Local Energy Accelerator

Waste Heat Strategic Areas Summary

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Report Disclaimer

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Glossary

Term	Definition
API	Application Programming Interface
ASHP	Air Source Heat Pump
BEIS	Departement for Business, Energy, and Industrial Strategy
BH	Buro Happold
CAPEX	Capital Expenditure
CSE	Centre for Sustainable Energy
DEC	Display Energy Certificate
DESNZ	Department for Energy Security and Net Zero
DHN	District Heat Network
EDEC	Excel D Exhibition Centre
EfS	Energy from Sewage
EfW	Energy from Waste
EPC	Energy Performance Certificate
ERF	Energy Recovery Facility
ESCo	Energy Servicing Company
ESM	Eastern Strategic Main
EU	European Union
FME	Feature Manipulation Engine
GLA	Greater London Authority
IRR	Internal Rate of Return
LAEP	Local Area Energy Plans
LB	London Borough
LBWF	London Borough of Waltham Forest
LEA	Local Energy Accelerator
LHM	London Heat Map
LSOA	Lower Layer Super Output Area
NHS	National Health Service
NLWA	North London Waste Authority
NPV	Net Present Value
OPDC	Old Oak and Park Royal Development
OPEX	Operational Expenditure
PDU	Programme Delivery Unite
REPEX	Replacement Expenditure
SAP	Standard Assessment Procedure
SELCHP	South East London Combined Heat and Power
SDEN	Sutton District Energy Network
STW	Sewage Treatment Works
TEM	Techno-economic Modelling
TfL	Transport for London

1 Combined Cover Note

Two strategic studies have been completed by Buro Happold on behalf of the Greater London Authority (GLA) to assess the utilisation of heat source opportunities across London. These were:

- Waste Heat Study
- River Thames Study

The Waste Heat Study takes London's largest known recoverable waste heat sources and examines how they could catalyse the development of strategic multi-borough heat networks that can support the decarbonisation of heat supply in London. The study identified significant waste heat sources including but not exclusive to Energy from Waste (EfW) facilities, Waste Water Treatment Works (WWTW), industrial processes, and data centres. These sources and their relative waste heat potential, along with heat demands, were used to develop seven strategic areas:

- NLWA
- Beddington
- Royal Dock
- Mogden & Twickenham
- Hayes & West Drayton
- Crossness & South Bermondsey
- OPDC

Within these areas, heat source availability and heat demands (taken from the London Heat Map) have been used alongside constraints and existing heat networks to model potentially viable strategic heat networks. These networks are indicative and are intended to illustrate the opportunity that London's waste heat resource provides and give an indication of what heat networks using those waste heat sources could look like. The study found that the seven waste heat clusters and subsequent networks could:

- Cover 25 Boroughs
- Utilise over 10,000 GWh/yr of Rejected Waste Heat to meet up to 3700 GWh/yr of heat demands
- Save ~40 million tCO2e over the next 40 years.

The River Thames Study assesses the opportunities around utilising heat from the River Thames to decarbonise both heating and cooling in areas close to its banks. The study identified that around 444MW of heat could be utilised from the river via Water Source Heat Pumps (WSHP), equating to 600MW once electrical input to these heat pumps has been accounted for. This would be capable of supplying circa 5% of London’s annual heat demand. The study assessed the challenges and implications of abstracting heat from the river, and the steps needed to create a standardised process for assessing this heat.

Given that the river has a limited capacity as a heat source, it is suggested that heat networks in London that have access to alternative strategic waste heat sources should, where practical, prioritise these, although it is recognised that there are also various technical and commercial challenges to securing heat from these sources. From a strategic London context this would allow areas that have high heat loads but a lack of alternative waste heat sources, to maximise the available river capacity for heat networks in central locations. Those particular clusters of interest identified to benefit from the River Thames were located in:

- Wandsworth
- Richmond
- Lambeth
- Westminster
- Hammersmith and Fulham
- Kensington and Chelsea
- City of London
- Southwark

In total, both studies collectively identified a potential of ~ 5,230 GWh/yr of usable heat across London, of which 3,700 GWh/yr is from waste heat sources, and 1,530 GWh/yr is from the River Thames.

Figure 1-1 shows both the main outputs of the two studies. This graphic demonstrates a widespread heat network opportunity across London from these strategic heat sources.

