



## **Lessons Learned from Establishing a City-wide Groundwater Temperature Observatory**

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Climate change has forced governments to adopt targets to reduce CO<sub>2</sub> emissions. To achieve this, novel approaches to energy production are needed. One such technology being explored across Europe is ground source heating. It is well known that shallow groundwater under cities is thermally enhanced by the Urban Heat Island effect and that this could prove a resource for ground source heating, but what is not well understood are the effects that long-term, mass-uptake of heat extraction could have at a city-wide scale.

In Cardiff, UK, the British Geological Survey has been working with the local authority since 2014 to examine the sustainable use of shallow geothermal energy. A city-wide observatory was established to characterise spatial and temporal changes within groundwater temperature, comprising 99 in situ sensors installed at discrete depths in 62 boreholes; the first high resolution, city-wide groundwater temperature network in the UK. The aim of the Cardiff observatory is to characterise baseline groundwater temperatures and the potential geothermal resource, as a tool to aid developers, planners and regulators in the sustainable development of the subsurface. Data also provides insight into subsurface processes and geotechnical properties, and is currently being utilised in a host of projects from research into seasonal fluctuation of groundwater temperatures to 3D geological modelling. The network also monitors the effects of a shallow, open-loop ground source heat pump on the aquifer at a test site installation.

A discussion of the significance of this observatory is presented including how the geographical extent was delineated and how sites were chosen from a pre-existing groundwater level monitoring scheme, as well as factors for consideration on downsizing the network to make it efficient to manage into the future. The advantages and disadvantages of a range of approaches towards recording, processing and disseminating data are considered, the merits of open-source data portals explored and experience of different monitoring infrastructure shared. We hope these lessons can be upscaled to other cities and support development of new groundwater observatories.