



## Site Description

### Hawthorne

(updated 2010)

#### Geologic setting:

Geothermal features: Thermal fluids were first discovered in the 1940s and 1950s on U.S. Navy property at Hawthorne Ammunition Depot (Trexler et al., 1981). The wells ranged from 122 to 183 m deep, and the deepest penetrated sandstone gravels to a total depth of 183.5 m (Scott and Barker, 1962; Everett and Rush, 1967). The hotter wells are located near the Wassuk Range-front fault, west of municipal Hawthorne. GeothermEx (2004 ,Fig. HAW002) reported several wells with temperatures between 47 and 93°C.

In May 1980, the El Capitan Casino hit hot water while drilling south of Hawthorne (NW¼ SW¼ Sec. 33, T8N, R30E). The well had a reported temperature of 99°C, a total depth of 305 m, and was perforated from 152 to 305 m (Reno Gazette-Journal, May 13, 1980; Dennis Trexler, oral commun., 1980). Several studies were conducted to evaluate heating the casino and other Hawthorne buildings with geothermal fluids, but no facilities were constructed. In 2006, Mt Grant General Hospital received \$25,000 for a feasibility study and engineering assistance in replacing its heating system with geothermal. The GeoHeat Center (Klamath Falls, OR) was technical consultant on the project.

The first shallow temperature survey (Trexler and others, 1981) outlined two areas of anomalous temperatures in the Hawthorne area: 1) west of Hawthorne along the Wassuk Rangefront in Secs. 19, 20, 29, and 32, T8N, R30E, and 2) southeast of Hawthorne in Sec. 35, T8N, R31E and Secs. 4, 5, 9, T7NR31E. A test well in the area west of Hawthorne recorded temperatures over 80°C and temperatures greater than 60°C were recorded in a test well in the area southeast of Hawthorne (Trexler and others, 1981).

In 2009-2010, the Naval Geothermal Program Office subcontracted with the Center for Geothermal Energy (UNR) to identify areas of geothermal potential at Hawthorne Ammunition Depot. Three thermal anomalies were identified from shallow temperature surveys, well temperature measurements, and chemical geothermometry. Anomaly **A** coincides with a ~7 km step in the Wassuk range-front fault, anomaly **B** centers on the Garfield Hills NW terminus, and anomaly **C** surrounds the tufa lineation NNE of municipal Hawthorne. Prior to UNR's collaboration with the Naval Geothermal Program Office, little was known about well geochemistry throughout Hawthorne Ammunition Depot. Only nine wells had adequate geochemistry for geothermometer calculations,



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despite numerous recorded well temperatures, and seven of these localized along the south Walker Lake shoreline.

Anomaly **A** extends from the base of Corey Creek Canyon north to Cat Creek (Hinz et al., 2010). Structural surveys identified this part of the Wassuk Range as the zone of highest geothermal potential. Hinz et al. (2010) recommended drilling in the highly-faulted Cat Creek right step, which has high Holocene slip rates relative to the Wassuk range-front fault, and major damage zones in the footwall (i.e., may serve as an excellent reservoir rock).

Well temperatures drop east of the range-front, indicating localized fracture / flow patterns. Well MC-5, 3.5 km east of Corey Creek Canyon, is 32°C, versus boiling-range temperatures 1.5–2.5 km east of the range-front at El Capitan, Maples #1, and navy test wells HWAAD-2A and -3. Similarly, wells 2–3 km east of Cat Creek (HHT-1, Quarters B, and IPRMW53) have temperatures of 40.3°–64.4°C, much warmer than wells 3.5 km east (WO-6, IRPMW54, and IRPMW55) at 30.1°–32.1°C. These localized shifts are also evident in boron and lithium concentrations, calculated temperature gradients, and total dissolved solids concentrations (Penfield et al., 2010).

Geothermometer values near Cat Creek are low, with an average value of  $79 \pm 9.2^\circ\text{C}$  (Na-K-Ca-Mg). However, these wells exhibit anomalous boron and lithium, and the highest heat gradients in Hawthorne (well IPRMW53, for example, has a gradient of  $589 \pm 7.3^\circ\text{C}/\text{km}$ ). Low geothermometry could be related to catchment runoff, flowing eastward from Cat Creek, diluting the geochemical signal. Low total dissolved solids support the idea of catchment-related dilution.

A second anomaly **B** centers on the Garfield Hills NW terminus, delineated by a 2m temperature survey (Kratt et al., 2010). No wells fall within this anomaly, but 2.5 km west, wells IRPMW38 and IRPMW39 have high cation geothermometry at  $121^\circ\text{C} \pm 2.3^\circ\text{C}$  and  $129^\circ\text{C} \pm 5.2^\circ\text{C}$ , respectively. (Neither well has measured temperatures or silica concentrations.) Well HWAD-3, 2.5 km southwest of the anomaly, has temperatures of  $37.8 \pm 3.2^\circ\text{C}$  and geothermometers of  $94.5 \pm 15.1^\circ\text{C}$  (Na-K-Ca-Mg) and  $86.2 \pm 16.7^\circ\text{C}$  (chalcedony). 4 km south of the anomaly, HHT-2 has an anomalously high temperature at 63°C (Penfield et al., 2010).

A third anomaly **C** traces the tufa lineation identified by Bell and Hinz (2010), NNE of municipal Hawthorne. Wells in anomaly **C** have consistently warm temperatures and elevated total dissolved solids. This distribution is far more diffuse than the compartmentalized Wassuk range-front pattern. There are two anomalous geothermometers (Na-K-Ca-Mg) in this cluster and 16 thermal wells: 8 wells range from 20°–28°C, and 8 from 28°–37°C. The elevated geothermometers were calculated for wells IRPMW32 ( $136.9 \pm 2.3^\circ\text{C}$ ) and IRPMW30 ( $132.6 \pm 3.7^\circ\text{C}$ ). The other 12 wells with cation geothermometers have values between 90°–110°C, with two 70°C exceptions. Well HAAD-7 has



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an unusually high silica geothermometer (133.5°C), but given the 77.0°C cation geothermometer and 21°C measured temperature, this value may be an error. No other well in the vicinity has silica measured; the nearest is 3.9 km (Penfield et al., 2010).

Leasing information: The Navy, along with researchers from the University of Nevada, Reno, have conducted shallow temperature surveys, structural mapping, geophysics, and drilling over portions of the U.S. Army Depot lands at Hawthorne. Work has identified three previously unknown thermal anomalies which appear to be blind geothermal systems.

No information is available on the 3050 acre lease held by RAM Power. Oski Energy also holds a small lease block, but no work has been completed recently.

### Bibliography: