CP3 - Open-Loop groundwater source heat pumps:
Code of Practice for the UK

Open-loop groundwater source heat pumps:
Code of Practice for the UK

Harnessing energy from water in the ground for heating and cooling

Final Author's Draft
April 2018

Submitted by: Themba Technology Ltd.
Project team: David Matthews, Nic Wincott and Jen Billings

Nic Wincott – Lead Author

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CP3 - 3rd of the series

https://www.cibse.org/Knowledge/CIBSE-Publications/CIBSE-Codes-of-Practice

The Code of Practice

- Voluntary code
- Focused on large projects but useful to all
- NOT a textbook – What needs to be done, not how to do it.
- Written around Minimum standards, yet highlights best practice
- New build & retrofit/conversion
- Heating, Cooling & Thermal Energy Storage (TES)
- For the whole supply chain
- For client tendering & contracts
- Underpins and informs training & certification.

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CP3 is a collaborative publication

Important contributions from:

Environment Agency

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

The Coal Authority

Consortium funded by BEIS and led by CIBSE in association with HPA & GSHPA supported by a 20+ strong and diverse steering committee of industry experts and other relevant stakeholders.

With input from many more companies, organisations and individuals both informally and during the consultation process.

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Why install a GWSHP?

Economic Benefit

In most cases a key motivating factor will be financial:

- Government Grants and Incentives - RHI
- GWSHP systems can return an attractive ROI and mitigate against rising energy prices
- Any increase in CAPEX compensated by OPEX saving over lifetime reducing TOTEX
- Other costs saving e.g. Gas supply and flue unnecessary
- Can provided heating and/or cooling – significantly improving efficiency and reducing costs.
- A low carbon alternative to combustion based systems.

Legislative requirements

To comply with national and international legislation e.g.: Climate Change Act of 2008, Carbon Reduction Commitment (CRC) Energy Performance Building Directive (EPBD), Renewable Energy Sources Directive (RES), Climate Change Levy (CCL), Building regulations Etc.

Uses the same clear structure as before:

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Groundwater yield - Risk Mitigation

Can the design be finalised before the actual Water Well yield is known? How does this influence the construction programme?

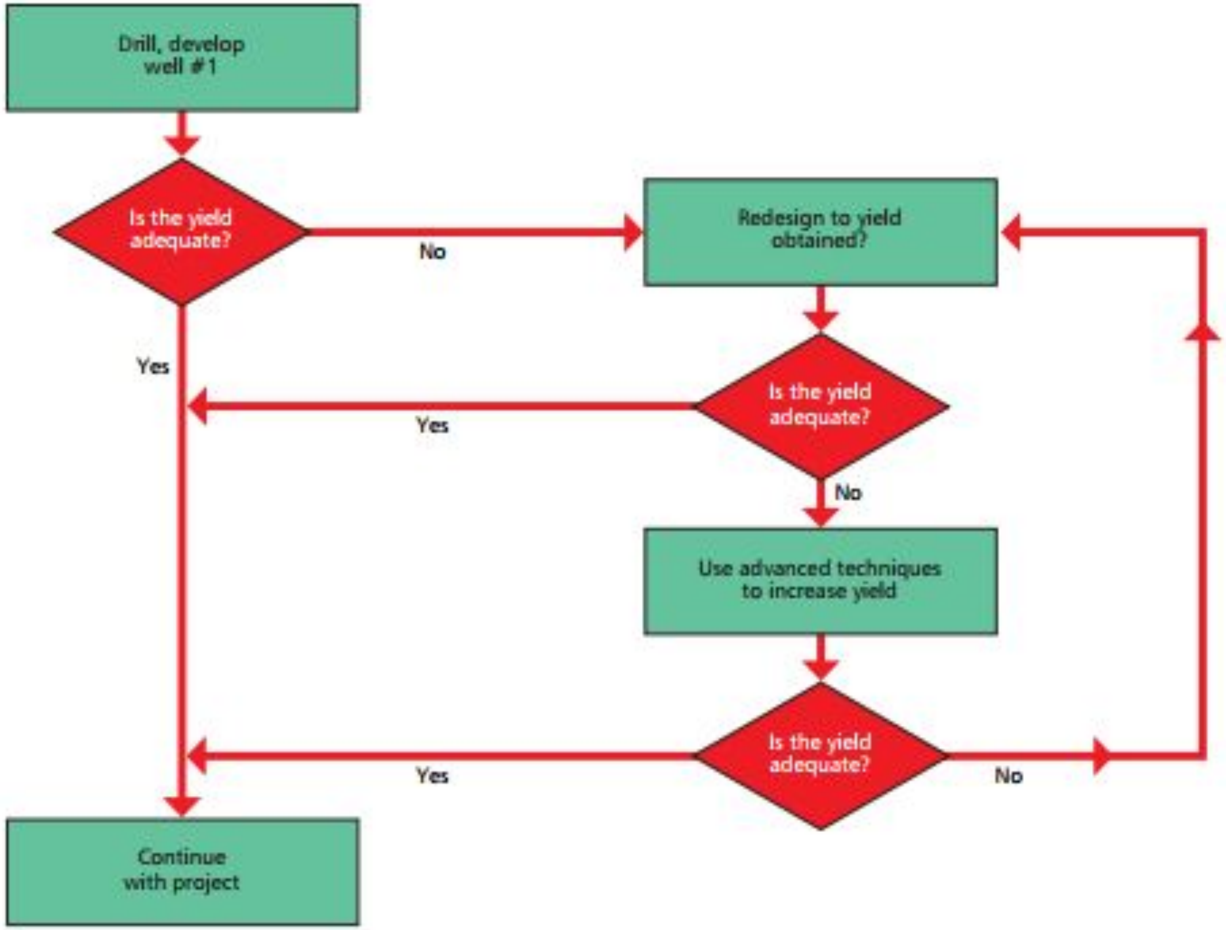
Steps to achieving a viable yield to supply a groundwater source heat pump

Which output enhancement technique(s) to use and in what order will differ with geology and from site to site. Common well development measures may take less than an hour or several days.

