Geothermal Resources in the Castle Mountain Creek, Idaho, Area

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Introduction

Geothermal water is being used in the Castle Mountain Creek Subdivision in Boise County, Idaho, to provide heating for domestic structures (permanent homes and occasional-use cabins). Over 90 wells with geothermal resources have been drilled since the 1980's in order to extract heat from the water columns in the well bores. The heat is extracted without the need to discharge water from the wells. The heat is transferred from the water in the well bore through the walls of a closed-loop piping system and into a working fluid (water or glycol mix) in the piping system. The working fluid is circulated from the well to the structure being heated and then back to the well. Heat is extracted from the working fluid in the structure through various radiant methods such as arrays of piping under the floorboards or by circulation in heat registers. This closed-loop technology eliminates the need to withdrawal water from the aquifer which could result in harmful depletions to the aquifer system. IDWR inventoried about 50 geothermal wells in the Castle Mountain Creek area in the early 1990's. Additional geothermal wells were identified by examining well driller's reports. This report is a compilation of the current knowledge of the geothermal resources in the Castle Mountain Creek area.

Geothermal Resources in Idaho

In Idaho, water temperatures greater than 85 degrees Fahrenheit (°F), and up to 212 °F, are classified as Low Temperature Geothermal. Water temperatures greater than 212 °F are classified as Geothermal. Water temperatures in the range of 68 °F to 85 °F are informally classified as Warm. Waters with temperatures less than 68 °F are informally classified as Cold.

Over 760 Low Temperature Geothermal wells and Geothermal wells have been identified in Idaho with a majority being Low Temperature Geothermal. IDWR maintains an electronic database of these resources with metadata such as Station Name (based on township, range, section, and subsection), original owner name (based on the well driller's report or information acquired from other sources), well depth, casing record, water temperatures (at land surface for most wells and at various depths for other wells), static water level, and comments. There are also about 200 Low Temperature Geothermal springs throughout the state.

With the exception of a few cold and warm water wells, all of the water temperatures in the Castle Mountain Creek area fall into the Low Temperature Geothermal range. For simplicity, the term geothermal is used throughout this report instead of low temperature geothermal.

Description of the Castle Mountain Creek Area

The Castle Mountain Creek area is about four miles northwest of Garden Valley, Idaho, in Boise County (Figure 1). The area is about 4,000 feet by 2,000 feet, primarily located in the southeast quarter of Section 32 and the southwest quarter of Section 33, Township 10 North, Range 4 East. The Castle Mountain Creek area is comprised of 7 subdivisions according to the 2018 taxlots: Castle Mountain Creek #1 - #5, Warm Springs Estate #1, and Livingston Estates #1. There are over 260 land parcels in these seven subdivisions. Development has occurred on many of the parcels as homes occupied by full-time residents or recreation cabins with occasional use.

Geology in the Castle Mountain Creek Area

The wells in the Castle Mountain Creek area are completed in the granitic rocks of the Idaho Batholith, which is a large-scale geological feature that occurs throughout much of central Idaho. Granite is a dense and hard igneous rock which often has limited reservoir space for water. Typically, wells completed in granite have low yields on the order of 1-5 gallons per minute (gpm). However, many of the yields from well driller reports in the Castle Mountain Creek subdivision are in the range of 10-50 gpm, with a few wells having even higher reported rates of discharge. These rates are often based on short-term tests of 1-2 hours, and thus may not reflect a well's yield and drawdown over longer usage. Consequently, two problems may occur in wells completed in granite aquifers. First, the well yield may be too small to meet the required needs. Second, the water may be depleted over time due to excessive withdrawal. The residents of Castle Mountain Creek overcame these potential problems using downhole heat exchanger technology that does not require withdrawals of water from the wells. The technology is discussed in an upcoming section of this report.

