Ground Source Heat Pump Association Webinar Series 2020

CLOSED LOOP BOREHOLES

Drilling & Construction

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25th June 2020

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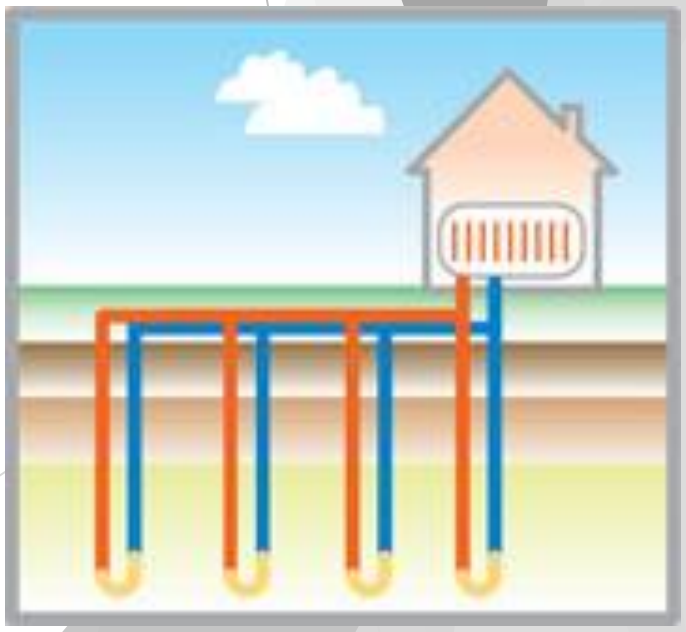
Subjects, to include:

- Basics of closed loop boreholes
- References, competences etc
- Regulation
- Know what you are drilling into!
- Geology & Drilling methods
- Grouting
- ….Artesian

GSHP systems are unique in the breadth of expertise required for design, installation and commissioning



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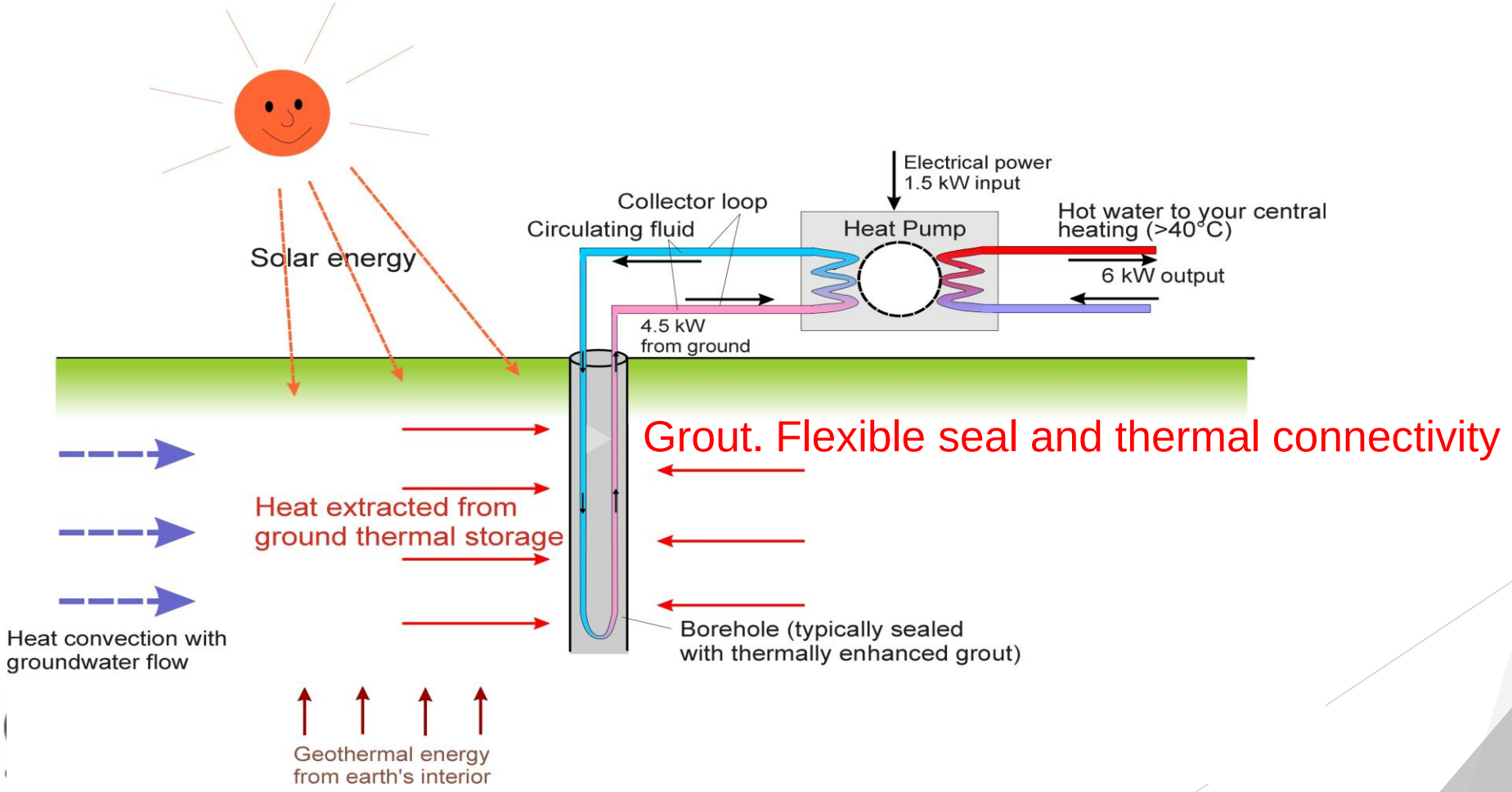
Closed loop borehole basics

