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CITY OF NORTH BONNEVILLE
WASHINGTON

DE83 008984

GEOTHERMAL EXPLORATION PROJECT

PRODUCTION TEST WELL

Phase II

For

EG & G Idaho, Inc.
Idaho Falls, Idaho

June, 1982

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CITY OF NORTH BONNEVILLE
WASHINGTON

G E O T H E R M A L E X P L O R A T I O N P R O J E C T

P R O D U C T I O N T E S T W E L L

P h a s e I I

For

EG & G Idaho, Inc.
Idaho Falls, Idaho

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1.0 SUMMARY AND FINDINGS

1. The geologic units in NB-4 include 144 feet of overburden fluvial material, 149 feet of fluvial and volcanoclastics, 629 feet of andesite flows with interbedded tuffs and occasional breccia, 261 feet of hard welded ash flows, and 1043 feet of essentially tuff beds. Several faults, fracture zones, and possible intrusive dikes were also encountered.
2. Preliminary pump tests indicate a moderately permeable aquifer system with marginal capacity at a high yield. Specific capacities are estimated at 2.5 to 3.5 gpm/ft of drawdown with yields of 500 to 800 gpm. Below 980 feet, test yields were about 40 gpm at 294 feet of drawdown and caused a pressure head drop in overlying units. The flow temperatures were about 90°F. Analyses indicate a sodium-chloride-high pH type water for the upper geothermal target zone. This artesian zone has a slightly higher pH and much higher conductance than other waters encountered. Moderate TDS and Ca, and high pH indicates a possibility of encrustation during production. High chloride content and hardness indicate that the water may be corrosive to some metals. Some ground water contact with nearby basic intrusives is inferred.
3. The primary geothermal target Zones 1 through 4 are located at depths of 422 to 443 feet, 478 to 483 feet, 516 to 532 feet, and 1,175 to 1,180 feet. These zones are identified based on factors including the highest temperature deflections and apparent increase in upflow rates estimated from the geophysical logs. The resource exists as a leaky aquifer system, interconnected by a complexity of fractures and faults.
4. Four development options are recommended for consideration. These include pumping from Zone 1-443 feet within the existing hole, and, or drilling an additional hole, nearby the existing NB-4. A maximum pumping rate of 400 gpm from within the 12 inch casing (175 feet depth) is estimated from the results of preliminary pump tests. A definitive test is recommended to select the design pumping rate, both sustained and peak, for the City's 12 inch pump.

2.0 INTRODUCTION

2.1 Purpose And Scope

General

The purpose of drilling and testing a production well at the City of North Bonneville, Washington, is to determine the general availability of warm water from artesian zones encountered during the previous temperature gradient drilling phase. Based on discussions with the City of North Bonneville, the production test well was drilled to a depth that would also explore for ground water temperatures near 130°F (54.4°C). Depth projections to a 130°F bottom hole temperature were made by assuming a constant ground water temperature rise greater than 50°C per kilometer, and by assuming that essentially homogeneous or equivalent conductive rock units would be encountered. Minimum water production requirements were not set, although the City determined that about 800 gpm would be acceptable. Large upper casing diameters of 16 and 12 inches were installed in order to provide the future use of either a vertical turbine or submersible pump, as desired by the City.

The detailed scope of work is included in Attachment A - Statement of Work of Subcontract No. K-7883 issued to Richard C. Kent (dba Kent Associates) by EG & G Idaho, Inc., Idaho Falls, Idaho. In general, the scope of work included interpretation of well characteristics, evaluation of ground water as a geothermal resource, geologic analysis of data from drilling and testing, drilling supervision, daily drilling cost accounting, and preparation of a final report. The report includes geologic evaluation of the drilling and test data, ground water and geothermal potential. These subjects are described in following sections of this report.

Drilling History And Costs

Drilling supervision and daily cost accounting were significant time

consuming activities which are included in this report as Appendices. As part of the original work scope, the supervision included general monitoring of the driller's activity and times, such as, footage rates, maintenance time (non-chargeable), standby time, and total daily times for each item. The scope was expanded to include hourly rates, hourly rotary time, hourly bit rotation and footage accounting for the City, who purchased the bits used below 981.5 feet. This included unforeseen diligent monitoring of the rotary rpm and down-pressure for the City to be assured that their bits were being utilized to the maximum extent possible by the driller. Such data is tabulated on the daily sheets in Appendix C. Daily operational history was transferred to the separate cost accounting daily sheets, included as Appendix G. The cost accounting was somewhat complicated by the unexpected change in drilling contracts from a fixed to an hourly price. Under the hourly price drilling contract, only the actual time when the drill string was rotating and penetrating could be charged. Our field procedures were modified to accommodate the additional monitoring and consequently allowed less time for the planned on-site logging of cuttings. All cuttings were therefore reviewed in the office.

In addition to sample descriptions, information shown on the Geologic Logs includes: drilling water return temperature and horizontal pipe discharge, occasional discharges while blowing water from the hole, NB-2 pressure readings, water sample depths and pH data, evening and morning static water levels, and miscellaneous drilling progress notes.

2.2 Location

The Columbia River, serving as the border between Oregon and Washington, has eroded and formed the Columbia Gorge with cliffs rising 3,000 feet above the drill sites. The project site is located in the core of the Cascade Mountains, near several of the Cascade volcanoes. Mt. Hood (11,245 feet) is about 24 miles southeast; Mt. St. Helens (8,364 feet) is about 38 miles northwest; and Mt. Adams (12,307 feet) is about 36 miles northeast.

Production test hole NB-4 is located within the city limits of North Bonneville, about 1,000 feet north of the Columbia River, in the northeast quarter of the northwest quarter, Section 21, Township 2 N., Range 7 E. Hole NB-4 is on a N 21 E bearing, about 140 feet, from hole NB-2, which has coordinates of N725,954.3, E1,628,106.7, and an elevation of 45.2 feet MSL. Hole NB-4 is estimated to be at elevation 55 feet.

2.3 Previous Work - Phase I

General

This report draws on the interpretations and data presented in the previous report titled "Geothermal Exploration Project, Phase I - Temperature Gradient Drilling, City of North Bonneville, Washington", by Kent Associates (June, 1981). Phase I included the drilling of 3 holes to gather temperature gradient information, as well as, an evaluation of geologic structures and potential aquifers. The Phase I report includes an extensive discussion of regional geology, structure, and hydrology as it relates to the North Bonneville project because previous geologic studies had been essentially limited by the geographic aspect of state boundaries. The following is a summary of the Phase I report.

Geology

The uppermost geologic units encountered in the 3 drill holes are correlated to volcaniclastics (Eagle Creek Formation) cropping out in the vicinity. An underlying lava flow sequence, containing the potential geothermal resource(s), had not been reported in previous investigations of the project area. Therefore, an in-depth evaluation was presented in the Phase I report to correlate the lava flows to regional outcrops and a flow sequence informally named "Lava Flows of Three Corner Rock" (Hammond, 1980), a part of the Fifes Peak Formation. The flows were previously considered to be the "Rock Creek Lava Flows". Although assigned locally to the Fifes Peak Formation, the flows are distinguished by their

stratigraphic position, immediately overlying a thick, widely distributed pyroclastic flow sequence generally mapped as a part of the Stevens Ridge Formation. Regionally, these interstratified lenses of different lava and pyroclastic flows overlap each other, extend discontinuously, and vary in thickness.

Based on these Phase I conclusions, and tentative correlations to the outcrop surface mapping, the following thicknesses were projected beneath the Bonneville project site:

<u>Age</u>	<u>Formation</u>	<u>Thickness</u>
0 - 722 ybp	Overburden (alluvium, landslide debris)	140 to 160 feet
early Miocene	Eagle Creek Formation	180 to 270 feet
late Oligocene - early Miocene (?)	Lava Flows of Three Corner Rock	700 to 1,000 feet
early Oligocene (32.8 mybp; Hammond, 1980)	Stevens Ridge Formation of Rock Creek "Pass"	500 to 800 feet
late Eocene - Oligocene (31-45 mybp; Hammond, 1980)	Ohanepecosh	1520 to 2230 feet depth

Ground Water

Understanding the regional geologic setting is important to defining the stratigraphic sequences and associated faults as a potential aquifer system. Assuming a regional gradient of 50°C/Km for the Bonneville Basin, an approximate ground water temperature of 58°C was projected at about 3,000 feet depth beneath the project site. The calculations were based on least squares fit of gradient intervals. These kinds of temperature projections are dependent upon many assumed subsurface conditions and they can only be used as general exploration guides. Source implications for the artesian warm water in hole NB-2 were discussed. These included faults as conduits and intrusions as heat sources. Artesian flow at NB-2 was greater than 200 gpm. An evaluation of water chemistry was made to see if vicinity waters had been in contact, or near, a heat source. Very little data is available on the chemistry of ground water in the

Cascades, in particular, near Bonneville except at local hot springs. It was generally concluded that the artesian ground water in the Three Corner Rock Lava is thermal meteoric water. Vertical leakage, probably along a complexity of fractures and faults, allows surface discharge (springs) in various places near the project site.

Production Test Well

A production test well was recommended to gather artesian and pump data, and to explore for ground water with the desired 54°C temperature. Both the projected temperature depth (from gradients), and the depth to the Ohanepecosh-type rocks were in the range of 1,000 to 2,500 feet. Encountering shallow, higher temperature water would be dependent upon the success of finding isolated geothermal conduits. The production test recommendations included a 48 to 72 hour downhole stepped pumping test with discharges exceeding the City's desired production level.

3.0 GEOLOGY

3.1 General

The Cascade Range of northern Oregon and southern Washington is subdivided into two major groups: High Cascade and Western Cascade, with the age boundary generally accepted as Pliocene-Miocene. The High Cascade Group was deposited during the latest arch building of the Cascade Mountains. Broad and diffused eruptive centers and associated intrusions and structures created by this arching are considered to be the heat sources of the Bonneville region. Such potential sources are shown on the Regional Structure Map and Vicinity Geologic Map (Plates 1 and 2; Kent, 1981). The Cascade Mountain arch, or uplift, apparently affected southern Washington-northern Oregon more than central Oregon, with uplifting significantly decreased by about 1 million years ago. Bonneville is considered to be at the crest of the Cascade uplift as evidenced by dips in the Columbia River Basalt Group. The minimum uplift at Bonneville is around 3,000 feet. The arch-type uplift is complicated by large north trending grabens near Hood River, Indian Heaven, Mt. Adams, and Mt. Hood. There is a suggestion that Bonneville is aligned with a west hinge of the postulated Mt. Hood "graben". Also, during antecedent downcutting near Bonneville, the Columbia River may have paralleled an east-west structural transition feature.

The Western Cascade Group (Figure 1), subdivided into Upper, Middle, and Lower parts in Oregon, has been expanded by age into Washington (Hammond 1980). However, except for the Columbia River Basalt Group and the Eagle Creek Formation, geologic units have yet to be strictly correlated between the two states. Therefore, discussions regarding the potential geothermal aquifers in this report emphasize the Washington side of the Columbia River. It is recognized that nomenclature problems exist in Cascades interstratified volcanic environments. The Columbia River serves as a regional hydrologic "sink", and extrapolations to the south regarding water production would not be meaningful at this time. A more extensive discussion of the regional

geology and structure is found in Kent (1981).

3.2 Bonneville Basin

The Bonneville geothermal project is centrally located in a basin surrounded by older rock types (see Figure 2). For the purposes of this report, the region around the project site is termed "Bonneville Basin". The Bonneville Basin is characterized along its center by the northwest trending Bonneville Syncline axis, with generally 15° to 30° dips. The Basin is bounded by the Ohanepecosh Formation and the Bonneville Syncline axis is presumed to be the primary hinge line.

Internal Basin features include the northwest trending Rock Creek Fault, "Rock Creek Syncline", and Wind River Fault. The internal folds plunge southerly and the faults define a graben. Scattered Columbia River Basalt Group flows occur primarily as rimrock. Occasional Quaternary eruptive centers and flows occur within the Basin. They are essentially confined along the Basin boundaries or near the center. Intrusions in the form of dikes and sills occur near the axis and near the Columbia River. These intrusions are primarily diabase and gabbro, and are younger than the Eagle Creek Formation.

There is a possibility that cross faulting occurs near the Columbia River. Some of the faulting is inferred to be moderate angle reverse (Figure 3). A fault south of NB-3 may trend north-northeasterly, similar to a fault near Bonney Rock. Also, the Eagle Creek Formation apparently changes dip as it crosses the Columbia River, an indication of structural discontinuity.

3.3 Drill Hole NB-4

The geologic log of hole NB-4 is included as Appendices A and B. A geologic summary of the hole is shown on the Location Map (Figure 2). Tentative formational names have been assigned to the various rock types in NB-4 that are believed to be similar to those cropping out along the northwest edge of the Bonneville Basin.

The major rock types in hole NB-4 have been divided as follows:

<u>Depth(Ft.)</u>	<u>Description</u>
0-144	"Overburden" (recent sands and gravels)
144-293	Lithic tuffs, clay, silts, sands, gravels
293-922	Porphyritic to fine-grained andesite flows with lithic, crystal and fine tuff interbeds
922-1183	Very hard welded lithic, crystal tuffs with soft tuff interbeds
1183-1450	Soft tuff with very hard welded lithic, crystal tuff interbeds
1450-2226	Crystal tuffs predominate with blue-green inclusions abundant

The top of the "Lava Flows of Three Corner Rock" has been arbitrarily picked as the top of andesite in each drill hole of the project site. The upper flows in NB-2 are very weathered and have the appearance of weathered crystal tuffs. Four major tuff interbeds occur in NB-4 within the andesite flow sequence. These tuffs are at 340 to 394 feet, 472 to 501 feet, 573 to 590 feet, and 742 to 897 feet in depth.

Geophysical logs are included as Appendix H. The neutron and electric suites clearly indicate the saturated zones. Some of the tuffs, although having high moisture and porosity, have very low apparent permeabilities. A correlation of the geophysical logs and geologic logs was made to identify potential geothermal target zones for future pump testing and possible development

(Figure 3). The following is an evaluation of those zones:

<u>Depth(Ft.)</u>	<u>Lithology</u>	<u>Remarks</u>
293-333	Andesite	Dense, low moisture, flow breccia at 320 feet with high clay content
394-395	Fault	Wet, flow increase 5fpm, clayey gouge
395-438	Andesite, faulted	Andesite generally low moisture and porosity with moderate bulk density; 420-438 feet contains numerous fractures/faults with warm water flow increase 35fpm; 400-407 feet fault zone, flow increase 5fpm; 412 feet quartz veining, joints, high moisture and porosity with sudden 50fpm increase; 425-426 feet fault or dike, very open, high pressure head, warm water, flow increase about 40fpm
438-442	Tuff, faulted	Clayey, soft, very siliceous tuff with numerous joints and veins; high moisture and porosity with moderate bulk density; warm water probably with relative lower pressure head, slight hole cavitation; flow increase 5fpm; fluid resistivity change; probable separate aquifer
442-446	Tuff	Gray-blue tuff with abundant sulphides (pyrite predominate); low porosity, warm water, very low to no flow, low resistivity could be due to sulphides
446-449	Tuff	Red clayey tuff, warm water, very low to no flow, possibly leaking from underlying unit
449-461	Andesite	Low porosity, moderate bulk density, possibly warm zone uppermost part, fluid resistivity change
472-501	Tuff	Saturated, low resistivity, low density, very high hole cavitation, less than 5fpm flow increase, development with screens only
501-516	Andesite	Vesicular, low resistivity, vuggy, probably very altered/leached, high moisture, low bulk density, two warm water zones leaking to overlying tuffs?(higher pressure head?)

516-546	Andesite	Vesicular upper part, then warm water zone with very low flow increase, moderate porosity, needs pump testing
546-548	Tuff breccia	Low moisture and porosity, high bulk density, very hard, no flow response
548-556	Andesite	Red with hematite coatings, quartz veining, low resistivity due to sulphides (?), low moisture, warmer water in fractures
556-561	Sandstone	Low porosity, wet, slight flow decrease
561-565	Andesite	Upper part saturated, low resistivity, low bulk density, temperature and 10fpm flow increase
565-573	Andesite	Low moisture and porosity, high bulk density, bottom of vertical fluid resistivity, possible separate aquifer
601-628	Andesite	High moisture, low bulk density, erratic resistivity may be due to sulphides including copper, thin warm water zone about 610 feet
640-666	Andesite	Low moisture and porosity, two warm water zones, very slight flow increase, possible very altered lava flow
667-742	Andesite	Numerous tuff interbeds, high resistivity, moisture and porosity increases with depth, moderate density, upper part with thin warm water zones, sudden flow decrease in upper part, veins or dikes sulphide-bearing with low resistivity from 689-702 feet
1176-1180	Tuff	Low bulk density, fair moisture and porosity but low resistivity; may have fair permeability, fluid resistivity sudden change, flow increases

The lithologies below 1450 feet depth are almost indistinct except for color changes. Blue-green inclusions of altered crystals or grains are abundant below 1450 feet, and are believed to be mainly celadonite. This lower zone is also characterized by crystal tuffs, altered meta-lava, and a general lack of welded and lithic tuffs. Throughout the hole, except within an occasional

andesite unit, most of the feldspars are altered to clay. The crystals in the crystal tuffs tend to be euhedral plagioclase and zeolites, typically altered to white clay.

The higher temperature deflections tend to be associated with the red iron coated units. Pyrite is abundant in several zones, especially in faults and fractures, inferred from flow rates, temperature, density, moisture, and gamma response changes. Generally, the pyrite and red iron coatings are associated, but not always. Pyrite was observed in outcrop along the highway west of Stevenson in soft white-gray, very weathered andesite flows. Other iron-related minerals are found in "iron cemented clusters". The clusters tended to be concentrated in the upper portion of NB-4, but are found throughout the hole, a significance that has not been yet determined. Copper mineralization occurs in a few zones, primarily as chalcopyrite, bornite, and possibly copper-bearing pyrite. Quartz veins are commonly associated with the copper minerals, but occur as veinlets in numerous zones, particularly where waterflows increase. These copper zones are similar to some of those described for the Wind River copper district, about 20 miles north of Carson. In this district, quartz veins occur in basalt, pyrite is abundant, and diorite and basalt also occur as dikes, sills and plugs. The quartz veining, copper mineralization, pyrite concentrations, hematite, and iron cemented clusters indicate the complexity of the faulting and fracturing network existing in the project area.

3.4 Correlation

Correlation of the units in the exploration holes to the surface outcrops is shown in Figure 3. Apparent thinning occurs from northwest to southeast within the Bonneville Basin. Correlation between the exploration holes is hindered by the lack of petrographic data for the samples. Weathered volcanic suites often have similar appearances, and the geologic logs are essentially based on megascopic description (aided by a magnifying scope). Thin sections should be made of the Three Corner Rock sequence. Gross sample lithologies were correlated to the natural gamma logs. Weathering and alteration products can affect the natural gamma responses, and some of the weathered andesites have about the same gamma intensity response as tuffs. The natural gamma logs of

the other holes were compared to the moisture, density, caliper, resistivity, and gamma logs of NB-4.

One zone of low gamma response is apparent in all three holes. A gentle 3° to 5° southerly dip is inferred for the andesites. While the overlying Eagle Creek volcaniclastics have a slightly greater dip, this is assumed to be apparent and an indication of an unconformity between the two formations.

As suggested in the Phase I report, there appears to be a reverse fault between NB-4 and NB-2, and NB-3. The strike cannot be determined although it seems to be northeasterly. The location of NB-4 was based on this assumption. If the fault dips southeast, it is greater than 30° , and, if it dips northwest, it is greater than 15° . These attitudes are based on several structure models, including a review of the nearby BPA substation and City water wells. Reverse faulting in the bedrock is also reported near the Bonneville damsite. A second fault appears to cut the artesian fault. It may strike northwesterly based on an image boundary solution, but this conclusion is very tenuous at this time. Any correlation of structures beyond a few hundred feet is difficult. Bedrock faulting and fracturing is extensive, especially along the Columbia River.

4.0 GROUND WATER

4.1 Occurrence

The artesian water zone encountered at about 426 feet in NB-4 is considered an open void. The zone appears to be very altered-weathered dikelets intruding a fault. Salt and pepper colored samples from this and other zones contain a very soft, clayey, siliceous, groundmass which could be easily eroded by ground water movement. Very large open joints, typically over three feet wide, can be seen in the Three Corner Rock outcrops between Carson and Stevenson. Other minor potential geothermal zones are the andesites, with vesicular flow tops and fractured tuff units. However, the geothermal resource is essentially confined to the upper andesite and fault zones encountered in NB-2 and NB-4. The resource will be developed primarily through fracture permeability.

Numerous other cool water-bearing zones were encountered as shown by a comparison of the temperature and flowmeter logs. For example, a sustained flow increase occurs from about 1000 feet to 1099 feet. Some of these zones have a much lower head, and would therefore accept invasion from an open hole production well.

The elevation difference between the artesian fault zones in NB-4 and NB-2 is about ten feet, but the dip is apparent. A structural analysis, using andesite flow log responses in NB-3 and NB-1, as well as the total depths of all holes, suggests a moderately dipping reverse fault (Figure 3). The strike of the fault appears to be in a direction opposing the dip of the strata. The "artesian fault" is assumed to be somehow interconnected through other faults and fractures throughout the vicinity. The Resort Well is much shallower and warmer than the zones in the exploration holes. In addition, warm water springs occur northeast and northwest of the Resort Well, at the mouth of Hamilton Creek, near Bass Lake, Cascade Island, and Bonney Rock. These springs and seeps occur in a variety of rock types, including landslide, alluvium, and volcanoclastics. Generally, the Bonneville Basin serves as a thermal depression, assuming that some downward ground water movement occurs at the outcrops. The

major source of thermal water, however, appears to be confined to within a few miles of the Columbia River area.

4.2 Temperature and Flow

A dynamic temperature profile and flowmeter log are shown on Figure 3, Correlation Chart. The temperature range, from surface to total depth, on the 12/9/81 log is 32.3°C to 44°C. Calculated flow rates range from 2 to 126 feet per minute (fpm). Also shown on the flowmeter log is the flow in gallons per minute (gpm) using the caliper log of 12/10/81. The rates range from 5 to 364 gpm. The temperature and flow significantly increase in the 422 to 443 foot zone. A temperature log was obtained under near equilibrium conditions on 1/28/82, from which the geothermal gradients (Figure 3) were calculated. The incremental gradients decrease downhole from 198°C to 2°C per kilometer. The average gradient in the primary target zone of 422 to 443 feet is 2.1°C/100 feet. A shut-in flowmeter log taken on 1/28/82 indicates that very little flow is taking place between the various aquifers at depth, and that the thief zones were no longer active, or that some plugging occurred since the previous flow logs. The difference between the two later flowmeter logs was also used as a relative indication of flow. Approximately 35% of the total surface flow comes from the 428 to 443 foot zone while the remaining flow essentially comes from about 422 to 428 feet. Less than 5% of the flow is contributed from below 500 feet. The erratic flow responses are typical of turbulent flow, and a correction factor of about 85% total measured flow should be used. Corrections for the fluid viscosity have not been made.

The average geothermal gradients for the gross lithologies of NB-4 are as follows:

<u>Lithology</u>	<u>Depth (Ft.)</u>	<u>°C/100 Feet</u>
Overburden	0-144	6.21 (cased)
Eagle Creek	144-293	6.25 (cased)
Three Corner Rock	293-922	1.29
Tuffs (Upper welded)	922-1450	0.19
Tuffs	1450-2226	0.05

Aspects of the higher temperature zones generally include red iron coatings, open joints with clear, euhedral quartz, occasional saussuritization, very altered tuffs, easily eroded soft siliceous veinlets, and slickensided tuff.

The following zones have the largest incremental temperature and flow increases and were considered as potential sources of production:

<u>Depth(Ft.)</u>	<u>Remarks</u>
422-443	Also contains two thin, cool thief(?) zones
478-483	Fractured tuff
506-509	Thin zone, thief(?)
516-532	Possibly primary permeability in a vesicular andesite flow top
629-692	Apparent low permeability indicated by flowmeter, but high porosity
726-735	Thin, apparent low permeability
750-775	Average temperature profile, some flow
1175-1180	Overlies very low(?) permeable tuffs of Ohanapecosh

Minor artesian flow was also encountered at 390 feet, representing probable leaking from the underlying artesian aquifer. Very small temperature gradients, generally below 1600 feet, may represent higher conductive rock types. Some of the gradients are near vertical and indicate mixing, generally downward, due to a rapid cooling effect. There may also be some effect caused by possible air trapped during drilling. Low and reversed gradients have been experienced in similar conditions of gas wells.

Fairly low temperatures were recorded at the following depths. These zones should be further investigated and possible sealed off during production:

<u>Depth(Ft.)</u>	<u>Description</u>
449	Andesite flow top
604	Abundant sulphide/fracture zone
740	Andesite
860	Red crystal tuff (fractured?)
1044	Lithic tuff with iron cemented clusters

Flows recorded on 12/11/81, using a standard impeller, are shown below. The upflow rates shown on the log (Appendix H) are calibrated by removing the impeller velocity. Flows are also summarized on Figure 3. Maximum recorded flows are over 350 gpm in an uncased portion of the faulted andesite. The largest hole diameter measured on the caliper is about 12 inches in a soft clayey tuff.

<u>Depth(Ft.)</u>	<u>Flow(tpm)</u>	<u>Remarks</u>
0-300	44-51	Within casing
300-392	54	Fractured tuff below 380 feet
392-393	53	Fault
393-396	52	Fault
396-398	56	Andesite top, some faulting
398-406	55	Andesite, faulting
406-408	62.5	Andesite flow contact
408-425	136	Andesite, faulted
425-434	15	Andesite, quartz veins, faults
434-440	14	Andesite, veins, faults
440-443	21	Clayey tuff, jointed, veins
443-470	2	Reddish andesite
470-475	1	Crystal tuff
478-483	7	Saturated crystal tuff contact

The wellhead pressure recordings at NB-2 decreased daily as NB-4 was being drilled. NB-2 morning pressure recordings were about 32 feet (equivalent), dropping to about 20 feet (equivalent) when drilling commenced. Overnight pressure increases were generally higher by about 5 to 7 feet while drilling below 1500 feet. The highest recorded NB-2 pressure reading was about 49 feet on 11/10/80, after 19 days of no drilling.

4.3 Water Quality

Water analyses are included as Appendix E. Seven samples from NB-4 and three samples from NB-2 have been evaluated. There is not agreement between the analyses of both holes, and the calcium values of NB-2 are probably a reflection

of cementing the casing in NB-2. The following is a list of reviewed analyses:

<u>Sample</u>	<u>Depth(s)</u>	<u>Temperature</u>	<u>Remarks</u>
NB-4 W-1	379*-486	30.2°C	
W-2	379*-951	31.3°C	
W-3	379*-1380	28.3°C	
W-4	620	36.4°C	Anion imbalance
W-5	1000	38.5°C	Anion imbalance
W-6	1500	41.2°C	Anion imbalance
W-7	2226	44.1°C	
NB-2 W-8	250-460	27.7°C	
W-9	250-460	28.2°C	Anamolous Ca, pH
W-10	250-460	28°C(?)	Anamolous pH

*casing depth (adjusted from prior recordings)

Plots on a trilinear diagram indicate a sodium chloride, high pH, type water that is typical of some hot springs areas. The chloride concentrations are high (relatively) while magnesium is low. The following is the average value of major constituents, in percent, using meq/l:

	<u>Ca</u>	<u>Mg</u>	<u>Na</u>	<u>K</u>	<u>Cl</u>	<u>SO₄</u>	<u>CO₃</u>	<u>HCO₃</u>
NB-4	19	0.36	80	0.7	67	28	2	3
NB-2	30	< 1	61	0.7	71	27	3	3

The following is a list of molality ratios that were evaluated in order to compare general relationships between analyses.

	<u>Cl/Ca</u>	<u>Cl/Mg</u>	<u>Cl/Na</u>	<u>Cl/K</u>	<u>Cl/SO₄</u>	<u>Cl/HCO₃</u>	<u>Ca/Mg</u>	<u>Na/K</u>
NB-4 W-1	5.08	380	.792	161	-	-	74.9	204
W-2	5.28	137	.628	175	7.62	33.7	25.9	279
W-3	5.23	108	.79	162	6.77	24.8	20.8	204
W-4	-	-	-	-	-	-	32.7	196
W-5	-	-	-	-	-	-	29.5	170
W-6	-	-	-	-	-	-	26.9	136
W-7	5.6	207	.525	83	8.06	-	37	159
NB-2 W-8	4.17	19166	1.07	130	-	-	4597	120

It is noted that sample W-1, representing the artesian and uppermost aquifers, is characterized by a high Cl/Mg and Ca/Mg ratio. The ratios fall within a range for other areas of Na-Ca-Cl springs and heated meteoric water. In addition, the pH is higher in the artesian zone as shown in the following list for NB-4:

<u>Depth(Ft.)</u>	<u>pH</u>	<u>Depth(Ft.)</u>	<u>pH</u>
385-390	8.6	385-390	9.25
385-436	9.7	385-486(W-1)	9.7
385-951(W-2)	9.35	385-1380(W-3)	9.0
2226(W-7)	9.7(?)		

The pH's obtained for NB-2 are 11.2, 11.6 and 10.9. Two of the NB-2 samples were analyzed at a different laboratory and shipping times may have affected the results. Also, the Ca, Na, and some ratios are not comparable to the NB-4 analyses.

The following are the calculated TDS values, with the bicarbonate/carbonate ion adjustments made:

W-1	467.9	W-5	328(?)
W-2	646.6	W-6	354(?)
W-3	607.5	W-7	673.7
W-4	382.2(?)	W-8	451.9

The average total 'hardness', using $\text{meq/l}(\text{Ca}+\text{Mg}) \times 50$, is 127 for the NB-4 samples. The conductance log shows a significant increase in the 435 to 450 foot zone of NB-4.

Higher pH is sometimes associated with hydrolysis reactions involving silicates in systems containing little carbon dioxide. The calculated partial pressures of CO_2 in the NB-4 analyses are well below an accepted average of $10^{-3.53}$. Waters that have lost large amounts of Ca and Mg by exchange may later produce reactions that raise the pH. Many metallic elements will precipitate as hydroxides or basic salts with increasing pH. At the Butte copper mine it has been shown that the Cu content suddenly decreases as the pH rises above

5.3 with the Cu precipitating as insoluble basic salts. A low iron concentration has been recorded for sample W-9, in NB-2. In a high pH system, hematite does not easily dissolve and would therefore be less mobile in a reducing system. However, in some of the upper near surface areas, oxidation may result in leaching of copper minerals, if a lower pH exists. At the high pH seen in NB-4, Cl, Ca, and Na have higher mobilities, and the somewhat alkaline waters are expected and maintained.

The high pH and probable hydrolysis reactions of carbonate solution, as well as, the dissociation of acid forming solutes is indicated by the analyses. A comparison of ion activity products to solubility products (with respect to calcite) indicates that the samples are saturated or supersaturated with respect to magnesium-silicate-hydroxides and, undersaturated in hydrous-sodium-carbonate. Minerals of these suites fall into the categories of basic, serpentine, gabbro, peridotite, some basalts, contact metamorphic, and saline lake deposits. Of these, the Table Rock 'diabase' and gabbro dikes, Bonney Rock 'diabase', and the basalt flows of Rock Creek could be a compatible environment for ground water of this composition.

5.0 PUMP TESTS

5.1 General

Pump test data is included as Appendix F. As shown on the geologic and geophysical logs, yield from NB-4 will be primarily from secondary zones, such as faults, fractures, and andesite-scoriaceous contacts. The main source of water is the 422 to 443 foot zone which includes 2 or 3 separate intervals. The pump test program was initially designed as two separate tests in order to determine the contribution of yield from the lower part of the hole, from about 600 to 2226 feet. If the yield turned out to be substantial, future production could include the entire open hole. By removing the packer and temporary 8" casing, a second test was suggested by pumping in the 12" casing from the entire open hole (380 to 2226 feet). The following pump tests were attempted:

<u>Date</u>	<u>Test Zone(Ft)</u>	<u>Packer(Ft)</u>	<u>Pump(Ft)</u>	<u>Remarks</u>
3/19/82	594-2226	594	100	15gpm airlift, 2hrs
3/24/82	594-2226	594	570	About 25gpm, 5hp subm, air interference, 1½hrs
3/29/82	594-2226	594	500	About 30gpm, 600cfm, 3½hrs
3/30/82	594-2226	594	550	About 30gpm, 600cfm, 3hrs
3/31/82	594-2226	594	400	About 28gpm, 5hp subm, 2½hrs
4/2/82	980-2226	980	400	About 38gpm, 5½hrs, 5hp subm
4/6/82	379-2226	none	200	About 700gpm, 1½hrs, 50hp subm
4/7/82	379-2226	none	200	714gpm, 12hrs, 50hp subm

The earlier packer tests were run in a 5" and coupled 6" pipe through the 8" casing. The final packer test (980 feet) was performed with a 5" pump pipe through the 8" casing. The bottom of the 8" casing is 380 feet.

The tests attempted with the packer set at 594 feet are questionable due to a large amount of air interference. The source of the air is unknown, but

is thought to be trapped air pockets resulting from drilling with the air rotary equipment down to 981 feet. Air bubbles significantly decreased after 6½ hours of airlift surging on 3/29/82 and 3/30/82. The first 5 pump test attempts met with severely reduced pump capacities and a maximum pump efficiency of only 63%. The first few tests generally yielded 25 to 30 gpm, with a drawdown of about 140 feet. There is a possibility of either a poor cement bond or a break in the temporary coupling between the 8" and 12" casings near 175 feet depth. Artesian flow is leaking between the casings. The drawdown level was kept above the 380 foot 8" casing depth in all of the tests.

Minimum 48 to 72 hour pump tests were suggested in the Phase I report. A 2 to 3 day test is still suggested as part of the production well development, even though artesian wells tend to develop drawdown more rapidly than water-table wells. Essentially no tests at these depths have been previously performed in the North Bonneville area. Equilibrium data is needed on which to base production from these fractured rock units. Fault boundary conditions are expected as the resource is fully developed. There will also be some effective recharge from the interconnected fault zones as pressures vary during production. Longer term testing will allow more accurate predictions of the geothermal resource.

5.2 Lower Hole Pump Tests

The pump test on 4/2/82 yielded an average of 40 gpm at a drawdown of 294 feet during 330 minutes. The 5 hp submersible pump, rated at 50 gpm with 300 feet of total head, was set at 400 feet depth. Previous tests, with the packer set at 594 feet, were abandoned due to the air interference discussed above. The 4/2/82 test was designed to obtain data in the lower part of the hole, and the packer was set at 980 feet. The well was flowing about 1 gpm over the casing, which was 7 feet above ground level. NB-2 is about 140 feet from NB-4, and open hole from about 250 to 460 feet depth. Flow temperatures decreased in NB-4 from about 90.1°F to 89.8°F during the pump test.

A time-drawdown plot on a semi-log graph was evaluated for the 980 to 2226 foot test of 4/2/82 (Figure 4). The slope of the curve flattens beyond about 280 feet, normally an indication of recharge in the zone of influence. The rate of recharge became sufficient to almost equal the rate of pumping. It was at about this same depth of 280 feet, and time (90 to 120 minutes), that the flow within the 8" casing dropped from about 65 gpm to 39 gpm. Pumping from below the packer then, developed a cone of depression that eventually created a lower pressure head and caused the 8" casing flows to decrease.

A transmissivity of less than 65 gpd/ft was calculated for this lower zone (modified non-equilibrium method). Theoretical yields of less than 40 gpm are estimated at a sustained drawdown of around 500 feet. Transmissivity based on residual drawdown plotted against the ratio of recovery period times is essentially equivalent to the time-drawdown transmissivity (Figure 4). The residual drawdown curve also indicates a recharge effect.

Several factors affect the validity of the test, and calculations, including variable pressure heads, turbulent flow, fracturing, and short test period. The aquifer conditions do not conform to those required for strict non-equilibrium analysis. The aquifer characteristics may be explained by low permeability of the volcanoclastics found in the lower portion of the hole. The tests show that the packer could not seal off interconnected fractures. The flowmeter log indicates that higher flows were encountered at 952 to 956 feet, as well as, immediately below the main andesite sequence, from 740 to 775 feet depth. While it is interpreted that these zones may have the largest yields below 594 feet, where the packer was set in the previous tests, the 65 gpm flow from the 8" casing was the same at both packer depths. This indicates that yields to provide the 65 gpm casing flow comes from above 594 feet depth.

5.3 Including Upper Artesian

Figures 5, 6, and 7 are drawdown and recovery graphs for the open hole test. A 50 hp submersible pump on 5" pipe was set at 200 feet. Pumping efficiency ranged between 75% and 78%, with some interference by trapped air and cavitation. The pumping rate varied, especially at the beginning of the test. The test

period was 690 minutes with a drawdown level at 185 feet. An average discharge of 714 gpm has been used to determine aquifer characteristics. The casing string in NB-4 was:

<u>Diameter</u>	<u>Length</u>
16 inch	0 to 161 feet (cable tool driven)
12 inch	161 to 178 feet (cemented into 16 inch)
8 inch	175 to 380 feet (cemented into 12 inch and hole)

Future production from a pump installed in the 12 inch casing will require drilling out the cement. The nominal hole sizes used in pump test calculations are: 8-inch, surface to 981 feet (actual bit size was 7 7/8" from 436 to 981 feet); and 6 3/4", 981 to 2226 feet. An air line was used to monitor the water level. Back pressure on the pump fluctuated around 6 to 10 psi. The pump is rated at 1000 gpm with 144 feet of total head. A preliminary 90 minute test the day before indicated a yield capability of about 700 gpm with moderate drawdown. The pressure response was almost immediate (within 1 minute) in NB-2, which was used as an observation well. The Hot Springs Resort well head pressures were also monitored. An apparent decrease of 0.2 psi at the Resort Well during the test is insignificant and is attributable to the useage of the well water by the Resort residents.

NB-2 is uncemented from about 250 to 460 feet. The largest yields in NB-4 come from 380 feet to about 450 feet, as interpreted from the geological and geophysical logs. Within this zone, peak flows were logged at depths of about 422 to 443 feet depth. Peak flows were encountered in NB-2 during drilling at depths of about 408 to 435 feet. These peak flow zones, designated as the main artesian aquifer, are approximately 25 feet thick. For the purpose of determining aquifer characteristics, the main aquifer should include the adjacent fractured andesite. An open void, such as the fault at 425 feet depth in NB-4, would have higher relative permeabilities.

The average transmissivity is in the range of 4500 to 5000 gpd/ft of drawdown. At a yield of 500 to 800 gpm, the average daily drawdown would be about 200 to 300 feet if the well and pump are efficient. The variable network and thickness of the aquifer system support using the lower transmissivities until

a test of the main artesian zone is completed. The specific capacity is estimated to be 2.5 to 3.5 gpm/ft of drawdown.

The aquifer characteristics are listed below. Data used in modified non-equilibrium well formulas were based on a straight line analysis.

Method	Delta s (Ft)	T (gpd/ft)	S	t ₀	r ² (Ft)
NB-4					
Time drawdown	24	7854		7x10 ⁻⁶	0.32-0.45
Residual drawdown	20	9424			
NB-2					
Time drawdown	39	4833		2.6x10 ⁻³	19600
Time recovery	57	3306	6.3x10 ⁻⁴		
Residual drawdown	17.5	10771			
Theis reverse curve*		4465	1.7x10 ⁻⁴	where $S = \frac{uTt}{1.87r^2}$	

* where $1/u=100$; $h_0-h=74$ feet; $t=200$ minutes; $r^2=19600$ feet

$$\text{Where } T = \frac{264 Q}{\Delta s}, \quad S = \frac{0.3 T t_0}{r^2}, \quad s = \frac{264 Q}{T} \left[\log \frac{0.3 T t}{r^2 S} \right]$$

Using the transmissivities of 4500 to 5000 gpd/ft, a distance of 140 feet from NB-2 to NB-4, and a storage coefficient of 1.7 to 1.9×10^{-4} , the value of u is about 1.3×10^{-3} , a value that indicates the straight line method can be used with reasonable results. The time drawdown curves for NB-4 and NB-2 begin a new slope at about 400 minutes and show that the aquifer and fractured andesites behave as a leaky aquifer, with a smaller component of boundary conditions displayed by the offsetting of these faults and fractures by each other. Such a condition would also produce a variable storage coefficient due to the many fracture sizes and orientations. This condition was also confirmed by the lower hole test.

Yields in the range of 500 to 800 gpm, with drawdowns of 200 to 300 feet are based upon the tests that did not stabilize. The yields at a drawdown within the 12 inch casing (above 178 feet) will need to be confirmed by a pump test. In summary, the test results so far indicate a moderately permeable aquifer system with marginal capacity at a high sustained yield. Flow temperatures during testing were variable between 89.5°F to 90.2°F.

6.0 GEOTHERMAL RESOURCE DEVELOPMENT

6.1 Conclusions

Phase I and II studies have included drilling and geologic logging, downhole geophysical surveys, both water quality and pump testing, and a synthesis of existing data regarding regional geology and geothermal potential. Based upon detailed analyses of the results of these studies, several conclusions may be drawn regarding the geothermal resource potential and options for resource development.

The available stratigraphic resource thickness, represented by NB-4 (total depth 2226 feet), may be grouped into a lower and upper geothermal "regime". The lower regime, below about 1180 feet depth, is considered to have the least potential as a geothermal resource because no significant higher temperature zones exist, that would be represented by deflection peaks on the temperature logs, and the well yields are generally less than 40 gpm. While the well yield is low, a gradual temperature increase does occur with depth (to 44°C at 2226 feet), and the utilization of this temperature is discussed in the resource options.

The Phase I report concluded that the temperature gradient for NB-2 was 86°C/km. This gradient is higher than the accepted 45°C-55°C/km gradient for this region (Kent, 1981). Some informal studies indicate much higher gradients for the Bonneville holes that are based simply on dividing the depth of the hole by the surface and bottom hole temperature differences. Gradients are especially useful as a regional exploration tool when coupled with rock conductivities and other geophysical studies, such as gravity, seismic, and density. Use of temperature gradients in petroleum exploration has shown that statistical representations of selected zones can be used to target oil and gas invasion into wells. The total hole gradient for NB-4, based on the hole length divided by temperature differences is: $(44^{\circ}\text{C} - 12^{\circ}\text{C})/2226 \text{ feet} = 46.8^{\circ}\text{C/km}$. This generalized gradient falls within the lower end of the gradient scale for the region. The following is a comparison of temperature gradients in °C/km:

<u>Depths (Ft)</u>	<u>NB-2</u>	<u>NB-4</u>
0-650	86	129
165-345	160	
144-293		205
377-609	78	
400-600		25

It is obvious that the gradients can be correlated to the known selected invasion zones of warm water in NB-2 and NB-4. Temperature projections based on the higher gradients would not be as useful without the accompanying hydraulic characteristics of each hole.

The higher temperature regime, above about 1180 feet depth, is considered to have the greatest potential as a geothermal resource. Four geothermal target zones are identified, based upon higher temperatures, artesian flows, and well yields, which ranged up to 714 gpm during the pumping tests. The four target zones, referred to as Zone 1 through Zone 4, are described below.

ZONE 1

422 to 443 feet Considered to be main high pressure zone, faulted andesite and tuffs, fracture permeability, flows increase at least 110 fpm and calculated at over 350 gpm in the hole at time of logging, minimum temperatures in the mid-30°'sC (high 90°'sF), nearby turbulent flow expected

ZONE 2

478 to 483 feet Fractured tuff, fracture permeability, high 30°'sC (±100°f), 25 to 30 gpm flow increase, minor target but should be tested

ZONE 3

516 to 532 feet Vesicular andesite, may have sufficient porosity, may yield depending upon permeability, flows increased about 3 fpm or 20 gpm in the upper part, no significant temperature rise, minor target but should be tested

ZONE 4

1175 to 1180 feet Lithic-crystal tuff, very hard, fracture permeability, flows increase only about 15 gpm, good 1°C temperature rise, minor target zone

The available potential geothermal resource, then, consists primarily of a combination of higher temperatures, artesian flows and potential well yields in the upper hole regime; and gradual temperature increases to a maximum at the bottom of NB-4 of 44°C. Several options exist for development of the potential geothermal resource, which consist mainly of variations of pump sizes and depths of installation, zones of hole developed, and use of alternate systems, such as a pumping heat exchange system. Selection of one development option will be dependent not only on maximum available temperatures and well yield, but also well development costs and projected requirements in terms of sustained and peak pumping rates anticipated. The requirement available for consideration in this study was an acceptable well yield of 800 gpm, with no sustained or peak rates specified.

6.2 Recommendations

Four development options are recommended for consideration. These four options take into account the goals of maximizing temperatures and well yield, further development requirements, and anticipated use of a 12 inch pump owned by the City of North Bonneville.

OPTION 1

In Option 1, all of NB-4 could be developed as an open hole using the City's 12 inch pump. This option may represent the least cost in well development, since the hole could probably be developed without additional casing. However, this would blend both warm and cool waters, resulting in an overall degradation of water temperatures available.

Option 1 would allow use of the City's 12 inch pump, which could be set at a maximum depth of 178 feet, which is the bottom of the 12 inch casing. While a range of well yield is estimated to be 500 to 800 gpm, this would be with a range in drawdown of 200 to 300 feet, exceeding the maximum depth at which the 12 inch pump could be set. A yield of less than 400 gpm is estimated at the 12 inch casing depth. Therefore, additional testing is recommended with Option 1, to define the sustained and peak pumping rate possible for a maximum drawdown of 175 feet.

OPTION 2

Option 2 would provide for development of NB-4 only above 443 feet depth, the identified main Zone 1, to maximize the available temperatures and well yield. This would prevent mixing of cooler waters from outside the Zone 1. This option would involve a cost to seal off the hole at 443 feet, but would allow use of the City's 12 inch pump and probably development of NB-4 as an open hole. As in Option 1, the 12 inch pump can be set at a maximum depth of 178 feet, and, therefore, further pump tests would also be required to define sustained and peak pumping rates with a maximum drawdown of 175 feet.

With Option 2, additional alternate pump systems are available for consideration. A smaller size pump may be used to pump from the hole above 443 feet, with a heat exchanger-type system installed in the uncased hole below the 443 foot seal. This would allow for isolated development of the hole above 443 feet, while simultaneously allowing utilization of the higher temperature (up to 44°C) measured in the bottom of NB-4. The depth of the 44°C temperature, in terms of pumping head, and the presence of numerous cool water zones in the overlying strata, makes it impractical to draw on this zone by pumping the entire open hole from a depth of 178 feet. Another alternate pump system would be to use a heat exchange system below 443 feet, while pumping with the 12 inch pump above 443 feet. This alternate is possible only if the heat exchanger can be installed in the hole with the 12 inch pump.

