GEOTHERMAL HEAT KEEPS STUDENTS WARM AT THE COLLEGE OF SOUTHERN IDAHO

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ABSTRACT

Two geothermal wells supply about 85 percent of the heat required for the facilities at the College of Southern Idaho (CSI) located in Twin Falls County, Idaho. The heating system for the college, which has been in operation since 1981, serves 12 buildings and four greenhouses. The hot water comes from an extensive geothermal system that underlies large portions of Twin Falls County. The water temperature at the CSI wells is about 101° Fahrenheit. CSI's annual production from 1990 to 1995 ranged from 185.8 to 269.5 million gallons. Geothermal development in the area near CSI has been halted by the Idaho Department of Water Resources due to rapidly declining wellhead pressures in several wells.

INTRODUCTION

The College of Southern Idaho (CSI) is located within the city of Twin Falls in northcentral Twin Falls County, Idaho (Figure 1). CSI, which was founded in 1965, is a two year campus that offers Associate degrees in art, science and engineering as well as courses and degrees in Vocational Technology. The student enrollment for the spring semester in 1996 was 4,188. The campus covers about 300 acres and contains 12 educational and administration buildings and one dormitory (Figure 2). Twelve of the 13 buildings and four greenhouses are heated with 101° Fahrenheit water that is pumped from the college's two geothermal wells. The annual cost savings to CSI over electric heating is at least $80,000.

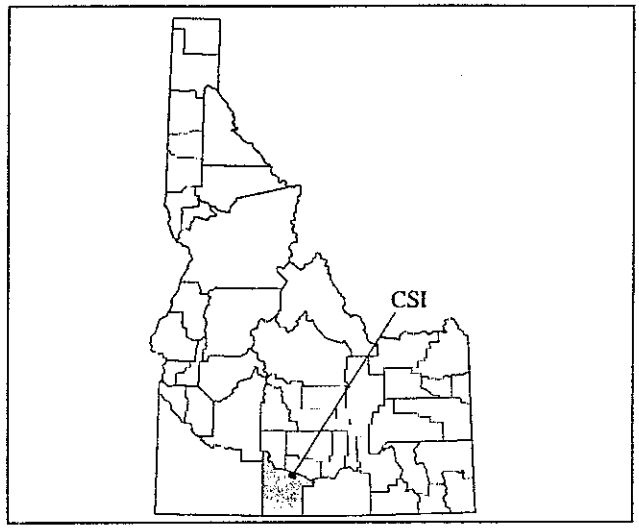

Figure 1. Location map for the College of Southern Idaho (CSI) in Twin Falls County, Idaho.

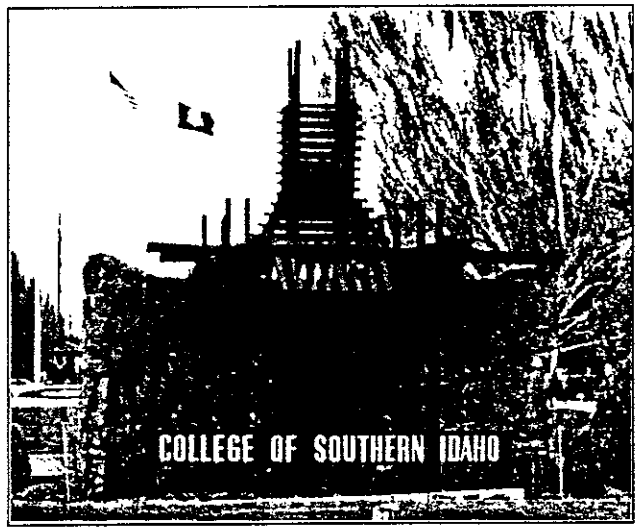

Figure 2. Entrance to the College of Southern Idaho.

GEOTHERMAL RESOURCES IN TWIN FALLS COUNTY

Geothermal resources in Twin Falls County, Idaho, have been documented in technical studies by several authors (Baker and Castelin, 1990; Lewis and Young, 1982; Lewis and Young, 1989; Street and Detar, 1987). The area's geology is characterized by: 1) rhyolite lava flows and welded ash-flow tuffs of the Idavada Volcanics Formation, 2) olivine basalts of the Banbury and Glenns Ferry Formations, which are interbedded in places with sedimentary fluvial and lacustrine deposits, and 3) olivine basalts of the Snake River Group (Figure 3). The formations dip to the north and are cut by a series of southeast-northwest trending faults whose downthrown blocks are to the north and northeast.