- Access to (very) long-term heat exchange process
- Drilled borehole: stable for installation of loop and for grouting process
- Permanent prevention of entry of contaminants to ground/aquifer
- Safe, quick, cheap, efficient, clean, minimise impact on groundwater/environment



Drilling contractor competence

See
'GSHPA Vertical Borehole Standard' and '*Good practice guidelines', 'National Sector Schemes Quality Management for Geothermal Drilling…'*

- Conversant with BDA safe drilling practice
- Drillers to have Audit Card of competence
- Health & safety and CDM
- NVQ Land Drilling
- CSCS
- Rigs must comply with Work Equipment & Lifting Equipment Regs
- U-tubes to comply with requirements set out in the GSHPA Standard
- Pipes delivery to site. *Do not drop, drag, damage, crush or allow entry of water or mud*!

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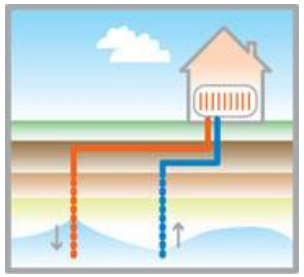
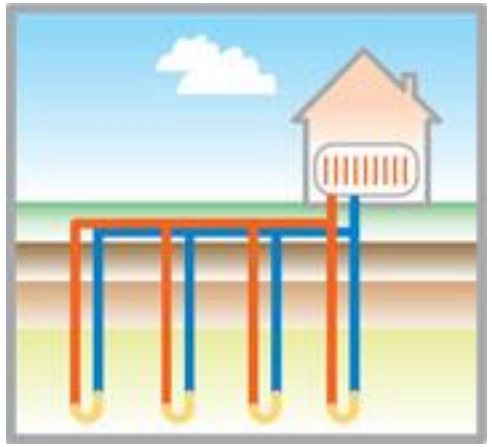
Regulation?



Open-loop boreholes. Yes – most are regulated.
See 25th July Webinar!

