	111 49.8600		33.0	0.0	0.00000	0.0	0.0
8	33 32.2800	111 50.3400		32.0	0.0	0.00000	0.0	0.0
9	33 32.2800	111 50.5200		34.0	31.0	49.63727	0.0	552.0

MARICOPA 2D LATITUDE=33.6380 LONGITUDE=112.0520 TOWNSHIP/RANGE=A030300

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)

MARICOPA 2D LATITUDE=33.6380 LONGITUDE=112.0920 TOWNSHIP/RANGE=A030300 AREA IN KM**2= 27.0 VOLUME IN KM**3= 68.1

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 36.7120	112 0.5360	A030313BDB	31.0	0.0	0.00000	405.0	310.0
2	33 36.4200	112 0.3600		30.6	0.0	0.00000	330.0	0.0

MARICOPA 2E LATITUDE=33.6388 LONGITUDE=111.9883 TOWNSHIP/RANGE=A030400

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 36.1220	111 57.2560	A030421BAA	33.0	35.0	54.78952	1045.0	278.0
2	33 34.8000	111 54.4800		42.0	20.0	25.88849	0.0	257.0
3	33 35.7600	111 57.1500		30.0	26.0	47.11194	1045.0	220.0
4	33 35.7600	111 57.1800		32.8	35.0	54.79041	1045.0	278.0

MARICOPA 2F LATITUDE=33.6394 LONGITUDE=111.8829 TOWNSHIP/RANGE=A030500

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 35.9260	111 52.6490	A030519ADB	30.0	39.0	59.70615	1158.0	328.0
2	33 35.5800	111 52.6200		30.0	39.0	59.70615	0.0	328.0

MARICOPA 3A   LATITUDE=33.5474 LONGITUDE=112.2985 TOWNSHIP/RANGE=A020100   AREA IN KM**2= 85.8   VOLUME IN KM**3= 55.7

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 32.4700	112 13.3160	A02010200D	30.0	0.0	0.00000	150.0	389.0
2	33 32.4700	112 13.3160	A02010200D	30.0	0.0	0.00000	190.0	804.0
3	33 32.3400	112 13.2600		30.0	0.0	0.00000	0.0	0.0

MARICOPA 3B   LATITUDE=33.5504 LONGITUDE=112.1949 TOWNSHIP/RANGE=A020200

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 31.1400	112 10.5600		43.5	0.0	0.00000	1570.0	403.0
2	33 32.1600	112 11.0400		36.5	0.0	0.00000	1736.0	383.0
3	33 32.7000	112 11.5800		30.0	0.0	0.00000	700.0	233.0
4	33 32.9400	112 11.5800		40.0	0.0	0.00000	1901.0	340.0

MARICOPA 3C   LATITUDE=33.6346 LONGITUDE=112.2998 TOWNSHIP/RANGE=A030100

(NONE)

MARICOPA 3D   LATITUDE=33.6367 LONGITUDE=112.1943 TOWNSHIP/RANGE=A030200

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 34.3200	112 7.5600		32.0	0.0	0.00000	303.0	536.0
2	33 34.8600	112 6.6600		31.7	3.4	-75.01323	1210.0	793.0
3	33 36.6000	112 10.0800		30.0	0.0	0.00000	622.0	0.0
4	33 36.6000	112 10.0800		30.0	23.0	36.53070	0.0	534.0
5	33 37.0200	112 7.5000		30.0	0.0	0.00000	500.0	0.0
6	33 37.9200	112 9.0600		37.8	39.0	59.90479	1903.0	469.0
7	33 37.9200	112 9.0600		37.8	33.0	51.71677	1903.0	477.0

MARICOPA 4A   LATITUDE=33.4616   LONGITUDE=112.4011   TOWNSHIP/RANGE=B010100   AREA IN KM**2= 43.0   VOLUME IN KM**3= 22.9

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 25.5600	112 21.7800		50.0	34.0	42.14819	1500.0	0.0

MARICOPA 4B   LATITUDE=33.4606   LONGITUDE=112.4965   TOWNSHIP/RANGE=B010200

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 23.8700	112 25.5000		30.0	29.0	46.16776	0.0	1270.0
2	33 24.6000	112 27.9000		36.1	32.0	50.90350	907.0	0.0
3	33 26.1000	112 27.6000		46.0	26.0	37.30441	0.0	566.0
4	33 26.1000	112 28.6800		43.3	30.0	6.78528	0.0	0.0
5	33 26.1000	112 28.6800		46.0	0.0	0.00000	0.0	0.0
6	33 26.3400	112 28.7400		40.6	45.0	66.05167	1693.0	0.0
7	33 26.4000	112 28.6200		33.0	24.0	38.07578	0.0	1360.0
8	33 26.7600	112 27.6600		31.0	0.0	0.00000	1450.0	0.0
9	33 27.0600	112 25.5000		45.5	0.0	0.00000	1902.0	0.0
10	33 27.0600	112 27.0600		49.0	0.0	0.00000	1800.0	0.0
11	33 27.0600	112 26.5800		48.5	0.0	0.00000	1800.0	0.0
12	33 27.0600	112 26.5800		32.0	0.0	0.00000	1800.0	0.0
13	33 27.8400	112 26.5800		45.5	38.0	58.64926	1520.0	443.0

MARICOPA 4C   LATITUDE=33.5471   LONGITUDE=112.4017   TOWNSHIP/RANGE=B020100

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 31.4870	112 24.5550	B020118BBB	30.6	0.0	0.00000	112.0	1780.0
2	33 30.6300	112 23.7790	B020119AAB	31.7	0.0	0.00000	72.2	559.0
3	33 30.2010	112 24.5550	B020119CBB	32.2	0.0	0.00000	96.6	670.0
4	33 30.2010	112 24.0380	B020119DBB	31.1	0.0	0.00000	62.7	528.0
5	33 29.3450	112 24.1670	B020130CAA	31.1	0.0	0.00000	56.4	935.0
6	33 29.3450	112 24.1670	B020130CAA	31.1	0.0	0.00000	0.0	97.4
7	33 28.7400	112 24.3000		39.4	0.0	0.00000	914.0	0.0
8	33 28.7400	112 24.3000		40.6	0.0	0.00000	914.0	0.0
9	33 29.1600	112 24.6000		33.0	0.0	0.00000	0.0	0.0
10	33 29.7600	112 22.4400		41.7	0.0	0.00000	740.0	0.0
11	33 29.7600	112 22.4400		51.1	0.0	0.00000	740.0	0.0
12	33 29.7600	112 22.4400		47.2	0.0	0.00000	740.0	0.0
13	33 29.7600	112 22.4400		47.0	0.0	0.00000	0.0	0.0
14	33 29.7600	112 22.4400		56.1	0.0	0.00000	740.0	0.0
15	33 30.0600	112 24.4800		32.0	0.0	0.00000	966.0	0.0
16	33 30.4200	112 23.7600		37.0	0.0	0.00000	0.0	0.0
17	33 30.4200	112 23.7600		31.1	26.0	41.88611	722.0	451.0
18	33 30.4800	112 21.9600		40.0	0.0	0.00000	1044.0	3650.0
19	33 30.4800	112 21.9600		40.0	0.0	0.00000	1044.0	3280.0
20	33 30.4800	112 21.9600		42.0	0.0	0.00000	1044.0	4930.0
21	33 30.4800	112 21.9600		46.1	17.0	24.64474	1044.0	0.0
22	33 30.4800	112 21.9600		48.9	0.0	0.00000	1044.0	0.0
23	33 30.8400	112 20.4000		33.3	0.0	0.00000	0.0	0.0
24	33 31.2600	112 24.4800		31.0	0.0	0.00000	0.0	0.0
25	33 31.8600	112 22.4400		34.4	23.0	33.27303	1200.0	335.0
26	33 31.8600	112 22.4400		31.7	0.0	0.00000	1200.0	0.0
27	33 31.8600	112 22.4400		31.7	22.0	34.17559	1200.0	0.0
28	33 32.2200	112 24.0000		33.3	26.0	41.73526	700.0	289.0
29	33 32.7000	112 22.9800		38.0	8.6	9.81583	0.0	357.0
30	33 32.7000	112 22.9800		38.0	15.0	19.98524	0.0	256.0
31	33 32.7600	112 19.7400		30.6	25.0	40.03870	840.0	475.0
32	33 32.7600	112 19.7400		31.5	36.0	56.27353	840.0	9490.0
33	33 32.8800	112 20.2200		32.2	24.0	38.57827	926.0	654.0

MARICOPA 4C   LATITUDE=33.5471 LONGITUDE=112.4017 TOWNSHIP/RANGE=B020100   AREA IN KM**2= 43.0 VOLUME IN KM**3= 22.9

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
34	33 32.9400	112 22.9200		31.1	28.0	44.77887	1000.0	269.0

MARICOPA 4D   LATITUDE=33.5462 LONGITUDE=112.5059 TOWNSHIP/RANGE=B020200

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 33.1460	112 24.9460	B020201ABA	32.2	0.0	0.00000	105.8	356.0
2	33 31.4340	112 26.7700	B020215AAA	30.0	0.0	0.00000	50.0	257.0
3	33 30.1490	112 25.5980	B020224CBB	31.7	0.0	0.00000	78.8	365.0
4	33 30.1490	112 25.5980	B020224CBB	31.7	0.0	0.00000	0.0	36.6
5	33 30.1490	112 25.0760	B020224DBB	32.8	0.0	0.00000	95.6	559.0
6	33 30.1490	112 25.0760	B020224DBB	32.8	0.0	0.00000	0.0	0.0
7	33 29.2930	112 25.5980	B020225CBB	34.4	0.0	0.00000	70.6	509.0
8	33 29.2930	112 24.6850	B020225DAA	33.3	0.0	0.00000	71.2	792.0
9	33 29.2930	112 24.6850	B020225DAA	33.3	0.0	0.00000	0.0	51.9
10	33 28.9710	112 27.6830	B020227CCC	30.6	0.0	0.00000	50.2	296.0
11	33 28.9710	112 27.6830	B020227CCC	30.6	0.0	0.00000	100.0	0.0
12	33 28.8640	112 25.5980	B020236BBB	32.2	0.0	0.00000	51.0	406.0
13	33 28.3200	112 25.5600		43.3	0.0	0.00000	1750.0	0.0
14	33 28.3200	112 25.5600		43.3	0.0	0.00000	1750.0	0.0
15	33 28.3200	112 25.5600		48.0	0.0	0.00000	1750.0	0.0
16	33 28.6800	112 25.5000		32.0	0.0	0.00000	0.0	0.0
17	33 28.7400	112 28.1400		30.0	24.0	38.80237	920.0	248.0
18	33 28.7400	112 28.1400		30.0	0.0	0.00000	920.0	0.0
19	33 28.7400	112 28.1400		30.0	0.0	0.00000	920.0	0.0
20	33 28.7400	112 28.1400		30.0	0.0	0.00000	920.0	0.0
21	33 28.8000	112 27.5400		30.0	0.0	0.00000	0.0	0.0
22	33 29.1600	112 24.6000		33.0	0.0	0.00000	0.0	0.0
23	33 29.1600	112 25.0200		30.0	0.0	0.00000	275.0	0.0
24	33 29.2200	112 25.0800		30.0	18.0	26.44351	0.0	505.0
25	33 29.2200	112 25.0800		30.0	19.0	28.49771	0.0	508.0
26	33 29.2250	112 25.0800		31.0	19.0	28.20343	0.0	458.0
27	33 29.5800	112 26.7000		40.0	33.0	13.42645	1602.0	274.0
28	33 29.[illegible]400	112 25.5600		32.0	18.0	26.40601	0.0	384.0
29	33 30.5000	112 25.5000		32.0	0.0	0.00000	0.0	0.0
30	33 30.4800	112 27.6000		30.0	25.0	39.60410	1194.0	204.0
31	33 31.3200	112 26.7000		30.0	0.0	0.00000	0.0	0.0
32	33 32.9400	112 26.1000		32.0	18.0	26.62469	0.0	228.0
33	33 33.0600	112 24.9000		32.0	0.0	0.00000	0.0	0.0
34	33 33.0600	112 24.8400		30.0	19.0	29.52872	0.0	296.0
35	33 33.0600	112 25.5600		30.0	19.0	28.22773	1010.0	222.0

MARICOPA 4E   LATITUDE=33.6335 LONGITUDE=112.4016 TOWNSHIP/RANGE=B030100

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 38.3890	112 24.1590	B030106BAA	30.6	0.0	0.00000	50.0	0.0
2	33 33.3890	112 24.1590	B030106BAA	30.6	0.0	0.00000	100.0	268.0
3	33 33.5400	112 23.5800		30.0	0.0	0.00000	0.0	0.0
4	33 33.3050	112 23.2200		32.8	28.0	44.54031	1032.0	344.0
5	33 33.9000	112 24.4800		33.0	0.0	0.00000	0.0	0.0
6	33 33.9600	112 23.0400		34.0	0.0	0.00000	0.0	0.0
7	33 33.9600	112 23.5800		34.0	0.0	0.00000	0.0	0.0
8	33 33.9600	112 22.5600		36.0	0.0	0.00000	0.0	0.0
9	33 34.3200	112 20.4600		30.0	0.0	0.00000	0.0	0.0
10	33 34.3200	112 21.1000		30.0	0.0	0.00000	1000.0	655.0

MARICOPA 4E LATITUDE=33.6335 LONGITUDE=112.4016 TOWNSHIP/RANGE=8030100 AREA IN KM**2= 43.0 VOLUME IN KM**3= 22.9

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
11	33 34.3800	112 21.9000		31.7	28.0	45.05450	650.0	336.0
12	33 34.4400	112 23.5800		33.0	0.0	0.00000	0.0	0.0
13	33 34.7400	112 19.3800		30.5	0.0	0.00000	0.0	0.0
14	33 34.7400	112 19.3900		30.5	0.0	0.00000	0.0	0.0
15	33 34.7400	112 19.3800		30.5	0.0	0.00000	0.0	0.0
16	33 34.7400	112 19.3800		30.5	0.0	0.00000	0.0	0.0
17	33 34.7400	112 19.3800		31.0	0.0	0.00000	0.0	0.0
18	33 34.7400	112 19.3800		31.0	0.0	0.00000	0.0	0.0
19	33 34.7400	112 19.3500		31.0	0.0	0.00000	0.0	0.0
20	33 34.7400	112 19.3500		31.0	0.0	0.00000	0.0	0.0
21	33 34.7400	112 19.3800		31.0	0.0	0.00000	0.0	0.0
22	33 34.7400	112 19.3800		31.0	0.0	0.00000	0.0	0.0
23	33 34.7400	112 19.3800		31.0	0.0	0.00000	0.0	0.0
24	33 34.7400	112 19.3800		31.0	0.0	0.00000	0.0	0.0
25	33 34.7400	112 19.3800		31.0	0.0	0.00000	0.0	0.0
26	33 34.7400	112 19.3800		31.0	0.0	0.00000	0.0	0.0
27	33 34.7400	112 19.3800		31.0	0.0	0.00000	0.0	0.0
28	33 34.7400	112 19.3800		33.0	0.0	0.00000	0.0	0.0
29	33 34.7400	112 19.3800		33.9	12.0	12.70999	638.0	2140.0
30	33 34.8030	112 20.1000		33.0	0.0	0.00000	0.0	0.0
31	33 34.8000	112 20.4600		30.0	0.0	0.00000	0.0	0.0
32	33 34.8000	112 22.5600		32.0	0.0	0.00000	0.0	0.0
33	33 34.8000	112 22.8050		33.0	0.0	0.00000	0.0	0.0
34	33 34.8000	112 23.5400		31.0	0.0	0.00000	0.0	0.0
35	33 35.7000	112 22.5000		34.0	0.0	0.00000	0.0	0.0
36	33 35.7000	112 21.4800		32.0	0.0	0.00000	0.0	0.0
37	33 35.7000	112 23.0400		32.0	0.0	0.00000	0.0	0.0
38	33 36.1200	112 21.7800		35.0	0.0	0.00000	0.0	0.0
39	33 36.1200	112 21.9600		34.0	0.0	0.00000	0.0	0.0
40	33 36.1200	112 23.0400		32.0	0.0	0.00000	0.0	0.0
41	33 36.3500	112 23.5800		35.0	0.0	0.00000	0.0	0.0
42	33 36.5400	112 23.0400		33.0	0.0	0.00000	0.0	0.0
43	33 37.3800	112 22.0200		31.0	0.0	0.00000	0.0	0.0
44	33 37.4430	112 23.0400		33.0	21.0	32.73141	0.0	347.0
45	33 37.4400	112 23.0400		33.0	0.0	0.00000	0.0	0.0
46	33 37.4400	112 24.0600		30.0	0.0	0.00000	0.0	0.0
47	33 37.4490	112 24.5400		39.0	0.0	0.00000	736.0	290.0
48	33 37.9200	112 24.0600		37.2	18.0	24.03464	1203.0	267.0
49	33 37.9200	112 24.0600		32.0	0.0	0.00000	0.0	0.0
50	33 38.1000	112 24.4800		30.0	0.0	0.00000	0.0	0.0
51	33 38.2800	112 24.1200		30.0	0.0	0.00000	0.0	0.0
52	33 38.2800	112 23.0400		31.0	0.0	0.00000	0.0	0.0

MARICOPA 4F LATITUDE=33.6323 LONGITUDE=112.5052 TOWNSHIP/RANGE=8030200

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 38.3130	112 24.6530	8030201AAA	30.0	0.0	0.00000	60.0	287.0
2	33 38.3130	112 24.6530	8030201AAA	30.0	0.0	0.00000	100.0	236.0
3	33 38.3130	112 26.2150	8030202BAA	30.0	0.0	0.00000	65.5	275.0
4	33 38.3130	112 26.2150	8030202DAA	30.0	0.0	0.00000	100.5	192.0
5	33 35.7240	112 26.7360	8030222AAA	30.0	0.0	0.00000	50.0	295.0
6	33 34.8610	112 25.1740	8030225BAA	32.8	0.0	0.00000	50.2	267.0
7	33 34.8610	112 25.1740	8030225DAA	32.8	0.0	0.00000	100.2	185.0
8	33 34.8009	112 25.0500		33.0	0.0	0.00000	0.0	0.0
9	33 34.1800	112 27.1200		41.7	27.0	43.00568	2420.0	209.0

MARICOPA 4F   LATITUDE=33.6323   LONGITUDE=112.5052   TOWNSHIP/RANGE=B030200   AREA IN KM**2= 4[illegible].0   VOLUME IN KM**3= 22.9

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
10	33 36.1800	112 27.1200		39.5	0.0	0.00000	2420.0	0.0
11	33 36.6000	112 27.1200		34.0	0.0	0.00000	1533.0	0.0
12	33 38.2800	112 26.2200		30.0	0.0	0.00000	0.0	0.0

MARICOPA 4G   LATITUDE=33.7188   LONGITUDE=112.4016   TOWNSHIP/RANGE=B040100

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 40.9630	112 24.1620	B040119BAA	31.1	0.0	0.00000	59.0	331.0
2	33 40.9630	112 24.1620	B040119BAA	31.1	0.0	0.00000	108.0	380.0
3	33 40.7510	112 23.5290	B040120BCB	32.8	0.0	0.00000	55.0	428.0
4	33 40.7510	112 23.5290	B040120BC[illegible]	32.8	0.0	0.00000	100.0	337.0
5	33 40.2230	112 23.4020	B040120CCD	33.3	0.0	0.00000	57.7	452.0
6	33 40.2230	112 23.4020	B040120CCD	33.3	0.0	0.00000	119.5	363.0
7	33 40.1170	112 22.1370	B040128BAA	[illegible]	0.0	0.00000	52.4	390.0
8	33 40.1170	112 22.1370	B040128BAA	[illegible]	0.0	0.00000	103.2	358.0
9	33 40.1170	112 22.6430	B040129AAA	32.8	0.0	0.00000	54.8	308.0
10	33 40.1170	112 22.6430	B040129AAA	32.8	0.0	0.00000	108.0	320.0
11	33 39.3770	112 23.9090	B040130DCD	31.1	0.0	0.00000	52.0	376.0
12	33 39.3770	112 23.9090	B040130CCD	31.1	0.0	0.00000	102.5	288.0
13	33 38.9400	112 23.5800		32.0	22.0	33.85599	0.0	322.0
14	33 39.2400	112 23.9400		31.0	0.0	0.00000	520.0	0.0
15	33 40.0200	112 22.6800		33.0	0.0	0.00000	1080.0	0.0
16	33 40.0200	112 22.1400		31.0	0.0	0.00000	524.0	0.0
17	33 40.0200	112 21.5400		41.0	0.0	0.00000	0.0	0.0
18	33 40.0200	112 24.1200		30.0	0.0	0.00000	600.0	0.0
19	33 40.1400	112 23.4000		33.3	0.0	0.00000	577.0	0.0
20	33 40.1400	112 23.4000		33.5	0.0	0.00000	1195.0	0.0
21	33 40.1400	112 23.4000		33.0	0.0	0.00000	1195.0	0.0
22	33 40.6800	112 23.5800		33.0	0.0	0.00000	1000.0	0.0
23	33 40.9700	112 24.1200		31.0	0.0	0.00000	1040.0	0.0
24	33 41.7600	112 21.0000		31.0	0.0	0.00000	0.0	0.0

MARICOPA 4H   LATITUDE=33.7177   LONGITUDE=112.5050   TOWNSHIP/RANGE=B040200

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 39.3270	112 25.7050	B040225DDD	30.6	0.0	0.00000	100.0	190.0
2	33 38.9400	112 25.5600		30.0	18.0	26.17682	0.0	191.0
3	33 39.2400	112 25.6200		30.0	0.0	0.00000	0.0	0.0

MARICOPA 5A   LATITUDE=33.4594   LONGITUDE=112.5996   TOWNSHIP/RANGE=B010300   AREA IN KM**2= 23.8   VOLUME IN KM**3= 37.1

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 24.8400	112 33.8400		30.0	22.0	34.43402	0.0	1000.0

MARICOPA 5B   LATITUDE=33.4588   LONGITUDE=112.7038   TOWNSHIP/RANGE=B010400

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 23.2900	112 37.7400		40.0	0.0	0.00000	1990.0	0.0
2	33 23.5200	112 42.7200		33.0	27.0	30.63367	0.0	368.0

MARICOPA 5C   LATITUDE=33.3734   LONGITUDE=112.5990   TOWNSHIP/RANGE=C010300

(NONE)

MARICOPA 5D   LATITUDE=33.3724   LONGITUDE=112.7025   TOWNSHIP/RANGE=C010400

(NONE)

MARICOPA 6A   LATITUDE=33.3710 LONGITUDE=112.8086 TOWNSHIP/RANGE=C010500 AREA IN KM**2= 75.4 VOLUME IN KM**3= 52.6

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 18.3600	112 44.8800		31.0	25.0	39.91943	0.0	464.0
2	33 18.3600	112 44.8800		30.0	0.0	0.00000	0.0	0.0
3	33 19.1400	112 45.9600		34.0	24.0	37.86583	0.0	696.0
4	33 19.1400	112 45.9600		34.0	0.0	0.00000	0.0	0.0

MARICOPA 6B   LATITUDE=33.3709 LONGITUDE=112.9116 TOWNSHIP/RANGE=C010600

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 20.9040	112 55.1460	C010618BBB	35.0	46.0	67.90433	133.3	1160.0
2	33 18.4800	112 49.9200		34.0	0.0	0.00000	0.0	0.0
3	33 19.5600	112 52.9800		34.0	0.0	0.00000	0.0	0.0
4	33 19.9800	112 54.6500		34.0	0.0	0.00000	0.0	0.0
5	33 20.8900	112 55.0800		35.0	46.0	67.90433	1333.0	1160.0
6	33 20.8800	112 55.0800		34.0	0.0	0.00000	0.0	0.0

MARICOPA 6C   LATITUDE=33.2850 LONGITUDE=112.8086 TOWNSHIP/RANGE=C020500

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 16.3200	112 46.7400		32.0	0.0	0.00000	0.0	0.0

MARICOPA 6D   LATITUDE=33.2845 LONGITUDE=112.9117 TOWNSHIP/RANGE=C020600

(NONE)

MARICOPA 7A LATITUDE=33.4569 LONGITUDE=112.9115 TOWNSHIP/RANGE=B010600 AREA IN KM**2= 65.1 VOLUME IN KM**3= 49.5

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 23.1000	112 51.4800		33.0	0.0	0.00000	0.0	0.0
2	33 23.1000	112 51.4800		33.0	44.0	64.38013	0.0	1170.0
3	33 27.0000	112 53.5200		32.0	25.0	39.03275	0.0	557.0
4	33 27.0000	112 53.5200		30.0	0.0	0.00000	0.0	0.0

MARICOPA 7B LATITUDE=33.4561 LONGITUDE=113.0150 TOWNSHIP/RANGE=B010700

(NONE)

MARICOPA 7C LATITUDE=33.5430 LONGITUDE=112.9114 TOWNSHIP/RANGE=B020600

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 28.3200	112 54.1200		33.0	0.0	0.00000	0.0	0.0
2	33 30.0600	112 54.1200		30.0	26.0	40.32895	0.0	673.0
3	33 30.0600	112 54.1200		30.0	0.0	0.00000	0.0	0.0
4	33 32.6400	112 54.1200		35.0	35.0	52.36890	0.0	461.0

MARICOPA 7D LATITUDE=33.5422 LONGITUDE=113.0145 TOWNSHIP/RANGE=B020700

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 30.7600	112 57.1970	B020714CBB	36.0	32.0	51.03409	60.5	659.0
2	33 29.4710	112 56.2940	B020726AAA	48.0	0.0	0.00000	20.0	890.0
3	33 29.4710	112 56.6810	B020726ABB	44.0	28.0	45.23538	40.0	797.0
4	33 28.3200	112 56.1000		35.0	0.0	0.00000	0.0	0.0
5	33 28.3200	112 56.1000		33.0	0.0	0.00000	0.0	0.0
6	33 28.7400	112 55.9800		37.0	0.0	0.00000	0.0	0.0
7	33 28.7400	112 55.9800		35.0	0.0	0.00000	0.0	0.0
8	33 28.7400	112 55.6200		39.0	30.0	46.03235	0.0	788.0
9	33 28.7400	112 55.6200		37.0	0.0	0.00000	0.0	0.0
10	33 29.1600	112 58.8000		32.0	0.0	0.00000	0.0	0.0
11	33 29.4000	112 55.9800		40.0	0.0	0.00000	0.0	0.0
12	33 29.4000	112 56.7000		37.0	37.0	55.81836	0.0	825.0
13	33 29.4000	112 56.7000		36.0	0.0	0.00000	0.0	0.0
14	33 29.5800	112 56.2800		48.5	0.0	0.00000	200.0	890.0
15	33 29.5800	112 57.4200		33.0	36.0	54.69586	0.0	846.0
16	33 29.5800	112 57.4200		32.0	0.0	0.00000	0.0	0.0
17	33 29.5800	112 56.6400		44.0	28.0	43.78305	0.0	797.0
18	33 29.5800	112 56.6400		44.0	0.0	0.00000	0.0	0.0
19	33 29.5800	112 56.9400		35.0	35.0	52.36890	0.0	660.0
20	33 29.5800	112 56.9400		34.0	0.0	0.00000	0.0	0.0
21	33 29.6400	112 58.9200		33.0	0.0	0.00000	0.0	0.0
22	33 29.6400	112 59.1600		33.0	0.0	0.00000	0.0	0.0
23	33 29.8200	112 57.1800		34.0	37.0	55.46557	0.0	444.0
24	33 30.9000	112 57.1800		35.5	32.0	51.03409	685.0	659.0
25	33 30.9000	112 57.1800		39.0	32.0	49.64713	0.0	592.0
26	33 30.9000	112 57.1800		37.0	0.0	0.00000	0.0	0.0

MARICOPA 8A   LATITUDE=33.3697 LONGITUDE=113.1170 TOWNSHIP/RANGE=C010800 AREA IN KM**2= 95.4 VOLUME IN KM**3= 48.[illegible]

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 21.5400	113 6.5400		32.0	26.0	41.19272	0.0	790.0
2	33 21.7200	113 5.4600		33.0	40.0	59.27561	0.0	701.0

MARICOPA 8B   LATITUDE=33.3692 LONGITUDE=113.2192 TOWNSHIP/RANGE=C010900

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 21.7730	113 8.4770	C010901CCC	33.0	27.0	43.32245	1006.0	64.0
2	33 20.9400	113 9.6000		33.0	29.0	45.97800	0.0	587.0
3	33 21.3600	113 11.6400		30.0	0.0	0.00000	0.0	0.0
4	33 21.7800	113 9.6000		30.0	24.0	37.53430	0.0	820.0
5	33 21.7800	113 7.6200		32.0	0.0	0.00000	0.0	0.0
6	33 21.8400	113 13.2600		44.0	0.0	0.00000	0.0	0.0
7	33 21.8400	113 8.5800		33.0	27.0	43.32245	1006.0	705.0
8	33 21.8400	113 8.5800		34.0	0.0	0.00000	0.0	0.0

MARICOPA 8C   LATITUDE=33.3683 LONGITUDE=113.3223 TOWNSHIP/RANGE=C011000

(NONE)

MARICOPA 8D   LATITUDE=33.4556 LONGITUDE=113.1181 TOWNSHIP/RANGE=B010800

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 27.7130	113 6.6360	B010806AAA	32.0	91.0	96.19254	759.0	0.0
2	33 26.4210	113 7.5350	B010807CBB	41.0	60.0	80.55875	800.0	764.0
3	33 24.8070	113 7.5350	B010819BCC	30.0	49.0	70.85611	700.0	501.0
4	33 25.2600	113 7.5600		32.0	0.0	0.00000	0.0	0.0
5	33 26.5800	113 7.5600		40.5	60.0	80.56555	800.0	764.0
6	33 27.0000	113 6.6600		35.0	46.0	67.19070	0.0	666.0
7	33 27.4800	113 6.6600		35.0	0.0	0.00000	0.0	0.0

MARICOPA 8E   LATITUDE=33.4553 LONGITUDE=113.2216 TOWNSHIP/RANGE=B010900

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 27.6940	113 8.5850	B010901BBB	33.0	73.0	92.09299	153.6	0.0
2	33 26.9410	113 13.7490	B010906CCC	34.0	27.0	43.69650	142.0	659.0
3	33 26.0800	113 13.2330	B010907DCC	34.0	22.0	35.28265	91.5	864.0
4	33 25.9720	113 9.6180	B010914BBB	30.0	130.0	107.84201	1216.0	1060.0
5	33 25.3420	113 12.7160	B010917CBB	36.0	30.0	46.91360	1495.0	631.0
6	33 25.1110	113 12.7160	B010920BBB	32.0	27.0	43.69690	90.0	650.0
7	33 25.1110	113 12.7160	B010920BBB	32.0	0.0	0.00000	90.0	0.0
8	33 24.7880	113 11.6840	B010921BCC	32.0	0.0	0.00000	103.3	0.0
9	33 23.4970	113 11.1670	B010928BCC	31.0	0.0	0.00000	103.0	0.0
10	33 23.4970	113 11.1670	B010928DCC	31.0	36.0	56.07721	1030.0	0.0
11	33 22.6800	113 7.6200		[illegible]	37.0	49.25156	0.0	694.0
12	33 22.6800	113 12.7800		31.0	28.0	44.50516	0.0	703.0
13	33 23.5800	113 11.2200		30.5	0.0	0.00000	1030.0	0.0
14	33 23.5800	113 11.2200		30.5	36.0	56.07941	1030.0	0.0
15	33 24.4200	113 11.7600		30.0	0.0	0.00000	0.0	0.0
16	33 24.4200	113 12.7800		35.0	32.0	50.22116	0.0	641.0
17	33 24.8400	113 11.7600		32.0	0.0	0.00000	1033.0	0.0
18	33 24.9000	113 13.7400		32.0	0.0	0.00000	0.0	0.0
19	33 25.2000	113 12.7800		32.0	27.0	43.69690	900.0	650.0
20	33 25.2000	113 12.7800		32.0	0.0	0.00000	900.0	0.0

MARICOPA 8F LATITUDE=33.4553 LONGITUDE=113.2216 TOWNSHIP/RANGE=B010900 AREA IN KM**2= 95.4 VOLUME IN KM**3= 48.6

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
21	33 25.6800	113 12.7800		35.5	30.0	46.92493	1495.0	631.0
22	33 26.1000	113 8.1000		32.0	46.0	67.22763	0.0	516.0
23	33 26.1600	113 8.6400		37.0	0.0	0.00000	0.0	0.0
24	33 26.1600	113 13.3200		34.0	22.0	35.28265	915.0	864.0
25	33 26.1600	113 8.5800		34.0	0.0	0.00000	0.0	0.0
26	33 26.5800	113 8.5800		32.0	52.0	73.12402	0.0	656.0
27	33 27.0000	113 9.6600		34.0	59.0	79.32519	0.0	738.0
28	33 27.0600	113 7.8000		37.0	0.0	0.00000	0.0	0.0
29	33 27.0600	113 13.6000		34.5	27.0	43.69690	1420.0	659.0
30	33 27.4200	113 9.2400		35.0	0.0	0.00000	0.0	0.0

MARICOPA 8F LATITUDE=33.4545 LONGITUDE=113.3235 TOWNSHIP/RANGE=B011000

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 26.8930	113 14.7550	B011001CCC	31.0	27.0	43.69690	91.0	649.0
2	33 26.8930	113 14.2450	B011001DCC	33.0	0.0	0.00000	80.0	0.0
3	33 26.8930	113 13.9900	B011001DDC	36.0	30.0	48.00409	2010.0	0.0
4	33 26.1600	113 13.8600		35.0	32.0	51.03409	1700.0	0.0
5	33 26.1600	113 13.8600		35.0	0.0	0.00000	0.0	0.0
6	33 27.0600	113 13.8000		34.5	27.0	43.69690	1420.0	659.0
7	33 27.0600	113 14.0400		36.0	30.0	48.00409	2010.0	0.0
8	33 27.0600	113 14.3400		33.5	0.0	0.00000	800.0	0.0
9	33 27.0600	113 14.8200		31.0	27.0	43.69690	915.0	649.0

MARICOPA 8G LATITUDE=33.5418 LONGITUDE=113.1179 TOWNSHIP/RANGE=B020800

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 30.7330	113 5.5880	B020817DAA	32.0	0.0	0.00000	51.9	0.0
2	33 30.7330	113 5.5880	B020817DAA	31.0	44.0	64.08337	510.0	442.0
3	33 28.5860	113 6.6720	B020831AAA	34.0	34.0	53.47955	1218.0	437.0
4	33 28.5860	113 6.3630	B020832BBA	33.0	27.0	43.62239	1720.0	0.0
5	33 27.8400	113 6.6600		37.0	91.0	104.28579	759.0	0.0
6	33 27.8400	113 6.6600		32.0	0.0	0.00000	0.0	0.0
7	33 28.3800	113 6.6000		32.0	0.0	0.00000	0.0	0.0
8	33 28.7400	113 6.3000		33.5	27.0	43.67170	1720.0	0.0
9	33 28.7400	113 6.3000		35.0	0.0	0.00000	0.0	0.0
10	33 28.7400	113 6.3000		35.0	0.0	0.00000	0.0	0.0
11	33 28.7400	113 6.6000		34.0	34.0	53.47955	1219.0	437.0
12	33 29.1600	113 6.5400		34.0	0.0	0.00000	0.0	0.0
13	33 29.2200	113 6.1200		38.0	0.0	0.00000	0.0	0.0
14	33 29.6400	113 6.6600		35.0	30.0	47.57361	0.0	417.0
15	33 30.0600	113 7.5600		35.0	0.0	0.00000	0.0	0.0
16	33 30.9000	113 5.5800		31.5	0.0	0.00000	510.0	0.0
17	33 30.9000	113 5.5400		31.0	44.0	64.08337	0.0	442.0

MARICOPA 8H LATITUDE=33.5412 LONGITUDE=113.2211 TOWNSHIP/RANGE=B020900

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 31.9890	113 11.1370	B020909ABB	34.0	36.0	56.32343	154.0	400.0
2	33 31.9890	113 11.1370	B020909ABB	34.0	0.0	0.00000	1540.0	0.0
3	33 31.5600	113 11.1370	B020909DBB	33.0	39.0	59.88656	1500.0	488.0
4	33 31.5600	113 11.1370	B020909DBA	34.0	43.0	64.50095	1500.0	0.0
5	33 31.9890	113 10.1060	B020910CABB	33.0	38.0	58.72751	1500.0	0.0

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MARICOPA 8H LATITUDE=33.5412 LONGITUDE=113.2211 TOWNSHIP/RANGE=B020900 AREA IN KM**2= 95.4 VOLUME IN KM**3= 48.6

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
6	33 31.9890	113 10.6210	B020910BBB	33.0	0.0	0.00000	130.0	0.0
7	33 31.9890	113 10.6210	B020910BBB	33.0	112.0	110.35281	1300.0	0.0
8	33 31.1300	113 9.1720	B020913BAA	33.0	41.0	62.35804	60.3	432.0
9	33 31.1300	113 8.1720	B020913BAA	32.0	44.0	65.61133	603.0	0.0
10	33 31.1300	113 9.5900	B020914BBB	32.0	38.0	58.80569	153.0	455.0
11	33 31.1300	113 9.5900	B020914BBB	32.0	0.0	0.00000	153.0	0.0
12	33 31.1300	113 9.5900	B020914BBB	32.0	41.0	62.23792	1530.0	460.0
13	33 31.1300	113 9.5900	B020914BBB	33.0	44.0	65.47418	1530.0	124.0
14	33 27.9400	113 8.6400		33.5	73.0	92.09299	1536.0	0.0
15	33 27.8400	113 9.1800		39.0	0.0	0.00000	0.0	0.0
16	33 28.3200	113 10.2000		37.0	50.0	71.07733	0.0	535.0
17	33 28.7400	113 8.6400		33.0	0.0	0.00000	0.0	0.0
18	33 28.9200	113 8.6400		33.0	0.0	0.00000	0.0	0.0
19	33 29.2200	113 8.8800		38.0	33.0	51.53524	0.0	486.0
20	33 31.3200	113 8.1600		33.0	41.0	62.36804	603.0	432.0
21	33 31.3200	113 8.1600		32.0	44.0	65.61133	603.0	0.0
22	33 31.3800	113 9.6600		31.5	38.0	58.80569	1530.0	455.0
23	33 31.3800	113 9.6600		31.5	0.0	0.00000	1530.0	0.0
24	33 31.3800	113 9.6600		32.0	41.0	62.23792	1530.0	460.0
25	33 31.3800	113 9.6600		33.0	44.0	65.47418	1530.0	0.0
26	33 31.3800	113 9.6600		32.0	38.0	57.79065	0.0	703.0
27	33 31.3800	113 9.6600		33.0	37.0	56.93088	0.0	589.0
28	33 31.8000	113 9.6600		35.0	0.0	0.00000	0.0	0.0
29	33 31.8000	113 11.2800		33.5	39.0	59.92577	1500.0	484.0
30	33 31.8000	113 11.2800		34.0	43.0	64.50035	1500.0	0.0
31	33 31.8000	113 11.2800		35.0	0.0	0.00000	0.0	0.0
32	33 32.2200	113 10.1400		33.5	38.0	58.72717	1500.0	0.0
33	33 32.2200	113 10.1400		35.0	0.0	0.00000	0.0	0.0
34	33 32.2200	113 10.7400		33.5	0.0	0.00000	1300.0	0.0
35	33 32.2200	113 10.7400		33.0	112.0	110.35281	1300.0	0.0
36	33 32.2200	113 10.7400		35.0	0.0	0.00000	0.0	0.0
37	33 32.2200	113 11.2800		34.5	36.0	56.32343	1540.0	480.0
38	33 32.2200	113 11.2800		35.0	35.0	54.20556	0.0	520.0
39	33 32.2200	113 9.6600		35.0	38.0	58.80569	1.5	461.0
40	33 32.2200	113 9.6600		34.5	0.0	0.00000	1500.0	0.0
41	33 32.2200	113 9.6600		34.5	41.0	59.59851	1500.0	476.0
42	33 32.2200	113 9.6600		34.5	0.0	0.00000	1500.0	0.0
43	33 32.2200	113 9.6600		35.0	0.0	0.00000	0.0	0.0

MARICOPA 8I LATITUDE=33.5403 LONGITUDE=113.3230 TOWNSHIP/RANGE=B021000

(NONE)

MARICOPA 9A LATITUDE=33.1108 LONGITUDE=113.0222 TOWNSHIP/RANGE=C040700 AREA IN KM**2= 47.7 VOLUME IN KM**3= 74.3

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 1.8100	112 58.4550	C040734CDC	31.0	0.0	0.00000	83.0	0.0
2	33 1.8100	112 58.4550	C040734CDC	31.0	0.0	0.00000	83.0	0.0

MARICOPA 9B LATITUDE=33.1075 LONGITUDE=113.1258 TOWNSHIP/RANGE=C040800

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 2.6050	113 2.9480	C040826DDD	35.0	0.0	0.00000	[illegible]	1420.0
2	33 2.6050	113 2.9480	C040826DDD	35.0	38.0	58.80969	[illegible]	1840.0
3	33 2.1720	113 3.4670	C040835BDD	30.8	66.0	86.52472	[illegible]	2970.0
4	33 2.0640	113 3.3370	C040835DBB	30.3	42.0	63.51251	22.4	1100.0
5	33 1.7400	113 3.5400		30.0	0.0	0.00000	0.0	0.0
6	33 1.9800	113 4.5600		30.0	0.0	0.00000	0.0	0.0
7	33 1.9800	113 2.7600		31.5	0.0	0.00000	0.0	0.0
8	33 2.0400	113 3.3600		31.0	66.0	84.65454	272.0	2870.0
9	33 2.4600	113 2.9400		37.0	0.0	0.00000	0.0	0.0
10	33 2.4600	113 2.7600		35.0	0.0	0.00000	152.0	1420.0
11	33 2.4600	113 2.7600		35.0	47.0	68.95941	152.0	1750.0
12	33 2.4600	113 2.7600		35.0	38.0	58.80969	152.0	1840.0
13	33 2.4600	113 2.7600		34.5	0.0	0.00000	192.0	0.0
14	33 2.4600	113 2.7600		34.5	0.0	0.00000	192.0	0.0
15	33 2.4600	113 2.7600		34.5	0.0	0.00000	192.0	0.0
16	33 2.4600	113 2.7600		34.5	0.0	0.00000	192.0	0.0
17	33 2.4600	113 2.7600		34.5	0.0	0.00000	192.0	0.0
18	33 2.4600	113 2.7600		33.0	37.0	56.93088	0.0	2740.0
19	33 2.4600	113 2.7600		33.0	0.0	0.00000	0.0	0.0
20	33 2.4600	113 2.7600		34.5	0.0	0.00000	192.0	0.0
21	33 2.4600	113 2.7600		34.5	0.0	0.00000	192.0	0.0
22	33 2.4600	113 2.7600		34.5	0.0	0.00000	192.0	0.0
23	33 2.4600	113 2.7600		34.5	0.0	0.00000	192.0	0.0

MARICOPA 9C LATITUDE=33.1110 LONGITUDE=113.2286 TOWNSHIP/RANGE=C040900

(NONE)

MARICOPA 9D LATITUDE=33.0220 LONGITUDE=113.0222 TOWNSHIP/RANGE=C050700

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 1.8100	112 58.4550	C040734CDC	31.0	0.0	0.00000	83.0	0.0
2	33 1.8100	112 58.4550	C040734CDC	31.0	0.0	0.00000	83.0	0.0
3	33 1.6980	112 55.7540	C050701AAA	31.0	36.0	56.32343	70.0	1300.0
4	32 56.8800	112 56.4600		34.0	0.0	0.00000	0.0	0.0
5	33 1.5200	112 55.6700		31.0	36.0	56.32343	700.0	1300.0
6	33 1.7400	112 58.3800		30.5	0.0	0.00000	830.0	0.0

MARICOPA 9E LATITUDE=33.0211 LONGITUDE=113.1259 TOWNSHIP/RANGE=C050800

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 1.7400	113 3.5400		30.0	0.0	0.00000	0.0	0.0

MARICOPA 9F LATITUDE=33.0245 LONGITUDE=113.2288 TOWNSHIP/RANGE=C050900

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)

MARICOPA 9F   LATITUDE=33.0245 LONGITUDE=113.2288 TOWNSHIP/RANGE=C050900   AREA IN KM**2= 47.7 VOLUME IN KM**3= 74.3

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 0.6510	113 8.3940	C050912ACD	32.2	19.0	22.34341	610.0	1240.0
2	33 0.6510	113 8.3940	C050912ACD	32.8	0.0	0.00000	62.0	1350.0
3	33 0.6510	113 8.3940	C050912ACD	32.8	21.0	33.42226	62.0	1330.0
4	33 0.9000	113 8.5800		35.0	0.0	0.00000	0.0	0.0
5	33 0.2400	113 8.4000		32.0	0.0	0.00000	0.0	0.0
6	33 0.4200	113 8.3400		33.0	21.0	33.41119	615.0	1330.0
7	33 0.4200	113 8.3400		32.0	19.0	22.37085	615.0	1240.0

MARICOPA 9G   LATITUDE=32.9374 LONGITUDE=113.0175 TOWNSHIP/RANGE=C060700

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 54.7700	112 57.3000		32.5	0.0	0.00000	0.0	0.0
2	32 54.7800	112 56.8200		31.0	20.0	27.14615	0.0	1080.0
3	32 54.7800	112 56.8200		31.0	0.0	0.00000	0.0	0.0
4	32 54.8400	112 56.2800		33.0	26.0	39.73311	0.0	1030.0
5	32 55.7800	112 56.8200		30.5	0.0	0.00000	0.0	0.0
6	32 55.8000	112 56.8200		31.0	33.0	50.46750	0.0	1120.0
7	32 55.6200	112 56.2200		30.0	0.0	0.00000	0.0	0.0
8	32 55.6200	112 57.3000		32.5	0.0	0.00000	0.0	0.0
9	32 56.0400	112 56.8200		33.0	0.0	0.00000	0.0	0.0
10	32 56.0400	112 55.8500		30.0	30.0	45.86557	0.0	998.0

MARICOPA 9H   LATITUDE=32.9367 LONGITUDE=113.1195 TOWNSHIP/RANGE=C060800

(NONE)

MARICOPA 9I   LATITUDE=32.9370 LONGITUDE=113.2238 TOWNSHIP/RANGE=C060900

(NONE)

MARICOPA 10A   LATITUDE=33.2872 LONGITUDE=112.6077 TOWNSHIP/RANGE=C020300   AREA IN KM**2= 8.9 VOLUME IN KM**3=182.7

(NONE)

MARICOPA 10B   LATITUDE=33.2865 LONGITUDE=112.7035 TOWNSHIP/RANGE=C020400

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 13.1470	112 37.5670	C020425CCC	36.0	0.0	0.00000	85.5	0.0
2	33 13.7800	112 37.9860	C020426ADD	34.0	0.0	0.00000	51.2	0.0
3	33 13.6720	112 38.2240	C020426DBA	32.0	31.0	49.39870	428.0	932.0
4	33 13.6720	112 38.2240	C020426DBA	34.0	0.0	0.00000	60.0	0.0
5	33 13.0230	112 40.8400	C020432ADA	33.0	29.0	46.74203	45.0	1530.0
6	33 13.0230	112 40.8400	C020432ADA	34.0	0.0	0.00000	45.0	0.0
7	33 12.8070	112 41.3160	C020432CAA	33.0	29.0	46.74203	46.0	1430.0
8	33 12.8070	112 41.3160	C020432CAA	36.0	0.0	0.00000	46.0	0.0
9	33 13.0230	112 40.6020	C0204338CA	34.0	0.0	0.00000	99.7	0.0
10	33 12.4560	112 40.6740	C030404BAA	32.0	29.0	46.74203	25.0	1680.0
11	33 12.4560	112 40.6740	C030404BAA	32.0	0.0	0.00000	25.0	0.0
12	33 12.6000	112 41.5800		33.0	29.0	46.74203	460.0	1430.0
13	33 12.7800	112 41.1600		34.0	29.0	46.74203	450.0	1530.0
14	33 13.0200	112 40.4400		37.0	0.0	0.00000	0.0	0.0
15	33 13.0800	112 37.8600		36.0	0.0	0.00000	0.0	0.0
16	33 13.6200	112 38.5800		31.5	31.0	49.39883	428.0	932.0

MARICOPA 10C   LATITUDE=33.2850 LONGITUDE=112.8086 TOWNSHIP/RANGE=C020500

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 16.3200	112 46.7400		32.0	0.0	0.00000	0.0	0.0

MARICOPA 10D   LATITUDE=33.2845 LONGITUDE=112.9117 TOWNSHIP/RANGE=C020600

(NONE)

MARICOPA 10E   LATITUDE=33.2015 LONGITUDE=112.6082 TOWNSHIP/RANGE=C030300

(NONE)

MARICOPA 10F   LATITUDE=33.2013 LONGITUDE=112.7113 TOWNSHIP/RANGE=C030400

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 12.4560	112 40.6740	C030404BAA	32.0	29.0	46.74203	25.0	1680.0
2	33 12.4560	112 40.6740	C030404BAA	32.0	0.0	0.00000	25.0	0.0
3	33 12.1300	112 40.6740	C030404BDD	31.5	29.0	46.74203	49.2	1500.0
4	33 11.5870	112 40.6740	C030409BAA	31.0	0.0	0.00000	49.0	0.0
5	33 11.5870	112 40.6740	C030409BAA	30.0	0.0	0.00000	49.0	0.0
6	33 11.5870	112 40.6740	C030409BAA	30.0	0.0	0.00000	490.0	0.0
7	33 11.5870	112 40.6740	C030409BAA	31.0	0.0	0.00000	490.0	0.0
8	33 11.5870	112 40.6740	C030409BAA	31.0	0.0	0.00000	490.0	0.0
9	33 10.6090	112 38.0510	C030414AAC	31.0	0.0	0.00000	60.0	0.0
10	33 11.3400	112 40.5600		30.5	27.0	[illegible]	0.0	2323.0
11	33 11.3400	112 40.5600		30.5	0.0	0.00000	490.0	0.0
12	33 11.3400	112 40.5600		30.0	0.0	0.00000	490.0	0.0
13	33 11.3400	112 40.5600		30.5	0.0	0.00000	490.0	0.0
14	33 11.3400	112 40.5600		[illegible]	0.0	0.00000	490.0	0.0
15	33 11.3400	112 40.5600		[illegible]	0.0	0.00000	490.0	0.0

MARICOPA 10F   LATITUDE=33.2013 LONGITUDE=112.7113 TOWNSHIP/RANGE=C030400   AREA IN KM**2= 8.9 VOLUME IN KM**3=182.7

NO.	LATITUDE	LONGITUDE	T/R_LOC	TEMP_(C)	SIO2_(MG/L)	CHALCEDONY	DEPTH_(FT)	TDS_(MG/L)
16	33 11.8800	112 40.5600		31.0	0.0	0.00000	0.0	0.0
17	33 12.1200	112 40.5600		31.5	29.0	46.74203	250.0	1680.0

MARICOPA 10G   LATITUDE=33.2013 LONGITUDE=112.8150 TOWNSHIP/RANGE=C030500

(NONE)

MARICOPA 10H   LATITUDE=33.1999 LONGITUDE=112.9197 TOWNSHIP/RANGE=C030600

(NONE)

MARICOPA 10I   LATITUDE=33.1152 LONGITUDE=112.6076 TOWNSHIP/RANGE=C040300

(NONE)

