BLACKROCK GEOSCIENCE

Zbinden Geothermal Feasibility Study Project
Oregon Energy Trust Grant Program

Final Report: Summary of Activities and Results
October 28, 2014

Purpose of Report

This report summarizes the activities and results of the project funded by the Oregon Energy Trust on property owned by Mr. Jon Zbinden in Klamath Falls.

Location

The project site is located at 4828 Southside Expressway, Klamath Falls, Oregon, approximately 5 miles southeast of the City of Klamath Falls in the lower Klamath lakebed and adjacent to the northeastern border of the Kingsley Air Field Geographical location is Section 14, Township 39S, Range 09 E at Latitude 42°10'22" N Longitude 121°43'56" E.

Scope of Work

The scope of work for this project is as follows:

1. Conduct temperature gradient in the 1048-foot, 6" borehole completed in April 2014. Blackrock Geoscience will conduct the gradient logging using ACR Nautilus 135 data probe, obtaining readings at 10-foot intervals. The log will be analyzed and a determination will be made on where to perforate the casing in order to maximize flow of geothermal fluids. Blackrock will be on-site for two days. Day one will constitute gradient logging; day two will be for oversight of well perforation; day 3 will constitute re-logging of the perforated casing.
2. Perforate the well casing at intervals determined from the temperature gradient logging. It is anticipated that the driller will be on site for approximately 12 hours.
3. Develop an economic feasibility report which details costs and revenues associated with development options. This report will include analysis for power development and generation and selected direct-use applications, chosen based on the well temperature.

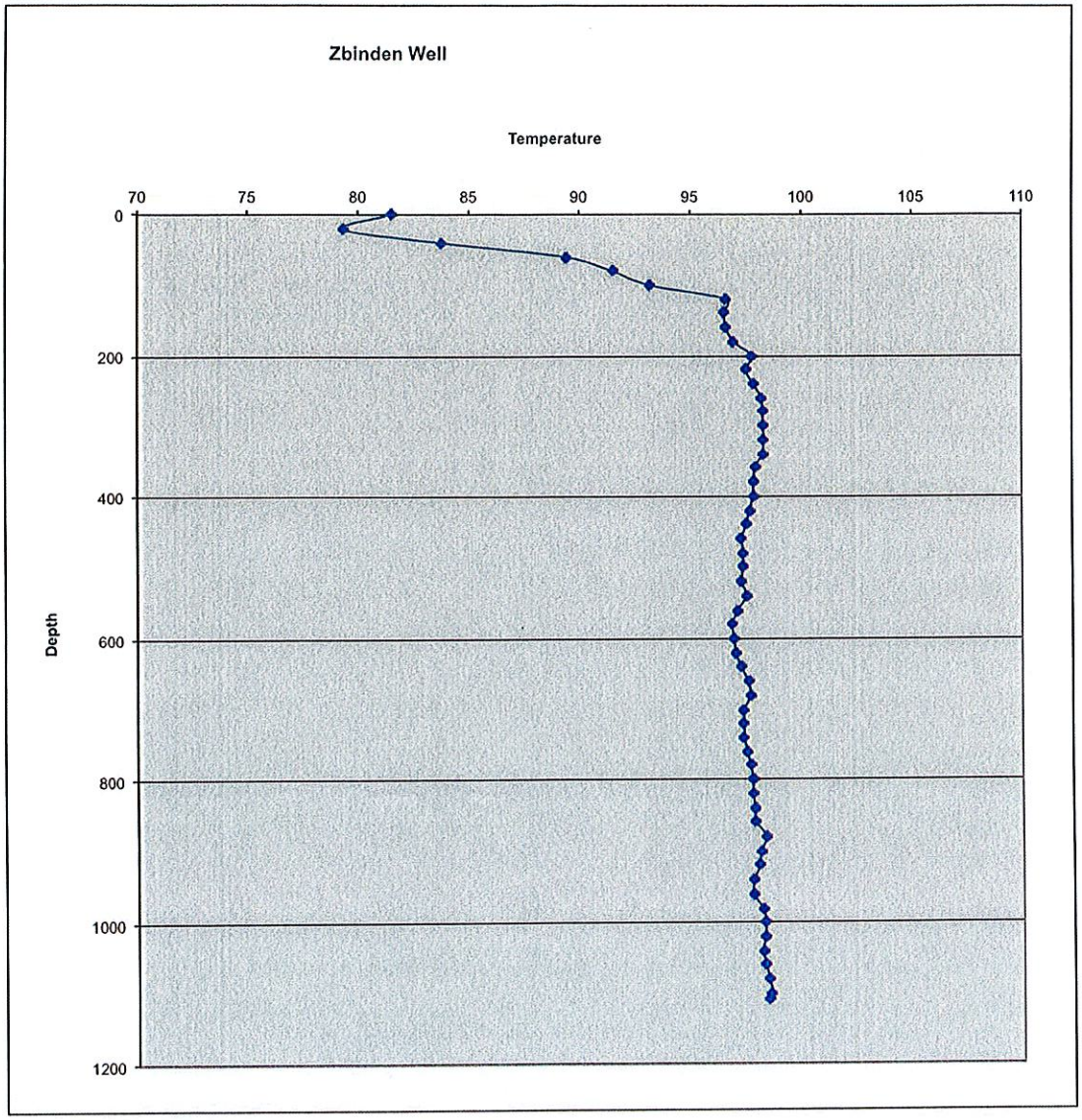
The original budget estimate for this project is as follows:

