Geothermal Resources of Oregon

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KLAMATH FALLS

Utilization of geothermal energy at the City of Klamath Falls began in the 1900's. Applications now include heating houses, apartments, hotels, greenhouses, swimming pools, commercial laundries, and pasteurizing milk in a creamery. The northeastern part of the city is underlain by a large reservoir-reservoir of thermal water. More than 400 wells ranging in depth from 30 to 610 m (100 to 2,000 ft), with temperatures of 21° to 110°C (70° to 230°F), are used mainly for space heating, about 500 residences. The principal heat-extraction system is a closed-loop system. Because of conservation, the decline in the aquifer fluid production of thermal water from the reservoir is not required. Klamath Falls now has a planned city-wide geothermal heating district. The U.S. Department of Energy has funded the drilling and completion of two production wells and distribution lines for heating 14 city, county, state, and federal buildings. With another U.S. Department of Energy loan, the district is making a feasibility study of using thermal water to directly equal waste for fuel. (Culver-Lund, 1981).

At the north end of the Klamath Falls thermal zone the Oregon Institute of Technology (OIT) has three wells (KL-17, 18, 20) 305 to 350 m deep which pump up to 1,700 L/min of 89°C water for heating and cooling ten buildings with total floor space of over 46,500 m² (500,000 ft²). The geothermal system has saved an estimated $40,000, there is a saving of almost $100,000 per year compared to the cost of heating with conventional fuel. OIT is the first geothermally applied building complex in the United States. All the adjacent Presbyterian Intercommunity Hospital's well (KL-19) 403 m deep produces 86°C water for a retrofitted heating system in buildings with 30,480 m² (327,600 ft²) of floor space. The hospital has per period the projected cumulative fuel savings is $26.5 million.

The Geo-Heat Center was established at Oregon Institute of Technology in 1974 as a geothermal information and research facility. It has U.S. Department of Energy funding to provide information and technical assistance to prospective users of geothermal energy, especially for direct applications. Address is Geo-Heat Center, Oregon Institute of Technology, Klamath Falls, Oregon 97601.

Thermal Wells

- Temperature 20°-50°C
- Temperature higher than 50°C

50°C — Contours, degrees Celsius - maximum downhole temperature

Temperature data and contours by G. Cene Culver, Paul J. Lienau, and John W. Lund, Geo-Heat Center, Klamath Falls

City of Klamath Falls Inset
Scale 1 Inch = 1,000 feet

Oregon Institute of Technology Campus and Geothermal System

Information for wells KL-17,18 is in the thermal springs and wells list at the base of this sheet. Information for other wells shown on this map is listed below in "Thermal Wells—Klamath Falls Map Inset"

