ANALYSIS OF GEOTHERMAL WELL INTERFEERENCE
IN THE TABLE ROCK VICINITY
BOISE, IDAHO

DECEMBER 21, 1983

SHERL L. CHAPMAN
CONSULTANT

SPECIALIST IN
GROUND-WATER HYDROLOGY/WATER RIGHTS/WATER WELL DESIGN/GEOTHERMAL RESOURCES
This firm was retained by Mr. Dallas Harris to analyze the potential for interference between geothermal development proposed for his property located in the SE/4 NW/4, Section 20, T3N, R3E, near Barber Flat, Idaho, and the wells drilled along the Boise Front herein referred to as the Boise Geothermal Limited wells and the Warm Springs Water District wells. The need for the analysis of potential interference was prompted by protests of Mr. Harris's applications for diversion of geothermal fluids for space heating and other purposes in the Barber Flat area. The protesters claimed that diversion of water from Mr. Harris's wells would interfere with senior water and geothermal rights and adversely affect their ability to maintain the use of geothermal fluids as contemplated under existing and pending water right applications.

In order to determine the interrelationship of all wells, the parties involved in the dispute stipulated to monitor their respective wells and provide data to the other parties for analysis. This stipulation entered into on October 8, 1982 required that data be collected from a period November 1, 1982 through April 1, 1983 for this determination. This report is the result of an analysis of these data, geologic and hydrologic field work and research of the literature on geothermal resources in southern Idaho.

Activities of this firm include supervision of the drilling program for the original Harris well, collection of drill cuttings, water samples for analysis, downhole thermal gradient surveys and monitoring of the static water level for a period from November, 1982 through April, 1983. Measurements of the static water level on the well were made using a Stevens Type F water level recorder.
with correlative measurements made using a steel tape and electric well sounder. The Stevens Type F recorder failed to operate between February 2 and March 5, 1983 and the data collected for that period from the Harris well was collected by using an electric well sounder and steel tape.

Water level data were provided this office by Anderson-Kelly Consulting for the Warm Springs Water District well #3 and the Boise Geothermal Limited well #3 and data from the Harris geothermal well #1 was provided to Anderson-Kelly by this firm. All of these data were plotted on a master graph included for this report as Appendix I showing the relationship of the water level fluctuations for the period of record. These data and their interpretation will be discussed in a later section of this report.

GEOLGY

The geologic framework of this general area is composed of cretaceous granitic rocks forming the hills to the north of this Boise Valley. The granitic rocks are expressed as rounded knobs and outcrops in the foothills to the north and northeast of the subject area and outcrops of the rock unit occur within a few hundred feet of the Harris geothermal well. Younger sediments and volcanic rocks occur to the south, southeast and southwest of the foothills and are expressed either as table lands adjacent to the foothills or as flat sedimentary terraces. The volcanic rocks commonly include rhyolite and latite as found in the Table Rock area and while some rhyolitic rocks are found on Table Rock, the Table Rock bench itself is composed of a consolidated sandstone related more to the
lacustrine and fluvial sediments found further into the valley. The Boise Warm Springs Water District well and the Boise Geothermal Limited well are drilled into sedimentary materials rather than the volcanic or granitic rocks and a third geothermal well, not a party to this action known as the "Beard well", is reported to be drilled into tuffaceous rhyolitic materials which may underlie the sediments at some locations further south beneath the Boise Valley. The Harris geothermal well is the only well known to this author to be drilled directly into the granitic rocks and obtains its water solely from that rock unit rather than either the tuffaceous rhyolites or sediments as in the other geothermal wells. For the purposes of this report and because of the conflict that exists over geothermal and water rights, the sedimentary units were not subdivided but merely considered as part of the Idaho Group.

Geothermal fluid movement in the Boise Front area is generally understood to be complex and fault controlled. A number of intersecting faults parallel and sub-parallel to the Boise Front as well as additional faults which appear to trend northeast-southwest traverse the area and it is through these faults that it is believed that cold waters migrate downwards to be heated. The hot water then rises along other faults to appear at the surface as hot springs or to be withdrawn through wells at several locations along the Boise Front and in the Boise Valley. A great deal of work has been done on the structural makeup of this area by private consultants, the State of Idaho, and the U. S. Geological Survey and Boise State University personnel.

It appears that the water obtained in the Dallas Harris well is rising from a fault or faults in this area which trend north to
northwest which are somewhat parallel to the faults providing water to the Boise Warm Springs Water District and the Boise Geothermal Limited wells to the northwest. It is important to note, however, that there appears to be at least one major cross-cutting fault which trends north-northwest which transects the faults that are sub-parallel to the Boise Front which could very well provide a barrier to northwest-southeast movement of geothermal fluids. The water level data collected seems to confirm the isolation of the Barber Flat area from the area being developed for geothermal resources to the northwest near the penitentiary.