The conceptual hydrogeologic model developed by Street and Detar (1987) for the Twin Falls geothermal system shows that the ground water is recharged in the Cassia Mountains and Monument Hills to the south (Figure 4). The water flows to the northwest through the Idavada Volcanics during which time it is heated by deep circulation and the regional high temperature gradient. The geothermal water moves upward through the Idavada Volcanics and into the overlying basalts along the Berger-Buhl Structure Zone which is a series of southeast-northwest trending faults (Street and Detar, 1987).

GEOTHERMAL RESOURCE DEVELOPMENT

Thermal waters in Twin Falls County were used by Native Americans and early settlers as indicated by the discovery of artifacts near several springs (Street and Detar, 1987). The first geothermal well in the county was drilled near the City of Twin Falls in 1938 (Street and Detar, 1987). Currently, there are 82 wells and 5 springs in Twin Falls County with water temperatures greater than 85° Fahrenheit at the land surface (which is the cutoff temperature used by IDWR for designating geothermal water). Thermal waters are used for domestic heating, space heating of large buildings and greenhouses, aquaculture, alligator farming and recreation. A few wells are used for non-geothermal uses such as hydropower generation and irrigation.

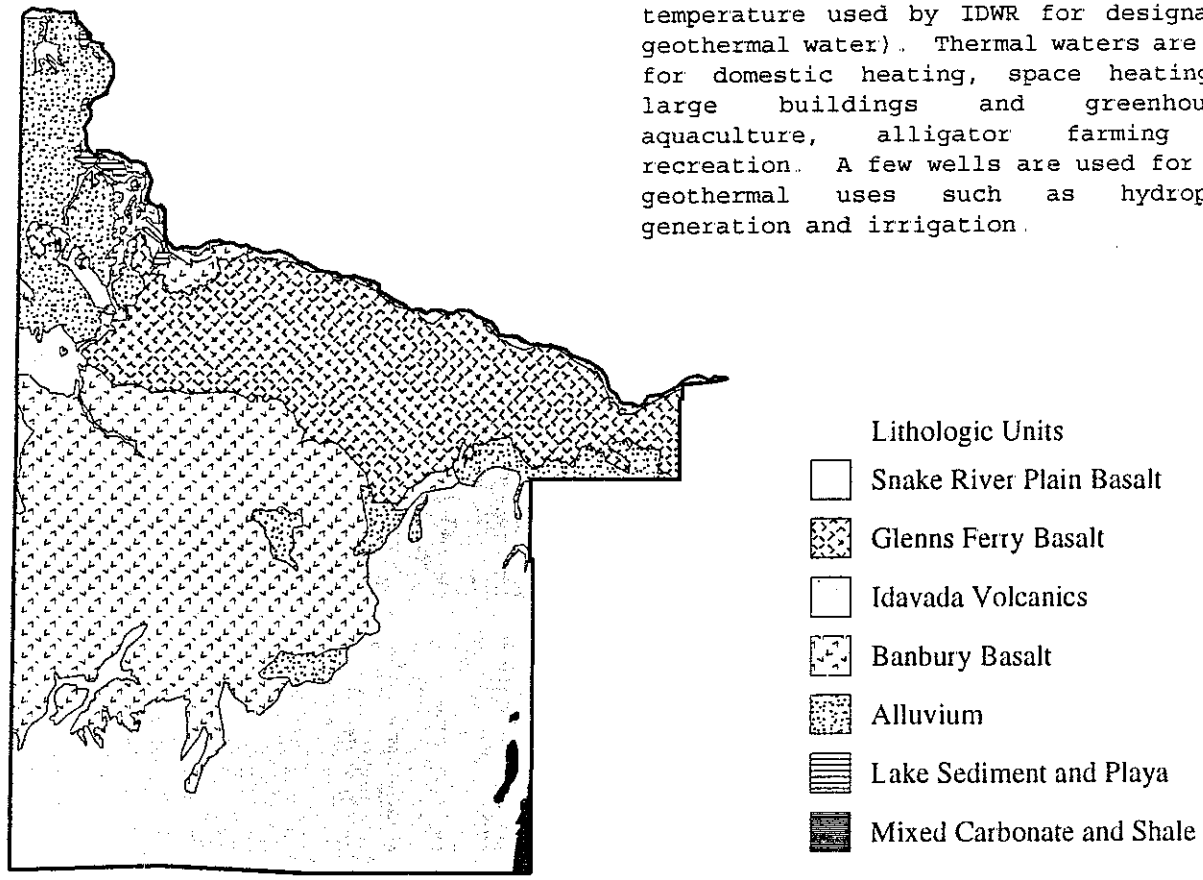

Figure 3. Generalized geology for Twin Falls County (modified from Bond, 1978 and from Johnson and Raines, 1995).

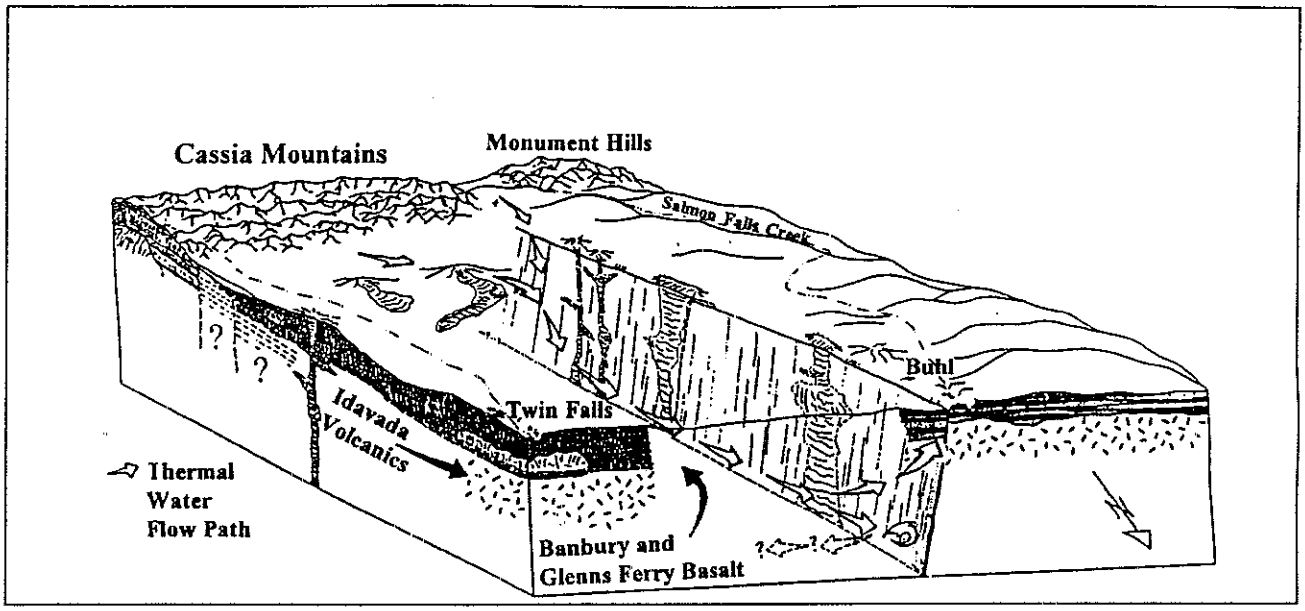

Figure 4. Conceptual model for the geothermal system in Twin Falls County (modified from Street and Detar, 1987).

