



Brixton Heat Network Viability Assessment

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Glossary of terms

Table 1: Glossary of abbreviations used throughout this report

Abbreviation	Full name
ASHP	Air Source Heat Pump
BEES	Building Energy Efficiency Standard
BSRIA	Building Services Research and Information Association
CAPEX	Capital Expenditure
CHP	Combined Heat and Power
CIBSE	Chartered Institute of Building Services Engineers
COP	Coefficient of Performance
DH	District Heating
EC	Energy Centre
GIA	Gross Internal Area

Abbreviation	Full name
GSHP	Ground Source Heat Pump
GWh, MWh, kWh	Gigawatt-hour (units of electrical or thermal energy)
HNIP	Heat Networks Investment Programme
IRR	Internal Rate of Return
NOx	Nitrogen oxides
SCOP	Seasonal Coefficient of Performance
OPEX	Operational Expenditure
PW	Private Wire
REPEX	Replacement Expenditure
WSHP	Water Source Heat Pump

Executive Summary

Executive summary

This study has investigated the implications of implementing district heating in Brixton, serving planned new developments and the Brixton Recreational Centre. London Plan Policy puts district heating at the top of the Heating Hierarchy, meaning referable planning applications (like these ones are) would be expected to either connect to an existing network or show building inter-connectivity.

Buildings were grouped into 4 key clusters (where colours are denoted in Figure 0.1): planned developments on council owned plots (blue), the existing Brixton Recreational Centre (green), privately owned Town Centre plots (yellow) and the Homes for Lambeth Somerleyton Road development (red).

Four building inter-connection scenarios were modelled, using the blue plots as the anchor load and extending the network from there. The full network extent as depicted in Figure 0.1 has an estimated peak heat demand of 4.7MW and annual consumption of 4.5GWh. These are based on benchmarks and could be reduced through efficient building design.

For each connection scenario, four technology solutions were modelled:

- gas boilers and gas CHP,
- air source heat pump and gas boilers,
- ground source heat pump and gas boilers, and
- an all electric solution of air and ground source heat pumps.

Results of the network scenarios were compared to the likely alternative solution (the 'counterfactual') that would be pursued by developers in order to secure planning permission and meet building regulations, which was assumed to be individual building air source heat pumps.

Many network solutions were estimated to compete on capital cost with the counterfactual. Across all scenarios the ASHP and gas boiler solution has the lowest capital cost (CAPEX). The hybrid network solutions are eligible for Heat Network Investment Projects (HNIP) capital grants, but the impact of this has not been modelled.

All the hybrid fuel networks (ASHP/GSHP with gas boilers) perform better financially than the counterfactual. This is because heat generation costs are lower than the counterfactual due to gas meeting demand when heat pump efficiencies are lowest.

Connection of Somerleyton Road does offer performance improvements over the counterfactual, and provides an opportunity to pursue a lower carbon heating strategy than the CHP currently proposed for that site. The pipework length joining the site to the other developments runs along the busy Coldharbour Lane; this route needs further viability assessment.

The counterfactual building-by-building ASHP requires a significant amount of roof space for the energy plant on each building. In some instances, such as in the developments

under the railway arches, this may prove difficult. In contrast, district heating schemes can deliver the required heat using up to 50% less space overall. A high level study has shown that this could be housed on a singular council owned plot in the city centre or in Somerleyton Road. This would allow for the other rooftop space to be used for other amenities or solar PV, should the development be required to reduce carbon emissions further.

District heating options with gas boilers have higher carbon emissions than the counterfactual. Electric backup boilers were not investigated, but could offer good compromise for capital cost and space requirements in comparison to the full ASHP/GSHP network solution. Operating costs will be higher than the counterfactual, making this solution higher cost for consumers. It would also increase the electrical grid connection capacity requirement, introducing further risk to network implementation.

For a network to be viable, early communication with developers is vital, helping ensure their buildings' heating systems are designed in a way that is compatible with the network. Further investigation of the following key points would give greater certainty on viability:

- Whether electric backup boilers could be a viable alternative to gas boilers. This requires:

- Modelling financial performance; and
- Understanding the implications of higher capacity grid connection;
- Technical viability of the proposed connection route between Somerleyton Road and the Town Centre;
- Include development phasing plans in the modelling;
- Further refine the space requirements of the proposed scheme; and
- Engage with Somerleyton Road developer to understand implications of using/ hosting different heat generation technology than the proposed CHP.

In final conclusion, a heat network in Brixton could save carbon and be financially viable, as well as saving considerable space for developers.



Figure 0.1 Proposed network

1. Introduction

1.1 Introduction

Arup was commissioned by Lambeth Council to carry out a high-level feasibility study of district heating (DH) in Brixton town centre.

District heating is a method of distributing heat, from an energy centre or centres to residential and commercial customers for space and water heating.

District heating can enable heating decarbonisation through the integration of low carbon technologies, which would otherwise not be economic or practical. By aggregating heat requirements of various buildings, district heating offers benefits in terms of overall plant sizing, 'waste heat' use, energy storage, supply technology flexibility and capital costs compared to a building-by-building approach.

Now, with Lambeth council's announcement of a climate emergency and pledge to reduce carbon emissions to net zero by 2030, alongside the high level of planned development in the area, it is an opportune time to assess the potential of a DH network. The Greater London Authorities (GLA's) heating hierarchy recommends connection to a district heating network as a priority for new developments.

Study Area

Brixton town centre is a densely populated area with a well-used market behind the station. The developments in this study lie

within this area and at Somerleyton road. There is significant rail and road infrastructure immediately adjacent to the sites, making construction very challenging. Furthermore, installation of pipework will have to be coordinated through rail underpasses, adding further risk.

The buildings have been divided into four clusters based on their ownership/planning status.

Our Approach

The key heat demand clusters are the Brixton recreation centre, Plots 1, 2A & 2B, plots 3, 4 & 5 and the Somerleyton road development, as shown in Figure 1.

An assessment of potential supply options was carried out, considering the suitability of various heat (and power) generating technologies which could serve the DH scheme.

Economic and carbon analysis was conducted to compare the scenarios against an agreed counterfactual of building-by-building air source heat pumps (ASHPs). ASHPs have been chosen as the counterfactual technology to be in alignment with the draft New London Plan and Part L of the Building Regulations.

Potential energy centre locations are identified and the merits of each considered as part of this study.

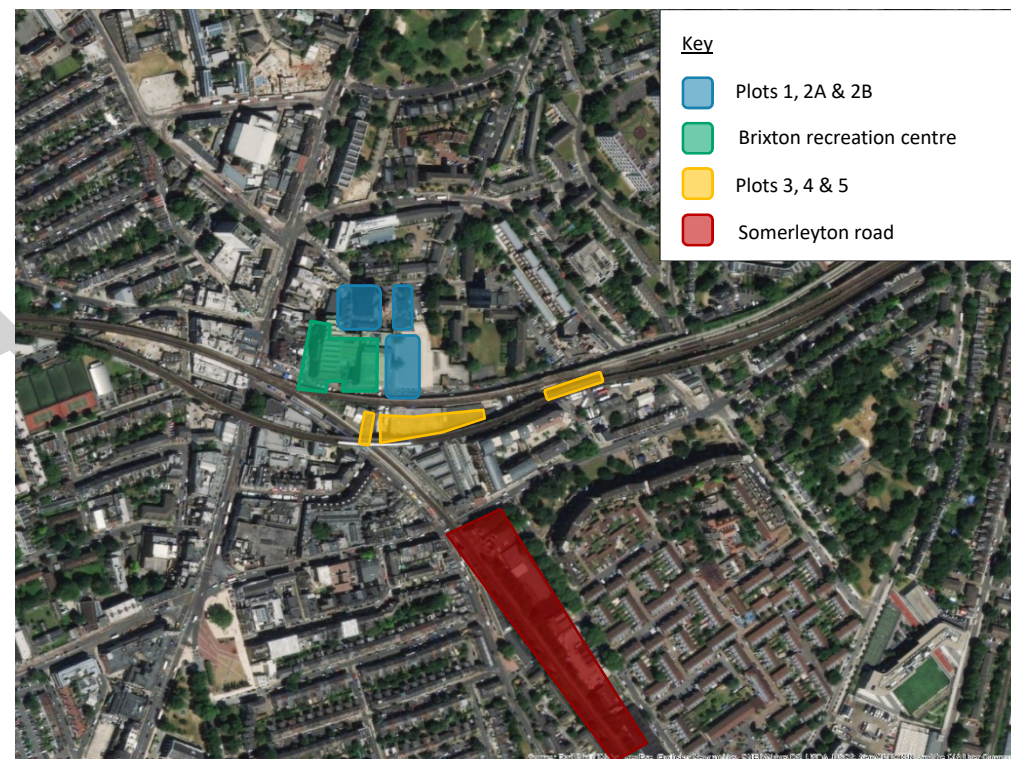


Figure 1.1 Study area map

2. Connection scenarios

2. Connection scenarios

2.1 Introduction

Heat load assessment

A demand and consumption assessment was carried out to estimate the building's heating loads. For planned developments this was based on the Building Energy Efficiency Standard (BEES) benchmarks for annual heat requirements, and Building Services Research and Information Association (BSRIA) rule of thumb for peak heat demand. High-level diversity factors between 70-90% were assumed depending on the level of building inter-connectivity. For the Brixton recreation centre, annual heat requirements were obtained from the WSP report.

Connection Scenarios

Different scenarios for connecting buildings to a network have been tested as part of this study as follows:

- Plots 1, 2A & 2B only;
- Plots 1, 2A, 2B, 3, 4 & 5;
- Plots 1 – 5 & the Recreation Centre;
- Plots 1 – 5, the Recreation Centre and Somerleyton road.

Plots 1, 2A & 2B

These council owned buildings make up the anchor loads of the district heating scheme and as such are included in all scenarios. Plots consist of 207 dwellings and 9,500m² office/retail space.

Plots 3, 4 & 5

Plots 3, 4 & 5 are situated between two over ground railway lines. Parcel 3A has a gross internal area (GIA) of c. 7,000m² of work/retail space; the others have a combined retail space of c. 8,000m². The location of the these plots will make the pipework and routing of the district heating network more challenging.

Recreation Centre

The recent WSP report proposes various future scenarios for this existing space including provision of work space, refurbishment of the leisure centre and building a new leisure centre. The indicative plan for the space has a GIA of 1105m². The Recreation Centre has recently replaced their gas boilers but have a shortfall of 36% of their energy demand. In this study we anticipate that the recreation centre will continue to use these boilers for the remainder of their lifetime and connect to the network to provide baseload heating.

Somerleyton Road

The redevelopment of Somerleyton road is south of the rest of the network. It is proposed to provide c.300 residential units with a further c. 9,000m² of non-residential space, split over 6 blocks. Somerleyton road would require 210m of additional pipework to connect. scenario.

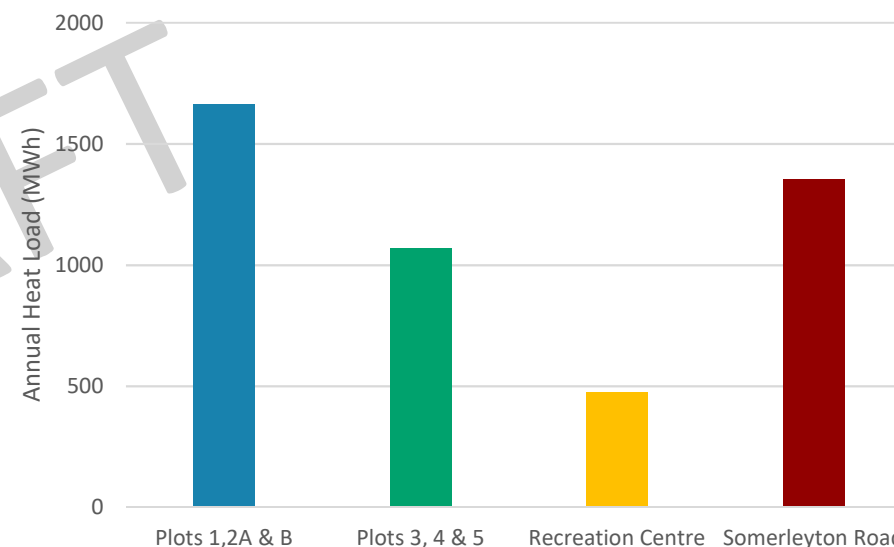
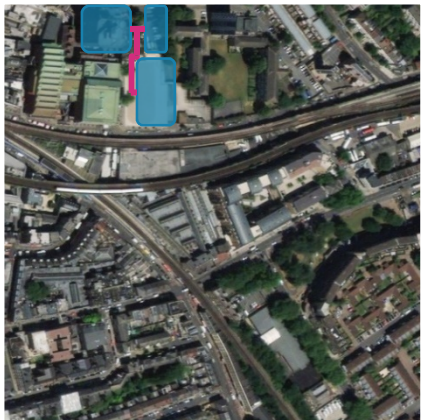
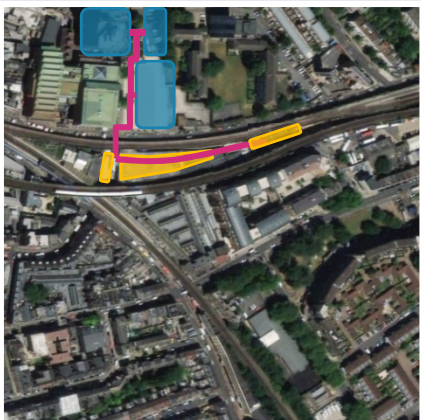


Figure 2.1 Heat load summary

2. Connection scenarios

2.2 Modelled scenarios and associated network routing

Table 2.1 Summary of the four connection scenarios

Scenario no.	1	2	3	4
Clusters included	Plots 1, 2A & 2B	Plots 1, 2A, 2B 3, 4 & 5	Plots 1, 2A, 2B, 3, 4 & 5 and recreation centre	Plots 1, 2A, 2B, 3, 4 & 5, recreation centre and Somerleyton Road
				
Indicative Heat consumption (GWh)	1.7	2.7	3.2	4.5
Indicative Peak demand (MW)	1.3	2.5	3.8	4.7
Network length (m)	90	340	350	560

3. Supply technologies

3. Supply technologies

3.1 Introduction

Heat supply technologies

For this study Arup has considered various heat sources and have assessed them based on their economic and carbon performance whilst also considering their capacity, practicability and availability in Brixton.

Typically district heating networks include both baseload and peaking plant. The baseload technology provides the majority of the annual heat load and is generally operational all year round and should therefore be low carbon. Peaking plant is sized to supply during times of peak demand and will typically run for a shorter duration throughout the year (mainly in the winter), and may not be low carbon.

Gas-fired CHP

Gas-fired Combined Heat & Power (CHP) generates electricity and heat from combustion of gas. Revenues from electricity production are typically maximised by operating the CHP as a baseload technology.

Before significant UK grid decarbonisation, CHP offered carbon emission savings by offsetting power that may have otherwise been generated by coal.

With increased renewable electricity penetration, CHP is no longer viewed as a low carbon technology. Due to updates to the SAP carbon emissions factors, CHP will no longer provide the carbon emission savings

required to secure planning permission when assessing a development proposal under Part L of the Building Regulations. In addition to this, CHP has poor air quality implications.

Until recently, CHP was the business as usual technology for new developments in London. As such, it has been included in this assessment to illustrate the implications of electrically derived heating.

Gas boilers

Gas boilers are a low cost, low space technology, often used as peaking plant in district heating (due to their high carbon emissions per unit heat output). They are typically used alongside a lower carbon baseload.

Whilst NOx emissions are lower per unit heat than CHP engines, care must be taken around air quality implications. This can be achieved through the use of ultra-low NOx gas boilers; flue gasses must be vented to atmosphere at an appropriate height above surrounding buildings.

Ground Source Heat Pumps

Ground source heat pumps (GSHPs) harness low grade heat from the ground, using electricity to raise the heat to useful temperatures. A well designed system may be able to provide 4 units of heat for every one unit of electricity consumed.

'Closed-loop' systems incorporate sub-surface heat exchangers that can recover heat from or reject heat to the ground. This system is well suited to applications where there are balanced heating and cooling demands over the year, such that the net ground load is as close to zero as possible over the year.

Open loop systems extract water from an aquifer or water body at one location and reinject it in another. Due to the load profile of development in Brixton, and space constraints in the area, it is thought open-loop is more viable. The Environment Agency GSHP screening tool indicates that 50-100m deep boreholes would be required to reach the London aquifer. High level temperature and flow yield assumptions have been made to assess this technology currently.

Air source heat pumps

Air source heat pumps (ASHPs) harness energy from the ambient atmosphere. Inherent lower air temperatures than those found underground make ASHPs less efficient than GSHPs.

Due to their cost, space requirements and associated carbon emissions for the provision of heat, ASHPs are increasingly becoming the go-to heating technology for new developments.

They require access to ambient air and as

such are commonplace on the roofs of buildings or in an outdoor compound. Where large banks of ASHPs are installed, care must be taken around formation of ice on and under evaporator coils, noise and the potential for provoking a 'coolth-island' effect, i.e. large volumes of cold air.

However, ASHPs have the advantage that they can be utilised whenever external/roof space is available, and are not resource and location dependant like GSHPs and surface water heat pumps. In addition, ASHPs are generally a well-established technology, with lower costs and complexities compared to GSHPs or surface water heat pumps.

Waste heat from the London Underground ventilation shafts

Through a separate study being undertaken by Arup for TfL, a London Underground ventilation shaft was identified on the site of the Somerleyton Road development. Due to elevated temperatures on the London Underground (LU) network, heat recovery from the air flow there could offer high heat pump efficiencies.

