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GROUNDWATER SAMPLING AND MONITORING PLAN

FOR

LIGHTNING DOCK GEOTHERMAL NO. 1, HI-01 LLC

HIDALGO COUNTY, NEW MEXICO

Prepared By:

Lighting Dock Geothermal No. 1, HI-01 LLC
5152 North Edgewood Drive. Uite 375
Provo, Utah

NOVEMBER 2008

BEFORE THE OIL CONSERVATION DIVISION
Hidalgo, New Mexico
Case No. 14246..... Exhibit No. 10
Submitted by:
RASER POWER SYSTEM, LLC
Hearing Date: December 1, 2008

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A)Agreement for Mutual Non-Disclosure of Proprietary Information

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LIGHTNING DOCK GEOTHERMAL NO. 1, HI-01 LLC
HIDALGO COUNTRY, NEW MEXICO

1.0 INTRODUCTION

- LDGThe Lightning Dock Geothermal (LDG), No.1 project location comprises about 3,100 acres in the Animas Valley of Hidalgo County, New Mexico. This general location includes a shallow and relatively high-temperature geothermal resource that has been developed for direct heating of greenhouses and a fish farm. A deep well drilled in 1984 found high temperatures and significant water flow at a depth of about 1,500 feet. LDG is proposing to install an exploratory well to gather necessary data to evaluate the lateral extent and shallow and deeper characteristics of the geothermal reservoir. This data will asset LDG in determining the viability of producing geothermal resources in commercial quantities from the proposed facility, including five production wells to supply a 10 MW geothermal power plant and three injection wells to return the fluids to the geothermal reservoir.

The purpose of this document is to define the monitoring plan. The data will be gathered from the exploratory well, production wells, injection wells, monitoring wells and private wells. The data collected will further the understanding of the local hydrology, provide insight into the rate, volume and flow paths of geothermal water and heat, and detect any impacts to the shallow or deep thermal aquifers. The data will also provide water chemistry of the geothermal fluids. See Map 1 for location of proposed, production, injection, monitoring and private wells selected for monitoring.

Previous studies and geologic mapping have inferred the presence of fault structures at depth to near surface. Communication between aquifers is uncertain, and is one of the questions that may be answered by data acquired in drilling and this monitoring program.

2.0 GEOLOGIC SETTING

The Animas Valley of southwestern New Mexico is in the Mexican Highland part of the Basin and Range Province of the Western United States. The complexity of the Animas Valley area is demonstrated by the widely differing structures, stratigraphy, and ages of rocks exposed in the surrounding mountain ranges. The Animas Valley is a topographic low and a structural graben, and is bounded on the west by the Peloncillo Mountains and on the east by the Pyramid Mountains. The primary structural trends in the area are the north-trending Basin and Range features and an inferred caldera ring-fracture zone. Relatively young basaltic volcanism is widespread in the area with the most recent activity being a small cinder cone dated at 140,000 years old on the west side of the valley. These Cenozoic features are superimposed on a Laramide thrust belt setting that in turn occurs at the edge of the Paleozoic cratonic region of North America (Chang et al, 199; Corbitt and Woodward 1973, and Woodward and Duchene, 1981). Elston, et al, (1983) give a good overview of the geology and provide a thorough geochemical analysis of the water of the Lightning Dock KGRA.

According to Blackwell and Wisian (2001), gravity data illustrates the basement and fault structures of Animas Valley. North-trending, range-bounding faults define the valley on the west and east. An east-northeast-trending fault with a right-lateral component appears to cut across the valley through the production area. Blackwell and Wisian also filtered and inverted the gravity data to produce a depth-to basement map that highlights the northeast-southwest structure trend across the Animas Valley.

Rocks exposed in the bordering mountain ranges include Precambrian granodiorite, Paleozoic and Mesozoic sedimentary rocks. Tertiary/Cretaceous volcanic rocks, Tertiary intrusive rocks, Tertiary conglomerate, Quaternary/Tertiary basalt flows, and Quaternary/Tertiary conglomerate (O'Brien and Stone, 1984). The Pyramid Mountains, composed of rocks primarily of Cretaceous age and younger (Flege, 1959), form a complex volcanic sequence known as the Muir cauldron (Deal and others, 1978, and Elston et al, 1983). In contrast, the Peloncillo Mountains consist of a Precambrian granite core, a complete Paleozoic section, Cretaceous sedimentary rocks, and Tertiary intrusive and eruptive rock (Gillerman, 1958, Dane and Bachman, 1961, and Dane and Bachman, 1965).