The decisions made will usually be cost-driven although in some cases the critical parameter may be time, reliability or longevity.

It is also often possible to revise the overall system design to work with the quantities available.

Low yield designs may increase capacity with bi or multi valent systems incorporating CHP, heat recovery, thermal energy storage, dry air coolers, solar thermal panels etc.



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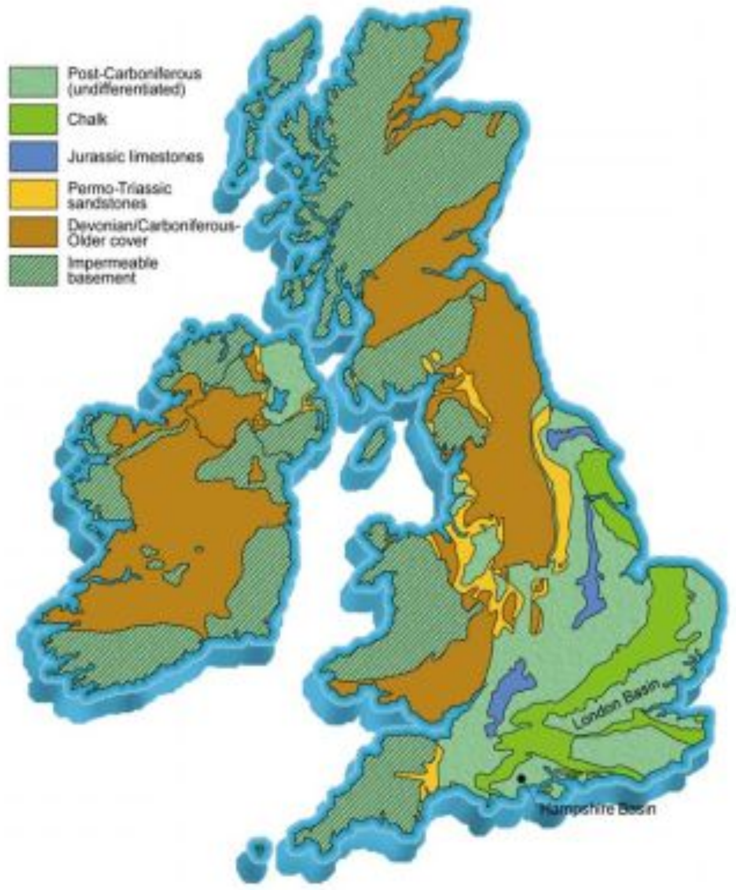
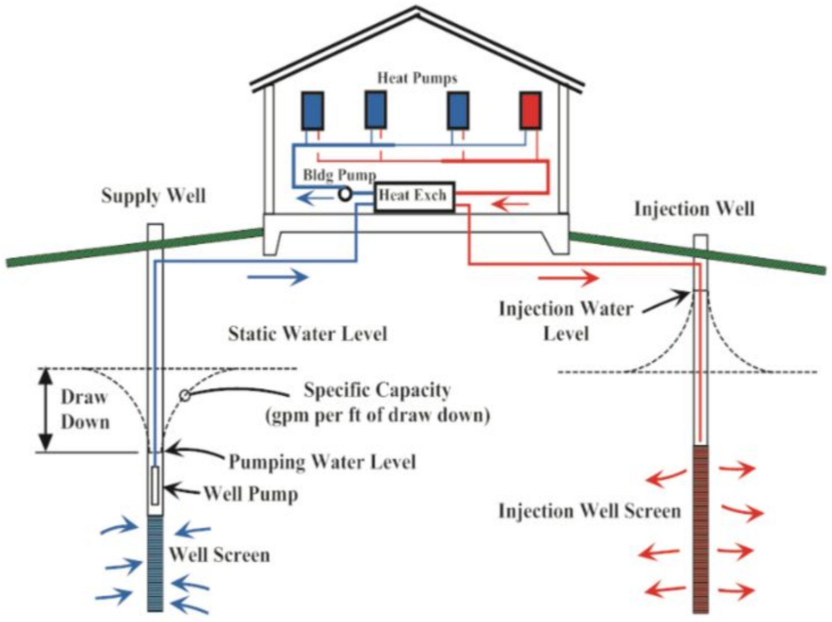
Ground Water – Where and How

Water found in or under the ground, including minewater.