MARICOPA 10J   LATITUDE=33.1144 LONGITUDE=112.7109 TOWNSHIP/RANGE=C040400

NO.	LATITUDE	LONGITUDE	T/R_LOC	TEMP_(C)	SIO2_(MG/L)	CHALCEDONY	DEPTH_(FT)	TDS_(MG/L)
1	33 7.2430	112 42.5920	C040406ABB	30.0	0.0	0.00000	35.0	0.0
2	33 7.2430	112 39.4890	C040403ABB	30.0	0.0	0.00000	35.0	0.0
3	33 5.1830	112 39.4890	C040415ACC	33.0	0.0	0.00000	97.7	0.0
4	33 4.7490	112 39.1000	C040415DDD	31.0	36.0	56.32343	846.0	1450.0
5	33 4.7490	112 39.1000	C040415DDD	30.0	0.0	0.00000	84.6	0.0
6	33 3.0150	112 39.2300	C040427DDC	30.0	0.0	0.00000	93.6	0.0
7	33 2.7980	112 39.2300	C040434AAC	30.0	0.0	0.00000	95.3	0.0
8	33 3.9000	112 39.0000		30.0	0.0	0.00000	0.0	0.0
9	33 4.3800	112 39.0000		31.0	36.0	56.22552	846.0	1450.0
10	33 6.9000	112 39.3600		30.0	0.0	0.00000	350.0	0.0

MARICOPA 10K   LATITUDE=33.1133 LONGITUDE=112.8146 TOWNSHIP/RANGE=C040500

(NONE)

MARICOPA 10L   LATITUDE=33.1121 LONGITUDE=112.9197 TOWNSHIP/RANGE=C040600

NO.	LATITUDE	LONGITUDE	T/R_LOC	TEMP_(C)	SIO2_(MG/L)	CHALCEDONY	DEPTH_(FT)	TDS_(MG/L)
1	33 3.6470	112 53.6940	C040629AAA	30.0	28.0	45.23538	94.8	1640.0
2	33 3.6470	112 53.6940	C040629AAA	30.0	33.0	52.02493	948.0	1830.0
3	33 3.6470	112 53.6940	C040629AAA	30.0	0.0	0.00000	948.0	0.0
4	33 3.6470	112 53.6940	C040629AAA	31.0	0.0	0.00000	948.0	0.0
5	33 3.6470	112 53.6940	C040629AAA	31.0	0.0	0.00000	94.8	0.0
6	33 3.4200	112 53.5200		30.5	28.0	45.23528	948.0	1640.0
7	33 3.4200	112 53.5200		30.5	33.0	52.02151	948.0	1830.0
8	33 3.4200	112 53.5200		30.0	0.0	0.00000	948.0	0.0
9	33 3.4200	112 53.5200		30.5	0.0	0.00000	948.0	0.0

MARICOPA 10M   LATITUDE=33.0285 LONGITUDE=112.6069 TOWNSHIP/RANGE=C050300

NO.	LATITUDE	LONGITUDE	T/R_LOC	TEMP_(C)	SIO2_(MG/L)	CHALCEDONY	DEPTH_(FT)	TDS_(MG/L)

MARICOPA 10M LATITUDE=33.0285 LONGITUDE=112.6069 TOWNSHIP/RANGE=C050300 AREA IN KM**2= 8.9 VOLUME IN KM**3=182.7

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 1.1160	112 35.8390	C050308BBC	32.0	21.0	33.43326	0.0	133.0

MARICOPA 10N LATITUDE=33.0279 LONGITUDE=112.7092 TOWNSHIP/RANGE=C050400

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 1.7290	112 39.4080	C050403ACC	30.0	0.0	0.00000	98.6	0.0
2	33 1.4040	112 39.5370	C050403CDA	30.0	0.0	0.00000	84.1	0.0
3	33 0.4280	112 40.0500	C050409DDD	30.0	0.0	0.00000	140.0	0.0
4	33 1.0780	112 39.6650	C050410BAC	33.0	34.0	53.60544	1031.0	1420.0
5	33 1.0780	112 39.6650	C050410BAC	32.0	0.0	0.00000	103.1	0.0
6	33 0.6450	112 39.9710	C050410CBC	31.0	0.0	0.00000	113.3	0.0
7	32 57.1760	112 42.7420	C050431CAC	35.0	32.0	51.03409	174.6	1210.0
8	32 57.1760	112 42.7420	C050431CAC	42.0	39.0	60.01761	174.6	1060.0
9	33 0.3600	112 39.8400		31.5	0.0	0.00000	0.0	0.0
10	33 1.0800	112 39.4800		33.0	34.0	53.60544	841.0	1420.0
11	33 1.0800	112 39.4800		31.5	0.0	0.00000	0.0	0.0
12	33 1.5600	112 39.9000		30.5	0.0	0.00000	0.0	0.0
13	33 1.8000	112 39.9[illegible]		30.0	0.0	0.00000	0.0	0.0
14	33 1.8600	112 39.24[illegible]		30.0	0.0	0.00000	0.0	0.0

MARICOPA 10P LATITUDE=33.0270 LONGITUDE=112.8141 TOWNSHIP/RANGE=C050500

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 58.2600	112 43.2600		30.0	21.0	32.37549	0.0	1220.0
2	32 58.2600	112 46.9200		30.5	0.0	0.00000	0.0	0.0
3	32 58.4400	112 45.1800		30.0	24.0	38.25626	0.0	1090.0
4	32 58.7400	112 46.6200		33.0	33.0	51.90146	0.0	1330.0
5	32 58.7400	112 46.6200		31.0	0.0	0.00000	0.0	0.0

MARICOPA 10Q LATITUDE=33.0253 LONGITUDE=112.9197 TOWNSHIP/RANGE=C050600

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 56.8200	112 55.4400		31.0	32.0	47.96277	0.0	925.0
2	33 1.6200	112 55.6200		31.0	36.0	56.32343	700.0	1300.0

MARICOPA 10R LATITUDE=32.9421 LONGITUDE=112.6050 TOWNSHIP/RANGE=C060300

(NONE)

MARICOPA 10S LATITUDE=32.9414 LONGITUDE=112.7081 TOWNSHIP/RANGE=C060400

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 53.0630	112 41.3870	C060429ACC	31.0	34.0	53.73520	30.2	1220.0
2	32 52.6200	112 41.2200		30.5	34.0	53.73520	302.0	1220.0
3	32 56.8200	112 42.7800		41.5	39.0	60.01761	1746.0	1060.0
4	32 56.8200	112 42.7800		35.0	32.0	51.03409	1746.0	1210.0
5	32 56.8200	112 42.7800		48.5	0.0	0.00000	1752.0	0.0

MARICOPA 10T LATITUDE=32.9403 LONGITUDE=112.8113 TOWNSHIP/RANGE=C060500 AREA IN KM**2= 8.9 VOLUME IN KM**3=182.7

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 56.5830	112 44.2260	C060502AD5	33.0	44.0	65.31577	1000.0	1770.0
2	32 56.5830	112 44.2260	C060502AD9	35.0	0.0	0.00000	100.0	0.0
3	32 56.4750	112 44.7420	C060502ADC	38.0	31.0	49.55292	985.0	1390.0
4	32 56.2580	112 45.9040	C060503CB9	34.0	0.0	0.00000	100.0	0.0
5	32 56.1500	112 46.5450	C060504DC5	34.0	0.0	0.00000	106.1	0.0
6	32 53.5540	112 44.0970	C060523DDA	30.0	31.0	49.40518	405.0	1060.0
7	32 53.3370	112 43.9680	C060525D99	31.0	39.0	59.89154	400.0	1080.0
8	32 55.5600	112 47.5800		32.0	38.0	57.52411	0.0	1180.0
9	32 55.5600	112 47.5800		32.0	0.0	0.00000	0.0	0.0
10	32 55.8000	112 47.1000		34.0	0.0	0.00000	0.0	0.0
11	32 55.8500	112 46.3200		35.0	0.0	0.00000	0.0	0.0
12	32 55.9200	112 45.7200		33.0	29.0	45.77853	0.0	1070.0
13	32 55.9200	112 45.7200		35.0	0.0	0.00000	0.0	0.0
14	32 56.1600	112 44.7050		38.0	31.0	49.55292	985.0	1390.0
15	32 56.1600	112 44.7000		37.0	0.0	0.00000	0.0	0.0
16	32 56.1600	112 44.1600		33.0	44.0	65.31577	1000.0	1770.0
17	32 56.1600	112 44.1600		35.5	0.0	0.00000	0.0	0.0
18	32 56.4600	112 43.5600		40.0	42.0	57.23276	0.0	1090.0
19	32 56.4600	112 43.5600		41.3	0.0	0.00000	0.0	0.0

MARICOPA 10U LATITUDE=32.9388 LONGITUDE=112.9153 TOWNSHIP/RANGE=C060600

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 54.7200	112 50.4690		32.0	37.0	56.56717	0.0	1000.0

MARICOPA 10V LATITUDE=32.8325 LONGITUDE=112.6066 TOWNSHIP/RANGE=C070300

(NONE)

MARICOPA 10V LATITUDE=32.8315 LONGITUDE=112.7095 TOWNSHIP/RANGE=C070400

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	32 50.2110	112 39.3440	C070403AB	31.0	35.0	55.04269	38.5	1290.0

MARICOPA 10W LATITUDE=32.8306 LONGITUDE=112.8123 TOWNSHIP/RANGE=C070500

(NONE)

MARICOPA 10X LATITUDE=32.8290 LONGITUDE=112.9136 TOWNSHIP/RANGE=C070600

(NONE)

MARICOPA 11A   LATITUDE=33.2888 LONGITUDE=112.4019 TOWNSHIP/RANGE=C020100   AREA IN KM**2=247.7 VOLUME IN KM**3= 74.3

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 15.5520	112 23.6110	C020118DAA	36.0	28.0	45.21429	958.0	1780.0
2	33 14.6910	112 23.6110	C020119DAA	33.0	24.0	38.77954	0.0	1210.0
3	33 15.1220	112 23.0950	C020120BAA	33.0	30.0	47.90152	1549.0	1900.0
4	33 14.6910	112 22.8370	C020120DBA	36.0	26.0	42.05017	717.0	1960.0
5	33 13.7730	112 21.5470	C020128DAB	37.0	25.0	40.43213	805.0	1610.0
6	33 14.2610	112 23.2240	C020129BAB	35.0	79.0	64.34201	809.0	1450.0
7	33 13.8310	112 22.5790	C020129DAA	36.0	105.0	44.11282	936.0	1400.0
8	33 13.8310	112 23.8690	C020130DBA	34.0	55.0	73.09381	600.0	1080.0
9	33 13.1850	112 22.5790	C020132ADA	35.0	23.0	36.77563	880.0	1010.0
10	33 12.8400	112 22.5600		35.0	23.0	36.77563	880.0	1010.0
11	33 12.8400	112 22.5600		35.0	0.0	0.00000	0.0	0.0
12	33 12.8400	112 23.8200		37.0	0.0	0.00000	0.0	0.0
13	33 13.0700	112 21.5400		37.0	0.0	0.00000	0.0	0.0
14	33 13.0700	112 21.9600		38.0	19.0	28.93643	0.0	1140.0
15	33 13.3200	112 22.5600		36.0	0.0	0.00000	0.0	0.0
16	33 13.3700	112 24.5400		34.0	18.0	26.91571	0.0	760.0
17	33 13.3800	112 21.5400		36.7	25.0	40.43249	805.0	1610.0
18	33 13.5000	112 22.5600		35.6	100.0	42.88055	936.0	1400.0
19	33 13.5000	112 23.0400		36.0	0.0	0.00000	0.0	0.0
20	33 13.5000	112 23.8200		33.9	55.0	73.10062	600.0	1080.0
21	33 13.5000	112 23.8200		34.0	0.0	0.00000	0.0	0.0
22	33 13.9700	112 23.1600		35.0	79.0	64.34201	809.0	1450.0
23	33 13.9200	112 22.1400		38.0	0.0	0.00000	0.0	0.0
24	33 14.3400	112 22.8000		35.6	26.0	42.05060	717.0	1960.0
25	33 14.4000	112 23.5800		32.8	24.0	38.77960	0.0	1210.0
26	33 14.5700	112 18.7300		37.0	39.0	59.73773	0.0	1050.0
27	33 14.6400	112 23.5800		38.0	0.0	0.00000	0.0	0.0
28	33 14.7600	112 24.1200		33.0	20.0	30.64325	0.0	1250.0
29	33 14.8200	112 23.1000		32.8	30.0	47.90259	1549.0	1900.0
30	33 15.1200	112 23.5200		35.6	28.0	45.21468	958.0	1780.0
31	33 15.6600	112 24.5400		32.0	0.0	0.00000	0.0	0.0

MARICOPA 11B   LATITUDE=33.2881 LONGITUDE=112.5044 TOWNSHIP/RANGE=C020200

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 15.6200	112 25.6640	C020214ADD	32.0	25.0	40.30119	992.0	1260.0
2	33 15.6200	112 28.9050	C020217ADC	31.0	25.0	40.41107	1002.0	1010.0
3	33 14.3290	112 27.0930	C020222DCC	31.0	29.0	45.26199	1250.0	685.0
4	33 14.3290	112 26.5710	C020223CCC	31.0	20.0	31.51730	126.3	783.0
5	33 13.8980	112 26.0530	C020226ACC	32.0	92.0	73.95441	1100.0	957.0
6	33 13.4680	112 26.5710	C020226CCC	32.0	30.0	47.82889	1031.0	1060.0
7	33 13.7910	112 27.6090	C020227C99	32.0	44.0	65.57690	1055.0	929.0
8	33 13.4680	112 27.6090	C020227CCC	36.0	30.0	48.07916	940.0	857.0
9	33 13.4680	112 27.2200	C020227CDD	35.0	26.0	42.03418	1084.0	1230.0
10	33 12.6070	112 25.0150	C020236DCC	32.0	22.0	35.17267	875.0	603.0
11	33 13.0800	112 26.5200		33.3	27.0	43.54733	1031.0	834.0
12	33 13.0800	112 26.5200		31.7	30.0	47.83050	1031.0	1060.0
13	33 13.0800	112 26.5200		34.0	21.0	31.14035	0.0	861.0
14	33 13.0800	112 26.5200		35.0	21.0	32.51624	0.0	949.0
15	33 13.0800	112 26.5200		33.0	20.0	29.29333	0.0	924.0
16	33 13.1400	112 27.4800		35.6	30.0	48.08665	940.0	857.0
17	33 13.1400	112 27.4800		37.0	0.0	0.00000	0.0	0.0
18	33 13.1400	112 27.1800		35.6	26.0	42.03470	1084.0	1230.0
19	33 13.3700	112 24.5400		34.0	18.0	26.91571	0.0	760.0
20	33 13.3200	112 26.9400		34.0	0.0	0.00000	0.0	0.0
21	33 13.4400	112 27.4800		31.7	44.0	65.57779	1055.0	925.0

MARICOPA 11B   LATITUDE=33.2881 LONGITUDE=112.5044 TOWNSHIP/RANGE=C020200   AREA IN KM**2=247.7 VOLUME IN KM**3= 74.3

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
22	33 13.4400	112 27.4800		35.0	0.0	0.00000	0.0	0.0
23	33 13.6200	112 26.0400		31.7	92.0	74.16260	1100.0	957.0
24	33 13.9800	112 27.1200		30.6	29.0	45.27271	1250.0	685.0
25	33 13.9800	112 26.5800		30.6	20.0	31.51730	1263.0	783.0
26	33 13.9800	112 26.5800		30.6	98.0	85.65213	1263.0	846.0
27	33 13.9800	112 26.5800		33.0	0.0	0.00000	0.0	0.0
28	33 14.8800	112 25.5000		32.0	0.0	0.00000	0.0	0.0
29	33 15.2400	112 28.8600		30.6	25.0	40.41159	1002.0	1010.0
30	33 15.3000	112 25.6200		31.7	35.0	54.84625	992.0	1260.0
31	33 15.3000	112 25.6200		31.0	0.0	0.00000	0.0	0.0
32	33 15.6600	112 24.5400		32.0	0.0	0.00000	0.0	0.0
33	33 15.8400	112 26.8200		30.0	24.0	38.58560	0.0	1090.0
34	33 16.2000	112 24.6000		30.0	21.0	32.59479	0.0	1180.0
35	33 16.2000	112 28.2000		30.0	0.0	0.00000	0.0	0.0

MARICOPA 11C   LATITUDE=33.2029 LONGITUDE=112.4014 TOWNSHIP/RANGE=C030100

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 7.9200	112 21.9000		30.0	21.0	33.10104	0.0	602.0
2	33 12.2400	112 21.9000		34.0	0.0	0.00000	0.0	0.0

MARICOPA 11D   LATITUDE=33.2020 LONGITUDE=112.5049 TOWNSHIP/RANGE=C030200

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 12.2400	112 25.9800		33.0	23.0	36.84457	0.0	683.0
2	33 12.2400	112 24.9600		31.7	22.0	35.17325	875.0	603.0

MARICOPA 12A LATITUDE=33.2929 LONGITUDE=111.8870 TOWNSHIP/RANGE=0020500 AREA IN KM**2=41[illegible] VOLUME IN KM**3=123.[illegible]

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 13.3700	111 49.4400		44.0	31.0	49.26480	0.0	51[illegible].0
2	33 16.7400	111 50.4600		31.5	23.0	36.93192	0.0	1010.0

MARICOPA 12B LATITUDE=33.2942 LONGITUDE=111.7832 TOWNSHIP/RANGE=0020600

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 14.0400	111 41.6400		30.0	0.0	0.00000	500.0	438.0
2	33 14.0400	111 41.6400		30.5	39.0	60.01761	900.0	468.0
3	33 14.0400	111 41.6400		30.6	0.0	0.00000	900.0	0.0
4	33 14.0400	111 41.6400		30.0	0.0	0.00000	900.0	0.0
5	33 14.0400	111 41.6400		30.0	0.0	0.00000	900.0	0.0
6	33 14.0400	111 41.6400		34.4	0.0	0.00000	900.0	0.0
7	33 14.0400	111 41.6400		34.4	0.0	0.00000	900.0	0.0
8	33 14.0400	111 41.6400		31.9	0.0	0.00000	900.0	0.0
9	33 14.1600	111 43.7400		30.0	0.0	0.00000	0.0	0.0
10	33 14.4600	111 41.6400		30.0	0.0	0.00000	0.0	0.0
11	33 15.3600	111 42.1800		30.0	34.0	53.25937	0.0	439.0
12	33 15.3600	111 42.1800		31.5	0.0	0.00000	0.0	0.0

MARICOPA 12C LATITUDE=33.2955 LONGITUDE=111.6794 TOWNSHIP/RANGE=0020700

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 13.2000	111 41.1600		37.5	0.0	0.00000	0.0	0.0
2	33 13.5600	111 41.1600		37.0	26.0	40.84485	0.0	392.0
3	33 13.5600	111 41.1600		37.0	0.0	0.00000	0.0	0.0
4	33 14.0400	111 38.0400		30.0	0.0	0.00000	0.0	0.0
5	33 14.0400	111 38.8200		30.0	0.0	0.00000	0.0	0.0
6	33 14.2800	111 35.4600		30.0	0.0	0.00000	0.0	0.0
7	33 14.3400	111 39.0600		31.0	0.0	0.00000	0.0	0.0
8	33 15.7800	111 37.2600		30.0	0.0	0.00000	0.0	0.0
9	33 15.9600	111 41.1600		30.0	0.0	0.00000	600.0	0.0
10	33 17.1600	111 38.1000		30.0	0.0	0.00000	0.0	0.0
11	33 17.4600	111 37.0800		31.5	0.0	0.00000	0.0	0.0

% TOWNSHIP/RANGE 0020800 NOT DIGITIZED
% TOWNSHIP/RANGE 0030500 NOT DIGITIZED
% TOWNSHIP/RANGE 0030600 NOT DIGITIZED
% TOWNSHIP/RANGE 0030700 NOT DIGITIZED
% TOWNSHIP/RANGE 0030800 NOT DIGITIZED

MARICOPA 13A LATITUDE=33.8866 LONGITUDE=113.1316 TOWNSHIP/RANGE=B060800 AREA IN KM**2=206.4 VOLUME IN KM**3= 61.9

(NONE)

MARICOPA 13B LATITUDE=33.8857 LONGITUDE=113.2361 TOWNSHIP/RANGE=B060900

(NONE)

MARICOPA 13C LATITUDE=33.8852 LONGITUDE=113.3406 TOWNSHIP/RANGE=B061000

(NONE)

MARICOPA 13D LATITUDE=33.9727 LONGITUDE=113.1310 TOWNSHIP/RANGE=B070800

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 54.4800	113 5.9400		32.0	0.0	0.00000	0.0	0.0
2	33 55.2600	113 7.5000		32.0	0.0	0.00000	0.0	0.0
3	33 56.6400	113 6.6000		36.0	0.0	0.00000	0.0	0.0
4	33 56.6400	113 6.8400		36.0	25.0	37.33264	0.0	337.0
5	33 56.9400	113 6.7800		37.0	0.0	0.00000	0.0	0.0

MARICOPA 13E LATITUDE=33.9719 LONGITUDE=113.2353 TOWNSHIP/RANGE=B070900

NO.	LATITUDE	LONGITUDE	T/R LOC	TEMP (C)	SIO2 (MG/L)	CHALCEDONY	DEPTH (FT)	TDS (MG/L)
1	33 58.6900	113 12.4860	B07090+BBB	34.0	0.0	0.00000	165.0	291.0
2	33 58.2600	113 12.4860	B070904CBB	32.0	0.0	0.00000	165.0	274.0
3	33 56.6400	113 12.9000		31.0	0.0	0.00000	0.0	0.0
4	33 57.1830	113 12.6600		31.0	0.0	0.00000	0.0	0.0
5	33 57.4200	113 9.6600		35.0	26.0	42.11194	717.0	235.0
6	33 57.9000	113 9.5400		30.0	0.0	0.00000	0.0	0.0
7	33 58.3200	113 9.9600		30.0	0.0	0.00000	0.0	0.0
8	33 58.3200	113 10.5600		30.0	0.0	0.00000	0.0	0.0
9	33 58.6800	113 12.5400		33.0	0.0	0.00000	0.0	0.0
10	33 58.7400	113 12.4800		31.7	0.0	0.00000	1650.0	333.0
11	33 58.7400	113 12.4800		32.2	0.0	0.00000	1650.0	274.0

MARICOPA 13F LATITUDE=33.9713 LONGITUDE=113.3408 TOWNSHIP/RANGE=B071000

(NONE)

ARIZONA REPORT - PART B

GEOTHERMAL DIRECT HEAT USE
MARKET POTENTIAL/PENETRATION ANALYSIS
ARIZONA

Larry A. Goldstone

October 1979

University of Arizona
Tucson, Arizona

A-74 INTENTIONALLY BLANK

GEOTHERMAL DIRECT HEAT USE MARKET POTENTIAL/PENETRATION ANALYSIS

ARIZONA

Introduction

The following analysis represents a preliminary attempt to define the potential market for geothermal energy within Arizona. The tables presented summarize total 1975 energy consumption and energy use by the State's industrial and residential/commercial sectors. Projected energy use is shown for selected years until 2020 for these sectors. For each of these years, the total possible potential market capture for geothermal energy is defined for the industrial and residential/commercial sectors as well as a forecast capture of these markets. The reader should be given an idea of the impact geothermal energy could have under certain special conditions.

The assumptions used in compiling this information will be outlined in the remainder of this report. Modelling methods for the category "Forecast Geothermal Capture" have not been refined to reflect Arizona's unique energy situation. The mining industry was not considered as a potential market nor was industrial space conditioning. Each of these sectors currently consume substantial amounts of energy within the State; clearly they are important markets for geothermal applications.

Methodology and assumptions

In any study where the objective is to model future activity, certain assumptions must be made about the future. A lack of assumptions is usually desirable, but to present results a minimum number of assumptions is required. Thus this section attempts to define all the assumptions used in formulating the following tables. The techniques employed reflect a simple methodology, rather than a sophisticated computer modeling.

Tables 1 through 5 provide a capsulated view of Arizona's energy situation as well as an estimate of geothermal market penetration between 1975 and 2020. The markets considered are limited to 1) the demand for industrial process heat, and 2) residential/commercial demand for space conditioning and hot water.

Table 1 presents a one page summary of results of this study. Shown in the table is growth in total energy consumption plus growth in the industrial and residential/commercial sectors over the next 45 years.

The basis of the energy projections is population growth. Population has been assumed to grow at a compound rate of four percent per year between 1975 and 2020. Many demographers within the state predict Arizona's future population growth to range somewhere between two percent and three percent, whereas the historical rate has been over five percent per year. Consequently, a midpoint value of four percent has been selected.

The energy consumption data for 1975 and 1985 were taken from a study by Dr. Helmut Frank of the Division of Economic and Business Research, University of Arizona (1). The 1975 values represent preliminary figures for that year. The values given for the industrial and residential/commercial sectors are net of energy consumption used for transportation. The 1985 values, also from Dr. Frank's study, represent conservation case values. When generating the remaining state energy use values, compound annual growth rate between 1975 and 1985 was assumed to continue to 2020. These rates are four percent, four percent and 4.55 percent for residential/commercial, industrial and total use, respectively. It should be noted that the values for the years 2000 and 2020 compare favorably with other long range energy use forecasts for Arizona, though the methodology is less sophisticated.

The remaining values for "Potential Geothermal Capture" and "Forecast Geothermal Capture" were taken from other tables which follow the "Regional Hydrothermal Forecast" table. Methods used to derive these numbers will be described shortly.

Table 2, "Arizona Energy Use by County for 1975", is referred to as a bottom-up approach to energy use by the industrial and residential/commercial sectors. In each county (except for Gila, Navajo and Yavapai) an estimate was made of how much industrial process heat could be supplied by geothermal energy, given the assumed average reservoir temperature in each county. These data were developed using the employment data reported in the Arizona Directory of Manufacturers for 1979 (2) and data from the Solar Energy Research Institute (3), which provided estimates of annual energy consumption by four digit SIC code and the process temperatures needed by these industries (4). This procedure enabled the locations of potential industrial users and geothermal resources to be matched. The industrial section of Table 2 is a list of the matching industries and an estimate of their annual process heat energy consumption.

As a qualification, it must be noted that the mining industry's process energy requirements are not included, even though copper mining accounts for fifty percent of industrial energy consumption. Moreover, it has been shown that low-to-moderate temperature geothermal energy may be integrated in the solution mining process, resulting in a fossil fuel savings over conventional solution mining techniques. Industrial demand for space conditioning is also excluded from this analysis, even though twenty-eight percent of industrial energy consumption, net of transportation needs, is used for space conditioning. These two points are significant in that the use of a geothermal resource requires a large initial capital investment only economical for large users of energy who can afford such an investment.

Referring back to Table 2, a discussion of the estimates of residential/commercial energy use and space conditioning demand is required. Again, it was necessary to make some simplifying assumptions which may not be universally true. For example, it was assumed that the percentage of heating and cooling required was the same for all counties in Arizona. However, Southern Arizona's demand for space cooling is much greater than that for Northern Arizona. The reverse is true for space heating. It should also be noted that space cooling requires electricity, whereas space heating requires petroleum products and natural gas. No attempt has been made to assess the relative merits of electricity savings versus natural gas savings. However, the electricity generation cycle is only thirty-five percent to forty percent efficient, while home furnaces have been shown to be sixty-five percent efficient (5).

In deriving estimates for residential/commercial total energy use and space conditioning, the following procedure was used. First, it was necessary to estimate the number of households in each county in Arizona. This was accomplished by using the Arizona Department of Economic Security's county population estimates for 1975. It was assumed that there are 2.8 persons per household, thus we can compute the number of households in each county. By knowing total residential energy consumption in Arizona net of transportation, an average annual consumption value for each household was computed. This value was found to be 150 million Btu per year. Multiplying this value times the number of households in a given county gives a total residential energy use estimate for that county. However, this only generates an estimate for residential consumption. Thus, it also becomes necessary to estimate total commercial energy consumption. This was accomplished by computing a statewide ratio of residential consumption to commercial consumption. The 1975 ratio is assumed to hold for all counties until 2020. Thus, commercial consumption for any county is defined as:

$$E_C = \frac{E_R}{.85}$$

where E_C = estimated commercial consumption

E_R = estimated residential consumption

Again, both of these values are net of transportation. The sum of the two values ($E_C + E_R$) is therefore the estimated residential/commercial energy consumption for counties.

A subset of total energy consumption is energy consumption for space conditioning and water heating. It was found that the residential sector consumed a larger percentage of its total energy for space conditioning and water heating than did the commercial sector. In fact, the following relations were found: For the residential sector, thirty-five percent of total energy consumed was for space heating, twenty percent was for space cooling and twenty-eight percent for water heating (6). Thus, eighty-three percent of residential energy consumption net of transportation was consumed for space comfort and hot water. In the commercial sector, a similar total relationship was found, but the component parts were quite different. Commercial consumption for space heat accounted for fifty-eight percent of the total while space cooling was nine percent and water heating required six percent (7).

Thus seventy-three percent of total commercial energy consumption was used for space conditioning and water heating. By applying these percentages to respective total energy use, an estimate of space conditioning and water heating energy consumption for each county was derived. These values appear in Table 2 in aggregate form.

The 1975 values presented in the Growth Projection Calculation Table (Table 3) are a compilation of the industrial section of the County Energy Use Table. The basic underlying assumption is that increased employment results directly in increased energy consumption. The growth rates shown are taken from employment projections done by the Arizona Department of Economic Security (8), and represent projections at the two digit SIC level. Where growth rates were not provided, one percent per year was assumed. Therefore, the projected growth does not fully reflect new growth within the industrial sector of the economy. However, the table does conservatively project growth in demand for process heat which could be supplied by geothermal energy.

These projections, therefore, represent the total potential market penetration that could be attained by geothermal energy. Two shortcomings must be pointed out. First, the potential market for geothermal energy is not as limited as this study may indicate. No mention has been made of potential agricultural or aquacultural applications, and as has been mentioned, mining and industrial space conditioning markets have not been quantitatively defined. Second, it has been assumed that moderate temperature geothermal energy can be used to space cool. Further, it would be prohibitively costly for an individual home-owner to tap a geothermal resource for private use, even if space cooling technology were available.

With these shortcomings in mind, Tables 4 and 5 attempt to model geothermal market penetration over the next forty-five years. It is assumed that retrofit of existing industrial facilities in the proces heat market will occur at a rate of one percent per year beginning in 1980, not to exceed 25% of the 1980 market. In the space conditioning market, it is assumed that retrofit will occur at a rate of 1% per year beginning in 1983, not to exceed 25% of the 1983 market. Market penetration for process heat is assumed to be 30% of new growth while market penetration in the residential/commercial market is assumed to be 20% of new growth.

Many factors will be involved in the eventual market penetration of geothermal energy in Arizona. Not all of these factors have been accounted for within this study. It is known that geothermal resources are present in Arizona, but temperature and depth data are lacking.

However, the successful demonstration of geothermal utilization could increase the rate of market penetration in the years ahead. Thus, the Arizona Geothermal Planning Team will pursue its goal of commercialization of geothermal energy. Such planning will be helpful in eventual development plans.

FOOTNOTES

(1) Arizona Energy Inventory: 1977 A Report on the State's Energy Position and Outlook to 1985. Prepared by Dr. Helmut J. Frank, University of Arizona under contract with the Office of Economic Planning and Development of the State of Arizona, February 1977.

(2) 1979 Directory of Arizona Manufacturers. Compiled by the Economic Development Department of the Phoenix Metropolitan Chamber of Commerce. Published by Valley National Bank of Arizona, 1979.

(3) Industrial Process Heat Demand. Solar Energy Research Institute Draft, Ken Brown, 1978.

(4) Some of these calculations were provided by New Mexico Energy Institute. See table for information provided by them.

(5) Tucson Electric Power Co., Personal Communication, September, 1979.

(6) 1977 Arizona Energy Flow, Office of Energy Programs, State of Arizona, 1979.

(7) Ibid.

(8) Arizona Occupational Profiles, Arizona Department of Economic Security, 1978, 1979.

TABLE 1: REGIONAL HYDROTHERMAL FORECAST - ARIZONA

STATE	1975 (Btu x 10^{12})		1985 (Btu x 10^{12})			2000 (Btu x 10^{12})			2020 (Btu x 10^{12})		
	State Energy Use (1)	Potential Geoth. Capture	State Energy Use (1)	Potential Geoth. Capture	Forecast Geoth. Capture	State Energy Use	Potential Geoth. Capture	Forecast Geoth. Capture	State Energy Use	Potential Geoth. Capture	Forecast Geoth. Capture
Arizona (4%)	614.4		959.0			1868.8			4550.2		
Indust.	142.9	5.031	211.5	7.22	.610	380.9	13.012	3.102	834.7	30.992	8.748
R/C	259.5	199.690	384.1	295.59	15.994	691.8	295.590	104.337	1515.8	1166.42	253.017
TOTALS	402.4	204.721	595.6	302.81	16.604	1072.7	308.602	107.439	2350.5	1197.412	261.765

(1) Arizona Energy Inventory: 1977 A Report on the States Energy Position and Outlook to 1985; Dr. Helmut [illegible]nk, 1977.

TABLE 2: ARIZONA ENERGY USE BY COUNTY

County	Assumed Average Reservoir Temp. °C	INDUSTRIAL: Standard Industrial Code (SIC)	INDUSTRIAL: Energy Use Btu/yr x 10^{12}	RESIDENTIAL/COMMERCIAL: Total * Energy Used (Btu/yr x 10^{12})	RESIDENTIAL/COMMERCIAL: Energy used for Space conditioning and water heating (Btu/yrx10^{12})
Apache**		2421	0.003	4.9	3.8
		2431	0.0005		
	95	3273	0.0001		
		3281	0.0003		
		3999	0.0003		
		SUBTOTALS	0.004	4.9	3.8
Cochise**	70	3273	0.000008	8.62	6.69
Coconino	50	no match		7.33	5.67
Gila				3.77	2.93
Graham	105	2086	.02772	2.26	1.76
		3949	.0083		
		SUBTOTALS	0.03602	2.26	1.76
Greenlee	125	no match		1.37	1.11
Maricopa		2016	0.0035	140.75	109.21
		2021	0.0879		
		2024	0.1856		
	110	2026	0.0679		
		2063	0.208		
		2065	0.0013		
		2086	0.4402		
		2097	0.0164		
		2421	0.0449		
		2431	0.1042		
		2441	0.0187		
		2491	0.0082		
		2499	0.0142		
		2511	0.0577		
		2512	0.0082		
		2515	0.0367		
		2519	0.0003		
	110	2521	0.0005		

TABLE 2: ARIZONA ENERGY USE OF COUNTY

County	Assumed Average Reservoir Temp. °C	INDUSTRIAL		RESIDENTIAL/COMMERCIAL	
		Standard Industrial Code (SIC)	Energy use Btu/yrx10^{12}	Total * Energy Used (Btu/yrx10^{12}	Energy used for space conditioning and water heating (Btu/yrx10^{12})
Maricopa (cont)		2541	0.0497		
		2542	0.0148		
		2591	0.0040		
		2599	0.0063		
		2822	0.0776		
		3111	0.0135		
		3161	0.0003		
		3171	0.0002		
		3172	0.0389		
		3199	0.0015		
		3273	0.2241		
		3281	0.0040		
		3411	0.0442		
		3423	0.0073		
		3429	0.0937		
		3431	0.0067		
		3432	0.0040		
		3433	0.0062		
		3441	0.1278		
		3442	0.0343		
	110	3443	0.0183		
		3444	0.4344		
		3449	0.0708		
		3451	0.0260		
		3452	0.0327		
		3471	0.1138		
		3479	0.0503		
		3496	0.0023		
		3499	0.0381		
		3519	0.0141		
		3713	0.0147		
		3751	0.0026		
		3811	0.0242		
		3949	0.0782		
		3953	0.0021		
		3961	0.0005		
	110	3962	0.0003		
		3999	0.0214		
		SUBTOTALS	3.0780	140.75	109.21

TABLE 2: 1975 ARIZONA ENERGY USE BY COUNTY

County	Assumed Average Reservoir Temp. °C	INDUSTRIAL		RESIDENTIAL/COMMERCIAL	
		Standard Industrial Code (SIC)	Energy use Btu/yrx10^{12}	Total * Energy Used (Btu/yrx10^{12}	Energy used for space conditioning and water heating (Btu/yrx10^{12})
Mohave**	110	2434	0.00004	4.37	3.4
		2499	0.0010		
		2512	0.001		
		2590	0.0015		
		3079	0.0004		
		3273	0.0061		
		3451	0.002		
		SUBTOTALS	0.01208	4.37	3.4
Navajo				6.86	5.31
Pima	100	2026	0.0081	51.63	40.05
		2086	0.0995		
		2097	0.0039		
		2431	0.0188		
		2499	0.0351		
		2511	0.0038		
		2515	0.0021		
		2519	0.0011		
		2522	0.0491		
		2591	0.0035		
		3161	0.0051		
		3171	0.0010		
		3273	0.0554		
		3281	0.0015		
		3441	0.0424		
		3442	0.0179		
		3443	0.0037		
		3444	0.1459		
		3449	0.0366		
		3452	0.0050		
		3471	0.0077		
	100	3496	.00009		
		3499	.0112		
		3811	.0039		
		3841	.0168		
		3843	.0004		
		3911	.0005		
		3914	.0108		
		3949	.006		
		3953	.0011		
		3999	.1663		
		SUBTOTAL	.7644	51.63	40.05

TABLE 2: 1975 ARIZONA ENERGY USE BY COUNTY

County	Assumed Average Reservoir Temp. °C	INDUSTRIAL		RESIDENTIAL/COMMERCIAL	
		Standard Industrial Code (SIC)	Energy use Btu/yrx10^{12}	Total * Energy Used (Btu/yrx10^{12})	Energy used for space conditioning and water heating (Btu/yrx10^{12})
Pinal**	105	2048	.323	9.77	7.59
		2086	.0016		
		2099	.0033		
		2451	.0025		
		2519	.1802		
		2599	.1395		
		2750	.0006		
		3273	.0058		
		3441	.0164		
		3443	.0014		
		3499	.4526		
		3911	.0003		
		SUBTOTAL	1.127	9.77	7.59
Santa Cruz	65	no match		2.00	1.55
Yavapai				5.90	4.58
Yuma**	75	2097	.0007	7.79	6.04
		2511	.0004		
		3299	.0085		
		SUBTOTAL	.0096	7.79	6.04
STATE TOTALS			5.031	259.50	199.69

** Process heat demand information provided by NMEI.

* Numbers will not add due to rounding

TABLE 3: INDUSTRIAL GROWTH PROJECTION CALCULATIONS - ARIZONA

SIC	Growth Rate *	Btu x 10^{10} 1975 Energy Use	1985 Energy use	2000 Energy Use	2020 Energy Use
2016	2.4	.354	.449	.640	1.029
2021	2.4	8.790	11.143	15.903	25.556
2024	2.4	18.564	23.53	33.587	53.972
2026	2.4	7.605	9.640	13.759	22.110
2048	2.4	32.266	40.902	58.377	93.809
2063	2.4	20.800	26.367	37.632	60.473
2065	2.4	.128	.162	.232	.372
2086	2.4	56.902	72.132	102.95	165.434
2097	2.4	2.094	2.654	3.788	6.088
2099	2.4	.334	.423	.604	.971
2421	1.0	4.765	5.264	6.111	7.456
2431	1.0	12.357	13.650	15.847	19.336
2434	1.0	.004	.005	.005	.006
2441	1.0	1.873	2.069	2.402	2.931
2451	1.0	.25	.276	.321	.391
2491	1.0	.820	.906	1.052	1.283
2499	1.0	5.035	5.562	6.457	7.879
2511	2.16	6.186	7.660	10.554	16.183
2512	2.16	.921	1.140	1.571	2.409
2515	2.16	3.877	4.801	6.615	10.142
2519	2.16	18.159	22.485	30.982	47.504
2521	2.16	.050	.062	.085	.131
2522	2.16	4.911	6.081	8.379	12.847
2541	2.16	4.972	6.157	8.483	13.007
2542	2.16	1.481	1.834	2.527	3.874
2590	2.16	.150	.186	.256	.392
2591	2.16	.750	.929	1.280	1.962
2599	2.16	14.583	18.057	24.881	38.149
2750	1.88	.06	.072	.096	.139
2822	1.12	7.761	8.675	10.253	12.811
3079	4.32	.04	.061	.115	.268
3111	1.0	1.345	1.486	1.725	2.105
3161	1.0	.547	.604	.701	.856
3171	1.0	.113	.125	.145	.177
3172	1.0	3.888	4.295	4.986	6.084
3199	1.0	.149	.165	.191	.233
3273	2.88	29.149	38.720	59.279	104.596
3281	2.88	.579	.769	1.177	2.078
3299	2.88	.850	1.129	1.729	3.050
3411	5.6	4.424	7.629	17.275	51.369
3423	5.6	.731	1.261	2.854	8.488
3429	5.6	9.368	16.154	36.580	108.773
3431	5.6	.675	1.164	2.636	7.837
3432	5.6	.400	.690	1.562	4.644
3433	5.6	.617	1.064	2.409	7.164
3441	5.6	18.667	32.189	72.891	216.746

TABLE 3 (cont)

SIC	Growth Rate *	Btu x 10^{10} 1975 Energy Use	1985 Energy Use	2000 Energy Use	2020 Energy Use
3442	5.6	5.218	8.998	20.375	60.587
3443	5.6	2.339	4.033	9.133	27.158
3444	5.6	58.028	100.064	226.587	673.773
3449	5.6	10.747	18.532	41.965	124.785
3451	5.6	2.798	4.825	10.926	32.488
3452	5.6	3.767	6.496	14.709	43.739
3471	5.6	12.145	20.943	47.424	141.018
3479	5.6	5.027	8.669	19.629	58.369
3496	5.6	.237	.409	.925	2.752
3499	5.6	50.184	86.538	195.958	582.695
3519	1.44	1.406	1.622	2.010	2.675
3713	3.20	1.470	2.014	3.231	6.066
3751	3.20	.259	.355	.569	1.069
3811	3.76	2.805	4.057	7.058	14.767
3822	3.76	.475	.687	1.195	2.501
3841	3.76	2.829	4.092	7.118	14.893
3342	3.76	.334	.483	.840	1.758
3843	3.76	.0413	.060	.104	.217
3861	3.76	4.583	6.629	11.532	24.127
3911	3.32	.526	.729	1.190	2.287
3914	3.32	1.083	1.501	2.450	4.709
3949	3.32	9.246	12.817	20.920	40.202
3953	3.32	.32	.444	.724	1.391
3961	3.32	.054	.075	.122	.235
3962	3.32	.030	.042	.068	.130
3999	3.32	18.798	26.059	42.533	81.735
		503.088	721.951	1301.179	3099.240

* Department of Economic Security. Labor Market Information Publication of Arizona, 1978 & 1979.

TABLE 4: INDUSTRIAL PROCESS HEAT - ARIZONA

Potential Geoth. Capture	1975 (Btu x 10^{12})	1985 (Btu x 10^{12})	2000 (Btu x 10^{12})	2020 (Btu x 10^{12})
11 Counties evaluated (Out of 14)	5.031	7.220	13.012	30.992
0% Per Capita Increase	0	0	0	0
0% Per Capita Stimulation	0	0	0	0
0% New Discovery	0	0	0	0
TOTAL	5.031	7.220	13.012	30.992
Forecast Geoth. Capture				
Retrofit	0	.252	1.006	1.258
New Growth Capture	0	.358	2.096	7.490
TOTAL	0	.610	3.102	8.748

TABLE 5: RESIDENTIAL/COMMERCIAL SPACE CONDITIONING - ARIZONA

Potential Geoth. Capture	1975 (Btu x 10^{12})	1985 (Btu x 10^{12})	2000 (Btu x 10^{12})	2020 (Btu x 10^{12})
14 Counties Evaluated *	199.69	295.59	532.34	1166.42
14 Counties Considered	0	0	0	0
0% Per Capita Increase	0	0	0	0
0% New discovery	0	0	0	0
TOTAL	199.69	295.59	532.34	1166.42
Forecast Geoth. Capture				
Retrofit	0	5.466	46.459	68.323
New Growth	0	10.528	57.878	184.694
TOTAL	0	15.994	104.337	253.017

* Growth projected at 4% compounded annually

CALIFORNIA REPORT

California Market Potential
for Direct-Heat Use of
Geothermal Energy

prepared for
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RPA

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RPA

Introduction

As part of the Department of Energy's continuing assessment of energy resources, the Division of Geothermal Resource Manager (DGRM) is refining estimates of the market potential for direct-heat use of geothermal energy in a four-state region. Although the geothermal resource potential in the four states (Arizona, California, Hawaii, and Nevada) is significant, the price of geothermal energy and the associated technical and institutional factors affect the rate of commercial use of this energy source. Resource Planning Associates, Inc. (RPA) was asked to estimate the market potential and the market penetration rate for direct-heat use of geothermal energy in California. Our analysis covers the period from 1976 to 2020.

California has approximately 50 percent of the estimated geothermal resource potential for nonelectric applications in the four-state region being examined by DGRM. The United States Geological Survey (USGS) estimates that approximately two quadrillion Btus of medium-temperature hydrothermal resources have been identified within the state. These resources are concentrated in 20 out of 58 California counties and, potentially, could be used for direct-heat applications such as space conditioning and industrial process heating. In addition to these medium-temperature reservoirs, numerous areas of low-temperature surface waters have been identified, and these reservoirs could also be used to meet California's direct-heat energy requirements. However, no estimates have been made of the total available energy from these low-temperature, hydrothermal resources.*

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* California also has the 13 major high-temperature systems that comprise nearly 85 percent of the four-state region's high-temperature resources, with estimated electrical potential of 12,200 MWe for 30 years.

We determined the proportion of the total geothermal resources which could be used in California by estimating the technically-suitable market which is comprised of four end-use sectors: residential and commercial, industrial, agricultural, and military. We estimate that the total technically-suitable market for direct-heat use of geothermal in the 20 identified counties is approximately 83 trillion Btus in 1980, increasing to 143 trillion Btus in 2020. This demand would require only seven percent of total available resources in 2020. The residential/commercial and the industrial sectors each account for nearly half of this demand, which is concentrated in southern counties such as San Diego, Imperial, San Bernardino, Riverside and Ventura. However, with the exception of Imperial County, most of the state's geothermal resources are concentrated in northern counties such as Lake, Lassen, Modoc and Plumas.

Penetration of this technically-suitable market by cost-competitive geothermal energy will not occur immediately upon commercialization of the energy source and the associated technology. Rather, the use of geothermal energy will increase slowly over time as its deliverability is proven and it gains consumer acceptance. Consequently, the estimated market potential of geothermal energy in the state is 436 billion Btus in 1980, increasing to 43,135 billion Btus in 2000 and 100,216 billion Btus in 2020. Geothermal energy will capture less than one percent of the technically-suitable market in 1980 increasing to seventy percent in 2020.

We calculated the market potential for direct-heat use of geothermal energy in California by analyzing the geothermal resource base and, for those counties believed to have geothermal resources, estimating the total technically-suitable market demand. These demand estimates are an initial attempt at determining the realistic size of the direct-heat market in California. Next, we made estimates of the proportion of this market that will be captured by geothermal energy.

We discuss our estimates of the market demand for geothermal energy in nonelectric applications in Chapter 1 and present our estimates of the market potential for geothermal energy in Chapter 2. In Appendix A, we describe our methodology for estimating demand and in Appendix B, we show our county-by-county estimates of resource potential, market demand and market potential.

1 TECHNICALLY-SUITABLE MARKET POTENTIAL

The market for direct-heat use of geothermal energy in California appears to be constrained by demand rather than by resource. That is, the extensive geothermal resources of the state are located primarily in remote, mountainous, or desert areas and are often within national and state parks and forests. Because the efficient and economic use of this energy requires that it be consumed within a 20-to-50 kilometer (i.e., 10-to-30 mile) radius, the technically-suitable market in 1980 is less than one percent of the current total demand for energy in California.

The technically-suitable market potential for direct-heat use of geothermal energy in California is that portion of total demand which is co-located with the geothermal resources and which can be met by medium- and low-temperature geothermal resources. To estimate this potential, we identified resource potential by county and projected demand in these counties co-located with the resource.

RESOURCE POTENTIAL

California has abundant geothermal resources, nearly 75 percent of the total identified resources in the four-state region. These resources are found in the Coast Range Mountains, in the volcanic mountains of northern California, along the eastern slope of the Sierra Nevada, and throughout the deserts of southern California. Twenty of California's fifty-eight counties have some identified geothermal resources with estimated temperatures ranging from 30^0C to well over 250^0C (Exhibit 1.a shows those counties having geothermal resource potential).

Current United States Geological Survey (USGS) estimates show that California has nearly 12,200 MWe for 30-year potential for electric applications (or 26.53 quadrillion Btus of beneficial heat for direct-heat use) from the 13 identified high-temperature (i.e., greater than 150^{0}C) reservoirs. The USGS has not made detailed estimates of available work from low-temperature (i.e., 90^{0}C) surface waters, but believes the resource potential at this temperature is substantial.

Generally, high temperature resources are considered sources for generating electricity and medium- and low-temperature resources are judged more appropriate for nonelectric (direct-heat) applications.* However, high-temperature resources may be used economically for specific industrial direct-heat purposes. Nearly three quarters of the estimated low- and medium- temperature resource potential available for direct-heat use (i.e., 2,100 trillion Btus) is located in Imperial, Lake, Lassen, Modoc, Plumas, and Mono Counties;** further, geologists believe low-temperature geothermal resources exist in all six counties (see Exhibit 1.b for the total estimated resource potential by county. Appendix B provides site-specific resource information for each county).

The actual usable potential from these reservoirs will depend on the:

- Flow rates which can be sustained over time
- Salinity of the resource and its corrosive and scaling effect on the extraction and production equipment
- Temperature of the resource over time
- Location of the field (i.e., is the resource located on national park or forest service land which would inhibit its development; what is its proximity to demand).

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* Nonelectric or direct applications include such activities as space conditioning for residential, commercial, and industrial buildings; crop drying, daily water heating, and industrial-process uses such as steam raising, product drying, providing direct heat or hot water.

** Imperial, Mono, Modoc, and Lake Counties also have the greatest high temperature resource potential.

RPA

To determine the ultimate economic potential of a particular resource, these four characteristics must be evaluated during the exploration and development of any field. However, only more exploratory drilling will lessen the high uncertainty associated with estimating resource potential.

The exploration and development of these resources has increased substantially over the last decade, much of it in Imperial County. Specifically, six high-temperature sites, three medium-temperature sites, and numerous low-temperature areas have been identified; at these sites, over 60 wells have been drilled to depths of .7 to 2.6 kilometers. Additionally, Lake and Lassen Counties have high levels of exploration activity.

DEMAND FOR DIRECT-HEAT USE OF GEOTHERMAL ENERGY

The market for the direct-heat use of geothermal energy in California will be located in those 20 counties which we identified as having or being adjacent to counties with resources. We estimate that total potential demand for geothermal energy within these 20 counties will be 84.5 trillion Btus in 1980 increasing to 103.5 trillion Btus in 2000 and 141.2 trillion Btus in 2020. However, these amounts account in 1980 for less than one percent of California's total 1976 demand for energy. Estimated demand in each of these 20 counties is significantly less than available resource potential in each county. Therefore, we did not adjust demand for any lack of available resource. Additionally, if in 2020 all of this demand for geothermal energy were met by California resources, it would use less than seven percent of the estimated available beneficial heat from medium-temperature resources alone.

For each of the 20 California counties, we estimated total market demand that can be met by geothermal energy (i.e., direct-heat use of hydrothermal resources) during the 1976-2020 time period for the residential/commercial, industrial, agricultural, and military end-use sectors. We based our estimate of demand on four steps:

Step 1: Estimate base demand

Step 2: Identify co-located demand

Step 3: Determine technically-suitable demand

Step 4: Estimate growth in technically-suitable demand for 1976-2020.

Appendix A details our methodology and Appendix B presents these estimates for each of the twenty California counties.

We briefly discuss below major characteristics of these estimates and their underlying assumptions for each end-use sector.

