T-LEVELS | Institute for Apprenticeships & Technical Education

T Level Technical Qualification in Building Services Engineering for Construction (8710-30)

8710-033 Employer-Set Project Exemplar – A Grade

Summer 2023

City & Guilds | eal

Contents

Introduction

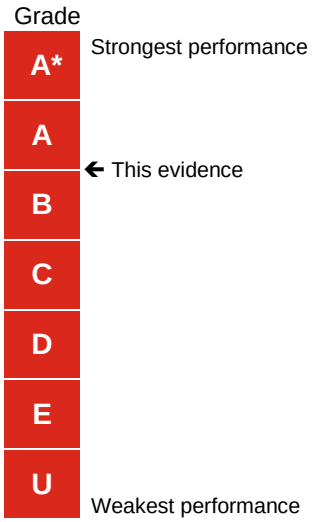
Summer 2023 Results

This document is aimed at providers and learners to help understand the standard that was required in the summer 2023 assessment series to achieve an A grade for the 8710-033 Building Services Engineering for Construction Employer-Set Project (ESP).

Providers and learners may wish to use it to benchmark the performance in formative assessment against this to help understand a potential grade that may be achieved if a learner was to attempt the next summative assessment series.

The Employer-Set Project is graded A* to E and Unclassified.

The exemplar evidence provided for the A grade displays the holistic standard required across the tasks to achieve the A grade boundary for the summer 2023 series. A slightly weaker performance would have resulted in a B grade result being issued.



The Employer-Set Project brief and tasks can be downloaded from here.

Important things to note:

- We discussed the approach to standard setting/maintaining with Ofqual and the other awarding organisations before awarding this year. We have agreed to take account of the newness of qualifications in how we award this year to recognise that students and teachers are less familiar with the assessments (Vocational and technical qualifications grading in 2023 – Ofqual blog), whilst also recognising the standards required for these qualifications.

- The exemplar evidence presented, as a whole, was sufficient to achieve the A grade. However, performance across the tasks may vary (i.e. some tasks completed to a higher/lower standard than an A grade).

Marking of this Employer-Set Project is by task and Assessment Objective, below is a summary of these along with the mark achieved by the evidence presented and the maximum mark available for each aspect.

Task	Assessment Objectives	Mark achieved	Max mark available
Task 1.1 Research	- AO1 Planning skills and strategies - AO2a Apply knowledge to the context of the project - AO3 Analyse contexts to make informed decisions - AO4c Use digital skills	6	9
Task 1.2 Report	- AO1 Planning skills and strategies	5	6
	- AO2 Apply knowledge and skills to the context of the project	9	12
	- AO3 Analyse contexts to make informed decisions	2	2
	- AO4 Use maths, English and digital skills	4	6
Task 1.3 Project plan	- AO1 Planning skills and strategies - AO3 Analyse contexts to make informed decisions - AO4a Use maths skills	6	8
	- AO2 Apply knowledge and skills to the context of the project	8	16
Task 1.4 Presentation	- AO1 Planning skills and strategies - AO3 Analyse contexts to make informed decisions - AO4b Use English skills	4	6
	- AO2 Apply knowledge and skills to the context of the project	8	12

Task 2.1 Collaborative problem-solving	- AO2 Apply knowledge and skills to the context of the project - AO3 Analyse contexts to make informed decisions - AO5a Carry out tasks	10	15
Task 2.2 Evaluation	- AO4b Use English skills - AO5b Evaluate for fitness for purpose	5	8

Task 1.1 Research

Assessment number (eg 1234-033)	8710-033
Assessment title	Employer-Set Project

Candidate name	<first name> <surname>
City & Guilds candidate No.	ABC1234

Provider name	<provider name>
City & Guilds provider No.	999999a

Task(s)	1.1
Evidence title / description	Research notes (with record of sources)
Date submitted by candidate	DD/MM/YY

Task 1.1 - Research (<first name> <surname>)

Ground Source Heat Pump

(Ground source heat pump 12kw (250m2 property))

Overview

Ground source Heat pump

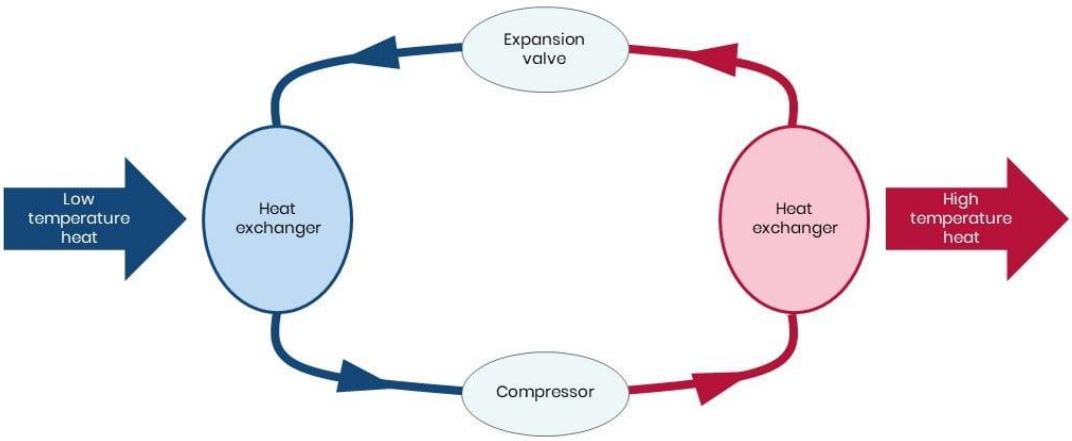
A heat pump captures heat from outside and moves it into your home. It uses electricity to do this, however the quantity of heat delivered into your home is much greater than the quantity of electricity used to power the system.

As a heat pump captures heat that is already present in the environment, the system itself does not burn any fuel and therefore emits no carbon dioxide.

How does a heat pump work?

Everything around us contains thermal energy – or heat. Heat naturally flows from a warmer place to a colder place. To provide the heat energy in a home when outdoor temperatures are colder, we need heat to flow in the other direction – from a colder place to a warmer place. But how does it do it?

When the pressure of a gas increases, the temperature also increases. When the pressure decreases, the temperature decreases. This relationship between pressure and temperature is the key to how a heat pump works.



The gas is called a ‘refrigerant’ and a heat pump uses electricity to compress this refrigerant, increasing the pressure and therefore the temperature.

As the refrigerant’s heat is transferred to your home through the heat exchanger, it cools down a little. The refrigerant is then allowed to expand so that it cools even further. It’s now cold enough to absorb more heat from outside and begin the process again.

The heat delivered to the heat exchanger can then be used to heat your home. This would normally be done using a central heating system – but it could also be done using warm air in either an air-to-air heat pump or an exhaust air heat pump.

Ground source heat pump

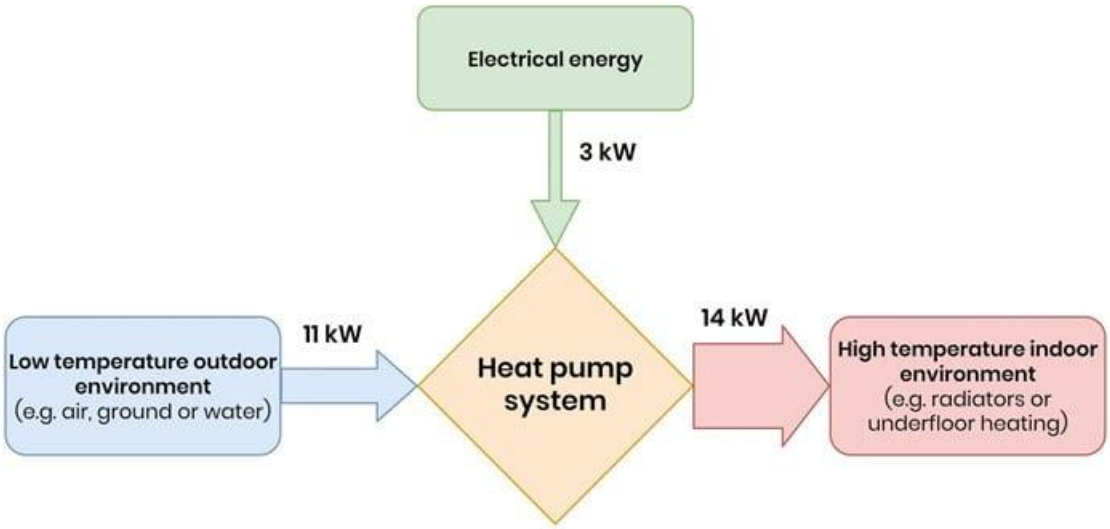
With a ground source heat pump (GSHP), the heat energy is gathered from water circulating in underground pipes, which is pumped to a heat exchanger inside the house. The cool water, which is mixed with antifreeze and referred to as ‘brine’, passes through the heat exchanger, transferring the heat to the refrigerant, which continues its journey around the compressor circuit.

How efficient are heat pumps?

Heat pumps are more efficient than other heating systems because the amount of heat they produce is more than the amount of electricity they use. The amount of heat produced for every unit of electricity used is known as the Coefficient of Performance (CoP). So, if a heat pump has a CoP of 3.0, then it will give out three units of heat for every unit of electricity consumed.

The diagram below shows the basic energy flow of a 14-kilowatt (kW) heat pump to help show how the CoP is calculated. In this example, the heat pump has an electrical power input of 3kW and a heat output of 14kW. The remaining 11kW are

obtained from the environment. To calculate the CoP, you divide the heat output by the electrical input, which in this example results in a CoP of 4.7.



Every heat pump has a published datasheet telling you what its measured CoP is. The CoP is measured at a single point in time, under specific test conditions. However, in real life the heat pump experiences temperature variations throughout the year (ie with ground or air temperatures rising and falling throughout the seasons), so the CoP is not always helpful in understanding what the cost of running the heat pump will be, or its 'real world' efficiency over the course of the whole year.

Instead, the Seasonal Coefficient of Performance (SCoP) or Seasonal Performance Factor (SPF) is used to show the efficiency of the heat pump across the whole year. Heat pump installers must calculate the SPF based on their system design for your home. This calculation demonstrates how the heat pump should perform given the average temperatures at your location and other details such as the size of your radiators. The installer should share this calculation with you before beginning any work. The SPF will give you a better indication of what to expect in terms of running costs and efficiency than the CoP figure.

Will installing a heat pump help save money on my heating bills?

While the compressor and pumps need electricity to work, they use less than the quantity of heat they move from outside to inside. The amount of heat energy moved versus the amount of electrical energy used depends on the source temperature and the output temperature, so it varies constantly throughout the year as outside temperatures change.

How this will affect your energy bill will depend on several factors, including:

- What fuel you are replacing and how much it costs.

Your electricity tariff.

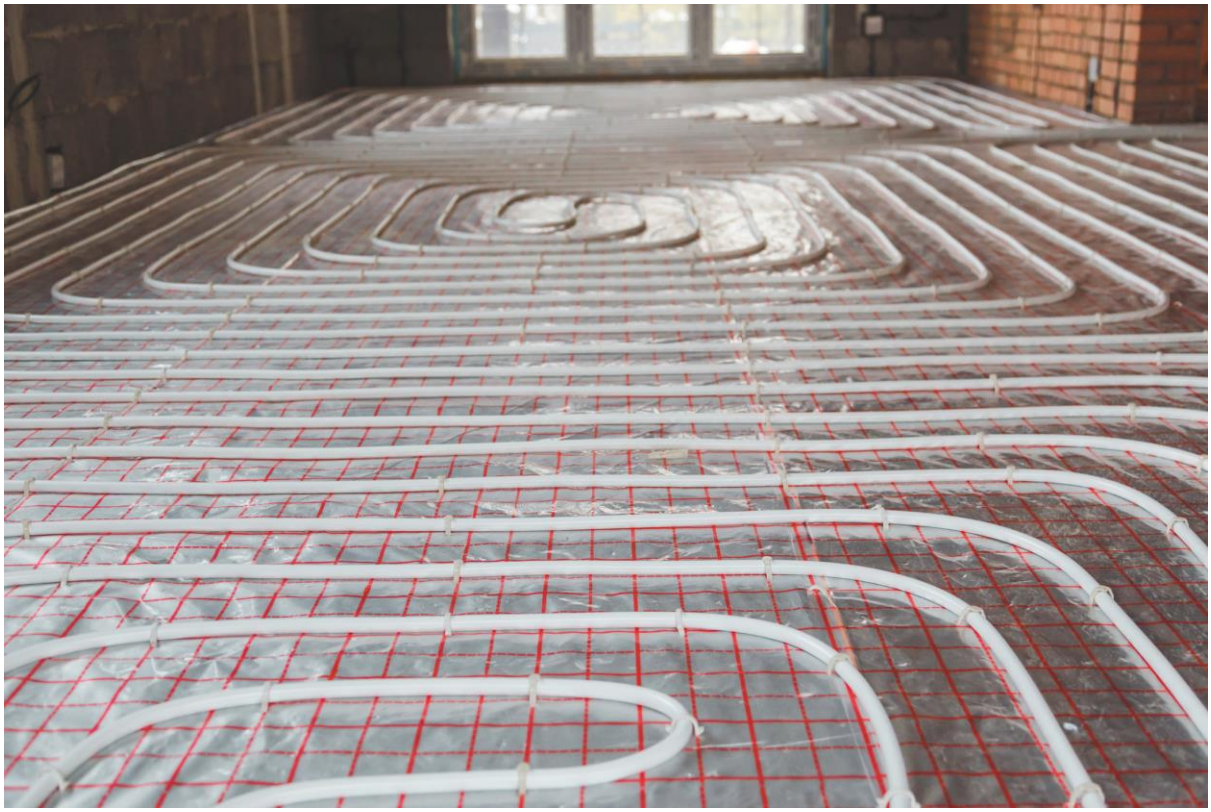
Which type of heat pump you install and how efficient it is.

The design of your central heating system.

Your location and its average air or ground temperatures throughout the year.

For people using gas boilers (not LPG or oil boilers), heat pumps are likely to be slightly more expensive to run unless particular attention is paid to ensuring maximum efficiency of the heat pump in the heating system by using best practice radiator / underfloor heating design. However, as utility prices fluctuate over time, we expect that heat pumps will become the cheapest as well as the lowest carbon form of heating available.

For those on LPG or oil, annual variations in prices mean that it’s difficult to give an exact estimate of annual heating costs. For example, heating oil has typically fluctuated between 40-65 pence per litre over the last five-year period, with a general upward trend in price. Unless you can buy oil or LPG at the very cheapest time of the year to cover your entire annual use, heat pumps should save you money on running costs assuming a well-designed system is installed.



Designing and operating your heat pump system

The compressor in a heat pump works harder when there is a larger temperature difference between the outside source temperature and the water temperature needed in your radiators or underfloor heating. The less the compressor needs to work, the less electricity the heat pump uses.

While we can’t control the outdoor source temperature, it’s possible to design heating systems that use low temperature water indoors, meaning the heat pump can use less electricity and still heat your home comfortably.

By using radiators with a larger surface area, or underfloor heating, more heat can be delivered into the room without increasing the water temperature. Running the heating system for longer is another way of delivering more heat into the room with lower temperature water.

If you have radiators with a smaller surface area, then the heat pump will have to run at a higher temperature. This means the compressor is working harder to deliver the same amount of heat as it would with larger radiators, or if it had a longer time to run. When the compressor works harder, it uses more electricity, which makes the system more expensive to run.

The aim of a well-designed system is to reduce the heating water temperature as much as possible. The closer the required temperature is to the source temperature (ie the outside air or ground temperature), the more efficient the heat pump will be, and therefore the lower the running costs.

HOT WATER

A standard air-to-water or ground-to-water heat pump needs to be able to store hot water for when you need it. The size of hot water cylinder required will depend on the volume of hot water that you need, but often it can be fitted inside a cupboard measuring 80x80cm. A hot water cylinder allows the heat pump to gradually heat the water, with the cylinder storing the hot water for when you need it.

While most heat pumps can provide water at 55°C, hot water in the cylinder will need to periodically reach 60°C or higher to kill harmful bacteria. While some heat pumps can deliver water to this temperature, most systems are designed to use an immersion heater (an electric heater within your hot water cylinder) to top up the temperature to the required level.

An air-to-air heat pump does not generate hot water, so you will need to consider an alternative way of heating your water, such as using an immersion heater.

If you don't have space for a hot water cylinder, you still have options. Some hybrid systems are designed so that the heat pump provides space heating, while the boiler provides hot water instead.

You could also consider installing a heat battery, which takes up less space than a hot water cylinder. Instantaneous hot water heaters are also available and can be installed under your kitchen sink to provide a smaller volume of hot water.

Radiators and underfloor heating

Conventional fossil fuel boilers were typically designed to deliver water to your radiators at 75°C – though modern condensing boilers should ideally run at lower temperatures to run as efficiently as possible. In comparison, a heat pump would ideally circulate hot water to the radiators or underfloor heating at temperatures between 35°C and 45°C, depending on the outside temperature. This is when the heat pump will work most efficiently with the lowest running costs.

