

THE BOISE, IDAHO GEOTHERMAL RESERVOIR

R. C. Stoker - EG&G Idaho, Inc.
J. F. Kunze - EG&G Idaho, Inc.
L. B. Nelson - EG&G Idaho, Inc.
D. Goldman - University of Idaho

Idaho National Engineering Laboratory (INEL)*
Idaho Falls, Idaho 83401

ABSTRACT

Geothermal district space heating has been practiced in Boise over the last 85 years. The system has used two wells drilled approximately 50 ft (15 m) apart in the early 1890s. The wells have a combined maximum reported production rate of 1800 gpm (114 l/sec) at 170°F (77°C) discharge at the well-head. The system has served as many as 400 homes and Natatorium; presently it serves approximately 200 homes and a large state laboratory and office building.

The heating district remained at the present capacity (two wells) for 85 years primarily because of the unknown nature of the reservoir and availability of other energy sources. Not until 1974 was the question of further development given serious consideration. Rising energy costs due to expanding energy demands and higher costs for foreign oil brought about a reevaluation of the resource. The INEL, Boise State University, and the Idaho Bureau of Mines and Geology began an investigation into the nature of the resource and the economics of space heating several large buildings and homes. Two deep, approximately 1250 ft (381 m), exploratory wells were drilled and tested by the INEL to determine the nature and size of the reservoir. Drilling and reservoir engineering test results have confirmed the presence of a large reservoir that can be developed further without adversely affecting the two production wells and heating system now in operation.

EXISTING PENITENTIARY WELLS

Hot water at 170°F (77°C) was first encountered in two wells drilled in early 1891 to a depth of only 394 ft (120 m) and 404 ft (123 m). The wells were only 50 ft (15 m) apart and were drilled in a swampy area formed by hot water seepage. Eventually the system evolved into two 16-in. (41 cm) production wells about 425 ft (130 m) deep with centrifugal pumps set to 160 ft (49 m). These wells will still become artesian if pumping is stopped and the wells are allowed to recover for approximately 3 or 4 days. The original artesian head of 50 ft (15 m) in these wells is still attainable by shutting in for a longer period.

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During the last year, these old production wells have been monitored for water level drawdown. During late January, 1977, the drawdown reached a maximum of 143 ft (44 m) below ground level (just above the pump bowls). High flow rates (up to 1600 gpm from both wells) caused by unusually cold weather and system leakage accounted for this extreme drawdown.

TWO EXPLORATORY WELLS

In the winter and early spring of 1976, the INEL drilled two exploratory wells 1000 ft (305 m) apart and approximately 1-1/2 mi (2.4 km) northwest of the penitentiary wells. Each of the exploratory wells were drilled within the immediate area of the main NW-SE trending Boise Front Fault and intersecting linears trending from the NE out of the mountains. The well locations are identified on Figure 1. The BEH-1 (BLM) well was drilled to a total depth of 1222 ft (372 m), has 7-in. (18 cm) production casing set to 610 ft (186 m) and a slotted 3-1/2 in. (9 cm) liner hung from the production casing to total depth. See Figure 2.

The BHW-1 (Beard) well was drilled to a total depth of 1283 ft (391 m), has 8-in. (20 cm) production casing set to 202 ft (62 m) and a slotted 4-1/2 in. (11 cm) liner with 100 ft (30 m) of screen hung from the production casing to total depth. See Figure 3.

The BEH-1 (BLM) well was drilled with water out of the production casing but encountered clay lenses (Montmorillonite) during drilling which necessitated cleanout of the pits three different times. BHW-1 (Beard) well was drilled with light mud in an attempt to stabilize the loosely-cemented sand beds encountered between 450 and 800 ft (137 and 245 m).