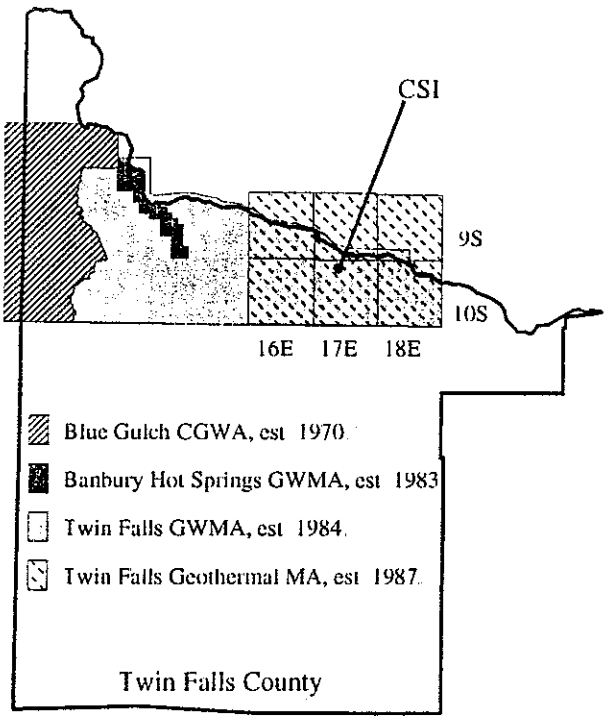

Figure 5. Map showing the extent of the Twin Falls and Banbury Hot Springs Ground Water Management Areas, the Blue Gulch Critical Ground Water Area and the Twin Falls Moratorium Area.

Development of geothermal resources caused significant declines in wellhead pressures in some areas of Twin Falls County during the late 1970's and early 1980's (Baker and Castelin, 1990). In 1984, IDWR designated the Twin Falls Ground Water Management Area (TFGWMA) to abate this decline (Figure 5). Development of geothermal resources was curtailed in the management area.

Continuing pressure declines in an area around the City of Twin Falls prompted IDWR to establish a five year moratorium in 1987 on any geothermal development within Townships 9 and 10 South and Ranges 16, 17 and 18 East of the Boise Meridian (Figure 5). The moratorium was renewed in 1992 and is scheduled for review and probable renewal in 1997. IDWR also established the Blue Gulch Critical Area in 1970 because of declining water levels and potential overdraft and the Banbury Hot Springs Ground Water Management Area in 1983 because of pressure declines in the geothermal system (Figure 5).

GEOTHERMAL SYSTEM AT CSI

The campus layout for CSI is in a "wheel with spokes" type pattern with the common area in the center hub, the education buildings between the hub and the surrounding transportation loop, and the parking lots, maintenance buildings and the dormitory along the outermost rim (Figure 6). The college was originally designed to be heated entirely using electric power. The energy "crunch" of the 1970's prompted the college to investigate cost savings through an aggressive conservation program and an alternative heating source. In 1979, CSI drilled it's first geothermal well (Figure 7). The well is 2,220 feet deep and was completed in the brown and gray rhyolites of the Idavada Volcanics according to the well driller's report. The second geothermal well was drilled in 1981, is 1,480 deep and was completed in reddish-brown rhyolite. Both wells flowed at the land surface with the shutin pressures equal to about 30 pounds per square inch.

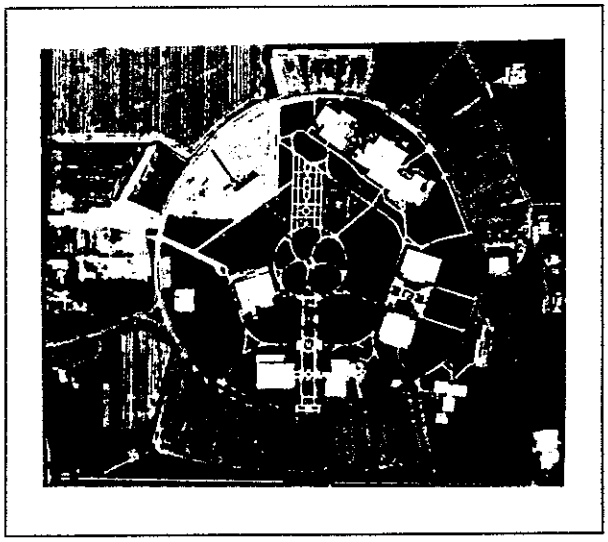

Figure 6. Aerial view of the College of Southern Idaho (photograph courtesy of CSI).