Fitting underfloor heating after the house has already been built can be challenging. Instead, you may opt to install a heat pump and continue using existing radiators at a higher temperature or install radiators with greater surface area to provide enough heat using lower water temperatures.

Radiators come in many different shapes and sizes. Often single panel radiators can be swapped for double or triple panel radiators to increase surface area, without needing to increase the amount of wall area taken up. Moving from single panel radiators to triple panels can more than triple the heat output without taking up more wall space. Radiator upgrades can be a cost-effective way of improving the efficiency of your heat pump and reducing running costs.

Underfloor heating should be designed to work with water no warmer than 45°C in most cases, so it’s safe to assume that if you have underfloor heating it should work well with a heat pump.

Some wet central heating systems installed in the 1970s have a particular type of pipe called ‘microbore’, which has a small internal diameter. This can be problematic when upgrading to a heat pump. The very small pipe diameter means the heat pump cannot transfer water quickly enough to the radiators. If you think you have microbore pipe, speak to your installer when they come to survey your house.

Insulation

Your heat pump installer will calculate the energy required to heat your home by considering its size and the level of insulation and draught-proofing it has.
Improving the insulation of your home makes your home more comfortable and reduces your heating costs.
If your home is well insulated, each room needs less heat to stay warm, so the radiators can provide this heat using lower temperature water, allowing the heat pump to run more efficiently.
This saves energy and money in two ways: by reducing your heating requirement and increasing the efficiency of your heat pump's output.
Another benefit is that reducing your overall heating need could mean you require a smaller sized heat pump, with lower running costs and lower purchase cost than a larger heat pump.
Draught-proofing can also reduce your overall heating need by reducing heat loss through uncontrolled ventilation.
We have advice on how to reduce your home's heat loss through insulation and draught-proofing.
In some homes, increasing insulation may not be practical or cost-effective.
Insulation installers can visit your home and advise where rooms could be improved with appropriate insulation, and if you live in an older home built before 1919, or in a listed building or conservation area, we recommend speaking to insulation specialists with experience of working with these types of properties.
If you can't install insulation, or increase your radiator size, there are alternatives available. Some heat pumps are specifically designed to deliver water at a higher temperature. Your installer should be able to design a system that works for your needs. You could also consider a hybrid system.

Do I need permission to install a heat pump?

Before installing a heat pump, it's important to check if you need to apply to your local planning authority for permission. Most heat pump installations are considered 'permitted developments', meaning no permission is required. However, there are exceptions, and it's best to check with your local planning department before proceeding, especially if you live in a listed building or conservation area.

Find out more about getting permission.

You should also inform your local district network operator (DNO) that you are planning to install a heat pump. The DNO is the company responsible for bringing electricity from the network to your home. You can ask your installer to assist you with this, as they will have all the information required to complete the forms.

To find out more about the process for notifying a DNO of your heat pump installation, you can refer to the 'Connecting electric vehicles (EVs) and heat pumps' section in this guidance from the Energy Network Association.

Further guidance on registering a heat pump (as well as similar devices including solar panels, electric batteries, and electric vehicle chargepoints) in England, Scotland and Wales can be found on the UK Government website.

Getting the most out of your heat pump

Finding a good installer

We always recommend you get quotes from at least three different installers. We have more advice on getting the installation done by well qualified installers.

Controls

To ensure you're getting the highest performance from your heat pump, it's important to use your controls effectively. Depending on the controls you have, and the level of heating and hot water you need, there are different ways to get the most from your

heat pump. Setting the system controls can sometimes be confusing – more guidance can be found in our blog on getting the most out of your heat pump.

Maintenance

As with any heating system, a heat pump needs to be well maintained to operate as designed – though luckily most heat pumps tend to be easy to maintain with minimal input required from the end user.

Workmanship warranties for heat pumps can last for up to 10 years, for example, through Quality Assured National Warranties (QANW). Many manufacturers also offer options for warranty extensions for a fee.

With regular scheduled maintenance, you can expect a heat pump to operate for 15 years or more.

Typical checks include a visual inspection of the water pump, external pipes, fittings and electronics. Ground source heat pumps may also occasionally need to be re-pressurised or have the quality of the antifreeze checked, which can be done by a professional every 2-3 years.

Ask your installer for written details of any other maintenance checks you should undertake to ensure everything is working properly. You should also check any requirements under your warranty to ensure that the system remains compliant. For example, you may need to have the system serviced each year.

Electricity tariff

An electricity tariff is how your energy supplier charges you for the electricity you use. It's typically made up of a price per unit (kWh) of electricity you consume, and a daily standing charge. Because heat pumps use electricity, finding a low-cost electricity tariff can help keep your running costs low. We have more information about choosing an electricity supplier and tariff.

What kind of heat pump is right for me?

Air source heat pumps are the most common type of domestic heat pump in the UK and are suitable for many types of home.

If you have a garden or large outdoor space, you may be interested in finding out more about ground source heat pumps.

If you don't have radiators or underfloor heating, and can't or don't want to install these, you might be interested in finding out more about air-to-air heat pumps. Air-to-air systems are more commonly associated with smaller properties such as flats and park homes.

You can find more information on the differences between ASHPs and GSHPs in our blog.

Ground loop

The ground will need to be suitable for digging and accessible to machinery from a road entrance. The area will need to avoid trees, as roots will cause problems when digging trenches. The length of ground loop and trenches depend on the size of your home and the amount of heat you need.

Reference above

How big or small is the heat pump I need?

***Answer**: Generally, the bigger the house the bigger the heat pump. Depending on heat loss, property age, and room types, a 100 sq m house may need a 4kW ground source heat pump or a 5kW air source heat pump. This doubles to 8kW or 10kW respectively for 200 sq m houses.*

Type of property

The size of heat pump for new build houses is easy to calculate, because in order to comply with building regulations in the UK, properties must have certain levels of insulation. The heat loss level is calculated accurately at the design stage, and therefore the size of the heat pump is relatively easy to predict.

Calculating heat loss in older properties is more challenging, and for houses built before the turn of the century a detailed survey of the building is always required before a heat loss assessment can be undertaken.

Important questions need to be answered about:

- Insulation, property fabric, and heat loss
- Size of radiators and/or underfloor heating
- The number of rooms in the property
- The types of rooms and their uses
- The desired indoor temperature for different rooms
- Seasonal temperature fluctuations (for ASHP)

The number of different types of room is a consideration, because some rooms need to be heated more intensively than others; for example, living rooms generally need to be kept warmer than bedrooms, and bathrooms warmer still. So the number and type of

rooms add up to determine the overall heat demand of the house and therefore the size of the heat pump.

For homes in the UK, we often install heat pumps which are 4kW, 5kW, 6kW, 8kW, 10kW, or 12kW sizes. We can go bigger, of course. But this is only really needed for very large properties, shared heat pump systems, and district heating installations.

Also read: Air Source Heat Pumps & Underfloor Heating: Your Guide

Type of heat pump

The size of the heat pump differs depending on whether you choose a **ground source heat pump** or **air source heat pump**.

Ground source heat pumps

As outlined at the start of this article, a new house of roughly 100 square metres in size can install a small 4kW ground source heat pump. If you double the size of the house, you typically double the heat load and therefore the size of the heat pump. This means that a 200 square metre house would probably demand an 8kW ground source system.

If installed correctly, the output of a ground source system is quite consistent year-round. The amount of power produced by a heat pump is heavily influenced by the temperature of the energy resource; soil temperatures below 1 metre depth are relatively consistent, so the output of the heat pump doesn't vary significantly.

Reference Above

Health and safety (access and egress + Safe Isolation procedures)

2.3 General good practice for excavations and drilling There are two main types of excavation that can be used for closed loop GSHC schemes: shallow trenches and deeper boreholes. In practice, shallow trenches pose little risk to the groundwater environment, but we recommend you follow the good practice in section 3 to prevent pollution of soil and shallow groundwater. Before you start drilling a borehole (for both closed and open loop schemes) you should seek the advice of a qualified hydrogeologist to understand the geology and hydrogeology you will be drilling into in order to anticipate and mitigate any problems. When drilling a closed loop borehole there is no obligation to consult us, but it is good practice to identify the risks in advance. For open loop schemes, you require a groundwater investigation consent from us to drill and test the borehole. Further details can be found in section 4. Critical zone for low permeability grout Clay Contamination Sandstone aquifer CONCERN: migration of contamination into underlying aquifer. MITIGATION: - obtain advice from us to plan clean drilling method; - low permeability, frost resistant non shrinking grout backfill in entire borehole; GROUT 9 For water wells drilled deeper than 15m you are legally required to notify the British Geological Survey, however it is good practice to notify them for any borehole. On completion of drilling, a brief report and drilling log should be submitted to the British Geological Survey, using the form found on their website. The geological checklist below is a guide to what you need to consider for vertical schemes (horizontal schemes that do not go into an aquifer or intersect the water table are deemed to be low risk and therefore this assessment is not needed). The use and interpretation of geological data is likely to require the involvement of a specialist consultant or advisor. There are a number of documents detailing best practice for borehole construction including our Water Supply Borehole Construction and Headworks: Guide to Good Practice (EA2000). As part of your assessment of risks you should use the checklist in table 2.2 to find out if there may be problems encountered during drilling that you should consider. Where your answer is yes to any of these questions, please refer to the relevant notes As well as the geological risks of borehole construction dealt with here, you should also consider health and safety, driller competence, liability, ground conditions, stability and impact on other structures (refer

to the information sources in section 5). Table 2.2 Geological checklist Tick box Yes No A geological checklist Note Number Is the proposed scheme in a principal aquifer? 1 Is the proposed scheme likely to penetrate multiple aquifer horizons? 2 Is the proposed scheme likely to go through contaminated soil, rock or water? 3 Is the proposed scheme in an area with likely artesian conditions? 4 Is the proposed scheme in a coal mining or unworked coal area? 5 Is the proposed scheme in an area of significant evaporites or karstic conditions? 6 Note 1: You can use the WIYBY pages on our website to check aquifer designations but please note that these are the designations mapped at the surface. For installation of boreholes it is likely you may encounter several aquifer types, so you need to assess the likely sub-surface geology. Principal aquifer designations identify our aquifers with the highest resource potential, so you may need to take extra measures to prevent pollution for closed loop schemes (see section 3). An assessment of the type and resource potential of the aquifer will form part of the assessment for open loop schemes (section 4). Note 2: If you plan to drill through multiple aquifer horizons you should obtain information from geological maps and literature and seek advice from a qualified hydrogeologist so that the geological conditions can be anticipated. Drilling through multiple aquifer horizons presents risks of interconnecting aquifers of different quality, or significantly altering flow patterns. You will need to agree a drilling and grouting plan with us to ensure that the aquifers remain hydraulically separate during and after borehole completion (figure 2.2). The low permeability (aquitard) section separating the aquifer horizons should be backfilled with a non-shrinking grout of known low hydraulic conductivity (10-9 m/s or less) or grouted the entire length for a closed loop system. 10 Environment Agency: Environmental good practice guide for ground source heating and cooling Vsn 3 Note 3: See note 3 in previous section 2.2. Note 4: You also need to understand the aquifer conditions prior to excavation. If there is a risk of artesian groundwater conditions being encountered during drilling, we recommend you find an alternative location for closed loop schemes due to the risk of causing uncontrolled artesian overflow. Be aware that it can be very difficult (and costly) to control artesian groundwater pressures if appropriate precautions are not taken at the design and construction stages. Where this is not possible you will need to: • identify the risks of artesian overflow • seek advice from competent professionals such as hydrogeologists and drilling experts • contact us to discuss a drilling and grouting plan to control the artesian pressure during construction and on completion. If you have assessed the risks prior to drilling this should minimise the chance to encountering unexpected artesian flows. However if small artesian flows are inadvertently encountered, the completed borehole must be securely sealed, typically by backfilling with a non-shrinking grout mixture of low enough hydraulic conductivity (10-9 m/s or less) that any future leakage of artesian groundwater is prevented. If you allow uncontrolled artesian overflow you will be in contravention of water resources legislation, which could lead to regulatory action by us. For open loop schemes, the method of drilling and a contingency plan should be agreed with us to ensure that artesian heads can be safely controlled during and after drilling. Where the artesian pressures are too great for the abstracted water to be returned to the aquifer when also taking into account the

additional pressure of reinjection, such schemes would likely be classed as consumptive. It is possible that we would not be able to issue an abstraction licence in these circumstances because of the potential impact on other users and the water resource. For more information see section 4. Note 5: If drilling in an area that is currently being used or has been used for coal mining, a mining assessment of coal workings beneath is required using information held by the Coal Authority. The Coal Authority will be able to advise on risks related to mine gas and contaminated water in mine workings. In addition, if you are proposing to drill through coal-bearing strata or through abandoned or operational coal mine workings (this applies to all boreholes, for both open and closed loop schemes), there is a requirement to seek consent from the Coal Authority under the Coal Industry Act 1994. Current guidance on the application for permission can be obtained from the Coal Authority. Note 6: If you intend to drill boreholes through karstic rock or significant thicknesses of evaporite minerals (for example, anhydrite, gypsum or halite such as that found in the Cheshire Basin), we recommend you consult a qualified hydrogeologist in order to assess the risks and plan actions to avoid subsidence. In the German town of Staufen, significant structural damage is alleged to have occurred after closed loop boreholes allowed confined groundwater to come into contact with anhydrite layers in the German equivalent of the Mercia Mudstone. The anhydrite reacted with the water to form gypsum, causing ground swelling and heave.

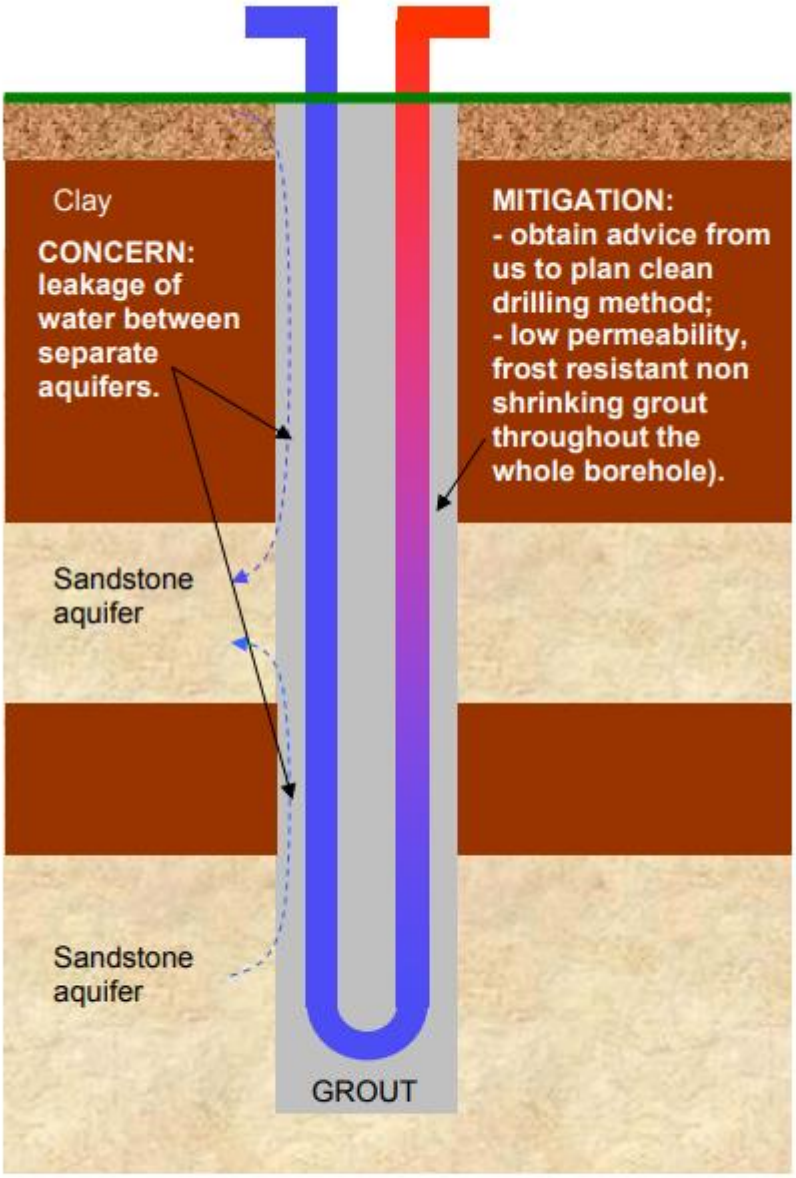


Figure 2.2 The risks associated with drilling in a multiple aquifer situation. A closed loop system installed through several aquitards (such as clay) and aquifer (such as limestone, sandstone or sand/gravel) horizons.

