SB GEO, INC.

December 13, 2000

Mr. Dan Sanchez
US DOE – Albuquerque Operations
PO Box 5400
Albuquerque, NM 87185

RE: DE-FC04-00AL66975

Dear Mr. Sanchez:

Enclosed please find our Final Technical Report for the Phase I effort. The report includes the Exploration Data Report, Exploration Well Permit Requirements, Financial Arrangements and the Exploration Well Drilling Program as required by the Cooperative Agreement.

Given the current state of need for new electrical generation in the West, we are anxious to proceed with Phase II and Phase III of the solicitation. As you may know, Nevada's Energy Policy Committee is currently in the process of making recommendations to Governor Guinn. There has been a keen interest in promoting geothermal development in Nevada since it is a reliable and clean source of energy that is not subject to the volatility of the commodity market. We see this as an excellent opportunity to identify and develop new geothermal resources.

SB Geo looks forward to continuing it relationship with the Department of Energy. If you have any questions or need additional information, please contact me at 775-852-1444 ext. 21.

Sincerely,

Rebecca Wagner
Compliance Manager

cc: Nancy Hoffman
Norm Warpinski
Marshall Reed
OSTI

Offices:
P.O. Box 18199
Reno, Nevada 89511
(775) 852-1444
Fax (775) 852-1807

Billing:
1010 Power Plant Dr.
Reno, Nevada 89511
(775) 852-1444
Fax (775) 852-1807

GEOTHERMAL EXPLORATION

ACTIVITIES AT THE

STEAMBOAT SPRINGS KGRA

Steamboat, Nevada

Prepared for
SB GEO, Inc.

By
Colin Goranson
(Geology Portion Edited from P. van de Kamp)
Sept. 2000

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Geothermal Exploration in the Steamboat Springs KGRA

1.0) Steamboat Springs KGRA Geothermal Overview

The Steamboat Springs Known Geothermal Resource Area (SBS KGRA) is located in the South Truckee Meadows area approximately 9 miles south of Reno, Nevada (see Figure 1). The geothermal system consists of a high temperature area (Steamboat Hills) with measured downhole temperatures >400°F and a moderate temperature geothermal area with reservoir temperatures between 285°F to 360°F (Steamboat Springs). The Steamboat Springs resource region is located directly northeast of the Steamboat Hills area. The Steamboat Springs and Steamboat Hills resource areas share a common heat source; however, the producing geothermal geologic horizons differ.

Several low temperature (80°F to 250°F) geothermal areas have been identified in the South Truckee Meadows area. These low temperature geothermal systems are formed from mixing of geothermal and groundwater fluids. The distribution, in terms of subsurface depth and areal location, of these low temperature areas is not well defined.

Currently, approximately 43 MWnet of electrical power is being generated through three-power plant operations in the SBS KGRA. These operations include the: SB 1/1A 7 MW air–cooled binary power plant (US Energy Systems-1986), the Yankee-Caithness Joint Venture (YCJV-1990) 12 MW water-cooled single-flash steam plant, and the 24 MW air-cooled binary power plant (Far West Capital-1992). The geothermal power plant locations are shown in Figure 2.

Geothermal exploration and development in the SBS KGRA for balneological uses began in the early 1920's. Geothermal exploration by the USGS, for scientific studies of mineral systems, began in the late 1940's and continued through the 1960's. Geothermal exploration for commercial power generation uses began in the late 1950's by Nevada Thermal Power (a subsidiary of Magma Power). Geothermal exploration is currently underway in the area to determine additional geothermal resource availability.

Additional geothermal resource drilling investigation is needed to define the full production potential of the SBS KGRA system. SB Geo is currently in the process of extending its geothermal resource base with the drilling of a slim hole on the southern portion of its Meyberg properties.

2.0) Geothermal Resources Development in the South Truckee Meadows

Felix Monet reportedly "discovered" Steamboat Springs in 1860 (Garside and Shilling, 1979). This "discovery" transpired during the same period that mineral operations development of the Comstock Lode in the Virginia Range (1859) and the Union mine (1860), located in the Galena Mining District on the southeast flank of Steamboat Hills, were begun (Bonham, 1969). The geothermal hot springs at Steamboat were so-named, reportedly, because of the noise created by steam and water escaping from springs and fissures in the area. The United States Geological Survey (USGS) classified the Steamboat Springs geothermal area as a Known Geothermal Resource Area in the early 1970's.

Numerous geothermal and mineral exploration wells have been drilled in the Steamboat Springs KGRA area since the discovery of Steamboat Springs. The locations of selected exploration wells, drilled for commercial geothermal investigations, are shown in Figure 3.

These exploration wells have led to the development of two geothermal production areas in the Steamboat Springs KGRA. These production areas are operated by two separate entities (see Figure 2 for power plant locations):

a) Steamboat Springs Geothermal Region- SB Geo, Inc (SBG) operates the Steamboat Springs power plant operations area. SBG operations utilize binary power plant technologies to generate electrical power from thermal fluids at average temperatures of □325°F. The SBG power plant operations consist of two independently owned plants. The SB 1/1A power plants have a nominal rating of 7.1 MWnet. The SB 2/3 power plants have a nominal rating of 24 MWnet. In the SBG operations area, a total of twelve production wells and five injection wells are used for electrical power generation activities. Power plant operations began in 1986 for SB 1/1A and in 1992 for the SB 2/3 operations.

b) Steamboat Hills Geothermal Region- Caithness Power, Inc. (CPI) operates the Steamboat Hills power plant generation facilities. The CPI power plant utilizes single-flash steam power plant technology to generate a nominal 12 MWnet of electrical power. Average produced geothermal fluid temperatures are reportedly 425°F (Goranson and others, 1990). Three production wells and one injection well are used in power generation operations. Power plant operations began in 1990.

In addition to wells drilled specifically for commercial geothermal exploration and geothermal production operations, homeowners and private and quasi-municipal water companies have drilled numerous groundwater wells in the South Truckee Meadows. Several wells have been drilled for mineral exploration. Many of the wells drilled for groundwater uses and mineral exploration have encountered geothermal and mixed groundwater-geothermal fluids at depths.

2.1) Geothermal Drilling Exploration in the Steamboat Springs KGRA

Early commercial uses of geothermal fluids at Steamboat Springs were for bathing, spa and heating operations. Thermal fluids flowing from the Steamboat Springs Upper and Lower Terrace area were connected to use areas with surface piping. In the early 1920's, several production wells were drilled on the Low Terrace hot spring area (see Figure 2) to supply fluids, in a more dependable manner, to the Steamboat Resort. Production wells were also drilled on the Main Terrace spring area to supply thermal fluids to the Reno Resort swimming pool and Mt. Rose Resort. One well drilled in the 1940's, the West Reno well, was used for pool uses at the Reno Resort until 1965. Additional wells were drilled between 1930 to 1980 at the Steamboat Spa (Steamboat Resort, Lower Terrace area). Several of these wells are still in use at the Steamboat Spa.

The USGS conducted a research program between 1945 to 1952 in the Steamboat Springs area to investigate the fundamental hydrothermal mechanisms related to ore–bearing (epithermal) deposition. The Steamboat Springs area was viewed as an area where natural hydrothermal ore-forming processes were occurring that could not be duplicated in the laboratory. These USGS investigations culminated in a series of four professional papers covering the research activities (White, et al 1964 -1968). Numerous published and proprietary reports have been produced based on the USGS research and other commercial and private groundwater and geothermal development activities in the South Truckee Meadows/SBS KGRA areas.

The USGS exploration program included the drilling of eight small-diameter exploratory wells, GS-1 through GS-8, in the Steamboat Springs area between 1950 and 1951. These small-diameter exploratory wells (well locations not shown) were diamond drilled core holes and varied in depths between 130 feet to 686 feet. Fourteen shallow auger holes (hole locations not shown), Auger 1 through 9, 10a and 10b, Auger 11, 12 and 13, were also drilled with depths ranging between 2 feet to 18 feet. Data from these wells and several other wells in the Steamboat Springs and South Truckee Meadows area drilled by private entities were evaluated and documented in the USGS reports. The available data include temperature versus depth, thermal fluid level as a function of time, fluid geochemistry and subsurface geological data. Seventy-four hot springs were located in the Steamboat Springs and South Truckee Meadows areas. Data relating to spring fluid level, thermal fluid discharge and fluid geochemistry as a function of time were obtained and documented.

In the mid–1950's a privately owned company, Nevada Thermal Power (a subsidiary of Magma Power Company), began the drilling of several large diameter production-size exploration wells. A total of six large diameter wells, NTP-1 through NTP-6, were drilled in the Steamboat Springs area between 1954 and 1962 (see Figure 3 for well locations). Well depths ranged between 716 feet to 1,830 feet. These holes were drilled as exploratory production wells, employing large diameter casings. Several of the wells were flow tested during and subsequent to the drilling activities. The available data include temperature versus depth, thermal fluid levels and fluid geochemistry. The geothermal wellbores reportedly scaled with calcite during discharge testing and discharge periods were, therefore, limited. No data are available on the testing activities.

Gulf Mineral Resources Company and Phillips Petroleum Company separately began geothermal exploration activities in the Steamboat Hills and South Truckee Meadows areas in the late 1970's. These two companies entered into a joint exploratory and operations agreement (as Phillips-Gulf) in 1980. The initial exploration program included the drilling of twenty-five shallow thermal gradient holes, SB-1 through SB-25 (see Figure 3 for well locations). These small diameter holes were drilled in 1976 to depths ranging between 170 feet to 300 feet. Temperature versus depth and subsurface geologic data were obtained for these wells.

Phillips-Gulf jointly drilled fourteen deep small-diameter stratigraphic test holes, ST-1 through ST-14, in the Steamboat Hills and South Truckee Meadows areas between 1977 and 1981. These wells were drilled to depths ranging between 844 feet to 1,990 feet. These stratigraphic test well locations are shown in Figure 3. Static temperature versus depth and subsurface geologic data were obtained from these test holes.

Two large diameter exploration wells (well locations are shown in Figure 3) were drilled in the Steamboat Hills area by Phillips-Gulf. The first well, SBP-1, was drilled in 1979 to a depth of 3,050 feet. This well was discharge tested and termed a commercial geothermal production well. Maximum downhole temperature was reported at 440°F. A second large diameter well, COXI-1, was drilled in 1980 to a depth 3,471 feet. The well was not judged to be a commercial production well at the time of completion (currently this well is used as an injection well by YCJV). Maximum downhole temperature was reported as 350°F. Data available from these wells include static temperature versus depth, fluid geochemistry and subsurface geologic data. Some flow test data were obtained for well SBP-1.