Residential/Commercial Sector

By 2020, the residential and commercial sectors will comprise 47 percent of the total technically-suitable market. Most of this demand is concentrated in the populous San Diego, Sonoma, Napa and Lake counties. Major direct-heat use applications in these sectors are space heating, space cooling and hot water heating.* These applications are especially promising for these areas where the resource and population centers are co-located because co-location facilitates economies of district heating. However, the location of geothermal resources within California limits the widespread use of district heat. Specifically, Inyo, Mono, Lassen and Siskiyou Counties are rural and rely heavily on liquefied petroleum gas (LPG) for heating and cooking purposes while those counties with the largest residential and commercial demand, San Diego, Ventura and Riverside, have low-temperature waters rather than the more readily exploitable medium-temperature resources.

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* We assumed that these applications comprise the demand in these sectors.

The demand estimates for the residential and commercial sectors do not include areas served by LPG because counties using LPG do not have the population density to justify the installation of a steam distribution system.

Industrial Sector

About 49 percent of the estimated technically-suitable market for direct-heat use of geothermal energy in 2020 is for the industrial sector; of this, two-thirds are located in three counties: San Diego, Imperial, and San Bernardino. Of the 31 four-digit SIC codes which form the industrial sector, 24 are in these three major counties (see Exhibit 1.c). The major potential industrial users of geothermal energy are:

- Food and kindred products (SIC-20) and chemicals and allied products (SIC 28) in southern California
- Lumber and wood products (SIC 24) and paper and allied products (SIC 26) in northern California.

We estimated base-year demand for the approximately 30 four-digit industries with process heat requirements that could be met by geothermal energy and adjusted the estimated total industrial demand to reflect only that portion of demand used for direct-heat use applications. Typically, applications in the major industries include steam for curing and canning food products, raising hot water for process use, alfalfa drying. lumber drying, and space heating.

After estimating base-year demand, we forecasted the total technically-suitable market using three assumptions: first, all industrial demand is co-located with the geothermal resource, second, all industrial process-temperature requirements can be met by these resources; and third, relocation of industries to counties with geothermal resources will not occur. That is:

- Because we could not precisely identify current industrial location, we could not estimate that portion of demand which is co-located with demand, therefore we assumed co-location for all demand.
- Because current estimates of size, available work, and temperature of identified geothermal resources are imprecise and likely to change over the next few decades, we did not change demand estimates based on these data.

RPA

- Because we could not examine the numerous factors which affect industrial relocation decisions (e.g., energy costs and reliability of energy supply, availability of raw materials, and costs of transportation-to-market) for all the target industries, we did not adjust demand estimates to reflect relocation of industries from nongeothermal to geothermal counties (relocation could affect demand, for example, in southern California where industries currently in Los Angeles and Orange counties might relocate to Riverside or San Bernardino counties, however, this possible growth in demand due to relocation is captured by our current estimates through our assumptions about growth rate and co-location).

Agricultural Sector

Agricultural use of geothermal energy represents only 3 percent (i.e., 3.8 trillion Btus) of the total technically-suitable market in 2020. About 60 percent of this market is concentrated in Kern, San Bernardino, and Monterey Counties.

We estimated base-year agricultural demand for 20 California counties. However, the bulk of California's agricultural activity occurs in the Central Valley, e.g., in Sacramento, San Joaquin, and Fresno Counties, whose location is not within economic steam-transmission distances from identified geothermal systems. Additionally, thermal energy requirements in this sector constitute only 20 percent of total demand for energy and is limited to energy used, for example, for crop drying, animal husbandry, and space heating of agricultural buildings, particularly chicken coops. For each county, we assumed all agricultural demand is co-located with geothermal resources although this may not be accurate for some of the large counties (e.g., San Bernardino, Kern, and Inyo).

Military

We did not estimate the total potential for direct-heat use of geothermal energy by the various military facilities because estimates of potential demand for total and direct-heat energy for military facilities are currently unavailable. However, it is known that several opportunities for direct-heat and electric applications do exist in military installations throughout California; most notable of these is the Naval development of Coso Hot Springs in Inyo County for use by the China

Lake Naval Weapons Center. Currently, the Navy plans to have 75 MW of capacity on line by 1985 and 350 MW by 1995 and development of other Naval lands, especially in the Imperial Valley, will probably occur in the next twenty-five years (see Exhibit 1.d for a list of major military installations which we believe are co-located with geothermal resources). San Diego and Monterey counties, have some of the heaviest concentration of military facilities in the state but do not offer much potential for military use because of the location of their low-temperature resources.

Exhibit 1.a

COUNTIES WITH RESOURCE POTENTIAL
(Shaded)

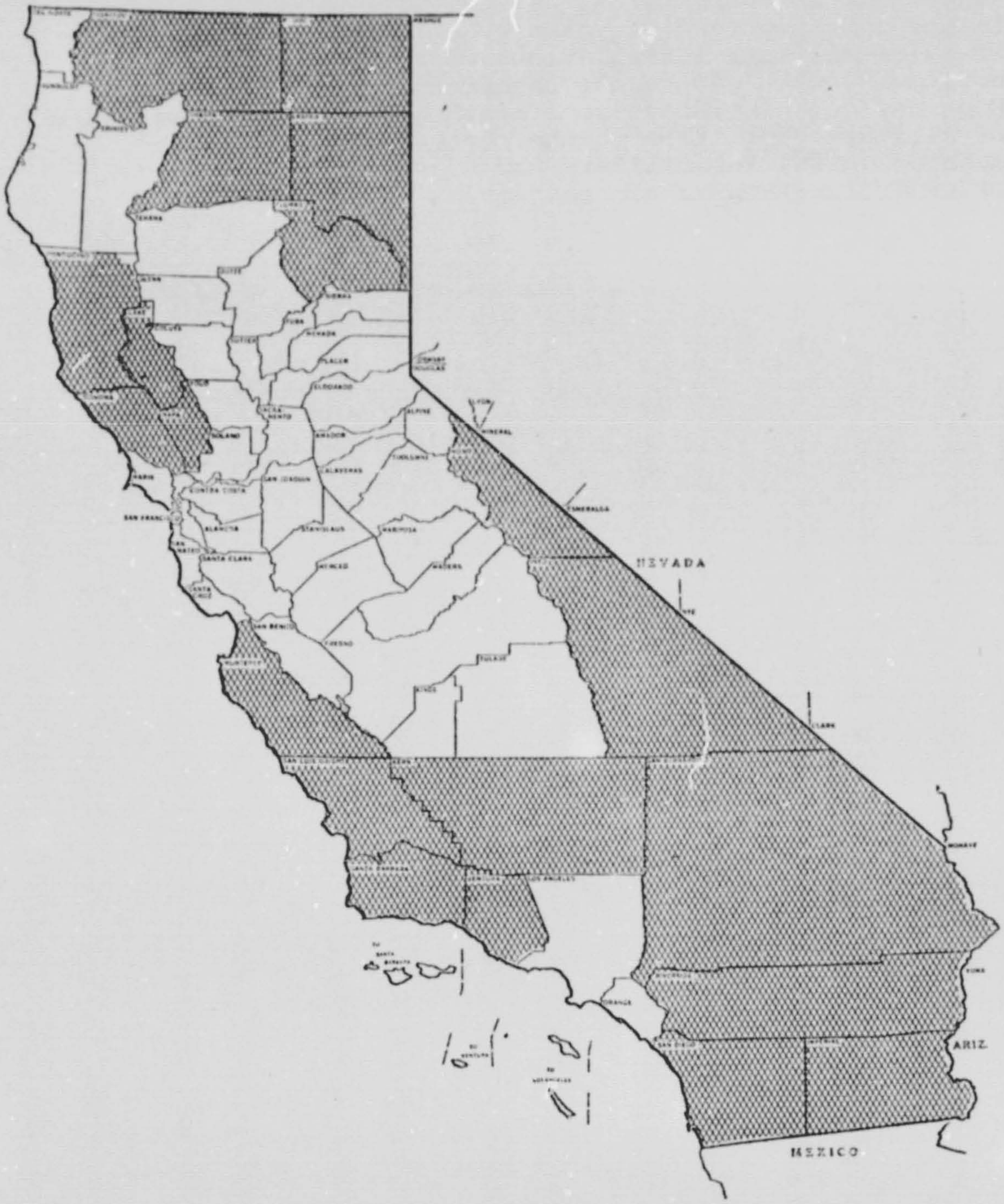

Exhibit 1.b

RESOURCE POTENTIAL BY
COUNTY BY TEMPERATURE RANGE

County*	<90°C**	90-150°C** (trillion Btus)	>150°C*** (MWe for 30 years)
Imperial	Yes	308.10	6,791
Lake	Yes	296.72	975
Lassen	Yes	287.24	116†
Mono	Yes	255.54	2,100
Modoc	Yes	221.83	1,490
Plumas	Yes	169.63	116†
Napa	No	137.46	-
San Bernardino	Yes	117.55	84††
Ventura	Yes	58.78	-
Inyo	Yes	56.88	650
Shasta	No	52.14	116†
Sonoma	No	50.24	1,620†††
Riverside	Ye	46.45	-
Kern	No	46.45	84††
Mendocino	No	(Share with Lake)	-
Siskiyou	No	(Share with Shasta)	-
Monterey	Yes	-	-
San Diego	Yes	-	-
San Luis Obispo	Yes	-	-
Santa Barbara	Yes	-	-
TOTAL		2,105.01	12,206

* Counties are ranked in descending order according to amount of available work.

** Generally, resources in this range are used in nonelectric applications. Counties with favorable areas only.

*** Generally, resources in this range are used in electric applications. Total is 26.53 Quad for beneficial heat, excluding the Geysers.

† Resource shared among Lassen, Plumas and Shasta counties.

†† Resource shared between San Bernardino and Kern counties.

††† Estimate includes Geysers KGRA which are currently dedicated to generating electricity.

Exhibit 1.c

TARGET INDUSTRIES IN COUNTIES
HAVING MAJOR MARKET POTENTIAL

Industry	SIC	San Diego	Imperial	San Bernardino	Kern	Riverside	Ventura
Meat Packing	2011	●		●	●		
Poultry Dressing	2016	●				●	
Fluid Milk	2026	●		●	●	●	
Canned Specialities	2032					●	
Canned Fruits & Vegetables	2033						●
Dehydrated Fruits and Vegetables	2034					●	●
Frozen Fruits & Vegetables	2037			●			●
Prepared Foods	2048	●	●	●	●	●	
Bread & Baked Goods	2051	●		●			
Beet Sugar	2063		●				
Animal & Marine Fats	2077						●
Soft Drinks	2086	●		●	●	●	●
Sawmills & Planning Mills	2421			●	●		
Plywood	2435			●			
Wooden Furniture	2511	●				●	
Upholstered Furniture	2512	●		●			
Solid & Corrugated Fiber Board	2653	●		●		●	●
Alumina	2819				●		
Noncellulosic Fibers	2824	●					
Soaps & Detergents	2841	●					
Organic Chemicals N.E.C.	2869	●					
Urea	2873		●				
Chemical Preparations N.E.C.	2899					●	
Concrete Block	3271	●		●			
Ready-Mix Concrete	3273	●		●	●	●	●
Gypsum	3275		●				
Treated Minerals	3295			●		●	
Blast Furnaces	3312	●					
Galvanizing	3479	●					
Motors & Generators	3621	●					

Exhibit 1.d

MAJOR MILITARY INSTALLATIONS
CO-LOCATED WITH GEOTHERMAL RESOURCES

County	Facility
Imperial	National Parachute Test Range
Imperial	El Centro Naval Air Facility
Imperial	Marine Corps Air Station
Inyo	China Lake Naval Weapons Center
Modoc	Fort Bidwell
San Bernardino	China Lake Naval Weapons Center
San Bernardino	Twenty-Nine Palms Marine Corps

2 MARKET PENETRATION ESTIMATES

We estimate the market potential for direct-heat use of geothermal energy in California will be 436 billion Btus in 1980, increasing to 43,135 billion Btus in 2000 and 100,126 billion Btus in 2020 (see Exhibit 2.a).* Twenty counties have market potential for direct-heat use of geothermal energy (see Exhibit 2.b), 70 percent of which potential will be in San Diego, Imperial, San Bernardino, Kern, Riverside, and Ventura Counties. The industrial sector is the end-use sector with the largest market potential, constituting nearly two thirds of the total potential (see Exhibit 2.c; Appendix B presents market potential estimates by end-use sector for the 20 counties examined). Geothermal energy used in nonelectric applications is assumed to be cost-competitive with traditional fuels, such as natural gas and electricity, and most nontraditional energy sources such as solar, wind and biomass.** However even if we assume consumers will base investment decisions on cost-competitiveness of the product, we cannot conclude that acceptance of geothermal energy and investments in equipment to utilize this energy will occur immediately. Rather, to estimate the true market potential of direct use of geothermal energy, we must estimate the rate of market penetration.

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* Market potential is defined as that portion of the technically-suitable market which is captured by geothermal energy.

** However, the estimated dates for when geothermal energy will achieve competitiveness and the uniformity of costs throughout California are uncertain; consequently, market penetration estimates are also uncertain.

RPA

Market penetration rates usually reflect assumptions about market acceptance of a new technology or product. History indicates that market acceptance and use of a new technology, product, or fuel does not occur immediately upon introduction and does not follow a linear pattern. The process by which products or technologies do come into use is called diffusion and, typically, can be divided into three distinct phases: a demonstration period of a few years, during which penetration is slow; a period of rapid growth which indicates more widespread acceptance and often continues until the appropriate market is nearly saturated; and a mature growth period of relatively constant penetration rates. These distinct phases of market penetration reflect the interaction of several consumer-related factors; major factors include the slow spread of information and awareness concerning the existence and performance of the new product or technology, uncertainty about the benefits of the product or technology, consumer desire to wait for products to become cheaper or better, and recent consumer investment in a competing product.

To estimate the geothermal market potential in California, we developed six market penetration rates (or curves) that approximate this diffusion process for geothermal energy. We then applied these rates to the technically-suitable market estimates to obtain the estimated market potential. Each curve reflects a different set of assumptions about the start of commercialization, the length of development and rapid-growth phases, and the annual rates of penetration during these periods.

We determined the applicable curve for estimating the percentage of technically-suitable demand captured by geothermal energy for each end-use sector within a county by applying a set of decision rules which reflect the major factors that will influence the rate of penetration in each end-use sector (in Exhibit 2.d we present the decision tree for applying these rules). We briefly describe the major factors influencing penetration and assumptions about penetration for each end-use sector below.

RESIDENTIAL/COMMERCIAL SECTOR

We estimate that geothermal energy will capture approximately 55 percent of the technically-suitable market in the residential and commercial sectors by 2020. Market potential for these sectors comprises 35 percent of total California potential or 34.6 trillion Btus in 2020. With 75 percent of the total market potential, San Diego, Ventura, Sonoma, and Napa Counties have the greatest potential for residential and commercial use of geothermal energy. Three major factors will affect the rate and timing of market penetration within the residential and commercial sectors:

- Temperature of resource
- Dependency on LPG
- Density of the population.

We used the temperature of a resource within a county as a proxy for estimating the start of commercialization. That is, if a county has any high- or medium-temperature (i.e., greater than 90^{0}C), we assumed penetration will begin in 1980 because this date reflects existing exploration, development, and production activities that are normally associated with these resources and that can effect a higher probability of early commercialization. If a county has low-temperature resources (i.e., less than 90^{0}C) low-temperature resources only, we assumed commercialization and penetration will not begin until 1985.

One quarter of the counties with geothermal-resource potential have no natural gas service and must depend on LPG. If the residential and commercial establishments within a county depend on LPG, we assumed that geothermal energy would not replace these existing energy sources because the use of LPG implies population density insufficient to support an economic steam-distribution system. Consequently, we assume geothermal energy will not be competitive in the residential/commercial sector in these counties.

We used density of population in a county to determine the near-term possibilities for district heating and the speed with which knowledge, acceptance, and use of the geothermal energy would occur.* We assumed counties having high-population densities will experience a development phase lasting five years and a rapid-growth phase lasting ten years. Contrastingly, we assumed counties having low-population densities will experience a development phase lasting 8 years and a rapid-growth period lasting 15 years. We assumed the remaining years until 2020 will be in the mature-growth phase. Annual penetration rates were the same for all counties: one percent per year for the development phase, two percent per year for the rapid-growth phase, and one percent per year for the remaining period.* Market Penetration curves 1, 2, 3, and 4 of Exhibit 2.e reflect these assumptions.

INDUSTRIAL SECTOR

We estimate that geothermal energy will capture 90 percent of the industrial demand for energy (63.5 trillion Btus) by 2020. This sector comprises nearly two-thirds of total state-wide potential and is concentrated in San Diego, Imperial, San Bernardino, Santa Barbara, and Riverside Counties. Together, these counties make up nearly 80 percent of California's potential demand by industries.

We assumed penetration of the industrial sector will begin in either 1980 or 1985, depending on the temperature characteristics of the resources in a county. We assumed the development phase for industry will be eight years, a duration of time reflecting the concerns of industry executives about the technical and economic feasibility of using geothermal energy. For example, uncertainties over the purity and reliability of the steam will need to be clarified.

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* Average population density of the 20 counties (i.e., 54.4 people per square mile) was used as the determining factor.

** In forecasting demand, major gas and electric utilities use one percent per year as the average projected growth in housing stock during the 1976-1998 time period.

We assumed annual penetration rates during this time period will be two percent. Annual penetration rates during an estimated 15-year rapid-growth phase will be 4 percent, an assumption which reflects estimates of the percentage of annual turnover of capital equipment used for fuel-burning equipment and of the percentage of retrofit applications. We assumed penetration during the mature-growth phase will be two percent per year. Market Penetration Curves 5 and 6 of Exhibit 2.e reflect these assumptions.

AGRICULTURAL SECTOR

We estimate that about 55 percent (2.1 trillion Btus) of the agricultural demand for energy will be captured by geothermal energy in 2020. However, this sector accounts for only two percent of total statewide potential. Most of this potential (57 percent) is located in Kern, San Bernardino, and Mendocino Counties.

The two main factors influencing the timing of geothermal penetration in the agricultural sector are the temperature of the resource in the county and the percentage of land in the county which is dedicated to farming. As was true for the other sectors, penetration will begin either in 1980 or 1985, depending on the temperature of resources within the county. We used density of farmland as a proxy for estimating size and sophistication of farms and their capability for using geothermal energy cost-effectively.*

Annual penetration rate and length of diffusion-phase assumptions for the high and low density agricultural counties are the same as for high- and low-density population counties (see Market Penetration Curves 1, 2, 3, and 4 of Exhibit 2.e).

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* We used average density of farmland for the 20 counties (i.e., 26.2 percent of total county acreage) as the determining factor.

MILITARY SECTOR

We could not make comprehensive market potential estimates for the military sector because of the lack of resource and demand estimates for resources and facilities owned by the military. Market potential estimates can be made once these estimates are available.

We do not expect the penetration of the military market by geothermal energy to follow the traditional diffusion process. Rather, because of the captive nature of demand and the tendency of federal policy to encourage energy conservation and use of nontraditional fuels, we assumed penetration will be 100 percent when the resource becomes available for use.

Exhibit 2.a

ESTIMATED MARKET POTENTIAL FOR DIRECT-HEAT USE OF GEOTHERMAL ENERGY IN CALIFORNIA: 1980 to 2020

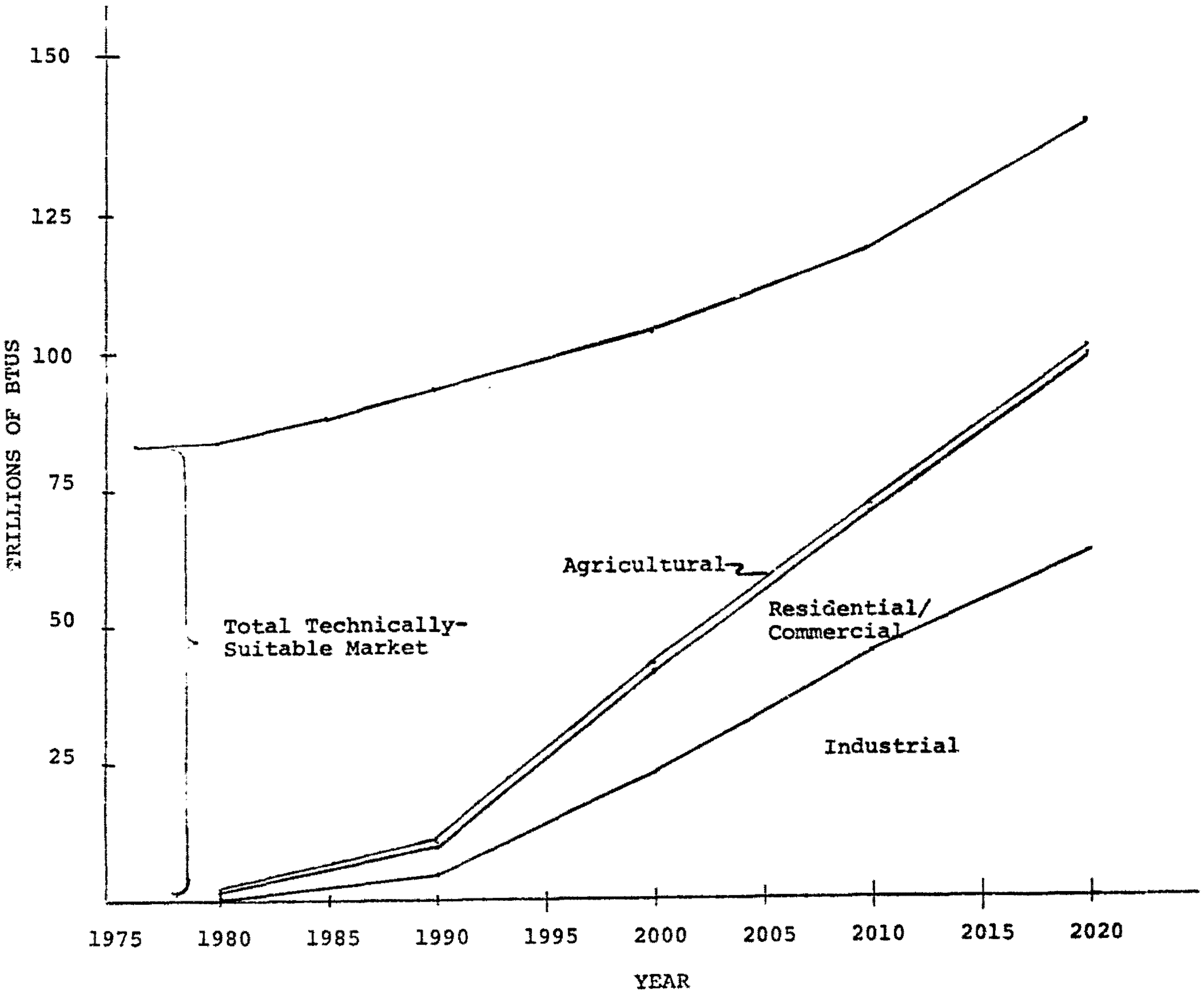


Exhibit 2.b
ESTIMATED MARKET POTENTIAL
BY COUNTY
(billions of Btus)

County*	1980	1985	1990	1995	2000	2010	2020
San Diego	0	541.45	2,871.09	8,580.35	16,074.59	28,646.69	39,485.54
Imperial	89.34	541.19	1,543.54	3,488.14	6,502.29	10,871.17	15,688.95
San Bernardino	76.34	440.58	1,200.80	2,588.48	4,609.29	7,185.14	9,716.33
Kern	45.83	254.89	697.37	1,445.71	2,419.74	3,885.59	5,473.60
Riverside	45.84	257.95	757.21	1,537.34	2,459.00	3,789.35	5,212.75
Ventura	60.92	323.07	969.57	1,821.82	2,535.78	3,696.38	5,001.90
Santa Barbara	0	48.92	282.23	798.72	1,684.44	3,775.50	4,963.81
Sonoma	39.48	212.44	636.89	1,207.69	1,712.68	2,521.58	3,405.28
Monterey	0	34.89	192.05	501.92	1,125.88	2,159.32	2,978.82
Shasta	16.35	94.68	258.79	560.38	1,000.85	1,572.70	2,137.22
Napa	28.30	146.04	447.83	795.28	978.77	1,383.45	1,881.27
Siskiyou	9.12	55.63	158.63	357.79	664.34	1,062.34	1,458.50
Plumas	5.21	30.36	83.52	181.79	326.18	516.88	705.08
Mendocino	8.65	45.53	117.50	226.21	345.89	480.86	597.06
Lake	7.45	38.39	93.97	179.23	276.73	413.16	536.82
San Luis Obispo	0	5.99	32.34	89.70	174.56	345.75	480.86
Lassen	2.05	12.57	35.68	80.45	149.33	238.81	327.93
Modoc	.80	4.86	13.86	31.27	58.06	92.84	127.47
Inyo	.63	3.58	9.60	20.18	34.55	55.87	77.76
Mono	.04	.20	.57	1.05	1.73	2.92	4.24
TOTAL	436.35	3,013.21	10,402.98	24,493.50	43,134.68	72,696.30	100,261.19

* Counties are ranked in descending order according to market potential.

Exhibit 2.C

ESTIMATED MARKET DEMAND AND MARKET POTENTIAL FOR END-USE SECTOR (billions of Btus)

END-USE SECTOR*	YEAR					
	1980	1985	1990	1995	2000	2020
Residential/Commercial						
• Market Demand	65,660.70	65,271.38	65,056.42	64,942.36	64,973.29	66,763.86
• Market Potential	192.01	1,444.87	5,125.24	11,983.93	18,745.70	34,593.04
Industrial						
• Market Demand	18,373.68	21,584.77	25,442.38	30,044.16	35,525.99	70,549.17
• Market Potential	226.92	1,547.32	4,967.79	11,886.34	23,438.99	63,493.38
Agricultural						
• Market Demand	2,382.31	2,524.40	2,676.73	2,840.48	3,016.47	3,863.80
• Market Potential	17.42	100.97	309.95	623.25	949.99	2,174.83
Total						
• Market Demand	84,416.69	89.380.54	93,175.53	97,827.00	103,515.75	141,176.83
• Market Potential	436.35	3,093.16	10,402.98	24,293.52	43,134.68	100,261.25

* The current projection for the 1995 market potential in the military end-use sector is for Coso Hot Springs, Inyo County: 350 MWe for electric applications. The Navy projects that other bases which are co-located with geothermal resources in southern California will use geothermally-generated electricity; however, the Navy could not provide estimates of market demand at this time.

Exhibit 2.d

DECISION TREE FOR DETERMINING APPLICABLE PENETRATION RATE

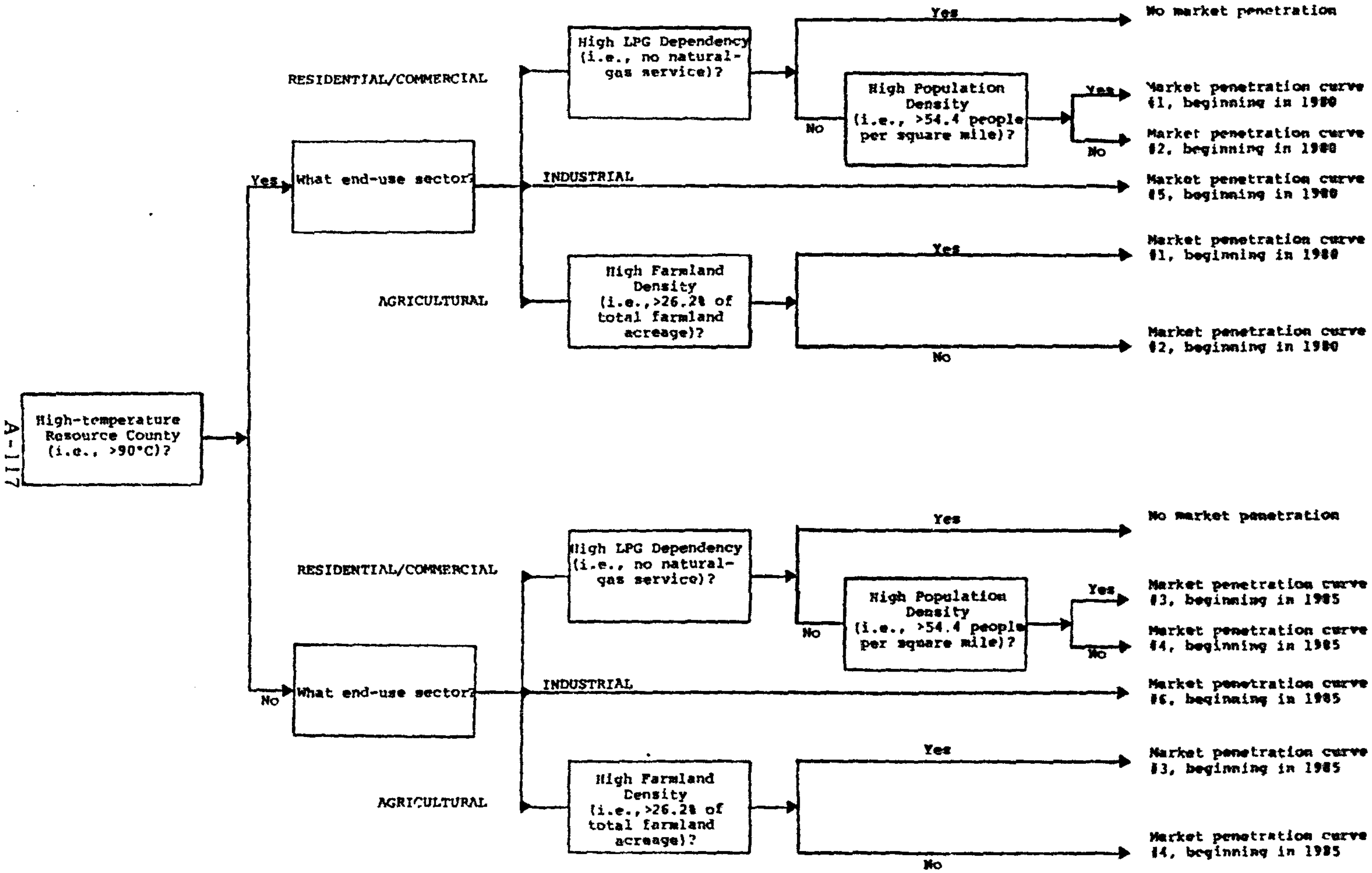


Exhibit 2.e

MARKET PENETRATION
CURVE NUMBER 1
(High temperature, residential/
commercial or agricultural, low
LPG dependency, high population
density or high farmland density)

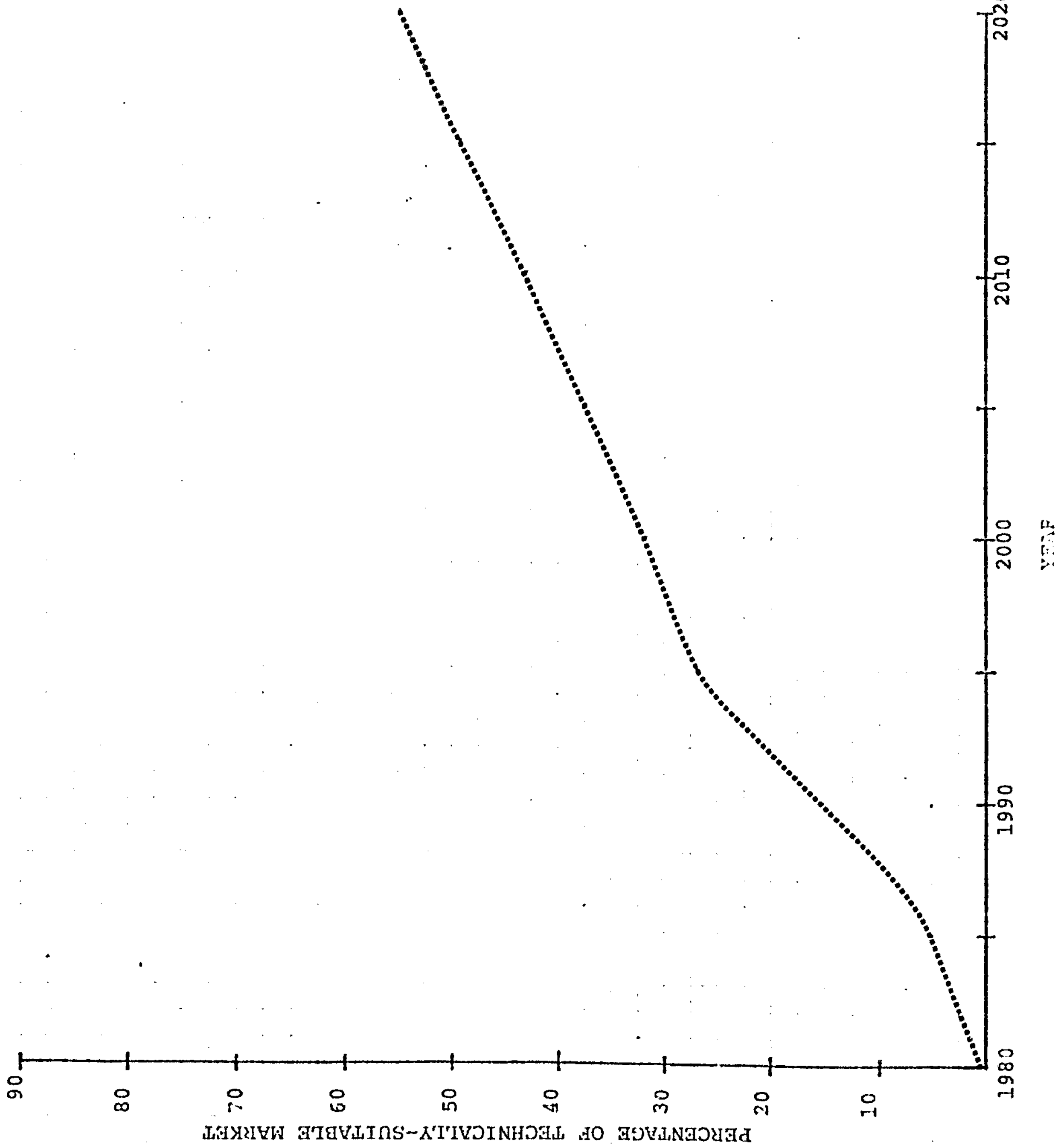


Exhibit 2.e (continued)

MARKET PENETRATION CURVE
NUMBER 2 (High temperature,
residential/commercial or
agricultural, low LPG dependency,
low population density or low
farmland density)

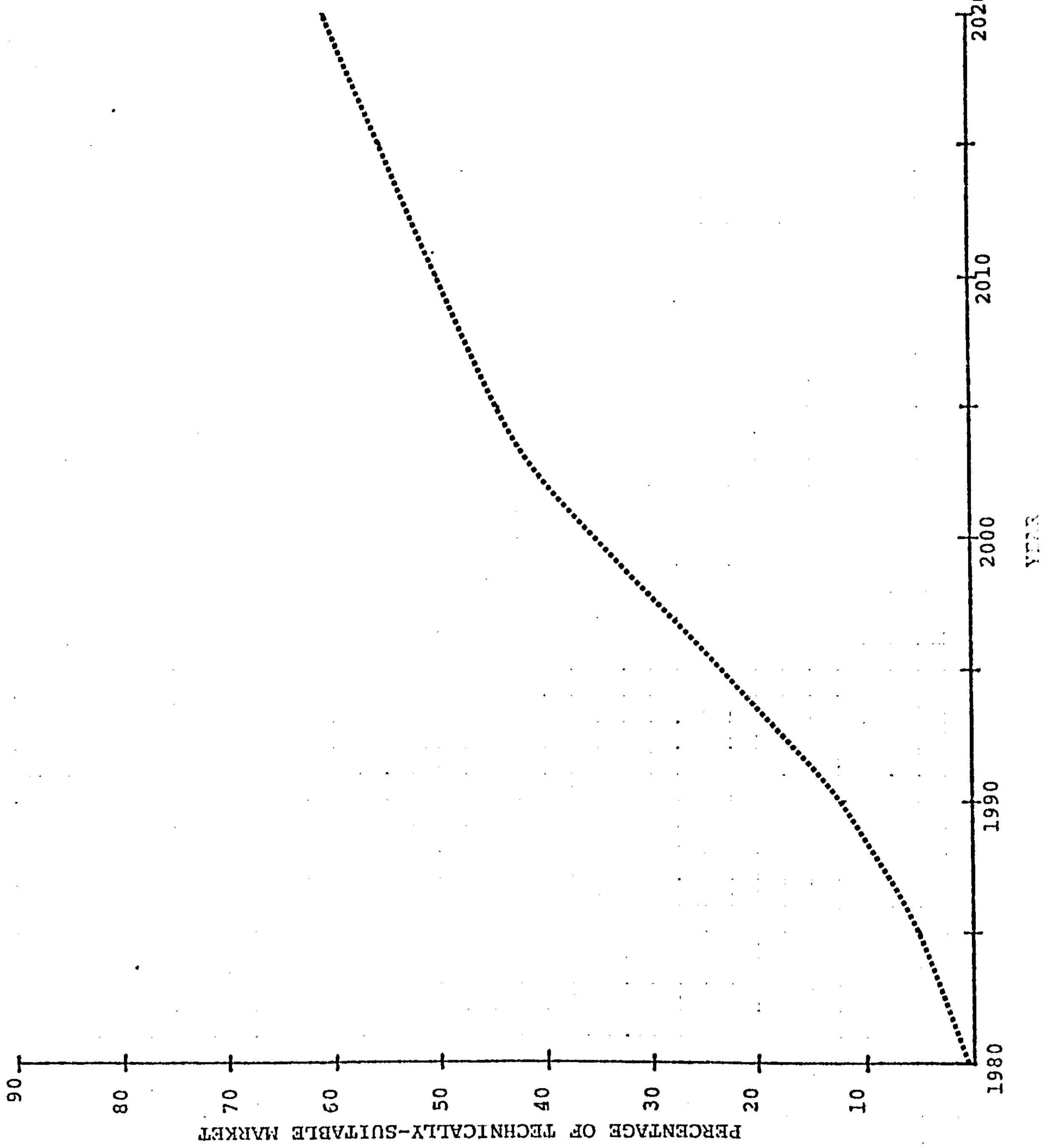


Exhibit 2.e (continued)

MARKET PENETRATION
CURVE NUMBER 3
(Low temperature, residential/
commercial or agricultural, low LPG
dependency, high population density
or high farmland density)

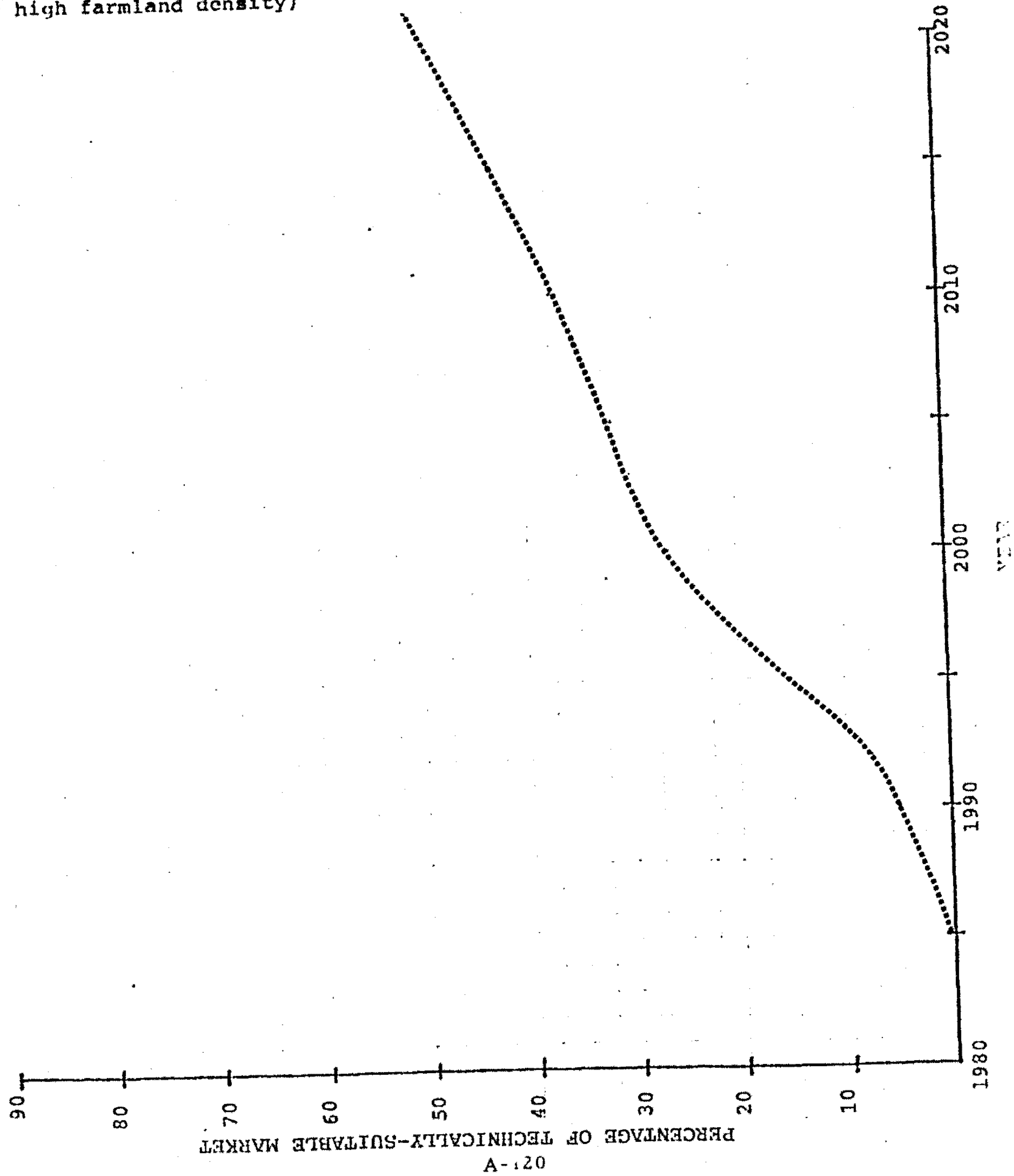


Exhibit 2.e (continued)

MARKET PENETRATION
CURVE NUMBER 4
(Low temperature, residential/
commercial or agricultural, low
LPG dependency, low population
density or low farmland density)

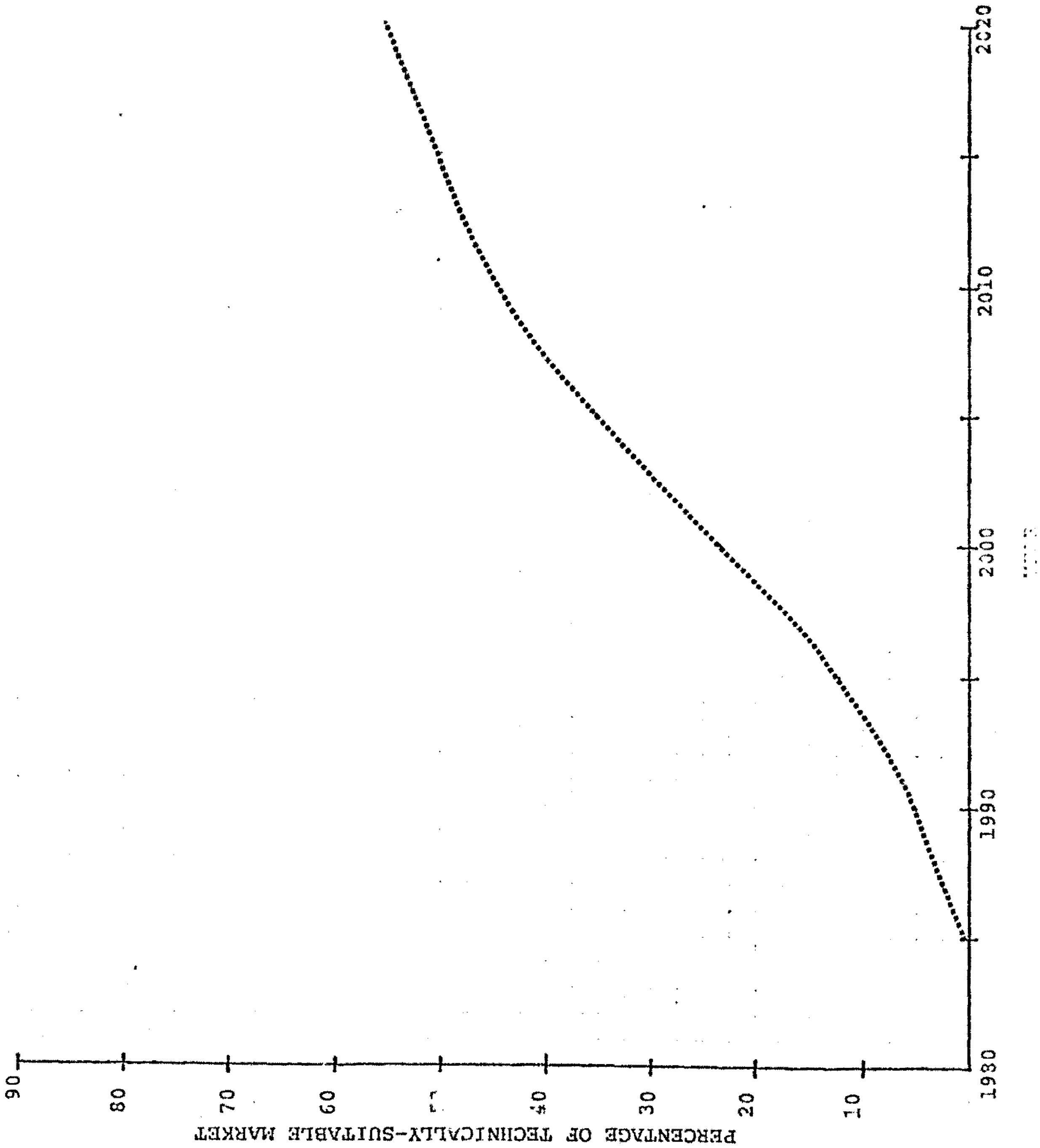


Exhibit 2.e (continued)

MARKET PENETRATION
CURVE NUMBER 5
(High temperature)

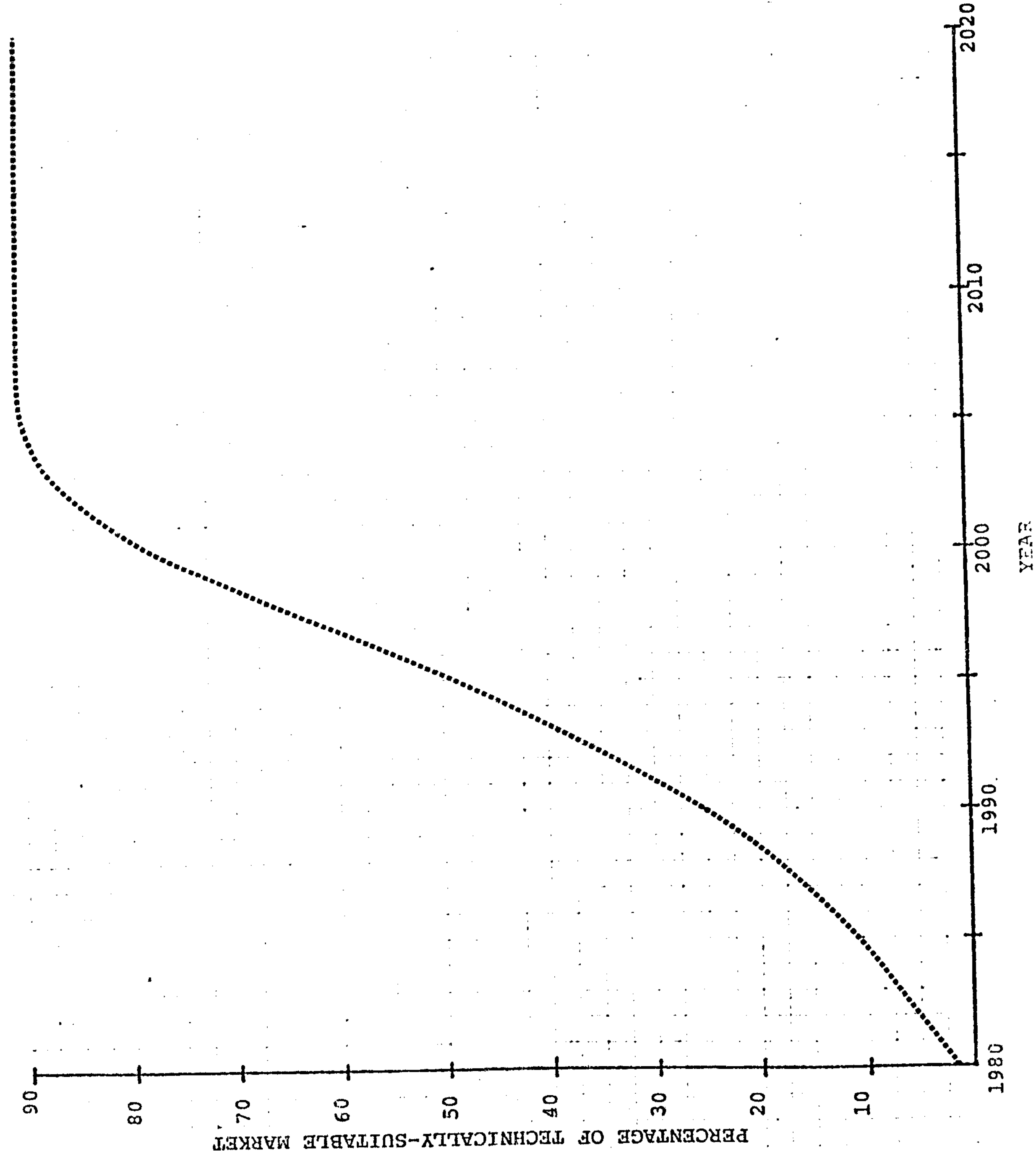
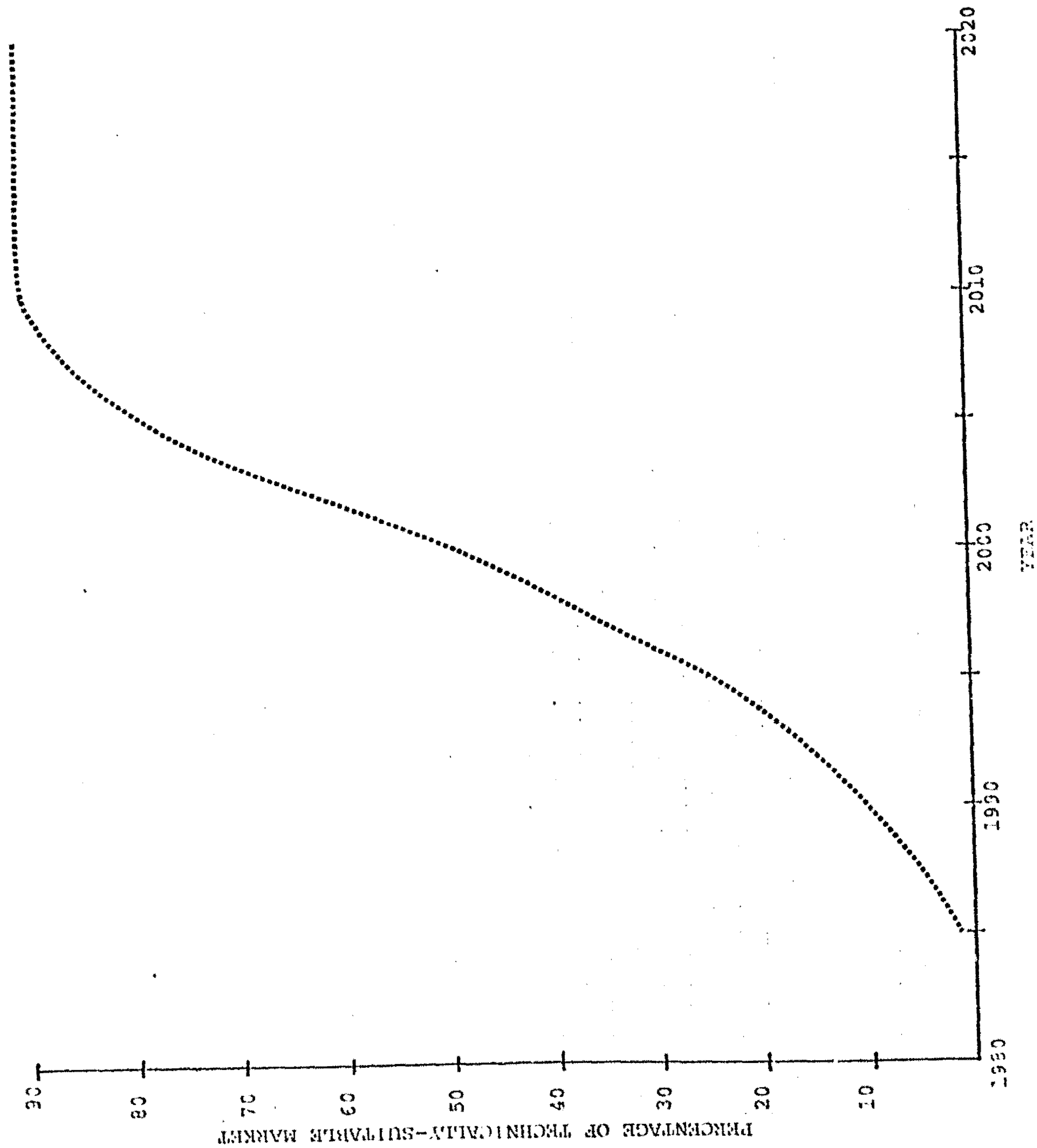


Exhibit 2.e (continued)

MARKET PENETRATION
CURVE NUMBER 6
(Low temperature)



Appendix A

METHODOLOGY FOR ESTIMATING
TECHNICALLY-SUITABLE MARKET
POTENTIAL FOR DIRECT-HEAT
USE OF GEOTHERMAL ENERGY

RPA

A-124

We estimated the technically-suitable market potential for direct-heat use of geothermal energy by end-use sector for each of the 20 California counties having geothermal-resource potential. Within each county, we examined the residential and commercial, industrial, agricultural, and military end-use sectors and estimated the technically-suitable market potential in four steps:

Step 1: Estimate base-year demand

Step 2: Identify proportion of demand co-located with geothermal resource

Step 3: Determine proportion of technically-suitable demand (i.e., demand which can be provided by geothermal energy in a specific location)

Step 4: Project growth in demand for 1976-2020 time period

In this appendix, we discuss our assumptions, information sources, and the procedures used for each end-use sector.