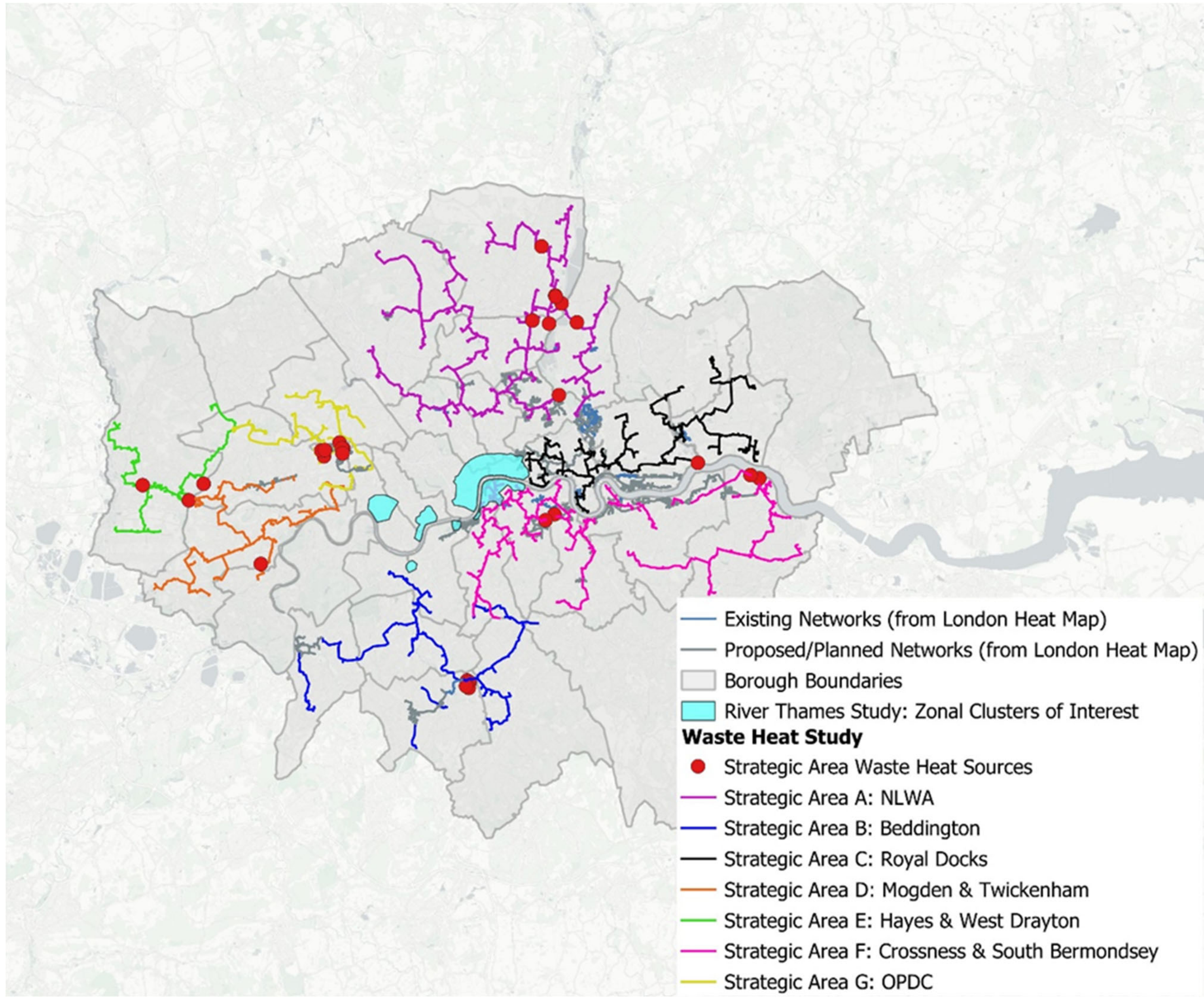


Figure 1-1 Waste heat and River Thames study key outputs

The individual reports outline recommended next steps to pursue these opportunities further - including further engagement and analysis within each strategic area.

2 Waste Heat Study: Executive Summary

2.1 Overview

This study takes London's largest known recoverable waste heat sources and examines how they could catalyse the development of strategic multi-borough heat networks that can support the decarbonisation of heat supply in London. This study identifies seven waste heat clusters in areas across London and proposes how they could catalyse the development of strategic multi-borough heat networks. These are indicative modelled heat networks and are intended to illustrate the opportunity that London's waste heat resource provides and give an indication of what heat networks using those waste heat sources could look like.

This study will feed into the sub-regional Local Area Energy Plans (LAEP) that the Greater London Authority (GLA) are undertaking in partnership with London Councils and London Boroughs (LB). It will create additional intelligence and greater evidence around the opportunity for multi-borough heat networks across London. Where these multi-borough heat networks fall within a LAEP sub-region many of the suggested 'Next Steps' could be progressed through the sub-regional LAEP process as the relevant London Boroughs will already be working in partnership to develop strategies and plans for decarbonising these areas. Where these heat networks inevitably cross sub-regional LAEP boundaries the relevant London Boroughs from the respective sub-regional LAEPs should be contacted and a similar process undertaken.

The study illustrates the significant amount of waste heat that is available in London and could be recovered to supply large low carbon multi-borough heat networks. The size and distribution of the waste heat sources across London has led to the study suggesting the consideration of seven low carbon multi-borough heat networks that could:

- Cover **25** of the 32 London Boroughs and Corporation of London
- Utilise over **10,000 GWh/yr** of Rejected Waste Heat to meet up to **3700 GWh/yr** of heat demands, with the potential for further recovery through infill and/or expansion
- Incorporate **~487 km** of pipework
- Require over **£2.3 billion** of CAPEX for the primary network to each heat cluster
- Save **~40 million tCO2e** over the next 40 years.

The introduction of Heat Network Zoning is designed to catalyse the development of large-scale strategic heat networks and in London this means they will often be multi-borough heat networks. This will bring technical financial and political challenges which will need to be assessed through further project development and tackled through partnership working between the relevant London Boroughs.

Detailed below are the main outputs of the study which include the clusters of strategic waste heat sources assessed in the study and the potential heat networks that could be developed to utilise them.

Table 2—1 Summary of key findings – high level estimates

	Strategic Area	Boroughs Covered	Waste Heat Available (GWh/yr)	Potential Heat Load (GWh/yr)	Length of Pipework (km)	Estimated CAPEX (£)
A	North London Waste Authority	**7** Enfield, Waltham Forest, Haringey, Barnet, Camden, Islington, Hackney	2050	1004	59	225m
B	Beddington	**7** Kingston upon Thames, Merton, Wandsworth, Sutton, Croydon, Lambeth, Bromley	524	386	70	308m
C	Royal Docks	**3** Tower Hamlets, Barking & Dagenham, Newham	1029	1011	90	394m
D	Mogden & Twickenham	**3** Ealing, Hounslow, Richmond upon Thames	673	222	58	331m
E	Hayes & West Drayton	**2** Hillingdon, Ealing	1558	218	43	225m
F	Crossness & South Bermondsey	**5** Bexley, Greenwich, Lewisham, Southwark, Lambeth	4005	943	119	644m
G	Old Oak and Park Royal (OPDC)	**3** Brent, Ealing, Hammersmith & Fulham	379	276	48	235m
Total	**Total**	**25 Borough**	**10,218 GWh/yr**	**3668 GWh/yr**	**487 km**	**£2.3bn**

