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# Groundwater cooling

Using cool groundwater as a geothermal energy source

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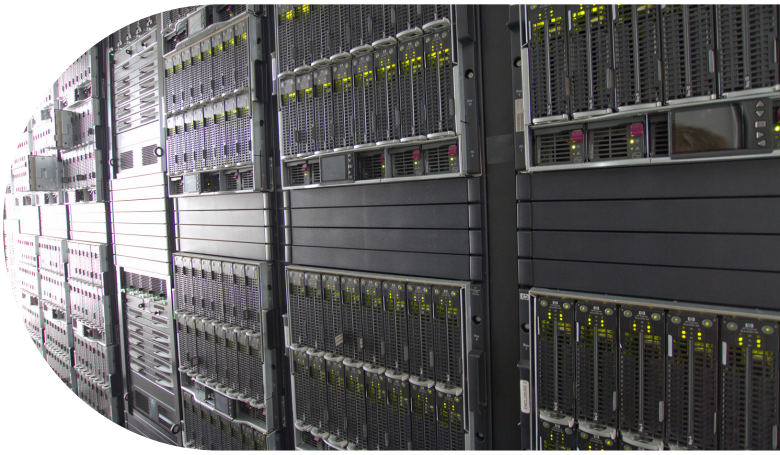
Groundwater cooling (GWC) describes a cooling technology where excess heat generated from buildings, machinery or equipment is injected into underground stores of cool water. This novel, efficient, environmentally friendly system is being used by CSIRO to cool the Pawsey Centre Supercomputer at the Australian Resources Research Centre (ARRC) site in Perth.



## CSIRO groundwater cooling

Anyone who has used a laptop will know that computers generate a lot of heat. Supercomputers consume large amounts of electrical power, almost all of which is turned into heat and therefore requires cooling. A component of the CSIRO Geothermal Project in Perth involves using a groundwater cooling system to cool the Pawsey Centre Supercomputer- a purpose-built centre housing supercomputing facilities and expertise to support SKA (Square Kilometre Array) research and other high-end science. This is the first time a groundwater cooling system has been used on this scale in metropolitan Australia.

The system works by pumping cool water from a shallow aquifer beneath the ARRC facility through an above-ground heat exchanger to cool the supercomputer, and then reinjecting the now heated water back into the same aquifer, slightly downstream, resulting in no net loss of groundwater.

CSIRO estimates that using this system to cool the Pawsey Centre is expected to save up to 14.5 million litres of water in the first two years of operation (that's like running your tap constantly for three and a half years), compared with conventional cooling towers. The technology concept, if deployed more widely, also has the potential to replace cooling towers in commercial and residential buildings all over Perth, which would be a significant milestone in establishing Perth as one of the world's first geothermally-cooled cities.

Using groundwater cooling to cool the Pawsey Centre Supercomputer involved drilling several wells approximately 100 metres deep to access water with an ambient temperature of around 21°C. This water is then pumped through a heat exchanger and reinjected into the shallow aquifer at a temperature of approximately 30°C.

CSIRO estimates that using groundwater cooling to cool the Pawsey Centre Supercomputer will save approximately 14.5 million litres of water in the first two years of operation.

## How does it work?

Water of different temperatures can be extracted from underground layers of rock formations known as aquifers, and used for various thermal purposes. While the harnessing of geothermal energy from deeper high-temperature aquifers is a well-known procedure, cooler underground water found closer to the surface can also provide useful thermal capacity. The process is known as groundwater cooling, and involves pumping cool water from a shallow aquifer through an above-ground heat exchanger to provide the necessary cooling effect, then reinjecting the heated water back into the same aquifer. The water returned to the aquifer is a few degrees warmer than the surrounds, and the groundwater cooling systems are engineered to ensure there are no significant impacts to the surrounding environment.

## Advantages of using groundwater cooling

Groundwater cooling is a novel and efficient way of addressing the cooling requirements of buildings and facilities. The absence of conventional cooling towers, which use large amounts of water, means the system is environmentally friendly, and it also performs reliably around the clock regardless of the weather or season.