RESIDENTIAL/COMMERCIAL SECTOR

Base-Year (1976) Demand

The residential and commercial sectors primarily consume natural gas and electricity. Several of the more rural and inaccessible counties use liquefied petroleum gas (LPG) in place of natural gas because gas distribution systems do not exist in these remote areas.

We used sales data reported by electric and gas utilities* to the Federal Energy and Regulatory Commission (FERC) in Forms 1 and 2 and Uniform Statistical Reports of individual companies to estimate base-year (1976) demand in the residential/commercial sectors. We allocated

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* Six major electric companies serve the 20 counties: Pacific Gas & Electric Company (PG&E), San Diego Gas & Electric Company (SDG&E), Southern California Edison Company (SCE), Pacific Power and Light Company, CP National Corporation, and Sierra Pacific Power Company; additionally, several municipal utilities offer service within these counties (e.g., Imperial Irrigation District and Riverside Department of Public Utilities). Southern California Gas Company, Southwest Gas Corporation, PG&E, and SDG&E provide gas service.

total sales of gas and electricity for each utility to a given county based on the percentage of the utility service area's population that was accounted for by each county. Where two or more utilities serviced the same county, we adjusted the base county population to avoid double counting. Similarly, for those utilities which include agricultural consumption in their commercial accounts, we reduced total commercial sales by the amount of agricultural consumption. This allocation procedure resulted in base-year residential and commercial demand for each county.

Co-Located Demand

Only a portion of the base-year demand in each county lies within a physically-feasible and economic transmission distance from the geothermal resources. Therefore, we adjusted base year-demand to reflect that portion of total demand which could feasibly be served by geothermal energy. We used 20 kilometers* as the maximum delivery radius for geothermal steam distribution and matched this transmission distance to county-specific population densities to estimate the proportion of population co-located with the potential service area of the identified resources. These proportions also reflected market areas which cross over county lines; however, we did not include demand which could be met by geothermal resources in neighboring states or Mexico.

Technically-Suitable Demand

It is not always technically possible for a geothermal resource to serve a co-located demand. For example, in the residential and commercial sectors, a significant portion of the demand for electricity (i.e., electricity used for refrigeration, lighting, and running appliances) cannot readily be replaced by direct-heat uses of geothermal energy. Therefore, we assumed that geothermal energy could replace energy used for space heating and cooling and hot-water heating in these two sectors. Specifically, we assumed that 94 percent of the natural gas and 48 percent of the

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* Currently, this is the maximum distance for economic transmission of geothermal energy in Iceland.

electricity requirements could be displaced by geothermal energy in the residential sector; similarly, we assumed that geothermal energy could displace 100 percent of the natural gas and 42 percent of the electricity in the commercial sector.[1] Our adjusted estimates of co-located demand reflect these assumptions.

Demand Projections

After adjusting the base-year total demand to account for location and technical requirements, we used forecasts by the California Energy Commission to estimate demand for the 1976-2020 period. The growth rates for demand specified below vary by sector and by fuel type.

ANNUAL GROWTH RATE
IN DEMAND: 1977-1998[2]
(percent)

	Electricity	Natural Gas
Residential Sector	2.9	.5
Commercial Sector	1.7	.17

We have assumed above growth rates also apply to 1998-2020.

INDUSTRIAL SECTOR

Base-Year Demand

Generally, the industrial sector is defined as those industries with Standard Industrial Classification (SIC) codes between 20 and 39. Using data from a previous study

1. U.S. Federal Energy Administration. Project Independence Report: Residential and Commercial Energy Use Patterns, 1970-1990. 1974. Table A.b for Western U.S.

2. California Energy Commission. Natural Gas Supply and Demand for California 1978-1995: Staff Report - Appendix A. 1978.

which identified 55 four-digit (SIC) codes with process-heat requirements which could probably be met by solar energy,[1] we assumed that geothermal energy could, with few exceptions, meet these same requirements. Accordingly, we identified industries located within the target counties. These industries, form the industrial sector (see Exhibit A.1).

To estimate base-year demand for the industrial sector by county we performed three steps. First, we estimated the number of employees by SIC code in each county.[2] Next, we estimated average fuel use per employee by SIC code in California. Because only fuel use by three-digit code is available at the state level, we apportioned total fuel used at the three-digit level in California among the relevant four-digit industries using national averages.[3] Finally, we estimated fuel use at a county level for each four-digit SIC code by multiplying fuel use per employee by the number of employees in a given county.

Co-Located Demand

We assumed that all of the estimated industrial demand within a county is co-located with geothermal resources in that county.

Not all of the industrial demand for energy can be met by medium-temperature geothermal energy, especially that portion of energy required for electric drive. Because estimates for each four-digit SIC code of the portion of total energy which

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1. Intertechnology Corporation, Analysis of the Economic Potential of Solar Thermal Energy to Provide Industrial Process Heat, volumes 1, 2 and 3,

2. Bureau of Census, U.S. Department of Commerce. County Business Patterns; California, 1976.

3. U.S. Department of Commerce, Bureau of Census. Annual Survey of Manufacters; - Fuels and Electric Energy Consumed. 1976.

can be provided by geothermal energy were not readily available, we aggregated fuel use by four-digit SIC codes to a two-digit level and used the percentage estimates shown below to estimate a technically-suitable industrial demand for each county.

Demand Projections

Estimates of annual growth in value-added by two-digit SIC codes for California industries formed the basis of our industrial demand projections.[1] We believe that growth in energy requirements will more closely parallel value-added growth than employment growth.

ASSUMPTIONS ABOUT INDUSTRIAL DEMAND

SIC Code	Proportion of Thermal Energy (%)	Annual Growth Rate (%)
20	.72	2.68
22	.89	3.41
23	.48	4.54
24	.67	3.22
25	.75	3.97
26	.75	3.22
28	.82	4.23
32	.98	3.16
33	.79	0.98
34	.89	3.74
36	.89	3.09

1. California Energy Commission. Natural Gas Supply and Demand for California 1978-1995: Staff Report - Appendix A. 1978.

AGRICULTURAL SECTOR

Base-Year Demand

The agricultural sector primarily consumes natural gas and electricity.* We used sales data reported to FERC by gas and electric utilities in Forms 1 and 2 as well as in the Uniform Statistical Reports of those companies to estimate base-year demand. We allocated sales data for each utility among counties in that utility's service area according to the percentage of total farmland served by the utility within a given county and adjusted our estimates if two or more utilities served a particular county.

Co-Located Demand

We assumed that all of the estimated agricultural demand within a county is co-located with geothermal resources in that county.

Technically-Suitable Demand

In California, a large amount of (approximately 79 percent) of agricultural requirements for energy are for irrigation, and geothermal energy is not thought to be able to displace the energy required for these and similar electricity-requiring activities. Therefore, we assumed that the remaining (i.e., 21 percent) agricultural requirements for energy can be met by geothermal energy[1], and adjusted base-year demand to reflect this assumption.

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1. State of California Energy Resources Conservation and Development Commission. Process Heat in California: Applications and Potential for Solar Energy in the Industrial, Agricultural and Commercial Sectors. Prepared by Jet Propulsion Laboratory. 1978.

* The same gas and electric utilities which serve the residential and commercial sectors serve the agricultural sectors.

Demand Projections

Many estimates of growth in agricultural consumption of energy in California have been made in recent years. However, many of these are on a crop-by-crop basis, rather than by county or by fuel category. Therefore, we have used CEC estimates of 1.7 percent per year growth in electricity use and .6 percent per year growth in natural gas use.[1] We have assumed, as in the case for the residential and commercial sectors, that these annual growth rates also apply to the period 1998 to 2020.

MILITARY SECTOR

The military sector includes major Naval, Army, and Air Force installations within California. Estimates of base-year demand for these facilities are not available at this time. However, we were able to identify those facilities which are co-located with geothermal resources. Therefore, the demand from these facilities should be considered part of the technically-suitable market potential when estimates become available.

1. California Energy Commission. Natural Gas Supply and Demand for California 1978-1995: Staff Report - Appendix A. 1978.

Exhibit A.1

INDUSTRIES FORMING
THE INDUSTRIAL SECTOR
BY FOUR-DIGIT SIC CODE

SIC Code	Industry	Applicable Counties
2011	Meat Packing Plants	Kern, Mendocino, San Bernardino, San Luis Obispo, San Diego
2016	Poultry Dressing Plants	Riverside, San Diego, Sonoma
2026	Fluid Milk	Kern, Riverside, San Bernardino, San Diego, Shasta, Sonoma
2033	Canned Fruits and Vegetables	Riverside, Sonoma, Ventura
2034	Dehydrated Fruits and Vegetables	Riverside, Sonoma, Ventura
2037	Frozen Fruits and Vegetables	San Bernardino, Santa Barbara, Ventura
2048	Prepared Feeds, NEC	San Diego, San Bernardino, Riverside, Kern, Imperial
2051	Bread, Cake, Related Products	Imperial, Inyo, San Bernardino, Santa Barbara, San Diego, Sonoma
2063	Beet Sugar	Santa Barbara, Imperial
2077	Animal and Marine Fats and Oils	Ventura
2086	Bottled and Canned Soft Drinks	Riverside, San Bernardino, Santa Barbara, San Diego, Shasta, Ventura
2421	Saw Mills, Planning Mills, General	Sonoma, Siskiyou, Shasta, San Luis Obispo, San Bernardino, Plumas, Monterey, Modoc, Mendocino, Lake, Lassen, Kern
2435	Hardwood, Veneer, and Plywood	Shasta, San Luis Obispo, San Bernardino, Monterey, Lake
2436	Softwood, Veneer, and Plywood	Mendocino, Shasta, Siskiyou, Sonoma
2511	Wood Household Furniture	Mendocino, Monterey, Riverside, San Diego
2512	Upholstered Household Furniture	Monterey, San Bernardino, San Diego
2653	Corrugated, Solid Fiber Boxes	Monterey, Riverside, San Bernardino San Diego, Ventura
2819	Industrial Inorganic Chemicals, NEC	Kern, Monterey
2924	Organic Fibers, Noncellulosic	San Diego
2841	Soap and Other Detergents	San Diego
2865	Cyclic Crudes and Intermediates	Monterey, San Bernardino
2869	Industrial Organic Chemicals, NEC	San Diego
2873	Nitrogenous Fertilizers	Imperial, Monterey
2899	Chemical Preparations, NEC	Monterey, Napa, Riverside
3271	Concrete Block and Brick	San Bernardino, San Diego
3273	Ready Mix Concrete	Kern, Monterey, Riverside, San Bernardino, San Diego, Sonoma, Ventura
3275	Gypsum Products	Imperial
3295	Minerals, Ground or Treated	Monterey, Riverside, San Bernardino
3312	Blast Furnaces & Steel Mills	San Bernardino, San Diego
3479	Metal Coating, Allied Services	Monterey, San Bernardino, San Diego
3621	Motors and Generators	Santa Barbara, San Diego

Appendix B

SUMMARY OF RESOURCE AND
MARKET POTENTIAL BY COUNTY

RPA

IMPERIAL COUNTY

Summary of Resource Potential

Resource	Average Temperature (°C)	Depth of Wells (m)	Number of Wells	Average Volume (km^3)	Resource Potential 90°C	90-150°C* (10[illegible] Btus)	150°C (MWe)
Salton Sea	323 ± 8	700 - 2400	>20	116.0 ± 34.0			3400
Westmoreland	217 ± 7	up to 2600	6	123.0 ± 35.0			1710
Brawley	253 ± 10	up to 4000	6	34.0 ± 8.0			640
East Mesa	182 ± 7	900 - 2800	>20	36.0 ± 7.0			360
Border	160 ± 4	NA	NA	4.0 ± 0.6			31
Heber	175 ± 5	900 - 3300	11	71.0 ± 14.0			650
Glamis (East Brawley)	132 ± 14	NA	NA	3.3 ± 0.9		59.72	
Glamis East	132 ± 14	NA	NA	5.0 ± 1.7		89.11	
Dunes	132 ± 14	612	1	8.9 ± 2.4		159.26	
Imperial - Coachella Valleys	39 - 98	<150	14	NA	Yes		
Ocotillo Hot Springs	31 - 39	45 - 365	8	NA	Yes		

* Resource Potential for 90° - 150°C resources is estimated beneficial heat as calculated by the USGS.

Summary of Market Potential

END-USE SECTOR	YEAR 1976	1980	1985	1990	1995	2000	2020
Residential/Commercial							
• Market Demand	1,421.25	1,458.81	1,513.03	1,576.29	1,649.75	1,734.72	2,22[illegible]
• Market Potential (2)*	0	14.59	77.16	194.36	382.07	609.13	1,362.[illegible]
Industrial							
• Market Demand	3,193.02	3,679.94	4,398.65	5,263.41	6,304.91	7,560.42	15,790.[illegible]
• Market Potential (5)*	0	73.60	457.81	1,333.22	3,074.27	5,841.94	14,211.[illegible]
Agricultural							
• Market Demand	109.97	115.13	122.01	129.40	137.33	145.86	186.[illegible]
• Market Potential (2)*	0	1.15	6.22	15.96	31.80	51.22	114.[illegible]
Total							
• Market Demand	4,724.24	5,253.88	6,033.69	6,969.1	8,091.99	9,441.00	18,200.[illegible]
• Market Potential	0	89.34	541.19	1,543.54	3,488.14	6,502.29	15,688.[illegible]

* Number in parentheses refers to the specific market penetration curve used in the end-use sector in this county.

INYO COUNTY

Summary of Resource Potential

Resource	Average Temperature (°C)	Depth of Wells (m)	Number of Wells	Average Volume (km)³	Resource Potential 90°C	90-150°C* (10^{12} Btus)	150°C (MWe)
Coso Hot Springs	220 ± 11	1477	NA	46.0 ± 12.0			650
Tecopa Hot Springs	176 ± 10	NA	NA	3.3 ± 0.9		56.88	
Tecopa Hot Springs	27 - 48	122	1	NA	Yes		
Trona Hot Springs	30 - 58	92 - 182	4	NA	Yes		

* Resource Potential for 90° - 150°C resources is estimated beneficial heat as calculated by the USGS.

Summary of Market Potential

END-USE SECTOR	YEAR 1976	1980	1985	1990	1995	2000	2020
Residential/Commercial							
• Market Demand	17.63	19.30	21.64	24.28	27.26	30.63	49.2[illegible]
• Market Potential (0)*	0	0	0	0	0	0	0
Industrial							
• Market Demand	9.83	10.92	12.47	14.23	16.24	18.54	31.4[illegible]
• Market Potential (5)*	0	.22	1.30	3.60	7.92	14.33	28.[illegible]
Agricultural							
• Market Demand	38.42	41.09	44.71	48.64	52.92	57.57	80.[illegible]
• Market Potential (2)*	0	.41	2.28	6.00	12.26	20.22	49.4[illegible]
Total							
• Market Demand	65.88	71.31	78.82	87.15	96.42	106.74	161.4[illegible]
• Market Potential	0	.63	3.58	9.60	20.18	34.5[illegible]	77.[illegible]

* Number in parentheses refers to the specific market penetration curve used in the end-use sector in this county.

KERN COUNTY

Summary of Resource Potential

Resource	Average Temperature (^{o}C)	Depth of Wells (m)	Number of Wells	Average Volume $(km)^3$	Resource Potential 90°C	90-150°C* (10^{12} Btus)	150°C (MWe)
Randsberg	172 ± 29	235	NA	9.4 ± 2.3			84
Scovern Hot Spring	106 ± 7	NA	NA	3.3 ± 0.9		46.45	

* Resource Potential for 90° - 150°C resources is estimated beneficial heat as calculated by the USGS.

Summary of Market Potential

END-USE SECTOR	YEAR 1976	1980	1985	1990	1995	2000	2020
Residential/Commercial							
• Market Demand	2,355.00	2,362.91	2,378.63	2,401.51	2,432.38	2,472.21	2,745.[illegible]
• Market Potential (2)*	0	-23.63	121.31	296.11	563.31	868.09	1,683.[illegible]
Industrial							
• Market Demand	686.90	796.33	958.75	1,155.35	1,399.53	1,682.26	3,602.1[illegible]
• Market Potential (5)*	0	15.93	99.79	292.65	682.41	1,299.88	3,241.[illegible]
Agricultural							
• Market Demand	600.34	626.98	662.52	700.32	740.97	784.55	993.[illegible]
• Market Potential (1)*	0	6.27	33.79	108.61	199.99	251.77	548.[illegible]
Total							
• Market Demand	3,642.24	3,786.22	3,9[illegible]9.90	4,257.18	4,572.88	4,939.02	7,341.[illegible]
• Market Potential	0	45.83	254.89	697.37	1,4[illegible]5.71	2,419.74	5,473.[illegible]

* Number in parentheses refers to the specific market penetration curve used in the end-use sector in this county.

LAKE COUNTY

Summary of Resource Potential

Resource	Average Temperature (°C)	Depth of Wells (m)	Number of Wells	Average Volume (km^3)	Resource Potential 90°C	90-150°C* (10^{18} Btus)	150°C (MWe)
Geysers	237 ± 8	NA	200	1167.0 ± 39.0			1610
Sulphur Bank Mine (Hot Bolata)	194 ± 6	400 - 1400	4	6.7 ± 1.9			75
Clear Lake Volcanic Field Area	190 ± 9	up to 3000	NA	83.0 ± 35.0			900
Wilbur Springs Area	144 ± 2	up to 1132	2	12.5 ± 4.0		246.48	
Chalk Mountain Area	113 ± 5	NA	NA	3.3 ± 0.9		50.24	

* Resource Potential for 90° - 150°C resources is estimated beneficial heat as calculated by the USGS.

Summary of Market Potential

END-USE SECTOR	YEAR 1976	1980	1985	1990	1995	2000	2020
Residential/Commercial							
• Market Demand	712.34	715.34	720.54	727.53	736.50	747.70	820.78
• Market Potential (2)*	0	7.15	36.75	89.70	170.57	262.55	503.14
Industrial							
• Market Demand	0	0	0	0	0	0	0
• Market Potential (5)*	0	0	0	0	0	0	0
Agricultural							
• Market Demand	28.10	29.83	32.15	34.67	37.40	40.37	54.95
• Market Potential (2)*	0	.30	1.64	4.27	8.66	14.18	33.68
Total							
• Market Demand	740.44	745.17	752.69	762.20	773.90	788.07	875.73
• Market Potential	0	7.45	38.39	93.97	179.23	276.73	536.82

* Number in parentheses refers to the specific market penetration curve used in the end-use sector in this county.

LASSEN COUNTY

Summary of Resource Potential

Resource	Average Temperature (°C)	Depth of Wells (m)	Number of Wells	Average Volume $(km)^3$	Resource Potential 90°C	90-150°C* ($10^{[illegible]}$ Btus)	150°C (MWe)
Morgan Springs - Growler Springs (Plumas, Shasta)	217 ± 15	NA	NA	8.3 ± 2.6			116
West Valley Reservoir Hot Springs (Modoc)	143 ± 3	NA	NA	3.3 ± 0.9		65.41	
Bassett Hot Springs (Modoc)	98 ± 7	NA	NA	3.3 ± 0.9		41.71	
Wendel-Amadee Area	126 ± 7	58 - 1538	6	10.6 ± 3.0		180.12	
Susanville	36 - 49	90 - 180	2	NA	Yes		

* Resource Potential for 90° - 150°C resources is estimated beneficial heat as calculated by the USGS.

Summary of Market Potential

END-USE SECTOR	YEAR 1976	1980	1985	1990	1995	2000	2020
Residential/Commercial							
• Market Demand	40.60	44.65	50.32	56.75	64.06	72.37	118.7[illegible]
• Market Potential (0)*	0	0	0	0	0	0	0
Industrial							
• Market Demand	90.05	102.22	119.77	140.34	164.43	192.67	363.1[illegible]
• Market Potential (5)*	0	2.04	12.47	35.55	80.18	148.88	326.8[illegible]
Agricultural							
• Market Demand	.85	.90	.98	1.07	1.16	1.27	1.7[illegible]
• Market Potential (2)*	0	.01	.05	.13	.27	.45	1.0[illegible]
Total							
• Market Demand	131.50	147.77	171.07	198.16	229.65	266.31	483.[illegible]
• Market Potential	0	2.05	12.57	35.68	80.45	149.33	327.9[illegible]

* Number in parentheses refers to the specific market penetration curve used in the end-use sector in this county.

MENDOCINO COUNTY

Summary of Resource Potential

Resource	Average Temperature (°C)	Depth of Wells (m)	Number of Wells	Average Volume (km)^3	Resource Potential 90°C	90-150°C* (10^{12} Btus)	150°C (MWe)
Low Temperature Thermal Water							

* Resource Potential for 90° - 150°C resources is estimated beneficial heat as calculated by the USGS.

Summary of Market Potential

END-USE SECTOR	1976	1980	1985	1990	1995	2000	2020
				YEAR			
Residential/Commercial							
• Market Demand	401.62	403.77	407.32	411.97	417.84	425.09	471.54
• Market Potential (2)*	0	4.04	[illegible]0.77	50.80	96.77	149.27	289.0[illegible]
Industrial							
• Market Demand	169.37	172.20	175.92	179.87	184.07	188.55	209.6[illegible]
• Market Potential (5)*	0	3.44	18.31	45.56	89.75	145.69	188.6[illegible]
Agricultural							
• Market Demand	110.49	117.29	126.42	136.33	147.07	158.72	216.06
• Market Potential (1)*	0	1.17	6.45	21.14	39.69	50.93	[illegible]
Total							
• Market Demand	681.48	693.26	709.66	728.17	748.98	772.36	897.23
• Market Potential	0	8.65	45.53	117.50	226.21	345.89	597.06

* Number in parentheses refers to the specific market penetration curve used in the end-use sector in this county.

MODOC COUNTY

Summary of Resource Potential

Resource	Average Temperature (°C)	Depth of Wells (m)	Number of Wells	Average Volume (km^3)	Resource Potential 90°C	90-150°C* (10^{12} Btus)	150°C (MWe)
Surprise Valley	152 ± 12	1100 - 2000	8	210.0 ± 90.0			1490
Fort Bidwell	135 ± 17	NA	NA	3.3 ± 0.9		61.62	
West Valley Reservoir Hot Springs (Lassen)	143 ± 3	NA	NA	3.3 ± 0.9		65.41	
Kelley Hot Spring	118 ± 10	978 - 1035	2	3.3 ± 0.9		53.09	
Basset Hot Spring (Lassen)	98 ± 7	NA	NA	3.3 ± 0.9		41.71	
Surprise Valley	40 -139	60 - 655	4	NA	Yes		

* Resource Potential for 90° - 150°C resources is estimated beneficial heat as calculated by the USGS.

Summary of Market Potential

END-USE SECTOR	1976	1980	1985	1990	1995	2000	2020
Residential/Commercial							
• Market Demand	14.52	15.52	16.90	18.39	20.00	21.77	30.[illegible]
• Market Potential (0)*	0	0	0	0	0	0	[illegible]
Industrial							
• Market Demand	35.12	39.87	46.71	54.73	64.13	75.14	141.[illegible]
• Market Potential (5)*	0	.80	4.86	13.86	31.27	58.06	127.[illegible]
Agricultural							
• Market Demand	.003	.003	.003	.004	.004	.004	.0[illegible]
• Market Potential (2)*	†	†	†	†	†	†	†
Total							
• Market Demand	49.643	55.393	63.613	73.124	84.134	96.914	172.[illegible]
• Market Potential	0	.803	4.86	13.86	31.27	58.06	127.[illegible]

* Number in parentheses refers to the specific market penetration curve used in the end-use sector in this county.

† Potential is negligible.

MONO COUNTY

Summary of Resource Potential

Resource	Average Temperature (°C)	Depth of Wells (m)	Number of Wells	Average Volume (km)³	Resource Potential 90°C	90-150°C* (10^{12} Btus)	150°C (MWe)
Long Valley Caldera	227 ± 10	up to 2100	> 1	136.0 ± 36.0			2100
North Shore Mono Lake	100 ± 8	3000	> 1	3.3 ± 0.9		43.61	
Grovers Hot Springs	126 ± 6	NA	NA	3.3 ± 0.9		56.88	
Fales Hot Springs	116 ± 12	126	1	3.3 ± 0.9		52.14	
Bridgeport	50	290	2	NA	Yes		
Mono Lake	56	245 - 743	2	NA	Yes		
Buckeye Hot Springs	101 ± 6	NA	NA	3.3 ± 0.9		43.61	
Travertine Hot Springs Area	111 ± 10	300	1	3.3 ± 0.9		49.30	

* Resource Potential for 90° - 150°C resources is estimated beneficial heat as calculated by the USGS.

Summary of Market Potential

END-USE SECTOR	1976	1980	1985	1990	1995	2000	2020
Residential/Commercial							
• Market Demand	15.99	17.54	19.69	22.13	24.90	28.02	45.36
• Market Potential (0)*	0	0	0	0	0	0	0
Industrial							
• Market Demand	0	0	0	0	0	0	0
• Market Potential (5)*	0	0	0	0	0	0	0
Agricultural							
• Market Demand	3.29	3.52	3.83	4.17	4.54	4.94	6.92
• Market Potential (2)*	0	.04	.20	.51	1.05	1.73	4.24
Total							
• Market Demand	19.28	21.06	23.52	26.30	30.49	32.96	52.28
• Market Potential	0	.04	.20	.51	1.05	1.73	4.24

* Number in parentheses refers to the specific market penetration curve used in the end-use sector in this county.

MONTEREY COUNTY

Summary of Resource Potential

Resource	Average Temperature (°C)	Depth of Wells (m)	Number of Wells	Average Volume (km^3)	Resource Potential 90°C	90-150°C* (10^{12} Btus)	150°C (MWe)
Low Temperature Thermal Water							

* Resource Potential for 90° - 150°C resources is estimated beneficial heat as calculated by the USGS.

Summary of Market Potential

END-USE SECTOR	YEAR 1976	1980	1985	1990	1995	2000	2020
Residential/Commercial							
• Market Demand	1,963.71	1,969.93	1,981.42	1,997.50	2,018.17	2,045.54	2,225.3[illegible]
• Market Potential (3)*	0	0	19.81	101.87	248.84	552.09	1,090.64
Industrial							
• Market Demand	470.76	533.25	623.14	728.19	850.95	994.41	1,854.4[illegible]
• Market Potential (6)*	0	0	12.46	75.79	215.55	485.12	1,668.96
Agricultural							
• Market Demand	228.61	242.72	261.64	282.16	304.41	328.53	447.31
• Market Potential (3)*	0	0	2.62	14.39	37.53	88.67	219.22
Total							
• Market Demand	2,663.08	2,745.90	2,866.20	3,007.85	3,173.53	3,368.48	4,527.09
• Market Potential	0	0	34.89	192.05	501.92	1,125.88	2,978.82

* Number in parentheses refers to the specific market penetration curve used in the end-use sector in this county.

NAPA COUNTY

Summary of Resource Potential

Resource	Average Temperature (°C)	Depth of Wells (m)	Number of Wells	Average Volume $(km)^3$	Resource Potential 90°C	90-150°C* (10^{15} Btus)	150°C (MWe)
Calistoga Hot Springs	144 ± 3	610	NA	6.9 ± 1.5		137.46	

* Resource Potential for 90° - 150°C resources is estimated beneficial heat as calculated by the USGS.

Summary of Market Potential

END-USE SECTOR	YEAR 1976	1980	1985	1990	1995	2000	2020
Residential/Commercial							
• Market Demand	2,724.59	2,733.21	2,749.18	2,771.48	2,800.85	2,838.12	3,087.5[illegible]
• Market Potential (1)*	0	27.33	140.21	429.80	755.95	910.78	1,705.34
Industrial							
• Market Demand	24.54	28.97	35.62	43.80	53.92	66.34	151.91
• Market Potential (5)*	0	.58	3.71	11.09	26.29	51.26	136.72
Agricultural							
• Market Demand	36.28	38.52	41.53	44.78	48.31	52.14	70.99
• Market Potential (1)*	0	.39	2.12	6.94	13.04	16.73	39.21
Total							
• Market Demand	2,785.41	2,800.70	2,826.33	2,860.06	2,903.08	2,956.60	3,310.43
• Market Potential	0	28.30	146.04	447.83	795.28	978.77	1,881.27

* Number in parentheses refers to the specific market penetration curve used in the end-use sector in this county.

PLUMAS COUNTY

Summary of Resource Potential

Resource	Average Temperature (°C)	Depth of Wells (m)	Number of Wells	Average Volume (km^3)	Resource Potential 90°C	90-150°C* (10^{15} Btus)	150°C (MWe)
Morgan-Growler Springs (Lassen, Shasta)	217 ± 15	NA	NA	8.3 ± 2.6			116
Sierra Valley	125 ± 6	680	1	10.0 ± 3.2		169.69	
Susanville (Lassen)	36 - 49	90 - 180	2	NA	Yes		

* Resource Potential for 90° - 150°C resources is estimated beneficial heat as calculated by the USGS.

Summary of Market Potential

END-USE SECTOR	YEAR 1976	1980	1985	1990	1995	2000	2020
Residential/Commercial							
• Market Demand	132.17	132.82	133.90	135.35	137.19	139.49	154.46
• Market Potential (2)*	0	1.33	6.83	16.69	31.77	48.98	94.68
Industrial							
• Market Demand	161.48	183.31	214.78	251.66	294.88	345.51	651.23
• Market Potential (5)*	0	3.67	22.35	63.75	143.78	266.98	586.11
Agricultural							
• Market Demand	20.24	21.49	23.17	24.99	26.96	29.10	39.63
• Market Potential (2)*	0	.21	1.18	3.08	6.24	10.22	24.29
Total							
• Market Demand	313.89	337.62	371.85	412.00	459.03	514.10	845.32
• Market Potential	0	5.21	30.36	83.52	181.79	326.18	705.08

* Number in parentheses refers to the specific market penetration curve used in the end-use sector in this county.

RIVERSIDE COUNTY

Summary of Resource Potential

Resource	Average Temperature (°C)	Depth of Wells (m)	Number of Wells	Average Volume $(km)^3$	Resource Potential 90°C	Resource Potential 90-150°C* (10^{12} Btus)	Resource Potential 150°C (MWe)
Pilger Hot Springs	105 ± 7	92	1	3.3 ± 0.9		46.45	
Coachella Hot Springs (Imperial)	39 - 98	<150	14	NA	Yes		

* Resource Potential for 90° - 150°C resources is estimated beneficial heat as calculated by the USGS.

Summary of Market Potential

END-USE SECTOR	YEAR 1976	1980	1985	1990	1995	2000	2020
Residential/Commercial							
• Market Demand	2,103.63	2,116.54	2,138.60	2,168.00	2,205.60	2,252.43	2,577.6
• Market Potential (1)*	0	21.17	109.07	336.21	595.29	722.83	1,423.7
Industrial							
• Market Demand	1,042.09	1,177.81	1,373.25	1,602.03	1,870.04	2,184.12	4,091.0
• Market Potential (5)*	0	23.56	142.93	405.79	911.83	1,687.67	3,681.9
Agricultural							
• Market Demand	105.82	110.50	116.71	123.36	130.48	138.12	174.71
• Market Potential (2)*	0	1.11	5.95	15.21	30.22	48.50	107.1
Total							
• Market Demand	3,251.54	3,404.85	3,628.56	3,893.39	4,206.12	4,574.67	6,643.41
• Market Potential	0	45.84	257.95	757.21	1,537.34	2,459.00	5,212.7

* Number in parentheses refers to the specific market penetration curve used in the end-use sector in this county.

SAN BERNARDINO COUNTY

Summary of Resource Potential

Resource	Average Temperature (°C)	Depth of Wells (m)	Number of Wells	Average Volume $(km)^3$	Resource Potential 90°C	Resource Potential 90-150°C* (10^{12} Btus)	Resource Potential 150°C (MWe)
Randsburg (Kern)	172 ± 29	235	1	9.4 ± 2.3			84
Arrowhead Hot Springs	132 ± 8	NA	NA	3.3 ± 0.9		60.67	
Tecopa Hot Springs (Inyo)	126 ± 10	NA	NA	3.3 ± 0.9		56.88	
Trono Hot Springs (Inyo)	30 - 58	92 - 182	4	NA	Yes		
Tecopa Hot Springs (Inyo)	27 - 48	122	1	NA	Yes		

* Resource Potential for 90° - 150°C resources is estimated beneficial heat as calculated by the USGS.

Summary of Market Potential

END-USE SECTOR	YEAR 1976	1980	1985	1990	1995	2000	2020
Residential/Commercial							
• Market Demand	1,390.72	1,397.89	1,410.55	1,437.75	1,450.03	1,478.02	1,662.8[illegible]
• Market Potential (2)*	0	13.98	71.94	177.27	335.81	518.99	1,019.3[illegible]
Industrial							
• Market Demand	1,294.34	2,873.44	3,288.71	3,774.99	4,345.53	5,015.59	9,136.2[illegible]
• Market Potential (5)*	0	57.47	342.29	956.20	2,118.88	3,875.55	8,222.5[illegible]
Agricultural							
• Market Demand	468.34	489.11	516.63	546.10	577.70	611.57	773.9[illegible]
• Market Potential (2)*	0	4.89	26.35	67.33	133.79	214.75	474.4[illegible]
Total							
• Market Demand	3,153.40	4,710.44	5,215.89	5,758.84	6,373.26	7,105.18	11,572.9[illegible]
• Market Potential	0	76.34	440.53	1,200.80	2,588.48	4,609.29	9,716.33

* Number in parentheses refers to the specific market penetration curve used in the end-use sector in this county.

SAN DIEGO COUNTY

Summary of Resource Potential

Resource	Average Temperature (°C)	Depth of Wells (m)	Number of Wells	Average Volume (km^3)	Resource Potential 90°C	90-150°C* (10^{12} Btus)	150°C (MWe)
Low Temperature Thermal Water							

* Resource Potential for 90° - 150°C resources is estimated beneficial heat as calculated by the USGS.

Summary of Market Potential

END-USE SECTOR	YEAR 1976	1980	1985	1990	1995	2000	2020
Residential/Commercial							
• Market Demand	43,595.61	43,104.24	42,522.91	41,979.69	41,476.66	41,016.28	39,666.
• Market Potential (3)*	0	0	425.23	2,140.96	6,432.20	11,070.29	19,440.
Industrial							
• Market Demand	4,107.06	4,770.00	5,757.95	6,959.17	8,420.60	10,199.75	22,159.
• Market Potential (6)*	0	0	115.16	724.31	2,132.94	4,973.40	19,943.
Agricultural							
• Market Demand	91.86	97.72	105.58	114.12	123.38	133.43	183.
• Market Potential (4)*	0	0	1.06	5.82	15.21	30.90	101.
Total							
• Market Demand	47,794.53	47,971.95	48,386.44	49,052.98	50,020.64	51,349.45	62,009.
• Market Potential	0	0	541.45	2,871.09	8,580.35	16,074.59	39,485.

* Number in parentheses refers to the specific market penetration curve used in the end-use sector in this county.

SAN LUIS OBISPO COUNTY

Summary of Resource Potential

Resource	Average Temperature (°C)	Depth of Wells (m)	Number of Wells	Average Volume (km)³	Resource Potential 90°C	90-150°C* (10^{18} Btus)	150°C (MWe)
Low Temperature Thermal Water							

* Resource Potential for 90° - 150°C resources is estimated beneficial heat as calculated by the USGS.

Summary of Market Potential

END-USE SECTOR	YEAR 1976	1980	1985	1990	1995	2000	2020
Residential/Commercial							
• Market Demand	293.66	301.97	313.93	327.82	343.91	362.50	469.22
• Market Potential (4)*	0	0	3.14	16.72	42.40	83.95	260.67
Industrial							
• Market Demand	32.88	36.54	41.71	47.61	54.34	62.02	105.26
• Market Potential (6)*	0	0	.83	4.96	13.76	30.24	94.73
Agricultural							
• Market Demand	190.54	195.65	202.25	209.11	216.25	223.68	255.99
• Market Potential (3)*	0	0	2.02	10.66	33.54	60.37	125.46
Total							
• Market Demand	467.08	534.16	557.89	584.54	614.50	648.24	830.47
• Market Potential	0	0	5.99	32.34	89.70	174.56	480.86

* Number in parentheses refers to the specific market penetration curve used in the end-use sector in this county.

SANTA BARBARA COUNTY

Summary of Resource Potential

Resource	Average Temperature (°C)	Depth of Wells (m)	Number of Wells	Average Volume (km)³	Resource Potential 90°C	90-150°C* (10^{12} Btus)	150°C (MWe)
Low Temperature Thermal Water							

* Resource Potential for 90° - 150°C resources is estimated beneficial heat as calculated by the USGS.

Summary of Market Potential

END-USE SECTOR	YEAR 1976	1980	1985	1990	1995	2000	2020
Residential/Commercial							
• Market Demand	980.71	986.85	997.28	1,011.12	1,028.73	1,050.61	1,192.[illegible]
• Market Potential (3)*	0	0	9.97	51.57	159.54	283.56	584.[illegible]
Industrial							
• Market Demand	1,492.00	1,658.68	1,893.47	2,161.50	2,467.48	2,816.77	4,78[illegible]
• Market Potential (6)*	0	0	37.87	224.97	625.01	1,373.46	4,305.2[illegible]
Agricultural							
• Market Demand	102.72	105.19	108.34	111.59	114.94	118.39	133.2[illegible]
• Market Potential (3)*	0	0	1.09	5.69	14.17	27.42	74.0[illegible]
Total							
• Market Demand	2,575.43	2,750.72	2,999.09	3,284.21	3,611.15	3,985.77	6,109.54
• Market Potential	0	0	48.92	282.23	798.72	1,684.44	4,963.81

* Number in parentheses refers to the specific market penetration curve used in the end-use sector in this county.

SHASTA COUNTY

Summary of Resource Potential

Resource	Average Temperature (°C)	Depth of Wells (m)	Number of Wells	Average Volume (km)³	Resource Potential 90°C	90-150°C* (10^{15} Btus)	150°C (MWe)
Morgan-Growler Springs (Lassen/Plumas)	217 ± 15	NA	NA	8.3 ± 2.6			116
Big Bend Hot Springs	116 ± 9	NA	NA	3.3 ± 0.9		52.14	

* Resource Potential for 90° - 150°C resources is estimated beneficial heat as calculated by the USGS.

Summary of Market Potential

END-USE SECTOR	1976	1980	1985	1990	1995	2000	2020
Residential/Commercial							
• Market Demand	491.69	493.82	493.09	495.27	498.47	502.78	534.0[illegible]
• Market Potential (2)*	0	4.92	25.15	61.07	115.44	176.55	336.9[illegible]
Industrial							
• Market Demand	499.03	565.85	662.36	774.82	906.70	1,061.06	1,990.6[illegible]
• Market Potential (5)*	0	11.32	68.94	196.26	442.11	819.88	1,791.5[illegible]
Agricultural							
• Market Demand	10.93	11.19	11.52	11.87	12.23	12.59	14.1[illegible]
• Market Potential (2)*	0	.11	.59	1.46	2.83	4.42	8.6[illegible]
Total							
• Market Demand	1,001.65	1,068.86	1,166.97	1,281.96	1,417.40	1,576.43	2,538.81
• Market Potential	0	16.35	94.68	258.79	560.38	1,000.85	[illegible],137.22

* Number in parentheses refers to the specific market penetration curve used in the end-use sector in this county.

SISKIYO COUNTY

Summary of Resource Potential

Resource	Average Temperature (°C)	Depth of Wells (m)	Number of Wells	Average Volume (km^3)	Resource Potential 90°C	90-150°C* (10^{15} Btus)	150°C (MWe)
Big Bend Hot Springs (Shasta)	116 ± 9	NA	NA	3.3 ± 0.9		52.14	

* Resource Potential for 90° - 150°C resources is estimated beneficial heat as calculated by the USGS.

Summary of Market Potential

END-USE SECTOR	1976	1980	1985	1990	1995	2000	2020
Residential/Commercial							
• Market Demand	.0004	.0004	.0005	.0005	.0006	.0007	.00
• Market Potential (0)*	†	†	†	†	†	†	†
Industrial							
• Market Demand	401.84	456.15	534.47	626.25	733.78	859.77	1,620.5
• Market Potential (5)*	0	9.12	55.63	158.63	357.79	664.34	1,450.50
Agricultural							
• Market Demand	.004	.004	.004	.005	.005	.01	.01
• Market Potential (2)*	0	†	†	†	†	†	†
Total							
• Market Demand	401.8444	456.1544	534.4745	626.2555	733.7856	859.7807	1,620.5
• Market Potential	0	9.12	55.63	158.63	357.79	664.34	1,458.

* Number in parentheses refers to the specific market penetration curve used in the end-use sector in this county.

† Potential is negligible.

SONOMA COUNTY

Summary of Resource Potential

Resource	Average Temperature (°C)	Depth of Wells (m)	Number of Wells	Average Volume (km)^3	Resource Potential 90°C	90-150°C* (10^{12} Btus)	150°C (MWe)
Skaggs Hot Springs	113 ± 13	NA	NA	6.9 ± 1.9		50.24	

* Resource Potential for 90° - 150°C resources is estimated beneficial heat as calculated by the USGS.

Summary of Market Potential

END-USE SECTOR	1976	1980	1985	1990	1995	2000	2020
Residential/Commercial							
• Market Demand	2,782.04	2,790.28	2,805.79	2,827.69	2,856.69	2,893.63	3,142.17
• Market Potential (1)*	0	27.90	143.10	438.52	771.02	928.57	1,735.51
Industrial							
• Market Demand	468.75	527.90	612.51	710.78	824.97	957.63	1,741.36
• Market Potential (5)*	0	10.56	63.75	180.04	402.26	739.96	1,566.32
Agricultural							
• Market Demand	95.76	101.66	109.58	118.17	127.48	137.58	187.29
• Market Potential (1)*	0	1.02	5.59	18.33	34.41	44.15	103.45
Total							
• Market Demand	3,346.55	3,419.84	3,527.88	3,656.64	3,809.14	3,988.84	5,070.87
• Market Potential	0	39.48	212.44	636.89	1,207.69	1,712.68	3,405.28

* Number in parentheses refers to the specific market penetration curve used in the end-use sector in this county.

VENTURA COUNTY

Summary of Resource Potential

Resource	Average Temperature (°C)	Depth of Wells (m)	Number of Wells	Average Volume (km)^3	Resource Potential 90°C	90-150°C* (10^{12} Btus)	150°C (MWe)
Sespe Hot Springs	131 ± 8	NA	NA	3.3 ± 0.9		58.78	

* Resource Potential for 90° - 150°C resources is estimated beneficial heat as calcula'ed by the USCS.

Summary of Market Potential

END-USE SECTOR	1976	1980	1985	1990	1995	2000	2020
Residential/Commercial							
• Market Demand	4,508.18	4,597.31	4,596.66	4,665.89	4,753.37	4,861.38	5,545.9[illegible]
• Market Potential (1)*	0	45.97	234.43	723.59	1,282.93	1,560.07	3,063.[illegible]
Industrial							
• Market Demand	656.40	730.30	834.53	953.65	1,087.66	1,245.44	2,124.9[illegible]
• Market Potential (5)*	0	14.61	86.86	241.56	530.34	962.35	1,912.44
Agricultural							
• Market Demand	33.02	33.81	34.82	35.87	36.94	38.05	42.81
• Market Potential (2)*	0	.34	1.78	4.42	8.55	13.36	26.24
Total							
• Market Demand	5,197.60	3,561.42	5,466.01	5,655.41	5,877.97	6,144.87	7,713.7[illegible]
• Market Potential	0	60.92	323.07	969.57	1,821.82	2,535.78	5,001.[illegible]

* Number in parentheses refers to the specific market penetration curve used in the end-use sector in this county.

HAWAII REPORT

HAWAII HYDROTHERMAL MARKET PENETRATION ANALYSIS

Prepared for

Department of Energy
Region IX
San Francisco, California

By

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EXECUTIVE SUMMARY

Introduction

- Over 90% of Hawaii's energy needs are supplied by foreign imports of fossil fuels.
- The State's governments and businesses are aggressively seeking alternatives to the dependence on foreign supplies.
- Over the past year and still continuing, a number of research projects on geothermal resource locations, economic and engineering feasibility of electricity generating and direct applications of hydrothermal fluids have been taking place.
- Based on potential resources and need, Hawaii is a prime candidate for direct applications of hydrothermal fluids in industrial and agricultural processing.
- The State's limited heavy industrial activity, the climatic conditions, and its island formations are considered to be limiting factors associated with the commercialization of direct application.

Key Assumption

- Geothermal reservoirs were assumed to be at great depths (over 5,000 feet) and high temperature (greater than 150° C).
- High exploration and development costs and the costs of transmission, royalties, and other infrastructure costs combined with retrofit and backup system costs will prevent geothermal energy from being dramatically cheaper than other energy sources.
- Institutional, legal, political, environmental, and ownership barriers will be overcome.
- Private industry will have the primary responsibility for the commercialization of industrial direct applications.
- Potential users will connect to available hydrothermal fluid resources if made available.
- Electricity generation will be the primary force behind development of geothermal reservoirs and direct applications will follow.

- Hawaii's location, present economic base and water shortage concerns will tend to dissuade new, large energy intensive industrial operations from locating Hawaii.

(Comment: This is a controversial assumption, but is derived from a consensus of opinion by industry and government persons interviewed.)

- Hawaii's sugar factories will utilize geothermal for both direct applications and electricity generation.

- Alternative energy sources will eventually compete with each other and may slow development.

(Comment: The State is currently conducting research projects in solar, OTEC, biomass, wind, and geothermal energy resources.)

Methodology

- Baseline data was developed for all non-transportation and non-military energy consumption in 1975 by County and by SIC classification.

- Direct industrial heating and water heating energy consumption were considered the potential market for geothermal direct application.

- Space conditioning was not considered a primary potential due to the lack of space heating and the availability of data on air conditioning consumption.

(Comment: Air conditioning is generally confined to office buildings, retail outlets, hotels, and high rise condominiums.)

- The 20 potential sites identified by the Hawaii Institute of Geophysics were used as the State's reservoir base.

- Growth estimates for potential geothermal applications were based on the State's energy, population, and tourism projections and a survey of industry. (The estimates were made by County and by resource.)

- Market penetration projections were derived by assigning a rate of retrofit activity and new market penetration. The rates vary by County and in some cases, by industry.

Conclusion

- Tables A and B summarize the estimates for potential geothermal use and the projected geothermal capture. (The formulas for deriving the forecast are attached to the tables.)
- All four of Hawaii's counties have potential geothermal resources.
- Over 80% of State's population, commerce and industry are within potential geothermal markets.
- By 2020, 40% of the industrial energy requirements could be provided by geothermal.
- Geothermal estimated captures is 10% of the State's forecasted total non-electric energy usage excluding transportation and electricity generation.

TABLE A

INDUSTRIAL PROCESS HEAT

HAWAII

	1975 ENERGY USE BTU X 10^{12}/YR	1985 ENERGY USE BTU X 10^{12}/YR	2000 ENERGY USE BTU X 10^{12}/YR	2020 ENERGY USE BTU X 10^{12}/YR
POTENTIAL GEOTHERMAL USE				
4 counties evaluated	45.015	51.179	69.232	101.762
(of 4 counties total)	'A'	'D'	'D'	'D'
Total	45.015	51.179	69.232	101.762
FORECAST GEOTHERMAL CAPTURE				
Retrofit 'B'	-0-	1.506 'B'	12.643 'B'	17.232 'B'
New Growth Capture 'C'	-0-	-0-	1.527 'C'	4.319 'C'
Total	-0-	1.506	14.170	21.551

TABLE A

'A' Energy Use in Hawaii. County and consumption by end user data.

'B' Energy from expected retrofit of co-located sugar companies plus:

Honolulu - 20% retrofit beginning in 1985 of Campbell Industrial Park by 2000. 1% per year of all other potential retrofit starting in 1985 through 2020.

Hawaii - 1% per year beginning in 1985 through 2020.

Kauai - 1% per year beginning in 2000 through 2020.

'C' 50% of new growth beginning in 1985 for Honolulu, Hawaii, and starting in 2000 for Kauai.

'D' 1975 x growth factors.

TABLE B

RESIDENTIAL/COMMERCIAL WATER HEATING

HAWAII

	1975 ENERGY USE BTU X 10^{12}/YR	1985 ENERGY USE BTU X 10^{12}/YR	2000 ENERGY USE BTU X 10^{12}/YR	2020 ENERGY USE BTU X 10^{12}/YR
POTENTIAL GEOTHERMAL USE				
4 counties evaluated	60.63	88.59	158.93	293.23
(of 4 counties considered)	'a'	'b'	'b'	'b'
Total	60.63	88.59	158.93	293.23
FORECAST GEOTHERMAL CAPTURE				
Retrofit 'c'	-0-	1.506	2.945	8.720
New Growth Capture 'd'	-0-	-0-	2.394	10.589
Total	-0-	1.506	5.339	19.309

Table B

'a' Energy Use in Hawaii. County and consumption by end user data.

'b' Growth rates taken from projections by the Hawaiian Electric Company and State population projections.

'c' 1% per year retrofit rate for all counties beginning in 1990 except Kauai which starts in 2005 at a 1% retrofit rate.

'd' Step increases for all counties except Kauai, starting in 1985, to a maximum of 30% of the new growth by 2000. Kauai begins in 2000 up to a maximum of 30% by 2015.

I. INTRODUCTION

Ever since the OPEC embargo of 1973, Hawaii's governments, businesses, and residents have been very concerned about the State's vulnerability to foreign fossil fuels. The State legislature, the administration, the local governments, the University and businesses have been very aggressive in their efforts to achieve energy self-sufficiency. Currently, the State is actively promoting a state-wide energy conservation program, conducting research on various types of alternative energy resources and reviewing legal, political, and institutional barriers to the development of commercialization of various alternative energy resources. With the support of the federal government, Hawaii is rapidly gaining a great deal of expertise in alternative energy development.