The geology of Britain and its aquifers



A typical “doublet” groundwater system



Open-Loop Groundwater Heat Pump with Isolation Heat Exchanger

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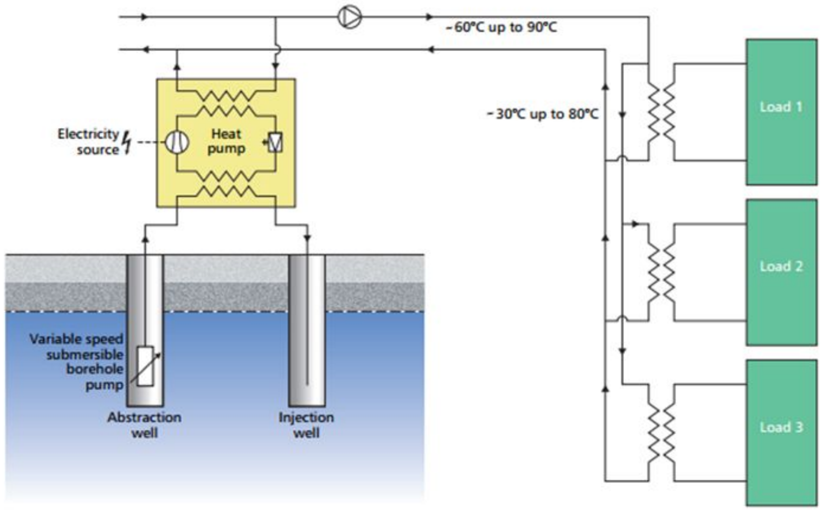
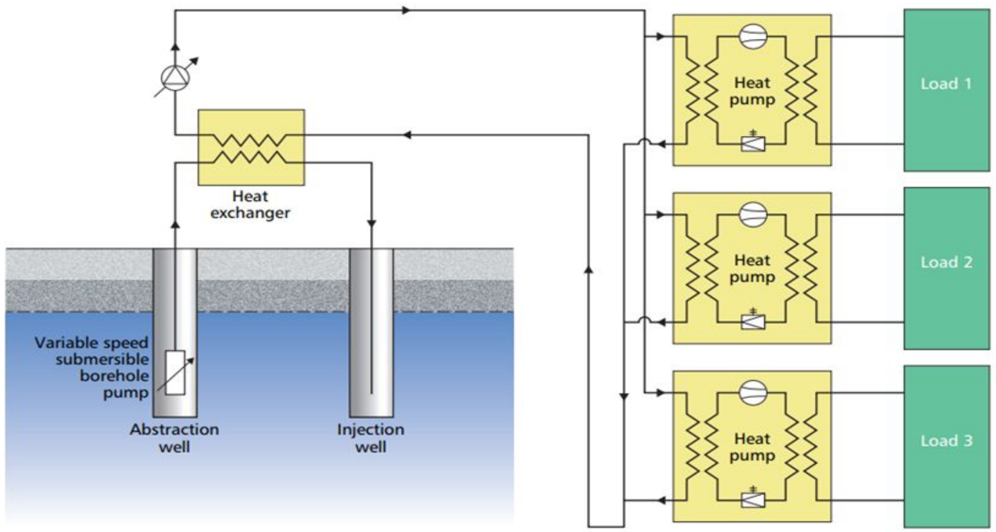
Ground Water Source Heat pumps are versatile they can used with both source and load side networks for both heating and cooling…





In "traditional" **load side** applications GSHPAs are used as the primary generator for heating or cooling networks.

Increasingly **source side networks** (SSNs) allow multiple heat pumps to be attached to a network to collect or reject heat at or near ambient ground temperature.

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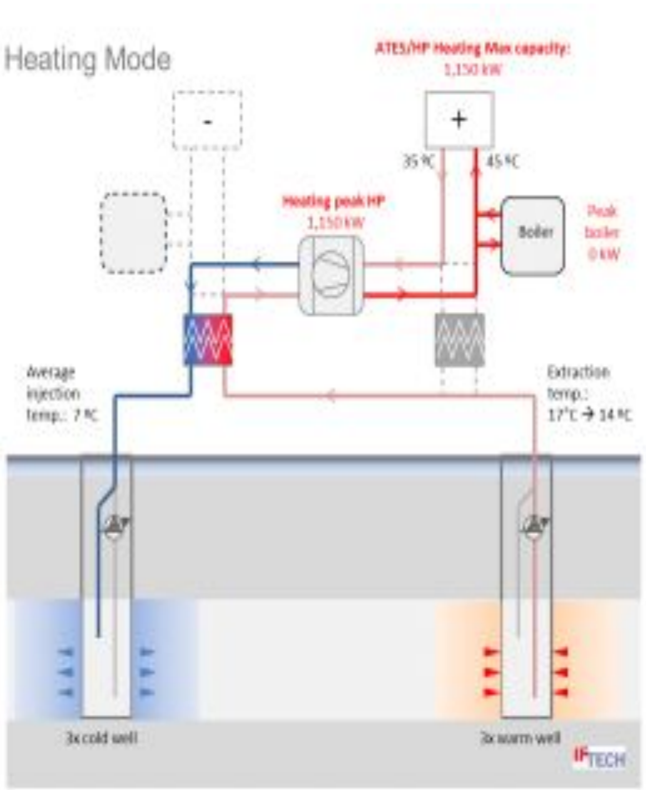
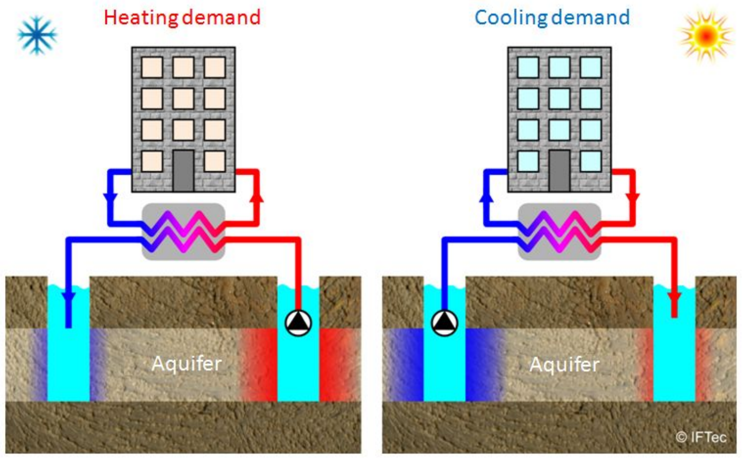
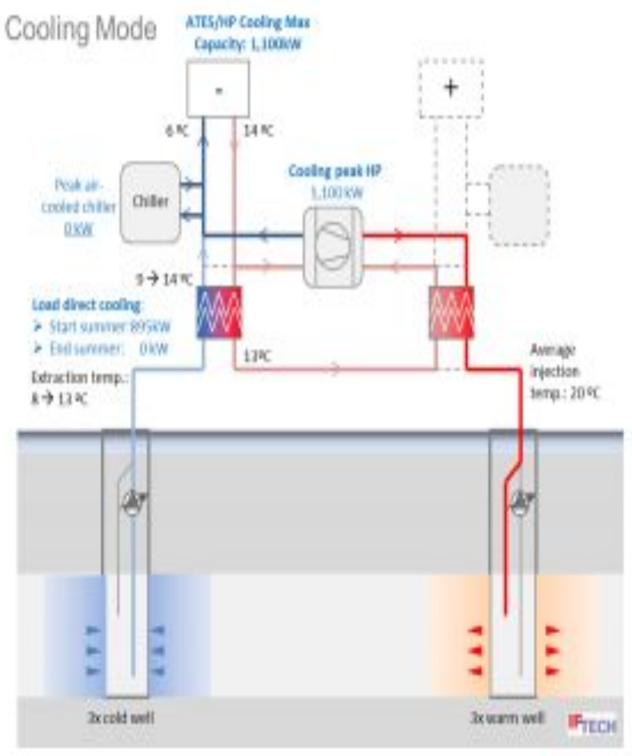
Aquifer Thermal Energy Storage (ATES)