Closed-loop boreholes. *Not regulated*

- So, nobody to tell you about potential hazards
- Buried services, tunnels, caves, brownfield contaminants etc
- Occasionally ‘picked-up’ by the Environment Agency or Water Companies via the planning process
- Coal Authority – permit to drill



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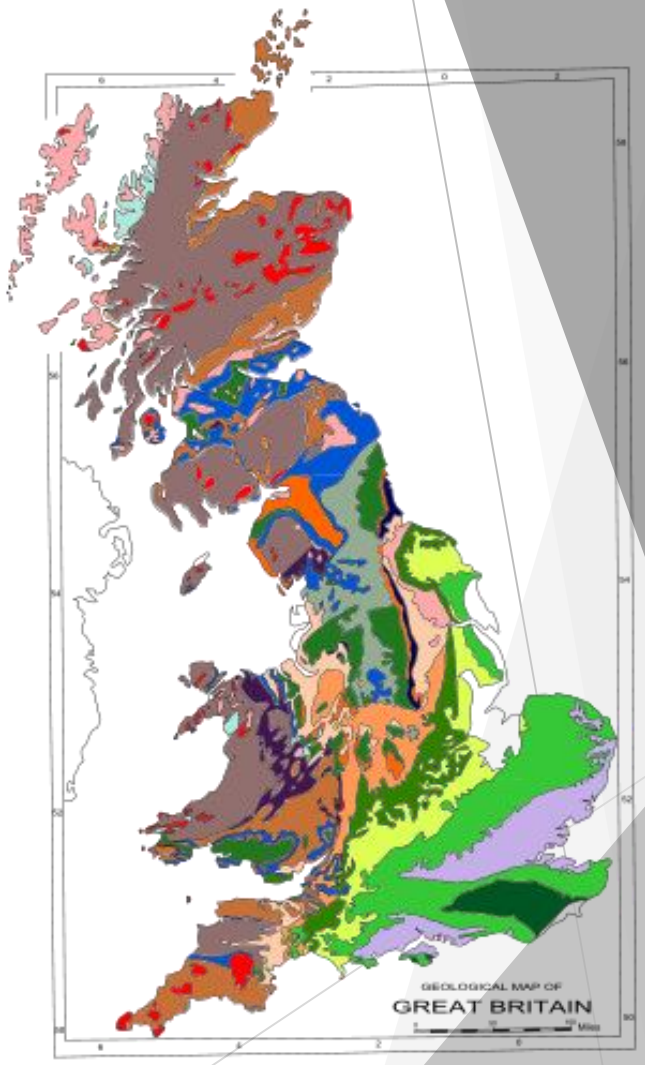
KNOW THE GEOLOGY

- ***HUGE*** **variation of shallow & deeper geology**

- Obtain experienced geological advice – early
  - List of members on GSHPA website
- Borehole design. *Coming-up in next week's Webinar!*
- *Expected geology, borehole depth and location will decide on rig type, drilling method and equipment required*



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DRILLING RIGS……and drilling rigs

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DRILLING METHODS SUITED TO GEOLOGY

- Again – know what you are likely to encounter. Minimise your risks
- Physical dimension of drilling location (centre of London or in a field?)
- Rig/Drilling method and selection of drilling mud, casing design is key
  - Drilling with air is simplest, cheapest – but often not appropriate (mess, instability, groundwater, depth).
  - London clay can hydrate and ‘swell’ and grab your drill string and/or prevent install of U-tube if mud selection is wrong
  - Clean drilling; drilling mud, conditioning and recirculation
  - Temporary casing for support of superficial deposits, or unstable deeper geology. Do you need twin-head rotary drilling?
  - Good practice for loop install – see GSHPA Standard
  - List of Drilling members on GSHPA website