3.0 MONITORING REQUIREMENTS

3.1 Water Sampling

3.1.1 Monitoring of Private Wells

Monitoring of private wells shown in Table 2 shall be conducted by LDG for temperature, fluid levels, and chemistry at the schedule shown. Some wells will be monitored regularly, (D), then semi-annually (s) and others annually (A) for the chemistry constitutes shown on Tables 4 (Level I) and 5 (Level II). Semi-annual measurements shall be conducted as follows: winter measurement in February or early March prior to the start of the irrigation season; and summer measurement in August or September prior to the end of the irrigation season. A selection of private wells penetrating the intermediate thermal aquifer are identified in Table 2 for daily monitoring of temperature and static water levels. All other monitored private wells will be tested for temperature and static fluid level semi-annually.

These wells will be flowed or pumped long enough for the temperature reading to stabilize. Permission ns will be obtained by LDG from each leaseholder or private well owner prior to monitoring. Should LDG be denied access to any wells selected fro monitoring, New Mexico Oil Conservation Division (OCD) will be notified and well(s) in question will be removed from the well monitoring table. A replacement well may be added to the well monitoring table.

3.1.2 Monitoring of LDG Wells

Production and injection wells will be monitored per the schedule outlined in Table 1. All new used for production or injection will be monitored according to Table 1.

The proposed construction of the monitoring wells will be a nested piezometer approach. The casing strings for the wells will be at least 4-inch, in order to accommodate pumps that can handle the water

temperature. A maximum of two casing strings in a single borehole; one string for monitoring the deep aquifer, and 1 string for an intermediate zone. Another borehole to be drilled immediately adjacent to the nested string, and a single well would be completed in the shallow aquifer. Monitoring Well will be monitored per the schedule outlined in Table 1.

3.1.3 Surface Water Sampling

Surface water drain and canal sites will also be monitored as defined on Table 3. For the canals semi-annual measurements shall be made after the start of the irrigation season sometime in early May or the near the end of the season in September or October before delivery canals are shut off. Since drain water quality is highly variable, drain measurements shall be conducted quarterly with two samples during the non- irrigation season and two during the irrigation season. Approximate drain collection times would be roughly as follows: December 15, March 1, June 15 and September 15.

3.1.4 Surface Discharge of Deep Thermal Aquifer Fluids

Any discharge of deep thermal aquifer fluid during drilling, testing or operation of production, injection or monitoring wells whereby discharge is routed to an approved discharge pit shall be tested mid- way through the test for the constituents identified under Level II water quality testing on Table 5. The total volume of fluid discharge during each test shall also be reported. Discharge into approved pits due to power plant upset conditions will be recorded for date of discharge and total volume.

3.1.5 Changes in Monitoring

The scheduled of monitoring outlined in Tables 1-3 and/or constituents for analysis listed in Tables 4 and 5 may be subject to change depending on circumstances. They may ne increased or relaxed pending prior results or trends in the data. Monitoring procedures shall be conducted pursuant to the following sub-sections.

3.2 Data Collection

3.2.1 Water Level Measurement

Prior to ground water sampling from each well, depth to water will be measured with a sonic depth sounder, standard well sounder, or air-line, as may be appropriate. A pressure gauge will be used to determine hydraulic head of the well is artesian. Measurement shall be from some set consistent measuring point (MP) such as the top of casing or other suitable permanent feature. Height of the MP above ground surface shall also be recorded and all water levels reported as depth above or below ground surface and elevation AMSL. Elevation of the wellhead shall be surveyed to and accuracy of one (1) foot. Water level elevations must be reported within an accuracy of one (1) foot.

For water level measurements on private wells, every attempt will be made to collect measurements after sufficient recovery time has elapsed following possible recent pumping. If water levels cannot be measured due to well head completions or lack of a sounding tube, a sounding tube or air-line will be installed the next time the pump is removed for service or repair. Duplicate water level measurements

will be made at least ten (10) minutes apart to ensure water level is not recovering or drawing down. The intent is to collect static levels in the private and LDG monitoring wells. For injection and production wells, the pumping or injection status should be noted during water level data collection.

