OPEN LOOP GROUND SOURCE HEATING

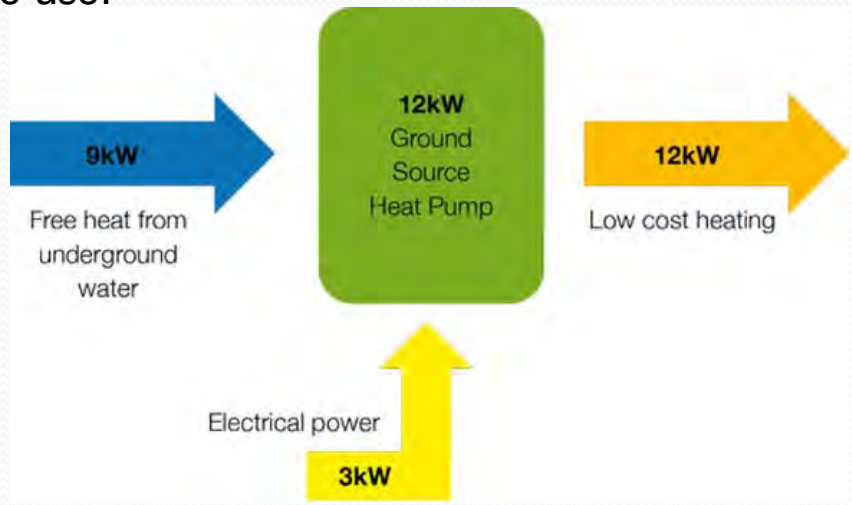
HEATING THAT WON'T COST THE EARTH

HD services LTD

Heating that won't cost the Earth

WHAT IS AN OPEN-LOOP GSHP?

- An Open-Loop GSHP utilises ground water as a heat source.
- The heat extracted is raised in temperature and delivered to the domestic hot water and space heating systems.
- The highest grade temperature is available to the hot water, enabling temperatures in excess of 60°C.
- Once the heat is removed, the same water is then returned to the aquifer from where it was taken. This is know as non-consumptive use.
- With coefficients of performance (COPs) of up to 5.0, open-loop ground source heat pumps offer an environmentally friendly source of heating with significantly lower running costs than a conventional heating system.



