THE SPA CITY

Box 10
193

HR
3/18/76

CITY OF
DESERT HOT
SPRINGS

March 18, 1976

Mr. Herbert Rogers, Jr.
President
Rogers Engineering Co., Inc.
111 Pine St.
San Francisco, Ca. 94111

Dear Mr. Rogers:

I have enclosed, for your information, a copy of a report prepared by Sue Marshall, dated September 9, 1975, entitled "An Evaluation of the Geology, Hydrology Geochemistry and Geophysics of Desert Hot Springs, California.

If I can be of any further assistance please do not hesitate to contact me.

Very truly yours,

ANN MASON
Deputy City Clerk

Donated By:
Herbert Rogers Jr.
Rogers Engineering Co.

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

September 9, 1975

Prepared by
Sue Marshall

AN EVALUATION OF THE GEOLOGY, HYDROLOGY
GEOCHEMISTRY AND GEOPHYSICS OF
DESERT HOT SPRINGS, CALIFORNIA

ACKNOWLEDGMENTS

The assistance provided by the following people is greatly appreciated:

Mr. Sullivan and Mr. Dippner of the City of Desert Hot Springs for suggesting contacts in the area; Mr. Kibbe of the Desert Hot Springs Co. Water District for well logs and other information; Mr. Spencer of the Coachella Valley County Water District for well log data; Mr. Sanford of S & S Water Drilling and Pump Company for local well data; Dr. Donnelly of Occidental Petroleum for their report on the Indio Hills region; Mr. MacMillan of Texaco for information from their abandoned well in the area; Dr. Biehler of U. C. Riverside for geophysical data; several contacts at Southern California Edison for a variety of information; and of course, the people at JPL who helped make this report possible.

SUMMARY

Geological, hydrological, geochemical, and geophysical data pertaining to the upper Coachella Valley were collected and evaluated for the Desert Hot Springs Geothermal Resource Utilization Proposal. This information led to the description of important problems and possible solutions. The potential sites for geothermal wells were determined by the analysis of raw well log data and previous studies.

There are three high temperature regions in the Desert Hot Springs area. Two of these regions, the Two Bunch Palms area and the area near Dillon Road (southeast of Desert Hot Springs) provide the most favorable conditions for geothermal wells. The third region, in the north part of the city, lacks the high temperatures typical of the other two regions.

The highest temperatures are found in the Dillon Road area. This area is outside of the city and far from the potential space-conditioning demonstration sites. The fluoride content of the wells in this area often exceed the maximum standards for domestic and municipal water. Reinjection to the original aquifer may be prohibited. The distance from the ground surface to the first ground water is greater than in areas within Desert Hot Springs. Geothermal development may be suitable for this low density land use area.

The Two Bunch Palms area is within the City of Desert Hot Springs. The water temperatures are not as high as the Dillon Road area. The main advantages in this area are the close proximity to the potential space-conditioning sites and the lower fluoride concentrations in the water. The depth from the ground surface to the ground water is very shallow in some places. The land use plans for this area may not be compatible with geothermal development.

Greater input is necessary to determine if a shallow or deep well would best serve a geothermal demonstration project. Problems with subsidence, recharge, and reinjection of geothermal waters require more study. Investigation of the extent of the geothermal reservoir is recommended. Therefore, a hydrological study of the Desert Hot Springs area is of primary importance. Such an investigation should provide solutions to the above problems.

Water chemistry studies are recommended in order to better define the nature of the geothermal reservoir and determine the limitations imposed by poor water quality. The temperature of the reservoir may be estimated. The hazards of recharge or reinjection may be evaluated by water chemistry studies. Agricultural and aquacultural sensitivity to the water quality should be considered.

A thermal gradient survey may be desirable to correlate temperature with depth. It may be instrumental in locating the most practical site for a geothermal well.

These three studies are recommended in order to gain valuable qualitative and quantitative reservoir data. The nature of the geothermal reservoir will be better defined through such investigations. In this respect, the risks associated with the utilization of the geothermal resource will be minimized.

Maps

Several maps were created which together, delineate the best probable sites for a geothermal well. The thermal and ground water elevation maps are based upon data from shallow wells in the area. No correlation between temperatures and depth could be made (see Appendix D). Thus, the criteria for the choice of sites is applicable to shallow wells alone. Probable sites for deep geothermal wells may be inferred by the shallow well data. Caution must be taken since the extrapolation of shallow water data to greater depths may not be valid.

Thermal Map (Figure 1) A map showing water temperature contours was constructed using temperature data from well logs. This map was modified from R. J. Proctor. (1) It should be more accurate and up-to-date as many new wells have been drilled since the original study.

The isothermal lines delineate three high temperature zones. These zones present the best possible sites for shallow geothermal wells. Note that the high temperature zones are immediately adjacent to the main Mission Creek fault trace. These high temperature areas are fault controlled. Temperatures on the southwest side of the fault zone are low, in the 70°F to 85°F range. On the northeast side of the fault zone temperatures range from 82°F to 208°F. The average water well temperature in the area is between 120°F and 130°F. The hottest water is located in the high temperature zone near Dillon Road. Temperatures there reach 208°F. A smaller very high temperature zone is located in the Two Bunch Palms area where temperatures are believed to range up to 180°F.

Three sections of the thermal map were constructed (Figure 2). These temperature profiles plot temperature versus the length of the section.

Section AA' is roughly perpendicular to the fault zone in the high temperature zone in the eastern part of the city. It shows a steep temperature gradient against the fault. The temperature gradient is more gradual as distance is increased away from the fault. This high temperature region is the widest zone in the area.

FIGURE 2
TEMPERATURE PROFILES

Section BB' is also roughly perpendicular to the Mission Creek Fault in the temperature zone near Dillon Road. It delineates a very narrow zone of high temperatures adjacent to the fault. The Lucky Seven and the two Venturino wells have the highest water temperatures in the area at 200°F, 204°F and 208°F respectively. Temperatures drop off rapidly with increased distance from the fault. The Mission Creek fault is designated as a vertical line for reference in sections AA' and BB'.

Section CC' is approximately parallel to the Mission Creek fault and extends through the highest temperature zones. The three zones of high temperature water stand out in this plot. These areas are fault controlled and may delineate splinter faults that are not designated or are not completely extended on the thermal map.

Ground Water Elevation Map (Figure 3) A map indicating the elevation (in feet above sea level) of ground water in the top aquifer modified from an earlier map by Proctor⁽¹⁾ was constructed. This map is very approximate as it is based on data from typically incomplete or inaccurate well logs. The location of the well and depth to the first water encountered by the driller was plotted. The elevations of the well heads were then approximated through the use of a topographic map. The final map shows the ground water elevations within the well in the Desert Hot Springs area. The contours indicate a rapid drop of 100 ft in ground water elevation at the Mission Creek fault. The land topography does not show a sudden ground surface drop at the fault. It is, therefore, obvious that the fault zone serves to dam ground water.

Three cross-sections of the ground water elevation map corresponding to the preceding thermal sections were constructed (Figures 4 and 5). Ground surface and ground water elevations above sea level were plotted versus the length of the sections. Vertical exaggeration is on the order of 100 times. The Mission Creek fault is vertical in cross-sections AA' and BB'. It actually dips 80° to 90° to the north (near vertical) in the mapped area.

Figure 3

Ground Water Elevation Map

- Boundary of the "sphere of influence" of the City of Desert Hot Springs
- City Limits
- Ground water contours to top aquifer. Feet above sea level.
- ... Located, inferred, or concealed fault.

FIGURE 4
GROUND WATER PROFILES

FIGURE 5
GROUND WATER PROFILE

Cross section AA' is roughly perpendicular to the Mission Creek fault zone and corresponds to AA' on the thermal map. There is a steep ground water gradient near the fault zone where the ground water approaches within 15 to 20 feet of the ground surface. Some water wells have hit ground water in as little as 16 feet in similar areas immediately adjacent to the fault.

Cross section BB' is also nearly perpendicular to the Mission Creek fault in the Dillon Road area. It corresponds to BB' on the thermal map. Section BB' also shows a steep ground water elevation adjacent to the fault. The damming effect of the fault is most obvious in this cross-section. The comparison of cross-sections AA' and BB' demonstrates the drop in ground water elevation to the southeast along the north side of the Mission Creek fault. The distance from the ground surface to ground water increases to the southeast along the fault. The difference between the two remains rather constant along the same southeastern trend in areas parallel to the fault but adjacent to the Little San Bernardino Mountains.

Cross section CC' roughly parallel the north side of the Mission Creek fault. It corresponds to CC' on the thermal map. The variations in the distance from the ground surface to the ground water suggest the possibility of dam action by splinter faults that head toward the Little San Bernardino Mountains. The comparison of the temperature and ground water profiles of Section CC' does not show any clear correlation between groundwater levels and high temperature regions.

Zoning Map (Figure 6) This map indicates the planned land use in the City of Desert Hot Springs. Comparison of the thermal map and the zoning map indicates that the high temperature zone in the Two Bunch Palms area (Section 32) is zoned primarily as "resort-spa-residential" and also "open land and low intensity use district." Superimposed on the highest temperature water in the area is a "residential single family zone." The high temperature region in the Dillon Road area is not within the city of Desert Hot Springs, so the area is not zoned. Although most of this region is outside the "sphere of influence" of Desert Hot Springs, the highest temperatures in the area are within it.