Of the several alternative energy resources suited to Hawaii's climate, location, and geology, geothermal development has been viewed as one of the most promising and feasible alternatives. The successful drilling of Hawaii's first geothermal well, and the quality of the resource, have encouraged government and business to attempt to accelerate the development of this resource. The State has an active Geothermal Advisory Committee comprised of State government personnel, researchers, potential users, and community leaders who are seeking to find ways to promote geothermal development and overcome barriers. Appendix A contains a list of recommendations composed by this body to be presented to the State legislature for consideration.

To date, most of the research in Hawaii for measuring geothermal potential as an alternative energy resource has been focused on resource location and electricity generation. This study focuses on the potential for geothermal in

Hawaii as a direct energy source. The results are intended to provide a benchmark and guide for future studies and development of a Regional Plan by DOE to accelerate commercialization of hydrothermal resources in the State.

The primary purpose of this study has been to estimate the potential existing and future markets for direct applications of hydrothermal resources in Hawaii on a county level. Both industrial process applications and water heating applications for residential and commercial sectors were considered. Hydrothermal applications were factored out of total energy demand and annual growth estimates were developed for both existing and future energy demand. Estimated market penetration factors were developed on a county level and in some cases, by industry.

Several key assumptions were made during the development of the growth and penetration estimates. It was assumed that the geothermal resources in Hawaii would share many of the characteristics of Hawaii's only geothermal well, HGP-A at Puna, Hawaii. This resource has a very high temperature (572°F) and is considered highly suitable for electricity generation. The well is 6,450 feet deep and required new state-of-the-art drilling and casing technology. It is not known at this time whether all geothermal reservoirs are as high temperature or as deep as HGP-A. It would be beneficial to the commercialization of geothermal reservoirs in Hawaii if future wells prove to be shallower. The costs of exploration and development would decline appreciatively. Also, for the purposes of direct heat applications, low and intermediate temperature wells would be suitable for a large percentage of the potential users. However, due to the expected depth of the wells, the geological formations to be drilled through, and the exploration costs, it was assumed that the development costs would be quite high. As a consequence of these high capital costs, and the added costs of pipelines, royalties, and other infrastructure costs, the assumption was made that geothermal will not be dramatically cheaper than other alternative energy resources.

If the benefit to the overall community dictates, it was assumed that institutional, legal, political, environmental, and ownership barriers would be overcome. The potential impact that these barriers would have on the commercialization of geothermal cannot be underestimated.

For the purposes of estimating the potential geothermal market and forecasting the market penetration, it was assumed that private industry would have the major responsibility of commercializing geothermal. If government assumes the major role for commercialization, the forecasts presented in this report would most likely change.

A recent study conducted by the Hawaii Institute of Geophysics, "Hawaii Geothermal Resource Assessment Program," was used as the basis for geothermal resource location. The report list 20 sites that have anomalies indicating a probability of geothermal reservoirs. As the report states, this listing is not exhaustive of all potential geothermal sites, but rather, is the first priority for additional testing and investigating.

Potential market growth was derived through a combination of forecasting projection based on the state of Hawaii's Department of Planning and Economic Development projections for energy demands, population, and tourism and industry surveys.

The potential for space conditioning was not included in the market penetration estimates for future use of hydrothermal fluids. Hawaii's climate exempts the need for space heating and eliminates the need for residential air conditioning except in high rise residential buildings. Many of these high rise units have unit air conditioners. Commercial establishments such as hotels, restaurants, retailers, and office buildings are heavier users of central air conditioning. In recent years, improved efficiency and operating improvements have been instituted. As a result, accurate data on air conditioning energy consumption is not readily available at this time. A valid assumption to make is that if hydrothermal fluids were available and absorption air conditioning technology was available for economical applications, that new commercial establishments would use the resources. However, it was not possible within the scope of this survey to develop the necessary data to forecast potential usages for air conditioning.

For industrial applications, geothermal potential was based on steam and preheat applications. Excluded from the potential was energy consumed in the form of electricity for industrial motors, lighting, etc., and energy required for direct electricity generation.

Market penetration by geothermal energy was estimated separately for industrial applications and residential/commercial application. It was assumed that because of existing plans, geothermal penetration would not begin until 1985. Estimates were developed on a county and resource location basis. Penetration factors for retrofit and new growth were developed based on the assumption that if hydrofluids were made available to potential users, these users would retrofit or design accordingly.

The penetration of geothermal sources presented in this report reflects the consensus of the business and government persons interviewed. Judgmentally, it is a realistic view of Hawaii's potential, but does not set either upper or lower limits on the potential development. It assumes that Hawaii will not experience a dramatic change in its economic activity. Hawaii has never been an industrial state, and its distance from markets, lack of raw materials, industrial infrastructure, and the cost of living all strongly suggest that Hawaii will not have a substantial growth in industrial activities.

Hawaii has, and is being evaluated as an industrial site by several energy intensive industries, but the feeling among government and business leaders contacted is that the probability of large energy users locating in Hawaii is relatively low. Most reason that the same conditions and factors that have kept large industry away from Hawaii will prevail in the future. Additionally, the major attraction of a dependable, inexpensive energy source is associated with a relatively high risk geological area. The sites being considered for these industries are near the Puna Geothermal Reservoir and, are active geological areas and the plants would be subject to risks such as lava flows, landslides, earthquakes, and other hazards associated with volcanic areas. Specifically, the prospects of a magnesium nodules processing plant and/or an aluminum refinery are considered to be less than fifty percent.

Industry growth considered in this survey will be in those segments where the major consumers are located in Hawaii or the raw materials are locally available in Hawaii. Examples for the former growth market are food and feed processes and for the latter, sugar factories and canneries.

In summary, Hawaii's geothermal resources appear to be substantial and suitable for direct heat hydrothermal applications. Its vulnerability to embargoes, shipping strikes and other uncontrollable factors, makes the development of geothermal very desirable for the community at large. Also, the prospects of a dependable, cheaper than fossil fuels alternative have aroused the interest of Hawaii's businesses. Hawaii's lack of energy intensive industry, its low probability of attracting new major industry, and the cost of exploration, development, and transmission may retard the commercialization of geothermal. However, on a selective basis, in the industrial park areas, and agriculture processing factories, there appears to be a relatively high potential for the commercialization of direct geothermal use.

Hawaii's sugar factories account for almost 27% of the State's total non-transportation energy consumption. Their industrial process energy consumption is 38% of the State's industrial non-electrical energy use. As an industry, they offer one of the best potential for geothermal commercialization and a recent study by Puna Sugar Company indicates that it is economically feasible for a company to drill its own well and transport the hydrofluids via pipeline. However, the economic model included the production of electricity for sale to the local utility on a firm power basis and the value of extracted sulfur dioxide.

The estimates for the State's potential geothermal market show that by the year 2020, 40% of the State's industrial energy consumption could be provided by geothermal. Penetration by geothermal in the industrial sector is projected to be 50% of the potential. This is based on the assumption that geothermal colocated sugar factories will use geothermal for their industrial energy needs.

In the residential/commercial sectors, (R/C) potential geothermal applications are projected to be 25% of the State's R/C usage. Penetration is expected to be 25% of the total potential. The competition from other alternative energy sources is expected to be greater in the residential/commercial sectors and penetration is very dependent on state and local government's involvement.

By the year 2020, geothermal is projected to supply Hawaii with 10% of the total non-transportation energy usage, under the assumptions that resources are developed, barriers are overcome, and that geothermal's cost is competitive with other energy sources.

II. METHODOLOGY AND ASSUMPTIONS

A. Baseline Market Size Demand

The State's total gross BTU consumption for 1975 was determined. The consumption was then segmented by county. Exhibit I illustrates the segmentation for non-transportation usage. Roughly 58% of the State's non-transportation BTU consumption is in the form of electricity. The remaining consumption is either petroleum products such as residual oil or diesel fuel and biomass created steam. Several assumptions were made in deriving this data. First, all residual fuel not being used for electricity generation was allocated to industrial usage. All non-transportation diesel fuel was allocated to the commercial sectors such as construction and agricultural field operations. Appendix B shows a breakdown of petroleum consumption by use and by county. An analysis of the sugar factories energy consumption was then conducted. Appendix C shows the energy source mix and energy consumption by sugar factories in each of the counties. The sugar factories for the most part are not dependent on utility electricity, and in fact, are net sellers of electricity. Sugar factories consume approximately 40% of their total BTU usage for electricity generation. A portion of this electricity is put into the various counties' electrical grids and used by utility customers.

The above analysis resulted in a breakdown of gross BTU consumption by residential, commercial and industrial sectors for each county. Residential and commercial consumption were then combined and industrial treated separately.

The 20 potential geothermal sites identified by the Hawaii Institute of Geophysics were used as the resource base. These potential reservoir sites were located on county maps. 12-mile radius circles were drawn around each of the sites and the enclosed areas were considered potential geothermal market

XHIBIT I

ENERGY CONSUMPTION BREAKDOWN
HAWAII, 1975
10^{12} BTU's

Total Energy Use
237.895

Transportation
132.25

Non-Transportation
105.645

Electricity
60.773

Residential

		Hot Water
Hawaii	1.678	.671
Hono	28.744	11.492
Maui	1.516	.606
Kauai	.601	.240
TOTAL	32.539	13.009

Commercial

		Hot Water
Hawaii	1.480	.159
Hono	17.837	.894
Maui	1.091	.231
Kauai	.623	.120
TOTAL	21.031	1.404

Industrial

Hawaii	.531
Hono	5.761
Maui	.545
Kauai	.366
TOTAL	7.203

Biomass and Petroleum
44.872

Industrial/Sugar

Hawaii	12.016
Hono	4.061
Maui	6.520
Kauai	5.718
TOTAL	28.315

Non-Sugar
16.557

Residential

		Hot Water
Hawaii	.047	.038
Hono	.757	.606
Maui	.009	.007
Kauai	.007	.006
TOTAL	.820	.657

Commercial

Hawaii	.616
Hono	4.910
Maui	.454
Kauai	.259
TOTAL	6.239

Industrial

Hawaii	.700
Hono	7.596
Maui	.719
Kauai	.483
TOTAL	9.498

areas. Major physical barriers such as high mountain ranges and the ocean were located and the potential market areas adjusted. Next, the latest published land use, zoning, and state plan information was applied to the areas to determine what future development might take place in the various potential geothermal market areas. The county maps in Appendix D show the present designated land use for each of the counties. It was taken under consideration that land use and zoning status are subject to change.

Each of the 4 counties were surveyed for industrial plants. Over 600 companies were identified as industrial establishments, according to the Standard Industrial Classification, (SIC). However, only 125 of these companies had 50 or more total employment and the average number of employees was 38.

From the list of 125 companies, those having industrial processes that require direct heat applications or preheat requirements were selected. The resulting 79 companies were classified by SIC and location. 64 of the companies were co-located with the 20 potential geothermal resource sites. 48 of the companies, including at least 1 from each SIC, were contacted to obtain data on energy consumption, company and industrial growth estimates and attitudes, perceptions, and understanding of and about hydrothermal usage in industrial processes. Several of the companies declined to give information for a number of reasons, but representative data was obtained for all industries.

The data acquired through the survey was measured against data available through the State's Department of Planning and Economic Development, the electrical utilities, and previous energy studies. In most cases, the data had a high correlation. Where large discrepancies existed, industrial sources were reinterviewed to determine which data was in error.

For companies where specific data was not available, factors for industrial process BTU consumption were developed. These factors were based on employee counts and the energy intensity of respective product mixes.

37% of the State's industrial energy consumption was identified by company. The remaining 13% was allocated to smaller companies and secondary usages. Also, an error factor of 20% was applied to industry data because of the translation of source consumption into gross BTU consumption.

The resulting baseline data was then tabulated by county. A similar analysis was conducted to determine gross BTU consumption by the residential/commercial sector. Through data provided by the electrical utilities and Hawaii's Department of Planning and Economic Development, per capita energy consumption factors was determined and multiplied by the various county populations to determine residential consumptions. To convert KWH into gross BTU's, a factor of 11,150 BTU's was used. This is the State's average level of efficiency.

The commercial sector was difficult to break down by type of usage. Energy consumption for hotels (one of Hawaii's major business segments), office space and retailing space were identified. This accounts for less than 60% of the total energy consumed by the commercial sectors. However, electrical and gas utility data confirmed the size of the commercial market. The potential market for geothermal applications was determined to be primarily water heating. Space conditioning was considered, but excluded from the potential market. There is practically no space heating in the State and a high percentage of the central air conditioning units are located in the heavy urban areas and would require a great deal of disruptive activity to get hydrothermal fluids piped to them. Also, because the larger systems are used year round, most operators have invested in equipment and engineering to gain operating efficiencies and several have retrofit heat exchangers to provide hot water.

Baseline data for industrial consumption by county and site and residential and commercial consumption by county are shown in Exhibit II.

EXHIBIT II

1975 GEOTHERMAL POTENTIAL BY RESOURCE LOCATION

County / Resource Location	Industrial: Standard Industrial Code (SIC)	Industrial: Energy Use (BTU/yr x 10^{12})	Residential/Commercial: Total Energy Used (BTU/yr x 10^{12})	Residential/Commercial: Energy Used For Space Conditioning And Water Heating (BTU/yr x 10^{12})
Hawaii				
1. Puna*	201	.007		
	2061	1.506		
	2065	.049		
	209	.004		
2. Ka'u	2061	1.430		
4. Hualalui	209	.009		
	327	.012		
5. Kawaihae	201	.003		
	327	.002		
6. Keaau	201	.004		
	202	.002		
	203	.010		
	204	.006		
	2061	3.347		
	287	.007		
	327	.015		
	329	.015		
	Subtotal	6.428	3.82	1.484
Honolulu				
15. Lualualei	204	.014		
	249	.001		
	281	.234		
	287	.024		
	291	.721		
	324	3.612		
	327	.030		
	331	.291		
16. Honolulu Volcanic Series	201	.010		
	202	.009		
	203	.573		
	205	.005		
	2065	.001		
17. Haleiwa	2061	1.525		
19. Pearl Harbor	201	.010		
	202	.007		
	203	.005		
	204	.014		
	205	.002		
	2061	1.555		

*Locations correspond to the sites identified in "Hawaii Geothermal Resource Assessment Program."

EXHIBIT II
(cont'd)

1975 HAWAII ENERGY USE BY COUNTY

County / Resource Location	Industrial: Standard Industrial Code (SIC)	Industrial: Energy Use (BTU/yr x 10^{12})	Residential/Commercial: Total Energy Used (BTU/yr x 10^{12})	Residential/Commercial: Energy Used For Space Conditioning And Water Heating (BTU/yr x 10^{12})
Honolulu (cont'd.)	2062	.228		
	2065	.001		
	209	.025		
	265	.080		
	307	.024		
	327	.002		
	Subtotal	9.003	52.25	17.902
Kauai				
20. Post Erosional Volcanic Series	205	.001		
	2061	1.688		
	287	.001		
	327	.013		
	Subtotal	1.703	1.49	.625
Maui				
10. Pauwela	203	.120		
	2061	3.370		
	327	.002		
11. Lahaina	2061	.870		
	Subtotal	4.362	3.07	1.298
State Total		21.496		21.309

B. Market Growth Projection Development

Potential market growth was derived through a combination of forecasting projection based on the state of Hawaii's Department of Planning and Economic Development projections for energy demands, population, and tourism and industry surveys. A summary is given in Exhibit III.

Industrial growth rates were developed for each of the SIC categories from company interviews, industry projections, and state projections. Growth projections were made on an annual compounded rate for the periods 1985-2000 and 2000-2020. These figures were not adjusted for efficiencies that might occur due to rapidly rising energy costs.

The sugar factories were not expected to show growth. Foreign competition has suppressed the price of sugar and many companies are looking for alternative uses of the land. Historical data indicates that the industry is consolidating and that a number of smaller inefficient factories have been shut down. Countering these trends is the increasing value of sugar by-products such as electricity generation.

The other two large energy SIC categories, refinery and cement, were given growth rates based on company projections. Food processors and agriculture processors, other than sugar, were given growth rates equal to population projections. In construction related industries, growth rates were based on projected construction activity in the housing and tourism industries.

The potential geothermal market growth was projected to be lower than the general growth for industry. This reflects the no-growth trend of the sugar factories' energy consumption. Where the sugar factories were subtracted out of the data, the potential geothermal growth rate is higher than the growth rate for industry in general. This can be expected as new industries locate near geothermal resources. It was assumed that in-place industries would not

EXHIBIT III

HAWAII GROWTH PROJECTION CALCULATIONS

Standard Industrial Code (SIC)	Growth Rate (%/Year)	1975 Energy Use (BTU/Yr x 10^{12})	1985 Energy Use (BTU/Yr x 10^{12})	2000 Energy Use (BTU/Yr x 10^{12})	2020 Energy Use (BTU/Yr x 10^{12})
201	Based on population growth	.034	.080	.195	.339
202	"	.018	.045	.117	.226
203	"	.708	1.666	3.975	4.861
204	"	.034	.084	.224	.421
205	"	.008	.019	.045	.091
2061	No growth	15.294	15.294	15.294	15.294
2062	"	.228	.228	.228	.228
2065	Based on population growth	.051	.070	.095	.134
209	"	.038	.095	.201	.379
249	Construction projections	.001	.001	.013	.026
265	Population	.080	.088	.110	.134
281	Industry sources	.234	.300	.434	.875
287	Agriculture projections	.032	.040	.055	.067
291	Industry sources	.721	.793	.793	.793
307	Industry sources	.024	.012	.024	.048
324	Construction projections	3.612	3.612	4.516	6.711
327	"	.076	.162	.253	.332
329	Industry sources	.015	.030	.039	.052
331	"	.291	.355	.355	.675
TOTAL PROCESS HEAT		21.499	22.974	26.966	31.686

relocate to geothermal resources. Also assumed was a continuation of Hawaii's pattern of attracting smaller scale industrial processes rather than large manufacturers.

It should be noted that if the State if successful in attracting an energy intensive process such as manganese nodules or aluminum refinery that the industrial energy growth rates and geothermal growth rates would change dramatically. For example, a three product manganese nodule plant requires 150 MW capacity and a four product plant or aluminum refinery requires a 300 MW capability. However, as previously stated, it was assumed that these industries would not locate in Hawaii for a number of non-energy reasons.

Growth rates for R/C were based on energy use projections by the State Department of Planning and Economic Development based on per capita consumption, population growth, and tourism growth. Over time, these rates decline. Population growth for the State declines from a high of 1.87 average annual percentage growth in the 1977 to 1980 period to a low of 1.05% in the 2000 to 2005 period. This growth rate was assumed to continue through year 2020. These forecasts assume a middle fertility level of 2.1 births per woman. The State's economy, growth rate, and commercial activity is very dependent on the tourism industry State projections for tourism growth starting at 7% per annum in the 1977 to 1979 time frame and declining to 1% in the 1996 to 2000 period.

The State's projections assume a constant growth rate of 4% for electricity generation. This rate includes a growth in per capita energy consumption. The projections also assumed a continuing dependence on petroleum products and did not consider the importance of alternative energy sources.

New discovery factors were not applied to potential geothermal growth since all major population, commercial, and industrial areas of the State are located within potential geothermal market areas. Several sugar factories are not in these areas and new discoveries within this area (which cannot be predicted at this time) would increase the potential growth.

C. Market Capture Potential Estimate Development

The market capture potential estimates were developed on a county basis. Present plans indicate that the earliest possible direct application of geothermal to be 1983. All co-located sugar plants are projected to convert to geothermal by year 2000. Other major retrofit applications were projected to start in 1985 in Honolulu at the Campbell Industrial Park. By the year 2000, a 20% retrofit is estimated. All other retrofit is projected at a rate of 1% per year until the year 2020. Kauai County's retrofit is not projected to start until year 2000, because of the current size of its population and commercial/industrial base. However, for Hawaii, Honolulu, and Maui, geothermal is projected to capture 50% of new growth beginning in the year 1985 and starting in 2000 for Kauai. These rates were assumed constant through year 2020.

Potential capture for R/C was based on an assumed 1% per year retrofit rate for all counties beginning in 1990 for Hawaii, Honolulu, and Maui, and 2005 for Kauai. Starting in 1985, step increases for new growth in Hawaii, Honolulu, and Maui were estimated to a maximum of 30% of the new growth by 2000, Kauai's capture of new growth is assumed to start in 2000 up to a maximum of 30% by 2015.

Exhibit IV summarizes by county the baseline data, market potential projections, and the forecasted geothermal capture.

EXHIBIT IV

HYDROTHERMAL FORECAST FOR HAWAII

County	1975 (BTU/Yr x 10^{12})		1985 (BTU/Yr x 10^{12})			2000 (BTU/Yr x 10^{12})			2020 (BTU/Yr x 10^{12})		
	State Energy Use	Potential Geothermal Use	State Energy Use	Potential Geothermal Use	Forecasted Geothermal Capture	State Energy Use	Potential Geothermal Use	Forecasted Geothermal Capture	State Energy Use	Potential Geothermal Use	Forecasted Geothermal Capture
Hawaii											
Industrial	13.240	9.943	13.657	9.980	1.506	14.500	10.027	6.634	15.600	10.097	7.283
Residential/ Commercial	3.82	1.484	6.39	2.456	-0-	11.54	4.116	.537	20.91	7.449	2.017
TOTAL	17.060	11.427	20.047	12.436	1.506	26.04	14.143	7.171	36.51	17.546	9.300
Honolulu											
Industrial	17.421	10.676	21.384	12.025	-0-	34.734	14.978	3.555	64.364	20.450	8.102
Residential/ Commercial	52.25	17.902	71.75	24.076	-0-	125.35	34.645	4.238	240.85	55.035	14.841
TOTAL	69.671	28.578	93.134	36.101	-0-	160.084	49.623	7.793	305[illegible]	75.485	22.943
Kauai											
Industrial	6.568	4.860	6.918	4.864	-0-	7.628	4.867	-0-	9.158	4.869	1.971
Residential/ Commercial	1.49	.625	2.72	1.084	-0-	5.36	1.993	-0-	10.71	3.589	.809
TOTAL	8.058	5.485	9.638	5.948	-0-	12.988	6.860	-0-	19.868	8.458	2.780
Maui											
Industrial	7.780	4.963	9.22	5.021	-0-	12.37	5.073	3.981	12.640	5.112	4.195
Residential/ Commercial	3.07	1.298	7.73	2.528	-0-	16.68	4.144	.564	20.760	6.108	1.642
TOTAL	10.850	6.261	16.95	7.549	-0-	29.05	9.217	4.545	33.400	11.220	5.837
State											
Industrial	45.015	30.442	51.179	31.890	1.506	69.232	34.945	14.170	101.762	40.528	21.551
Residential/ Commercial	60.63	21.309	88.59	30.144	-0-	158.93	44.898	5.339	293.23	72.181	19.309
TOTAL	105.645	51.751	139.769	62.034	1.506	228.162	79.843	19.509	394.992	112.709	40.860

III. RESOURCE OVERVIEW - DIRECT HEAT

The State of Hawaii consists of a chain of five major islands and several minor islands. The islands were formed by volcanic activity and are relatively young land masses. The island of Hawaii still has an active volcano which erupted as recently as 1977. The geological and hydrological conditions of Hawaii are substantially different from those found on the Mainland.

An assessment of potential geothermal resource areas in the state of Hawaii was recently completed by the Hawaii Institute of Geophysics. This evaluation was based on geological, geophysical, geochemical data. The report appraises the probability of low temperature and high temperature resources. The appraisals were based on surface tests. More intensive site investigation is planned for the future.

Unlike many geothermal resources around the world, it is believed that Hawaii's resources are at a great depth. The cost of reaching these resources may prevent individual companies from drilling their own wells for direct heat applications in the near and intermediate future.

It was assumed for purposes of estimating market potential that direct heat applications would be a secondary application after electricity generation. In other words, it is not anticipated that the geothermal resources will be developed unless the primary objective is to generate electricity.

IV. MARKET OVERVIEW - DIRECT HEAT

Most of the publicity on geothermal development in Hawaii has been on its potential for generating electricity. The consensus of the business executives surveyed was that they had not even considered the possibility of applying hydrothermal fluids to their companies' direct heat needs. Most stated that their companies did not have plans for researching the feasibility of hydrothermal usage. However, most allowed that this could change if geothermal resources and quality were known to be located near their plants.

Hawaii's island economy, unique climate, and geological formation limits the potential of hydrothermal energy as a substitute for fossil fuel generated direct heat. The lack of space heating needs, the size of the economy and its various participants lessen the probability of widespread usage by individual companies or communities unless it is developed and distributed by a utility.

The present development of geothermal has been confined to one site on the island of Hawaii in an agricultural area. This area is subject to volcanic activity and there are a number of risks associated with this activity. Concurrent to the development of geothermal as an alternative energy resource, Hawaii is actively pursuing the development of other alternative energy resources.

A pilot Ocean Thermal Energy Conversion (OTEC) project was recently launched and results to date appear promising. The State's major utility recently announced plans to apply to the U.S. government for a grant to build an OTEC generating plant off the island of Oahu. They have also announced plans to build a windmill farm.

Hawaii's proximity to the equator makes it a high potential candidate for solar energy resources. Already, many homeowners are using solar for their water heating and the market is growing. Several hotels have recently installed solar collectors to meet a portion of their hot water requirements and plans for future homes, condominiums and hotels often include solar.

When and if solar cell technology makes direct conversion from solar to electricity economically competitive, it is likely that this technology will gain widespread use in Hawaii.

In the meantime, other technologies and resources are being investigated by Hawaii's businesses. One of the major cement factories recently announced that it was converting to coal. A pre-stressed concrete manufacturer is seriously considering converting from steam curing to chemical curing and indicated that it will most likely be an industry-wide change.

The impact that the development of other alternative energy sources and the activities of businesses to decrease their consumption of petroleum products will have on geothermal development is impossible to measure at this time because of unknown economics. But business and government leaders throughout the State have indicated that geothermal's major potential will be in electricity generation, rather than direct heat. These attitudes are not firm, and additional insights into direct heat applications, the economics involved, and the time frame for development could have a positive effect.

At this time, the largest potential user of hydrothermal fluids appear to be the sugar factories. They have both process heat requirements and electricity generation capabilities, and many are located in potential geothermal resource areas. Other strong potentials exist at Campbell Industrial Park and Puna area in Hawaii County. Most of Hawaii's heavy non-sugar industry are located in or near the Campbell Industrial Park. If the Laulaulie reservoirs (owned by the Department of Defense) is developed and made available to commercial users via a utility pipeline, new industry may be attracted to that location because of the availability of hydrothermal fluids.

The Dillingham Company, one of Hawaii's leading companies and a major developer is conducting "An Engineering and Economics Studies for Direct Application of Geothermal Energy in an Industrial Park at Pahoa, Hawaii." This study is being sponsored by the DOE. The results of this study and the development efforts by Dillingham may accelerate the industrialization of Hawaii County faster than this study has estimated.

APPENDIX A

Hawaiian Dredging & Construction Company

August 28, 1979

Dr. John Shupe
University of Hawaii
College of Engineering
Holmes Hall #240
2540 Dole Street
Honolulu, Hawaii 96822

Dear John:

The chairman of the Geothermal Advisory Committee has asked me to furnish you our legislative recommendations for the forthcoming session of the State Legislature. The Legislative Subcommittee's recommendation to the full committee listed the issues related to the commercialization of Geothermal Energy as follows:

	Issue	Priority
1.	Incentives	high
2.	Community, Social, Environment	high to medium
3.	Resource Assessment	medium to high
4.	Risk Insurance	medium to high
5.	Barrier Removal	medium
6.	Resource Ownership	medium to low
7.	Technical, Scientific	low

A DILLINGHAM COMPANY
BOX 4168 HONOLULU HAWAII 96801 CABLE HAWDREDGE TELEX 723-8795 TELEPHONE (808) 735-3211

Within the context of these issues, the several legislative proposals which have been discussed and endorsed by the committee and recommended for consideration by the committee are:

1. "Forgive state royalty payments for first ten years production of wells and provide gradual reduction and elimination through sunset provision."

Discussion: The need for additional wells to prove the extent of Hawaii's geothermal resource is of prime importance. In order to attract the necessary investment to undertake the drilling and development of future wells with application for both electric and non-electric commercial ventures the forgiving of state royalty payments can be a key incentive. We doubt that investors will act without this incentive and we do not believe the state will lose any direct benefit. Certainly, without the development there could be no royalty payment and after ten years the royalty payments and other direct benefits will flow from producing wells.

However, the legislature may wish to differentiate between an exploratory well and a producing well. We believe the greatest incentive in Hawaii at this time is needed to encourage and support the drilling of "exploratory" wells. Therefore, we believe the full ten years forgiveness is necessary to get these wells drilled and developed. Then, after several exploratory wells have been placed in operation the Legislature may determine that the succeeding "production wells" drilled in that reservoir could have a reduced period of time for forgiveness of the royalty payments.

2. "Pass a resolution instructing the PUC to permit public utilities to make a higher rate of return on investments in non-fossil fuel generating facilities."

Discussion: Because Hawaii government and private interests probably will benefit from the avoidance of sending money out of the state for every barrel of oil that is replaced by alternative energy generating facilities, the public utilities should be encouraged with proper incentives to invest in these alternative facilities. It is recommended that the Legislature consider a "higher rate of return on investment", that is, markedly higher reflecting the long range benefit to the rate payers of the state that may result from the development of these alternative resources.

3. "Establish a 3 mills per kwh tax credit for generation of electricity for all new or improved plants using 'alternate' forms of energy."

Discussion: Whereas the cost of imported fuel oil has drastically increased in cost approximately 60% since January 1969, the best interests of the State of Hawaii and its residents can be served by the early development of alternative electricity generating facilities using non-fossil fuel energy including geothermal, ocean thermal and bio-mass energy. To encourage private and public utility investment, the recommended 3 mills per kwh tax credit is believed to be necessary. Existing state funds will not be expended and neither will future funds be reduced because the new and improved alternate energy generating plants may not be constructed without such an inducement as the 3 mills per kwh tax credit.

4. "Pass a resolution to the Department of Land and Natural Resources to provide for a reduced royalty payment for the direct use of geothermal energy applications such as the production of ethanol, sugar, etc."

Discussion: Direct use application of geothermal energy can enhance the development of Hawaii's geothermal resource. Acceptance of the use of geothermal energy by residents and others can be facilitated through diverse direct uses in commercial processes which are currently being studied. Because of the many unknowns associated with such a new business venture, extra incentives will be necessary. Furthermore, any "direct use" business would be an additional business activity which would not require payment of existing funds.

5. "Provide 15% differential to increase geothermal loan guarantee from federal support of 75% to a full 90% support."

Discussion: Geothermal loan guarantees have proven very valuable in the mainland western states for geothermal developments. However, the 75% level has also proven an inadequate amount for many businesses that are unable to provide the 25% required funding. Thus, the additional 15% state supported geothermal loan guarantee will reduce the risk of businesses investing in the exploration, drilling and end use applications of Hawaii's geothermal resource.

However, one way DOE assesses a geothermal loan guaranty application is based on the amount of the borrower's investment. With a 25% investment by the borrower, DOE considers that his risk will be sufficient to encourage him to do his utmost to assure success of the development. With a reduction to 10% there may be some hesitancy by DOE. Even so, we believe that in Hawaii there is a need for this additional 15% loan guarantee assistance to make the geothermal development attractive.

It is noted that there would be no reduction in the Federal Loan Guarantee of 75% with the State's provision for an additional 15%.

6. "Provide funds for 'affected' communities, such as the Puna District, to do socio-economic research that can develop and protect the interests of residents in an objective and realistic manner."

Discussion: The cooperation of near-by residents of any commercial development should be encouraged. The amount of funds required to provide for reimbursement of costs of the residents representatives to follow activities such as hearings, conferences and meetings can be considered a modest investment not only for the awareness of the people of Hawaii directly involved, but also to assure acceptance of a project before sizeable funds are committed.

It is contemplated that socio-economic research would be conducted by representatives of the community in conjunction with some assistance by professionals from industry or academia. Also representatives of the community at some stage of development would expect to participate in critical decision making by the businesses.

7. "Forgive for a period of five years after commercial production commences, state sales taxes on all construction and equipment purchased for geothermal exploration and development until a positive revenue flow for the project is attained."

Discussion: This is an incentive to attract investors so that geothermal energy can be developed. Once the 'positive revenue flow' is established, the State will realize an income from the development of a geothermal industry.

8. "Provide general support in a resolution for federal geothermal energy omnibus legislation."

Discussion: In July, Dr. Eugene Grabbe participated with other state government representatives in a review of two proposed bills in the U.S. Senate. The list of recommendations of that group are attached.

Two additional items, which are considered to be of high priority relate to 'Risk Insurance'. They will be handled separately as an administrative manner. They are:

1. Alleviate uncertainties of risks associated with volcanic, seismic and 'acts of God' activities by providing state risk insurance at early date pending provisions by Federal legislation at level's required to stimulate electric and non-electric applications of geothermal energy.

2. Provide early depletion reservoir insurance to compensate geothermal production companies investing in direct use applications in the event of premature failure of the geothermal supply.

If there is additional information you may require, please do not hesitate to call me.

Very truly yours,

Lloyd Jones

W. Lloyd Jones
Manager, Energy Projects

WLJ:JWM:p

Attachment as indicated

Attachment

GEOTHERMAL ENERGY OMNIBUS LEGISLATION

July 10, 1979
Economic Sub-group Concurrence
Seattle

All parties present agreed:

1. That the program establishing direct forgivable loans for for exploratory drilling, which is a part of S1388, would be extremely beneficial and should be strongly supported.

2. That a limit be established in the legislation to preclude a single company from obtaining a large percentage of the loans issued under the exploratory drilling loan program.

3. That the limitation on the size of the loan for a single well currently in S1388 be increased from three million to ten million.

4. That the reservoir insurance in S1330 should be implemented provided that this does not preclude adequate funding for loans supporting reservoir exploration.

   a. That S1330 Sec 1149 Sub Sec (B) Paragraph 3 (pg. 36) should be ammended to read:

      . . . . . . risk means a hazard that a reservoir of geothermal resources will cease to provide sufficient quantities of geothermal resource shown to exist at the time of application at minimum conditions required to maintain an economically (or technically) viable operation for utilization of the geothermal resource:

   b. That the regulations covering reservoir insurance should include risks associated with:

      seismic risks
      volcanic risks
      other acts of God

   c. That S1330 Sec 1149 Sub Sec (F), be ammended to include the sentence:

      The insurance shall be for a period not to exceed the expected life of the project or 30 years, whichever is less.

5. That the legislation should add provisions which are not currently incorporated in either S1330 or S1388, to eliminate the royalties charged under the Geothermal Stam Act for applications utilizing resources not exceeding 150 degrees centidrage or any non-electric applications.

6. That it is important for Congress to set a time limit within which applications under the Geothermal Loan Guarantee Act must be processed. Such a time limit is currently in S1330.

7. That the Geothermal Loan Guarantee program for municipals, cooperatives, and small businesses should be increased to 90%.

8. That an increase in the acreage limit should be made along with increased diligence requirements. Both of these are important and it may be advantageous to combine them to assure that companies holding larger lease areas will not tie up the resources in a particular area.

9. That the 90% forgivable loans for feasibility studies and the 75% construction loans currently in S1330 should not be included in the final Omnibus legislation.

10. That the SBA, HUD, REA and Fm HA should be encouraged to support geothermal loans. No consensus was reached whether the Geothermal Loan Guarantee Program is the best mechanism for accomplishing this.

11. That the definition of geothermal reservoir in S1388 needs to be changed. The definitions under Title III of S1330 would be acceptable.

12. That the economic incentive portions of the Omnibus legislation have a sunset clause similar to what is currently in Section 104 of Title 1 of S1388.

PETROLEUM USE
1975
BTU/yr. x 10^{12}

	Hawaii	Honolulu	Kauai	Maui	Total
Electric Utilities	4.7	50.6	2.2	3.9	61.4
Cement		1.5			1.5
Other Non-commercial		1.1			1.1
Gas Marketing & Distributing	.7	3.4	.2	.3	4.6
Agriculture & Ag. Processing	2.1	4.0	—	1.4	7.5
Construction	.2	2.2	—	.1	2.5
Commercial/Industrial	.1	2.5	—	—	2.6
Refinery Use		3.7			3.7
	7.8	69.0	2.4	5.7	84.9

APPENDIX B

APPENDIX B
SUGAR FACTORIES
ENERGY PRODUCED FOR FACTORY PROCESSING AND ELECTRICITY GENERATION
1975

County	Biomass BTU/yr. x 10^{12}	Fuel Oil BTU/yr. x 10^{12}	Hydro	Total BTU/yr. x 10^{12}
Hawaii	9.912	2.084	.02	12.016
Honolulu	3.840	.221	——	4.061
Kauai	5.170	.088	.46	5.718
Maui	4.873	1.427	.22	6.520
State	23.795	3.820	.7	28.315

APPENDIX C

APPENDIX C
ENERGY USE - SUGAR FACTORIES
1975

County	Industrial Process BTU/yr. x 10^{12}	Electricity Generation BTU/yr. x 10^{12}	Total BTU/yr. x 10^{12}
Hawaii	7.889	4.122	12.016
Honolulu	2.176	1.885	4.061
Kauai	3.650	2.068	5.718
Maui	3.116	3.404	6.526
State	16.831	11.484	28.315

APPENDIX D

APPENDIX D

KEY TO LOCATION OF GEOTHERMAL SITES

Location

Hawaii
1. Puna
2. Ka'u
3. South Point
4. Hualalai-North Kona
5. Kawaihae
6. Keaau
7. Kohala

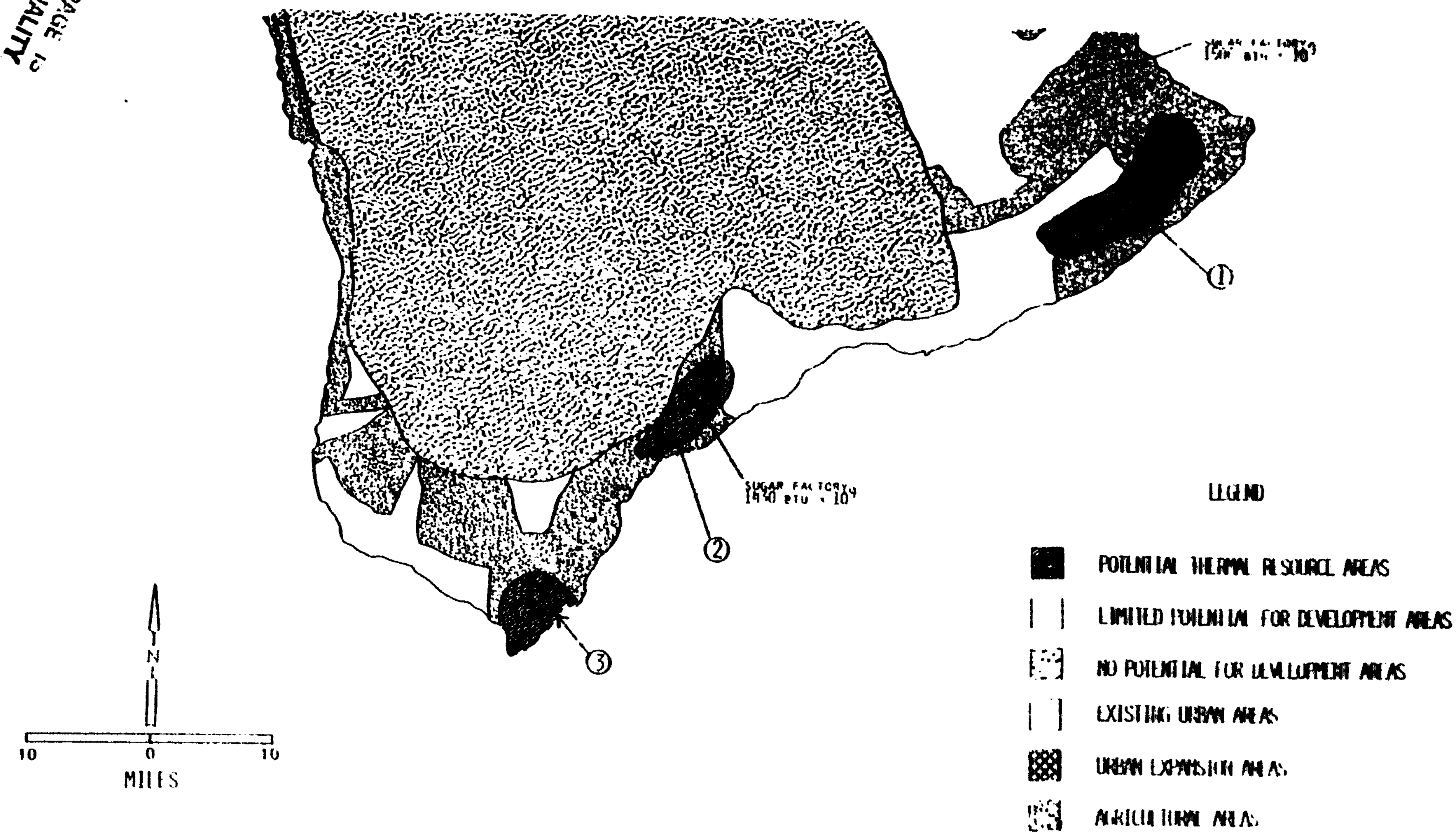
Maui
8. Haleakala-Southwest Rift
9. Haleakala- East Rift
10. Pauwela
11. Lahaina
12. Olowalu- Ukumehame
13. Honokawai

Oahu
14. Waimanalo
15. Lualualei
16. Honolulu Volcanic Series
17. Haleiwa
18. Laie
19. Pearl Harbor

Kauai
20. Post erosional Volcanic Series

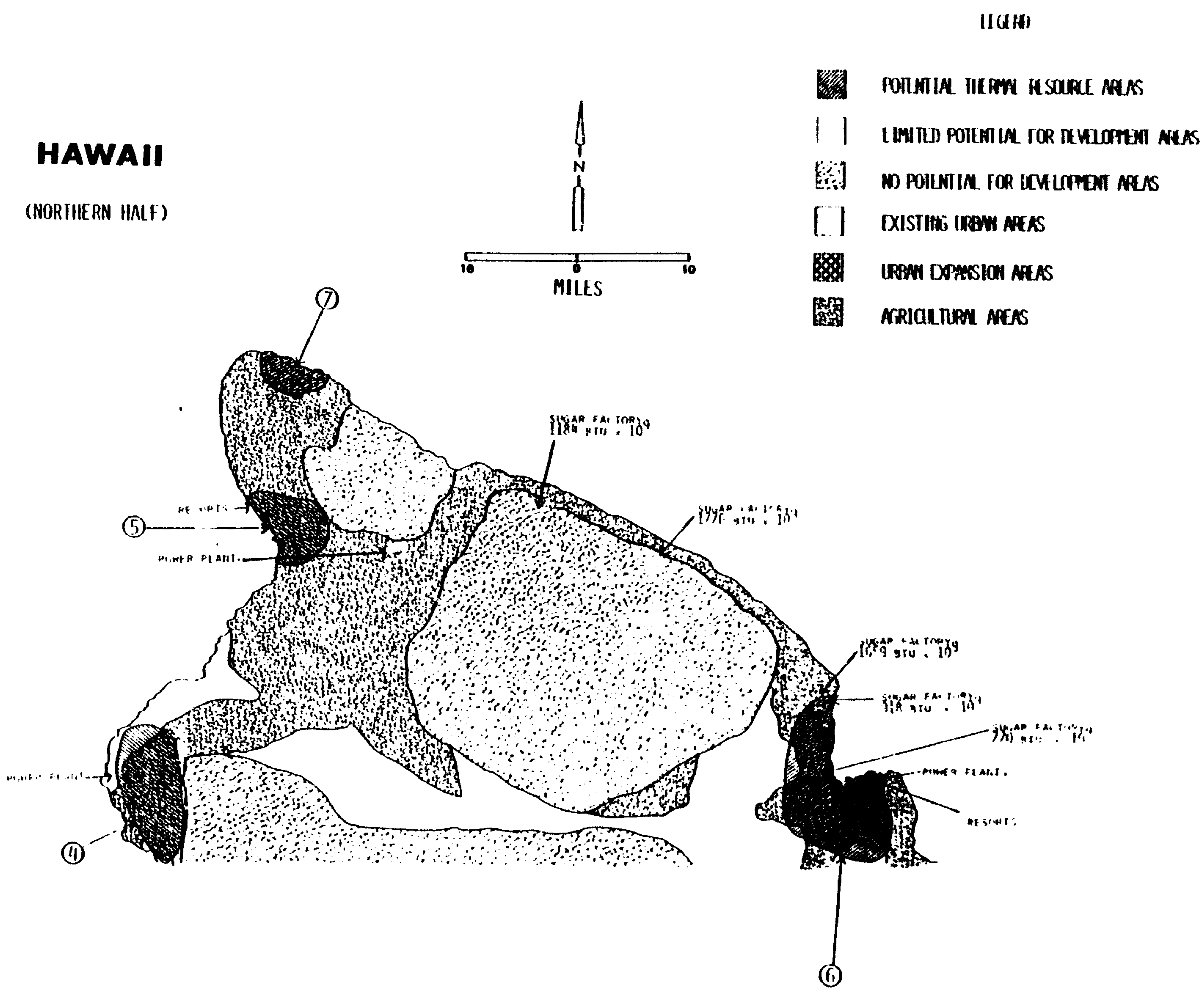
HAWAII

(SOUTHERN HALF)

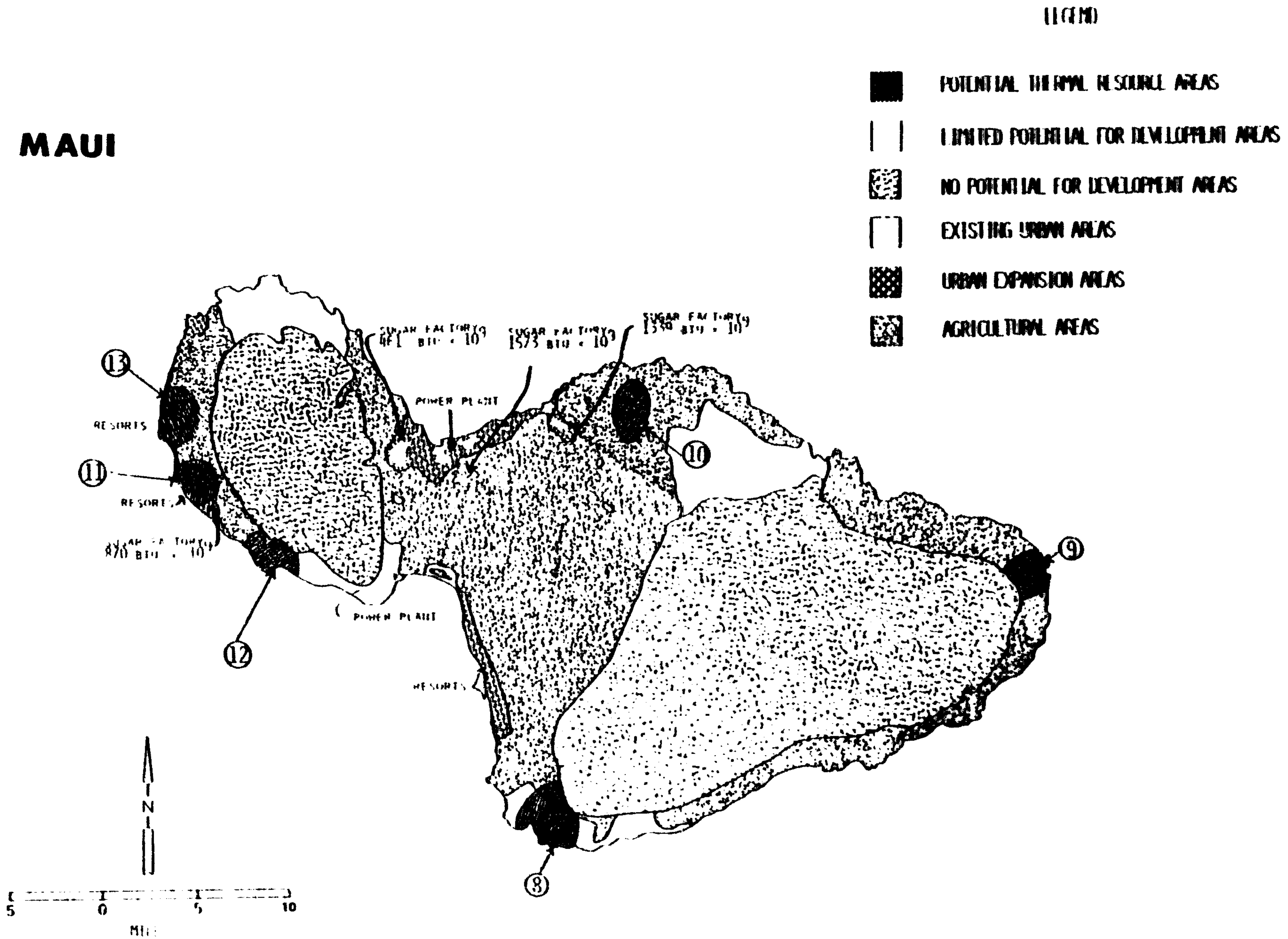


HAWAII

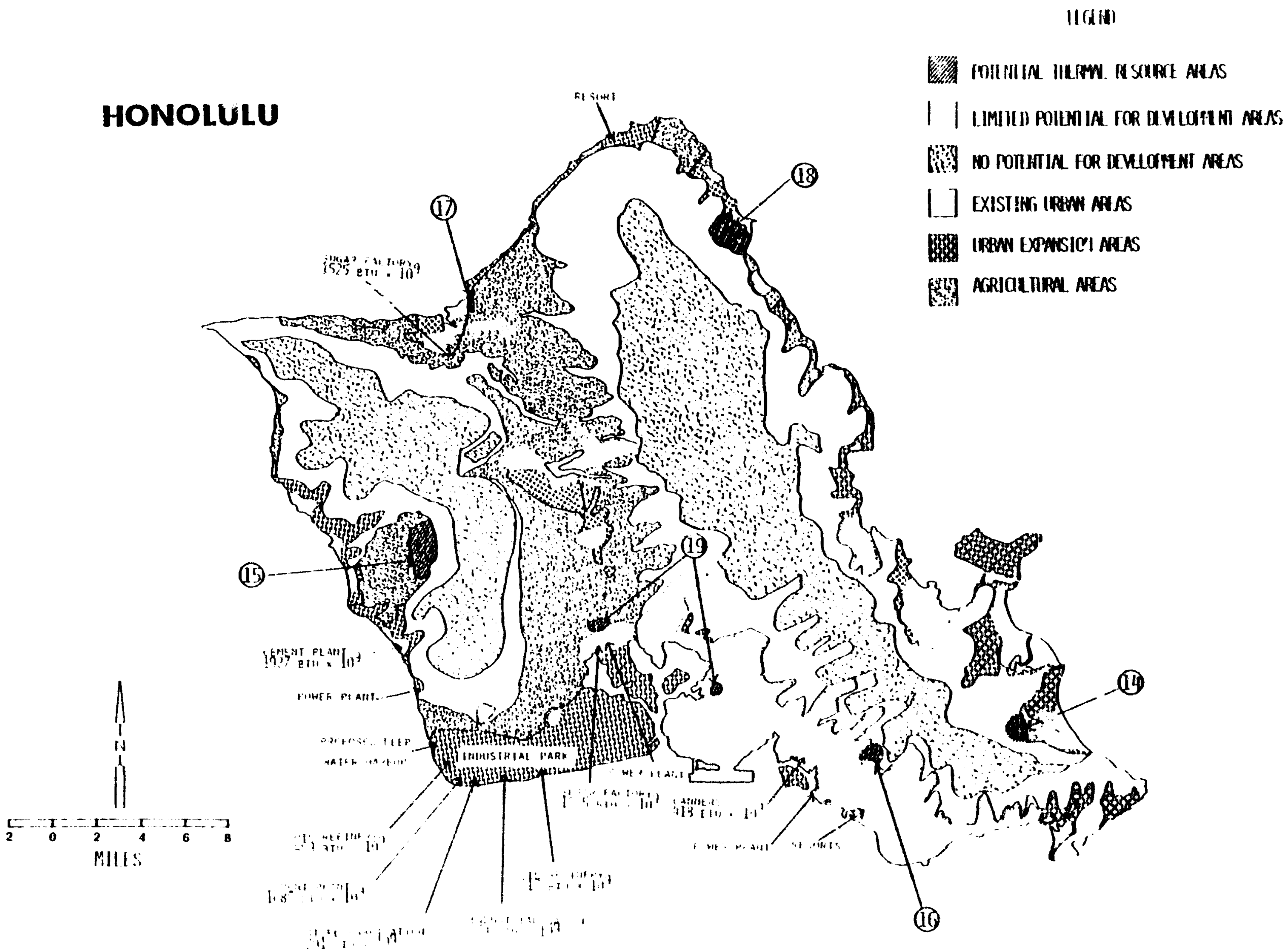
(NORTHERN HALF)



MAUI


LEGEND
POTENTIAL THERMAL RESOURCE AREAS
LIMITED POTENTIAL FOR DEVELOPMENT AREAS
NO POTENTIAL FOR DEVELOPMENT AREAS
EXISTING URBAN AREAS
URBAN EXPANSION AREAS
AGRICULTURAL AREAS
SUGAR FACTORY
1573 BTU × 10⁹
SUGAR FACTORY
POWER PLANT
POWER PLANT
RESORTS
RESORTS
RESORTS
8
9
10
11
12
13
N
5
0
5
10

HONOLULU



LEGEND
POTENTIAL THERMAL RESOURCE AREAS
LIMITED POTENTIAL FOR DEVELOPMENT AREAS
NO POTENTIAL FOR DEVELOPMENT AREAS
EXISTING URBAN AREAS
URBAN EXPANSION AREAS
AGRICULTURAL AREAS
RESORT
SUGAR FACTORY
POWER PLANT
PROPOSED DEEP WATER HARBOR
INDUSTRIAL PARK
CANNERY
RESORTS
14
15
16
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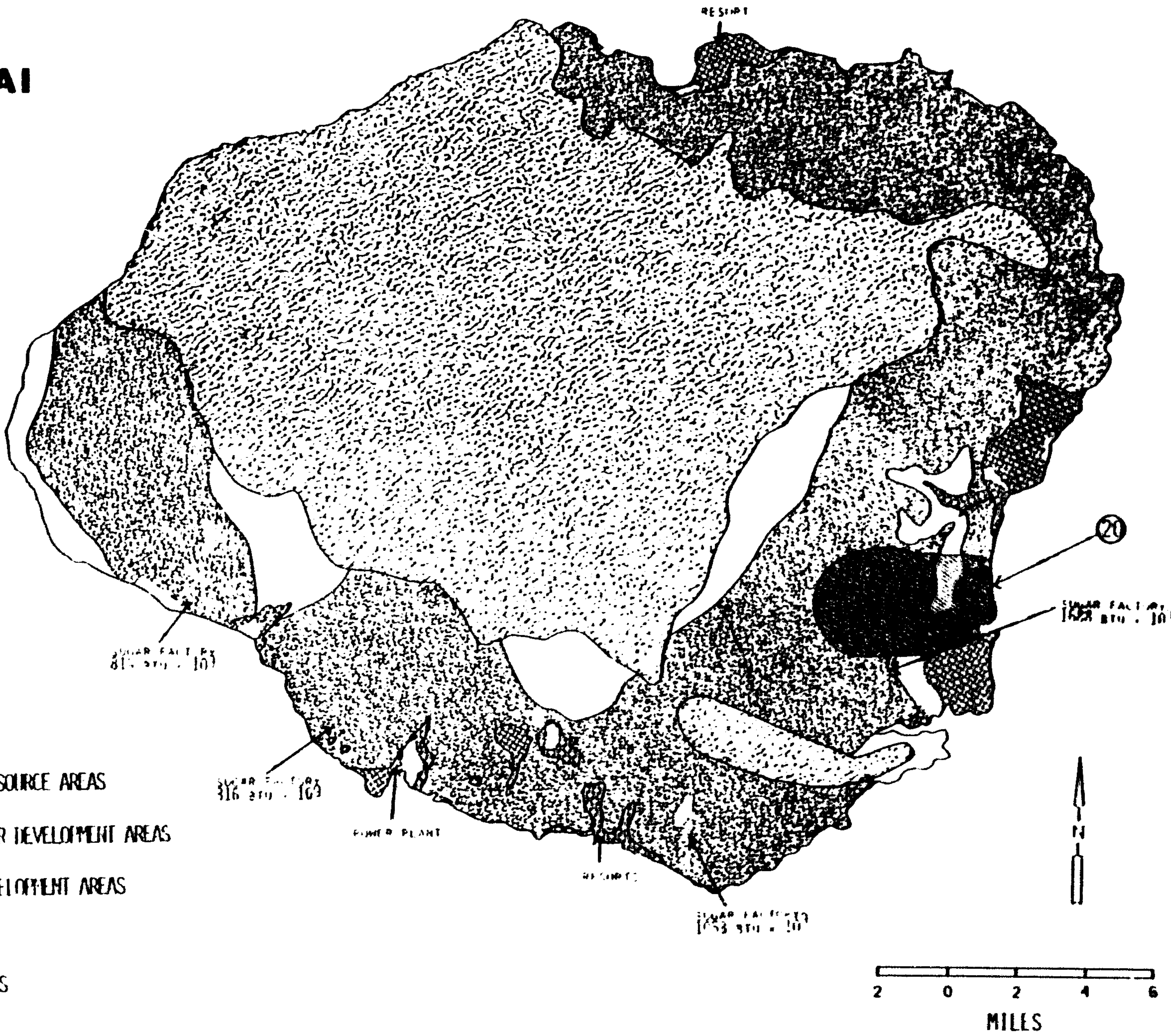
19
N
2 0 2 4 6 8
MILES

KAUAI



LEGEND

- POTENTIAL THERMAL RESOURCE AREAS
- LIMITED POTENTIAL FOR DEVELOPMENT AREAS
- NO POTENTIAL FOR DEVELOPMENT AREAS
- EXISTING URBAN AREAS
- URBAN EXPANSION AREAS
- AGRICULTURAL AREAS

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NEVADA REPORT

GEOTHERMAL DIRECT HEAT USE MARKET POTENTIAL / PENETRATION ANALYSIS FOR NEVADA, DOE REGION IX

Submitted By

GEOTHERMAL DEVELOPMENT ASSOCIATES
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For

U.S. Department of Energy

111 Pine Street
San Francisco, CA 94111

Contract No. DE-AP-03-79-SF-10690

September 30, 1979

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1.0 STATEMENT

At the direction of the Department of Energy, the document entitled, Regional Hydrothermal Market Penetration Analysis, by EG&G Idaho, Inc. has been used as a baseline for this study. The general content and format of this study follows the preliminary outline presented in Jet Propulsion Laboratory Interoffice Memo 311.3-207, of July 13, 1979.