Thermal Wells—Klamath Falls Map Inset

WELL NO.	DEPTH TO TOP OF PERFORATIONS (m)	DEPTH TO TOP OF PERFORATIONS (ft)	DEPTH TO BOTTOM OF PERFORATIONS (m)	DEPTH TO BOTTOM OF PERFORATIONS (ft)	DATE DRILLED	TEMPERATURE (°C)	TEMPERATURE (°F)	PRESSURE (kPa)	PRESSURE (psi)	FLOW (L/min)	FLOW (gpm)
KL-1	61	200	91	300	1930	57	135				
KL-2	61	200	91	300	1930	57	135				
KL-3	61	200	91	300	1930	57	135				
KL-4	61	200	91	300	1930	57	135				
KL-5	61	200	91	300	1930	57	135				
KL-6	61	200	91	300	1930	57	135				
KL-7	61	200	91	300	1930	57	135				
KL-8	61	200	91	300	1930	57	135				
KL-9	61	200	91	300	1930	57	135				
KL-10	61	200	91	300	1930	57	135				
KL-11	61	200	91	300	1930	57	135				
KL-12	61	200	91	300	1930	57	135				
KL-13	61	200	91	300	1930	57	135				
KL-14	61	200	91	300	1930	57	135				
KL-15	61	200	91	300	1930	57	135				
KL-16	61	200	91	300	1930	57	135				
KL-17	61	200	91	300	1930	57	135				
KL-18	61	200	91	300	1930	57	135				
KL-19	61	200	91	300	1930	57	135				
KL-20	61	200	91	300	1930	57	135				
KL-21	61	200	91	300	1930	57	135				
KL-22	61	200	91	300	1930	57	135				
KL-23	61	200	91	300	1930	57	135				
KL-24	61	200	91	300	1930	57	135				
KL-25	61	200	91	300	1930	57	135				
KL-26	61	200	91	300	1930	57	135				
KL-27	61	200	91	300	1930	57	135				
KL-28	61	200	91	300	1930	57	135				
KL-29	61	200	91	300	1930	57	135				
KL-30	61	200	91	300	1930	57	135				
KL-31	61	200	91	300	1930	57	135				
KL-32	61	200	91	300	1930	57	135				
KL-33	61	200	91	300	1930	57	135				
KL-34	61	200	91	300	1930	57	135				
KL-35	61	200	91	300	1930	57	135				
KL-36	61	200	91	300	1930	57	135				
KL-37	61	200	91	300	1930	57	135				
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KL-39	61	200	91	300	1930	57	135				
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KL-81	61	200	91	300	1930	57	135				
KL-82	61	200	91	300	1930	57	135				
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KL-93	61	200	91	300	1930	57	135				
KL-94	61	200	91	300	1930	57	135				
KL-95	61	200	91	300	1930	57	135				
KL-96	61	200	91	300	1930	57	135				
KL-97	61	200	91	300	1930	57	135				
KL-98	61	200	91	300	1930	57	135				
KL-99	61	200	91	300	1930	57	135				
KL-100	61	200	91	300	1930	57	135				

Thermal Waters

Low Grade. Area known or inferred to be underlain at shallow depth (less than 1,000m) by thermal water of sufficient temperature for direct heat application. Thermal water may be present in other areas not shown or within the area, the boundaries are subject to change as new information is obtained. Individual areas are defined on the basis of locations of thermal springs and wells and on known or inferred local geologic and hydrologic conditions.

High Grade. Region favorable for the discovery of thermal water from 1,000 to 2,000m of depth of sufficient temperature for direct heat applications. It is probable that only small areas of this region are in a condition by such thermal water; the region represents that part of the state that deserves exploration for thermal areas. The region is defined on the basis of known geothermal, volcanic, and tectonic phenomena such as that, the presence of anomalous conductive heat flow, volcanism, mineralization, seismicity, and anomalous concentrations of faults and lineaments.

Thermal Springs and Wells

Thermal Springs:

- 90°C and above, surface temperature 50°C or lower
- Hot, surface temperature higher than 50°C

Thermal Wells:

- Warm, temperature 50°C or lower
- Hot, temperature higher than 50°C

Well and exploration temperatures are maximum measured. Well flowing unless otherwise pumping.

Heat Flow

- Heat flow measurement in milliwatts/meter² (1 mW/m² = 0.024 Heat Flow Unit (HFU) See Blackwell, D.D., Hull, D.A., Bowen, R.G., and Steele, J.L., 1978)

Scale 1:500,000
1 centimeter equals 5.3 kilometers
1 inch equals approximately 8 miles

Contour interval 500 feet
Datum is mean sea level
1927 North American datum
Lambert conformal conic projection based on standard parallels of 33° and 45°
Base map revised in 1979

Known Geothermal Resources Area (KGRA) as designated by the U.S. Department of the Interior (some in red tinting)

Indian reservation

Military reservation

National forest or state forest

National park, national recreation area, national monument, national wilderness area, national wildlife refuge, state park or state game range

Private land may exist within federal boundaries

Metric Conversion Factors

1 liter = .2642 gallon
1 meter = 3.281 feet
1 milligram/liter = 1 part per million
°Celsius × 9/5 + 32 = °Fahrenheit
°Fahrenheit - 32 × 5/9 = °Celsius