Figure 6

City of Desert Hot Springs Zoning Map

- O-1 Open land and low intensity use district
- R-1-C Residential single family
- R-2 Residential medium-density
- R-3 Residential multiple-density
- R-M Residential mobile home
- T-R Resort spa-residential
- T-C Resort tourist-commercial
- C-1 Commercial Neighborhood convenience
- C-2 Commercial community district
- C-3 Commercial service district
- M-1 Industrial district
- W-1 Watercourse district

June 12, 1975

SCALE

N

Figure 7

City of Desert Hot Springs
Possible Space-Conditioning Demonstration Sites

- A - Wardman Center
- B - City Hall
- C - Senior Citizens Center
- D - Angel View Crippled Children's
Rehabilitation Foundation
- E - Federal Low-Income Housing for the
Elderly

Potential Site Map (Figure 7) The five potential space-conditioning demonstration sites are indicated on this map. All of the potential sites are within the City of Desert Hot Springs. The comparison of this map with the thermal map yields two sites within the high temperature zone near Two Bunch Palms (Section 32). The Angel View Crippled Children's Rehabilitation Foundation (Site D) is within the 150°F to 175°F region. Federal low-income housing (Site E) overlies water temperatures around 120°F. The Wardman Center (Site A) is within the 90°F temperature region. The Senior Citizens' Center (Site C) and City Hall (Site B) overlie water temperatures of less than 90°F. The lowest temperatures may be found at City Hall which was built on the southwest side of the Mission Creek fault. The high temperature zone in the Dillon Road area is not within reasonable distance to the potential space-conditioning sites but does represent the highest possible temperatures in the Desert Hot Springs area.

The potential sites are zoned as follows: The Wardman Center (Site A) is within a residential single family zone. City Hall (Site B) is within an area zoned specifically for a civic center. The Senior Citizens' Center (Site C) is in a commercial community district. The Angel View CCRF (Site D) is located in a resort-spa residential zone. The federal low income housing (Site E) is within a residential multiple-density area. Zoning is important to consider as regulations for certain areas may limit size or nature of a geothermal operation.

Well Drilling

The drilling costs of the different geothermal wells are compared in Appendix C. The cost alone does not indicate the suitability of a particular well. Each of the three wells presents certain advantages and disadvantages unique to that depth.

A 500 foot well would be the least expensive well. It would yield hot water at temperatures up to 208°F (possibly higher). Since the well would be similar to present wells, there would be no problem fitting in with the surrounding community. Several wells may be necessary to obtain the desired water volume.

The withdrawal of large amounts of ground water may dry neighboring wells (see: Nature and Extent of the Geothermal Reservoir) and could therefore be forbidden. A 500 foot well would be most practical for a geothermal project where temperatures less than 210°F and small volumes of water are required.

A deeper well at 1500 feet would be roughly twice as expensive as a 500 foot well. The greater depth would yield higher temperatures and most likely, a mixture of water and steam. A well at this depth could be expected to have little or no effect on pre-existing community wells. The disadvantages of such a well would include the possibility of low volume yield from semi-permeable deposits. The uncertainty of unpredicted temperatures and brine chemistry is another risk.

A deep, 5000 foot geothermal well would be the most costly. It would probably yield high temperature flashed steam. A primary advantage would be that the well would have no effect on pre-existing community wells. Reinjection would present fewer problems (see: Recharge and Reinjection). However, a 5000 foot well could possibly have a greater environmental impact than a 500 foot well. The metamorphic rocks at depths greater than 1500 feet would create drilling difficulties. These rocks are impermeable unless fractured (as in the case of a fault zone). The yield or brine chemistry from this depth can not be predicted with any certainty prior to the drilling operation. High risks would be involved in this drilling venture. There is a possibility that the hole might not produce at all without stimulation. A 5000 foot well would be most advantageous for a geothermal project where the necessity for high temperatures, steam, and high volume with few side effects would justify the costs.

It will be necessary to determine more exactly the temperature and yield requirements of the geothermal project before a definitive choice of well type can be made.

~~Water Chemistry~~

The ground water in the Miracle Hill subarea (Desert Hot Springs subbasin) receives very little recharge and ground water movement is slow. The water contains

high amounts of total dissolved solids. The dominant dissolved solid is sodium sulfate. A representative ground water analysis from a well (3S/5E-10J1) in the Miracle Hill subarea is shown below:

<u>Constituents</u>	<u>1</u> epm	<u>2</u> ppm
Ca	2.2	44
Mg	0.50	6
Na	12.17	280
K	--	--
CO ₃	0.10	33
HCO ₃	0.65	40
SO ₄	10.42	500
Cl	4.00	142
NO ₃	0	0
F		8.5
Boron		1.6
Silica		--
Total Dissolved Solids		
Solids by Summation		1005
Percent Na		82
Total hardness		135
Sampled by		Riverside County Flood Control District
Date Sampled		10-30-57
Temperature		109°F
pH		8.2
EC x 10 ⁶		1487

Table 1, "Quality Criteria for Irrigation Water," is based on three measures of quality. First, high amounts of total dissolved solids are harmful. Plants must have tissue fluid of higher osmotic pressure than the soil water in order to absorb water. The plant must have higher salt content than the soil water. If salt content in the soil is high, then the high salt content required in the plant may be injurious to it. Second, some substances in the soil water are toxic to plants when present in certain concentrations. Boron is an example. Third, a high percentage of cations in the water can induce a base exchange process which lowers the permeability of the soil.

¹Chemical equivalents per million

²Parts per million by weight

Table 1

QUALITY CRITERIA FOR IRRIGATION WATER^a

Criterion	Class 1 ^b Excellent to good	Class 2 ^c Good to Injurious	Class 3 ^d Injurious to unsatisfactory
Conductance ^e EC X 10 ⁶ at 25° C	Less than 1,000	1,000-3,000	More than 3,000
Chloride, epm ^f	Less than 5	5-10	More than 10
Percent sodium ^g	Less than 60	60-75	More than 75
Boron, ppm ^h	Less than 0.5	0.5-2.0	More than 2.0

a. The values shown should be used as a guide only, since permissible limits vary widely with different crops, soils, and climatic conditions.

b. Class 1. Excellent to good--regarded as safe and suitable for most plants under any condition of soil and climate.

c. Class 2. Good to injurious--regarded as possibly harmful to certain crops under certain conditions of soil or climate, particularly in the higher ranges of this class.

d. Class 3. Injurious to unsatisfactory--regarded as probably harmful to most crops and unsatisfactory for all but the most tolerant.

e. Specific electrical conductance ($K \times 10^6$ at 25° C). This measurement is reported in reciprocal ohm per cm., multiplied by 10^6 (1,000,000), and provides an index of total dissolved electrolytes or total salinity.

Dividing the conductance ($EC \times 10^6$ at 25° C) by 10 gives an approximation of the salt content in milligram equivalents per liter. Multiplying the conductance ($EC \times 10^6$ at 25° C) by 0.7 gives a rough estimate of parts per million (ppm) total salts.

f. Chloride is expressed as equivalents per million.

g. Sodium percentage is computed by the formula $\frac{Na \times 100}{Na+Ca+Mg}$, when these are expressed as equivalents per million.

h. Boron content is expressed in parts per million.

Table 2

UNITED STATES PUBLIC HEALTH SERVICE
DRINKING WATER STANDARDS

Dissolved Constituent	Concentration which constitutes grounds for rejection*	Recommended maximum concentration*
Arsenic (As)	0.05	0.01
Barium (Ba)	1.0	
Cadium (Cd)	0.01	
Chromium (Hexavalent) (Cr ⁺⁶)	0.05	
Cyanide (CN)	0.2	0.01
Lead (Pb)	0.05	
Selenium (Se)	0.01	
Silver (Ag)	0.05	
Chloride (Cl)		250
Copper (Cu)		1.0
Iron (Fe)		0.3
Manganese (Mn)		0.05
Nitrate (NO ₃)		45
Sulfate (SO ₄)		250
Zinc (Zn)		5
Phenols		.001
Total dissolved solids, desirable		500
Alkyl Benzene Sulfonate		0.5
Carbon Chloroform Extract (CCE)		0.2

*Concentrations of the dissolved constituents in water are expressed in parts per million by weight.

The Miracle Hill water analysis shows high sodium concentration in the injurious to unsatisfactory class. Boron and conductance fall in the good to injurious class. Chlorine lies in the excellent to good class.

The sulfate content is twice the recommended maximum concentration for domestic and municipal water (Table 2). The sulfate content of a water well usually increases with greater depth.

Fluoride content is a problem in the Desert Hot Springs area. Fluoride content in drinking waters is of concern due to the danger of inhibiting or halting the development of tooth enamel. The permissible concentration of fluoride depends on the mean annual temperature and is determined by the State Department of Public Health. The maximum limit of fluoride concentrations in domestic and municipal water in Desert Hot Springs is 1.2 parts per million by weight. The Miracle Hill and other water analyses in the Desert Hot Springs subbasin show concentrations of 6 to 8 ppm fluoride. This is approximately 6 to 8 times the allowed maximum. The general trend for the City of Desert Hot Springs is the increase in fluoride concentrations along the northeast side of the Mission Creek fault in a southeast trend.³ The wells located near Dillon Road, most with very high temperatures, often have extremely high fluoride concentrations. Water wells in the north end of the city have lower fluoride concentrations (<1.0 ppm) but some are still unacceptable.

The fluoride problem is counteracted by obtaining water from the southwest side of the fault with acceptable concentrations or mixing water from both sides of the fault to meet the necessary standards. The Desert Hot Springs County Water District utilizes both methods.

The silica concentration in ground water can be used to estimate water temperatures in the geothermal reservoir. Silica usually indicates the minimum water temperatures. For accurate results, water samples must be analyzed immediately. The mixing or dilution of ground water leads to incorrect results.

Chloride concentrations in the ground water can also be utilized to estimate water temperatures at depth. Chloride content yields higher reservoir temperatures than silica concentrations. Vapor dominated and hot water systems can be distinguished by the chloride content of the water. The chloride limit for a vapor dominated system is 20

mg/l. As with silica, the mixing or dilution of ground water presents problems.