ATES (Aquifer Thermal Energy Storage) system at Wandsworth Riverside







An open-loop system of 8 x 120m boreholes supplies a peak cooling capacity of 2.25 MW and a peak heating output of 1.2 MW. The aquifer provides interseasonal thermal energy storage

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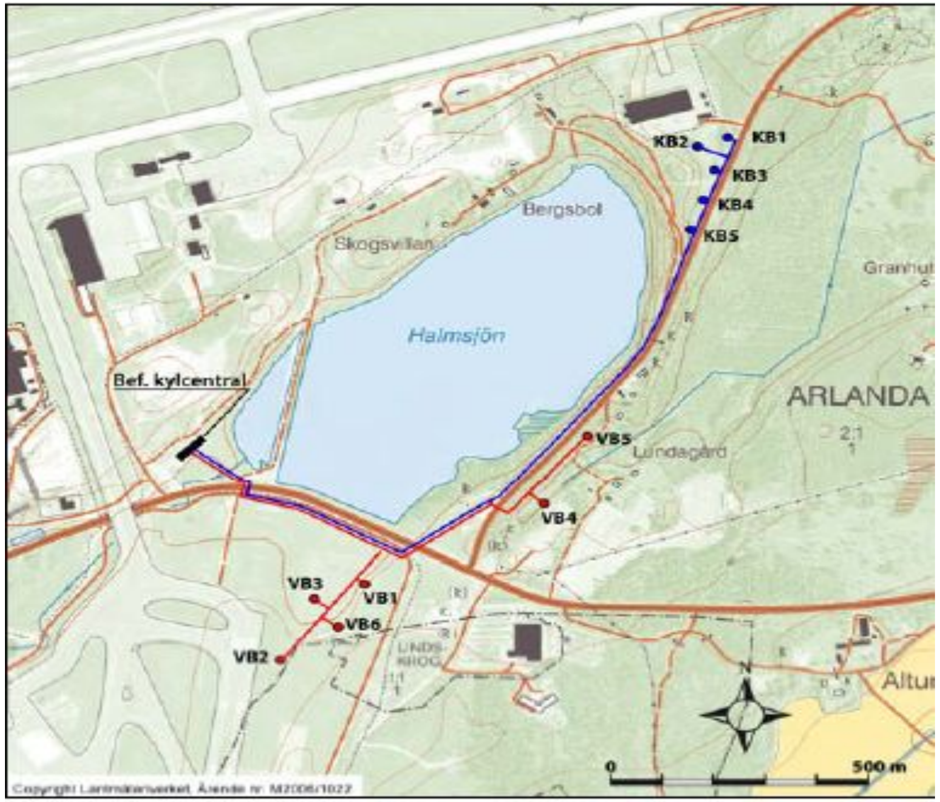
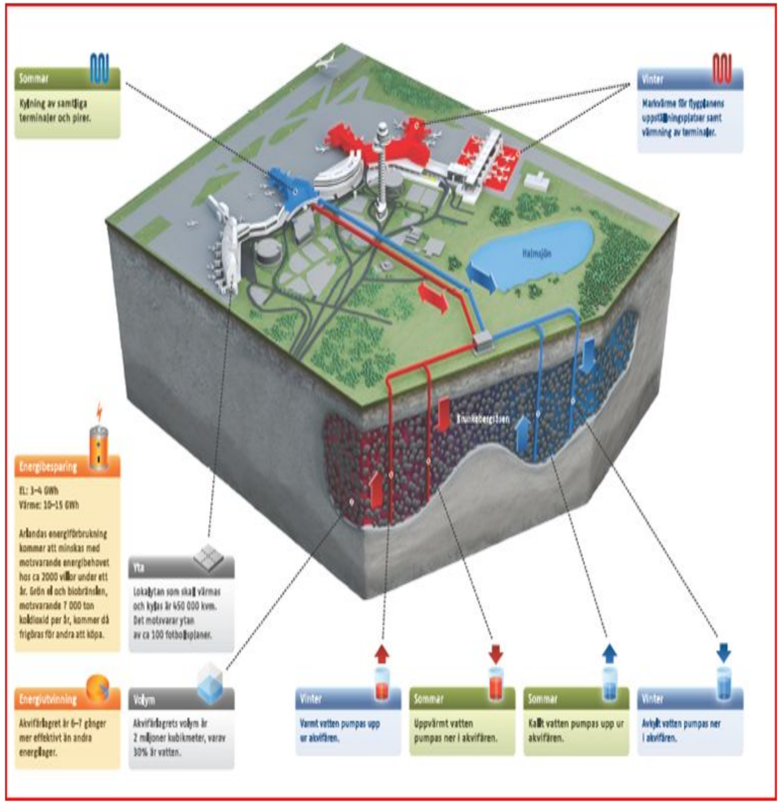
Arlanda Airport