3.2.2 Downhole Temperature Measurements

Downhole temperature profiles shall be obtained on LDG wells whenever pumps are pulled or new wells constructed. Downhole temperature profiles will be run on selected private wells, penetrating the intermediate thermal aquifer, chosen based on location, depth, accessibility and landowner agreeability. Upon selection, those wells will ne added to Table 1. Profiles will be continuous or periodic, with distance between readings not to exceed ten (10) feet, and the temperature allowed to stabilize between readings.

3.2.3 Monitor or Private Well Purging

Subsequent to measuring the water levels, those wells that are not in active use will be purged. Well purging will be performed according to standard professional practices, with a minimum of three casings volumes of water purging using a dedicated ground water pump, or until pH, temperature, and conductivity have stabilized to within 10% for three consecutive readings spaced at least one (1) minute apart. The well will be purged at a relatively low flow rate to minimize the possibility of purging the well dry. If a well is purged dry, the sample will not be collected until the well has recovered to a minimum 50% of its initial volume. All ground water sampling equipment will be thoroughly rinsed with fresh water. Any deviation from the procedure will be performed according to standard professional practices and pre-approved by OCD.

3.2.4 Field Parameter Collection

Prior to collection of the ground water sample, at each monitor or private well, temperature, pH, and electrical conductivity will be measured. These parameters will be obtained using calibrated temperature, pH and electrical conductivity probes according to standard professional practices.

3.2.5 Ground Water Sample Collection

Once the well is satisfactorily purged, water samples will be collected from each well. Water samples will be collected from the dedicated ground water pumps and stored in laboratory-prepared sample containers with appropriate preservatives. The samples well be properly labeled (sample identification, sampler initials, date, time of collection, site location, and requested analyses), placed in an ice chest with wet ice, and delivered to an analytical laboratory within the prescribed time for the particular constituent analysis.

3.2.6 High Temperature Sample Collection

Pumped geothermal and any injection flow lines that are at a temperature high enough to boil and lose steam during sample collection should be sampled from a port of the side of the flow line, using a

cooling coil under pressure to prevent boiling and steam separation prior to sample collection. Flow line temperature will be recorded.

Flowing two-phase geothermal production well should be sampled either: (a) from the water phase outlet of the dedicated production-sized steam- water separator, using a cooling coil under pressure, and with recorded pressure or temperature of phase separation, or (b) if there is a no steam-water separator dedicated to the well, then samples should be collected from the two-phase flow line close to the wellhead, using a portable steam-water separator according to the methods specified by ASTM Standard E1675-04e1, Standard Practice for Sampling Two-Phase Geothermal Fluid for Purposes of Chemical Analysis.

3.2.7 Silica

Sample splits for analysis of silica (SiO2) should be preserved by dilution and/or pH adjustments, according to whatever method is preferred by the laboratory. If none, sample splits for analysis of silica should be diluted 1:10 with a de-ionized, silica-free water, preferably by the following procedure: (I) weigh the clean, empty and dry sample bottle (125 ml or 4 oz. Plastic bottle): (ii) add 90 ml of de-ionized, silica-free water and re-weigh, (iii) collect the sample by adding 10 ml of sample, measured with a clean and pre-rinsed plastic pipet, to the 90 ml of de-ionized, silica-free water, (iv) re-weigh to determine exact dilution factor. Any deviation from the procedure by LDG consultants or contractors will be performed according to standard professional practices and pre-approved by OCD.

3.2.8 Field Records

Daily Field Report records will be maintained by staff personal to provide daily records of significant event events, observations, and measurements during field investigations. Observations shall be recorded which may explain data anomalies. These documents will contain information such as: personnel present, site conditions, sampling procedures, measurement procedures, calibration records, etc. Field measurements will be recorded on the appropriate forms. All entries on the data forms will be signed and dated. The data forms will be kept as permanent records.

3.3 Chain of Custody Procedure

Sample identification documents will be carefully prepared so identification and chain of custody can be maintained and sample disposition can be controlled. The sample collection identification documents include Chain-of-Custody (COC) records and Daily Field Report forms. COC procedures are outlined as follows:

3.3.1 Field Custody Procedures

The field sampler is personally responsible for the care and custody of the samples collected until they are properly transferred. All samples will have individual labels. The information in these labels will correspond to the COC which shows the identification of individual samples and the contents of the shipping container. The original COC will accompany the shipment, and a copy will be retained by the sampler for the client.

3.3.2 Transfer of Custody and Shipment

A COC accompanies all samples. When transferring samples, the individuals relinquishing and receiving the samples will sign, date, and note the time on the COC. This COC documents the sample custody transfer. Samples are to be properly packaged and dispatched to the appropriate laboratory for analysis with a separate COC accompanying each shipment. All shipments are accompanied by the original COC. Samples will be delivered by LDG personnel or consultant to the laboratory.