OPTION 3

A third option would be to develop NB-4, below a seal at 443 feet, using a smaller size pump or a heat exchanger, and to drill a second hole adjacent to NB-4 (to the 443 foot Zone 1) for the City's 12 inch pump. In this option, a seal should be placed in NB-4 above 443 feet. Option 3 would allow use of the blended overall lower temperature waters of the open NB-4 hole or utilization of the 44°C temperature at the bottom of the hole, and isolated development of the artesian high flow/temperature Zone 1. A second hole to 443 feet would allow development of two separate zones that could be utilized simultaneously, or with one serving as an alternate or backup system to the other.

Additional costs would include drilling of a second hole, sealing NB-4 above 443 feet, purchase of a second pump or heat exchanger, and further pump testing. The pump testing is recommended for NB-4 mainly to confirm whether or not a head loss effect will occur in the Zone 1 aquifer when pumping at depth in NB-4.

OPTION 4

Option 4 would maximize the highest temperatures and artesian flows of NB-4, by selectively developing the target geothermal zones. This would be accomplished by sealing off the Zones 1 through 4, thereby preventing mixing of these zones with surrounding cooler aquifer zones. The City's 12 inch pump could also be used. This option would probably involve the highest cost for development, primarily for further pump testing, and the cost of materials and installation of well screen to seal off each of the target zones. Pump testing is recommended for the four target zones to determine the sustained and peak pumping rate for the City's 12 inch pump set at 178 feet, with a maximum drawdown of 175 feet.

In all four options, the City's 12 inch pump can be utilized. To increase the well yield and temperature beyond that anticipated for pumping as in Option 1, however, will involve a cost for additional equipment and, or drilling. Whichever option is selected, further pump testing is recommended to define the pumping rate, both sustained and peak, that may be anticipated using the City's 12 inch pump set within the 12 inch casing of NB-4, at a depth of 178 feet.

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CASCADE MOUNTAINS - WESTERN CASCADE GROUP IN PART

MYBP

FIGURE 1

LOCATION MAP

BONNEVILLE GEOTHERMAL PROJECT

Based on mapping by Hammond (1980)

FIGURE 2

BONNEVILLE BASIN

Central Cascades
Washington

0 4 miles

BONNEVILLE HOLE NB-4

EG & G, IDAHO, INC.

KENT ASSOCIATES
Geologic Consultants
Lake Oswego, Oregon

JUNE, 1982

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CORRELATION CHART

Bonneville Geothermal Project

FIGURE 3

EG & G IDAHO, INC.

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Geologic Consultants
Lake Oswego, Oregon

JUNE 1982
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FIGURE 4

t/t'

FIGURE 5

E646 Idaho, Inc.
Kent Associates
Geologic Consultants
Lake Oswego, OR

NB-2

380'-2226'

4-7-82

Nonequilibrium Reverse Type Curve Match

$(h_o - h)$
S
feet

TYPE
CURVE

$W(\mu)$

FIGURE 7

$t, \text{min.}$

1000

100

10

$\frac{1}{\mu}$

100

1000

.1

1

10

100

EG & G Idaho, Inc.
Bonneville Geothermal
June, 1982

A P P E N D I X A

G E O L O G I C L O G S

KENT ASSOCIATES

Geologic Consultants

P.O. Box 484

Lake Oswego, Oregon 97034

LOG OF DRILL HOLE

A - 1

DRILL HOLE NO. NB-4

PROJECT OR AREA NORTH BONNEVILLE, WASHINGTON			DATE STARTED 8-25-81		DATE COMPLETED 12-8-81		SHEET 1 OF 56	
COORDINATES N Geothermal E			SEC-TWP-RNG NW/4 21-2N-7E		ELEVATION ± 55'		JOB NO. K7883	
CLIENT EG + G Idaho, Inc.			LABORATORY water-Mogul		TYPE OF GEOPHYSICAL LOG temp, cal, flow, T₂, N₂		TOTAL DEPTH 2226 feet	
DEPTH TO WATER 425' - artesian			DRILLING AGENCY Bach and Jannsen		MAKE OF DRILL CT and Porta.		BIT TYPE 7 7/8", 6 3/4"	
							FIELD REPRESENTATIVE Kent	

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
0				8-25-81 0730
5			no sample	BE 22-W Cable Tool start 16" casing.
9				backhoe remove 3' boulder at 4'
10				1800
15		15		8-26-81 0730
20		20	Cl, sdy, pbl, dp, med brn, sbrndd sdy, uncons, lit, pbl < 1 cm	1800
25		25	incr pbl, lit Tf pbl abd, Bas pbl, gtz	8-27-81 0800
30		30		1800
35		35		8-28-81 0700
40		40		cement delivered to site by city

KENT ASSOCIATES

Geologic Consultants

P.O. Box 484

Lake Oswego, Oregon 97034

A - 2

LOG OF DRILL HOLE

DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>2</u> OF <u>56</u>	
COORDINATES <u>N Geothermal/E</u>		SEC-TWP-RNG <u>NW/4 21 - 2N-7E</u>		ELEVATION <u>± 55 ft</u>		JOB NO. <u>K7883</u>	
CLIENT <u>EG & G Idaho, Inc</u>		LABORATORY <u>Water - Mogul</u>		TOTAL DEPTH <u>2226 ft</u>		TYPE OF GEOPHYSICAL LOG <u>CASING 16" - 160.7'</u>	
DEPTH TO WATER <u>425 ft - artesian</u>		DRILLING AGENCY <u>Boh and Jannsen</u>		MAKE OF DRILL <u>CT and Porta.</u>		BIT TYPE <u>7 7/8", 6 3/4"</u>	
FIELD REPRESENTATIVE <u>Kent</u>							

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
40			Sd, crs, cl, olv gry, sbrndd, < 3mm, ang Bas, wl rndd srt	
45		6	Tf red-gn, Mtrx plas, sd gr wl srt	1600
		7		8-31-81 1200
50		8		1900
55		9	Sd, f-m, cl, slty, sbrndd, 70% ang Bas, Mtrx plas, Fspar	9-1-81 0730
60		10	incr @ 60'	loose sand slough
65		11	Sd, m, cl, lt bl gry, frwl srt, 10% wl srt sbrndd gtz, r cbl < 6 cm	encountered water at 65 feet drilling 10' ahead of casing drive
70		12	cl incr > 50%, lit Tf incr yel-rd	
75		13	Sd, slty, olv gry, 30% ang Bas, abd Fspar, 30% sbrndd gtz, mod-wl srt	encountered water
80			Grv, sdy, olv gry, dns, ang-sbrndd, < 3cm, 80% Bas, lt Tf, r Fspar, gtz	

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A - 3

LOG OF DRILL HOLE

DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>3</u> OF <u>56</u>	
COORDINATES <u>N Geothermal</u>		SEC.-TWP.-RNG <u>NN/21-2N-7E</u>		ELEVATION <u>±55 ft</u>		JOB NO. <u>K7883</u>	
CLIENT <u>EG & G Idaho, Inc.</u>		LABORATORY <u>Water - Mogul</u>		TYPE OF GEOPHYSICAL LOG <u>temp, cal, flow, T, rd</u>		TOTAL DEPTH <u>2226 ft</u>	
DEPTH TO WATER <u>425' - artesian</u>		DRILLING AGENCY <u>Bach and Jannsen</u>		MAKE OF DRILL <u>CT and Porta.</u>		BIT TYPE <u>7 7/8", 6 3/4"</u>	
						FIELD REPRESENTATIVE <u>Kent</u>	

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
80		00		81 1800
		00		9-2-81
		14	a.a.	0730
		00		encountered water
		00		
85		85		
		00		
		00		
		15	Sd, m, olv gry, wl srt,	
		00	40% sbrndd gtz, 20% lt Tf	
90		90	occ Bas	
		00	Tf yel-rd	
		16	gtz rose-clr gen X1	
		00	cl incr	
95		95	mic @ 95'	
		00		
		17	a.a.	
		00		
100		100		
		00	occ yel brn sbrndd Tf pbl	sand slough common
		18		
		00		
105		105		
		00		
		19	incr cl + slit	107 1800
		00		9-3-81
110		110		0730
		00		
		20	occ wl rndd Bas pbl < 2cm	
		00		
115		115		
		00		water encountered
		21	a.a.	
		00		
120		120		

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DRILL HOLE NO. NB-4

PROJECT OR AREA		DATE STARTED		DATE COMPLETED		SHEET	
NORTH BONNEVILLE, WASHINGTON		8-25-81		12-8-81		4 OF 56	
COORDINATES		SEC-TWP-RNG	ELEVATION	JOB NO.	TOTAL DEPTH		
N Geothermal/E		11W/21-2N-7E	±55ft	K7883	2226 ft		
CLIENT		LABORATORY	TYPE OF GEOPHYSICAL LOG		CASING		
EG & G Idaho Inc		Water-Mogul	temp, cal, flow, T, N		16" - 160.7'		
DEPTH TO WATER		DRILLING AGENCY	MAKE OF DRILL	BIT TYPE	FIELD REPRESENTATIVE		
425' - artesian		Bach and Jannsen	CT and Bita	7 7/8", 6 3/4"	Kent		
DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS		REMARKS		
120		22	a.a.				
125		125			1700		
			126		9-4-81 0730		
130		23	Grv, sdy, lt gry-m bl gry, moist, m-wl srt Sd Mtrx, av 1-3 cm, wl rndd ply srt Bas pbl/cbl, mnv Tf, occ sbrndd Fspr pbl, scat mky gtz, abd Fe cmt Clus				
135		135			less water encountered		
		25					
140		140			1600		
		26			9-8-81 1200		
145		145	TOP EAGLE CREEK FM. 144		2000		
			Grv, 100% lt Tf, ang-sbrndd bcm indst 146		very slow drilling 9-9-81 0730		
		27	Tf, lit, v cl, m-dk gry, slily ind, abd frag lt Tf				
150		150	v sdy				
		28	152				
155		155	Tf, lit, v cl, m-dk gry, slily-mod ind		1800		
		29			9-10-81 0730		
160		160	159.5				

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LOG OF DRILL HOLE

DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>5</u> OF <u>56</u>	
COORDINATES <u>N Geothermal E</u>		SEC-TWP-RNG <u>NW/4 21-2N-7E</u>		ELEVATION <u>±55'</u>		JOB NO. <u>K7883</u>	
CLIENT <u>EG & G Idaho, Inc</u>		LABORATORY <u>Water-Mogul</u>		TYPE OF GEOPHYSICAL LOG <u>temp, cal, flow, γ, N</u>		TOTAL DEPTH <u>2226 ft</u>	
DEPTH TO WATER <u>425' - artesian</u>		DRILLING AGENCY <u>Bach and Janssen</u>		MAKE OF DRILL <u>CT and Porter</u>		BIT TYPE <u>7 7/8", 6 3/4"</u>	
						FIELD REPRESENTATIVE <u>Kent</u>	

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
160		30	Tf, lit, v cl, m-dk gry, mod ind, v f gr	16" 160.7
165		31	Tf, lit, m-lt gry, occ lpl rnd Tf, clr Qtz, abd blk f Frag	164 1800 9-11-81 0730
170		32	Sst, Lt, Lpl, m-lt gry, mod ind, Qtz < 25%, occ sbrndd Qtz x1, ply srt (Lt+Lpl Tf)	173 1800 9-14-81 0830 9-16 hole caved to 155' 1130
175		33	Tf, v cl, v f gr, grysh-rd, mst, occ Bas Frag, canch Fik Calc	175 9-17, 9-18, redrill 9-21, 9-22, 9-23 redrill, 9-25 0730 and install 16"/12" casing 1900
180		34	Sst, +f, m-lt gry, mst, sbrndd, qn wthd Tf gr, occ Qtz	177 12" 177.5 start 6" air hammer 9-28-81 TLS Portadrill 1000 Aux. Air Compressor
185		35	Tf, Lt, m gry, occ C strgr	* 9-25 7050 lbs cement 375 gal water set 12" casing 1520 - slurry mixture flow out top of 16" casing
190		36	Tf, v cl, brn-gry, dmp, v f gr, lt, evhd clr Qtz, v wthd Fspr, qn Fspr	
195		37	Sst, Tf, v f gr, m brn-gry, slily ind, 50% m gry-grn Tf gr, Bas, Qtz (Lt+Lpl Tf)	
200				

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A - 6

LOG OF DRILL HOLE

DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>6</u> OF <u>56</u>	
COORDINATES <u>N Geothermal / E</u>		SEC-TWP-RNG <u>NW/4 21-2N-7E</u>	ELEVATION <u>±55'</u>	JOB NO. <u>K7883</u>	TOTAL DEPTH <u>2226 ft</u>		
CLIENT <u>EG + G Idaho Inc</u>	LABORATORY <u>Water - Moqui</u>	TYPE OF GEOPHYSICAL LOG <u>temp, cal, flow, 7, N</u>			CASING <u>16"-160.7'</u> <u>12"-177.5' 8"-385'</u>		
DEPTH TO WATER <u>425' - artesian</u>	DRILLING AGENCY <u>Richard Jannsen</u>	MAKE OF DRILL <u>CT and Porto</u>	BIT TYPE <u>7 3/8", 6 3/4"</u>	FIELD REPRESENTATIVE <u>Kent</u>			

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
200			a.a.	
			occ clr euhd Qtz	
205		38	thn cl Bd, lt bl-wh-grn	
210		39	intbd xl Tf euhd pyx, Hnbl, Pyr	
			Tf, Lit, lt bl-gry, wet	
			euhd Plag, clr sbrnd Qtz,	
215		40	sbrng Bas, wh-bl Mtrx,	6" air hammer
			mnr hnbl xl, occ cl Fspr	TLs Portadrill
				Aux. Air Compressor
220			intbd xl Tf	
			rndd pumice frag	
225		41		
230		42		
235		43	Tf, Lpl, m bl-gry, f-m	
			qr, wet, qn Fspr, clr Qtz,	
			gry Tf mtrx, abd qn K-spar,	
			euhd Calc xl, Ze-chabasite	
			euhd clr, abd Pyr	
240				

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LOG OF DRILL HOLE

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DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>7</u> OF <u>56</u>	
COORDINATES <u>N Geothermal E</u>		SEC-TWP-RNG <u>NW/21-2N-7E</u>		ELEVATION <u>± 55'</u>		JOB NO. <u>K7883</u>	
CLIENT <u>EG & S Idaho, Inc.</u>		LABORATORY <u>Water - Mogul</u>		TOTAL DEPTH <u>2226 ft</u>		TYPE OF GEOPHYSICAL LOG <u>CASING 16'-160.7'</u>	
DEPTH TO WATER <u>425' - artesian</u>		DRILLING AGENCY <u>Bach and Janssen</u>		MAKE OF DRILL <u>CT and Port.</u>		BIT TYPE <u>7 7/8", 6 3/4"</u>	
FIELD REPRESENTATIVE <u>Kent</u>							

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
240				
		44	Tf, v cl, Lit, v fgr, wet, gry-rd, occ wh alt Fspr X1, r euhd clr atz, abd Ze-chabazite, Calc, blk dendritic xls	
245		249 1/2		
250				
		45	Tf, X1, wet, alt cl euhd Plaq wh X1	
255				
		258 1/2		
260			Tf, v cl, Lit, v fgr, wet, gry-rd, occ wh alt Fspr X1, r euhd clr atz, abd Ze-chabazite, Calc	
265		46		
		269 1/2		
270				
		47		
		274 1/2		
275			Tf, m-dk gry, v fgr, occ wh alt Fspr, v r Calc, v cl	
		48		
280				

6" air hammer
TCS Portadill
Aux. Air Compressor

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LOG OF DRILL HOLE

DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>8</u> OF <u>56</u>	
COORDINATES <u>N Geothermal E</u>		SEC-TWP-RNG <u>NW/21-2N-7E</u>	ELEVATION <u>±55'</u>	JOB NO. <u>K7883</u>	TOTAL DEPTH <u>2226 ft</u>		
CLIENT <u>EG&G Idaho, Inc.</u>		LABORATORY <u>Water - Mogul</u>		TYPE OF GEOPHYSICAL LOG <u>temp, cal, flow, & N</u>		CASING <u>16"-160.71</u> <u>12"-177.5'</u> <u>8"-385'</u>	
DEPTH TO WATER <u>425'-artesian</u>		DRILLING AGENCY <u>Bach and Jannson</u>		MAKE OF DRILL <u>CT and Porter</u>	BIT TYPE <u>7 7/8"; 6 3/4"</u>	FIELD REPRESENTATIVE <u>Kent</u>	

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
280			281	
			Tf, Lit, brn, Plag xl,	
			alt cl, r ze, clr euhd	
285		284 1/2	twined Calc xls, mky vug	
			Qtz, micro-slick occ	
290		49		
			TOP	
			LAVA FLOWS OF THREE CORNER ROCK	
			293	
295		294 1/2	And, v withd, m brn, abd	
			euhd Plag xls (Phen), abd	
			Calc Vnlet, ze Cotg, all	
			xls v alt, Grdmas sil v	
300		50	f clr-dk gn, saprolitic,	
			com Lim	
305		304 1/2		
		51		
			308	
310		309 1/2	And, Pphyt, mgry, m hd,	
			Plag euhd vit < 3mm, Calc	
			Vnlet com, Calc frac < 1mm,	
			glas Grdmas gran, occ gn	
315		52	Fsp, occ Fe ox Botg	
320		319 1/2	Brec, And or Flt?	
			abd Lim, Cmt sd-Xl Tf-And	
			320	

6" air hammer
TLC Portadrill
Aux Air Compressor

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LOG OF DRILL HOLE

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DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>9</u> OF <u>56</u>	
COORDINATES <u>N Geothermal/E</u>		SEC-TWP-RNG <u>NW/21-2N-7E</u>	ELEVATION <u>±55'</u>	JOB NO. <u>K7883</u>	TOTAL DEPTH <u>2226 ft</u>		
CLIENT <u>EG & G Idaho, Inc.</u>		LABORATORY <u>Water-Mogul</u>		TYPE OF GEOPHYSICAL LOG <u>temp, cal, flow, T, N</u>		CASING <u>10"-100.7'</u> <u>12"-177.5'</u> <u>8"-305'</u>	
DEPTH TO WATER <u>425'-artesian</u>		DRILLING AGENCY <u>Bach and Janssen</u>		MAKE OF DRILL <u>CT and Port.</u>	BIT TYPE <u>7 7/8", 6 3/4"</u>	FIELD REPRESENTATIVE <u>Kent</u>	

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
320			And, Pphyt, m gry, m hd, alt Plag euhd (Phen), Plag com saussuritized, v f Grd mas, v wthd	
325		53		
330		329 1/2	abd Jt, rd Lim Str	
335		54	Tf, v Cl, m bl gry, v sil, com Incl gn Chlor? - wthd K-spar? 333	6" air hammer TKS Portadrill Aux. Air Compressor
340		339 1/2	And, Pphyt, m gry, m hd, com euhd Calc & Qtz in tgn, Calc occ powdery, Vuq grn sec Min 340	
345		55	Tf, Lit-xl, v wthd, m bl gry, v sil, v f gr	
		344 1/2		344.5 2000
		56		9-29-81 0730
350		349 1/2		
355		57	Tf, v Cl, dk rdsh brn, occ conch Frac, sil, xl Plag euhd v alt thru	
360		359 1/2		

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LOG OF DRILL HOLE

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DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>10</u> OF <u>56</u>	
COORDINATES <u>N Geothermal E</u>		SEC-TWP-RNG <u>NW/421-2N-7E</u>		ELEVATION <u>±55'</u>		JOB NO. <u>K7883</u>	
CLIENT <u>EG + G Idaho, Inc</u>		LABORATORY <u>Water - Mogul</u>		TOTAL DEPTH <u>2226 ft</u>		TYPE OF GEOPHYSICAL LOG <u>CASING 16"-160.7'</u>	
DEPTH TO WATER <u>425' - artesian</u>		DRILLING AGENCY <u>Bach and Janssen</u>		MAKE OF DRILL <u>CT and Porta</u>		BIT TYPE <u>7 7/8", 6 3/4"</u>	
FIELD REPRESENTATIVE <u>Kent</u>							

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
360		58		6" air hammer
365		364 1/2	Tf, xl intbd And m brn, xl frs ap, vug s Fe ox, Calc rad Qtz + Ze- Nat < 3mm, abd gn orientalt Plag	THS Portadill Aur Air Compressor
370		59		
375		374 1/2	Tf, ^{xl} Lit, m gry, sft, v f gr, sli conch Frac, blk Incl com, vug Qtz	
380		60	a.a. dmp Decr Vug	8" ream 176' - 385' 1310-2000
385		384 1/2		
390	66.5 72.2	390 62 391		no 99c @ H.S.
395		61	Tf, v Cl, m dk gry - m lt brn, abd gn cl Incl, sil rapid staking	field pH 8.6 @ 390' 1 qpm artesian flow @ 390'
400		63	r Pyr	390 2000
		396	Flt 90g, abd Pyr, Fe Stn, Wl Cat	pH 9.25 10-5-81 1130 (prior cement 8") KATU 0730 8" casing: 174.7'-384.7' 1600 97 sks cement 10-2-81 1330-1530 City bit F3 Smith BR8068-8" abundant metal in cuttings 396 and 8" cement 280' 1945
		64	And, Pphyt, dk gry, abd euhd vit Plag, abd Pyr cmt Clus	10-6-81 0745
			Gog, Pyr	400 and fixed price 1115

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LOG OF DRILL HOLE

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DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>11</u> OF <u>56</u>	
COORDINATES <u>N Geothermal/E</u>		SEC-TWP-RNG <u>NW/4 21-2N-7E</u>		ELEVATION <u>±55'</u>		JOB NO. <u>K7883</u>	
CLIENT <u>E6 + G Idaho Inc</u>		LABORATORY <u>Water-Mogul</u>		TYPE OF GEOPHYSICAL LOG <u>temp, cal, flow, T, N</u>		TOTAL DEPTH <u>2226 ft</u>	
DEPTH TO WATER <u>425' - artesian</u>		DRILLING AGENCY <u>Bach and Janssen</u>		MAKE OF DRILL <u>CT and Porta</u>		BIT TYPE <u>7 7/8", 6 3/4"</u>	
						FIELD REPRESENTATIVE <u>Kent</u>	

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
400		401	abd Pyr < 10mm	
			Gog Mat + Clus	
405	78.2 1800	65		
		406		
				407
410	78.5 1245	66	And, fqr, abd Qtz xls	
		411	+ Vn, Calc com, Pyr Cotg	
			com, Qtz clr-grysh,	
			xln Grdmas	
415	77.5 1315	67		NB-2 33.1 ? 10gpm during drilling
420	77.0 1350	421		
		68		423' drill chatter
425	86.5 1440	426	abd wh frs euhd Qtz	424' very hard drilling
			dike?	425' 400-500 gpm (driller) flow
		69	X1 Tf? one chip gn, sauss. euhd	900-1000 gpm (driller) blow
			Plaq, Hnld, Pyr	NB-2 d top to 13.5 psig
430		431		426' NB-2 17.5 psig
		70	And a.a.	v. hard drilling
			abd frs Qtz w/ yel Pyr Cotgs	(metal continues in cuttings)
			thru frac	
435	85.7 1700	436		1610 NB-2 3.5 psig 400-500 flow
	86.3 0815			436' NB-2 0 psig 1700
		71		436 NB-2 13.5, 1815 1930
440			Tf, vCl, gn-wh, sft, sil,	New bit 7 7/8" F3 Smith 10-7-81
			It + Vn com	BR 8060 0730
				pH 9.7 200-300 gpm flow
				W-1 water sample 385'-436'

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LOG OF DRILL HOLE

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DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>12</u> OF <u>56</u>	
COORDINATES <u>N Geothermal/E</u>		SEC-TWP-RNG <u>NW/4-21-2N-7E</u>		ELEVATION <u>± 55'</u>		JOB NO. <u>K7883</u>	
CLIENT <u>E6+G Idaho Inc</u>		LABORATORY <u>water - Mogul</u>		TOTAL DEPTH <u>2226 ft</u>		TYPE OF GEOPHYSICAL LOG <u>CASING 16"-160.7'</u>	
DEPTH TO WATER <u>425' - artesian</u>		DRILLING AGENCY <u>Back and Jensen</u>		MAKE OF DRILL <u>CT and Porta.</u>		BIT TYPE <u>7 7/8", 6 3/4"</u>	
				FIELD REPRESENTATIVE <u>Kent</u>			

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
440	86.7 1050	441	_____ 442	900-1000 gpm blow - stopped drilling
		72	Tf, gry-bl, sil, dissem Pyr xl Qtz Pyrcl Flow?	easier drilling
445	86.9	446	_____ 446	flow stopped - no artesian repairs 11/1-1/23
		73	Tf, v Cl, v f gr, rdsh brn, wh cl Incl com - alt Fspr	900-1000 blow v. slow drilling 125 flow through pipe during drilling
450	87.1 1242 87.1	450	_____ 449	
		74	And, Pphyt, m-dk gry, hd, 2mm pyx xl, gn-blk Hnbl xl < 4mm frs ap, occ Pyr ap assoc hnbl	900-1000 gpm blow est 118 flow (pipe)
455	87.2 1650	455		
		75		
460	87.3 1820	460	Frac	easier drilling 950-1050 blow out hole drill chatter and jumping
		76	Tf, xl, m brn, frs Plaq xls	463 2000
	87.5 1840 87.6 1905 87.8 1930 86.0 0810 87.3 0920	465	_____ 463	
465		77	And, Pphyt, dk gry-blk, Fe ox stn abd, clr frs Qtz xl, Pyr assoc w/Qtz	NB-2 Opsig 10-8-81 SWL 0810 10.5' (no flow) 950-1050 blow est 118 flow (pipe)
470	89.1 1025 87.6 1030 88.2 1111 87.6 1121 88.9 1142 87.9 1145 87.4 1205 87.5 1220 87.4	470	rd scoria btm	easier drilling
		78	Tf, xl-wlded, lt gry, wl ind, rchd microxln qrdmas, grysh rd	900-1000 blow 111 flow (pipe)
475		475	_____ 474	700-800 blow est
		79	Tf, xl, bl gn, sft, sil, wet, ang gn vit xls thru	
480				

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LOG OF DRILL HOLE

A - 13

DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>13</u> OF <u>56</u>	
COORDINATES <u>N Geothermal E</u>		SEC-TWP-RNG <u>NW/4 21-2N-7E</u>		ELEVATION <u>± 55'</u>		JOB NO. <u>K 7883</u>	
CLIENT <u>EG & G Idaho Inc</u>		LABORATORY <u>Water - Mogul</u>		TYPE OF GEOPHYSICAL LOG <u>temp, cal, flow & N</u>		TOTAL DEPTH <u>2226 ft</u>	
DEPTH TO WATER <u>425' artesian</u>		DRILLING AGENCY <u>Bach and Jannson</u>		MAKE OF DRILL <u>CT and Porta.</u>		BIT TYPE <u>7 7/8", 6 3/8"</u>	
						FIELD REPRESENTATIVE <u>Kent</u>	

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
480	87.4 1250	481	— — — — — 481	
		80	Tf, Lit, gry rd, sft, saturated, intbd rd brn, abd Hem cotg, occ wh sft alt Fspr, v f gr, occ blk frag (And saphite?)	
485		486		
		81		
490	87.6 1328	491		
		82		
495	87.6 1325	495		
		83		
500	87.6 1335	501	— — — — — 501	
		84	And, Ves, m lt gry, m hd, top v wthd, euhd pyx xl ≤ 1mm	105 flow (pipe)
505		506		
		85		easier drilling
510	87.5 1355	511		
		86		
515		516	— — — — — 516	
			And, Ves, m dk gry, m hd, abd atz vugs, v wthd, sft qrdms occ subhd Plag alt wh cl, pphyt Plag oec	
520	91.4 1435	87		

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LOG OF DRILL HOLE

A - 14

DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>14</u> OF <u>56</u>	
COORDINATES <u>N Geothermal E</u>		SEC-TWP-RNG <u>NW/4 21-2N-7E</u>		ELEVATION <u>155'</u>		JOB NO. <u>17883</u>	
CLIENT <u>EG & G Idaho, Inc.</u>		LABORATORY <u>Water - Mogul</u>		TYPE OF GEOPHYSICAL LOG <u>temp. cal. flow, T, N</u>		TOTAL DEPTH <u>2226 ft</u>	
DEPTH TO WATER <u>425' - artesian</u>		DRILLING AGENCY <u>Bach and Jannsen</u>		MAKE OF DRILL <u>CT and Porta.</u>		BIT TYPE <u>7 7/8", 6 3/4"</u>	
						FIELD REPRESENTATIVE <u>Kent</u>	

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
520	88.0 1437	521	occ Qtz Vn < 1mm	
	87.6 1440	88		
525				
	88.1 1530	526	And, m dk gry, m hd, blk gn striated euhd Hnbl xls < 1 1/2 mm	red water return
	87.8 1542	89		
530				
	88.7 1545	531	And, m dk gry - brn gry, m hd, abd Vug w/ xls, abd clr vit Qtz Vn < 1 1/2 mm	red water return
		90		
535				
	88.0 1555	536	— ? — — — ? —	125 flow (pipe)
		91	a.a. hd	
540				
	87.8 1612	541		
		92		
545				
	88.3 1630	546	Tf Brec, gn gry w/ dk gry And frag, m hd sil Mtry dike?	harder drilling
		93		
550				
	88.1 1715	551	And, Pphyt, brn gry, m hd, specular Hem catys, abd euhd clr-brn Qtz, wh Qtz Vn < 1mm, Pyx + Hnbl xls < 1mm	
		94		
555				
	88.4 1741			
	88.3 1800	556		
	87.9 1822			
560	87.8 1845	95	Sst intbd Sltst, brnsh gry, v sft, fgr, v ang gr And + Tf, abd euhd clr Qtz xls, Fis, Calc Cmt (Hcl) airfall?	700-800 blow surge then very little water from blowing

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LOG OF DRILL HOLE

A - 15

DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>15</u> OF <u>56</u>	
COORDINATES <u>N Geothermal E</u>		SEC-TWP-RNG <u>11N/21-2N-7E</u>		ELEVATION <u>±55'</u>		JOB NO. <u>K7883</u>	
CLIENT <u>EG + G Idaho, Inc</u>		LABORATORY <u>Water - Mogul</u>		TYPE OF GEOPHYSICAL LOG <u>temp, cal, flow, T, N</u>		TOTAL DEPTH <u>2226 ft</u>	
DEPTH TO WATER <u>425' - artesian</u>		DRILLING AGENCY <u>Bach and Jannsen</u>		MAKE OF DRILL <u>CT and Berta</u>		BIT TYPE <u>7 7/8", 6 3/4"</u>	
						FEED REPRESENTATIVE <u>Kent</u>	

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
560	87.9 1900	561	And, ves, brnshgry, m hd, abd Qtz clr-brn, Hnbl euhd < 1 1/2 mm, ves w/Qtz/cl	
565	88.0 1915	96		
	87.9 1930	566		566 2000
				SWL 34.5 0746 10-9-81 (no flow) 0727 NB-2 0 psig 0750
	87.9 0840	97	specular Hem thru	125 flow (pipe) - during drilling
570	88.0 0900	571		
	87.8 0920			red water return
		98		easier drilling - 576' (1005')
575	87.9 1000	576	Tf, Lit, mod rd, sft, ang Tf frag < 2 mm, f Mtrx, occ whcl ang incl	
		99		
580	87.8 1016	581		
		100		
585		586	— — ? — — ? — 585 Tf, Lit, rdsh gry, sft, occ And Frag, ang whcl frag, occ Fe cmt Clus w/#95 slst frag	reddish gray water return 586'-1030 harder drilling
		101		
590	88.1 1115	591	— — — — — 590 And, fgr, m gry, hd, occ Pyx phen, r Plag phen	
		102		
595	87.6 1145	596		
	88.0 1203			
		103	— — ? — — ? — 597 abd wh Qtz Vn, And brnshgry dike?	harder drilling
600	88.0 1220			

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LOG OF DRILL HOLE

A - 16

DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>			DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>16</u> OF <u>56</u>	
COORDINATES <u>N Geothermal E</u>			SEC-TWP-RNG <u>NW/21-2N-7E</u>		ELEVATION <u>155'</u>		JOB NO. <u>K7883</u>	
CLIENT <u>EG + 6 Idaho, Inc</u>			LABORATORY <u>Water - Mogul</u>		TYPE OF GEOPHYSICAL LOG <u>temp, cal, flow, 8, N</u>		TOTAL DEPTH <u>2226 ft</u>	
DEPTH TO WATER <u>425' - artesian</u>			DRILLING AGENCY <u>Bach and Jannsen</u>		MAKE OF DRILL <u>C and P</u>		BIT TYPE <u>7 7/8", 6 3/4"</u>	
							FIELD REPRESENTATIVE <u>Kent</u>	
DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS				REMARKS	
600	88.0 1265	601	And, f gr, dk gry, hd, occ pyx, clr-mky Qtz abd sul 2mm Vlet, Zn rd brn Fe stn, occ clr euhd Plag, occ rd brn - or Fe cm + Clus				800-900 blow est, gpm	
605	88.0 1400	104						
610	88.0 1438	105					easier drilling	
615	88.3 1445 88.5 1455 88.4 1500	106	occ Pyr euhd smut assoc w/ mky wh vn min, abd Fe alt And - Tf grysh rd - rd Frag s r irr purp bleb (Cu min?)				red water return	
620	90.0 1510 88.4 1513 88.3 1525	107	microves w/ Qtz vn, Fspr Vn, f dissem Qtz x l Clus Vuq, r euhd Pyr, Plag alt (sauss) epidote				900-1000 gpm blow est 620' water sample W-4	
625	88.3 1548	108	vn min grn transp + clr transp poss Ep + Ze				SWL 48.2' 1557 end of shift	
630	87.2 1015 87.1 1034 87.2 1045	109	fibr blk x l (amph?) Cl intbd, rd - grysh purp, V alt And a.a. xcept rd Vn alt gn xln mat + f Qtz				626 1602 10-12-81 0840 0915 SWL 1.5' [46.7' / 17.3 hrs = 2.7' / hr] "overnight" recovery 0915 NB-2 7.8 psig 2' cave on bottom difficult to blow hole! 0941 start NB-2 2 psig → 0 psig 628' - red water return	
635	87.3 1114	110						
640	87.4 1130	111	Tf, Lit - x l, gry-rd, m hd, lit incl, Tf frag ves					

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LOG OF DRILL HOLE

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DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>17</u> OF <u>56</u>	
COORDINATES <u>N Geothermal E</u>		SEC-TWP-RNG <u>NW/421-2N-7E</u>		ELEVATION <u>±55'</u>		JOB NO. <u>K7883</u>	
CLIENT <u>E6 + 6 Idaho Inc.</u>		LABORATORY <u>Water-Mogol</u>		TYPE OF GEOPHYSICAL LOG <u>temp, cal, flow, T, N</u>		TOTAL DEPTH <u>2226 ft</u>	
DEPTH TO WATER <u>425' - artesian</u>		DRILLING AGENCY <u>Bach and Janssen</u>		MAKE OF DRILL <u>CT and Porta</u>		BIT TYPE <u>7 7/8", 6 3/4"</u>	
						FIELD REPRESENTATIVE <u>Kent</u>	

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
640	87.4 1140	692 1/2	And, f gr, grysh rd, m-hd, Hem stn thru, microv Zn, r blle wh diko?, Tr Ryr, occ Qtz Vn, occ bree And w/Ze	131 flow (pipe) harder drilling
645	87.5 1210	112		
	87.5 1248	647 1/2		
650	87.9 1320	113	Tf intbd, gry rd, sft, alt Plag incl cl	
	87.9 1346	652 1/2		
	87.8 1355		a.a. And	
655		114		
	87.6 1430	657 1/2	com Ze Brec And, occ Qtz Vn, Ze rad-Nat? / Hewl?	
660	87.8 1450	115		
	87.9 1510	662 1/2		
	87.9 1520			
665	87.9 1530	116		
	88.0 1553	667 1/2	Tf, gry rd, sft, alt cl Plag	
	87.8 1605			950-1050 blow during drilling slight increase in return flow
670	87.9 1630	117	And-bcm-Pphyt . . . ? . . .	
	87.6 1645	672 1/2		
675		118	Ze Vn Com assoc w/gry And, Tr evhd dog tooth Calc Hnbl pphyt com, Ze + Sul com as Zning in Vn, S + P	rig clutter
	88.0 1715	677 1/2		
680	87.9 1730	119	occ dru Qtz ves / Vn, Cu ²⁺ min	

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LOG OF DRILL HOLE

DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>18</u> OF <u>56</u>	
COORDINATES <u>N Geothermal E</u>		SEC-TWP-RNG <u>NW/4-21-2N-7E</u>		ELEVATION <u>± 55'</u>		JOB NO. <u>K7883</u>	
CLIENT <u>EG & G Idaho Inc</u>		LABORATORY <u>Water - Mogul</u>		TYPE OF GEOPHYSICAL LOG <u>temp, cal, flow, & N</u>		TOTAL DEPTH <u>2226 ft</u>	
DEPTH TO WATER <u>425 - artesian</u>		DRILLING AGENCY <u>Bach and Janssen</u>		MAKE OF DRILL <u>CT and Porta</u>		BIT TYPE <u>7 7/8", 6 3/4"</u>	
						FIELD REPRESENTATIVE <u>Kent</u>	

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
680			---?---	
	87.9	682 1/2	And, fgr, gry rd, hd, Ze Vn	
	1750		w/ brec And com, incr Sul	
685		120	assoc w/ Ze Vn, Cu min - shale,	
			Born, bl min	SWL 42.2' 1838 end of shift
	88.1	687 1/2		687.5 1840
	1820		Tf, Lit, gry rd - gry bl, sft	
	86.7			SWL 36.2' 10-13-81
	0846			0715 0700
690	87.5	121	And, fgr, m brn, hd, Qtz	No return → 0732 NB-2 10.0 psi g
	1002		+ Ze Vn, occ Fe Cmt Clus	flow 0836 NB-2 11.5 psi g
	87.7			Blow 2009pm 0836 NB-2 7.0 psi g
	1032	692 1/2		water sample pH 9.45
			slily pphyt	mixed w/ mud?
			occ Slick	clear cave by blowing - data
695	87.8	122	Cu assoc w/ Ze Vn & Brec	tabulated on separate Summary
	1100			sheet 0837-0944
		697 1/2		NB-2 loss 0.5 psi/min sample
	87.8		Vn. / Dik, pkish gry, soft,	blow
	1122		V alt, Sil + Fspr	loss 0.13 psi/min
				2009pm blow
700	87.9	123	intrusive? S + P	loss 0.99 psi/min
	1145		mnr gry rd - gry bl sft + Tf	10009pm blow
	87.9	702 1/2		gain 1.1 psi/min
	1153		And, fgr, m brn - brn blk,	recharge
	87.9		hd	695.5' - 131 flow (pipe)
705	87.9	124		707' - 131 flow (pipe)
	1250			
	87.9	707 1/2		
	1314			
710	88	125		
	1335			
	88	712 1/2		
	1345			
715	88.1	126		
	1415			
	87.9	717 1/2		
	1430		Tf, Lit, gry rd - gry bl, sft,	
				717
720		127	Ze Vn w/ Sul olv gry, crs xln	

rig chatter

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LOG OF DRILL HOLE

DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>19</u> OF <u>56</u>	
COORDINATES <u>N 60° 00' 00" E</u>		SEC-TWP-RNG <u>NW 1/4 21-2N-7E</u>		ELEVATION <u>± 55'</u>		JOB NO. <u>K7883</u>	
CLIENT <u>EG & G Idaho Inc</u>		LABORATORY <u>Water - Magul</u>		TYPE OF GEOPHYSICAL LOG <u>temp, cal, flow, T, N</u>		TOTAL DEPTH <u>2226 ft</u>	
DEPTH TO WATER <u>425' - artesian</u>		DRILLING AGENCY <u>Bach and Jannsen</u>		MAKE OF DRILL <u>CT and Porta</u>		BIT TYPE <u>7 7/8", 6 3/4"</u>	
						FIELD REPRESENTATIVE <u>Kent</u>	

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
720	87.9 1450	722 1/2	And, fgr, brn blk, hd, Ze Vn	1456 hrs
725	88.1 1520	725 1/2	Tf, gry rd sft	easier drilling red water return
	88 1528	727 1/2	And a.a.	
730	88 1545	729 1/2	r ves w/ze	
	88 1565	732 1/2	slily pphy + Hnbl + Plag Brec w/ ze, Fe cnt Clus	harder drilling
735	87.9 1625	735 1/2	Tf, grysh rd - brnsh gry, sft	
	88 1635	737 1/2		
740	88 1653	742 1/2	And, fgr, brn blk, hd, num Fe cnt Clus	v. easier drilling red water return
	88 1655	744 1/2	Tf, Lit - xl, m gry, m hd, evhd Mag Qtz + Ze, Fspr alt cl	
745		747 1/2	Tf, xl-Lit, m gry, m hd, slily inc frs xls	
		752 1/2		
750		755 1/2		
		758 1/2		
755	88 1750	758 1/2	Tf a.a. prob intbd gry rd Tf	gray water return
		758 1/2	Tf a.a.	
760		135		

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A - 20

DRILL HOLE NO. NB-4

PROJECT OR AREA		DATE STARTED		DATE COMPLETED		SHEET	
NORTH BONNEVILLE, WASHINGTON		8-25-81		12-8-81		20 OF 56	
COORDINATES		SEC-TWP-RNG	ELEVATION	JOB NO.	TOTAL DEPTH		
N Geothermal E		NW/4-21-2N-7E	55'	K7883	2226 ft		
CLIENT		LABORATORY	TYPE OF GEOPHYSICAL LOG		CASING		
EG & G Idaho Inc		Water-Mogul	temp, cal, flow, T, N		16"-160.7' 12"-177.5' 8"-385'		
DEPTH TO WATER		DRILLING AGENCY	MAKE OF DRILL	BIT TYPE	FIELD REPRESENTATIVE		
425'-artesian		Richard Jannsen	CT and Porta	7 7/8", 6 3/4"	Kent		
DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS		REMARKS		
760							
		135					
765							
		767 1/2	766 Tf, grysh rd, abd cl incl		SWL 80.2' 1837 767.5 1838		
					SWL 50.2' 10-14-81 0715 0700		
770		136			[30'/12.6 hr = 2.4'/hr recovery]		
	87.8 1140	772 1/2	771 Tf, x1-Lit, brn blk, sft- m hd. Fspr alt cl				
775		137					
	88 1205	777 1/2	777 Tf, x1-Lit, welded, hd. dk gnsh gry		harder drilling		
780	88 1230 88 1300	138			131 flow (pipe)		
		782 1/2					
785	88 1320	139					
	88.1 1345	787 1/2	788 Tf, Lit-x1, m gry-gn gry, m hd, ap xln, welded?				
790	88.1 1425	140					
		792 1/2	793				
795		141	Tf, a.a. Fspr-lab?				
	88.1 1506	797 1/2					
800		142	799				

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LOG OF DRILL HOLE

DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>21</u> OF <u>56</u>	
COORDINATES <u>N Geothermal/E</u>		SEC-TWP-RNG <u>NW/4 21 - 2N-7E</u>		ELEVATION <u>±55'</u>		JOB NO. <u>K7883</u>	
TOTAL DEPTH <u>2226 ft</u>		CLIENT <u>E6 + 6 Idaho Inc</u>		LABORATORY <u>Water - Mogul</u>		TYPE OF GEOPHYSICAL LOG <u>temp, cal, flow, etc.</u>	
CASING <u>16"-160.7'</u>		DEPTH TO WATER <u>425 - artesian</u>		DRILLING AGENCY <u>Bach and Jannsen</u>		MAKE OF DRILL <u>CT and Orth</u>	
BIT TYPE <u>7 7/8", 6 3/4"</u>		FIELD REPRESENTATIVE <u>Kent</u>					

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
800	88 1542	802 1/2	And, dk gn gry, hd, abd Hnbl + Plag Phen 802	
			Tf, Lit-xl, gry, hd	
805		143		
	88 1645	807 1/2	Tf, gry rd, abd Clincl 806	
810	88.1 1720	144	Tf, Lit-xl, gry, hd	rig chatter
	88.1 1740	812 1/2	welded	
815		145		
	88.1 1826	817 1/2	Tf, a.a.	
			Tr gry rd Tf, sft, clincl	SWL 15' 1910
820	88.1 1900	146		820 1913
	88 0800	822 1/2		SWL 59' 0650 10-15-81 0650
			Tf, a.a.	[44' / 11.8 hr = -3.7' / hr "thief"]
825		147	Tr Frag dk rdsh brn Fe stn 827	
	88 0844	827 1/2		
			Tf, a.a.	
830		148	Tr Fe Cmt Clus	
	88 0950	832 1/2		
			Tf, a.a.	
			incr dns, decr Lit Frag	
835	88 1020	149		835 131 flow (pipe)
	88 1040	837 1/2		
			Tf, a.a.	
840		150		

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LOG OF DRILL HOLE

DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>22</u> OF <u>56</u>	
COORDINATES <u>N Geothermal E</u>		SEC-TWP-RNG <u>1N/4 21-2N-7E</u>		ELEVATION <u>155'</u>		JOB NO. <u>K7883</u>	
CLIENT <u>EG + G Idaho, Inc</u>		LABORATORY <u>Water - Mogul</u>		TYPE OF GEOPHYSICAL LOG <u>temp, cal, flow, T, N</u>		TOTAL DEPTH <u>2226 ft</u>	
DEPTH TO WATER <u>425' - artesian</u>		DRILLING AGENCY <u>Bach and Jannsen</u>		MAKE OF DRILL <u>CT and Porta</u>		BIT TYPE <u>7 7/8", 6 3/4"</u>	
						FIELD REPRESENTATIVE <u>Kent</u>	

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
840	88.1 1125	842 1/2	a.a.	
845		151		
	88.2 1220	847 1/2	847	
850		152	Tf, Lit Frag abd, Ze Vn	
	88.3 1320	852 1/2	853	"softer" drilling
855	88.3 1340	153	Tf, Lit-xl, gn gry, welded	131 flow (pipe)
	88.2 1410	857 1/2	incr Fe Grdmas strn, v rd	
860		154		
	88.4 1456	862 1/2	863	
865		155	a.a.	
	88.3 1545	867 1/2	und Augite xl	
870	88.3 1615	156		
		872 1/2		
875	88.3 1632	157	bcm f gr	rig chatter
	88.3 1700		Tr lt gry Tf	131 gpm flow (pipe)
	88.3 1718	877 1/2		1200 gpm blow
880	88.4 1744	158		slight increase water return flow

