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A HYDROLOGIC MONITORING PROGRAM TO DETECT POTENTIAL IMPACTS OF GEOTHERMAL DEVELOPMENT IN LONG VALLEY CALDERA, CALIFORNIA

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ABSTRACT

Long Valley caldera is a tectonically active area in east-central California that contains a high-temperature geothermal system currently being explored and developed for electric power production. Concerns expressed by public agencies and private citizens over the potential impacts of geothermal development on thermal springs at the Hot Creek Fish Hatchery and Hot Creek gorge have resulted in the establishment of a Hydrologic Advisory Committee. The committee includes representatives from development projects and regulatory agencies. Its role is to formulate and oversee a hydrologic monitoring program capable of detecting such impacts before they become significant. The advisory committee and the monitoring program provide effective mechanisms with which to proceed with geothermal development in areas such as Long Valley, where the level of environmental risk cannot be determined a-priori because the relavent geo-hydrologic parameters are not adequately delineated.

INTRODUCTION

The ground water and geothermal resources of the Long Valley caldera, in east-central California, are currently being explored and developed by commercial and municipal interests. At present there are four production wells supplying hot water to a 10 MWe binary-electric power plant at Casa Diablo and one well producing cold ground water for municipal consumption in Mammoth Lakes (fig. 1). Permits are being sought for four additional 10 MWe geothermal plants on both private and public land. Additional cold-water wells will also needed in the near future to supply water to Mammoth Lakes and to a proposed expansion project at the Mammoth/June Lakes Airport.

Recent studies of the ground water system in Long Valley caldera have indicated that both the hot and cold-water aquifers involved in these developments are in hydrologic connection with thermal springs at the Hot Creek Fish Hatchery and Hot Creek gorge (Sorey, 1976, 1985: ESA, 1987: Westec, 1987). However, fluid flow paths and hydrologic parameters are not well enough understood at this point to adequately assess the potential risks to the thermal springs or to specify mitigation measures to prevent such impacts. This uncertainty has given rise to considerable public debate, which has resulted in permitting delays and has raised the possibility of costly litigation to resolve the issue.

In an effort to overcome these difficulties, a Hydrologic Advisory Committee (HAC) has been formed to formulate and oversee a hydrologic monitoring program capable of detecting impacts to the ground water system before the springs are significantly affected. Representatives of each development project and and the appropriate regulatory agencies participate in the HAC, and technical guidance is provided by the U.S. Geological Survey. The Geological Survey has conducted similar hydrologic monitoring in the Long Valley area since 1982 (Farrar et al., 1987).

MONITORING PROGRAM

The monitoring network includes surface water sites, springs, wells, and precipitation gages (fig. 2). Data collection includes measurements of stream flows and spring discharge, well production rates and temperatures, ground water levels, and chemical and isotopic characterization of water from wells, springs, and streams. Data collected under this program will be collated into three quarterly reports and an annual summary report each year. The reports will be reviewed by the HAC and significant hydrologic trends at variance with natural background conditions will be discussed by committee members. The committee will provide these data to interested parties and will advise appropriate regulatory agencies of their findings. The monitoring program is dynamic and will change as needed if and when future ground water development or geothermal projects come into fruition.

A key feature of the monitoring program is the completion of observation wells at depths and locations such that any changes induced in production or injection aquifers can be detected before they migrate to the thermal springs. Although the technical and financial obligations for completing these wells rests with the developers, their adequacy for the

intended purpose must be reviewed by the HAC and certified by the appropriate regulatory agency. Initially, one obervation well located near each development would be required. If induced pressure or temperature changes are detected in an observation well, additional wells may be needed at locations closer to the thermal springs. It is also anticipated that use permit conditions will include requirements that aquifer tests be carried out prior to production at each development project to better delineate aquifer characteristics and the potential for hydrologic impacts on the thermal springs.

CURRENT STATUS

As of January 1988, the HAC has been functioning for about six months. Details of the initial monitoring program have been worked out and one observation well has been completed at Casa Diablo. Arrangements for funding the program are not yet finalized; some combination of funding from each developer who obtains a use permit and from a grant to Mono County by the State Energy Commission is anticipated. Data collection and reporting activities will most likely be carried out by the U.S. Geological Survey.