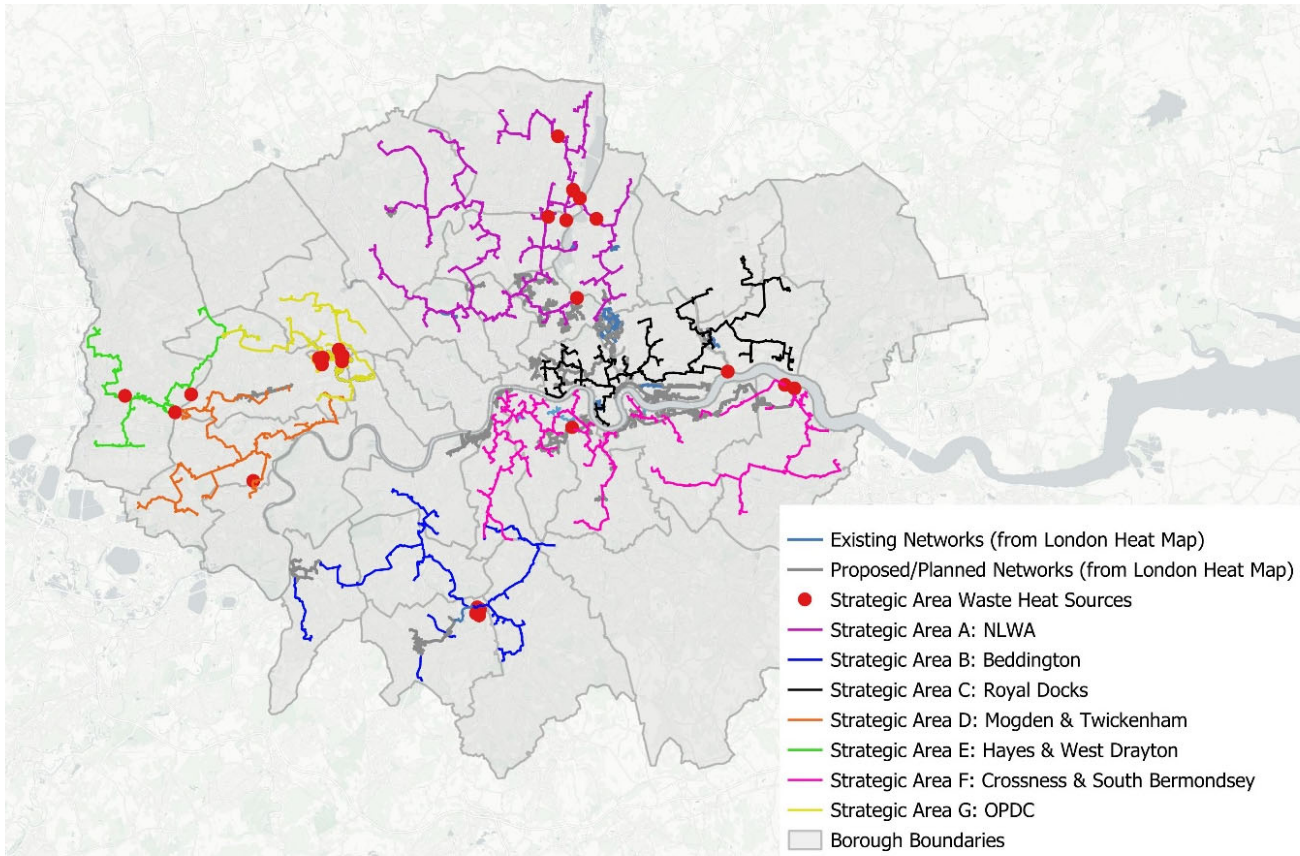


Figure 2-1 All Strategic Area Potential Networks

A comparison between Heat Network Zones from the first run of the National Zoning Model (publish in the Department for Energy Security and Net Zero (DESNZ) Heat Network Zoning Consultation 2023) and the strategic area networks is presented in Appendix A.

2.2 Methodology

The study uses analytical methods to assess appropriate heat demand to create potential clusters and that use the strategic waste heat sources identified in each strategic area. An indicative heat network routing to utilise the heat has been identified using the Steiner Tree method that prioritises a linear heat density of 8+MWh/m. These have been used to provide an indication of potentially viable heat networks to help initiate discussions between relevant London Boroughs, where possible as part of the sub-regional LAEP process, on their appetite for pursuing further investigations of the opportunity together.

2.3 Next Steps

To better understand the opportunity that each of these multi-borough heat networks represent for London and the boroughs in which they are located the following steps are suggested:

- To integrate this report and its findings into the sub-regional LAEPs and use that process and the existing partnerships to help develop these opportunities where there is interest and support to do so.
- The GLA and London Councils to work with the relevant Boroughs for each of the seven areas to discuss the opportunity and then, their appetite and preferred approach for taking each of the strategic heat networks forward.
- For each strategic heat network area where there is an interest from the relevant Boroughs, they along with the GLA and London Councils should establish a Working Group of relevant Borough officers to develop and agree an approach, including a governance structure, for how the heat network could be taken forward.
- For each Working Group that wanted to develop the opportunity further they would need to undertake an Outline Business Case, this would include developing more detailed techno-economic models.
- The outputs of the Outline Business Case can then be utilised by the relevant Boroughs to decide if they want to progress the work and what their preferred Delivery Model could be. That would mean either putting the project out to tender and using the Outline Business Case as the basis for Heat Network Developers to bid for the project or undertaking further work to develop a Detailed Business Case to inform the decision around the preferred Delivery Model and help the relevant London Borough partners decide how they want to proceed with the project.

3 Introduction

3.1 Overview

As part of the Programme Delivery Unit (PDU) role on the Local Energy Accelerator (LEA), Buro Happold carried out a study of the various waste heat opportunities across London. The Waste Heat Study focused on identifying and quantifying waste heat sources across the Greater London. Details on these waste heat sources have been uploaded to the London Heat Map (except where confidentiality issues arise).

There were many different sources of waste heat identified: including transformers, data centres, industrial sites, wastewater treatment plants, energy generation sites, and food retail. Figure 3-1 is an overview of the waste heat sources across London displaying their annual heat rejected by symbol size and categorised by waste heat type.