Hunt Oil Company drilled several thermal gradient wells in the 1980's. These wells were drilled in the southeast portion of the South Truckee Meadows area. There are no data available for these wells.

Geothermal Development Associates (GDA) drilled three small diameter exploration holes, OW-1 through OW-3, in the Steamboat Springs Upper Terrace area in 1985 (well locations shown in Figure 3). These wells ranged in depths between 570 feet to 966 feet. Static temperatures versus depth data are available. The wells were drilled under loss of circulation conditions and subsurface geologic data are limited.

Far West Capital, Inc. (FWC) drilled one production-size geothermal exploration well, Hot Air #4 (HA#4), in the Steamboat Springs Upper Terrace area in 1990 (see figure 3 for well location). This well was drilled to a depth of 729 feet. The well was discharge tested after drilling and completed as a commercial geothermal production well. Daily drilling operations, static temperature versus depth and subsurface geologic data (above 525 feet) are available. Fluid geochemistry data were also obtained for this well. No geologic samples were obtained below 525 feet due to loss of circulation drilling conditions.

FWC drilled three small diameter core holes, TH-1, TH-2 and TH-3, in 1991 near the Main and Upper Terrace areas of Steamboat Springs (well locations are shown in Figure 3). These slimholes ranged in depths between 861 feet to 910 feet. The slim-holes were injection tested after completion to determine reservoir characteristics. The available data include daily drilling operations, static temperature and pressure versus depth, pressure and temperature versus depth during injection and pressure fall-off data. Subsurface geologic data include cores.

These TH series slimholes were subsequently discharge tested in 1992. Discharge rate versus time, fluid geochemistry, flowing pressure, temperature and spinner (PTS) survey data and downhole pressure build-up data were obtained.

In 1993, SB Geo (operations entity for Far West Capital) drilled a deep exploratory slim-hole (GTH 87-29) to a depth of 4,000 feet in the Upper Terrace area of Steamboat Springs. The well location is shown in Figure 3. This slimhole was drilled in conjunction with the US Department of Energy and Sandia National Laboratory. The slimhole was drilled to investigate the effectiveness of using inexpensive small-diameter wells to delineate and measure the productive capacities of geothermal systems. The available data include; daily drilling records, static temperature and pressure surveys, flowing temperature, pressure and spinner surveys, downhole pressure build-up and fall-off data, discharge rate versus time and geothermal fluid and non-condensable gas data. In addition, subsurface geologic data are summarized and cores are available.

SBG drilled an exploratory slim hole, MTH 21-33, in 1994 (see Figure 3 for the well location). This slimhole was drilled to a depth of 710 feet near the northeastern edge of Steamboat Hills. Daily drilling records and static pressure and temperature versus depth data are available. Subsurface geologic data include cores.

3.0) Geothermal Power Plant Operations at the Steamboat Springs KGRA

Power plant operations in the Steamboat Springs KGRA began in 1986. Total fluid production rate (year 2000) from the Steamboat Springs KGRA is □26,200 gpm (□12,000,000 pph). The total amount of fluid produced, since power plant operations began in 1986, is □110 billion gallons (525 billion pounds). Total electrical (nominal) power output is □43 MWnet.

Three geothermal power plants are operating within the USGS defined Steamboat Springs KGRA. Figure 4 shows the location of the power plants and associated production and injection wells. Two of the power plants, SB 1/1A and SB 2/3, are operated by SB Geo, Inc (SBG). and are located on private property in the Steamboat Springs area. SBG wells supply thermal fluids to their respective power plants using downhole shaft-driven pumps. These power plants use binary technology to convert thermal heat from produced geothermal fluids to electrical power. Air-cooled condensers are used in the binary-fluid cooling process.

A third power plant, operated by Caithness Power, Inc. (CPI), is located in the Steamboat Hills area. This plant operates on a combination of federal US Bureau of Land Management (BLM-subsurface rights) and US Department of Agriculture (Forest Service-surface rights) lands and private properties. CPI wells are produced to the power plant by free-flowing methods, i.e., by density driven conditions developed within the wellbore under discharging conditions. A single-flash steam power plant converts thermal heat of the steam separated from the produced fluids to generate electrical power. The power plant uses a standard wet-cooling (cooling tower) process in power generation operations.

4.0) Regional Geologic Description of the South Truckee Meadows

Thompson and White (1965) have best described the regional geology of the Steamboat Springs KGRA and the South Truckee Meadows areas (detailed geologic map not shown in this report). The major features of the region are the result of the Sierra Nevada Batholith and Basin and Range block faulting. Voluminous Tertiary volcanism (Kate Peak and Alta formations) covered most of the Truckee Meadows at one time. The volcanics were deposited from numerous vents. The Cenozoic uplift of Cretaceous granodiorite is the result of high-angle, normal faulting thought to be caused by major tectonic extensional forces. As a result, structural basins have been formed between the Carson and Virginia Ranges. Alluvial fans and pediments form between the mountain fronts with bajada and valley floor deposits towards the center of the valley basins.

Concurrent with the Cenozoic uplifting and volcanism are episodes of erosion and deposition of sediments derived from the volcanic and granitic rocks. Thompson and White give evidence and discuss several pediments, particularly on the east flanks of the Carson Range. A unique structure of the region is the Steamboat Hills and the Steamboat Springs geothermal hot spring area. The Steamboat Hills are uplifted, faulted, granitic and overlain with volcanics ranging from rhyolite to andesitic basalt. The Steamboat Springs KGRA is a site with continuing subsurface geothermal discharges. Surface (hot spring) discharges disappeared in the late 1980's, prior to the SB 2/3 and YCJV geothermal operations.

Most faulting within the South Truckee Meadows has been identified as trending north south (Cordova, 1969; Thompson and White, 1964) and are presently active. Recent work (van de Kamp, this report) has identified northeasterly trending faults (see Figure 5) that are associated with thermal fluid movement through the system. The north-south trending faults are probably related to extensional forces resulting in both normal and reverse faults. Localized grabens have been identified (Bonham and Rogers, 1983; Widmer, 1991).

4.1) Generalized Geology of the Steamboat Hills and Steamboat Springs Areas

Faulting and fracture patterns mapped in the Steamboat Hills and Steamboat Springs areas are shown in Figure 5. In general, the northeast trending Steamboat Hills are a part of the Carson section of the Walker Lane Structural Belt and are within the Basin and Range physiographic and geologic province. Gross structure of the Steamboat Hills is folded metavolcanics intruded to the north by Cretaceous granodiorite. The Alta and Kate Peak volcanics unconformably overly the granodiorite to the west and northeast of Steamboat Hills. The whole block comprising Steamboat Hills is bounded to the north and south by N50-60E trending normal faults and to the east and west by north-northeast to north-south normal faults. This yields a parallelogram shaped block, in map view, which is 2,000 feet to 3,000 feet higher, structurally, than the adjacent areas to the east, west and north. This parallelogram also forms the boundaries to the high and moderate temperature geothermal system, as shown in Figure 5. A third prominent normal fault pattern occurs in a northwesterly direction in the Steamboat Springs area.

In and adjacent to Steamboat Hills, the most recent tectonic movement occurred along northerly trending faults which extend through the hills 5+ miles south to Washoe Valley and 5+ miles north to Huffaker Hills. However, the northeast trend may have been active in the recent past as indicated by offsets in the Lousetown volcanic formation. The northeast and northwest trending faults were conduits for volcanic extrusions. Pleistocene rhyolite domes occur for five miles along this same northeast trend. This is strongly suggestive of a deep reaching fault zone through which lava rose from their mantle source. The heat source for the geothermal system is most likely associated with these volcanics and deep-seated faults.

Figure 6 is a schematic geologic representation of the Steamboat Springs KGRA geothermal system. This figure is a north-south cross section through Steamboat Hills, Steamboat Springs and the alluvial valley-fill areas located to the north and south of the Steamboat Springs KGRA.

4.2) Detailed Geology of the Steamboat Hills and Steamboat Springs Area

Granodiorite is the oldest rock unit present in the northern Steamboat Hills. This granodiorite is of Jurassic-Cretaceous age, estimated as >80 million years old by apatite fission track analysis (Duddy ET al., 1995). The older (Triassic?) Peavine Sequence of metamorphic rocks, into which the granodiorite is intruded in central Steamboat Hills, is not found in the Steamboat Springs area. The Peavine Sequence is noted on the southern flank of Steamboat Hills and is the primary producing formation for geothermal fluids in the Steamboat Hills area. Several wells in the Steamboat Hills production area penetrate an alternating sequence of metamorphic and granodiorite rocks, indicative of tonguing along an intrusive contact. Outcroppings also suggest a steeply dipping contact between the Peavine Sequence and the intrusive granodiorite.

The granodiorite which underlies the Steamboat Springs area is a younger intrusive, about 22 million years old to 16 million years old (Duddy ET al., 1995). This sequence of granodiorite is penetrated by numerous wells drilled in the Steamboat Springs area. The granodiorite serves as the reservoir for geothermal fluid production in the Steamboat Springs area of the SBS KGRA. Younger sediments, hot spring deposits, volcanic rocks and alluvial deposits overlie the granodiorite. The surface of the granodiorite in the northern Steamboat Hills area slopes northward, the surface declining in depth approximately 15° to 20°.

The granodiorite in the Steamboat Springs area ranges from very fine to coarse-grained and generally shows little internal structure other than faults, fractures, and joints. Within it, there are quartz veins and aplite and pegmatite dikes. Major minerals in the granodiorite are quartz, plagioclase, and K-feldspar with variable biotite, muscovite, chlorite, and amphibole with accessory sphene, zircon, apatite, epidote, pyrite, and magnetite. In some rock samples, plagioclase is zoned ranging from fresh to intensely sericitized with some grains partially replaced by calcite. K-feldspar includes orthoclase, microcline, and perthites.

In surface outcrops, the granodiorite is fractured and faulted. These features are also found in cores and are evidenced in drill cuttings from the subsurface by fragments of protomylonite and calcite and silica veins (fracture fillings) in rock fragments. Hydrothermal alteration in and adjacent to fractures is shown by intense sericitization +/– clay alteration (montmorillonite or kaolin) of plagioclase, in some cases accompanied by calcite replacement of feldspar as well as altered biotite. The biotite is more or less "bleached" to pale tan from deep brown or green and contains numerous minute grains of opaque material, probably iron oxides. The clay alteration yields "chalky" whitish feldspar in the less intensely altered rocks. Highly altered granodiorite is a crumbly white clay and quartz aggregate with many minute pyrite grains. Noted in several cores in the Steamboat Springs area are intervals, up to 30 cm to 40 cm long, of moist dark grey clay, likely developed by intense alteration of the granodiorite, apparently in fractured zones. Cores in this area also contain many steeply dipping open fractures lined with common calcite. Below 3,000 feet in depth, fractures are lined by quartz with only minor calcite.