Water in the Coachella Valley is considered moderate² hard in most areas. The water is not sufficiently hard to be a major problem. The well owners in the City of Desert Hot Springs do not have the massive scaling problems typical of other geothermal areas. However, high water hardness can be decreased to acceptable levels for most domestic and municipal uses with relative ease.

Further water chemistry studies may be warranted before the development of a geothermal project. Existing analyses of well water could be scrutinized to yield chemical trends in the Desert Hot Springs area. Geographic plots (maps) of important constituents may be instrumental in the location of an ideal site for a geothermal well. Water chemistry studies may produce reasonable reservoir temperature estimates. Problems associated with reinjection of geothermal waters will require study (see: Recharge and Reinjection).

Subsidence

If the withdrawal of water exceeds the recharge then subsidence may occur. Reinjection of water to the aquifer from which it was withdrawn will often halt subsidence. It is not always possible to reinject fluids to the original aquifer without contaminating the ground water (see below). The amount of subsidence depends upon the drop in pressure, the compressibility of the deposits, the thickness of the compressible beds and the time increased stress has been applied. Seismic activity may be induced by displacement along a fault during subsidence.

Recharge and Reinjection

A common practice for the disposal of geothermal wastes is reinjection at depth. In some cases brines can be returned to the original aquifer. Industrial wastes (including geothermal wastes) are disposed of in deep injection wells. The injection process may induce seismic activity. In confined systems, swarms of microearthquakes may be caused by injection. In an active fault zone, as in Desert Hot Springs, withdrawal or injection of large amounts of water can trigger earthquakes due to changes in pore pressure. Induced seismic activity is not considered a major danger or problem in most geothermal developments.

by the appropriate Regional Water Quality Control Board requires the approval of the State Board of Public Health. The reinjection of geothermal waters to the original aquifer may be prohibited as contamination of the ground water may result. The return by percolation through the soil may also contaminate the ground water. This is important to consider in any plans for field irrigation.

If reinjection at shallow depths is prohibited due to the danger of contamination, deep well reinjection may serve to dispose of waste water. In this case, the withdrawal of fluids would exceed the recharge to the aquifers in the Desert Hot Springs subbasin. Artificial recharge may be necessary if the ground water levels change significantly.

Artificial recharge in the Whitewater River area in the upper Coachella Valley has been studied in great detail.⁽⁶⁾ The percolation basin method was suggested as the most feasible way to replenish the diminishing ground water supply of the upper Coachella Valley. This recharge will not affect the Desert Hot Springs subbasin. A similar method may be feasible in the Desert Hot Springs subbasin where ground water flows in a southeast trend. The site of recharge determines the effect of the introduced water on groundwater levels. The northwest corner of the subbasin, adjacent to the Little San Bernardino Mountains provides a logical site for recharge. The new groundwater would replenish the aquifers underlying Desert Hot Springs. As in the Whitewater River area, the Colorado River Aqueduct might serve as a source of relatively pure recharge water. Further hydrological studies will be necessary to determine the need for and/or feasibility of such action.

Nature and Extent of the Geothermal Reservoir

The yield (flow rates) of the Desert Hot Springs area cannot be predicted using available data from existing wells. Storage capacity and the annual recharge for the Desert Hot Springs subbasin were estimated by the Department of Water Resources for shallow depths up to 300 feet (see: Ground Water Basins).⁴ If one or more shallow wells withdraw a continuous stream of water from the subsurface a considerable drop in the water table may occur. Existing wells in the area may become dry in the process. The drawdown alone from a geothermal well may also dry neighboring shallow wells. Either case would

raise objections from well owners who depend on a hot water well for their home or business. This is of primary concern in Desert Hot Springs where the hot water spas attract tourism. The major business in the upper Coachella Valley including Desert Hot Springs is tourism. This potential problem may be alleviated by recharge or reinjection into the original aquifer(s).

Occidental Petroleum Corp., in cooperation with Southern California Edison, expressed interest in the potential for electric utilization of geothermal energy in and near the Indio Hills region (southeast of Desert Hot Springs). The nature of the geothermal reservoir was evaluated through the study of available water analyses. The result was these four conclusions:

1. There exists one large or several smaller geothermal systems. The data poorly covers the entire area.
2. The geothermal system(s) is a hot water system.
3. The probable reservoir temperature is in excess of 350°F (177°C).
4. The reservoir brine probably has under 2-3000 mg/l chloride ion. Occidental apparently decided that the reservoir is inadequate for electric applications.

The above conclusions may or may not be applicable to the Desert Hot Springs area. In any event, the Occidental study indicates that the geothermal system(s) in and near the Indio Hills is suitable for non-electric applications. No valid predictions for the Desert Hot Springs area can be made without further evidence.

Mineralization in Desert Hot Springs Wells

Scaling in the water wells in the Desert Hot Springs area has not been a significant problem. The water is relatively pure in comparison with the brines withdrawn from geothermal wells in the Imperial Valley. There is a major problem in recent years with rapid corrosion of water well pipes in Desert Hot Springs. Bronze parts are required to prolong pump life in the hot water. Even with bronze parts, water pumps may wear out in 2 to 3 months. The rapid deterioration of equipment in contact with the mineralized water should be considered in the planning for applications of geothermal resources.

Miscellaneous Problems

The water temperatures in the Desert Hot Springs area wells occasionally fluctuate by an average 10°F within several months. Not all of the wells demonstrate temperature variations. The fluctuations appear to be seasonal and should be expected.

The environmental impact of a drilling operation in close proximity to the City of Desert Hot Springs should be analyzed in greater detail. The drilling operation may constitute an eyesore and noise problem or otherwise adversely affect the local residents.

APPENDIX A.
GEOLOGY, GEOPHYSICS, HYDROLOGY

Geology - Faults

Geothermal waters in the Desert Hot Springs area are closely related to faulting. The faults act as partial barriers to groundwater movement, affecting both ground water levels and water quality. Groundwater rises near to the surface where the fault acts as a dam. As a result, dense vegetation will often mark the trace of the fault, growing only in the shallow water area on one side of the fault.

The San Andreas Fault is relatively inactive in this area. It extends southeast from the junction of the Banning and Mission Creek Faults in the central Indio Hills and follows along the base of the Indio and Mecca Hills, the fault plane is near vertical and dominant movement is horizontal. Vegetation marks the straight trace of the fault.

The Banning Fault is well defined by a straight trace from the foothills of the Little San Bernardino Mountains, through the Coachella Valley to the Indio Hills. It represents a very effective ground water barrier with a difference of 200 feet in ground water levels on either side of the fault between the Whitewater River and the Indio Hills (1961). Dense vegetation marks the trace of the fault in Seven Palms Valley. The Banning reverse fault shows right lateral displacement along the near vertical fault plane that dips steeply northward. (The Banning Fault is designated as the San Andreas Fault in Proctor's ⁽¹⁾ report).

The Garnet Hill Fault is located $1\frac{1}{2}$ miles south and approximately parallel to the Banning Fault. It forms a barrier to groundwater below 100 feet. The fault has not displaced recent alluvium. The Garnet Hill Fault was located through a gravity anomaly survey of the Coachella Valley by a major oil company (Standard or Occidental?).

The Mission Creek Fault is the most active fault in the area. It extends southeast from the Little San Bernardino Mountains through the Indio Hills to the junction of the Banning and San Andreas faults. Vegetation marks the fault dammed waters on the north side of the fault. Between Morongo Valley and the Indio Hills, ground water levels differ on either side of the fault by 130 to 260 feet. In this same area, the fault consists of a near vertical fault zone trending southeast with several splinter breaks that extend toward the Little San Bernardino Mountains on the northeast. Miracle Hill is recent alluvium uplifted between the main traces of the Mission Creek Fault and a splinter fault on the NW flank of the hill. Proctor⁽¹⁾ expects branch faults under the alluvium in the Miracle Hill area. Temperatures in that area range up to 176°F. The displacement of the Mission Creek Fault is right lateral and reverse vertical. The Indio Hills represent uplift of the southwest block relative to the northeast block. This is the direct opposite of the uplift at Miracle Hill. The Mission Creek Fault originated in late Miocene and has expressed Recent movement during the Desert Hot Springs earthquake of 1948.

A map showing potentially active faults in the Desert Hot Springs area is included (Figure 8). It is taken directly from the State of California "Special Studies Zones" map of the Desert Hot Springs quadrangle (July 1, 1974). Refer to Proctor's Map of the Desert Hot Springs area for identification of major faults.⁽¹⁾

Descriptive Geology

The descriptive geology of the Desert Hot Springs area is thoroughly presented in Proctor's report.⁽¹⁾ It should be consulted for details.

Briefly, the Desert Hot Springs area is underlain by alluvium, 1000 to 3000 feet of conglomerate and fanglomerate; less than 500 feet of sandstone, and metamorphic basement rocks (migmatic gneisses). There are three aquifers in this area as defined by well drillers. The aquifers slope down toward the Little San Bernardino Mountains from the Mission Creek Fault. It is not clear in which formation the three aquifers lie.

Geophysical Studies

There are no available extensive geophysical studies of the Desert Hot Springs area.

A gravity interpretation of the Coachella Valley was made in 1963 to 1964 by Shawn Biehler as a part of his doctoral thesis.⁽⁵⁾ His study includes maps of Bouguer gravity anomalies in the valley and a refraction line for the upper valley. Dr. Biehler has an aeromag map in his possession on loan from an oil company (Standard?). These maps support the geological interpretation of the Coachella Valley and also help to delineate previously unobserved faults.

Hydrology

Ground Water Basins

The Desert Hot Springs area is contained within two subbasins. The division between the two subbasins is made at the Mission Creek fault. The Desert Hot Springs subbasin lies to the north of the fault. Alluvial fan deposits form the water bearing materials. The poor water quality of this basin limits the use of water for drinking and agricultural purposes.