However, following further investigation as part of that study, it has been found that for various reasons heat recovery at that location would be particularly difficult and not yield enough energy to make the system worthwhile installing.

3. Supply technologies

3.2 Summary of four technology scenarios

Table 3.1 Summary of four technology scenarios

Scenario	Technology Scenario	Ambition level	Baseload technology	Peaking technology	Considerations
A	Traditional	Low	Gas-fired CHP	Gas boiler	- Carbon intensive technology - May be difficult to comply with planning policy - Poor air quality implications - Electricity is assumed to be exported to grid, sold at c. 50% of the retail price
B	Hybrid ASHP	Medium	ASHP	Gas boiler	- Diverse fuel supplies means an increased reliance against fluctuations in fuel prices. - The gas boiler peaking plant mitigates against the risk of ice build up during coldest days (i.e. in the case of ASHP peaking plant). - Lower efficiency than ground or water source heat pumps.
C	Hybrid GSHP	Medium	Open-loop GSHP	Gas boiler	- Higher efficiency than air source heat pumps. - Preliminary investigations suggest open loop technology may be viable at this locations - Minimum 100m spacing required between extraction and injection wells - Diverse fuel supplies means an increased reliance against fluctuations in fuel prices. - Amount of heat that can be extracted from the aquifer is heavily reliant on the aquifer flow and water table height at the location. There are inherent risks with predicting this and it is likely a test borehole would be needed to confirm potential.
D	All Electric	High	Open-loop GSHP	ASHP	- See also above - Lowest carbon solution - Greatest space requirement - No on-site combustion, with benefits in terms of local air quality. - Potential to achieve zero-carbon heat supply through the use of renewable electricity. - Lower resilience as it is reliant on only one energy vector. - Risks around ice build-up. This can be mitigated against in early design stages. - Lowest heat pump efficiency, therefore highest cost

4. Modelled scenarios

4. Modelled scenarios

4.1 Summary of 16 modelled scenarios

Scenarios

16 scenarios have been modelled to assess the impact of the supply technology and the extent of building inter-connectivity. A summary of the technology supply assumptions used is described below.

Traditional scenario

This scenario assumes CHP to supply 75% of the heat consumption and the gas boiler to supply the remaining 25%. In this scenario the gas boiler supplies 80% of the peak demand. This is in line with requirements of HNIP funding, a £320m UK Government fund for heat network capital.

Hybrid ASHP

This scenario assumes the ASHP 60% of the heat demand and the gas boiler to supply the remaining 40%. In this scenario the gas boiler supplies 80% of the peak.

Hybrid GSHP

A high level geological survey has been conducted for the proposed Ground source heat pumps (GSHPs). Assuming a temperature differential of 5°C and an extraction rate of 10l/s a singular well could produce 200kW. This means that depending on the size of the network the GSHP can supply between 70-30% of the heat demand and between 22-6% of the peak. The remaining demand would be met by the gas boiler.

For an open-loop GSHP an indicative distance of 150m is required between flow and extract points. This may be achievable within Plots 1 2A & B, although further research is required.

It is assumed wells cannot be drilled between railway lines due to difficulties of accessing area with a drilling rig, and complications around Network Rail.

All electric

The all electric scenario assumes the same GSHP constraints but uses air source heat pumps (ASHPs) to supply the remaining supply and peak load.

There are risks around the assumption that ASHPs can be used to provide peak demand, as when temperatures drop, heat pump output capacity falls too. Whilst there are examples in Denmark, it is not common in the UK. Below about 6°C, defrost cycles have to be used to prevent freeze up of evaporators. This further reduces efficiency. Urban 'coolth' island effects are also a risk, whereby cool air produced by the evaporators sits around at ground level.

Designing an all-electric heat pump solution would require very low network temperatures in order to raise efficiencies. This has not been modelled here.

Table 4.1 Summary modelled technologies and plant capacities

Scenarios: Connection → Technology ↓	1	2	3	4
A	CHP: 240kWth Boiler: 1.1MW	CHP: 440kWth Boiler: 2.1MW	CHP: 610kWth Boiler: 2.9MW	CHP: 720kWth Boiler: 3.4MW
B	ASHP: 240kWth Boiler: 1.1MW	ASHP: 440kWth Boiler: 2.1MW	ASHP: 610kWth Boiler: 2.9MW	ASHP: 720kWth Boiler: 3.4MW
C	GSHP: 260kW Boiler: 1.1MW	GSHP: 240kW Boiler: 2.4MW	GSHP: 210kW Boiler: 3.4MW	GSHP: 220kW Boiler: 4.0MW
D	GSHP: 260kW ASHP: 1.1MW	GSHP: 240kW ASHP: 2.4MW	GSHP: 210kW ASHP: 3.4MW	GSHP: 220kW ASHP: 4.0MW

5. Techno-economic analysis

5. Techno-economic analysis

5.1 Capital cost

Capital cost

The capital cost (CAPEX) of the project is made up of the connection costs, plant capital costs, pipework costs and the costs for the energy centre, space and utility connections. The techno-economic modelling has revealed the following conclusions about the CAPEX of the proposed networks.

- As would be expected, the CAPEX of the projects increases with the size of the scheme connected. This is due to the longer network pipe lengths as well as the increased plant capacities.
- Across all of the connection scenarios the air source heat pump (ASHP) and gas boiler solution has the lowest CAPEX. The major contributing factor to this is the comparatively cheaper plant capital cost of the ASHP to the Ground source heat pumps (GSHPs) and CHP.
- Across all of the scenarios the all electric GSHP / ASHP solution has the highest CAPEX. This is primarily due to the ASHP being relied on to provide peaking heat demand rather than the significantly cheaper gas boiler. An alternative all-electric solution is to use electric **backup** boilers. Whilst these are cheap and take less space, they are very expensive to operate. The cost to the occupant could be mitigated by installed on-site renewables such as PV panels.

- Grants from HNIP for up to 50% of the capex are for between £0 and £5million for projects that supply 75% of heat from CHP or 50% of their heat from renewable sources. Whilst CHP and hybrid ASHP and all-electric scenarios meet this requirement, GSHP scenarios 2,3,4D do not.
- It should be noted that this cost represents the capital expenditure only and does not capture the operational costs or costs associated with carbon offsetting.
- A 50% optimism bias has been allowed for in the CAPEX assumptions to adjust for the high level nature of this study.

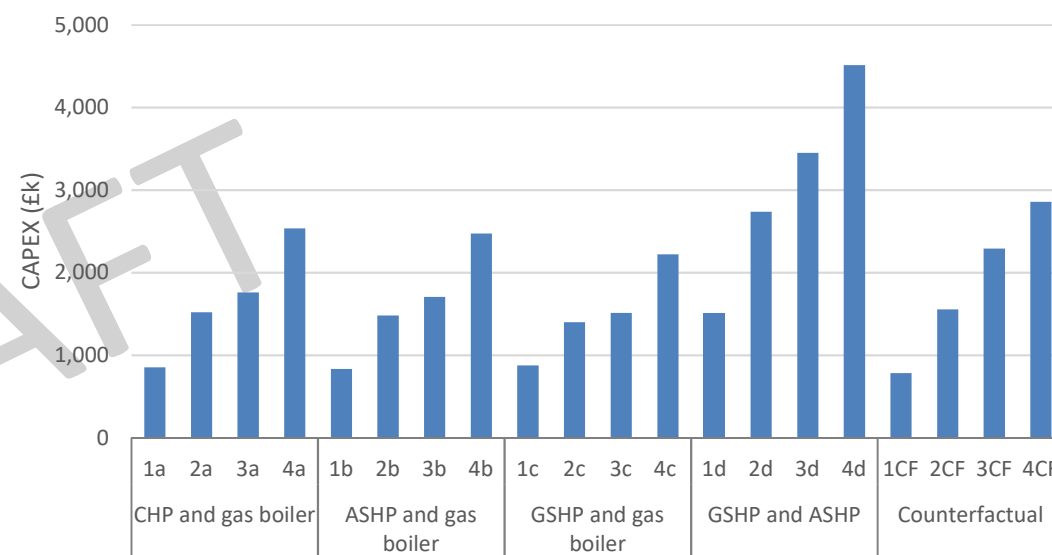


Figure 5.1 CAPEX of each scenario

5. Techno-economic analysis

5.2 Economic analysis

Impact of the counterfactual

Traditionally, a dwelling by dwelling gas boiler solution would be assumed for the counterfactual heat network. However in alignment with the draft New London Plan and Part L of the Building Regulations, a counterfactual of building by building ASHP have been used for this assessment. This assumes a partially centralised system in which roof space and an energy centre would be required in each building.

The IRR values presented in this report are as a comparator to the counterfactual, and do not represent a true project IRR.

Assumptions for the capital cost (CAPEX), operational cost (OPEX) and replacement cost (REPEX) values of the counterfactual case were used to derive the counterfactual variable price of heat based on the heat delivered under each scenario, found to be around £0.13/kWh. This price of heat was then adopted in the district heating scenarios, with financial performance being compared to the building-by-building ASHP counterfactual.

All of the results should be viewed as a comparative to the counterfactual and as indicative predictions of the financial performance of the schemes only.

Economic results

The high-level techno-economic modelling has identified the following conclusions about

the proposed networks in comparison to the counterfactual:

- Hybrid fuel networks (ASHP.GSHP & boilers) give a higher return than the counterfactual over 40 years;
- Network economic performance increases with the connection of plots 3, 4, 5 and the Brixton Recreational Centre; district heating typically benefits from economies of scale. Additionally, more connections brings greater diversity to peak load, reducing the overall network peak and lowering plant requirements (CIBSE CP1);
- Economic performance decreases with the addition of the Somerleyton Road development due to the relatively long pipework length in comparison to connected heat load;
- Ground source heat pump (GSHP) scenarios perform better than air source heat pump (ASHP) scenarios due to higher Coefficient of Performance (COP). There are higher risks associated with this system as the heat output can only be confirmed after drill testing;
- The 'all electric' scenarios perform poorly due to the high CAPEX and OPEX of using ASHPs as peaking plant;
- Private wire electricity export from CHP is not included but would improve the economic case for scenario 1 - 4.

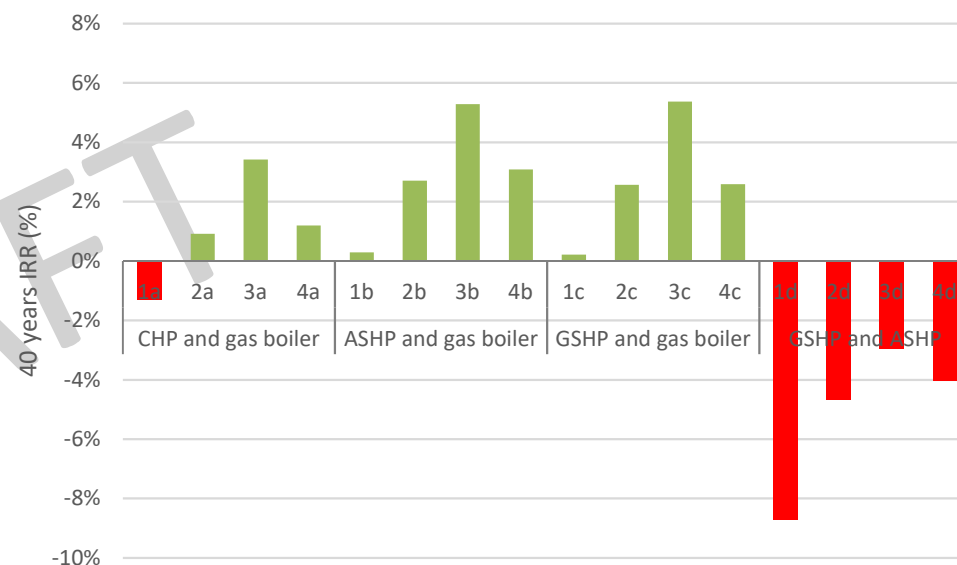


Figure 5.2 40 years comparator IRR of each scenario compared to the counterfactual (not actual project IRR)

5. Techno-economic analysis

5.3 Carbon emission assessment

Part L of the Building Regulations requires developers to show how a 35% reduction in carbon emissions against a 'notional' building will be met. This is achieved in many ways, largely through energy efficiency measures and the use of low-carbon or renewable energy sources.

Known as the 'Standard Assessment Procedure' (SAP), carbon emissions are calculated with published factors for various fuels. In London, the draft New London Plan requires new buildings to estimate their energy consumption using the latest SAP 10 carbon emissions factors. These figures favour electric solutions more than the previous SAP figures. Furthermore, in London, developments are required to contribute to an offset fund in order to be 'net zero carbon'. The amount paid is relative to the emissions remaining post Part L assessment and in Lambeth is equal to £60/tonne over 30 years, payable in year 1. This has significantly increased the value of low carbon solutions in London.

The counterfactual chosen in this study (a building by building ASHP solution) represents an ambitious, all-electric and low carbon solution, as shown by the blue line in Figure 5.3. Solutions shown here with gas peaking plant give higher carbon emissions than the counterfactual, and therefore will be subject to higher carbon offset payments (this

is accounted for in our model).

The 'notional' building calculation assumes a gas boiler for the baseline carbon calculations, as shown by the red line in Figure 5.3, calculated over a 40yr period.

The district heating solutions modelled here all emit more carbon than the ASHP building-by-building counterfactual. Hybrid and all electric HP solutions emit less carbon than the 'notional' building baseline, but when CHP is in the mix, it does not.

Meeting planning policy and Building Regulation requirements can be achieved in many ways other than just through low carbon heating solutions; scenarios that emit more carbon than the counterfactual could avoid higher offset payments through implementation of other interventions such as higher energy efficiency measures or installation of solar PV.

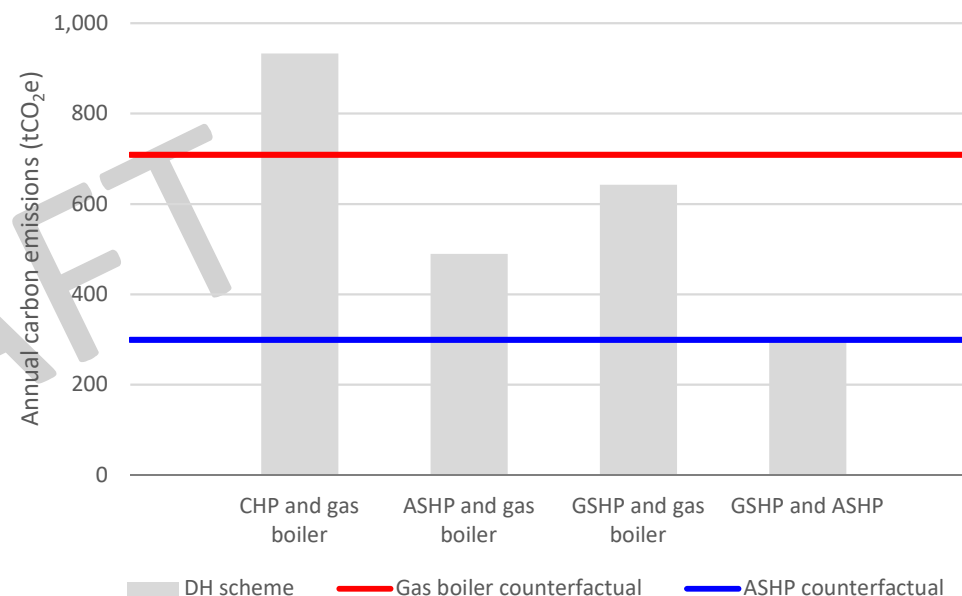


Figure 5.3 Annual carbon emissions for scenario with Plots 1, 2A, 2B, 3, 4, 5 and the Recreation Centre

6. Energy Centre Locations

6 Energy Centre Location

6.1 Space requirements

Counterfactual space take

The counterfactual space take far exceeds that of any of the DH network solutions. The space required is approximately double that of the largest DH network energy centre.

Figure 6.2 shows the percentage of its roof space each building would need to reserve for plant space for the ASHP counterfactual.

This shows that it is possible for all buildings to host the counterfactual ASHP solution but that it would take up significant amount of valuable roof space that could not then be used for PV or other uses such as terraces or green roofs.

Space requirements

The space requirement of the energy centre for each scenario has been calculated based on high-level industry standards and is inclusive of ancillary equipment.

External space is required in some scenarios for the evaporators of the air source heat pumps (ASHPs), and internal space is required for other plant items such as boilers, CHPs and heat pump units.

This analysis reflects on if the central plant of the DH network could be housed in either the recreation centre or in one of the council owned developments, plots 1 2A & B.

The recreation centre has a 200m² basement space that could be available for an energy

plant (Buro Happold Report – Brixton WP2/3, Detailed Feasibility Report, p38). The external roof space of the Brixton recreation centre is 178m². The actual available space should be confirmed in a more detailed feasibility study.

The largest of the council owned planned developments is parcel 2A with a ground floor internal area of c.2,500m² and an assumed available external roof space of 400m².

Figure 6.1 shows in green all of the scenarios that are possible given the space restrictions of each building. The scenarios in red show when the required space is not available on a single building.

For all the CHP and Ground source heat pump (GSHP) scenarios both the recreation centre or council building have sufficient internal space for the energy centre.

In scenarios using the ASHP as a baseload with peaking gas boilers the council owned building is the only building with sufficient roof space.

In the all-electric scenarios the space requirement of the ASHP in the three larger networks is too large for any single building to house the energy centre. This could be reduced through the use of electric backup boilers, but the operational costs of this system would be particularly high.