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LOG OF DRILL HOLE

DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>23</u> OF <u>56</u>	
COORDINATES <u>N Geothermal E</u>		SEC-TWP-RNG <u>NW/421-2N-7E</u>		ELEVATION <u>±55'</u>		JOB NO. <u>R7883</u>	
CLIENT <u>EG & S Fdaks, Inc</u>		LABORATORY <u>Water - Mogul</u>		TYPE OF GEOPHYSICAL LOG <u>Temp, sl. flow, T, N</u>		TOTAL DEPTH <u>2226 ft</u>	
DEPTH TO WATER <u>425' - artesian</u>		DRILLING AGENCY <u>Bach and Janssen</u>		MAKE OF DRILL <u>CT and Port</u>		BIT TYPE <u>7 7/8", 6 3/4"</u>	
						FIELD REPRESENTATIVE <u>Kent</u>	

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
880	88.4 1805	982 1/2	Tr Pyr	
885	88.3 1830	159	Tf, Lit-Xl, dk gnshqry hd, welded	SWL 55' 1905
	88.4 1855	887 1/2		887.5 1907
890		160	occ Ves Frag	SWL 77' 0725 10-16-81 0700 [22'/12.2 hr = -1.8'/hr "thief"]
	88.1 0850	892 1/2		
895	88.2 0930	161		
	88.3 1000	897 1/2	— — — — — 897	131 gpm flow (pipe) slow drilling
900	88.3 1040	162	And, Pphyt, olv blk, hd, abd vnlet Qtz, occ Fe cmt ang Clus	
	88.4 1145	902 1/2		
	88.4 1210			
905	88.5 1300	163		
	88.5 1325			
	88.5 1400	907 1/2		
910	88.4 1510	164		SWL 95' 1603
	88.4 1545	911	— — — — — 911	911 1605
		165	Tf, Xl, grysh rd, sft, Xlc alt cl, occ lt gry Tf	0905 NB-2 9.5 spig (air) 10-19-81 SWL 15.5' 1110 1100 [79.5'/63.8 hr = 1.3'/hr recovery]
	88 1435		— — — — — 914	131 gpm flow (pipe)
915	88.1 1515	166	And a.a.	
	88 1600	917 1/2		
920	88 1710	167		

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LOG OF DRILL HOLE

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DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>24</u> OF <u>56</u>	
COORDINATES <u>N Geothermal E</u>		SEC-TWP-RNG <u>NN/421 2N-7E</u>	ELEVATION <u>± 55'</u>	JOB NO. <u>K7883</u>	TOTAL DEPTH <u>2226 ft</u>		
CLIENT <u>EG & G Idaho, Inc</u>		LABORATORY <u>Water-Mogul</u>	TYPE OF GEOPHYSICAL LOG <u>temp, cal, flow, γ, N</u>		CASING <u>16"-160.7'</u> <u>12"-177.5' 8"-226'</u>		
DEPTH TO WATER <u>425'-artesian</u>		DRILLING AGENCY <u>Bach and Jannsen</u>	MAKE OF DRILL <u>CT and Porta</u>	BIT TYPE <u>7 7/8", 6 3/4"</u>	FIELD REPRESENTATIVE <u>Kent</u>		

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
920	88 1800	922 1/2	TOP STEVENS RIDGE FM (TUFFS) 922	
925	88.1 1845	168	Tf, xl, olv gry, hd, welded abd Fe cmt ang clus	SWL 39' 2003 926 2003
930	88.2 0945	169	Tr ze xl	0700 SWL 49' 10-20-81 0700 [10' / 11 hr = 0.9' / hr "thief"]
935	88.2 1100	170		131 gpm flow (pipe)
940	88.4 1210	171	incr Fe stn Grdmas Tr lt gry xl Tf Frag	
945	88.4 1325	172	Tf, Lit-Xl, olv gry, hd, welded	
950	88.4 1615	173	Tr Fe cmt ang clus	water sample w-2 385'-951' pH 9.35
955	88.3 1745	174	poss incr Cl alt	
960	88.4 1808	175	Tf, xl, f gr, grysh rd, s.d. dm	

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LOG OF DRILL HOLE

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DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>25</u> OF <u>56</u>	
COORDINATES <u>N Geothermal E</u>		SEC-TWP-RNG <u>NW/4 21-2N-7E</u>	ELEVATION <u>± 55'</u>	JOB NO. <u>K7883</u>	TOTAL DEPTH <u>2226 ft</u>		
CLIENT <u>EG & G Idaho Inc</u>		LABORATORY <u>Water - Mogul</u>	TYPE OF GEOPHYSICAL LOG <u>temp. cal. flow. 8, N</u>		Casing <u>15"-160.7'</u> <u>12"-177.5'</u> <u>8"-385'</u>		
DEPTH TO WATER <u>425'-casing</u>		DRILLING AGENCY <u>Boch and Jansson</u>	MAKE OF DRILL <u>CT and Porta</u>	BIT TYPE <u>7 7/8", 6 3/4"</u>	FIELD REPRESENTATIVE <u>Kent</u>		
DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS		REMARKS		
960	88.3 1955	962 1/2	a.a.		SWL 7' 2002 961.5 2005		
	88.3 1230				SWL 75' 0715 10-21-81 0700 [68'/11.2 hrs = 6.0'/hr "thief"]		
965	88.3 1315						
	88.4 1400	176					
	88.5 1430				131 gpm flow (pipe)		
970							
	88.4 1525	972 1/2					
	88.4 1645						
975					end TLS Air Rotary Drilling		
	88.4 1815	177			SWL 20' 2002 10-22-81 SWL 75' 0700 981.5 [55'/11hr = 5.0'/hr "thief"] 2009		
980	88.4 1955	981 1/2	Tf, X1, gry rd, sft, Plag alt Cl, abd met Lstr brn blk- blk Frag, poss C		Start TKT Water Rotary 11-11-81 6 3/4" F7AE3486 bit 0930 operational data logged on history sheets 10-29-81 NB-2 4.5 psig logs 10/28 10-10-81 NB-2 20.8 psig 10/29 NB 4 15 psig but leaking between 8" and 12" casings 0955 11-11-81 NB 4 flow est 200 gpm (NB 2 185) 1040 NB 2 13.5		
	87.4 1210						
	87.6 1415						
985			Tf, Lit-X1, olv gry, hd, welded		988.5 1700		
		178			NB 2 7.5 0815 11-12-81 0830		
	88.2 0830	989 1/2			87 gpm flow (pipe) weir } made while 125 gpm flow (pipe) } drilling		
990					(X) pipe est. flows - see Summary sheet		
		179			"weir" est. flows - (f) - partial discharge		
					bucket est. flows - 5 gal bucket timed with watch		
995			Tf, Lit-X1, olv gry, hd, welded scat Fe cnt clus		Since the discharge pipe did not have full discharge, the "weir" calculated flow is considered more accurate.		
		180			NB 2 7.0 psig 1310		
					water sample W-5 1000' pH ± 9.3 no chatter		
1000			Tr 2e incr v alt min dk rd brn				

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LOG OF DRILL HOLE

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DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>26</u> OF <u>56</u>	
COORDINATES <u>N Geothermal E</u>		SEC. TWP. RNG <u>NW/4 21, 2N-7E</u>		ELEVATION <u>155'</u>		JOB NO. <u>K7883</u>	
CLIENT <u>ES & Idaho Inc</u>		LABORATORY <u>water - Mogul</u>		TYPE OF GEOPHYSICAL LOG <u>temp, cal, flow, T, N</u>		TOTAL DEPTH <u>2226 ft</u>	
DEPTH TO WATER <u>425' - artesian</u>		DRILLING AGENCY <u>Bach and Janssen</u>		MAKE OF DRILL <u>CT and Forta</u>		BIT TYPE <u>7 7/8" 6 3/4"</u>	
						FIELD REPRESENTATIVE <u>Kent</u>	

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
1000		181		
		1004 1/2		
1005		182	a. a.	
		1007 1/2		
1010		183	Tr gry rd Tf Frag	
		1014 1/2		
1015	87.8 0815	184	Tf, Lit-X1, grysh bl, sft	1015.5 1720 NB-2 6.5 psi 0815 11-13-81 0800 180 gpm flow (pipe)
		1019 1/2		
1020	84.6 1000	185	Tf, Lit-X1, olv gry, hd	
	84.5 1030	1024 1/2		
1025		186	Tf, Lit-X1, olv gry, hd, welded	
		1029 1/2		
1030		187	Tr 2x1 incr xls	
		1034 1/2		
1035	84.7 1340	188	Tf, Lit, olv gry, hd	
		1039 1/2		
1040	84.7 1445		bem f gr Tf a. a.	

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LOG OF DRILL HOLE

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DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>27</u> OF <u>56</u>	
COORDINATES <u>N 60° 40' 00" E</u>		SEC-TWP-RNG <u>N 41° 21' 30" E</u>		ELEVATION <u>± 55'</u>		JOB NO. <u>K7883</u>	
CLIENT <u>EG + G Idaho Inc</u>		LABORATORY <u>water - Mogul</u>		TYPE OF GEOPHYSICAL LOG <u>temp, sal, p, t, N</u>		TOTAL DEPTH <u>2226 ft</u>	
DEPTH TO WATER <u>425' - artesian</u>		DRILLING AGENCY <u>Bach and Janssen</u>		MAKE OF DRILL <u>CT and Porta</u>		BIT TYPE <u>7 1/8" 6 3/4"</u>	
FIELD REPRESENTATIVE <u>Kent</u>							

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
1040		189	Tf, Lit, fgr, olv gry, hd	1528 NB-2 6.1 psi
	87.7	1043.5		1043.5 1605
1045	0830			0805 NB-2 12.2 psi 11-16-81
	87.9			open valve, flow 0830
	0838			316 gpm (water)
	82.4	190	Tr Fe cmt clus	200 gpm (bucket) 0832 NB-2
	0858			484 gpm (pipe) 10.0 psi
		1049.5		NB-2 9.2 psi 1020
1050		191		
		1054.5		
1055			1055	
		192	Tf, grysh rd, v f gr	
		1059.5	1059	
1060	83.6		Tf, Lit, fgr, olv gry, hd	NB-2 9.1 psi 1125
	1115	193		
		1064.5	Tr Ze + Fe cmt clus	
1065	83.4			harder drilling
	1205	194		1245 NB-2 8.9 psi
		1069.5		
1070			1071	
		195	Tf, xl, olv blk, mhd-hd,	
		1074.5	brit, cf ab > gran + xl	1405 NB-2 8.5 psi
1075	84.6			
	1400	196		rig chatter
	84.5	1079.5		
	1415			
1080				

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LOG OF DRILL HOLE

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DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>28</u> OF <u>56</u>	
COORDINATES <u>N Geothermal E</u>		SEC-TWP-RNG <u>NW/4 21-2N-7E</u>		ELEVATION <u>± 55'</u>		JOB NO. <u>K7883</u>	
CLIENT <u>EG & G Idaho, Inc</u>		LABORATORY <u>Water-Mogul</u>		TYPE OF GEOPHYSICAL LOG <u>Temp. sal. flow, T, N</u>		TOTAL DEPTH <u>2226 ft</u>	
DEPTH TO WATER <u>425' - artesian</u>		DRILLING AGENCY <u>Bach and Janssen</u>		MAKE OF DRILL <u>CT and Ronto</u>		BIT TYPE <u>7 7/8", 6 3/4"</u>	
						FIELD REPRESENTATIVE <u>Kent</u>	

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
1080		197	a.a.	
1085	84.7 1510	1089 1/2		1525 NB-2 8.5 psi/g
		198	Tf, xl, olv gry, m hd-hd, f gr	
1090	84.8 1545	1089 1/2		
		199		
1095	84.7 1625	1094 1/2	Tf, grysh bl, sft, abd sul	1630 NB-2 8.4 psi/g
		200		
1100		1099 1/2		1099.5 1707
		201	Tf, grysh rd, sft, v fgr abd sul	0810 NB-2 10.9 psi/g 0837 NB-2 9 psi/g 120 gpm wear 418 gpm pipe 170 gpm bucket
1105	83.1 0935	1104 1/2	Tf, xl, olv blk, m hd-hd, brit, bcm f gr	11-17-81 0830 open valve flow
		202		
1110	84.1 1008	1109 1/2		
		203	Tf, xl, grysh rd sft, v fgr	
1115	85.4 1040	1114 1/2	Tf, xl, olv blk, m hd-hd, brit, f gr xln	1055 NB-2 8.5 psi/g
		204		
1120	85.3 1120			

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LOG OF DRILL HOLE

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DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>29</u> OF <u>56</u>	
COORDINATES <u>N Geothermal E</u>		SEC-TWP-RNG <u>NW 1/4 21-2N-7E</u>		ELEVATION <u>± 55'</u>		JOB NO. <u>K7883</u>	
CLIENT <u>EG & G Idaho, Inc.</u>		LABORATORY <u>Water - Hesper</u>		TYPE OF GEOPHYSICAL LOG <u>Temp, sal, flow, T, N</u>		TOTAL DEPTH <u>2226 ft</u>	
DEPTH TO WATER <u>425' - artesian</u>		DRILLING AGENCY <u>Bachand Jannson</u>		MAKE OF DRILL <u>et and Barta</u>		BIT TYPE <u>7 7/8", 6 3/4"</u>	
FIELD REPRESENTATIVE <u>Kent</u>							

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
1120				
1125		1121 1/2	a.a.	
1130	89.6 1227 85.7 1230	205		196 gpm (wear) slow 484 gpm (pipe)
1135	86.4 1248	1134 1/2	Tf, grysh rd, sft, fgr	
	88-85.8 1303	206	Tf, grysh bl, sft	
1140	87.8 1315	1139 1/2	Tf, grysh rd, sft, fgr	
			Tf, xl, olv blk, m hd-hd, brit, f gr xln	
			occ sul	
1145	87.5 1330	207		
1150	87.5 1348	1149 1/2	Tf, xl-Lit, olv gry, m hd, fgr	
		208	Tr ze	
1155	87.6 1418	1149 1/2		
		209	a.a.	
			occ Fe emt clus	
1160	85.2 1445	1160		

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LOG OF DRILL HOLE

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DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>	DATE COMPLETED <u>12-8-81</u>	SHEET <u>31</u> OF <u>56</u>
COORDINATES <u>N Geothermal E</u>	SEC-TWP-RNG <u>N421-2N-7E</u>	ELEVATION <u>± 55'</u>	JOB NO. <u>K7883</u>	TOTAL DEPTH <u>2226 ft</u>
CLIENT <u>EG & G Idaho, Inc</u>	LABORATORY <u>Water-Mogul</u>	TYPE OF GEOPHYSICAL LOG <u>Temp, cal. flow, T, N</u>		<u>CASING 16"-160.7'</u> <u>12"-177.5' 8"-308'</u>
DEPTH TO WATER <u>425' - artesian</u>	DRILLING AGENCY <u>Bach and Jannsen</u>	MAKE OF DRILL <u>CT and Port</u>	BIT TYPE <u>7 7/8", 6 3/4"</u>	FIELD REPRESENTATIVE <u>Kent</u>

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
1200	84.2 1035	217	a.a.	
1205	84.7 1052	218		
1210	85.3 1125	219	Tf, xl, gry brn, fgr intbd w/ gry rd-purp Tf, xl, gry red - gry bl fgr, sft	1100 NB-2 8.5 psi g
1215		220	Tf, xl, dk qn gry, sft, occ wh Cl frag + w/qn Frag	
1220	85.6 1205	221	Tr Fe cmt Clus	196 gpm wier flow 444 gpm pipe
1225		222	Tf, xl, grysh olv qn, m hd, welded?, xln ap, brit	rig chatter
1230	86.5 1240 86.4 1250	223	Tr Qtz yel Vn	
1235		224	Tf, xl, gry rd, sft, fgr Tr Fe cmt Clus	
1240				

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LOG OF DRILL HOLE

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 DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>30</u> OF <u>56</u>	
COORDINATES <u>N 60° 00' 00" E</u>		SEC-TWP-RNG <u>NW/4 21-2N-7E</u>		ELEVATION <u>± 55'</u>		JOB NO. <u>K 7883</u>	
CLIENT <u>EG & G Idaho Inc</u>		LABORATORY <u>water-Mogul</u>		TYPE OF GEOPHYSICAL LOG <u>Temp, Cal, flow, T, N</u>		TOTAL DEPTH <u>2226 ft</u>	
DEPTH TO WATER <u>425' - artesian</u>		DRILLING AGENCY <u>Beck and Jansson</u>		MAKE OF DRILL <u>CT and Porto</u>		BIT TYPE <u>7 1/8", 6 3/4"</u>	
						FIELD REPRESENTATIVE <u>Kent</u>	

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
1160		210	Tf, x1-Lit, lt gry, sft, brit	
1165	84.7 1508	1164 1/2		
		211	Tr Fe cnt Clus	
1170	88.5 1542	1169 1/2	Tf, grysh rd, sft, fgr	
	89.7 1605		Fe cnt Clus	drill chatter
	88.5 1608	212	Tf, x1-Lit, olv gry, m hd; f gr xln	
1175		1174 1/2		
		213	Ze xls	
			Tf, grysh purp, sft	
1180		1179 1/2	Tf, x1-Lit, olv gry - olv blk	
	87.6 0840			± 5 gpm leak around 8" casing
				1182.8 1705
1185		214	Tf, gry rd, x1, sft	0805 NB-2 12.5 psig 11-18-81
			Intbdd	0825 NB-2 10 psig 0810
				167 gpm wear
				470 gpm pipe flow [2.5 psig loss in NB-2 when open NB-4 valve to start drilling]
				176 gpm bucket
1190		1189 1/2	Tf, x1, v ltqn	after open NB4 valve: 0835
			Tr Ze + Sul	start drilling, flow
			Intbdd Tf, x1 lt gry	127 gpm wear
			Tr Ze + Sul lt blsh sft	457 gpm pipe
		215		171 gpm bucket
				Polymer mud added
1195	83.5 1020	1196	Tf, x1 grysh bl	
			Intbdd lt rd purp sft	
			Sul assoc ltqn - lt gry	
		216	Tr Ze + Sul	
1200		1200		

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LOG OF DRILL HOLE

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DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>			DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>32</u> OF <u>56</u>	
COORDINATES <u>N Geothermal E</u>			SEC-TWP-RNG <u>NW/421 2N-7E</u>		ELEVATION <u>± 55'</u>		JOB NO. <u>1K7883</u>	
CLIENT <u>EG + G Idaho Inc</u>			LABORATORY <u>Water - Mogul</u>		TYPE OF GEOPHYSICAL LOG <u>temp, cal, flow, D, N</u>		TOTAL DEPTH <u>2226 ft</u>	
DEPTH TO WATER <u>425' - artesian</u>			DRILLING AGENCY <u>Bach and Jannsen</u>		MAKE OF DRILL <u>CT and Porta</u>		BIT TYPE <u>7 7/8", 6 3/4"</u>	
							FIELD REPRESENTATIVE <u>Kent</u>	

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
1240	86.5 1350	1241	Tf, xl, gry gn, sft, abd sol ^{intrusive?} _{pyr} 1241	
		225		
1245	86.6 1415	1246	Tf, xl, gry rd, sft, f gr Tr Fe cnt clus	1420 NB-2 7.5 psig
		226		
1250	87.0 1450	1251		stopped drilling: 1450, flow 98 gpm water
		227		418 gpm pipe
		1253		start drilling: 1453, blow
1255	86.6 1510	1256	Tf, xl, gry gn, sft, abd dissem Pyr occ Fe cnt clus	250 gpm water 536 gpm pipe
		228		
1260	86.7 1525	1261	Tf, xl, gry bl, sft, f gr, Tr Fe cnt clus, occ gn gry Tf Fraa w/ Pyr	
		229		
1265	86.6 1545	1266	Tf, xl, gry bl - gry rd purp - gry rd - brn gry, f gr	
		230		
1270		1271	Tf, xl - Lit, lt gry - lt brn gry, poss pumice, Tr stick	NB-2 8.3 psig 1552
		231		
1275	86 1640	1276	Tf, xl, gry rd - brn gry, f gr	
		232		
1280				1279.8 1705

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LOG OF DRILL HOLE

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DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>	DATE COMPLETED <u>12-8-81</u>	SHEET <u>33</u> OF <u>56</u>
COORDINATES <u>N Geothermal E</u>	SEC-TWP-RNG <u>NW/4 21-2N-7E</u>	ELEVATION <u>± 55'</u>	JOB NO. <u>K7883</u>	TOTAL DEPTH <u>2226 ft</u>
CLIENT <u>EG + 6 Faber Inc</u>	LABORATORY <u>Water-Mogul</u>	TYPE OF GEOPHYSICAL LOG <u>Long. col. flow, T, N</u>		<u>CASING 16"-160.7'</u> <u>12"-177.5' 8"-285'</u>
DEPTH TO WATER <u>425' artesian</u>	DRILLING AGENCY <u>Bach and Jonsson</u>	MAKE OF DRILL <u>CT and Porter</u>	BIT TYPE <u>7 7/8", 6 3/4"</u>	FIELD REPRESENTATIVE <u>Kent</u>

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
1280	88.1 0835	1281 1/2	Tf, gry bl, Xl. - m gry	0818 NB-2 11.5 psi 11-19-81 0830 166 gpm water 0825 405 gpm pipe flow
	84.5 0938		f gr sft	0900 NB-2 8.8 psi after open valve on NB-4
1285			abd wh yel Vnlets	0920 122 gpm water flow 379 gpm pipe
	84.0 1000	233	w/ Pyr evhd	140 gpm bucket 0930 start drill 230 gpm water blow 470 gpm pipe
1290				
	84 1018	1291 1/2	incr lit	
			occ gn gry Xl Tf vn?	
1295		234		
	88 1045	1297		
			Tf, xl, brn gry, sft,	
1300			f gr, J+? w/ wh	
	84.1 1105	235	Cl + evhd Pyr & Ze xl	
			w/ Pyr	
1305				
	84.3 1125	1307		
				213 gpm water blow 470 gpm pipe
1310				
	84.3 1142	236		
		1312	Tf, xl, m gry - m lt gry,	
			m hd, xln Tex	
1315		237		
	84 1215	1317		
1320		238		

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LOG OF DRILL HOLE

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DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>34</u> OF <u>56</u>	
COORDINATES <u>N Geothermal E</u>		SEC-TWP-RNG <u>NN/4 21-2N-7E</u>		ELEVATION <u>± 55'</u>		JOB NO. <u>K7883</u>	
CLIENT <u>EG & S Idaho Inc</u>		LABORATORY <u>Water-Mogul</u>		TYPE OF GEOPHYSICAL LOG <u>Temperature, flow, T, N</u>		TOTAL DEPTH <u>2226 ft</u>	
DEPTH TO WATER <u>425' - artesian</u>		DRILLING AGENCY <u>Bach and Jaansen</u>		MAKE OF DRILL <u>CT and Fork</u>		BIT TYPE <u>7 7/8", 6 3/4"</u>	
						FIELD REPRESENTATIVE <u>Kent</u>	

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
1320	84.1 1235	1322	Tf, xl, dk gngry, m hd, welded, ap gran Tex, abd vn Calc + sft wh Cl w/ Pyr	
1325	84.3 1252	239	Tr Ze xl Tr Fe cmt Clus	1252 NB-2 8.8 psiq
1330	84.6 1305	1332		
1335	84.5 1335	240	Tf, xl, bl gry, sft, fgr	
1340	84.7 1350	241	Tf, xl, gry olv, m hd, welded, gran Tex, lge Pyr, occ Fe cmt Clus, occ gngry xls w/ vn evhd Pyr	
1345	84.7 1405	242	Tf, xl, mdk gry, sft, plaq xls alt wh Cl	
1350	84.7 1422	243	Tf, gry rd, fgr occ brngry Tr Fe cmt Clus	
1355	84.8 1500	244	Ze < 2mm	
1360				1500 NB-2 8.5 psiq

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LOG OF DRILL HOLE

DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>35</u> OF <u>56</u>	
COORDINATES <u>N Geothermal E</u>		SEC. TWP. RNG <u>NW/421-2N-7E</u>		ELEVATION <u>±55'</u>		JOB NO. <u>K7883</u>	
TOTAL DEPTH <u>2226 ft</u>		CLIENT <u>EG + G Idaho Inc</u>		LABORATORY <u>Water-Mogul</u>		TYPE OF GEOPHYSICAL LOG <u>temp, cal, flow, T, N</u>	
Casing <u>16"-160.7'</u>		DEPTH TO WATER <u>425'-artesian</u>		DRILLING AGENCY <u>Bach and Jannsen</u>		MAKE OF DRILL <u>CT and Porta</u>	
BIT TYPE <u>7 7/8" 6 3/4"</u>		FIELD REPRESENTATIVE <u>Kent</u>					

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
1360	85.1 1522	1363	Tf, xl, dk gn gry, m hd, welded?	
1365		245		
		1368	Tf, xl-Lit, lt bl gry- lt gn gry, sft, lit frag ap ves, occ Fe cmt clus, com Qtz vn + Jt? wh cl vn in brnqr fgr Tf frag w/ f dissem Pyr	1626 NB-2 8.5 psig
1370	85 1545	246		
		1373		
1375	85.9 1605	247	Bem incr lit, poss Cu (chry?) min Ves assoc Lit frag, Tr Ze	open valve flow overnight to take sample
		1378		
1380	85.9 1635	248	varic Lit Tf, bl gry- gn blk	1379.8 1655
		1383		
1385	see note	249	B con gry rd	W-3 water sample 11-20-81 385'-1378' 0820 PH 9.0 82.9°?
		1393		0840 NB-2 7.0 psig flow- 46 gpm wear 261 gpm pipe 0845 0900 start drilling, blow 166 gpm wear 457 gpm pipe NOTE using water directly from nearby fire hydrant this day only.
1390	66.9 0920			
		1393	Tf, xl, dk gn gry, m hd- hd, welded	0950 NB-2 7.5 psig
1395	67.3 0932	250		
		1398 1/2	Tr Ze + Calc xl	
1400	66.4 1002	2e		

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LOG OF DRILL HOLE

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DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>36</u> OF <u>56</u>	
COORDINATES <u>N 60° 00' 00" E</u>		SEC-TWP-RNG <u>11N 421-2N-7E</u>		ELEVATION <u>±55'</u>		JOB NO. <u>K7883</u>	
CLIENT <u>EG & G Idaho Inc</u>		LABORATORY <u>Water - Mogul</u>		TYPE OF GEOPHYSICAL LOG <u>Temp, cal, flow, T. N</u>		TOTAL DEPTH <u>2226 ft</u>	
DEPTH TO WATER <u>425' - artesian</u>		DRILLING AGENCY <u>Bach and Jannsen</u>		MAKE OF DRILL <u>CT and Pira</u>		BIT TYPE <u>7 7/8" 6 3/4"</u>	
						FIELD REPRESENTATIVE <u>Kent</u>	

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
1400				
1405		251	a.a.	
1410	65.4 1032	1408 1/2		
1415	65.1 1045	252	Tf, x1-Lit, brn gry, sft, occ lt bl gry	
1420	66.7 1108	1419	Tf, x1, olv blk, hd, welded Tr Calc, ze, Fe cnt Clus	occ thread grease, copper? based, not same as Cu minerals easier drilling
1425	65.3 1124	253	Tf, x1, gry rd, sft, f gr	
1430	65.3 1135	1429	Tf (cl), gry olv, sft	
1435	65.4 1150	1434		
1440	67.6 1230	255		

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LOG OF DRILL HOLE

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DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>37</u> OF <u>56</u>	
COORDINATES <u>N 120° 10' 00" E</u>		SEC-TWP-RNG <u>NW 1/4 21-24-7E</u>		ELEVATION <u>± 55'</u>		JOB NO. <u>K7883</u>	
CLIENT <u>EG & S Idaho Inc</u>		LABORATORY <u>water-Mogul</u>		TYPE OF GEOPHYSICAL LOG <u>temp, cal flow, T, N</u>		TOTAL DEPTH <u>2226 ft</u>	
DEPTH TO WATER <u>425' - artesian</u>		DRILLING AGENCY <u>Boch and Jansson</u>		MAKE OF DRILL <u>CT and Porta</u>		BIT TYPE <u>7 7/8" 6 3/4"</u>	
FIELD REPRESENTATIVE <u>Kent</u>							

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
1440			Tf, X1, gry olv, sft - m hd, gran Tex	
		1444		rig chatter
1445			Tf, X1, gry bl - lt gry, sft, f gr Tex	rig chatter
			<u>TOP OHANAPECOSH FM. 1448</u>	
1450		256	Tf, X1, dk gn gry, m hd, dns w/ bl gn Incl, occ cren slick, ap Qtz Pbl? shears	166 gpm wear } stop drilling 444 gpm pipe } blow 1305
		1452		
		1454	Intbd bl gry - gry rd fgr X1 Tf	65 gpm wear } flow during drilling 287 gpm pipe } 1330
1455			a.a.	
		1459		
1460		257	Tf, X1, gn gry - lt gn gry, m hd - hd, occ bl gn Incl mott	
		1464		
1465			Tf, gry rd - brn gry, fgr, sft	
		1465		
			Tf, X1 - Lit, gn gry, m hd, poss Intbd bl gry - gry rd fgr Tf	red water return 87 gpm wear 389 gpm pipe 1512 flow
1470	65.7 1420	258		hydrant water hose broke
		1474		
1475				
		259		
1480				

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LOG OF DRILL HOLE

DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>			DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>38</u> OF <u>56</u>		
COORDINATES <u>N 60° 00' 00" E</u>		SEC-TWP-RNG <u>14W-42N-7E</u>		ELEVATION <u>±55'</u>		JOB NO. <u>K7883</u>		TOTAL DEPTH <u>2226 ft</u>	
CLIENT <u>EG & G Idaho Inc</u>		LABORATORY <u>water - Mogol</u>		TYPE OF GEOPHYSICAL LOG <u>temp. cal. flow, 8, 11</u>		9ASNG 16"-160.7'		12"-177.5' 8'-385'	
DEPTH TO WATER <u>425' - artesian</u>		DRILLING AGENCY <u>Bach and Jaansen</u>		MAKE OF DRILL <u>CT and Porter</u>		BIT TYPE <u>7 7/8" 6 3/4"</u>		FIELD REPRESENTATIVE <u>Kent</u>	
DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS				REMARKS		
1480			a.a.				1484.7 1603		
1485		1485					167 gpm wear 0830 open valve flow		11-23-81 0815
1490		260	Tf, brnary, fgr, sft poss Frac Zn				0902 NB-2 11.5 psig		
1495	80.9 0905	1495	Tf, Lit-XI, gn gry, sft- m hd.				during drilling blow 329 gpm wear 562 gpm pipe stop drilling flow 196 gpm wear 457 gpm pipe		
1500	82.1 0930	261	Tf, XI-Lit, gn gry-lt gry, m hd ox Frac Zn or Intbd occ Fe cnt Clus Tr Ze ox Frac Zn or Intbd occ bl-gn Incl matt				water sample w-6 1500' pH approx. 9.0		
1505		1505					307 gpm wear 0948 blow 523 gpm pipe		
1510	82.3 0948	262							
1515	82.6 1002	1515							
1520		263							

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LOG OF DRILL HOLE

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DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>			DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>39</u> OF <u>56</u>	
COORDINATES <u>N Geothermal E</u>			SEC-TWP-RNG <u>NW/4 21-2N-7E</u>	ELEVATION <u>± 55'</u>	JOB NO. <u>K7883</u>	TOTAL DEPTH <u>2226 ft</u>		
CLIENT <u>E6 + 6 Idaho Inc</u>		LABORATORY <u>Water - Mogul</u>		TYPE OF GEOPHYSICAL LOG <u>temp, cal, flow, T, N</u>		Casing <u>10"-160.7'</u> <u>12"-177.5' 8"-395'</u>		
DEPTH TO WATER <u>425' - a-tesion</u>		DRILLING AGENCY <u>Bach and Jannsen</u>		MAKE OF DRILL <u>Ct and Porta</u>		BIT TYPE <u>7 7/8", 6 3/4"</u>		FIELD REPRESENTATIVE <u>Kent</u>
DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS				REMARKS	
1520			ox Frac Zn or Intbd					
1525	84.1 1040	1525						
1530		264	ox Frac Zn or Intbd				307 gpm wear 1040 blow 562 gpm pipe	
1535	84.9 1102	1535	Tf, xl-Lit, gn gry, sft-m hd, occ blgn Inc/mott					
1540	85.1 1126	265	Tr Ze, occ bl-gn Qtz euhd clus				1130 NB-2 9.5 psig	
1545	85.2 1140	1545	Tf, xl-Lit, gry rd-brn gry, f gr, sft					
1550	85.5 1150	266	Tf, xl-Lit, gn gry, sft-mhd, occ blgn Inc, Tr Ze, occ bl-gn Qtz euhd clus				269 gpm wear 1200 blow 523 gpm pipe	
1555	85.6 1201	1555	a.a. bcm olv gry Col					
1560		267						

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LOG OF DRILL HOLE

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DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>			DATE STARTED <u>8-25-81</u>	DATE COMPLETED <u>12-8-81</u>	SHEET <u>40</u> OF <u>56</u>
COORDINATES <u>N Geothermal E</u>		SEC-TWP-RNG <u>NW1/4 21-2N-7E</u>	ELEVATION <u>±55'</u>	JOB NO. <u>K7883</u>	TOTAL DEPTH <u>2226 ft</u>
CLIENT <u>EG & Idaho Inc</u>	LABORATORY <u>Water - Mogul</u>	TYPE OF GEOPHYSICAL LOG <u>temp, cal, flow, T, N</u>		CASING <u>16"-160.7'</u> <u>12"-177.5'</u> <u>8"-385'</u>	
DEPTH TO WATER <u>425' - Gitesion</u>	DRILLING AGENCY <u>Bach and Jannsen</u>	MAKE OF DRILL <u>CT and Rata</u>	BIT TYPE <u>7 7/8", 6 3/4"</u>	FIELD REPRESENTATIVE <u>Kent</u>	
DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS		REMARKS
1560	86 1228				
1565	86 1242	1565	a.a.		
1570	86.2 1252	268			
1575	86.2 1302	1575	Tf, gry rd-brn gry, sft, f gr		
1580		269			
	86.8 1335	1583	Tf, x1-Lit, olv blk, m hd		
1585		270			
		1588	Tf, x1-Lit, olv gry, sft- m hd, gran Tex, ap cl + slty		
1590	86.6 1402	271	Tr Fe cmt Clus		
1595					
	86.8 1415	1598	Tf, gry rd, sft, f gr		
1600					

1350 NB-2 8.9 psi/g

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LOG OF DRILL HOLE

DRILL HOLE NO. NB-4

PROJECT OR AREA NORTH BONNEVILLE, WASHINGTON		DATE STARTED 8-25-81		DATE COMPLETED 12-8-81		SHEET 41 OF 56	
COORDINATES N Gattelman E		SEC. TWP. RNG NW/4 21-2N-7E		ELEVATION ±55'		JOB NO. K7883	
						TOTAL DEPTH 2226 ft	
CLIENT EG & G Idaho Inc		LABORATORY water - mogul		TYPE OF GEOPHYSICAL LOG temp. cal. flow, T, N		CASING 16"-160.7' 12"-177.5' 8"-385'	
DEPTH TO WATER 425' - Artesian		DRILLING AGENCY Bach and Jansen		MAKE OF DRILL CT and Porta.		BIT TYPE 7 7/8", 6 3/4"	
						FIELD REPRESENTATIVE Kent	

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
1600			Tf, xl-Lit, olv gry-olv blk, sft-m hd, fnt bl-gn Incl	
1605	86.9 1448	272 1605	Tr Ze	269 gpm wier 1448 rig chatter
1610	86.9 1505	273 1610	Tf, xl, gry rd, sft	
1615	86.9 1518	274	Tf, xl, gn gry-dk gn gry, m hd, occ bl-gn Incl, Tr Fe cmt Clus	
1620	87.0 1532	1620		
1625	87.2 1602	275	Tf, xl-Lit, gn gry-dk gn gry, hd, welded?, occ bl-gn Incl, com Pyr	
1630	87 1614	1630		
1635		276	a.a. m hd-hd, whcl alt Tf Frag, Pyr cub	
1640				1640.4
				1655

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LOG OF DRILL HOLE

DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>42</u> OF <u>56</u>	
COORDINATES <u>N Geothermal E</u>		SEC-TWP-RNG <u>NW/421-2N-7E</u>		ELEVATION <u>±55'</u>		JOB NO. <u>K7883</u>	
TOTAL DEPTH <u>2226 ft</u>		CLIENT <u>EG + G Idaho Inc</u>		LABORATORY <u>Water - Mogul</u>		TYPE OF GEOPHYSICAL LOG <u>temp, cal, flow, T, N</u>	
CASSING <u>16" 160.7</u>		DEPTH TO WATER <u>425' - Artesian</u>		DRILLING AGENCY <u>Richard J. Jensen</u>		MAKE OF DRILL <u>CT and Data</u>	
BIT TYPE <u>7 7/8", 6 3/4"</u>		FIELD REPRESENTATIVE <u>Kent</u>					

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
1640	87.1 1640 85.6 1106	1640	a.a.	0930 NB-2 13.1 psig 11-24-81 1053 open valve, flow 0820 166 gpm water 471 gpm pipe 1110 start drilling 1114 NB-2 11.0 psig 269 gpm water 1128 blow 470 gpm pipe
1645	84.6 1124	277		
1650	84.5 1138	1650	Tf, X1, sft, varic- gry rd, brn gry, bl gry, brn	
1655	84.7 1154	278	Tf, X1-Lit, dk gn gry, m hd, w/alt Tf Frag wh-gn-gry + lt gn gry Cl, poss lchd, Pyr + Chal Pyr min	
1660		1660	Tr Fe cnt clws	
1665	84.8 1225	279		
1670	85 1240	1670		269 gpm water 1240 blow 523 gpm pipe
1675	85.3 1252	280	Tf, X1-Lit, gry rd- brn gry, sft, f gr Tex w/crnk Frac Surf	
1680		1680		

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LOG OF DRILL HOLE

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DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>43</u> OF <u>56</u>	
COORDINATES <u>N 60° 30' 00" E</u>		SEC-TWP-RNG <u>NW/4 21-2N-7E</u>		ELEVATION <u>±55'</u>		JOB NO. <u>K7883</u>	
CLIENT <u>EG + G Idaho, Inc</u>		LABORATORY <u>Water - Mogul</u>		TYPE OF GEOPHYSICAL LOG <u>temp, cal, flow, T, N</u>		TOTAL DEPTH <u>2226 ft</u>	
DEPTH TO WATER <u>425' - artesian</u>		DRILLING AGENCY <u>Beck and Janssen</u>		MAKE OF DRILL <u>CT and Parts</u>		BIT TYPE <u>7 7/8" 6 3/4"</u>	
						FIELD REPRESENTATIVE <u>Kent</u>	

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
1680	85.3 1302		1681 Tf, Lit-Xl, lt gn gry, m hd-hd, xl alt wh Cl thru <2 mm, prob <1' intbd gry rd sft Tf	110 gpm water 1315 flow 366 gpm pipe
1685	85.9 1332	281		
1690		1690 .3		
			1692 Tf, Lit-Xl, gn gry, m hd, Tr Fe cm + clus, Tr bl gn Incl	250 gpm water 1402 403 gpm pipe blow
1695	86 1357 85.3 1402	282		
1700	86.3 1408	1700 .3	1701 Tf, Lit-Xl, gn gry, sft-m hd, f gr Tex, Tr Fe cm + clus + bl gn Incl	
1705	86.3 1434	283		
1710	86.5 1446	1710 .3	1709 Tf, gry rd, f gr, sft 1710 Tf, Xl-Lit, olv gry, m hd, bl gn Incl com, Qtz + Fspr Vn assoc w/ Pyr min	1456 NB-2 8.5 psig
1715	86.5 1458	284		
1720		1720	1718 Tf, Xl, lt olv gry, sft, f gr 1720	

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LOG OF DRILL HOLE

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DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>44</u> OF <u>56</u>	
COORDINATES <u>N Geothermal E</u>		SEC-TWP-RNG <u>21-2N-7E</u>		ELEVATION <u>± 55'</u>		JOB NO. <u>K7883</u>	
TOTAL DEPTH <u>2226 ft</u>		CLIENT <u>EG + S Idaho Inc</u>		LABORATORY <u>Water - Mogul</u>		TYPE OF GEOPHYSICAL LOG <u>Temp, cal, flow, T, N</u>	
DEPTH TO WATER <u>425' - artesian</u>		DRILLING AGENCY <u>Reich and Joensen</u>		MAKE OF DRILL <u>CT and Porta</u>		BIT TYPE <u>7 7/8", 6 3/4"</u>	
FIELD REPRESENTATIVE <u>Kent</u>							

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
1720	86.6 1511	285	Tf, xl-Lit, olv gry, m hd-hd, occ bl gn Incl	
1725	86.8 1537	286		
1730	86.8 1550	287	Tf, xl-Lit Tf, dk gn gry, gn blk, m hd, occ bl gn Incl, Tr Fe cmt clus, v f gr "Mtrx"	230 gpm wear 1606 483 gpm pipe blow
1735	86.8 1604	288		
1740	86.8 1616	289	Tf, xl-Lit, dk gn gry, m hd, sat, sdy-like Tex x/s + lit frag 0.2-2mm cmt poss w/ze, Lit qr occ ap rndd	269 gpm wear 1640 529 gpm pipe blow easier drilling
1745	86.9 1640	290		
1750	86.9 1700	291	Tf, xl-Lit, olv gry, sft - m hd, occ bl gn Incl, olv blk lpt-size And gr	1750.3 1715 0805 NB-2 14.5psig 11-25-81 0815 open valve, flow 0800 166 gpm wear 457 gpm pipe start drilling 0830, blow 307 gpm wear 575 gpm pipe
1755	82.7 0844	292	Tf, xl, brn gry, sft, f gr	
1760			Tf, xl, lt gn gry, m hd, abd dissem Pyr + wh-yel Sul	

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LOG OF DRILL HOLE

A - 45

DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>45</u> OF <u>56</u>	
COORDINATES <u>N Geothermal E</u>		SEC-TWP-RNG <u>NW/4 21-2N-7E</u>		ELEVATION <u>±55'</u>		JOB NO. <u>K7883</u>	
TOTAL DEPTH <u>2226'</u>							
CLIENT <u>EG & G Idaho Inc</u>		LABORATORY <u>water - Mogul</u>		TYPE OF GEOPHYSICAL LOG <u>temp, cal, flow, T, N</u>		Casing <u>16"-160.7'</u>	
DEPTH TO WATER <u>425' - Artesian</u>		DRILLING AGENCY <u>Rachand Janssen</u>		MAKE OF DRILL <u>CTand Porta.</u>		BIT TYPE <u>7 7/8" 6 3/4"</u>	
FIELD REPRESENTATIVE <u>Kent</u>							

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
1760	83.1 0857		Tf, X1-Lit, dk grn gry, m hd - hd, occ bl gn Incl, sdy-like Tex, poss Ze cmt	0918 NB-2 10.0 psig
1765	84 0924	289	1765 Tf, X1-Lit, bl gry mott wh, sft, Ze Vn	
1770	84.1 0936	1700 .3	1772 Tf, X1-Lit, brn gry, sft	
1775	84.4 0948	290	1775 Tf, X1, lt gn, m hd, fgr	
1780	84.5 1002	1780 .3	1781 Tf, X1, gry rd - brn gry, sft	
1785	85.3 1030	291	1786 a.a. gn gry, m hd, Tr Fe cmt Clvs	
1790	85.3 1045	1790 .3	1790 Tf, X1-Lit, olv gry, m hd, Ze Vn, Vn w/ alt sft Cl, com Pyr	
1795	85.5 1057	292	1797	
1800		1800		

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LOG OF DRILL HOLE

DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>46</u> OF <u>56</u>	
COORDINATES <u>N Geothermal E</u>		SEC-TWP-RNG <u>NW/4 21-2N-7E</u>		ELEVATION <u>±55'</u>		JOB NO. <u>K7883</u>	
CLIENT <u>EG & G Idaho Inc</u>		LABORATORY <u>Water-Mogul</u>		TOTAL DEPTH <u>2226 ft</u>		TYPE OF GEOPHYSICAL LOG <u>CASING 16"-160.7'</u>	
DEPTH TO WATER <u>425' - artesian</u>		DRILLING AGENCY <u>Bach and Jannsen</u>		MAKE OF DRILL <u>C Tand Porta</u>		BIT TYPE <u>7 7/8" 6 3/4"</u>	
FIELD REPRESENTATIVE <u>Kent</u>							

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
1800	87.7 1112		Tf, xl, brn gry, sft, grad bl gry	
1805	86 1133	293		
			1807 Tf, xl, gn blk, m hd, fgr Tex	
			1809	
1810	86.1 1145	1810 11	Tf, xl-Lit, olv gry, m hd, occ bl gn Incl	269 gpm weir 1154 523 gpm pipe blow NB-2 9.0 psi 1157
1815	86.3 1202	294		
			1817 Tf, xl, brn gry, sft, wh cl alt Tex	
			1818	
1820	86.5 1216	1820 13	Tf, xl-Lit, dk grn gry, m hd, Lit gr ap rndd, poss Ze Grdmas, cub Pyr	1820.3 1245 0815 NB-2 15.9 psi 11-30-82 0835 open valve, flow 0900 250 gpm weir 549 gpm pipe
	88.2 0840			
	88.3 0855			
	88.4 0930			
1825	86 1005	295	Tf, xl, brn gry-bl gry, sft	0900 NB-2 12.0 psi 0925 166 gpm weir flow 484 gpm pipe
	86.2 1010			0935 230 gpm bucket 0955 start drilling
			Tf, xl, gn gry, m hd-hd, Pyr, Ze Vn, Tr Fe mt Clus	1005 367 gpm weir blow 562 gpm pipe
1830	86.2 1020	1830 13		1010 273 gpm weir blow 536 gpm pipe
			1833	
1835	86.3 1030	296	Tf, xl-Lit, grysh rd purp, brn gry-bl gry, sft	
1840		1840		

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LOG OF DRILL HOLE

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DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>47</u> OF <u>56</u>	
COORDINATES <u>N Geothermal E</u>		SEC-TWP-RNG <u>NW/421-2N-7E</u>		ELEVATION <u>±55'</u>		JOB NO. <u>K7883</u>	
CLIENT <u>EG & Idaho Inc</u>		LABORATORY <u>Water-Mogul</u>		TYPE OF GEOPHYSICAL LOG <u>temp, cal, flow, T, N</u>		TOTAL DEPTH <u>2226 ft</u>	
DEPTH TO WATER <u>425' - artesian</u>		DRILLING AGENCY <u>Bach and Jannsen</u>		MAKE OF DRILL <u>CT and Porta.</u>		BIT TYPE <u>7 7/8", 6 3/4"</u>	
						FIELD REPRESENTATIVE <u>Kent</u>	