3.4 Irrigation Monitoring

Division of Minerals review indicates irrigation activity plays a large part in the annual fluctuations of the shallow non-thermal reservoir and the USGS OFR 82-345 made similar findings in their water budget analysis. Irrigation deliveries and irrigated acreage to fields within the study area shown on Map 1 shall be reported in the annual reports as well as a map showing fields irrigated. Irrigated fields shall be designed with imagery acquired during current irrigation season flights conducted by NRCS or BOR aerial photographs or Landsat images, should they be available on an annual basis. Provided imagery is publically available. A seepage testing may be required by OCD. A review of meter records of pumping for irrigated agriculture on file with the New Mexico Office of the State Engineer will also be made to the extent that it is available.

3.5 Landowner/Lessor Contact

3.5.1 Communication Log

A detailed communication log shall be kept whenever there is a contact with any adjacent land or well owner recording the date, time, and nature of the dialogue, concerns and any mitigation efforts offered by LDG.

3.5.2 Landowner Reporting

LDG shall supply the landowners that have wells participating in this monitoring program a simple summary report of data that was collected at their individual well or wells. The information shall include but not limited to:

Date and Time information was collected
Recorded Pressure
Recorded Temperature
Recorded Fluid Level
Provide landowner a copy of water chemistry results from well or wells.

4.0 Laboratory Analysis

Collected groundwater samples will be submitted to a New Mexico certified laboratory for the analyses detailed in Tables 4 and 5. As described above, pH, temperatures and electrical conductivity measurements will be collected in the field during purging of the well.

5.0 Annual Review and Reporting

All well identification, sample date, temperatures, water levels, field parameters and laboratory data will be complied in a single Excel database for reporting and review. Water level, temperature and laboratory reports shall be reviewed upon collection or reporting and compared to the historical record to that particular sit to determine any significant deviations from prior reports or measurements. Water level elevations, temperature and selected fluid chemistry parameters including TDS, pH, Ec, Silica, and Na/K concentrations shall be charted with historical data for the site on Excel spreadsheets. The Excel database will be distributed to OCD. Any information LDG submits to OCD that is deemed confidential or proprietary will be water marked or labeled as such and will be subject to a confidentially agreement entered into by LDG and OCD.

A GIS (ArcGIS) mapping product similar to map 1 shall be produced and included in the annual report at a scale of 1:12,000 of the study area. The map shall include all wells and features shown on Map1 plus any new wells constructed or added to the monitoring program that particular year. One base map shall be the USGS 1:24,000 quad maps and a second containing aerial photographs coverage acquired during that particular irrigation season assuming that coverage can be obtained from a publically available source.

LDG will provide a detailed annual report summarizing all requested data which will be prepared by a qualified expert to provide review and interpretation of the data collected the past year and observe variations in chemistry, fluid level, temperature of field parameters within the context of the past ten years trends in recorded data. The annual report and databases shall contain all prior data collected as required by this monitoring plan plus historical data. The intent of the annual report is to provide a complete package detailing past, present, and future anticipated conditions (quantity, quality, thermal) relating a geothermal power productions operations at the Lightning Dock site.

An annual report shall be submitted to OCD by February 15 summarizing the prior calendar year and historical data required in the plan. Should LDG personnel, consultants, ODC or surrounding property owners observe any significant changes during the course of the year, in interim report may be required or more frequent status reports and/or monitoring schedule may be required.

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Subsequent to measuring the water levels, those wells that are not in active use will be purged. Well purging will be performed according to standard professional practices, with a minimum of three casings volumes of water purging using a dedicated ground water pump, or until pH, temperature, and conductivity have stabilized to within 10% for three consecutive readings spaced at least one (1) minute apart. The well will be purged at a relatively low flow rate to minimize the possibility of purging the well dry. If a well is purged dry, the sample will not be collected until the well has recovered to a minimum 50% of its initial volume. All ground water sampling equipment will be thoroughly rinsed with fresh water. Any deviation from the procedure will be performed according to standard professional practices and pre-approved by OCD.

3.2.4 Field Parameter Collection

Prior to collection of the ground water sample, at each monitor or private well, temperature, pH, and electrical conductivity will be measured. These parameters will be obtained using calibrated temperature, pH and electrical conductivity probes according to standard professional practices.