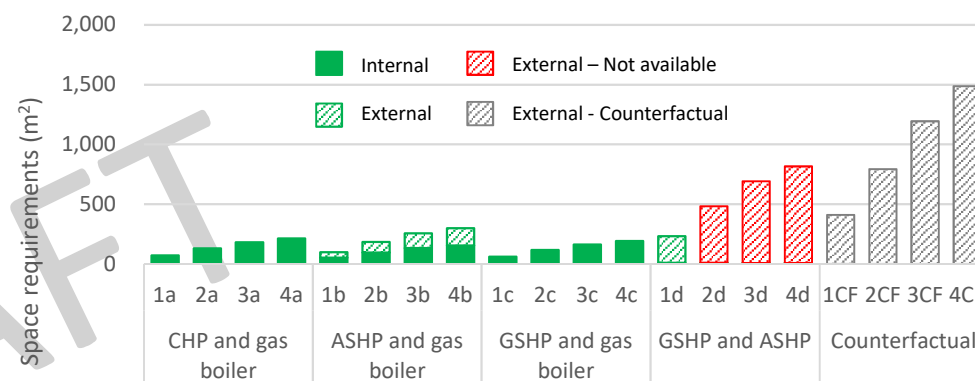


Figure 6.1 Space take requirement of each scenario

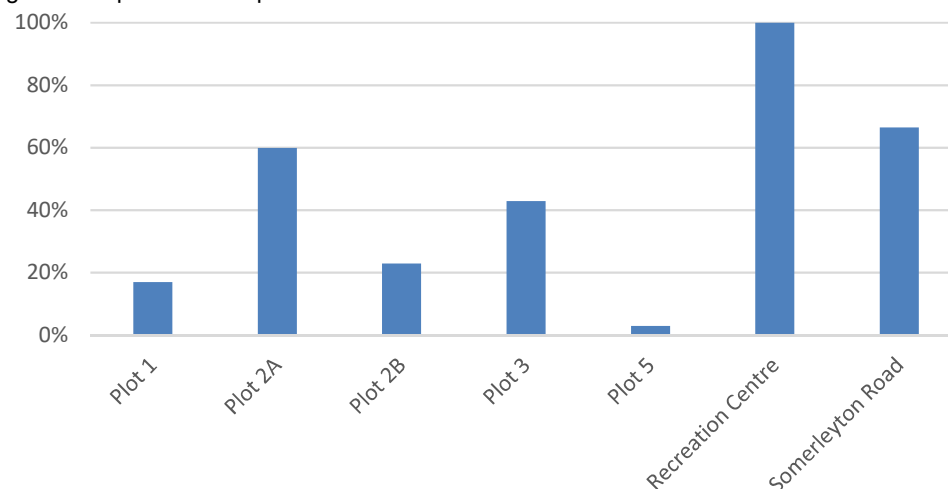


Figure 6.2 The percentage of roof space required by the ASHP counterfactual for each building

6 Energy Centre Location

6.2 Proposed locations

Energy centre location

Arup has proposed potential sites for the energy centre. The key considerations for selecting an energy centre are the ownership of the building, available space and access. Each of these metrics are discussed further in this section and recorded in Table 6.1.

Ownership

The council has set ambitious targets for emissions reduction of its own portfolio of buildings. It is therefore likely to be more motivated to connect to a DH network and even host the energy centre than a private developer would be. As such, the only areas considered for Energy Centre location are the Brixton Recreational centre, plots 1, 2A and 2B and Somerleyton Road.

Space

The highest performing DH network in both economic and carbon terms is the ASHP led solution. In the largest network (4B), it requires approximately 150m² internal space and 140m² external space. All of the proposed locations have sufficient space to house this solution.

Access

Access to the energy centre is important not only for construction phase but also for the maintenance of the plant. Access constraints considered are major roads or railways and

the height of the building. Hosting plant on building roofs would likely need cranes for installation and potentially future maintenance.

Exclusions and assumptions

The council shall require further in depth planning for the energy centre beyond this high level study. No site surveys have been undertaken, and broad assumptions have been made on space requirement and availability for the purposes of this assessment. Should the council wish to pursue a district solution, the energy centre and its location shall need to be a focus of further design development.

Table 6.1 Potential energy centre locations

Proposed Location	Considerations	RAG score
Brixton recreation centre	- Council owned 178m² external roof space, 200m² internal plant area - Roof is existing, so structure is likely not capable of supporting additional infrastructure, eg Air source heat pumps (ASHPs) which require outside space. Surveys required. - No known significant access constraints 6 storeys - Brixton Recreation Centre in grade II listed.	
Plot 1	- Council owned 446m² external roof space - No significant access constraints - Planned development so can be designed around proposals 13 storeys	
Plot 2A	- Council owned 416m² external roof space - No significant access constraints - Planned development 15 storeys	
Plot 3	- Privately owned 514m² external roof space - Between viaducts – very challenging to access roofs for construction/maintenance. - Planned development 13 storeys	
Somerleyt on Road	- Council owned 4,000 GEA - Is c.210m from closest part of the network - Planned development of 304 homes - At planning stage and could adapt energy centre.	

7. Conclusions and Next Steps

Conclusions

This study has investigated heat network opportunities for connection of various developments in Brixton town centre, as well as the existing Brixton Recreational Centre. Various technical solutions and building connectivity scenarios have been compared to an assumed counterfactual solution.

The counterfactual solution for use in the comparison was chosen to be an air source heat pump (ASHP) system for each individual building. This was selected based on it being the typical low carbon heating solution chosen by developers in order to secure planning permission under the London Plan and Part L of the Building Regulations.

Connection scenarios

Carbon, cost and space requirements for four connection scenarios (i.e. the extent of network inter-connectivity) were presented:

1. Plots 1, 2A & 2B only;
2. Plots 1, 2A, 2B, 3, 4 & 5;
3. Plots 1, 2A, 2B, 3, 4, 5 & Recreation Centre;
4. Plots 1, 2A, 2B, 3, 4, 5, the Recreation Centre and Somerleyton road.

Pipework routing

The study area is a particularly congested part of Brixton, with three overground railway lines separating the town centre developments from the Somerleyton Road development. Indicative routing shows

pipework joining these two areas crossing under the railway on Valentia Place then running south-west along Coldharbour Lane.

The viability of this route and the existence of other buried services that may prevent installation has not been investigated, but is a high risk aspect of whether this connection is deliverable.

Technology scenarios

Under each connection scenario, four potential technology solutions for supplying heat to the network were modelled:

- A. Gas CHP + Gas boiler;
- B. Air source heat pump + Gas boiler;
- C. Open loop aquifer based ground source heat pump + Gas boiler; and
- D. An all electric solution with ground and air source heat pumps.

Techno-economic analysis

Network solutions with gas boilers installed to provide peak demands (with low carbon technology meeting the 'base-load') were found to be cheaper than the alternative. This is due to the relative low cost of gas boilers in comparison to air source heat pumps.

Connecting buildings together provided better economic performance in general in comparison to the counterfactual.

Whilst ground source heat pump (GSHP) scenarios perform best due to higher

efficiencies, there are inherent risks with their use due to uncertainties of the ground conditions at the site. Whilst initial study shows that the technology could be feasible (see Appendix A), further analysis is required and test wells may be needed to corroborate assumptions.

The all-electric network solution performs worse than the counterfactual because the increase in overall heat pump efficiency obtained through the use of GSHP is not offset by the negative effects of pipe losses and pipework capital outlay.

If the council wants to pursue an all-electric solution, it is recommended to go with the counterfactual or to extend the study to investigate electric backup boilers.

The network solutions with gas mean that carbon emissions attributed to heating are higher than the counterfactual. This means additional low carbon measures would be needed (e.g. solar PV) in order to compete with the counterfactual on carbon. The alternative is making higher carbon offset payments in order for the building to be net zero carbon, as necessary under the draft New London Plan. The CHP and gas boiler solution emits the most carbon.

Space requirements

The counterfactual building-by-building air source heat pump approach requires the greatest amount of space. By implementing a district network, the council can achieve space savings through provision of peak heat demand with gas boilers. This frees up valuable roof space for other uses like solar PV and terraces/roof gardens.

The best performing and lowest risk district heating solution is to use air source heat pump (ASHP) and boilers, which requires a certain amount of roof space for the heat collectors of the ASHPs (but far less than the counterfactual). Whilst the Brixton Recreational Centre may have some internal area available for hosting of plant, it is not known whether this space is available, nor whether the roof would be capable of supporting the weight of the ASHPs. Flues for gas boilers would be necessary, which may have planning implications. It is recommended to use a new, purpose built space in one of the new plots.

By incorporating the Energy Centre into the design of the proposed council developments (Plots 1, 2A & 2B or Somerleyton Road), structural support for ASHPs can be planned in early, and space properly ring-fenced. Noise implications of air source heat pumps should also be considered, with roofs of higher buildings a key location.

Recommendations and next steps

Recommendations

District heating in Brixton town centre could help the development save significant overall plant space against the likely, all-electric, alternative of building-by-building air source heat pumps (the counterfactual). It could also save carbon emissions and be financially viable and so it is recommended further study is undertaken.

The GLA recommends that all major developments should connect to local existing or planned heat networks as a priority over using available local secondary heat sources, such as heat pumps. Installing a network would therefore be supported by planners and could help remove some of the risks around being granted planning permission.

Of the technology options modelled, those where gas boilers are used to meet peak heating loads, network options have poor air quality and carbon emission implications when compared to the counterfactual.

An alternative solution is to use electric backup boilers to meet peak demands – an option not modelled in this report due to concerns over the ability for it to compete financially with the counterfactual. There is affordable housing proposed in the Town Centre developments, so any solution that could potentially increase energy costs presents fuel poverty risks. Installation of

solar PV may help offset the additional power requirements for the electric backup boilers.

The connection of Somerleyton Road could offer good financial performance when compared to the counterfactual. This development, which has planning granted with a CHP fired network, should reassess its heat generation plant to look into alternative, lower carbon solutions. In particular, looking at availability of space for air source heat pumps (ASHPs) would help indicate whether this site could host the energy generation plant for the network. Due to the fact that Somerleyton Road is planning to build its energy centre in Phase 2 (starting 2021), hosting the energy centre for all development sites may be an enabler for the area-wide district scheme. However, there are risks around the route identified between Somerleyton Road and the other development sites which need mitigation against through ground surveys.

All electric solutions would increase the sites' demand for electricity, which presents risks around the ability to secure the necessary supply of power from UKPN. Any demand over 300kVA is likely to require reinforcement. Understanding the grid capacity limitations in the area is crucial if the council wants to pursue an all-electric solution (especially one with all-electric backup boilers).

The ASHP/gas boiler hybrid network offers the best combination of low risk and good financial performance. If this solution is pursued, some roof space on plots 1, 2A or 2B or in Somerleyton Road would need to be secured. Boiler plant and other ancillaries could be located in the existing Brixton Recreational Centre. Further design work is necessary to refine the required plant spaces and to give greater certainty on capital costs.

Next steps

District heating could offer a cost and carbon competitive solution for heating in Brixton, but needs further investigation. We propose further reallocation of decentralised energy enabling project (DEEP) funds from the Nine Elms area to Brixton, to investigate the following:

- Whether electric backup boilers could be a viable alternative to gas boilers. This requires:
 - Modelling financial performance with electric backup boilers; and
 - Engaging with UKPN to understand the implications of increased grid connection capacity requirements;
- Technical viability of the proposed connection route between Somerleyton Road and the Town Centre developments;
- Development phasing plans through techno-economic modelling, to assess effects of time on financial performance;
- Further refinement the space requirements of the proposed scheme; and
- The appetite of the Somerleyton Road development team (Homes for Lambeth) to understand implications of using different heat generation technology for the site than the proposed CHP, as well as the ability to host plant on that site.

8. Report Addendum

8. Report Addendum

8.1 Introduction

Report Addendum

Sections 1-7 of this report represent the outcomes of the initial feasibility study for the heat network in Brixton. The two key outcomes of the work to that point were:

- A heat network served by air source heat pumps could be viable
- Further key aspects of the proposals could be interrogated to provide greater certainty on viability

This addendum sets out the agreed additional items for investigation, as follows:

- Update the existing energy model with new GIA figures for the Brixton Town Centre developments;
- Model the technical and economic performance of electric boilers, installed in place of gas boilers to meet peak demand;
- Submitting applications to the local District network Operation (DNO), UKPN, to obtain electricity connection budget estimates for Energy Centre locations in Somerleyton Road and the Town Centre;
- Assessing the viability of the proposed pipework route necessary to connect the Somerleyton Road development to the Town Centre plots, based on utility searches from GroundWise and a physical site survey;
- Provision of energy centre layouts; and

- Present options to the council for how to deliver the network.

Following on from discussions with Lambeth Council and representatives from Somerleyton Road it was decided that the largest network scenario with all buildings connecting would be used for further analysis. It was also decided to apply for electrical connection certificates and design energy centres for the scenario with ASHP + electric boiler as this was the solution with the greatest carbon emission savings, as well as the highest demand for electricity.

New technology Scenario C

The new supply technology Scenario C was generated and replaces Scenario C in the previous sections 1 – 7 (GSHP + Gas boiler solution - deemed unfeasible as the capacity output from GSHP is minimal). It assumes the ASHP would meet 80% of the heat consumption and the electric boiler would supply the remaining 200%. In this scenario the electric boiler supplies 80% of the peak heat demand.

Scenarios: Connection → Technology ↓	1: Plots 1, 2A & 2B	2: Plots 1, 2A, 2B 3, 4 & 5	3: Plots 1, 2A, 2B, 3, 4 & 5 and recreation centre	4: Plots 1, 2A, 2B, 3, 4 & 5, recreation centre and Somerleyton Road
a: Gas CHP + gas boiler	CHP: 240kWth Gas Boiler: 1.2MW	CHP: 440kWth Gas Boiler: 2.1MW	CHP: 610kWth Gas Boiler: 3.0MW	CHP: 715kWth Gas Boiler: 3.4MW
b: ASHP + Gas boiler	ASHP: 240kWth Gas Boiler: 1.1MW	ASHP: 440kWth Gas Boiler: 2.1MW	ASHP: 610kWth Gas Boiler: 2.9MW	ASHP: 720kWth Gas Boiler: 3.4MW
c: ASHP + Electric boiler	ASHP: 240kW Electric Boiler: 1.1MW	ASHP: 440kW Electric Boiler: 2.1MW	ASHP: 610kW Electric Boiler: 2.9MW	ASHP: 720kW Electric Boiler: 3.4MW *
d: ASHP + GSHP	GSHP: 260kW ASHP: 1.1MW	GSHP: 240kW ASHP: 2.3MW	GSHP: 210kW ASHP: 3.4MW	GSHP: 220kW ASHP: 4.0MW

Table 8.1 Previous connection and technology scenarios with updated Scenario C (blue)

[*] Denotes the core scenario used for electrical connection costs and energy centre design

8. Report Addendum

8.2 Updated heat demands and techno-economic modelling

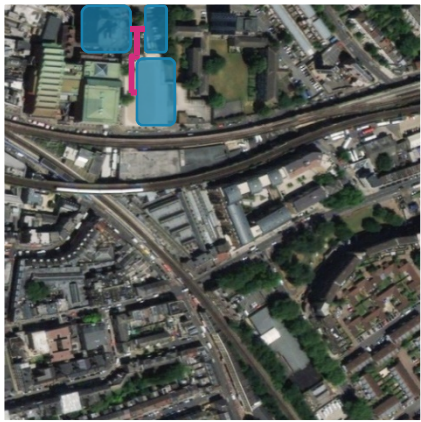
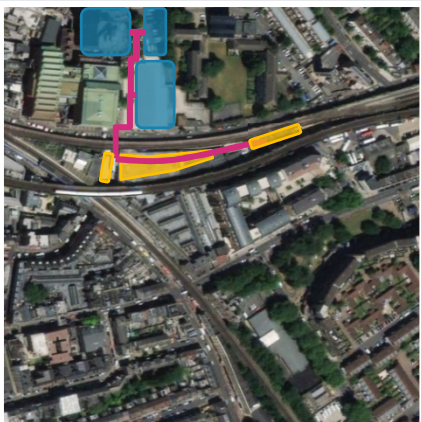
Connection Scenario	1	2	3	4
Clusters included	Plots 1, 2A & 2B	Plots 1, 2A, 2B 3, 4 & 5	Plots 1, 2A, 2B, 3, 4 & 5 and recreation centre	Plots 1, 2A, 2B, 3, 4 & 5, recreation centre and Somerleyton Road
				
Indicative Heat consumption (GWh)	1.7	3.1	3.5	4.9
Indicative Peak demand (MW)	1.3	2.8	4.0	4.9
Network length (m)	90	340	350	560

Table 8.2 Updated heat consumption and demand figures based on updated area schedule

8. Report Addendum

8.2 Updated heat demands and techno-economic modelling

Capital cost

Techno-economic modelling has been updated to reflect the updated area schedules, electrical connection costs and to model the new technology scenario. The capital cost (CAPEX) of the project is made up of the connection costs, plant capital costs, pipework costs and the costs for the energy centre, space and utility connections. Figure 8.1 shows scenarios that include all building connections. The techno-economic modelling has revealed the following conclusions about the CAPEX of the proposed networks:

- Across all of the scenarios the all electric GSHP / ASHP solution still has the highest CAPEX. This is primarily due to the ASHP being relied on to provide peaking heat demand rather than the significantly cheaper gas or electric boiler.
- The alternative all-electric solution is to use electric backup boilers. Whilst these are cheap and take less space, they are very expensive to operate. The cost to the occupant could be mitigated by installed on-site renewables such as PV panels, potential for this will be explored in section 8.4.
- Grants from HNIP for up to 50% of the capex are for between £0 and £5million for projects that supply 75% of heat from CHP or 50% of their heat from renewable sources. Whilst CHP and ASHP + gas

boiler and all-electric scenarios meet this requirement, GSHP scenario does not.