Following the drilling of the two wells, the distribution system was installed. This part of the project began in 1981 and the majority of the work was completed by 1990. The primary work tasks were: 1) laying the underground supply and return lines, 2) retrofitting the existing buildings for geothermal heating, and 3) designing and installing heating systems in the new buildings. Trenches were dug across the campus for the 10 inch supply and return lines (Figure 8). The supply pipes were made of fiberglass reinforced plastic and were insulated with two inches of urethane foam. The total length of supply and return lines is about 5,300 feet. Heat exchangers and standard HVAC equipment are used to extract the thermal heat for the buildings. The used geothermal water is discharged into canals which empty into the Snake River to the north.

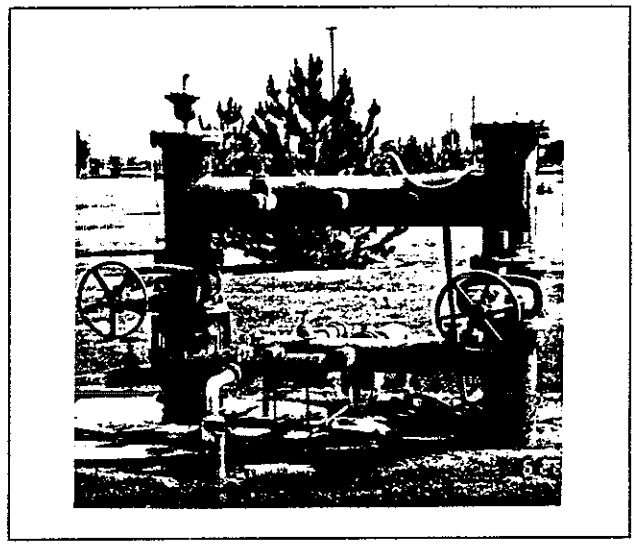

Figure 7. College of Southern Idaho Well #1 prior to the installation of the turbine pump (Photograph by Don Buettner, CSI).

CSI began heating campus buildings with geothermal water in October, 1981. Eleven campus buildings were being heated by geothermal by 1991. In April, 1996, the library was finished and added to the heating system. Figure 9 shows the location of the two wells and the current distribution system. The total square footage of buildings heated using geothermal is 446,537 which is 85 percent of the total square footage of buildings on the college's campus. CSI also uses geothermal water to heat four greenhouses.

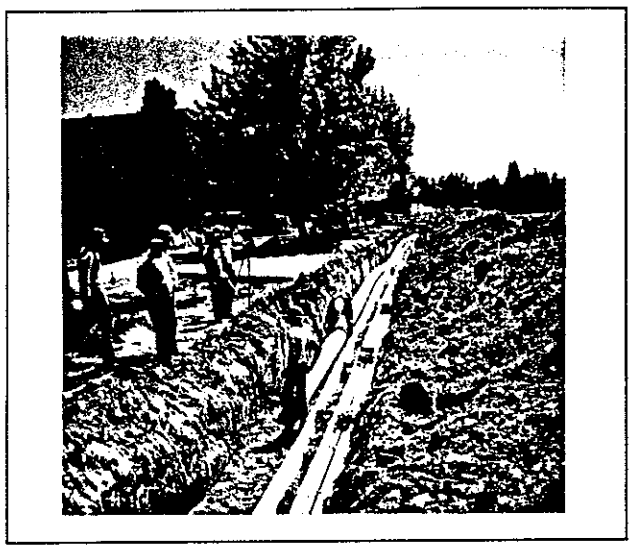

Figure 8. Trenches used for the geothermal supply and return lines at CSI (Photograph by Don Buettner, CSI).

The original system design relied on the natural aquifer pressure to supply sufficient quantities of water (with the assistance of booster pumps in the supply lines). However, the geothermal resources in the Twin Falls area continued to be developed, causing pressures at the CSI wells to decline significantly during the early 1990's. In the fall of 1992, aquifer tests were performed on both wells (Figure 10) and turbine pumps were installed to ensure that adequate volumes could continue to be obtained for the heating system (Figure 11).

