”GONE FISHING” AQUACULTURE PROJECT
KLAMATH FALLS, OREGON

Overview of the 72 15-ft x 100-ft fish ponds near Klamath Falls, OR.

LOCATION

The “Gone Fishing” aquaculture project is located about 10 miles south of Klamath Falls, Oregon, near Merrill in the Lower Klamath Valley adjacent to the Klamath Hills. The original ponds were construct in 1984 and had limited use. The present facility, operated by Ron Barnes, started in 1990 using the effluent from a geothermal greenhouse operation on the Liskey Ranch on Lower Klamath Lake Road. In 1998, he purchased 80 acres of land just north of the greenhouses on the opposite side of the road. Today, the operation consists of 37 ponds located on the Liskey Ranch and 35 at the new location. The aquaculture ponds are used to raise 85 varieties of tropical fish (cichlids) that originated from Lake Malawi in East Africa’s Great Rift Valley and from Central America. He sells 250,000 of the fish (3" to 4" long) annually to tropical fish wholesalers from Portland, OR to San Francisco, CA; shipped weekly by truck to Sacramento, and then by air to the various outlets.

RESOURCE

The geology of the area consists of large normal fault blocks, typical of the Basin and Range province. The Klamath Hills are typical of these fault blocks, allowing geothermal waters that circulate at depth, and move to the surface in shallow aquifers. At the original location, a greenhouse complex consisting of four 6,000 square-foot buildings are heated using a peak of 400 gpm from six geothermal wells ranging in temperature from 80E to 200EF and all are around 100 feet deep. The newer set of ponds are provided geothermal water from a 460-foot deep well that pumps up to 300 gpm of 210EF water. The water surface in the newer well is at 120 feet and the lineshaft pump bowls are set at 190 feet. The water from the wells is alkaline with a pH of 8.8 out of the wells, but the chemical composition of the pond liners (diatomaceous earth) and soil surrounding the ponds reduce the pH to about 7.5 as the water flows through the system. The water is primarily a sodium-sulfate type of about 600 ppm that can be used directly in the ponds without harm to the fish. This is about the same chemical composition as the water of Lake Malawi.

UTILIZATION

At the greenhouse location, a 14,000-gallon steel railroad car tank is buried in the ground that receives water from one of the wells, and then supplies 180E to 185EF water to the greenhouses. Depending upon the outside temperature, the water leaves the greenhouses at 165E to 180EF; where, it is then piped to Barnes' original ponds that are kept at nearly a constant temperature of 80EF ±3EF; even though, the fish can easily tolerate ±10EF. The wastewater from the ponds is then fed to a holding pond where it is cooled and then used for stock watering and irrigation. The water from the newer well is stored in a similar railroad car tank of 14,000 gallons and then gravity fed through a 4-inch diameter aluminum pipe adjacent to the ponds. Each pond is then supplied 197EF water through 1-inch CPVC pipe. It quickly mixes with the pond water, causing no harm to the fish, and levels out the pond water at around 80EF. The pond water is kept within 3EF of the desired temperature. The wastewater, that is not lost through evaporation and leakage, is disposed of into the same stock pond. The flow to the ponds varies from 50 to 300 gpm depending on the outside temperature and wind, with an annual average of about 100 gpm. A few of the ponds, which are in a more porous soil, have to be lined with black plastic to prevent severe water leakage.

The temperature and flow rate into the various ponds is controlled manually by feel. Gate valves at each pond are then set to achieve the proper temperature. This "hand feel" method is felt superior to electronic control valves, as these often stick open and thus, "fry" the fish. It is felt that pond temperature is kept with ±3ºF, sufficient for optimum growth.

It is estimated that the installed capacity of the newer facility, based on a peak of 300 gpm and a 10ºF-temperature drop in the water, is 1.5 million Btu/hr or 0.44 MWt. Using an annual average of 100 gpm, the total energy use is then 4.38 billion Btu/yr.

OPERATING COST

No cost figures are available for the original ponds constructed adjacent to the greenhouses. The new ponds and well construction in 1998 were funded by two Oregon Economic Development loans for a total of $100,000. The well cost $15,000 and the excavation for the ponds cost $15,000. The remainder of the funds were used for controls, pumps, piping and storage tank. Operating cost at the original site is at a fixed rate of $350 per month, since the resource is owned by Liskey Farms, Inc. There are no pumping power costs, since the ponds are filled with wastewater from the greenhouses. At the new location, the pumping power cost varies from $280 to $400 per month with an annual average of $350 per month. The cost of electricity is 5.7 cents/kWh; thus, an average of 6,140 kW are used monthly. Approximately $500 per month is used for repairs and maintenance. Thus, the total annual operating cost is approximately $9,000. Barnes estimates that by using the geothermal heat energy, that he avoids the use of about 24 million kWh in electricity annually, for a savings of $1,350,000.

REGULATORY/ENVIRONMENTAL ISSUES

The main concern originates from the Oregon Department of Fish and Game. They do not want any of the fish to escape into waterways in the area. As a result, a 200EF barrier is provided in the original pond area that would "cook" any escaping fish. In the newer pond area, very little if any water overflows out of the ponds, and the little that does, mainly during the winter months, goes into a holding pond. Barnes is considering raising Tilapia and in this case, Fish and Game will require him to have a greenhouse type structure over the raising ponds and tanks to prevent any fish from escaping or being picked up and dropped by birds. The harvested fish cannot be shipped to market live, and thus must be killed and frozen on site before shipping. Also the Oregon Department of Environmental Quality would regulate the waste discharge from the Tilapia ponds; thus, a filter system would have to be installed, and a closed circuit system used. Water disposal from the tropic fish ponds is not a problem, as 500 lbs of fish per pond provide little waste. Discharge from over 20,000 lbs/year would be regulated by DEQ.