- It should be noted that this cost represents the capital expenditure only and does not capture the operational costs or costs associated with carbon offsetting.
- A 50% optimism bias has been allowed for in the CAPEX assumptions to adjust for the high level nature of this study.
- The connection cost for the electrical capacity of the ASHP + electric boiler at Council owned building plot 1 has been used in all scenarios.

CAPEX results for the other connection scenarios are included as an appendix.

Financial results

As with previous analysis, the highest performing network scenario is 3b. The counterfactual price of heat is the same across all scenarios. Therefore the IRR is dependent primarily on the CAPEX and OPEX costs. The scenario with the electric boiler has a lower IRR as a result of the higher cost of electricity. Again this has an impact of reducing the IRR by 3%.

The financial performance of all of the schemes are quite poor and would struggle to attract private investment.

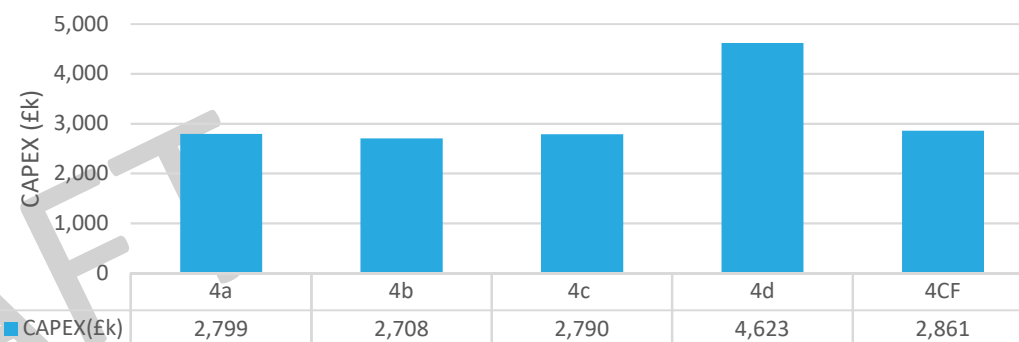


Figure 8.1: CAPEX of each technology type with fully built out network

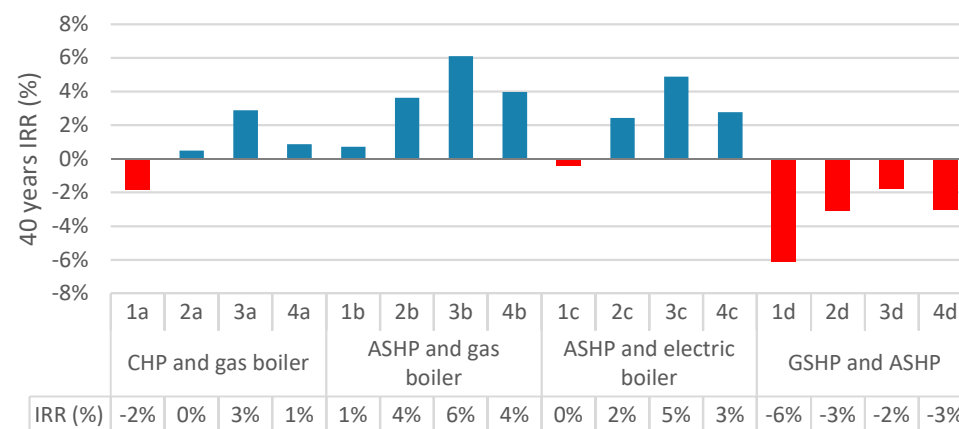


Figure 8.2: 40-year IRR of each scenario

8. Report Addendum

8.3 Sensitivities

What is the impact of the energy centre location?

Applications have been made to UKPN, the local electricity distributor as to the cost of additional electricity capacity at two locations: Council Plot 1 and Somerleyton Road. Both identified in Section 6.2 as suitable potential locations of energy centres. The quotation received for Plot 1 was £180,000. This was significantly higher at Somerleyton Road with a quotation of £350,000. (Both quotes received in February 2020).

By putting the energy centre at Somerleyton Road, costs are higher and has an impact on the overall scheme of reducing the 40 – year IRR by 0.4% in comparison to the counterfactual.

Therefore in all core scenarios the energy centre is assumed to in Council owned building – Plot 1.

What is the impact of HNIP funding?

The main HNIP scheme is open to private, public (excluding central governments departments) and third sector applicants for the commercialisation and construction of new heat networks and the refurbishment, expansion and / or interconnection of existing heat networks.

HNIP can provide funding by way of the following:

- Grants – up to £5 million or 50% of capital value
- Corporate loans – between £25,000 and £10 million with discounted interest rates and term of up to 25 years
- Project loans – secured non-recourse loans to a project company of between £25,000 and £10 million.

It is hoped that this will assist in providing the financial boost necessary to get project internal rate of returns over 10-15%, often seen as the hurdle rate for private investors.

Figure 8.5 shows the 40-year IRR results for securing capital grant funding to the value of 50%. However, at 3.7% it is still quite low for attracting private investments.

Making the network more attractive

The heat price assumed in the model is based around the counterfactual cost of heat of around 14p/kWh. By increasing the heat price, the financial performance could be improved. The council should consider the effects this may have on fuel poverty and whether any increase can be justified.

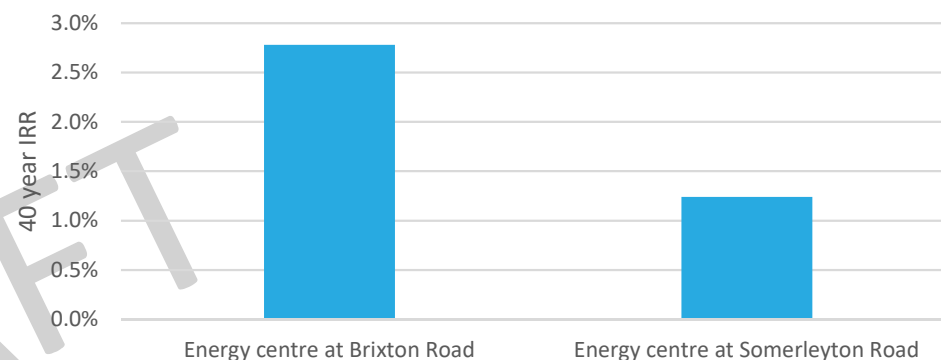


Figure 8.4: Impact of energy centre location

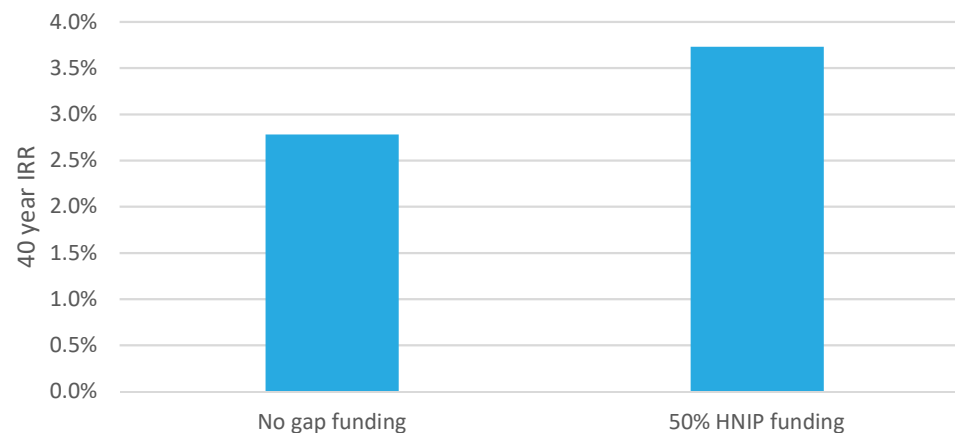


Figure 8.5: Impact of 50% HNIP gap funding

8. Report Addendum

8.4 Network route assessment

Scope

The feasibility of the underground pipework required for the proposed district heating network has been reviewed, alternative routes suggested as needed and any key constraints/risks have been highlighted that are to be overcome in the next project stage.

Level of Detail

The mid-level review of the proposed district heating network included:

- Desktop review of available information including PDF buried utility record drawings sourced via Groundwise (report Ref: 25662JS Rev 3) and Google maps.
- A Civil Engineer from Arup performed a route walk to visually assess the proposed network route and identify any above ground constraints.

Potential alternatives which could be investigated if on-site surveys render the proposed route unviable has been shown indicatively.

Note that no horizontal or vertical coordination has been completed to date.

No consultation with private entities or statutory undertakers has been undertaken.

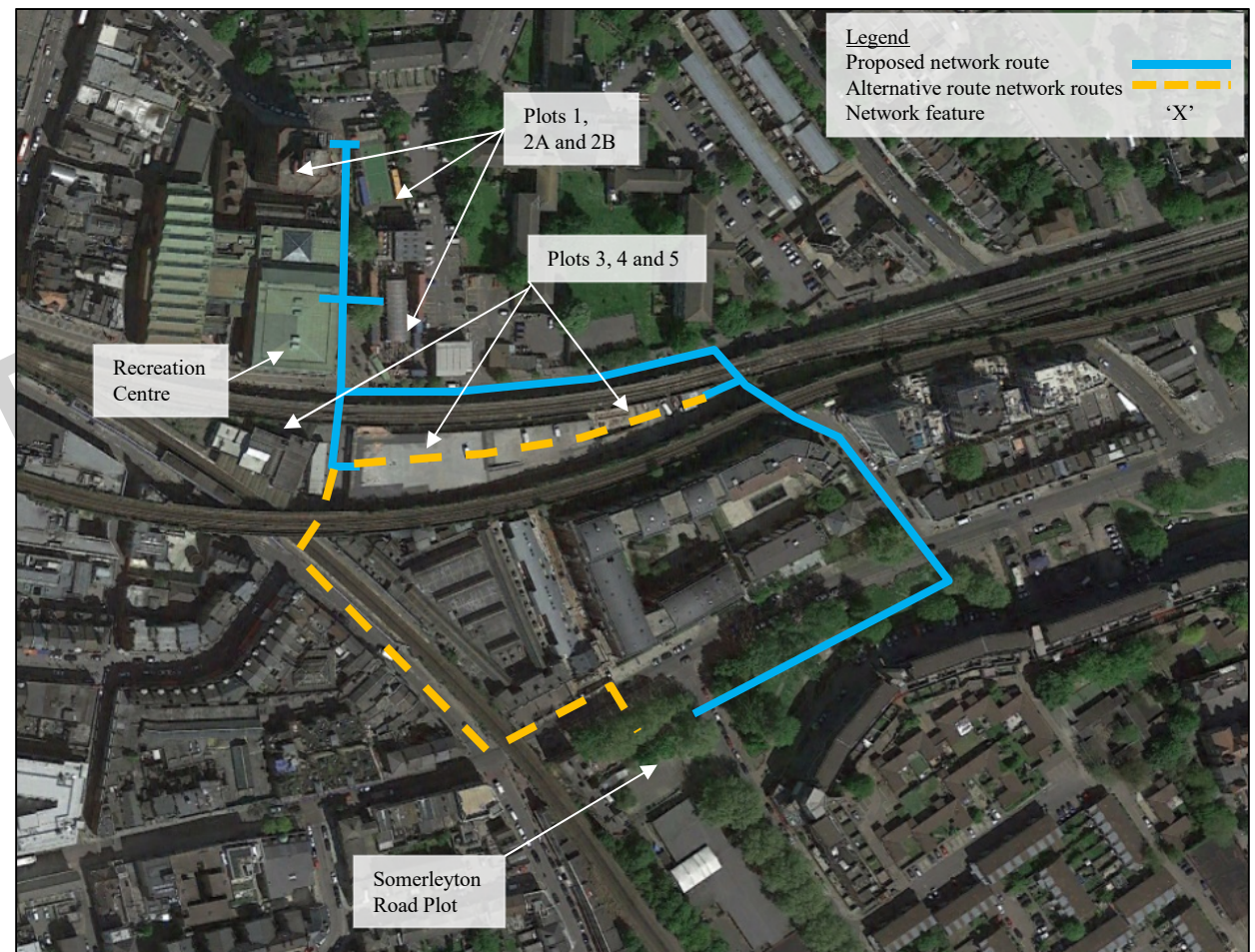


Figure 8.6 Proposed Network Route (Map Sourced from Google Earth Pro, dated: May 2018)

8. Report Addendum

8.4 Network route assessment

Network Route Constraints

The network route features and constraints, identified during the site walkover and through a review of the Groundwise utility records, are described in Tables 8.2 - 8.4 and Figure 8.6 - 8.9.

Table 8.2 Network Route features and Constraints

Location ID	Route Features and Constraints	Details
1	Hidden River	A plaque, stating that one of London's Hidden Rivers passes beneath the road, was located on the western corner of Popes Road and Canterbury Crescent.
2	Plot 1, 2A and 2B	Future developments which have been included in the network. Refer to R11.
3	Recreation Centre	This is an existing building which is proposed to be connected to the district heating network. Refer to R11.
4	Popes Road	Popes Road is a 1-lane road with car parking on each side. Various Trees are located within the footpath; two are large mature trees. The exact network location will need to consider the presence of tree roots. Groundwise records suggest there is likely horizontal space for the district heating network. Refer to R1 and R3.
5	Bridge 1 (Rail over Road)	The headroom under this bridge is 13 foot 6-inches. Refer to R2.
6	Brixton Station Road	Brixton Station Road is a 1-lane road with car parking on the northern side. Various trees are located within the northern footpath which may affect the network route. Overhead cables were noted during the site visit. The historic railway arches are located along the southern side of this road and the southern footpath is narrowed. Groundwise records suggest there is likely horizontal space for the district heating network. Refer to R1 and R3.
7	Plot 3, 4 and 5	Future developments are proposed behind the railway arches and have been included in the district heating network. The existing use of the land behind the arches is understood to include carparking, storage and retail. The western shops extend entirely along the plot boundary but the Council have confirmed these will be removed to make way for the new development. Refer to R11. The London Borough of Lambeth have provided a land ownership drawing (Land information Drawing No: 00000000, LB Lambeth, Demise plan 2 BRX00300/BRX01000/BRX02100, dated 16 Jan 2018) which highlights that this land is of mixed ownership including 'Freehold Ownership' by Network Rail and as a 'Right of Way Reserved to Network Rail'. Refer to Appendix XXX.

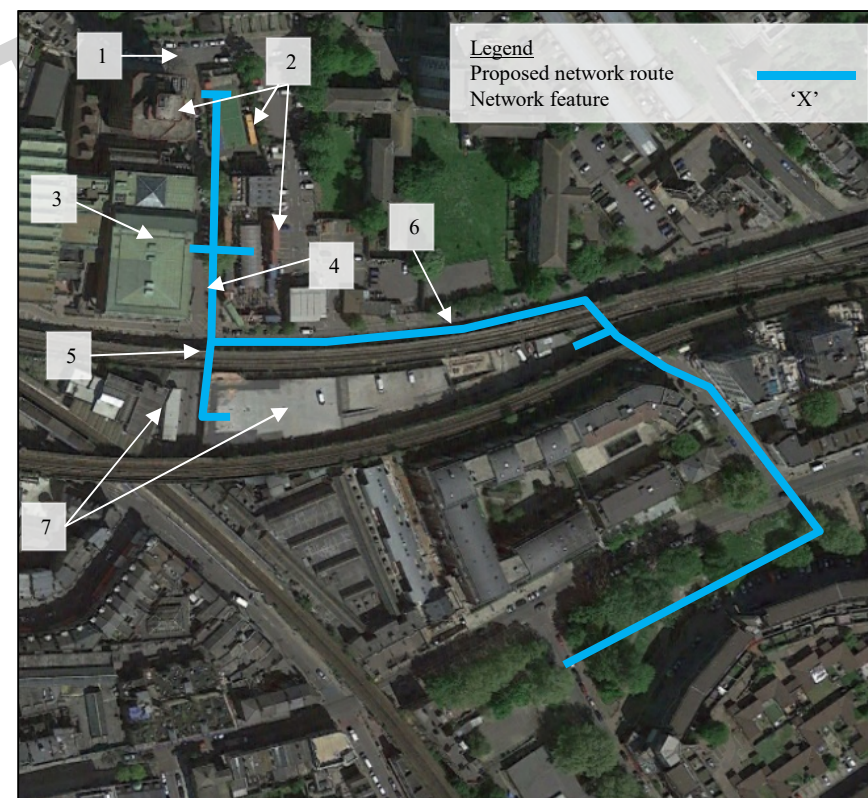


Figure 8.7 Proposed Network Route Features and Constraints

8. Report Addendum

8.4 Network route assessment

Table 8.3 Network Route features and Constraints

Location ID	Route Features and Constraints	Details
8	Bridge 2 (Rail over Road)	This overhead railway bridge does not have any headroom signs. Refer to R2.
9	Eastern entrance to the land behind the arches	The plots behind the arches are currently accessed from this location.
10	Bridge 3 (Rail over Road)	This overhead railway bridge does not have any headroom signs; however, the available headroom is significantly greater than the previously mentioned railway bridges. Refer to R2.
11	Valentia Place	This road is a 2-lane road with reduced width where carparking is situated along the eastern kerb line. There were trees within the western footpath and therefore the root zones need to be considered when finalising the heating network alignment. Groundwise records suggest there is likely horizontal space for the district heating network. Refer to R1 and R3.
12	A2217 – Coldharbour Lane	Coldharbour Lane is a two-lane, A-road with footpaths on either side. A-roads are major roads which have high traffic volumes. This road is heavily congested with utilities including, but not limited to: - A combined public sewer understood to be 3.67m deep (to soffit). The size varies from 1100mm diameter to 1160x 800mm from west to east; - A 24-inch, 18-inch and unknown diameter Low Pressure (LP) Southern Gas Networks gas mains; - A 3-inch and a 7-inch water supply distribution main and a 16-inch water supply trunk main; 33kV EHV cable which crosses the road; - Virgin media cables, BT cables, fibre cables and likely private utilities. An underground utilities survey will be required at minimum to prove a route within this road, likely followed by trial holes. Refer to R1 and R3-R5.