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
1840	86.7 1043		Tf, Xl-Lit, olv gry, m hd, occ blgn Incl, Tr Fe cmt Clus	
1845	86.6 1108	297		
			1847 Tf, Xl, brngry - bl gry, sft, fgr	
			1848 Tf, Xl, lt gn - gn gry, sft - m hd, gran Tex, mnr Pyr	
1850	86.5 1124	1850		
			1851 Tf, Xl-Lit, olv gry, m hd, occ blgn Incl, Qtz Vn, Pyr catg Jt, Fe cmt Clus	
1855	86.8 1136	298		
			1857 Tf, Lit-Xl, brngry - bl gry, sft	
1860	86.9 1150	1860		
			1861 Tf, Xl-Lit, olv gry - dk gn gry, m hd, bl-gn Incl, Tr Fe cmt Clus	
1865	87.1 1221	299		
1870	87.1 1235	1870		
			1870 Tf, Xl-Lit, bl gry - olv gry, sft - m hd, v ang lit Frag, Pyr	harder drilling
1875	87.2 1250 87.5 1324	300		
				1324 NB-2 10.0 psi
1880		1880		
			1879	

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LOG OF DRILL HOLE

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DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>48</u> OF <u>56</u>	
COORDINATES <u>N Geothermal E</u>		SEC-TWP-RNG <u>NW/421-2N-7E</u>	ELEVATION <u>±55'</u>	JOB NO. <u>K7883</u>	TOTAL DEPTH <u>2226 ft</u>		
CLIENT <u>EG+G-Info Inc</u>		LABORATORY <u>Water-Mogul</u>		TYPE OF GEOPHYSICAL LOG <u>temp, cal, flow, T, N</u>		CASING <u>16"-160.7'</u> <u>12"-177.5'</u> <u>8"-385'</u>	
DEPTH TO WATER <u>425'-artesian</u>		DRILLING AGENCY <u>Bachand Janssen</u>		MAKE OF DRILL <u>LT and Porta.</u>		BIT TYPE <u>7 7/8", 6 3/4"</u>	FIELD REPRESENTATIVE <u>Kent</u>

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
1880			Tf, x1-Lit, dk gn gry, olv gry, m hd-hd, occ bl-gn Incl	
1885	87.4 1337	301		
1890	87.5 1350	1890 3	Tf, x1, gn blk, hd, welded?, dns + gran Tex	
1895	89 1400	302	Tf, x1, brngry-bl gry, sft, f gr	
1900	88.9 1410 89.2 1434	1900 3	Tf, x1-Lit, dk gn gry, m hd, P?, abd Ze cotg Jt, Pyr	
1905	88.2 1440	303	Tf, x1, bl gry-brngry, sft, f gr	
1910	88.1 1450	1910 3	Tf, x1-Lit, dk gn gry-olv gry, m hd-hd, x/n Tex, dns, occ dull bl-gn Incl, Pyr, Fe cmf Clus	
1915	88.9 1500	304	Tf, x1, brngry-bl gry, sft, f gr, com sft wh cl Frag, cub Pyr	
1920	89.5 1512	1920		

1505 NB-2 10.0 psig

152 gpm weir 1512
392 gpm pipe flow-stopped drilling

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LOG OF DRILL HOLE

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DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>49</u> OF <u>56</u>	
COORDINATES <u>N Geothermal/E</u>		SEC-TWP-RNG <u>NW/4 21-2N-7E</u>		ELEVATION <u>±55'</u>		JOB NO. <u>K7883</u>	
TOTAL DEPTH <u>2226 ft</u>		CLIENT <u>EG & G Idaho, Inc.</u>		LABORATORY <u>water-Mogul</u>		TYPE OF GEOPHYSICAL LOG <u>temp, cal, flow, T, N</u>	
CASING <u>18"-160.7'</u>		DEPTH TO WATER <u>425'-artesian</u>		DRILLING AGENCY <u>Bach and Janssen</u>		MAKE OF DRILL <u>CT and Porta</u>	
BIT TYPE <u>7 7/8" 6 3/4"</u>		FIELD REPRESENTATIVE <u>Kent</u>					

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
1920	89.2 1535		Tf, X1-Lit, dk gn gry, m hd	
			1923	
1925	89.3 1542	305	Tf, X1, brn gry-bl gry, sft	
			1929	
1930	88.9 1552	1930	Tf, X1-Lit, gn gry, m hd, occ bl-gn Incl	
			1934	
1935	88.6 1602	306	Tf, X1, lt gry-yel gry, sft, cpet	1602 NB-2 10.0 psig
			1936	
			Tf, X1, brn gry-gry rd, sft	
1940	89 1630 89.1 1645	1940		1940.3 1655
			1942	
1945	88.3 0822 88.4 0835 85.5 0903	307	Tf, X1-Lit, dk gn gry, m hd, Ze alt Grd mas, Tr Fe cmnt Incl, occ dull bl-gn Incl	0815 NB-2 11.5 psig 12-1-81 0818 open valve (NB4) 0810 0818 1/2 NB-2 10.6 psig NB-2 response 0819 10.2 psig to opening 0819 1/2 10.1 psig NB-4 valve 0820 10.0 psig ± 0.08 psi/min 0845 9.2 psig 0852 start drilling, flow 152 gpm weir 444 gpm pipe 0903, blow 288 gpm weir 536 gpm pipe
			1949	
1950	85.6 0915	1950	Tf, X1-Lit, lt bl gry- lt gry, sft, P?	
1955	85.4 0926	308		
1960		1960		
			1960	

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LOG OF DRILL HOLE

DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>50</u> OF <u>56</u>	
COORDINATES <u>N Geothermal E</u>		SEC-TWP-RNG <u>NW/4 21-2N-7E</u>		ELEVATION <u>155'</u>		JOB NO. <u>K7883</u>	
CLIENT <u>E6 + 6 Idaho Inc</u>		LABORATORY <u>Water-Mogul</u>		TYPE OF GEOPHYSICAL LOG <u>Temp, cal, flow, T, N</u>		TOTAL DEPTH <u>2226 ft</u>	
DEPTH TO WATER <u>425' - or less</u>		DRILLING AGENCY <u>Bach and Jannson</u>		MAKE OF DRILL <u>CT and Bata</u>		BIT TYPE <u>7 7/8", 6 3/4"</u>	
						FIELD REPRESENTATIVE <u>Kent</u>	

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
1960	85.6 0939		Tf x1, brn gry - gry rd, sft, Ze Vn w/ ap slick Jt <u>1963</u>	harder drilling
1965	85.9 1010	309	Tf, X1-Lit, brn blk, m hd, occ bl-gn Incl	
1970	86 1023	1970 .3	Intbd, sft, gry rd / bl gry, X1, Tf	
1975	86 1035	310		
1980	86 1046	1980 .3	Intbd sft, gry rd / bl gry, X1, Tf	
1985	86.4 1114	311	thn X1 Tf, gry rd, sft, for <u>1983</u> Tf, X1-Lit, olv gry-dk qn gry, m hd, occ dull bl-gn Incl, Plag X1 < 1mm, Tr Ze <u>1989</u>	
1990	86.5 1130	1990 .3	Tf, X1, bl gry, sft, P <u>1991</u>	
1995	86.5 1143	312	Tf, X1, qn blk, hd, Xln Tex, welded?, occ bl-gn vnlts & Incl <u>1999</u>	
2000	86.5 1155	2000		

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LOG OF DRILL HOLE

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DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>51</u> OF <u>56</u>	
COORDINATES <u>N 60° 10' 00" E</u>		SEC-TWP-RNG <u>NW 1/4 21-2N-7E</u>		ELEVATION <u>± 55'</u>		JOB NO. <u>1K7883</u>	
CLIENT <u>EG & S Idaho Inc</u>		LABORATORY <u>Water - Mogul</u>		TYPE OF GEOPHYSICAL LOG <u>Temp, cal. flow, T, N</u>		TOTAL DEPTH <u>2226 ft</u>	
DEPTH TO WATER <u>425' - artesian</u>		DRILLING AGENCY <u>Bach and Hansen</u>		MAKE OF DRILL <u>CT and Corp.</u>		BIT TYPE <u>7 7/8", 6 3/4"</u>	
FIELD REPRESENTATIVE <u>Kent</u>							

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
2000			Tf, Lit, olv gry, sft - m hd, v cl Grdmas, fgr	
2005	86.8 1222	313		1224 NB-2 @ 2 psig
2010	86.9 1236	2010 -3	Tf, x1, gry rd-brn gry, sft	
2015	86.8 1248	314	Tf, x1-Lit, lt olv gry-qn gry, sft - m hd, Ze	
2020	86.8 1301	2020 -3	Tf, x1, brn gry, sft, fgr, Fe clus	
2025	87.1 1334	315	Tf, x1-Lit, olv gry-dk qn gry, m hd, occ bl-qn Incl, Tr Fe cmt Clus	
2030	87 1349	2030 -3	Tf, x1, gry rd, sft, fgr	
2035	87.1 1402	316	Tf, Lit-x1, lt gry-lt olv gry, sft, P, v cl alt, Vn / Grdmas Ze	
2040		2040		

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LOG OF DRILL HOLE

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DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>52</u> OF <u>56</u>	
COORDINATES <u>N Geothermal E</u>		SEC-TWP-RNG <u>NW/4 21 2N-7E</u>		ELEVATION <u>±55'</u>		JOB NO. <u>K7883</u>	
TOTAL DEPTH <u>2226 ft</u>		CLIENT <u>EG & G Idaho Inc</u>		LABORATORY <u>Water - Mogul</u>		TYPE OF GEOPHYSICAL LOG <u>temp, cal, flow, 8, N</u>	
CASING <u>16" 160.7'</u>		DEPTH TO WATER <u>425' - artesian</u>		DRILLING AGENCY <u>Bach and Janssen</u>		MAKE OF DRILL <u>CT and Porth</u>	
BIT TYPE <u>7 7/8", 6 3/4"</u>		FIELD REPRESENTATIVE <u>Kent</u>					

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
2040	87.1 1415		2041 Tf, x1-Lit, olv gry, m hd, bl-gn Incl abd, mnr Ze, Intbd bl-gry f gr x1 Tf	
2045	87.3 1445	317		
2050	87.3 1504	2050 .3		1504 231 gpm weir blow 523 gpm pipe
2055	87.3 1516	318	2056 Tf, x1-Lit, lt olv gry, sft, Ze Grdmas, brit	
2060	87.3 1529	2060 .3	2059 Tf, x1-Lit, lt olv gry, m hd, Ze Grdmas, Plag alt Cl lge than ab	
2065	87.3 1558	319		
2070	87.2 1615	2070 .3	2071 Tf, x1, bl gry, sft, f gr	
2075		320	2073 Tf, x1-Lit, lt olv gry, m hd, bl-gn Incl, Plag + Grdmass alt Cl a Ze, Tr Fe emt clus	
2080		2080		

2080.3 feet

12-2-81 pipe fishing
0815 65 gpm weir open valve
366 gpm pipe
0825 NB-2 6.9 psig
12-3-81 pipe fishing
12-4-81 pipe fishing
0800 NB-4 7.0 psig
NB-2 14.5 psig
12-5-81 pipe fishing
NB-2 11.0 psig

1558 NB-2 7.9 psig

2080.3 (end 12-1-81) 1810

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LOG OF DRILL HOLE

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DRILL HOLE NO. NB-4

PROJECT OR AREA NORTH BONNEVILLE, WASHINGTON		DATE STARTED 8-25-81		DATE COMPLETED 12-8-81		SHEET 53 OF 56	
COORDINATES N Geothermal E		SEC-TWP-RNG NW/4 21-2N-7E		ELEVATION ± 55'		JOB NO. K7883	
TOTAL DEPTH 2226 ft		CLIENT EG & G Idaho, Inc		LABORATORY Water-Mogul		TYPE OF GEOPHYSICAL LOG temp, cal, flow, T, N	
CASING 16"-160.7'		DEPTH TO WATER 425'-artesian		DRILLING AGENCY Bach and Janssen		MAKE OF DRILL CT and Porta	
BIT TYPE 7 7/8", 6 3/4"		FIELD REPRESENTATIVE Kent					

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
2080	88.4 0815		a.a.	0820 NB-2 11.0 psig 12-7-81 0820 see also page 52
2085	85 1059	321	Frac, lt-dk yel or Qtz f Xls + Vn, Fe Jt	1059 start drilling, blow 250 gpm weir 496 gpm pipe
2090	85.3 1118	2090	Frac, lt-dk yel or Qtz f Xls + Vn Fe Jt	
		322		1130 NB-2 7.5 psig
2095	85.9 1139	2095	Tf, Xl, bl gry, sft, fgr bcm gry rd Tf, Lit, lt olv gry-gn gry, m hd, lt yel or Qtz f Vn, pt Intr?	
		2093		
		2094		
		2098		
2100	85.9 1212	323	Tf, Xl, bl gry, sft, fgr	
		2101		
		2104		
2105	86 1232	2105	Tf, Xl, gry rd, sft, fgr	
		2105		
		2105		
2110	86.3 1254	324	Tf, Xl-Lit, olv gry, sft- m hd, Grdmas pt Ze	
		2115		
2115	86.3 1318	2115	Tf, Xl-Lit, dk rd brn, sft	
		2117		
		2117		
2120	86.5 1407	325	Tf, Xl-Lit, olv gry, m hd-hd, abd ze, mnr Pyr	1407 230 gpm weir 484 gpm pipe blow

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LOG OF DRILL HOLE

A - 54

DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>54</u> OF <u>56</u>	
COORDINATES <u>N Geothermal E</u>		SEC-TWP-RNG <u>NW/4 21-2N-7E</u>		ELEVATION <u>±55'</u>		JOB NO. <u>K7883</u>	
CLIENT <u>EG + B Idaho, Inc.</u>		LABORATORY <u>Water-Moqui</u>		TOTAL DEPTH <u>2226 ft</u>		TYPE OF GEOPHYSICAL LOG <u>CASING 16"-160.7'</u>	
DEPTH TO WATER <u>425'-artesian</u>		DRILLING AGENCY <u>Bach and Jannsen</u>		MAKE OF DRILL <u>CT and Porta</u>		BIT TYPE <u>7 7/8", 6 3/4"</u>	
				FIELD REPRESENTATIVE <u>Kent</u>			

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
2120				
		2122	Tf, x1, gry rd, sft, f gr	
		2123		
2125	86.6 1434	2125	Tf, x1-Lit, olv gry, m hd- hd, abd ze, mnr Pyr	
2130	86.5 1458	326		
		2133	Tf, x1, brn, gry, sft	
2135	86.5 1518	2135		
			Tf, x1-Lit, olv gry, m hd- hd, abd ze, mnr Pyr	
2140	86.5 1559	327	Tf, x1-Lit, dk rdsh brn, sft-m hd, abd Qty 1+yel or, Cl, al+Intr?	
2145	86.5 1622	2145	Tf, x1-Lit, olv gry, m hd- hd, abd ze, mnr Pyr	harder drilling 1720 250 gpm weir blow 497 gpm pipe measured drilling pond 83.6°
		328		
2150	86.9 1748	2150	Tf, x1, brn gry, sft, fgr	easier drilling
			Tf, x1-Lit, olv gry, m hd- hd, abd ze, mnr Pyr	
2155	86.9 1804	329	Tf, 1+yel, sft-m hd, v fgr	harder drilling
			a.a. x1-Lit Tf	
			Cl, 1+yel-or, poss val+Intr	
2160		2160		

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LOG OF DRILL HOLE

A - 55

DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>		DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>55</u> OF <u>56</u>	
COORDINATES <u>N Geothermal E</u>		SEC-TWP-RNG <u>NW/4 21 2N-7E</u>		ELEVATION <u>± 55'</u>		JOB NO. <u>K7883</u>	
CLIENT <u>E6 & G Idaho Inc</u>		LABORATORY <u>Water - Mogol</u>		TYPE OF GEOPHYSICAL LOG <u>temp, cal, flow, T, N</u>		TOTAL DEPTH <u>2226 ft</u>	
DEPTH TO WATER <u>425' - artesian</u>		DRILLING AGENCY <u>Backlund Johnson</u>		MAKE OF DRILL <u>CT and Ponto</u>		BIT TYPE <u>7/8", 6 3/4"</u>	
						FIELD REPRESENTATIVE <u>Kent</u>	

DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS	REMARKS
2160	86.8 1851	330	Tf, X1-Lit, olv gry. m hd - hd, abd Ze.	
2165	86.8 1914	285	mnr Pyr, Tr Fe cmt Clus	harder drilling
2170	86.8 1948	331		
2175	86.8 2011	2175	Intbd grysh rd - dk rd brn, sft - m hd, X1, Tf	
2180	86.7 2053	332	Intbd grysh rd - dk rd brn, sft - m hd, X1, Tf	
2185	86.6 2115	2185	Intbd grysh rd - dk rd brn, sft - m hd, X1, Tf	drilling pond water 82.7°
2190	86.8 2134	333		
2195	86.7 2200	2190		
2200		334		
		335		
		2200		

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LOG OF DRILL HOLE

DRILL HOLE NO. NB-4

PROJECT OR AREA <u>NORTH BONNEVILLE, WASHINGTON</u>			DATE STARTED <u>8-25-81</u>		DATE COMPLETED <u>12-8-81</u>		SHEET <u>56</u> OF <u>56</u>	
COORDINATES <u>N Geothermal E</u>			SEC-TWP-RNG <u>NW/4 21-2N-7E</u>		ELEVATION <u>± 55'</u>		JOB NO. <u>K7883</u>	
TOTAL DEPTH <u>2226 ft</u>								
CLIENT <u>EG + G Idaho Inc</u>			LABORATORY <u>Water - Mogel</u>		TYPE OF GEOPHYSICAL LOG <u>Temp, cal, flow, & N</u>		CASING <u>16" / 160.7'</u>	
DEPTH TO WATER <u>425' - gr test</u>			DRILLING AGENCY <u>Bach and Janssen</u>		MAKE OF DRILL <u>CT and Arla</u>		BIT TYPE <u>7 7/8", 6 3/4"</u>	
FIELD REPRESENTATIVE <u>Kent</u>								
DEPTH IN FEET	TEMP	SAMPLE NUMBER	DESCRIPTION OF MATERIALS				REMARKS	
2200	86.7 2235	336	2202					
2205	86.6 2300	337	Tf, Li-Xl, m gry, sft- m hd, f gr Tex, r bl-gr Incl <1mm					
2210	86.7 2332	338	Tr Fe cmt Clus				2210 2400 12-8-81 0000	
2215	86.7 0005	339						
2220	87 0048	341	Intbd Tf, Xl, grysh rd purp, sft, f gr, Fe Vn					
2225	87 0120 87.1	342 2226					0140 NB-2 9.3 psig W-7 water sample 2226' 0205	
			TOTAL DEPTH 2226.0 feet					

EG & G Idaho, Inc.
Bonneville Geothermal
June, 1982

A P P E N D I X B

ABBREVIATIONS AND GRAPHIC SYMBOLS

FOR GEOLOGIC LOGS

GRAPHIC SYMBOLS
GEOLOGIC LOGS

ROCK TYPES

Lithic tuff		Gravel
Crystal tuff		Sand
Lapilli tuff		Lithic sand
Tuff altered to clay		Silt
Andesite		Clay
Intrusive		Coal

ACCESSORIES

+	Chloritic	≠	Pyrite
Feldspar		Quartz crystal
H	Hematite	•	Sulphides, undiff.
L	Limonite	Ze	Zeolite
Mica	○	Mafic mineral

STRUCTURES

Vein		Breccia
Fracture	x	Iron cemented clusters
Slickensides		Vug

ABBREVIATIONS FOR LITHOLOGIC DESCRIPTIONS

Based on AAPG Sample Examination Manual, R. G. Swanson, 1981

WORD	ABBREVIATION	WORD	ABBREVIATION
about	abt	claystone	Clst
above	ab	clean	cln
absent	abs	clear	clr
abundant	abd	cleavage	Clvg
agglomerate	Aglm	cluster	Clus
aggregate	Agg	coal	C
altered	alt	coarse	crs
alternating	altg	coated (-ing)	cotd, cotg, Cotg
amount	Amt	cobble	Cbl
and	&	color (-ed)	Col, col
andesite	And	common	com
angular	ang	compact	cpct
anhedral	ahd	compare	cf
aphanitic	aph	concentric	cncn
apparent	app	conchoidal	conch
appears	ap	conglomerate (-ic)	Cgl, cgl
approximate	apprx	considerable	cons
as above	a.a.	consolidated	consol
associated	assoc	contact	Ctc
at	@	contamination (-ed)	Contam, contam
average	Av, av	content	Cont
basalt (-ic)	Bas, bas	covered	cov
become (-ing)	bcm	crinkled	crnk
bed (-ed)	Bd, bd	cross-bedded	x-bd
bedding	Bdg	crystal (-line)	Xl, xln
black (-ish)	blk, blksh	cube, cubic	Cub, cub
blocky	blky	cuttings	Ctgs
blue (-ish)	bl, blsh	damp	dmp
bored (-ing)	Bor, bor	dark (er)	dk, dkr
bottom	Btm	decrease (-ing)	Decr, decr
boulder	Bld	dense	dns
breccia (-ted)	Brec, brec	deposit	dep
bright	brt	description	Descr
brittle	brit	diameter	Dia
brown	brn	dike	dik
buff	bu	disseminated	dissem
calcite (-ic)	Calc, calctc	ditto	" or do
calcareous	calc	dominant (-ly)	dom
carbonaceous	carb	drilling	drlg
caving	Cvg	drusy	dru
cement (-ed, -ing)	Cmt, cmt	equivalent	Equiv
chalcedony (-ic)	Chal, chal	euhrdal	euhrd
chlorite (-ic)	Chlor, chlor	excellent	ex
circulate (-ion)	cir, Circ	extremely	extr
clastic	clas		
clay (-ed)	Cl, cln		

WORD	ABBREVIATION	WORD	ABBREVIATION
faint	fnt	layer	Lyr
fault (-ed)	Flt, flt	leached	lchd
feldspar (-athic)	Fspr, fspr	lens, lenticular	Len, lent
ferruginous	ferr/Fe	light	lt
fine (-ly)	f, fnly	lignite (-itic)	Lig, lig
fi ssile	fis	limonite (-itic)	Lim, lim
flake, flaky	Flk, flk	lithic	lit
foliated	fol	little	Ltl
formation	Fm	lustre	Lstr
fossil (-iferous)	Foss, foss		
fracture (-d)	Frac, frac	mafic	maf
fragment (-al)	Frag, frag	magnetite, magnetic	Mag, mag
frequent	freq	manganese,	Mn, mn
fresh	frs	manganiferous	
friable	fri	massive	mass
fusain	fus	material	Mat
		matrix	Mtrx
generally	gen	maximum	max
glass (-y)	Glas, glas	medium	m or med.
good	gd	metallic	met
gouge	gog	mica (-ceous)	Mic, mic
grading	grad	microcrystalline	microxln
grain (-s, -ed)	Gr, gr	middle	Mid
granule (-ar)	Gran, gran	milky	mky
gravel	Grv	mineral (-ized)	Min, min
gray, grey (-ish)	gry, grysh	minor	mnr
green (-ish)	gn, gnsh	moderate	mod
groundmass	grdmas	moist	mst
		mottled	mott
hard	hd	mudstone	Mdst
heavy	hvy		
hematite (-ic)	Hem, hem	numerous	num
high (-ly)	hi		
horizontal	hor	occasional	occ
hornblende	hnb1	olive	olv
		orange (-ish)	or, orsh
inclusion (-ded)	Incl, incl	orthoclase	Orth
increasing	incr	overgrowth	ovgth
indistinct	indst	oxidized	ox
indurated	ind		
interbedded	intbd	part (-ly)	Pt, pt
intergrown	intgn	particle	Par, par
interval	Intvl	parting	Ptg
irregular (-ly)	irr	pebble (-ly)	Pbl, pbl
		phenocryst	phen
joint (-ed, -ing)	Jt, jt	pink	pk
		pinkish	pkish
lamina (-tions, -ated)	Lam, lam	plagioclase	Plag
lapilli	lpl	plane	pln
large	lge	plastic	plas
		platy	plty
		poorly	ply

WORD	ABBREVIATION
porphyritic	pphyt
possible (-ly)	poss
predominant (-ly)	pred
primary	prim
probable (-ly)	prob
prominent	prom
pumice	p
purple	purp
pyrite (-itized, -itic)	Pyr, pyr
pyroclastic	pyrc1
pyroxene	pyx
quartz (-ose)	Qtz, qtz
radial (-ating)	Rad, rad
rare	r
red (-ish)	rd, rdsh
replaced (-ment)	rep, Repl
rhomb (-ic)	Rhb, rhb
rock	Rk
round (-ed)	rnd, rndd
salt and pepper	s & p
same as above	a.a.
sample	Spl
sand (-y)	Sd, sdy
sandstone	Sst
saturation (-ated)	Sat, sat
scarce	scs
scattered	scat
secondary	sec
shale (-ly)	Sh, sh
silica (-iceous)	Sil, sil
silky	slky
silt (-y)	Slt, slty
siltstone	Sltst
similar	sim
slabby	slb
slickenside (-d)	Slick, slick
slight (-ly)	sli, slily
small	sm1
soft	sft
somewhat	smwt
sorted (-ing)	srt, srtg
spotted (-y)	sptd, spty
stain (-ed, -ing)	Stn, stn
strata (-ified)	Strat, strat
streak (-ed)	Strk, strk
stringer	strgr
structure	Str
subangular	sbang
subrounded	sbrndd

WORD	ABBREVIATION
sulphides	sul
surface	Surf
texture (-d)	Tex, tex
thick	thk
thin	thn
thin-bedded	t.b.
throughout	thru
trace	Tr
translucent	trns1
tuff (-aceous)	Tf, tf
unconsolidated	uncons
varicolored	varic
vein (-ing, -ed)	Vn, vn
veinlet	Vnlet
very	v
vesicular/vesicles	ves, Ves
visible	vis
vitreous (-ified)	vit
vug (-gy)	Vug, vug
weak	wk
weathered	wthd
well	W1, w1
white	wh
with	w/
without	w/o
yellow (-ish)	yel, yelsh
zeolites	Ze
zone	Zn

EG & G Idaho, Inc.
Bonneville Geothermal
June, 1982

A P P E N D I X C

DRILLING DATA SUMMARY

Geothermal Production Test
City of North Bonneville

DRILLING DATA SUMMARY

Kent Associates - Geologic Consultants
Lake Oswego, Oregon

SHEET 1 of 25

FORMATION OR GEOLOGIC UNIT	DATE	TIME	* WATER FLOW Gpm	WELLHEAD WATER TEMPERATURE °F	DEPTH FEET	PH	PAIG PRESSURE NB-2 RESORT	STATIC WATER LEVEL FEET	WATER SAMPLE Lab. No. shown
SUMMARY Alluvium & Landslide 0' - 144'	9-29-81	1200	1-2						
Eagle Ck. Fm. 144' - 293'		1300		66.5	390	8.6			
Lava Flows 3 Corn. Rock 293' - 922'	9-30-81	0930	1-2	72.2	390	9.25			
Stevens River Pyroclastic 922' - 1450'	10-6-81	1200		78.2	406				
Chaparralash Fm. 1450' - 2226'		1245		78.5	411				
293' Andesite Flows 340' (breccia @ 326')		1315	10	77.5	416		33.1		
340' Tuffs									
394' (fault @ 394')		1350		77.0	421				
Andesite Flows 395' - 438'		1440	400-500 blow 900-1000 blow	86.5	425		17.5 flow 13.5 blow		
425' - open joint? quartz crystals, euhedral in Andesite		1610					3.5		
		1700	400-500 flow	85.7	436		0		
		1815					13.5?		
Andesite	10-7-81	0815	200-300 flow	86.3	436	9.7			W-1 385' to 436' lab A 9610
GRAY/BLUE TUFF at 442'		1050	900-1000 blow	86.7	441				
				86.9	445				
Very clayey tuff @ 446'		1123	no artesian						
ANDESITE FLOWS contact 449'		1242	900-1000 blow 124.2, say: 125 flow	87.1	449				
		1400		87.1	451				
		1650	900-1000 blow 117.7, say: 118 flow	87.2	456				
Fractured		1820		87.3	460				

* WATER FLOW ESTIMATES

$$GPM = X K$$

for 8" ID pipe, $K = 52.3$
Labeled "pipe"

$$GPM = D_f \cdot k$$

D_f = discharge when pipe is full
 $k = \frac{f}{D} \cdot 100 = \%$
Labeled "weir"

%	$\frac{f}{D}$
5	0.981
10	0.948
15	0.905
20	0.858
25	0.806
30	0.747
35	0.682
40	0.627
45	0.564
50	0.500
55	0.436
60	0.375
65	0.312
70	0.253
75	0.195
80	0.142
85	0.095
90	0.052
95	0.019
100	0.010

Blow - refers to drilling return
circulation flow under high
pressure

Flow - refers to formational
piezometric pressures
evidenced by artesian flow.

Geothermal Production Test
City of North Bonneville

DRILLING DATA SUMMARY

Kent Associates - Geologic Consultants
Lake Oswego, Oregon

SHEET 2 of 25

FORMATION OR GEOLOGIC UNIT	DATE	TIME	WATER FLOW	WATER TEMPERATURE	DEPTH	pH	PRESSURE NB-2	RESORT	STATIC WATER LEVEL	WATER SAMPLE
ANDESITE FLOWS continued	10-7-81	1840	950-1050 blow	87.5	462					
Crystal tuff		1905		87.6	462.4					
probably jointed		1930		87.8	462.5					
Andesite	10-8-81	0810		during cleanout 86.0	463		0		10.5	
		0920	950-1050 blow 118 flow	87.3	466					
probable joints		1025		89.1	469					
clear fresh- looking quartz		1030		87.6	469.5					
		1111		88.2	470.5					
		1121		87.6	471					
WELDED TUFF 472'		1142		88.9	472.5					
		1145		87.9	473					
		1205		87.4	473.5					
Clayey tuff 474'-475'		1220	400-1000 blow 111 flow	87.5	474					
		1245	700-800 blow	87.4	476					
CLAY, red, wet 481'-501'		1250		87.4	481					
		1318		87.6	491					
		1325		87.6	496					
ANDESITE FLOWS at 501'		1335		87.6	501					
		1345	105 flow		506					

Geothermal Production Test
City of North Bonneville

DRILLING DATA SUMMARY

Kent Associates - Geologic Consultants
Lake Oswego, Oregon

SHEET 3 of 28

FORMATION OR GEOLOGIC UNIT	DATE	TIME	WATER FLOW	WATER TEMPERATURE	DEPTH	pH	PRESSURE NB-2	RESORT	STATIC WATER LEVEL	WATER SAMPLE
Artesian continued	10-8-81	1355		87.5	509.5					
WEATHERED FLOW CONTACT?		1435		91.4	520					
		1437		88.0	521					
		1440		87.6	522					
flow contact 526' red water		1530		88.1	526					
flow contact 529' red water		1542		87.8	529					
		1545		88.7	531					
		1555	125 flow	88.0	536					
		1612		87.8	541					
TUFF BRECCIA at 546'-548' fractured		1630		88.3	546					
Fe coatings		1715		86.1	551					
		1741		88.4	554					
SANDY SILTSTONE at 556'-561'		1800		88.3	556					
		1822	700-800 blow sudden loss of blow water	87.9	558					
		1845		87.8	560					
		1900		87.9	561					
		1915		88.0	561.5					
		1930		87.9	562					

Geothermal Production Test
City of North Bonneville

DRILLING DATA SUMMARY

Kent Associates - Geologic Consultants
Lake Oswego, Oregon

SHEET 4 of 28

FORMATION OR GEOLOGIC UNIT	DATE	TIME	WATER FLOW	WATER TEMPERATURE	DEPTH	pH	PRESSURE		STATIC WATER LEVEL	WATER SAMPLE
Andesite - continued	10-9-81	0746			566				34.5	
		0750					C			
		0840		87.9	568					
		0900	125 flow	88.0	570					
		0920		87.8	571					
LITHIC TUFFS 572' - 590'		1000		87.9	575					
		1005			576					
		1016		87.8	581					
		1030			586					
		1115		88.1	591					
Quartz veining c 597'		1145		87.6	594					
		1203		88.0	596					
		1220		88.0	599					
		1255	800-900 blow	88.0	601					
		1400		88.0	606					
sulfides increase 605'		1438		88.0	611					
		1445		88.3	613					
		1455		88.5	614					
		1500		88.4	615					

Geothermal Production Test
City of North Bonneville

DRILLING DATA SUMMARY

Kent Associates - Geologic Consultants
Lake Oswego, Oregon

SHEET 5 of 28

FORMATION OR GEOLOGIC UNIT	DATE	TIME	WATER FLOW	WATER TEMPERATURE	DEPTH	pH	PRESSURE NB-2	RESORT	STATIC WATER LEVEL	WATER SAMPLE
fracture joint & flow, cement	2-9-81	1510	900-1000 blow	90.0	618					
numerous g.f.s. veins		1513		88.4	619	2 pH 4.4				11-4 625' A4726
		1525		88.3	621					
		1548		88.3	626					
		1557			626				48.2	
	10-12-81	0915			626		7.8		1.5	
		0941					2 → 0 blowing			
Clay 626'-6292'		1015		87.2	627.5					
red water		1034		87.1	630					
		1045		87.2	632.5					
Tuff 638'-640'		1114		87.3	637.5					
		1130		87.4	640					
Fe root ras throughout		1140	131 flow	87.4	642					
		1210		87.5	644					
		1248		87.5	647.5					
TUFF 650'-653'		1320		87.9	650					
		1346		87.9	651.5					
		1355		87.8	652.5					
		1430		87.6	657.5					

Geothermal Production Test
City of North Bonneville

DRILLING DATA SUMMARY

Kent Associates - Geologic Consultants
Lake Oswego, Oregon

SHEET 6 of 28

FORMATION OR GEOLOGIC UNIT	DATE	TIME	WATER FLOW	WATER TEMPERATURE	DEPTH	pH	PRESSURE		STATIC WATER LEVEL	WATER SAMPLE
							NB-2	RESORT		
Andesite - continued	10-12-81	1450		87.8	659.5					
		1510		87.9	661					
		1520		87.9	662.5					
		1530		87.9	664					
TUFF 666'-667'		1553		88.0	667.5					
		1605	450-1050 blow	87.8	668.5					
		1630		87.9	670.5					
abundant zeolites at 674'		1645		87.6	672.5					
fractured		1715		88.0	677.5					
		1730		87.9	680					
		1750		87.9	684					
TUFF 687'-688'		1820		88.1	687.5					
abundant gtz. and zeolite		1838			687.5				42.2	
filled veins 687'-693'	10-13-81	0715			687.5				36.2	
abundant sulfide minerals		0732	200 blow		687.5		10.0			
		0835		86.7		9.45	11.5			w-1A disposed probably contaminated
		0836	blowing			7.0				
		* 0837 to 0944 *	see adjacent column				*			
		1002	1000-1200 blow	87.5	689		0			

TIME	PSIG	REMARKS
0837	6.5	blow hole
0838	6.0	
0839	5.5	
0840	5.0	foot water sample
0846		509' stopped blowing
0848	7.5	
0856	9.8	begin blowing 200 gpm
0900		upper section only
0903		
0904	4.2	
0905	4.0	
0906	8.9	
0910	6.5	
0915		stop blow
0920	9.5	start blow upper section
15"	9.2	200 gpm
0921	9.8	blow increase to 1000 gpm
30"	8.0	
45"	7.5	
0922	6.5	
15"	6.0	
30"	5.8	
45"	5.6	
0923	5.6	
15"	5.5	
0924	4.9	
15"	4.6	
45"	4.3	
0925	4.2	
30"	4.0	
0926	3.6	
0927	3.2	
0928	2.9	stop blow, hole recharging
30"	3.2	
45"	3.5	
0929	3.8	
15"	4.2	
30"	4.9	
45"	5.2	
0930	5.6	
15"	5.9	
30"	6.0	
45"	6.2	
0931	6.4	
30"	6.7	
0932		begin blow 1000 gpm
0944	0	
loss of 0.5 psi/min during sampling		
loss of 0.13 psi/min during 200 gpm blow		
loss of 0.97 psi/min during 1000 gpm blow		
gain of 1.1 psi/min during recharge		

Geothermal Production Test
City of North Bonneville

DRILLING DATA SUMMARY

Kent Associates - Geologic Consultants
Lake Oswego, Oregon

SHEET 7 of 28

FORMATION OR GEOLOGIC UNIT	DATE	TIME	WATER FLOW	WATER TEMPERATURE	DEPTH	pH	PRESSURE NB-2	RESORT	STATIC WATER LEVEL	WATER SAMPLE
Andesite, tertiary	10-13-81	1032		87.7	692.5					
		1100	131 flow	87.8	695.5					
		1122		87.8	697.5					
Probably dike intrusion		1145		87.9	700.5					
697'-702'		1153		87.9	701					
		1220		87.9	702.5					
		1250		87.9	706					
		1314		87.9	707.5					
		1335		88	711					
		1345		88	712.5					
Several tuff interbeds		1415		88.1	715.5					
717'-742'		1430		87.9	717.5					
soft		1450		87.9	720.5					
		1456			722.5					
		1520		88.1	725.5					
		1528		88	727.5					
abundant zeolites		1545		88	730					
breccia		1555		88	732.5					
		1625		87.9	735.5					

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Kent Associates - Geologic Consultants
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SHEET 8 of 29

FORMATION OR GEOLOGIC UNIT	DATE	TIME	WATER FLOW	WATER TEMPERATURE	DEPTH	pH	PRESSURE		STATIC WATER LEVEL	WATER SAMPLE
							NB-2	RESORT		
Andesite 734'-742'	10-13-81	1635		88	737.5					
Tuffs 742'-897'		1653		88	740					
		1655		88	742.5					
		1750		88	757.5					
		1815		88	767.5					
		1837			767.5				80.2	
	10-14-81	0715			767.5				50.2	
		1140		87.8	772.5					
		1205		88	777.5					
		1230	131 flow	88	780					
		1300		88	782.5					
		1320		88	785					
		1345		88.1	787.5					
		1425		88.1	792.5					
		1506		88.1	797.5					
Andesite (int?) 797'-802'		1542		88	802.5					
		1645		88	807.5					
		1720		88.1	810					
		1740		88.1	812.5					

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Kent Associates - Geologic Consultants
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SHEET 9 of 28

FORMATION OR GEOLOGIC UNIT	DATE	TIME	WATER FLOW	WATER TEMPERATURE	DEPTH	pH	PRESSURE NB-2	RESORT	STATIC WATER LEVEL	WATER SAMPLE
TUFFS - Continued	10-14-81	1826		88.1	817.5					
		1900		88.1	820					
		1910			820				15	
10-15-81	0650				820				59	
		0800		88	822.5					
		0844		88	827.5					
		0950		88	832.5					
		1020	131 flow	88	835					
		1040		88	837.5					
		1125		88.1	842.5					
		1220		88.2	847.5					
goolites soft tuff		1320		88.3	852.5					
		1340		88.3	854.5					
		1410		88.2	857.5					
		1456		88.4	862.5					
		1545		88.3	867.5					
		1615		88.3	870					
finer grained		1632	1200 blow 131 flow	88.3	873.5					
		1700		88.3	875.5					

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DRILLING DATA SUMMARY

Kent Associates - Geologic Consultants
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SHEET 10 of 28

FORMATION OR GEOLOGIC UNIT	DATE	TIME	WATER FLOW	WATER TEMPERATURE	DEPTH	pH	PRESSURE NB-2 RESORT		STATIC WATER LEVEL	WATER SAMPLE
(Tuffs - continued)	10-15-81	1718		88.3	877.5					
		1744		88.4	880					
		1805		88.4	882.5					
		1830		88.3	885					
		1855		88.4	887.5					
		1905			887.5				55	
		10-16-81 0725			887.5				77	
		0850		88.1	892.5					
		0930		88.2	895.5					
ANDESITE 897'-922'		1000	131 flow	88.3	897.5					
Andesite - quartz		1040		88.3	900					
		1145		88.4	901					
		1210		88.4	902.5					
		1300		88.5	903.5					
		1325		88.5	904					
		1440		88.5	907.5					
		1510		88.4	908.5					
TUFF 911'-914'		1545		88.4	911					
		1603			911				95	

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FORMATION OR GEOLOGIC UNIT	DATE	TIME	WATER FLOW	WATER TEMPERATURE	DEPTH	PH	PRESSURE NB-2	RESORT	STATIC WATER LEVEL	WATER SAMPLE
	10-19-81	0905			911		9.5			
		1110			911				15.5	
		1435		88	914					
		1515	131 flow	88.1	915.5					
		1600		88	917.5					
		1710		88	919.5					
		1800		88	921					
Tuffs, often well-sorted little 322'-1183'		1845		88	922.5					
		1956		88.1	926					
		2003			926				39	
	10-20-81	0700			926				49	
		0745		88.2	930					
		1030		88.2	932.5					
		1100	131 flow	88.2	935					
		1135		88.3	937.5					
Fe coatings 940'		1210		88.4	940					
		1245		88.4	942.5					
		1325		88.4	945.5					
		1400		88.4	947.5					

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DRILLING DATA SUMMARY

Kent Associates - Geologic Consultants
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FORMATION OR GEOLOGIC UNIT	DATE	TIME	WATER FLOW	WATER TEMPERATURE	DEPTH	pH	PRESSURE		STATIC WATER LEVEL	WATER SAMPLE
							NB-2	RESORT		
Hard Tuffs containing	10-20-81	1615		88.4	951	9.35				385' to 951' W-2 1/2 A 9652
		1710		88.4	952.5					
		1745		88.3	955.5					
		1808		88.3	957.5					
		1900		88.4	959					
		1955		88.3	961.5					
		2002			961.5				7	
	10-21-81	0715			961.5				75	
		1230		88.3	962.5					
		1315		88.3	965					
		1400		88.4	967.5					
		1430	131 flow	88.5	969					
		1525		88.4	972.5					
		1645		88.4	975					
		1815		88.4	977.5					
Increase in manganese stains 981' red		1955		88.4	981.5					
		2002			981.5				20	
	10-22-81	0700			981.5				75	
Logged hole	10-28-81					flowing				
Logged hole	10-29-81	1400			981.5	4.5			flowing	

LOGS: FT-C, FR-C (0-980')
LOGS: SP/R, Cal, Net T, TP, TT, RT

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Kent Associates - Geologic Consultants
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SHEET 13 of 28

FORMATION OR GEOLOGIC UNIT	DATE	TIME	WATER FLOW	WATER TEMPERATURE	DEPTH	pH	PRESSURE NB-2	RESORT	STATIC WATER LEVEL	WATER SAMPLE
Hard tuffs Continued	11-10-81	0815			981.5		20.8		flowing 15	
	11-11-81	0940			981.5					
		0950	200 flow		981.5					
		0955			981.5		18.5			
		1040			981.5		13.5			
		1210		87.4	981.5					
		1415		87.6	981.5					
	11-12-81	0815	4.6.25 = 87 flow 5.2.24 = 125		988.5		7.5		flowing	
		0830		88.2	988.5					
soft blue tuff 943-944'		1310			999.5	approx. 9.3	7.0			W-5 1000' A 9726
	11-13-81	0815	180 flow	87.8	1015.5		6.5		flowing	
		1000		84.6	1019.5					
soft blue gray tuff 1017-1021'		1030		84.5	1022					
		1340		84.7	1034.5					
		1445		84.7	1039.5					
finer grained 1038'		1528			1043.5		6.1			
	11-16-81	0805			1043.5		12.2			
		0815	(1) 316 flow back 200 pipe 484		1043.5					
		0830		87.7	1043.5					

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DRILLING DATA SUMMARY

Kent Associates - Geologic Consultants
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SHEET 14 of 28

FORMATION OR GEOLOGIC UNIT	DATE	TIME	WATER FLOW	WATER TEMPERATURE	DEPTH	pH	PRESSURE		STATIC WATER LEVEL	WATER SAMPLE
							NB-2	RESORT		
Hard luffs fractures	11-16-81	0832			1043.5		10.0			
		0838		87.9	1043.5					
		0858		82.4	1043.5					
		1020			1049.5		9.2			
		1115		83.6	1059.5					
		1125			1060.5		9.1			
		1205		83.4	1064.5					
contact 1071'		1245			1067.5		8.9			
		1400		84.6	1074.5					
		1405			1074.5		8.5			
		1415		84.5	1077					
		1510		84.7	1084.5					
		1525			1086.5		8.5			
		1546		84.8	1089.5					
soft gray blue 1093'-1100'		1625		84.7	1094.5					
		1630			1094.5		8.4			
	11-17-81	0810			1099.5		10.9			
abundant sulphates		0825	(4) 120 psi 4.8 bk. 170 flow		1099.5					
		0837			1099.5		9			

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SHEET 15 of 28

FORMATION OR GEOLOGIC UNIT	DATE	TIME	WATER FLOW	WATER TEMPERATURE	DEPTH	pH	PRESSURE NB-2	RESORT	STATIC WATER LEVEL	WATER SAMPLE
	11-17-81	0935		83.1	1105.5					
		1008		84.1	1109.5					
		1040		85.4	1114.5					
		1055			1114.5		8.5			
		1120		85.3	1119.5					
contact hard full with		1227	(f) 196 1" 484 slow	89.6	1130.5					
		1230		85.7	1131.5					
thin alternating soft beds		1248		86.4	1134.5					
		1303		88.0 → 85.8	1136					
		1315		87.8	1139.5					
		1330		87.5	1144.5					
		1348		87.5	1149.5					
		1418		87.6	1154.5					
		1445		85.2	1159.5					
softer		1508		84.7	1164.5					
		1542		88.5	1169.5					
soft, red buff 1169'-1171'		1605		89.7	1171					
		1608		88.5	1172					