MONITORING

The geothermal monitoring history in the Twin Falls area is complex because several different agencies have been involved with data collection at various times. IDWR collected data at the CSI and Twin Falls High School wells on a weekly basis from 1984 to 1989. IDWR ceased collecting data at these wells in 1989 due to funding and personnel changes. CSI entered into a joint funding agreement with the U.S. Geological Survey (USGS) in 1986 to monitor the Nazarene Church well which is located about ⅛ mile to the northwest of the campus.

In 1987, IDWR and 11 users of low temperature geothermal water in the Twin Falls area, including CSI, entered into an agreement to help protect the resource. One of the points in the agreement required users to provide monitoring data to IDWR as necessary. The USGS was contracted to collect monthly data at six wells including the two CSI wells in 1990 with the users paying for ½ of the costs (up to $1,000 total for all of the users) and the USGS paying for the remainder of the costs. The contract was discontinued at the end of 1994 because the USGS costs became prohibitive. IDWR began collecting the data on a monthly basis in 1995. CSI assists with the collection by submitting monthly monitoring data for their two wells to IDWR. Recently, CSI installed a trend monitoring system which will capture data electronically at specified time intervals.

IDWR recorded shutin pressure data at the CSI wells from 1984 to 1989. No pressure readings were recorded after 1989 until IDWR began collecting data again in 1995. Water levels (calculated from the shutin pressure data) show that a dramatic decline occurred sometime between the end of 1989 and the beginning of 1995 (Figure 12). Water levels in the nearby Nazarene church well show a steep drop beginning in late 1990 (Figure 13). The Nazarene church well was unused until 1994; however, the well is now being used to heat the church and pressure measurements have not be reliable.

IDWR plans to continue to monitor water levels closely. If water levels stabilize, then a new hydrologic equilibrium may be established. If water levels continue to decline, the geothermal system may be in an overdraft (ground water mining) condition. In that case, production will likely be reduced because ground water mining is illegal in Idaho.