An unconformity between the granodiorite and the overlying Miocene Alta Fm. represents a time hiatus. The hiatus represents a mid-Tertiary uplift (Laramide uplift), an erosional event which removed the rocks into which the granodiorite was intruded, exposing the granodiorite. Subsequently, volcaniclastic sediments and volcanic flows of the Alta Fm. and the Kate Peak Fm. were deposited on the eroded granodiorite. These volcanic units and the younger granodiorite represent igneous activity which accompanied the late Oligocene-Miocene (25±10 Mya) tectonic extension in the Basin and Range Province. In the Steamboat Springs area, these volcanics and volcaniclastic sediments are up to 500 feet thick. Since deposition, the Tertiary volcanics have been uplifted and subsequently eroded from higher areas in the Steamboat Hills. The Tertiary volcanics are now found in a northward thickening wedge in the Steamboat Springs area.

The Alta Fm. is an early to mid-Miocene soda trachyte occurring mostly as lava flows and pyroclastics. Where fresh, the volcanics are black, glassy rocks with plagioclase and hornblende phenocrysts. More commonly, the rock is altered and is grey to purple.

For simplicity, in the subsurface of the Steamboat Springs area all volcanic rocks in depositional contact with the granodiorite are classified in the Kate Peak Fm. The following description covers the volcanics penetrated by various wells in the Steamboat Springs area.

The Kate Peak Fm., overlying the Alta Fm., is late Miocene to Pliocene age and is composed of thin to thick-bedded andesitic pyroclastics and tuff-breccias. This formation is up to 400 feet thick in the Steamboat Springs area, thinning southwestward into the Steamboat Hills. In cores, these volcaniclastics range from relatively fresh, hard, grey and grey-green rocks to very soft, highly altered rocks in which clays have replaced the original minerals while retaining the clastic textures. Thus, mechanically, these altered rocks are more like soft shales than the original pyroclastic deposits. The Kate Peak volcanics lie on top of the granodiorite at depositional contact as evidenced in cores from the Steamboat Springs area. In some cores, a poorly sorted conglomeratic deposit represents the contact with fresh to weathered granodiorite and volcanic clasts. A 300–foot thick interval of red-brown to grey-green soft, clay-rich clastics were encountered in one injection well drilled in the Steamboat Springs area.

Above the Tertiary volcanics, there is an erosional unconformity representing late Pliocene and Pleistocene uplift and subsequent erosion. This event caused erosion of volcanics and granodiorite toward the south. Alluvium now covers the erosionally thinned volcanics and granodiorite southward of Steamboat Springs towards the Steamboat Hills area. Faulting of the granodiorite and volcanics accompanied the uplift. Older Pleistocene alluvium is present in some areas beneath basaltic andesite flows, and is referred to as the Lousetown Fm. The Lousetown Formation also includes a series of rhyolitic domes. These rhyolitic dome structures called the Steamboat Hills Rhyolite, trend in a northeast–southwest direction. The large rhyolite dome located directly southwest of Steamboat Springs was preceded and accompanied by extensive pyroclastic eruptions that covered the Truckee Meadows area. At several locations, younger alluvium overlies these volcanics.

The alluvial sands, gravels, and boulder conglomerates are the youngest deposits in the area and mostly represent debris eroded from rocks in the mountains west of the Steamboat Springs area. These deposits are about 100 feet to 300 feet thick in the Steamboat Springs area. The alluvial deposits thin to the south toward topographically higher bedrock outcrops of the Steamboat Hills and thicken north and east into the South Truckee Meadows. In the Steamboat Springs area there is abundant silica sinter in the alluvium deposited by ancient hot springs. The effect of the sinter is to cement the unconsolidated alluvium into a hard rock with much lower porosity and permeability than typical alluvium in the South Truckee Meadows area. The sinter is up to 100 feet thick in places. Adjacent to faults, which fed water to the ancient hot springs, the sinter forms low mounds with layering dipping away from the faults. In the Lower Terrace area, south of the Main Terrace area, another significant area of older sinter, indicative of past geothermal activity and possible continuing subsurface hot water circulation is noted.

5.0) <u>Conceptual Model of the Steamboat Springs KGRA Geothermal System</u>

The latest conceptual model, based on the additional data that has been obtained to date, is as follows:

Some of the waters accumulating as snow and rainfall in the Carson Range are heated as they flow downward through fractured basement rock west of Steamboat Hills. Surface run-off from the Mount Rose area of the Carson Range is divided by Steamboat

Hills (Hydrosearch, 1991; Widmer, 1991) as it flows towards Steamboat Creek. The surface run-off is channeled through Brown, Galena, Whites and Thomas Creeks. Accumulated snowfall and rainfall are, also, divided in the subsurface and flow through the groundwater system; being, either evapotranspirated, produced as groundwater sources or discharged in the subsurface to Steamboat Creek. A portion of the groundwater, most likely, leaves the South Truckee Meadows area as subsurface flow through Huffaker Hills (Cohen and Loetz, 1964).

The heated fluids rise and discharge into the Steamboat Springs KGRA geothermal system beneath Steamboat Hills area at/or near thermodynamically saturated conditions. The caprock identified in the Steamboat Hills area limits the vertical movement of fluid and maintains saturated fluid conditions beneath the southern portion of Steamboat Hills. The thermal fluids entering the system are forced to flow in a northeasterly direction due to hydrogeologic constraints associated with faults bounding the Steamboat Hills up-lifted block on the north, south and west. Thermal fluid flow is towards the northeast, also constrained by groundwater flow paths associated with the South Truckee Meadows drainage basin. The easterly flow of thermal fluids is limited by fault induced down-dropping of the granodiorite towards the east, the granodiorite being the main reservoir rock for geothermal fluids in the Steamboat Springs area.

The steam-water (two-phase) mixture separated from the thermal fluids entering the system beneath the Steamboat Hills area flow in a northeasterly direction in the upper portions of the geothermal system. Some of the separated steam condenses in the shallow portions of the reservoir and is returned to the northeasterly flowing thermal fluids, cooling the flowing fluids. In addition to the condensed steam, the flowing thermal fluids are cooled conductively through heat loss to the surrounding rock, i.e., as heat flow to the boundaries of the system, as they flow to the northeast.

Some of the thermal fluids are, most likely, convectively mix and flow vertically downwards on the northeastern boundaries of the geothermal system to be re-heated with the thermal fluids entering the system. The thermal fluids escaping from the geothermal system enter the groundwater system northeast of Steamboat Springs. Mixing of the thermal and groundwater fluids takes place in this area. Some groundwater wells that are located to the north of Steamboat Springs are heated by steam separated from the geothermal system (Mariner, 1994), whereas, some groundwater wells are heated by direct mixing of geothermal and groundwater fluids. Non-condensable gases, separated from the flowing thermal fluids also enter the groundwater system (Derocher, 1999).

Due to lack of data, it is not clear at this time as to what mechanisms govern the behavior of the subsurface areas located to the east of Steamboat Springs proper. Thermal fluids and thermally derived non-condensable gases are found to the east of Steamboat Springs. In addition, several anomalous thermal areas exist in the southeast part of Steamboat Valley, Pleasant Valley (located to the southeast and south of Steamboat Hills, respectively) and near Zolezzi Lane (Old Zolezzi Hot Springs) to the north of Steamboat Springs.

Several factors that support a shallow boiling (two-phase) reservoir system in the northern Steamboat Hills and Steamboat Springs areas;

1). Wells drilled in the Steamboat Springs area and the northern Steamboat Hills area do not encounter a subsurface caprock, similar to that noted in the CPI production area.

2) The surface rock alteration in the northern Steamboat Hills (CoxI-1 silica pit area) is indicative of surface hydrothermal oxidation (Bonham 1969). This oxidation and mineral deposition is most likely caused by steam and non-condensable vapors escaping vertically to the surface through faults, fractures and fissures.

3) The large hot spring deposits and the hot spring discharge areas indicate flow paths between the geothermal system and the atmosphere.

4) The observed high permeability based on the small pressure drops in the Steamboat Springs production area may de related to boiling in the reservoir

in that the boiling surface will behave as a constant pressure boundary, thereby, reducing pressure loss in the reservoir system during production operations. This shallow constant pressure (two-phase) boundary condition requires a large convective heat flux through the geothermal system.

5) The geothermal fluid geochemistry supports condensed steam re-entering the geothermal system in that the non-reactive fluid chemical constituents (Na, Cl, B, Br, etc) do not reflect a complete separation of steam. If complete steam separation were to occur as thermal fluids move through the system, the non–reactive chemical constituents would increase between the Steamboat Hills area (460°F) and the Steamboat Springs area (330°F) by a factor of approximately 16 percent, which is not the case.

6.0) <u>Subsurface Temperature Distributions in the South Truckee Meadows Area</u>

A large flux of thermal fluids through the Steamboat Springs KGRA into the South Truckee Meadows area is also born out in temperature versus depth data and areal subsurface temperature distributions. Downhole well temperatures and temperature gradient data for selected wells in the South Truckee Meadows are shown in Figure 7. The shallow well data given in Figure 7 can be combined with production and injection well downhole temperature data to yield temperature contours at a depth of 4,000 feet above mean sea level (amsl). These temperature contours are shown in Figure 8. The temperature contours clearly show that geothermal fluid outflow effects the South Truckee Meadows area along a northeasterly trend. There are distinct boundaries to the geothermal fluid temperature influence in the South Truckee Meadows to the north, south and west of the Steamboat Springs KGRA. In addition, temperature versus depth data for various wells in the area also illustrates the effects of horizontal thermal discharge (i.e., temperature reversals versus depth) from the Steamboat Springs KGRA (Goranson 1999).

7.0) SB Geo Planned Exploration Drilling Operations- Meyberg Property

To further define the geothermal resources beneath the SBG operations area, a 2,500-foot deep exploration slimhole is planned on the southern edge of the Meyberg Property. The proposed location of the slimhole is shown in Figure 9.

At this time there have been no exploration wells drilled in this portion of the SBG operations area or the SBS KGRA. The well location has been chosen based on its location relative to the property boundaries and the location of several mapped fractures in the area. This exploration well is expected to increase the resource base of the Steamboat Springs KGRA by at minimum of 24 MWnet.