A use permit application by Mammoth Pacific for a 10 MWe power plant (MP-II on private land at Casa Diablo) was approved by the Mono County Planning Commission in October 1987. This decision was appealed by the Sierra Club, and a hearing on the appeal before the Board of Supervisors is scheduled for late February 1988. A decision by the U.S. Bureau of Land Management on a 10 MWe power plant (PLES-I on federal land at Casa Diablo) proposed by Pacific Lighting Energy Systems is expected in the near future. A use permit application by Bonneville Pacific Corporation for a 10 MWe power plant on private land northwest of the Hot Creek Fish Hatchery (BP in fig. 1) was rejected by the Planning Commission in September 1987. That decision was appealed by Bonneville Pacific and a final decision by the Board of Supervisors is set for February 2, 1988. If each proposed geothermal project is approved, a total generating capacity of 40 MWe could be on line by 1989.

A permit for ground water production to supply the airport expansion project, which is to include a hotel and golf course, has not yet been applied for. The anticipated water requirement for this project is 662 acre-feet per year, or 410 gpm. A potential impact of development is a decrease in the nonthermal component of flow in the hatchery springs, whose total discharge is currently about 60 gpm. The hatchery springs could also be affected by future ground-water production from wells recently completed and tested by the Mammoth County Water District south of Mammoth Lakes (fig. 1). Consequently, the hydrologic monitoring program will eventually include observation wells associated with each of these developments.

REFERENCES

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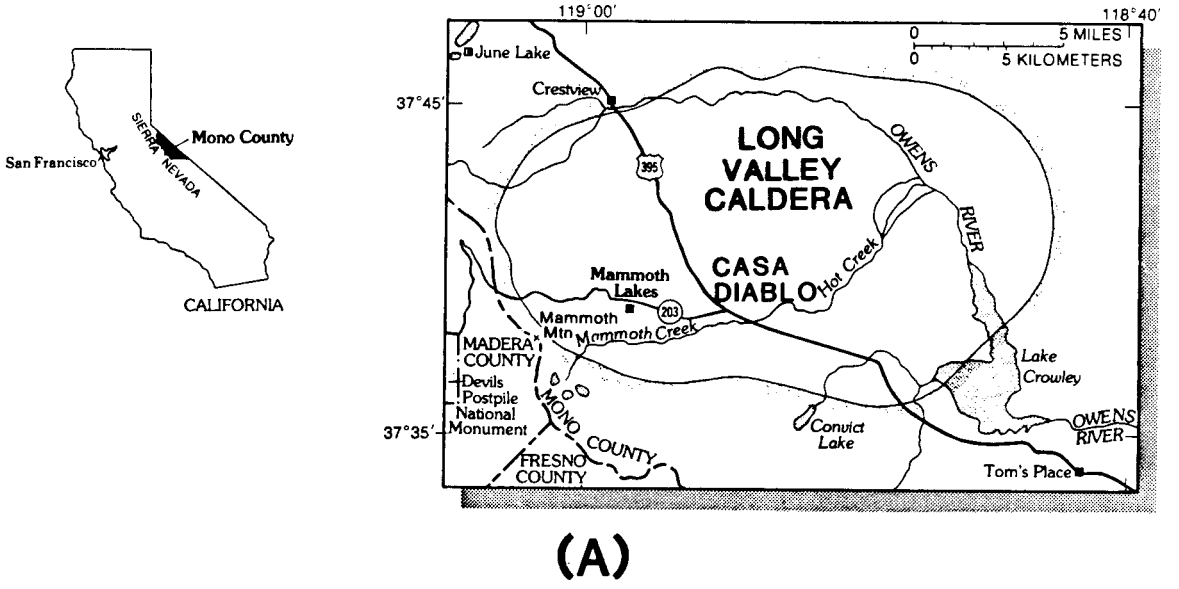
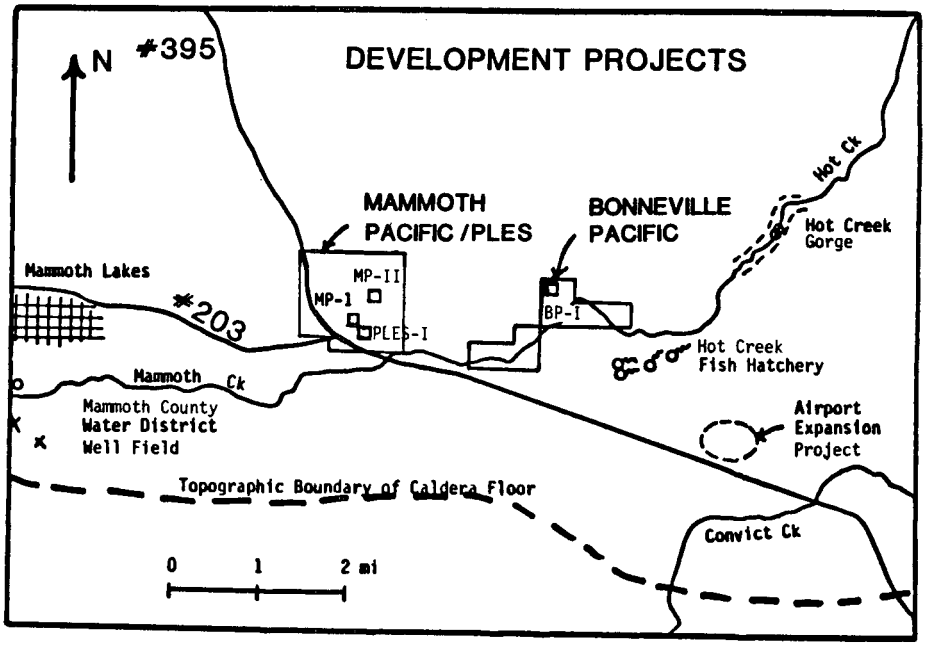