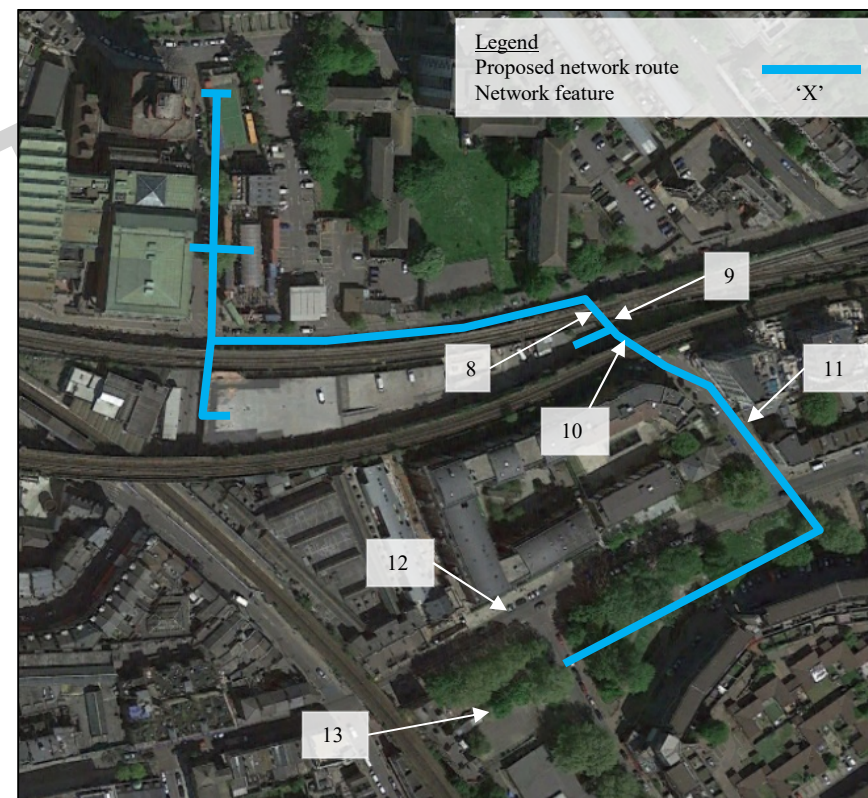


Figure 8.8 Proposed Network Route Features and Constraints continued

8. Report Addendum

8.4 Network route assessment

Table 8.4 Network Route features and Constraints

Location ID	Route Features and Constraints	Details
13	Somerleyton Road Plot	A future development which has been included in the network. It was observed during the route walkover that the development is already under construction. Works appear to be beginning on the land closest to the A2217 road. Refer to R11.
14	Pinch point	It is likely that the network will cross various existing utilities including, but not limited to, multiple High Voltage (HV) and Low Voltage (LV) cables, gas mains, Telecomms ducts, sewers and water supply pipes. There is a major 'pinch point' where the network crosses Coldharbour Lane in order to serve Somerleyton Road plot due to the high number of existing utilities within this road. It is possible that the district heating network would need to be tunnelled beneath these utilities. Refer to R1, R3-R5 and R9.
15	33kV HV crossing points	A 33kV, originating from Canterbury Crescent in the north, runs down Brixton Station Road, Valentia Place and then crosses Coldharbour Lane before continuing south down Somerleyton Road. It is likely that the district heating network will need to cross this EHV network at twice to serve the Somerleyton Road Plot. Refer to R1.
16	Public realm – park	A raised grassed park area is located on the south side of the road, between Somerleyton Road and Moorland Road. This landscaped area is planted with numerous mature trees. Pending consultation, it would be preferable for the network route to run within this landscaped area as opposed to the A2217 road. It is understood that this park is owned freehold by the Council. It is recommended that this is reviewed in detail at the next stage of the project in order to establish if there are any existing covenants/other leasehold interests in this plot of land. Refer to R6.
17	Transport for London (TfL) Tunnels	A TfL map was provided as part of the Groundwise Report which approximates the location of the Victoria line and the Brixton Station. It should be noted that this tunnel runs beneath the Somerleyton Road Plot and also the alternative network route. Refer to R10.

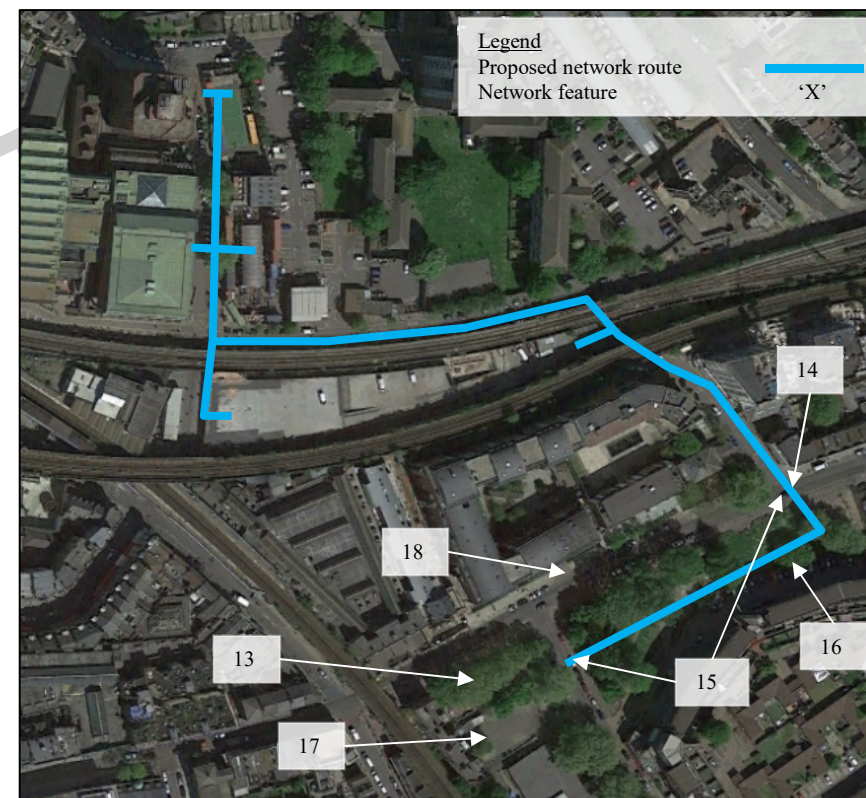


Figure 8.9 Proposed Network Route Features and Constraints continued

8. Report Addendum

8.4 Network route assessment

Risk Methodology

A high-level risk rating system has been used to quantify the risks in terms of the likelihood of occurrence and the consequence. Tables 8.5 – 8.7 summarise the preliminary engineering/delivery risks to be resolved in the next stages of the project. Please note that generic construction and health and safety risks have not been outlined.

Table 8.5 Network Route Preliminary Risk Matrix

Risk		Description of risk	Likelihood	Consequence	Risk Magnitude	Mitigation Measures to Reduce Risk
R1	Existing Utilities	From experience, record drawings alone pose a risk to the project due to variable accuracy. Note that private utility records are not provided for in a Groundwise report and so a risk remains until a GPR survey is undertaken. Significant risk remains until the existing utilities are accurately located. The exact in-situ location of existing utilities may impact the proposed network alignment which could result in additional cost or changes to the route. The requirement for existing utility diversions is not understood at this stage due to the lack of accurate location data. Diversions of public utilities can increase project costs and delay the program due to liaising with utility providers. The diversion of some existing utilities may make the route unfeasible.	High	High	High	Initially, a topographical survey should be performed and compared with a CAD composite drawing of the utility records. This information will confirm the horizontal constraints imposed by the various other utilities. Following this, to accurately locate all existing utilities, it will be necessary to carry out an underground services survey and 3D modelling of the network. Trial holes may be required, particularly at the pinch point, to further reduce the risk of clashes with existing utilities. All surveys should be in accordance with PAS 128: 2014.
R2	Rail bridges	There are several locations where the proposed network passes beneath existing Network Rail railway bridges. These areas are largely pedestrianised and have reduced headroom. The risk of bridge strike during construction increases risk to the project cost as well as health and safety of workers.	High	High	High	The contractor for the works should have in place suitable method statements and all staff should have undergone suitable training for working in close proximity to overhead rail bridges. Network Rail hold a relevant training course called 'Prevention of bridge strikes'. This risk may further be reduced through consultation with Network Rail to ensure suitable construction and operations and maintenance (O&M) methodologies are in place.

8. Report Addendum

8.4 Network route assessment

Table 8.6 Network Route Preliminary Risk Matrix

Risk		Description of risk	Likelihood	Consequence	Risk Magnitude	Mitigation Measures to Reduce Risk
R3	General traffic management	The traffic management plan for the works requires consultation and agreement with the local Highway Authority. This negotiation process can be lengthy, and restrictions imposed may result in programme delays (i.e. works to take place at night).	High	Medium	High	Early consultation with the local Highway Authority, understood to be London Borough of Lambeth, is recommended so that fees and programme can be confirmed. A section 50 licence, under the New Roads and Street Works Act 1991 (NRSWA), will be required for excavations within the public Highway. The cost of this licence is to be confirmed with the local Highway Authority and may vary depending on network length and road classification.
R4	Major 'A' roads	In addition to R3 above, the proposed network involves ~10m of works in an 'A' road (Coldharbour Lane - A2217) resulting in potential project programming risk.	High	Medium	High	To minimise programme risk, it is recommended that engagement with public bodies is begun early.
R5	Works within major roads	Works within any highway pose a health and safety risk to both construction and O&M contractors. Within major 'A' roads this risk increases.	Medium	Medium	Medium	The proposed network route aims to reduce the works within Coldharbour Lane by installing the network within the Council owned park on the south side of Coldharbour Lane. Careful consideration to construction methodology is required where the network crosses the road and suitable trained contractors should be selected to reduce this risk.
R6	Land Ownership	It is anticipated that the network will be routed through public land where possible (footpaths, highways and parks). The required negotiations if the route passes through private land can be a risk to programme and cost. Any non-availability of land may result in updates to the route or overall non-feasibility. In locations where the network passes outside of the public highway, the land ownership needs to be understood. This is particularly relevant for the Council owned park to the south of Coldharbour Lane. If other routes are proven to be unviable, there may be an opportunity to route the network through the land between the arches (plots 4 and 5) however, due to the current Network Rail land ownership, this would require consultation.	Medium	High	Medium	Negotiations with third party landowners should begin as soon as possible to prevent programme delays and allow early opportunity for investigating alternatives.

8. Report Addendum

8.4 Network route assessment

Table 8.7 Network Route Preliminary Risk Matrix

Risk		Description of risk	Likelihood	Consequence	Risk Magnitude	Mitigation Measures to Reduce Risk
R7	Old utilities	The presence of old utilities can pose a risk to the project. Any works near to old utilities may result in the need for specific design or agreements. Route alignment may need to be revised to meet the requirements.	Medium	Medium	Medium	Early consultation with the various utility companies is recommended to determine the presence of any old/fragile utilities and any specific requirements relating to these.
R8	Safeguarding space in the congested areas.	There may be other projects proposed near the network route which may reduce available space. This may result in changes to the route, potentially increasing programme and cost.	Low	Medium	Medium	Once a feasible route is confirmed, early liaison with the council planning department, highways authority (Lambeth Council) and other significant bodies is crucial to safe-guard the route for future installation.
R9	Deep excavations and tunnelling	It is likely that the network will pass beneath existing utility networks in some locations. This may require either directional drilling, headings or tunnelling. Trenching, headings or tunnelling can pose a health and safety risk during construction, operation and maintenance (O&M) due to the potential for collapse, flooding and confined spaces.	Medium	Medium	Medium	It is likely that the network will need to tunnel beneath the existing utilities within Coldharbour Lane. Following the additional recommend survey work, if necessary, deep trenches or tunnels can be designed by a specialist to reduce the associated risk.
R10	Existing TfL Tunnels	TfL have provided a plan which approximates the location of the Victoria Line, near to the proposed works. This is relevant to the development at the Somerleyton Road plot and the suggested alternative district heating network route. TfL require Underground Infrastructure Protection to be provided with details.	Medium	Medium	Medium	TfL should be engaged early in the project to ensure the requirements are clearly understood and the Underground Infrastructure Protection methodology is agreed.
R11	Consultation	Further consultation is required to confirm that each of the loads will connect to the network. Without this confirmation, the network may not be viable.	Medium	High	High	Consultation should continue with the various stakeholders to confirm the proposed loads will be connected to the district heating network.

Network Route Assessment Summary

The currently proposed route is generally, based on professional judgement, considered viable, but significant risk remains until the horizontal and vertical alignment of the existing utilities is confirmed. Where significant adverse risks have been identified in tables 8.5 – 8.7, further mitigation is required to reduce risks to acceptable levels. The mitigation measures put in place should be managed to ensure risks are as low as practically possible (ALARP). Should any of the risks render the route infeasible during later design stages, a different route will need to be considered. The risks identified as 'High' should be given priority for further evaluations of feasibility.

8. Report Addendum

8.5 Energy centre design

Energy centre design

Figure 8.3 presents an example plant room layout for the full network with the preferred technology, an ASHP solution with electric boiler back-up. This has been split into the external and internal space requirements. The technologies have been sized based on products that are commercially available. The plant room layout is inclusive of, access requirements, attenuation space and additional space for ancillaries. Technical performance may be improved through the use of thermal storage (not shown). The ease of installation and replacement of boilers and roof top access has been accounted for in the plant room layouts.

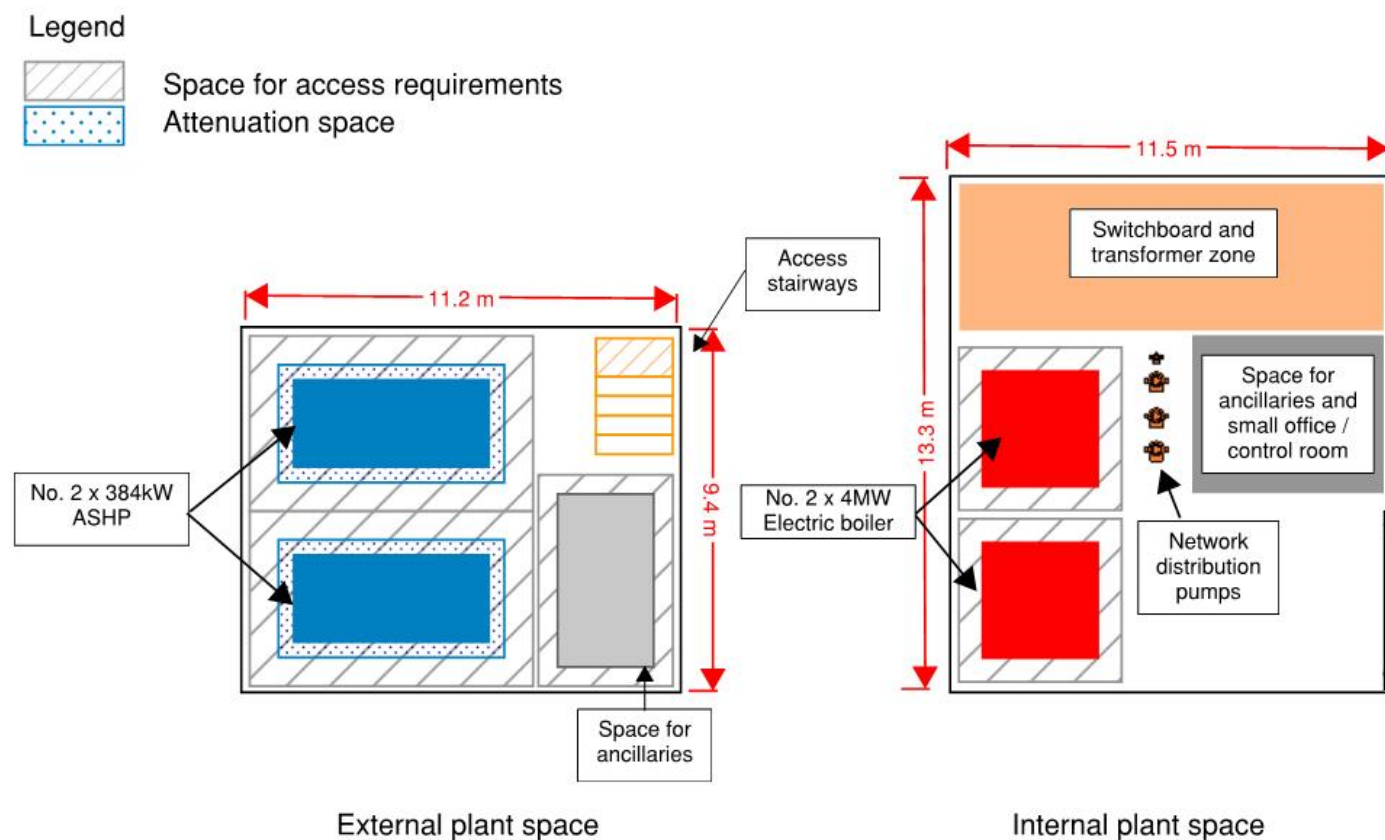


Figure 8.3 Proposed energy centre design

8. Report Addendum

8.6 The price of heat

To compare the price of heat a customer on the network would be paying to what they would ordinarily be paying, we need to look at the price of heat as a whole. A typical customer in the UK will pay approximately 3p/kWh for gas. However, 'The Price of Heat' study by Arup includes the sometimes overlooked costs of heat to a domestic customer with a gas boiler, namely the maintenance and replacement of that system.