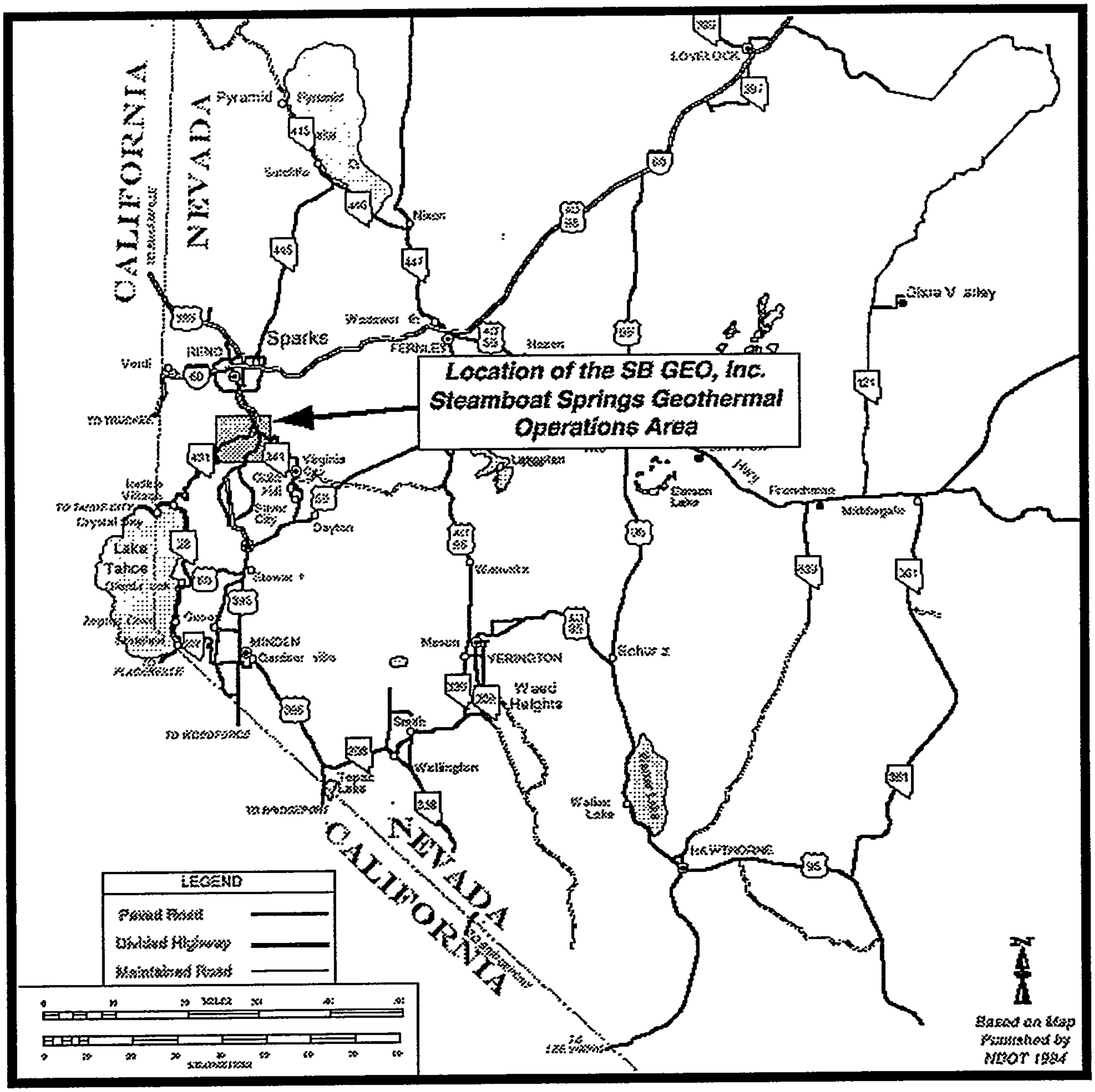

Figure 1) Location of the SB GEO Steamboat Springs Operation Area

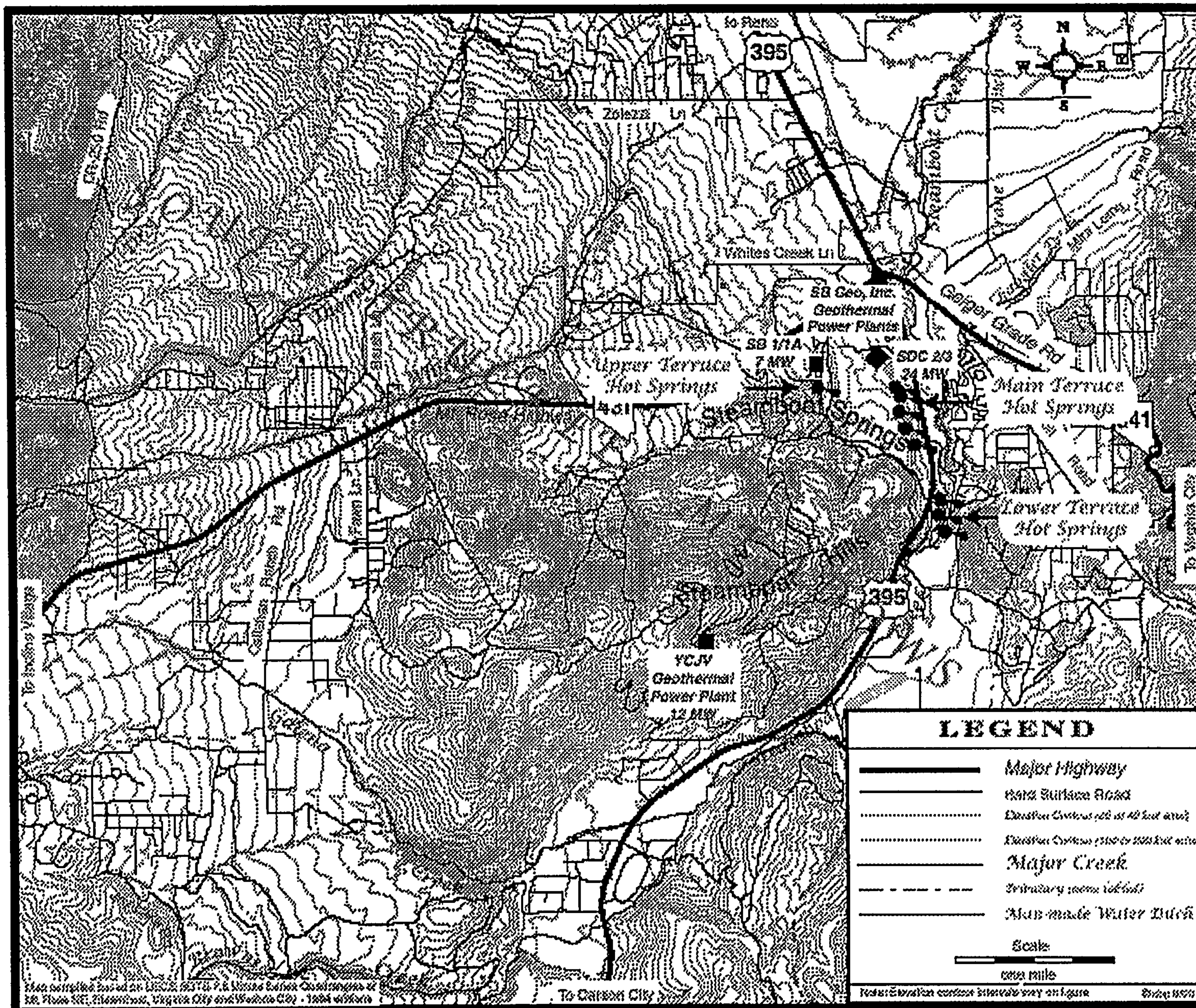

Figure 2) South Truckee Meadows and the Location of Geothermal Operations in the Steamboat Springs KGRA

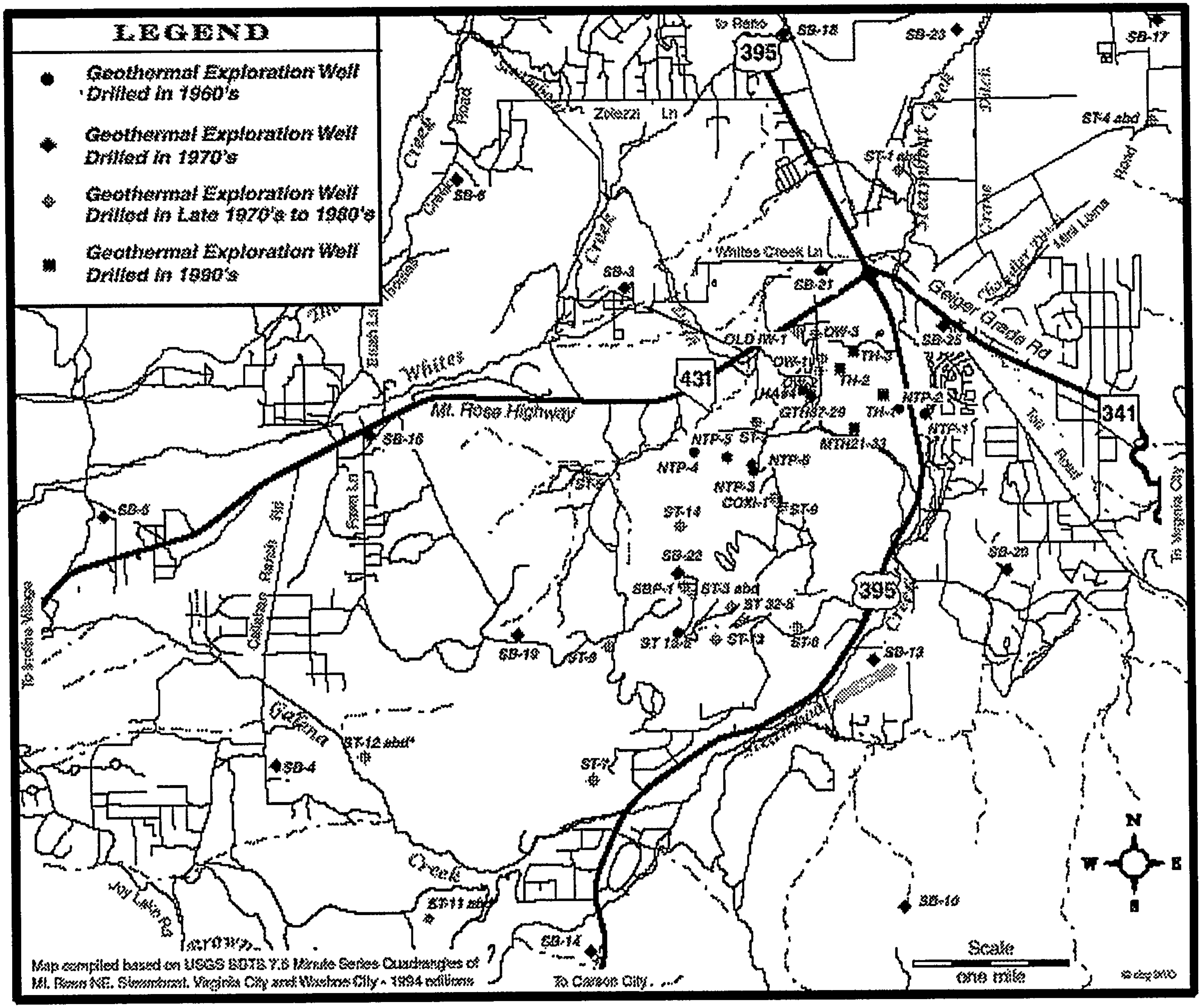

Figure 3) Location of Geothermal Exploration Wells Drilled for Commercial Operations at the SBS KGRA