EXPLORATORY WELL TESTING

Reservoir engineering testing of the two exploratory wells has been as follows:

1. Temperature profiles of the wells were taken during drilling and after the well had stabilized. See Figure 4 for the temperature profile of BHW-1 (Beard). The profile on BEH-1 (BLM) is essentially identical.
2. Artesian wellhead pressure was monitored all during the 1976-77 heating season at BEH-1 (BLM). No correlatable pressure communication was observed as a result of the pumping conducted at the old penitentiary wells. A seasonal pressure decline of 2-1/2 psia was observed during the winter, but recovery began with the spring run off.
3. Artesian and pumped flow tests on each of the exploratory wells was conducted. A shaft driven pump set at approximately 185 ft (56 m) was employed for the pumped flow tests. Table I summarizes the Boise testing completed to date.

4. Interference testing revealed a rapid pressure communication between the two wells; 0.1 psia change within two minutes of the start of a test.

The BEH-1 well production (artesian flow) will be used for space heating of a BLM warehouse this winter and the long term drawdown will be monitored.

CONCLUSIONS

1. The 170° F geothermal reservoir boundaries have not been detected and the reservoir appears to be capable of usage rates far exceeding the present rate.
2. The reservoir is proven to extend at least 1-1/2 miles along the Fault.
3. Similar geologic conditions occur in several locations along the Boise Front Fault that apparently control the geothermal resource as now defined by the existing four wells.
4. Test results indicate that future production wells (properly located) will have high production rates in the order of 600 to 1000 gpm for 12 to 16 in. (30 to 40 cm) wells at pump setting depths of 400 feet.
5. The geothermal resource can be encountered at relatively shallow depths (<1000 ft or 305 m) and at temperatures (170°F or 77°C) adequate for large scale space heating. The wells should be located close to the intersection of NE trending linears with the Front Fault for the greatest possible production rates and highest temperatures close to the service areas.

The authors wish to thank the geology students, faculty and especially Renald N. Guillemette of Boise State University for their assistance and help during the Boise Project.