Reference- file://center.barking-coll.ac.uk/students/Student%20Home/20490321/Downloads/Item_13___EA_GSHC_Good_Practice_Guide_220519_151012.pdf

Specialist contractors and equipment - Key job roles and how they work

Installing a ground source heat pump (GSHP) requires specialized knowledge and equipment. Here are some specialist contractors and equipment you may need:

1. Groundwork contractors: Before installing the heat pump, you need to excavate the area where the ground loop will be installed. Groundwork contractors are responsible for this task, and they will also be involved in drilling boreholes or laying horizontal ground loops.
2. HVAC contractor: A heating, ventilation, and air conditioning (HVAC) contractor is responsible for installing the heat pump itself and connecting it to the ground loop. They will also install the ductwork or radiators needed to distribute the heat throughout your home.
3. Geotechnical engineers: These specialists will assess the soil conditions and provide recommendations on the type of ground loop to be installed. This could be a horizontal or vertical loop, depending on factors such as the size of your property and the soil type.
4. Drill rig operators: If vertical boreholes are required, you will need a drill rig operator to drill the boreholes. The rig will need to be transported to your property and set up on site.
5. Heat pump suppliers: You will need to purchase the heat pump itself, along with any necessary components such as heat exchangers, pumps, and controllers. It is important to choose a reputable supplier who can provide you with a high-quality product.
6. Thermal conductivity testing equipment: This equipment is used to measure the thermal conductivity of the soil. This is important for determining the size and type of ground loop needed for your property.

Overall, installing a ground source heat pump requires a team of specialists with a variety of skills and equipment. It is important to work with experienced professionals to ensure that the installation is completed safely and efficiently.

Reference above

What Happens During a Ground Source Heat Pump Installation?

Installers of ground source heat pumps will design and specify the equipment including the ground loops, heating capacity, location of equipment, distribution networks and the user interfaces such as room thermostats.

They will also physically install the system and let you know what is not included in the installation (especially in an existing property where things like repairing decoration work is not usually included).

Some installers are also fully qualified plumbers and may include other sanitary and plumbing installation works within the contract. The installer will also commission the ground source heat pump system and give the homeowner a handover and explain how it all works. They may also offer a maintenance package and aftercare support.

What Does a Ground Source Heat Pump Look Like When it’s Installed?

A ground source heat pump heating system would typically have a compressor and heat exchanger unit unit that sits in a plant room (these typically range is size from a bar fridge size to a tall fridge freezer size) and is then connected to at least one hot water cylinder which is around 600mm wide by around 1600mm tall.

There could also be a further cylinder (buffer tank or low loss header) around a third of the size of the hot water cylinder.

A ground source heat pump unit is sited inside the house and you may also need a controller and possibly two cylinders inside. There will also be a number of circulation pumps and pipework as well as a manifold and control box for any underfloor heating.

An example plant room in a home using a ground source heat pump from Viessmann

(opens in new tab)

. (Image credit: Viessmann)

This is all best placed in a plant room that allows enough space for the materials and pipework but also for any engineer to perform any future repairs or maintenance. By putting it all together it is easier for the engineer to see all the components in one place and also understand the circuits and controls.

Outside of the property is a ground collector system made up of long lengths of pipework that are buried in trenches around 1.5meters deep. 50 m2 of ground will need to be trenched per kilowatt capacity of the heat pump. Therefore a 12kW heat pump would typically require around 600m2 of clear ground.

How Long Does Installing a Ground Source Heat Pump Take?

Depending on the complexity of the works, a ground source heat pump unit could be installed in as little as a day, but the ground loop will take longer.

A good groundworks team could also prepare the ground loops in a couple of days but it would be usual to expect around a week for that element.

When Should You Install a Ground Source Heat Pump?

You may not have the benefit of a choice when to install the ground source heat pump but it can make a big difference to the ground works complexity and cost. The exact nature of the ground conditions can define the best time of year to excavate the ground trenches.

In wet areas, it is best to avoid the rain season as the water table could be high and cause issues with the excavation. In drier areas, the ground could be incredibly hard in summer, which could also add to the excavation cost.

How Much Will it Cost to Install a Ground Source Heat Pump?

The ground array, including a geologist report, will cost around £100 per meter

Waste management + Removal and disposal of redundant services (pipes and wires)

If you have more than 10 bags consider a load size

Soil (Per Rubble Bag)

£20.00

Item Position Note* : All items to be left outside and collected anytime during the day receive 10% discount.	○ Inside the Property Needs Dismantling (+£0.00) ◉ Inside the Property No Dismantling (+£0.00) ○ Outside the Property (+£0.00)

- 1 + Add To Cart

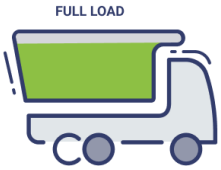
Ensure it is disconnected and completely empty

Sink

£20.00

Item Position Note* : All items to be left outside and collected anytime during the day receive 10% discount.	○ Inside the Property Needs Dismantling (+£0.00) ○ Inside the Property No Dismantling (+£0.00) ○ Outside the Property (+£0.00)

- 1 + Add To Cart



– Bigger than most skips
– Includes labour for 75 minutes
– Equivalent space to 32 washing machines
– Max. weight limit 1000kg

Full Load / Large Load

£350.00

Our full load capacity 20 cubic yards

Item Position Note* : All items to be left outside and collected anytime during the day receive 10% discount.	○ Inside the Property Needs Dismantling (+£18.00) ○ Inside the Property No Dismantling (+£6.00) ○ Outside the Property (+£0.00)

- 1 + Add To Cart

[Reference above]

Waste Electrical and Electronic Equipment recycling (WEEE)

Introduction

Recycling of WEEE is a specialist part of the waste and recycling industry. It is a rapidly growing sub-sector due largely to the implementation of the original WEEE Directive in the UK by the WEEE Regulations 2006, With that came the associated requirements for the recovery, reuse, recycling and treatment of WEEE. The Waste Electric and Electronic Equipment (WEEE) Regulations 2013 ("the Regulations") became law in the UK on the 1st of January 2014 and replaced the 2006 Regulations. The new Regulations transpose the main provisions of Directive 2012/19/EU on WEEE which recasts the previous Directive 2002/96/EC. These regulations also provide for a wider range of products to be covered by the Directive with effect from 1st January 2019.

Further information on the WEEE Regulations 2013 can be found in the Government Guidance Notes (PDF) produced by the Department for Innovation and Skills.

Every year an estimated 2 million tonnes of WEEE items are discarded by householders and companies in the UK. WEEE includes most products that have a plug or need a battery. There are ten broad categories of WEEE currently outlined within the Regulations (see Schedules 1 and 2 of the Regulations), namely:

- Large household appliances - eg fridges, cookers, microwaves, washing machines and dishwashers
- Small household appliances – eg vacuum cleaners, irons, toasters and clocks
- IT and telecommunications equipment – eg personal computers, copying equipment, telephones and pocket calculators
- Consumer equipment – eg radios, televisions, hi-fi equipment, camcorders and musical instruments

- Lighting equipment – eg straight and compact fluorescent tubes and high intensity discharge lamps
- Electrical and electronic tools – eg drills, saws and sewing machines, electric lawnmowers
- Toys, leisure and sports equipment – eg electric trains, games consoles and running machines
- Medical devices – eg (non infected) dialysis machines, analysers, medical freezers and cardiology equipment
- Monitoring and control equipment - eg smoke detectors, thermostats and heating regulators
- Automatic dispensers – eg hot drinks dispensers and money dispensers

The scope of the Regulations will be extended from January 2019 to cover further categories of electric and electronic equipment (EEE) (see Schedules 3 and 4 of the Regulations for more information)

Treatment of WEEE

Large household appliances (eg ovens, fridges, washing machines) currently make up over 40% of WEEE but there are large volumes of other equipment such as IT equipment (mainly computers), TVs (over two million discarded each year), small household appliances (eg kettles and hair dryers), electrical tools, digital watches, electronic toys and medical devices.

Such items contain a wide variety of materials, eg an average TV contains 6% metal and 50% glass, whereas a cooker is 89% metal and only 6% glass. Other materials found include plastics, ceramics and precious metals.

As a result of this complex mix of product types and materials, some of which are hazardous (including arsenic, cadmium, lead and mercury and certain flame retardants) WEEE recycling poses a number of health risks that need to be adequately managed. For example, exposure to substances released during processing (such as mercury released from fluorescent tubes, lead and phosphorous pentachloride as a result of breaking cathode ray tubes).

It is important to stress that if effective measures are taken to control exposure to mercury and lead then normally the control of exposure to other hazardous substances should also be adequate.

The exact treatment of WEEE can vary enormously according to the category of WEEE and technology that is used. Some treatment facilities utilise large-scale shredding technologies, whilst other use a disassembly process, which can be manual, automated or a combination of both.

For disassembly operations, treatment facilities should comply with the minimum requirements specified in the DEFRA document Guidance on Best Available Treatment Recovery and Recycling Techniques (BATRRT) and treatment of Waste Electrical and Electronic Equipment (WEEE) (PDF) . This provides a useful overview of the standards for treatment, recycling and recovery of materials from WEEE. It outlines the requirements for the removal of certain substances and components (see Guidance on Specific Substances/Components below).

For shredding operations, treatment facilities may not be required to remove these components and substances. This is dependent on the size and type of technology used, although some hazardous components and substances must be removed in advance to avoid risks to health and safety and damage to equipment.

The Waste Resources Action Programme (WRAP) have made available online good practice guidance on the collection

of WEEE

and processing of WEEE (including sections on treatment of WEEE and health and safety policies and procedures) directed at different audiences including AATFs and waste management companies which inspectors may find useful.

Guidance on specific substances/components

The following summary is based largely on the DEFRA document Guidance on Best Available Treatment Recovery and Recycling Techniques (BATRRT) and treatment of Waste Electrical and Electronic Equipment (WEEE) (PDF) .

Fluids - these are typically found in heating and cooling appliances, such as fridges and freezers (coolant circuit) and oil-filled radiators. The WEEE Directive requires the removal of all fluids from WEEE. Fluids must be safely removed prior to crushing or shredding operations. Cooling appliances containing refrigerants (fridges and freezers) – most refrigerators reaching the waste stream are between 10 and 15 years old and are therefore

likely to contain Ozone Depleting Substances (ODS) (eg CFCs and HCFCs). Units manufactured after 1994 are unlikely to contain CFCs.

Fridges and freezers identified as containing ammonia must have their ammonia extracted and transferred to a suitable container pending disposal. As well as presenting a fire and explosion risk, ammonia is potentially hazardous to both the environment and human health.

Capacitors containing polychlorinated biphenyls (PCBs) - Historically PCBs were used extensively in electrical equipment such as capacitors and transformers. However, their use in open applications was widely banned in 1972 and they have not been used in the manufacture of new equipment since 1986. Plants that had been installed prior to 1986 were allowed to continue until the end of their working life. Thus it should be assumed that capacitors manufactured before 1976 contain PCBs. However, unless an appliance is more that 20 years old the chance that it contains capacitors containing PCBs is very remote. All uses of PCBs were to be phased out by the year 2000. For guidance re capacitors containing polychlorinated biphenyls see "Do you know how to work safely with PCBs?

Mercury containing components such as switches or back-lighting

Mercury is used in fluorescent lamps, medical equipment, data transmission, telecommunications and mobile phones. Its use in electrical and electronic equipment has declined significantly in recent years and its use is banned (save certain exempt uses) from 2006. Apart from batteries, most other mercury containing items are likely to be found on a circuit board. Thus removing the circuit board would result in removal of most mercury containing competent such as switches.

Increasing numbers of non-CRT flat panel screens (such as liquid crystal display (LCD), laptop and desk top monitors and plasma screens) are entering the waste stream and requiring specialist treatment. In 2010, an estimated 9 million flat screens were likely to have been sold. Whilst evidence suggests that since the mid-2009 there is a switch to LED backlit screens this is relatively slow and the use of backlights containing mercury will continue. It is considered that there will over 145,000 tonnes of flat panel displays in the waste stream by 2016/17. One of the main issues surrounding the treatment and recovery of flat panels at end of life is the presence of mercury containing fluorescent backlights required in particular to illuminate the LCD, laptop and desk top monitor screens from behind (NB: plasma screens do not present the same hazard). Manufacturers declare an average of 3.5mg of mercury per backlight and the average 37" television can have up to 18 lamps but research suggests this

value is often higher. The current main option for treatment is manual disassembly to remove the mercury containing backlights for specialist treatment and the separation of the remaining material streams. This has high labour costs and potential health and safety implications. For further information see WRAP report on flat panel display recycling technologies.

Toner cartridges, liquid and paste, as well as colour toner – commonly found in printers, fax machines and photocopiers. These should be removed whole and intact so as to prevent the dispersal of toner and then stored in suitable labelled containers.

Asbestos waste and components which contain asbestos – asbestos has been used in older appliances such as electric coffee pots, toasters and irons. Asbestos was also a component of some electric heaters and other items that benefited from the heat resistant properties of the material. Modern appliances are not permitted to contain asbestos; however, operators of treatment facilities need to be vigilant for items which might contain asbestos. Appliances that are over 20 years old might contain asbestos and therefore should be examined carefully and treated accordingly. Detailed risk assessment, training and safe systems of work will be required for handling products likely to contain asbestos. Work should be organised so that materials likely to contain asbestos are identified and work not initiated without adequate controls being taken in accordance with Control of Asbestos at Work Regulations 2006.

Lead and other substances including phosphorous pentachloride in CRTs – lead and other substances hazardous to health such as phosphorous pentachloride can be liberated during the processing of the glass to remove the fluorescent coating.

Components containing refractory ceramic fibres (RCFs) – mainly used in furnace/heater/kiln linings. Respirable RCFs are classified as category 2 carcinogen. Although RCFs may be used in both domestic appliances and building heating appliances, the insulation material used in domestic electrical appliances are more likely to contain components based on mineral wools rather than RCFs. Appliances which might contain RCFs must be examined to determine if they contain RCFs and appropriate controls put in place before they are removed (see further guidance on RCFs).

Components containing radioactive substances – can be found in a variety of equipment in many commercial settings (eg fill level detectors, static eliminators, radium luminised dials, old trim phones) as well as smoke detectors.

Other hazards associated with WEEE recycling

- Machinery safety – some WEEE recycling plants use a wide variety of machinery/equipment as materials are treated including crushing, grinding, conveying, baling, compacting and palletising machines.
- MSDs – from manual handling – some WEEE items, white goods (fridges/freezers) in particular, can be heavy, but even some TVs can weigh in excess of 25kg.
- WRULDS – from repetitive movements to remove wiring looms for example
- Cuts and abrasion risks etc – from use of such items as knives used to remove antibreak coatings on florescent lamps, sharp edges on items as they are being dismantled, or if broken.
- Stacking of items of WEEE – white goods (stability of stacks - eg no more than three times the height of the minimum base dimension as a rule of thumb)
- Electrical safety – in particular if any element of refurbishment is being carried out consider electrical testing issues.
- Fire and explosion risks – eg hydrocarbons and ammonia in fridges and freezers; polystyrene (eg polystyrene can be found in fridges/freezers as an insulator and is commonly used packaging material. The pentane within the polystyrene is flammable); batteries (removed batteries from WEEE products should be stored in appropriately labelled containers having due regard to the potential fire risk they can present).

Environmental benefits + Carbon neutral technology + Energy Efficiency

BENEFITS OF INSTALLING A HEAT PUMP

What are the main benefits of heat pumps?

There are many benefits, both financial and environmental, associated with heat pump installations which are the reason heat pump systems have become very popular over the last decade or so. They can be used to heat or cool space through radiators, air convectors and under floor heating systems, and can also be used to heat water for general use in your home.

Heat Pumps provide heating and cooling.

Heat pumps can provide space heating and space cooling at the touch of a button using a wall monitor, a remote or even a phone app. This heating or cooling can be provided very quickly due to the nature of their design. When installed to the right specifications and in the correct manner they provide very effective control over room temperature, are very quick to heat or cool a space and then sustain the desired temperature.

Heat Pumps have very high energy efficiency ratings.

Heat pumps are currently the most cost-effective form of heating using electricity, achieving an average COP (Coefficient of Performance) figures of 2.5 or more (sometimes in excess of 4), meaning that to achieve 2.5 kilowatts of heating or cooling power, they use an average of less than one kilowatt of electricity! To put this into perspective, a conventional heating system such as an electric fire or gas boiler generally has a COP of less than one, so more than one kilowatt of power is used to generate one kilowatt of heat power. This makes a heat pump system cheap to run and will also most likely lower your carbon footprint. Generally speaking, a heat pump system can be 200% – 400% efficient. This makes a heat pump system one of the cheapest ways to heat your property.

Heat Pumps have great financial benefits.

A heat pump will most likely save you a lot of money on your annual fuel bills due to its very high energy efficiency ratings. The initial outlay can be daunting and although they have been shown to add value to your property, it's often a good idea to look at a theoretical pay-back-period. If you don't see yourself staying at the property or if you are in old age, it may be more cost effective to stay with your current heating system. Do take into consideration the other benefits of a heat pump system though.

Heat Pump systems are likely to substantially lower your carbon footprint.