3.2.5 Ground Water Sample Collection

Once the well is satisfactorily purged, water samples will be collected from each well. Water samples will be collected from the dedicated ground water pumps and stored in laboratory-prepared sample containers with appropriate preservatives. The samples well be properly labeled (sample identification, sampler initials, date, time of collection, site location, and requested analyses), placed in an ice chest with wet ice, and delivered to an analytical laboratory within the prescribed time for the particular constituent analysis.

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Flowing two-phase geothermal production well should be sampled either: (a) from the water phase outlet of the dedicated production-sized steam- water separator, using a cooling coil under pressure, and with recorded pressure or temperature of phase separation, or (b) if there is a no steam-water separator dedicated to the well, then samples should be collected from the two-phase flow line close to the wellhead, using a portable steam-water separator according to the methods specified by ASTM Standard E1675-04e1, Standard Practice for Sampling Two-Phase Geothermal Fluid for Purposes of Chemical Analysis.

3.2.7 Silica

Sample splits for analysis of silica (SiO2) should be preserved by dilution and/or pH adjustments, according to whatever method is preferred by the laboratory. If none, sample splits for analysis of silica should be diluted 1:10 with a de-ionized, silica-free water, preferably by the following procedure: (I) weigh the clean, empty and dry sample bottle (125 ml or 4 oz. Plastic bottle): (ii) add 90 ml of de-ionized, silica-free water and re-weigh, (iii) collect the sample by adding 10 ml of sample, measured with a clean and pre-rinsed plastic pipet, to the 90 ml of de-ionized, silica-free water, (iv) re-weigh to determine exact dilution factor. Any deviation from the procedure by LDG consultants or contractors will be performed according to standard professional practices and pre-approved by OCD.

3.2.8 Field Records

Daily Field Report records will be maintained by staff personal to provide daily records of significant event events, observations, and measurements during field investigations. Observations shall be recorded which may explain data anomalies. These documents will contain information such as: personnel present, site conditions, sampling procedures, measurement procedures, calibration records, etc. Field measurements will be recorded on the appropriate forms. All entries on the data forms will be signed and dated. The data forms will be kept as permanent records.

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Sample identification documents will be carefully prepared so identification and chain of custody can be maintained and sample disposition can be controlled. The sample collection identification documents include Chain-of-Custody (COC) records and Daily Field Report forms. COC procedures are outlined as follows:

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3.5 Landowner/Lessor Contact

3.5.1 Communication Log

A detailed communication log shall be kept whenever there is a contact with any adjacent land or well owner recording the date, time, and nature of the dialogue, concerns and any mitigation efforts offered by LDG.

3.5.2 Landowner Reporting

LDG shall supply the landowners that have wells participating in this monitoring program a simple summary report of data that was collected at their individual well or wells. The information shall include but not limited to:

Date and Time information was collected
Recorded Pressure
Recorded Temperature
Recorded Fluid Level
Provide landowner a copy of water chemistry results from well or wells.

4.0 Laboratory Analysis

Collected groundwater samples will be submitted to a New Mexico certified laboratory for the analyses detailed in Tables 4 and 5. As described above, pH, temperatures and electrical conductivity measurements will be collected in the field during purging of the well.

5.0 Annual Review and Reporting

All well identification, sample date, temperatures, water levels, field parameters and laboratory data will be complied in a single Excel database for reporting and review. Water level, temperature and laboratory reports shall be reviewed upon collection or reporting and compared to the historical record to that particular sit to determine any significant deviations from prior reports or measurements. Water level elevations, temperature and selected fluid chemistry parameters including TDS, pH, Ec, Silica, and Na/K concentrations shall be charted with historical data for the site on Excel spreadsheets. The Excel database will be distributed to OCD. Any information LDG submits to OCD that is deemed confidential or proprietary will be water marked or labeled as such and will be subject to a confidentially agreement entered into by LDG and OCD.

A GIS (ArcGIS) mapping product similar to map 1 shall be produced and included in the annual report at a scale of 1:12,000 of the study area. The map shall include all wells and features shown on Map1 plus any new wells constructed or added to the monitoring program that particular year. One base map shall be the USGS 1:24,000 quad maps and a second containing aerial photographs coverage acquired during that particular irrigation season assuming that coverage can be obtained from a publically available source.