PROBLEMS AND SOLUTIONS

Four main problems exist at the facility: 1) lack of cold water for cooling the ponds; 2) corrosion in the aluminum pipes; 3) taking of fish by birds; and 4) limited capacity of the resource. Since, this is a geothermal area, cold water is a problem for both the greenhouse and aquaculture facilities. Cold water is then provided by cooling geothermal water in holding ponds. Internal corrosion in the aluminum pipe is a problem in the new facility due to the 195EF temperature of the water. In the facility adjacent to the greenhouses, the pipes have been in for over 20 years and have experienced no corrosion, as the water temperature is only 180EF. Black iron pipe placed under roads have experienced external corrosion from the soil. Birds are a problem at the older facility, since the ponds are adjacent to irrigation canals where Egrets and other birds live. This is not a major problem in the newer facility - so all that is really done at this point is to scare them away when they are working around the ponds. The maximum amount that can be pumped from the newer well is 300 gpm, and this is often reached during the winter months, especially when there is wind. This would then limited the size of the proposed Tilapia facility. Based on consultations with engineers at the Geo-Heat Center, they will experiment with two methods to reduce the evaporation. Since evaporation from the ponds can contribution to as much as 50 to 60% of the total heat loss, a wind barrier, and bubble mat pond cover are being considered. The bubble mat, similar to ones used for swimming pools and hot tubs, would cover a portion of the pond, since some of the pond area must be exposed to the air to provide oxygen to the fish. Various combination of 25, 50 and 75% pond coverage will be tried.

CONCLUSIONS

The "Gone Fishing" aquaculture operation appears to be successful, and plans are to expand from tropic fish to Tilapia. The success of the operation is due to two factors: 1) a readily source of geothermal energy, available at shallow depth with adequate temperature and flow; and 2) a operator/manager, Ron Barnes, who has the background and knowledge of aquaculture methods. He started small, and has increased in reasonable increments as he gained experience with using the geothermal resources. There are minor problems with corrosion of metal pipes, and efficient use of the resource, but these are being solved, and do not present a major expense and management problems.

REFERENCES

Clutter, Ted, 2002. "Out of Africa - Aquaculturist Ron Barnes Uses Geothermal Water in Southern Oregon to Rear Tropic Fish from African Rift Lake" in, *Geo-Heat Center Quarterly Bulletin*, Vol. 23, No. 3 (September), Klamath Falls, OR, pp. 6-8 [also published in *Geothermal Resources Council Bulletin* (Vol. 30, No. 2, March/April 2001), Davis, CA].

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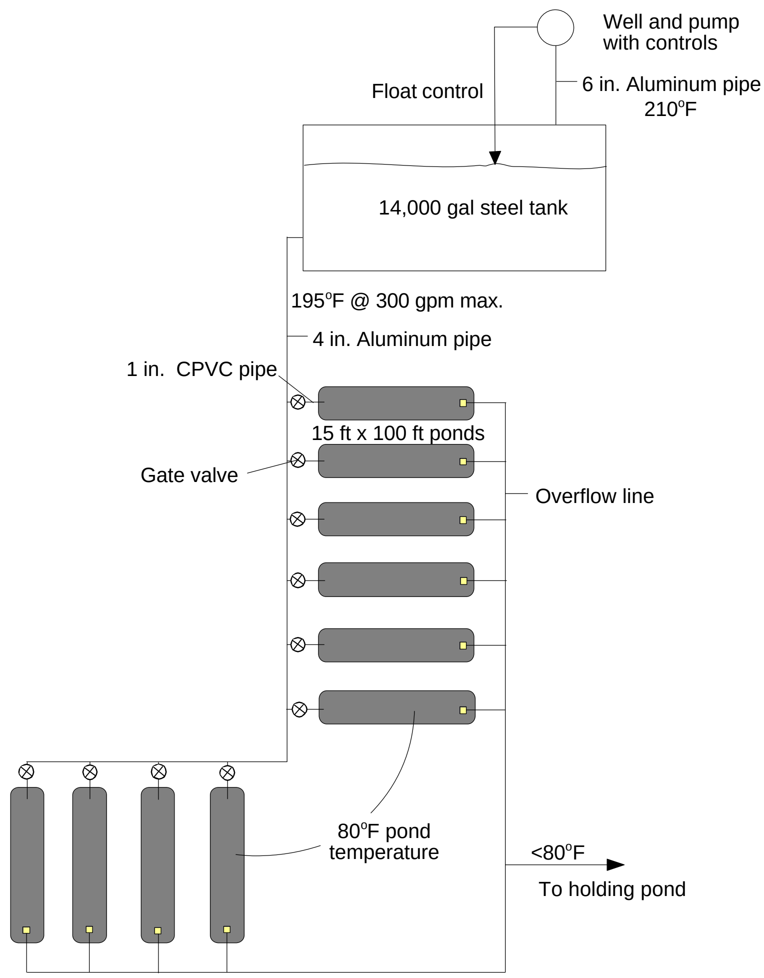

"Gone Fishing" - Schematic of the Newer Installation