(A)



(B)

Figure 1(A). Maps of Long Valley caldera and Mono County, California.

1(B). Map of southern part of Long Valley caldera showing locations of proposed and existing (MP-I) development projects that would utilize ground water and geothermal resources, and thermal springs at the Hot Creek Fish Hatchery and Hot Creek gorge.

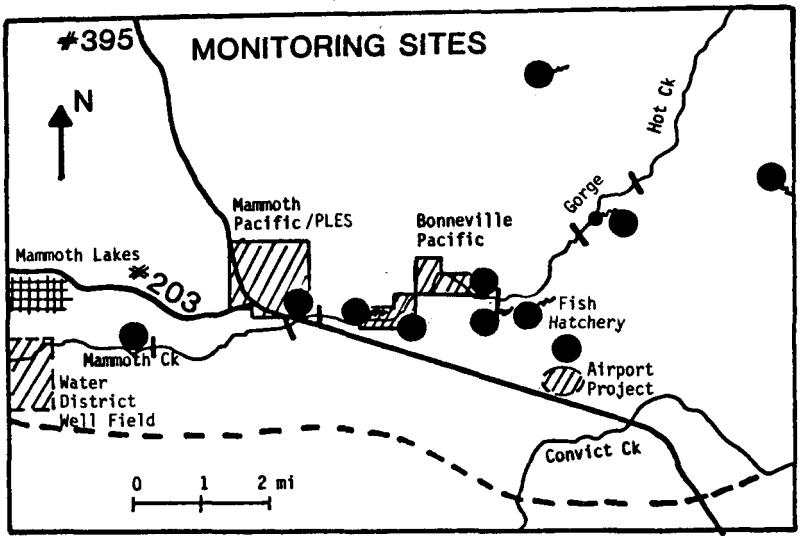


Figure 2. Map of the southern part of Long Valley caldera showing locations of data collection sites in hydrologic monitoring program. Dots represent observation wells, dots with tails are springs, and bars are stream gaging and sampling sections.