Due to the fact that a heat pump doesn't directly use combustion to generate heat (heat pumps do not burn anything), there are no carbon emissions other than those created at the point of the electricity's production and only a small amount of electricity is needed to run the compressor. This makes a heat pump an extremely eco-friendly space heating / cooling technology. Heat pumps are also more environmentally friendly than ever, as they now use R410A refrigerant which does not harm the ozone layer if released.

A heat pump will help prevent condensation.

If you decide to use your heat pump for cooling in the summer, then your room will be automatically dehumidified as a function of the heat pump. In the winter the warm air that's circulated around your property by your heat pump will also serve to reduce condensation.

Heat pumps help improve your home's air quality.

As heat pumps don’t burn anything to create heat, they don’t produce any smoke or add fumes to the air. As your heat pump circulates the air in your room, the filters clean and purify the air removing dust, mould spores, odours, smoke, and other particles. This makes them excellent for people that suffer from asthma and allergies.

Heat Pump Efficiencies (COP)

System efficiencies vary between installations and the parts used. Your property’s energy efficiency is also a hugely important factor to consider when calculating potential system efficiencies.

The efficiency (coefficient of performance or COP – sometimes CP) of the system itself (the ratio between the electricity invested in order to run the heat pump and the pump’s output) varies between the types of system used.

Ground source heat pumps tend to have an efficiency of between 2.5 and 3 (that is, 3 units of heat generated per unit of power needed to drive the system). Air source heat pumps can be slightly less efficient, with an average efficiency of between 1.5 and 3. However it must be noted that these figures are increasing as technologies advance, and it is likely that manufacturer’s claims on a products’ COP will be very much a ‘best case scenario’.

System efficiency is dependent on other factors, however, such as the quality of the installation, the system owner’s competency in maximising the system output, and the property’s energy needs and efficiency.

Coefficient of performance (COP) Heating Equation

Q = **Heat supplied to the exchanger from the ground or water source**

W = **Work consumed by the heat pump**

$$COP_{heating} = \frac{|Q_H|}{W} = \frac{|Q_C| + W}{W}$$

Financial Savings Offered by Heat Pumps

It is very difficult to calculate the precise savings offered by air and ground source heat pumps given the huge range of factors.

The savings offered by heat pumps depend on the following factors:

- Your property's RHI eligibility (the RHI has now closed to new applicants and been replaced by the Boiler Upgrade Scheme)
- Your current heating source (oil, LPG, etc)
- Your property's specifications and available outside space
- Its energy efficiency
- Your energy consumption
- Cost of system installation and parts, based on its size and quality
- Type of system installed (i.e. air or ground source)

The table below gives you a rough idea of the amount of money you could save by installing air or ground source heat pumps. It should be kept in mind, however that the huge number of variables involved makes an accurate projection of costs and savings difficult.

System type	System cost**	Energy source being replaced	Annual saving***	Break-even point
Air source	£8,250	Oil	£236	15 years
Air source	£8,250	Liquid gas	£285	13 years
Ground source	£10,750	Oil	£200	17 years
Ground source	£10,750	Liquid gas	£247	16 years

* These figures assume that a property has loft and wall cavity insulation and double glazed windows. They assume that the property has two floors, around 90 square meters of floor area, and, in the case of ground source heat pumps, around 180 square meters of available outside space for the installation of tubing.

** These figures assumed that the property was eligible for the RHPP one-off voucher at the time. The Renewable Heat Premium Payment and the Renewable Heat Incentive are no longer available. The RHI has been replaced by the Boiler Upgrade Scheme.

NB. The figures for annual savings exclude payments received from the RHI, which have since come into effect. The annual saving/profit will be significantly higher and the break-even point lower now that the RHI scheme is running (the RHI scheme is no longer available and has been replaced by the Boiler Upgrade Scheme).

reference

Financial benefits + Rough costs of different systems/components and technologies
How systems/components and technologies impact building performance

MASTERTHERM AQUAMASTER 5-12KW KIT

REF: MTAQ30IBS

ITEM CONTENTS

- 1 x MasterTherm pGDx Touch Screen (1OPGDXSM)
- 1 x 100l Mild Steel Buffer - Soft (TEHSS100)
- 1 x Robokit 1/2" Sealed Kit (8-80l) (CA-900000)
- 1 x Reflex Heating Expansion Vessel 25l (HV25C)
- 1 x Heat Pump 3 Port Diverter 28mm (TED28)
- 1 x ESBE VTA323 35-60°C 20-1 (31100200)
- 1 x MasterTherm Electric Meter 25a (1OEM25AMID)
- 1 x DirtMAG IQ Plus 28mm (545353LTC)
- 1 x Wilo-Yonos PICO 25/1-6-130 (4215516)
- 1 x MasterTherm pGDx Internet (1OICON)
- 1 x Cyclone Heat Pump and Solar 250l (CYHP250S)
- 1 x MasterTherm AQ Inverter 5-12kW (3AQ30I1)
- 5 x Lever Ball Valve - 28mm (ER-28MMBV)

Reference above

1.3.2 Mechanical installation The inner unit of the Heat Pump should be located in a detached room – a machinery room. In the case the room is next to protected areas (bedroom, children rooms etc.), the wall between must be made as sound-proof, minimum sound reduction of 30dBA. It is also not recommended to install fixtures of piping system or circulating pumps etc. on the dividing wall. Make sure to always check the noise values of heat pumps in the catalogue sheets and verify the installation area for acoustically protected areas. Always check the load capacity compared with the unit weight. If necessary, build a concrete base. Do not position the units on light structures as floor heating etc. Do not position the Heat Pumps in higher floors of the building, we recommend installation in the lowest floor – on solid ground. Installation in higher floors can cause transfer of vibrations to the heated building. The units have adjustable legs which allow for balancing of minor uneveness and inclination (up to 20 mm) of the floor

Reference above

Inner unit of heat pump shall be installed in the plant room

Benefits of using a ground source heat pump

Because the ground temperature is relatively consistent throughout the year there are numerous benefits to using a ground source heat pump heating system:

- **Your fuel costs may be reduced, particularly if replacing heat by direct electric, LPG, coal or oil**
- **You could earn income from the Government's Renewable Heat Incentive**
- **Reduced carbon emissions**
- **Provides hot water and heat for your property**
- **No need for fuel deliveries**
- **Reduction in annual maintenance costs**

How much does a GSHP cost and save?

Ground source heat pumps can be expensive to install initially but they can also offer considerable savings in the long term.

System costs

The cost of a ground source heat pump will depend on several factors, such as the property, its location and the ground loop system chosen. A horizontal trench system would cost less to install than a vertical one as boreholes require specialist equipment. However, a ground trench system may not always be feasible as it is dependent on suitable land space and ground conditions.

The average cost of a GSHP pump with installation is estimated at around £18,000 according to installations registered on our job registration system.

Potential savings

The Coefficient of Performance (COP) of your GSHP will determine what you will save on your heating bill. The COP is a measure of the efficiency of the heat pump. For instance, if the GSHP has a COP of 4, then it will output 4kW of heat for every 1kW of electricity consumed by the heat pump.

Installation costs

Extensive excavation work may be required for the installation of a GSHP. Trenches or boreholes will have to be dug for the heat pump loops, which can be buried either horizontally in a shallow channel (between 1m-2m deep), or vertically in a borehole (at a depth ranging from 15m to 120m).

Depending on the local geology, drilling and lining a borehole for the GSHP could cost in the range of £60 to £100 per metre. *[1]

Grants & financial support

Domestic Renewable Heat Incentive

If you install a ground source heat pump, then you may be eligible to receive regular cash payments for the heat you generate over seven years through the Renewable Heat Incentive (RHI), the UK Government scheme to encourage the uptake of renewable heat technologies.

Please note, the DRHI is now closed to new applications.

Boiler Upgrade Scheme

Recently, Government has announced plans for a new initiative known as the Boiler Upgrade Scheme which looks to reduce the cost of low carbon heating technologies, such as heat pumps, so that they are more affordable for consumers to buy and run. As part of the Scheme, a £6,000 grant will be available for ground source heat pumps for those who meet the eligibility requirements. Find out more here.

How efficient are ground source heat pumps?

The efficiency of a ground source heat pump system will depend on the quality and design of the installation. However, modern ground source heat pumps can be very efficient and may deliver between three to four kilowatts of heat to the property for every kilowatt of electricity used to power the pump.

What to consider?

There are several factors to consider when thinking about having a ground source heat pump installed:

- Although the grounds of your property don't necessarily need to be large, the land would have to be accessible for specialist digging equipment and suitable for a trench to be dug or borehole drilled.
- Ground source heat pumps work best in a well-insulated property as they generate heat at a lower temperature than traditional boilers.
- If you're replacing an electricity or coal heating system then a ground source heat pump should deliver significant savings, particularly if the property is well insulated. If you currently use mains gas then switching to a GSHP may not be the best option.

- **If you have an underfloor heating or a warm air heating system, rather than radiators, then a ground source heat pump will perform much more efficiently due to the lower temperatures needed.**
- **If the property that you are installing the ground source heat pump into is a new development then you will be able to reduce the cost of installation by combining it with other building work. The property can also be designed to higher insulation values, making the GSHP more efficient.**

Reference for above

Laws or regulations associated with the installation and maintenance

In the United Kingdom, the installation and maintenance of ground source heat pumps are subject to a number of laws and regulations, including:

1. Planning Permission: In some cases, planning permission may be required before installing a ground source heat pump. This is particularly true for large-scale installations or those that may have an impact on the surrounding landscape or environment.
2. Building Regulations: Ground source heat pump installations must comply with the Building Regulations 2010, which cover a wide range of building-related issues including energy efficiency, safety, and ventilation.
3. Microgeneration Certification Scheme: The Microgeneration Certification Scheme (MCS) is a certification scheme for renewable energy technologies, including ground source heat pumps. Installers must be certified under the MCS in order to access government incentives such as the Renewable Heat Incentive.
4. Health and Safety Regulations: The installation and maintenance of ground source heat pumps must comply with the Health and Safety at Work etc. Act 1974, which sets out general health and safety duties for employers and employees.
5. Environmental Protection Regulations: The installation and maintenance of ground source heat pumps must comply with a range of environmental protection regulations, including the Environmental Permitting Regulations and the Control of Pollution (Oil Storage) Regulations.
6. Standards: Ground source heat pumps must meet certain standards, including the EN 15827 standard for heat pumps and the MCS 012 standard for the installation of ground source heat pumps.

Overall, it is important to work with a certified and reputable installer to ensure that your ground source heat pump installation complies with all applicable laws and regulations in the United Kingdom.

Information retrieved from this website (not copied)

Advantages and disadvantages

Pros and Cons of Ground Source Heat Pumps

Are Ground Source Heat Pumps Worth It?

Ground source heat pumps are excellent low carbon heating systems that are popular due to their high efficiency rate and low running costs, therefore they can definitely be worth it. A **ground source heat pump** makes use of the ground's constant temperature and uses that to heat up your home; either for space and/or domestic water heating.

Once installed, there are very few running costs, and as this type, among various **heat pumps**, is eligible for the **Renewable Heat Incentive**, you can actually earn a bit of additional income on the side. However, the initial price of a ground source heat pump is high, which can turn some homeowners away.

Heat pumps play an important role in reducing the UK's overall carbon emissions. There are currently 240,000 units installed, and to help reach the UK's 2050 Net Zero goals, an additional 19 million heat pumps need to be installed. By investing in a ground source heat pump you can help achieve that goal, though it is important to research the system to determine if it is the right solution for your specific home.

Advantages of Ground Source Heat Pumps

- Low running costs
- Energy efficient
- Low carbon heating
- Provides cooling and heating
- Eligible for grants
- Constant and inexhaustible
- Virtually silent
- Increases property value

Disadvantages of Ground Source Heat Pumps

- High installation costs
- Efficiency affected by soil type
- Tricky to install in retrofits

What Are the Advantages of GSHPs?

The following list comprises what we consider are some of the most outstanding advantages of GSHP:

- Low running costs – Their **running costs of heat pumps** are very low compared to those of direct electric heating systems. That is due to the fact that the only basic element of a simple GSHP that requires the use of electric energy is the compressor.
- Energy-efficient – In fact, the energy output is roughly 3-4 times greater than the energy that is required to run them.
- Low carbon heating system – They don't produce carbon emissions on site and don't involve the use of any fuels, and are therefore a good choice if you're looking for **low carbon heating solutions**. Additionally, if a sustainable source of electricity is used to power them, such as **solar panels**, they don't produce carbon emissions at all.
- Provides both cooling and heating – Unlike air conditioners, which demand the use of a furnace for heating. That is achieved by means of a reversing valve that changes the direction of circulation of the fluid.
- Eligible for grants – GSHPs are eligible for green energy grants, including the **RHI** and the more recent **Green Homes Grant**. By making use of grants, you can lower installation and/or running costs, making it an even more attractive investment.
- Constant and inexhaustible – Ground heat is usually constant and inexhaustible (there are almost no fluctuations in its capability for heating and cooling), is available worldwide and has a massive potential (estimated at 2 terawatts).
- Virtually silent – GSHPs are silent runners, so you or your neighbours will not be bothered by a **noisy heat pump** unit.
- Increases property value – If the GSHP installation is well designed, it will increase the value of your property, making it a great **home improvement option** for your home.

What Are the Disadvantages of GSHPs?

The list below shows the probably most concerning disadvantages related to GSHP

- High installation costs – The installation costs of a GSHP are considerably higher than the costs of installing a traditional furnace and air conditioner. That requires a quite expensive initial investment. However, there are grants available to you that can help lower the installation costs.
- Efficiency affected by soil type – Though GSHPs can be installed in either sandy or clay soil, sandy soil will reduce the efficiency slightly. That being said, your installer will be able to assess this and implement the necessary components to maximise efficiency for your specific property.
- Tricky to install in retrofits – GSHPs are most common for new-builds, as it can be a bit tricky to install in existing builds. If a property does not have a large enough garden, then a vertical **ground source heat pump borehole** can be installed instead, though this is more costly than a horizontal system.

Reference above

Local wildlife

The construction industry is considered to be among the most resource-hungry and environmentally-detrimental sectors globally. It might seem strange for us to be writing about such a subject, but Birketts Bogmat's takes it's responsibility seriously which is how the concept of bog mats came about, not only to make construction sites easier to travel around, but to preserve and protect the ground and therefore the wildlife. This is also why we only use sustainable timber that is sourced responsibly.

Global statistics indicate that the construction sector makes up more than 40% of raw resources net flow in the economy. This percentage amounts to more than 3 billion cubic tons of raw materials in the world. The industry also contributes to 9% of the global GDP and is used as an indicator of economic conditions frequently.

It is essential to note that the construction industry directly affects wildlife due to its reliance on ecology for the most significant art of raw materials. Various categories of construction that directly impact biodiversity and wildlife include civil infrastructure development, industrial and commercial developments, and projects that deal with housing developments. All these aspects point to the need to balance construction and wildlife preservation.

Since the construction industry depends so much on biodiversity, it can be concluded that biodiversity plays a significant role in the sector of construction. Industry honchos must emphasize construction plans and designs that minimize adverse effects on wildlife. Additionally, they have to consider the fact that the industry relies so much on biodiversity hence the need to

tweak their strategies accordingly. The following section shows how the industry affects wildlife and what can be done to enhance wildlife preservation.

Onsite Disturbance to Wildlife

Construction processes and activities can sometimes pose significant threats to wildlife preservation, especially at the sites of construction. For instance, construction requires land, and this can have a direct effect on wildlife habitat. Additionally, the noise produced during construction activities can sometimes lead to alteration of breeding and feeding patterns. The species that are mostly affected by noise include badgers, bats, great crested newts, and birds.

The site and nature of construction processes and activities should be selected after weighing the impact of these activities on plant and animal lives. Wildlife preservation at construction sites must be organized in a way that identifies wildlife species and formulating the construction plans accordingly. For instance, the use of bog mats help to preserve wildlife and protect the ground underneath them.

Other strategies should be focused on isolating species based on the following criteria:

- Identification of areas where the most vulnerable species are found.
- Identification of habitats where species require a large area of land.
- Identification of areas where species with low reproductive rates are found.
- Setting standards that enhance the preservation of wildlife.

Off-site Disturbances to Wildlife

Wildlife preservation at the sites of construction should consider all other off-site activities that affect wildlife. Some of these activities may include:

- **Air, land, and water pollution:** These essential resources support wildlife and polluting them directly proves detrimental to the ecology.
- **Disturbances:** Construction processes and activities have a direct effect on wildlife.
- **Vandalism and risks of fire:** Almost all construction works and activities pose the risk of destruction of natural habitats, which represent a lot of stress on wildlife. Additionally, there are always risks of fire, and this can be a significant challenge for wildlife preservation.
- **Subsequent developments:** Road constructions and any other form of the ancillary structure pose a significant danger to wildlife. Such activities can sometimes skewer natural habitats and have adverse effects on wildlife.