This study explores the strategic opportunities around some of these major waste heat sources. Early-stage analysis has been carried out to highlight the potential scale of these opportunities for London and its boroughs and sets out what associated multi-borough heat network routes could look like in the context of the forthcoming Heat Network Zoning. This document summarises the waste heat locations which have been tested to date. It is envisaged that the outputs of this report will be used to initiate discussions between London boroughs and support the development of partnerships in these key strategic areas to decide if they want to work together and, if so, how they will undertake further studies to test the feasibility of these potential heat networks in more detail.

Note - there are several areas of waste heat availability that either are not being considered for heat network development (as per Buro Happold knowledge) due to their being too small to establish a network on but they could be used once a network is established or are already being studied, such as the River Thames, and therefore not considered in this study. As heat networks are further planned in the coming years it will be important to consider all the opportunities in London within a strategic context so that opportunities for interconnection and/or heat supply across networks are maximised to provide heat networks that provide London and Londoners with the most affordable low carbon heat supply.

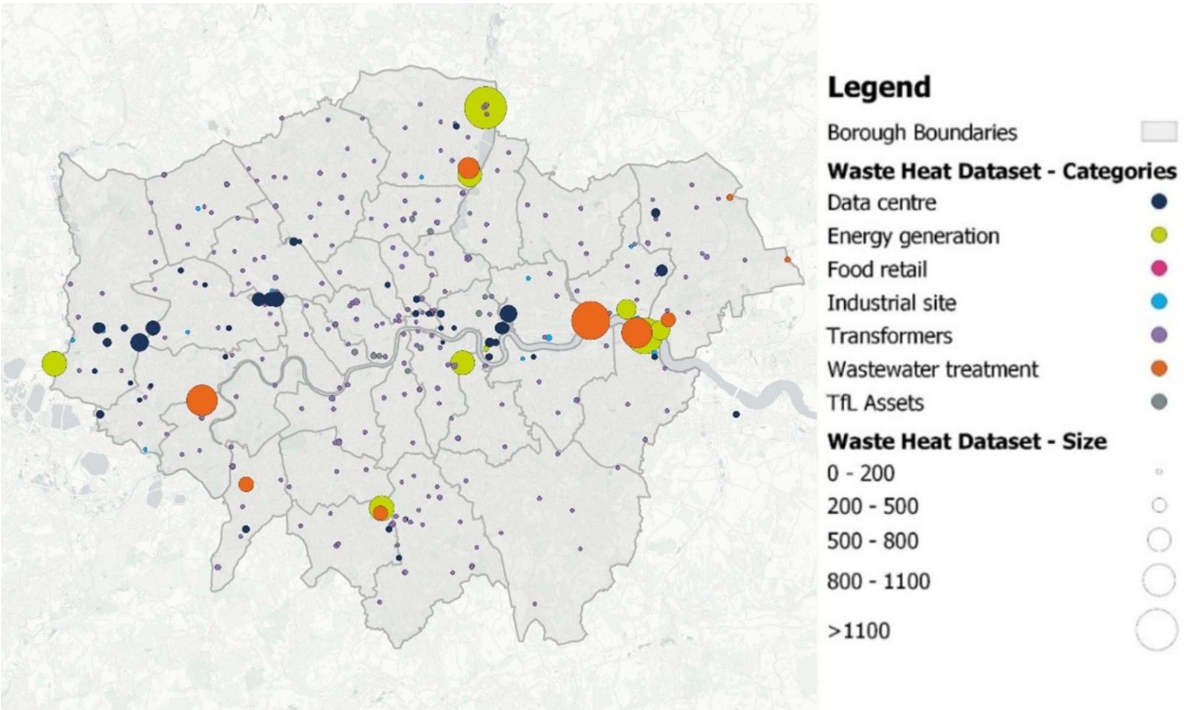


Figure 3-1 Overview of the location of Waste Heat Sources across London

3.2 Strategic areas

This study aims to demonstrate the significant London-wide opportunity that waste heat offers for creating low carbon heat networks that can help decarbonise London's heat supply. Therefore, a wide range of waste heat sources across a number of geographical locations in London have been examined. The strategic areas and the potential size of their associated heat networks have been identified based upon the amount of waste heat available and the potential heat loads in the surrounding area.

The strategic areas identified are as follows:

A. North London Waste Authority (NLWA) - North London Heat Network Study *
B. Beddington
C. Royal Docks
D. Mogden & Twickenham
E. Hayes & West Drayton
F. Crossness & South Bermondsey
G. Old Oak and Park Royal Development (OPDC).

*Note – Analysis of the NLWA strategic area has been completed as part of a separate and more detailed study that was funded by DESNZ, the North London Heat Network Study. As such, the analysis for this area varies a little in methodology and provides outputs at a greater level of detail than the others. This area study includes several different routing options, and a more detailed Techno-Economic Model assessment compared to the other areas, which only include a high-level CAPEX assessment. But if partner boroughs decided to pursue the opportunities identified in any of the other strategic areas then, with additional funding, the next stage would be to undertake a study similar to the North London Heat Network Study.

Figure 3-2 shows the geographical location of the waste heat sources and the potential heat network coverage in each of the strategic areas.