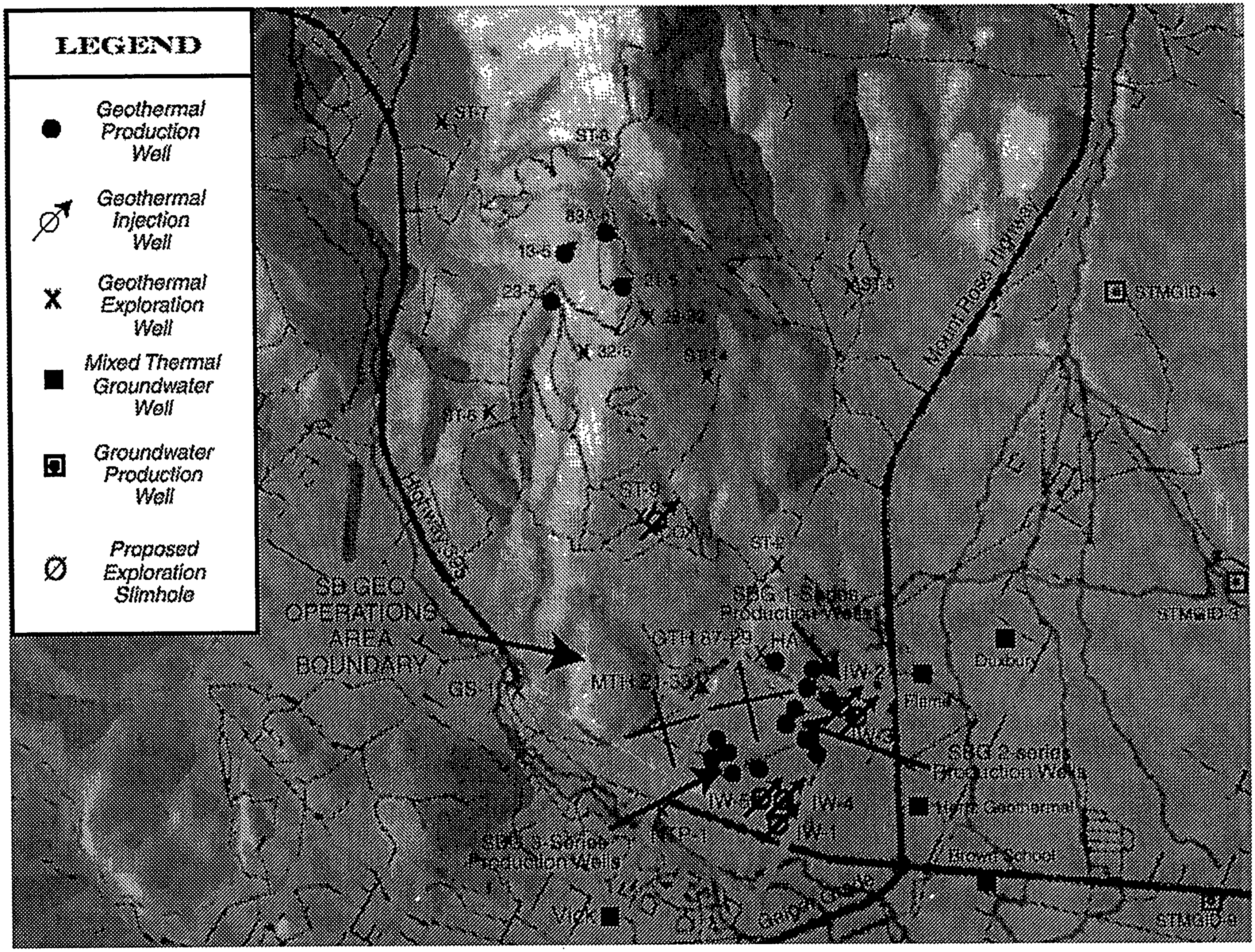

Figure 4) Location of Geothermal Production and Injection Wells used for Commercial Operations at the SBS KGRA

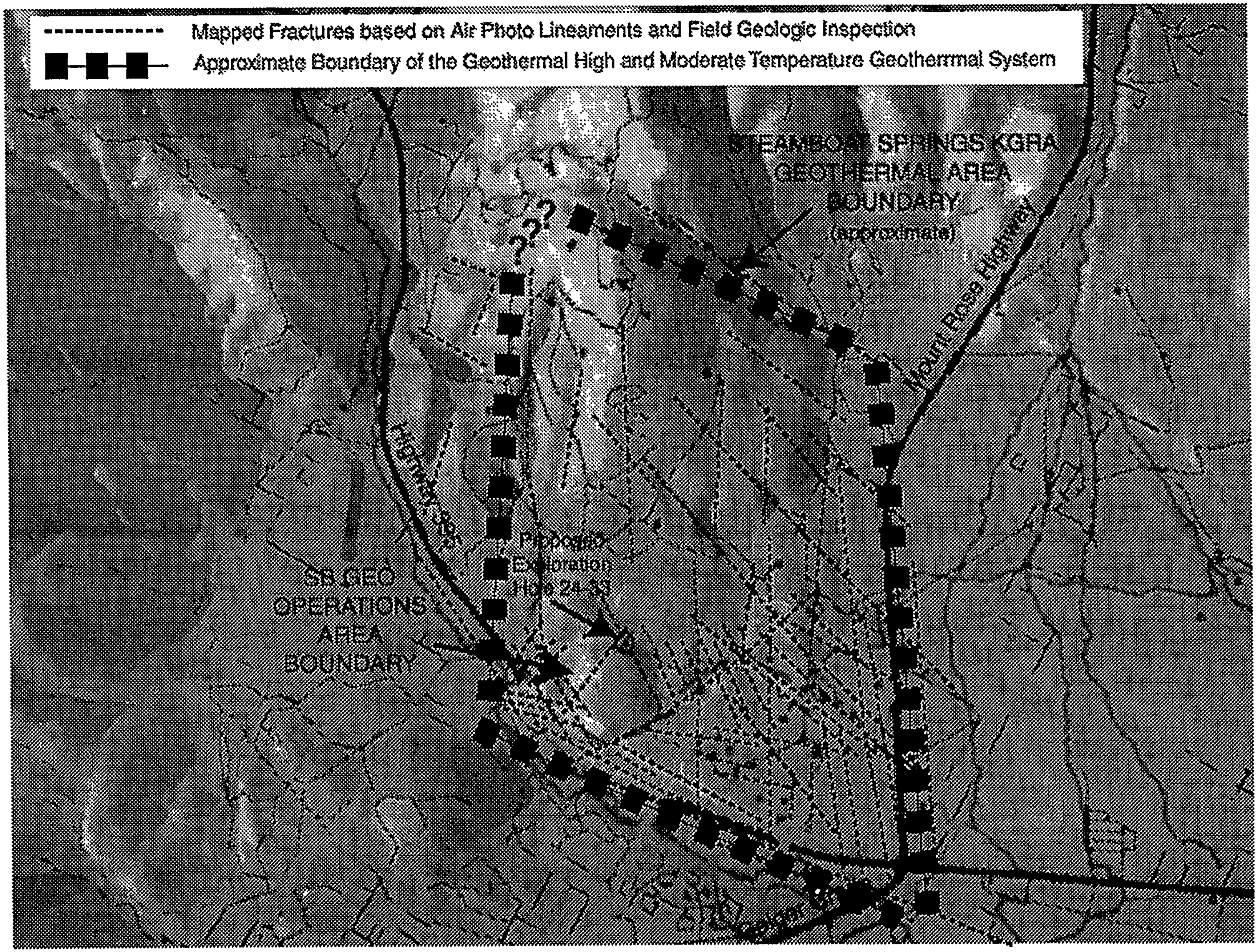

Figure 5) Location of Fractures and Air Photo Lineaments and Geothermal System Boundaries at the SBS KGRA