WELL LOCATIONS IN BOISE IDAHO

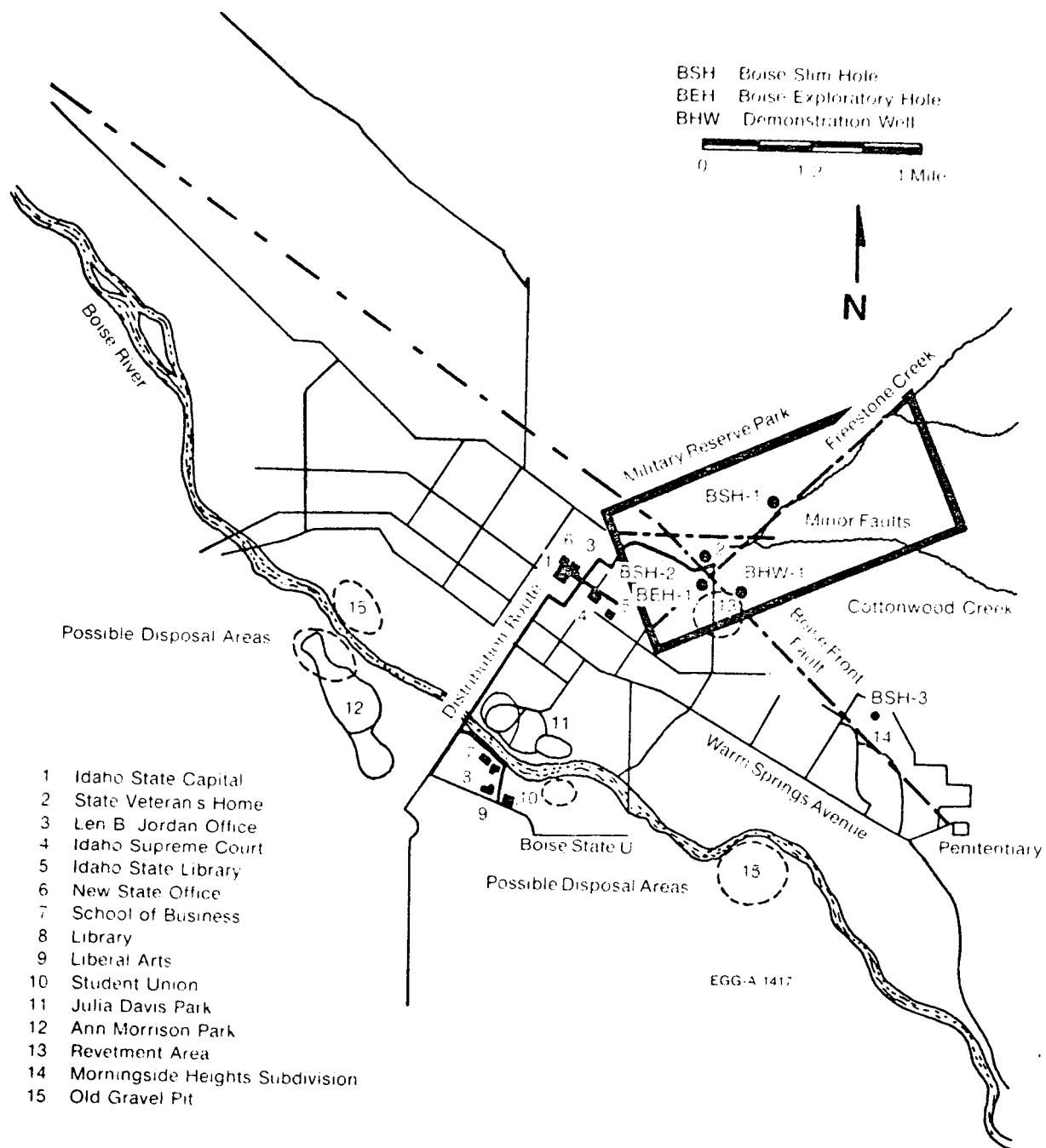


Figure 1