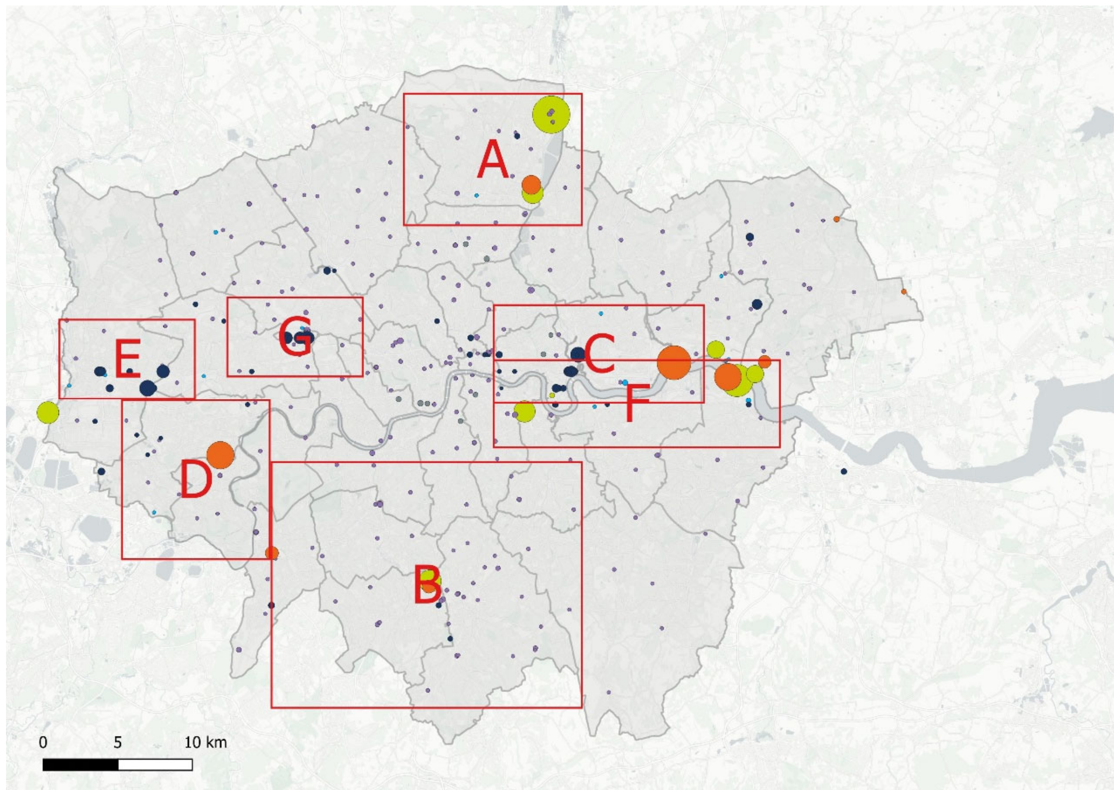


Figure 3-2 Strategic areas

Table 3—2 gives an overview of the strategic areas shown in Figure 3-2. Each Strategic Area has various types of waste heat sources that may be able to be utilised, in some areas a combination of various heat sources has been modelled due to their proximity. Additionally, the table sets out the boroughs that are within each of the strategic areas.

There are two different types of waste heat sources: high and low grade waste heat. High grade will not require upgrading to reach the required temperatures suitable for a heat network and therefore requires no additional energy to upgrade its temperature. Whereas low grade heat will require upgrading (typically through heat pumps) to reach the temperatures required for a heat network. Table 3—1 shows what types of waste heat sources are assessed in this study and which category either high or low grade they fall into.

Table 3—1 Heat Grade Classifications

Heat Grade	Source
Low	Data Centre, Energy from sewage (EfS), Transformers, Waste management facility
High	Energy from waste / energy recovery facility (EfW), Power Stations

Table 3—2 Strategic areas and their Waste Heat Sources and Heat Rejected

Label	Strategic Area	Main Waste Heat Sources modelled	Annual Heat Rejected (GWhr/yr)	Potential Boroughs Covered
A	North London Waste Authority	Edmonton's EfW Facility, Deepham Sewage Treatment Works, Ark Meridian, HACK1 National Grid substation, Virtus London 1, Sainsburys (Northumberland Park), TOTT1 National Grid substation, Sainsburys (Walthamstow Avenue)	2,050 (1200, 440, 310, 60, 16, 16, 5, 5, 5)	Barnet, Enfield, Haringey, Camden, Islington, Hackney, Waltham Forest.
B	Beddington	Beddington Sewage Treatment Works, Beddington Energy Recovery Facility, Unit B Prologis Park Data Centre, Pro-Logis Greenland Way Transformer.	541.4 (130, 400, 11, 1.4)	Kingston Upon Thames, Richmond upon Thames, Wandsworth, Merton, Sutton, Lambeth, Bromley, Croydon.
C	Royal Docks	Beckton Sewage Treatment Works.	1,029	Tower Hamlets, Newham, Barking & Dagenham.
D	Mogden & Twickenham	Mogden Sewage Treatment Works.	673	Hounslow, Ealing, Richmond upon Thames.
E	Hayes & West Drayton	Virtus London 8, Virtus London 7, Virtus London 5, Virtus London 6, Union Park, Colt London 4.	516 (37, 59, 50, 34, 210, 126)	Hillingdon, Hounslow, Ealing, Harrow.
F	Crossness & South Bermondsey	Riverside, Crossness Sewage Treatment Works, South East London Combined Heat and Power (SELCHP)	4,005 (2,952, 652, 401)	Bexley, Greenwich, Lewisham, Southwark, Lambeth.
G	Old Oak and Park Royal Development (OPDC)	Equinix LD3, Equinix LD9, Vantage LHR1 / Park Royal (Upcoming Site), Vantage LHR2, London Colt West, Vodaphone Matrix Park, Alliance Park.	379.2 (4.4, 61, 42, 139, 104, 21, 6.8)	Brent, Ealing, Hammersmith & Fulham.

4 Methodology

4.1 Heat Sources

The available heat sources within each Strategic Area have been identified and mapped. Then, based on the type and size of the heat source, a prioritisation process has been undertaken to identify which heat sources are best used in order to meet the potential heat load in the surrounding area. Figure 4-1 shows the waste heat sources across London that were considered when identifying the strategic areas.