Avoiding Sensitive Areas for Construction

The best way to ensure wildlife preservation in the construction industry is by avoiding the following areas:

- Places that would lead to complete loss of natural habitat or total damage to the distribution and abundance of individual species.
- Areas that are likely to create an ecological imbalance and possible loss of wildlife.
- Areas in which construction processes and activities would have negative impacts on the quality of wildlife and decrease its ability to support breeding, migration, and genetic exchange of species.
- Locations that can be easily fragmented by construction processes and activities, leading to barriers between the fragments.

Restoring and Enhancing Wildlife Habitats

The need of the hour is to establish and implement measures that eliminate or reduce the adverse effects of construction on wildlife. The following method should shed some light on the actions that can be taken to enhance wildlife preservation in the construction industry:

- Restoring and linking existing wildlife habitat and land aspects that support wildlife. Construction activities should be aimed at retaining existing habitats to preserve and save ecological strips.
- Compensating for the damage caused to wildlife habitats by recreating features, restoring, and developing the existing landscape to support wildlife. Additionally, relocating wildlife to better habitats is necessary if the existing ones are damaged.
- Managing the existing habitat to ensure that the landscapes are in the best condition to support plant and animal lives.
- Monitoring the measures listed above to ensure better wildlife preservation at construction sites.

Reference above

Non Concussive taps

Non-concussive, self closing push taps for washrooms

Our range of push taps includes cheaper, more basic forms of non-concussive taps as well as those with a more modern and contemporary style. Their automatic shut off function makes them a more environmentally friendly option than lever taps as they eliminate the possibility of water being left running.

We stock self-closing taps from leading manufacturers such as Bristan, Intatec, Franke, Delabie and Armitage Shanks. All available from stock for fast delivery. You can choose from deck or wall mounted push taps to suit your specific washroom requirements. Our complimentary range of basins and wash troughs make us an ideal partner for the supply of all your washroom products.

Non-concussive taps are available in a variety of finishes, including chrome and stainless steel. The use of non-concussive basin taps is vast as they're easy to use and limit water wastage; they can be found in any commercial washroom environment including office toilets, schools, public washrooms and anywhere that may experience a risk of water left running.

Many common questions and general advice on commercial taps and TMVs can be found by reading our blog. Of particular relevance is the questions and information on Washroom Taps.Can't find the non-concussive tap you're looking for? Contact us today and we'll do our best to help you find the right product for your needs.

Our products can be purchased easily and quickly online or by talking to our experienced sales team for a rapid project supported quote. If you're looking to refurbish your bathroom facilities, we offer a full supply and fit service to bring your washroom project to life!

FAQs

What is a non-concussive tap?

Non-concussive taps (also known as self-closing taps and push-down taps) are types of taps which deliver a timed flow of water once pressed down. Once the set time is reached, they self close, stopping the flow of water.

Can you adjust non-concussive taps?

Yes, you can easily adjust many non-concussive taps to control the run time of the water flow. Typically, this can be done by locating the time variable control hole and using a screw to adjust the time delay but how you adjust self-closing taps varies across brands and models. Push taps that do not allow you to alter the flow duration should be labelled as non-adjustable, so make sure you check the product description.

How do non-concussive taps work?

When non con-concussive basin taps are pressed, water will flow for a specified amount of time. These are self-closing taps, which means that once the water flow is switched off, the top of the tap will gradually move back up into its original position.

How do you clean a self-closing tap?

You can clean your self-closing tap with a soft damp cloth. If your taps are stained, you can try to remove these with washing up liquid. Please bear in mind that some bathroom cleaning products can damage the surface of the taps.You should avoid using abrasive cleaning solutions and scrub pads. If your washroom is located in a hard water area, you should aim to get your taps serviced regularly.

Which non-concussive mixer tap is right for me?

Here are some things for you to consider when choosing the right push taps:

- **What is your budget? Your budget for refurbishing your washroom will inevitably impact your decision.**
- **What style is your bathroom? We sell both traditional and modern styled non-concussive taps.**
- **How much available space do you have by your basins? You can choose from deck mounted and wall mounted push taps.**
- **Do you want to control the water flow time? Many non-concussive taps will allow you to adjust the timing for the water flow, whereas some push taps will specify their flow time. Either way, non-concussive taps are self-closing**

and will prevent users from leaving taps running or using more water than needed.

What are the benefits of non-concussive mixer taps?

Self-closing taps are ideal for many commercial washrooms for the following reasons:

- **They turn off automatically which helps to reduce water waste and expenses attached to water usage as well as minimising the risk of flooding.**
- **They're easy to use - users simply need to push down on the taps.**
- **They're often constructed from solid brass and finished in chrome which makes them robust and easy to clean.**
- **You can choose between wall mounted taps and deck mounted push taps to suit your washroom space.**
- **They can be a more affordable option to sensor taps which also feature automatic shut off functions**

Bristan Single Pillar Basin Soft Touch Timed Flow Tap (with flow regulator) £57.00 (£68.40 inc. VAT)

Reference above

Low-volume flush WCs

Executive Summary

A low-flush or low-flow toilet is a flush toilet that is adapted in order to use significantly less water than a full-flush toilet. Low-flush toilets use a special design of the cistern and the siphon in order to allow the removal of faeces and excreta with less water. Most often, they also include a dual flush system, with one flush being designed for urine only, using even less water than the other designed for faeces. Today, there exist many suppliers of different models of low-flush toilets all over the world. Low-flush toilets reduce the water consumption, however, low-flush toilet still require large amounts of fresh water and with certain models, users have to flush even twice in order to achieve the complete removal of faeces from the bowl.

Advantages

Ultra-low-flow toilets reduce water consumption and costs to the consumer

They contribute to preserving the environment by protecting ground water from depletion and possible contamination

Easy to use and clean

Disadvantages

Some ultra-low-flow models may require flushing more than once to adequately clean the toilet bowl

Risk of clogging/plugging

It still requires a constant source of water, it will not function without it

Basic Design Principles

Factsheet Block Body

Low-flush toilets work with a very small amount of water. The exact amount of water varies between less than a litre (for urine only) up to 6 or 8 litres. These toilets can operate by gravity or vacuum. You can read more on vacuum toilets here. Gravity toilets have special requirements regarding the slope of the pipe. Large water savings are thus possible, which even facilitate the source separation of greywater and blackwater. If the gradient to the public sewer systems is steep enough, low-flush toilets can also be retrofitted into existing buildings. However, there is a risk of pipe clogging (HEEB et al. 2007).

In some cases, the volume of water used per flush is not sufficient to empty the bowl and consequently the user is forced to use two or more flushes to adequately clean the bowl, which negates the intended water saving (TILLEY 2014). Thus, many users were

disappointed and frustrated with performance problems of the first generation of low-flush toilets. Since then, the manufacturers have solved these problems by modifying passageways to move a reduced amount of water more vigorously around the bowl. To make these toilets even more efficient, dual-low-flush toilets where developed. This type of toilet saves water by offering different flush volumes: a full-flush for solids (faeces) and a half-flush for liquids (urine) (JCSA n.y.).

With a toilet dual flush button, users have the possibility to choose between two volumes either for solids or for liquids. Source: ROUS WATER (2011)

Nowadays, products vary in that they may have narrower bowls with a smaller water surface, manually controlled water flow (via a foot pedal) into the bowl, or water pumps to assist in bowl emptying and cleaning. One model eliminates the "S" trap of a conventional

toilet design, enabling waste to be washed down using less water. Another product flushes by opening a hinged flap to let wastes and a small amount of water fall into a lower chamber. After several seconds the flap reseals, and a blast of compressed air forces the wastewater over the trap and out a discharge line from the toilet (PIPELINE 2000).

Drain Lines

Factsheet Block Body

There are discussions about the performance of low-flush toilets to transport the waste trough the building drains to the public sewer system. As already mentioned, there is a risk of pipe clogging. Especially in older buildings, drain lines (slope, diameter, length) were designed for common flush toilets. More information and researches can be found in the document “Evaluation of Low-Flush-Volume Toilet Technologies to Carry Waste in Drain lines” (GAULEY and KOELLER 2005).

This low-flush toilet from Microphor in Willits, California, uses approximately 4.8 litres of water per flush. Source: PIPELINE (2000)

Reuse of Faecal Sludge as Fertiliser

Factsheet Block Body

The toilet waste or blackwater (urine and faecal matter) contains the majority of the nutrients in wastewater. A century ago, toilet waste was collected in major European cities and used as fertiliser in near urban agriculture. Ordinary flush toilets use much water and the blackwater becomes diluted. Modern toilet technology (vacuum or low-flush gravity) have flush volumes below 1 litre. With these toilets collection and separate treatment of the concentrated blackwater is more interesting in order to treat and reuse it (JENSSEN et al. 2004).

Costs Considerations

Factsheet Block Body

Costs are not higher than a common flush toilet system. But the huge savings of flush water and the smaller volume of generated blackwater reduce operation costs significantly.

Operation and Maintenance

Factsheet Block Body

Although flushing water rinses the bowl, the toilet should be scrubbed clean regularly. It is important that no other object than faeces or urine are tried to flush away, because in this case the risk of clogging is even higher and could lead to expensive cleanout costs.

Health Aspects

Factsheet Block Body

The low-flush toilet itself is safe and comfortable to use provided it is kept clean. There are no real problems with odours if used correctly (TILLEY et al. 2014). If the flush performance is bad, the bowl should be cleaned more often. Furthermore, in the absence of an appropriate (semi-)centralised treatment system, toilet wastewater flows through a sewer system directly into the environment without any treatment. This spreads pathogens and can endanger the health of residents.

At a Glance

Factsheet Block Body

Working Principle	**Human excreta is flushed away by a minimised amount of water.**
Capacity/Adequacy	**Basically, it can be built everywhere, urban and rural areas. A constant source of water and an appropriate sever system and (semi-)centralised treatment system must be available.**
Performance	**Depends on type, but there are many models with a high performance available.**
Costs	**Not higher than a common flush toilet system. Minimised flushed water and blackwater reducing operation costs.**
Self-help Compatibility	**Low, it might be difficult to find spare parts.**

O&M	**Easy to use and clean. Beside human excreta and toilet paper, no other objects should be flushed.**
Reliability	**If well maintained and constructed, high.**
Main strength	**Comfortable and hygienic for the user. Saves large amounts of water in comparison with common flush-toilets.**
Main weakness	**Still requires water. The risk of water pollution in sequence of unprofessional wastewater discharge is high**

Applicability

A flush toilet should not be considered unless all of the connections and hardware accessories are available locally. The low-flush toilet must be connected to both a constant source of water (can be a big problem and controversy in arid climates) for flushing and a collection and storage/treatment or conveyance technology to receive and treat the blackwater. The flush toilet is suitable for both public and private applications and can be used in every climate (TILLEY et al. 2014).

Reference above

Milano Elizabeth - Low Level Toilet Flush Kit - Choice of Finish

£99.99

Reference Above

Flow reducing valves

The water systems in domestic, commercial and industrial properties can present unique problems and challenges as plumbing fittings become ever more sophisticated.

The water supply pressure in the UK can vary from 1bar to 20bar (or even higher in some low usage areas). The water pressure will also tend to vary through the day, for instance at high usage times (typically mornings and late afternoons), the pressure may drop by comparison with low water usage times (throughout the night), when the pressure may increase dramatically.

Such periods of high pressure can cause several problems: excessive noise from high flow velocities, water hammer from quick closing taps or solenoid valves, plus the risk of water wastage is particularly great because higher pressure means higher flow rates.

The water supply usually enters domestic dwellings beneath the kitchen sink so the first effect of high pressure is often experienced at that point; when the cold tap is turned on too quickly or too far, this creates a gush of water which hits the bottom of the sink and bounces back, soaking the user and creating a wet mess!

The best way to control high pressure is by installing a pressure reducing valve. These take a high pressure at the inlet, then the valve reduces it to a lower pressure at the outlet as desired, under both flow and no-flow conditions.

How do PRVs work?

A pressure reducing valve is a valve which takes a high inlet pressure and reduces it to a lower outlet pressure. When it does this under both flow and no-flow conditions, the type of control is known as ‘drop tight’. Reliance’s pressure reducing valves use a balanced spring and diaphragm to control the downstream pressure. This ‘drop tight’ feature is one of the most important criteria for any pressure reducing valves, as this stops the pressure from ‘creeping’ – a term which is used when an increase in the downstream pressure occurs under no flow conditions. A valve which will allow this ‘creep’ cannot be known as ‘drop tight’ or in fact a true pressure reducing valve, as it will eventually allow the pressure to creep up to equal the upstream pressure, which can cause significant problems and essentially negates the point of using a pressure reducing valve in the first place.

The diaphragm effectively separates all of the water contact parts and the pressure from the water supply away from the control spring and associated mechanism. The body is then protected from debris by the use of a stainless-steel strainer.

Under no flow conditions the downstream pressure puts back-pressure on the seat and diaphragm of the valve, which in turn overcomes the spring pressure. This means the seat moves up, forcing it to seal against the diaphragm, therefore not allowing the downstream pressure to increase.

Under flow conditions the back pressure against the seat is reduced thus allowing the seat to open and water to flow through the valve.

How to size a PRV

This is predominantly based on two different criteria: application and flow rates. Application describes the type of property the valve is to be used in: whether it is commercial/industrial or a domestic installation.

Flow rate is the most important factor for sizing a pressure reducing valve. Sizing a valve incorrectly can cause several problems; if oversized the valve seat may open for a very small flow rate, which may occasionally be acceptable but over a long period of time can result in a wire drawing across the valve seat. A wire drawing occurs when the valve disc

and seat position operate close to the shut-off point of the valve for extended periods of time. This then means the water flow scores a pathway in the seat material which remains when the valve closes tight to the shut-off position and allows a little flow and pressure to creep through the valve.

To calculate the flow rate you must work out how many outlets are required and what the combined maximum flow rate for these will be. You can then use the provided table to ascertain which size valve is required:

For larger commercial applications various sizing solutions can be used: for example, if the flow rate is lower at some times than at others then using several smaller size PRVs in parallel may be more practical, or use one smaller valve as a bypass thus allowing water to flow easily through the valve when the flow rate is lower than normal, without causing either wire drawings or creating noise across the valve, as previously mentioned.

Reliance UK PRVs

All Reliance UK pressure reducing valves are WRAS approved: this means that they have undergone independent third-party testing to ensure that they comply with the current UK water regulations for pressure reducing valves. It also ensures that all materials used within the make-up of the valves have been verified as safe for potable water systems.

You can find out more about our PRV range in the 'Flow Control' section of our website's product portfolio, by contacting our team via the below form, or by speaking to your local sales representative.

Reference Above

ARISTON PRESSURE REDUCING VALVE X

£49.99

INC VAT

Reference above

Point of use infrared taps and WC flushing

Sensor-operated taps have a huge advantage over manually operated models as they reduce water usage, only functioning when a user's hands pass through the sensor. However, they also help to improve hygiene in your commercial washroom, as users do not need to touch the tap before, or after washing their hands because they work automatically when the user's hands approach the basin. This makes sensor taps a great investment for any business and an attractive feature in any washroom facility. To fully highlight the benefit of sensor taps we have written a Blog specifically on the subject.

DVS Wall Mounted Minimalistic Sensor Operated Spout Tap Kit

£54.00 £64.80 (inc VAT)

Reference above

Rainwater and Greywater Reuse systems

There are high-tech ways of capturing and reusing rainwater and greywater (the wastewater from showers & sinks) in place of mains water. However, the best options are simple and low cost – such as garden watering or irrigation.

You may want to use captured rainwater within your home. However, systems to enable this can be expensive. They may not save any money, and could also have a high environment impact. It's therefore important to look carefully at the design and operation of any system for reusing rainwater and greywater. A complicated system may not be an effective way to reduce your environmental impact.

The vast majority of the carbon emissions related to UK domestic water use are from the energy used to heat water in the home. So the first measure should always be to minimise hot water use – for example with a water-efficient shower and taps. Look also at overall water efficiency measures, such as a low-flush toilet. And then look at how to heat water using **renewable energy**.

In other countries the comparison between mains water and alternatives can be quite different. For example, in Germany their principal groundwater sources are very dirty and require expensive treatment. A technology that is effective in one country's situation may not be as effective in the UK.

How can I collect and use rainwater?

In the UK, the best way for most householders to make use of rainwater is with a large water butt on your down-pipe. You can then just save the water for use in the garden, and perhaps also bike or car washing.

The equipment for this costs tens of pounds, rather than the thousands needed for a more complicated system. A complete water butt kit will include a diverter pipe to fit to your down-pipe and prevent overflowing, and a stand to allow easy access to the tap.

Can I flush my toilet with rainwater?

If you have a small garden but a large roof you may be considering a system to collect water for your toilet or washing machine. However, it's worth looking into this quite carefully as such a system will not necessarily be financially or environmentally beneficial.

The impacts include manufacture & installation (e.g. with concrete backfill) of the tank, energy use, and periodic pump replacement. Systems often cost thousands of pounds to install, but may save only a few tens of pounds per year.