2.0 TASKS

The tasks accomplished to completion from August 1 to September 30, 1979 are:

1. Assessment of the geothermal resources at a county level, defining the available energy at individual sites.

2. Locating within each county the residential, commercial, and industrial energy use sites. Define the space heating, water heating, and industrial process heat requirements which are compatible with the geothermal resource in the area.

3. Model the energy demand requirements which could be supplied by the geothermal resources in 1985, 2000, and 2020, using 1975 as the baseline year.

4. Estimate the amount of energy which will be supplied to the residential, commercial, and industrial sec-

tors by geothermal resources in the years 1985, 2000, and 2020. Penetration possibilities include retrofit of the current (1975) energy market, new facilities designed to utilize geothermal direct heat, and growth inducement following commercial development of geothermal energy.

3.0 RESOURCE ASSESSMENT & METHODOLOGY

A total of 280 known geothermal sites have been defined throughout all seventeen Nevada counties. A preponderant number of the high (>150°C) and intermediate (90° to 150°C) temperature resource sites are located in the northern half of Nevada. The many low temperature (<90°C) sites are rather evenly distributed geographically, but are an unknown energy quantity. This is largely due to the fact that resource assessment by both the private and the public sectors has been almost wholly concerned with the higher temperature reservoirs. There are no readily available reservoir geothermometry and volume data for these sites. This is particularly significant in Nevada, because the State's largest population center in the Greater Las Vegas Area, is co-located with a potentially large, but very low-temperature resource.

3.1 Beneficial Heat Available

A list of each county and the estimated beneficial heat available (10^{12} Btu) for each is given below in Table I:

TABLE I. Estimated Total Beneficial Heat Available (10^{12} Btu) by County for the State of Nevada

COUNTY	BENEFICIAL HEAT AVAILABLE (10^{12} Btu)
Carson City	26
Churchill	4,546
Clark	60
Douglas	49
Elko	806
Esmeralda	71
Eureka	551
Humboldt	1,219
Lander	450
Lincoln	63
Lyon	472
Mineral	132
Nye	879
Pershing	1,494
Storey	42
Washoe	1,383
White Pine	183
TOTAL	12,427

The total of 12.427 quads of beneficial heat available is a very conservative number. Fully 9.914 quads, or 80% of the total, comes from 46 recognized high and intermediate temperature sites — only 16% of the total 280 geothermal sites in this study.

The geothermal sites reported by the Geological Survey as having large energy reserves, are only those which have been partially delineated by drilling. This fraction of the total is still very small. As more prospects are drilled, the reserves may be expected to multiply many times. A good proportion of the present high temperature energy reserves, and those which will be found in the future, will be applied to electrical power generation, with probable direct thermal co-use at many sites.

3.2 Hot-Water Convection Systems

The known geothermal sites are tabulated in Table II, County Hot-Water Convection Systems. Each site has a unique number. The first two digits refer to one of the seventeen counties (in alphabetical order) and the last two digits correspond to a particular resource site within that county. Geographic locations are given by section, township, and range. The thermal water temperatures, reservoir assumptions, and the energy potential for each site are also listed. Further explanation to Table II is outlined in the Footnotes to Table II.

4.0 MARKET DEFINITION METHODOLOGY

4.1 Residential and Commercial

Estimates of the amount of energy used in the residential and commercial sectors at the local level were developed using population data to apportion total Nevada energy consumption. The population data used was obtained from the Office of the State Planning Coordinator. The SPC uses U.S. Bureau of Census figures for historical estimates of population between census years, and performs in-house projections of population by county. These projections, in 1 year increments to 1985 and 5 year increments to 2000, were used to obtain projections of population in the year 2020. Linear regression was the statistical tool used to relate population to time. In all counties but one, the regression explained 95% or more of the variance in population with time. In White Pine County the population has fluctuated severely in recent years due to economic difficulties in the copper industry. Still, a coefficient of determination of slightly better than 90% was obtained.

Data describing the total consumption of energy in each class — residential, commercial, and industial, was obtained from a study performed for the Nevada Department of Energy, entitled, Energy in Nevada, Second Edition, to be published later this year.

Energy in Nevada includes forecasts of future energy consumption both by major sectors and by major energy form. These forecasts are given through 1985 in 1 year increments, and through 2000 in 5 year increments. Linear regression was again used to obtain projections for 2020, using the projections in Energy in Nevada as 'Historical' data.

The energy consumption estimates for the residential and commercial sectors were obtained for each county by apportioning the total energy used in the two sectors on the basis of population. Local population estimates were obtained from U.S. Bureau of

Census data and used to further reduce the county estimates, again by apportioning on the basis of population. In arriving at the local estimates, some of the smaller communities which have little chance of growing, were held at the 1975 level through 2020. All other communities were assumed to grow in direct proportion to their respective counties.

To estimate the fraction of residential and commercial energy use that is directly attributable to space heating and water heating, an analysis of the fuels used in these sectors was performed. This work indicated that about 30% of the electrical energy used in these sectors is for space or water heating. About 95% of the natural gas and LPG, and virtually all of the kerosene, #2 oil, #6 oil, and coal used in these sectors is for space heating or water heating. These fractions were each weighted according to the total contribution of each and a weight average of approximately 70% resulted. This figure was then applied to all of the estimates of local residential and commercial energy requirements to obtain the estimates for potential geothermal energy use.

In 1975 Nevada had an estimated population of 590,300 persons. Table III lists 117 communities which had a combined population of 564,025.

The major centers of residential, commercial and industrial energy use in 1975 are in:

CITY	POPULATION
Carson City	25,300
Greater Las Vegas Area	323,200
Henderson	19,400
Boulder City	7,785
Elko	8,299
Reno/Sparks	116,234

4.1.1 Co-Location of Residential and Commercial Energy Use Sites and Geothermal Resource Sites

Table IV, Co-Location of City/Energy Use Sites and Geothermal Sites by County, Nevada, lists the Table III communities and the estimated beneficial heat available (10^{12} Btu) for the nearest resource sites. Other resource sites listed in Table II could also be beneficially used by a number of these communities. It is probable that the higher temperature reservoirs — even those in presently remote areas — will attract new industries and the attendant new residential and commercial growth.

The 1975 communities with a population of at least 1,000, which are (or potentially are) favorably co-located with one or more resource sites, are:

Fallon
Fallon N.A.S.
Gardnerville
Carlin
Elko
Wells
Winnemucca
Battle Mountain
Fernley

Yerington
Lovelock
New Washoe City
Greater Reno/Sparks Area

Somewhat more questionable are the lower temperature resources co-located with:

Boulder City
Henderson
Greater Las Vegas Area
Overton
Babbitt
Hawthorne
Tonopah
Ely/East Ely
McGill

Examples of communities of less than 1,000 persons which are favorably located for geothermal energy use are:

Minden
Jackpot
Silver Peak
Golconda
Caliente
Wabuska
Beatty
Gabbs
Virginia City
Gerlach

4.3 Industrial

4.3.1 Nevada Industry by SIC Code.

The industrial sector of Nevada includes manufacturing, mining and milling, and large scale warehousing. The manufacturing for Standard Industrial Classification Code categories 20 through 39 are tabulated in Table V . Energy Use by City/Energy Use Site for Industrial Sector (by County). An explanation of Table and detailed methology are set out in the accompanying Footnotes section.

This data provides a good cross section of the manufacturing. Table VI , Comparison of the Listed Number of Establishments and Employees in Industrial Directories and the Nevada Department of Employment Security, is a summary of Table V . For the State as a whole, calculations give a figure of 6.705 x 10^{12} Btu of energy used per year for the manufacturing sector. However, the industrial directories are incomplete. They list only 37% of the firms, and 43% of the employees listed by the Nevada Department of Employment Security. Although valuable for future planning purposes, the SIC data has not been used directly in the final industrial energy use and market penetration projections.

4.3.2 Total Industrial Energy Consumption by Nevada

Based on data and projections given in the 2nd edition of Energy in Nevada, the total industrial energy consumption for manufacturing, mining, milling and warehousing in Nevada is estimated to be (excluding losses in electrical generation):

Year	10^{12} Btu
1975	21.764
1985	30.656
2000	37.714
2020	51.033

TABLE VI COMPARISON OF THE LISTED NUMBER OF ESTABLISHMENTS AND EMPLOYEES IN INDUSTRIAL DIRECTORIES AND THE NEVADA DEPARTMENT OF EMPLOYMENT SECURITY

COUNTY Name	Industrial Directories		Nevada Dept. of Employment Security		Energy Use 10^{12} Btu/yr
	No. of Firms	No. of Employees	No. of Firms	No. of Employees	
Carson City	22	494	61	1,275	0.375
Churchill	7	69	13	163	0.077
Clark	119	2,229	280	7,086	1.150
Douglas	3	394	12	888	0.240
Elko	5	54	13	138	0.257
Esmeralda	-	-	-	-	-
Eureka	-	-	-	-	-
Humboldt	4	39	11	288	0.057
Lander	-	-	1	6	0.000
Lincoln	1	8	2	10	0.132
Lyon	1	175	14	159	1.104
Mineral	-	-	3	14	0.118
Nye	-	-	3	74	0.073
Pershing	-	-	6	49	0.019
Storey	-	-	2	5	0.007
Washoe	112	4, 075	315	7,889	3.068
White Pine	1	312	1	312	0.008
Multi-County	-	-	8	19	0.020
TOTAL	275	7,849	745	18,375	6.705

4.3.3 Total Industrial Energy Consumption by County

Estimates of the amount of energy used by industrial customers in each county were obtained in a manner similar to that used for the residential and commercial sectors. That is, county population projections were used to apportion (Table III) the total industrial energy demand, as projected in the 2nd edition of Energy in Nevada.

Industrial energy use sites are situated in the cities, mining and milling communities, as well as in isolated localities. There are 114 mineral resource mills in sixteen counties on record with the State Inspector of Mines office.

5.0 GEOTHERMAL MARKET PENETRATION METHODOLOGY

5.1 Residential/Commercial Market Penetration

To obtain estimates of the amount of energy captured by geothermal development in the various communities, a "Capture Fraction" was used. The numerical values assigned to these fractions were developed logically, but not without a considerable amount of considered judgement applied to insure reasonable results. The fractions used are shown in Table VII.

To develop these fractions, optimistic but realistic values for 1985 were estimated. The 1985 fractions where then used to compute the fractions for 2000 and 2020 by assuming 10% annual growth in the capture rates through 2020.

TABLE VII CAPTURE FRACTIONS (%)

GEOTHERMAL POTENTIAL	1975[(a)]	1985	2000	2020
NIL	0	0	0	0
LOW	0	0.50	2.09	14.05
MODERATE	0	1.00	4.18	28.10
HIGH	0	1.50	6.27	42.43

[(a)] In 1975, very little geothermal energy was utilized outside of the Truckee Meadows (Reno/Sparks) which had a captive fraction of approximately 1/8 of 1 percent (for Reno).

The capture fractions were used as multipliers to convert the estimates of potential geothermal space and water heating (Table III) into estimates of expected geothermal energy use.

A subjective judgement was made to determine which communities could expect high, moderate, low or negligible geothermal development. The factors considered in arriving at this determination include: the temperature, size and depth to resource and proximity to the resource. Thus, a city such as Reno received a high rating because of its proximity to a hot, large, shallow geothermal resource (Steamboat-Huffaker and Moana). A town such as Searchlight in southern Nevada, which is 14 kilometers from a well with 31°C water, was assigned a negligible (Zero) captive fraction.

Table VIII lists the estimated geothermal penetration of the residential and commercial sectors for the counties and communities.

5.2 Industrial Market Penetration

Residential and commercial growth are projected to be largely in existing communities. On the other hand, industrial growth will be in communities where existing (1975) industry is located, and secondly, where significant savings can be realized right at a geothermal resource site.

The basic assumptions for the estimates of the industrial market penetration analysis are:

1. The bulk of the new high energy-use industry, between 1985 and 2020, will be attracted by, and locate in close proximity to, high and intermediate temperature geothermal resources.

2. Light industry will continue to locate near population centers, but will favor those communities offering geothermal energy.

5.2.1 Penetration Based on County Population Fractions and Geothermal Resource Distribution

Total industrial energy use (in 10^{12} Btu's) for the entire State is projected to be 30.656 in 1985, 37.714 in 2000, and 51.033 in 2020. It is assumed for this study that:

1. Geothermal energy use penetration was nil in 1975 for all counties, but statewide it is projected to be:

YEAR	PERCENTAGE PENETRATION	10^{12} Btu
1985	5%	1.533
2000	20%	18.857
2020	50%	25.517

2. 50% of the geothermal capture is assumed to be in the cities and larger communities presently existing, regardless of geothermal use potential. Estimated capture by county is assumed to be in proportion to population (Table IX).

3. 50% of the geothermal capture is assumed to be in those counties where the geothermal resources presently exhibit the greatest potential. The geothermal resource potential is based on the weighted potential of the high, intermediate and low temperature resources in each county.

   Table X lists the number of high and intermediate temperature resources for each county as listed in U.S. Geolog-

TABLE IX INDUSTRIAL ENERGY USE BY COUNTY
APPORTIONED BY POPULATION (10^{12} Btu)

COUNTY	1975	1985	2000	2020
Carson	0.934	1.738	2.485	3.628
Churchill	0.442	0.469	0.445	0.505
Clark	12.192	16.625	20.618	28.150
Douglas	0.409	0.622	0.683	0.862
Elko	0.559	0.653	0.690	0.847
Esmeralda	0.026	0.031	0.030	0.036
Eureka	0.041	0.043	0.041	0.046
Humboldt	0.261	0.319	0.351	0.439
Lander	0.111	0.110	0.098	0.097
Lincoln	0.100	0.110	0.121	0.148
Lyon	0.383	0.254	0.215	0.219
Mineral	0.244	0.239	0.215	0.230
Nye	0.207	0.224	0.223	0.255
Pershing	0.100	0.110	0.109	0.128
Storey	0.037	0.046	0.049	0.061
Washoe	5.345	8.765	11.137	15.213
White Pine	0.372	0.297	0.204	0.168
TOTAL	21.764	30.656	37.714	51.033

TABLE X WEIGHTED GEOTHERMAL RESOURCE POTENTIAL AS UTILIZED IN CALCULATING PARTIAL PENETRATION OF THE INDUSTRIAL SECTOR, BY COUNTY

County	Number of U.S.G.S. High & Intermediate Temperature Reservoirs	Weighted Rating Number	Weighted Rating Percentage
Carson City	0	1	2.5
Churchill	6	4	10.0
Clark	0	1	2.5
Douglas	1	1	2.5
Elko	7	4	10.0
Esmeralda	0	1	2.5
Eureka	4	3	7.5
Humboldt	11	6	15.0
Lander	3	2	5.0
Lincoln	0	1	2.5
Lyon	3	2	5.0
Mineral	0	1	2.5
Nye	2	2	5.0
Pershing	8	5	12.5
Storey	0	1	2.5
Washoe	6	4	10.0
White Pine	1	1	2.5
TOTAL		40	100.0

ical Survey Circulars 726 and 790. Although some counties have none listed, the fact that all have some low temperature sites and a potential for undiscovered high and intermediate temperature reservoirs, all counties are given a weighted rating number, as follows:

Number of U.S.G.S. High & Intermediate Temperature Reservoirs	Weighted Rating Number
0-1	1
2-3	2
4-5	3
6-7	4
8-9	5
10-11	6

The weighted rating numbers total 40. Elko County, for example has 4 out of 40, or 10% of the total for all the counties.

The capture fraction for a county in 10^{12} Btu's is the product of the weighted rating percentage, the 50% penetration based on geothermal resource distribution, and the estimated geothermal use penetration statewide for a given year. For example, the geothermal energy capture for Elko County in the year 2000 would be:

$$0.10 \times 0.50 \times 18.857 \times 10^{12} \text{ Btu} = .943 \times 10^{12} \text{ Btu}$$

Table XI lists the penetration based on geothermal resource distribution (50% of the total) and penetration based on county population fractions (50% of the total). The three columns to the right give the sum of the two, or total geothermal market penetration.

TABLE XI INDUSTRIAL ENERGY USE AND GEOTHERMAL MARKET PENETRATION BY COUNTY FOR 1985, 2000, and 2020 (10^{12} Btu)

COUNTY	Penetration based on County Population Fractions			Penetration Based on Geothermal Resource Distribution			Total Geothermal Market Penetration		
	1985	2000	2020	1985	2000	2020	1985	2000	2020
CARSON CITY	0.043	0.621	0.907	0.019	0.236	0.319	0.062	0.857	1.226
CHURCHILL	0.012	0.111	0.126	0.077	0.943	1.276	0.089	1.054	1.402
CLARK	0.416	5.154	7.037	0.019	0.236	0.319	0.435	5.390	7.356
DOUGLAS	0.016	0.171	0.216	0.019	0.236	0.319	0.035	0.407	0.535
ELKO	0.016	0.172	0.212	0.077	0.943	1.276	0.093	1.115	1.488
ESMERALDA	0.001	0.007	0.009	0.010	0.236	0.319	0.020	0.243	0.328
EUREKA	0.001	0.010	0.011	0.057	0.707	0.957	0.058	0.717	0.968
HUMBOLDT	0.008	0.088	0.110	0.115	1.414	1.913	0.123	1.502	2.023
LANDER	0.003	0.024	0.024	0.038	0.471	0.638	0.041	0.495	0.662
LINCOLN	0.003	0.030	0.037	0.019	0.236	0.319	0.022	0.266	0.356
LYON	0.006	0.054	0.055	0.038	0.471	0.638	0.044	0.525	0.693
MINERAL	0.006	0.054	0.058	0.019	0.236	0.319	0.025	0.290	0.377
NYE	0.006	0.056	0.064	0.038	0.471	0.638	0.044	0.527	0.702
PERSHING	0.003	0.027	0.032	0.096	1.179	1.594	0.099	1.206	1.626
STOREY	0.001	0.012	0.015	0.019	0.236	0.319	0.020	0.248	0.334
WASHOE	0.219	2.784	3.803	0.077	0.943	1.276	0.296	3.727	5.079
WHITE PINE	0.407	0.051	0.042	0.019	0.236	0.319	0.026	0.287	0.361
TOTAL	0.767	9.426	12.758	0.765	9.430	12.758	1.532	18.856	25.516

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TABLE 11 CARSON CITY COUNTY HOT-WATER CONVECTION SYSTEMS

LOCATION			TEMPERATURE °C			RESERVOIR ASSUMPTIONS		ENERGY POTENTIAL	
Site ID No.	Site Name	Site Location	Surface (1)	Geochemical (2)	Mean, BHT PT (3)	Volume km^3 (4)	Reservoir thermal energy (10^{18}J) (5)	Wellhead thermal energy (10^{18}J) (6)	Beneficial Heat (10^{18}J) (7)
0101	Carson Hot Springs	Sec. [illegible], 15N-20E	49° S		7[illegible]° PT	1	0.16	0.04	0.009
0102	Nevada State Prison Sp.	Sec.1[illegible], 15N-20E	Warm S		71° PT	1	0.15	0.04	0.009
0103	Pinyon Hills	Sec.23, 15N-20E	46° W		69° PT	1	0.15	0.04	0.009

Footnotes 1 thru 7 - See Explanation Page A-1

TABLE II CHURCHILL COUNTY HOT-WATER CONVECTION SYSTEMS

LOCATION			TEMPERATURE °C			RESERVOIR ASSUMPTIONS		ENERGY POTENTIAL	
Site ID No.	Site Name	Site Location	Surface (1)	Geochemical (2)	Mean, BHT PT (3)	Volume km^3 (4)	Reservoir thermal energy (10^{18}J) (5)	Wellhead thermal energy (10^{18}J) (6)	Beneficial Heat (10^{18}J) (7)
0201	Senator Fumeroles	Sec. 31, 25N-37E	Boil S		144° PT	3	1.04	0.26	0.063
0202	Dixie Comstock Mine	Sec. 14, 23N-35E	Hot MW		144° PT	3	1.04	0.26	0.063
0203	Dixie Hot Springs	Sec. 8, 22N-35E	72° S	127° (K)	139°±4°	3.3 ± 0.9	1.12 ± 0.31	0.28	0.067
				145° (A)					
				145° (A)					
0204	Settlement Road Wells	Sec. 36, 21N-34E	23° W		35° PT	1	0.05	0.01	0.003
0205	Edwards Creek Valley	Sec. 6, 20N-38E	24° W		36° PT	2.5	0.14	0.04	0.009
0206	Brady's Hot Springs	Sec. 1, 22N-26E	98° S	140°	155°±6°	22 ± 11	8.2 ± 4.2	2.0	0.48
				155°	188° BHT				
				170°					
0207	Carson Sink-Alkali Flat, East Side	Sec. 10, 22N-31E	25° W		38° PT	3	0.19	0.05	0.011
0208	Carson Sink-Alkali Flat, West Side	Sec. 15, 22N-30E	Hot W		38° PT	3	0.19	0.05	0.011
0209	Desert Peak	Sec. 21, 22N-27E	None	208° (M)	221°±5°	52 ± 18	29 ± 10	7.2	1.73
				225° (I)	199° BHT				
				229° (K)					
0210	Eagle Salt Works	Sec. 34, 22N-26E	Hot S		144° PT	3	1.04	0.26	0.063
0211	Upsal Hogback	Sec. 7, 21N-29E	22° W		33° PT	3	0.15	0.04	0.009
0212	Soda Lake	Sec. 28, 20N-28E	Boil W	144° (M)	157°±5°	19.6 ± 11.3	7.5 ± 4.3	1.88	0.45
				161° (I)					
				165° (A)					
0213	Stillwater	Sec. 6, 19N-31E		140° (I)	159°±8°	59 ± 22	22 ± 9	5.7	1.37
				159° (C)	136° BHT				
				177° (K)					
0214	Fallon Naval Air Station	Sec. 14, 18N-29E				3			
0215	Carson Lake	Sec. 7, 17N-30E	70° S		105° PT	3	0.85	0.21	0.051
0216	Eight Mile Flat	Sec. 14, 17N-30E	81° S		120° PT	2.5	0.71	0.18	0.043
0217	Four Mile Flat	Sec. 6, 16N-32E	Hot S		120° PT	2.5	0.71	0.18	0.043
0218	Lee Hot Springs	Sec. 34, 16N-29E	Boil S	162° (C,I)	166°±3°	3.3 ± 0.9	1.36 ± 0.38	0.34	0.08
				162° (C,I)					
				173° (A)					

Footnotes 1 thru 7 - See Explanation Page

TABLE II CLARK COUNTY HOT-WATER CONVECTION SYSTEMS

LOCATION			TEMPERATURE °C			RESERVOIR ASSUMPTIONS		ENERGY POTENTIAL	
Site ID No.	Site Name	Site Location	Surface (1)	Geochemical (2)	Mean, BHT PT (3)	Volume km^3 (4)	Reservoir thermal energy ($10^{18}J$) (5)	Wellhead thermal energy ($10^{18}J$) (6)	Beneficial Heat ($10^{18}J$) (7)
0301	Bunkerville	Sec.35, 13S-70E	25° W		31° PT	1	0.04	0.01	0.003
0302	Moapa (Muddy River)	Sec.16, 14S-65E	32° S		40° PT	1	0.07	0.02	0.004
0303	Whipple	Sec.34, 15S-67E	24° W		30° PT	1	0.04	0.01	0.003
0304	Indian Springs	Sec.16, 16S-56E	26° S		33° PT	1	0.05	0.01	0.003
0305	Mud Wash	Sec. 6?,17S-69E	24° S		30° PT	1	0.04	0.01	0.002
0306	Roger's Springs	Sec.13, 18S-67E	30° S		38° PT	1	0.06	0.02	0.004
0307	White Rock Spring	Sec.33, 20S-58E	26° S		33° PT	1	0.05	0.01	0.003
0308	Las Vegas	Sec.16, 22S-61E	41° W		60° PT	10	0.12	0.03	0.007
0309	National Park Serv. Well	Sec. 9, 21S-65E	29° W		44° PT	1	0.08	0.02	0.005
0310	Brown's Spring	Sec.15, 22S-54E	24° S		30° PT	1	0.04	0.01	0.002
0311	Black Canyon	Sec.32, 22S-65E	47° S		71° PT	1	0.15	0.04	0.009
0312	Jean Lake	Sec.13, 25S-60E	27° W		41° PT	1	0.07	0.02	0.004
0313	Well NW of Nelson	Sec.29, 24S-63E	28° W		35° PT	1	0.05	0.01	0.003
0314	Well South of Searchlight	Sec. 9, 30S-63E	31° W		39° PT	1	0.06	0.02	0.004
0315	Willow	Sec. 9, 31S-65E	31° W		39° PT	1	0.06	0.02	0.004
0316	Davis Dam	Sec.24, 32S-66E	27° W		34° PT	1	0.[illegible]5	0.01	0.003

Footnotes 1 thru 7 - See Explanation Page

TABLE II DOUGLAS COUNTY HOT-WATER CONVECTION SYSTEMS

LOCATION			TEMPERATURE °C			RESERVOIR ASSUMPTIONS		ENERGY POTENTIAL	
Site ID No.	Site Name	Site Location	Surface (1)	Geochemical (2)	Mean, BHT PT (3)	Volume km^3 (4)	Reservoir thermal energy ($10^{18}J$) (5)	Wellhead thermal energy ($10^{18}J$) (6)	Beneficial Heat ($10^{18}J$) (7)
0401	Hobo Hot Springs	Sec.23, 14N-19E	46° S		69° PT	1	0.15	0.04	0.009
0402	Saratoga Hot Springs	Sec.21, 14N-20E	50° S		75° PT	1	0.16	0.04	0.009
0403	Wally's (Genoa) Hot Sps.	Sec.22, 13N-19E	83° W	109°(P) 85°(I)	110°	2.0	0.51	0.13	0.031
0404	Doud Spring	Sec.20, 11N-21E	21° S		31° PT	1	0.04	0.01	0.003

Footnotes 1 thru 7 - See Explanation Page

TABLE II ELKO COUNTY HOT-WATER CONVECTION SYSTEMS

LOCATION			TEMPERATURE °C			RESERVOIR ASSUMPTIONS		ENERGY POTENTIAL	
Site ID No.	Site Name	Site Location	Surface (1)	Geochemical (2)	Mean, BHT PT (3)	Volume km^3 (4)	Reservoir thermal energy (10^{18}J) (5)	Wellhead thermal energy (10^{18}J) (6)	Beneficial Heat (10^{18}J) (7)
0501	Jackpot	Sec.18, 47N-65E	38° W		57° PT	1	0.11	0.03	0.007
0502	Milligan Creek	Sec. 9, 47N-67E	30° S		45° PT	1	0.08	0.02	0.004
0503	Goose Creek	Sec.15, 46N-69E	43° W		65° PT	1	0.14	0.03	0.008
0504	Tennessee Mountain	Sec.14, 46N-56E	40° S		60° PT	1	0.12	0.03	0.007
0505	Gray Rock Mine	Sec. , 46N-58E	27° MW		41° PT	1	0.07	0.02	0.004
0506	San Jacinto Ranch	Sec.23, 46N-64E	64° S	100° (D,I)	109°±7°	3.3 ± 0.9	0.85 ± 0.25	0.21	0.05
	(Mineral) Spring			100° (D,I)					
				128° (A,I)					
0507	Mountain City	Sec.36?,46N-53E	Warm S		60° PT	1	0.12	0.03	0.007
0508	Rizzi Ranch Hot Springs	Sec.20, 45N-54E	41° S		60° PT	1	0.12	0.03	0.007
0509	Mineral Hot (Contact	Sec.16, 45N-64E	60° S		90° PT	1	0.20	0.05	0.012
	Mineral) Spring			127° (P) 129° (I)	130°	1.5	0.47	0.12	0.028
0510	Warm Sps. Crk. Canyon Sp.	Sec.19?,43N-51E	Warm S		65° PT	1	0.14	0.03	0.008
0511	Wild Horse Hot Spring	Sec. 4, 43N-55E	54° S		71° PT	1	0.15	0.04	0.009
0512	Hot Creek Springs	Sec.32, 43N-60E	68° S		102° PT	1	0.23	0.06	0.014
0513	Hot Sulfur Springs (Near	Sec. 8, 41N-52E	90° S	144° (D)	165°±8°	3.3 ± 0.9	1.35 ± 0.39	0.34	0.08
	Tuscarora)			167° (A)					
				184° (I)					
0514	Wine Cup Ranch	Sec.25, 41N-64E	59° W		89° PT	1	0.20	0.05	0.012
0515	Well SE of Tony Mountain	Sec.15, 41N-67E	22° W		33° PT	1	0.05	0.01	0.003
0516	Petaini Springs	Sec. 6, 40N-53E	Warm S		33° PT	1	0.05	0.01	0.003
0517	Thousand Springs	Sec.10, 40N-69E	Boil S		306° PT	1.5	1.18	0.29	0.070
0518	Midas	Sec.36?,39N-45E	Hot S		71° PT	1	0.15	0.04	0.009
0519	Dry Creek Mountain	Sec.18, 39N-50E	47° S		71° PT	1	0.15	0.04	0.009
0520	Warm Creek	Sec. 2, 39N-53E	Warm? S		33° PT	1	0.05	0.01	0.003
0521	Mary's River Ranch	Sec.68, 71N-72E	Hot S		71° PT	1	0.15	0.04	0.009
0522	Hot Lake	Sec.25, 38N-46E	Hot Lk.		71° PT	1	0.15	0.04	0.009
0523	Willow Creek Reservoir	Sec.11, 38N-48E	Warm? S		71° PT	1	0.15	0.04	0.009
05[illegible]	Humboldt Wells	Sec.17, 38N-62E	61° S	85° (J)	105°±9°	6.7 ± 1.9	1.63 ± 0.48	0.41	0.098
				102° (D)					
				179° (A)					

Footnotes 1 thru 7 - See Explanation Page

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TABLE II ELKO COUNTY HOT-WATER CONVECTION SYSTEMS

LOCATION			TEMPERATURE °C			RESERVOIR ASSUMPTIONS		ENERGY POTENTIAL	
Site ID No.	Site Name	Site Location	Surface (1)	Geochemical (2)	Mean, BHT PT (3)	Volume km^3 (4)	Reservoir thermal energy (10^{18}J) (5)	Wellhead thermal energy (10^{18}J) (6)	Beneficial Heat (10^{18}J) (7)
0525	Railroad Spring	Sec.29, 37N-62E	Warm S		71° PT	1	0.15	0.04	0.009
0526	Cobre	Sec. 3, 37N-67E			77° BHT	1	0.17	0.04	0.010
0527	Winter Creek	Sec.26, 37N-58E	Warm S		71° PT	1	0.15	0.04	0.009
0528	Ralph's Warm Springs	Sec. 4, 35N-64E	30° S		45° PT	1	0.08	0.02	0.005
0529	Johnson Ranch Spring	Sec.28, 36N-66E	23° S		35° PT	1	0.05	0.01	0.003
0530	Elko Hot Springs	Sec.21, 34N-55E	89° S	80° (J) 86° (D) 114° (A)	93°±7°	3.3 ± 0.9	0.70 ± 0.21	0.175	0.042
0531	Cold Creek	Sec.31, 34N-59E	Warm S		71° PT	1	0.15	0.04	0.009
0532	Carlin	Sec.33, 33N-52E	Boil S	81° (I) 90° (D) 118° (A)	96°±8°	3.3 ± 0.9	0.73 ± 0.22	0.183	0.044
0533	Hot Sulfur Spring (near Vivian Siding)	Sec. 8, 33N-53E	37° S		56° PT	1	0.11	0.28	0.007
0534	Spring South End of Humboldt Range	Sec.12, 33N-61E	Warm S		71° PT	1	0.15	0.04	0.009
0535	Sulfur Hot Springs	Sec.11, 31N-59E	96° S	171° (C) 181° (I) 183° (A)	178°±3°	7.8 ± 2.8	3.4 ± 1.2	0.86	0.21
0536	Smith Ranch Spring	Sec. 2, 27N-58E	65° S		98° PT	1	0.22	0.6	0.013

Footnotes 1 thru 7 - See Explanation Page

TABLE II ESMERALDA COUNTY HOT-WATER CONVECTION SYSTEMS

LOCATION			TEMPERATURE °C			RESERVOIR ASSUMPTIONS		ENERGY POTENTIAL	
Site ID No.	Site Name	Site Location	Surface (1)	Geochemical (2)	Mean, BHT PT (3)	Volume km^3 (4)	Reservoir thermal energy (10^{18}J) (5)	Wellhead thermal energy (10^{18}J) (6)	Beneficial Heat (10^{18}J) (7)
0601	Fish Lake Valley	Sec.16, 1S-36E			159° BHT	1.5	0.58	0.15	0.035
0602	Southern Big Smokey V.	Sec. 6, 1N-38E	27° W		41° PT	1	0.07	0.02	0.004
0603	Big Divide Mine	Sec.26, 2N-42E	Hot MW		41° PT	1	0.07	0.02	0.004
0604	Pearl Hot Springs	Sec.25, 1S-40E	37° S		56° PT	1	0.11	0.28	0.007
0605	Alkali Springs	Sec.26, 1S-41E	60° S		90° PT	1	0.20	0.05	0.012
0606	Silver Peak Hot Springs	Sec.15, 2S-39E	48° S		72° PT	1	0.15	0.04	0.009
0607	Amargosa Range	Sec. 6, 11S-43E	25° S		38° PT	1	0.06	0.02	0.004

Footnotes 1 thru 7 - See Explanation Page

TABLE II EUREKA COUNTY HOT-WATER CONVECTION SYSTEMS

LOCATION			TEMPERATURE °C			RESERVOIR ASSUMPTIONS		ENERGY POTENTIAL	
Site ID No.	Site Name	Site Location	Surface (1)	Geochemical (2)	Mean, BHT PT (3)	Volume km^3 (4)	Reservoir thermal energy (10^{18}J) (5)	Wellhead thermal energy (10^{18}J) (6)	Beneficial Heat (10^{18}J) (7)
0701	Horseshoe Ranch Springs	Sec.32, 32N-49E	58° S		87° PT	1.5	0.29	0.07	0.017
0702	Beowawe Geysers	Sec.17, 31N-48E	96° S	211° (M)	229°±8°	8.2 ± 1.9	4.7 ± 1.1	1.18	0.28
				226° (C)	212° BHT				
				251° (K)					
0703	Raine Ranch(?) Springs	Sec. 6, 31N-52E	Warm S		57° PT	1	0.11	0.03	0.007
0704	Hot Springs Point	Sec. 1, 29N-48E	74° W	74° (M)	92°±9°	3.3 ± 0.9	0.70 ± 0.21	0.175	0.042
				87° (D)					
				116° (A)					
0705	Duff Creek	Sec.10, 28N-49E	86° S		129° PT	1.5	0.46	0.115	0.028
0706	Hot Creek, Carlotti Ranch Springs	Sec.24, 29N-52E	38° S		57° PT	1	0.11	0.03	0.007
0707	Bruffey's (Mineral Hill) Hot Springs	Sec.14, 27N-52E	67°S		101° PT	1.5	0.35	0.09	0.021
0708	Flynn Ranch Springs	Sec. 5, 25N-53E	26° S		39° PT	1	0.06	0.02	0.004
0709	Walti Hot Springs	Sec.33, 24N-48E	73° S	117° (P) 78° (I)	120°	3	0.85	0.21	0.051
0710	Siri Ranch	Sec. 6, 24N-52E	35° W		53° PT	1	0.10	0.03	0.006
0711	Shirley (Sadler) Hot Sps.	Sec.23, 24N-52E	41° S		61° PT	1.5	0.19	0.05	0.011
0712	Thompson (Jacobson) Ranch Spring	Sec. 3, 23N-54E	24° S		36° PT	1	0.06	0.01	0.003
0713	Sulfur Springs	Sec.36, 23N-52E	23° S		34° PT	1	0.06	0.02	0.004
0714	Bartine Hot Springs	Sec.17?, 19N-50E	47° W		71° PT	1.5	0.23	0.06	0.014
0715	Klobe (Bartholomae) Hot Springs	Sec.28, 18N-50E	70° W	129° (P) 72° (I)	130°	3	0.93	0.23	0.056

Footnotes 1 thru 7 - See Explanation Page

TABLE II HUMBOLDT COUNTY HOT-WATER CONVECTION SYSTEMS

LOCATION			TEMPERATURE °C			RESERVOIR ASSUMPTIONS		ENERGY POTENTIAL	
Site ID No.	Site Name	Site Location	Surface (1)	Geochemical (2)	Mean, BHT PT (3)	Volume km^3 (4)	Reservoir thermal energy ($10^{18}J$) (5)	Wellhead thermal energy ($10^{18}J$) (6)	Beneficial Heat ($10^{18}J$) (7)
0801	Cordero Mercury Mine	Sec.28, 47N-37E	60°W		90° PT	1.5	0.30	0.76	0.018
0802	Bog Hot Springs	Sec.18, 46N-28E	88° S	108° 109°	115°	3	0.81	0.20	0.049
0803	Baltazor (Continental)	Sec.13, 46N-28E	93° S	152° (I)	158°±3°	6.1 ± 2.1	2.4 ± 0.8	0.59	0.14
	Hot Springs			158° (K)					
				165° (A)					
0804	Virgin Valley Campground	Sec. 2, 45N-26E	32° W		48° PT	1	0.09	0.02	0.005
0805	McGee Mountain	Sec.24, 45N-27E	55° W		83° PT	1	0.18	0.05	0.011
0806	Five Mile Spring	Sec.22, 45N-33E	28° S		42° PT	1	0.07	0.02	0.004
0807	Goosey Lake Flat	Sec.19?, 45N-41E	Hot S		87° PT	1	0.19	0.05	0.012
0808	Gridley Lake	Sec.12, 44N-27E	Warm S		83° PT	1	0.18	0.05	0.011
0809	Howard Hot Springs	Sec. 5, 44N-31E	73° S	128° (P) 81° (I)	130°	2.5	0.78	0.19	0.047
0810	Ninemile Spring	Sec.10, 44N-33E	26° S		39° PT	1	0.06	0.02	0.004
0811	Dyke Hot Springs	Sec.25, 43N-30E	70° S	76° (E)	106°±12°	3.3 ± 0.9	0.82 ± 0.26	0.20	0.048
				106° (B)					
				137° (E)					
0812	Quinn River Crossing	Sec.11, 42N-31E	24° W		36° PT	1	0.06	0.01	0.003
0813	Delong	Sec.32, 42N-33E	24° W		36° PT	1	0.06	0.01	0.003
0814	Quinn River	Sec.20, 41N-35E	27° W		41° PT	1	0.07	0.02	0.004
0815	Gondra-The Hot Spring	Sec.20, 41N-41E	58° S	109° (P) 209° (I)	87° PT	1.5	0.38	0.10	0.023
0816	South Fork	Sec. 4, 41N-43E	Hot S		87° PT	1	0.19	0.05	0.012
0817	Soldier Meadows Hot Sps.	Sec.23, 40N-24E	54° S	113° (P) 65° (I)	115°	2.5	0.68	0.17	0.041
0818	Pinto Hot Springs	Sec.21, 40N-28E	94° S	153° (C)	173°±8°	10 ± 3.1	4.3 ± 1.4	1.07	0.26
				176° (I)					
				190°					
0819	Cain Spring	Sec.30, 39N-27E	23° S		35° PT	1	0.05	0.01	0.003
0820	Double Hot Springs	Sec. 4, 36N-26E	90° S	114° (D)	127°±5°	12.2 ± 4.2	3.7 ± 1.3	0.92	0.22
				127° (I)					
				140° (A)					
0821	MacFarlane's	Sec.27, 37N-29E	77° S		115° PT	3	0.81	0.20	0.049
0822	Sand Dunes	Sec. 3, 37N-39E	70° W		105° PT	2.5	0.61	0.15	0.036
0823	Hot Springs Ranch Sps.	Sec.35, 37N-43E	Hot S		87° PT	1.5	0.29	0.07	0.017

Footnotes 1 thru 7 - See Explanation Page

TABLE II HUMBOLDT COUNTY HOT-WATER CONVECTION SYSTEMS Page 2

LOCATION			TEMPERATURE °C			RESERVOIR ASSUMPTIONS		ENERGY POTENTIAL	
Site ID No.	Site Name	Site Location	Surface (1)	Geochemical (2)	Mean, BHT PT (3)	Volume km^3 (4)	Reservoir thermal energy (10^{18}J) (5)	Wellhead thermal energy (10^{18}J) (6)	Beneficial Heat (10^{18}J) (7)
0824	Caine Spring	Sec.11, 36N-24E	23° S		34° PT	1	0.05	0.01	0.003
0825	Winnemucca Mountain	Sec.13, 36N-37E	34° S		41° PT	1	0.07	0.02	0.004
0826	Winnemucca	Sec.26, 36N-38E	23° W		34° PT	1	0.05	0.01	0.003
0827	Golconda	Sec.29, 36N-40E	74° S	86° (D,I)	96°±7°	3.3 ± 0.9	0.73 ± 0.21	0.183	0.044
				86° (D,I)					
				115° (A)					
0828	Lone Butte	Sec. 2, 36N-41E	21° S		32° PT	1	0.05	0.01	0.003
0829	Northern East Range	Sec.21, 35N-36E	29° W		44° PT	1	0.08	0.02	0.005
0830	Sulfur Spring	Sec.34, 35N-41E	Hot S		58° PT	1	0.12	0.03	0.007
0831	Hot Pot (Blossom) Hot Sps.	Sec.11, 35N-43E	57° S	97° (D)	112°±6°	3.3 ± 0.9	0.87 ± 0.25	0.22	0.053
				114° (J)					
				125° (A)					
0832	Brooks Hot Spring	Sec.13, 34N-41E	37° S		58° PT	1	0.12	0.03	0.007
0833	Hot Springs (Tipton) Ranch	Sec. 5, 33N-40E	85° S	125° (D)	145°±7°	3.3 ± 0.9	1.17 ± 0.33	0.29	0.070
				150° (A)					
				160° (J)					

Footnotes 1 thru 7 - See Explanation Page

TABLE II LANDER COUNTY HOT-WATER CONVECTION SYSTEMS

LOCATION			TEMPERATURE °C			RESERVOIR ASSUMPTIONS		ENERGY POTENTIAL	
Site ID No.	Site Name	Site Location	Surface (1)	Geochemical (2)	Mean, BHT PT (3)	Volume km^3 (4)	Reservoir thermal energy (10^{18}J) (5)	Wellhead thermal energy (10^{18}J) (6)	Beneficial Heat (10^{18}J) (7)
0901	Izzenhood Ranch Spring	Sec.10, 35N-45E	28° S		42° PT	1	0.07	0.02	0.004
0902	White Rock Springs	Sec. 8, 33N-47E	Warm S		126° PT	1	0.30	0.75	0.018
0903	Battle Mountain	Sec. 6, 32N-46E	Warm S		126° PT	1	0.30	0.75	0.018
0904	Timber Canyon	Sec.11, 31N-42E	24° S		36° PT	1	0.06	0.01	0.003
0905	Buffalo Valley Hot Spring	Sec.23, 39N-41E	79° S	97° (D)	124° ± 10°	5.7 ± 2.0	1.67 ± 0.60	0.42	0.100
				135° (J)					
				140° (K)					
0906	Mound Springs	Sec. 7, 28N-44E	43° S		65° PT	1	0.14	0.03	0.008
0907	Hot Springs Ranch	Sec.26, 27N-43E	54° S		81° PT	1.5	0.27	0.07	0.016
0908	Chillis Hot Springs	Sec.27, 27N-46E	39° S		59° PT	1	0.12	0.03	0.007
0909	Carico Lake	Sec.15, 26N-45E	22° S		33° PT	1	0.05	0.01	0.003
0910	Lister	Sec.27, 24N-43E	39° W		59° PT	1	0.12	0.03	0.007
0911	Little Hot Springs	Sec. 2, 23N-47E	Hot S		110° PT	1	0.26	0.06	0.015
0912	McCoy-Wild Horse	Sec.18, 23N-40E			307° PT	3	2.37	0.59	0.142
0913	Peterson's Mill Hot Sp.	Sec.36, 20N-40E	Hot S		59° PT	1	0.12	0.03	0.007
0914	Southern Smith Crk.Valley	Sec.26, 17N-39E	Boil	116° (D)	138° ± 8°	3.3 ± 0.9	1.11 ± 0.32	0.28	0.067
				143° (A,K)					
				156° (I)					
0915	Grimes Hills	Sec.20, 18N-47E	21° W		31° PT	1	0.04	0.01	0.003
0916	Spencer Hot Springs	Sec.13, 17N-45E	Boil S	88° (J)	102° ± 8°	3.3 ± 0.9	0.78 ± 0.23	0.195	0.047
				95° (D)					
				123° (A)					
0917	Sante Fe Creek	Sec.24, 16N-44E	29° W		44° PT	1	0.08	0.02	0.005
0918	Clipper Gap Canyon	Sec.14, 16N-45E	Hot S		73° PT	1	0.07	0.02	0.004