The Miracle Hill subarea is a further subdivision of the Desert Hot Springs subbasin. The subarea contains the northeast portion of the City of Desert Hot Springs. The water in this subarea is used primarily for hot water spas. Water temperatures range from 82°F to 208°F with an average between 120°F and 130°F. Water temperatures on the southwest side of the fault range from 74°F to 86°F. There are approximately 150 wells in the Miracle Hill subarea but not all are active. The depth at which water is first reached in drilling these wells ranges from 16 feet near the Mission Creek fault to over 300 feet in the southeastern portion of the subarea. The ground water levels and temperature data suggest that water is heated on the north side of the fault. Ground water movement is generally to the southeast except within a narrow strip between the main Mission Creek fault and a splinter fault on the northeast flank of Miracle Hill.

Surface runoff from Morongo Creeks is likely to be the source for ground water recharge in the Desert Hot Springs subbasin. The average annual recharge is approximately 3500 acre-feet. Storage in the Desert Hot Springs subbasin is estimated at 779,000 acre-feet assuming 300 feet of saturated deposits which can be utilized economically and hydrologically. (4) Storage capacity is limited by the relatively impermeable Mission Creek Fault zone and the impermeable Little San Bernardino Mountains. The ground water flows underground through the alluvium of the Morongo Valley and the Little San Bernardino Mountains to Desert Hot Springs where it is dammed by the Mission Creek fault.

The Mission Creek subbasin lies to the southwest of the Mission Creek fault. It receives very little groundwater flow from the Desert Hot Springs subbasin. The depths to ground water along the fault are greater by up to 250 feet than on the immediate north side of the fault. Flowing wells are found in a narrow strip along the Banning fault northwest of Seven Palms Ridge. Most of the ground water is unconfined flows slowly to the south due to the flat gradient.

WATER WELL CHEMICAL ANALYSIS

Chemical analyses of water wells in the Desert Hot Spring area are available from the California Department of Water Resources in Los Angeles and the Coachella Valley County Water District. Chemical analyses are seldom conducted where not required. Private well owners usually have their water analyzed for total dissolved solids and fluoride only.

A half-gallon sample is collected and sent to a laboratory usually in Riverside. The problem with this procedure is the inaccuracies in the results. The measurement of pH and H_2S is seldom accurate unless measured on site. If pH and H_2S are analyzed on-site, there is still a good possibility that readings will be inaccurate due to the unavailability of reliable lab equipment in the field.

The water samples range in temperature from $80^{\circ}F$ to $200^{\circ}F$. The temperature of the water drops during transport to the lab resulting in the precipitation of various solids. This leads to inaccuracies in the results of the chemical analysis. This could be prevented by collecting the samples in thermos containers which should maintain the temperature of the water to a certain extent.

Only one laboratory (Truesdail, Inc.) is willing to do on-site water analyses but they strongly suggested that such analyses would not be worthwhile due to excessive costs and inherent inaccuracies in the results.

There are two reputable labs in the Desert Hot Springs area:

Edward S. Babcock and Sons
P. O. Box 492
3215 Chicago Avenue
Riverside, CA
(714) 684-1881

Clinical Laboratory of San Bernardino
1595 N. D. Street
San Bernardino, CA
(714) 885-3216

The above labs will not conduct on-site chemical analyses. A standard analysis for Ca, Mg, Na, K, CO_3 , HCO_3 , SO_4 , Cl, NO_3 requires a clean half-gallon sample and costs approximately \$30.

A large, reputable () in the Los Angeles area is: (

Truesdail Laboratories, Inc.

225-1564

Contact: Mr. Ziner

This company will collect samples, bring them back to the lab and analyze the water for approximately \$300 (includes \$210 travel expense). However, they will provide thermos containers if we choose to do our own sampling. They will analyze the total contents of the container for approximately \$100. It includes a standard analysis (as above) plus B, F, SiO_2 , pH, electrical conductivity, etc. All solids will also be analyzed.

APPENDIX C
WELL DRILLING COSTS

Water wells in the Desert Hot Springs area were either cable tooled or rotary drilled. Most recent wells were drilled by the more efficient rotary method. Wells are commonly gravel packed with an 8-inch casing. The deepest well is 850 feet and is located on the southwest side of the Mission Creek fault zone. The majority of the wells are less than 300 feet in depth. These shallow depths permit the use of truck mounted rigs in drilling operations.

The subsurface deposits to 1500 feet consist of alluvium, conglomerate, and fanglomerate. This presents difficulties for drillers in that alluvium is a problem to drill, and an occasional boulder in the conglomerate may slow down drilling operations considerably.

Three depths; 500 feet, 1500 feet and 5000 feet, were considered for a prospective geothermal well. Drillers of wells in the Desert Hot Springs area were contacted for estimates of drilling costs for 500 and 1500 foot wells. Two oil well and geothermal well drillers provided estimates for a 5000 foot well.

500 and 1500 foot wells can be drilled by truck mounted rigs using the rotary drilling technique. The estimated costs reflect the drilling, casing, gravel pack, etc for a completed well. Two casing sizes of 8 inches and 12 inches in diameter were considered. A 500 foot well with an 8" casing will cost \$10,000 to \$12,550 in 1975. The same depth well with a 12-inch casing will cost approximately \$12,500 to \$19,000 (Table 3). The estimated costs for a 1500 foot well with an 8-inch casing vary from \$21,000 to \$40,650. A 1500 foot well with a 12-inch casing will cost approximately \$45,000 (Table 4). Additional moving costs of \$3,000 will be required for drillers located outside of the Coachella Valley.

The drillers estimated a two-week drilling operation for a 500 foot well. A rough estimate of 30-plus days was obtained for the drilling of a 1500 foot well.

Local drillers suspect steam at depths greater than 500 feet. They are reluctant to drill deeper due to the limitations of their equipment (which does not include blow out preventers).

Deep Wells

Several types of deep wells were considered (Table 5). An exploratory well is an expendable hole which is used to determine the nature of the reservoir at depth. Generally, two wells are required to analyze a reservoir. This type of well may or may not be utilized for production. It is best to assume that it will serve as a purely exploratory hole which can not be counted on for production purposes. It was suggested that the exploratory well be drilled as follows: 12½ inch diameter hole to 1500 feet; set 8 5/8 inch casing; 7 7/8 inch hole to 5000 feet, run an electric log. This type of well will cost \$120,000 to \$125,000 in 1975 in the Desert Hot Springs area. The price does not include drill steam tests, coring, production pipe or cement. If circumstances are favorable, the exploratory well may be completed as a production well. This requires the installation of a 5½ inch casing to the 5000 foot depth at an additional cost of \$65,000 to \$70,000. This will bring the total cost of a producing exploratory well to \$185,000 to \$195,000 only if circumstances are favorable.

A wildcat well is a potentially producing well drilled in an unfamiliar area where no previous deep wells exist. If a producing zone is encountered, the wildcat well becomes a production well. A wildcat well is roughly twice as expensive as a production well. A 5000 foot wildcat well will cost at least \$200,000 to drill in 1975. An additional \$50,000 would be required to complete the well. A completed wildcat well will cost \$250,000 minimum and \$500,000 maximum.

If results are positive from either the wildcat or the exploratory well, further production wells may be drilled in the area. Two cost estimates were obtained. One is a rough estimate of \$250,000 to \$500,000 for one production well. The second estimate is \$150,000 for a single production (development) well.

All estimates were based on the following drilling conditions: 500 feet of alluvium, 1000 to 1500 feet of conglomerate and fanglomerate, and 3000 to 3500 feet of metamorphics (migmatic gneisses). No predictions for the increase in well drilling costs in the upcoming years is available. However, 1975 drilling costs are generally 30 percent higher than those in 1974 according to Anschultz Corporation. (7)

In addition to drilling costs, mobilization costs involved in transporting the drilling rig to the site must be evaluated. The initial costs to transport the rig to the site will be \$25,000 to \$50,000 in 1975. If the rig is to be moved around to drill new wells in the same area, mobilization costs would be \$2000 to \$3000 for each well site.

Table 3

1975 Well Drilling Costs - 500 ft

<u>Driller</u>	<u>8" Casing</u>	<u>12" Casing</u>
Coachella Valley Pump and Supply	\$10,000	
James E. Wright Co.		\$12,500
McCalla Bros.	\$12,550	\$18,915

Table 4

1975 Well Drilling Costs - 1500 ft

<u>Driller</u>	<u>8" Casing</u>	<u>12" Casing</u>
James E. Wright Co.	\$21,000	\$45,000
McCalla Bros.	\$40,650	

Table 5

1975 Well Drilling Costs - 5000 ft.

<u>Driller</u>	<u>Exploratory Well</u>	<u>Wildcat Well</u>	<u>Production Well</u>
Big Chief Drilling Co.	\$120,000 to 125,000		\$250,000 to 500,000
Anschultz Corp.		\$250,000	\$150,000

APPENDIX D
WATER WELL DATA

Water Well data for the Desert Hot Springs area was collected from various sources including the Coachella Valley County Water District (CVCWD), the Desert Hot Springs County Water District, Proctor's Report, water well drillers and water well owners.

Problems Encountered

- 1 - Access to Well Logs. The water well driller is required to submit copies of the well log to the Department of Public Health and the CA Department of Water Resources (DWR). These agencies will not release a well log unless permission to review the log has been given by the well owner or driller. DWR will release information concerning ground water levels and chemical analyses of the water. DWR sends well logs to the CVCWD for the assignment of state well numbers.

The CVCWD maintains two files containing well logs. The active file contains the records of eight wells in the Desert Hot Springs area. These wells are visited periodically to obtain chemical analyses and to note any changes in ground water levels. The inactive file contains all other well logs and voluntarily submitted data including chemical analyses. All wells are assigned state well numbers. The CVCWD files contain only those well logs which have been voluntarily submitted by the driller or the well owner. As a result, the CVCWD files do not contain data for many of the wells drilled in the Desert Hot Springs area prior to 1954.