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SHEET 16 of 28

FORMATION OR GEOLOGIC UNIT	DATE	TIME	WATER FLOW	WATER TEMPERATURE	DEPTH	pH	PRESSURE NB-2	RESORT	STATIC WATER LEVEL	WATER SAMPLE
hard tuffs, (continued)	11-18-81	0805			1182.8		12.5			
numerous, thin		0815	(f) 167 pH 4.70 blow		1182.8					
alternating		0825			1182.8		10.0			
varicolored		0835	(f) 127 pH 4.57 blow		1182.8					
beds		0840		87.6	1182.8					
Tuffs, softer		1020		83.5	1195.1					
1183'-1445'		1035		84.2	1200.1					
but still hard, welded generally		1052		84.7	1205.1					
		1100			1208		8.5			
thin, varicolored		1125		85.3	1211					
1210'-1223'		1205	(f) 196 pH 4.44 flow	85.6	1220.5					
hard, welded		1240		86.5	1229					
tuff 1223'		1250		86.4	1230.5					
sulfides increase at 1242'		1350		86.5	1240.8					
		1415		86.6	1245.8					
		1420			1245.8		7.5			
		1450	(f) 98 pH 4.18 blow	87.0	1250.8					
sulphide gone		1455	(f) 250 pH 5.36 blow		1250.8					
1253'-1256'		1510		86.6	1256.1					

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SHEET 17 of 28

FORMATION OR GEOLOGIC UNIT	DATE	TIME	WATER FLOW	WATER TEMPERATURE	DEPTH	pH	PRESSURE NB-2	RESORT	STATIC WATER LEVEL	WATER SAMPLE
coarse tuffs (capped)	11-18-81	1525		86.7	1261.1					
		1545		86.6	1266.1					
trace slickensides at 1271'		1552			1271.1		8.3			
		1640		86	1276.5					
	11-19-81	0818			1279.8		11.5			
		0830	(4) 166 pipe 406 flow		1279.8					
		0835		88.1	1279.8					
		0900			1279.8		8.8			
		0920	(4) 122 pipe 379 blow 140		1279.8					
abundant pyrite x/s at 1280'		0930	(4) 230 pipe 470 blow		1279.8					
		0938		84.5	1281.5					
		1000		84.0	1286.5					
		1018		84.0	1291.5					
		1045		84.0	1296.8					
		1105		84.1	1301.8					
jointed? white clay with abundant pyrite		1125	(4) 213 pipe 470 blow	84.3	1306.8					
		1142		84.3	1311.8					
		1215		84.0	1317.1					
		1235		84.1	1322.1					

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DRILLING DATA SUMMARY

Kent Associates - Geologic Consultants
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SHEET 18 of 28

FORMATION OR GEOLOGIC UNIT	DATE	TIME	WATER FLOW	WATER TEMPERATURE	DEPTH	pH	PRESSURE NB-2	RESORT	STATIC WATER LEVEL	WATER SAMPLE
Softer tuffs (continued)	11-19-81	1252		84.3	1327.1		8.8			
		1305		84.6	1332.1					
1335'-1337' blue-gray tuff		1335		84.5	1337.5					
abundant pyrite		1350		84.7	1342.5					
		1405		84.7	1347.5					
		1422		84.7	1352.5					
		1500		84.8	1357.8		8.5			
		1522		85.1	1362.8					
		1545		85.0	1367.8					
abundant veins and joints		1605		85.9	1372.8					
		1626			1372.8		8.5			
		1635		85.9	1378					
	11-20-81	0835	(overnight flow)	82.9 ?	1379.8	9.0				385'-1378' W-3 lot A9690
		0840			1379.8		7.0			
		0845	(5) 46 pps 261 flow		1379.8					
		0900	(5) 166 pps 457 blow							
		0920		66.9	1388					
contact soft and welded tuff		0930		67.3	1393					
		0950			1393		7.5			
		1002		66.4	1398.3					

using water directly from fire hydrant - decreased well head temperatures

Geothermal Production Test
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DRILLING DATA SUMMARY

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FORMATION OR GEOLOGIC UNIT	DATE	TIME	WATER FLOW	WATER TEMPERATURE	DEPTH	pH	PRESSURE NB-2	RESORT	STATIC WATER LEVEL	WATER SAMPLE
Softer tuffs (continued)	11-20-81	1032		65.4	1408.3					
contact		1045		66.1	1413.3					
		1108		66.7	1418.7					
		1124		65.3	1423.7					
		1135		65.3	1428.7					
clayey		1150		65.4	1433.7					
		1230		67.6	1439					
1450'-2226' blue-green		1305	(f) 166 f# 444 blow		1449					
mottled groundmass/ matrix (cel??)		1330	(f) 65 f# 287 flow		1454					
		1420		65.7	1469.3					
		1512	(f) 87 f# 329 flow		1472.9					
	11-23-81	0830	(f) 167 flow		1484.7					
		0902			1489.7		11.5			
Fractured		0905	(f) 329 f# 562 blow	80.9	1493					
		0915	(f) 196 f# 457 flow							
		0930		82.1	1500	approx. 9.0				W-6 1500' A9726
fractures		0948	(f) 307 f# 523 blow	82.3	1510					
		1002		82.6	1515					
		1040	(f) 307 f# 562 blow	84.1	1525.3					

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SHEET 20 of 28

FORMATION OR GEOLOGIC UNIT	DATE	TIME	WATER FLOW	WATER TEMPERATURE	DEPTH	pH	PRESSURE NB-2	RESORT	STATIC WATER LEVEL	WATER SAMPLE
blue-green mottled (continued)	11-23-81	1102		84.9	1535.3					
		1126		85.1	1540.6					
		1130			1540.6		9.5			
soft tuff 1542'-1545'		1140		85.2	1545.6					
		1150		85.5	1550.6					
		1200	(S) 269 pipe 523 blow		1550.6					
		1201		85.6	1555.6					
		1228		86	1560.6					
		1242		86	1565.6					
		1252		86.2	1570.6					
		1302		86.2	1575.6					
hard tuff 1579'-1583'		1335		86.8	1583					
		1350			1588		8.9			
		1402		86.6	1593					
		1415		86.8	1598					
		1448	(S) 269 blow	86.9	1605.4					
		1505		86.9	1610.4					
welded? abundant pyrite		1518		86.9	1615.4					
1622'-1648' jointed?		1532		87.0	1620.4					

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SHEET 21 of 28

FORMATION OR GEOLOGIC UNIT	DATE	TIME	WATER FLOW	WATER TEMPERATURE	DEPTH	pH	PRESSURE NB-2	RESORT	STATIC WATER LEVEL	WATER SAMPLE
blue-green mottled (continued)	11-23-81	1602		87.2	1625.4					
		1614		87	1630.4					
		1640		87.1	1640.4					
	11-24-81	0930			1640.4		13.1			
		1053	(F) 166 Pipe 471 flow		1640.4					
		1105		85.6	1640.4					
		1114					11.0			
		1124		84.6	1645.4					
		1128	(S) 269 Pipe 470 blow		1645.4					
		1138		84.5	1650.4					
alternating gray with		1154		84.7	1655.4					
soft white-gray pyrite-Cu		1225		84.8	1665.3					
minerals pervasive		1240	(F) 269 Pipe 523 blow	85.0	1670.3					
1652'-1672'		1252		85.3	1675.3					
		1302		85.3	1680.3					
		1315	(F) 110 Pipe 366 flow							
		1332		85.9	1685.3					
		1357		86	1695.3					
		1402	(F) 250 Pipe 482 blow	85.3	1695.3					

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FORMATION OR GEOLOGIC UNIT	DATE	TIME	WATER FLOW	WATER TEMPERATURE	DEPTH	pH	PRESSURE NB-2	RESORT	STATIC WATER LEVEL	WATER SAMPLE
blue-green mottled (sandstone)	11-24-81	1408		86.3	1700.3					
		1434		86.3	1705.3					
		1446		86.5	1710.3					
		1456					8.5			
		1458		86.5	1715.3					
		1511		86.6	1720.3					
		1537		86.8	1725.3					
very fine grained		1550		86.8	1730.3					
		1604		86.8	1735.3					
		1606	(f) 230 fpm 483 blow		1735.3					
saturated		1616		86.8	1740.3					
		1640	(f) 269 fpm 529 blow	86.9	1743					
equigranular		1700		86.9	1750.3					
	11-25-81	0805			1750.3		14.5			
		0815	(f) 166 fpm 457 flow							
sulphides		0844	(f) 307 fpm 575 blow	82.7	1755.3					
		0857		83.1	1760.3					
		0918					10.0			
equigranular		0924		84.0	1765.3					

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SHEET 23 of 28

FORMATION OR GEOLOGIC UNIT	DATE	TIME	WATER FLOW	WATER TEMPERATURE	DEPTH	pH	PRESSURE NB-2	RESORT	STATIC WATER LEVEL	WATER SAMPLE
blue-green mottled (continued)	11-25-81	0936		84.1	1770.3					
		0948		84.4	1775.3					
		1002		84.5	1780.3					
		1030		85.3	1785.3					
zeolite veins pyrite 1790'-1797'		1045		86.3	1790.3					
		1057		85.5	1795.3					
		1112		87.7	1800.3					
		1133		86.0	1805.3					
		1148		86.1	1810.3					
		1154	(S) 269 pp 523 blow		1810.3					
		1157			1810.3		9.0			
		1202		86.3	1815.3					
		1216		86.5	1820.3					
	11-30-81	0815	(S) 260 pp 549 flow		1820.3		15.9			
		0835			1820.3					
		0840		88.2	1820.3					
		0855		88.3	1820.3					
		0900			1820.3		12.0			
		0925	(S) 166 pp 484 flow		1820.3					
		0930		88.4	1820.3					
		0935	but. 230 flow		1820.3					
zeolite veins 1826'-1833'		1005	(S) 367 pp 562 blow	86.0	1825.3					
		1010	(S) 273 pp 536 blow	86.2	1827					

Geothermal Production Test
City of North Bonneville

DRILLING DATA SUMMARY

Kent Associates - Geologic Consultants
Lake Oswego, Oregon

SHEET 24 of 28

FORMATION OR GEOLOGIC UNIT	DATE	TIME	WATER FLOW	WATER TEMPERATURE	DEPTH	pH	PRESSURE NB-2	RESORT	STATIC WATER LEVEL	WATER SAMPLE
blue-green silted (continued)	11-30-81	1020		86.2	1830.3					
		1030		86.3	1835.3					
		1043		86.7	1840.3					
		1108		86.6	1845.3					
		1124		86.5	1850.3					
pyrite disseminated		1136		86.8	1855.3					
		1150		86.9	1860.3					
		1201		87.1	1865.3					
		1235		87.1	1870.3					
		1250		87.2	1875.3					
		1324		87.5	1875.3		10.0			
		1337		87.4	1885.3					
		1350		87.5	1890.3					
		1400		89.0	1895.3					
		1410		88.9	1900					
hard tuff 1906'-1912'		1434		89.2	1902					
		1440		88.2	1905.3					
		1450		88.1	1910.3					
		1500		88.9	1915.3					
		1505			1915.3		10.0			
		1512	(5) 152 8" 392	89.5	1920					
		1535		89.2	1922					
		1542		89.3	1925					
		1552		88.9	1930.3					
		1602		88.6	1935.3		10.0			
		1630		89.0	1940.3					
		1645		89.1	1940.3					
	12-1-81	0815					11.5			
		081830	opened valve		1940.3		10.6			
		0819					10.2			
		081930			1940.3		10.1			
		0820					10.0			
		0822		88.3	1940.3					
		0824	(5) 152							
		0835	8" 444 slow	88.4	1940.3					
		0845			1940.3		9.2			

C - 24

Geothermal Production Test
City of North Bonneville

DRILLING DATA SUMMARY

Kent Associates - Geologic Consultants
Lake Oswego, Oregon

SHEET 25 of 28

FORMATION OR GEOLOGIC UNIT	DATE	TIME	WATER FLOW	WATER TEMPERATURE	DEPTH	pH	PRESSURE		STATIC WATER LEVEL	WATER SAMPLE
							NB-2	RESORT		
blue-green mottled (continued)	12-1-81	0903	(f) 288 blow pipe 536	85.5	1945.3					
		0915		85.6	1950.3					
		0926		85.4	1955.3					
slickensided 1960'-1963'		0939		85.6	1960.3					
		1010		85.9	1965.3					
		1023		86.0	1970.3					
		1035		86.0	1975.3					
		1046		86.0	1980.3					
		1114		86.4	1985.3					
		1130		86.5	1990.3					
		1143		86.5	1995.3					
		1155		86.5	2000.0					
		1222		86.8	2005.3					
		1224					8.2			
		1236		86.9	2010.3					
		1248		86.8	2015.3					
		1301		86.8	2020.3					
		1334		87.1	2025.3					
3rd line veins 2034'-2041'		1349		87.0	2030.3					

Geothermal Production Test
City of North Bonneville

DRILLING DATA SUMMARY

Kent Associates - Geologic Consultants
Lake Oswego, Oregon

SHEET 26 of 28

FORMATION OR GEOLOGIC UNIT	DATE	TIME	WATER FLOW	WATER TEMPERATURE	DEPTH	pH	PRESSURE NB-2	RESORT	STATIC WATER LEVEL	WATER SAMPLE
Lithology not added (continued)	12-1-81	1402		87.1	2035.3					
		1415		87.1	2040.3					
		1445		87.3	2045.3					
		1504	(F) 231 pipe 523 blow	87.3	2050.3					
		1516		87.3	2055.3					
		1529		87.3	2060.3					
		1558		87.3	2065.3		7.9			
		1615		87.2	2070.3					
	12-2-81	0815		88.4	2080.3					
		0820	(F) 65 pipe 366 flow		2080.3					
		0825			2080.3		6.9			
	12-4-81	0800			2080.3		14.5 (NB-4 = 7.0)			
	12-5-81				2080.3		11.0			
	12-7-81	0820					11.0			
Fractures 2085', 2090'		1059	(F) 250 pipe 496 blow	85.0	2085.0					
		1118		85.3	2090.0					
alternating, thin varicolored		1130			2093.0		7.5			
possible dikes		1139		85.9	2095.0					
		1212		85.9	2102.0					

Geothermal Production Test
City of North Bonneville

DRILLING DATA SUMMARY

Kent Associates - Geologic Consultants
Lake Oswego, Oregon

SHEET 27 of 28

FORMATION OR GEOLOGIC UNIT	DATE	TIME	WATER FLOW	WATER TEMPERATURE	DEPTH	pH	PRESSURE		STATIC WATER LEVEL	WATER SAMPLE
blue-green siltstone (continued)	12-7-81	1232		86.0	2105.0					
		1254		86.3	2110.0					
		1318		86.3	2115.0					
3oolites akur 322 f		1407	(5) 230 pipe 484 blow	86.5	2120.0					
		1434		86.6	2125.0					
		1458		86.5	2130.0					
		1518		86.5	2135.0					
		1559		86.5	2140.0					
		1622		86.5	2143.0					
		1720	(4) 250 pipe 497 blow	(pond water) 83.6	2145.5					
		1748		86.9	2150.0					
		1804		86.9	2155.0					
possible dike		1851		86.8	2160.0					
		1914		86.8	2165.0					
		1948		86.8	2170.0					
		2011		86.8	2175.0					
		2053		86.7	2180.0					
		2115		(pond = 82.7) 86.6	2185.0					
		2134		86.8	2190.0					

Geothermal Production Test
City of North Bonneville

DRILLING DATA SUMMARY

Kent Associates - Geologic Consultants
Lake Oswego, Oregon

SHEET 28 of 28

FORMATION OR GEOLOGIC UNIT	DATE	TIME	WATER FLOW	WATER TEMPERATURE	DEPTH	pH	PRESSURE NB-2	RESORT	STATIC WATER LEVEL	WATER SAMPLE
blue-green mudstone (sandstone)	12-7-81	2200		86.7	2195.0					
		2235		86.7	2200.0					
		2300		86.6	2205.0					
		2332		86.7	2210.0					
	12-8-81	0005		86.7	2215.0					
		0048		87.0	2220.0					
		0120		87.0	2225.0					
		0140		87.1	2226.0	9.3				W-7 2226' lab. A-9791
Logged hole	12-9-81				2226.0					
Logged hole	12-10-81				2226.0					
Logged hole	12-11-81				2226.0					
Logged hole	1-28-82				2226.0					
Pump test	3-19-82	120 m	15 gpm	NA	air lift				594' packer	
	3-23-82	30 m	Set up	NA	570' sub. pump				594' packer	
Pump test	3-24-82	90 m	27-66 gpm	12-95	570' sub. pump		2-5	NA	594' packer	
	3-29-82	210 m	30 gpm	86-89	594' packer		2.9-5.5	15.5	594' packer	
Pump test	3-30-82	180 m	30 gpm	NA	550' air lift				594' packer	
	3-31-82	145 m	27-50 gpm	93-98	594' packer		5-5.8	15.7-16.5	594' packer	
			Set up		400' sub. pump				981' packer	
Pump test	4-1-82									
	4-2-82	330 m	38-60 gpm	96-97	400' sub. pump		5-6	15.25-15.4	981' packer	
Pump test	4-5-82		pull packer	86.5			4.9-0			
	4-6-82	90 m	695-760 gpm	89.7	200' sub. pump		46' DD	15.25	open hole	
Pump test	4-7-82	720 m	428-850 gpm	89.7-90.2	200' sub. pump		5.2-0	15.25-		
							105' DD	15.05	open hole	

LOGS: FT-C, FR-C, SP/R

LOGS: Not. 8, 88, 98, 99, 100 per

LOGS: Flow (0-500'), Flow (0-220)

LOGS: FT-C, Flow

Severe air bubbles interference

abandoned due to bubble interference

bubbles
bubbles

decrease in bubbles

below air drilled portion of hole

prelim. test

incomplete test; drawdown
continuing

EG & G Idaho, Inc.
Bonneville Geothermal
June, 1982

A P P E N D I X D

DAILY DRILLING HISTORY

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: AUGUST 25, 1981 Day Number 1

Drilling Company Bach Ellensburg

Equipment BE 22-W Cable Tool Backhoe

1. DRILLING PROJECT

A. TIME: From 0730 To 1800

Today's Hours 10.5 Hours To Date 10.5

B. FOOTAGE: From 0 To 9

Today's Footage 9 Feet To Date 9

Today's Feet Per Hour 0.86 To Date Feet Per Hour 0.86

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY: Includes trips _____ and hole cleanout _____

Today's Hours _____ Hours To Date _____

Today's Feet Per Hour _____ To Date Feet Per Hour _____

B. BIT DATA Bit Serial Number _____

Today's Hours _____ Hours To Date _____

<u>Time</u>		<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>
<u>From</u>	<u>To</u>			
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

3. CASING: Diameter 16 inch From 0' To 9'

Cable Tool Rig Hours 10.5 Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

4 ft. boulder removed at 3 ft. depth.

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: AUGUST 26, 1981 Day Number 2

Drilling Company Bach Ellensburg

Equipment BE 22-W Cable Tool

1. DRILLING PROJECT

A. TIME: From 0730 To 1800

Today's Hours 10.5 Hours To Date 21

B. FOOTAGE: From 9 To 20

Today's Footage 11 Feet To Date 20

Today's Feet Per Hour 1.05 To Date Feet Per Hour 0.95

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY: Includes trips _____ and hole cleanout _____

Today's Hours _____ Hours To Date _____

Today's Feet Per Hour _____ To Date Feet Per Hour _____

B. BIT DATA Bit Serial Number _____

Today's Hours _____ Hours To Date _____

<u>Time</u>				
<u>From</u>	<u>To</u>	<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>

_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

3. CASING: Diameter 16" From 9' To 20'

Cable Tool Rig Hours 10.5 Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: AUGUST 27, 1981 Day Number 3

Drilling Company Back Ellensburg

Equipment BE 22-W Cable Tool

1. DRILLING PROJECT

A. TIME: From 0800 To 1800

Today's Hours 10 Hours To Date 31

B. FOOTAGE: From 20 To 32

Today's Footage 12 Feet To Date 32

Today's Feet Per Hour 1.2 To Date Feet Per Hour 1.03

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY: Includes trips _____ and hole cleanout _____

Today's Hours _____ Hours To Date _____

Today's Feet Per Hour _____ To Date Feet Per Hour _____

B. BIT DATA Bit Serial Number _____

Today's Hours _____ Hours To Date _____

<u>Time</u>		<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>
<u>From</u>	<u>To</u>			

_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

3. CASING: Diameter 16 inch From 20 To 32

Cable Tool Rig Hours 10 Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

40' 7" casing in

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: AUGUST 28, 1981 Day Number 4

Drilling Company Bach Ellensburg

Equipment BE 22-W Cable Tool

1. DRILLING PROJECT

A. TIME: From 0700 To 1600

Today's Hours 9 Hours To Date 40

B. FOOTAGE: From 32 To 45

Today's Footage 13 Feet To Date 45

Today's Feet Per Hour 1.44 To Date Feet Per Hour 1.13

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY: Includes trips _____ and hole cleanout _____

Today's Hours _____ Hours To Date _____

Today's Feet Per Hour _____ To Date Feet Per Hour _____

B. BIT DATA Bit Serial Number _____

Today's Hours _____ Hours To Date _____

<u>Time</u>	<u>From</u>	<u>To</u>	<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>

3. CASING: Diameter 16 inch From 32 To 45

Cable Tool Rig Hours 9 Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

Cement delivered to site by city

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: AUGUST 31, 1981

Day Number 5

Drilling Company Bach Ellensburg

Equipment BE 22-W Cable Tool

1. DRILLING PROJECT

A. TIME: From 1200 To 1900

Today's Hours 7 Hours To Date 47

B. FOOTAGE: From 45 To 52

Today's Footage 7 Feet To Date 52

Today's Feet Per Hour 1.0 To Date Feet Per Hour 1.11

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY:

Includes trips _____ and hole cleanout _____

Today's Hours _____ Hours To Date _____

Today's Feet Per Hour _____ To Date Feet Per Hour _____

B. BIT DATA

Bit Serial Number _____

Today's Hours _____ Hours To Date _____

<u>From</u>	<u>To</u>	<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

3. CASING:

Diameter 16 inch From 45 To 52

Cable Tool Rig Hours 7 Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: SEPTEMBER 1, 1981 Day Number 6

Drilling Company Bach Ellensburg

Equipment BE 22-w Cable Tool

1. DRILLING PROJECT

A. TIME: From 0730 To 1800

Today's Hours 10.5 Hours To Date 57.5

B. FOOTAGE: From 52 To 81

Today's Footage 29 Feet To Date 81

Today's Feet Per Hour 2.76 To Date Feet Per Hour 1.41

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY: Includes trips _____ and hole cleanout _____

Today's Hours _____ Hours To Date _____

Today's Feet Per Hour _____ To Date Feet Per Hour _____

B. BIT DATA Bit Serial Number _____

Today's Hours _____ Hours To Date _____

<u>Time</u>		<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>
<u>From</u>	<u>To</u>			
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

3. CASING: Diameter 16 inch From 52 To 81

Cable Tool Rig Hours 10.5 Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: SEPTEMBER 2, 1981 Day Number 7

Drilling Company Bach Ellensburg

Equipment BE 22-W Cable Tool

1. DRILLING PROJECT

A. TIME: From 0730 To 1800

Today's Hours 10.5 Hours To Date 68

B. FOOTAGE: From 81 To 107

Today's Footage 26 Feet To Date 107

Today's Feet Per Hour 2.48 To Date Feet Per Hour 1.57

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY: Includes trips _____ and hole cleanout _____

Today's Hours _____ Hours To Date _____

Today's Feet Per Hour _____ To Date Feet Per Hour _____

B. BIT DATA Bit Serial Number _____

Today's Hours _____ Hours To Date _____

<u>Time</u>		<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>
<u>From</u>	<u>To</u>			

_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

3. CASING: Diameter 16 inch From 81 To 107

Cable Tool Rig Hours 10.5 Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

121 ft of casing on.

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: SEPTEMBER 3, 1981 Day Number 8

Drilling Company Bach Ellensburg

Equipment BE 22-w Cable Tool

1. DRILLING PROJECT

A. TIME: From 0730 To 1700

Today's Hours 9.5 Hours To Date 77.5

B. FOOTAGE: From 107 To 125

Today's Footage 18 Feet To Date 125

Today's Feet Per Hour 1.9 To Date Feet Per Hour 1.6

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY: Includes trips _____ and hole cleanout _____

Today's Hours _____ Hours To Date _____

Today's Feet Per Hour _____ To Date Feet Per Hour _____

B. BIT DATA Bit Serial Number _____

Today's Hours _____ Hours To Date _____

<u>Time</u>	<u>From</u>	<u>To</u>	<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>

3. CASING: Diameter 16 inch From 107 To 125

Cable Tool Rig Hours 9.5 Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: SEPTEMBER 4, 1981 Day Number 9

Drilling Company Bach Ellensburg

Equipment BE 22-W Cable Tool

1. DRILLING PROJECT

A. TIME: From 0730 To 1600

Today's Hours 8.5 Hours To Date 86

B. FOOTAGE: From 125 To 139

Today's Footage 14 Feet To Date 139

Today's Feet Per Hour 1.65 To Date Feet Per Hour 1.62

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY: Includes trips _____ and hole cleanout _____

Today's Hours _____ Hours To Date _____

Today's Feet Per Hour _____ To Date Feet Per Hour _____

B. BIT DATA Bit Serial Number _____

Today's Hours _____ Hours To Date _____

<u>Time</u>				
<u>From</u>	<u>To</u>	<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

3. CASING: Diameter 16 inch From 125 To 139

Cable Tool Rig Hours 8.5 Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: SEPTEMBER 8, 1981 Day Number 10

Drilling Company Bach Ellensburg

Equipment BE 22-W Cable Tool

1. DRILLING PROJECT

A. TIME: From 1200 To 2000

Today's Hours 8 Hours To Date 94

B. FOOTAGE: From 139 To 144

Today's Footage 5 Feet To Date 144

Today's Feet Per Hour 0.63 To Date Feet Per Hour 1.53

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY: Includes trips _____ and hole cleanout _____

Today's Hours _____ Hours To Date _____

Today's Feet Per Hour _____ To Date Feet Per Hour _____

B. BIT DATA Bit Serial Number _____

Today's Hours _____ Hours To Date _____

<u>Time</u>	<u>From</u>	<u>To</u>	<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>
-------------	-------------	-----------	-----------------------	------------	----------------------

3. CASING: Diameter 16 inch From 139 To 144

Cable Tool Rig Hours 8 Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: SEPTEMBER 9, 1981 Day Number 11

Drilling Company Bach Ellensburg

Equipment BE 22-w Cable Tool

1. DRILLING PROJECT

A. TIME: From 0730 To 1800

Today's Hours 10.5 Hours To Date 104.5

B. FOOTAGE: From 144 To 154

Today's Footage 10 Feet To Date 154

Today's Feet Per Hour 0.95 To Date Feet Per Hour 1.47

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY: Includes trips _____ and hole cleanout _____

Today's Hours _____ Hours To Date _____

Today's Feet Per Hour _____ To Date Feet Per Hour _____

B. BIT DATA Bit Serial Number _____

Today's Hours _____ Hours To Date _____

<u>Time</u>		<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>
<u>From</u>	<u>To</u>			

_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

3. CASING: Diameter 16 inch From 144 To ~~144~~ 144

Cable Tool Rig Hours 10.5 Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: SEPTEMBER 10, 1981 Day Number 12

Drilling Company Rach Ellensburg

Equipment BE 22-W Cable Tool

1. DRILLING PROJECT

A. TIME: From 0730 To 1800

Today's Hours 10.5 Hours To Date 115

B. FOOTAGE: From 154 To 164

Today's Footage 10 Feet To Date 164

Today's Feet Per Hour 0.95 To Date Feet Per Hour 1.43

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY: Includes trips _____ and hole cleanout _____

Today's Hours _____ Hours To Date _____

Today's Feet Per Hour _____ To Date Feet Per Hour _____

B. BIT DATA Bit Serial Number _____

Today's Hours _____ Hours To Date _____

<u>Time</u>	<u>From</u>	<u>To</u>	<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>

3. CASING: Diameter 16 inch From ~~144~~ 144 To ~~144~~ 144

Cable Tool Rig Hours 10.5 Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: SEPTEMBER 11, 1981

Day Number 13

Drilling Company Bach Ellensburg

Equipment BE 22-W Cable Tool

1. DRILLING PROJECT

A. TIME: From 0730 To 1800

Today's Hours 10.5 Hours To Date 125.5

B. FOOTAGE: From 164 To 173

Today's Footage 9 Feet To Date 173

Today's Feet Per Hour 0.86 To Date Feet Per Hour 1.38

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY:

Includes trips _____ and hole cleanout _____

Today's Hours _____ Hours To Date _____

Today's Feet Per Hour _____ To Date Feet Per Hour _____

B. BIT DATA

Bit Serial Number _____

Today's Hours _____ Hours To Date _____

<u>Time</u>				
<u>From</u>	<u>To</u>	<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

3. CASING:

Diameter 16 inch From ~~144~~ 144 To ~~144~~ 144

Cable Tool Rig Hours 10.5 Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: SEPTEMBER 14, 1981 Day Number 14

Drilling Company Bach Ellensburg

Equipment RE 22-W Cable Tool

1. DRILLING PROJECT

A. TIME: From 0830 To 1130

Today's Hours 3 Hours To Date 128.5

B. FOOTAGE: From 173 To 173

Today's Footage 0 Feet To Date 173

Today's Feet Per Hour 0 To Date Feet Per Hour 1.34

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY: Includes trips _____ and hole cleanout _____

Today's Hours _____ Hours To Date _____

Today's Feet Per Hour _____ To Date Feet Per Hour _____

B. BIT DATA Bit Serial Number _____

Today's Hours _____ Hours To Date _____

<u>Time</u>	<u>From</u>	<u>To</u>	<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>
-------------	-------------	-----------	-----------------------	------------	----------------------

_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

3. CASING: Diameter 16 inch From ~~144~~ 144 To ~~144~~ 144

Cable Tool Rig Hours _____ Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

Hole caved. Rig clutch burned out.

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

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Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: SEPTEMBER 15, 1981 Day Number 15

Drilling Company Bach Ellensburg

Equipment BE 22-W Cable Tool

1. DRILLING PROJECT

A. TIME: From 0800 To 1900

Today's Hours 11 Hours To Date 139.5

B. FOOTAGE: From 173 To 173

Today's Footage 0 Feet To Date 173

Today's Feet Per Hour 0 To Date Feet Per Hour 1.24

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY: Includes trips _____ and hole cleanout _____

Today's Hours _____ Hours To Date _____

Today's Feet Per Hour _____ To Date Feet Per Hour _____

B. BIT DATA Bit Serial Number _____

Today's Hours _____ Hours To Date _____

<u>Time</u>		<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>
<u>From</u>	<u>To</u>			

_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

3. CASING: Diameter 16 inch From ~~144~~ 144 To ~~144~~ 144

Cable Tool Rig Hours _____ Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

Repair rig clutch. Attempt to free stuck bit in hole.

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
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Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: SEPTEMBER 16, 1981 Day Number 16

Drilling Company Bach Ellensburg

Equipment BE 22-W Cable Tool

1. DRILLING PROJECT

A. TIME: From 1200 To 1800

Today's Hours 6 Hours To Date 145.5

B. FOOTAGE: From 173 To 173

Today's Footage 0 Feet To Date 173

Today's Feet Per Hour 0 To Date Feet Per Hour 1.19

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY: Includes trips _____ and hole cleanout _____

Today's Hours _____ Hours To Date _____

Today's Feet Per Hour _____ To Date Feet Per Hour _____

B. BIT DATA Bit Serial Number _____

Today's Hours _____ Hours To Date _____

<u>Time</u>		<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>
<u>From</u>	<u>To</u>			

_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

3. CASING: Diameter 16 inch From ~~144~~ 144 To ~~144~~ 144

Cable Tool Rig Hours _____ Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

Bit removed from hole Repair tools

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

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Project No. 81824/K7883

DRILLING HISTORY

DATE: SEPTEMBER 17, 1981 Day Number 17

Drilling Company Bach Ellensburg

Equipment BE 22-W Cable Tool

1. DRILLING PROJECT

A. TIME: From 0700 To 1830

Today's Hours 11.5 Hours To Date 157

B. FOOTAGE: From 173 To 173

Today's Footage 0 Feet To Date 173

Today's Feet Per Hour 0 To Date Feet Per Hour 1.1

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY: Includes trips _____ and hole cleanout _____

Today's Hours _____ Hours To Date _____

Today's Feet Per Hour _____ To Date Feet Per Hour _____

B. BIT DATA Bit Serial Number _____

Today's Hours _____ Hours To Date _____

<u>From</u>	<u>To</u>	<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

3. CASING: Diameter 16 inch From 144 To 158

Cable Tool Rig Hours _____ Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

Hole caved about 155 feet with gravel(?).

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
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Project No. 81824/K7883

DRILLING HISTORY

DATE: SEPTEMBER 18, 1981

Day Number 18

Drilling Company Bach Ellensburg

Equipment BE 22-W Cable Tool

1. DRILLING PROJECT

A. TIME: From 0800 To 1800

Today's Hours 10 Hours To Date 167

B. FOOTAGE: From 173 To 173

Today's Footage 0 Feet To Date 173

Today's Feet Per Hour 0 To Date Feet Per Hour 1.04

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY:

Includes trips _____ and hole cleanout _____

Today's Hours _____ Hours To Date _____

Today's Feet Per Hour _____ To Date Feet Per Hour _____

B. BIT DATA

Bit Serial Number _____

Today's Hours _____ Hours To Date _____

<u>Time</u>	<u>From</u>	<u>To</u>	<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>
-------------	-------------	-----------	-----------------------	------------	----------------------

_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

3. CASING:

Diameter 16 inch From 158 To 158

Cable Tool Rig Hours _____ Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

Continue to re-drill hole case-in.

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

Kent Associates
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Project No. 81824/K7883

DRILLING HISTORY

DATE: SEPTEMBER 21, 1981 Day Number 19

Drilling Company Bach Ellensburg

Equipment BE 22-W Cable Tool

1. DRILLING PROJECT

A. TIME: From 0730 To 1800

Today's Hours 10.5 Hours To Date 177.5

B. FOOTAGE: From 173 To 173

Today's Footage 0 Feet To Date 173

Today's Feet Per Hour 0 To Date Feet Per Hour 0.98

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY: Includes trips _____ and hole cleanout _____

Today's Hours _____ Hours To Date _____

Today's Feet Per Hour _____ To Date Feet Per Hour _____

B. BIT DATA Bit Serial Number _____

Today's Hours _____ Hours To Date _____

<u>From</u>	<u>To</u>	<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

3. CASING: Diameter 16 inch From 158 To 158

Cable Tool Rig Hours _____ Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

Fishing for piece of metal stuck in hole.

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

Kent Associates
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Project No. 81824/K7883

DRILLING HISTORY

DATE: SEPTEMBER 22, 1981 Day Number 20

Drilling Company Bach Ellensburg

Equipment BE 22-W Cable Tool

1. DRILLING PROJECT

A. TIME: From 0730 To 1800

Today's Hours 10.5 Hours To Date 188

B. FOOTAGE: From 173 To 173

Today's Footage 0 Feet To Date 173

Today's Feet Per Hour 0 To Date Feet Per Hour 0.92

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY: Includes trips _____ and hole cleanout _____

Today's Hours _____ Hours To Date _____

Today's Feet Per Hour _____ To Date Feet Per Hour _____

B. BIT DATA Bit Serial Number _____

Today's Hours _____ Hours To Date _____

<u>Time</u>		<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>
<u>From</u>	<u>To</u>			

_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

3. CASING: Diameter 16 inch From 158 To 158

Cable Tool Rig Hours _____ Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

Fishing for piece of metal stuck in hole.

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: SEPTEMBER 23, 1981 Day Number 21

Drilling Company Bach Ellensburg

Equipment BE 22-W Cable Tool

1. DRILLING PROJECT

A. TIME: From 0730 To 1900

Today's Hours 11.5 Hours To Date 199.5

B. FOOTAGE: From 173 To 175

Today's Footage 2 Feet To Date 175

Today's Feet Per Hour 0.17 To Date Feet Per Hour 0.88

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY: Includes trips _____ and hole cleanout _____

Today's Hours _____ Hours To Date _____

Today's Feet Per Hour _____ To Date Feet Per Hour _____

B. BIT DATA Bit Serial Number _____

Today's Hours _____ Hours To Date _____

<u>From</u>	<u>To</u>	<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>
-------------	-----------	-----------------------	------------	----------------------

_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

3. CASING: Diameter 16 inch From 158 To 160.7

Cable Tool Rig Hours 11.5 Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

Kent Associates
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Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: SEPTEMBER 24, 1981 Day Number 22

Drilling Company Bach Ellensburg

Equipment RE 22-W Cable Tool

1. DRILLING PROJECT

A. TIME: From 0730 To 1900

Today's Hours 11.5 Hours To Date 211

B. FOOTAGE: From 175 To 177

Today's Footage 2 Feet To Date 177

Today's Feet Per Hour 0.17 To Date Feet Per Hour 0.64

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY: Includes trips _____ and hole cleanout _____

Today's Hours _____ Hours To Date _____

Today's Feet Per Hour _____ To Date Feet Per Hour _____

B. BIT DATA Bit Serial Number _____

Today's Hours _____ Hours To Date _____

<u>Time</u>				
<u>From</u>	<u>To</u>	<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

3. CASING: Diameter 16 inch From 160.7 To 160.7

Cable Tool Rig Hours _____ Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

Kent Associates
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Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: SEPTEMBER 25, 1981 Day Number 23

Drilling Company Bach Ellensburg

Equipment BE 22-w Cable Tool, Welder

1. DRILLING PROJECT

A. TIME: From 0700 To 1600

Today's Hours 9 Hours To Date 220

B. FOOTAGE: From 177 To 177

Today's Footage 0 Feet To Date 177

Today's Feet Per Hour 0 To Date Feet Per Hour 0.8

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY: Includes trips _____ and hole cleanout _____

Today's Hours _____ Hours To Date _____

Today's Feet Per Hour _____ To Date Feet Per Hour _____

B. BIT DATA Bit Serial Number _____

Today's Hours _____ Hours To Date _____

<u>From</u>	<u>To</u>	<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>
-------------	-----------	-----------------------	------------	----------------------

_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

3. CASING: Diameter 12 inch From Surface To 177.5

Cable Tool Rig Hours _____ Cementing Hours 2

Sacks of Cement 7050 lbs. Ream Footage _____

4. REMARKS:

Pumped cement through 12" until flowed out at
surface between 12" and 16" casings.

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

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Project No. 81824/K7883

DRILLING HISTORY

DATE: SEPTEMBER 28, 1981

Day Number 24

Drilling Company Bach Ellensburg

Equipment TLS Portadrill, IR Compressor

1. DRILLING PROJECT

A. TIME: From 1000 To 2000

Today's Hours 10 Hours To Date 230

B. FOOTAGE: From 177 To 344.5

Today's Footage 167.5 Feet To Date 344.5

Today's Feet Per Hour 39.4 To Date Feet Per Hour 1.5
(4.25 hrs)

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY:

Includes trips _____ and hole cleanout _____

Today's Hours _____ Hours To Date _____

Today's Feet Per Hour _____ To Date Feet Per Hour _____

B. BIT DATA

Bit Serial Number _____

Today's Hours _____ Hours To Date _____

<u>Time</u>	<u>From</u>	<u>To</u>	<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>
-------------	-------------	-----------	-----------------------	------------	----------------------

_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

3. CASING:

Diameter _____ From _____ To _____

Cable Tool Rig Hours _____ Cementing Hours 0.75

Sacks of Cement 4 94 lbs Ream Footage _____

4. REMARKS:

36" air hammer used to drill out cement plug

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

Kent Associates
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Project No. 81824/K7883

DRILLING HISTORY

DATE: SEPTEMBER 29, 1981 Day Number 25

Drilling Company Bach Ellensburg

Equipment TLS Portadrill IR Compressor

1. DRILLING PROJECT

A. TIME: From 0730 To 2000

Today's Hours 12.5 Hours To Date 242.5

B. FOOTAGE: From 344.5 To 390

Today's Footage 45.5 Feet To Date 390

Today's Feet Per Hour $\frac{24.8}{1.8hr}$ To Date Feet Per Hour 1.6

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY: Includes trips _____ and hole cleanout _____

Today's Hours _____ Hours To Date _____

Today's Feet Per Hour _____ To Date Feet Per Hour _____

B. BIT DATA Bit Serial Number _____

Today's Hours _____ Hours To Date _____

<u>Time</u>	<u>From</u>	<u>To</u>	<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>

3. CASING: Diameter 8 inch From 290 To 390

Cable Tool Rig Hours _____ Cementing Hours _____

Sacks of Cement _____ Ream Footage 8" 176'-385' (209')

4. REMARKS:

6" air hammer pilot hole

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

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Project No. 81824/K7883

DRILLING HISTORY

DATE: SEPTEMBER 30, 1981 Day Number 26

Drilling Company Bach Ellensburg

Equipment TLS Portadill IR Compressor

1. DRILLING PROJECT

A. TIME: From 0730 To 1600

Today's Hours 8.5 Hours To Date 251

B. FOOTAGE: From 390 To 390

Today's Footage 0 Feet To Date 390

Today's Feet Per Hour 0 To Date Feet Per Hour 1.56

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY: Includes trips _____ and hole cleanout _____

Today's Hours _____ Hours To Date _____

Today's Feet Per Hour _____ To Date Feet Per Hour _____

B. BIT DATA Bit Serial Number _____

Today's Hours _____ Hours To Date _____

<u>Time</u>	<u>From</u>	<u>To</u>	<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>

3. CASING: Diameter 8 inch From 174.7 To 290

Cable Tool Rig Hours _____ Cementing Hours 1

Sacks of Cement 75 Ream Footage _____

4. REMARKS:

Pulled 8" casing to 385' cemented 8" into hole and
to 12" casing.

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
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Project No. 81824/K7883

DRILLING HISTORY

DATE: OCTOBER 2, 1981 Day Number 27

Drilling Company Bach Ellensburg

Equipment TLS Portadrill, IR Compressor

1. DRILLING PROJECT

A. TIME: From 1330 To 1530

Today's Hours 2 Hours To Date 253

B. FOOTAGE: From 390 To 390

Today's Footage 0 Feet To Date 390

Today's Feet Per Hour 0 To Date Feet Per Hour 1.54

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY: Includes trips _____ and hole cleanout _____

Today's Hours _____ Hours To Date _____

Today's Feet Per Hour _____ To Date Feet Per Hour _____

B. BIT DATA Bit Serial Number _____

Today's Hours _____ Hours To Date _____

<u>Time</u>		<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>
<u>From</u>	<u>To</u>			
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

3. CASING: 16" Surface 160.7
12" Surface 177.5
Diameter 8" From 174.7 To 384.7

Cable Tool Rig Hours _____ Cementing Hours _____

Sacks of Cement 22 Ream Footage _____

4. REMARKS:

16" = 160.7 feet; 12" = 177.5 feet; 8" = 210 feet

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

Kent Associates
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Project No. 81824/K7883

DRILLING HISTORY

DATE: OCTOBER 5, 1981 Day Number 28

Drilling Company Bach Ellensburg

Equipment TLs Portadill IR Compressor

1. DRILLING PROJECT : END PHASE I - CASING INSTALLATION

A. TIME: From 1130 To 1945

Today's Hours 8.25 Hours To Date 261.25

B. FOOTAGE: From 390 To 396

Today's Footage 6 Feet To Date 396

Today's Feet Per Hour 0.72 To Date Feet Per Hour 1.52

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY: Includes trips _____ and hole cleanout _____

Today's Hours _____ Hours To Date _____

Today's Feet Per Hour _____ To Date Feet Per Hour _____

B. BIT DATA Bit Serial Number F 3 Smith BR 8068

Today's Hours 2.7 Hours To Date 2.7

<u>Time</u>	<u>From</u>	<u>To</u>	<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>
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3. CASING: Diameter _____ From _____ To _____

Cable Tool Rig Hours _____ Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

City owned bit 8" F3 Smith BR 8068 used 2.7 hours.

Possible metal in hole. Out of cement plug at 385 ft.

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: OCTOBER 6, 1981 Day Number 29

Drilling Company Bach Ellensburg

Equipment TLS Portadrill, Compressor

1. DRILLING PROJECT - PHASE II - CHIP DRILLING
0745 to 1115 (charged to Phase I): drilled 396' to 400'.

A. TIME: From 1115 To 1930

Today's Hours 8.25 Hours To Date 8.25

B. FOOTAGE: From 400 To 436

Today's Footage 36 Feet To Date 36

Today's Feet Per Hour 4.36 To Date Feet Per Hour 4.36

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY: Includes trips ✓ and hole cleanout ✓

Today's Hours 5.92 Hours To Date 5.92

Today's Feet Per Hour 6.1 To Date Feet Per Hour 6.1

B. BIT DATA Bit Serial Number 8068

Today's Hours 9.1 Hours To Date 11.8
includes from 396'

<u>Time</u>	<u>From</u>	<u>To</u>	<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>

3. CASING: Diameter _____ From _____ To _____

Cable Tool Rig Hours _____ Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

Abundant metal in cuttings.

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: OCTOBER 7, 1981 Day Number 30

Drilling Company Bach Ellensburg

Equipment TLS Rotadrill Aux. Compressor

1. DRILLING PROJECT

* ON-SITE → A. TIME: From 0730 To 2000

CHARGEABLE → Today's Hours 11.4 Hours To Date 19.65

* all days following show same

B. FOOTAGE: From 436 To 463

Today's Footage 27 Feet To Date 63

Today's Feet Per Hour 2.4 To Date Feet Per Hour 3.2

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY:

Includes trips / and hole cleanout ✓

Today's Hours 11.4 Hours To Date 17.32

Today's Feet Per Hour 2.4 To Date Feet Per Hour 3.6

B. BIT DATA

Bit Serial Number 7 7/8" F3 Smith BR8060

Today's Hours 11.35 Hours To Date 11.35

From	To	Pulldown (lbs)	RPM	Feet Per Hour
------	----	----------------	-----	---------------

_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

3. CASING:

Diameter _____ From _____ To _____

Cable Tool Rig Hours _____ Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

0.83 hr standby for sampling. 0.2 hr for rig repair.