LDG will provide a detailed annual report summarizing all requested data which will be prepared by a qualified expert to provide review and interpretation of the data collected the past year and observe variations in chemistry, fluid level, temperature of field parameters within the context of the past ten years trends in recorded data. The annual report and databases shall contain all prior data collected as required by this monitoring plan plus historical data. The intent of the annual report is to provide a complete package detailing past, present, and future anticipated conditions (quantity, quality, thermal) relating a geothermal power productions operations at the Lightning Dock site.

An annual report shall be submitted to OCD by February 15 summarizing the prior calendar year and historical data required in the plan. Should LDG personnel, consultants, ODC or surrounding property owners observe any significant changes during the course of the year, in interim report may be required or more frequent status reports and/or monitoring schedule may be required.

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GROUNDWATER SAMPLING AND MONITORING PLAN

FOR

LIGHTNING DOCK GEOTHERMAL NO. 1, HI-01 LLC

HIDALGO COUNTY, NEW MEXICO

Prepared By:

Lighting Dock Geothermal No. 1, HI-01 LLC
5152 North Edgewood Drive. Uite 375
Provo, Utah

NOVEMBER 2008

DRAFT

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APPENDIX

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A)Agreement for Mutual Non-Disclosure of Proprietary Information

GROUNDWATER SAMPLING AND MONITORING PLAN FOR LIGHTNING DOCK GEOTHERMAL NO. 1, HI-01 LLC HIDALGO COUNTRY, NEW MEXICO

1.0 INTRODUCTION

- LDGThe Lightning Dock Geothermal (LDG), No.1 project location comprises about 3,100 acres in the Animas Valley of Hidalgo County, New Mexico. This general location includes a shallow and relatively high-temperature geothermal resource that has been developed for direct heating of greenhouses and a fish farm. A deep well drilled in 1984 found high temperatures and significant water flow at a depth of about 1,500 feet. LDG is proposing to install an exploratory well to gather necessary data to evaluate the lateral extent and shallow and deeper characteristics of the geothermal reservoir. This data will asset LDG in determining the viability of producing geothermal resources in commercial quantities from the proposed facility, including five production wells to supply a 10 MW geothermal power plant and three injection wells to return the fluids to the geothermal reservoir.

The purpose of this document is to define the monitoring plan. The data will be gathered from the exploratory well, production wells, injection wells, monitoring wells and private wells. The data collected will further the understanding of the local hydrology, provide insight into the rate, volume and flow paths of geothermal water and heat, and detect any impacts to the shallow or deep thermal aquifers. The data will also provide water chemistry of the geothermal fluids. See Map 1 for location of proposed, production, injection, monitoring and private wells selected for monitoring.

Previous studies and geologic mapping have inferred the presence of fault structures at depth to near surface. Communication between aquifers is uncertain, and is one of the questions that may be answered by data acquired in drilling and this monitoring program.

2.0 GEOLOGIC SETTING

The Animas Valley of southwestern New Mexico is in the Mexican Highland part of the Basin and Range Province of the Western United States. The complexity of the Animas Valley area is demonstrated by the widely differing structures, stratigraphy, and ages of rocks exposed in the surrounding mountain ranges. The Animas Valley is a topographic low and a structural graben, and is bounded on the west by the Peloncillo Mountains and on the east by the Pyramid Mountains. The primary structural trends in the area are the north-trending Basin and Range features and an inferred caldera ring-fracture zone. Relatively young basaltic volcanism is widespread in the area with the most recent activity being a small cinder cone dated at 140,000 years old on the west side of the valley. These Cenozoic features are superimposed on a Laramide thrust belt setting that in turn occurs at the edge of the Paleozoic cratonic region of North America (Chang et al, 199; Corbitt and Woodward 1973, and Woodward and Duchene, 1981). Elston, et al, (1983) give a good overview of the geology and provide a thorough geochemical analysis of the water of the Lightning Dock KGRA.

According to Blackwell and Wisian (2001), gravity data illustrates the basement and fault structures of Animas Valley. North-trending, range-bounding faults define the valley on the west and east. An east-northeast-trending fault with a right-lateral component appears to cut across the valley through the production area. Blackwell and Wisian also filtered and inverted the gravity data to produce a depth-to basement map that highlights the northeast-southwest structure trend across the Animas Valley.

