The Nation’s Oldest and Largest Geothermal District Heating System

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Keywords

District Heating

ABSTRACT

Boise Idaho is site of the Nation's oldest and largest geothermal district heating system and may well boast as one of the largest in the world. The first two wells were drilled in 1890 to supply hot water to a natatorium and new houses being built in East Boise. Subsequently additional wells were drilled in the 1980's by the city, the State of Idaho and the Veterans Administration to develop a geothermal district heating system within their service area. The City of Boise system heats over 5.5 million square feet of space within the heating district. Adding the State of Idaho, Veterans, and Warm Springs district heating systems make an estimated total of 7.4 million square feet heated by geothermal resources.

Introduction

Geothermal energy in and near Boise, Idaho has a long history of use. Long ago the Native Americans used local hot springs as a peaceful gathering place for bathing and medicinal purposes. Miners and pioneers coming off the Oregon Trail looked forward to stopping in the Boise River Valley for rest and bathing in the warm waters of the hot springs. Early drilling for cold water intersected warmer water in the area but it was not until 1890 that a project was initiated to drill deeper for hot water.

Boise Warm Springs Geothermal System

The Boise Warm Springs Geothermal District Heating system actually started in the spring of 1890 with shallow cold water wells to supply a hotel and the nearby neighbors with cold drinking water at a cost of $3.00/faucet per month. In the fall of 1890, three investors sought to drill for hot water in an area near the Territorial Penitentiary which had discharging warm springs. Drilling started in December 1890 and by Christmas, the wells had reached a temperature of 112 degrees F at 112 feet. A larger drilling rig was brought in and on January 24, 1891, the drilling had reached 404 feet deep and "tremendous" flow of 175 degree F water was encountered.

A second well was then drilled to make a total combined flow of 800,000 gallon per day and on March 28, 1891, the Artesian Hot and Cold Water Company was formed.

Initial projects included a large natatorium, the company president's new mansion, and a neighbor's house built nearby on Warm Springs Road. Geothermal water was supplied to these two homes in 1892. Several other homes were subsequently added to the geothermal system as the cost of heating with geothermal water was far less than coal. Small homes of eight rooms or less were charged $2.00/month and larger homes $3.00/month. Coal heat was costing other residents of Boise $7-$8/ton. The Natatorium, a 15,000 square foot structure, was opened on May 25, 1892. The 65 by 125 foot pool was one of the largest in the United States. In addition, the facility offered 50 bath and dressing rooms along with parlors, card rooms, dining room, and a café.

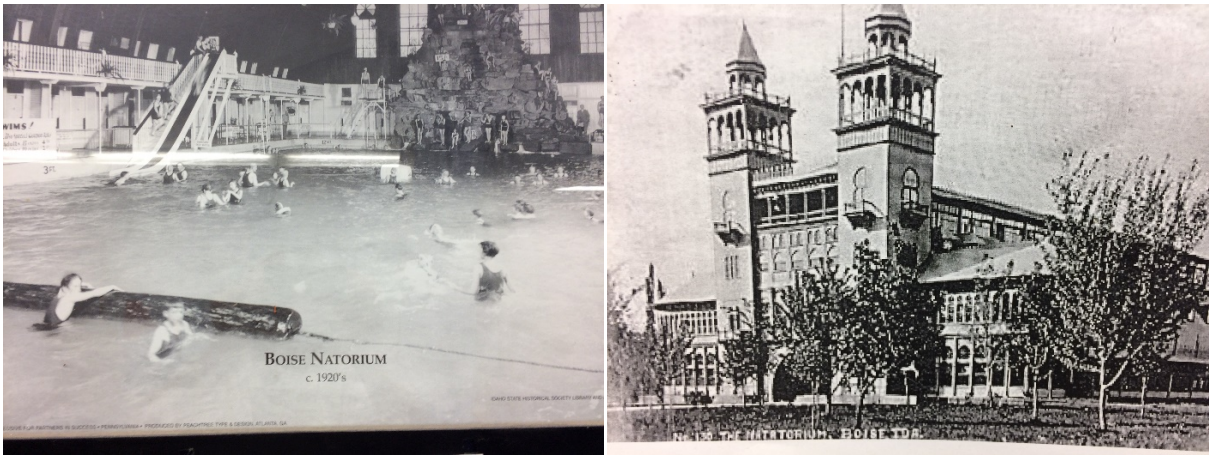

Figure 1

Today, Boise Warm Springs Water District Heating system still uses the two original wells drilled in 1890/1891. Presently the system provides geothermal water to over 300 homes, the State Health Laboratory, and the Idaho State Agricultural Building.