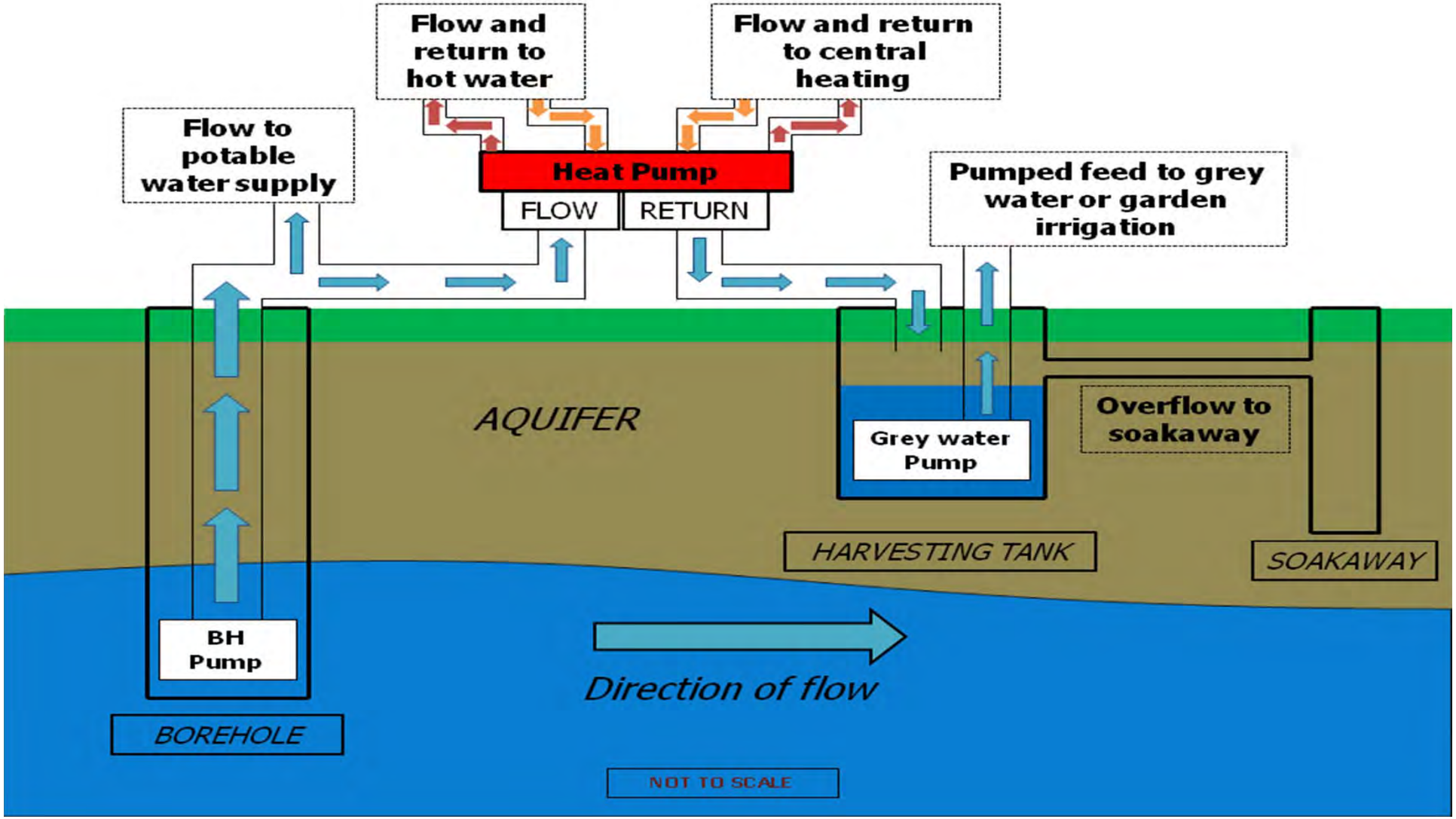
THE COMMON MISCONCEPTION

‘Open-Loop GSHPs are only useful for large commercial or industrial purposes, due to the high flow rates required and the consequent requirement of abstraction licences and discharge permits’.

FALSE. While it is true that some Open-Loop heat pumps would require an abstraction licence due to the higher flow rate required, Soleco dedicated Open-Loop GSHPs require a much lower flow rate and consequently abstraction licences are not necessarily required, meaning they are ideally suited for use in domestic properties.

H.D. Services Ltd have been installing Soleco Open-Loop GSHPs since 2009, and we have never come across a domestic site where an abstraction licence was required for the heat pump installation.

OPEN-LOOP INSTALLATION DIAGRAM



WHERE TO INSTALL

Open-Loop GSHP's are not suitable for every location as they require sufficient ground water to operate.

The first thing to determine is whether there is sufficient ground water available. A hydro-geological survey should be conducted.

H.D. Services Ltd. have been drilling water supply boreholes in South East England for over 30 years and will conduct a hydro-geological assessment for free, upon receipt of a site postcode.

If sufficient ground water **is** available then an Open-Loop installation should be considered. If sufficient ground water **is not** available then a closed-loop system should be considered.

FINANCIAL BENEFITS

These include:

Lower running costs – better average coefficient of performance (COP) compared to air source or Closed-Loop heat pumps.

Independent Water Supply – no mains water required, saving you money on water charges.

Eligible for Renewable Heat Incentive (RHI) Scheme – financial support is available for those using renewable heat technologies.

GENERAL BENEFITS

Reduced carbon footprint – including CO_2 produced by electricity generation, a Soleco heat pump is responsible for less CO_2 that even the most efficient gas condensing boiler.

High system efficiency – as underground water temperatures remain constant.