- 2 - Location of Water Wells. The CVCWD records are inaccurate. The locations of many of the wells is not clearly specified. For example, one well may be assigned two different state well numbers and remain listed separately in the CVCWD files.

- 3 - Temperatures. The recorded information concerning water temperatures on the well log does not specify the appropriate aquifer or aquifers. The location of perforations in the casing of the well can not be used to determine the temperature for a specific aquifer due to the great length of the perforated zones and/or the problems in interpreting the description of the core samples (see below). Often water temperatures were simply not recorded. These problems made correlation of temperature with depth impossible.
- 4 - Core Descriptions. The driller's description of core samples are usually vague and inconsistent, e.g., "sand and rock" or "mucky sand." One driller obviously employed a variety of terms to describe one core type in several different well logs. The lack of consistent geologic descriptions of the various rock types prevents sharp distinctions between the three aquifers
- 5 - Well Pump Test. Most drillers complete this portion of the well log although few conduct true well pump tests. The driller usually tests by bailing to determine the approximate flow rate before installing a pump for a private customer. After the pump is installed, it is allowed to pump freely for approximately eight hours. The gallons per minute (gpm) and drawdown are measured at that point. The recorded gpm does not reflect the true pumping potential of the well. In the privately owned well, the flow rate usually depends on the size and horsepower of the pump.
- 6 - Other Problems. Water levels are occasionally omitted. Older well logs and more recent untyped well logs are often illegible.

Well Numbering System

Wells are numbered according to their location in the rectangular system for the subdivision of public land (Figure 9). The first number and letter as in 2S5E30F3 indicate the township (T.2S). The following number and letter indicate the range (R.5E). The next two-digit number indicates the section (sec. 30), and the letter following the section number indicates the 40-acre subdivision of the section according to the lettered diagram. The final digit is a serial number for wells in each 40-acre subdivision.

FIGURE 9

Well Name or Owner	Location	Date Drilled	Depth (ft)		Elevation (ft)		Temp. (F)	Flow rate (gpm)	Draw down (ft)	Test Hours	Chemical Analysis	Perforations (ft)
			to 1st water	total	of 1st water	of well head						
Schicke (DHS Recaly Mix, Inc.)	2S4E 13	1957	180	297			82	27	10	8	partial	74-114
Mission Lakes Golf Course	2S4E 23	1975		842			75	1100	35	48		
Driscoll	2S4E 24	1948	160	251			90					
Cree (now DHS Co. Water District)	2S4E 25 B	1950	160	191	1035	1195	82					
Burrow	2S4E 25 A1	1957	180	297			82	27	10	8		175-295
Herbold	2S4E 25 A	1947	132		1018	1150	82				CVCWD	
Edwards	2S4E 34 A1	1966	405	610	775	1180	78	620	14	-		
"22 DHS Co. Water District	2S4E 36 D	1970		807			78	2300	20	24		390-750
Moore	3S4E 02 D	1955	284	310	761	1050	78	15	1	5		
Tarbutton	3S4E 02 E	1952	255	286	775	1030	77	10	1	6		
Ropp	3S4E 11 B?	1956	151	210	759	910	80				CVCWD	
Guthrie	3S4E 11 B	1958	153	211	757	910	84	20	3"	8		191-211
Benham	3S4E 11 B	1964	149	205	761	910	82	25	1	8		
Yerxa	3S4E 12 C	1953	114	150	806	920	78	14	6"	-		
Bannon + Eskijian	3S4E 12 H	1955	89	198	791	880	78	40	5	8		
Miller	3S4E 15 R1						75-85				CVCWD	
Allen	3S4E 18	1956	none	500								240-285
Vista del Valle	2S5E 19 K	1966		487							CVCWD	
Woods	2S5E 20	1939	340	487	1110	1450	80					
Realty Co. of America (Annex #5)	2S5E 29 N	1958	165	260	1025	1190	98	25	11	8		200-240
Discovery	2S5E 30	1934	154		1046	1200	146					
Original Bath House (Coffee)	2S5E 30	pre 1940	170		1040	1210	118					
Chandler	2S5E 30	pre 1950	160		1050	1210	125					
Blue Haven	2S5E 30	pre 1950	140		1060	1200	130					
Realty Co. of Amer. Demonstration	2S5E 30	1952	212		1048	1260	120					

Well Name or Owner	Location	Date Drilled	Depth (ft.)		Elevation (ft.)		Temp (°F)	Flow rate (gpm)	Draw down (ft.)	Test Hours	Chemical Analysis	Perforations (ft.)
			to 1st Water	total	of 1st Water	of well head						
Realty Co. of America	2S 5E 30 A	1958	236	307	1154	1390	105	14	3	8		205-300
Kirby (Stardust Motel)	2S 5E 30 A?	1964	143	261	1237	1380	112	25	10	8		
Coffee	2S 5E 30 F	1954	167	295	1023	1190	110	30	3	-		
Coffee	2S 5E 30 F3	1953	167	303	1023	1190	116	35	3	-		
Palm Village Land Co., Inc.	2S 5E 30 F.R	1963	186	307			134	35	no	8		
Johnson (Nirvana Lodge)	2S 5E 30 G	1959	212	315	1028	1240	135	20	5	8	CVCWD	
McLaughlin Manor	2S 5E 30 G						120				CVCWD	
Coffee	2S 5E 30 H	1954	263	381	927	1190	120	30	20	-		
Licata	2S 5E 30 J	1965	145	275	1095	1240	104	30	6	8		
Cohen	2S 5E 30 J	1958	152	310	1088	1240						
Carney (Sand & Sage Spa Tel)	2S 5E 30 J	1967	173	262	1067	1240	130	22	2.5	8	CVCWD	156-207
Dorsk	2S 5E 30 J+G	1953	153	305			125	40	9	-	CVCWD	
Dorsk	2S 5E 30 K	1957	149	290	1081	1230	120	35	5	8		
Tradewinds Motel	2S 5E 30 K	1957	253	327	927	1180	120	13	8.5	8		
Dowell	2S 5E 30 K	1967	~168	278	1012	1180	121	12	2	8		
Simonian	2S 5E 30 K	1966	162	270	1018	1180	100	40	4	8		
Bengert	2S 5E 30 K	1956	163	310	1017	1180	122	30	20	8		
Berger & Sachs	2S 5E 30 K	1963	156	286	1024	1180	112	50	8	8		
Crandall	2S 5E 30 K	1957	183	325	997	1180	116	28	10	-		
Neone	2S 5E 30 K	1946	127		1053	1180	104					
Robison	2S 5E 30 K	1954	165	209	1015	1180	129	10	3	8		
Fox (Ponce de Leon Motel)	2S 5E 30 K	1973	188	311		1180	100 (130)	60	10	2	partial	195-275
Dinsmore	2S 5E 30 K1						120				CVCWD	
Dorf (Waldorf Motel)	2S 5E 30 K3						116				CVCWD	
Miner (Sahara Motel)	2S 5E 30 K4	1962	140	286	1040	1180	111-112				CVCWD	
Tramview Lodge	2S 5E 30 K7			278			132				CVCWD	
White House Motel	2S 5E 30 K8						122				CVCWD	

Well Name or Owner	Location	Date Drilled	Depth (ft.)		Elevation (ft.)		Temp. (°F)	Flow rate (gpm)	Draw-down (ft.)	Test hours	Chemical Analysis	Perforations (ft.)
			to 1st Water	total	of 1st Water	of well head						
Johson or Allen (Box Motel)	2S 5E 30 K9	1968	165	304	1015	1180	113-125	24	4	8		206-304
Trade Winds Motel	2S 5E 30 K10	1969		278		1180	130	15	3	8		178-278
Coffee	2S 5E 30 L1	1951	135	168	1055	1190	72-88	50	6.5	-	CVCWD	
Smith (formerly Kibby)	2S 5E 30 L2	1951	135	168	1025	1160	72-88	50	6.5	-	CVCWD	
#1 DHS Co. Water District	2S 5E 30 Q	1941	92		1004	1096	88				Proctor	80-195
#8 DHS Co. Water District	2S 5E 30 Q	1957	85	385	1025	1110	90	100	4	8	CVCWD	260-240 365-355
#9 DHS Co. Water District	2S 5E 30 Q	1964		738		1120	102	525	127		CVCWD	360-700
Hedges	2S 5E 30 Q1	1951	134	276	986	1120	108	21	8	8		
#6 DHS Co. Water District	2S 5E 30 Q2	1955	90	207	1008	1098	88	60	4	-		80-100 140-160 172-195
#10 DHS Co. Water District	2S 5E 30 Q7	1965-6		775		1120	90	960?	95	10	CVCWD	250-304 360-700
#3 DHS Co. Water District	2S 5E 31 H	1940	48		1012	1060	95					
#5 DHS Co. Water District	2S 5E 31 H	1948	43	805	987	1030	95	200-300	72		CVCWD	153-170 201-211 213-217
Longyear	2S 5E 31 J (or U)	1959	38	175			86	70	37?	8		135-175
Mc Collough	2S 5E 31 L	1940-6 1954	220		770	990	88					
Desert Springs Estates (Rancho Ramon #100)	2S 5E 31 L1	1954	220	288	770	990	88	75	2	-		220-288
#11 DHS Co. Water District	2S 5E 31 L1	1959	217	288	768	985		75	2	-	CVCWD*	
Hudson (Miracle Manor)	2S 5E 32	1960	150	210			158 (<140)	11	35	8		140-210
Bannon	2S 5E 32	1957	43	103			122	25	4	8		50-103
Fischer	2S 5E 32	1957	63	170			116	45	7	8		
Cabot Yerxa #1	2S 5E 32	1940	90			?	122					
Cabot Yerxa #3	2S 5E 32	1940	40	>200		?	140-176					
Davis	2S 5E 32	1949	128		997	1125	102					
Templeman	2S 5E 32	1955	95		1040	1135	156	10	9	8		
Sullivan	2S 5E 32	1956	161*		849	1010	166					
Two Birch Palms	2S 5E 32		~62	190	855	920	141 (167)					