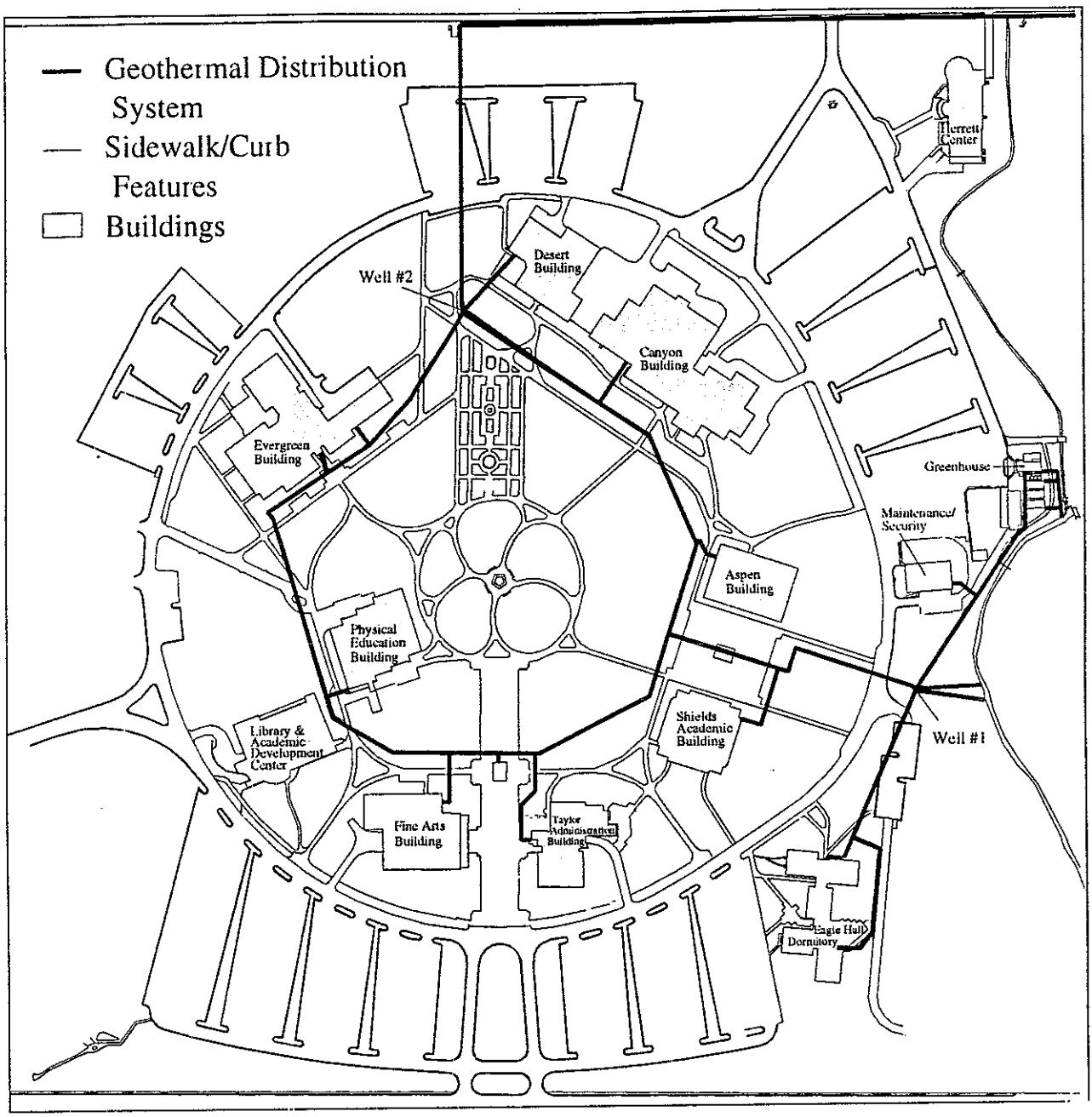

Figure 9. Location of geothermal wells and distribution lines at CSI.

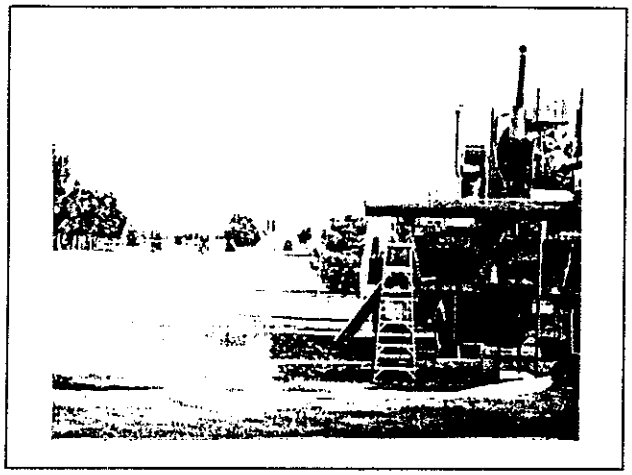

Figure 10. Aquifer tests were conducted on CSI #1 and CSI #2 (shown here) prior to the installation of turbine pumps (Photograph by Don Buettner, CSI).

Geothermal production at CSI ranged from 185.8 to 269.5 million gallons for years 1990 to 1995 (Figure 14). The average annual withdrawal for the college during this time period was 232.2 million gallons. CSI's production constitutes about 10 percent of the total geothermal usage in the Twin Falls moratorium area. Water supply temperatures have increased about 2° Fahrenheit since 1984.

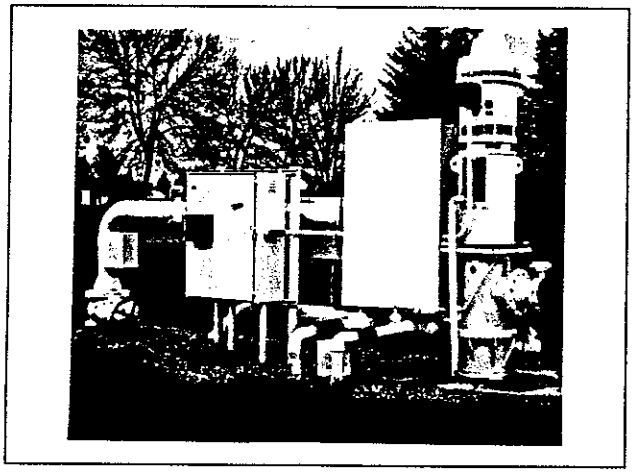

Figure 11. Recent photograph of CSI #1 showing the wellhead after the installation of the turbine pump.