Footnotes 1 thru 7 - See Explanation Page

TABLE II LINCOLN COUNTY HOT-WATER CONVECTION SYSTEMS

LOCATION			TEMPERATURE °C			RESERVOIR ASSUMPTIONS		ENERGY POTENTIAL	
Site ID No.	Site Name	Site Location	Surface (1)	Geochemical (2)	Mean, BHT PT (3)	Volume km^3 (4)	Reservoir thermal energy (10^{18}J) (5)	Wellhead thermal energy (10^{18}J) (6)	Beneficial Heat (10^{18}J) (7)
1001	Geyser Ranch Springs	Sec. 1, 9N-65E	21° S		31° PT	1	0.04	0.01	0.003
1002	Hammond Ranch	Sec.17, 5N-69E	29° S		44° PT	1	0.08	0.02	0.005
1003	Flatnose Ranch Spring	Sec.34, 1N-69E	25° S		37° PT	1	0.06	0.01	0.004
1004	Delmue's Spring	Sec.13, 1S-68E	21° S		31° PT	1	0.04	0.01	0.003
1005	Bennett's Spring	Sec. 7, 2S-66E	21° S		31° PT	1	0.04	0.01	0.003
1006	Panaca (Owl) Warm Springs	Sec. 4, 2S-68E	32° S		48° PT	1	0.09	0.02	0.005
1007	Sand Spring Valley	Sec.26, 2S-55E	30°S		45° PT	1	0.08	0.02	0.005
1008	Hiko Spring	Sec.14, 4S-60E	32° S		48° PT	1	0.09	0.02	0.005
1009	Caliente Hot Springs	Sec. 8, 4S-67E	63° W		95° PT	1.5	0.327	0.08	0.019
1010	Crystal Springs	Sec.10, 5S-60E	32° S		48° PT	1	0.09	0.02	0.005
1011	Ash (Alamo) Springs	Sec.36, 5S-60E	36° S		54° PT	1	0.11	0.03	0.006
1012	Ash Creek Spring	Sec. 1, 12S-58E	22° S		33° PT	1	0.05	0.01	0.003

Footnotes 1 thru 7 - See Explanation Page

TABLE II LYON COUNTY HOT-WATER CONVECTION SYSTEMS

LOCATION			TEMPERATURE °C			RESERVOIR ASSUMPTIONS		ENERGY POTENTIAL	
Site ID No.	Site Name	Site Location	Surface (1)	Geochemical (2)	Mean, BHT PT (3)	Volume km^3 (4)	Reservoir thermal energy (10^{18}J) (5)	Wellhead thermal energy (10^{18}J) (6)	Beneficial Heat (10^{18}J) (7)
1101	Hazen-Patua Hot Spring	Sec.18?,20N-26E	132° W	161° (A)	182°±13°	3.3 ± 0.9	1.51 ± 0.44	0.38	0.09
				166° (I)					
				220° (K)					
1102	Sutro Tunnel	Sec. 2, 16N-21E	28° MW		42° PT	1	0.07	0.02	0.004
1103	Dayton	Sec.12, 16N-21E	35° W		48° PT	1	0.09	0.02	0.005
1104	Wabuska Hot Springs	Sec.16, 15N-25E	108° W	106° (M)	131°±9°	18.3 ± 11.9	5.7 ± 3.8	1.43	0.34
				140° (K)					
				146° (M)					
1105	Artesia Lake	Sec.25, 13N-23E	28° W		42° PT	1	0.07	0.02	0.004
1106	Hind's (Nevada) Hot Sps.	Sec.16, 12N-23E	67° S	104°(P) 86°(I)	105°	1.5	0.36	0.09	0.022
1107	Wilson Hot Springs	Sec.34, 11N-25E	Warm S		74° PT	1.5	0.24	0.06	0.014
1108	Wellington	Sec. 2, 10N-23E	Hot W		74° PT	1	0.16	0.04	0.010
1109	Aldrich Station	Sec. 4, 7N-27E	43° S		65° PT	1	0.14	0.03	0.008

Footnotes 1 thru 7 → See Explanation Page

TABLE II MINERAL COUNTY HOT-WATER CONVECTION SYSTEMS

LOCATION			TEMPERATURE °C			RESERVOIR ASSUMPTIONS		ENERGY POTENTIAL	
Site ID No.	Site Name	Site Location	Surface (1)	Geochemical (2)	Mean, BHT PT (3)	Volume km^3 (4)	Reservoir thermal energy ($10^{18}J$) (5)	Wellhead thermal energy ($10^{18}J$) (6)	Beneficial Heat ($10^{18}J$) (7)
1201	Double Spring	Sec.25, 13N-29E	Warm S		57° PT	1	0.11	0.03	0.007
1202	Dead Horse Wells	Sec.21, 12N-32E	Hot W		79° PT	1	0.17	0.04	0.010
1203	Wedell Springs	Sec. 7, 12N-34E	67° S		101° PT	2.5	0.58	0.15	0.035
1204	Hawthorne	Sec.18, 8N-30E	51° W		76° PT	3	0.49	0.25	0.060
1205	Sodaville (Soda) Springs	Sec.29, 6N-35E	38° S		57° PT	1	0.11	0.03	0.007
1206	Whiskey Flat	Sec.19, 5N-31E	42° W		63° PT	1	0.13	0.03	0.008
1207	Huntoon Valley	Sec. 7, 3N-31E	26° W		39° PT	1	0.06	0.02	0.004
1208	Basalt	Sec.32, 2N-33E	45° W		68° PT	1	0.14	0.04	0.008

Footnotes 1 thru 7 - See Explanation Page

TABLE II NYE COUNTY HOT-WATER CONVECTION SYSTEMS

LOCATION			TEMPERATURE °C			RESERVOIR ASSUMPTIONS		ENERGY POTENTIAL	
Site ID No.	Site Name	Site Location	Surface (1)	Geochemical (2)	Mean, BHT PT (3)	Volume km^3 (4)	Reservoir thermal energy ($10^{18}J$) (5)	Wellhead thermal energy ($10^{18}J$) (6)	Beneficial Heat ($10^{18}J$) (7)
1301	McLeod's Ranch Spring	Sec.34, 14N-43E	Hot S		86° PT	1.5	0.29	0.07	0.017
1302	Charnock (Big Blue) Sps.	Sec.16, 13N-44E	27° S		41° PT	1.5	0.11	0.03	0.006
1303	Diana's Punch Bowl- Pott's Ranch	Sec.22, 14N-47E	59° S		89° PT	2.5	0.50	0.12	0.030
1304	Gabbs	Sec.28, 12N-36E	68° W		102° PT	2.5	0.59	0.15	0.035
1305	Duckwater	Sec.32, 13N-56E	33° S		50° PT	1	0.09	0.02	0.006
1306	Mosquito Creek Ranch	Sec. 6, 11N-47E	35° S		53° PT	1	0.10	0.03	0.006
1307	Darrough's Hot Springs	Sec. 7, 11N-43E	Boil W	129° (M)	132°±1°	14.4 ± 7.9	4.6 ± 2.5	1.14	0.27
				132° (C)					
				136° (A)					
1308	Little Fish Lake Valley	Sec. 7, 11N-49E	101° W		150° PT	2.0	0.73	0.18	0.044
1309	Locke's Hot Spring	Sec.15, 8N-55E	38° S		57° PT	2.0	0.23	0.06	0.014
1310	Chimney Springs	Sec.16, 7N-55E	71° S		160° PT	2.0	0.49	0.12	0.029
1311	Storm, Coyote Hole, & Abel Springs	Sec.23, 6N-54E	46° S		69° PT	2.0	0.29	0.07	0.017
1312	Eagle Springs	Sec. 2, 7N-56E			109° BHT	2.5	0.63	0.16	0.038
1313	Morman (Moorman) Spring	Sec.32, 9N-61E	38° S		57° PT	1	0.11	0.03	0.007
1314	Emigrant Spring	Sec.19, 9N-62E	21° S		31° PT	1	0.04	0.01	0.003
1315	Hot Creek Canyon	Sec.29, 8N-50E	82°		123° PT	2.0	0.58	0.15	0.035
1316	Hot Creek Valley	Sec.30, 7N-51E	61°		91° PT	2.0	0.41	0.10	0.025
1317	Royston Hills	Sec.28, 7N-40E	Warm W		33° PT	1	0.05	0.01	0.003
1318	Indian Springs	Sec.34?, 7N-42E	Warm S		33° PT	1	0.05	0.01	0.003
1319	Butterfield Springs	Sec.28, 7N-62E	24° S		36° PT	1	0.06	0.01	0.003
1320	Pinon Peak	Sec.36, 6N-47E	26° S		39° PT	1	0.06	0.02	0.004
1321	Hot Creek Ranch Springs	Sec.18, 6N-61E	33° S		50° PT	1	0.09	0.02	0.006
1322	Moon River Spring	Sec.25, 6N-60E	33°		50° PT	1	0.09	0.02	0.006
1323	Salisbury Spring	Sec.28, 5N-46E	30° S		45° PT	1	0.08	0.02	0.005
1324	Warm (Nanny Goat) Sps.	Sec.20, 4N-50E	Boil S	111°(P) 192°(I)	125°	2.5	0.74	0.19	0.045
1325	Tonopah Mining District	Sec.35, 3N-42E	41° MW		61° PT	1	0.12	0.03	0.007
1326	Central Ralston Valley	Sec.16, 3N-44E	22° W		33° PT	1	0.05	0.01	0.003
1327	Willow Creek	Sec.14, 2N-47E	29° S		44° PT	1	0.08	0.02	0.005

Footnotes 1 thru 7 - See Explanation Page

TABLE II NYE COUNTY HOT-WATER CONVECTION SYSTEMS

LOCATION			TEMPERATURE °C			RESERVOIR ASSUMPTIONS		ENERGY POTENTIAL	
Site ID No.	Site Name	Site Location	Surface (1)	Geochemical (2)	Mean, BHT PT (3)	Volume km^3 (4)	Reservoir thermal energy (10^{18}J) (5)	Wellhead thermal energy (10^{18}J) (6)	Beneficial Heat (10^{18}J) (7)
1328	Reveille Mill Spring	Sec.28, 2N-50E	29° S		44° PT	1	0.08	0.02	0.005
1329	Well East of Reveille Peak	Sec.28, 1S-53E	21° W		31° PT	1	0.04	0.01	0.003
1330	Cedar Spring	Sec.21, 2S-51E	25° S		38° PT	1	0.06	0.02	0.004
1331	Scottys Junction	Sec.28, 7S-44E	23° W		35° PT	1	0.05	0.01	0.003
1332	Southern Sarcobatus Flat -Beatty	Sec.16, 11S-47E	43° S		65° PT	10	1.35	0.34	0.081
1333	Yucca Flat	37°03'20"N- 116°00'50"	42° W		63° PT	1.5	0.19	0.05	0.012
1334	Steves Pass	Sec.35, 13S-47E	29° W		44° PT	1	0.08	0.02	0.005
1335	Jackass Flats	Sec.30, 13S-51E	33° W		50° PT	1	0.09	0.02	0.006
1336	Frenchman Flat	Sec. 3, 14N-52E	65° W		98° PT	1	0.22	0.06	0.013
1337	Lathrop Wells	Sec.14, 15S-49E	28° W		42° PT	1	0.07	0.02	0.004
1338	Desert Rock	Sec. 4, 16S-53E	33° W		50° PT	1	0.09	0.02	0.006
1339	Lower Amargosa Valley-Ash Meadows	Sec.36, 17S-50E	34° S		51° PT	10	0.97	0.24	0.058
1340	Pahrump	Sec.15, 20S-53E	28° W		42° PT	1.5	0.11	0.03	0.007

Footnotes 1 thru 7 - See Explanation Page

TABLE II PERSHING COUNTY HOT-WATER CONVECTION SYSTEMS

LOCATION			TEMPERATURE °C			RESERVOIR ASSUMPTIONS		ENERGY POTENTIAL	
Site ID No.	Site Name	Site Location	Surface (1)	Geochemical (2)	Mean, BHT PT (3)	Volume km^3 (4)	Reservoir thermal energy (10^{18}J) (5)	Wellhead thermal energy (10^{18}J) (6)	Beneficial Heat (10^{18}J) (7)
1401	Ronda	Sec.28, 35N-28E	22° S		33° PT	1.5	0.07	0.02	0.004
1402	Trego (Butte) Hot Sps.	Sec.31?,34N-26E	86° S	96° (D)	115°±7°	3.3 ± 0.9	0.90 ± 0.26	0.22	0.53
				124° (A,I)					
				124° (A,I)					
1403	Mill City	Sec. SW/4, 33N-35E	Warm S		44° PT	1	0.08	0.02	0.005
1404	Leach Hot Springs	Sec.36, 32N-38E	97° S	155° (A)	162°±3°	9.7 ± 2.7	3.9 ± 1.1	0.96	0.23
				160° (J)					
				170° (K)					
1405	Humboldt House (Rye Patch)	Sec.21, 31N-33E		172° (K)	217°±16°	3.3 ± 0.9	1.92 ± 0.53	0.45	0.110
				230° (J)	213° BHT				
				249° (I)					
1406	Gold Mountain	Sec.34, 29N-34E	24° W		36° PT	1	0.06	0.01	0.003
1407	Kyle Hot Springs	Sec.12, 29N-36E	96° S	154°(K)	159°± 2°	12.8 ± 5.6	5.0 ± 2.2	1.24	0.30
				161°(A)					
				161°(A)					
1408	Colado	Sec.27, 28N-32E	67° W	61° (M)	97°± 14°	3.3 ± 0.9	0.73 ± 0.24	0.183	0.044
				101° (D)					
				128° (A)					
1409	Southern Pleasant Valley	Sec. 2, 27N-38E	22° W		33° PT	1	0.05	0.01	0.003
1410	Jersey Valley (Home Station Ranch Hot Sp.)	Sec.29, 27N-40E	57° S	143°(P) 182°(I)	185°	2.5	1.15	0.29	0.069
1411	Sou (Seven Devil's, Gilbert's) Hot Sps.	Sec.29, 26N-38E	85° S	79° (J)	93°±8°	3.3 ± 0.9	0.70 ± 0.21	0.175	0.042
				86° (D)					
				114° (A)					
1412	McCoy Hot Springs	Sec.33, 26N-39E	49° S		74° PT	2.5	0.40	0.10	0.024
1413	New York Canyon Kaolin Deposit	Sec. 1, 25N-35E	Hot W		84° PT	1.5	0.28	0.07	0.017
1414	Hyder (Cone) Hot Springs	Sec.28, 25N-38E	79° S		119° PT	2.5	0.70	0.18	0.042
1415	Lower Ranch Hot Springs	Sec.16, 25N-39E	40° S		60° PT	1.5	0.18	0.05	0.011

Footnotes 1 thru 7 - See Explanation Page

LOCATION			TEMPERATURE °C			RESERVOIR ASSUMPTIONS		ENERGY POTENTIAL	
Site ID No.	Site Name	Site Location	Surface (1)	Geochemical (2)	Mean, BHT PT (3)	Volume km^3 (4)	Reservoir thermal energy ($10^{18}J$) (5)	Wellhead thermal energy ($10^{18}J$) (6)	Beneficial Heat ($10^{18}J$) (7)
1416	Black Rock Point	Sec. 34, 36N-26E		116° (I)	129°±7°	3.3 ± 0.9	1.02 ± 0.29	0.25	0.06
				122° (D)					
				148° (A)					

Footnotes 1 thru 7 - See Explanation Page

TABLE II STOREY COUNTY HOT-WATER CONVECTION SYSTEMS

LOCATION			TEMPERATURE °C			RESERVOIR ASSUMPTIONS		ENERGY POTENTIAL	
Site ID No.	Site Name	Site Location	Surface (1)	Geochemical (2)	Mean, BHT PT (3)	Volume km^3 (4)	Reservoir thermal energy (10^{18}J) (5)	Wellhead thermal energy (10^{18}J) (6)	Beneficial Heat (10^{18}J) (7)
1501	Biddleman Spring	Sec.20, 19N-23E	23° S		35° PT	1	0.05	0.01	0.003
1502	Comstock Mining District	Sec.32, 17N-21E	77° MW		116° PT	2.5	0.68	0.17	0.041

Footnotes 1 thru 7 - See Explanation Page

TABLE II WASHOE COUNTY HOT-WATER CONVECTION SYSTEMS

LOCATION			TEMPERATURE °C			RESERVOIR ASSUMPTIONS		ENERGY POTENTIAL	
Site ID No.	Site Name	Site Location	Surface (1)	Geochemical (2)	Mean, BHT PT (3)	Volume km^3 (4)	Reservoir thermal energy (10^{18}J) (5)	Wellhead thermal energy (10^{18}J) (6)	Beneficial Heat (10^{18}J) (7)
1601	Hill's Warm Spring	Sec.18, 44N-20E	28° S		42° PT	1	0.07	0.02	0.004
1602	Twin (Vya) Spring	Sec. 4, 42N-19E	22° S		33° PT	1	0.05	0.01	0.003
1603	Southern Surprise Valley	Sec. ?, 38N-18E	Hot S		43° PT	1	0.08	0.02	0.005
1604	Leadville	Sec. 9?,37N-23E	Warm S		43° PT	1	0.08	0.02	0.005
1605	Squaw Valley	Sec.18, 34N-22E	29° S		44° PT	1	0.08	0.02	0.005
1606	Ward's (Fly Ranch) Hot Springs	Sec. 1, 34N-23E	>104°W	99° (D)	108°±6°	4.4 ± 1.3	1.12 ± 0.35	0.28	0.067
				100° (J)					
				126° (A)					
1607	Wall Spring	Sec. 3, 32N-21E	Warm S		50° PT	1	0.09	0.02	0.006
1608	Gerlach	Sec.15, 32N-23E	Boil S	158° (C)	178°±10°	3.3 ± 0.9	1.46 ± 0.42	0.36	0.086
				170°					
				205° (I)					
1609	Buffalo Spring	Sec. 6?,31N-20E	Warm S		50° PT	1	0.09	0.02	0.006
1610	Southern Smoke Creek Desert	Sec. 2?,29N-19E	33° S		50° PT	1	0.09	0.02	0.006
1611	San Emidio Desert	Sec. 9, 29N-23E	Boil W	125°	166°±15°	3.3 ± 0.9	1.36 ± 0.40	0.40	0.096
				185° (A)					
				189° (I)					
1612	Boiling Spring	Sec.26, 2[illegible]N-23E	86° S		129° PT	1.5	0.46	0.12	0.028
1613	Fish Spring	Sec.19, 26N-19E	23° S		35° PT	1	0.05	0.01	0.003
1614	The Needles Rocks	Sec. 6, 26N-21E		115° (D)	123°±5°	3.3 ± 0.9	0.97 ± 0.27	0.24	0.058
				116° (M)	116° BHT				
				137° (C)					
1615	Anaho Island	Sec.16?,24N-22E	49° S		74° PT	1.5	0.24	0.06	0.014
1616	Warm Springs Valley	Sec. 7, 22N-21E	43° W		65° PT	1	0.14	0.03	0.008
1617	Wadsworth	Sec.21?,21N-24E	Warm S		65° PT	1	0.14	0.03	0.008
1618	Wedekind Mine	Sec.28, 20N-20E	Hot MW		65° PT	1	0.14	0.03	0.008
1619	Lawton Hot Springs	Sec.13, 19N-18E	60° W		90° PT	1	0.20	0.05	0.012
1620	Verdi	Sec.17, 19N-18E	26° W		39° PT	1	0.06	0.02	0.004

Footnotes 1 thru 7 - See Explanation Page

TABLE II WASHOE COUNTY HOT-WATER CONVECTION SYSTEMS

LOCATION			TEMPERATURE °C			RESERVOIR ASSUMPTIONS		ENERGY POTENTIAL	
Site ID No.	Site Name	Site Location	Surface (1)	Geochemical (2)	Mean, BHT PT (3)	Volume km^3 (4)	Reservoir thermal energy (10^{18}J) (5)	Wellhead thermal energy (10^{18}J) (6)	Beneficial Heat (10^{18}J) (7)
1621	Moana	Sec.26, 19N-19E	96° W	96° (M)	116°±14°	8.8 ± 1.8	2.4 ± 0.6	0.60	0.144
				96° (M)					
				155° (A)					
1622	Steamboat-Huffaker	Sec.32, 18N-20E	179° W	186° (M)	200°±5°	29 ± 12	14.4 ± 5.9	3.6	0.86
				207° (I)					
				207° (K)					
1623	Pleasant Valley	Sec. 7, 17N-20E	38° W		52° PT	1.5	0.15	0.04	0.009
1624	Bower's Mansion(Frank-town) Hot Springs	Sec. 3, 16N-19E	48° S		72° PT	1	0.15	0.04	0.009
1625	New Washoe City	Sec. 6, 16N-20E	26° W		39° PT	1	0.06	0.02	0.004

Footnotes 1 thru 7 - See Explanation Page

TABLE II WHITE PINE COUNTY HOT-WATER CONVECTION SYSTEMS

LOCATION			TEMPERATURE °C			RESERVOIR ASSUMPTIONS		ENERGY POTENTIAL	
Site ID No.	Site Name	Site Location	Surface (1)	Geochemical (2)	Mean, BHT PT (3)	Volume km^3 (4)	Reservoir thermal energy ($10^{18}J$) (5)	Wellhead thermal energy ($10^{18}J$) (6)	Beneficial Heat ($10^{18}J$) (7)
1701	Collar and Elbow Spring	Sec.33, 26N-65E	33° S		50° PT	1	0.09	0.02	0.006
1702	Shell Oil Co. Steptoe	Sec.19, 24N-64E			151° BHT	1.5	0.06	0.14	0.003
	Unit No. 1 Well								
1703	Becky Peak	Sec.31, 24N-65E	28° S		42° PT	1	0.07	0.02	0.004
1704	Cherry Creek (Young's)	Sec. 7, 23N-63E	65° S	90° (	115°±10°	3.3 ± 0.9	0.90 ± 0.27	0.22	0.053
	Hot Springs			114° (D)					
				140° (A)					
1705	Northern Spring Valley	Sec.31, 23N-6[illegible]E	32° W		48° PT	1	0.09	0.02	0.005
1706	Giocoechea (Simonsen)								
	Warm Springs	Sec. 1, 2[illegible]-56E	24° S		36° PT	1	0.06	0.01	0.003
1707	Shellbourne Springs	Sec.12, 2[illegible]-64E	25° S		38° PT	1	0.06	0.02	0.004
1708	Monte Neva Hot (Melvin,	Sec.24, 21[illegible]-6[illegible]E	89° S		134° PT	3	0.96	0.24	0.058
	Goodrich) Springs								
1709	Kern Mountains	Sec.21?,21N-70E	Wa[illegible] S		48° PT	1	0.09	0.02	0.005
1710	Campbell Ranch (North	Sec. 5, 19N-63E	24° S		36° PT	1	0.06	0.01	0.003
	Group) Springs								
1711	McGill, Schoolhouse Warm	Sec.21, 18N-64E	29° S		44° PT	1	0.08	0.02	0.005
	Springs								
1712	Lackawanna, Ely Hot Sps.	Sec. 3, 16N-63E	35° S		53° PT	1	0.10	0.03	0.006
1713	Big Blue Spring	Sec.23, 14N-56E	Warm S		50° PT	1	0.09	0.02	0.006
1714	Williams Hot Springs	Sec.33, 13N-60E	53° S		80° PT	1	0.18	0.04	0.010
1715	Preston Springs	Sec. 2, 12N-61E	22° S		33° PT	1	0.05	0.01	0.003
1716	Southern Spring Valley	Sec. 2, 12N-67E	24° W		36° PT	1	0.06	0.01	0.003
1717	Warm Sulfur Springs	Sec.22?,11N-65E	Warm S		33° PT	1	0.05	0.01	0.003
1718	Big Spring	Sec.33, 10N-70E	Warm ?		33° PT	1	0.05	0.01	0.003

Footnotes 1 thru 7 - See Explanation Page

Footnotes to TABLE II. County Hot-Water Convection Systems

(1) This is the maximum reported temperature from a spring (S); drill hole or well (W); or mine working (MW). Deep exploratory geothermal and petroleum well temperatures are reported as bottom hole temperatures (BHT) in column six.

(2) All geochemical temperatures are those of the U.S. Geological Survey, as published in Circulars 726 and 790. For those sites where three temperatures are given, the first is the minimum likely value, the second is the most likely value, and the third is the maximum value. Letters indicate the method used to estimate the temperature:

A. Quartz
B. Quartz conductive, pH-corrected
C. Quartz adiabatic
D. Chalcedony
E. Chalcedony, pH-corrected
F. Cristobalite
G. Amorphous silica
H. Na-K
I. Na-K-Ca
J. Na-K-Ca, Mg-corrected
K. Sulfate-water isotope
L. Surface
M. Reported well
N. Mixing
O. Renner, 1976
P. Assumes saturation of SiO_2 with respect to quartz.

(3) The mean reservoir temperatures are those calculated by the U. S. Geological Survey (Brook et al., 1979). The bottom hole temperature (BHT) has been taken as the reservoir temperature, only for deep geothermal or petroleum exploratory tests.

Most of the geothermal sites are in the low to moderate temperature range, well below that which is presently necessary for electrical power generation. Reservoir data (temperature and volume) is not available for any of these sites. In order to provide an estimated reservoir thermal energy for each site, a planning temperature (PT) was calculated for each site which does not have a U.S.G.S. mean temperature or a bottom hole temperature. A planning temperature was calculated by increasing the surface temperature by a multiple of 1.5 (e.g., surface temperature of 45°C x 1.5 = 69°C PT), for each county with the exception of Clark. In Clark County, where the surface water temperatures are all very low, and the mean annual air surface temperature is high, a multiple of 1.25 was used.

(4) The U.S. Geological Survey reservoir volumes have been utilized for those sites which show a geochemical reservoir temperature. For those sites which do not have a U.S.G.S. estimate of volume, an estimate has been made using the parameters established by the Survey for minimum volumes. That is, "Where the only evidence of a reservoir of hot water is a single spring or well or group of springs in a small area, a minimum area of 1 km^2 and a maximum of 3 km^2 with a most likely area of 2 km^2 are assumed...Because the estimates in this assessment involve thermal energy only to a depth of 3 km below the surface, the bottom of a reservoir is normally assumed to be at 3 km unless there is evidence to suggest a shallower depth ...Otherwise, a minimum depth of 0.5 km, a maximum of 2.0 km, and a most likely depth of 1.5 km to the top of the reservoir

are assumed." (Smith and Shaw 1979)

Closely following the aforeme tioned assumptions and those stated in more detail in the riginal text, the present study assumes a 1 km^3 minimum reser oir volume, and a maximum 3 km^3 reservoir volume for smaller sites. The minimum volume is usually taken for those sites with surface water temperatures below 90°C, expecially in areas where high temperature reservoirs are not now known.

(5) Estimation of the reservoir thermal energy is derived from the product of assumed reservoir temperature (minus 15°C), the assumed reservoir volume, and the constant, 2.7 $J/cm^3/°C$. (See Brook, et al., 1979, p. 20).

(6) Determination of hot-water geothermal resources involves the definition of a geothermal recovery factor, which is the ratio of geothermal energy recovered at the wellhead to the geothermal energy originally in the reservoir. This factor is 25% for all hot-water reservoirs.

(7) "Following the methology of Nathenson and Muffler (1975), the amount of the resource that could be directly applied to non-electric uses is calculated for systems of 90° to 150°C. This amount of thermal energy is called beneficial heat..." (See Brook, et al., 1979, p. 26). Beneficial heat is the product

of the wellhead thermal energy and the beneficial heat utilization factor of 0.24.

This calculation may be used to obtain beneficial heat for reservoirs above 150°C as well. According to Nathenson (personal communication, 1979) this formula might be used for low temperature reservoirs, but with questionable results below about 40°C. In the absence of a better method this formula was applied to all geothermal reservoirs in this study.

TABLE III. POPULATION AND RESIDENTIAL/COMMERCIAL ENERGY USE FOR 1975, 1985, 2000 and 2020
(TOTAL ENERGY USE AND POTENTIAL GEOTHERMAL SPACE AND WATER HEATING)

CITY/ENERGY USE SITE	POPULATION					RESIDENTIAL/COMMERCIAL ENERGY USE				POTENTIAL GEOTHERMAL SPACE AND WATER HEATING			
	1970	1975	1985	2000	2020	1975	1985	2000	2020	1975	1985	2000	2020
CARSON CITY	15,468	25,300	55,071	104,500	171,336	1.997	3.872	6.773	10.577	1.398	2.710	4.741	7.404
CHURCHILL	10,513	12,000	14,868	18,730	23,869	0.945	1.045	1.213	1.472	0.662	0.732	0.849	1.030
Cold S ting	15	15	15	15	15	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Fallon	2,959	3,378	4,185	5,272	6,718	0.266	0.294	0.341	0.414	0.186	0.206	0.239	0.290
Fallon N.A.S	1,045	1,193	1,478	1,862	2,373	0.094	0.104	0.121	0.146	0.066	0.073	0.085	0.102
Frenchman	5	5	5	5	5	-	-	-	-	-	-	-	-
Hazen	20	20	20	20	20	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
CLARK	273,288	330,700	526,945	866,900	1,329,585	26.081	37.035	56.185	82.056	18.257	25.925	39.330	57.439
Boulder City		7,785	12,405	20,408	31,300	0.614	0.872	1.323	1.932	0.430	0.610	0.926	1.352
Blue Diamond		220	351	577	885	0.017	0.025	0.037	0.055	0.012	0.018	0.026	0.039
Boulder Beach		400	400	400	400	0.032	0.032	0.032	0.032	0.022	0.022	0.022	0.022
Bunkerville		300	300	300	300	0.024	0.024	0.024	0.024	0.017	0.017	0.017	0.017
Cottonwood Cove		200	200	200	200	0.016	0.016	0.016	0.016	0.011	0.011	0.011	0.011
Echo Bay		25	25	25	25	0.002	0.002	0.002	0.002	0.001	0.001	0.001	0.001
Glendale		75	120	197	302	0.006	0.008	0.013	0.019	0.004	0.006	0.009	0.013
Goodsprings		230	366	603	925	0.018	0.026	0.039	0.057	0.013	0.018	0.027	0.040
Henderson		19,400	30,912	50,855	77,998	1.530	2.173	3.296	4.814	1.071	1.521	2.307	3.370
Indian Sps.		1,200	1,200	1,200	1,200	0.095	0.095	0.095	0.095	0.067	0.067	0.067	0.067
Jean		90	143	236	362	0.007	0.010	0.015	0.022	0.005	0.007	0.011	0.015
Kyle Canyon		350	350	350	350	0.028	0.028	0.028	0.028	0.020	0.020	0.020	0.020
Las Vegas		323,200	514,994	847,239	1,299,431	25.490	36.195	54.911	80.195	17.843	25.337	38.438	56.137
Lee Canyon		150	150	150	150	0.012	0.012	0.012	0.012	0.008	0.008	0.008	0.008
Logandale		565	900	1,481	2,272	0.045	0.063	0.096	0.140	0.032	0.044	0.067	0.098
Mesquite		675	675	675	675	0.053	0.053	0.053	0.053	0.037	0.037	0.037	0.037
Moapa		45	72	118	181	0.004	0.005	0.008	0.011	0.003	0.004	0.006	0.008
Nelson		105	105	105	105	0.008	0.008	0.008	0.008	0.006	0.006	0.006	0.006
Overton		1,415	2,255	3,709	5,689	0.112	0.158	0.240	0.351	0.078	0.111	0.168	0.246
Overton Beach		50	50	50	50	0.004	0.004	0.004	0.004	0.003	0.003	0.003	0.003

TABLE III. POPULATION AND RESIDENTIAL/COMMERCIAL ENERGY USE FOR 1975, 1985, 2000 and 2020 (TOTAL ENERGY USE AND POTENTIAL GEOTHERMAL SPACE AND WATER HEATING)

CITY/ENERGY USE SITE	POPULATION					RESIDENTIAL/COMMERCIAL ENERGY USE				POTENTIAL GEOTHERMAL SPACE AND WATER HEATING			
	1970	1975	1985	2000	2020	1975	1985	2000	2020	1975	1985	2000	2020
CLARK (Cont)													
Searchlight		425	677	1,114	1,709	0.034	0.048	0.072	0.105	0.024	0.034	0.050	0.074
DOUGLAS	6,882	11,100	19,697	28,700	40,788	0.875	1.386	1.860	2.514	0.613	0.970	1.302	1.760
Gardnerville	900	1,452	2,576	3,753	5,334	0.114	0.181	0.243	0.329	0.080	0.127	0.170	0.230
Genoa	115	185	329	480	682	0.015	0.023	0.031	0.042	0.011	0.016	0.022	0.029
Glenbrook	50	81	143	208	296	0.006	0.010	0.014	0.018	0.004	0.007	0.010	0.013
Minden	400	645	1,145	1,668	2,371	0.051	0.081	0.108	0.146	0.036	0.057	0.076	0.102
Stateline	900	1,452	2,576	3,753	5,334	0.114	0.181	0.243	0.329	0.080	0.127	0.170	0.230
Topaz Lake	75	121	215	313	445	0.010	0.015	0.020	0.027	0.007	0.011	0.014	0.019
ELKO	13,958	15,200	20,727	28,940	39,917	1.196	1.455	1.881	2.469	0.837	1.019	1.317	1.728
Carlin	1,313	1,430	1,950	2,722	3,755	0.113	0.137	0.177	0.232	0.079	0.096	0.124	0.162
Contact	15	15	15	15	15	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Deeth	75	75	75	75	75	0.006	0.006	0.006	0.006	0.004	0.004	0.004	0.004
Elko	7,621	8,299	11,317	15,801	21,794	0.653	0.794	1.027	1.348	0.457	0.556	0.719	0.944
Hallack	10	10	10	10	10	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Jackpot	500	544	742	1,037	1,430	0.043	0.052	0.067	0.088	0.030	0.036	0.047	0.062
Jarbidge	32	32	32	32	32	0.003	0.003	0.003	0.003	0.002	0.002	0.002	0.002
Jiggs	10	10	10	10	10	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Lamoille	100	109	148	207	286	0.009	0.010	0.013	0.018	0.006	0.007	0.009	0.013
Lee	50	54	74	104	143	0.004	0.005	0.007	0.009	0.003	0.004	0.005	0.006
Montello	180	180	180	180	180	0.014	0.014	0.014	0.014	0.010	0.010	0.010	0.010
Mountain City	100	100	100	100	100	0.009	0.009	0.009	0.009	0.006	0.006	0.006	0.006
Owyhee	700	762	1,039	1,451	2,002	0.060	0.073	0.094	0.124	0.042	0.051	0.066	0.087
Ruby Valley	75	75	75	75	75	0.006	0.006	0.006	0.006	0.004	0.004	0.004	0.004
Tuscarora	75	82	111	156	214	0.006	0.008	0.010	0.013	0.004	0.006	0.007	0.009
Wells	1,081	1,177	1,605	2,241	3,091	0.093	0.113	0.146	0.191	0.065	0.079	0.102	0.134

TABLE III. POPULATION AND RESIDENTIAL/COMMERCIAL ENERGY USE FOR 1975, 1985, 2000 and 2020
(TOTAL ENERGY USE AND POTENTIAL GEOTHERMAL SPACE AND WATER HEATING)

CITY/ENERGY USE SITE	POPULATION					RESIDENTIAL/COMMERCIAL ENERGY USE				POTENTIAL GEOTHERMAL SPACE AND WATER HEATING			
	1970	1975	1985	2000	2020	1975	1985	2000	2020	1975	1985	2000	2020
ESMERALDA	629	700	1,018	1,298	1,628	0.056	0.070	0.083	0.104	0.039	0.049	0.058	0.073
Coaldale	35	35	35	35	35	0.003	0.003	0.003	0.003	0.002	0.002	0.002	0.002
Dyer	10	10	10	10	10	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Goldfield	185	206	299	382	482	0.016	0.021	0.024	0.031	0.011	0.015	0.017	0.022
Sliver Peak	150	167	243	310	391	0.013	0.017	0.020	0.025	0.009	0.012	0.014	0.018
EUREKA	948	1,100	1,392	1,707	2,093	0.088	0.096	0.113	0.134	0.006	0.007	0.008	0.009
Crescent Valley	25	25	25	25	25	0.002	0.002	0.002	0.002	0.001	0.001	0.001	0.001
Eureka	500	580	734	900	1,104	0.046	0.051	0.060	0.071	0.032	0.036	0.042	0.050
HUMBOLDT	6,375	7,100	10,104	14,690	20,710	0.559	0.710	0.956	1.279	0.391	0.497	0.670	0.895
Denio	20	20	20	20	20	0.002	0.002	0.002	0.002	0.001	0.001	0.001	0.001
Golconda	200	200	200	200	200	0.016	0.020	0.027	0.036	0.011	0.014	0.019	0.025
McDermitt	200	223	317	461	650	0.018	0.022	0.030	0.040	0.013	0.015	0.021	0.028
Orovada	30	30	30	30	30	0.002	0.003	0.004	0.005	0.001	0.002	0.003	0.004
Paradise Valley	100	111	158	230	325	0.009	0.011	0.015	0.020	0.006	0.008	0.011	0.014
Valmy	50	56	79	115	162	0.004	0.006	0.007	0.010	0.003	0.004	0.005	0.007
Winnemucca	3,587	3,995	5,685	8,266	11,653	0.315	0.399	0.538	0.720	0.221	0.279	0.377	0.504
LANDER	2,666	3,000	3,519	4,043	4,697	0.238	0.245	0.267	0.283	0.167	0.172	0.187	0.198
Austin	300	338	396	455	529	0.027	0.028	0.030	0.032	0.019	0.020	0.021	0.022
Battle Mtn.	1,856	2,089	2,450	2,815	3,270	0.166	0.171	0.186	0.197	0.116	0.120	0.130	0.138
LINCOLN	2,557	2,700	3,451	5,039	7,102	0.214	0.245	0.329	0.432	0.150	0.172	0.230	0.3[illegible]2
Alamo	250	264	337	493	694	0.021	0.024	0.032	0.041	0.015	0.017	0.022	0.029
Caliente	916	967	1,236	1,805	2,544	0.077	0.088	0.118	0.155	0.054	0.062	0.083	0.109
Caselton	40	40	40	40	40	0.003	0.003	0.003	0.003	0.002	0.002	0.002	0.002
Hiko	50	50	50	50	50	0.004	0.004	0.004	0.004	0.003	0.003	0.003	0.003
Panaca	550	581	742	1,084	1,528	0.046	0.053	0.071	0.093	0.032	0.037	0.050	0.065
Pioche	700	739	945	1,379	1,944	0.059	0.067	0.090	0.118	0.041	0.047	0.063	0.083
Ursine	50	50	50	50	50	0.004	0.004	0.004	0.004	0.003	0.003	0.003	0.003

TABLE III. POPULATION AND RESIDENTIAL/COMMERCIAL ENERGY USE FOR 1975, 1985, 2000 and 2020
(TOTAL ENERGY USE AND POTENTIAL GEOTHERMAL SPACE AND WATER HEATING)

CITY/ENERGY USE SITE	POPULATION					RESIDENTIAL/COMMERCIAL ENERGY USE				POTENTIAL GEOTHERMAL SPACE AND WATER HEATING			
	1970	1975	1985	2000	2020	1975	1985	2000	2020	1975	1985	2000	2020
LYON	8,221	10,400	8,055	9,088	10,271	0.819	0.567	0.585	0.640	0.573	0.397	0.410	0.448
Dayton	250	316	245	276	312	0.025	0.017	0.018	0.019	0.018	0.012	0.013	0.013
Fernley	900	1,139	882	995	1,124	0.090	0.062	0.064	0.070	0.063	0.043	0.045	0.049
Silver Sps.	220	278	216	243	275	0.022	0.015	0.016	0.017	0.015	0.011	0.011	0.012
Silver City	100	127	98	111	125	0.010	0.007	0.007	0.008	0.007	0.005	0.005	0.006
Smith	50	63	49	55	62	0.005	0.003	0.004	0.004	0.004	0.002	0.003	0.003
Wabuska	15	19	15	17	19	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Weed Heights	650	822	637	719	812	0.065	0.045	0.046	0.051	0.046	0.032	0.032	0.036
Wellington	110	139	108	122	137	0.011	0.008	0.008	0.009	0.008	0.006	0.006	0.006
Yerington	2,010	2,543	1,969	2,222	2,511	0.200	0.139	0.143	0.156	0.140	0.097	0.100	0.103
MINERAL	7,051	6,600	7,551	8,983	10,935	0.522	0.533	0.585	0.669	0.365	0.373	0.410	0.468
Babbitt	1,579	1,478	1,691	2,012	2,449	0.117	0.119	0.131	0.150	0.082	0.083	0.092	0.105
Hawthorne	3,539	3,313	3,790	4,509	5,488	0.262	0.268	0.294	0.336	0.183	0.188	0.206	0.235
Luning	60	56	64	76	93	0.004	0.005	0.005	0.006	0.003	0.004	0.004	0.004
Mina	425	398	455	541	659	0.031	0.032	0.035	0.040	0.022	0.022	0.025	0.028
Schurz	[illegible]	281	321	382	465	0.022	0.023	0.025	0.028	0.015	0.016	0.018	0.020
NYE	5,599	5,600	7,071	9,285	11,931	0.442	0.498	0.606	0.743	0.309	0.359	0.424	0.520
Beatty	900	900	1,137	1,492	1,918	0.071	0.080	0.097	0.119	0.050	0.056	0.068	0.083
Currant	10	10	10	10	10	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Duckwater	20	20	25	33	43	0.002	0.002	0.002	0.003	0.001	0.001	0.001	0.002
Gabbs	874	874	1,104	1,449	1,862	0.069	0.078	0.095	0.116	0.048	0.055	0.067	0.081
Ione	20	20	20	20	20	0.002	0.002	0.002	0.002	0.001	0.001	0.001	0.001
Lathrop	175	175	221	290	373	0.014	0.016	0.019	0.023	0.010	0.011	0.013	0.016
Manhattan	30	30	30	30	30	0.002	0.002	0.002	0.002	0.001	0.001	0.001	0.001
Pahrump	500	[illegible]	631	829	1,065	0.039	0.044	0.054	0.066	0.027	0.031	0.038	0.046
Round Mtn.	100	[illegible]	126	166	213	0.008	0.009	0.011	0.013	0.006	0.006	0.008	0.009
Tonopah	1,716	[illegible]	[illegible],167	2,846	3,657	0.135	0.153	0.186	0.228	0.095	0.107	0.130	0.160
Warm Springs	25	[illegible]	25	25	25	0.002	0.002	0.002	0.002	0.001	0.001	0.-01	0.001

TABLE III. POPULATION AND RESIDENTIAL/COMMERCIAL ENERGY USE FOR 1975, 1985, 2000 and 2020
(TOTAL ENERGY USE AND POTENTIAL GEOTHERMAL SPACE AND WATER HEATING)

CITY/ENERGY USE SITE	POPULATION					RESIDENTIAL/COMMERCIAL ENERGY USE				POTENTIAL GEOTHERMAL SPACE AND WATER HEATING			
	1970	1975	1985	2000	2020	1975	1985	2000	2020	1975	1985	2000	2020
PERSHING	2,670	2,700	3,508	4,605	6,102	0.214	0.245	0.298	0.372	0.150	0.172	0.209	0.260
Imlay	170	172	223	293	389	0.014	0.016	0.019	0.024	0.010	0.011	0.013	0.017
Lovelock	1,571	1,589	2,064	2,710	3,590	0.126	0.144	0.175	0.219	0.088	0.101	0.123	0.153
Mill City	10	10	10	10	10	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Unionville	30	30	30	30	30	0.002	0.002	0.002	0.002	0.001	0.001	0.001	0.001
STOREY	695	1,000	1,481	2,047	2,802	0.080	0.102	0.134	0.179	0.056	0.071	0.094	0.125
Gold Hill	30	43	64	88	121	0.003	0.004	0.006	0.008	0.002	0.003	0.004	0.006
Virginia City	600	863	1,279	1,767	2,419	0.069	0.088	0.116	0.155	0.048	0.062	0.081	0.109
WASHOE	121,068	145,000	277,742	468,300	718,554	11.434	19.525	30.349	44.345	8.004	13.668	21,244	31.042
Empire	300	359	688	1,160	1,781	0.028	0.048	0.075	0.110	0.020	0.034	0.053	0.077
Gerlach	130	156	298	503	772	0.012	0.021	0.033	0.048	0.008	0.015	0.023	0.033
New Washoe City	1,000	1,198	2,294	3,868	5,935	0.094	0.161	0.251	0.366	0.066	0.113	0.176	0.256
Nixon	100	120	229	387	594	0.009	0.016	0.025	0.037	0.006	0.011	0.018	0.026
Reno	72,863	87,266	167,155	281,839	432,451	6.881	11.751	18.265	26.688	4.817	8.226	2.786	18.682
Sparks	24,187	28,968	55,487	93,557	143,553	2.284	3.901	6.063	8.859	1.599	2.731	4.244	6.201
Steamboat	150	180	344	580	890	0.014	0.024	0.038	0.055	0.010	0.017	0.027	0.039
Sun Valley	2,414	2,891	5,538	9,338	14,327	0.228	0.389	0.605	0.884	0.160	0.272	0.424	0.619
Sutcliff	60	72	138	232	356	0.006	0.010	0.015	0.022	0.004	0.007	0.011	0.015
Verdi	500	599	1,147	1,934	2,968	0.047	0.081	0.125	0.183	0.033	0.057	0.088	0.128
Wadsworth	250	299	574	967	1,484	0.024	0.040	0.063	0.092	0.017	0.028	0.044	0.064
WHITE PINE	10,150	10,100	9,407	8,630	7,902	0.796	0.663	0.555	0.491	0.557	0.464	0.389	0.344
Baker	50	50	46	43	39	0.004	0.003	0.003	0.002	0.003	0.002	0.002	0.001
Ely/E. Ely	6,168	6,138	5,716	5,244	4,802	0.484	0.403	0.337	0.298	0.339	0.282	0.236	0.207
Lund	300	299	278	255	234	0.024	0.020	0.016	0.015	0.017	0.014	0.011	0.011
McGill	2,164	2,153	2,006	1,840	1,685	0.170	0.141	0.118	0.105	0.119	0.099	0.083	0.074
Ruth	750	746	695	638	584	0.059	0.049	0.041	0.036	0.041	0.034	0.029	0.025

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TABLE IV. CO-LOCATION OF CITY/ENERGY USE SITES AND GEOTHERMAL SITES, BY COUNTY, NEVADA

City/Energy Use Site	Distance to Geothermal Site (km)	Geothermal Site ID No.	Geothermal Site Name	Beneficial Heat Available (10^{12} Btu)
CARSON CITY	2	0102	Nevada State Prison Spring	8.5
	3	0101	Carson Hot Springs	8.5
	6	0103	Pinyon Hills	8.5
	12	0401	Hobo Hot Springs	8.5
	12	0402	Saratoga Hot Springs	8.5
	13	1625	New Washoe City	3.8
	14	1624	Bowers Mansion Hot Springs	8.5
	17	1502	Comstock Mining District	38.9
	21	1623	Pleasant Valley	8.5
	22	1622	Steamboat-Huffaker	815.9
CHURCHILL				
Cold Spring	25	0205	Edwards Creek Valley	8.5
	27	0914	Southern Smith Creek Valley	63.6
	33	0204	Settlement Road Wells	2.8
Fallon	9	0214	Fallon Naval Air Station	
	12	0212	Soda Lake	42.7
	17	0215	Carson Lake	48.3
Fallon N.A.S.	2	0214	Fallon Naval Air Station	
	7	0215	Carson Lake	48.3
	12	0216	Eight Mile Flat	40.8
Frenchman	13	0217	Four Mile Flat	40.8
	27	0216	Eight Mile Flat	40.8
	34	0215	Carson Lake	48.3
Hazen	6	1101	Geyser Ranch Spring	85.4
	18	0212	Soda Lake	426.9
	18	0210	Eagle Salt Works	59.8

TABLE IV. CO-LOCATION OF CITY/ENERGY USE SITES AND GEOTHERMAL SITES, BY COUNTY, NEVADA

City/Energy Use Site	Distance to Geothermal Site (km)	Geothermal Site ID No.	Geothermal Site Name	Beneficial Heat Available (10^{12} Btu)
CLARK				
Blue Diamond	14	0307	White Rock Spring	2.8
	22	0308	Las Vegas	6.6
	36	0312	Jean Lake	3.8
Boulder Beach	7	0311	Black Canyon	8.5
	13	0309	National Park Service Well	4.7
	28	0313	Well NW of Nelson	2.8
Boulder City	9	0311	Black Canyon	8.5
	20	0309	National Park Service Well	4.7
	21	0313	Well NW of Nelson	2.8
Bunkerville	2	0301	Bunkerville	2.8
	34	0303	Whipple	2.8
	34	0305	Mud Wash	1.9
Cotton Cove	27	0315	Willow	3.8
	29	0314	Well South of Searchlight	3.8
	39	0316	Davis Dam	2.8
Echo Bay	5	0306	Roger's Spring	3.8
	21	0305	Mud Wash	1.9
	30	0303	Whipple	2.8
Glendale	12	0303	Whipple	2.8
	15	0302	Moana (Muddy River)	3.8
	30	0305	Mud Wash	1.9
Goodsprings	22	0312	Jean Lake	3.8
	33	0308	Las Vegas	6.6
	37	0307	White Rock Spring	2.8
Henderson	16	0308	Las Vegas	6.6
	21	0311	Black Canyon	8.5
	23	0313	Well NW of Nelson	2.8

TABLE IV. CO-LOCATION OF CITY/ENERGY USE SITES AND GEOTHERMAL SITES, BY COUNTY, NEVADA

City/Energy Use Site	Distance to Geothermal Site (km)	Geothermal Site ID No.	Geothermal Site Name	Beneficial Heat Available (10^{12} Btu)
CLARK (Cont.)				
Indian Springs	3	0304	Indian Springs	2.8
	32	1338	Little Fish Lake Valley	5.7
	44	1336	Frenchman Flat	12.3
Jean	11	0312	Jean Lake	3.8
	32	0313	Well NW of Nelson	2.8
	32	0308	Las Vegas	6.6
Kyle Canyon	13	1307	Darrough's Hot Springs	256.1
	33	1304	Gabbs	33.2
	39	1310	Chimney Springs	27.5
Las Vegas	15	0308	Las Vegas	6.6
Includes:	31	0307	White Rock Springs	2.8
No. Las Vegas	38	0309	National Park Service Well	4.7
Winchester Town				
Paradise Town				
Sunrise Manor Town				
East Las Vegas Town				
Lee Canyon	24	0307	White Rock Spring	2.8
	27	0304	Indian Springs	2.8
	31	1340	Pahrump	6.6
Logandale	1	0303	Whipple	2.8
	20	0305	Mud Wash	1.9
	24	0302	Moapa (Muddy River)	3.8
Mesquite	8	0301	Bunkerville	2.8
	42	0305	Mud Wash	1.9
	44	0303	Whipple	2.8
Moapa	9	0302	Moapa (Muddy River)	3.8
	16	0303	Whipple	2.8
	34	0305	Mud Wash	1.9