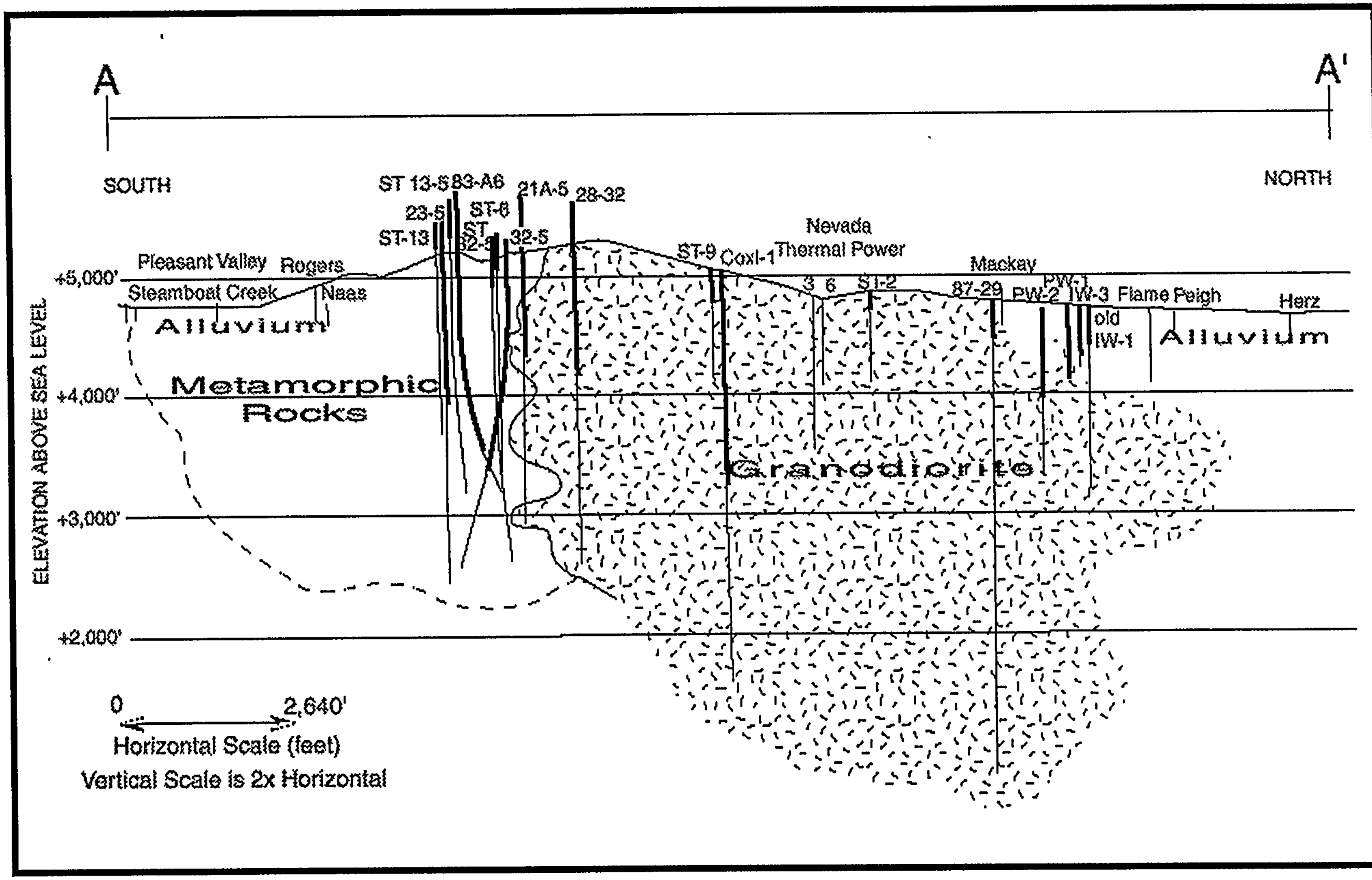

Figure 6) Geologic Cross-Section through the SBS KGRA

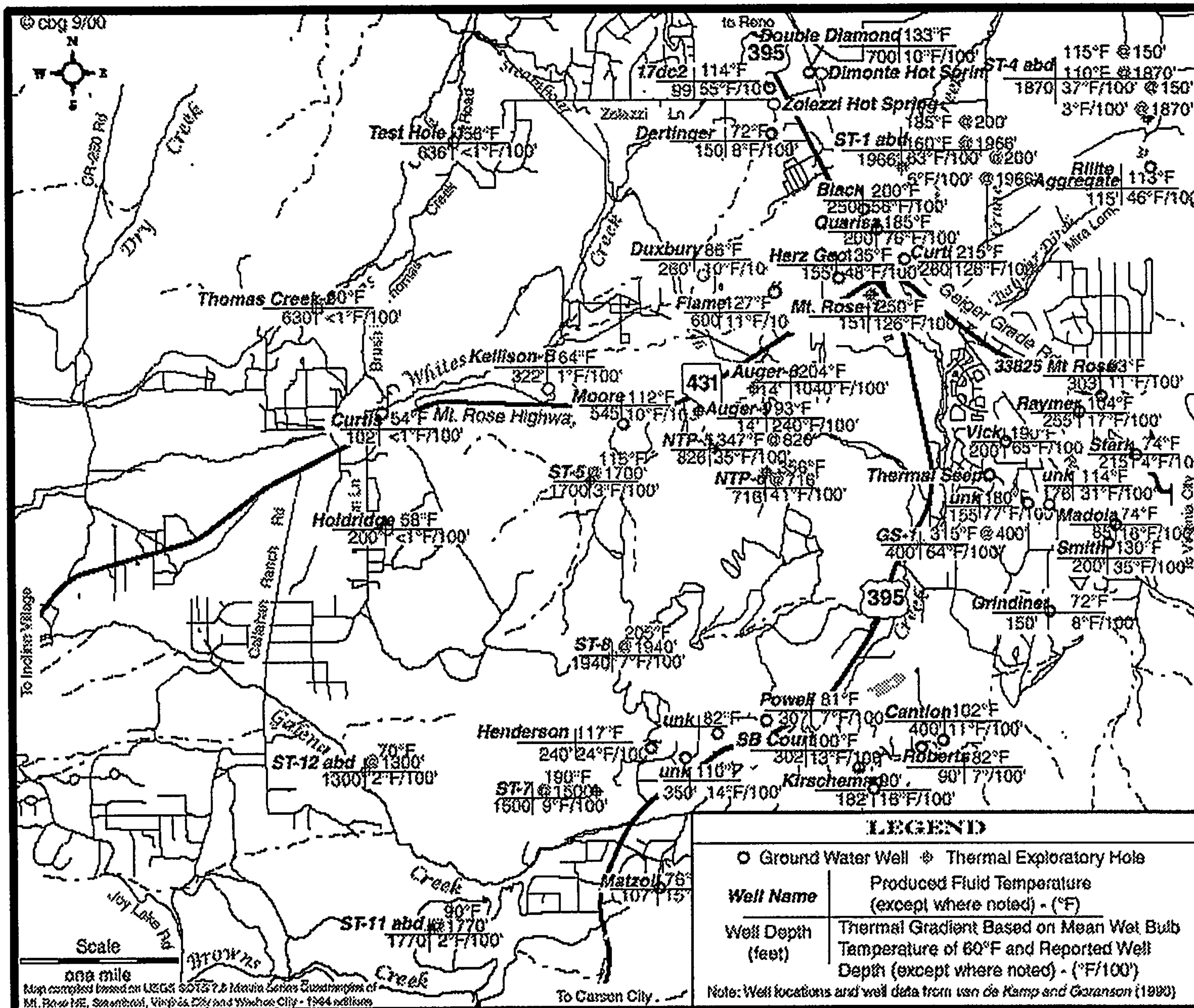

Figure 7) Downhole Well Temperature Data for Selected Wells in the South Truckee Meadows