* depth for middle strata

Well Name or Owner	Location	Date Drilled	Depth (ft.)		Elevation (ft.)		Temp. (°F)	Flow rate (gpm)	Draw down (ft)	Test Hours	Chemical Analysis	Perforations (ft.)
			to 1st water	total	of 1st water	of well head						
Miracle ("2 of Proctor)	2S SE 32	1948	143		1047	1190	145					
#8 of Proctor	2S SE 32	1952?	76	387	1059	1135	142					
#11 of Proctor	2S SE 32	1956	40		1025	1065	146					
#12 of Proctor	2S SE 32	1952?	150		1070	1220	134					
#13 of Proctor	2S SE 32	1952?	165		1075	1240	153					
Bannon	2S SE 32 A	1958	150	212	1150	1300	118	14	20	8		
Sylvanus	2S SE 32 A	1960	142	198	1108	1250	160	15	10	8		
Calbert Yerxa	2S SE 32 A2	1956	204	248	1096	1300	152	5	10	8		
Mona Lisa Lodge	2S SE 32 B	1963	112	180	1128	1240	150	15	21	8	CVCWD	
Hudson	2S SE 32 B-G	1960	150	210			158	11	35	8		
Gheta	2S SE 32 B1	1961	195	246	1055	1250	120	10	17	8		180-246
Fowler	2S SE 32 B4	1968	160	226	1040	1200	123	18	12	8		
Angel View C.C.R.F., Inc.	2S SE 32 C	1955	138	205	1032	1170	136	25	9	-	CVCWD	130-193
Moore	2S SE 32 E	1956	100	165	1000	1100	166	12	27	8	CVCWD	
Racanelli (Lido Palms Motel)	2S SE 32 E	1963	57	170	1043	1100	124	25	4	8	CVCWD	
Bridges	2S SE 32 E1	1958	45	141	995	1040	126	50	4.5	8		80-141
Howard	2S SE 32 E6	1966	68	182	992	1060	120	46	4	8	CVCWD**	110-180
Hess	2S SE 32 F	1959	118	180	1002	1120	130	22	8	8		100-180
Bannon	2S SE 32 G1?	1957	81	180			166	40	7	8		110-180
Romalick "Linda Vista" ^{Broadview Lodge}	2S SE 32 G4	1959	112	170	1028	1140	156	15	20	8		100-165
Riley (Mary Ann Manor)	2S SE 32 H1	1961	145	207	1055	1200	120	23	27	8		140-207
Swirest	2S SE 32 I1	1961	130	200	1070	1200	135	20	9	8		130-190
Lorane Manor	2S SE 32 J	1959	92	161	1068	1160	140 (120)	20	35	8	CVCWD	
DHS Highlands	2S SE 32 K	1956	40	170	1060	1100	176	60	9	8		145-165
Barzow	2S SE 32 L	1959	42	115	1018	1060	130	60	4	8		45-115
Troutman	2S SE 32 L	1956	60	180	1120	1180	168	50	18	8		
Riley	2S SE 32 L	1960	65	125	1115	1180	112	40	4	8		

** active file

Well Name or Owner	Location	Date Drilled	Depth (ft)		Elevation (ft)		Temp. (°F)	Flow rate (gpm)	Draw down (ft)	Test hours	Chemical Analysis	Perforations (ft)
			to 1st water	total	of 1st water	of well head						
Schwartz (Finca Riviera)	2S 5E 32 L	1955	54	135	1016	1070	150	40	3			50-110
DHS Highlands	2S 5E 32 L4	1956	43	200	1127	1170	170	70	11	8		40-125
Das Palmas Hotel Water (now DHS Co. water)	2S 5E 32 NW	1956		610							CVCWD	
Podruchy (Mecca Motel)	2S 5E 32 Q	1965	90	160			129	22	8	8		
Lobb	2S 5E 32 Q1	1957	68	126			136	22	6	8		65-126
Locmis	2S 5E 32 Q3	1974	52	150			123					50-130
Kismet Ledge	2S 5E 32 R1	1960	103	200	997	1100	110-112	35	24	8	CVCWD	
Plett (El Encanto Conv. Hospital)	2S 5E 32 R1	1956	70	150			130	40	5	8	CVCWD	66-146
Warsshaw	2S 5E 32 R2	1958	114	200			115	24	25	8		
Eurcott (Burwood Ledge)	2S 5E 33	1958	145	202			105	5	44	8	CVCWD	140-178
Rabin	2S 5E 33	1960	none	160								
Rabin	2S 5E 33	1960	175	250			100	20	4	8		170-240
Rabin	2S 5E 33	1965	160	230			120	?	30	8		135-230
Broadview Ledge	2S 5E 33	1954	112				156?	19?	26	8		
DHS Highlands	2S 5E 33 E	1955	165	250	1050	1215	120	20				
DHS Highlands	2S 5E 33 E	1956	168	230	1047	1215	110	7	32	8		
DHS Highlands	2S 5E 33 E	1958	104	220	1111	1215	110	27	31	8		170-212
Zide + Rose	2S 5E 33 E	1962	135	270	1095	1230	114	25	no	-		
Smith	2S 5E 33 E5	1964	158	281	1072	1230	115	10	50	8	CVCWD	
Smith (Dorville's Sun Spa Ledge)	2S 5E 33 G5	1973		301			114	38	63	24		
Dravlet (Kismet Ledge)	2S 5E 33 M1	1960	103	200	1097	1200	110	35	24	8		130-200
Simone + Rabin	2S 5E 33 M3	1954	141	245	1044	1185	112	20	30	-		177-245
Bartusch (Little Admiral Inn)	2S 5E 33 M3	1963	116	250	1084	1200	110	25	38	8	CVCWD	
Bartusch	2S 5E 33 N	1958		200			115	20	10	8		
Bannen	2S 5E 03	1955-6	207	335		?						200-260

Well Name or Owner	Location	Date Drilled	Depth (ft)		Elevation (ft)		Temp. (F)	Flow rate (gpm)	Draw down (ft)	Test Hours	Chemical Analysis	Perforations (ft)	
			to 1st water	total	of 1st water	of test head							
Erwin and Assoc.	3S SE 03 L1	1954	235	390	915	1150	98				CVCWD**	175-256	
* West Coast Bldg. Specialties	3S SE 03 N	1957	142	267	937	1080	90						
Erwin (Terra Vista Corp.)	3S SE 03 P1	1954	164	300		?	94	30	4	-			
* Johnson #2	3S SE 03 R1	1955	147	300		?	106	38	2	---			
Car (Tru Wall Construction)	3S SE 04 A	1964		400		1180							
Culbertson	3S SE 04 C	1952		275		1120	92						
Freeman	3S SE 04 D	1957	75	170	1005	1080	106	35	7	8			
Reaves	3S SE 04 D2	1948	76	108	1004	1080		15	3.5				
Tru Wall Construction	3S SE 04 H1	1965	246	355	904	1150	92	15	2	8	CVCWD**		
Bannon, Bain, Stewart	3S SE 04 J	1957	182	260	938	1120	90	18	6	8			
Sternath	3S SE 04 L1	1959	110	175	1015	1125	83	20	10	8			
Guptill	3S SE 04 L2	1959	155	207	965	1120	86	14	37	8			
Dewell + Minton	3S SE 04 M	1959	210	330	870	1080	96	40					
Alpin	3S SE 04 M1	1960	199	308	801	1000	92	26	no	2			
Twitchell	3S SE 04 N	1959	161	235		990	90	7	65	4			
Erickson	3S SE 04 N1	1959	161	235		990	80.5	7	63	4			
Kolesnikoff	3S SE 05 A or R	1967	55	200			123						
Reed	3S SE 05 A	1960	75	129	965	1040	90	30	4	8			
Cabot Yerxa	3S SE 05 A	1960	55	147	985	1040	110	50	12	8			
Cabot Yerxa	3S SE 05 A	1957	43	121	997	1040	96	43	7	8			
Cabot Yerxa	3S SE 05 A1	1950	18	153	1022	1040	102	40	14	8			
Willd	3S SE 05 B1	1958	30	220	970	1000	108	100	13	8	CVCWD		
Hubbard #2 (Bubbling Wells)	3S SE 05 C	1947	23	150	967	990	108						
Hubbard #1	3S SE 05 G	1946	16		944	960	108						
Dumbeck	3S SE 05 J1	1964		303		950	104						
Aldrich	3S SE 05 J2	1973		398		950	80.5	70	5	12	CVCWD		
Shirley Bros.	3S SE 05 Q1 S	1973		632		900	84	950	11				