HYDROLOGY

The general hydrology of this region with regard to the geothermal resources would indicate that recharge to the geothermal system is generally from the north in the mountainous regions. Snowmelt and precipitation percolates downward through jointing, fractures and fault zones to a great depth below land surface where it is heated while it is moving laterally to the south. As the water becomes warmer, it rises due to a change in its density and approaches the surface along the Boise Front and beneath the Boise Valley. Development of geothermal resources has occurred along the Boise Front and to some extent in the Boise Valley taking advantage of the upward leakage from the deep geothermal systems. Where wells have penetrated open fault zones, production of the geothermal resource has been relatively high and an economic resource appears to be available.

Because the high production areas for geothermal resources is generally along relatively narrow fault zones, the concern existed
that significant development could possibly cause interference between wells thus this controversy was precipitated. Where wells penetrate a common geothermal aquifer or fault zone and significant production occurs, there well may be some interference. However, where these faults are intersected or cross cut by other faults, barriers often occur separating the two production aquifers or at least limiting the potential for interference. It is believed by this author that this type of limitation or boundary effect occurs along the Boise Front between the Harris development and the development for Boise Warm Springs Water District and the Boise Geothermal Limited wells.

As indicated previously, data were collected by Anderson-Kelly and Chapman Consulting on the Boise Warm Springs Water District well #3, the Boise Geothermal Limited well #3 and the Harris geothermal well #1. A plot of the water level fluctuations in each of the wells for the period of record collected is shown on Appendix 1. Boise Warm Springs Water District well began the monitoring period on November 1 with a water level of approximately 67 feet below land surface. Decline occurred in the well continuously until about mid February, 1983, at least partially because of withdrawal of geothermal water from the well and possibly some interference from other wells. About mid February, the water level began to recover in the well until about March 11, 1983 at which point in time it began to decline again, although not of the same magnitude as before. The period of record ended on April 14, 1983 with only one minor episode of recovery during the balance of the period of record. This severe decline to a water level of about 106 feet below land surface is believed to be the result of depletion of water from storage in the geothermal aquifer over the period of pumping of the
well. The Warm Springs Water District well #3 is utilized for geothermal space heating through the winter months and as such a constant period of record without pumping was impossible to obtain.

The Boise Geothermal Limited well #3 water level records were only available from about November 2 through December 1, 1982. During that period of record, the water level declined from approximately 8.5 feet below land surface to a low of about 10.5 feet below land surface, a decline of approximately two feet during a one month period. The Dallas Harris geothermal well was monitored from about November 8, 1982 to April 5, 1983. The initial static water level was 38.96 feet below the top of the casing at the initiation of the measurement and the fluctuation in the well, which was not pumped during the period of record, ranged from an increase of nearly one foot to a low in the well of 40.94 feet below the top of the casing, an overall decline throughout the entire period of record of 1.98 feet. This very gentle decline, which was nearly constant throughout the period of record, demonstrated no relationship to the severe decline in the Warm Springs Water District well of about 39 feet. Since the record was unable to be kept on into the spring months, it is entirely possible that the water level in the Dallas Harris well would have recovered to its original level through normal recharge during the spring months since May and June is the normal recovery period for this area.

Viewing the plot of water level measurements, it is apparent that no effect from the Warm Springs Water District well is found in the water level fluctuations of the Harris well. Additionally, it was reported by Mr. Jack Kelly of Anderson-Kelly at the Rocky Mountain Ground Water Conference in April, 1983, that during the
testing operations on the Boise Geothermal Limited wells that no
effect was found in the Warm Springs Water District well #3 which
lies between the Boise Geothermal Limited wells and the Harris
well. He also reported that boundary conditions exist throughout
the geothermal system as they have analyzed it which would indicate
limited effects or impacts on other wells as distance from the
discharging well increases.

CONCLUSIONS

Based on the data collected and the plot of water level
fluctuations in the Warm Springs Water District #3 well, the Boise
Geothermal Limited well #3, and the Dallas Harris geothermal well
#1 and the type of geology encountered by each, allows several
conclusions to be drawn. These are as follows:

1. The Harris geothermal well obtains thermal water directly from
   a granitic aquifer as opposed to thermal fluids withdrawn from
   sediments by the Boise Geothermal Limited and Warm Springs
   Water District wells.

2. The graph of water level fluctuations shows no interference or
   interconnection between the Harris geothermal well and the
   other wells for which data was collected for the period of
   record November 1, 1982 to April 1, 1983.

3. The primary geothermal aquifers are intersected and cross cut
   by many faults causing boundary conditions and limits or
   eliminates interference between wells.

4. Statements made by Mr. Kelly at the Rocky Mountain Ground Water
   Conference indicate no communication between the Boise Geothermal
   Limited wells and Warm Springs Water District well #3, therefore,
it is unreasonable to expect interference with either well by
the Harris well which lies to the southeast of both wells and is
approximately 12,500 feet from the Warm Springs Water District
#3 well.

5. Because of a total lack of data showing interference between the
wells, Mr. Harris's applications for use of the resource should
be approved without further delay.