Line Item	Qty	Units	Unit Cost	Total Cost	SUBTOTAL
Professional Services					
Temperature gradient logging, 2 persons/2 days	32	Hours	125	4,000.00	
Oversight of borehole perforating	16	Hours	125	2,000.00	
Driller's services	12	Hours	600	7,200.00	
Economic Feasibility Report	36	Hours	125	4,500.00	
SUBTOTAL				**17,700.00**	**$17,700.00**
Equipment Rental					
Data probe	1	Day	100	100.00	
SUBTOTAL				**100.00**	**$100.00**
Travel					
Mobilization/demobilization time for field work (2-person crew)	4	Days	500	2,000.00	
Lodging (2 person/3 nights, GSA rate)	6	Days	83	498.00	
Per diem (2 persons/3 days per person, includes 1 day for travel each way/pp)	10	Days	46	460.00	
Airfare	1	RT	665	665.00	
Car rental and fuel				325.00	
Fuel costs for mobilization/demobilization	1010		0.56	565.60	
SUBTOTAL				**4,513.60**	**$4,513.60**
TOTAL BUDGET					**$22,313.60**

Completed Activities

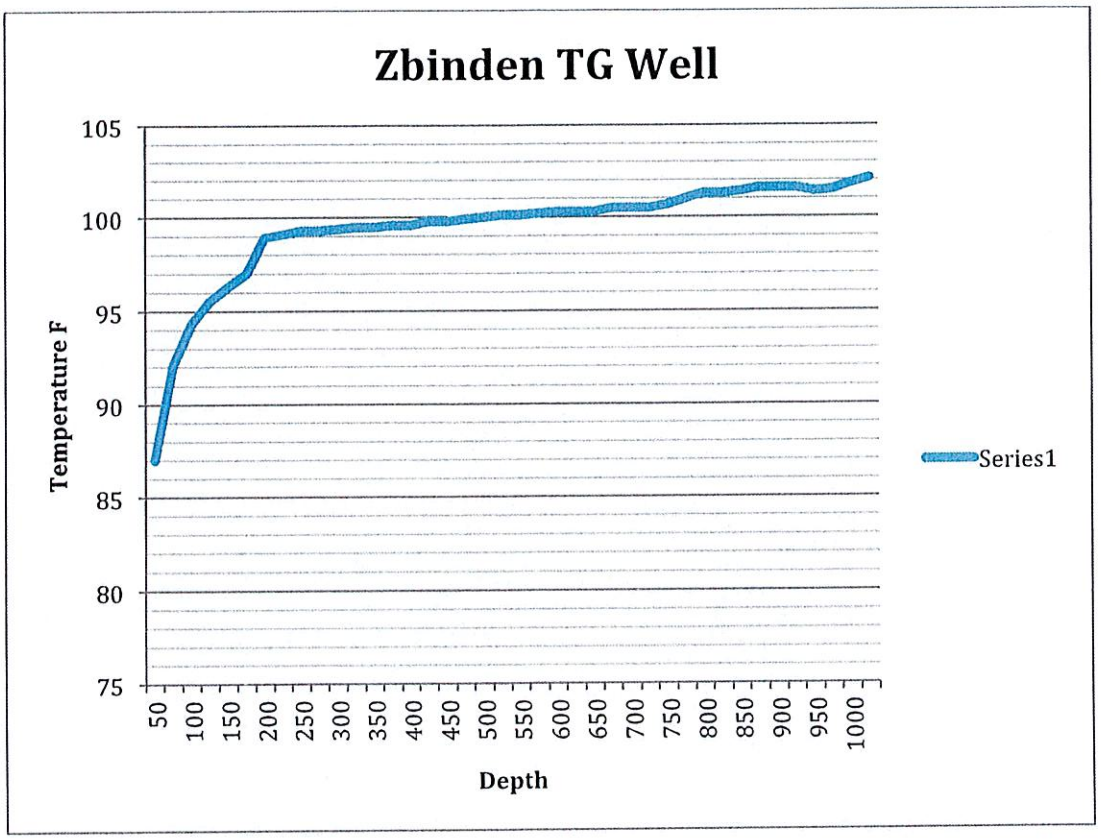
Task 1: Temperature gradient logging of the well was conducted on June 12, August 1, August 2, 2014. The first round of logging was performed by Toni Boyd of the Oregon Institute of Technology. This work was performed at no charge. Upon arriving at the well site, Ms. Boyd reported that the water level in the well was 15-20 feet below the top of the casing. This was an unexpected circumstance since the well was supposed to be plugged with blank casing from top to bottom and sealed with a well cap. Ms. Boyd proceeded to log the well. Her findings were a largely isothermal system as indicated in Figure 1. Maximum temperature did not exceed 98F. There were concerns that the well casing was compromised causing leakage of water and that the gradient may not accurately affect actual conditions.

Figure 1. Temperature gradient log of June 12, 2014.