** active file

Well Name or Owner	Location	Date Drilled	Depth (ft)		Elevation (ft)		Temp. (°F)	Flow rate (gpm)	Draw down (ft)	Test Hours	Chemical Analysis	Perforations (ft.)
			to 1st water	total	of 1st water	of well head						
McMillan	3S 5E 06	1960	135	197			84	30	4	8		127-197
Mc Knight	3S 5E 06 C	1963		215		940		25	2.5	8		
McDonald	3S 5E 06 D	1957	190	312	770	960	82	8	1	8		
Beltier	3S 5E 06 F	1965	160	215	800	960	70	22	no			
Volpe	3S 5E 06 LIS	1968	155	200	785	940	80	27	no			
Watry	3S 5E 06 P	1964	122	195	758	880	82	25	2	8		
Du Carme	3S 5E 06 P 2S	1967	120	195	760	880	84	58	4	8		
McDonald	3S 5E 07 F	1960	82	200	748	830	80	50	7	8		
Downing (Country Squire #1)	3S 5E 07 L	1966	78	185	747	825	84	40	4	8		
Berry	3S 5E 07 L	1956	74	140	751	825	82	34	5	8		
Country Squire Tr. Park	3S 5E 07 L	1971		209		825		70	20	24		
Watry	3S 5E 08	1960	62	170			82	25	25	8		100-170
Watry	3S 5E 08 E	1967	65	158	735	800	84	35	74	8		
Thomas	3S 5E 08 J1	1952	120	150	750	870	80	9	2	-	CVCWD	
McGreary	3S 5E 08 J2	1963	130	239			84	50	2.5	8	CVCWD	
Casper + Buol #1	3S 5E 08 J3	1969		197		870	82	25	3	8		
Casper + Buol #2	3S 5E 08 J4	1969	126	185	744	870	82	15	1.5	8		
Stevens	3S 5E 08 L1	1964		205		820	82	25	3	8		
House	3S 5E 08 L2	1965	96	225	724	820	82	55	8	8		
Kurt	3S 5E 08 L3S	1973	90	200	730	820		20	30	24		
Foster	3S 5E 08 M	1952	64	195	716	780		55	9			
Watry	3S 5E 08 N	1964	74	154	706	780	84	50	14	8		
Ricker	3S 5E 08 N	1956	60	150	720	780	70	5	20			
Froats	3S 5E 08 N	1964	72	157	708	780	82	45	24	8		
Hansen	3S 5E 08 N1	1951	60	178	720	780						
Jefferson	3S 5E 08 Q	1963	126	241	714	840	84	40	4	8		
Donaldson or Schilesen?	3S 5E 08 R	1956	108	135	732	840	84	9	5	8		100-130

Well Name. or Owner	Location	Date Drilled	Depth (ft.)		Elevation (ft.)		Temp. (°F)	Flow rate (gpm)	Draw down (ft.)	Test Hours	Chemical Analysis	Perforations (ft.)
			to 1st Water	total	of 1st Water	of well head						
Rasmussen	3S 5E 08 R 2	1967	122	180	718	840	86	25	5	8		
Perdue	3S 5E 09	1947	168		772	940	80					
Whitman (Perdue Well)	3S 5E 09 J 1	1965		285		930		25	2	8		
Farris	3S 5E 09 R	1965	150	200	770	920	70	20				
Shoemaker	3S 5E 09 R	1965	149	200	771	920	70	20				
Norris (formerly Yarnischon)	3S 5E 10	1959	180	260			85?	20		8	CVCWD	120? - 260
Guptill	3S 5E 10 A	1956	117		913	1030	106	25	3			
Tarbutton	3S 5E 10 A	1955	112	180	928	1040	96	30	4	8		
Holmes	3S 5E 10 G	1951	79	425	901	980	165 (76)	65	5	8		
Holmes	3S 5E 10 G	1951	78	200	902	980	204	58	13.5			
Kellog	3S 5E 10 G	1962	100	212	880	980	135	30	no			
Desert Crest Hot Springs	3S 5E 10 G	1963	81	255			82	200	12	8		50-255?
Desert Crest Hot Springs	3S 5E 10 G	1964		217			86	20	2	8		217-237
Desert Crest Hot Springs	3S 5E 10 G 1	1962	90	238	890	980	118	50	6.5			117-238
Desert Crest Hot Springs	3S 5E 10 G 2	1963	80	200	900	980	126 (100)	45	3	8		80-200
Tarbutton (Lucky 7)	3S 5E 10 H	1950	75-83	331	897-905	980	200	30-60	7-20	16		
Tarbutton	3S 5E 10 H	1951	72	200	908	980	165	30-45	4	8		
Elliot	3S 5E 10 H	1953	78	120	882	960	190	30	6			
Venturino	3S 5E 10 H 3	1963	79	500	881	960	208	65	5	8		
Venturino	3S 5E 10 H 5	1963	78	220	882	960	204	58	12.5	8	CVCWD	
Tarbutton	3S 5E 10 H 7	1959	102	168	878	980	86	20	3	8		
Kellog #2	3S 5E 10 H 8	1968	120	140	840	960	95					
Eldridge	3S 5E 10 J	1956	74	190	871	945	120	60	2	8		
Young	3S 5E 10 J 1	1951	75	206	870	945	118 (now 110)	45	11.5		CVCWD	
Markow	3S 5E 10 J 2	1970	98	220	847	945	145	35	no	8		
Crawford	3S 5E 10 L 4	1968	180	260	770	950	85					
Auer	3S 5E 10 R	1964	91	217			102	40	27	8		

Well Name or Owner	Location	Date Drilled	Depth (ft)		Elevation (ft)		Temp. (°F)	Flow rate (gpm)	Draw down (ft)	Test Hours	Chemical Analysts	Perforations (ft.)
			to 1st water	total	of 1st water	of well head						
Tarbutton	3S 5E 11	1955	112				96-125					
Tarbutton	3S 5E 11 J ^{or L}	1962	133	191			192	18	6'	6		
Tarbutton	3S 5E 11 J1	1953	234	304	846	1080	104	5-10	0.5	8		
Devers	3S 5E 11 J	1955	215	285	865	1080	134	12	1.5			
Weinberg	3S 5E 11 J2S	1972	255	316	835	1090	124	60				
Moody	3S 5E 11 K	1956	170	237	920	1090	150	17	2	8		
Tarbutton	3S 5E 11 K1	1956	210	248	830	1040	128	30	5	8		180-226 198-248
Langlois Bros.	3S 5E 11 L	1953	104	146	906	1010	175	18	9			
Langlois Bros	3S 5E 11 M	1952	163	200	847	1010	164	11	1			
Carlson	3S 5E 11 M ^{or P} _{or N}	1956	160	240	850	1010	176	20	1.5	8		
Langlois Bros.	3S 5E 11 M1	1951	123	163	887	1010	160	12	1			
Locke	3S 5E 11 M4	1952	99	142	911	1010	175	17.5	5			
Johnson	3S 5E 11 N1	1951	105	235	895	1000	190	37	4			
Bannon	3S 5E 11 P	1959	135	202	875	1010	160	20	2	8		130-202
Sullivan	3S 5E 11 Q	1956	170	240	870	1040	166 ⁵	15	4	8		
Muller	3S 5E 11 Q	1957	183	259	857	1040	160 ⁵	19	2	8		
Tarbutton	3S 5E 11 Q1	1961	202	271	838	1040	155	20	1	8		200-271
Longyear	3S 5E 11 R1	1960	212	270		1060	145	12	1	8	CVCWD	
Sorenson	3S 5E 12 P1	1954	308	379			104	10	1	8	CVCWD ²	304-379
Healing Water (Bridenbecker)	3S 5E 14	1958	146	255			138	30	5	8		180-249
Helwig	3S 5E 14	1955	212	242			120	17	0.6			205-235
Schoning	3S 5E 14	1959	168	234			106	16	4	8		165-234
Banon	3S 5E 15	1959	201	264			104	15	2.5	8		195-264
McHenry	3S 5E 20	1954	-	300								
Texaco	3S 5E 35	1954		7,474		1516	120					

Water Well Pumps

The submersible type pump is the most commonly used pump in the wells in Desert Hot Springs. Special bronze parts are necessary to prevent corrosion in the mineralized warm water. Bronze pumps last three to five years in private wells. Recently, pumps last an average of two to three months before showing extensive wear. Some attribute this to a decline in quality control at the point of manufacture.

Line shaft pumps are also used in Desert Hot Springs. This type is uncommon because the shaft often stretches in the warm water. It results in premature breakdown of the pump.

References Cited

1. Proctor, Richard J., "Geology of the Desert Hot Springs - Upper Coachella Valley area, California," California Division of Mines and Geology, Special Report 94, 1968.
2. California Department of Water Resources, "Coachella Valley Investigation," Bulletin No. 108, 1964.
3. Frank Kibbe, Desert Hot Springs County Water District - personal communication.
4. Tyley, Stephen J., "Analog Model Study of the Ground Water Basin of the Upper Coachella Valley, California," USGS Water Supply Paper 2027, 1974.
5. Biehler, Shawn, "Geophysical Study of the Salton Trough of Southern California," unpublished thesis, California Institute of Technology, 1964.
6. Tyley, Stephen J., "Artificial Recharge in the Whitewater River area, Palm Springs, California," USGS Open File Report, January, 1973.
7. Malcolm Mossman, Anschultz Corporation - personal communication.