Minimal installation disruption – no need to dig up the garden to install the system.

MCS accredited – guarantees a high quality standard.

Greater water efficiency – borehole water can usually be filtered for consumption, and discharge water can be used for grey water, to irrigate the garden or wash the car.

Better annual COP – compared to either air source or closed-loop heat pumps.

Minimal visual impact – only a manhole cover can be seen externally.

Less space needed – only a small plot is needed.

Compatible with under floor heating and low temperature radiators.

Hot water up to 65°c all year round

The main pillars of a good design are:

- Ensure adequate water flow at all times on both the heat source (borehole) and heat delivery (building) side.
- Guard against the units continually cycling by providing sufficient water volume in the system.
- Sufficient water temperature from source (borehole).
- Cleanliness of water from borehole.
- Location of the heat pump (noise & vibration).

WHAT ABOUT PERFORMANCE?

There is evidence to suggest that Open-Loop GSHPs are among the most energy efficient heat pumps available. This is, in part, due to the following:

- **Constant replenishment of heat source** – the ground water is constantly replenished and remains at a consistent temperature.

- **Small difference between borehole in and heating water out** – a Soleco GSHP will take ground water at approximately 11°C and return it at about 7°C. A closed-loop system will have a greater difference and can not guarantee a specific minimum ground temperature at extraction.

SELECTION FACTORS

Several things require consideration when selecting an Open-Loop GSHP system:

- **SAP calculations / EPC** – these are required to accurately size the heat pump. Incorrectly sized heat pumps can be costly and inefficient.
- **Connection to existing system** – do heat emitters require upgrade? All GSHP's work most efficiently with Low Temperature Radiators (LTR) or Under Floor Heating (UFH)
- **Borehole location** – the closer the borehole to the location of the heat pump the less heat loss in the system. Good practice dictates that all boreholes should be a minimum of 5 meters from a property.
- **Availability of electricity supply** - Soleco HPs are compatible with both single and 3-phase supplies.
- **Water usage** – if the borehole water is to be used for domestic consumption, analysis and treatment will be required. If water is to be used for grey water uses, a harvesting tank could be installed.
- **Insulation properties** – the better insulated the building, the more efficient the heat pump will be.