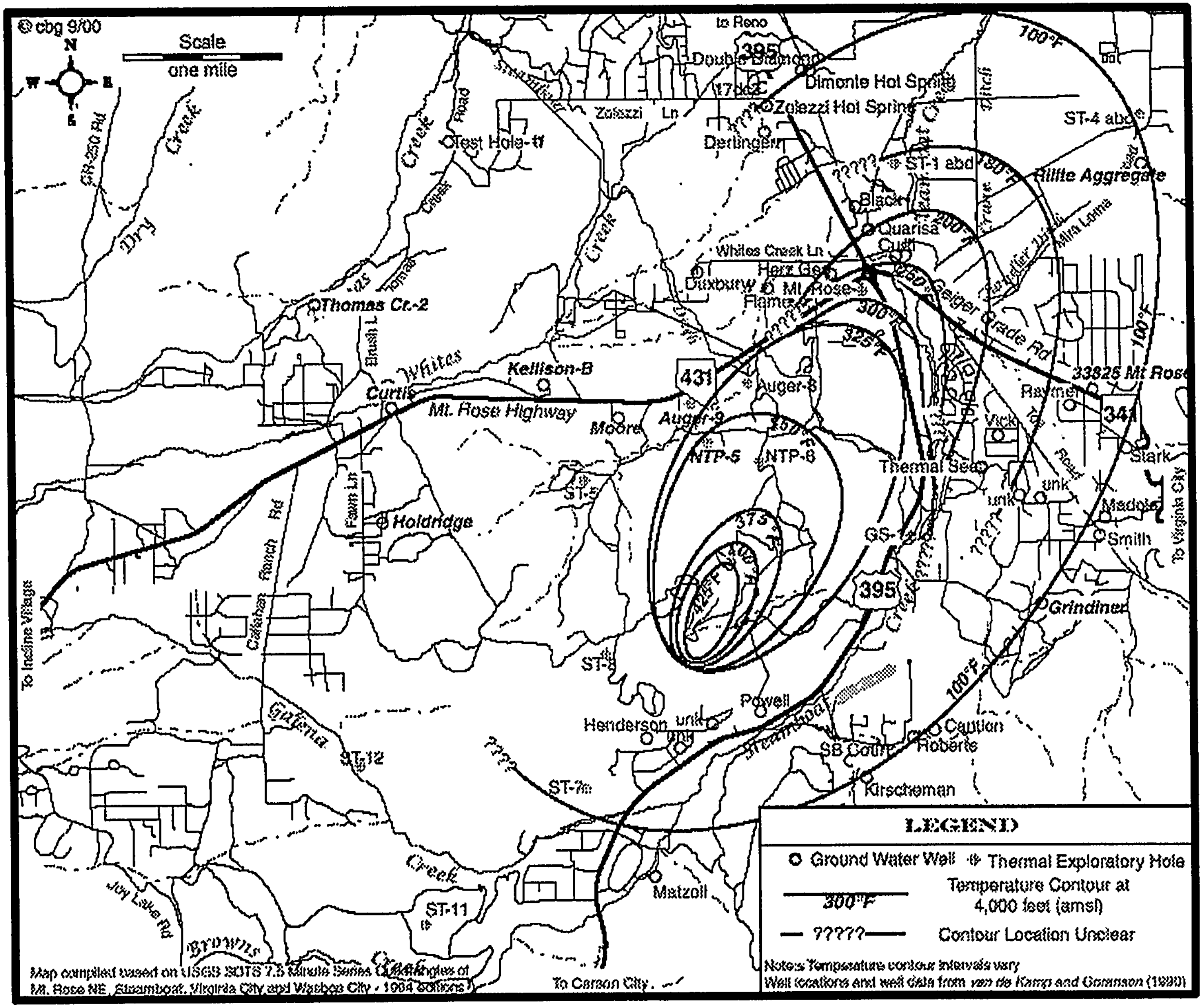

Figure 8) Temperature Contours at 4,000 feet amsl in the South Truckee Meadows

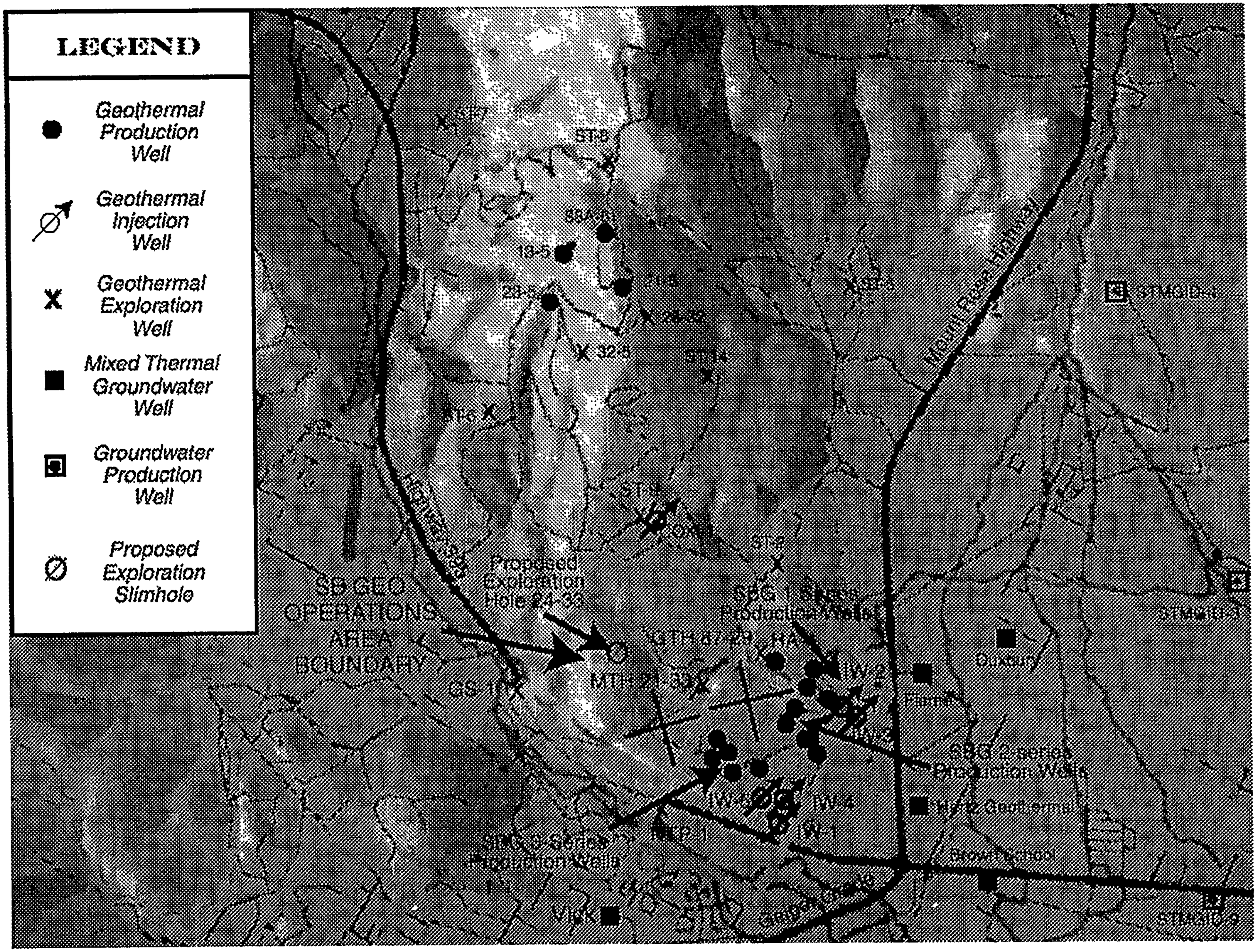

Figure 9) Location of the SBG Meyberg Property Slimhole Exploration Well MTH 24-33

EXPLORATION WELL PERMIT REQUIREMENTS

SLIM HOLE MTH 24-33
MEYBERG PROPERTY

STEAMBOAT SPRINGS GEOTHERMAL FIELD
STEAMBOAT, NEVADA

Prepared by

Rebecca Wagner
SB Geo, Inc.
September 2000

Meyberg Exploration MTH 24-33 Slim Hole Permitting Requirements

Introduction

As the operator of the Steamboat I/IA and Steamboat II and III power plants, SB Geo, Inc. (SBG) is in a fortunate position to easily permit the drilling of a test well on the Meyberg Property. In fact, all necessary permits have already been obtained. The following will provide an outline of the permit requirements and how they have been fulfilled.

Nevada Division of Minerals (DOM)

DOM has the regulatory oversight over all geothermal drilling and operations within Nevada. In 1998, SBG was granted an area wide permit (Permit #458PA) to allow for the drilling of 15 new production wells, seven injection wells and six observation wells. While SBG has not drilled any new wells, we have kept our area wide permit current. Just prior to drilling, SBG will notify the DOM of the final plans and submit any additional information required.

Nevada Department of Environmental Protection (NDEP) – Underground Injection Control

SBG currently has a five-year permit (Permit #UNEV50018) from the NDEP for injection of geothermal fluids. While fluids will be diverted to the surface temporarily during drilling, we do not need an additional permit. Prior to drilling, SBG will notify NDEP as a courtesy and supply any additional information necessary.

Washoe County Air Quality Management District (WCAQMD)

SBG has determined that an Air Quality Permit from WCAQMD is not necessary since the H2S output will be below 5 ppm per hour. Output above 5 ppm per hour would trigger the need for an Air Quality Permit.

Washoe County

SBG will not need a Special Use Permit from Washoe County since the oversight of geothermal drilling operations rests with DOM. The planned road upgrades do not need a Grading Permit as SBG is improving an existing roadway.

FINANCIAL ARRANGEMENTS
SLIM HOLE DRILLING PROGRAM

STEAMBOAT SPRINGS GEOTHERMAL FIELD
STEAMBOAT, NEVADA

Prepared by

Rebecca Wagner
SB Geo, Inc.
September 2000

Financial Arrangements for Slim Hole Drilling Program

Introduction

As the recipient of a US DOE Cooperative Agreement, SB Geo, Inc. (SBG) is committed to funding its portion of the cost-share through cash and in-kind contributions. SBG has a proven track record as a financially viable company as the operator of the Steamboat I/IA and Steamboat II/III power plants.

History

SBG was formed in 1988 and has been the operations and maintenance service contractor for the Steamboat I/IA power plants, located in Steamboat, Nevada, since 1990. In August of 1991, SBG was awarded the Operations and Maintenance contract for the new Steamboat II and III power plants also located in Steamboat, Nevada. SBG is incorporated under the laws of the State of Utah and is licensed to do business in the State of Nevada

Financial Arrangements

SBG has included its portion of the cost-share within its current budget. Additionally, all in-kind contributions such as equipment and manpower are currently available. Financial statements are available upon request.

EXPLORATION WELL DRILLING PROGRAM FOR

SLIM HOLE MTH 24-33

MEYBERG PROPERTY

STEAMBOAT SPRINGS GEOTHERMAL FIELD

STEAMBOAT, NEVADA

Prepared
for
SB GEO, Inc.

Prepared
By

Colin Goranson
September 2000

Meyberg Exploration MTH 24-33 Slim Hole Drilling Program

A map with the location of the Steamboat Springs Meyberg Exploration Slim Hole MTH 24-33 is shown in Figure 1. Exploration slim hole MTH 24-33 is to be completed as indicated in Figure 2.

The following information will be obtained during the drilling activities: Monitor the following data every 10 feet, unless otherwise noted, and write into tour sheets:

1) Fluid temperature in/out.
2) Fluid pit levels.
3) Fluid pump volumes/rates.
4) Mud density, viscosity, solids content, etc.
5) Drilling rate.
6) Take core and box with labels.
7) Note any fractures, LOC zones and material encountered.

The following drilling program will be adhered to under normal drilling conditions:

1) Clean up existing roads and de-brush location. Construct access road from existing road to well site. Construct small holding pit for drilling mud and cuttings (□15'W X 15'L X 3'D). Rig up water supply pipeline from SB I Power Plant to site. Have two (2-each) 400-bbl storage tanks set up to store water. Have casing and downhole cementing equipment on location.

2) Move in equipment and rig up drilling equipment (Longyear or Tonto Core Rig or equivalent), water tanks, storage tanks, sanitary facilities, etc. Notify DOM prior to spudding well. Rig up communications equipment, sanitary facilities, etc. prior to spudding well.

3) Core HQ (3.9" diameter) hole with mud to ±150 feet, or deeper to encounter competent (granodiorite) formation. Open hole to 6 1/4" with mud. Run 4 1/2" 12 ppf flush joint casing from 2-feet off bottom to surface. Run centralizer in center of bottom joint and one at each of next two casing collars.

4) Cement annular hole through cementing head and casing using rig pump with 30 cu. ft. (100% excess) cement using neat cement with 5.5 gallons water per sack of cement. Use additional excess cement if necessary, based on hole conditions, to insure adequate cement job to surface. Cement volume and cement additives to be determined by hole conditions.

5) Install 4 1/2" casing head flange, 4" full-opening steel valve, 2" side annulus outlets and 4" Annular BOP as per attached Figure 3. Notify DOM at (702)

687-5050 or (702) 882-6850 24 hours in advance of BOP test. Test BOPE and 4 1/2" casing to ±500 psi for 30 minutes or as per instructions of DOM personnel.

6) Drill out cement and core drill HQ size (3.9" diameter) slim hole to ±750 feet. Run 3 1/2" 9 ppf Flush Joint casing to ±750 feet with cement collar one-joint up. Place centralizers on center of bottom joint, one at next two collars.

7) Circulate hole with mud to cool and condition hole.

8) Cement 3 1/2" casing with 60 cu. ft.(100% excess) cement mixed with 40% silica flour, 1:1 perlite and friction reducer as per cement company recommendations. WOC 12 hours.

9) Nipple up 3 1/2" X 4 1/2" Swage nipple, 4" master valve and re-install 4 1/2" annular BOP on 3 1/2" casing. Install 2" annular valves on 3 1/2" casing string. Notify DOM at (702) 687-5050 or (702) 882-6850 24 hours in advance for BOP test. Test BOPE and 3 1/2" casing to ±500 psi for 30 minutes or approval by DOM representative.

10) Drill out cement and core NQ size (2.75" diameter) hole to 2,000 feet. Temperature surveys will be run at various depths. Several injection tests will also be carried out at various intervals during drilling operations.

11) Release rig, clean location and secure well with 4" valve.