Rocks exposed in the bordering mountain ranges include Precambrian granodiorite, Paleozoic and Mesozoic sedimentary rocks. Tertiary/Cretaceous volcanic rocks, Tertiary intrusive rocks, Tertiary conglomerate, Quaternary/Tertiary basalt flows, and Quaternary/Tertiary conglomerate (O'Brien and Stone, 1984). The Pyramid Mountains, composed of rocks primarily of Cretaceous age and younger (Flege, 1959), form a complex volcanic sequence known as the Muir cauldron (Deal and others, 1978, and Elston et al, 1983). In contrast, the Peloncillo Mountains consist of a Precambrian granite core, a complete Paleozoic section, Cretaceous sedimentary rocks, and Tertiary intrusive and eruptive rock (Gillerman, 1958, Dane and Bachman, 1961, and Dane and Bachman, 1965).

3.0 MONITORING REQUIREMENTS

3.1 Water Sampling

3.1.1 Monitoring of Private Wells

Monitoring of private wells shown in Table 2 shall be conducted by LDG for temperature, fluid levels, and chemistry at the schedule shown. Some wells will be monitored regularly, (D), then semi-annually (s) and others annually (A) for the chemistry constitutes shown on Tables 4 (Level I) and 5 (Level II). Semi-annual measurements shall be conducted as follows: winter measurement in February or early March prior to the start of the irrigation season; and summer measurement in August or September prior to the end of the irrigation season. A selection of private wells penetrating the intermediate thermal aquifer are identified in Table 2 for daily monitoring of temperature and static water levels. All other monitored private wells will be tested for temperature and static fluid level semi-annually.

These wells will be flowed or pumped long enough for the temperature reading to stabilize. Permission ns will be obtained by LDG from each leaseholder or private well owner prior to monitoring. Should LDG be denied access to any wells selected fro monitoring, New Mexico Oil Conservation Division (OCD) will be notified and well(s) in question will be removed from the well monitoring table. A replacement well may be added to the well monitoring table.

3.1.2 Monitoring of LDG Wells

Production and injection wells will be monitored per the schedule outlined in Table 1. All new used for production or injection will be monitored according to Table 1.

The proposed construction of the monitoring wells will be a nested piezometer approach. The casing strings for the wells will be at least 4-inch, in order to accommodate pumps that can handle the water

temperature. A maximum of two casing strings in a single borehole; one string for monitoring the deep aquifer, and 1 string for an intermediate zone. Another borehole to be drilled immediately adjacent to the nested string, and a single well would be completed in the shallow aquifer. Monitoring Well will be monitored per the schedule outlined in Table 1.

3.1.3 Surface Water Sampling

Surface water drain and canal sites will also be monitored as defined on Table 3. For the canals semi-annual measurements shall be made after the start of the irrigation season sometime in early May or the near the end of the season in September or October before delivery canals are shut off. Since drain water quality is highly variable, drain measurements shall be conducted quarterly with two samples during the non- irrigation season and two during the irrigation season. Approximate drain collection times would be roughly as follows: December 15, March 1, June 15 and September 15.

3.1.4 Surface Discharge of Deep Thermal Aquifer Fluids

Any discharge of deep thermal aquifer fluid during drilling, testing or operation of production, injection or monitoring wells whereby discharge is routed to an approved discharge pit shall be tested mid- way through the test for the constituents identified under Level II water quality testing on Table 5. The total volume of fluid discharge during each test shall also be reported. Discharge into approved pits due to power plant upset conditions will be recorded for date of discharge and total volume.

3.1.5 Changes in Monitoring

The scheduled of monitoring outlined in Tables 1-3 and/or constituents for analysis listed in Tables 4 and 5 may be subject to change depending on circumstances. They may ne increased or relaxed pending prior results or trends in the data. Monitoring procedures shall be conducted pursuant to the following sub-sections.

3.2 Data Collection

3.2.1 Water Level Measurement

Prior to ground water sampling from each well, depth to water will be measured with a sonic depth sounder, standard well sounder, or air-line, as may be appropriate. A pressure gauge will be used to determine hydraulic head of the well is artesian. Measurement shall be from some set consistent measuring point (MP) such as the top of casing or other suitable permanent feature. Height of the MP above ground surface shall also be recorded and all water levels reported as depth above or below ground surface and elevation AMSL. Elevation of the wellhead shall be surveyed to and accuracy of one (1) foot. Water level elevations must be reported within an accuracy of one (1) foot.