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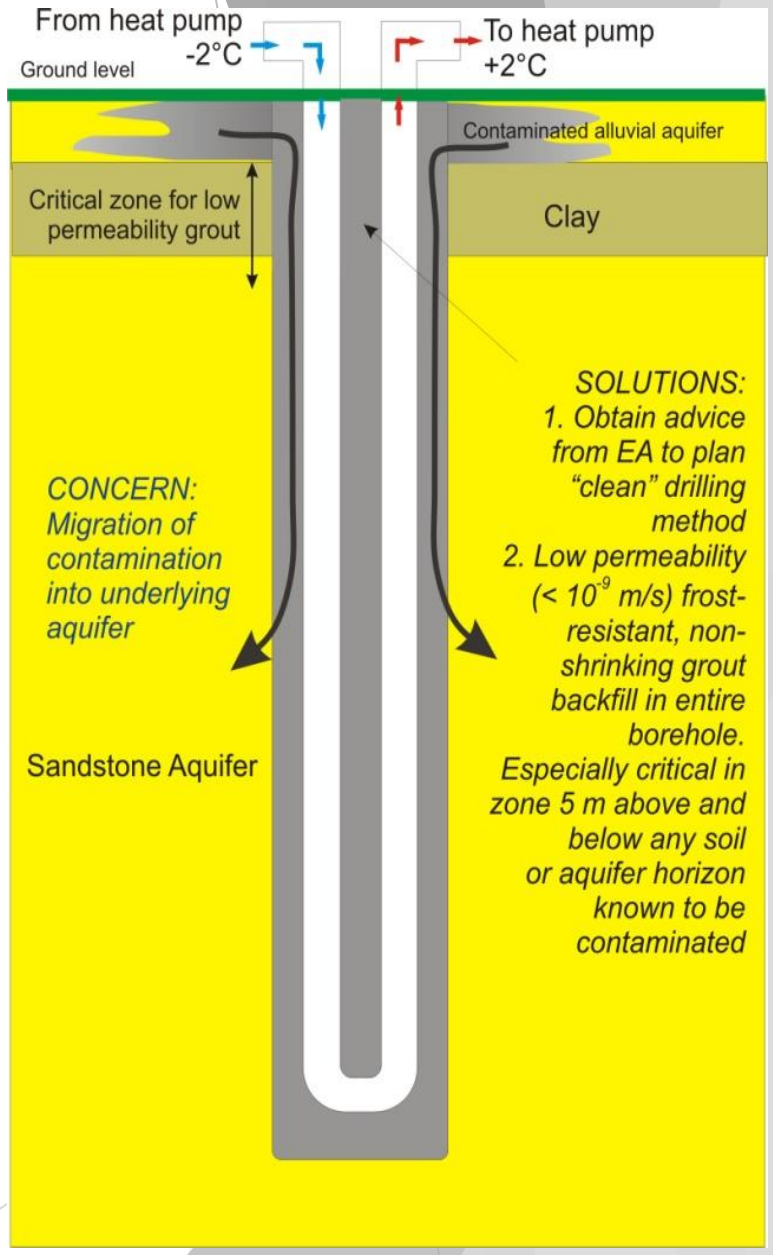
Grouting – and special case of contamination

Open Boreholes = pathway for movement of liquids
It is an offence to allow this to occur

- Grout: Tremie, bottom-top, entire length, low permeability, non-shrink (pipes expand & contract). Bentonite-based.
- Permanent, ‘semi-plastic’ grout to give consistent thermal connection between pipes and bedrock and prevention of fluid flow up or down the borehole
- Environment Agency: Avoid re-mobilising or movement of contaminants. Potentially criminal offence
- Surface casing (sometimes permanent). Support and sealing superficial or unstable zones during drilling and grouting