On August 2, Blackrock arrived on site to re-log the well. Personnel were prepared to trouble-shoot the well to determine why the water level would have dropped from the top of the casing to 15 feet below the top of the casing. Blackrock had contacted Chancellor Drilling to inform them that we would be on site and would like to have them available if we needed any assistance. When personnel arrived at the wellhead and removed the cap, we observed that the water level was about 4" below the top of the casing. This was quite surprising since Toni Boyd had observed it to be about 15 feet below the top of the casing. Coulter Chancellor had stopped by the site. We discussed the water level confusion. He said his crew was at the

wellhead the previous day but did not add any water to the well. We proceeded to log the well and found isothermal conditions. Temperature at 50 feet below ground surface was 80F and the temperature at 1,048 feet was 102.1F. We re-logged the well three times to verify the results.



Task 2: Chancellor Drilling completed the well with 6" casing. Perforations were made approximately 20 feet above bottom hole for a 40-foot interval. The well was developed and pumped at 200 gpm. Temperature was recorded at 98F at 100 feet below the surface.

The well was not re-logged for temperature gradient after drilling.

Task 3: Due to the results of the temperature gradient logging, it was decided that conducting an economic feasibility report would not be of value and therefore, the project was ceased.

Tasks 1 and 2 were completed. Task 3 was not completed. Mr. Zbinden has paid Chancellor Drilling and Blackrock Geoscience in full for the services rendered. Invoices are attached.

Actual expenditures for this project were:

- Chancellor Drilling ($5,500)
- Blackrock Geoscience ($7,787.74)

Total expenditures are $13,287.74.

Status of Project

Complete. However, due to the question of the water level, it is recommended that the completed well be re-logged at some point in the future.