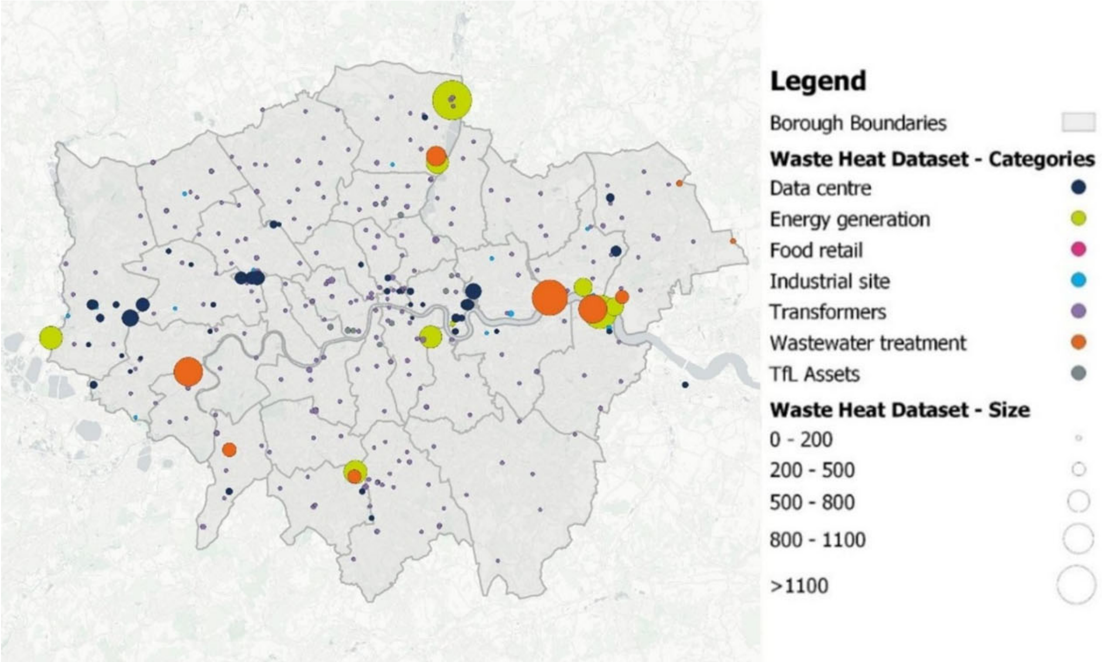


Figure 4-1 Potential Waste Heat Sources identified by type and size

4.1.1 Data Sources for Waste Heat

Heat demand mapping was crucial in identifying anchor loads and new developments withing the study area.

The following data sources were used to gather heat load data:

- The London Heat Map (LHM) provided data on existing heat loads, as well as a limited number of existing planning permissions. The data included diversified annual and peak heat loads (by each building). These heat loads are based on Energy Performance Certificate (EPC)/Display Energy Certificate (DEC) data or building geometry predictions.
- The London Datastore Application Progeamming Interface (API) provided data on developments in planning. The number of residential units and commercial square meters were provided, which were then used alongside benchmarks to estimate the annual and peak demands.
- For NLWA (Strategic Area A) Local policy documents and local plan maps were examined and used to identify future site allocations. Like the planning permissions API data, the site allocations did not include estimated annual and peak heat loads, so these were estimated alongside benchmarks using the number of residential units and commercial square meters. The specific local policy documents that were sourced, have been referenced in Appendix A. Note: some of the identified site allocations had no information attached to them, but they have been flagged as opportunities, nonetheless.

A gap analysis was conducted to ensure none of the data overlapped and loads were not double counted.

Heat network strategic areas were then identified close to the prioritised waste heat sources, where the high heat demand would make the heat network investment economically attractive. In particular, only heat sources with a potential to reject more than 1 GWh of waste heat were investigated as they were considered strategically important and of a sufficient size to allow the build out of a district heat network.

In terms of potential heat network connections, only those considered to be potentially mandatable loads in the context of heat network zoning were considered. A mandatable load is dependent on building type, on-site facilities, energy consumption and its existing heating system. As zoning is currently in the consultation phase, what makes a mandatable load required to connect in any future zone may well be subject to change.

A map showing the demand data in London with only loads deemed to be mandatable (over 100 MWh) is presented in Figure 4-2.

4.1.2 Risks of Waste Heat Sources

There are various risks associated with utilising waste heat sources such as:

- **Inaccurate data provided**: Discrepancies in data quality can hinder effective utilisation of waste heat such as the impact of different methodologies used to calculate the waste heat which can vary depending on the data source (whether it is the Departement for Business, Energy, and Industrial Strategy (BEIS), the European Union (EU) or the GLA). The heat demand is also likely to vary from the London Heat Map dataset. This could impact the modelled areas and the heat load that the waste heat source could serve.

- **Economic considerations:** Fluctuations in energy prices and market dynamics can influence the viability of utilising waste heat. Potential shifts in energy demand and pricing structures could impact the feasibility of waste heat sources.

- **Regulatory changes & compliance:** Clear policies and supportive frameworks are essential for encouraging waste heat integration. Additionally compliance with regulatory standards and requirements related to waste heat recovery and utilisation may pose challenges for businesses, particularly in terms of meeting emissions limits and ensuring safe operation.

- **Technology changes:** It is possible some types of waste heat sources, such as data centres, will undergo technological changes that improve the energy efficiency and therefore there is a decrease in rejected heat which would impact the heat load that the network is then able to serve.

- **Space and Infrastructure Requirements:** Depending on the scale of the waste heat source and the technology used for recovery, significant space and infrastructure may be required to implement waste heat recovery systems. It is uncertain whether all the waste heat sources used in this study have sufficient space for the required infrastructure.

- **Environmental Concerns:** The process of capturing and utilising waste heat may involve environmental risks, such as emissions from the equipment used of potential environmental impacts if not managed properly. It is possible that these concerns will vary on a site-by-site basis depending on location, type of waste heat and available infrastructure.

- **Operational challenges:** Integration of waste heat recovery systems into existing infrastructure may pose operational challenges, including maintenance requirements, system compatibility issues, and reliability concerns.

- **Social acceptance and stakeholder engagement:** Public perception and community acceptance of waste heat recovery projects may vary, potentially leading to opposition or resistance from stakeholders and communities, which could impact project feasibility and implementation. As a result this could increase the financial barriers for implementing and integrated waste heat sources into heat networks.