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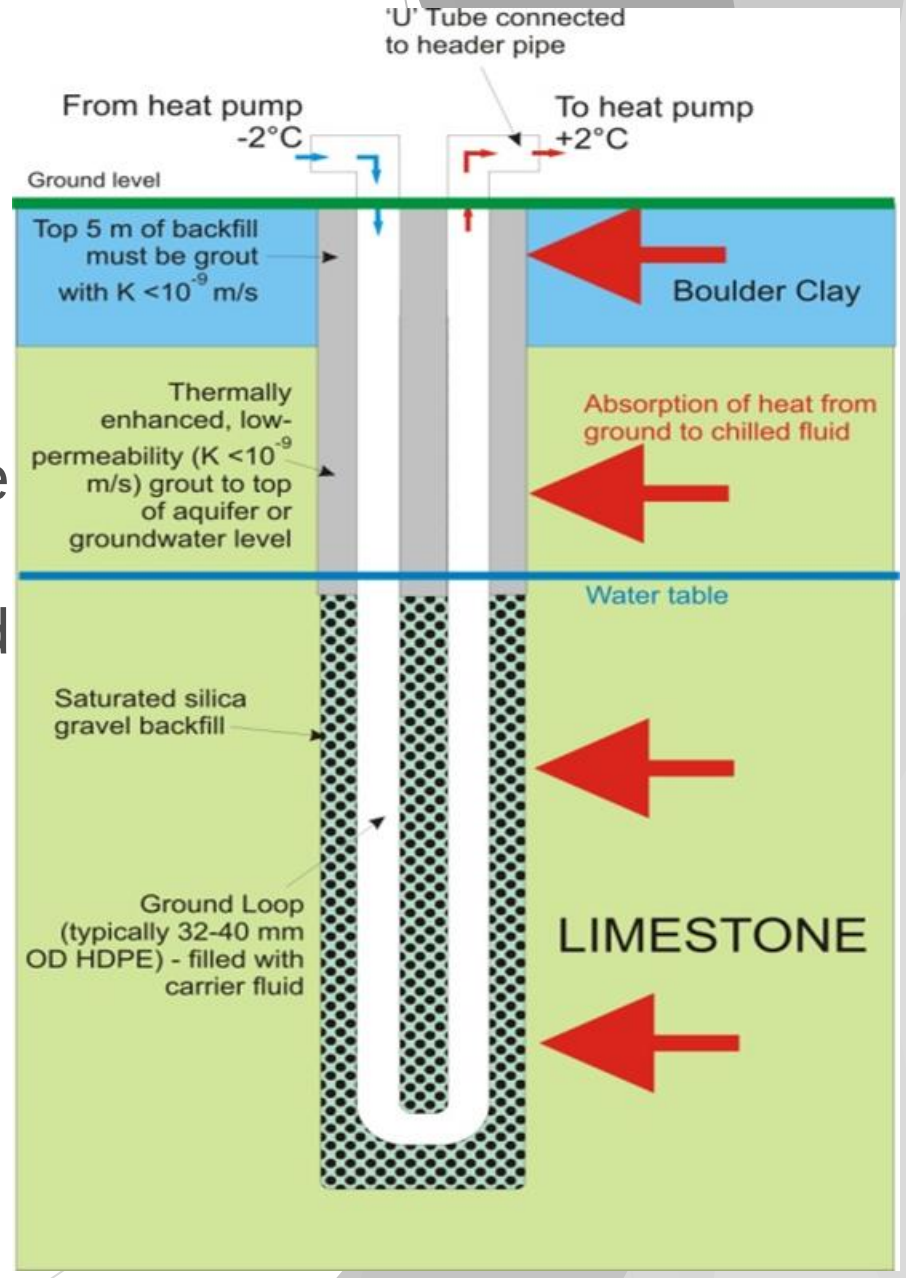
Granular backfill?

- Remember grout is used to SEAL the borehole and prevent entry of contaminants
- Pouring gravel or drill cuttings into a borehole to reduce costs is NOT ACCEPTABLE
- Sometimes geology is such that grout cannot fill the borehole (fractures, fluid loss, caverns)
- Then, granular media (rounded gravel) can be used to backfill sections of borehole.
- Top ≈20m always grouted for a good seal
- In hard rock, shallow groundwater, may consider suspending the loop in groundwater. Requires permanent casing seal, and a means to seal around loop at surface. See GSHPA Standard