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: OCTOBER 8, 1981 Day Number 31

Drilling Company Bach Ellensburg

Equipment TLS Portadill, Aux. Compressor

1. DRILLING PROJECT

A. TIME: From 0800 To 2000

Today's Hours 11.8 Hours To Date 31.5

B. FOOTAGE: From 463 To 566

Today's Footage 103 Feet To Date 166

Today's Feet Per Hour 8.7 To Date Feet Per Hour 5.3

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY: Includes trips ✓ and hole cleanout ✓

Today's Hours 11.75 Hours To Date 29.1

Today's Feet Per Hour 8.8 To Date Feet Per Hour 5.7

B. BIT DATA Bit Serial Number 8060

Today's Hours 11.5 Hours To Date 22.9

<u>From</u>	<u>To</u>	<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>

3. CASING: Diameter _____ From _____ To _____

Cable Tool Rig Hours _____ Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

0.2 hr standby

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: OCTOBER 9, 1981 Day Number 32

Drilling Company Bach Ellensburg

Equipment TLS Porta drill, Aux. Compiessor

1. DRILLING PROJECT

A. TIME: From 0727 To 1602

Today's Hours 8.23 Hours To Date 39.7

B. FOOTAGE: From 566 To 626

Today's Footage 60 Feet To Date 226

Today's Feet Per Hour 7.3 To Date Feet Per Hour 5.7

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY: Includes trips ✓ and hole cleanout ✓

Today's Hours 7.48 Hours To Date 36.6

Today's Feet Per Hour 8 To Date Feet Per Hour 6.2

B. BIT DATA Bit Serial Number 8060

Today's Hours 7.48 Hours To Date 30.4

<u>Time</u>	<u>From</u>	<u>To</u>	<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>
	<u>7.48 hrs</u>			<u>60</u>	

3. CASING: Diameter From To

Cable Tool Rig Hours Cementing Hours

Sacks of Cement Ream Footage

4. REMARKS:
0.3 hr maintenance

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: OCTOBER 12, 1981 Day Number 33

Drilling Company Bach Ellensburg

Equipment TLS Portadrill Aux. Compressor

1. DRILLING PROJECT

A. TIME: From 0840 To 1840

Today's Hours 10 Hours To Date 49.7

B. FOOTAGE: From 626 To 687.5

Today's Footage 61.5 Feet To Date 287.5

Today's Feet Per Hour 6.2 To Date Feet Per Hour 5.8

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY: Includes trips ✓ and hole cleanout _____

Today's Hours 8.6 Hours To Date 45.2

Today's Feet Per Hour 7.2 To Date Feet Per Hour 6.4

B. BIT DATA Bit Serial Number 8060

Today's Hours 8.45 Hours To Date 38.9

<u>Time</u>		<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>
<u>From</u>	<u>To</u>			
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

3. CASING: Diameter _____ From _____ To _____

Cable Tool Rig Hours _____ Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

0.25 hr standby

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: OCTOBER 13, 1981

Day Number 34

Drilling Company Bach Ellensburg

Equipment TLS Partodrill, Aux. Compressor

1. DRILLING PROJECT

A. TIME: From 0700 To 1838

Today's Hours 11.4 Hours To Date 61.1

B. FOOTAGE: From 687.5 To 767.5

Today's Footage 80 Feet To Date 367.5

Today's Feet Per Hour 7 To Date Feet Per Hour 6

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY:

Includes trips ☒ and hole cleanout

Today's Hours ~~8.4~~ 8.4 Hours To Date 53.6

Today's Feet Per Hour ~~219.5~~ 219.5 To Date Feet Per Hour 6.8

B. BIT DATA

Bit Serial Number 8060

Today's Hours 7.75 Hours To Date 46.7

<u>Time</u>	<u>From</u>	<u>To</u>	<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>
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3. CASING:

Diameter _____ From _____ To _____

Cable Tool Rig Hours _____ Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

0.25 hr maintenance. Difficult clearing debris from hole.

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: OCTOBER 14, 1981 Day Number 35

Drilling Company Bach Ellensburg

Equipment TLS Portadrill, Aux. Compressor

1. DRILLING PROJECT

A. TIME: From 0700 To 1913

Today's Hours 11.9 Hours To Date 73

B. FOOTAGE: From 767.5 To 820

Today's Footage 52.5 Feet To Date 420

Today's Feet Per Hour 4.4 To Date Feet Per Hour 5.8

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY: Includes trips ✓ and hole cleanout _____

Today's Hours 7.7 Hours To Date 61.3

Today's Feet Per Hour 6.8 To Date Feet Per Hour 6.9

B. BIT DATA Bit Serial Number 8060

Today's Hours 7.3 Hours To Date 54

<u>Time</u>		<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>
<u>From</u>	<u>To</u>			
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

3. CASING: Diameter _____ From _____ To _____

Cable Tool Rig Hours _____ Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:
0.25 hr standby

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: OCTOBER 15, 1981 Day Number 36

Drilling Company Reich Ellensburg

Equipment TLS Portadrill, Aux. Compressor

1. DRILLING PROJECT

A. TIME: From 0650 To 1907

Today's Hours 12.1 Hours To Date 85.1

B. FOOTAGE: From 820 To 887.5

Today's Footage 67.5 Feet To Date 487.5

Today's Feet Per Hour 5.6 To Date Feet Per Hour 5.7

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY: Includes trips ✓ and hole cleanout _____

Today's Hours 11.9 Hours To Date 73.2

Today's Feet Per Hour 5.7 To Date Feet Per Hour 6.7

B. BIT DATA Bit Serial Number 8060

Today's Hours 11.4 Hours To Date ~~73.2~~ 65.4

<u>Time</u>	<u>From</u>	<u>To</u>	<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>
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3. CASING: Diameter _____ From _____ To _____

Cable Tool Rig Hours _____ Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

0.2 hr maintenance

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: OCTOBER 16, 1981 Day Number 37

Drilling Company Bach Ellensburg

Equipment TLS Portadrill, Aux. Compressor

1. DRILLING PROJECT

A. TIME: From 0700 To 1605

Today's Hours 8.6 Hours To Date 93.7

B. FOOTAGE: From 887.5 To 911

Today's Footage 23.5 Feet To Date 511

Today's Feet Per Hour 2.7 To Date Feet Per Hour 5.5

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY: Includes trips ✓ and hole cleanout _____

Today's Hours 7.75 Hours To Date 81

Today's Feet Per Hour 3 To Date Feet Per Hour 6.3

B. BIT DATA Bit Serial Number 8060

Today's Hours 7.6 Hours To Date 73

<u>Time</u>	<u>From</u>	<u>To</u>	<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>

3. CASING: Diameter _____ From _____ To _____

Cable Tool Rig Hours _____ Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: OCTOBER 19, 1981 Day Number 38

Drilling Company Bach Ellensburg

Equipment TLS Portadrill, Aux. Compressor

1. DRILLING PROJECT

A. TIME: From 1100 To 2003

Today's Hours 9.1 Hours To Date 102.75

B. FOOTAGE: From 911 To 926

Today's Footage 15 Feet To Date 526

Today's Feet Per Hour 1.6 To Date Feet Per Hour 5.2

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY: Includes trips ✓ and hole cleanout _____

Today's Hours 6.7 Hours To Date 87.7

Today's Feet Per Hour 2.2 To Date Feet Per Hour 6

B. BIT DATA Bit Serial Number 8060

Today's Hours 6.7 Hours To Date 79.7

From	To	Pulldown (lbs)	RPM	Feet Per Hour
<u>1312</u>	<u>1956</u>		<u>60</u>	

3. CASING: Diameter _____ From _____ To _____

Cable Tool Rig Hours _____ Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:
345 psi Aux. comp.

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: OCTOBER 20, 1981 Day Number 39

Drilling Company Bach Ellensburg

Equipment TLS Portadrill, Aux. compressor

1. DRILLING PROJECT

A. TIME: From 0700 To 2005

Today's Hours 11.7 Hours To Date 114.5

B. FOOTAGE: From 926 To 961.5

Today's Footage 35.5 Feet To Date 561.5

Today's Feet Per Hour 3 To Date Feet Per Hour 4.9

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY: Includes trips ✓ and hole cleanout _____

Today's Hours 9.2 Hours To Date 96.9

Today's Feet Per Hour 3.9 To Date Feet Per Hour 5.8

B. BIT DATA

Bit Serial Number 8060

Today's Hours 9 Hours To Date 88.7

<u>Time</u>		<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>
<u>From</u>	<u>To</u>			

_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

3. CASING:

Diameter _____ From _____ To _____

Cable Tool Rig Hours _____ Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

1.4 hr maintenance

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: OCTOBER 21, 1981 Day Number 40

Drilling Company Boch Ellensburg

Equipment TLS Portadrill Aux. Compressor

1. DRILLING PROJECT

A. TIME: From 0700 To 2009

Today's Hours 13.2 Hours To Date 127.7

B. FOOTAGE: From 961.5 To 981.5

Today's Footage 20 Feet To Date 581.5

Today's Feet Per Hour 1.5 To Date Feet Per Hour 4.6

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY: Includes trips ✓ and hole cleanout _____

Today's Hours 7.4 Hours To Date 104.3

Today's Feet Per Hour 2.7 To Date Feet Per Hour 5.6

B. BIT DATA Bit Serial Number 8060

Today's Hours 7.2 Hours To Date 95.9

<u>Time</u>	<u>From</u>	<u>To</u>	<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>
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3. CASING: Diameter _____ From _____ To _____

Cable Tool Rig Hours _____ Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

Standby maintenance & fishing hours to date: 3.88

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

Kent Associates
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Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: OCTOBER 22, 1981

Day Number 41

Drilling Company Bach Ellensburg

Equipment TLS Portadrill Aux. Compressor

1. DRILLING PROJECT

A. TIME: From 0700 To 1042

Today's Hours 3.7 Hours To Date 131.4

B. FOOTAGE: From 981.5 To 981.5

Today's Footage 0 Feet To Date 581.5

Today's Feet Per Hour 0 To Date Feet Per Hour 4.4

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY:

Includes trips ✓ and hole cleanout

Today's Hours 0 Hours To Date 104.3

Today's Feet Per Hour 0 To Date Feet Per Hour 5.6

B. BIT DATA

Bit Serial Number JSSR NS 733

Today's Hours 0 Hours To Date 0

<u>From</u>	<u>To</u>	<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>
-------------	-----------	-----------------------	------------	----------------------

_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

3. CASING:

Diameter _____ From _____ To _____

Cable Tool Rig Hours _____ Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

Meet with city and drillers 1042-1550

Pull all pipe from hole. End air rotary.

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: NOVEMBER 11, 1981

Day Number 42

Drilling Company Jannsen Aloha

Equipment TKT Portadrill, Mud Pump

1. DRILLING PROJECT

A. TIME: From 0930 To 1700

Today's Hours 5.25 Hours To Date 136.7

B. FOOTAGE: From 981.5 To 988.5

Today's Footage 7 Feet To Date 588.5

Today's Feet Per Hour 1.3 To Date Feet Per Hour 4.3

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY:

Includes trips / and hole cleanout

Today's Hours 2.5 Hours To Date 106.8

Today's Feet Per Hour 2.8 To Date Feet Per Hour 5.5

B. BIT DATA

Bit Serial Number 6³/₄" F7 AE3486

Today's Hours 2.5 Hours To Date 2.5

<u>Time</u>	<u>From</u>	<u>To</u>	<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>
	<u>1430</u>	<u>1700</u>	<u>5000</u>	<u>60</u>	<u>2.8</u>

3. CASING:

Diameter _____ From _____ To _____

Cable Tool Rig Hours _____ Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

WSU logged hole 10/29-10/30. Start water rotary

Water leaking around 8" casing

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: NOVEMBER 12, 1981

Day Number 43

Drilling Company Tanner Alpha

Equipment TKT Portadrill Mud Pump

1. DRILLING PROJECT

A. TIME: From 0830 To 1720

Today's Hours 8.8 Hours To Date 145.5

B. FOOTAGE: From 988.5 To 1015.5

Today's Footage 27 Feet To Date 615.5

Today's Feet Per Hour 3 To Date Feet Per Hour 4.2

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY:

Includes trips ☒ and hole cleanout

Today's Hours 8.1 Hours To Date 114.9

Today's Feet Per Hour 3.3 To Date Feet Per Hour 5.4

B. BIT DATA

Bit Serial Number 3486

Today's Hours 8 Hours To Date 10.5

<u>Time</u>	<u>From</u>	<u>To</u>	<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>
	<u>0853</u>	<u>1300</u>	<u>5000</u>	<u>40</u>	<u>1.5</u>
	<u>1300</u>	<u>1435</u>	<u>7000</u>	<u>44</u>	<u>6.25</u>
	<u>1435</u>	<u>1700</u>	<u>9000</u>	<u>45</u>	<u>4.8</u>

3. CASING:

Diameter _____ From _____ To _____

Cable Tool Rig Hours _____ Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: NOVEMBER 13, 1981 Day Number 44

Drilling Company Jannsen Alcha

Equipment TKT Portadrill, Mud Pump

1. DRILLING PROJECT

A. TIME: From 0800 To 1605

Today's Hours 7.6 Hours To Date 153.1

B. FOOTAGE: From 1015.5 To 1043.5

Today's Footage 28 Feet To Date 643.5

Today's Feet Per Hour 3.7 To Date Feet Per Hour 4.2

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY: Includes trips ✓ and hole cleanout _____

Today's Hours 6.7 Hours To Date 121.6

Today's Feet Per Hour 4.2 To Date Feet Per Hour 5.3

B. BIT DATA Bit Serial Number 3486

Today's Hours 6.6 Hours To Date 17.1

Time	From	To	Pulldown (lbs)	RPM	Feet Per Hour
	<u>0845</u>	<u>1528</u>	<u>9000</u>	<u>45</u>	<u>4.2</u>
	_____	_____	_____	_____	_____
	_____	_____	_____	_____	_____
	_____	_____	_____	_____	_____
	_____	_____	_____	_____	_____

3. CASING: Diameter _____ From _____ To _____

Cable Tool Rig Hours _____ Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

0.5 hr maintenance

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: NOVEMBER 16, 1981

Day Number 45

Drilling Company Jannsen Alpha

Equipment TKT Portadrill Mud Pump

1. DRILLING PROJECT

A. TIME: From 0830 To 1707

Today's Hours 8.6 Hours To Date 161.7

B. FOOTAGE: From 1043.5 To 1099.5

Today's Footage 56 Feet To Date 699.5

Today's Feet Per Hour 6.5 To Date Feet Per Hour 4.3

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY:

Includes trips ✓ and hole cleanout

Today's Hours 7.9 Hours To Date 129.5

Today's Feet Per Hour 7.1 To Date Feet Per Hour 5.4

B. BIT DATA

Bit Serial Number 3486

Today's Hours 7.6 Hours To Date 24.7

<u>Time</u>	<u>From</u>	<u>To</u>	<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>
	<u>0858</u>	<u>0954</u>	<u>10000</u>	<u>49</u>	<u>7.5</u>
	<u>0954</u>	<u>1510</u>	<u>15000</u>	<u>47-49</u>	<u>6.9</u>
	<u>1510</u>	<u>1653</u>	<u>18000</u>	<u>60</u>	<u>9.3</u>

3. CASING:

Diameter _____ From _____ To _____

Cable Tool Rig Hours _____ Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: NOVEMBER 17, 1981 Day Number 46

Drilling Company Jannsen Aloha

Equipment TKT Partadrill Mud Pump

1. DRILLING PROJECT

A. TIME: From 0830 To 170.5

Today's Hours 8.6 Hours To Date 170.3

B. FOOTAGE: From 1099.5 To 1182.8

Today's Footage 83.3 Feet To Date 782.8

Today's Feet Per Hour 9.7 To Date Feet Per Hour 4.6

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY: Includes trips ✓ and hole cleanout _____

Today's Hours 7.9 Hours To Date 137.4

Today's Feet Per Hour 10.5 To Date Feet Per Hour 5.7

B. BIT DATA Bit Serial Number 3486

Today's Hours 7.4 Hours To Date 32.1

<u>From</u>	<u>To</u>	<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>
<u>0850</u>	<u>1445</u>	<u>18000</u>	<u>52-54</u>	<u>10.9</u>
<u>1445</u>	<u>1500</u>	<u>20000</u>	<u>54</u>	<u>20</u>
<u>1500</u>	<u>1645</u>	<u>18000</u>	<u>53</u>	<u>11.2</u>
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

3. CASING: Diameter _____ From _____ To _____

Cable Tool Rig Hours _____ Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: NOVEMBER 18, 1981 Day Number 47

Drilling Company Jannsen Aloha

Equipment TKT Ported drill Mud Pump

1. DRILLING PROJECT

A. TIME: From 0810 To 1705

Today's Hours 8.9 Hours To Date 179.2

B. FOOTAGE: From 1182.8 To 1279.8

Today's Footage 97 Feet To Date 879.8

Today's Feet Per Hour 10.9 To Date Feet Per Hour 4.9

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY: Includes trips ✓ and hole cleanout _____

Today's Hours 8 Hours To Date 145.4

Today's Feet Per Hour 12.1 To Date Feet Per Hour 6.1

B. BIT DATA Bit Serial Number 3486

Today's Hours 6.8 Hours To Date 38.9

<u>Time</u>		<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>
<u>From</u>	<u>To</u>			
<u>0850</u>	<u>1120</u>	<u>20000</u>	<u>68</u>	<u>15.8</u>
<u>1120</u>	<u>1250</u>	<u>20000</u>	<u>62</u>	<u>14.6</u>
<u>1250</u>	<u>1453</u>	<u>24000</u>	<u>63</u>	<u>13.6</u>
<u>1453</u>	<u>1610</u>	<u>24000</u>	<u>68</u>	<u>12</u>
<u>1610</u>	<u>1652</u>	<u>24000</u>	<u>72</u>	<u>12.4</u>

3. CASING: Diameter _____ From _____ To _____

Cable Tool Rig Hours _____ Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

Polymer thickner added to drilling water.

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: NOVEMBER 19, 1981

Day Number 48

Drilling Company Jannsen Alpha

Equipment TKT Portadrill Mud Pump

1. DRILLING PROJECT

A. TIME: From 0825 To 1655

Today's Hours 7.7 Hours To Date 186.9

B. FOOTAGE: From 1279.8 To 1379.8

Today's Footage 100 Feet To Date 979.8

Today's Feet Per Hour 13 To Date Feet Per Hour 5.2

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY:

Includes trips ☒ and hole cleanout

Today's Hours 7.2 Hours To Date 152.6

Today's Feet Per Hour 13.9 To Date Feet Per Hour 6.4

B. BIT DATA

Bit Serial Number 3486

Today's Hours 6.4 Hours To Date 45.3

From	To	Pulldown (lbs)	RPM	Feet Per Hour
<u>0930</u>	<u>1025</u>	<u>24000</u>	<u>71</u>	<u>14.6</u>
<u>1025</u>	<u>1152</u>	<u>24000</u>	<u>68</u>	<u>15.6</u>
<u>1152</u>	<u>1315</u>	<u>24000</u>	<u>64</u>	<u>16.9</u>
<u>1315</u>	<u>1614</u>	<u>24000</u>	<u>70-73</u>	<u>15.3</u>
<u>1614</u>	<u>1642</u>	<u>24000</u>	<u>62</u>	<u>14.9</u>

3. CASING:

Diameter _____ From _____ To _____

Cable Tool Rig Hours _____ Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

0.83 hr repair cable

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: NOVEMBER 20, 1981

Day Number 49

Drilling Company Jannsen Alpha

Equipment TKT Portadrill, Mud Pump

1. DRILLING PROJECT

A. TIME: From 0820 To 1603

Today's Hours 7.2 Hours To Date 194.1

B. FOOTAGE: From 1379.8 To 1484.7

Today's Footage 104.9 Feet To Date 1084.7

Today's Feet Per Hour 14.6 To Date Feet Per Hour 5.6

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY: Includes trips ✓ and hole cleanout _____

Today's Hours 6.7 Hours To Date 159.4

Today's Feet Per Hour 15.7 To Date Feet Per Hour 6.8

B. BIT DATA Bit Serial Number 3486

Today's Hours 5.3 Hours To Date 50.6

<u>From</u>	<u>To</u>	<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>
<u>0850</u>	<u>1055</u>	<u>24000</u>	<u>73-75</u>	<u>19.6</u>
<u>1055</u>	<u>1215</u>	<u>24000</u>	<u>68</u>	<u>23.2</u>
<u>1215</u>	<u>1536</u>	<u>24000</u>	<u>61-65</u>	<u>15.2</u>
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

3. CASING: Diameter _____ From _____ To _____

Cable Tool Rig Hours _____ Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

0.5 hr repair

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: NOVEMBER 23, 1981

Day Number 50

Drilling Company Jannsen Aloha

Equipment TKT Portadill Mud Pump

1. DRILLING PROJECT

A. TIME: From 0815 To 1655

Today's Hours 8.7 Hours To Date 202.8

B. FOOTAGE: From 1484.7 To 1640.4

Today's Footage 155.7 Feet To Date 1240.4

Today's Feet Per Hour 17.9 To Date Feet Per Hour 6.1

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY:

Includes trips ☒ and hole cleanout

Today's Hours 8.1 Hours To Date 167.5

Today's Feet Per Hour 19.2 To Date Feet Per Hour 7.4

B. BIT DATA

Bit Serial Number 3486

Today's Hours 6.5 Hours To Date 57.1

<u>Time</u>		<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>
<u>From</u>	<u>To</u>			

_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

3. CASING:

Diameter _____ From _____ To _____

Cable Tool Rig Hours _____ Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: NOVEMBER 24, 1981 Day Number 51

Drilling Company Jannsen Alha

Equipment TKT Pctedrill Mud Pump

1. DRILLING PROJECT

A. TIME: From 0820 To 1715

Today's Hours 6.25 Hours To Date 209.1

B. FOOTAGE: From 1640.4 To 1750.3

Today's Footage 109.9 Feet To Date 1350.3

Today's Feet Per Hour 17.6 To Date Feet Per Hour 6.5

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY: Includes trips ✓ and hole cleanout _____

Today's Hours 5.8 Hours To Date 173.3

Today's Feet Per Hour 18.9 To Date Feet Per Hour 7.8

B. BIT DATA Bit Serial Number 3486

Today's Hours 4.8 Hours To Date 61.9

From Time	To	Pulldown (lbs)	RPM	Feet Per Hour
<u>1110</u>	<u>1420</u>	<u>24000</u>	<u>65</u>	<u>23.5</u>
<u>1420</u>	<u>1628</u>	<u>24000</u>	<u>66-68</u>	<u>21.6</u>
<u>1628</u>	<u>1700</u>	<u>22000</u>	<u>65</u>	<u>18.9</u>
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

3. CASING: Diameter _____ From _____ To _____

Cable Tool Rig Hours _____ Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

2.7 hr maintenance and repair

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: NOVEMBER 25, 1981 Day Number 52

Drilling Company Jannsen Alka

Equipment TKT Portadrill, Mud Pump

1. DRILLING PROJECT

A. TIME: From 0800 To 1245

Today's Hours 4.75 Hours To Date 213.9

B. FOOTAGE: From 1750.3 To 1820.3

Today's Footage 70 Feet To Date 1420.3

Today's Feet Per Hour 14.7 To Date Feet Per Hour 6.6

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY: Includes trips ✓ and hole cleanout

Today's Hours 3.8 Hours To Date 177

Today's Feet Per Hour 18.4 To Date Feet Per Hour 8

B. BIT DATA Bit Serial Number 3486

Today's Hours 3.2 Hours To Date 65.1

<u>Time</u>	<u>From</u>	<u>To</u>	<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>
	<u>0830</u>	<u>1216</u>	<u>24000</u>	<u>68-70</u>	<u>21.7</u>
	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>
	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>
	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>
	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>

3. CASING: Diameter From To

Cable Tool Rig Hours Cementing Hours

Sacks of Cement Ream Footage

4. REMARKS:
1.25 hr maintenance

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: NOVEMBER 30, 1981 Day Number 53

Drilling Company Jannsen Alpha

Equipment: TKT Portadrill Mud Pump

1. DRILLING PROJECT

A. TIME: From 0900 To 1655

Today's Hours 7.6 Hours To Date 221.5

B. FOOTAGE: From 1820.3 To 1940.3

Today's Footage 120 Feet To Date 1540.3

Today's Feet Per Hour 15.8 To Date Feet Per Hour 7

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY: Includes trips ✓ and hole cleanout _____

Today's Hours 6.3 Hours To Date 183.3

Today's Feet Per Hour 19 To Date Feet Per Hour 8.4

B. BIT DATA Bit Serial Number 3486

Today's Hours 4.85 Hours To Date 70

Time		Pulldown (lbs)	RPM	Feet Per Hour
From	To			
<u>1055</u>	<u>1613</u>	<u>25000</u>	<u>70</u>	<u>22.2</u>
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

3. CASING: Diameter _____ From _____ To _____

Cable Tool Rig Hours _____ Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

0.3 hr maintenance

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: DECEMBER 1, 1981 Day Number 54

Drilling Company Jannsen Aloha

Equipment TKT Portadrill, Mud Pump

1. DRILLING PROJECT

A. TIME: From 0810 To 1810

Today's Hours 8.6 Hours To Date 230.1

B. FOOTAGE: From 1940.3 To 2080.3

Today's Footage 140 Feet To Date 1680.3

Today's Feet Per Hour 16.3 To Date Feet Per Hour 7.3

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY: Includes trips ✓ and hole cleanout _____

Today's Hours 7.4 Hours To Date 190.7

Today's Feet Per Hour 18.9 To Date Feet Per Hour 8.8

B. BIT DATA Bit Serial Number 3486

Today's Hours 5.8 Hours To Date 75.8

<u>Time</u>				
<u>From</u>	<u>To</u>	<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

3. CASING: Diameter _____ From _____ To _____

Cable Tool Rig Hours _____ Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

1.4 hr fishing Drill rods broke abt + 740 feet from surface.

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: DECEMBER 2, 1981

Day Number 55

Drilling Company Jannsen Alcha

Equipment TKT Portadill Mud Pump

1. DRILLING PROJECT

A. TIME: From 0900 To 1025

Today's Hours 0 Hours To Date 230

B. FOOTAGE: From 2080.3 To 2080.3

Today's Footage 0 Feet To Date 1680.3

Today's Feet Per Hour 0 To Date Feet Per Hour 7.3

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY:

Includes trips / and hole cleanout

Today's Hours 0 Hours To Date 190.7

Today's Feet Per Hour 0 To Date Feet Per Hour 8.8

B. BIT DATA

Bit Serial Number 3486

Today's Hours 0 Hours To Date 75.8

<u>Time</u>				
<u>From</u>	<u>To</u>	<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>
<u></u>	<u></u>	<u></u>	<u></u>	<u></u>
<u></u>	<u></u>	<u></u>	<u></u>	<u></u>
<u></u>	<u></u>	<u></u>	<u></u>	<u></u>
<u></u>	<u></u>	<u></u>	<u></u>	<u></u>
<u></u>	<u></u>	<u></u>	<u></u>	<u></u>

3. CASING:

Diameter From To

Cable Tool Rig Hours Cementing Hours

Sacks of Cement Ream Footage

4. REMARKS:

1.4 hr fishing for drill rod.

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: DECEMBER 3, 1981

Day Number 56

Drilling Company Jannsen Alcha

Equipment TKT Portadrill

1. DRILLING PROJECT

A. TIME: From 1420 To 1745

Today's Hours 0 Hours To Date 230

B. FOOTAGE: From 2080.3 To 2080.3

Today's Footage 0 Feet To Date 1680.3

Today's Feet Per Hour 0 To Date Feet Per Hour 7.3

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY:

Includes trips ☒ and hole cleanout

Today's Hours 0 Hours To Date 190.7

Today's Feet Per Hour 0 To Date Feet Per Hour 8.8

B. BIT DATA

Bit Serial Number 3486

Today's Hours 0 Hours To Date 75.8

<u>From</u>	<u>To</u>	<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>
-------------	-----------	-----------------------	------------	----------------------

3. CASING:

Diameter _____ From _____ To _____

Cable Tool Rig Hours _____ Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

3.4 hr fishing with overshot.

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: DECEMBER 4, 1981 Day Number 57

Drilling Company Jannsen Aloha

Equipment TKT Portadrill

1. DRILLING PROJECT

A. TIME: From 0930 To 1500

Today's Hours 0 Hours To Date 230

B. FOOTAGE: From 2080.3 To 2080.3

Today's Footage 0 Feet To Date 1680.3

Today's Feet Per Hour 0 To Date Feet Per Hour 7.3

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY: Includes trips ✓ and hole cleanout

Today's Hours 0 Hours To Date 190.7

Today's Feet Per Hour 0 To Date Feet Per Hour 8.8

B. BIT DATA Bit Serial Number 3486

Today's Hours 0 Hours To Date 75.8

<u>Time</u>		<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>
<u>From</u>	<u>To</u>			
<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>

3. CASING: Diameter From To

Cable Tool Rig Hours Cementing Hours

Sacks of Cement Ream Footage

4. REMARKS:

5.5 hr fishing successful. Previous 6.2 hr fishing this week.

2 hr maximum fishing per week allowable. 8-6.2 = 1.8 hr fishing allowable.

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: DECEMBER 7, 1981 Day Number 58

Drilling Company Jannsen Alcha

Equipment TKT Portadrill

1. DRILLING PROJECT

A. TIME: From 0820 (12/7) To 0205 (12/8)

Today's Hours 15.5 Hours To Date 245.5

B. FOOTAGE: From 2080.3 To 2226.0

Today's Footage 145.7 Feet To Date 1826.0

Today's Feet Per Hour 9.4 To Date Feet Per Hour 7.4

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY: Includes trips ✓ and hole cleanout _____

Today's Hours 15.2 Hours To Date 205.9

Today's Feet Per Hour 9.6 To Date Feet Per Hour 8.9

B. BIT DATA Bit Serial Number 3486

Today's Hours 13 Hours To Date 88.8

<u>Time</u>		<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>
<u>From</u>	<u>To</u>			

_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

3. CASING: Diameter _____ From _____ To _____

Cable Tool Rig Hours _____ Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

2.2 hr run pipe to TD. changeable as fishing time for
now 2 hr week.

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec.21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING HISTORY

DATE: DECEMBER 8, 1981

Day Number 59

Drilling Company Jannsen Alaha

Equipment TKT Portadrill

1. DRILLING PROJECT

A. TIME: From 0800 To 1625

Today's Hours 5.6 Hours To Date 251.1

B. FOOTAGE: From 2226 To 2226

Today's Footage 0 Feet To Date 1826

Today's Feet Per Hour 0 To Date Feet Per Hour 7.4

2. PENETRATION OR HOLE ADVANCEMENT

A. ROTARY:

Includes trips ☒ and hole cleanout _____

Today's Hours 0 Hours To Date 205.9

Today's Feet Per Hour 0 To Date Feet Per Hour 8.9

B. BIT DATA

Bit Serial Number 3486

Today's Hours 0 Hours To Date 88.8

<u>From</u>	<u>To</u>	<u>Pulldown (lbs)</u>	<u>RPM</u>	<u>Feet Per Hour</u>
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

3. CASING:

Diameter _____ From _____ To _____

Cable Tool Rig Hours _____ Cementing Hours _____

Sacks of Cement _____ Ream Footage _____

4. REMARKS:

2.75 hr maintenance

23.9 hr for maintenance, repairs and fishing to date.

EG & G Idaho, Inc.
Bonneville Geothermal
June, 1982

A P P E N D I X E

W A T E R A N A L Y S E S

The Mogul Corporation Laboratory
Portland, Oregon

Including NB-2 - State of Washington

CONFIDENTIAL

THE MOGUL CORPORATION

Enviroservice Programs
ANALYTICAL REPORT

NB-4

385'-436'

taken @ wellhead

15 hour flow

TOTAL WATER
MOGUL
MANAGEMENT

Company: City of North Bonneville

Address: P.O. Box 333
City, State and Zip: North Bonneville, Wa 98639

Attention:

Laboratory Reference Number: A 9610

Date Collected: 10/7/81

Date Received: 10/12/81

Date Reported:

SAMPLE NO.	SAMPLE TAKEN FROM	DATE	TIME	SAMPLE NO.	SAMPLE TAKEN FROM	DATE	TIME		
1	Test well NB-4T	10/7	08:15	3					
2	86.3°F pH 9.7			4					
CHEMICAL	NO. 1	NO. 2	NO. 3	NO. 4		NO. 1	NO. 2	NO. 3	NO. 4
Acidity as CaCO ₃					Nitrogen, Organic as N				
Alkalinity as CaCO ₃					Oil & Grease Freon				
Aluminum					Oil & Grease (Soxhlet)				
Antimony					pH S.U.				
Arsenic					Phenols				
Barium					Phosphorous, Total as P				
Beryllium					Phosphorous Ortho as P				
BOD (5 - day)					Potassium	1.5			
Cadmium					Selenium				
Calcium	49				Silicon as SiO ₂	17			
Carbon, Total Organic					Silver				
COD					Sodium	180			
Chloride	220				Solids, Dissolved	636			
Chlorine					Solids, Settleable				
Chlorine Demand					Solids, Suspended				
Chromium Hexavalent					Solids, Total				
Chromium Total					Solids, Total Volatile				
Cobalt					Solids, Volatile Dissolved				
Color (APHA)					Solids, Volatile Suspended				
Conductivity Micromhos @25°C					Sulfate				
Copper					Sulfide				
Cyanide					Tin				
Cyanide (Amen. to Chlor.)					Titanium				
Fluorides (Distillation)					Turbidity, NTU				
Fluorides (Direct)					Zinc				
Hardness, Total as CaCO ₃					Bicarbonate	0			
Iron									
Lead									
Magnesium	0.4								
Manganese					BIOLOGICAL (Bacteria)				
Mercury					Coliforms, Total *				
Molybdenum					Coliforms, Fecal *				
Nickel					Streptococci, Fecal				
Nitrate as N					Standard Plate Count **				
Nitrite as N									
Nitrogen, Amm. Distill. as N									
Nitrogen, Kjeldahl as N									

UNITS EXPRESSED IN MG/LITER UNLESS SPECIFIED OTHERWISE.

E - 1

* Indicates colonies 100/ml

** Indicates colonies/ml

< less than

> greater than

The analytical data reported represents the condition
of the sample as received by our laboratory.

Laboratory Manager

CONFIDENTIAL

THE MOGUL CORPORATION

EnviroService Programs
ANALYTICAL REPORT

385'-951'

taken @ wellhead

1 hour + 10 min

Company: Kent Associates

Address: P.O. Box 484

City, State and Zip: Lake Oswego, OR 97034

Attention: Mr. Michael Sosebee

Laboratory Reference Number: A 9652

Date Collected: 10/20/81

Date Received: 10/30/81

Date Reported:

SAMPLE NO.	SAMPLE TAKEN FROM	DATE	TIME	SAMPLE NO.	SAMPLE TAKEN FROM	DATE	TIME
1	Geothermal Test Well North	88.4°	1615	3			
2	Bonneville NB-4T951	pH 9.35		4			

CHEMICAL	NO. 1	NO. 2	NO. 3	NO. 4		NO. 1	NO. 2	NO. 3	NO. 4
Acidity as CaCO ₃					Nitrogen, Organic as N				
Alkalinity as CaCO ₃	31				Oil & Grease Freon				
Aluminum					Oil & Grease (Soxhlet)				
Antimony					pH S.U.	10.3			
Arsenic					Phenols				
Barium					Phosphorous, Total as P				
Beryllium					Phosphorous Ortho as P				
BOD (5 - day)					Potassium	1.4			
Cadmium					Selenium				
Calcium	52				Silicon	31			
Carbon, Total Organic					Silver				
COD					Sodium	230			
Chloride	222				Solids, Dissolved @180°C	621			
Chlorine					Solids, Settlingable				
Chlorine Demand					Solids, Suspended	4			
Chromium Hexavalent					Solids, Total				
Chromium Total					Solids, Total Volatile				
Cobalt					Solids, Volatile Dissolved				
Color (APHA)					Solids, Volatile Suspended				
Conductivity Micromhos @25°C	1000				Sulfate	90.1			
Copper					Sulfide				
Cyanide					Tin				
Cyanide (Amen. to Chlor.)					Titanium				
Fluorides (Distillation)					Turbidity, NTU				
Fluorides (Direct)					Zinc				
Hardness, Total as CaCO ₃					Bicarbonate HCO ₃ ⁻				
Iron					as CaCO ₃	3.6			
Lead					Carbonate CO ₃ ⁻⁻	7.4			
Magnesium	1.2				as CaCO ₃				
Manganese					BIOLOGICAL (Bacteria)				
Mercury					Coliforms, Total *				
Molybdenum					Coliforms, Fecal *				
Nickel					Streptococci, Fecal				
Nitrate as N					Standard Plate Count **				
Nitrite as N									
Nitrogen, Amm. Distill. as N									
Nitrogen, Kjeldahl as N									

UNITS EXPRESSED IN MG/LITER UNLESS SPECIFIED OTHERWISE.

E - 2

Carbonate and Bicarbonate Alkalinity based on 88.4° F

The analytical data reported represents the condition of the sample as received by our laboratory.

Laboratory Manager

* Indicates colonies 100/ml
 ** Indicates colonies/ml
 < less than
 > greater than

Alkalinity, Hydioxide 20mg/L as CaCO₃

HH-3

WHITE/CANARY - CUSTOMER

PINK - FILE

GOLDENROD - MISCELLANEOUS

Printed in the U.S.A.

CONFIDENTIAL

W-3
THE MOGUL CORPORATIONEnviroservice Programs
ANALYTICAL REPORTNB-4
385'-1379.8'
taken @ wellhead
after 16 hr flow.

Company: Kent Associates

Laboratory Reference Number: A 9690

Address: P.O. Box 484

Date Collected: 11/20/81

City, State and Zip: Lake Oswego, Or 97034

Date Received: 11/24/81

Attention:

Date Reported:

SAMPLE NO.	SAMPLE TAKEN FROM	DATE	TIME	SAMPLE NO.	SAMPLE TAKEN FROM	DATE	TIME
1	1379.8 ft. 82.9° F Geothermal Test Well N. Bonneville	11-20	08:35	3			
2	field pH 9.0			4			

CHEMICAL	NO. 1	NO. 2	NO. 3	NO. 4		NO. 1	NO. 2	NO. 3	NO. 4
Acidity as CaCO ₃					Nitrogen, Organic as N				
Alkalinity as CaCO ₃	32				Oil & Grease Freon				
Aluminum					Oil & Grease (Soxhlet)				
Antimony					pH S.U.	9.7			
Arsenic					Phenols				
Barium					Phosphorous, Total as P				
Beryllium					Phosphorous Ortho as P				
BOD (5 - day)					Potassium as K	1.5			
Cadmium					Selenium				
Calcium as Ca	52				Silicon as SiO ₂	33			
Carbon, Total Organic					Silver				
COD					Sodium as Na	180			
Chloride as Cl	220				Solids, Dissolved @160°C	611			
Chlorine					Solids, Settleable				
Chlorine Demand					Solids, Suspended @105°C	1.2			
Chromium Hexavalent					Solids, Total				
Chromium Total					Solids, Total Volatile				
Cobalt					Solids, Volatile Dissolved				
Color (APHA)					Solids, Volatile Suspended				
Conductivity Micromhos @25°C	1000				Sulfate as SO ₄	100			
Copper					Sulfide				
Cyanide					Tin				
Cyanide (Amen. to Chlor.)					Titanium				
Fluorides (Distillation)					Turbidity, NTU				
Fluorides (Direct)					Zinc				
Hardness, Total as CaCO ₃					Carbonate	6.6			
Iron					Bi carbonate	13			
Lead									
Magnesium as Mg	1.5								
Manganese									
Mercury									
Molybdenum									
Nickel									
Nitrate as N									
Nitrite as N									
Nitrogen, Amm. Distill. as N									
Nitrogen, Kjeldahl as N									

Alkalinity pH Hydroxide 20mg/l
as CaCO₃

UNITS EXPRESSED IN MG/LITER UNLESS SPECIFIED OTHERWISE.

Carbonate and Bicarbonate Alkalinity based on 88.4°F

The analytical data reported represents the condition
of the sample as received by our laboratory.

Laboratory Manager

E - 3

- * Indicates colonies 100/ml
- ** Indicates colonies/ml
- < less than
- > greater than

CONFIDENTIAL

W-4, W-5, W-6

THE MOGUL CORPORATION

EnviroService Programs
ANALYTICAL REPORT

NB-4

Downhole Sampler
@ 3 depths.

Kent Associates

Company: _____

Laboratory Reference Number: A-9726

Address: P.O. Box 484

City, State and Zip: Lake Oswego OR 97034

Date Received: 12-11-81

Attention: _____

Date Reported: _____

SAMPLE NO.	SAMPLE TAKEN FROM	DATE	TIME	SAMPLE NO.	SAMPLE TAKEN FROM	DATE	TIME		
1	N. Bonneville Drill Hole NB-4T 620'	12-11	36°C ^{Field} 1000	3	N. Bonneville Drill Hole NB-4T 1500'	12-11	41.2°C ^{Field}		
2	N.Bonn. Drill Hole	12-11	38.5°C ^{Field}	4					
CHEMICAL NB-4T 1000									
	NO. 1	NO. 2	NO. 3	NO. 4		NO. 1	NO. 2	NO. 3	NO. 4
Acidity as CaCO ₃					Nitrogen, Organic as N				
Alkalinity as CaCO ₃					Oil & Grease Freon				
Aluminum					Oil & Grease (Soxhlet)				
Antimony					pH S.U.				
Arsenic					Phenols				
Barium					Phosphorous, Total as P				
Beryllium					Phosphorous Ortho as P				
BOD (5 - day)					Potassium	2.0	1.8	2.5	
Cadmium					Selenium				
Calcium	49	49	45		Silicon	0.3	<0.2	1.5	
Carbon, Total Organic					Silver				
COD					Sodium	230	180	200	
Chloride					Solids, Dissolved				
Chlorine					Solids, Settleable				
Chlorine Demand					Solids, Suspended				
Chromium Hexavalent					Solids, Total				
Chromium Total					Solids, Total Volatile				
Cobalt					Solids, Volatile Dissolved				
Color (APHA)					Solids, Volatile Suspended				
Conductivity Micromhos @25°C					Sulfate	100	96	104	
Copper					Sulfide				
Cyanide					Tin				
Cyanide (Amen. to Chlor.)					Titanium				
Fluorides (Distillation)					Turbidity, NTU				
Fluorides (Direct)					Zinc				
Hardness, Total as CaCO ₃									
Iron									
Lead									
Magnesium	0.9	1.0	1.0						
Manganese					BIOLOGICAL (Bacteria)				
Mercury					Coliforms, Total *				
Molybdenum					Coliforms, Fecal *				
Nickel					Streptococci, Fecal				
Nitrate as N					Standard Plate Count **				
Nitrite as N									
Nitrogen, Amm. Distill. as N									
Nitrogen, Kjeldahl as N									

UNITS EXPRESSED IN MG/LITER UNLESS SPECIFIED OTHERWISE.

E - 4

* Indicates colonies 100/ml

** Indicates colonies/ml

< less than

> greater than

The analytical data reported represents the condition
of the sample as received by our laboratory.

Laboratory Manager

CONFIDENTIAL

W-7
THE MOGUL CORPORATION

EnviroService Programs

ANALYTICAL REPORT

NB-4
2226 feet
Downhole SamplerTOTAL WATER
MOGUL
MANAGEMENT

The City of North Bonneville

Company: _____

A-9791

Laboratory Reference Number: _____

Address: P.O. Box 7

City, State and Zip: North Bonneville, Washington 93639

Date Received: 1-29-82

Attention: _____

Date Reported: _____

SAMPLE NO.	SAMPLE TAKEN FROM	DATE	TIME	SAMPLE NO.	SAMPLE TAKEN FROM	DATE	TIME		
1	Well Water 43.9°C	1-28-82	4:30PM	3					
2				4					
CHEMICAL	NO. 1	NO. 2	NO. 3	NO. 4		NO. 1	NO. 2	NO. 3	NO. 4
Acidity as CaCO ₃					Nitrogen, Organic as N				
Alkalinity as CaCO ₃					Oil & Grease Freon				
Aluminum					Oil & Grease (Soxhlet)				
Antimony					pH S.U.	9.3			
Arsenic					Phenols				
Barium					Phosphorous, Total as P				
Beryllium					Phosphorous Ortho as P				
BOD (5 - day)					Potassium	3			
Cadmium					Selenium				
Calcium	49				Silicon	27.4			
Carbon, Total Organic					Silver				
COD					Sodium	280			
Chloride	226				Solids, Dissolved	633			
Chlorine					Solids, Setttable				
Chlorine Demand					Solids, Suspended				
Chromium Hexavalent					Solids, Total				
Chromium Total					Solids, Total Volatile				
Cobalt					Solids, Volatile Dissolved				
Color (APHA)					Solids, Volatile Suspended				
Conductivity Micromhos @25°C	1000				Sulfate as SO ₄	87.5			
Copper					Sulfide as H ₂ S	0.098			
Cyanide					Tin				
Cyanide (Amen. to Chlor.)					Titanium				
Fluorides (Distillation)					Turbidity, NTU				
Fluorides (Direct)					Zinc				
Hardness, Total as CaCO ₃									
Iron									
Lead									
Magnesium	0.8								
Manganese					BIOLOGICAL (Bacterial)				
Mercury					Coliforms, Total *				
Molybdenum					Coliforms, Fecal *				
Nickel					Streptococci, Fecal				
Nitrate as N					Standard Plate Count**				
Nitrite as N									
Nitrogen, Amm. Distill. as N									
Nitrogen, Kjeldahl as N									

UNITS EXPRESSED IN MG/LITER UNLESS SPECIFIED OTHERWISE.

E - 5

- * Indicates colonies 100/ml
- ** Indicates colonies/ml
- < less than
- > greater than

The analytical data reported represents the condition of the sample as received by our laboratory.

Laboratory Manager

WHITE/CANARY - CUSTOMER

• PINK - FILE •

GOLDENROD - MISCELLANEOUS

Printed in the U.S.A.

CONFIDENTIAL

THE MOGUL CORPORATION

Enviroservice Programs
ANALYTICAL REPORTNB-2
Wellhead

Company: City of North Bonneville

Address: P.O. Box 333

City, State and Zip: North Bonneville, Wa. 98639

Attention:

Laboratory Reference Number: A 9565

Date Collected: 9/18/81

Date Received: 9/18/81

Date Reported:

SAMPLE NO.	SAMPLE TAKEN FROM	DATE	TIME	SAMPLE NO.	SAMPLE TAKEN FROM	DATE	TIME
1	Geothermal Test NB-2 well-Artesian flow	9/18	11:00	3			
2				4			

CHEMICAL	NO. 1	NO. 2	NO. 3	NO. 4		NO. 1	NO. 2	NO. 3	NO. 4
Acidity as CaCO ₃					Nitrogen, Organic as N				
Alkalinity as CaCO ₃					Oil & Grease Freon				
Aluminum					Oil & Grease (Soxhlet)				
Antimony					pH S.U.				
Arsenic					Phenols				
Barium					Phosphorous, Total as P				
Beryllium					Phosphorous Ortho as P				
BOD (5 - day)					Potassium	1.9			
Cadmium					Selenium				
Calcium	63				Silicon as SiO ₂	28			
Carbon, Total Organic					Silver				
COD					Sodium	135			
Chloride	224				Solids, Dissolved	657			
Chlorine					Solids, Settleable				
Chlorine Demand					Solids, Suspended				
Chromium Hexavalent					Solids, Total				
Chromium Total					Solids, Total Volatile				
Cobalt					Solids, Volatile Dissolved				
Color (APHA)					Solids, Volatile Suspended				
Conductivity Micromhos @25°C					Sulfate				
Copper					Sulfide				
Cyanide					Tin				
Cyanide (Amen. to Chlor.)					Titanium				
Fluorides (Distillation)					Turbidity, NTU				
Fluorides (Direct)					Zinc				
Hardness, Total as CaCO ₃					Bicarbonate as Ca CO ₃	0			
Iron									
Lead									
Magnesium	<0.01								
Manganese					BIOLOGICAL (Bacteria)				
Mercury					Coliforms, Total *				
Molybdenum					Coliforms, Fecal *				
Nickel					Streptococci, Fecal				
Nitrate as N					Standard Plate Count**				
Nitrite as N									
Nitrogen, Amm. Distill. as N									
Nitrogen, Kjeldahl as N									

UNITS EXPRESSED IN MG/LITER UNLESS SPECIFIED OTHERWISE.

