1.0 Ground Source Heat Pump

1.1 Introduction

This document has been prepared to present further information on the feasibility study carried out for the Jamestown Road development in relation to the technical feasibility of implementing a Ground Source Heat Pump as the main heat generation technology for the development.

1.2 Technology

1.2.1 Ground Source Heat Pump

At high level, ground source heat pumps (GSHPs) use refrigerants - chemicals with very low boiling points - which are vapourised using low-grade latent heat from the ground. The gas-state refrigerant is pumped by an electrically powered compressor to a heat exchanger where it condenses to liquid-state, releasing heat which may be used to provide heating to the building.

GSHPs use boreholes in the ground to provide latent heat to the heat pump system. As the underground temperature is subject to less seasonal variability than the air temperature, the average coefficient of performance of a GSHP system can be expected to be greater than an equivalent air source heat pump system. However, GSHP systems are dependent on suitable site area for boreholes to extract sufficient thermal energy from the ground to supply the building's heat load.

Boreholes may be orientated horizontally or vertically to extract geothermal energy (the figures below illustrate these arrangements). Horizontal boreholes require significant site area to accommodate the spatial requirements for pipework. Therefore, vertical boreholes are proposed as the most suitable potential option for the site, subject to detailed consideration of the site's ground conditions and geothermal potential.

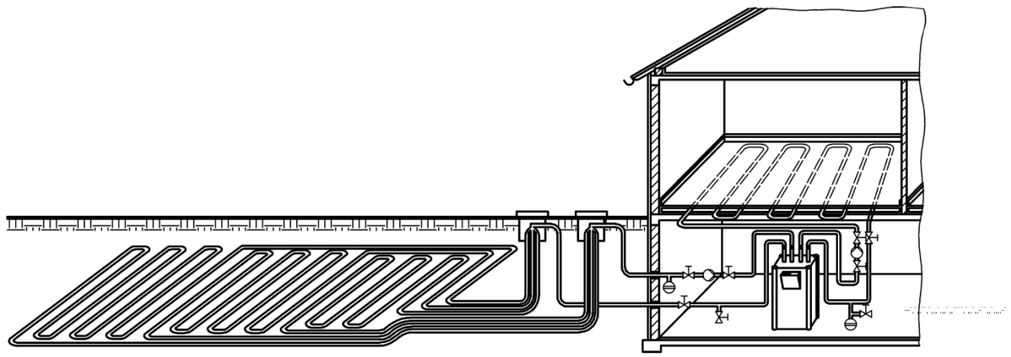

Figure 1 - Horizontal GSHP Borehole Arrangement (Extracted from BS EN 15450:2007)

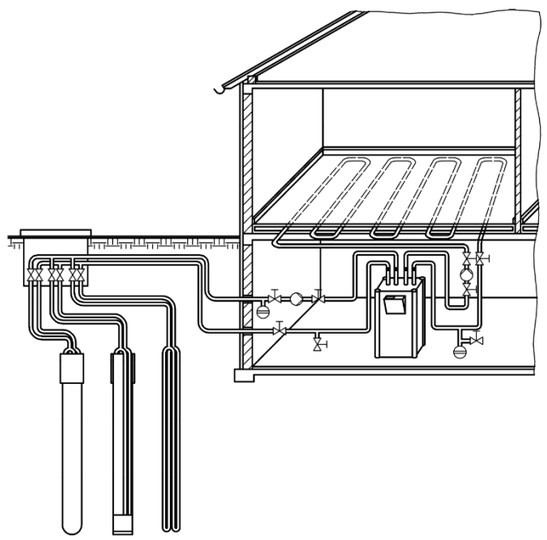

Figure 2 - Vertical GSHP Borehole Arrangement (Extracted from BS EN 15450:2007)

During Stage 2 WWL completed a high-level assessment of the suitability of GSHP at the proposed site, using typical parameters for borehole heat output and spacing requirements. The assessment assumes a typical output of 8kW per borehole, and a clearance radius of 6m around each borehole. An initial estimate of the building's heat loads has been provided to inform the assessment. The results are summarised in the table below.

Estimated Building Heat Load (kW)	No. Boreholes Required	Area Required to Meet Building Load (m^2)	Site Area (m^2)
978	123	13,911	2,697

Table 1 - Summary of GSHP Assessment

If 200m deep boreholes are used, the assumed heat output per borehole falls in the lower range of the specific heat extraction rate for an operational period of 2,400 hours, as provided in BS EN 15450:2007 Table A.3. The heat extraction rate depends on the ground type at the site and is anticipated to operate for more than 2,400 hours per year for the proposed development. Therefore, in practice, the available heat output may be lower than the assumed figure.

Based on these results, it is anticipated that a GSHP system will be unsuitable to meet the entire proposed development's heat demand. This assessment clearly identifies the space constraints at the site that inhibit the capacity of ground loops (boreholes or trenches) to meet the high heat energy demand of the proposed development.

In addition to the space requirements for sufficient heat generation, the densely built-up urban location of the proposed site is anticipated to have extensive underground infrastructure (pipes, cables, etc.) that would complicate installation.

From the assessment above it was concluded that ground source heat pumps would not be a feasible technology for the proposed Jamestown Road development.