For water level measurements on private wells, every attempt will be made to collect measurements after sufficient recovery time has elapsed following possible recent pumping. If water levels cannot be measured due to well head completions or lack of a sounding tube, a sounding tube or air-line will be installed the next time the pump is removed for service or repair. Duplicate water level measurements

will be made at least ten (10) minutes apart to ensure water level is not recovering or drawing down. The intent is to collect static levels in the private and LDG monitoring wells. For injection and production wells, the pumping or injection status should be noted during water level data collection.

3.2.2 Downhole Temperature Measurements

Downhole temperature profiles shall be obtained on LDG wells whenever pumps are pulled or new wells constructed. Downhole temperature profiles will be run on selected private wells, penetrating the intermediate thermal aquifer, chosen based on location, depth, accessibility and landowner agreeability. Upon selection, those wells will ne added to Table 1. Profiles will be continuous or periodic, with distance between readings not to exceed ten (10) feet, and the temperature allowed to stabilize between readings.

3.2.3 Monitor or Private Well Purging

Subsequent to measuring the water levels, those wells that are not in active use will be purged. Well purging will be performed according to standard professional practices, with a minimum of three casings volumes of water purging using a dedicated ground water pump, or until pH, temperature, and conductivity have stabilized to within 10% for three consecutive readings spaced at least one (1) minute apart. The well will be purged at a relatively low flow rate to minimize the possibility of purging the well dry. If a well is purged dry, the sample will not be collected until the well has recovered to a minimum 50% of its initial volume. All ground water sampling equipment will be thoroughly rinsed with fresh water. Any deviation from the procedure will be performed according to standard professional practices and pre-approved by OCD.

3.2.4 Field Parameter Collection

Prior to collection of the ground water sample, at each monitor or private well, temperature, pH, and electrical conductivity will be measured. These parameters will be obtained using calibrated temperature, pH and electrical conductivity probes according to standard professional practices.

3.2.5 Ground Water Sample Collection

Once the well is satisfactorily purged, water samples will be collected from each well. Water samples will be collected from the dedicated ground water pumps and stored in laboratory-prepared sample containers with appropriate preservatives. The samples well be properly labeled (sample identification, sampler initials, date, time of collection, site location, and requested analyses), placed in an ice chest with wet ice, and delivered to an analytical laboratory within the prescribed time for the particular constituent analysis.

3.2.6 High Temperature Sample Collection

Pumped geothermal and any injection flow lines that are at a temperature high enough to boil and lose steam during sample collection should be sampled from a port of the side of the flow line, using a

cooling coil under pressure to prevent boiling and steam separation prior to sample collection. Flow line temperature will be recorded.

Flowing two-phase geothermal production well should be sampled either: (a) from the water phase outlet of the dedicated production-sized steam- water separator, using a cooling coil under pressure, and with recorded pressure or temperature of phase separation, or (b) if there is a no steam-water separator dedicated to the well, then samples should be collected from the two-phase flow line close to the wellhead, using a portable steam-water separator according to the methods specified by ASTM Standard E1675-04e1, Standard Practice for Sampling Two-Phase Geothermal Fluid for Purposes of Chemical Analysis.

3.2.7 Silica

Sample splits for analysis of silica (SiO2) should be preserved by dilution and/or pH adjustments, according to whatever method is preferred by the laboratory. If none, sample splits for analysis of silica should be diluted 1:10 with a de-ionized, silica-free water, preferably by the following procedure: (I) weigh the clean, empty and dry sample bottle (125 ml or 4 oz. Plastic bottle): (ii) add 90 ml of de-ionized, silica-free water and re-weigh, (iii) collect the sample by adding 10 ml of sample, measured with a clean and pre-rinsed plastic pipet, to the 90 ml of de-ionized, silica-free water, (iv) re-weigh to determine exact dilution factor. Any deviation from the procedure by LDG consultants or contractors will be performed according to standard professional practices and pre-approved by OCD.

3.2.8 Field Records

Daily Field Report records will be maintained by staff personal to provide daily records of significant event events, observations, and measurements during field investigations. Observations shall be recorded which may explain data anomalies. These documents will contain information such as: personnel present, site conditions, sampling procedures, measurement procedures, calibration records, etc. Field measurements will be recorded on the appropriate forms. All entries on the data forms will be signed and dated. The data forms will be kept as permanent records.

3.3 Chain of Custody Procedure

Sample identification documents will be carefully prepared so identification and chain of custody can be maintained and sample disposition can be controlled. The sample collection identification documents include Chain-of-Custody (COC) records and Daily Field Report forms. COC procedures are outlined as follows:

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