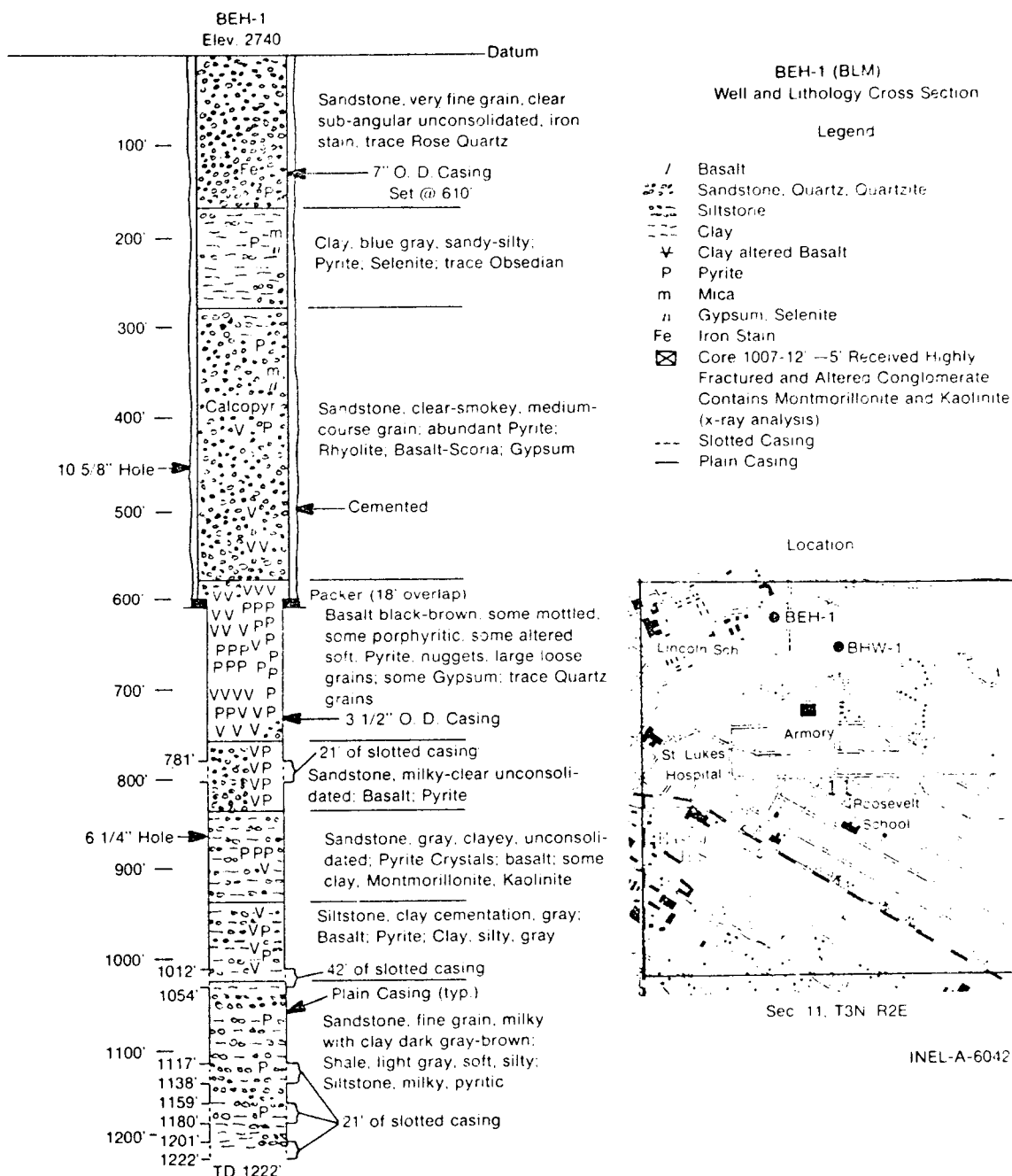
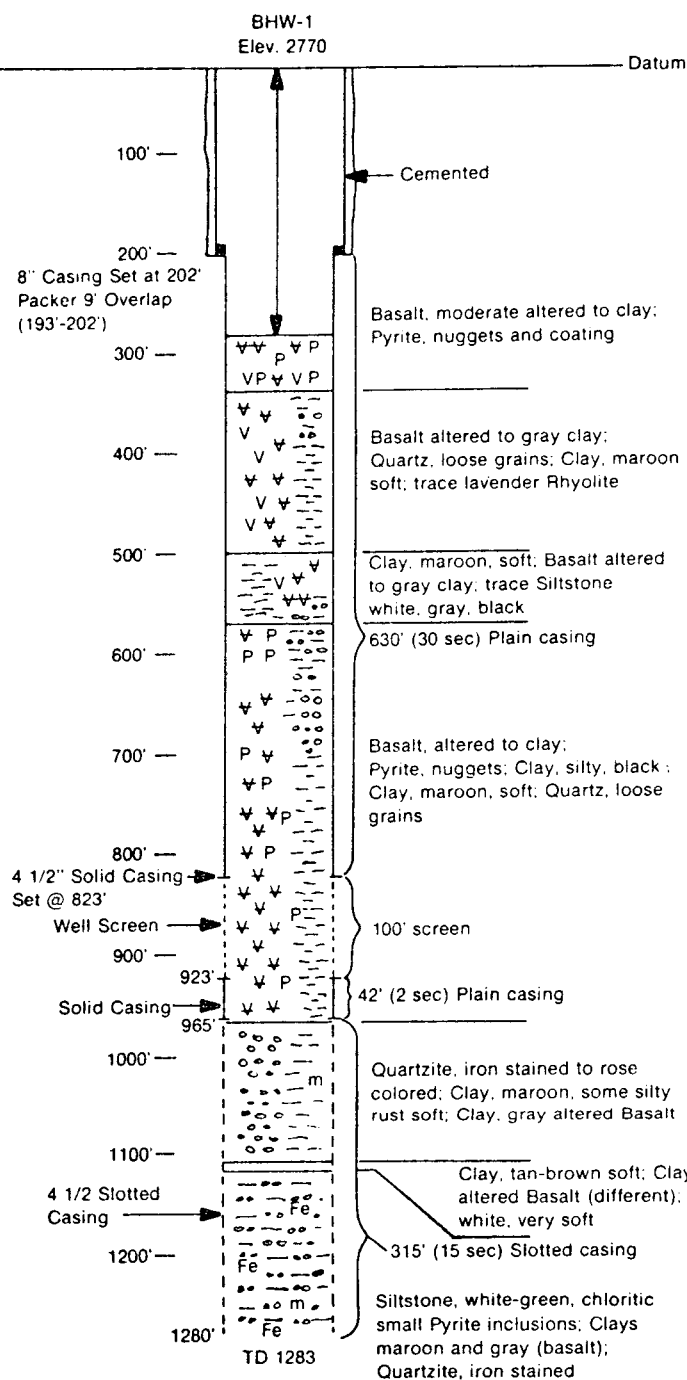