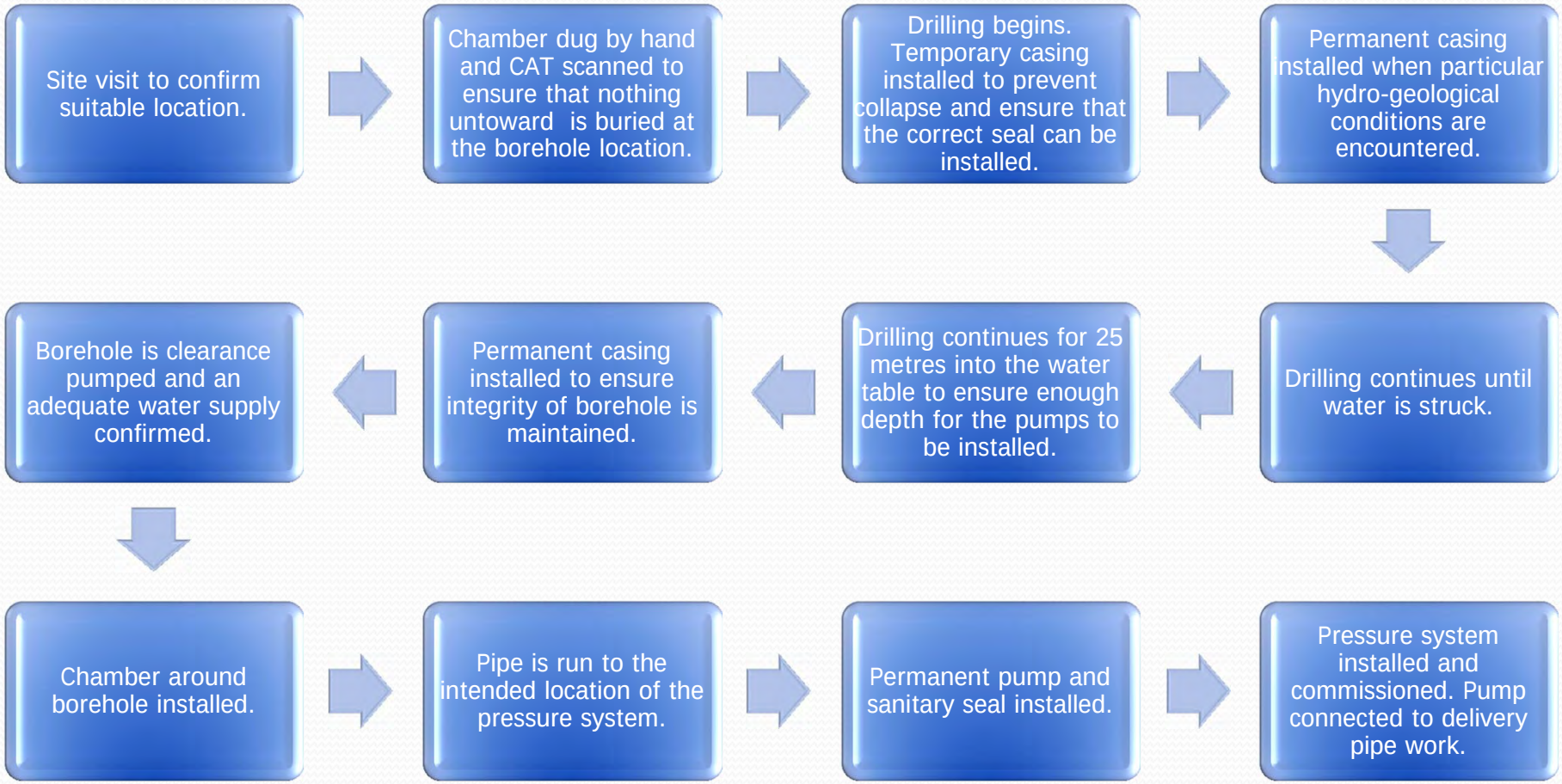
THE BOREHOLE AND SOAKAWAY

DRILLERS & RIGS

All H.D. Services boreholes are drilled using cable-percussion drilling rigs, the preferred method of the Environment Agency when drilling the chalk aquifer.

While this process is slower and more costly than rotary drilling, it is a cleaner drilling method and means that there is less likelihood of blocked fissures creating problems with water supply to the heat pump.

BOREHOLE CONSTRUCTION



PRESSURE SYSTEM

The pressure system of the borehole consists of a pressure vessel and a pressure switch. These:

- Allow the system to absorb fluctuations in flow and pressure.
- Extend borehole pump life by preventing cycling.
- Provide automatic control of the pump when the GSHP system is off-line with zero demand.
- Vessel size and pressure switch settings are selected to suit individual applications.

PERMITS AND LICENSES

ABSTRACTION LICENCES

The Water Act 2003 allows for the abstraction of water from the ground without charge, provided the daily abstraction rate is less than 20,000 litres (approx 4,400 gallons).

It is unlikely that a Soleco heat pump for domestic use will ever require more than 20,000 litres of water per day.

DISCHARGE PERMIT:
SINGLE DOMESTIC DWELLINGS

The environment agency approach states that a permit <u>is not</u> required where:

- The heat exchange system is an open-loop system used to heat or cool a **<u>single</u>** domestic property;
- The water is abstracted from, and discharged to, the same surface-water body (a river or stream and not a lake or pond);
- Cleaning chemicals are not discharged to the surface water;
- The property is not used for commercial purposes.

Further information regarding abstraction licenses and discharge permits can be found on the Environment Agency website.

HARVESTINGTANKS

Harvesting tanks - which can provide a grey water supply for garden irrigation, car washing etc - can be installed either above or below ground.