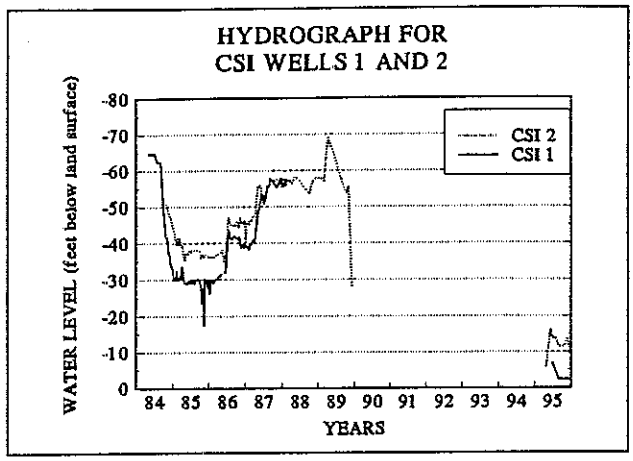

Figure 12. Shutin pressure hydrograph for CSI #1, 1984-1995.

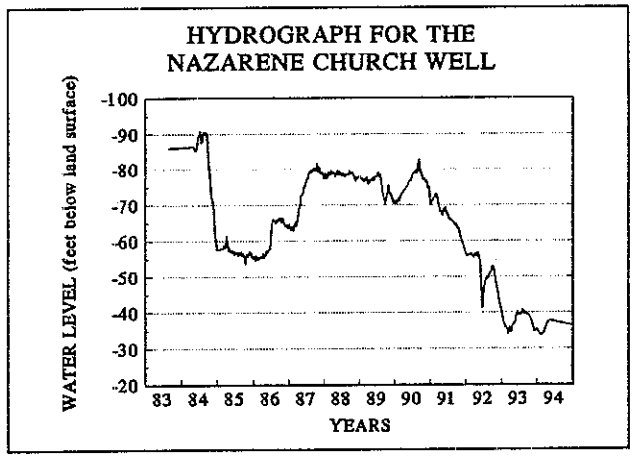

Figure 13. Hydrograph for the Nazarene Church well.

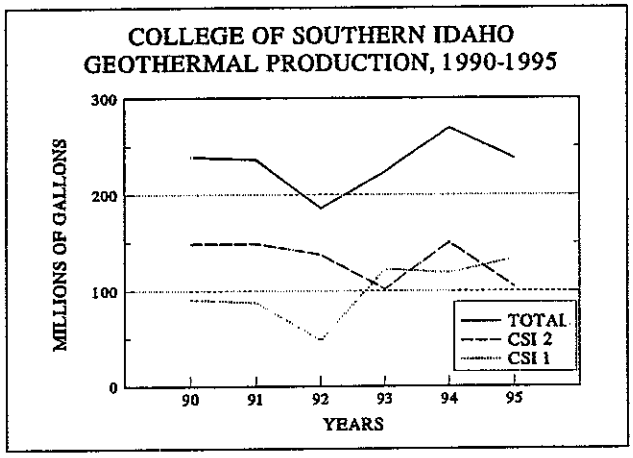

Figure 14. Annual geothermal production for CSI.

SUMMARY

Geothermal water is being used to heat 12 buildings and four greenhouses located on the campus of the College of Southern Idaho in Twin Falls County, Idaho. The heating system is comprised of: 1) two production wells, 2) an underground network of supply and return lines, and 3) heat exchangers and standard HVAC equipment. The annual cost savings to CSI over electric heating is at least $80,000. The system was originally designed to work using the natural artesian pressure of the aquifer. Declines in wellhead pressures in the CSI and other geothermal wells in the Twin Falls area caused the Idaho Department of Water Resources to enact a moratorium in 1987 curtailing further geothermal development in a six township area near CSI. The pressure descents at the CSI wells continued in the late 1980's and early 1990's necessitating the installation of turbine pumps in both wells in 1992.

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