E - 6

* Indicates colonies 100/ml

** Indicates colonies/ml

< less than

> greater than

The analytical data reported represents the condition of the sample as received by our laboratory.

Laboratory Manager

KENT ASSOCIATES
Geologic Consultants

W-9, W-10

NB-2

To: RCK

Date: 9/81

From: M. Korosec

State of Washington

Olympia

Project Name: EG + G Idaho, Inc.

Project No.: K7883

Proposal: _____

Memo to Files: _____

Telephone Memo: NB-2 Water Analyses

Transmittal Cover Memo: _____

	(W-9)	(W-10)
Other taken at wellhead:	5-21-81	9-11-81
Temperature	81.9° F	82.8° F
pH	11.6	10.9
Ca	197	62
Cl	238	238
Mg	<0.1	<0.1
K	2.6	1.2
SiO ₂	26	38
Na	162	155
Li	<0.1	<0.1
F	0.4	0.6
HCO ₃ /CO ₃	8	-
SO ₄	92	91
Total Alkalinity	265	-
Phenols	257	-
Br	3.2	2.7
Fe	<0.5	<0.5
Conductivity	2800	1150

E-7

EG & G Idaho, Inc.
Bonneville Geothermal
June, 1982

A P P E N D I X F

P U M P T E S T D A T A

A. M. Jannsen Well Drilling Co., Inc.
Aloha, Oregon

A. M. JANNSEN WELL DRILLING CO. INC.

21075 S.W. Tualatin Valley Highway

ALOHA, OREGON 97005

City of North Bonneville
North Bonneville, Washington

Report of Pump test of City owned 2226 foot well, Lot R-13, First
Addition to the Plats of North Bonneville

March 18, 1982

The well was uncapped and the 8" flow pipe attached to the side outlet on the 8" Tee wellhead. A Portadrill Model TKT was set over the hole. A Butler Larkin 8" hookwall packer would be utilized to isolate varying aquifers within the well bore from one another. The tool is essentially a rubber element mounted on a sliding sleeve. This element is engaged by a locking cage, which, when unlocked, grabs the bore wall. By rotating the tool counter-clockwise, the cage is unlocked. The packer is then lowered until the cage is fully engaged and the rubber element has been expanded to seal the annular space between the bore hole and the body of the packer. The packer is run on a casing string and is open through the bottom. When properly set any zones above the packer are isolated from those below. Any testing done from inside the packer string should, therefore, be reflective of only those zones that are below the packer body.

In this case the packer was run on 5" T&C pipe, both black and galvanized. As the testing progressed the galvanized pipe showed quite a bit of mineralization. A white chalky substance formed on the galvanized pipe, but not on the black steel pipe. This material was sampled, but not identified.

Once past the 8" tee on top, the packer and 5" T&C were run without problem. In order to get past the flow tee on top several centralizers on the packer cage had to be removed. This did not adversely affect its performance.

March 19, 1982

The packer was set at 594' with 454' of 5" T&C pipe on bottom and 140' of 6" T&C pipe on top. The packer engaged the bore well properly and suspended the total casing string weight at that point. The artesian flow continued over the top of the packer string, which was four feet above grade. A string of 2-3/8" Union drill pipe was run to 100 feet inside the 6" T&C and connected to a 600 cfm air compressor. Fifteen gallons per minute (gpm) was airlifted. The water was clear throughout the two hour test. Airlifts are generally considered conservative measures of water flow because the air pressure required to lift the water also pressurizes the well bore. As a consequence, water entering the well must overcome this artificial head and is usually restricted. This pipe was withdrawn in preparation for an extended pump test.

March 23, 1982

A 5 horsepower submersible pump was set to 570' on 2" T&C pipe. The pump was a Grunfos, Model SP10-15, capable of producing 50 gpm with 300' of total head. The pump was connected to a 20 KW portable generator and was checked for proper rotation. An airline was attached to the pump column for reading of the water level. Water flow was to be measured from a 2" hose into a 55 gallon drum.

March 24, 1982

Test pumping commenced at 9:30 a.m. It became apparent after approximately 15 minutes of pumping that either the pump and/or the well was not functioning properly. The expected yield of 65 gpm at 140' was only partially realized. Both pump rotation and amp load per leg were correct. It soon became apparent, however, that a substantial portion of the discharge was air/gas. It was difficult to determine the actual percentage by volume, but, as drawdown and test time increased, the pump efficiency dropped to about 42%. An attempt to flame the air/gas proved negative. Pumping was discontinued after 90 minutes. This was followed by another 90 minute test later in the day. Both tests proved essentially the same with recovery being monitored only after the second test. In both cases, however, a very distinct bubbling persisted after shutdown of the pump. This could be detected at the top of the 6" packer string. This activity would eventually drop off as the water level recovered up the hole. A substantial pressure drop in NB-2 was noted between the two 90 minute tests. This would seem to indicate commutation. After the second test a decision was made to identify the air/gas mixture present in the well and then proceed on this basis.

March 29, 1982

The air/gas mixture had been identified as essentially atmosphere. No exotic gases were present. This air could be a natural phenomenon of this geothermal system or it could have been introduced during drilling of the upper 980'. Air entrapment from drilling is not uncommon in highly porous zones, and especially those encountered below a high production, high static pressure aquifer. In attempting to lift the water from the hole air is

pressurized into porous and permeable zones. After the air is shut off, the entrapped air is pressurized further by the rapidly increasing head of water that flows, and eventually fills the well bore.

As a means of releasing this air, it was recommended that an airlift be employed. This would result in maximum drawdown, hence minimum hydrostatic pressure against the porous zones and entrapped air. A shrouded pump was also considered, but possible air damage to the pump and insufficient drawdown were limiting factors. Therefore, a 2" string of black pipe was run to 300' and connected to the 600 cfm compressor. This pipe was eventually lowered to 500' to increase drawdown and discharge. Total airlift time was 3-1/2 hours. Flow outside the packer remained constant, denoting a good set of the packer. NB-2 was erratic, initially losing pressure and then increasing by the end of the airlift period.

March 30, 1982

The airlift was continued with the 2" pipe being dropped to 550'. Total airlift time was 3 hours today - 6-1/2 hours total.

NB-2 had a predictable drop in pressure as the airlift continued, but the initial pressure was considerably higher than the previous day. This should be compared to previous readings to determine if this increase could be attributed to aquifer development by the airlift. The airlift pipe was withdrawn in preparation for another pump test.

March 31, 1982

The 5 h.p. submersible pump was reset to 400'. The artesian flow from inside the 6" packer string had increased, possibly indicating some improvement from the airlift. As pumping was started it became apparent that the percentage of air was drastically reduced. There was only a small trace of bubbles and this improved as the test time increased. Compared to the previous two 90 minute tests, the yield was the same, but the drawdown increased 240%. The pump was definitely moving more water but pump efficiency was still only about 63%. Whether the remaining air in the well, or possibly damage to the pump from the air was responsible for this poor efficiency, is not known.

Once again, NB-2 dropped pressure, although in this case, the reaction was more immediate. Within 6 minutes, as NB-4 dropped past 180', NB-2 lost more than 0.5 psi. This rapid reaction can probably be attributed to the increased drawdown in NB-4. Flow from outside the packer remained constant.

April 1, 1982

The pump was withdrawn from the well and the hook wall packer was pulled free. By turning the packer string counter-clockwise, the packer was re-locked and prepared for a deeper set. Additional 6" pipe was added and the packer lowered to the 980' level. As the packer unit approached 900' the flow increased inside the packer string. At 930' the flow was measured at 12 gpm at three feet above grade. This flow continued until the packer was set into the tight hole at 981'. At this point the packer string was 7' above grade and the artesian flow was only about 1 gpm. Several attempts were made to engage the hook wall packer at 981', but rotating the string was difficult, therefore, it was decided to set the 7-1/4" packer shoe into the 6-3/4" hole. This should effectively isolate the upper from the lower hole.

The increased artesian flow would seem to indicate a lower pressure or thief zone in the 900-980' area. As this zone was isolated from the lower aquifers the latter were permitted their normal production and hydrostatic pressures. This occurrence should have been indicated on any flow meter work done in the well during testing by W.S.U.

April 2, 1982

The 5 h.p. submersible pump was re-installed to 400' and connected to a 20 kw portable generator. Once again, an airline with a direct reading gauge would be employed to monitor the water level in NB-4.

There was no indication of air as in the previous tests. This would be reasonable considering that fluid drilling was employed below 981' depth, and, in fact, indicated that air drilling was the origin of previous problems. This pumping sustained a higher yield with less drawdown than the previous tests.

The flow from outside the packer dropped after 90-120 minutes of pumping. If this flow was leaking around the packer unit it probably should have been reflected before 90 minutes. The pumping rate from inside the packer had pretty well stabilized by this time and showed no indication that water from behind the packer had broken around the bottom. NB-2, which is approximately 200' away, once again dropped pressure after 12 minutes of pumping. Assuming the proper performance of the packer, these two pressure/flow drops seem to indicate a complex fracturing system in the area of NB-2 and NB-4.

At 5-1/2 hours this was the longest of the pump tests to date. The Hot Springs well reflected a pressure drop after 4-1/2 hours of pumping. With so little background data on that hole, however, it is not reasonable to associate this change with any activity at NB-4 at this time. It should be noted that overflow from one of the Hot Springs wells was (and is) flowing which could lead to variable pressure readings.

Recovery from below the packer string was considerably faster in this test as compared to the test on 3/24/82. This would seem to substantiate the existence of a possible thief zone in the 900-980' depth range. Once again, however, the presence of air in the upper zones is an unknown influence and could very well be the guilty party by itself.

Flow from around the outside of the packer was 90% complete after 40 minutes with NB-2 raising one-quarter psi in the same period. Recovery inside the packer string was 99% after 24 minutes.

April 5, 1982

The packer string was retrieved from the well with little difficulty. The couplings on the 6" T&C measured about 7-3/8" O.D. and presented some problems when entering the bottom of the 8" casing string. Artesian flows from inside and outside the packer string had recovered to their pre-test levels. Both flows measured at 86.5° F before pulling the packer free.

April 6, 1982

A 50 horsepower Red Jacket, Model 8-1020, Submersible pump was set to 200' on 5" T&C pipe. Discharge was controlled through a 5" butterfly valve and flow was measured by a 5" inline water meter. The pump was connected to a 75 KW portable generator and checked for proper rotation. A preliminary 90 minute test was run to check pump performance. NB-2 reacted within minutes, but an exact reading was not taken until late in the test. Drawdown was substantial even though the pump was only operating at about 70% efficiency. The quantity of air present in the discharge was difficult to determine but the variable back pressure on the pump indicated some cavitation. Back pressure would fluctuate between 6 and 10 psi. The pump was rated at 1000 gpm with 144' of total head.

April 7, 1982

A twelve hour pump test was started at 8:30 a.m. The same 50 h.p. pump was used as in the previous day's test. Utilizing an air line in NB-4 and an electric sounder in NB-2 drawdown was measured on both holes. The electric sounder did not perform properly in the pumping chamber of NB-4; possibly due to an electrical field developed by the submersible cable. Pumping efficiency ranged between 75% and 78%. Once again, the presence of air could have been a contributing factor in this relatively poor performance. The back pressure on the pump continued to fluctuate throughout the test. The valve was adjusted at 12 minutes to increase flow and maximize drawdown. This reduced pump back pressure from 15 psi to 6 psi.

Neither NB-4 or NB-2 stabilized during the 12 hour test and their recovery was correspondingly slow. Generally this is not reflective of a good aquifer recharge system, but so very little is known of this particular resource area. The Hot Springs well dropped pressure indicating commutation but, without further data, this is purely speculative.

Pump Test NB-4

Date 3/24/82 Packer Depth 594 Pump 5hp @ 565'

Time	Inside Packer			Outside Packer		NB-2 Pressure	Comments
	GPM	Level	Temp	Flow	Temp		
Start up	2	+3'	88.4°	65 gpm	88.5°	5.0 lb.	clear
1 min	66	55'	92.3°	65	88.0°	5.0 lb.	murky
5 min	55	130'	94.0°	65	88.0°	5.0 lb.	"
10 min	44	138'	94.5°	65	88.0°	5.0 lb.	clear w/ sin. bubbles
13 min	28.6	139'	93.6°	65	88.0°	5.0 lb.	Lots of bubbling
10 min	25	139'	93.8°	65	88.0°	5.0 lb.	"
74 min	27.5	139'	93.8°	65	88.0°	5.0 lb.	"
82 min	27.5	139'	93.8°	65	88.0°	5.0 lb.	"
Pump Off due to excessive bubbling - continues in casing after stop							
Start up	2	+3'	88.5°	65 gpm	88.5°	2.2 lb.	clear
2 min	45	125'		65 gpm	88.5°		
5 min	36	139'		65 gpm	88.5°		opened NP-2
1 min			92.3°	65 gpm	88.0°	2.1 psu @ 70.0°F	clear w/ bubbles
9 min	27.5		93.8°	65 gpm	88.5°		excessive bubbling
14 min	25	130'		65 gpm	88.5°		"
50 min	26.4	130'	93.5°	65 gpm	88.5°	2.4 psu	opened NB-2 again
69 min	25.4	130'	95.5°	65 gpm	89.0°		
72 min		130'		65 gpm	88.5°	1.8 psu	close NP-2
87 min		130'		65 gpm	88.5°	2.2 psu	
7 min	25.4	130'		65 gpm	88.5°		

Pump Test NB-4
Date 3/24/92 Packer Depth 594 Pump 5hp @ 565'

Pump Test NB-4
Date 3/24/92 Packer Depth 594 Pump 5hp @ 565'

F - 7

Air Lift NB-4

Date 3/29/82 Packer Depth 594 Compressor 600 cfm @ 250 psi

Time	Inside Packer flow @ depth	Outside Packer	NB-2	Compressor Pressure
1:15	30 gpm @ 300'	65 gpm	3.3 psi	50 psi
1:45	22.5 gpm @ 300'	65 gpm	3.3 psi	46 psi
2:15	18 gpm @ 300'	65 gpm	3 psi	46 psi
	Drop Airlift to 500'			
2:45	36 gpm @ 500'	65 gpm	2.9 psi	68 psi
3:15	30 gpm @ 500'	91.7° 65 gpm	2.9 psi	64 psi
3:45	30 gpm @ 500'	65 gpm	2.7 psi	63 psi
4:15	86.5° 30 gpm @ 500'	65 gpm	3.25 psi	63 psi
4:45	30 gpm @ 500'	91.6° 65 gpm	3.5 psi	62.5 psi
5:15	30 gpm @ 500'	65 gpm	3.75 psi	62.5 psi
	3/30/82			
11:00	29 gpm @ +4'	65 gpm	5.5 psi	Hot Springs 15.5 psi
11:15	30 gpm @ 500'	65 gpm	4.8 psi	63 psi
11:30	88.9° 36 gpm @ 550'	91.4° 65 gpm	4.0 psi	74 psi
12:00	89°F 33 gpm @ 550'	91.9 65 gpm	4.2 psi	70 psi
12:30	30 gpm @ 550'	65 gpm	4.2 psi	68 psi
1:00	88.4° 30 gpm @ 550'	91.9° 65 gpm	3.8 psi	68 psi
1:30	88.4° 30 gpm @ 550'	91.8° 65 gpm	3.5 psi	68 psi
2:00	88.8° 30 gpm @ 550'	91.8° 65 gpm	3.5 psi	68 psi

Pump Test NB-4
Date 3/31/82 Packer Depth 594 Pump 5hp @ 400'

Date 3/31/82 Packer Depth 594 Pump 5hp @ 400'

F - 9

Pump Test NB-4
Date 4/2/82 Packer Depth 980' Pump 5hp @ 400'

Time	Inside Packer			Outside Packer		NB-2 Pressure	Comments
	GPM	Level	Temp	Flow	Temp		
fast up	1 gpm	+7'	84.3°	65	90.1	6 psi	Hot Spring 15.4 psi
1 min	60	45'					
3 min	60	82'	92.8°				
6 min	60	126'	94.3°				
12 min	51	186'	96.0°	65	90.2°	5.25	
24 min	44	220'	95.5°	65	90.0°	5.20	switch to Air Line
48 min.	41	268'	96.7°	65	90.1°	5.20	
60 min	41	273'	96.4°	65	90.1°	5.20	
96 min.	41	275'	96.4°	65	90.1°	5.20	Hot Spring 15.4 psi
20 min.	41	279'	96.3°	60	90.1°	5.20	15.4 psi
50 min.	38	283'	96.3°	48	90.1°	5.20	
180 min.	38	284'	96.3°	42	90.1°	5.20	Hot Spring 15.4 psi
210 min.	36.6	285'	96.3°	39	89.8°	5.20	15.4 psi
240 min	36.6	287'	96.2°	39	89.8°	5.20	
270 min	38	287'	95.9°	38	89.7°	5.0	Hot Spring 15.25 ps
300 min	38	286'	96.2°	37	89.5°	5.0	
330 min	38	287'	96.2°	37	89.8°	5.0	Hot Spring 15.25 ps.

Pump Test NP-4
Date 4/2/92 Packer Depth 980' Pump 5hp @ 400'

Date 4/2/82 Packer Depth 980' Pump 5hp @ 400'

[illegible]

Pump Test NB-4
Date 4/6/82 Packer Depth — Pump 50hp @ 200'

Time	Inside Packer			Outside Packer		NB-2 Pressure	Comments
	GPM	Level	Temp.	Flow	Temp		
start up	65	+2				4.9 psi	Hot Springs 15.25 psi
4 min.	760	110'				0 psi	clear.
7 min.	760	120'	89.7°F				
10 min.	705	123'					
13 min.	705	125'					
16 min.	705	127'					
19 min.	705	129'					
22 min.	705	130'					
25 min.	695	131'	89.7°				Hot Springs 15.25 psi
		Adjust valve					
25 min.	730	145'	89.7°				
27 min.	720	150'	89.7°			water level 46'	
30 min.	700	152'					
— Recovery —							
5 sec.		78'					
10 sec.		58'					
1 min.		52'					
2 min.		46'					
3 min.		41'					
4 min.		38'					
5 min.		35'					
7 min.		33'					
9 min.		30'					
11 min.		28'					
13 min.		27'					

Pump Test NB-4

Date 4/7/82 Packer Depth — Pump 50 hp @ 200'

Time	Inside Packer			Outside Packer		NB-2 Pressure	Comments
	GPM	Level	Temp	Flow	Temp		
Start up	65	+2'	88.5°			5.2 psi	Hot Springs 15.25 psi
1 min	1000	101'				5'	
3 min	750	116'				12'	
6 min	750	122'				16'	
9 min	730	126'				21'	Pressure gauge on pump bouncing Air?
12 min	850	131'	Adjust valve			25'	
15 min	850	133'	89.5°			28'	
20 min	785	135'	89.5°			32'	pump efficiency 75%
25 min	785	138'	89.7°			35'	
30 min	785	139'	89.7°			36'	
35 min	750	140'	89.7°			37'	
40 min	760	141'	90.0°			39'	
45 min	750	142'	90.0°			41'	Amp Load over 20/leg
50 min	750	143'	90.0°			42'	
55 min	750	144'	90.0°			44'	
60 min	750	145'	90.0°			46'	Hot Springs 15.25 psi
90 min	78.5	149'	89.9°			52'	
120 min	735	153'	89.8°			57'	Hot Springs 15.1 psi
150 min	720	156'	89.7°			62'	
180 min	720	158'	89.7°			67'	15.1 psi
210 min	720	160'	89.7°			70'	pump efficiency 78%
240 min	705	163'	89.7°			74'	
270 min	670	165'	89.7°			76'	
300 min	670	164'	89.7°			78'	Hot Springs 15.0 psi
330 min	670	166'	90.1°			80'	F - 13

Pump Test NB-4
Date 4/7/82 Packer Depth — Pump 50hp @ 200'

Date 4/7/82 Packer Depth — Pump 50hp @ 200'

[illegible]

Pump Test NB-4 Date 4/7/82 Packer Depth - Pump 50 hps @ 200'

Time	Inside Packer			Outside Packer		NB-2 Pressure	Comments
	GPM	Level	Temp	Flow	Temp		
			- Recovery -				
0 sec.		100'					Bubbling in casing
15 sec.							
30 sec.		98'					
45 sec.		96'					
2 min		94'					
5 min		90'				77'	
10 min		86'				70'	no bubbling
15 min		80'				63'	
20 min		77'				60'	
25 min		74'				57'	
30 min		71'				54'	
35 min		68'				51'	
	4/8/82						
2 Hours after shut down		29'				19'	Hot Spring, 14.8 psc

Draw down NB-4 3/31/82

Pump Test NB-4 4/2/82

Draw down

Recovery

Drawdown NB-4 and NB-2

12 Hour Pump Test - 4/7/82

EG & G Idaho, Inc.
Bonneville Geothermal
June, 1982

A P P E N D I X G

C O S T A C C O U N T I N G

D A I L Y D R I L L I N G C O S T S

EG & G Idaho, Inc.
Bonneville Geothermal
June, 1982

DRILLING COMPLETION SUMMARY

Phase II - Production Test Hole NB-4
City of North Bonneville, Washington

0' - 400' Fixed Price Contract

Drilling

8-25-81 to 10-6-81
Cable Tool Rig: 0'-177' (16" span)
TLS Portadrill:
 6" Air Hammer 177'-390'
 8" Ream 176'-385'
 8" Air Rotary 385'-400'
16" Casing: 0'-160.7'
12" Casing: 0'-177.5'
8" Casing: 174.7'-379'

Rates And Costs

\$33,232
\$83 per foot overall
\$127 per hour overall
28 days
261 hours
1.5 feet per hour overall

400' - 2226' Hourly Price Contracts

Drilling

10-6-81 to 12-8-81
TLS Portadrill Rotary With Air
 13 days; 4.4 feet per hour
 8" Bit: 385'-436'
 7 7/8" Bit: 436'-981.5'
 \$34,758
 \$60 per foot; \$264 per hour
TKT Portadrill With Water
 18 days; 10.4 feet per hour
 6 3/4" Bit: 981.5'-2226'
 \$33,134
 \$26.60 per foot; \$276 per hour

Rates And Costs

\$67,893
\$37 per foot overall
\$270 per hour overall
31 days
251 hours
7.3 feet per hour overall

TOTAL HOLE

\$101,124
\$45.43 per foot
\$197 per hour
4.3 feet per hour
59 days
512.35 hours drilling (94% of time)
540.25 hours on-site

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: AUGUST 25, 1981 Day Number 1

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: BE 22-W-53 Cable Tool

HOURS: From 0730 To 1800

TODAY'S HOURS 10.5

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits _____

Air rotary tricone excluding bits _____

Water rotary tricone excluding bits _____

Mud rotary tricone excluding bits _____

TOTAL _____

(A) TOTAL HOURS x \$250.00 \$ _____

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby _____

Maintenance or repair _____

Fishing _____

TOTAL _____

(B) TOTAL HOURS x \$75.00 \$ _____

OTHER

Costs

Mob & De Mob to site \$1000.00 \$ 1000.00

Drill, install, and cement 8 inch casing (_____ feet) \$ _____

*97/ft * Drill, install, and cement ¹⁰12 inch casing (9 feet) \$ 873.00

(C) OTHER TOTAL \$ 1873.00

TAX

(A + B + C) + 5.3% \$ 1972.27

CUMULATIVE DRILLING COSTS

TODAY'S COSTS \$ 1972.27

PREVIOUS COSTS \$ 0

TO DATE COSTS \$ 1972.27

DRILLING DATA

TODAY'S FOOTAGE 9 PREVIOUS FOOTAGE 0

TO DATE FOOTAGE 9

TODAY'S COST PER FOOT \$ 219.14

TO DATE COST PER FOOT \$ 219.14 TO DATE COST PER HOUR \$ 187.84

* Lump sum price for 12" casing is { \$12,600 for drilling
\$2,700 for installing and cementing
\$2,160 for steel casing
TOTAL = \$17,460 for 180 feet
OR \$97.00 per foot
G - 2

CITY OF NORTH BONNEVILLE
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

KENT ASSOCIATES
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: AUGUST 26, 1981

Day Number 2

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: BE 22-W-53 Cable Tool

HOURS: From 0730 To 1800

TODAY'S HOURS 10.5

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

(A) TOTAL HOURS x \$250.00

\$

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

(B) TOTAL HOURS x \$75.00

\$

OTHER

Costs

Mob & De Mob to site \$1000.00

\$

Drill, install, and cement 8 inch casing (feet) \$

* Drill, install, and cement ¹⁰12 inch casing (11 feet) \$ 1067.00

* see day 1 (C) OTHER TOTAL

\$

1067.00

TAX

(A + B + C) + 5.3%

\$ 1123.55

CUMULATIVE DRILLING COSTS

TODAY'S COSTS

\$ 1123.55

PREVIOUS COSTS

\$ 1972.27

TO DATE COSTS

\$ 3095.82

DRILLING DATA

TODAY'S FOOTAGE 11

PREVIOUS FOOTAGE 9

TO DATE FOOTAGE 20

* TODAY'S COST PER FOOT \$ 102.14

TO DATE COST PER FOOT \$ 154.79 TO DATE COST PER HOUR \$ 147.42

* includes mob charges

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: AUGUST 27, 1981 Day Number 3

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: BE 22-W-53 Cable Tool

HOURS: From 0800 To 1800

TODAY'S HOURS 10

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

(A) TOTAL HOURS x \$250.00 \$

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

(B) TOTAL HOURS x \$75.00 \$

OTHER

Costs

Mob & De Mob to site \$1000.00 \$

Drill, install, and cement 8 inch casing (feet) \$

* Drill, install, and cement 12 inch casing (12 feet) \$ 1164.00

* See day 1 (C) OTHER TOTAL \$ 1164.00

TAX

(A + B + C) + 5.3% \$ 1225.69

CUMULATIVE DRILLING COSTS

TODAY'S COSTS \$ 1225.69

PREVIOUS COSTS \$ 3095.82

TO DATE COSTS \$ 4321.51

DRILLING DATA

TODAY'S FOOTAGE 12 PREVIOUS FOOTAGE 20

TO DATE FOOTAGE 32

TODAY'S COST PER FOOT \$ 102.14

TO DATE COST PER FOOT \$ 135.05 TO DATE COST PER HOUR \$ 139.40

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Uswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: AUGUST 28, 1981 Day Number 4

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: BE 22-W-53 Cable Tool

HOURS: From 0700 To 1600

TODAY'S HOURS 9

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

(A) TOTAL HOURS x \$250.00 \$ _____

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

(B) TOTAL HOURS x \$75.00 \$ _____

OTHER

Costs

Mob & De Mob to site \$1000.00 \$ _____

Drill, install, and cement 8 inch casing (____ feet) \$ _____

* Drill, install, and cement 12 inch casing (13 feet) \$ 1261.00

* see day 1 (C) OTHER TOTAL \$ 1261.00

TAX

(A + B + C) + 5.3% \$ 1327.83

CUMULATIVE DRILLING COSTS

TODAY'S COSTS \$ 1327.83

PREVIOUS COSTS \$ 4321.51

TO DATE COSTS \$ 5649.34

DRILLING DATA

TODAY'S FOOTAGE 13 PREVIOUS FOOTAGE 32

TO DATE FOOTAGE 45

TODAY'S COST PER FOOT \$ 102.14

TO DATE COST PER FOOT \$ 125.54 TO DATE COST PER HOUR \$ 141.24

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

NEIL ASSOCIATES
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: AUGUST 31, 1981 Day Number 5

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: BE 22-W-53 Cable Tool

HOURS: From 1200 To 1900

TODAY'S HOURS 7

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

(A) TOTAL HOURS x \$250.00 \$

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

(B) TOTAL HOURS x \$75.00 \$

OTHER

Costs

Mob & De Mob to site \$1000.00 \$

Drill, install, and cement 8 inch casing (feet) \$

* Drill, install, and cement 12¹⁶ inch casing (7 feet) \$ 679.00

* See day 1 (C) OTHER TOTAL \$ 679.00

TAX

(A + B + C) + 5.3% \$ 714.99

CUMULATIVE DRILLING COSTS

TODAY'S COSTS \$ 714.99

PREVIOUS COSTS \$ 5649.34

TO DATE COSTS \$ 6364.33

DRILLING DATA

TODAY'S FOOTAGE 7 PREVIOUS FOOTAGE 45

TO DATE FOOTAGE 52

TODAY'S COST PER FOOT \$ 102.14

TO DATE COST PER FOOT \$ 122.39 TO DATE COST PER HOUR \$ 135.41

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: SEPTEMBER 1, 1981

Day Number 6

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: BE 22-W Cable Tool

HOURS: From 0730 To 1800

TODAY'S HOURS 10.5

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

(A) TOTAL HOURS x \$250.00

\$ 2625.00

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

(B) TOTAL HOURS x \$75.00

\$ 787.50

OTHER

Costs

Mob & De Mob to site \$1000.00

\$ 1000.00

Drill, install, and cement 8 inch casing (feet) \$

* Drill, install, and cement ¹⁶12 inch casing (29 feet) \$ 2813.00

* See day 1

(C) OTHER TOTAL

\$ 2813.00

TAX

(A + B + C) + 5.3%

\$ 2962.09

CUMULATIVE DRILLING COSTS

TODAY'S COSTS

\$ 2962.09

PREVIOUS COSTS

\$ 6364.33

TO DATE COSTS

\$ 9326.42

DRILLING DATA

TODAY'S FOOTAGE 29

PREVIOUS FOOTAGE 52

TO DATE FOOTAGE 81

TODAY'S COST PER FOOT \$ 102.14

TO DATE COST PER FOOT \$ 115.14 TO DATE COST PER HOUR \$ 162.20

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: SEPTEMBER 2, 1981

Day Number 7

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: BE 22-w Cable Tool

HOURS: From 0730 To 1800

TODAY'S HOURS 10.5

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

(A) TOTAL HOURS x \$250.00

\$ 2625.00

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

(B) TOTAL HOURS x \$75.00

\$ 787.50

OTHER

Costs

Mob & De Mob to site \$1000.00

\$ 1000.00

Drill, install, and cement 8 inch casing (16 feet) \$

\$ 1200.00

* Drill, install, and cement ¹⁶12 inch casing (26 feet) \$ 2522.00

+ See day 1

(C) OTHER TOTAL

\$ 2522.00

TAX

(A + B + C) + 5.3%

\$ 2655.67

CUMULATIVE DRILLING COSTS

TODAY'S COSTS

\$ 2655.67

PREVIOUS COSTS

\$ 9326.42

TO DATE COSTS

\$ 11982.09

DRILLING DATA

TODAY'S FOOTAGE 26

PREVIOUS FOOTAGE 81

TO DATE FOOTAGE 107

TODAY'S COST PER FOOT \$ 102.14

TO DATE COST PER FOOT \$ 111.98 TO DATE COST PER HOUR \$ 176.21

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: SEPTEMBER 3, 1981

Day Number 8

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: BE 22-W Cable Tool

HOURS: From 0730 To 1700

TODAY'S HOURS 9.5

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

(A) TOTAL HOURS x \$250.00

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

(B) TOTAL HOURS x \$75.00

OTHER

Costs

Mob & De Mob to site \$1000.00

Drill, install, and cement 8 inch casing () feet \$

* Drill, install, and cement ¹⁶12 inch casing (18 feet) \$ 1746.00

* See day 1 (C) OTHER TOTAL \$ 1746.00

TAX

(A + B + C) + 5.3%

\$ 1838.54

CUMULATIVE DRILLING COSTS

TODAY'S COSTS

\$ 1838.54

PREVIOUS COSTS

\$ 11982.09

TO DATE COSTS

\$ 13820.63

DRILLING DATA

TODAY'S FOOTAGE 18

PREVIOUS FOOTAGE 107

TO DATE FOOTAGE 125

TODAY'S COST PER FOOT \$ 102.14

TO DATE COST PER FOOT \$ 110.57 TO DATE COST PER HOUR \$ 178.33

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: SEPTEMBER 4, 1981 Day Number 9

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: BE 22-W Cable Tool

HOURS: From 0730 To 1600

TODAY'S HOURS 8.5

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

(A) TOTAL HOURS x \$250.00 \$ _____

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

(B) TOTAL HOURS x \$75.00 \$ _____

OTHER

Costs

Mob & De Mob to site \$1000.00 \$ _____

Drill, install, and cement 8 inch casing (____ feet) \$ _____

* Drill, install, and cement ¹⁶12 inch casing (14 feet) \$ 1358.00

* See day 1 (C) OTHER TOTAL \$ 1358.00

TAX

(A + B + C) + 5.3% \$ 1429.97

CUMULATIVE DRILLING COSTS

TODAY'S COSTS \$ 1429.97

PREVIOUS COSTS \$ 13820.63

TO DATE COSTS \$ 15250.60

DRILLING DATA

TODAY'S FOOTAGE 14 PREVIOUS FOOTAGE 125

TO DATE FOOTAGE 139

TODAY'S COST PER FOOT \$ 102.14

TO DATE COST PER FOOT \$ 109.72 TO DATE COST PER HOUR \$ 177.33

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: SEPTEMBER 8, 1981

Day Number 10

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: BE 22-W Cable Tool

HOURS: From 1200 To 2000

TODAY'S HOURS 8

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

(A) TOTAL HOURS x \$250.00

\$

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

(B) TOTAL HOURS x \$75.00

\$

OTHER

Costs

Mob & De Mob to site \$1000.00

\$

Drill, install, and cement 8 inch casing (feet) \$

* Drill, install, and cement ¹⁶/₁₂ inch casing (5 feet) \$ 485.00

+ See day 1

(C) OTHER TOTAL

\$ 485.00

TAX

(A + B + C) + 5.3%

\$ 510.71

CUMULATIVE DRILLING COSTS

TODAY'S COSTS

\$ 510.71

PREVIOUS COSTS

\$ 15250.60

TO DATE COSTS

\$ 15761.31

DRILLING DATA

TODAY'S FOOTAGE 5

PREVIOUS FOOTAGE 139

TO DATE FOOTAGE 144

TODAY'S COST PER FOOT \$ 102.14

TO DATE COST PER FOOT \$ 109.45 TO DATE COST PER HOUR \$ 167.67

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Uswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: SEPTEMBER 9, 1981

Day Number 11

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: BE 22-W Cable Tool

HOURS: From 07.30 To 1800

TODAY'S HOURS 10.5

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

(A) TOTAL HOURS x \$250.00

\$

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

(B) TOTAL HOURS x \$75.00

\$

OTHER

Costs

Mob & De Mob to site \$1000.00

\$

Drill, install, and cement 8 inch casing () feet) \$

* Drill, install, and cement ¹⁶12 inch casing (10 feet) \$ 970.00

+ See day 1

(C) OTHER TOTAL

\$ 970.00

TAX

(A + B + C) + 5.3%

\$ 1021.41

CUMULATIVE DRILLING COSTS

TODAY'S COSTS

\$ 1021.41

PREVIOUS COSTS

\$ 15761.31

TO DATE COSTS

\$ 16782.72

DRILLING DATA

TODAY'S FOOTAGE 10

PREVIOUS FOOTAGE 144

TO DATE FOOTAGE 154

TODAY'S COST PER FOOT \$ 102.14

TO DATE COST PER FOOT \$ 108.98 TO DATE COST PER HOUR \$ 160.60

City of North Bonneville
Geothermal Test Well NB-4-T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: SEPTEMBER 10, 1981 Day Number 12

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: BE 22-W Cable Tool

HOURS: From 0730 To 1800

TODAY'S HOURS 10.5

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

(A) TOTAL HOURS x \$250.00 \$ _____

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

(B) TOTAL HOURS x \$75.00 \$ _____

OTHER

Costs

Mob & De Mob to site \$1000.00 \$ _____

Drill, install, and cement 8 inch casing (____ feet) \$ _____

* Drill, install, and cement ~~12~~¹⁶ inch casing (10 feet) \$ 970.00

* see day 1 (C) OTHER TOTAL \$ 970.00

TAX

(A + B + C) + 5.3% \$ 1021.41

CUMULATIVE DRILLING COSTS

TODAY'S COSTS \$ 1021.41

PREVIOUS COSTS \$ 16782.72

TO DATE COSTS \$ 17804.13

DRILLING DATA

TODAY'S FOOTAGE 10 PREVIOUS FOOTAGE 154

TO DATE FOOTAGE 164

TODAY'S COST PER FOOT \$ 102.14

TO DATE COST PER FOOT \$ 108.56 TO DATE COST PER HOUR \$ 154.82

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: SEPTEMBER 11, 1981

Day Number 13

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: BE 22-W Cable Tool

HOURS: From 0730 To 1800

TODAY'S HOURS 10.5

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

(A) TOTAL HOURS x \$250.00

\$

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

(B) TOTAL HOURS x \$75.00

\$

OTHER

Costs

Mob & De Mob to site \$1000.00

\$

Drill, install, and cement 8 inch casing () feet \$

* Drill, install, and cement ¹⁶/₁₂ inch casing (9 feet) \$ 873.00

* See day 1

(C) OTHER TOTAL

\$ 873.00

TAX

(A + B + C) + 5.3%

\$ 919.27

CUMULATIVE DRILLING COSTS

TODAY'S COSTS

\$ 919.27

PREVIOUS COSTS

\$ 17804.13

TO DATE COSTS

\$ 18723.40

DRILLING DATA

TODAY'S FOOTAGE 9

PREVIOUS FOOTAGE 164

TO DATE FOOTAGE 173

TODAY'S COST PER FOOT \$ 102.14

TO DATE COST PER FOOT \$ 108.23 TO DATE COST PER HOUR \$ 149.19

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: SEPTEMBER 14, 1981

Day Number 14

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: BE 22-W Cable Tool

HOURS: From 0830 To 1130

TODAY'S HOURS 3

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

(A) TOTAL HOURS x \$250.00

\$

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

(B) TOTAL HOURS x \$75.00

\$

OTHER

Costs

Mob & De Mob to site \$1000.00

\$

Drill, install, and cement 8 inch casing (feet) \$

* Drill, install, and cement ¹⁰12 inch casing (0 feet) \$ 0 (bit intake)

* See day 1

(C) OTHER TOTAL

\$

TAX

(A + B + C) + 5.3%

\$ 0

CUMULATIVE DRILLING COSTS

TODAY'S COSTS

\$ 0

PREVIOUS COSTS

\$ 18723.40

TO DATE COSTS

\$ 18723.40

DRILLING DATA

TODAY'S FOOTAGE

0

PREVIOUS FOOTAGE

173

TO DATE FOOTAGE

173

TODAY'S COST PER FOOT \$ 0

TO DATE COST PER FOOT \$ 108.23 TO DATE COST PER HOUR \$ 145.71

Drilling = 149.19

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: SEPTEMBER 15, 1981 Day Number 15

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: BE 22-W Cable Tool

HOURS: From 0800 To 1900

TODAY'S HOURS 11

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

(A) TOTAL HOURS x \$250.00 \$

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

(B) TOTAL HOURS x \$75.00 \$

OTHER

Costs

Mob & De Mob to site \$1000.00 \$

Drill, install, and cement 8 inch casing () feet \$

Drill, install, and cement 12 inch casing (0 feet) \$ 0 (6 inch hole)

(C) OTHER TOTAL \$ 0

TAX

(A + B + C) + 5.3% \$ 0

CUMULATIVE DRILLING COSTS

TODAY'S COSTS \$ 0

PREVIOUS COSTS \$ 18723.40

TO DATE COSTS \$ 18723.40

DRILLING DATA

TODAY'S FOOTAGE 0 PREVIOUS FOOTAGE 173

TO DATE FOOTAGE 173

TODAY'S COST PER FOOT \$ 0

TO DATE COST PER FOOT \$ 108.23 TO DATE COST PER HOUR \$ 134.22

drilling = 149.19

CITY OF NORTH BONNEVILLE
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

KENT ASSOCIATES
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: SEPTEMBER 16, 1981

Day Number 16

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: BE 22-w Cable Tool

HOURS: From 1200 To 1800

TODAY'S HOURS 6

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

(A) TOTAL HOURS x \$250.00

\$

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

(B) TOTAL HOURS x \$75.00

\$

OTHER

Costs

Mob & De Mob to site \$1000.00

\$

Drill, install, and cement 8 inch casing (feet) \$

* Drill, install, and cement ¹⁶12 inch casing (0 feet) \$ 0 (bit-free)

See day 1

(C) OTHER TOTAL

\$

TAX

(A + B + C) + 5.3%

\$ 0

CUMULATIVE DRILLING COSTS

TODAY'S COSTS

\$ 0

PREVIOUS COSTS

\$ 18723.40

TO DATE COSTS

\$ 18723.40

DRILLING DATA

TODAY'S FOOTAGE 0

PREVIOUS FOOTAGE 173

TO DATE FOOTAGE 173

TODAY'S COST PER FOOT \$ 0

TO DATE COST PER FOOT \$ 108.23 TO DATE COST PER HOUR \$ 128.68

drilling = 149.19

CITY OF NORTH BOMBEVILLE
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

KENT ASSOCIATES
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: SEPTEMBER 17, 1981

Day Number 17

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: BE 22-W Cable Tool

HOURS: From 0700 To 1830

TODAY'S HOURS 11.5

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

(A) TOTAL HOURS x \$250.00

\$

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

(B) TOTAL HOURS x \$75.00

\$

OTHER

Costs

Mob & De Mob to site \$1000.00

\$

Drill, install, and cement 8 inch casing () feet) \$

* Drill, install, and cement ¹⁶12 inch casing (14 feet) \$ 0

* See day 1

(C) OTHER TOTAL

\$

TAX

(A + B + C) + 5.3%

\$ 0

CUMULATIVE DRILLING COSTS

TODAY'S COSTS

\$ 0

PREVIOUS COSTS

\$ 18723.40

TO DATE COSTS

\$ 18723.40

DRILLING DATA

TODAY'S FOOTAGE Re-drill 14' PREVIOUS FOOTAGE 173

144' - 158'

TO DATE FOOTAGE 173

TODAY'S COST PER FOOT \$ 0

TO DATE COST PER FOOT \$ 108.23 TO DATE COST PER HOUR \$ 119.26

drilling = 149.19

CITY OF NORTH BONNEVILLE
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

KENT ASSOCIATES
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: SEPTEMBER 18, 1981 Day Number 18

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: BE 22-W Cable Tool

HOURS: From 0800 To 1800

TODAY'S HOURS 10

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

(A) TOTAL HOURS x \$250.00 \$ _____

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

(B) TOTAL HOURS x \$75.00 \$ _____

OTHER

Costs

Mob & De Mob to site \$1000.00 \$ _____

Drill, install, and cement 8 inch casing (____ feet) \$ _____

* Drill, install, and cement ¹⁶/₁₂ inch casing (0 feet) \$ 0

* See day 1 (C) OTHER TOTAL \$ 0

TAX

(A + B + C) + 5.3% \$ 0

CUMULATIVE DRILLING COSTS

TODAY'S COSTS \$ 0

PREVIOUS COSTS \$ 18723.40

TO DATE COSTS \$ 18723.40

DRILLING DATA

continue re-drill

TODAY'S FOOTAGE 0 PREVIOUS FOOTAGE 173

TO DATE FOOTAGE 173

TODAY'S COST PER FOOT \$ 0

TO DATE COST PER FOOT \$ 108.23 TO DATE COST PER HOUR \$ 112.12

drilling = 149.19

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: SEPTEMBER 21, 1981

Day Number 19

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: BE 22-W Cable Tool

HOURS: From 0730 To 1800

TODAY'S HOURS 10.5

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

(A) TOTAL HOURS x \$250.00 \$ _____

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

(B) TOTAL HOURS x \$75.00 \$ _____

OTHER

Costs

Mob & De Mob to site \$1000.00 \$ _____

Drill, install, and cement 8 inch casing (____ feet) \$ _____

* Drill, install, and cement ¹⁶12 inch casing (0 feet) \$ 0

* See Day 1 (C) OTHER TOTAL \$ 0

TAX

(A + B + C) + 5.3% \$ 0

CUMULATIVE DRILLING COSTS

TODAY'S COSTS \$ 0

PREVIOUS COSTS \$ 18723.40

TO DATE COSTS \$ 18723.40

DRILLING DATA re-drill encountered metal in hole

TODAY'S FOOTAGE 0 PREVIOUS FOOTAGE 173

TO DATE FOOTAGE 173

TODAY'S COST PER FOOT \$ 0

TO DATE COST PER FOOT \$ 106.23 TO DATE COST PER HOUR \$ 105.48

drilling = 149.19

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: SEPTEMBER 22, 1981

Day Number 20

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: BE 22-W Cable Tool

HOURS: From 0730 To 1800

TODAY'S HOURS 10.5

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

(A) TOTAL HOURS x \$250.00

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

(B) TOTAL HOURS x \$75.00

OTHER

Costs

Mob & De Mob to site \$1000.00

Drill, install, and cement 8 inch casing (feet) \$

+ Drill, install, and cement ¹⁶12 inch casing (0 feet) \$ 0

+ See day 1

(C) OTHER TOTAL

TAX

(A + B + C) + 5.3%

CUMULATIVE DRILLING COSTS

TODAY'S COSTS

PREVIOUS COSTS

TO DATE COSTS

DRILLING DATA

continue fishing out metal

TODAY'S FOOTAGE

PREVIOUS FOOTAGE

TO DATE FOOTAGE

TODAY'S COST PER FOOT \$ 0

TO DATE COST PER FOOT \$ 108.23 TO DATE COST PER HOUR \$ 99.59

drilling = 149.19

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: SEPTEMBER 23, 1981

Day Number 21

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: BE 22-w Cable Tool

HOURS: From 0730 To 1900

TODAY'S HOURS 11.5

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

(A) TOTAL HOURS x \$250.00

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

(B) TOTAL HOURS x \$75.00

OTHER

Costs

Mob & De Mob to site \$1000.00

Drill, install, and cement 8 inch casing () feet) \$

* Drill, install, and cement ¹⁶12 inch casing (2 feet) \$ 194.00

* See day 1 (C) OTHER TOTAL \$ 194.00

TAX

(A + B + C) + 5.3%

\$ 204.28

CUMULATIVE DRILLING COSTS

TODAY'S COSTS

\$ 204.28

PREVIOUS COSTS

\$ 18723.40

TO DATE COSTS

\$ 18927.68

DRILLING DATA

TODAY'S FOOTAGE

2

PREVIOUS FOOTAGE

173

TO DATE FOOTAGE

175

TODAY'S COST PER FOOT \$ 102.14

TO DATE COST PER FOOT \$ 108.16 TO DATE COST PER HOUR \$ 94.88

drilling = 138.16

CITY OF NORTH BOWENVILLE
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: SEPTEMBER 24, 1981

Day Number 22

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: 8E 22-w Cable Tool

HOURS: From 0730 To 1900

TODAY'S HOURS 11.5

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

(A) TOTAL HOURS x \$250.00

\$

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

(B) TOTAL HOURS x \$75.00

\$

OTHER

Costs

Mob & De Mob to site \$1000.00

\$

Drill, install, and cement 8 inch casing (feet) \$

* Drill, install, and cement ¹⁶12 inch casing (5 feet) \$ 485.00

* See day 1

(C) OTHER TOTAL

includes stickup

\$

485.00

TAX

(A + B + C) + 5.3%

\$

510.71

CUMULATIVE DRILLING COSTS

TODAY'S COSTS

\$

510.71

PREVIOUS COSTS

\$

18927.68

TO DATE COSTS

\$

19438.39

DRILLING DATA

TODAY'S FOOTAGE

5

PREVIOUS FOOTAGE

175

TO DATE FOOTAGE

180

TODAY'S COST PER FOOT \$ 102.14

TO DATE COST PER FOOT \$ 107.99 TO DATE COST PER HOUR \$ 92.13

drilling = 130.90

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: SEPTEMBER 25, 1981 Day Number 23

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: BE 22-W Cable Tool Cement supplies

HOURS: From 0700 To 1600

TODAY'S HOURS 9

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

(A) TOTAL HOURS x \$250.00 \$ _____

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

(B) TOTAL HOURS x \$75.00 \$ _____

OTHER

Costs

Mob & De Mob to site \$1000.00 \$ _____

Drill, install, and cement 8 inch casing (____ feet) \$ _____

Drill, install, and cement 12 inch casing (180 feet) \$ included in previous

(C) OTHER TOTAL 177'6" below G.L. \$ 0

TAX

(A + B + C) + 5.3% \$ 0

CUMULATIVE DRILLING COSTS

TODAY'S COSTS \$ 0

PREVIOUS COSTS \$ 19438.39

TO DATE COSTS \$ 19438.39

DRILLING DATA Install 180' of 12" casing and cement.