4.2 Heat Demands

Heat demand mapping was crucial in identifying anchor loads and new developments withing the study area.

The following data sources were used to gather heat load data:

1. The LHM provided data on existing heat loads, as well as a limited number of planning permissions. The data included diversified (by each building) annual and peak heat loads. These heat loads are based on EPC/DEC data or building geometry predictions.
2. The London Datastore API provided data on developments in planning. The number of residential units and commercial square meters were provided, which were then used alongside benchmarks to estimate the annual and peak demands.
3. For NLWA (Strategic Area A) Local policy documents and local plan maps were examined and used to identify future site allocations. Like the planning permissions API data, the site allocations did not include estimated annual and peak heat loads, so these were estimated alongside benchmarks using the number of residential units and commercial square meters. The specific local policy documents that were sourced, have been referenced in the Appendix A. Note: some of the identified site allocations had no information attached to them, but they have been flagged as opportunities, nonetheless.

A gap analysis was conducted to ensure none of the data overlapped and loads were not double counted.

Heat networks strategic areas were then identified close to some waste heat sources, where the high heat demand would make the investment economically attractive. In particular, only sources with a potential to reject more than 1 GWh of waste heat were investigated.

In terms of potential heat network connections, only potentially **mandatable loads** in heat network zoning areas were considered. A mandatable load is dependent on their building type, facilities, energy consumption and existing heating system – as zoning is currently in the consultation phase, what makes a load required to connect in any future zone may be subject to change.

A map showing the demand data in the Strategic Area with only loads deemed to be mandatable (over 100 MWh) is presented in Figure 4-2.

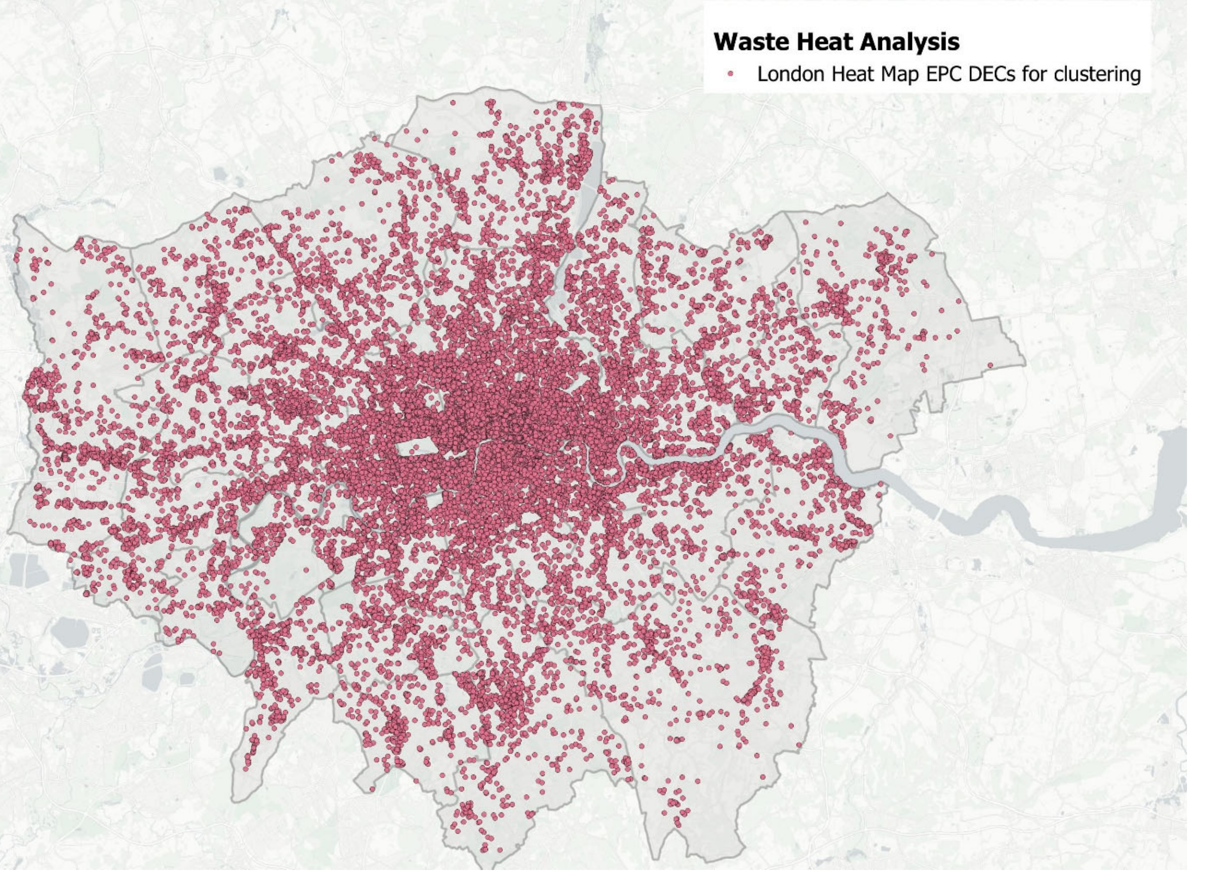


Figure 4-2 London Heat Loads Over 1 GWh

1. Following the identification of potential heat demands for connection to a network, adjacent demands were clustered together based on linear heat density method to form clusters suitable for assessment and for connection. This methodology is explained in further detail in section 4.3.