Academic studies have found that the benefits of systems for using rainwater within a house are often outweighed by the environmental impacts. In a rural area, a composting toilet could be a more sustainable way to reduce domestic water use. Rainwater harvesting is most effective when integrated into new developments, especially larger buildings. For example a school or commercial building that has a big roof area and a high non-potable water demand.

If you're building a new home in an isolated area without mains water or drainage, and your main water source is insufficient for anything other than drinking, cooking and washing, then a **composting toilet** would be a better way to reduce water use.

Can I store and use grey water from my bathroom and kitchen?

Grey water is the water from sinks, baths, washing machines and so on. It's already been in contact with us humans and our germs so storing it requires treatment, or it will quickly start to smell. The most suitable use for grey water is therefore direct garden irrigation, without long-term storage. Reducing the pollutants in grey water makes it more suitable for garden use.

Shower or bath water is easy to reuse for irrigation as shampoos and soaps are fairly mild and well diluted. Simple kits can enable you to divert grey water from your down-pipe, if this is easily accessible.

If you wish to irrigate with water from a washing machine then use a low-sodium detergent, because sodium damages plants and degrades soil (liquid detergents usually contain less salt than powders). Avoid phosphorus as well, because this causes algal blooms if it collects in ponds or rivers. Otherwise, the water has only very small and well diluted quantities of pathogens or grease and therefore these should not be of concern.

Ex-kitchen water can be very dirty – containing oil, grease, and chemicals. Because you will only have a small amount of this anyway, it may be best to avoid reusing it.

It's important to first reduce the amount of grey water you produce. The energy used to heat water leads to far higher carbon emissions than the small amount of energy needed to treat and deliver mains water to a house. So using hot water efficiently is very important – for example, fitting spray-head taps and a low flow shower head will make a big difference to water consumption and energy use.

What's the impact of treating and storing grey water?

Grey water contains bacteria and a nutrient source and is often discharged warm, giving an ideal situation for pathogens to multiply. Commercial grey water recycling systems use disinfectants that are often very energy intensive to produce. These additives may also cause problems if you have a private sewage treatment system.

Independent studies of systems that treat grey water for reuse in the home have found that their environmental impact outweighs any benefits. Also, with running costs higher than using a UK mains water supply, they don't save money either. Given the equipment and disinfectant we find it difficult to see these systems as environmentally friendly for individual households. This may change as technologies are improved. In other countries they may well be more beneficial than they are in the UK.

Reference above

HOW TO INSTALL

Access will be needed throughout the back and road to back for excavation vehicles

How Will the Winter Weather Affect My Excavation Project?

For the top layer of earth to become frozen, temperatures must remain below freezing for consecutive weeks. Typically a winter excavation project can be completed throughout a large part of the year. Snow and ice, however, can have an effect on your project.

When you add snow and ice to an excavation project, certain dangers present themselves. People are more susceptible to slipping, falling, and injuring themselves. Using electrical equipment in wet environments is also a cause for concern. When you work with our experienced team, we can work around these setbacks by using tarps to cover the work area if a snowstorm occurs.

Freezing temperatures can make digging difficult. If the temperature remains consistently below freezing, the ground can become hard and difficult to dig out. However, if the sun comes out and warms the ground, it can become easier to excavate. Constant freezing temperatures that remain for weeks at a time are not extremely common in Pittsburgh.

Advantages and Disadvantages of Winter Excavation Projects

Like with any project, there are advantages and disadvantages to scheduling your excavation project for winter. The experts at J Bird's Landscaping can help you determine if the winter excavation project is feasible or not. Here are some benefits of getting your excavation completed in the wintertime:

- **Get a spot on the schedule – Winter tends to be a slower time for many excavation companies, making it easier for you to get a spot on the schedule. Rather than having to squeeze you into a busy schedule, we can provide you with more of our focus and attention.**
- **More workers – Since we aren't swamped with work through the wintertime, our crew is available for one specific project in the winter, which can help minimise your project's timeline since we'll have more workforce available.**
- **Less wait time – Waiting all winter to get your urgent project done can cost you time and money. While a winter excavation project may come with extra costs, it will be worth completing the project when you take a look at the overall value of utilising your property.**

Disadvantages of Excavating in the Winter

Winter excavation can be challenging when battling snow or ice, which is why it is not a common time for excavation projects to be completed. Some of the disadvantages of winter excavation include:

- **Work crew discomfort – Working out in the snow, ice, and freezing temperatures is not ideal for the work crew. Fortunately, with the proper outwear, this issue can easily be overcome. Warming tents or a trailer on-site can also give workers a chance to warm up and remain comfortable throughout the workday.**
- **Difficult to break ground – If the ground becomes frozen due to consistent below freezing temperature, even the shallower excavation projects can be daunting. When the ground is frozen, special tools are required.**

Reference Above

A **ground source heat pump** (also **geothermal heat pump**) is a heating/cooling system for buildings that uses a type of heat pump to transfer heat to or from the ground, taking advantage of the relative constancy of temperatures of the earth through the seasons. Ground source heat pumps (GSHPs) – or geothermal heat pumps (GHP) as they are commonly termed in North America – are among the most energy-efficient technologies for providing HVAC and water heating, using far less energy than can be achieved by burning a fuel in a boiler/furnace or by use of resistive electric heaters.

Efficiency is given as a coefficient of performance (CoP) which is typically in the range 3 – 6, meaning that the devices provide 3 – 6 units of heat for each unit of electricity used. Setup costs are higher than for other heating systems due to the requirement to install ground loops over large areas or drill bore holes, and for this reason air source heat pumps are often used instead.

Thermal properties of the ground[edit]

Ground-source heat pumps take advantage of the difference between the ambient temperature and the temperature at various depths in the ground.

The thermal properties of the ground near the surface[1][2] can be described as follows:

- In the **surface layer** to a depth of about 1 metre, the temperature is very sensitive to sunlight and weather,
- In the **shallow layer** to a depth of about 8–20 metres depending on soil type, the thermal mass of the ground causes temperature variation to decrease exponentially with depth until it is close to the local annual average air temperature; it also lags behind the surface temperature, so that the peak temperature is about 6 months after the surface peak temperature
- Below that, in the **deeper layer**, the temperature is effectively constant, rising about 0.025 °C per metre according to the geothermal gradient.

The "penetration depth"[2] is defined as the depth at which the temperature variable is less than 0.01 of the variation at the surface, and this depends on the type of soil:

Soil Type	Day (m)	Year (m)
Rock	1.10	20.5
Wet clay	0.95	18.0
Wet sand	0.80	14.5

Dry clay	0.40	6.5
Dry sand	0.30	4.5

Arrangement[edit]

Internal arrangement[edit]

Liquid-to-water heat pump

A heat pump is the central unit for the building's heating and cooling. It usually comes in two main variants:

Liquid-to-water heat pumps (also called *water-to-water*) are hydronic systems that carry heating or cooling through the building through pipes to conventional radiators, underfloor heating, baseboard radiators and hot water tanks. These heat pumps are also preferred for pool heating. Heat pumps typically only heat water to about 55 °C (131 °F) efficiently, whereas boilers typically operate at 65–95 °C (149–203 °F). The size of radiators designed for the higher temperatures achieved by boilers may be too small for use with heat pumps, requiring replacement with larger radiators when retrofitting a home from boiler to heat pump. When used for cooling, the temperature of the circulating water must normally be kept above the dew point to ensure that atmospheric humidity does not condense on the radiator.

Liquid-to-air heat pumps (also called *water-to-air*) output forced air, and are most commonly used to replace legacy forced air furnaces and central air conditioning systems. There are variations that allow for split systems, high-velocity systems, and ductless systems. Heat pumps cannot achieve as high a fluid temperature as a conventional furnace, so they require a higher volume

flow rate of air to compensate. When retrofitting a residence, the existing ductwork may have to be enlarged to reduce the noise from the higher air flow.

Ground heat exchanger[edit]

A horizontal slinky loop prior to being covered with soil.

Ground source heat pumps employ a ground heat exchanger in contact with the ground or groundwater to extract or dissipate heat. Incorrect design can result in the system freezing after a number of years or very inefficient system performance; thus accurate system design is critical to a successful system [10]

Pipework for the ground loop is typically made of high-density polyethylene pipe and contains a mixture of water and anti-freeze (propylene glycol, denatured alcohol or methanol). Monopropylene glycol has the least damaging potential when it might leak into the ground, and is, therefore, the only allowed anti-freeze in ground sources in an increasing number of European countries.

Horizontal

A horizontal closed loop field is composed of pipes that are arrayed in a plane in the ground. A long trench, deeper than the frost line, is dug and U-shaped or slinky coils are spread out inside the same trench. Shallow 3–8-foot (0.91–2.44 m) horizontal heat exchangers experience seasonal temperature cycles due to solar gains and transmission losses to ambient air at ground level. These temperature cycles lag behind the seasons because of thermal inertia, so the heat exchanger will harvest heat deposited by the sun several months earlier, while being weighed down in late winter and spring, due to accumulated winter cold. Systems in wet ground or in water are generally more efficient than drier ground loops since water conducts and stores heat better than solids in sand or soil. If the ground is naturally dry, soaker hoses may be buried with the ground loop to keep it wet.

Vertical

Drilling of a borehole for residential heating

A vertical system consists of a number of boreholes some 50 to 400 feet (15–122 m) deep fitted with U-shaped pipes through which a heat-carrying fluid that absorbs (or discharges) heat from (or to) the ground is circulated.[11][12] Bore holes are spaced at least 5–6 m apart and the depth depends on ground and building characteristics. Alternatively, pipes may be integrated with the foundation piles used to support the building. Vertical systems rely on migration of heat from surrounding geology, unless recharged during the summer and at other times when surplus heat is available. Vertical systems are typically used where there is insufficient available land for a horizontal system.

Pipe pairs in the hole are joined with a U-shaped cross connector at the bottom of the hole or comprises two small-diameter high-density polyethylene (HDPE) tubes thermally fused to form a U-shaped bend at the bottom.[13] The space between the wall of the borehole and the U-shaped tubes is usually grouted completely with grouting material or, in some cases, partially filled with groundwater.[14] For illustration, a detached house needing 10 kW (3 ton) of heating capacity might need three boreholes 80 to 110 m (260 to 360 ft) deep.[15]

Radial or directional drilling

As an alternative to trenching, loops may be laid by mini horizontal directional drilling (mini-HDD). This technique can lay piping under yards, driveways, gardens or other structures without disturbing them, with a cost between those of trenching and vertical drilling. This system also differs from horizontal & vertical drilling as the loops are installed from one central chamber, further reducing the ground space needed. Radial drilling is often installed retroactively (after the property has been built) due to the small nature of the equipment used and the ability to bore beneath existing constructions.

Open loop

In an open-loop system (also called a groundwater heat pump), the secondary loop pumps natural water from a well or body of water into a heat exchanger inside the heat pump. Since the water chemistry is not controlled, the appliance may need to be protected from corrosion by using different metals in the heat exchanger and pump. Limescale may foul the system over time and require periodic acid cleaning. This is much more of a problem with cooling systems than heating

systems.[16] A standing column well system is a specialized type of open-loop system where water is drawn from the bottom of a deep rock well, passed through a heat pump, and returned to the top of the well.[17] A growing number of jurisdictions have outlawed open-loop systems that drain to the surface because these may drain aquifers or contaminate wells. This forces the use of more environmentally sound injection wells or a closed-loop system.

Pond

12-ton pond loop system being sunk to the bottom of a pond

A closed pond loop consists of coils of pipe similar to a slinky loop attached to a frame and located at the bottom of an appropriately sized pond or water source. Artificial ponds are used as heat storage (up to 90% efficient) in some central solar heating plants, which later extract the heat (similar to ground storage) via a large heat pump to supply district heating.[18][19]

(DX)

The direct exchange geothermal heat pump (DX) is the oldest type of geothermal heat pump technology where the refrigerant itself is passed through the ground loop.

Reference above

Task 1.2 Report

Assessment number (eg 1234-033)	8710-033
Assessment title	Employer-Set Project

Candidate name	<first name> <surname>
City & Guilds candidate No.	ABC1234

Provider name	<provider name>
City & Guilds provider No.	999999a

Task(s)	1.2
Evidence title / description	Report
Date submitted by candidate	DD/MM/YY

Task 1.2 - Report (<first name> <surname>)

Introduction

The best way to stay carbon neutral is by using technology such as ground source heat pumps -which is one of the main and most efficient ways to heat up large facilities- as well as water conservation technologies. Ground source heat pumps (GSHPs) are a renewable energy technology that use the natural heat stored in the ground to provide heating and cooling to buildings. They work by circulating a mixture of water and antifreeze through a ground loop, which is buried underground, and using a heat exchanger to transfer heat between the ground and a building's heating system. The water conservation technologies used are :

Non-Concussive Taps:

Non-concussive taps are a type of tap that are designed to deliver a short burst of water when activated. These taps are commonly used in public washrooms, as they help to conserve water and reduce the risk of flooding. The main advantage of non-concussive taps is that they are easy to use and require very little maintenance. However, they may not be suitable for all applications, as they can be prone to dripping and can be difficult to control the flow of water but this can be disregarded as it will only be used for public purposes and the flow of water is needed to be short and quick to prevent any unnecessary usage. Therefore it is extremely useful as it prevents any public interference. '*They turn off automatically which helps to reduce water waste and expenses attached to water usage as well as minimising the risk of flooding.*

They're easy to use - users simply need to push down on the taps.

They're often constructed from solid brass and finished in chrome which makes them robust and easy to clean.

You can choose between wall mounted taps and deck mounted push taps to suit your washroom space.

They can be a more affordable option to sensor taps which also feature automatic shut off functions' Cited from Link.

Low-Volume Flush WCs:

Low-volume flush WCs are designed to use less water than traditional WCs, while still maintaining their effectiveness. These WCs are commonly used in homes and businesses,

as they help to reduce water consumption and save money on water bills. The main advantage of low-volume flush WCs is that they are environmentally friendly and can help to reduce the carbon footprint of a building. However, they may not be suitable for all applications, as they can be more expensive to purchase and install than traditional WCs but when purchasing these WCs it will be more effective and water efficient therefore it will save more money in the long term. ' *A low-flush or low-flow toilet is a flush toilet that is adapted in order to use significantly less water than a full-flush toilet. Low-flush toilets use a special design of the cistern and the siphon in order to allow the removal of faeces and excreta with less water. Most often, they also include a dual flush system, with one flush being designed for urine only, using even less water than the other designed for faeces*.' Referenced from Link.

Flow Reducing Valves:

Flow reducing valves are used to reduce the flow of water through pipes and taps. These valves are commonly used in buildings where water conservation is a priority, as they help to reduce water consumption and save money on water bills. The main advantage of flow reducing valves is that they are easy to install and require very little maintenance. However, they may not be suitable for all applications, as they can reduce the flow of water to a level that is not suitable for some applications but the pressure can be controlled to a suitable amount for the people using the taps and as it is the general public using the taps, a high pressure is not necessary as they will not be using it for things such as cleaning dishes. '*Such periods of high pressure can cause several problems: excessive noise from high flow velocities, water hammer from quick closing taps or solenoid valves, plus the risk of water wastage is particularly great because higher pressure means higher flow rates*' Referenced from Link shows the disadvantages of having high pressure.

Point of Use Infrared Taps and WC Flushing:

Point of use infrared taps and WC flushing systems are designed to reduce water consumption in public washrooms. These systems use infrared technology to detect when a user is present and deliver a short burst of water when activated. The main advantage of point of use infrared taps and WC flushing systems is that they are hygienic and help to reduce the risk of cross-contamination. However, they may not be suitable for all applications, as they can be more expensive to purchase and install than traditional taps and flushing systems but is can save a lot of money in the long term run as similar to the non concussive taps it will save water from being wasted as it only runs at short bursts. '*Sensor-operated taps have a huge advantage over manually operated models as they reduce water usage, only functioning when a user's hands pass through the sensor. However, they also help to improve hygiene in your commercial washroom, as users do not need to touch the*

tap before, or after washing their hands because they work automatically when the user's hands approach the basin' Referenced from Link.

Technology

GSHPs consist of three main components: the ground loop, the heat pump unit, and the heat distribution system. The ground loop is buried underground and can be installed either horizontally or vertically, depending on the available space and the geological conditions of the site. The heat pump unit extracts heat from the ground loop and boosts it to a higher temperature suitable for heating the building. The heat distribution system then distributes the heated water or air to the building's heating system.The whole system itself can run on 12v depending on size and it produces more energy than it is given. The system also uses antifreeze which is mixed with water to create brine which absorbs the heat when passed through the heat exchanger. This advanced technology uses the laws of physics to replicate the high temperature displacing the cooler temperature. The technology in GSH is advanced but altogether simple when put together and planned out. The technology of the other systems such as the rainwater and greywater systems reuse the rain water or wasted water and filter to a lower degree to reduce cost and the water is then used as greywater or used as tap water however a higher degree of filtration is needed. The water conservation technologies are water efficient by either reducing pressure or reducing the amount of time the water is used for. Technologies such as pressure reducing valves can reduce pressure just by using a drop tight feature which uses balanced spring and diaphragm to control the downstream pressure. Other types of technology are used such as timed taps which turn off after a certain period of time which are controlled either mechanically or electronically. In conclusion the pavilion will be using the latest carbon neutral technology to stay efficient in all departments.