Bibliography

- Brantley, J.E., 1961. Rotary Drilling Handbook: Palmer Publications, New York.
- Bookman, Max, Edmonston, R.M., and Gianelli, W.R., 1960. Report on Water District Organization for the Whitewater - Coachella Area, Riverside County, California: Glendale, California, Bookman, Edmonston, and Gianelli, 24p.
- Biehler, Shawn, 1964. Geophysical Study of the Salton Trough of Southern California: unpublished PhD dissertation, California Institute of Technology, 139p.
- California Department of Water Resources, 1964, Coachella Valley Investigation: Bulletin 108, 145p.
- _____, 1963. Feasibility of Serving the Coachella Valley County Water District from the State Water Facilities: Bulletin 119-3, 94p.
- _____, 1970. Geothermal Wastes and Water Resources of the Salton Sea Area: Bulletin 143-7.
- _____, 1966. Reclamation of Water from Wastes - Coachella Valley: Bulletin 80-3, 82p.
- California Division of Water Resources, 1954. Ground Water Occurrence and Quality, Colorado River Basin Region: Water Quality Investigation No. 4, 59p.
- _____, 1952. Ground Water Basins in California: Quality of Water Investigation No. 3, 44p.
- California State Water Quality Control Board, 1963. Water Quality Criteria, 2nd Edition: Publication No. 3-A.
- Dibblee, T. W., Jr., 1954. Geology of the Imperial Valley Region, California: California Division of Mines, Bulletin 170, Chapter 2, pp. 21-28.
- Hill, R. A., 1940. Geochemical Patterns in Coachella Valley: American Geophysical Union Transactions, V. 21, pt. 1, pp. 46-58.
- Huberty, M.R., Pillsbury, A.F., and Sokoloff, V.P., 1948. Hydrological Studies in Coachella Valley, California: California University Agr. Expt. Sta., 31p.
- Koecher, A.E., and Harper, W.G., 1927. Soil Survey of the Coachella Valley Area, California: U.S. Department of Agriculture, pp. 485-535.
- Miller, R.E., 1967, Proposed Water Resource Study of the Upper Coachella Valley Area, California: U.S. Geological Survey, Open File Report, 25p.
- Pillsbury, A.F., 1941. Observations on the Use of Irrigation Water in Coachella Valley Area, California: U.C. Berkeley, Agricultural Expt. Station, Bulletin 649.
- Proctor, Richard J., 1968. Geology of the Desert Hot Springs - Upper Coachella Valley area, California: California Division of Mines and Geology, Special Report 94, 49p.
- Richter, C.F., Allen, C.R., and Nordquist, J.M., 1958. The Desert Hot Springs Earthquakes and their Tectonic Environment: Seismological Society of America Bulletin, Vol. 48, pp. 315-337.

Sonderegger, A.L., 1921. Coachella Valley County Water District Report on the Water Supply of Coachella Valley: Los Angeles, CA, 33p.

Soske, J.L., 1935. Theory of Magnetic Methods of Applied Geophysics with an Application to the San Andreas Fault: unpublished PhD dissertation, California Institute of Technology.

Troxell, H.C., 1948. Hydrology of Western Riverside County, California: Riverside County Flood Control and Water Conservation District Report, 11p.

Tyley, Stephen, 1974. Analog Model Study of the Ground Water Basin of the Upper Coachella Valley, CA: U.S. Geological Survey. Water Supply Paper 2027, 77p.

Tyley, Stephen, 1973. Artificial Recharge in the Whitewater River Area, Palm Springs, CA: U.S. Geological Survey, Open File Report, 51p.

U.S. Department of the Interior, 1973. Final Environmental Statement for the Geothermal Leasing Program, 4 Volumes.

Waring, G.A., 1965. Thermal Springs of the U.S. and Other Countries of the World: U.S. Geological Survey, Professional Paper 492.

Association	Contact	Address/Phone	Comment
<u>Water Well Drillers</u>			
James E. Wright Co., Inc.	Mr. T. G. Brown Executive Vice Pres General Manager	P.O. Drawer G 83801 Avenue 48 Indio, CA 92201 (714) 347-0741	Well logs at CVCWD; estimates on drilling costs
Meridian Drilling	---	55557 29 Palms Hwy Yucca Valley, CA (714) 365-4959	No contact
S&S Water Well Drilling and Pump Company	Mr. Sanford	64936 Desert View Ave DHS, CA (714) 329-5588	Info on DHS wells; emphasis on well service
Coachella Valley Pump and Supply, Inc.	Owner	89085 Avenue 64 Thermal, CA (714) 396-2192	Family operation; drilled only one well in DHS; estimates on drilling costs
Beylik Drill, Inc.		591 South Walnut St. La Habra, CA 90631 (213) 691-0903	Drilled for DHS Co. Water District; asked for estimates on drilling costs
McCalla Bros.	Mr. Bill Province	980 Nevada Redlands, CA (714) 793-2913	Driller for DHS Co. Water District, Mission Country Club; estimates on drilling costs
Barber Bridge Drilling Co.	---	3020 Empire Avenue Burbank, CA	Driller for DHS Co. Water District
C-T Pumps		San Bernardino (714) 884-8263	Service pumps only

Association	Contact	Address/Phone	Comment
<u>Geothermal Drillers</u>			
Anschultz Corp.	Mr. Malcolm Mossman	Denver, Colo. (303) 573-5665	Drilling cost estimates
Big Chief Drilling Co.	Mr. Bill Glass	Oklahoma City (405) 843-5721	Drilling cost estimates
<u>Miscellaneous Contacts</u>			
Coachella Valley Co. Water District	Mr. Spencer	85820 Coachella Hghts Coachella, CA (714) 398-2651	Well logs, chemical analyses
DHS County Water	Mr. Frank Kibbe Engineer	6547 E. Second St. DHS, CA (714) 329-6448	General water info on DHS area, some well logs, chemical analyses
Desert Water Agency		1345 N. Palm Canyon Dr. Palm Springs, CA (714) 325-1321	Referred to CVCWD
City of DHS	Mayor Schultz	Office: (714) 329-7814 Home: (714) 329-5740	Source of other contacts
	R. Dippner City Manager	City Hall (714) 329-6411	
	Bill Sullivan Administrative Asst.	City Hall (714) 329-6411	
	Bob Street Administrative Asst.	City Hall (714) 329-6411	
So. Calif. Edison	Mr. Jack McFadden	Palm Springs (714) 325-1206	Lead-in contact w/SCE

Association	Contact	Address/Phone	Comment
<u>Miscellaneous Contacts (contd)</u>			
So. Calif. Edison (contd)	Mel Swinney Geothermal	Rosemead (213) 572-2617	Referred to Robinson; SCE not planning geothermal development in DHS
	Russ Robinson Geologist	Box 800 Fuel Supply Dept. Rosemead, CA 91770 (213) 572-2992	Geological info not released--SCE preliminary studies on geology of DHS w/Occidental Petroleum
Occidental Petroleum	William D'Olier	(415) 981-5700	No longer w/Occidental; was in charge of DHS study, referred to Eschner for Occidental info
	Stanford Eschner	Bakersfield, CA (805) 327-7351	Referred to Collins
	Don Collins	Bakersfield, CA (805) 327-7351	Promised to find their info on DHS and call me, indicated that there wasn't much
	Mike Donnelly Geologist	Bakersfield, CA (805) 327-7351	provided Occidental's report on the Upper Coachella Valley
Texaco	A. J. MacMillan	LA	Only one well in area--Stone #1 "Edom"--sent well log
Phillips Petroleum	Dr. Berge Geothermal Office	P.O. Box 752 Del Mar, CA 92014 (714) 755-0131	Name given by Marshall Reed, USGS; referred to Crosby
	Gary Crosby Geothermal Office	P.O. Box 752 Del Mar, CA 92014 (714) 755-0131	No real info on DHS--just a collection of literature
Union Oil	Dr. Carel Otte Geothermal	(213) 486-6260	Union Oil not involved in that area--suggested contact w/D'Olier at Occidental

Association	Contact	Address/Phone	Comment
Miscellaneous Contacts. (contd)			
USGS Conservation Division	Mr. Marshall Reed	(415) 323-8111 Ext. 2841	Name given by Robinson, SCE; thesis study of Imperial Valley; suggested contacts
USGS	Ms. Birdsall	LA (213) 688-2850	Open file reports--must visit office to see them
UCLA Geologic Library		(213) 825-1055	
American Thermal Resources	Mr. Roy Parodi	Bakersfield (805) 833-1420	Name given by Robinson, SCE; did very little study of DHS area; interested in doing professional consulting work in the area for this project
U.C. Richman Field Station	Dr. Oswald High Protein Algae Project	(415) 642-0885 235-6000 235-2801	Never made contact--impossible to reach
Prasada, Inc.	L. M. Switzer	1350 Summit Berkeley, CA (415) 843-0797	Consultant for Oswald's project--did H ₂ O sample study of DHS area for their project--decided to use another area--sending info on their project
U.S. Bureau of Land Management	Neal Pfulb Director of Desert Planning Bill Collins	1414 University Riverside, CA (714) 787-1367 (714) 787-1355	Referred to Collins Gave me a copy of the final environmental statement for the Geothermal Leasing Program

Association	Contact	Address/Phone	Comment
<u>Miscellaneous Contacts (contd)</u>			
CA Department of Water Resources.	Mr. White	849 South Broadway (9th and Broadway) (12th Floor) LA (213) 620-5494	Well logs, but must have owner's permission to see them; may see chemical analyses and water level information
UC Riverside	Dr. Shawn Biehler Dr. Tyler Coplen	(714) 787-4507 (714) 787-4611	Info on geophysics of Coachells Valley UCR not involved in any geochem. studies of Coachella Valley
Riverside County Health Dept.	Paul Begley	(714) 787-6543	Well logs, reluctant to release
Scripps Institute of Oceanography	J. E. Lupton		Studied dissolved R and He gases in water to see if there was a connection w/earthquake prediction; Bill Sullivan, DHS, has copy of Lupton's paper
<u>DHS</u>			
Angel View Crippled Children's Rehabilitation Foundation	Bud Jasper	(714) 329-6471 12379 Miracle Hill Rd. DHS, CA	Info on their water well and other local wells
Former driller	Cap Buol	(714) 329-6262	Out of town until October
Well owner	Jim Fridly	(714) 329-6645	Dispelled rumor about water in DHS originating from Sierras (dye in water)
Ponce de Leon Motel	Oliver Fox	DHS, CA	Info on his well

Association	Contact	Address/Phone	Comment
<u>Chemical Labs</u>			
Edward S. Babcock and Sons		P.O. Box 492 3215 Chicago Avenue Riverside, CA (714) 684-1881	Well water analyses, estimates
Clinical Lab of San Bernardino		1595 North D St. San Bernardino, CA (714) 885-3216	Well water analyses
Truesdail Labs, Inc.	Mr. Ziner	LA (213) 225-1564	Well water analyses, estimates