TODAY'S FOOTAGE 0 PREVIOUS FOOTAGE 180

TO DATE FOOTAGE 177'6" in ground

TODAY'S COST PER FOOT \$ 0

TO DATE COST PER FOOT \$ 107.99 TO DATE COST PER HOUR \$ 88.36

drilling = 123.42

CITY OF NORTH BONNEVILLE
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

KENT ASSOCIATES
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: SEPTEMBER 28, 1981 Day Number 24

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: 7LS Portadill cement supplies

HOURS: From 1000 To 2000

TODAY'S HOURS 10

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

(A) TOTAL HOURS x \$250.00 \$ _____

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

(B) TOTAL HOURS x \$75.00 \$ _____

OTHER

Costs

Mob & De Mob to site \$1000.00 \$ _____

* Drill, install, and cement 8 inch casing (220 feet) \$ 13,200.00

Drill, install, and cement 12 inch casing (____ feet) \$ _____

* lump sum b/d (C) OTHER TOTAL \$ 13,200.00

TAX

(A + B + C) + 5.3% \$ 13,899.60

CUMULATIVE DRILLING COSTS

TODAY'S COSTS \$ 13,899.60

PREVIOUS COSTS \$ 19,438.39

TO DATE COSTS \$ 33,337.99

DRILLING DATA

TODAY'S FOOTAGE 167.5 PREVIOUS FOOTAGE 177.5

TO DATE FOOTAGE 345

TODAY'S COST PER FOOT \$ 82.98

TO DATE COST PER FOOT \$ 96.63 TO DATE COST PER HOUR \$ 144.95

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: SEPTEMBER 29, 1981

Day Number 25

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: TLS Portadrill

HOURS: From 0730 To 2000

TODAY'S HOURS 12.5

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

(A) TOTAL HOURS x \$250.00

\$

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

(B) TOTAL HOURS x \$75.00

\$

OTHER

Costs

Mob & De Mob to site \$1000.00

\$

Drill, install, and cement 8 inch casing (220 feet) \$ See previous day

Drill, install, and cement 12 inch casing (feet) \$

(C) OTHER TOTAL

\$

TAX

(A + B + C) + 5.3%

\$

CUMULATIVE DRILLING COSTS

TODAY'S COSTS

\$

PREVIOUS COSTS

\$

TO DATE COSTS

\$

DRILLING DATA

TODAY'S FOOTAGE 45.5

PREVIOUS FOOTAGE 345

TO DATE FOOTAGE 390.5

TODAY'S COST PER FOOT \$

TO DATE COST PER FOOT \$ 85.37 TO DATE COST PER HOUR \$ 137.48

CITY OF NORTH BUNNEVILLE
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: SEPTEMBER 30, 1981

Day Number 26

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: TLS Portadrill Cement supplies

HOURS: From 0730 To 1600

TODAY'S HOURS 8.5

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

(A) TOTAL HOURS x \$250.00

\$

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

(B) TOTAL HOURS x \$75.00

\$

OTHER

Costs

Mob & De Mob to site \$1000.00

\$

* Drill, install, and cement 8 inch casing (210 feet) \$ -100.00

Drill, install, and cement 12 inch casing (feet) \$

* pro rated from 220 feet = bid (C) OTHER TOTAL

\$ -100.00

TAX

(A + B + C) + 5.3%

\$ -105.30

CUMULATIVE DRILLING COSTS

TODAY'S COSTS

\$ -105.30

PREVIOUS COSTS

\$ 33337.99

TO DATE COSTS

\$ 33232.69

DRILLING DATA

TODAY'S FOOTAGE 0

PREVIOUS FOOTAGE 390.5

TO DATE FOOTAGE

390 adjusted
more cement

TODAY'S COST PER FOOT \$ -

TO DATE COST PER FOOT \$ 25.21 TO DATE COST PER HOUR \$ 132.40

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

KENT ASSOCIATES
Geologic Consultants
Lake Uswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: OCTOBER 2, 1981

Day Number 27

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: TL5 Portadrill Cement supplies

HOURS: From 1330 To 1530

TODAY'S HOURS 2

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

(A) TOTAL HOURS x \$250.00

\$

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

(B) TOTAL HOURS x \$75.00

\$

OTHER

Costs

Mob & De Mob to site \$1000.00

\$

Drill, install, and cement 8 inch casing (210 feet) \$ 0

Drill, install, and cement 12 inch casing (feet) \$

(C) OTHER TOTAL

\$

TAX

(A + B + C) + 5.3%

\$

CUMULATIVE DRILLING COSTS

TODAY'S COSTS

\$

PREVIOUS COSTS

\$

* TO DATE COSTS

\$

DRILLING DATA

TODAY'S FOOTAGE

0

PREVIOUS FOOTAGE

390

TO DATE FOOTAGE

390

TODAY'S COST PER FOOT \$ 0

* TO DATE COST PER FOOT \$ 85.21 * TO DATE COST PER HOUR \$ 131.36

* Completion of Phase I - casing installation and lump sum price.
Start next day with Phase II and hourly prices unless less than 400 for

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: OCTOBER 5, 1981

Day Number 28

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: TL5 Portadrill

HOURS: From 1130 To 1945

TODAY'S HOURS 8.25

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

* Air rotary tricone excluding bits 8" F3 Smith BR 8068 Bit 2.7 hrs.

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

New bit.

TOTAL

(A) TOTAL HOURS x \$250.00 \$

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

(B) TOTAL HOURS x \$75.00 \$

OTHER

Costs

Mob & De Mob to site \$1000.00 \$

* Drill, install, and cement 8 inch casing (6 feet) \$ drill out cement

Drill, install, and cement 12 inch casing (feet) \$

(C) OTHER TOTAL \$ 0

TAX

* continue Phase I - lump sum.

(A + B + C) + 5.3% \$ 0

CUMULATIVE DRILLING COSTS

TODAY'S COSTS \$ 0

PREVIOUS COSTS \$ 33232.69

TO DATE COSTS \$ 33232.69

DRILLING DATA

TODAY'S FOOTAGE 6 PREVIOUS FOOTAGE 390

TO DATE FOOTAGE 396

TODAY'S COST PER FOOT \$ 0

TO DATE COST PER FOOT \$ 83.92 TO DATE COST PER HOUR \$ 127.21

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: OCTOBER 6, 1981

Day Number 29

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: 7LS Portadrill

HOURS: From 1115 To 1930

(0745 to 1115 chargeable
to Phase I)

TODAY'S HOURS 8.25

(1)

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

* Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

* New bit. 7 7/8" Smith F3 BR 8060

TOTAL

8.25

(A) TOTAL HOURS x \$250.00

\$ 2062.50

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

(B) TOTAL HOURS x \$75.00

\$

OTHER

Costs

Mob & De Mob to site \$1000.00

\$

Drill, install, and cement 8 inch casing (4 feet) \$ to 400 feet recharge

Drill, install, and cement 12 inch casing (feet) \$

(C) OTHER TOTAL

\$

TAX

(A + B + C) + 5.3%

\$ 2171.81

CUMULATIVE DRILLING COSTS

TODAY'S COSTS

\$ 2171.81

PREVIOUS COSTS

\$ 0

TO DATE COSTS

\$ 2171.81

DRILLING DATA

TODAY'S FOOTAGE 40

PREVIOUS FOOTAGE 396

TO DATE FOOTAGE 436

* TODAY'S COST PER FOOT \$ 60.33 (from 400 feet)

* TO DATE COST PER FOOT \$ 60.33 * TO DATE COST PER HOUR \$ 263.25

(1) time drillers on-site, not necessarily chargeable

* From 400 feet.

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
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Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: OCTOBER 7, 1981 Day Number 30

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: TLS Portadrill

HOURS: From 0730 To 1956 (2000)

TODAY'S HOURS 12.4

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

11.4

(A) TOTAL HOURS x \$250.00

\$ 2850.00

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby 0730 - 0820 water sample

0.83

Maintenance or repair 1111 - 1123

0.2

Fishing

TOTAL

1.03

(B) TOTAL HOURS x \$75.00

\$ 77.25

OTHER

Costs

Mob & De Mob to site \$1000.00

\$

Drill, install, and cement 8 inch casing (____ feet) \$

\$

Drill, install, and cement 12 inch casing (____ feet) \$

\$

(C) OTHER TOTAL

\$

TAX

(A + B + C) + 5.3%

\$ 3082.39

CUMULATIVE DRILLING COSTS

TODAY'S COSTS

\$ 3082.39

PREVIOUS COSTS

\$ 2171.81

TO DATE COSTS

\$ 5254.20

DRILLING DATA

TODAY'S FOOTAGE 27

PREVIOUS FOOTAGE 436

TO DATE FOOTAGE 463

TODAY'S COST PER FOOT \$ 114.16

TO DATE COST PER FOOT \$ 83.40 TO DATE COST PER HOUR \$ 267.39

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
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Project No. 81824/K7883

DRILLING COSTS

DATE: OCTOBER 8, 1981

Day Number 31

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: TLS Portadrill

HOURS: From 0800 To 2000

TODAY'S HOURS 12

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

11.8

(A) TOTAL HOURS x \$250.00

\$ 2950.00

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

0.2

(B) TOTAL HOURS x \$75.00

\$ 15.00

OTHER

Costs

Mob & De Mob to site \$1000.00

Drill, install, and cement 8 inch casing (feet) \$

Drill, install, and cement 12 inch casing (feet) \$

(C) OTHER TOTAL

\$

TAX

(A + B + C) + 5.3%

\$ 3122.15

CUMULATIVE DRILLING COSTS

TODAY'S COSTS

\$ 3122.15

PREVIOUS COSTS

\$ 5254.20

TO DATE COSTS

\$ 8376.35

DRILLING DATA

TODAY'S FOOTAGE 103

PREVIOUS FOOTAGE 463

TO DATE FOOTAGE

566

TODAY'S COST PER FOOT \$ 30.31

TO DATE COST PER FOOT \$ 50.46 TO DATE COST PER HOUR \$ 265.92

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
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Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: OCTOBER 9, 1981 Day Number 32

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: TL5 Portadrill

HOURS: From 0727 To 1602

TODAY'S HOURS 8.6

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

8.23

(A) TOTAL HOURS x \$250.00

\$ 2057.50

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

0.3

(B) TOTAL HOURS x \$75.00

\$ 22.50

OTHER

Costs

Mob & De Mob to site \$1000.00

\$

Drill, install, and cement 8 inch casing (feet) \$

\$

Drill, install, and cement 12 inch casing (feet) \$

\$

(C) OTHER TOTAL

\$

TAX

(A + B + C) + 5.3%

\$ 2190.24

CUMULATIVE DRILLING COSTS

TODAY'S COSTS

\$ 2190.24

PREVIOUS COSTS

\$ 8376.25

TO DATE COSTS

\$ 10566.49

DRILLING DATA

TODAY'S FOOTAGE 60

PREVIOUS FOOTAGE 566

TO DATE FOOTAGE 626

TODAY'S COST PER FOOT \$ 36.50

TO DATE COST PER FOOT \$ 46.75 TO DATE COST PER HOUR \$ 266.16

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
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Project No. 81824/K7883

DRILLING COSTS

DATE: OCTOBER 12, 1981 Day Number 33

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: TLS Portadrill

HOURS: From 0840 To 1840

TODAY'S HOURS 10

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

10

(A) TOTAL HOURS x \$250.00

\$ 2500.00

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

0.25

Maintenance or repair

Fishing

TOTAL

0.25

(B) TOTAL HOURS x \$75.00

\$ 18.75

OTHER

Costs

Mob & De Mob to site \$1000.00

\$

Drill, install, and cement 8 inch casing (feet) \$

\$

Drill, install, and cement 12 inch casing (feet) \$

\$

(C) OTHER TOTAL

\$

TAX

(A + B + C) + 5.3%

\$ 2518.75

CUMULATIVE DRILLING COSTS

TODAY'S COSTS

\$ 2518.75

PREVIOUS COSTS

\$ 10566.49

TO DATE COSTS

\$ 13085.24

DRILLING DATA

TODAY'S FOOTAGE 61.5

PREVIOUS FOOTAGE 626

TO DATE FOOTAGE 687.5

TODAY'S COST PER FOOT \$ 40.96

TO DATE COST PER FOOT \$ 45.51 TO DATE COST PER HOUR \$ 263.28

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
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Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: OCTOBER 13, 1981 Day Number 34

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: TLS Portadrill

HOURS: From 0700 To 1838

TODAY'S HOURS 11.6

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

(A) TOTAL HOURS x \$250.00 \$ 2850.00

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

(B) TOTAL HOURS x \$75.00 \$ 18.75

OTHER

Costs

Mob & De Mob to site \$1000.00 \$

Drill, install, and cement 8 inch casing (feet) \$

Drill, install, and cement 12 inch casing (feet) \$

(C) OTHER TOTAL \$

TAX

(A + B + C) + 5.3% \$ 3020.79

CUMULATIVE DRILLING COSTS

TODAY'S COSTS \$ 3020.79

PREVIOUS COSTS \$ 13085.24

TO DATE COSTS \$ 16106.04

DRILLING DATA

TODAY'S FOOTAGE 80 PREVIOUS FOOTAGE 687.5

TO DATE FOOTAGE 767.5

TODAY'S COST PER FOOT \$ 37.76

TO DATE COST PER FOOT \$ 43.83 TO DATE COST PER HOUR \$ 263.60

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
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Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: OCTOBER 14, 1981

Day Number 35

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: TLS Portadill

HOURS: From 0700 To 1913

TODAY'S HOURS 12.2

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

11.9

(A) TOTAL HOURS x \$250.00

\$ 2975.00

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

0.25

Maintenance or repair

Fishing

TOTAL

0.25

(B) TOTAL HOURS x \$75.00

\$ 18.75

OTHER

Costs

Mob & De Mob to site \$1000.00

\$

Drill, install, and cement 8 inch casing (____ feet) \$

\$

Drill, install, and cement 12 inch casing (____ feet) \$

\$

(C) OTHER TOTAL

\$

TAX

(A + B + C) + 5.3%

\$ 3152.42

CUMULATIVE DRILLING COSTS

TODAY'S COSTS

\$ 3152.42

PREVIOUS COSTS

\$ 16106.04

TO DATE COSTS

\$ 19258.46

DRILLING DATA

TODAY'S FOOTAGE 52.5

PREVIOUS FOOTAGE 767.5

TO DATE FOOTAGE 820

*TODAY'S COST PER FOOT \$ 60.05

*TO DATE COST PER FOOT \$ 45.85 *TO DATE COST PER HOUR \$ 263.82

* previous and following are from 400 feet

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: OCTOBER 15, 1981 Day Number 36

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: TLS Portadrill

HOURS: From 0650 To 1907

TODAY'S HOURS 12.3

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL 12.1

(A) TOTAL HOURS x \$250.00 \$ 3025.00

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL 0.2

(B) TOTAL HOURS x \$75.00 \$ 15.00

OTHER

Costs

Mob & De Mob to site \$1000.00 \$

Drill, install, and cement 8 inch casing (feet) \$

Drill, install, and cement 12 inch casing (feet) \$

(C) OTHER TOTAL \$

TAX

(A + B + C) + 5.3% \$ 3201.12

CUMULATIVE DRILLING COSTS

TODAY'S COSTS \$ 3201.12

PREVIOUS COSTS \$ 19258.46

TO DATE COSTS \$ 22459.58

DRILLING DATA

TODAY'S FOOTAGE 67.5 PREVIOUS FOOTAGE 820

TO DATE FOOTAGE 887.5

TODAY'S COST PER FOOT \$ 47.42

TO DATE COST PER FOOT \$ 46.07 TO DATE COST PER HOUR \$ 263.92

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: OCTOBER 16, 1981 Day Number 37

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: TL5 Portadrill

HOURS: From 0700 To 1605

TODAY'S HOURS 9.1

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

8.6

(A) TOTAL HOURS x \$250.00

\$ 2150.00

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

0

(B) TOTAL HOURS x \$75.00

\$ 0

OTHER

Costs

Mob & De Mob to site \$1000.00

\$

Drill, install, and cement 8 inch casing (feet) \$

\$

Drill, install, and cement 12 inch casing (feet) \$

\$

(C) OTHER TOTAL

\$

TAX

(A + B + C) + 5.3%

\$ 2263.95

CUMULATIVE DRILLING COSTS

TODAY'S COSTS

\$ 2263.95

PREVIOUS COSTS

\$ 22459.58

TO DATE COSTS

\$ 24723.53

DRILLING DATA

TODAY'S FOOTAGE 23.5

PREVIOUS FOOTAGE 887.5

TO DATE FOOTAGE 911

TODAY'S COST PER FOOT \$ 96.34

TO DATE COST PER FOOT \$ 48.38 TO DATE COST PER HOUR \$ 263.86

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
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Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: OCTOBER 19, 1981

Day Number 38

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: TLS Portadrill

HOURS: From 1100 To 2003

TODAY'S HOURS 9.1

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

9.1

(A) TOTAL HOURS x \$250.00

\$ 2275.00

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

0

(B) TOTAL HOURS x \$75.00

\$ 0

OTHER

Costs

Mob & De Mob to site \$1000.00

\$

Drill, install, and cement 8 inch casing (____ feet) \$

\$

Drill, install, and cement 12 inch casing (____ feet) \$

\$

(C) OTHER TOTAL

\$

TAX

(A + B + C) + 5.3%

\$ 2395.58

CUMULATIVE DRILLING COSTS

TODAY'S COSTS

\$ 2395.58

PREVIOUS COSTS

\$ 24723.53

TO DATE COSTS

\$ 27119.11

DRILLING DATA

TODAY'S FOOTAGE 15

PREVIOUS FOOTAGE 911

TO DATE FOOTAGE 926

TODAY'S COST PER FOOT \$ 159.71

TO DATE COST PER FOOT \$ 51.56 TO DATE COST PER HOUR \$ 263.93

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: OCTOBER 20, 1981

Day Number 39

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: TL5 Portadrill

HOURS: From 0700 To 2005

TODAY'S HOURS 13.1

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

11.7

(A) TOTAL HOURS x \$250.00

\$ 2925.00

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

1.4

(B) TOTAL HOURS x \$75.00

\$ 105.00

OTHER

Costs

Mob & De Mob to site \$1000.00

\$

Drill, install, and cement 8 inch casing (feet) \$

Drill, install, and cement 12 inch casing (feet) \$

(C) OTHER TOTAL

\$

TAX

(A + B + C) + 5.3%

\$ 3190.59

CUMULATIVE DRILLING COSTS

TODAY'S COSTS

\$ 3190.59

PREVIOUS COSTS

\$ 27119.11

TO DATE COSTS

\$ 30309.70

DRILLING DATA

TODAY'S FOOTAGE 35.5

PREVIOUS FOOTAGE 926

TO DATE FOOTAGE 961.5

TODAY'S COST PER FOOT \$ 89.88

TO DATE COST PER FOOT \$ 53.98 TO DATE COST PER HOUR \$ 264.71

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: OCTOBER 21, 1981

Day Number 40

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: TLS Portadrill

HOURS: From 0700 To 2009

TODAY'S HOURS 13.2

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

13.2

(A) TOTAL HOURS x \$250.00

\$ 3300.00

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

0

(B) TOTAL HOURS x \$75.00

\$ 0

OTHER

Costs

Mob & De Mob to site \$1000.00

\$

Drill, install, and cement 8 inch casing (____ feet) \$

\$

Drill, install, and cement 12 inch casing (____ feet) \$

\$

(C) OTHER TOTAL

\$

TAX

(A + B + C) + 5.3%

\$ 3474.90

CUMULATIVE DRILLING COSTS

TODAY'S COSTS

\$ 3474.90

PREVIOUS COSTS

\$ 30309.70

TO DATE COSTS

\$ 33784.60

DRILLING DATA

TODAY'S FOOTAGE 20

PREVIOUS FOOTAGE 961.5

TO DATE FOOTAGE 981.5

TODAY'S COST PER FOOT \$ 173.75

TO DATE COST PER FOOT \$ 52.10 TO DATE COST PER HOUR \$ 264.56

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
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Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: OCTOBER 22, 1981 Day Number 41

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: 7LS Portadrill

HOURS: From 0700 To 1042

TODAY'S HOURS 3.7

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL 3.7

(A) TOTAL HOURS x \$250.00 \$ 925.00

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL 0

(B) TOTAL HOURS x \$75.00 \$ 0

OTHER

Costs

Mob & De Mob to site \$1000.00 \$

Drill, install, and cement 8 inch casing (feet) \$

Drill, install, and cement 12 inch casing (feet) \$

(C) OTHER TOTAL \$

TAX

(A + B + C) + 5.3% \$ 974.03

CUMULATIVE DRILLING COSTS

TODAY'S COSTS \$ 974.03

PREVIOUS COSTS \$ 33784.60

TO DATE COSTS \$ 34758.63

DRILLING DATA

TODAY'S FOOTAGE 3.0 PREVIOUS FOOTAGE 981.5

TO DATE FOOTAGE 981.5

TODAY'S COST PER FOOT \$ 0

TO DATE COST PER FOOT \$ 59.77 TO DATE COST PER HOUR \$ 264.52

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: NOVEMBER 11, 1981 Day Number 42

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: TKT Portadrill

HOURS: From 0930 To 1700

TODAY'S HOURS 7.5

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

(A) TOTAL HOURS x \$250.00

5.25
\$ 1312.50

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

(B) TOTAL HOURS x \$75.00

0
\$ 0

OTHER

Costs

Mob & De Mob to site \$1000.00

Drill, install, and cement 8 inch casing (feet) \$

Drill, install, and cement 12 inch casing (feet) \$

(C) OTHER TOTAL

\$

TAX

(A + B + C) + 5.3%

\$ 1382.06

CUMULATIVE DRILLING COSTS

TODAY'S COSTS

\$ 1382.06

PREVIOUS COSTS

\$ 34758.63

TO DATE COSTS

\$ 36140.69

DRILLING DATA

TODAY'S FOOTAGE 7

PREVIOUS FOOTAGE 981.5

TO DATE FOOTAGE 988.5

TODAY'S COST PER FOOT \$ 197.44

TO DATE COST PER FOOT \$ 61.41 TO DATE COST PER HOUR \$ 264.38

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: NOVEMBER 12, 1981 Day Number 43

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: TKT Portadrill

HOURS: From 0830 To 1720

TODAY'S HOURS 8.8

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

8.8

(A) TOTAL HOURS x \$250.00 \$ 2200.00

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

0

(B) TOTAL HOURS x \$75.00 \$ 0

OTHER

Costs

Mob & De Mob to site \$1000.00

\$

Drill, install, and cement 8 inch casing (feet) \$

\$

Drill, install, and cement 12 inch casing (feet) \$

\$

(C) OTHER TOTAL

\$

TAX

(A + B + C) + 5.3%

\$ 2316.60

CUMULATIVE DRILLING COSTS

TODAY'S COSTS

\$ 2316.60

PREVIOUS COSTS

\$ 36140.69

TO DATE COSTS

\$ 38457.29

DRILLING DATA

TODAY'S FOOTAGE 27

PREVIOUS FOOTAGE 988.5

TO DATE FOOTAGE 1015.5

TODAY'S COST PER FOOT \$ 85.80

TO DATE COST PER FOOT \$ 62.48 TO DATE COST PER HOUR \$ 264.31

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: NOVEMBER 13, 1981

Day Number 44

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: TKT Rotadrill

HOURS: From 0800 To 1605

TODAY'S HOURS 8.1

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

7.6

(A) TOTAL HOURS x \$250.00

\$ 1900.00

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

0.5

(B) TOTAL HOURS x \$75.00

\$ 37.50

OTHER

Costs

Mob & De Mob to site \$1000.00

\$

Drill, install, and cement 8 inch casing (feet) \$

\$

Drill, install, and cement 12 inch casing (feet) \$

\$

(C) OTHER TOTAL

\$

TAX

(A + B + C) + 5.3%

\$ 2040.19

CUMULATIVE DRILLING COSTS

TODAY'S COSTS

\$ 2040.19

PREVIOUS COSTS

\$ 38457.29

TO DATE COSTS

\$ 40497.48

DRILLING DATA

TODAY'S FOOTAGE 28

PREVIOUS FOOTAGE 1015.5

TO DATE FOOTAGE

1043.5

TODAY'S COST PER FOOT \$ 72.86

TO DATE COST PER FOOT \$ 62.93 TO DATE COST PER HOUR \$ 264.52

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: NOVEMBER 16, 1981

Day Number 45

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: TKT Portadill

HOURS: From 0830 To 1707

TODAY'S HOURS 8.6

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

8.6

(A) TOTAL HOURS x \$250.00

\$ 2150.00

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

0

(B) TOTAL HOURS x \$75.00

\$ 0

OTHER

Costs

Mob & De Mob to site \$1000.00

\$

Drill, install, and cement 8 inch casing (feet) \$

\$

Drill, install, and cement 12 inch casing (feet) \$

\$

(C) OTHER TOTAL

\$

TAX

(A + B + C) + 5.3%

\$ 2263.95

CUMULATIVE DRILLING COSTS

TODAY'S COSTS

\$ 2263.95

PREVIOUS COSTS

\$ 40497.48

TO DATE COSTS

\$ 42761.43

DRILLING DATA

TODAY'S FOOTAGE 56

PREVIOUS FOOTAGE 1043.5

TO DATE FOOTAGE 1099.5

TODAY'S COST PER FOOT \$ 40.43

*TO DATE COST PER FOOT \$ 61.13 *TO DATE COST PER HOUR \$ 264.45

* from 400 feet

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: NOVEMBER 17, 1981

Day Number 46

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: TKT Portadrill

HOURS: From 0830 To 1705

TODAY'S HOURS 8.6

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL 8.6

(A) TOTAL HOURS x \$250.00 \$ 2150.00

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL 0

(B) TOTAL HOURS x \$75.00 \$ 0

OTHER

Costs

Mob & De Mob to site \$1000.00 \$

Drill, install, and cement 8 inch casing (feet) \$

Drill, install, and cement 12 inch casing (feet) \$

(C) OTHER TOTAL \$

TAX

(A + B + C) + 5.3% \$ 2263.95

CUMULATIVE DRILLING COSTS

TODAY'S COSTS \$ 2263.95

PREVIOUS COSTS \$ 42761.43

TO DATE COSTS \$ 45025.38

DRILLING DATA

TODAY'S FOOTAGE 83.3 PREVIOUS FOOTAGE 1099.5

TO DATE FOOTAGE 1182.8

TODAY'S COST PER FOOT \$ 27.18

TO DATE COST PER FOOT \$ 57.52 TO DATE COST PER HOUR \$ 264.39

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: NOVEMBER 18, 1981 Day Number 47

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: TKT Portadrill

HOURS: From 0810 To 1705

TODAY'S HOURS 8.9

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

8.9

(A) TOTAL HOURS x \$250.00

\$ 2225.00

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

0

(B) TOTAL HOURS x \$75.00

\$ 0

OTHER

Costs

Mob & De Mob to site \$1000.00

\$

Drill, install, and cement 8 inch casing (feet) \$

\$

Drill, install, and cement 12 inch casing (feet) \$

\$

(C) OTHER TOTAL

\$

TAX

(A + B + C) + 5.3%

\$ 2342.93

CUMULATIVE DRILLING COSTS

TODAY'S COSTS

\$ 2342.93

PREVIOUS COSTS

\$ 45025.38

TO DATE COSTS

\$ 47368.31

DRILLING DATA

TODAY'S FOOTAGE 97

PREVIOUS FOOTAGE 1182.8

TO DATE FOOTAGE 1279.8

TODAY'S COST PER FOOT \$ 24.15

TO DATE COST PER FOOT \$ 53.84 TO DATE COST PER HOUR \$ 264.33

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: NOVEMBER 19, 1981

Day Number 46

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: TKT Portadrill

HOURS: From 0825 To 1655

TODAY'S HOURS 8.5

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

7.7

(A) TOTAL HOURS x \$250.00

\$ 1925.00

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

0.83

(B) TOTAL HOURS x \$75.00

\$ 62.25

OTHER

Costs

Mob & De Mob to site \$1000.00

\$

Drill, install, and cement 8 inch casing (feet) \$

\$

Drill, install, and cement 12 inch casing (feet) \$

\$

(C) OTHER TOTAL

\$

TAX

(A + B + C) + 5.3%

\$ 2092.57

CUMULATIVE DRILLING COSTS

TODAY'S COSTS

\$ 2092.57

PREVIOUS COSTS

\$ 47362.31

TO DATE COSTS

\$ 49460.88

DRILLING DATA

TODAY'S FOOTAGE 100

PREVIOUS FOOTAGE 1279.8

TO DATE FOOTAGE 1379.8

TODAY'S COST PER FOOT \$ 20.93

TO DATE COST PER FOOT \$ 50.48 TO DATE COST PER HOUR \$ 264.64

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: NOVEMBER 20, 1981 Day Number 49

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: TKT Portadrill

HOURS: From 0820 To 1603

TODAY'S HOURS 7.7

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

(A) TOTAL HOURS x \$250.00

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

(B) TOTAL HOURS x \$75.00

OTHER

Costs

Mob & De Mob to site \$1000.00

Drill, install, and cement 8 inch casing () feet \$

Drill, install, and cement 12 inch casing () feet \$

(C) OTHER TOTAL

TAX

(A + B + C) + 5.3%

CUMULATIVE DRILLING COSTS

TODAY'S COSTS

PREVIOUS COSTS

TO DATE COSTS

DRILLING DATA

TODAY'S FOOTAGE 104.9 PREVIOUS FOOTAGE 1379.8

TO DATE FOOTAGE 1484.7

TODAY'S COST PER FOOT \$ 18.45

TO DATE COST PER FOOT \$ 47.38 TO DATE COST PER HOUR \$ 264.79

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: NOVEMBER 23, 1981

Day Number 50

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: TKT Portadrill

HOURS: From 0815 To 1655

TODAY'S HOURS 8.7

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

8.7

(A) TOTAL HOURS x \$250.00

\$ 2175.00

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

0

(B) TOTAL HOURS x \$75.00

\$ 0

OTHER

Costs

Mob & De Mob to site \$1000.00

\$

Drill, install, and cement 8 inch casing (feet) \$

Drill, install, and cement 12 inch casing (feet) \$

(C) OTHER TOTAL

\$

TAX

(A + B + C) + 5.3%

\$ 2290.28

CUMULATIVE DRILLING COSTS

TODAY'S COSTS

\$ 2290.28

PREVIOUS COSTS

\$ 51395.77

TO DATE COSTS

\$ 53686.05

DRILLING DATA

TODAY'S FOOTAGE 155.7

PREVIOUS FOOTAGE 1484.7

TO DATE FOOTAGE 1640.4

TODAY'S COST PER FOOT \$ 14.71

TO DATE COST PER FOOT \$ 43.28 TO DATE COST PER HOUR \$ 264.72

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: NOVEMBER 24, 1981 Day Number 51

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: TKT Portadrill

HOURS: From 0820 To 1715

TODAY'S HOURS 8.95

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL 6.25

(A) TOTAL HOURS x \$250.00 \$ 1562.50

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL 2.7

(B) TOTAL HOURS x \$75.00 \$ 202.50

OTHER

Costs

Mob & De Mob to site \$1000.00 \$

Drill, install, and cement 8 inch casing (feet) \$

Drill, install, and cement 12 inch casing (feet) \$

(C) OTHER TOTAL \$

TAX

(A + B + C) + 5.3% \$ 1858.55

CUMULATIVE DRILLING COSTS

TODAY'S COSTS \$ 1858.55

PREVIOUS COSTS \$ 53686.05

TO DATE COSTS \$ 55544.60

DRILLING DATA

TODAY'S FOOTAGE 109.9 PREVIOUS FOOTAGE 1640.4

TO DATE FOOTAGE 1750.3

TODAY'S COST PER FOOT \$ 16.91

TO DATE COST PER FOOT \$ 41.14 TO DATE COST PER HOUR \$ 265.64

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: NOVEMBER 25, 1981 Day Number 52

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: TKT Portadrill

HOURS: From 0800 To 1245

TODAY'S HOURS 4.75

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

(A) TOTAL HOURS x \$250.00

4.75
\$ 1187.50

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

(B) TOTAL HOURS x \$75.00

1.25
\$ 93.75

OTHER

Costs

Mob & De Mob to site \$1000.00

Drill, install, and cement 8 inch casing (feet) \$

Drill, install, and cement 12 inch casing (feet) \$

(C) OTHER TOTAL

\$

TAX

(A + B + C) + 5.3%

\$ 1349.16

CUMULATIVE DRILLING COSTS

TODAY'S COSTS

PREVIOUS COSTS

TO DATE COSTS

\$ 1349.16

\$ 55544.60

\$ 56893.76

DRILLING DATA

TODAY'S FOOTAGE 70

PREVIOUS FOOTAGE 1750.3

TO DATE FOOTAGE 1820.3

TODAY'S COST PER FOOT \$ 19.27

TO DATE COST PER FOOT \$ 40.06 TO DATE COST PER HOUR \$ 265.98

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: NOVEMBER 30, 1981

Day Number 53

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: TKT Portadrill

HOURS: From 0900 To 1655

TODAY'S HOURS 7.9

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

(A) TOTAL HOURS x \$250.00

\$ 1900.00

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

(B) TOTAL HOURS x \$75.00

\$ 22.50

OTHER

Costs

Mob & De Mob to site \$1000.00

Drill, install, and cement 8 inch casing (feet) \$

Drill, install, and cement 12 inch casing (feet) \$

(C) OTHER TOTAL

\$

TAX

(A + B + C) + 5.3%

\$ 2024.39

CUMULATIVE DRILLING COSTS

TODAY'S COSTS

\$ 2024.39

PREVIOUS COSTS

\$ 56893.76

TO DATE COSTS

\$ 58918.15

DRILLING DATA

TODAY'S FOOTAGE 120

PREVIOUS FOOTAGE 1820.3

TO DATE FOOTAGE 1940.3

TODAY'S COST PER FOOT \$ 16.87

TO DATE COST PER FOOT \$ 38.25 TO DATE COST PER HOUR \$ 265.99

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: DECEMBER 1, 1981 Day Number 54

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: TKT Portadrill

HOURS: From 0810 To 1810

TODAY'S HOURS 10

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

8.6

(A) TOTAL HOURS x \$250.00 \$ 2150.00

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

1.4

(B) TOTAL HOURS x \$75.00 \$ 105.00

OTHER

Costs

Mob & De Mob to site \$1000.00 \$

Drill, install, and cement 8 inch casing (feet) \$

Drill, install, and cement 12 inch casing (feet) \$

(C) OTHER TOTAL \$

TAX

(A + B + C) + 5.3% \$ 2374.52

CUMULATIVE DRILLING COSTS

TODAY'S COSTS \$ 2374.52

PREVIOUS COSTS \$ 58918.15

TO DATE COSTS \$ 61292.67

DRILLING DATA

TODAY'S FOOTAGE 140 PREVIOUS FOOTAGE 1940.3

TO DATE FOOTAGE 2080.3

TODAY'S COST PER FOOT \$ 16.96

TO DATE COST PER FOOT \$ 36.48 TO DATE COST PER HOUR \$ 266.37

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: DECEMBER 2, 1981 Day Number 55

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: TKT Portadrill

HOURS: From 0900 To 1025

TODAY'S HOURS 1.4

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

(A) TOTAL HOURS x \$250.00 \$ 0

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

(B) TOTAL HOURS x \$75.00 \$ 105.00

OTHER

Costs

Mob & De Mob to site \$1000.00 \$

Drill, install, and cement 8 inch casing (feet) \$

Drill, install, and cement 12 inch casing (feet) \$

(C) OTHER TOTAL \$

TAX

(A + B + C) + 5.3% \$ 110.57

CUMULATIVE DRILLING COSTS

TODAY'S COSTS \$ 110.57

PREVIOUS COSTS \$ 61292.67

TO DATE COSTS \$ 61403.24

DRILLING DATA

TODAY'S FOOTAGE 0 PREVIOUS FOOTAGE 2080.3

TO DATE FOOTAGE 2080.3

TODAY'S COST PER FOOT \$ 0

TO DATE COST PER FOOT \$ 36.54 TO DATE COST PER HOUR \$ 266.97

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: DECEMBER 3, 1981 Day Number 56

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: TKT Ported drill

HOURS: From 1420 To 1745

TODAY'S HOURS 3.4

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

(A) TOTAL HOURS x \$250.00

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

(B) TOTAL HOURS x \$75.00

OTHER

Costs

Mob & De Mob to site \$1000.00

Drill, install, and cement 8 inch casing () feet) \$

Drill, install, and cement 12 inch casing () feet) \$

(C) OTHER TOTAL

TAX

(A + B + C) + 5.3%

CUMULATIVE DRILLING COSTS

TODAY'S COSTS

PREVIOUS COSTS

TO DATE COSTS

DRILLING DATA

TODAY'S FOOTAGE

PREVIOUS FOOTAGE

TO DATE FOOTAGE

TODAY'S COST PER FOOT

TO DATE COST PER FOOT

TO DATE COST PER HOUR

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: DECEMBER 4, 1981

Day Number 57

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: TKT Portadrill

HOURS: From 0930 To 1500

TODAY'S HOURS 5.5

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

0

(A) TOTAL HOURS x \$250.00

\$ 0

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

1.8

(B) TOTAL HOURS x \$75.00

\$ 135.00

OTHER

Costs

Mob & De Mob to site \$1000.00

\$

Drill, install, and cement 8 inch casing (feet) \$

\$

Drill, install, and cement 12 inch casing (feet) \$

\$

(C) OTHER TOTAL

\$

TAX

(A + B + C) + 5.3%

\$ 142.16

CUMULATIVE DRILLING COSTS

TODAY'S COSTS

\$ 142.16

PREVIOUS COSTS

\$ 61671.76

TO DATE COSTS

\$ 61813.92

DRILLING DATA

TODAY'S FOOTAGE

0

PREVIOUS FOOTAGE

2080.3

TO DATE FOOTAGE

2080.3

TODAY'S COST PER FOOT \$ 0

TO DATE COST PER FOOT \$ 36.79

TO DATE COST PER HOUR \$ 268.76

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: DECEMBER 7, 1981

Day Number 58

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: TKT Portadrill

HOURS: From 0820 (12/7) To 0205 (12/8)

TODAY'S HOURS 17.75

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

(A) TOTAL HOURS x \$250.00

15.5
\$ 3875.00

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

(B) TOTAL HOURS x \$75.00

2.2
\$ 165.00

OTHER

Costs

Mob & De Mob to site \$1000.00

Drill, install, and cement 8 inch casing (feet) \$

Drill, install, and cement 12 inch casing (feet) \$

(C) OTHER TOTAL

\$

TAX

(A + B + C) + 5.3%

\$ 4254.12

CUMULATIVE DRILLING COSTS

TODAY'S COSTS

PREVIOUS COSTS

TO DATE COSTS

\$ 4254.12

\$ 61813.92

\$ 66068.04

DRILLING DATA

TODAY'S FOOTAGE 145.7

PREVIOUS FOOTAGE 2080.3

TO DATE FOOTAGE 2226

TODAY'S COST PER FOOT \$ 29.20

TO DATE COST PER FOOT \$ 36.18 TO DATE COST PER HOUR \$ 269.17

City of North Bonneville
Geothermal Test Well NB-4 T
City Lot R-13, NW Sec. 21
T. 2 N., R. 7 E.

Kent Associates
Geologic Consultants
Lake Oswego, Oregon
Project No. 81824/K7883

DRILLING COSTS

DATE: DECEMBER 8, 1981 Day Number 59 of 59

Bach Drilling Company, Ellensburg, Washington

EQUIPMENT: TKT Portadrill

HOURS: From 0800 To 1625

TODAY'S HOURS 8.4

BREAKDOWN OF DAILY CHARGES

DRILLING

Hours

Rotary air hammer including bits

Air rotary tricone excluding bits

Water rotary tricone excluding bits

Mud rotary tricone excluding bits

TOTAL

(A) TOTAL HOURS x \$250.00

\$ 1400.00

STANDBY, MAINTENANCE/REPAIR, FISHING

Hours

Standby

Maintenance or repair

Fishing

TOTAL

(B) TOTAL HOURS x \$75.00

\$ 206.25

OTHER

Costs

Mob & De Mob to site \$1000.00

Drill, install, and cement 8 inch casing (feet) \$

Drill, install, and cement 12 inch casing (feet) \$

(C) OTHER TOTAL

\$

TAX

(A + B + C) + 5.3%

\$ 1691.38

CUMULATIVE DRILLING COSTS

TODAY'S COSTS

\$ 1691.38

PREVIOUS COSTS

\$ 66068.04

TO DATE COSTS

\$ 67759.42

DRILLING DATA

*** ACTUAL \$67,892.97**

TODAY'S FOOTAGE

0

PREVIOUS FOOTAGE

2226

TO DATE FOOTAGE

2226

TODAY'S COST PER FOOT \$ 0

TO DATE COST PER FOOT \$ 37.11 TO DATE COST PER HOUR \$ 269.85

*** Based on 251.03 hrs x \$250**

and 22.91 hrs x \$75

EG & G Idaho, Inc.
Bonneville Geothermal
June, 1982

A P P E N D I X H

G E O P H Y S I C A L L O G S

Albrook Hydraulic Laboratory
Pullman, Washington

DOWNHOLE GEOPHYSICAL LOGS

Phase II - Production Test Hole NB-4
City of North Bonneville, Washington

<u>Date</u>	<u>Log</u>	<u>To Depth</u>
10-28-81	FT-C	980'
	FR-C	980'
10-29-81	SP/R	980'
	Caliper	975'
	Nat. gamma	978'
	Nat. gamma re-run	978'
	Gamma gamma	978'
	Neutron neutron	977'
	Neutron gamma	978'
12-9-81	SP/R	2226'
	FR-C	2220'
	FT-C	2222'
12-10-81	Nat. gamma	2226'
	Gamma gamma	2226'
	Neutron gamma	2226'
	Neutron neutron	2226'
	Caliper	2216'
12-11-81	Flow	500'
	Flow	2200'
1-28-82	Flow	2227'
	FT-C	2226'

1185

1505

900

800

700

600

500

400

300

200

100

0.64

Drill R. BERNVILLE Depth 200 Location 1 Set ---
Date --- Coring Site 8 In ---
Revised by Gern & Parry Core 1000 ft Water Table Depth 0
Log Name FR-6 Scale 1/2 Obsec in 1 sec. Time Const. ---
Description --- 15' below surface
Core --- 15' below surface
Vertical Scale 20 Min Logging rates 50 Min/hr
Remarks --- 15' below surface
Supervisor --- Captain ---
Geologist --- ---
H = 3

WATER LEVEL 972 LOCATION 1 A SEA
DATE 20/10/1971 DRAINING SITE 1
WATER LEVEL 972 DATE 20/10/1971 WATER LEVEL 972
SLOPE 1:10 SLOPE 1:10 SLOPE 1:10
DISTANCE 1000 FEET TO POINT 10
WATER LEVEL 972 LOCATION 1 A SEA
DATE 20/10/1971 DRAINING SITE 1
WATER LEVEL 972 DATE 20/10/1971 WATER LEVEL 972
SLOPE 1:10 SLOPE 1:10 SLOPE 1:10
DISTANCE 1000 FEET TO POINT 10
WATER LEVEL 972 LOCATION 1 A SEA
DATE 20/10/1971 DRAINING SITE 1
WATER LEVEL 972 DATE 20/10/1971 WATER LEVEL 972
SLOPE 1:10 SLOPE 1:10 SLOPE 1:10
DISTANCE 1000 FEET TO POINT 10

100
Reference

100
Reference

1520
14. 1/2 in. 22

1520
14. 1/2 in. 22

115 in
stamps

176625