Sustainability

GSHPs are a sustainable and environmentally friendly option for heating and cooling buildings. They are considered carbon-neutral technology, as the energy they extract from the ground is renewable and emits no carbon dioxide. They also have lower emissions of other pollutants compared to traditional heating systems.

Many of the systems and technologies discussed above have significant environmental benefits, including reducing water consumption, energy use, and carbon emissions. Ground source heat pumps reduce energy consumption as it takes in less energy and produces more. The water conservation technology will be able to reduce water consumption at an extremely high rate and therefore save money as well as saving the environment. No carbon emissions will be produced by this pavilion as everything will be carbon neutral. This completely carbon neutral pavilion can attract more people as they will support the idea of a carbon neutral pavilion and it will inspire other companies to make their facilities more carbon neutral as well. In conclusion, GSHPs and water conservation technologies are a highly sustainable and environmentally friendly option for heating or cooling buildings and reducing water consumption. They are considered carbon-neutral technology and can significantly reduce a building's carbon footprint. They also have lower emissions of other pollutants compared to traditional heating systems.

Financial Benefits

While the initial costs of installing a GSHP can be higher than traditional heating systems, they can provide significant long-term cost savings through reduced energy bills and the availability of government incentives such as the Renewable Heat Incentive. GSHPs can also improve building performance by providing consistent and efficient heating and cooling, improving indoor air quality, and reducing energy consumption.The initial costs of the water conservation technologies and the rainwater and greywater reuse systems can be quite expensive in the long term run it will save more money and the money lost will be made back by the money saved.The cost of the non concussive taps for all basins in the bathroom is £342 but the infrared taps are £324 therefore it is cheaper to get the infrared taps. The cost of the infrared WCs would be £259.20. The cost of the Low volume flush WCs is £399.96 and the cost of the flow reducing valves was £449.91. The total price is quite large but when calculating the amount of money saved the investment will be worth it.

In conclusion, while the initial costs of installing a GSHP and water conservation technology can be higher than traditional heating and water systems, they can provide significant long-

term cost savings through reduced energy and water bills and the availability of government incentives such as the Renewable Heat Incentive.

Waste Management

When installing or upgrading building services, it is important to consider waste management and the removal and disposal of redundant services such as pipes and wires. This may involve hiring specialist contractors to safely remove and dispose of any hazardous materials (such as asbestos), in accordance with local regulations.Our company will remove all redundant services from each room starting from the rooms that are less occupied than others for example the plant room this will allow us to work without distracting any other workers in the pavilion. The waste management being used will be a waste collector who will take it to either a recycling plant or a landfill if necessary. These are the prices of the waste produced.

If you have more than 10 bags consider a load size

Soil (Per Rubble Bag)

£20.00

Item Position Note* : All items to be left outside and collected anytime during the day receive 10% discount.	○ Inside the Property Needs Dismantling (+£0.00) ◉ Inside the Property No Dismantling (+£0.00) ○ Outside the Property (+£0.00)

\- 1 + Add To Cart

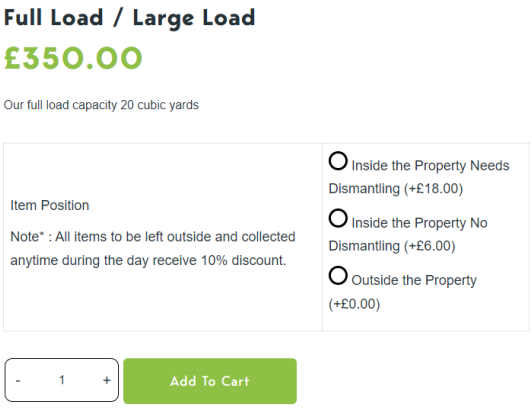
Ensure it is disconnected and completely empty

Sink

£20.00

Item Position Note* : All items to be left outside and collected anytime during the day receive 10% discount.	○ Inside the Property Needs Dismantling (+£0.00) ○ Inside the Property No Dismantling (+£0.00) ○ Outside the Property (+£0.00)

\- 1 + Add To Cart



Job roles and their work

The main workers needed for this project are groundwork contractors who will excavate the area for the horizontal ground loops and for any other groundwork needed. The groundwork may be harder as the work will be taking place during winter therefore the ground is harder to excavate. The HVAC contractor is needed to install the heat pump itself and connect it to the ground loop. They will also install the ductwork or radiators needed to distribute the heat throughout your home. The geotechnical engineers will evaluate and assess the soil conditions to see if it is suitable for excavating. A heat pump supplier will supply our heat pumps for the GSH. A plumber will be needed to install the water conservation technology and the greywater reuse system as well as connecting the GSH to the pavilion. An electrician will be needed to connect the power to the GSH and any power needed to any other systems. Overall, installing a ground source heat pump requires a team of specialists with a variety of skills and equipment. It is important to work with experienced professionals to ensure that the installation is completed safely and efficiently

Laws and regulations

It is important to work with a certified and reputable installer to ensure that the GSHP system is designed and installed correctly and complies with all applicable laws and regulations. GSHP installations are subject to a range of regulations including building codes, planning

permission, and environmental protection regulations. Installers must be certified under the Microgeneration Certification Scheme (MCS) to access government incentives.

In the United Kingdom, the installation and maintenance of ground source heat pumps are subject to a number of laws and regulations, including:

Planning Permission: In some cases, planning permission may be required before installing a ground source heat pump. This is particularly true for large-scale installations or those that may have an impact on the surrounding landscape or environment.

Building Regulations: Ground source heat pump installations must comply with the Building Regulations 2010, which cover a wide range of building-related issues including energy efficiency, safety, and ventilation.

Microgeneration Certification Scheme: The Microgeneration Certification Scheme (MCS) is a certification scheme for renewable energy technologies, including ground source heat pumps. Installers must be certified under the MCS in order to access government incentives such as the Renewable Heat Incentive.

Health and Safety Regulations: The installation and maintenance of ground source heat pumps and the water conserving technology must comply with the Health and Safety at Work etc. Act 1974, which sets out general health and safety duties for employers and employees.

Environmental Protection Regulations: The installation and maintenance of ground source heat pumps must comply with a range of environmental protection regulations, including the Environmental Permitting Regulations and the Control of Pollution (Oil Storage) Regulations.

Standards: Ground source heat pumps must meet certain standards, including the EN 15827 standard for heat pumps and the MCS 012 standard for the installation of ground source heat pumps.

Overall, it is important to work with a certified and reputable installer to ensure that your ground source heat pump installation complies with all applicable laws and regulations in the United Kingdom. In the United Kingdom, GSHP installations are subject to a range of regulations including building codes, planning permission, and environmental protection

regulations. Installers must be certified under the Microgeneration Certification Scheme (MCS) to access government incentives.

Link

Health and Safety

When installing any of these systems, it is important to ensure that health and safety measures are in place. This includes providing safe access and egress to the installation site, as well as implementing safe isolation procedures to prevent injury or damage to the system. Specialist contractors and equipment may be required to install some of these systems, and it is important to ensure that they are trained and qualified to carry out the work and to ensure that all laws and regulations are followed. Some things to consider is the local wildlife; the installation and maintenance of GSHPs can have a minimal impact on local wildlife. However, it is important to work with an installer who can assess and mitigate any potential impacts on local ecosystems.Therefore following procedures will be taken place such as animal control coming in to survey the land to look for any wild animals that have their homes there so they may be moved to a more safer location. In our project we wil make sure to adhere to these points ' *Identification of areas where the most vulnerable species are found. Identification of habitats where species require a large area of land. Identification of areas where species with low reproductive rates are found. Setting standards that enhance the preservation of wildlife.*' Link Safe isolation procedures will be made sure to be practised onsite when dealing with the electrical aspect as well as the plumbing aspect. This will be ensured to preserve the safety of our workers and users. When installing the ground collectors we will make sure to adhere to the health and safety regulations for excavation. As we are doing a closed loop GSH we will be digging trenches. First the land will be surveyed by geotechnical engineers who will analyse the ground conditions. We will make sure to be clean when excavating the area and to not pollute the ground soil. We will make sure to adhere to the set regulations provided by the government and other authorities. ' *closed loop GSHC schemes: shallow trenches and deeper boreholes. In practice, shallow trenches pose little risk to the groundwater environment, but we recommend you follow the good practice in section 3 to prevent pollution of soil and shallow groundwater. Before you start drilling a borehole (for both closed and open loop schemes) you should seek the advice of a qualified hydrogeologist to understand the geology and hydrogeology you will be drilling into in order to anticipate and mitigate any problems. When drilling a closed loop borehole there is no obligation to consult us, but it is good practice to identify the risks in advance*' Link- file://center.barking-coll.ac.uk/students/Student%20Home/20490321/Downloads/Item_13___EA_GSHC_Good_Practice_Guide_220519_151012.pdf

Advantages and disadvantages

Advantages: GSHPs are a highly sustainable and environmentally friendly heating and cooling option that can significantly reduce a building's carbon footprint. They also provide consistent and efficient heating and cooling, improve indoor air quality, and offer long-term cost savings. They are highly efficient and can provide consistent and reliable heating and cooling, regardless of external weather conditions. They also have a long lifespan of around 25 years, require little maintenance, and have low operating costs compared to traditional heating systems.

Disadvantages: The initial costs of installation can be high, and the effectiveness of GSHPs can depend on factors such as the size of the building and the quality of the ground loop installation. It is important to work with a reputable installer to ensure that the system is designed and installed correctly.

Future outlook

The systems, components, and technologies used in a building can have a significant impact on its performance. This includes factors such as energy efficiency, water consumption, and environmental impact. By choosing the right systems and technologies, building owners and operators can improve the performance of their buildings and reduce their carbon footprint.

GSHPs can improve building performance by providing consistent and efficient heating and cooling, improving indoor air quality, and reducing energy consumption.

Conclusion

In conclusion the ground source heat pumps are a type of heating system that uses the earth's natural heat to warm a building. These systems are commonly used in homes and businesses, as they are environmentally friendly and can help to reduce energy bills. The main advantage of ground source heat pumps is that they are efficient and reliable, and can be used to provide heating and cooling throughout the year. The water conservation technology and rainwater and greywater reuse system will help reduce water bills drastically and help save water in general for the environment. The GSH will be sited behind the pavilion where there is 400m2 of space and if any other space is needed there is a country

side behind the pavilion. The equipment will be taken round the back to do the work and any work to be done inside the building will be done after the GSH has been installed so the new services can be connected to the GSH. The installation of a GSHP typically takes around three months, although this can vary depending on the size and complexity of the system. It is important to plan for installation during a time of year when the ground is not frozen or too wet, which can impact the installation process.

Task 1.3 Project plan

Assessment number (eg 1234-033)	8710-033
Assessment title	Employer-Set Project

Candidate name	<first name> <surname>
City & Guilds candidate No.	ABC1234

Provider name	<provider name>
City & Guilds provider No.	999999a

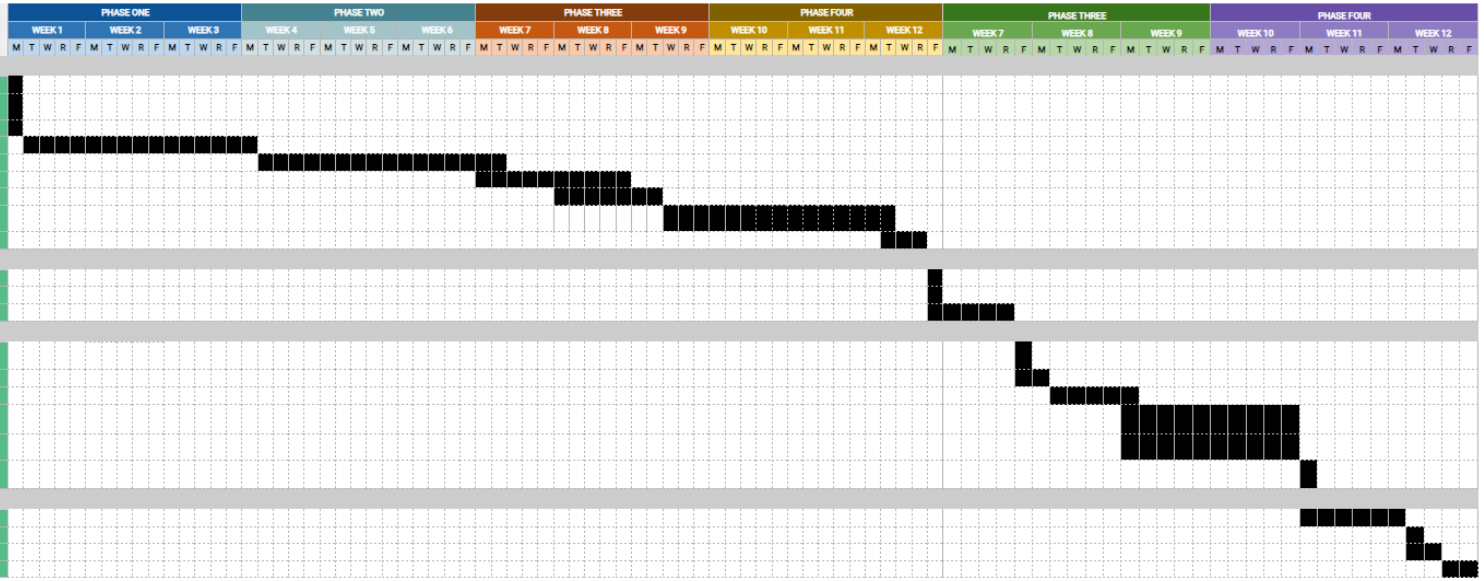
Task(s)	1.3
Evidence title / description	Programme of works Supporting statement
Date submitted by candidate	DD/MM/YY

GANTT CHART

Smartsheet Tip – details about each task as well as project

PROJECT TITLE	[Project's title]	COMPANY NAME	[Company's name]
PROJECT MANAGER	<first name> <surname>	DATE	DD/MM/YY

WBS NUMBER	TASK TITLE	DURATION	PCT OF TASK COMPLETE
1	GROUND SOURCE HEAT PUMP INSTALLATION		
1.1	Preparing site	1	0%
1.2	Gathering components+equipment onsite	1	0%
1.3	Testing ground conditions	1	0%
1.4	Starting excavation	15	0%
1.5	Installation of the ground loop	15	0%
1.6	Installation of heat pump unit	10	0%
1.7	Laying Pipework	7	0%
1.8	Installation of heat distribution system	15	0%
1.9	Testing equipment+pump	3	0%
2	REMOVAL OF REDUNDANT SERVICES		
2.1	Identifying redundant services	1	0%
2.2	Isolating the servies	1	0%
2.3	Removing the services	5	0%
3	WATER CONSERVATION TECHNOLOGY INSTALLATION		
3.1	Marking the places where new technology is needed	1	0%
3.2	Removal of old services	2	0%
3.3	Installing the new technology	5	0%
3.4	Conecting the technology to the supply	10	0%
3.5	Installing the rainwater greywater reuse system	10	0%
3.6	Testing the new technology and the system	1	0%
4	FINISHING PROJECT		
4.1	Tidying+cleaning the site	5	0%
4.2	Testing everthing	1	0%
4.3	Commisioning all new services	2	0%
4.4	Handover to client	1	0%



Task 1.3 - Project Plan (<first name> <surname>)

Project Overview

Ground Source Heat Pump Installation

Preparing site- Adding onsite facilities such as porta potties and an 110v electricity generator and services such as water. Warning signs and precautions will be placed around the site such as cones and fences around the site to maintain safety across the site. The site will be prepared for being worked on and this will take 1 day to do.

Gathering components+equipment onsite- Getting everything needed to install the ground source heat pump. All the equipment will be ready and at hand for example the excavator will be ready onsite. This will take one day.

Testing ground conditions- The ground will be tested by the geotechnical engineer to see if it is ready to be excavated and to see if there are any obstructions below. The weather will be cold as it is winter therefore the ground may be harder to dig. The animal control will come in and check to see if any animal habitats are nearby and if there are they will be sent off. This will take 1 day.

Starting excavation- The excavation will then begin after the ground has been tested. The excavation will be horizontal trenches. Safety precautions such as cones around the trench so no one falls in and lights on the excavator so no one gets run over. will take place and we will ensure the soil does not become contaminated. The groundwork contractors will be doing the excavation process and it will take around 3 weeks.

Installation of the ground loop- Once the excavation process is finished we will start to install the ground loop. Each ground loop will be placed in the trench while grout will be covered underneath it. The ground loop has to be tight and compact underground so it produces maximum heat and energy.This will take around 3 weeks to complete.