“Free” pre-heating and cooling

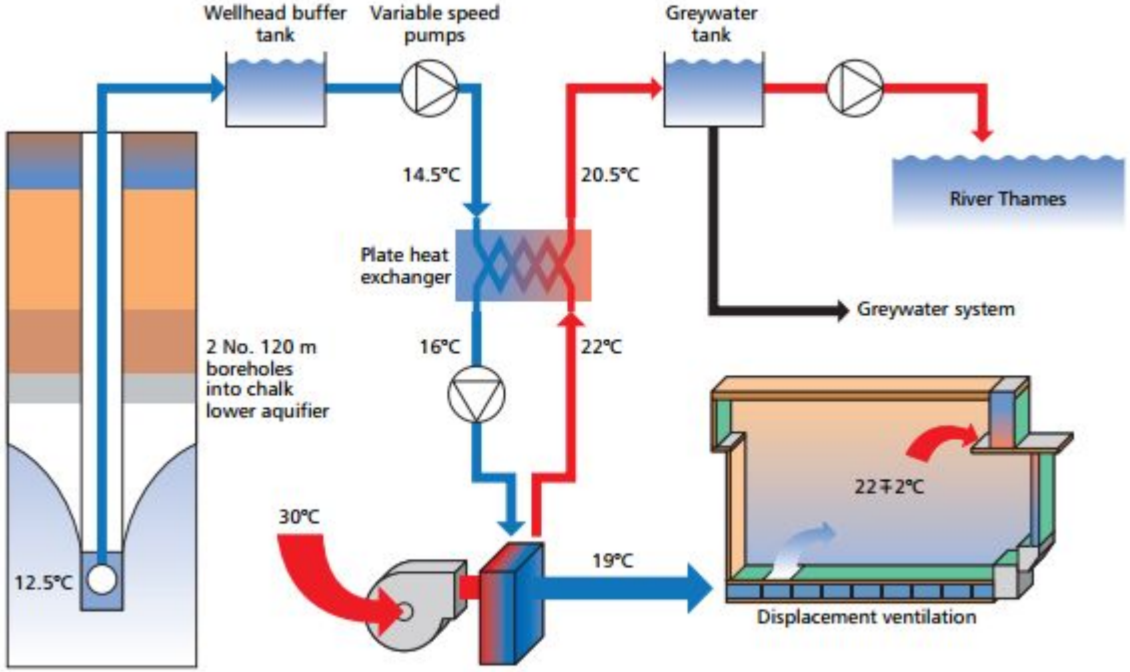




11 high capacity wells (5 Cold and 6 Warm) provide a total flow capacity of 720M^{3}h delivering between 6 and 10MW, a total of around 20GWh is delivered annually. Direct payback was less than 5 years!

Portcullis House

Innovative groundwater “Free” cooling system.



Free Cooling uses a low temperature resource without a chiller.

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Using Minewater as a source of thermal energy

Key: HE heat exchanger.
HP heat pump.