Figure 2

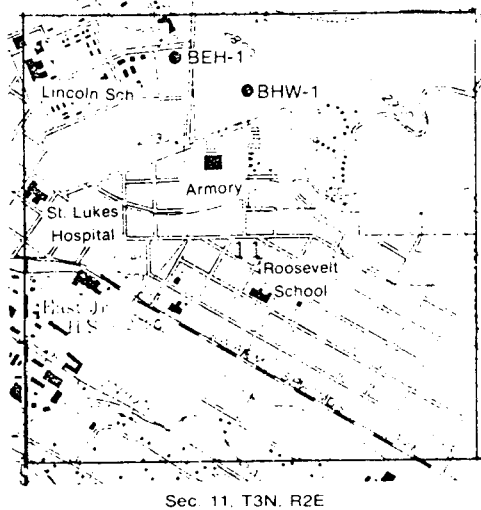


BHW-1 (Beard)
Well and Lithology Cross Section

Legend

- V = Basalt
- ⊞ = Sandstone, Quartz, Quartzite
- ⊞ = Siltstone
- ⊞ = Clay
- ⊞ = Clay altered Basalt
- P = Pyrite
- m = Mica
- // = Gypsum, Selenite
- Fe = Iron Stain
- ⊞ = Core 1007-12' —5' Received Highly Fractured and Altered Conglomerate Contains Montmorillonite and Kaolinite (x-ray analysis)
- Slotted Casing
- Plain Casing