POPULATION KEY

PORTLAND	more than 100,000
SALEM	25,000 to 100,000
Astoria	1,000 to 25,000
Tillamook	1,000 to 5,000
Cannon City	less than 1,000

Population indicated by size of letters

- State capital
- County seat
- City, town, or village
- Scheduled service airport
- Built up area shown for towns over 10,000 population
- Interstate highway
- U.S. highway
- State highway
- Other principal roads

geothermal data compiled by Norman V. Peterson, George A. Priest, Gerald L. Black, David A. Bowen, and Neil K. Woller, Oregon Department of Geology and Mineral Industries, Portland, Oregon. Heat flow data compiled by David D. Blackwell and John L. Steele, Southern Methodist University, Dallas, Texas. Geothermal use information compiled by Debra Dolan, Geo-Heat Center, Oregon Institute of Technology, Klamath Falls, Oregon.

For further information about the geothermal resources of Oregon, contact the Oregon Department of Geology and Mineral Industries, 1005 State Office Building, Portland, Oregon 97201.

Map available from:
Oregon Department of Geology and Mineral Industries
1005 State Office Building
Portland, Oregon 97201

Map produced by Ronald H. Smith, Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado/NOAA, Boulder, Colorado, in cooperation with the Earth Science Laboratory/University of Utah Research Institute, Salt Lake City, Utah

Digital thermal spell and spring data available from GEOTHERM Project, U.S. Geological Survey, 345 Middlefield Road, MS84, Menlo Park, California 94025

Base map supplied by the U.S. Geological Survey

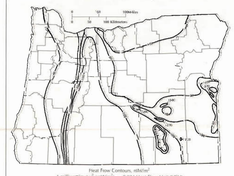
Geothermal data compiled by the

Oregon Department of Geology and Mineral Industries

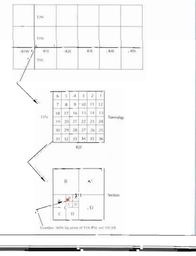
Map produced by the
National Geophysical Data Center
National Oceanic and Atmospheric Administration
for the
Division of Geothermal Energy
United States Department of Energy

Geomorphic Division of Oregon

Heat Flow Map of Oregon



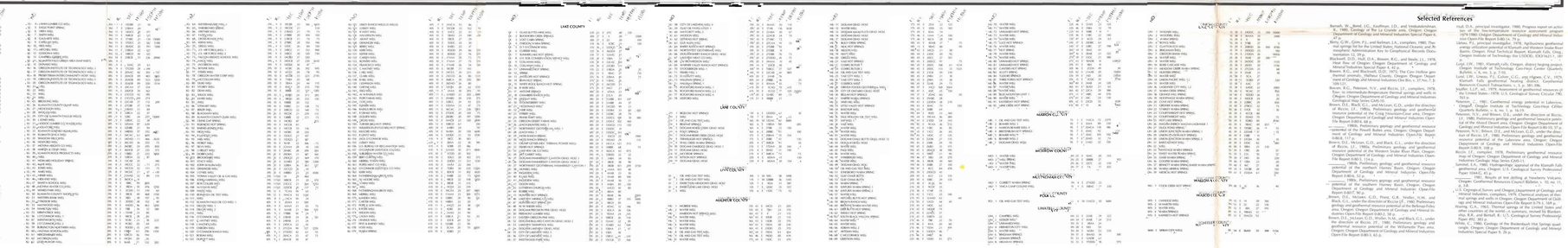
Spring and Well Location System



Thermal Springs and Wells

Well and weighted temperatures are maximum measured.
Well flowing rates are pumping.

LOWG—Low-Grade Geothermal Survey
GRAD—Temperature gradient
OWRD—Oregon Water Resources Board
DOG&MI—Oregon Department of Geology and Mineral Industries



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