Figure 8.6 shows the graph from that study, and how there are the fixed costs of fuel standing charges, maintenance and the cost of the boiler replacement over its typical expected lifetime. Under the Housing and Tenants Act, social or private rental tenants are not responsible for paying for the replacement / maintenance costs and only pay the fuel costs.

Average dwelling consumption is typically 3,500 – 4,500 kWh/annum but will depend hugely on size of the apartment, number of tenants, occupancy, location within the building and building fabric. This means that tenants might expect to pay in the region of 15-20p/kWh.

The sum of the shaded areas is the total cost of heat. The black line shows a comparator with a 10% reduction on that cost, as it would be typical for a district heating scheme to offer a price for heat slightly less than the gas market comparator.

When a network is delivering heat generated by gas boilers and gas CHP, it is possible for network operators to be profitable whilst offering their customers a saving on their heating bills (i.e. the black line).

With a departure away from gas and a move (at least currently) to electrically based heating systems, the price of heat is due to rise. Additionally, where networks are not permitted to have higher carbon heat sources (i.e. in London, under the London Plan), network operators may struggle to operate profitably when they are competing with a gas boiler comparator.

The modelling described in this report has developed the cost of heat by modelling a low-carbon counterfactual system of an air source heat pump. This price of heat calculated for the counterfactual system varies depending on the buildings included, but is in the range of 12-14p/kWh. The counterfactual price of heat is therefore included in the network scenarios to test whether the system can operate profitably at that rate.

The council should be aware of the price of heat in the new developments, and ensure that care is taken to avoid any increase in fuel poverty. The all-in rates of 12-14p/kWh would need to be broken down into a variable/fixed rate such that rental tenants only pay the variable charge.

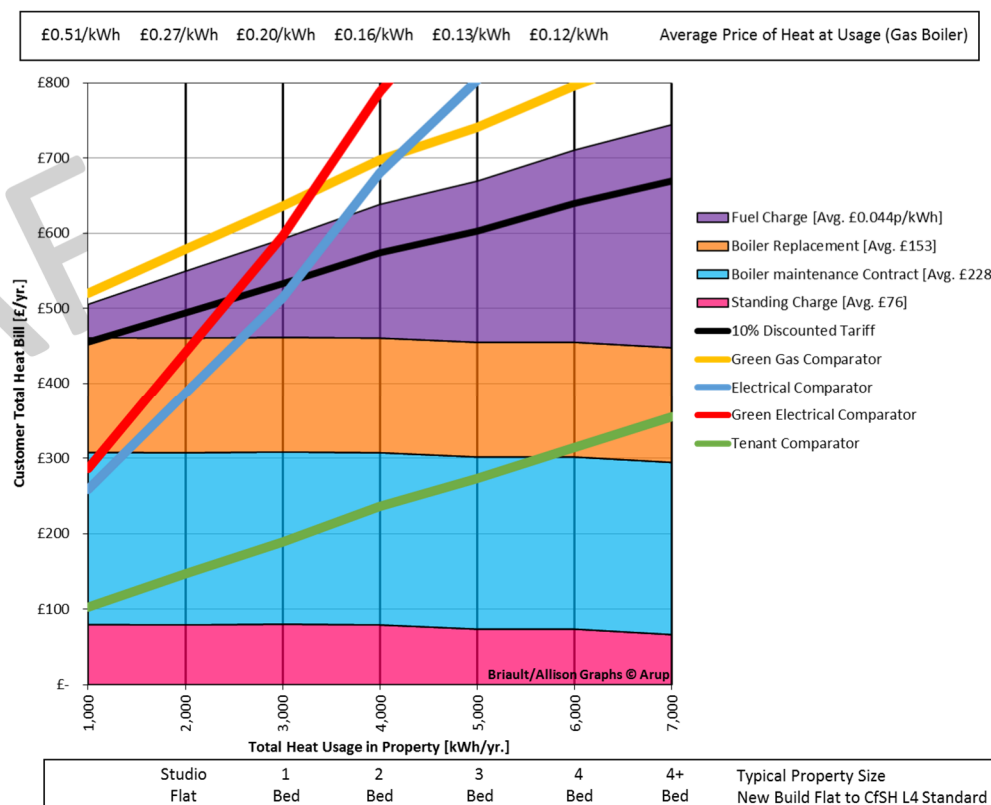


Figure 8.6: Price of heat for typical domestic users, CIBSE Arup presentation 2015

8. Report Addendum

8.7 Carbon emissions

Installation of solar PV

One way of reducing the operational costs of the network is to install solar PV to generate the systems own electricity, this electricity could be sold to the grid when it is not needed and act as an additional revenue stream for the network.

The electrical consumption on site is so great that to provide 100% of electrical demand by solar PV it would require 45,000m² of space for solar panels. Using the available roof space, other than space required for the ASHPs, PV panels could provide approximately 12% of the annual electrical consumption. This would further decarbonise the network and reduce operational costs. The additional CAPEX of this is approximately £1m, this would bring value to a similar value to the GSHP + ASHP.

Carbon emission factors

The carbon emission reduction calculated from any technology is dependent on the emission factor that is used. In this model we compare SAP 10 and BEIS. In section 5, SAP 10 carbon emission figures are used and explained. The BEIS carbon emission factors use future predictions of the UK grid, which includes the increase in renewable contribution.

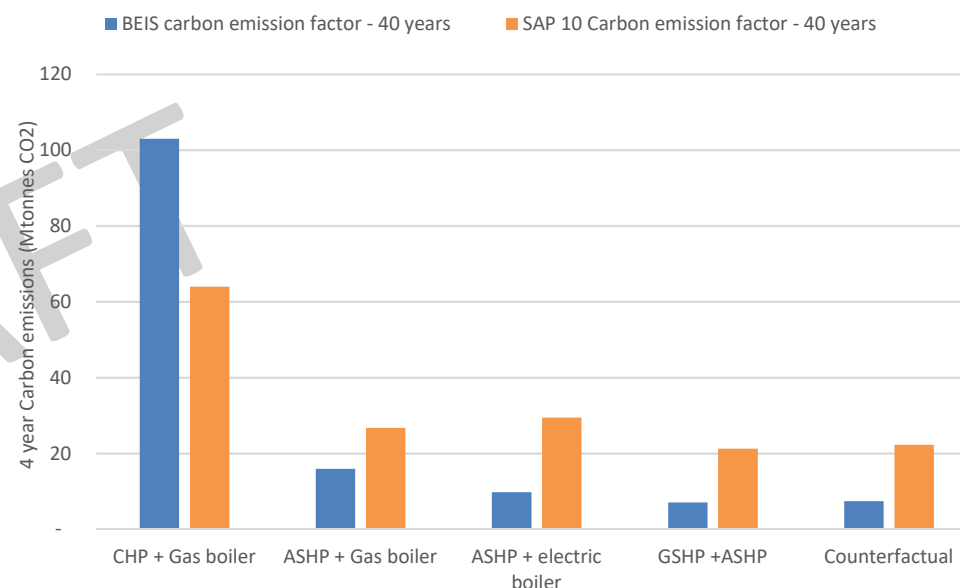
In this model we have compared the impact of different carbon emission factors in order

to calculate the actual benefit of different systems whilst also recognising what the consequence of different technologies will have on the planning proposals of different developments.

Carbon emission results

As can be seen from Figure 8.6 the carbon emissions from each supply technology, other than CHP, are lower when BEIS carbon emission factors are used. This is because the electricity carbon emission factor decreases over time.

Critically this shows that using BEIS factors the ASHP + electric boiler emits less carbon than the ASHP + gas boiler. This however, is not the case when you use SAP 10 values that are used for planning.



40 year emissions (Mtonnes CO ₂)	CHP + Gas boiler	ASHP + Gas boiler	ASHP + Electric boiler	GSHP + ASHP	Counterfactual
BEIS carbon emission factor	103	16	10	7	7
SAP 10 Carbon emission factor	64	27	30	21	22

Figure 8.6 Annual carbon emissions for scenario with Plots 1, 2A, 2B, 3, 4, 5 and the Recreation Centre – comparison between SAP 10 and BEIS

8. Report Addendum

8.8 Delivery model options

Heat network delivery models

Heat networks can be set up in a variety of ways, from a wholly private sector solution with no public sector involvement to an entirely public sector owned and operated scheme. There are many potential combinations of parties fulfilling various roles, and so the choice of delivery model is more a continuum of solutions rather than a defined set of solutions.

Nevertheless, four main types of delivery model can be identified, broadly following the categories set out in the CIBSE and ADE publication 'Heat Networks: Code of Practice for the UK':

1. Private sector led
2. Public – private joint venture
3. Local authority / housing association led
4. Community company (CoCo)

The appropriate delivery model for any given network can be determined by the opportunities and risks that each party is willing to take.

The descriptions of each delivery model and the roles that typically define them are set out in Table 8.2.

Proposed delivery model

The financial performance of the heat network alongside the fact that the majority of the heat load that will be connected to the scheme will be owned by Lambeth council suggests that the most suitable delivery model for this scheme will be public sector led.

This might involve the council setting up a Special Purpose Vehicle (SPV), wholly owned by the council, to administer the network. Enfield Council have done this recently, by setting up Energetik.

The role the Council is likely to undertake would be promotion, funding, governance and asset ownership. The council would likely have to tender a contract for Design and Build (D&B) and Operation and Maintenance (O&M) of the network, either separately or as a full DBOM contract for the network.

Further negotiation between the developers, Lambeth Council and the GLA will be necessary to fully understand the delivery model for the network.

Table 8.2 Delivery models

Delivery Models	1. Private Sector Led	2. Public-Private joint venture	3. Public Sector Led *	4. Community Company
Description	Private sector responsible for design, financing, building, owning and operation.	A public body and at least one private sector company share the risks and returns.	A public body would be responsible for the design, financing, building, owning and operation.	A community body has a leading role in the building supplying heat.
Roles	The following roles are typically fulfilled by the private sector: • Funding • Asset Ownership • Operation	The following roles are typically shared by the public and private sector: • Governance • Funding • Asset Ownership	The following roles are typically fulfilled by the public sector: • Governance • Funding • Asset Ownership	The following roles are typically fulfilled by community group: • Customer • Governance • Sale of Heat

[*] Denotes the recommended option

8. Report Addendum

8.9 Proposed roles

Table 8.3 Roles within the Brixton Town centre network

Role	Description	Possible responsible party
Promotion	The promoter is a party with the motivation to establish a successful heat network and takes responsibility for driving delivery.	Lambeth Council / GLA
Customer	A heat customer will contract with a supplier who will provide their heat in exchange for a promise to pay. The customer may be a commercial entity or a residential tenant or homeowner.	Lambeth, residents, private non-domestic businesses
Governance	The governance role includes setting objectives, prescribing policies and ruler of conduct and overseeing performance.	Lambeth Council / GLA
Regulation	The regulation role is focussed on consumer protection and to prevent abuse of the monopoly position that heat network operate in.	Lambeth Council / GLA
Funding	The funder arranges finance and enters agreements with the funding recipient. This role often ceases once finance has been repaid.	HNIP / public / private sector (TBC)
Asset ownership	The asset owner owns the physical assets of the network. Ownership could be split between different classes of assets.	Lambeth Council (TBC) / GLA / Private-public JV
Development of property	In the context of heat networks, developers are parties responsible for constructing or maintaining the buildings which will receive heat from the network.	Development Partner (TBC) / OJEU procured developer
Land ownership	The landowner grants leases and easements for the siting of network assets and provide rights of access for the installation, operation and maintenance of plant and equipment.	Lambeth Council / Somerleyton Road development
Landlordship	The landlord, in this context, owns the buildings in which network assets and heat customers are located.	Lambeth Council
Installation	The installer designs and installs the heat network. Typically this includes the energy centre and primary network with the secondary network often being the responsibility of the Property Developer.	JV partner, D&B or DBOM contractor procured by council
Operation	An operator is responsible for operation and maintenance of the heat network in such a manner as to ensure that heat of suitable quality can be delivered to customers.	DBOM or O&M contractor
Sale of heat	The sale of heat as a service is a logically distinct role from the physical delivery of heat to customers, as can be seen in the nationally regulated UK electricity and gas markets.	JV or other sub-contracted party
Supplier of last resort	As heat is not regulated like gas and electricity it is best practice to assign a supplier of last resort. This role involves providing heat to customers if the schemes provided is unable or no longer required to do so.	Sub-contracted role

8. Report Addendum

8.10 Contracts and funding

Contracts

The delivery and operation of heat networks are governed by a series of contracts and other forms of agreements between the parties involved. Some agreements are widely used in many other contexts, while others are unique, or uniquely applied, to a heat network situation. To develop the business case, the following contract-related issues should be considered:

- How will the functions of design, build, operation and maintenance of heat production and network assets be delivered?
- What are the installation costs and how they will be funded?
- What properties rights are required to enable works to proceed and subsequently, assets to be operated and maintained?
- What types of customers will there be, and what are their property interests and applicable supply arrangements for each?
- Who are potential counterparties, contractors and concessionaires, and partners?
- What is the approach to procurement?

A secure contract with clear delegation of roles and responsibilities should be in place prior to commencement of any heat network

project. Detailed design and planning of the network will be required to take place before the housing development construction begins. This will require significant negotiation and collaboration; the developer will also be required to advertise the properties for sale or letting to potential customers as being served by a heat network.

Funding

Heat networks can be funded in a number of ways. A local authority might provide loans to a special purpose vehicle (SPV) or might capitalise the vehicle through equity injection. A private sector funder will have the same opportunities. However, both these options assume that the opportunity is attractive enough (in terms of IRR and NPV) for investment.

Often, this is not the case and returns are not high enough to attract investors. As the UK Government views heat networks as a key aspect of decarbonising the UK's heat supply, capital grant funding is available for heat networks through the Heat Networks Investment Project (HNIP). See Section 8.3.

8. Report addendum

8.11 Conclusions and recommendations

Conclusions

This report addendum updated the model to account for the updated masterplan, added a scenario that looked at how electric boilers would perform in terms of carbon and economics, investigated the feasibility of the connection route between the Town Centre and Somerleyton Road, obtained utility connection cost estimates from UKPN and has provided input on the cost of heat and potential delivery models for the council.

Due to the high costs of electricity in comparison to gas, the operational costs of the ASHP + electric boiler scenario are higher than other solutions, giving a lower IRR.

It was found again that the connection of the Town Centre scheme to Somerleyton Road impeded the financial performance when compared to the Town Centre only case.

The Somerleyton Road development is due to have a gas boiler + gas CHP led communal heating network for the whole development. This is a high carbon option for that development and the council should explore lower carbon options. It should also ensure that all future buildings on that site have as low temperature heating systems as possible, to facilitate later decarbonisation should the CHP scheme go ahead.

The greatest opportunity for saving carbon is therefore at Somerleyton Road, since the

Town Centre developments would need to adhere to the more stringent SAP calculations under the New London Plan anyway. These calculations, which contain lower carbon emission factors for electricity, favour electrically based solutions. The results for carbon emissions are similar for the Town Centre in both a building by building based ASHP solution, compared with the network scenarios.

The pipework route between Somerleyton Road and the Town Centre was investigated for viability through an on-site survey and a desktop study of GroundWise utility search records. The route was found to be viable, but there are risks around the exact vertical and horizontal position of the existing buried services.

Additionally, if the Energy Centre is located at the Town Centre, as opposed to at Somerleyton Road, the costs of connection to the electricity grid are quoted at £180,000, as opposed to £350,000. As such it is recommended that the energy centre be located in the Town Centre.

Indicative layouts for the energy centre have been provided, assuming an ASHP + electric boiler solution is chosen, connecting all buildings including Somerleyton Road. The layouts would be the same for the ASHP + Gas boiler solution. It has been assumed to go onto the Council owned building Plot 1,

however locating the energy centre on Plot 2a would also be possible.

Use of solar panels can help to mitigate the operational costs. However, this will only be able to provide around 12% of the total electricity demand on site.

The financial performance of the heat network is low, even with HNIP funding. In order to increase this it is likely that the price of heat paid by the consumer would need to be increased above the indicative range of 12-14p/kWh (which we showed was comparable to a gas boiler led solution).

Recommendations

There are two distinct options for the Brixton Town Centre and Somerleyton Road developments:

1. Let the Somerleyton Road development adopt the energy solution that is currently planned, and adopt a building-by-building air source heat pump approach in the Town Centre
2. Develop a district heating network that gives the council the opportunity to extend it beyond the Town Centre later and decarbonise other buildings in the vicinity (one such connection being Somerleyton Road).

Both options have strong advantages and disadvantages in terms of technical

economic, planning, carbon and air quality implications, see overleaf for more details. The Council shall need to assess its appetite for taking on the additional complications of attempting to develop a District Heating network in Brixton. A delivery model will need to be chosen and procurement documentation developed.