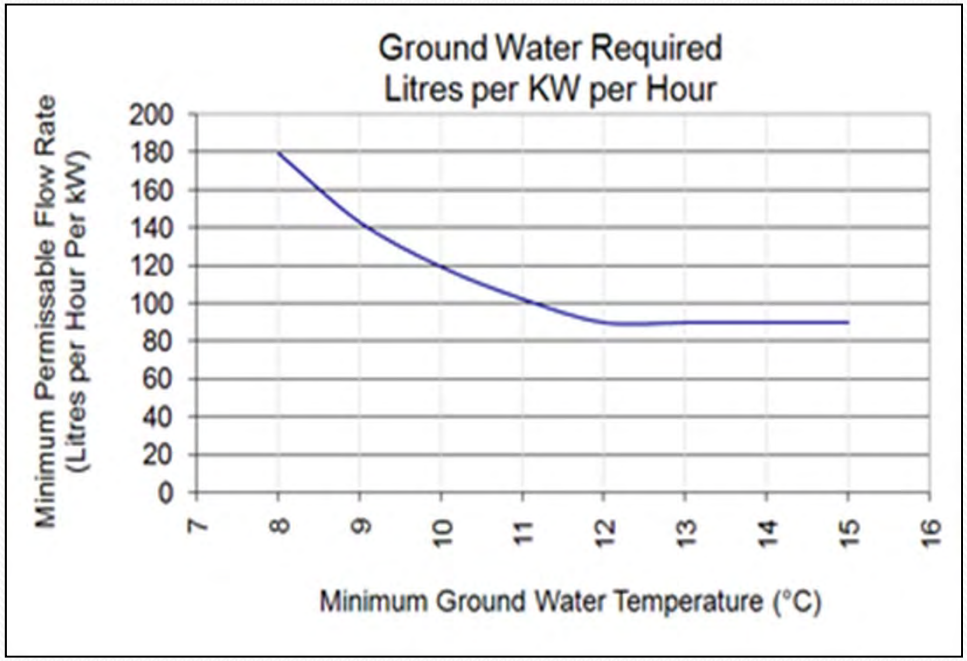
H.D. Services Ltd. always recommend the installation underground, as this allows the water to regain heat before returning to the aquifer.

The tanks can be equipped with powerful booster pumps to pressurise the house system or irrigation network up to 5 Bar.

Open Loop Ground Source Heat Pump

FEATURES

- **WEATHER COMPENSATOR –** compensates for variations in weather temperatures.
- **SOURCE WATER ECONOMISER -** varies the source water flow rates as required.
- **TWIN COMPRESSORS –** operates on half or full capacity, maintaining efficiency.
- **DE-SUPERHEATER FUNCTION -** for Domestic Hot Water.



Soleco heat pumps have been designed to operate with water temperatures from 8°C, with nominal output rated at 10°C.

If source water temperatures are below 12°C the unit will demand higher water flow rates.

A constant water supply is required for the heat pump to run safely and efficiently. Therefore a water source that will not fluctuate seasonally and which is not weather dependant will be most efficient.

DOMESTIC HOT WATER SUPPLY

Hot water for sanitary consumption is produced by two complimentary sources:

1. **The hot water cylinder -**This should have a suitable indirect heating coil which is supplied by heat from the main heating circuit of the heat pump (55°C max)

2. **A direct heat exchanger** (de-super heater) **-** Located within the heat pump this can boost the water temperature to 60-65°C

For water pasteurisation a minimum hot water temperature of 60°C for a minimum of 1 hour per day is required. (HSE CoP L8)

CONTROLS

It is vital that a control system is installed which ensures the correct operation of the heat pump and the associated system. The controls within the heat pump are self contained and designed to ensure safe and energy efficient operation of the heat pump itself and <u>not</u> the system as a whole.