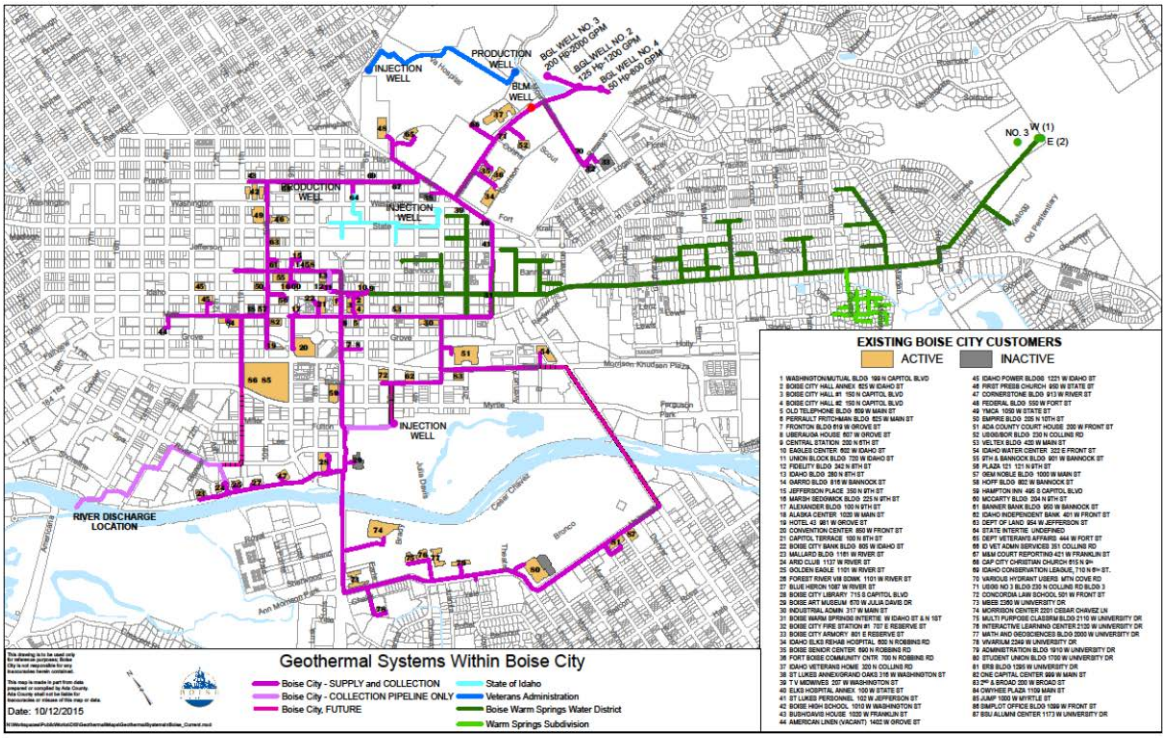

Figure 2

The homes range from smaller houses to larger, turn-of-the-century mansions of over 5000 square feet. The system currently delivers over 1400 gallon per minute of 175 degree F water during the winter months. During summer months, geothermal water is supplied to over 100 homes for hot water domestic use.

Figure 3

The system does not have injection wells so spent geothermal water is discharged to the city waste water system. A few of the older homes discharge the spent water to a canal. Discharge temperatures range from 100 to 140 degrees F. The system also serves about 64 homes in a newer subdivision and the newer City Natatorium through a heat exchanger.

The cost of geothermal water to the customer is governed by the size of the orifice coming into the house or facility. This method has not changed since its beginning in 1892. The table below compares the rate charged in 1897 by the Artesian Hot and Cold Water Company and rates charged in 2017 by the Boise Warm Springs Water District.

Geothermal Water Use Rate Schedule

	1897 (AHCWC)	2017 (BWSWD)
Orifice Size (in inches)	Rate/Year	Rate/Year
1/8	$ 60	$ 377
3/16	$ 80	$ 859
1/4	$100	$1,520

Not much happened with geothermal development during the mid 1900s. In 1934, a wind storm blew the roof off the Natatorium so the building was destroyed. Rotting wooden pipes together with cheap hydropower and natural gas coming to the area in 1956, caused the geothermal system to shrink. By 1970, there were about 200 homes and a few businesses.