Open loop with disposal of water to surface recipient

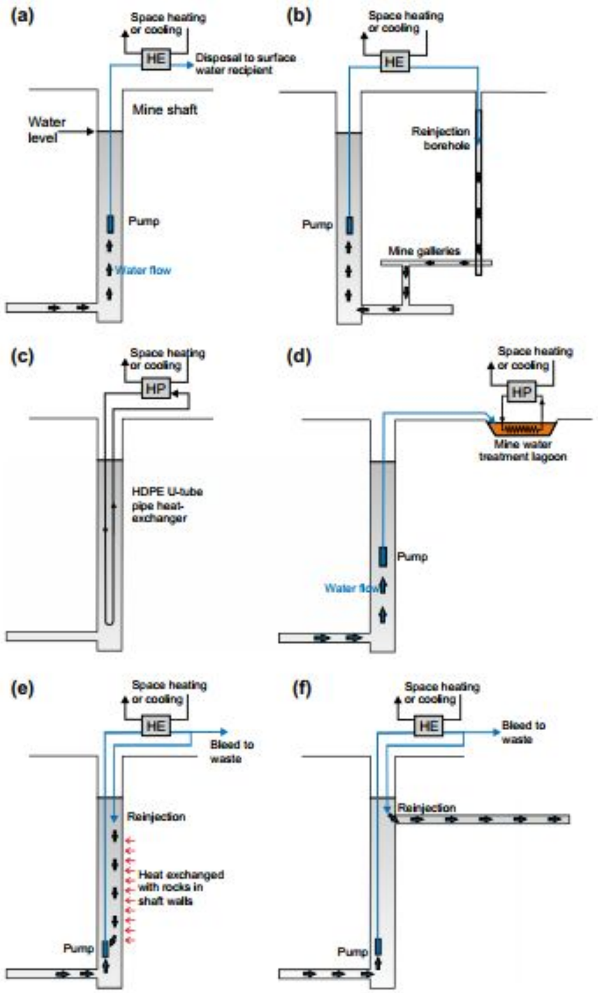
Open loop with reinjection,

Closed loop in flooded shaft,

Closed loop in surface mine water treatment pond,

Standing column with bleed and recirculation in shaft,

Standing column configuration, with large natural flow up shaft.



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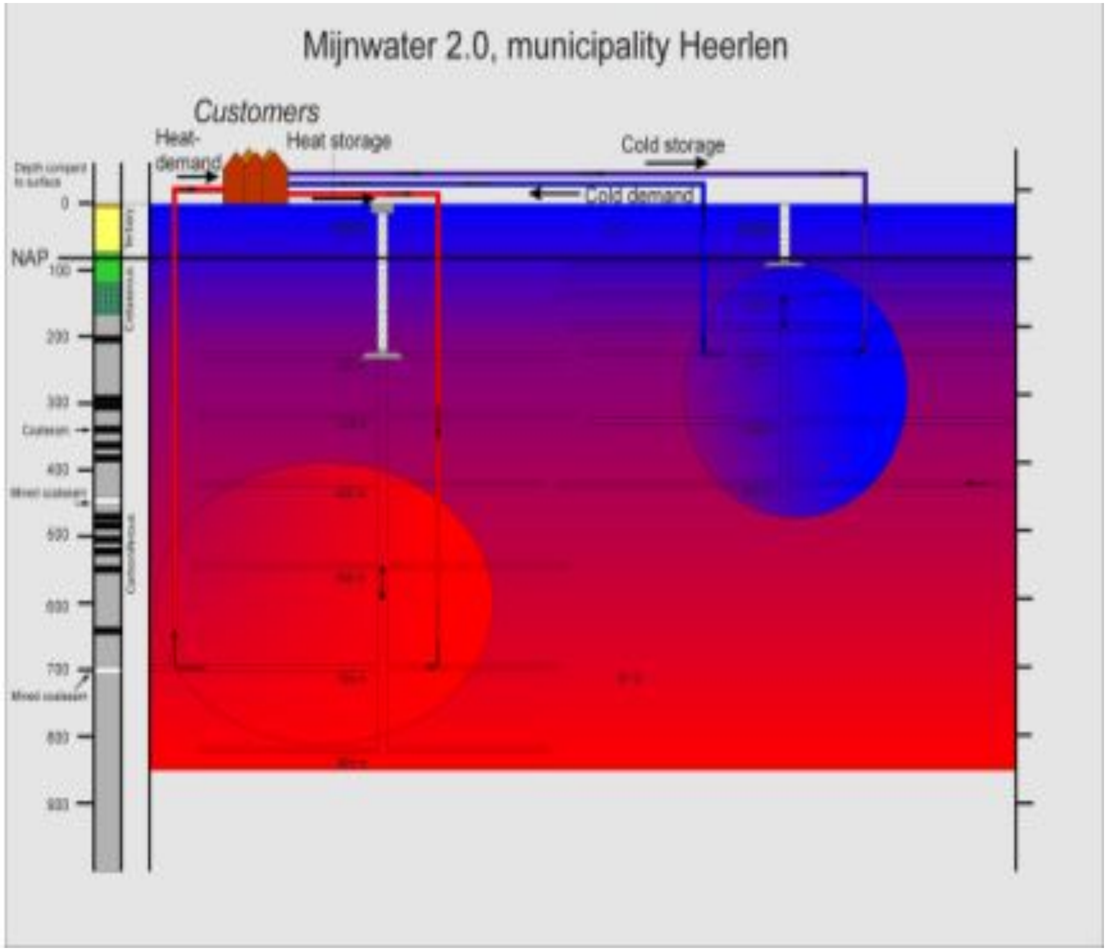
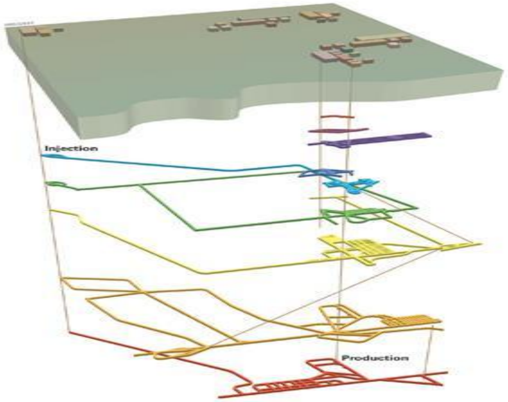
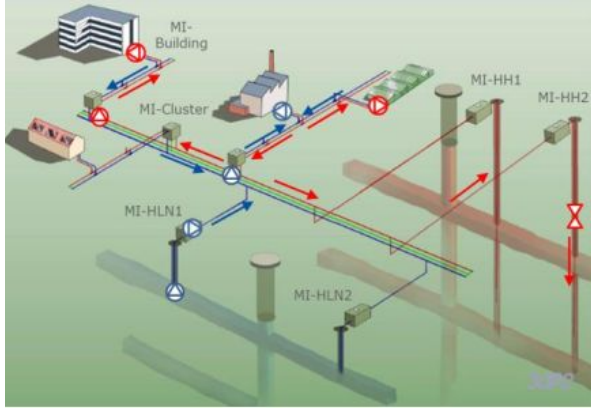
Using Minewater as a source of thermal energy