Location



INEL-A-6043

Figure 3

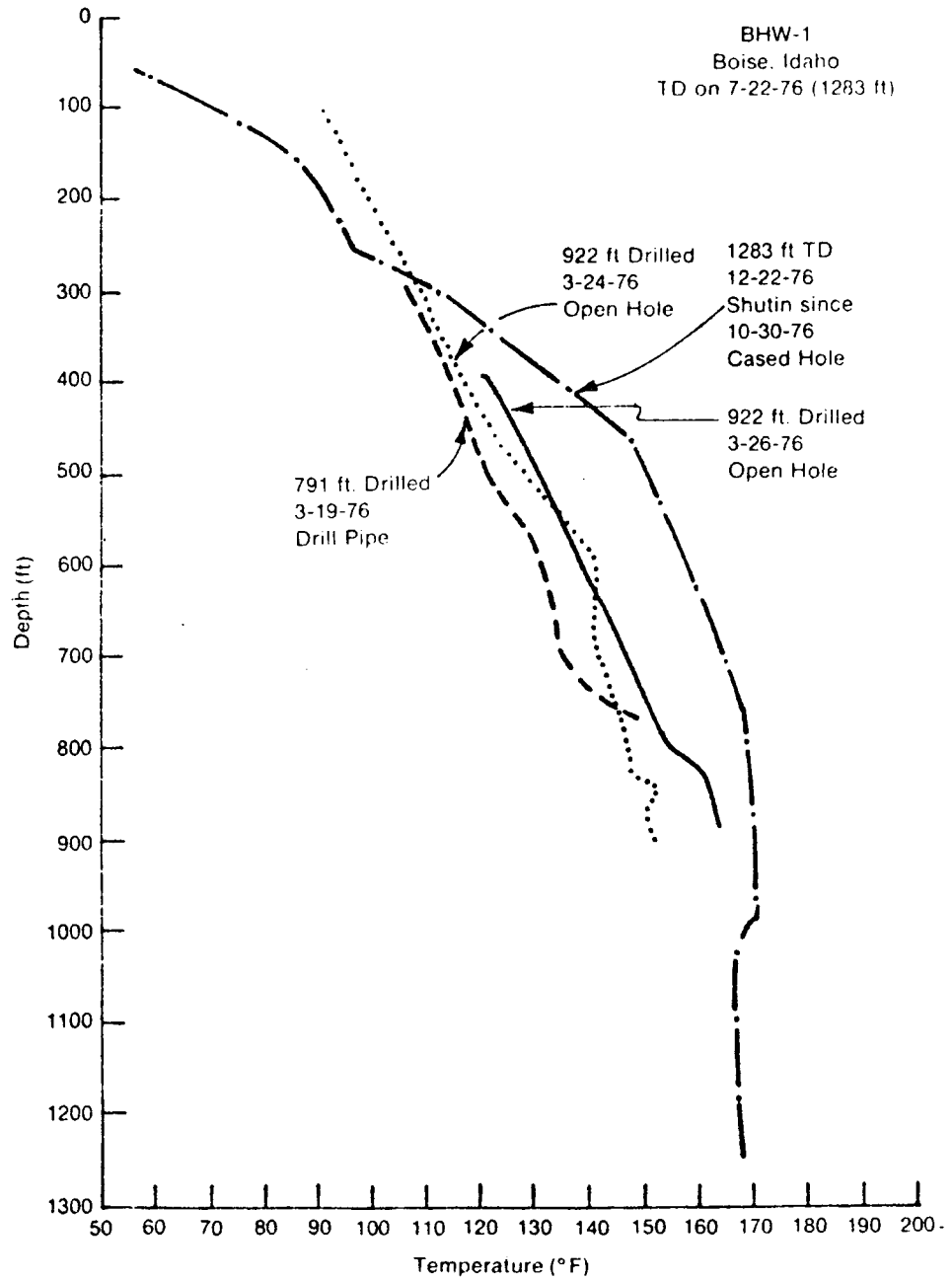


Figure 4

BOISE TESTING

Pumping Well	Q gpm	Date Begun	Duration	Calc. Based on Well	Kh Md. ft Drawdown	Kh Md. ft Recovery	Method	Notes
BLM	90	10-10-77	30 hrs	BLM	4.3×10^4	-	S/L	Questionable Poor
				Beard	1.6×10^7	2.2×10^6	S/L	Fair
				Beard	4.8×10^6	-	L/L	-
Beard	240	9-13-77	10 hrs	BLM	3.7×10^6	9.2×10^6	S/L	Fair
Beard	350	9-14-77	9 hrs	BLM	6.5×10^6 3.4×10^6	bef. bkpt. aft. bkpt.	S/L	R ~ 4300' from BLM
Beard (1)	150		12 days	BLM	3.5×10^5	$3.5 \times 10^{6(2)}$	SL	
				Beard	1.4×10^6	No data not fully shut in	SL	

(1) Field Plots

(2) Partial data

TABLE 1