8. Report addendum

8.11 Conclusions and recommendations

Town Centre energy solution	Advantages	Disadvantages
Building by building air source heat pumps	- This would be the most deliverable solution. Developers would choose their own energy solution to meet the planning requirements - Spending can be phased in line with the development build out, cheaper overall. - Comparable in terms of carbon emissions to network solutions - Comparable in terms of costs to end users	- Carries a planning risk under the New London Plan; the heating hierarchy sets a clear preference for low carbon district heating over building scale solutions for referable developments (like this one). - Lambeth would miss out on the opportunity of developing a network in Brixton, given that this anchor load development presents a good chance for implementing district heating and enabling future developers and existing building owners to go down this route. - Somerleyton Road might end up being served by gas boilers and gas CHP which would be inconsistent with the Council's Climate Emergency declaration and its objectives for air quality improvement in the area.
District heating network	- Could help to enable the developments between the railway tracks that may prefer to be served by a pipe into their basement as opposed to having to implement their own solution - Lower overall space requirements than the building-by-building approach, freeing up more roof space for solar PV etc - Provides an opportunity to decarbonise Somerleyton Road	- Requires greater input from the council, both in terms of capital as well as promotion and commercial delivery of the scheme. Would require a dedicated project sponsor. - Will take longer to deliver as project is more complex - No immediately obvious low carbon heat source is available in the location, so technologies are similar to those installed on a building by building basis.

Table 8.11 Advantages and disadvantages of the building by building vs the district heating route

8. Report addendum

8.12 Next steps

Recommendations

If the council chooses to pursue a district heating network, based on the findings of this report Arup would recommend the following:

- The council should develop the masterplan in the Town Centre with an allowance made for an Energy Centre capable of delivering heat to that development *and* Somerleyton Road, i.e. the indicative layout provided.
- Work with the Somerleyton Road team to better understand how the future connection could be implemented. Embed the council's low carbon ambitions into the development team and attempt to move them away from the CHP-led solution currently proposed.
- This will help with the HNIP application, a requirement of which is that the funded networks have an allowance for future expansion built in to their design.
- If the Somerleyton Road connection does not materialise, other buildings in the vicinity may want the low carbon heat later.
- With space set aside in the masterplan for the Energy Centre, continue to assess whether the council should install gas or electric boilers to meet the peak demands of the network. This may depend on a trade off between carbon emissions and

fuel poverty.

- The council may find that gas boilers can be useful in keeping costs for end users down, enabling the network and can be easily swapped for electric boilers later.

Next Steps

The council needs to make the choice between pursuing a network and realising the ambition in the area, or to take the more deliverable route of installing individual ASHPs on each building. In the first instance, the council should engage with GLA Planning Officers in order to understand the risks posed to planning if a network is not pursued.

Should the council choose the District Heating option, we recommend that Lambeth Council follows these procedures in order to realise the opportunity in Brixton Town Centre:

- Hold an early engagement meeting with Triple Point Heat Networks Investment Management, the consortium team delivering and managing the HNIP scheme on behalf of BEIS. They will appoint a Business Development Manager to the scheme, meet with you, and provide guidance on how best to apply for the funding.
- If the council is going to be the applicant for HNIP funding, the study must advance through the set Heat Networks Delivery

Unit (HNDU)-funded consultancy stages. As such, prior to applying for HNIP funding, it is expected that the feasibility of the scheme would have to be developed a little further.

- The HNDU funds consultancy studies, developing projects from initial Heat Mapping, Masterplanning, Feasibility, Commercialisation and Detailed Project Development. This project is currently about mid way through 'Feasibility' in the eyes of the HNDU. Typically an HNDU funded feasibility study would cost in the region of £50,000-£60,000 depending on the complexity of the project.
- The HNDU will appoint consultants directly through the DEEP framework (through which this study was procured), or councils can choose to procure consultants competitively with help writing procurement documentation from the HNDU.
- As well as being procured through the GLA's DEEP Framework, this study has also been funded by this framework. Currently there is no new funding available through DEEP, but the GLA are working to secure additional funding (earliest in Summer 2020).
- It is Arup's recommendation that Lambeth seeks HNDU funding for the next phase of work and procures a Consultant through

the DEEP Framework in order to do the work. The HNDU can appoint someone directly if the council accepts.

- Arup can also approach the HNDU directly with the outputs of this study and work with the HNDU to understand which items from their 'Feasibility' scope still need to be addressed, making a recommendation for what these items would cost to undertake.
- If the council decides it does not want to have any involvement in the potential scheme, it could go out to market to procure a private ESCo to deliver it for them. In order to do this, procurement documentation setting out the opportunity would need to be produced. The HNDU can fund the production of this documentation, but would need to have greater clarity on the feasibility of the scheme prior to funding that stage.
- In the first instance, it would be worth the Council engaging with the HNDU, to discuss the project and discuss your options for next steps. Arup can provide contact details if necessary.

Appendix A: GSHP feasibility

Brixton GSHP High Level Feasibility

Eren Gunuc, Alex Chen
20-09-2019

Summary

- Aquifer properties are favourable of open loop GSHP, due to moderate to high transmissivity,
- Water level is with London Clay ,
- Chalk rockhead is 70 to 80 mBGL,
- Water well is about 120m deep, cost £100 ~ 150K per well
- Assuming $\Delta T = 5 \text{ degC}$, well yield 10 l/s, each well produces 200 kW,
- There are no known open loops at least 500m radius (the known one is at 2.5km northwest)
- Need a big space to accommodate wells, allow for 150m or more separation between injection and abstraction points

Proposed GSHP Site

A3

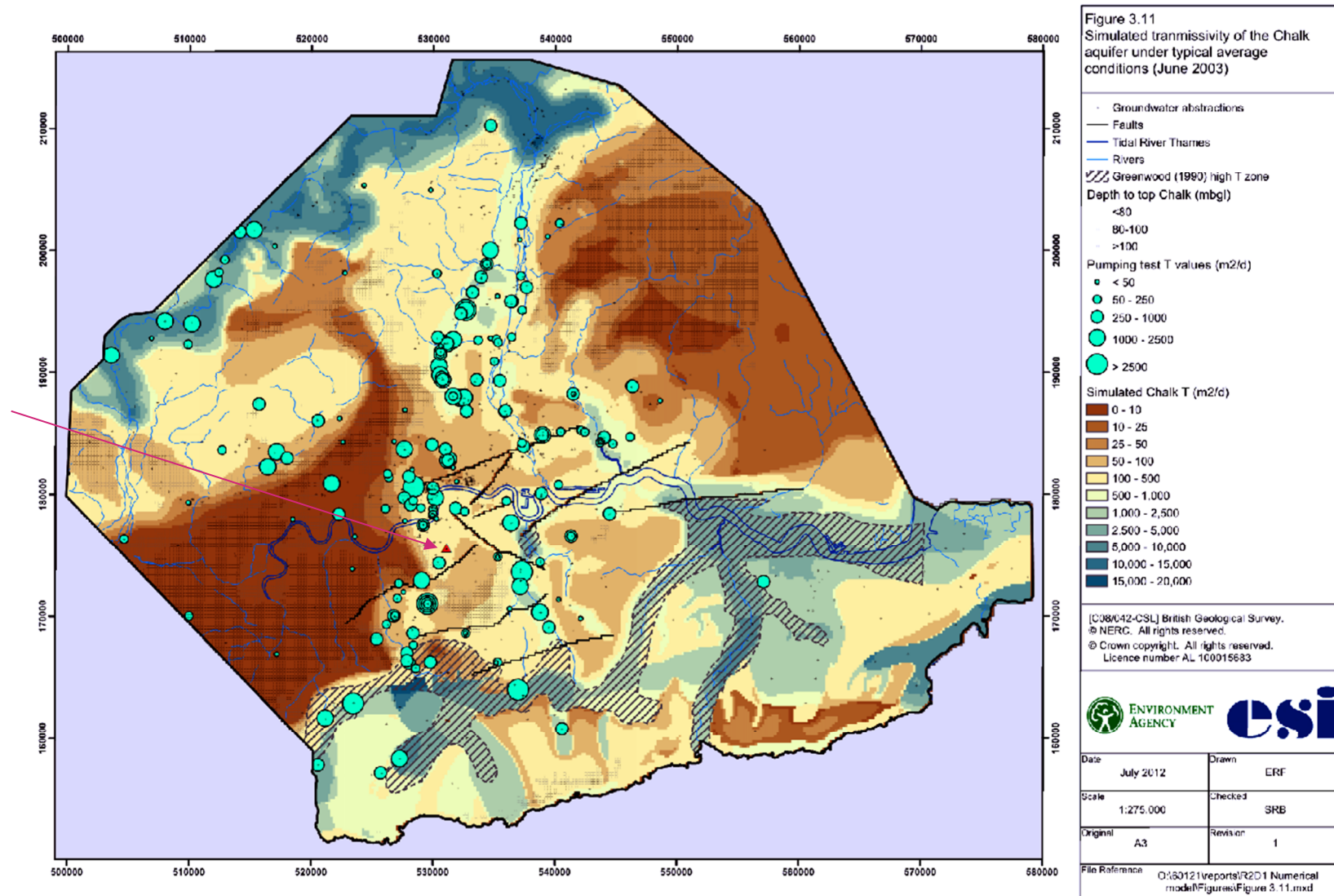


ARUP

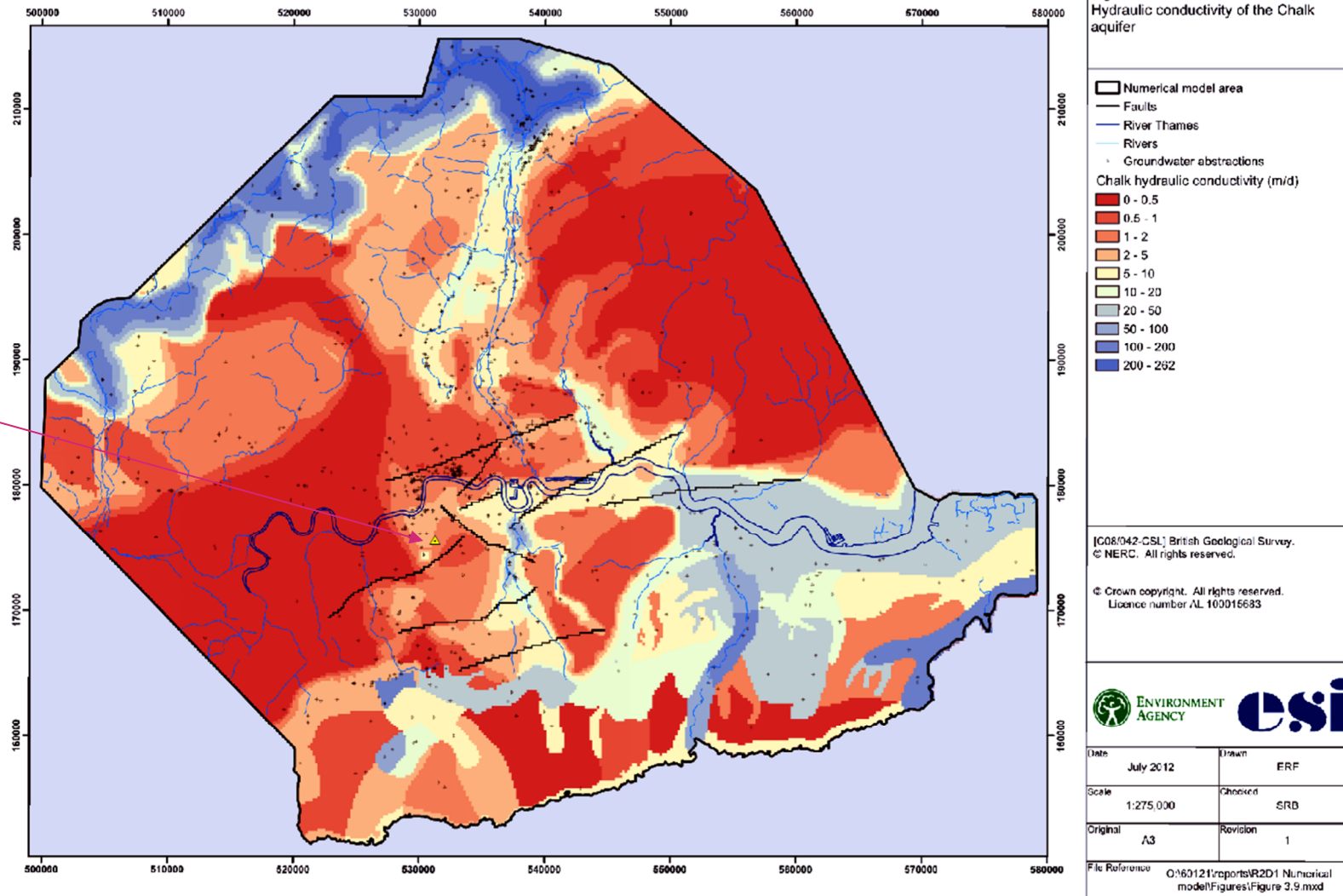
Aquifer Properties

- Transmissivity 100 to 500 m²/d,
- Top of the Chalk 75 mBGL (BH TQ37NW/1258 at 500m distance), about -53 mOD,
- Ground Level ~ +10 to +12 mOD,
- Groundwater Level: The EA GW map indicates water level is -10 ~ -20mOD, while the Lambeth Council flooding report indicates 40 to 50 mBGL (at TQ37/252A, 1.5km southwest to the site),
- No info is found in the London abstraction strategy report