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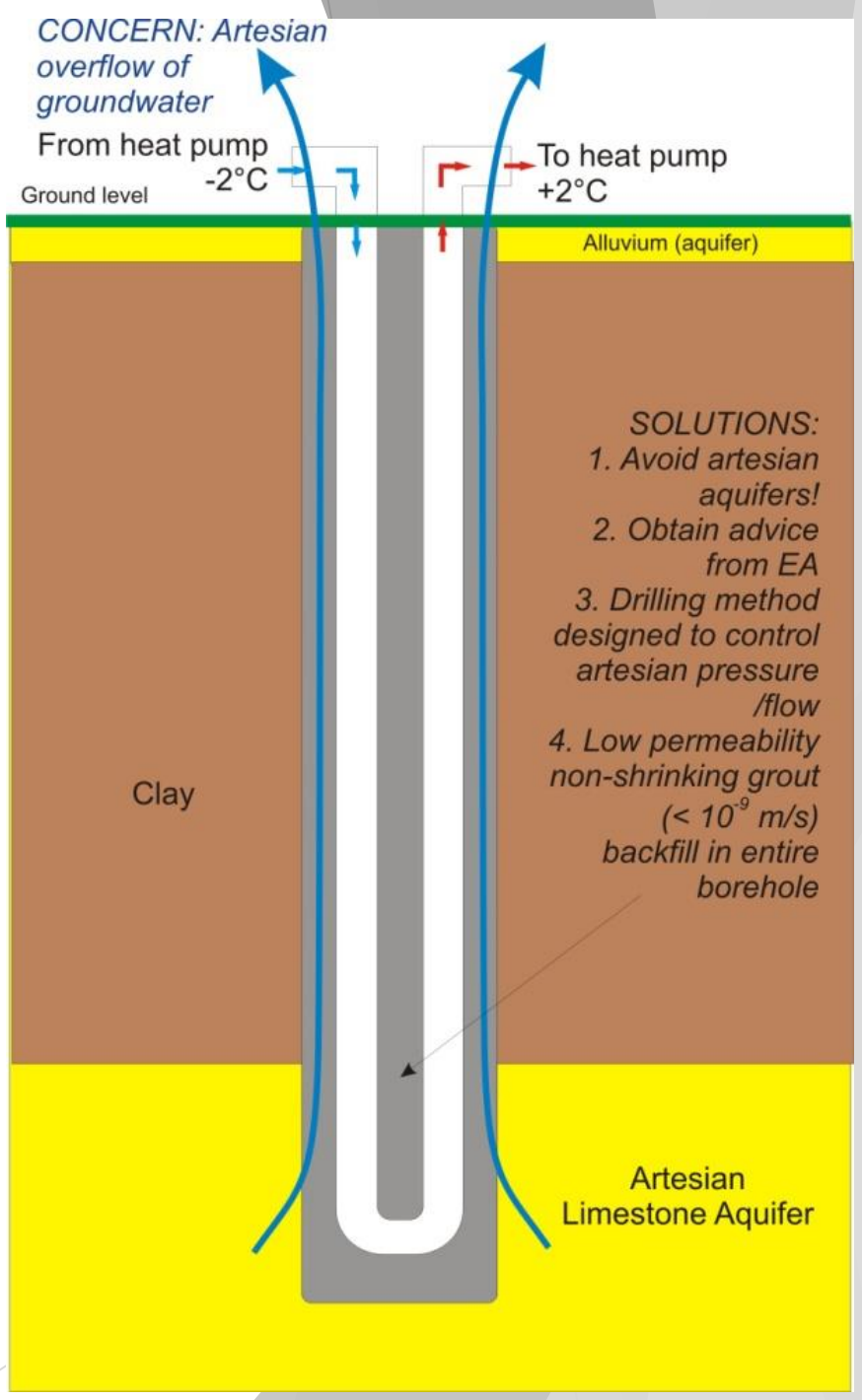
Artesian conditions

Rule 1. ***AVOID***.
Rule 2. Same as above!

- ***Obtain Professional support***: Geology, hydrogeology, topography, nearby boreholes?
- Rig & drilling methods, experience, mud, temporary and/or permanent casing
- Low artesian pressures, low permeability, non-shrink grout. Care it does not wash-out (mud and grout density, depth, pressure…….
- Consider other options (Open-loop?)



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Artesian conditions.
Be aware. Be Prepared. Be careful

This is a closed-loop test borehole.
Artesian flow from 60mbgl, 6bar pressure!

Drilling with high density mud, temporary casing & twin-head rig. Flow controlled at surface

Safely sealed using 3 packers, specialist, heavy grout. (1 month of work & very little sleep)

This is now a successful open-loop project of 600kW capacity. See July 25th Webinar

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Questions…..

and thank you

www.gshp.org.uk

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