At Heerlen in the Netherlands minewater is pumped to the surface at temperatures reaching 28ºC. The system is used to heat and cool, 200,000sq m of commercial and domestic buildings a further 10,000 renovated homes will be added over the next 5 years. The current capacity is 4MW.

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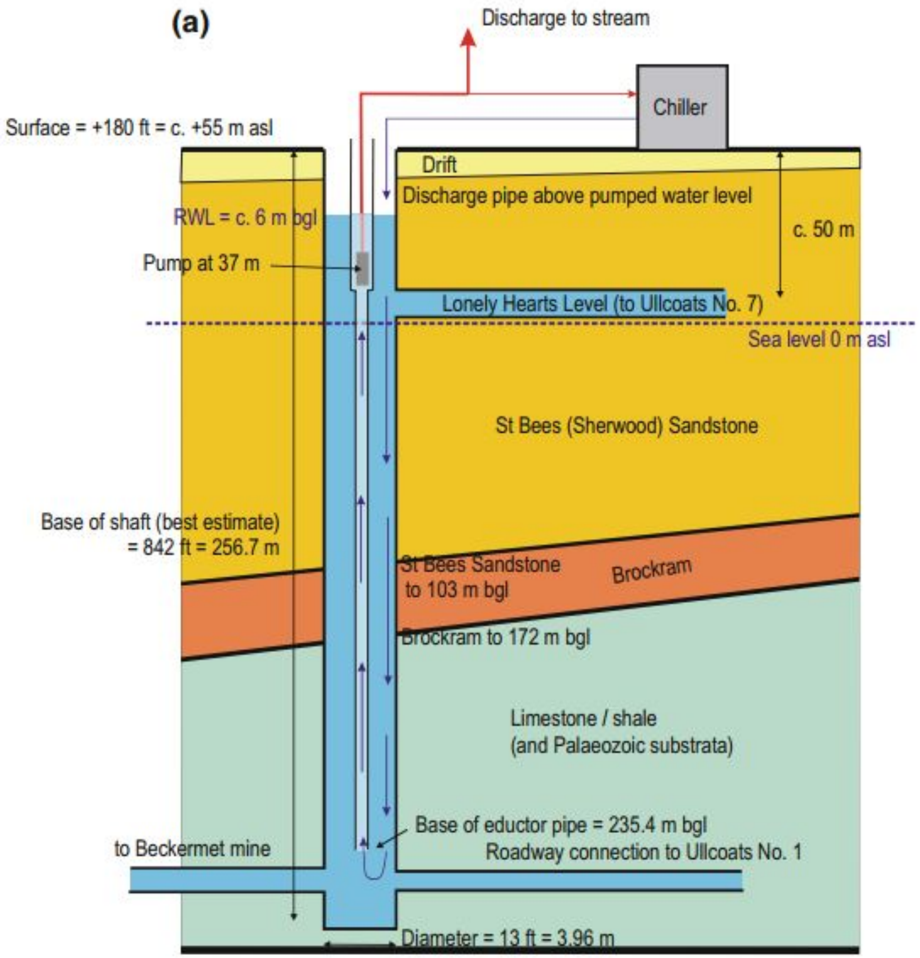
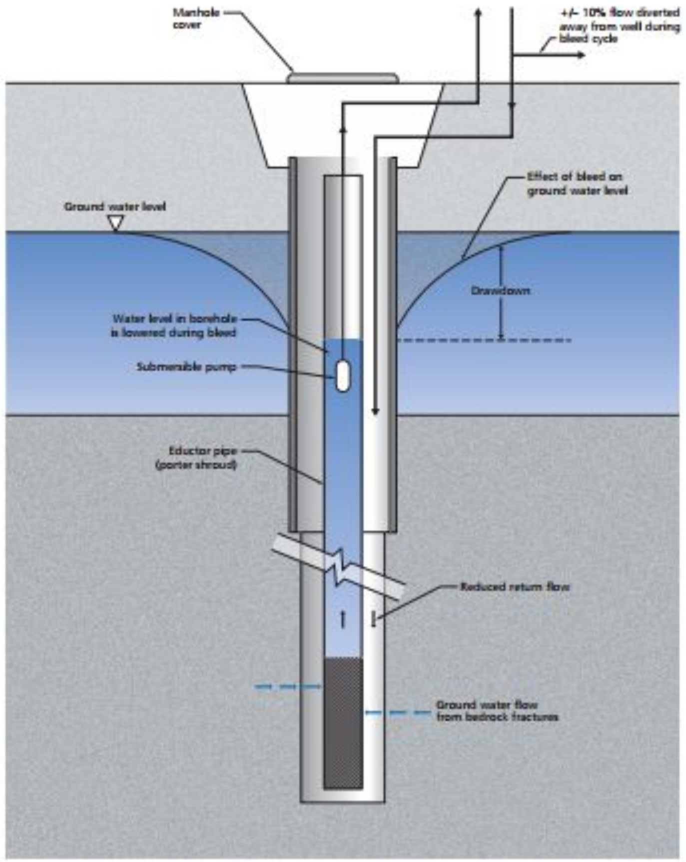
Standing Column Wells (SCW)