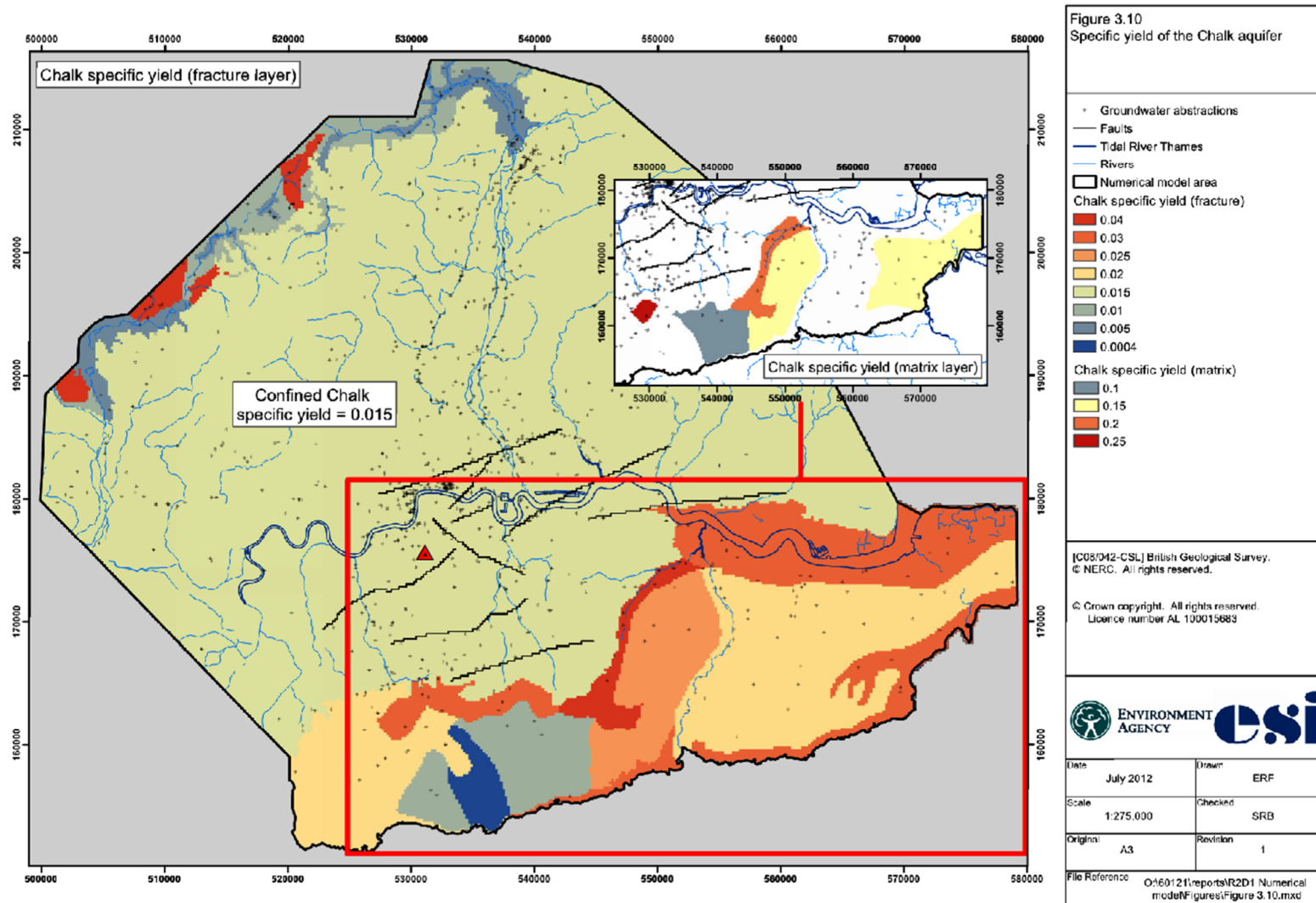
Transmissivity



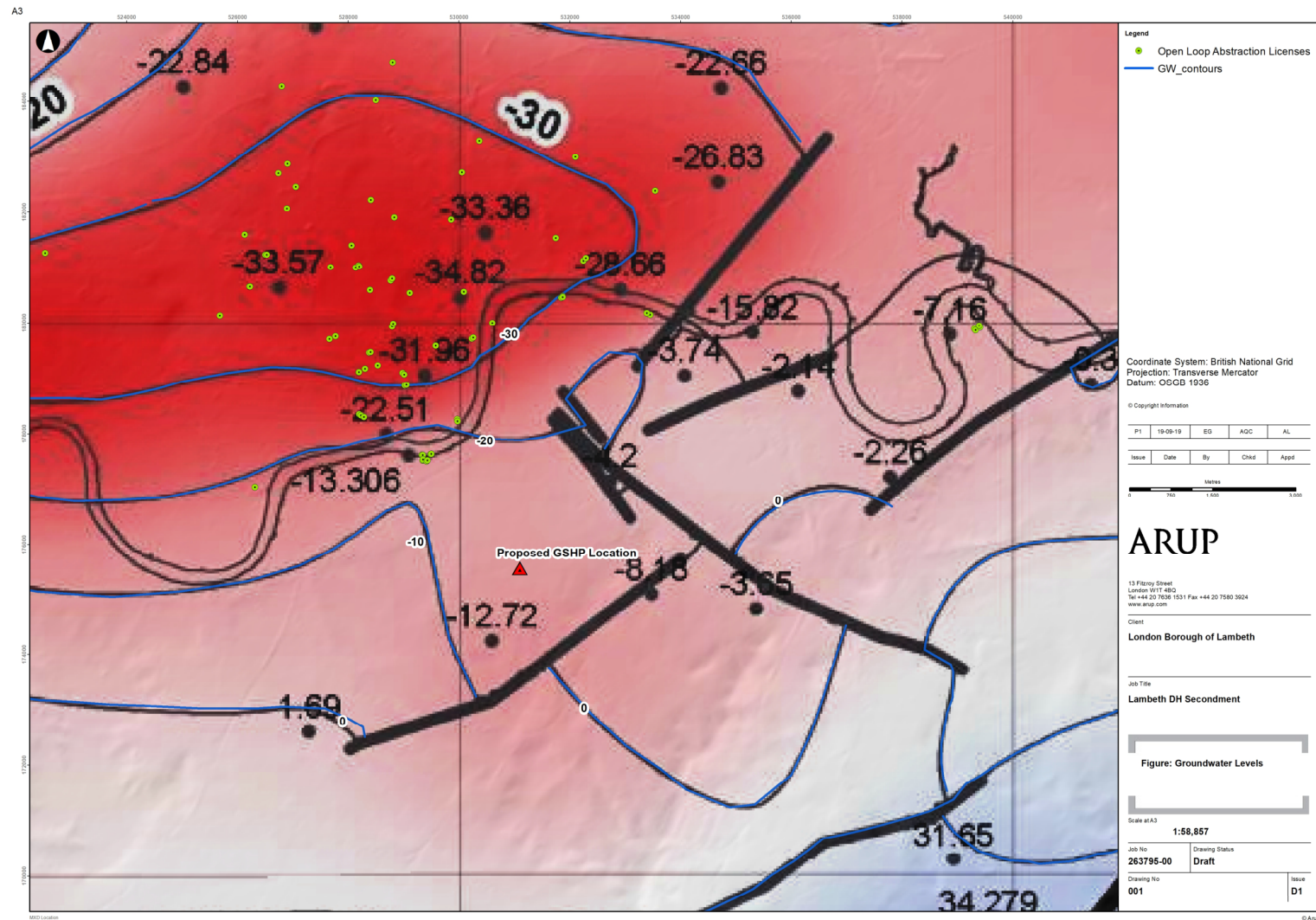
Chalk Hydraulic Conductivity



Chalk Specific Yield

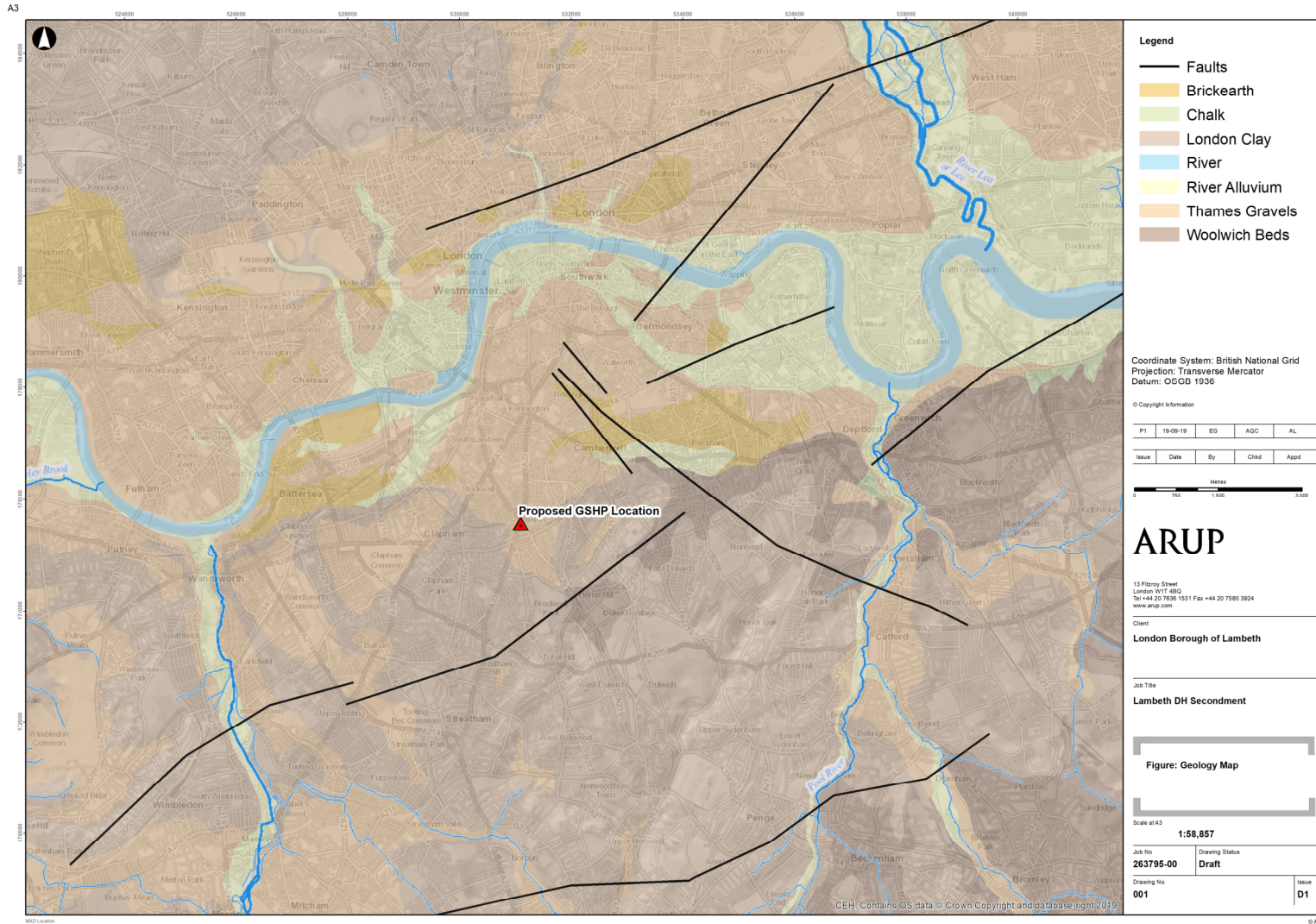


Groundwater Level



ARUP

Geology



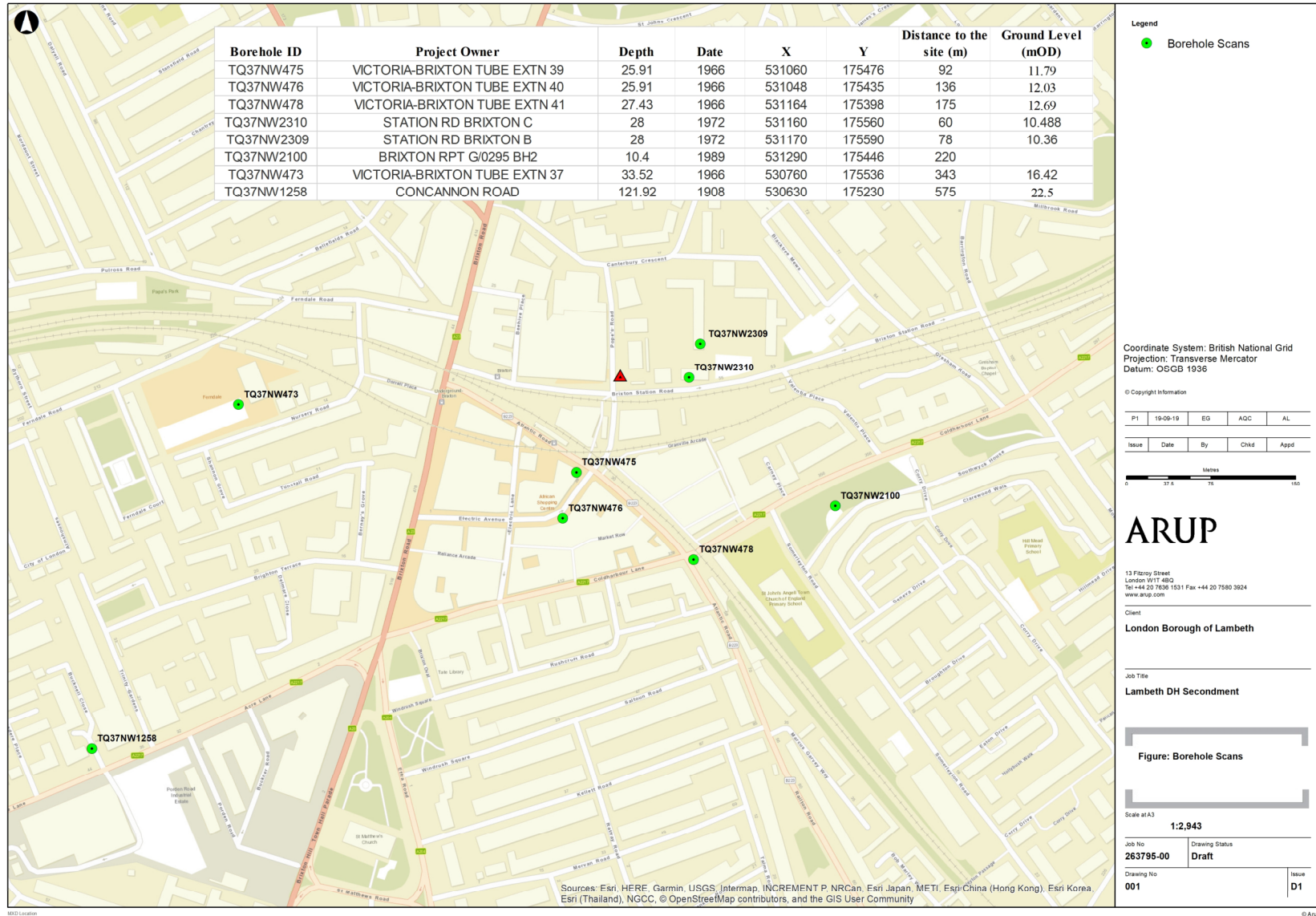
ARUP

Nearby Open Loops & SPZs



Borehole Scans

A3



ARUP

Appendix B: DNO Connection quotes

Ms. Catrina Cassie
Arup
8, Fitzroy Street
LONDON
W1T 4BQ

Date: 20 February 2020

Our Ref: 8500140407 / QID 3000025122

Dear Ms. Cassie

Site Address: Brixton Station Road / LONDON SW9 8PA

Thank you for your recent enquiry regarding the above premises. I am writing to you on behalf of London Power Networks plc the licensed distributor of electricity for the above address trading as UK Power Networks.

I am pleased to be able to provide you with a budget estimate for the development of an Energy Centre at the above site.

It is important to note that this budget estimate is intended as a guide only. It may have been prepared without carrying out a site visit or system studies. No enquiry has been made as to the availability of consents or the existence of any ground conditions that may affect the ground works. It is not an offer to provide the connection and nor does it reserve any capacity on UK Power Networks electricity distribution system.

Budget estimate:

Description

To provide 4MVA via a Metered RMU and new HV feeder from a spare panel in our local Primary Substation, as well as connection works to tie in an existing HV feeder in Canterbury Crescent.

Point of Connection at Primary Substation

£180,000 (exclusive of VAT) if the Point of Connection (PoC) is at our Brixton B 11kV Primary Substation.

Assumptions

This budget estimate is based on the following assumptions:

- The most appropriate Point of Connection (PoC) is as described above.
- A viable cable or overhead line route exists along the route we have assumed between the Point of Connection (PoC) and your site.
- In cases where the Point of Connection (PoC) is to be at High Voltage, that a substation can be located on your premises at or close to the position we have assumed.
- Where electric lines are to be installed in private land UK Power Networks will require an easement in perpetuity for its electric lines and in the case of electrical plant the freehold interest in the substation site, on UK Power Networks terms, without charge and before any work commences.
- You will carry out, at no charge to UK Power Networks, all the civil works within the site boundary, including substation bases, substation buildings where applicable and the excavation/reinstatement of cable trenches.

- Unless stated in your application, all loads are assumed to be of a resistive nature. Should you intend to install equipment that may cause disturbances on UK Power Networks' electricity distribution system (e.g. motors; welders; etc.) this may affect the estimate considerably.
- All UK Power Networks' work is to be carried out as a continuous programme of work that can be completed substantially within 12 months from the acceptance of the formal offer.

Please note that if any of the assumptions prove to be incorrect, this may have a significant impact on the price in any subsequent quotation. You should note also that UK Power Networks' formal connection offer may vary considerably from the budget estimate. If you place reliance upon the budget estimate for budgeting or other planning purposes, you do so at your own risk.

Post estimate call

I will contact you within the next few days to discuss your estimate, to ensure you understand the work we will do for the estimated price, your responsibilities, any dependencies and the likely timescales for the work. UK Power Networks are always looking to improve our service offering and as such, the post estimate call may be recorded for training purposes. We will not share the recorded call with anyone outside of our connections business and it will be deleted as soon as we have completed the training review. However, if you do not want us to record the call please let me know at the beginning of the call.

If you would like to proceed

If you would like to proceed to a formal offer of connection then you should apply for a quotation. Please refer to our website [click here](#) for 'The connection process' which details our application process.

To help us progress any future enquiry as quickly as possible please quote the UK Power Networks Reference Number from this letter on all correspondence.

If you have any questions about your budget estimate or need more information, please do not hesitate to contact me. The best time to call is between the hours of 9am and 4pm, Monday to Friday. If the person you need to speak to is unavailable or engaged on another call when you ring, you may like to leave a message or call back later.

Yours sincerely



Kunal Dhanani-Sumaria
Technical Support Assistant – LPN
UK Power Networks

Ms. Catrina Cassie
Arup
8, Fitzroy Street
LONDON
W1T 4BQ

Date: 20 February 2020

Our Ref: 8500140408 / QID 3000025129

Dear Ms. Cassie

Site Address: Somerleyton Road / LONDON SW9 8QR

Thank you for your recent enquiry regarding the above premises. I am writing to you on behalf of London Power Networks plc the licensed distributor of electricity for the above address trading as UK Power Networks.

I am pleased to be able to provide you with a budget estimate for the development of an Energy Centre at the above site.

It is important to note that this budget estimate is intended as a guide only. It may have been prepared without carrying out a site visit or system studies. No enquiry has been made as to the availability of consents or the existence of any ground conditions that may affect the ground works. It is not an offer to provide the connection and nor does it reserve any capacity on UK Power Networks electricity distribution system.

Budget estimate:

Description

To provide 4MVA via a Metered RMU and new HV feeder from a spare panel in our local Primary Substation, as well as connection works to tie in an existing HV feeder in Canterbury Crescent.

Point of Connection at Primary Substation

£350,000 (exclusive of VAT) if the Point of Connection (PoC) is at our Brixton B 11kV Primary Substation.

Assumptions

This budget estimate is based on the following assumptions:

- The most appropriate Point of Connection (PoC) is as described above.
- A viable cable or overhead line route exists along the route we have assumed between the Point of Connection (PoC) and your site.
- In cases where the Point of Connection (PoC) is to be at High Voltage, that a substation can be located on your premises at or close to the position we have assumed.
- Where electric lines are to be installed in private land UK Power Networks will require an easement in perpetuity for its electric lines and in the case of electrical plant the freehold interest in the substation site, on UK Power Networks terms, without charge and before any work commences.
- You will carry out, at no charge to UK Power Networks, all the civil works within the site boundary, including substation bases, substation buildings where applicable and the excavation/reinstatement of cable trenches.

- Unless stated in your application, all loads are assumed to be of a resistive nature. Should you intend to install equipment that may cause disturbances on UK Power Networks' electricity distribution system (e.g. motors; welders; etc.) this may affect the estimate considerably.
- All UK Power Networks' work is to be carried out as a continuous programme of work that can be completed substantially within 12 months from the acceptance of the formal offer.

Please note that if any of the assumptions prove to be incorrect, this may have a significant impact on the price in any subsequent quotation. You should note also that UK Power Networks' formal connection offer may vary considerably from the budget estimate. If you place reliance upon the budget estimate for budgeting or other planning purposes, you do so at your own risk.

Post estimate call

I will contact you within the next few days to discuss your estimate, to ensure you understand the work we will do for the estimated price, your responsibilities, any dependencies and the likely timescales for the work. UK Power Networks are always looking to improve our service offering and as such, the post estimate call may be recorded for training purposes. We will not share the recorded call with anyone outside of our connections business and it will be deleted as soon as we have completed the training review. However, if you do not want us to record the call please let me know at the beginning of the call.

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Yours sincerely



Kunal Dhanani-Sumaria
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