State of Idaho Capital Mall System

Later in the 1970s, rising natural gas prices and the interest in renewable energy sparked an awakening of the geothermal potential in Boise. In 1977, the State of Idaho put two new buildings on the Boise Warm Springs Water District System and in 1980, the State drilled a 2150 foot well and intersected a 200 gallon per minute (gpm) artesian flow of 153 degrees F.

A second well was drilled for injection to a depth of 3030 feet and intersected a fracture system which
initially produced 960 gpm at 160 degrees F. These two wells are used to heat the Capital Mall area consisting of the State capital and 11 State office buildings, totaling over 800,000 square feet of space.

Figure 4

The well produces 750 gpm during winter months at a temperature of 153 degrees F using the deeper resource and injecting into the 2150 foot deep well. The system provides heat for about 90 percent of the heating requirement for the Capitol Mall complex. There have been no issues with the system and consideration has been given to using spent thermal water to heat outdoor walkways and ramps before injecting.

City of Boise Geothermal System

Figure 5

In the early 1980s, the City of Boise became active in developing the geothermal resource for the city. Land was acquired in an area known as Military Reserve Park northwest of the city near the Veteran's Administration Hospital. In 1983, three wells were drilled and tested showing a potential of heating over 2 million square feet of space. Production temperatures ranged from 165 to 177 degrees F at depths of 2300 feet. This prompted the city to start construction of a 4 ½ mile distribution system. The system presently pumps approximately 300 million gallons of geothermal fluid per year and provides heat to 91 buildings in the city, heating approximately 5,500,000 square feet of space.

Initially, the geothermal fluid was discharged into the Boise River after being passed through the buildings. Because of substantial decline of the geothermal aquifer, serious consideration was given to placing a moratorium on any future development or drilling an injection well. In the period from 1981 to 1989, the aquifer declined nearly 50 feet. The state did, indeed, place a moratorium on any increased use of the geothermal system.

In 1988, geologic and geophysical studies were performed to determine the best location and depth for an injection well. The injection well was completed in 1999 and put into use with 100 percent of the geothermal water re-injected. Since the injection well has been in use, water level elevation of the thermal aquifer system has steadily increased to nearly the pre development status of the city system. As a result, the City of Boise system has been expanded to the Boise State University campus.

Figure 6

Presently there are 9 buildings being heated by geothermal energy on the BSU campus with more in the planning stage. With potential expansion of the City of Boise system within the city and at the BSU campus, consideration has been given to using the third well, which has not been used since being drilled in the early 1980s.

Veterans Affairs Regional Facility

Figure 7

The fourth geothermal district heating system in Boise is the US Department of Veterans Affairs Regional facility. The VA Hospital facility became interested in the potential to heat their facility in the 1980s when the State of Idaho and City of Boise started looking into their use of geothermal energy. A production and injection well was drilled in the early 1980s and a system installed which provides geothermal heat to essentially all of the buildings in the VA hospital complex.

This system produces over 600 gpm at a temperature of 161 to 167 degrees F. There are 19 buildings being heated with the geothermal system amounting to approximately 500,000 square feet of space. Injection temperatures range from 134 to 140 degrees F and presently the system is constrained by the
injection well. Efforts to increase injectivity have not proven beneficial so a second injection well is being explored to allow future expansion of the system. There are over 50 buildings in the VA Hospital Complex of which many could be retrofitted to use geothermal heat beyond those already using the resource.

Conclusion

In summary, the Boise area geothermal direct heat application has several achievements. It boasts as the first to be developed in the United States as the original wells and the geothermal direct use heating district started in 1890. It continues today using the same two wells. The City of Boise system can boast as being the largest in the US with the heating of 91 buildings totaling over 5,500,000 million square feet of space. The VA Hospital is the only Veterans Administration hospital utilizing geothermal heat involving 19 buildings and over 500,000 square feet of heated space. The State of Idaho Capital Mall geothermal system heats the State Capital and other state buildings in the capitol complex totaling over 800,000 square feet of space heated. Combining all the applications makes the Boise geothermal area the largest

district heating systems in the United States and quite possibly in the world with approximately 7,400,000 square feet of buildings heated by geothermal energy.

Boise is proud of their use of geothermal resources and plaques stating the building uses geothermal heat have been installed on each such building with the city.

Figure 8

At Boise State University, an art sculpture developed by the students has been created outside the Environmental Science Building, one of the buildings heated by the Boise geothermal system on the campus. A watershed exhibit has been constructed by the City of Boise which show cases the geothermal system in an interactive, engaging display describing the geology, technology, and sustainability of the "heat beneath your feet".

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