Summary of Castle Mountain Creek Wells

As of this report, there were 97 wells within the Castle Mountain Creek area (Figure 1). Seventy-five of those wells are classified as "proven" geothermal with verified temperatures that range from 95 °F to 190 °F. Thirteen other wells are classified as "probable" geothermal because some form of evidence exists to indicate they are most likely geothermal. The Castle Mountain Creek geothermal wells are classified into groups as follows:

Proven Geothermal wells with well driller's reports (63 wells). This is a composite of 1) geothermal wells that IDWR visited and inventoried in the 1990's, and had identifiable well driller's reports, and 2) wells that IDWR has not visited, but are listed in IDWR's database of well driller's reports with water temperatures greater than 85 °F

Proven Geothermal wells without well driller's reports (12 wells). These are wells that were inventoried by IDWR in the 1990's and the owner provided information (usually a specific water temperature) during the inventory that indicated the well was geothermal. However, no well driller's report could be located.

Probable Geothermal wells without well driller's reports (10 wells). These are wells that were inventoried by IDWR in the 1990's, but no water temperature measurements were acquired from the well owners, and no well driller's reports were located. The inventory work was led by an IDWR employee who had extensive knowledge of the Castle Mountain Creek area. Although field notes exist for each of these wells, there is no information on the notes to indicate why the wells were thought to be geothermal at the time of inventorying. Most likely, the IDWR employee either knew or suspected that the wells had geothermal water. Based on this assumption, despite the lack of temperature data, it was decided to classify the wells as "probable" geothermal.

Probable Geothermal wells with well driller's reports (3 wells). These are wells that have do not have temperatures recorded on the well driller's reports, but they have some other entry on the reports (such as "heat exchanger unit" or the use is checked as "thermal") that indicates the well has geothermal water.

Non-geothermal wells in the Castle Mountain Creek Area

2 warm water wells with water temperatures in the low 80's °F (well driller's reports).
1 cold water well based on information acquired during IDWR's inventory in 1995 (no well drillers' report).
1 cold water well based on information from the well driller's report.
1 well that has "<85 °F" recorded on the well driller's report (so it could be either warm or cold).
1 well that has no temperature recorded on the well driller's report.
2 wells that were drilled, no water was found, and they were abandoned.

Stacked well driller's reports

There are two locations that have more than one well driller's report listed. One location has 2 geothermal well reports. The other location has 4 geothermal reports. The reason for the stacking is because the locations are considered "nominal" by IDWR. The well reports are located in the centroid of the quarter quarter section as reported by the well driller. There is no additional information (Block and Lot numbers, street address, etc.) available to refine the location, nor are there matches made between the names on the well driller's report and the 2018 taxlots. The locations may possibly be determined by using older taxlot data or by interviewing long-time residents in the area who may recognize the names on the well driller's report and have knowledge of where those owners once lived.

Geothermal Spring in Castle Mountain Creek

The Warm Springs Creek Hot Spring is located along the eastern side of the Castle Mountain Creek subdivision. The water temperature of the spring is 167 °F. The spring provides water to a public recreation pool located about 200 feet to the northeast of the spring. The pool facility is owned by the Castle Mountain Creeks Owners Association.