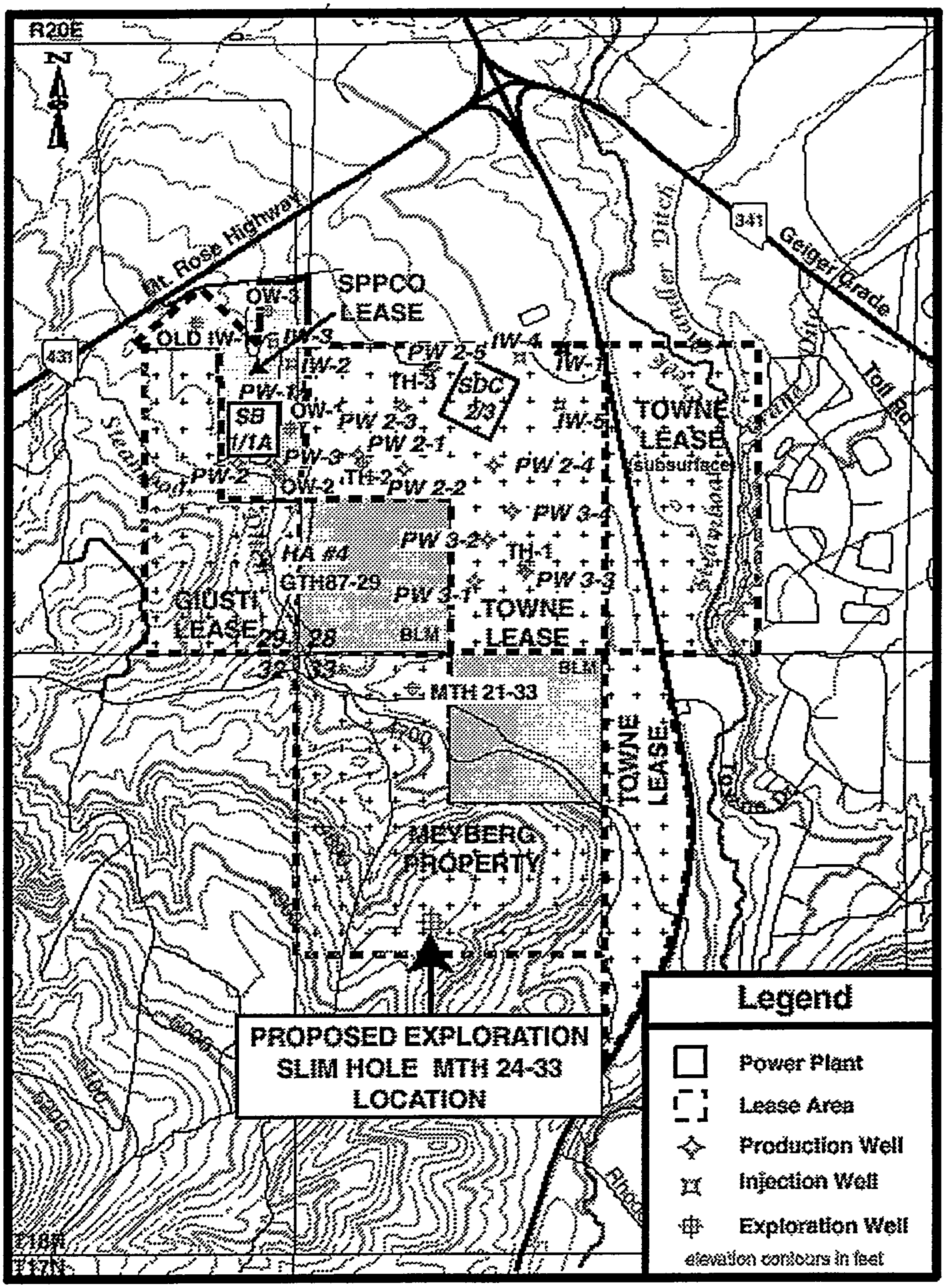

Figure 1) Location of the Meyberg Exploration Slim Hole MTH 24-33.

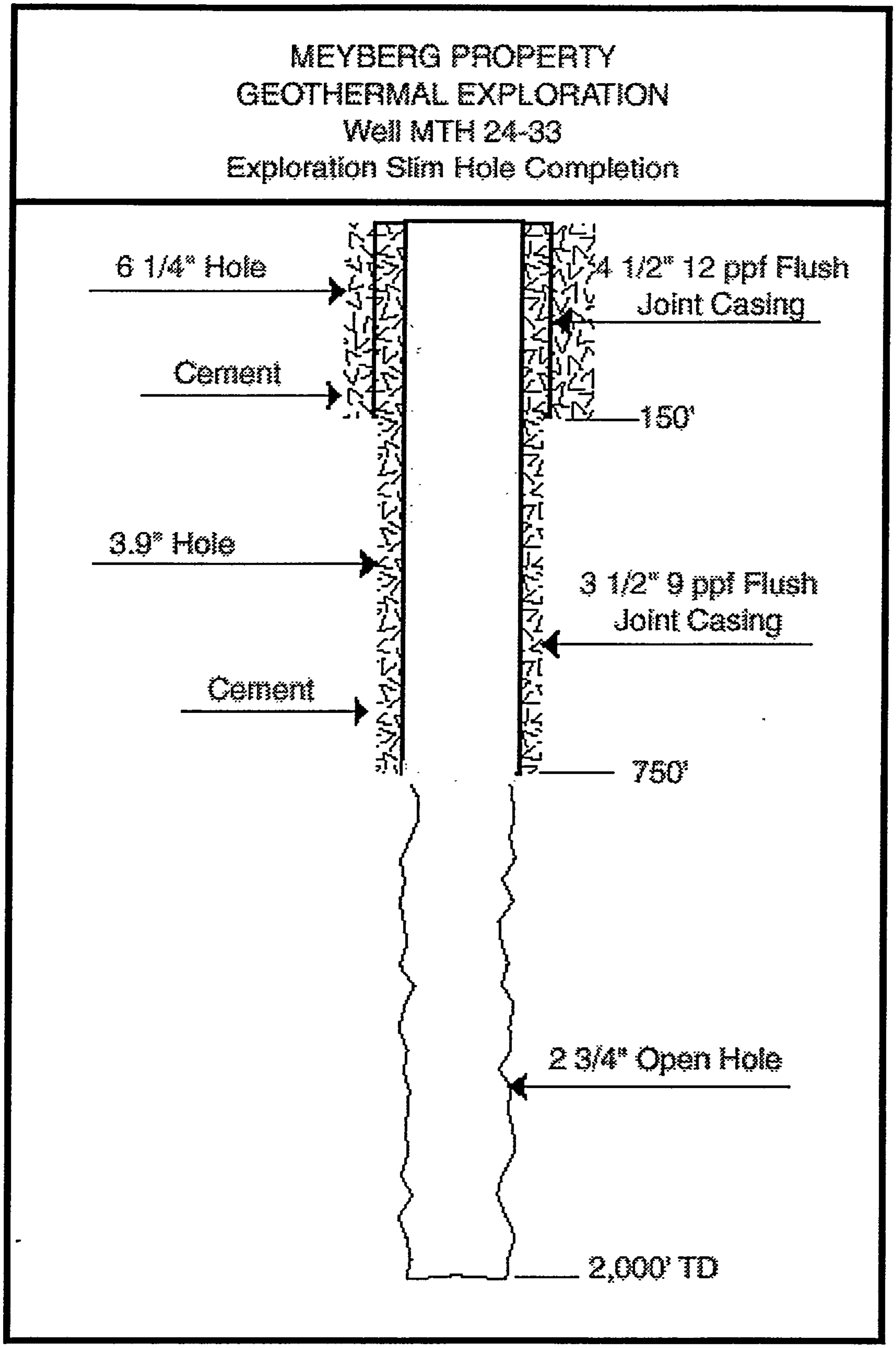

Figure 2) MTH 24-33 Slim Hole Completion.

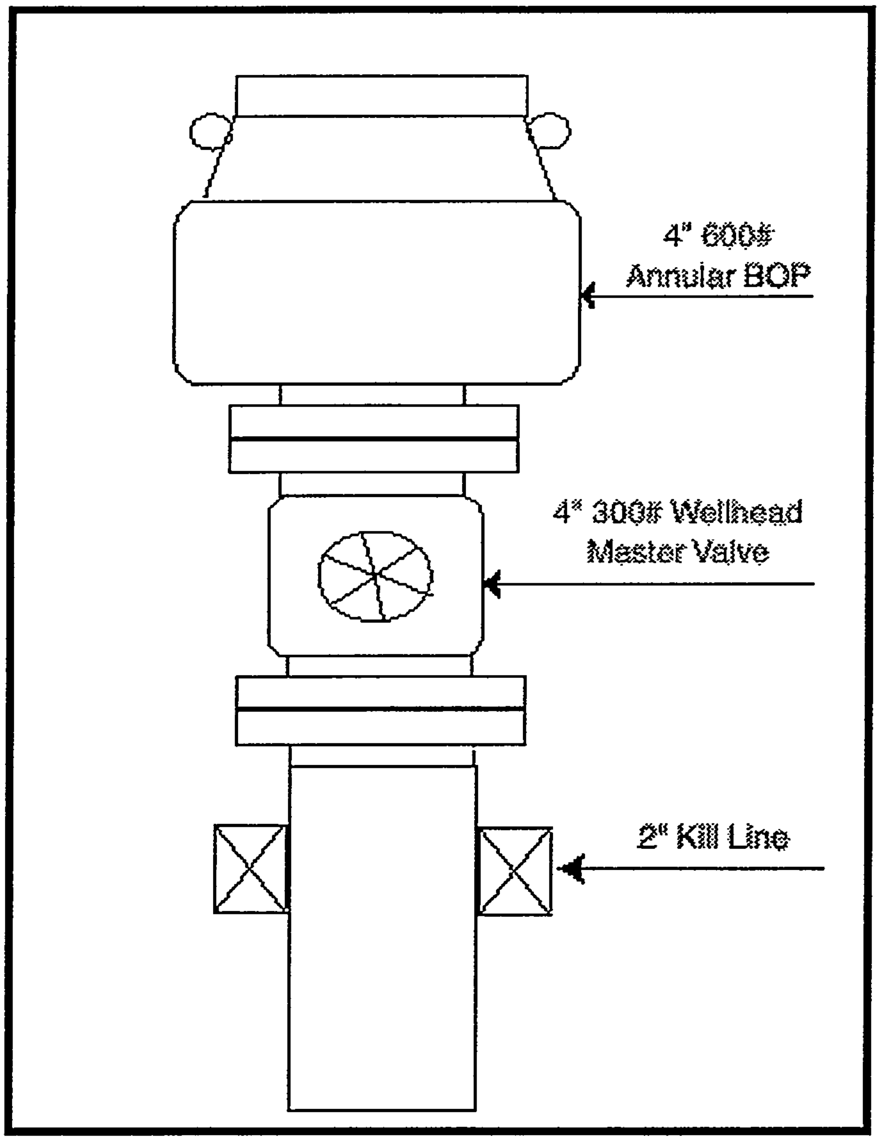

Figure 3) 4 1/2" Annular BOPE.