Installation of heat pump unit- The heat pump unit will be installed in the plant room and it will be connected to the ground loop before it has been covered up. An electric supply will be

needed for the unit to work so an electrician will be needed for this process. This will take around 2 weeks to complete.

Laying pipework- A plumber will come in to lay the pipework to the building that connects the pump to the building. This takes around 7 days to complete.

Installation of heat distribution system- This system will need to be connected all around the building so access and egress will be needed to the building. We will be mainly using the back entrance near the plant room and the back entrance in the store. Thermostat will need to be installed and programmed, a programmer and electrician will be needed for this stage. This will take 3 weeks to complete.

Testing equipment + pump- The GSH pump will be tested to see if it works properly as well as the heat pump unit and the heat distribution system. Any faults will be repaired and we will make sure that the equipment is safe and adheres to health and safety regulations. An electrician and a plumber will be needed to test all the equipment. This will take around 3 days to complete.

Removal of redundant services

Identifying redundant services- An electrician and a plumber will come in to identify all redundant services 1 day

Isolating the services- The services will then be isolated and using safe isolation procedures. Once this is done the services will be taken out and thrown away. This will take 1 day to complete.

Removing the services- This is the stage where all the services are removed and put to waste. This will take 5 days to complete.

Water conservation technology installation

Marking the places where new technology is needed- We will mark out which old services will be replaced with the new technology. This will be done within the day.

Removal of old services- Our plumber will come in and remove all the old services so it can be replaced with the new technology. We will make sure the services are switched off and safely isolated. This will take around 5 days.

Installing the new technology- The new technology will be installed by the plumber. There are 5 basins + the kitchen, 4 toilets and 10 showers. This will take around 10 days to install complete and test considering there may be more water outlets not shown on the plan.

Connecting the technology to the supply - The technology will be connected to the water supply and will have an electrical supply if needed (most likely batteries). This should only take 1 day.

Installing the Rainwater greywater reuse system- The system will be installed outside and along the roof to catch the rain so we will have to take into consideration the working at height regulations. The system will then be connected indoors. THis will take around 10 days.

Testing the new technology and the system- The new technology is all going to be tested to see if there are any hazards then the system will then be tested this will take around a day to complete.

Finishing the project

Tidying + cleaning the site- The site will be cleaned up and all waste will be removed inside and outside the site. All equipment will be put away. This will take 1 week to complete.

Testing everything- All newly installed equipment will be tested again just to make sure everything is safe. This will take 1 day.

Commissioning all new services- All the newly installed services will be commissioned by the commissioner. 1 day to complete

Handover to client- All paperwork will be filled out and completed and paycheck will be given out by the contractor. 1 day

Task 1.4 Presentation

Assessment number (eg 1234-033)	8710-033
Assessment title	Employer-Set Project

Candidate name	<first name> <surname>
City & Guilds candidate No.	ABC1234

Provider name	<provider name>
City & Guilds provider No.	999999a

Task(s)	1.4
Evidence title / description	Presentation slides Note: Presentation recording is not included with this document. Please refer to the Observation Record below the presentation slides for commentary
Date submitted by candidate	DD/MM/YY

Retrofit The Sports Pavillion

By <first name> <surname>

Benefits of Ground Source Heat Pumps

How sustainable are GSH?

GSH pumps are extremely energy efficient due to the fact that they produce more energy than they intake as they absorb most the energy from underground this means the small amount of electricity they do intake is very cheap and is only around 12 volts. The system does not run on any fossil fuels therefore the entire system is completely carbon neutral. ' *Due to the fact that a heat pump doesn't directly use combustion to generate heat (heat pumps do not burn anything), there are no carbon emissions other than those created at the point of the electricity's production and only a small amount of electricity is needed to run the compressor. This makes a heat pump an extremely eco-friendly space heating / cooling technology. Heat pumps are also more environmentally friendly than ever, as they now use R410A refrigerant which does not harm the ozone layer if released.*' Quoted from Reference. This shows how even the components such as the refrigerant will not affect the environment.

How much money will they save me?

While the initial costs of installing a GSHP can be higher than traditional heating systems, they can provide significant long-term cost savings through reduced energy bills and the availability of government incentives such as the Renewable Heat Incentive.

List of advantages of GSHP

- Energy efficient
- Financial investment - It saves up a lot of money throughout the years as you do not need to pay for your heating bills.
- Technologically advanced - It uses the latest and carbon neutral technology to get the best results
- They provide consistent and efficient heating and cooling, improve indoor air quality
- They are highly efficient and can provide consistent and reliable heating and cooling, regardless of external weather conditions.
- They have a long lifespan of around 25 years, require little maintenance, and have low operating costs compared to traditional heating systems.
- With our excellent team there is no need to worry about any installation issues that may occur as we specialise in GSHP.

Installation of the collector circuit

The collector circuit can be installed with 3 easy steps

The collector circuit will be installed by first being connected to the ground loops which is what absorbs the heat from underground. A horizontal based trench will be dug for your GSH pump, then the ground loops will be buried in the trenches.

1

Before it is buried it must be connected to the heat pump unit which is what boosts the temperature so it has enough power to heat up the building. This heat pump unit will be installed in the plant room.

2

Once the heat pump unit has finally been installed we connect it to the heat distribution system. The heat distribution system is the system that distributes heat across the entire building. A thermostat system must be programmed and connected to it so you can control your desired temperature.

3

Benefits of Water Conservation Technologies

Non-concussive taps are a type of tap that are designed to deliver a short burst of water when activated. These taps are commonly used in public washrooms, as they help to conserve water and reduce the risk of flooding. The main advantage of non-concussive taps is that they are easy to use and require very little maintenance. However we do understand the concerns that some people may have for example they may not be suitable for all applications, as they can be prone to dripping and can be difficult to control the flow of water but this can be disregarded as it will only be used for public purposes and the flow of water is needed to be short and quick to prevent any unnecessary usage.

Low-volume flush WCs are designed to use less water than traditional WCs, while still maintaining their effectiveness. These WCs are commonly used in homes and businesses, as they help to reduce water consumption and save money on water bills. The main advantage of low-volume flush WCs is that they are environmentally friendly and can help to reduce the carbon footprint of a building.

Benefits of Water Conservation Technologies

Flow reducing valves are used to reduce the flow of water through pipes and taps. These valves are commonly used in buildings where water conservation is a priority, as they help to reduce water consumption and save money on water bills. The main advantage of flow reducing valves is that they are easy to install and require very little maintenance. Sometimes high pressure in taps can even ruin the taps. '*Such periods of high pressure can cause several problems: excessive noise from high flow velocities, water hammer from quick closing taps or solenoid valves*' quoted from link.

Point of use infrared taps and WC flushing systems are designed to reduce water consumption in public washrooms. These systems use infrared technology to detect when a user is present and deliver a short burst of water when activated. The main advantage of point of use infrared taps and WC flushing systems is that they are hygienic and help to reduce the risk of cross-contamination.

Benefits of Rainwater and Greywater Systems

Rainwater harvesting involves capturing and storing rainwater for later use. The benefits of rainwater systems are numerous. Firstly, they reduce the demand for freshwater, particularly during times of drought. By capturing and storing rainwater, households and businesses can reduce their reliance on municipal water supplies, thereby saving money on water bills.

Video

Greywater is wastewater that has been produced by household activities such as washing dishes, doing laundry, and showering. Greywater systems involve capturing this wastewater and reusing it for non-potable purposes such as watering plants, flushing toilets, and cleaning. The benefits of greywater systems are numerous.

Conclusion

In conclusion, why should you get these products ?

GSH pumps are a long term investment that create a warm environment perfect for your sports pavilion while being completely carbon neutral.

The water conservation technology is also a great investment as it saves a considerable amount of water especially when public sports pavilion would be needing excessive amounts of water every day.

As well as saving water you'll also be saving a lot of money due to the huge reduction of water bills. Getting a Rainwater and Greywater System can save a lot of money as most the water being used will be recycled.

Therefore invest in these products to save money for years to come while also saving the planet.

Questions?

Employer-Set Project - Observation Record (Task 1.4)

8710-30 T Level Technical Qualification in Building Services Engineering for Construction

8710-033 Core: Employer-Set Project (Summer 2023)

Candidate name	<first name> <surname>
City & Guilds candidate No.	ABC1234
Date	DD/MM/YY

Provider name	<provider name>
City & Guilds Provider No.	999999a

Record observation notes below to inform external marking. **Notes must be detailed, accurate and differentiating. They should identify areas of strength and weakness to distinguish different levels of performance quality for each of the prompts below.**

Structure/detail
Very good. Most points covered. Made personal.

Techniques
Slide show. Good fonts and design.

Terminology
Good, easy to understand, used plain English, not too many technical terms.

Theories and concepts
All decisions explained. Good reasons given for decisions made.

Communication
Looking down at notes a lot but kept volume up.

Tutor questions to candidate	Candidate responses
Why have you chosen the location of the collector circuit where you have?	Behind the pavilion where there is space and the least disruption.
Describe how you will install the collector circuit.	Trenches will be dug by others (with right equipment). Pipes will be laid out then connected to GSHP then all the internal heating systems changed over. Trenches all filled in.
What is the most important H&S part of the project?	When digging the trenches, nobody falls in or the trenches collapse.

Any other aspects

Tutor signature	Date
X _____	DD/MM/YY

If completing electronically, double click next to the 'X' to add an electronic signature once the record is **finalised**.

Task 2.1 Collaborative problem-solving

Assessment number (eg 1234-033)	8710-033
Assessment title	Employer-Set Project

Candidate name	<first name> <surname>
City & Guilds candidate No.	ABC1234

Provider name	<provider name>
City & Guilds provider No.	999999a

Task(s)	2.1
Evidence title / description	Collaborative problem-solving group discussion notes Draft email Note: Collaborative discussion recording is not included with this document. Please refer to the Observation Record below for commentary
Date submitted by candidate	DD/MM/YY

Task 2.1 - [redacted]

Option 2 - cost's less
- Less Space
- ~~Use gym/kitroom~~
- No need for hiring specialists.
- ~~[redacted]~~ more parking space
  - more revenue
- ~~No one can use the gym/kitroom~~
  - ~~Loss of revenue~~
- Less hygenic 2 teams sharing
- All disadvantages for option 1 is do advantage to option 2
- ~~Mens~~ They can use Always changing rooms
- Saves more water
- May take longer as everyone is using the Save facilities
- more congestion
- More sustainable.
- Less professional

Option 1 - cost's more
- Increased reputation
  - provided facilities for Always teams
    - shows care
- External facilities can be used in the future
- Allows more space
- Delivery times may take long
- Less parking
- more traffic
- Angry Customers
- Loss of income
- Loss of reputation
- Going to need the right people for the installation of services
- Short Notice
- Away team may not want to play again
- ~~Stressful~~
- more of a delay
  - must wait for installing of services
- Hires seperate team

Task 2.1 - Collaborative Problem-Solving (<first name> <surname>) Email

Dear Renewable Retrofit Ltd (Business Development Manager),

I have decided to choose option 2 as it is cheaper and more efficient. The main advantages of option 2 is that it costs a whole lot less than option 1.

The costs of option 1 would be the cost of installing the external facilities at short notice, the cost of the delivery of the external services, the lack of income from parking, The cost of water and the cost of the workers needed for the installation.

This cost would sum up to an extortionate amount and this could easily be avoided if option 2 is chosen. Not only is option 1 is more expensive it will waste a lot of time such as: The time for deliveries to arrive, the time for the services to be installed and the time for the services to be taken down.

This lack of efficiency for option 1 would cause a huge decrease in reputation of the sports pavilion as well as: the less amount of parking spaces and the game may need to be pushed back and the pavilion will be held responsible. This reputation will make the pavilion look very bad and away teams may not want to use the pavilion again.

However option 2 is the best option as more money will be saved and it will be a lot more sustainable than installing services and then getting rid of them. More water will be saved as the taps in the away changing room are not working and less space will be wasted as they will still be able to use the away changing rooms but they will need to share facilities with the home team. I understand the fact that this may look unprofessional and can cause a lot of congestion within the pavilion however observing the huge loss of income, time and reputation option 1 provides it is a smarter decision to choose option 2.

In conclusion the best option is option 2 as it saves a lot of time and money and most importantly the reputation of the sports pavilion. This is only a slight hiccup on the amazing journey this pavilion has led to become the most carbon neutral and water efficient sport pavilion in the country and we cannot allow this hiccup to affect the reputation of this pavilion.

Yours sincerely, <first name> <surname>

Employer-Set Project - Observation Record (Task 2.1 Collaborative problem-solving)

8710-30 T Level Technical Qualification in Building Services Engineering for Construction

8710-033 Core: Employer-Set Project (Summer 2023)

Candidate name	<first name> <surname>
City & Guilds Candidate No.	ABC1234
Date	DD/MM/YY

Provider name	<provider name>
City & Guilds Provider No.	999999a

Record observation notes below to inform external marking. **Notes must be detailed, accurate and differentiating. They should identify areas of strength and weakness to distinguish different levels of performance quality for each of the prompts below.**

Communication skills
Could have been louder.

Collaboration/contribution
Listened to others, put forward some good points.

Methods to solve the problem
Gave some good opinions.

Any other aspects

Tutor signature	Date
X _____	DD/MM/YY

If completing electronically, double click next to the 'X' to add an electronic signature once the record is **finalised**.

Task 2.2 Evaluation

Assessment number (eg 1234-033)	8710-033
Assessment title	Employer-Set Project

Candidate name	<first name> <surname>
City & Guilds candidate No.	ABC1234

Provider name	<provider name>
City & Guilds provider No.	999999a

Task(s)	2.2
Evidence title / description	Evaluation
Date submitted by candidate	DD/MM/YY

Task 2.2 - Evaluation (<first name> <surname>)

I believe my work has met most of the requirements of the brief as I have evaluated the clients needs and have successfully identified the problems and resolved said problems. The tasks at hand that were given were challenging however I took it to rise up to the challenges and I tried my best to overcome these challenges. My work is overall acceptable however looking back there may be some improvements that could have taken place.

Research

During the research I believe I accumulated a good amount of research that would help me throughout the tasks. However I believe I did miss out on one important topic which was the research on safe isolation procedures. This lack of research may be the reason why I may lose marks. I attempted to recall my previous knowledge of safe isolation procedures but failed to recall such knowledge due to lack of revision and research. In the future I will make sure to create a checklist of individual topics I need to research and if I do mistakenly miss out a topic I will make sure to revise my knowledge of building service engineering. Overall, I believe the research I have completed is thorough and concise.

Report

I conclude that I have written an adequate report based upon my findings as I have mentioned all points required for my report except the point of doing safe isolation procedures due to my lack of research; however it is still briefly mentioned in the report to prevent a complete waste of an opportunity to gain marks. I believe my written report was the most successful task I have completed due to its concise language and its high amount of detail mentioned to help the client understand. Overall, I believe the report is the most successful task.

Project Plan

The project plan was, in my eyes, extremely well done due to the remarkable breakdown of the plan and the high level of detail included in each stage. This breakdown of each step in the form of a gantt chart will allow the client to understand each step of the project and the client will be able keep track of the project and will even understand each stage of the

project. However due to my high level of intricacy it caused me to be unable to write the supporting statement due to the lack of time. Overall I believe I have achieved high marks on this task and will ensure to be more time efficient and prepared for next time.

Presentation

For my presentation I successfully managed to create a detailed presentation for the client and managed to present well. However I may have missed out on some marks due to the lack of health and safety points in the powerpoint. However, I believe I redeemed myself when the teacher asked me questions related to health and safety. When presenting the powerpoint I did not reach the average time expectancy however it may be due to my fastened pace of speech in the beginning of the presentation. Therefore next time I will try and maintain a constant pace of speech and I will make sure to include more topics.

Collaborative Problem-Solving

In the collaborative problem solving I believe I inputted a fair amount of ideas towards the discussion. I also wrote an excellent email to fight for my point. However I believe I lacked an open mind during the discussion as I could not find a good reason as to why someone would waste an enormous amount of money and materials to provide for one game just because the taps were not in use. Therefore next time I will try to keep an open mind and evaluate both sides of the argument.

Conclusion

In these tasks I have learnt and mastered may skills such as identifying and researching topics, summarising research into an understandable report, plan an entire project step by step, do public speaking in front of an audience to portray my ideas and to communicate and collaborate with others to find the best solutions to problems that may unexpectedly occur. These important skills will be needed when dealing with real clients and their problems and I will need to break down and explain the solutions for them. In conclusion I believe I have completed the tasks fairly and I have completed all these tasks with high amounts of detail as I managed to break down each stage and topic to give the client a satisfactory level of understanding.

Get in touch

The City & Guilds Quality team are here to answer any queries you may have regarding your T Level Technical Qualification delivery.

Should you require assistance, please contact us using the details below:

Monday - Friday | 08:30 - 17:00 GMT

T: 0300 303 53 52

E: **technicals.quality@cityandguilds.com**

W: **http://www.cityandguilds.com/tlevels**

Web chat available **here**.