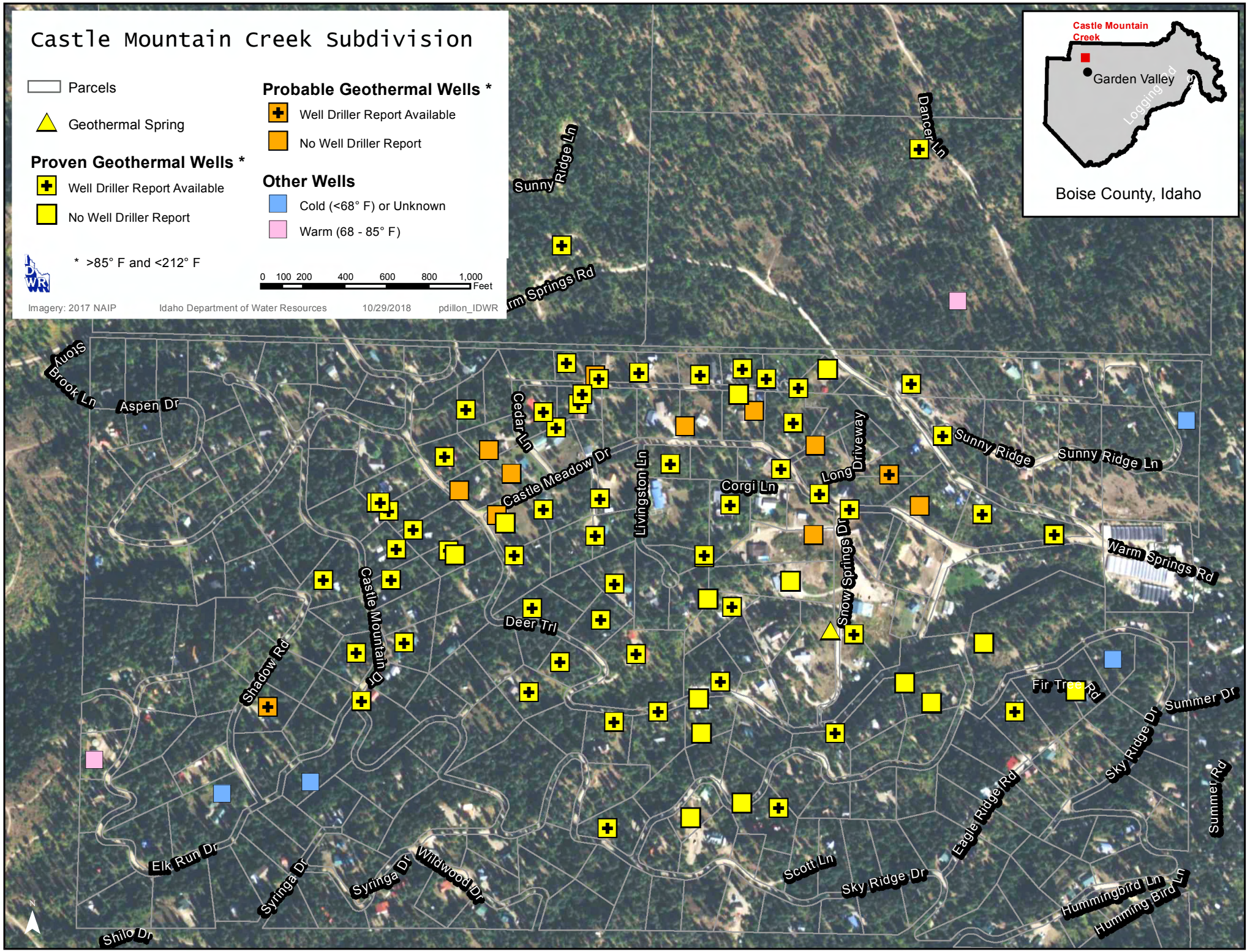
Heating Technology

Heat is extracted from the Castle Mountain Creek wells using Downhole Heat Exchangers and Closed Loop technology. These systems are typically a continuous string of pipe (usually copper) that is installed in a home with a loop of the pipe placed in the well deep enough to reach the hot water. The pipe is filled with a working fluid (water or an inert solution containing Glycol). The water circulates through the pipe by means of natural convection or through the use of an inline pump that increases the flow rate. If the water temperature is too low, a heater can be added to the system in order to boost the temperature. The heat can be extracted in the home using various transfer methods. For example, the owner may install an array of pipes under the floor boards, or in other parts of the building, and the heat gradually transfers from the pipe into the floors and into the airspace. Another transfer method is to install registers in the building which allow water to slow pass through them, radiating heat to the surrounding airspace. These methods have proven to be very effective in heating the homes and cabins in the Castle Mountain Creek area.

Additional Information

A large-scale detailed map and a table of the wells can be found at
https://idwr.idaho.gov/press/technical-publications.html

Figure 1. Geothermal wells in the Castle Mountain Creek Area.



References

Mitchell and others, 1980, Potential for Direct Heat Application of Geothermal Resources. Idaho Department of Water Resources, Water Information Bulletin #30, Part 9, 396 pages. https://idwr.idaho.gov/files/publications/wib30p9-geothermal-direct-heat-applications.pdf

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