TABLE IV. CO-LOCATION OF CITY/ENERGY USE SITES AND GEOTHERMAL SITES, BY COUNTY, NEVADA

City/Energy Use Site	Distance to Geothermal Site (km)	Geothermal Site ID No.	Geothermal Site Name	Beneficial Heat Available (10^{12} Btu)
CLARK (Cont.)				
Nelson	28	0313	Well NW of Nelson	2.8
	33	0311	Black Canyon	8.5
	35	0312	Jean Lake	3.8
Overton	6	0303	Whipple	2.8
	13	0305	Mud Wash	1.9
	19	0306	Roger's Springs	3.8
Overton Beach	6	0305	Mud Wash	1.9
	12	0306	Roger's Springs	3.8
	18	0303	Whipple	2.8
Searchlight	14	0314	Well South of Searchlight	3.8
	29	0315	Willow	3.8
	40	0313	Well NW of Nelson	2.8
DOUGLAS				
Gardnerville	7	0403	Wally's (Genoa) Hot Springs	29.4
	12	0402	Saratoga Hot Springs	8.5
	13	0401	Hobo Hot Springs	8.5
Genoa	3	0403	Wally's (Genoa) Hot Springs	29.4
	7	0401	Hobo Hot Springs	8.5
	11	0402	Saratoga Hot Springs	8.5
Glenbrook	11	0401	Hobo Hot Springs	8.5
	[illegible]	0403	Wally's (Genoa) Hot Springs	29.4
	17	0402	Saratoga Hot Springs	8.5
Minden	7	0403	Wally's (Genoa) Hot Springs	29.4
	12	0402	Saratoga Hot Springs	8.5
	13	0401	Hobo Hot Springs	8.5
Stateline	10	0403	Wally's (Genoa) Hot Springs	29.4
	16	0401	Hobo Hot Springs	8.5
	20	0402	Saratoga Hot Springs	8.5

TABLE IV. CO-LOCATION OF CITY/ENERGY USE SITES AND GEOTHERMAL SITES, BY COUNTY, NEVADA

City/Energy Use Site	Distance to Geothermal Site (km)	Geothermal Site ID No.	Geothermal Site Name	Beneficial Heat Available (10^{12} Btu)
DOUGLAS (Cont.)				
Topaz Lake	14	0404	Loud Springs	2.8
	16	1108	Wellington	9.5
	25	1106	Hind's (Nevada) Hot Springs	20.9
ELKO				
Carlin	2	0532	Carlin	41.7
	7	0533	Hot Sulfur Spring	6.6
	14	0703	Raine Ranch Springs	6.6
Contact	2	0509	Mineral Hot Spring	11.4
	10	0506	San Jacinto Ranch	47.4
	21	0501	Jackpot	6.6
Deeth	10	0527	Winter Creek	8.5
	13	0521	Mary's River Ranch	8.5
	24	0526	Cobre	9.5
Elko	3	0530	Elko Hot Springs	39.8
	25	0533	Hot Sulfur Spring	6.6
	34	0531	Cold Creek	8.5
Halleck	13	0527	Winter Creek	8.5
	19	0531	Cold Creek	8.5
	29	0521	Mary's River Ranch	8.5
Jackpot	3	0501	Jackpot	6.6
	13	0506	San Jacinto Ranch	47.4
	22	0509	Minerals Hot Spring	11.3
Jarbidge	2	0505	Gray Rock Mine	3.8
	15	0504	Tennessee Mountain	6.6
	38	0511	Wild Horse Hot Spring	8.5
Jiggs	29	0536	Smith Ranch Spring	12.3
	36	0535	Sulfur Hot Springs	199.2
	36	0506	San Jacinto Ranch	47.4

TABLE IV. CO-LOCATION OF CITY/ENERGY USE SITES AND GEOTHERMAL SITES, BY COUNTY, NEVADA

City/Energy Use Site	Distance to Geothermal Site (km)	Geothermal Site ID No.	Geothermal Site Name	Beneficial Heat Available (10^{12} Btu)
ELKO (Cont.)				
Lameille	12	0531	Cold Creek	8.5
	23	0535	Sulfur Hot Springs	199.2
	27	0530	Elko Hot Springs	39.8
Lee	27	0535	Sulfur Hot Springs	199.2
	31	0530	Elko Hot Springs	39.8
	32	0531	Cold Creek	8.5
Montello	11	0517	Thousand Springs	66.4
	23	0526	Cobre	9.5
	24	0515	Well SE of Tony Mountain	2.8
Mountain City	2	0507	Mountain City	6.6
	8	0508	Rizzi Ranch Hot Spring	6.6
	26	0511	Wild Horse Hot Spring	8.5
Owyhee	14	0507	Mountain City	6.6
	24	0508	Rizzi Ranch Hot Spring	6.6
	40	0504	Tennessee Mountain	7.6
Ruby Valley	12	0536	Smith Ranch Springs	12.3
	27	0535	Sulfur Hot Springs	199.2
	48	0531	Cold Creek	8.5
Tuscarora	16	0516	Petaini Springs	2.9
	16	0519	Dry Creek Mountain	8.5
	17	0513	Hot Sulfur Springs (near Tuscarora)	75.9
Wells	5	0524	Humboldt Wells	93.0
	6	0525	Railroad Spring	8.5
	26	0528	Ralph's Warm Springs	4.7

TABLE IV. CO-LOCATION OF CITY/ENERGY USE SITES AND GEOTHERMAL SITES, BY COUNTY, NEVADA

City/Energy Use Site	Distance to Geothermal Site (km)	Geothermal Site ID No.	Geothermal Site Name	Beneficial Heat Available (10^{12} Btu)
ESMERALDA				
Coaldale	10	0602	Southern Big Smokey Valley	3.8
	21	0601	Fish Lake Valley	33.2
	37	0606	Silver Peak Hot Springs	8.5
Dyer	21	0601	Fish Lake Valley	33.2
	39	1208	Basalt	7.6
	40	0606	Silver Peak Hot Springs	8.5
Goldfield	15	0605	Alkali Springs	11.4
	26	0604	Pearl Hot Springs	6.6
	32	0603	Big Divide Mine	3.8
Silver Peak	2	0606	Silver Peak Hot Spring	8.5
	15	0604	Pearl Hot Springs	6.6
	27	0605	Alkali Springs	11.4
EUREKA				
Crescent Valley	6	0704	Hot Springs Point	39.8
	14	0702	Beowawe Geyser	265.7
	18	0705	Duff Creek	26.6
Eureka	35	0714	Bartine Hot Springs	13.3
	35	0715	Klobe Hot Springs	53.1
	36	0713	Sulfur Springs	3.8
HUMBOLDT				
Denio	9	0803	Baltazor Hot Springs	13.2
	16	0802	Bog Hot Springs	46.5
	25	0805	McGee Mountain	10.4
Golconda	2	0827	Golconda	41.7
	15	0826	Winnemucca	2.8
	15	0828	Lone Butte	2.8
McDermitt	11	0801	Cordero Mercury Mine	17.1
	37	0807	Goosey Lake Flat	11.4

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TABLE IV. CO-LOCATION OF CITY/ENERGY USE SITES AND GEOTHERMAL SITES, BY COUNTY, NEVADA

City/Energy Use Site	Distance to Geothermal Site (km)	Geothermal Site ID No.	Geothermal Site Name	Beneficial Heat Available (10^{12} Btu)
HUMBOLDT (Cont.)				
Orovada	29	0814	Quinn River Crossing	3.8
	38	0815	Gondra-The Hot Spring	21.8
	39	[illegible]	Cordero Mercury Mine	17.0
Paradise Valley	16	0815	Gondra-The Hot Spring	21.8
	32	0807	Goosey Lake Flat	11.4
	34	0816	South Fork	11.4
Valmy	15	0831	Hot Pot (Blo[illegible]) Hot Springs	50.3
	15	0832	Brooks Hot Spring	6.6
	20	0830	Sulphur Hot Spring	6.6
Winnemucca	3	0825	Winnemucca Moutain	3.8
	5	0826	Winnemucca	2.8
	19	0827	Golconda	41.7
LANDER				
Austin	25	0916	Spencer Hot Springs	44.6
	30	0917	Santa Fe Creek	4.7
	31	0913	Peterson's Mill Hot Springs	6.6
Battle Mountain	9	0903	Battle Mountain	17.1
	23	0902	White Rock Springs	17.1
	25	0904	Timber Canyon	2.8
LINCOLN				
Caliente	2	1009	Caliente Hot Spring	18.0
	21	1005	Bennett's Spring	2.8
	24	1006	Panaca (Owl) Warm Springs	4.7
Caselton	16	1004	Delmue's Spring	2.8
	16	1006	Panaca (Owl) Warm Springs	4.7
	19	1005	Bennett's Spring	2.8

TABLE IV. CO-LOCATION OF CITY/ENERGY USE SITES AND GEOTHERMAL SITES, BY COUNTY, NEVADA

City/Energy Use Site	Distance to Geothermal Site (km)	Geothermal Site ID No.	Geothermal Site Name	Beneficial Heat Available (10^{12} Btu)
LINCOLN (Cont.)				
Hiko	3	1010	Crystal Springs	4.7
	5	1008	Hiko Springs	4.7
	10	1011	Ash (Alamo) Springs	5.7
Ursine	9	1003	Flatnose Ranch Spring	3.8
	17	1004	Delmue's Spring	3.8
	24	1006	Panaca (Owl) Warm Springs	4.7
LYON				
Dayton	3	1103	Dayton	4.7
	4	1102	Sutro Tunnel	3.8
	8	1502	Comstock Mining District	38.9
Fernley	7	1617	Wadsworth	7.6
	13	1101	Hazen-Patua Hot Spring	85.4
	20	1501	Biddleman Spring	2.8
Silver City	4	1502	Comstock Mining District	38.9
	4	1102	Sutro Tunnel	3.8
	5	1103	Dayton	4.7
Silver Springs	19	1501	Biddlemen Spring	2.8
	23	1101	Hazen-Patua Hot Spring	85.4
	28	1104	Wabuska Hot Springs	322.6
Smith	6	1108	Wellington	9.5
	12	1106	Hind's Hot Springs	20.9
	14	1107	Wilson Hot Springs	13.3
Wabuska	2	1104	Wabuska Hot Springs	322.6
	26	1105	Artesia Lake	3.8
	35	1103	Dayton	4.7
Weed Heights	13	1105	Artesia Lake	3.8
	20	1104	Wabuska Hot Springs	322.6
	20	1106	Hind's Hot Springs	20.9

TABLE IV. CO-LOCATION OF CITY/ENERGY USE SITES AND GEOTHERMAL SITES, BY COUNTY, NEVADA

City/Energy Use Site	Distance to Geothermal Site (km)	Geothermal Site ID No.	Geothermal Site Name	Beneficial Heat Available (10^{12} Btu)
LYON (Cont.)				
Wellington	2	1108	Wellington	9.5
	16	1106	Hind's Hot Springs	20.9
	17	1107	Wilson Hot Springs	13.3
Yerington	17	1105	Artesia Lake	3.8
	20	1104	Wabuska Hot Springs	322.6
	23	1106	Hind's Hot Springs	20.9
MINERAL				
Babbitt	3	1104	Wabuska Hot Springs	322.6
	29	1109	Aldrich Station	7.6
	30	1106	Hind's Hot Springs	30.9
Hawthorne	6	1204	Hawthorne	56.9
	27	1206	Whiskey Flat	7.6
	31	1109	Aldrich Station	7.6
Luning	19	1205	Sodaville Springs	6.6
	43	1204	Hawthorne	56.9
	43	1206	Whiskey Flat	7.6
Mina	5	1205	Sodaville Springs	6.6
	42	1206	Whiskey Flat	7.6
Schurz	11	1201	Double Spring	6.6
	29	0218	Lee Hot Springs	75.9
	37	1202	Dead Horse Wells	9.5
NYE				
Beatty	8	1332	Southern Sarcobatus Flat	76.8
	17	1334	Steves Pass	4.7
Currant	29	1305	Duckwater	5.7
	31	1312	Eagle Springs	36.0
	31	1714	Williams Hot Springs	2.8

TABLE IV. CO-LOCATION OF CITY/ENERGY USE SITES AND GEOTHERMAL SITES, BY COUNTY, NEVADA

City/Energy Use Site	Distance to Geothermal Site (km)	Geothermal Site ID No.	Geothermal Site Name	Beneficial Heat Available (10^{12} Btu)
NYE (Cont.)				
Duckwater	2	1305	Duckwater	4.7
	15	1713	Big Blue Spring	6.6
	42	1309	Locke's Hot Spring	13.3
Gabbs	1	1304	Gabbs	33.2
	24	1203	Wedel Springs	28.4
	40	1202	Dead Horse Wells	9.5
Ione	30	1304	Gabbs	33.2
	37	1307	Darrough's Hot Spring	256.2
	40	1301	McLeod's Ranch Spring	16.1
Lathrop	2	1337	Lathrop Wells	3.8
	18	1335	Jackass Flats	5.7
	25	1339	Lower Amargosa Valley-Ash Meadows	55.0
Manhattan	20	1318	Indian Springs	2.8
	33	1307	Darrough's Hot Springs	256.2
	37	1317	Royston Hills	2.8
Pahrump	2	1340	Pahrump	6.6
	21	0310	Browns Spring	1.9
	38	1339	Lower Amargosa Valley-Ash Meadows	55.0
Round Mountain	16	1307	Darrough's Hot Spring	256.2
	30	1302	Charnock (Big Blue) Springs	5.7
	32	1306	Mosquito Creek Ranch	5.7
Tonopah	2	1325	Tonopah Mining District	6.6
	8	0603	Big Divide Mine	3.8
	17	1326	Central Ralston Valley	2.8
Warm Springs	3	1324	Warm Nanny Goat Springs	42.7
	21	1328	Reveille Mill Spring	4.7
	29	1316	Hot Creek Valley	23.7

TABLE IV. CO-LOCATION OF CITY/ENERGY USE SITES AND GEOTHERMAL SITES, BY COUNTY, NEVADA

City/Energy Use Site	Distance to Geothermal Site (km)	Geothermal Site ID No.	Geothermal Site Name	Beneficial Heat Available (10^{12} Btu)
PERSHING				
Imlay	9	1403	Mill City	4.7
	17	1405	Humboldt House (Rye Patch)	104.4
	31	0829	No. East Range	4.7
Lovelock	12	1408	Colado	41.7
	23	1406	Gold Mountain	2.8
	43	1405	Humboldt House (Rye Patch)	104.4
Mill City	3	1403	Mill City	4.7
	23	1405	Humboldt House	104.4
	26	0829	No. East Range	4.7
STOREY				
Gold Hill	1	1502	Comstock Mining District	38.9
	6	1102	Sutro Tunnel	3.8
	8	1103	Dayton	4.7
Virginia City	2	1502	Comstock Mining District	38.9
	6	1102	Sutro Tunnel	3.8
	9	1103	Dayton	4.7
WASHOE				
Empire	7	1608	Gerlach	81.6
	21	1611	San Emidio Desert	91.1
	25	1607	Wall Spring	5.7
Gerlach	2	1608	Gerlach	81.6
	21	1607	Wall Spring	5.7
	23	1606	Ward's (Fly Ranch) Hot Spring	63.6
New Washoe City	3	1625	New Washoe City	3.8
	5	1623	Pleasant Valley	8.5
	6	1624	Bower's Mansion Hot Springs	8.5

TABLE IV. CO-LOCATION OF CITY/ENERGY USE SITES AND GEOTHERMAL SITES, BY COUNTY, NEVADA

City/Energy Use Site	Distance to Geothermal Site (km)	Geothermal Site ID No.	Geothermal Site Name	Beneficial Heat Available (10^{12} Btu)
WASHOE (Cont.)				
Nixon	18	1615	Anaho Island	13.3
	19	1617	Wadsworth	7.6
	27	1616	Warm Spring Valley	7.6
Reno/Sparks	6	1619	Lawton Hot Springs	11.4
Includes:	6	1621	Moana	136.6
Stead	10	1618	Wedekind Mine	7.6
Steamboat	[illegible]	1622	Steamboat-Huffaker	815.9
Sun Valley				
Sutcliff	7	1615	Anaho Island	13.3
	19	1616	Warm Springs Valley	7.6
	23	1614	The Needles Rocks	55.0
Verdi	2	1620	Verdi	3.8
	6	1619	Lawton Hot Springs	11.4
	15	1621	Moana	136.6
Wadsworth	4	1617	Wadsworth	7.6
	16	1501	Biddleman Spring	2.8
	19	1101	Hazen-Patua Hot Spring	85.4

TABLE IV. CO-LOCATION OF CITY/ENERGY USE SITES AND GEOTHERMAL SITES, BY COUNTY, NEVADA

City/Energy Use Site	Distance to Geothermal Site (km)	Geothermal Site ID No.	Geothermal Site Name	Beneficial Heat Available (10^{12} Btu)
WHITE PINE				
Baker	28	1716	Southern Spring Valley	2.8
	36	1718	Big Spring	2.8
Ely/East Ely	6	1712	Lackawanna,Ely Hot Springs	5.7
	22	1711	McGill, Schoolhouse Warm Springs	4.7
	32	1710	Campbell Ranch (No. Group) Springs	2.8
Lund	11	1715	Preston Springs	2.8
	21	1714	Williams Hot Springs	9.5
	26	1314	Emigrant Springs	2.8
McGill	2	1711	McGill, Schoolhouse Warm Springs	4.7
	14	1712	Lackawanna,Ely Hot Springs	5.7
	19	1710	Campbell Ranch (No. Group) Springs	2.8
Ruth	11	1712	Lackawanna, Ely Hot Springs	5.7
	24	1711	McGill Schoolhouse Warm Springs	4.7
	30	1710	Campbell Ranch (No. Group) Springs	2.8

TABLE [illegible] CITY/[illegible] INDUSTRIAL SECTOR

CARSON CITY

City/Energy Use Site (1)	SIC No. (2)	Industrial Directories (3) No. of Firms	Industrial Directories (3) No. of Employees	Nevada Department of Employment Security (4) No. of Firms	Nevada Department of Employment Security (4) No. of Employees	Standard Annual Energy Use (SAE) 10^{10} KJ/yr. (5)	Energy Use 10^{10} KJ/yr. (6)
Carson City	20			1	5	(1.775)	0.158
	24	3	11	5	16		
	2431	2	9			0.295	0.236
	2434	1	2				
	25	1		1	6		0.032
	2541	1				0.264	
	27	2	9	6	102		
	2752	2	9			0.193	0.787
	28	1	17	3	36		
	2879	1	17			3.249	1.746
	29			1	5	(2.743)	0.199
	30	3	209	3	40		
	3079	3	209			0.812	2.533
	32	4	134	9	198		3.101
	3224	1	17				
	3273	2	42			0.007	
	3293	1	75			0.949	
	33				42	(11.704)	2.926
	34	2	34	5	405		16.303
	3423	1	7			1.435	
	3452	1	25			2.226	
	35	2	24	4	118		3.459
	3549	1	7				
	3573	1	17			1.319	

(a) Carson City County (= Carson City town)

Footnotes 1 thru 6-see Explanation Page

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TABLE V ENERGY USE BY CITY/ENERGY USE SITE FOR INDUSTRIAL SECTOR
CARSON CITY - page 2

City/Energy Use Site (1)	SIC No. (2)	Industrial Directories (3) No. of Firms	Industrial Directories (3) No. of Employees	Nevada Department of Employment Security (4) No. of Firms	Nevada Department of Employment Security (4) No. of Employees	Standard Annual Energy Use (SAE) 10^{10} KJ/yr. (5)	Energy Use 10^{10} KJ/yr. (6)
Carson City	36			4	164	(2.611)	3.149
(Cont.)							
	37	1	17	4	17		
	3728	1	17			1.793	0.156
	38	3	39	7	57		3.987
	3823	1	7				
	3825	1	25				
	3861	1	7			5.316	
	39			4	64	(0.349	0.770
						TOTAL 10^{13} J/yr	39.542
						= 10^{12} Btu/yr	0.375

Footnotes 1 thru 6-see Explanation Page

TABLE V ENERGY USE BY CITY/ENERGY USE SITE FOR INDUSTRIAL SECTOR

CHURCHILL

City/Energy Use Site (1)	SIC No. (2)	Industrial Directories (3)		Nevada Department of Employment Security (4)		Standard Annual Energy Use (SAE) 10^{10} KJ/yr. (5)	Energy Use 10^{10} KJ/yr. (6)
		No. of Firms	No. of Employees	No. of Firms	No. of Employees		
Fallon	20	2	24	3	21		1.020
	2011	1	17			3.196	
	2048	1	7			1.562	
	24			1	1	(2.032)	0.102
	27	2	24	3	25		
	2711	2	24			0.195	0.195
	28			1	1	(2.373)	0.033
	30			1	8	(0.812)	0.097
	32	2	14	2	9		0.091
	3272	1	7			0.499	
	3273	1	7			0.007	
	33			1	91	(11.704)	6.340
	34	1	7				0.094
	3441	1	7			0.686	
	36			1	7	(2.611)	0.134
						TOTAL 10^{13} J/yr	8.106
						= 10^{12} Btu/yr	0.077

Footnotes 1 thru 6-see Explanation Page

TABLE V ENERGY USE BY CITY/ENERGY USE SITE FOR INDUSTRIAL SECTOR

CLARK

City/Energy Use Site (1)	SIC No. (2)	Industrial Directories (3) No. of Firms	Industrial Directories (3) No. of Employees	Nevada Department of Employment Security (4) No. of Firms	Nevada Department of Employment Security (4) No. of Employees	Standard Annual Energy Use (SAE) 10^{10} KJ/yr. (5)	Energy Use 10^{10} KJ/yr. (6)
Las Vegas	20	11	156	19	565		9.356
	2013	1	17			1.413	
	2048	1	5			1.562	
	2051	3	27			0.949	
	2086	1	40			1.022	
	2097	2	37			0.082	
	2099	3	30			1.444	
	22	1	30	3	33		2.584
	2211	1	30			10.337	
	23	3	21	11	63		0.620
	2391	1	17				
	2392	1	2			0.551	
	2394	1	2				
	24	7	438	26	417		6.151
	2411	1	17				
	2431	1	17			0.295	
	2434	4	216				
	2439	1	188				
	25	5	35	11	55		0.492
	2515	3	26			0.331	
	2521	1	2			0.300	
	2542	1	7			0.922	
	26	2	14	2	11		0.160
	2647	1	7				
	2649	1	7			1.529	
	27	23	241	66	1172		8.504
	2711	2	82			0.195	
	2721	2	9			0.085	
	2731	2	24			0.209	
	2741	1	2				

Footnotes 1 thru 6-see Explanation Page

TABLE V ENERGY USE BY CITY/ENERGY USE SITE FOR INDUSTRIAL SECTOR

CLARK - page 2

City/Energy Use Site (1)	SIC No. (2)	Industrial Directories (3)		Nevada Department of Employment Security (4)		Standard Annual Energy Use (SAE) 10^{10} KJ/yr. (5)	Energy Use 10^{10} KJ/yr. (6)
		No. of Firms	No. of Employees	No. of Firms	No. of Employees		
Las Vegas (Cont.)	2751	3	21			0.158	
	2752	8	83			0.193	
	2753	1	7				
	2791	3	11			0.057	
	2792	1	2				
	28	3	16	7	624		11.362
	2841	1	2			3.745	
	2842	1	4			0.517	
	2851	1	10			1.171	
	29			2	5	2.743	2.385
	30	1	7		60		0.727
	3079	1	7			0.812	
	31	4	21	3	15		0.029
	3171	3	19			0.162	
	3190	1	2			0.160	
	32	8	279	27	896		6.[illegible]08
	3229	1	2			9.915	
	3253	1	6			0.639	
	3271	2	37			1.403	
	3273	2	225			0.007	
	3281	2	9			0.074	
	33	1	33	3	800	(11.704)	55.733
	3391	1	33				
	34	17	317	21	165		2.258
	3429	1	2			4.778	
	3441	5	265			0.686	
	3444	1	7			0.439	
	3446	3	5				
	3471	2	34			0.643	

Footnotes 1 thru 6-see Explanation Page

TABLE V ENERGY USE BY CITY/ENERGY USE SITE FOR INDUSTRIAL SECTOR
CLARK - page 3

City/Energy Use Site (1)	SIC No. (2)	Industrial Directories (3)		Nevada Department of Employment Security (4)		Standard Annual Energy Use (SAE) 10^{10} KJ/yr. (5)	Energy Use 10^{10} KJ/yr. (6)
		No. of Firms	No. of Employees	No. of Firms	No. of Employees		
Las Vegas (Cont.)	3479	4	2			0.697	
	3496	1	2			0.059	
	35	7	86	13	89		1.276
	3523	1	25				
	3534	1	4				
	3544	1	7			0.158	
	3573	1	19			0.319	
	3581	1	7				
	3589	1	7			0.614	
	3599	1	17			0.105	
	36	3	186	16	543		4.136
	364-	1	9				
	3679	2	177			1.036	
	37	2	5	2	8		0.074
	3728	1	2			1.793	
	3792	1	3				
	38	1	17	8	60		0.393
	3841	1	17			0.498	
	39	20	327	35	705		8.509
	3911	1	6			0.118	
	3944	2	19				
	3953	2	4			0.174	
	3961	1	7			0.188	
	3964	1	17			0.812	
	3993	9	257				
	3999	4	34			0.214	
						TOTAL 10^{13} J/yr	121.158
						= 10^{12} Btu/yr	1.150

Footnotes 1 thru 6-see Explanation Page

TABLE V ENERGY USE BY CITY/ENERGY USE SITE FOR INDUSTRIAL SECTOR
DOUGLAS

City/Energy Use Site (1)	SIC No. (2)	Industrial Directories (3)		Nevada Department of Employment Security (4)		Standard Annual Energy Use (SAE) 10^{10} KJ/yr. (5)	Energy Use 10^{10} KJ/yr. (6)
		No. of Firms	No. of Employees	No. of Firms	No. of Employees		
Minden-Gardnerville(a)	24			4	112	(2.032)	11.379
	27	1	17	2	29		
	2711	1	17			0.195	0.226
	28			1	2	(2.373)	0.065
	32			1	6	(5.569)	0.857
	34			1	3	(1.324)	0.078
	35			2	2	(1.067)	0.047
	36	1	2	1	734		
	3622	1	7			0.150	0.810
	3829	1	375			(2.089)	10.308
						TOTAL 10^{13} J/yr	23.770
						= 10^{12} Btu/yr	0.226
Stateline	27	1	2	1	2		
	2752	1	2			0.193	0.015
						TOTAL 10^{13} J/yr	0.015
						= 10^{12} Btu/yr	0.014

(a) Industries of unknown site location; assume 100% to Minden/Gardnerville

Footnotes 1 thru 6-see Explanation Page

TABLE V ENERGY USE BY CITY/ENERGY USE SITE FOR INDUSTRIAL SECTOR

ELKO

City/Energy Use Site (1)	SIC No. (2)	Industrial Directories (3)		Nevada Department of Employment Security (4)		Standard Annual Energy Use (SAE) 10^{10} KJ/yr. (5)	Energy Use 10^{10} KJ/yr. (6)
		No. of Firms	No. of Employees	No. of Firms	No. of Employees		
Elko Town (a)	20			3	14	(1.775)	0.444
	24	1	10	1	10		
	2431	1	17			0.295	0.148
	27	2	38	2	34		
	2711	2	38			0.195	0.265
	32	1	7	2	8		
	3273	1	7			0.007	0.001
	38			2	56	(2.089)	1.539
	39			2	14	(0.349)	0.168
						TOTAL 10^{13} J/yr	2.565
						= 10^{12} Btu/yr	0.243
Wells	27	1	2	1	2		
	2711	1	2			0.195	0.015
						TOTAL 10^{13} J/yr	0.015
						= 10^{12} Btu/yr	0.014

(a) Industries of unknown site location; assume 85% to Elko and 15% to Wells

Footnotes 1 thru 6-see Explanation Page

TABLE V ENERGY USE BY CITY/ENERGY USE SITE FOR INDUSTRIAL SECTOR
HUMBOLDT

City/Energy Use Site (1)	SIC No. (2)	Industrial Directories (3)		Nevada Department of Employment Security (4)		Standard Annual Energy Use (SAE) 10^{10} KJ/yr. (5)	Energy Use 10^{10} KJ/yr. (6)
		No. of Firms	No. of Employees	No. of Firms	No. of Employees		
Winnemucca	20	3	21	5	208		4.750
	2051	1	17			0.949	
	2052	2	4			2.681	
	27			3	18	(0.130)	0.094
	32	1	18	1	18		
	3273	1	18			0.007	.003
	35			1	4	(1.067)	0.095
	38			1	40	(2.089)	1.099
						TOTAL 10^{13} J/yr	6.041
						= 10^{12} Btu/yr	0.057

Footnotes 1 thru 6-see Explanation Page

TABLE V ENERGY USE BY CITY/ENERGY USE SITE FOR INDUSTRIAL SECTOR
LANDER

City/Energy Use Site (1)	SIC No. (2)	Industrial Directories (3)		Nevada Department of Employment Security (4)		Standard Annual Energy Use (SAE) 10^{10} KJ/yr. (5)	Energy Use 10^{10} KJ/yr. (6)
		No. of Firms	No. of Employees	No. of Firms	No. of Employees		
Battle Mountain (a)	27			1	6	(0.130)	0.031
						TOTAL 10^{13} J/yr	0.031
						= 10^{12} Btu/yr	0.000

(a) Industry of unknown site location; assume 100% to Battle Mountain

Footnotes 1 thru 6-see Explanation Page

TABLE V ENERGY USE BY CITY/ENERGY USE SITE FOR INDUSTRIAL SECTOR

LINCOLN

City/Energy Use Site (1)	SIC No. (2)	Industrial Directories (3)		Nevada Department of Employment Security (4)		Standard Annual Energy Use (SAE) 10^{10} KJ/yr. (5)	Energy Use 10^{10} KJ/yr. (6)
		No. of Firms	No. of Employees	No. of Firms	No. of Employees		
Pioche (a)	27			1	2	(0.130)	0.001
	28	1	1	1	8		
	2819	1	8			126.576	13.871
						TOTAL 10^{13} J/yr	13.872
						10^{12} Btu/yr	0.132

(a) Industries of unknown site location; assume 50% to Pioche and 50% to Caliente.

Footnotes 1 thru 6-see Explanation Page

TABLE V ENERGY USE BY CITY/ENERGY USE SITE FOR INDUSTRIAL SECTOR

LYON

City/Energy Use Site (1)	SIC No. (2)	Industrial Directories (3) No. of Firms	Industrial Directories (3) No. of Employees	Nevada Department of Employment Security (4) No. of Firms	Nevada Department of Employment Security (4) No. of Employees	Standard Annual Energy Use (SAE) 10^{10} KJ/yr. (5)	Energy Use 10^{10} KJ/yr. (6)
Multi-Site (a)	20			2	31	(1.775)	0.983
	24			2	22	(2.032)	2.235
	25			1	32	(0.422)	0.270
	27			1	20	(0.130)	0.104
	28			1	4	(2.373)	0.130
	32			3	12	(5.569)	1.714
	34			1	1	(1.324)	0.026
	36			1	9	(2.611)	0.173
	39			2	28	(0.349)	0.337
						TOTAL 10^{13} J/yr	5.972
						= 10^{12} Btu/yr	0.057
Fernley	3241	1	175			242.604	1,088.608
						TOTAL 10^{13} J/yr	1,088.608
						= 10^{12} Btu/yr	1.033
Yerington	3494	1	17			3.280	1.093
						TOTAL 10^{13} J/yr	1.093
						= 10^{12} Btu/yr	0.014

(a) Industries of unknown site location; assume 50% to Fernley and 50% to Yerington.

Footnotes 1 thru 6-see Explanation Page

TABLE V ENERGY USE BY CITY/ENERGY USE SITE FOR INDUSTRIAL SECTOR

MINERAL

City/Energy Use Site (1)	SIC No. (2)	Industrial Directories (3)		Nevada Department of Employment Security (4)		Standard Annual Energy Use (SAE) 10^{10} KJ/yr. (5)	Energy Use 10^{10} KJ/yr. (6)
		No. of Firms	No. of Employees	No. of Firms	No. of Employees		
Multi-Site (a)	20			1	1	(1.775)	0.032
	24			1	7	(2.032)	0.711
	36			1	6	(2.611)	0.115
						TOTAL 10^{13} J/yr	0.858
						= 10^{12} Btu/yr	0.081
Hawthorne	2711	1	5	1	5	0.195	0.039
						TOTAL 10^{13} J/yr	0.039
						= 10^{12} Btu/yr	0.037

(a) Industries of unknown site location; assume 50% Hawthorne, 25% Mina, and 25% Luning.

Footnotes 1 thru 6-see Explanation Page

TABLE V ENERGY USE BY CITY/ENERGY USE SITE FOR INDUSTRIAL SECTOR
NYE

City/Energy Use Site (1)	SIC No. (2)	Industrial Directories (3)		Nevada Department of Employment Security (4)		Standard Annual Energy Use (SAE) 10^{10} KJ/yr. (5)	Energy Use 10^{10} KJ/yr. (6)
		No. of Firms	No. of Employees	No. of Firms	No. of Employees		
Multi-Site (a)	23			1	21	(0.551)	0.207
	29			1	47	(2.743)	1.868
	32			1	6	(5.569)	0.857
						TOTAL 10^{13} J/yr	2,932
						10^{12} Btu/ yr	0.028
Tonopah	2711	1	6	1	6	0.195	0.047
						TOTAL 10^{13} J/yr	0.047
						= 10^{12} Btu/ yr	0.045

(a) Industries of unknown site location; assume 100% to Tonopah.

Footnotes 1 thru 6-see Explanation Page

TABLE V ENERGY USE BY CITY/ENERGY USE SITE FOR INDUSTRIAL SECTOR
PERSHING

City/Energy Use Site (1)	SIC No. (2)	Industrial Directories (3) No. of Firms	Industrial Directories (3) No. of Employees	Nevada Department of Employment Security (4) No. of Firms	Nevada Department of Employment Security (4) No. of Employees	Standard Annual Energy Use (SAE) 10^{10} KJ/yr. (5)	Energy Use 10^{10} KJ/yr. (6)
Multi-Site (a)	20			1	24	(1.775)	0.761
	24			2	10	(2.032)	1.016
	27			1	5	(0.130)	0.026
	34			1	6	(1.324)	0.156
	35			1	4	(1.067)	0.095
						TOTAL 10^{13} J/yr	2.054
						= 10^{12} Btu/yr	0.019

(a) Industries of unknown site location; assume 100% to Lovelock.
Footnotes 1 thru 6-see Explanation Page

TABLE V ENERGY USE BY CITY/ENERGY USE SITE FOR INDUSTRIAL SECTOR
STOREY

City/Energy Use Site (1)	SIC No. (2)	Industrial Directories (3) No. of Firms	Industrial Directories (3) No. of Employees	Nevada Department of Employment Security (4) No. of Firms	Nevada Department of Employment Security (4) No. of Employees	Standard Annual Energy Use (SAE) 10^{10} KJ/yr. (5)	Energy Use 10^{10} KJ/yr. (6)
Multi-Site (a)	27			1	0	(0.130)	0.005
	32			1	5	(5.569)	0.714
						TOTAL 10^{13} J/yr	0.719
						= 10^{12} Btu/yr	0.007
Virginia City	20	1	4	1	4		

(a) Industries of unknown site location; assume 100% to Virginia City.
Footnotes 1 thru 6-see Explanation Page

TABLE V ENERGY USE BY CITY/ENERGY USE SITE FOR INDUSTRIAL SECTOR
WASHOE

City/Energy Use Site (1)	SIC No. (2)	Industrial Directories (3)		Nevada Department of Employment Security (4)		Standard Annual Energy Use (SAE) 10^{10} KJ/yr. (5)	Energy Use 10^{10} KJ/yr. (6)
		No. of Firms	No. of Employees	No. of Firms	No. of Employees		
Reno/Sparks (a)	20	6	251	17	715		23.268
	2035	2	27			1.413	
	2047	1	175			2.029	
	2051	1	17			0.949	
	2077	1	25			1.519	
	2099	1	7			1.444	
	22	1	7	2	31	(5.128)	1.204
	2299	1	7				
	23	2	7	10	109	(0.551)	1.072
	2391	1	7				
	24	11	218	28	344		5.074
	2431	5	141			0.295	
	2434	3	26				
	2439	1	17				
	2452	1	17				
	2499	1	17				
	25	2	9	7	157		1.011
	2515	1	7			0.331	
	2599	1	2			0.291	
	26	2	4	3	32		0.410
	2645	1	2			1.160	
	2649	1	2			1.529	
	27	20	470	69	1197		8.106
	2711	2	192			0.195	
	2721	2	82			0.085	
	2751	5	40			0.158	
	2752	9	147			0.193	
	2791	2	9			0.057	

(a) Industrial sites of unknown location; 100% to Reno/Sparks.
Footnotes 1 thru 6-see Explanation Page

TABLE V ENERGY USE BY CITY/ENERGY USE SITE FOR INDUSTRIAL SECTOR
WASHOE - page 2

City/Energy Use Site (1)	SIC No. (2)	Industrial Directories (3)		Nevada Department of Employment Security (4)		Standard Annual Energy Use (SAE) 10^{10} KJ/yr. (5)	Energy Use 10^{10} KJ/yr. (6)
		No. of Firms	No. of Employees	No. of Firms	No. of Employees		
Reno/Sparks	28	3	89	9	182		180.572
(Cont.)	2819	1	7			126.576	
	2821	1	75			73.836	
	2891	1	7			3.185	
	29			3	16	(2.743)	0.636
	30	4	74	13	353		4.278
	3079	4	74			0.812	
	3111	1	2			3.344	
	32	8	466	20	536		8.15[illegible]4
	3231	2	192			0.981	
	3271	2	50			1.403	
	3273	2	200			0.007	
	3281	1	7			0.074	
	3293	1	17			0.949	
	33	1	7	6	24	(11.704)	1.672
	3399	1	7				
	34	13	545	31	792		
	3432	1	7			1.245	30.534
	3441	1	75			0.686	
	3443	2	42			1.529	
	3444	1	17			0.439	
	3451	2	19			0.239	
	3463	1	175				
	3471	2	9			0.643	
	3479	1	2			0.697	
	3494	1	175			3.280	
	3499	2	24			0.415	
	35	19	474	37	1066		29.741
	3537	2	182				

Footnotes 1 thru 6-see Explanation Page

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TABLE V ENERGY USE BY CITY/ENERGY USE SITE FOR INDUSTRIAL SECTOR

WASHOE - page 3

City/Energy Use Site (1)	SIC No. (2)	Industrial Directories (3)		Nevada Department of Employment Security (4)		Standard Annual Energy Use (SAE) 10^{10} KJ/yr. (5)	Energy Use 10^{10} KJ/yr. (6)
		No. of Firms	No. of Employees	No. of Firms	No. of Employees		
Reno/Sparks	3544	1	25			0.158	
(Cont.)	3546	1	7				
	3551	1	25			0.422	
	3561	2	24			1.477	
	3564	1	2				
	3585	2	75			3.375	
	3589	1	75			0.614	
	3599	8	59			0.105	
	36	9	994	17	993		43.306
	3621	1	17			3.882	
	3622	1	17			0.150	
	3651	1	2			1.266	
	3661	2	767			7.088	
	3674	1	175			1.994	
	3679	1	7			1.036	
	3694	1	7			2.859	
	3699	1	2				
	37	4	18	9	115		1.741
	3713	1	2			1.048	
	3714	2	9			3.375	
	3792	1	7				
	38	2	24	8	313		7.71
	3842	1	17			0.454	
	3861	1	7			5.316	
	39	5	418	26	914		5.462
	3911	1	17			0.118	
	3953	1	375			0.174	
	3993	2	9				
	3999	1	17			0.214	
						TOTAL 10^{13} J/yr	323.419
						= 10^{12} Btu/yr	3.068

Footnotes 1 thru 6-see Explanation Page

TABLE V ENERGY USE BY CITY/ENERGY USE SITE FOR INDUSTRIAL SECTOR
WASHOE - page 4

City/Energy Use Site (1)	SIC No. (2)	Industrial Directories (3)		Nevada Department of Employment Security (4)		Standard Annual Energy Use (SAE) 10^{10} KJ/yr. (5)	Energy Use 10^{10} KJ/yr. (6)
		No. of Firms	No. of Employees	No. of Firms	No. of Employees		
Incline Village	3911	1	7			0.118	0.028
						TOTAL 10^{13} J/yr	0.028
						= 10^{12} Btu/yr	0.000

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Footnotes 1 thru 6-see Explanation Page

TABLE V ENERGY USE BY CITY/ENERGY USE SITE FOR INDUSTRIAL SECTOR
WHITE PINE

City/Energy Use Site (1)	SIC No. (2)	Industrial Directories (3)		Nevada Department of Employment Security (4)		Standard Annual Energy Use (SAE) 10^{13} KJ/yr. (5)	Energy Use 10^{10} KJ/yr. (6)
		No. of Firms	No. of Employees	No. of Firms	No. of Employees		
Multi-Site (a)	24			1	7	(2.032)	0.711
	27			1	22	(0.130)	0.114
						TOTAL 10^{13} J/yr	0.825
						= 10^{12} Btu/yr	0.008
Ely/East Ely	3599	1	2			0.105	0.005
						TOTAL 10^{13} J/yr	0.005
						= 10^{12} Btu/yr	0.000
McGill	3331	1	312	1	312		

(a) City/Energy Use Sites of unknown location; 100% to Ely/East Ely.
Footnotes 1 thru 6-see Explanation Page

TABLE V ENERGY USE BY CITY/ENERGY USE SITE IN INDUSTRIAL SECTOR

MULTI-COUNTY

City/Energy Use Site (1)	SIC No. (2)	Industrial Directories (3)		Nevada Department of Employment Security (4)		Standard Annual Energy Use (SAE) 10^{10} KJ/yr. (5)	Energy Use 10^{10} KJ/yr. (6)
		No. of Firms	No. of Employees	No. of Firms	No. of Employees		
Multi-Site (a)	24			1	2	(2.032)	0.203
	25			1	0	(0.422)	0.008
	27			1	1	(0.130)	0.005
	32			1	13	(5.569)	1.856
	35			3	3	(1.067)	0.0711
	39			1	0	(0.349)	0.012
						TOTAL 10^{13} J/yr	2.155
						≈ 10^{12} Btu/yr	0.020

(a) City/Energy Use Sites of Unknown County Location

Footnotes 1 thru 6-see Explanation Page

Footnotes to TABLE V Energy Use By City/Energy Use Site For Industrial Sector

(1) City/Energy Use Site for the purposes of this study is the county or a community within the county for which there is a record of the presence of industry for SIC categories 20 through 39.

(2) The Standard Industrial Classification Code categories covered in this study are major groups 20 through 39:

20	Food and kindred products
22	Textile mill products
23	Apparel and other finished products made from fabrics and similar materials
24	Lumber and wood products, except furniture
25	Furniture and fixtures
26	Paper and allied products
27	Printing, publishing, and allied industries
28	Chemicals and allied industries
29	Petroleum refining and related industries
30	Rubber and miscellaneous plastics products
31	Leather and leather products
32	Stone, clay, glass and concrete products
33	Primary metal industries
34	Fabricated metal products, except machinery and transportation equipment
35	Machinery, except electrical
36	Electrical and electronic machinery, equipment, and supplies
37	Transportation equipment
38	Measuring, analyzing, and controlling instruments; photographic, medical and optical goods; watches and clocks
39	Miscellaneous manufacturing industries

Major groups of particular interest in Nevada, but not specifically isolated, are:

10	Metal mining
14	Mining and quarrying of nonmetallic minerals, except fuels
42	Motor freight transportaion and warehousing
50	Wholesale trade - durable goods
51	Wholesale trade - nondurable goods

(3) Where ever possible 4-digit SIC numbers were obtained from industrial directories for the State of Nevada, the Greater Las Vegas Area, Reno/Sparks, and Carson City. Except for geographically isolated mining and milling operations which are present in all counties, nearly all industrial activity is located in the aforementioned metropolitan areas.

The industrial directories are complete, only to the extent of each individual firm's response to a mailed questionnaire. A total of 131 4-digit industrial categories has been recorded for Nevada.

(4) A list of the total number of firms and the aggregate total number of employees for each 2-digit SIC category establishes a realistic county by county tabulation of the industrial sector. Statewide the directories list only 37% of the establishments and 42% of the employees (see Table VI Comparison of Listed Number of Establishments and Employees in Industrial Directories and the Records of the Nevada Department of Employment Security).

The proprietary nature of this data did not allow the Nevada Department of Employment Security to release data on a 4-digit level. Nor was the 2-digit data available on a community or site specific basis.

(5) The Standard Annual Energy Use (SAE) in 10^{10} KJ/year, is the quantity of energy used by an average size establishment of a specific 4-digit SIC industry (S.E.R.I. data provided by Western Energy Planners, Ltd.). An average size establishment was calculated for each 2-digit SIC major group (rather than 4-digit) from statistics published in the U.S. Department of Commerce, Census of Manufacturers (1972), volume 1, Subject and Special Statistics. SAE values were available for 78% of the 4-digit SIC categories.

(6) A methology was developed which incorporated the imcomplete 4-digit and 2-digit SIC employee, establishment, and energy statistics, to provide industrial energy use data for specific city/energy use sites. In declining order of preference, the SAE (in 10^{10} KJ/year) for each 2-digit major group for a site was established as follows:

(a) Industry at the site had a listed 4-digit SIC number and a corresponding SAE value.

(b) When 4-digit SIC numbers were lacking or partially lacking for industry at a site, a weighted average of all 4-digit industries which were known for the site were taken. The corresponding weighted SAE value was used. If no other 4-digit SIC numbers were known for the site, then a weighted SAE value was calculated from corresponding data within that county, the State, or lastly the National level.

(c) With an SAE value for each 2-digit major group established, that energy value is multiplied times the ratio of the actual number of employees within this major group at the site, to the number of employees for the average establishment in the major group. The product is the energy used at the site in 10^{10} KJ/year.

TABLE VIII GEOTHERMAL PENETRATION OF RESIDENTIAL/COMMERCIAL BY COUNTY AND CITY FOR 1975, 1985, 2000, and 2020 (10^{12} Btu)

	CAPTURE (1)	1975	1985	2000	2020
CARSON CITY	M	-	0.027	0.198	2.081
CHURCHILL	H	0	0.011	0.053	0.437
Cold Spring	0	0	0	0	0
Fallon	H	0	0.003	0.015	0.123
Fallon N.A.S.	H	0	0.001	0.005	0.043
Frenchman	0	0	0	0	0
Hazen	M	0	0	0	0
CLARK	L	0	0.130	0.822	8.070
Boulder City	L	0	0.003	0.019	0.190
Blue Diamond	0	0	0	0	0
Boulder Beach	0	0	0	0	0
Bunkerville	L	0	0	0	0.002
Cottonwood Cove	0	0	0	0	0
Echo Bay	0	0	0	0	0
Glendale	0	0	0	0	0
Goodsprings	0	0	0	0	0
Henderson	L	0	0.008	0.048	0.473
Indian Springs	L	0	0	0.001	0.009
Jean	0	0	0	0	0
Kyle Canyon	0	0	0	0	0
Las Vegas	L	0	0.127	0.803	7.887
Lee Canyon	0	0	0	0	0
Logandale	L	0	0	0.001	0.014
Mesquite	0	0	0	0	0
Moapa	0	0	0	0	0
Nelson	0	0	0	0	0
Overton	0	0	0	0	0
Overton Beach	0	0	0	0	0
Searchlight	0	0	0	0	0
DOUGLAS	L	0	0.005	0.027	0.247
Gardnerville	L	0	0.001	0.004	0.032
Genoa	M	0	0	0.001	0.008
Glenbrook	0	0	0	0	0
Minden	L	0	0	0.002	0.014
Stateline	0	0	0	0	0
Topaz Lake	0	0	0	0	0

TABLE VIII Cont. - page 2

	CAPTURE (1)	1975	1985	2000	2020
ELKO	H	0	0.015	0.083	0.733
Carlin	H	0	0.001	0.008	0.069
Contact	H	0	0	0	0
Deeth	0	0	0	0	0
Elko	H	0	0.008	0.045	0.401
Halleck	0	0	0	0	0
Jackpot	M	0	0	0.002	0.017
Jarbidge	L	0	0	0	0
Jiggs	0	0	0	0	0
Lamoille	0	0	0	0	0
Lee	0	0	0	0	0
Montello	L	0	0	0	0
Mountain City	L	0	0	0	0.001
Owyhee	0	0	0	0	0
Ruby Valley	L	0	0	0	0.001
Tuscarora	L	0	0	0	0.001
Wells	M	0	0.001	0.004	0.038
ESMERALDA	L	0	0	0.001	0.010
Coaldale	0	0	0	0	0
Dyer	0	0	0	0	0
Goldfield	0	0	0	0	0
Silver Peak	M	0	0	0.001	0.005
EUREKA	L	0	0	0.002	0.013
Crescent Valley	M	0	0	0	0
Eureka	0	0	0	0	0
HUMBOLDT	M	0	0.005	0.028	0.251
Denio	0	0	0	0	0
Golconda	H	0	0	0.001	0.011
McDermitt	L	0	0	0	0.004
Orovada	0	0	0	0	0
Paradise Valley	0	0	0	0	0
Valmy	L	0	0	0	0.001
Winnemucca	M	0	0.003	0.016	0.142
LANDER	L	0	0.001	0.004	0.028
Austin	0	0	0	0	0
Battle Mountain	L	0	0.001	0.003	0.019

TABLE VIII Cont. - page 3

	CAPTURE (1)	1975	1985	2000	2020
LINCOLN	H	0	0.003	0.014	0.128
Alamo	L	0	0	0	0.004
Caliente	H	0	0.001	0.005	0.046
Caselton	0	0	0	0	0
Hiko	L	0	0	0	0
Panaca	L	0	0	0.001	0.009
Pioche	0	0	0	0	0
Ursine	0	0	0	0	0
LYON	M	0	0.004	0.017	0.126
Dayton	0	0	0	0	0
Fernley	H	0	0.001	0.003	0.021
Silver Springs	0	0	0	0	0
Silver City	L	0	0	0	0.001
Smith	0	0	0	0	0
Wabuska	H	0	0	0	0
Weed Heights	0	0	0	0	0
Wellington	L	0	0	0	0.001
Yerington	0	0	0	0	0
MINERAL	L	0	0.002	0.009	0.066
Babbitt	0	0	0	0	0
Hawthorne	L	0	0.001	0.004	0.033
Luning	0	0	0	0	0
Mina	0	0	0	0	0
Schurz	0	0	0	0	0
NYE	L	0	0.002	0.009	0.073
Beatty	L	0	0	0.001	0.012
Currant	0	0	0	0	0
Duckwater	L	0	0	0	0
Gabbs	H	0	0.001	0.004	0.034
Ione	0	0	0	0	0
Lathrop Wells	L	0	0	0	0.002
Manhattan	0	0	0	0	0
Pahrump	0	0	0	0	0
Round Mountain	0	0	0	0	0
Tonopah	L	0	0.001	0.003	0.022
Warm Springs	M	0	0	0	0

TABLE VIII Cont. - page 4

	CAPTURE (1)	1975	1985	2000	2020
PERSHING	M	0	0.002	0.009	0.073
Imlay	L	0	0	0	0.002
Lovelock	M	0	0.001	0.005	0.043
Mill City	L	0	0	0	0
Unionville	0	0	0	0	0
STOREY	M	0	0.001	0.004	0.035
Gold Hill	M	0	0	0	0.002
Virginia City	M	0	0.001	0.003	0.031
WASHOE	H	0.006	0.205	1.332	13.171
Empire	M	0	0	0.002	0.022
Gerlach	H	0	0	0.001	0.014
New Washoe City	L	0	0.001	0.004	0.036
Nixon	0	0	0	0	0
Reno, Includes: Sparks Steamboat Sun Valley	H	0.006	0.169	1.096	10.837
Sutcliff	0	0	0	0	0
Verdi	0	0	0	0	0
Wadsworth	0	0	0	0	0
WHITE PINE	L	0	0.002	0.008	0.048
Baker	0	0	0	0	0
Ely/East Ely	L	0	0.001	0.005	0.029
Lund	0	0	0	0	0
McGill	L	0	0	0.002	0.010
Ruth	0	0	0	0	0

(1)

	CAPTURE FRACTIONS (%)			
Geothermal Potential (a)	1975	1985	2000	2020
NIL	0	0	0	0
LOW	0	0.50	2.09	14.05
MODERATE	0	1.00	4.18	28.10
HIGH	0	1.50	6.27	42.43

(a) In 1975, very little geothermal energy was utilized outside of the Truckee Meadows (Reno/Sparks) which had a capture fraction of approximately 1/8 of 1 percent (for Reno).