It is currently necessary to provide:

- A room thermostat
- A cylinder thermostat
- A time-clock
- An additional water temperature control (for UFH)

All Soleco heat pump units will protect themselves by shutting down if:

- the heating circuit flow drops or is interrupted
- the borehole flow drops or is interrupted
- high refrigerant pressure is detected

MAINTENANCE

It is imperative that all parts of an Open-Loop system are regularly inspected to ensure that the installation remains at its most efficient.

- **An annual maintenance inspection** is advised by the manufacturer and required for the domestic RHI application. This inspection should only be carried out by suitably qualified personnel.

- **An annual borehole maintenance inspection** is advised. This should include water analysis to check for particulates that may require filtration to prevent blockage of the heat pump; acidisation (where necessary), pump checks etc.

- **Work on the refrigeration circuit within the heat pump requires suitably a qualified engineer.**

Maintenance inspection of an Open-Loop GSHP installation should include:

- Recording of Flow meter reading
- Recording of inlet and outlet water temperatures
- Inspection of circulating pumps
- Inspection of internal pipe work
- Cleaning strainer on central heating pipe work
- Cleaning strainer on hot water pipe work
- Cleaning strainer on Pressure Reducing Valve
- Inspection of flow sensor
- Inspection of temperature sensor
- Checking flow rates through central heating system
- Cleaning of DHW Heat Exchanger
- Checking borehole characteristics, flow rate and electrics
- Check and tighten electrical connections
- Check Voltage at unit
- Check running currents of compressors
- Check internal heat pump operation settings
- Submission of a written report

‘Green Apple Award’ winning development utilises water supply boreholes to provide drinking water, grey water and heating via Open Loop Ground Source Heat Pumps.

At a site in south Buckinghamshire, open-loop ground source heat pumps use water from the chalk aquifer to provide the renewable heat for the heating and hot water systems. The water can also be used for domestic consumption (subject to analyses and suitable filtration) and as a grey water supply. H.D. Services were asked to tender for the installation of three water supply boreholes to serve each of three prestige properties.

Closed-loop ground source heating was being considered, however the availability of a reliable ground water supply from the chalk aquifer resulted in the installation of three open-loop heat pumps. The development went on to win a Green Apple award in recognition of the Sustainable Nature of the development and the Architectural Design Excellence of the properties.

Each installation is covered by a 5 year workmanship warranty and annual maintenance contracts have been offered. Working from building plans and SAP reports, the quote allowed for the supply and installation of Soleco three-phase heat pumps; two 18-kW and one 26-kW. The boreholes were drilled using a cable-percussion rig - the method preferred by the Environment Agency when drilling into the chalk aquifer. Borehole logs were submitted to both the British Geological Survey and Environment Agency to protect the abstractions from derogation by a third party.

Single installation company can design, construct and install a bespoke Sewage Treatment Plant, Water Supply Borehole, Open-Loop Ground Source Heating System and Surface Water Soakaways.

At a site in Hertfordshire, H.D. Services Ltd. was instructed to install a Sewage Treatment System, Water Supply Borehole, Open-Loop Ground Source Heat Pump and Surface Water Soakaways for use by a single domestic dwelling. The idea was for the property to be as self-sufficient as possible.

Utilising water from the chalk aquifer to provide a grey water supply, a potentially potable supply and the heat source for an open-loop heat pump, this project offered many interesting challenges.

The water supply borehole and soakaway were drilled using a cable-percussion rig - the method preferred by the Environment Agency when drilling into the chalk aquifer. A duty/standby dual pumping system was adopted in the borehole, meaning there is always a standby pump to act as backup should one pump fail. This method is always recommended by H.D. Services Ltd. as it means that any pump issues can be addressed without disruption to the water supply and hence the heating system.

A bespoke HD-SM Sewage Treatment System was designed based upon the number of people that could live at the property. Working from detailed floor plans and SAP reports, H.D. Services Ltd. sized the heat pump and designed the water supply borehole and soakaway. The efficiency of both the water supply borehole and soakaway was proved by pumping from one to the other.

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