Using an Eductor pipe (Porter Shroud)



Standing Column Well test at the abandoned haematite mine, Egremont in Cumbria



SCW internals

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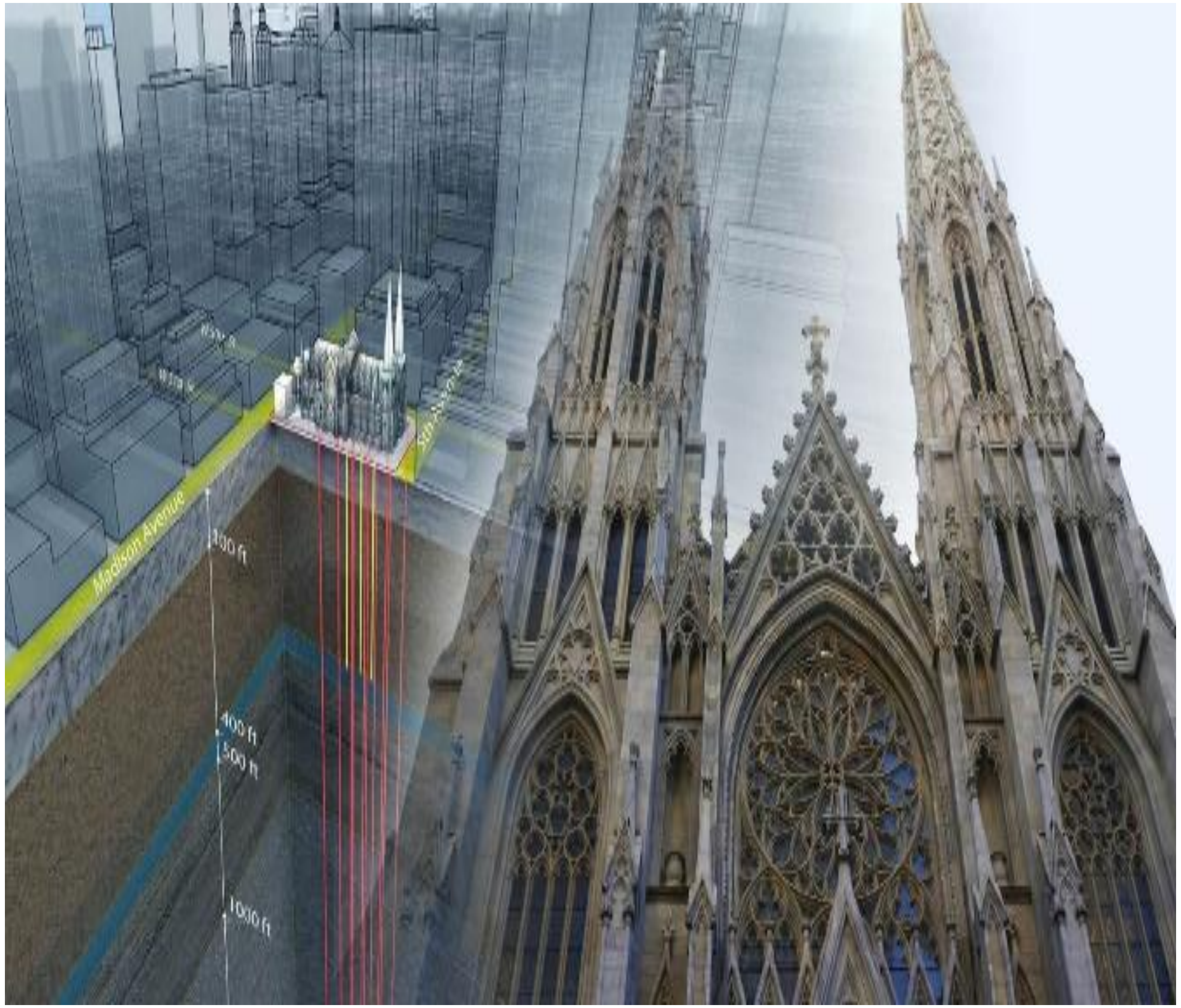
Standing Column Wells



The 10 ~200mm wells range from ~180M to ~ 675M and feed the system with groundwater at a constant ~13°C to provide ~850kWh of cooling, and/or ~940kWh of heating for the ~7,060M^2 building. It can cool and heat simultaneously.

Operating since February 2017 it saves around 30% of input energy, cuts CO_2 emissions by 94 Tonnes and takes up 60% less space.

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Conclusions

- Successful CIBSE/GSHPA/HPA partnership
- Input from industry ensuring consensus
- Promotes an under used technology
- Regular review
    - Best practice becomes minimum standard?
- Training pending
- Compliance checking and policing – Under discussion

Thank you

Nic Wincott

Lead Author - GWSHP Code of Practice
njwincott@gmail.com