Other benefits include the low visual impact created by groundwater cooling systems in urban environments, as well as the fact that heat injected into the subsurface is naturally dissipated.

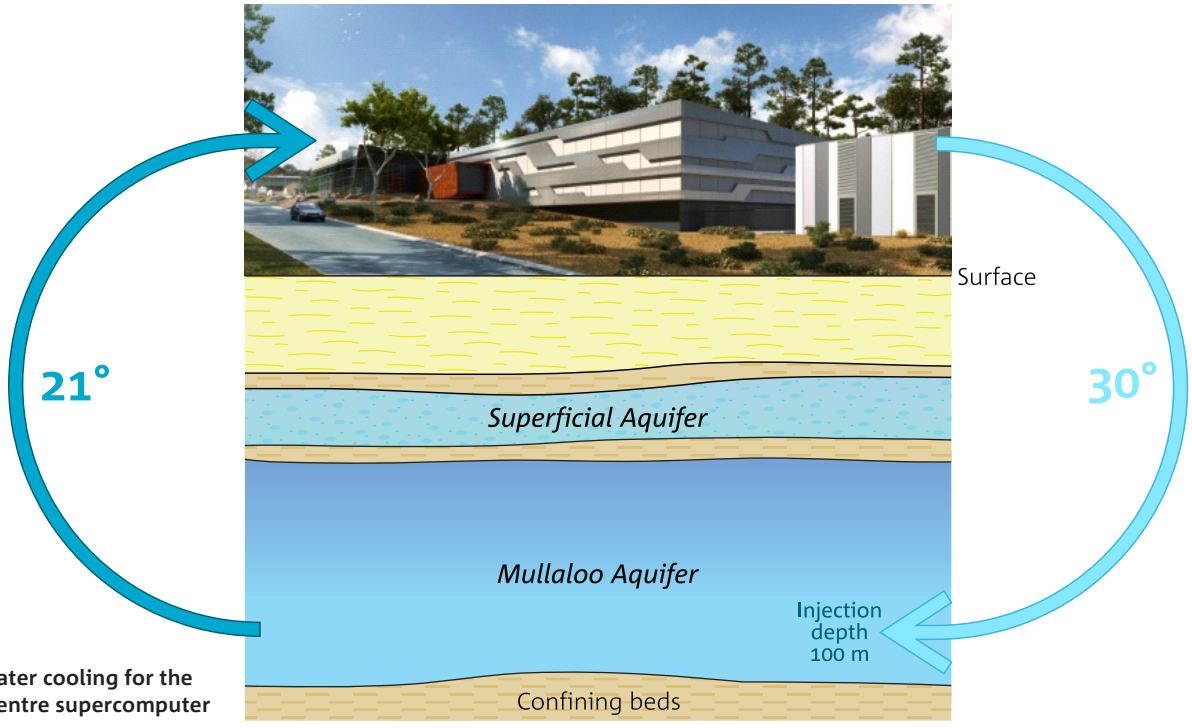
## Challenges

Groundwater cooling schemes require significant feasibility analysis before a project can proceed. As well as ensuring the venture is economically viable, projects must also satisfy environmental objectives.

One of the key challenges with the system is ensuring that the warmed water injected does not significantly impact on the aquifer or neighbouring environments. Well separation distance, flow rate and temperature difference are key design parameters for groundwater cooling schemes, as is an understanding of the aquifer biogeochemistry and nearby users of the aquifer.

CSIRO'S use of groundwater for the cooling system as part of the Geothermal Project was assessed and received approval from the West Australian Department of Water. In addition to this, CSIRO investigations indicated that the system will create negligible impacts to both the quality of the water in the Mullaloo aquifer and the neighbouring environment. CSIRO will continue to examine these impacts as part of an ongoing monitoring program.

For further information about groundwater cooling or geothermal energy go to www.groundwatercooling.csiro.au




**Groundwater cooling for the Pawsey Centre supercomputer**

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