4.3 Cluster Methodology

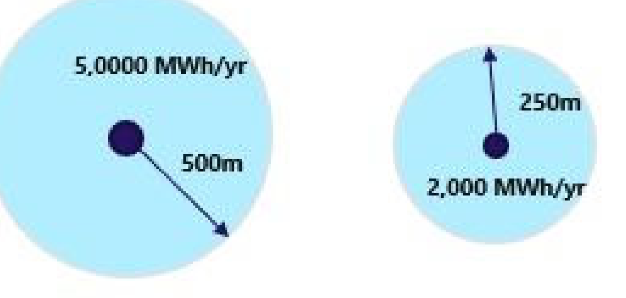


Figure 4-3 Cluster radius methodology

Clusters of heat demands have been formed using a 'buffered linear heat density' assessment. In this method, the annual heat of each demand was divided by 8MWh/yr/m to calculate a distance at which any demand closer than this could be connected and maintain a good linear heat density. A buffer can then be drawn around each demand with a radius of this distance. Radii are limited to a certain radius to avoid buffers being generated around the largest demands consuming an unrealistic area. For example, a heat demand of 2,000 MWh/yr has a radius of 250m, and 5,000 MWh/yr would have a radius of 625m, but is limited to 500m. This is demonstrated in Figure 4-3. Figure 4-5 shows the final result of the clustered heat loads across the entirety of London for a linear heat density of 8MWh/yr/m and a radius limit of 500m. This radius size has been used in order to demonstrate the London-wide heat load potential and higher demand areas.

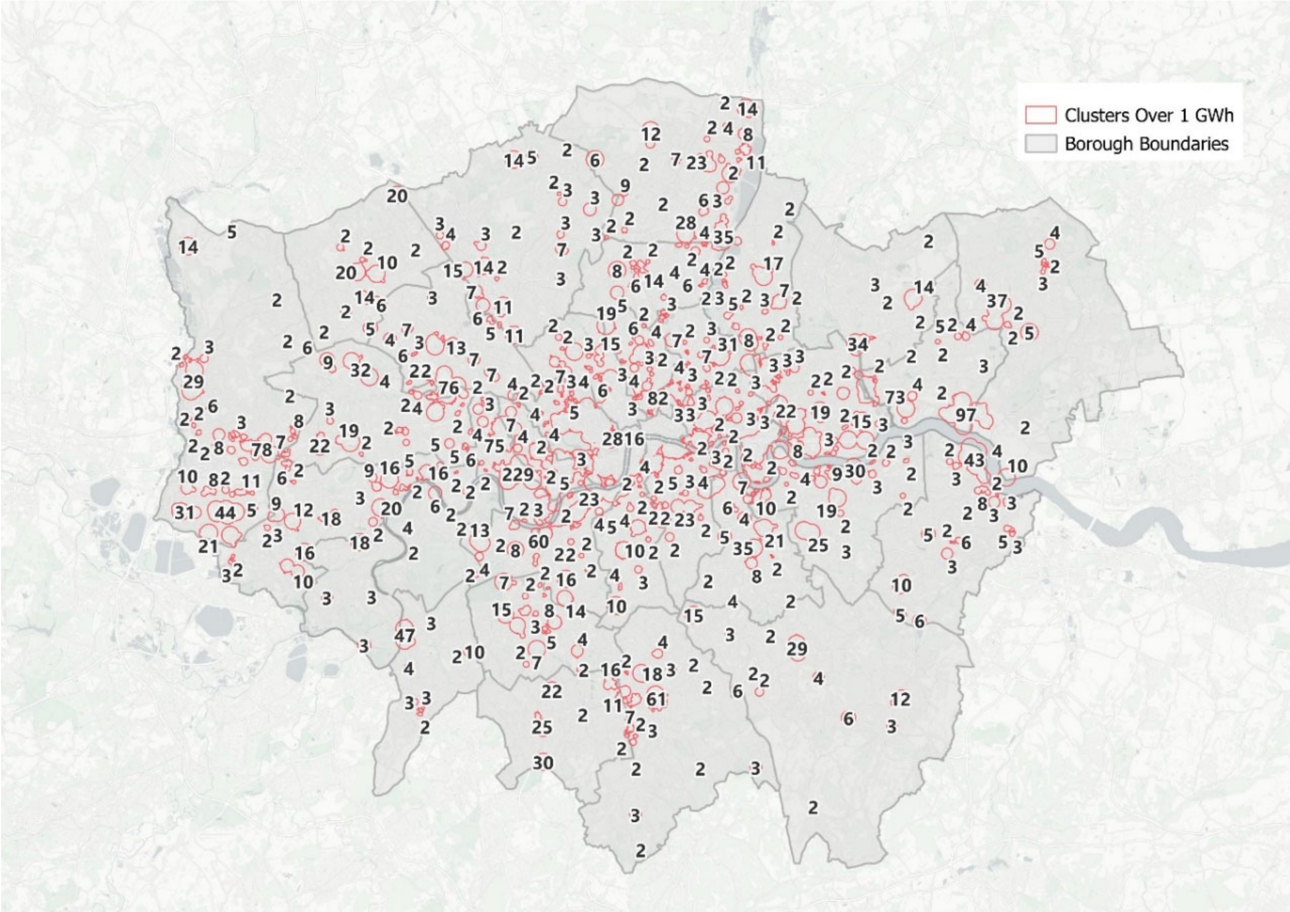


Figure 4-4 Clustered heat loads that sum to greater than 1 GWh across all London Boroughs

Depending on the size of each of strategic area being examined, the cluster size has been based on a size that is suitable for that area individually. The smaller areas, that are not as limited by the processing speed of our routing methodology utilised smaller radius clusters in order to produce a more accurate potential heat network.

4.4 Network Route Methodology

The routing methodology connected the centroids of the clusters to the chosen heat source via the Steiner-tree methodology.

The Steiner Tree minimum distance algorithm has been used to calculate the shortest routing option between clusters and heat sources following road networks. This method is applied in an internal Feature Manipulation Engine (FME) processing tool, giving the shortest network lengths. Figure 4-5 shows and example of the OSMaps layer of potential highways for routing. A processing tool is first applied to this OSMap to connect each cluster and energy centre to the road network. This altered OSMap is then used in the Steiner processing tool in order to find the shortest route. In order to decrease the processing time, the map can be trimmed to remove excess roads that have no possibility of being used.

An example showing pipe route connecting cluster points along the highways network is presented in Figure 4-6.

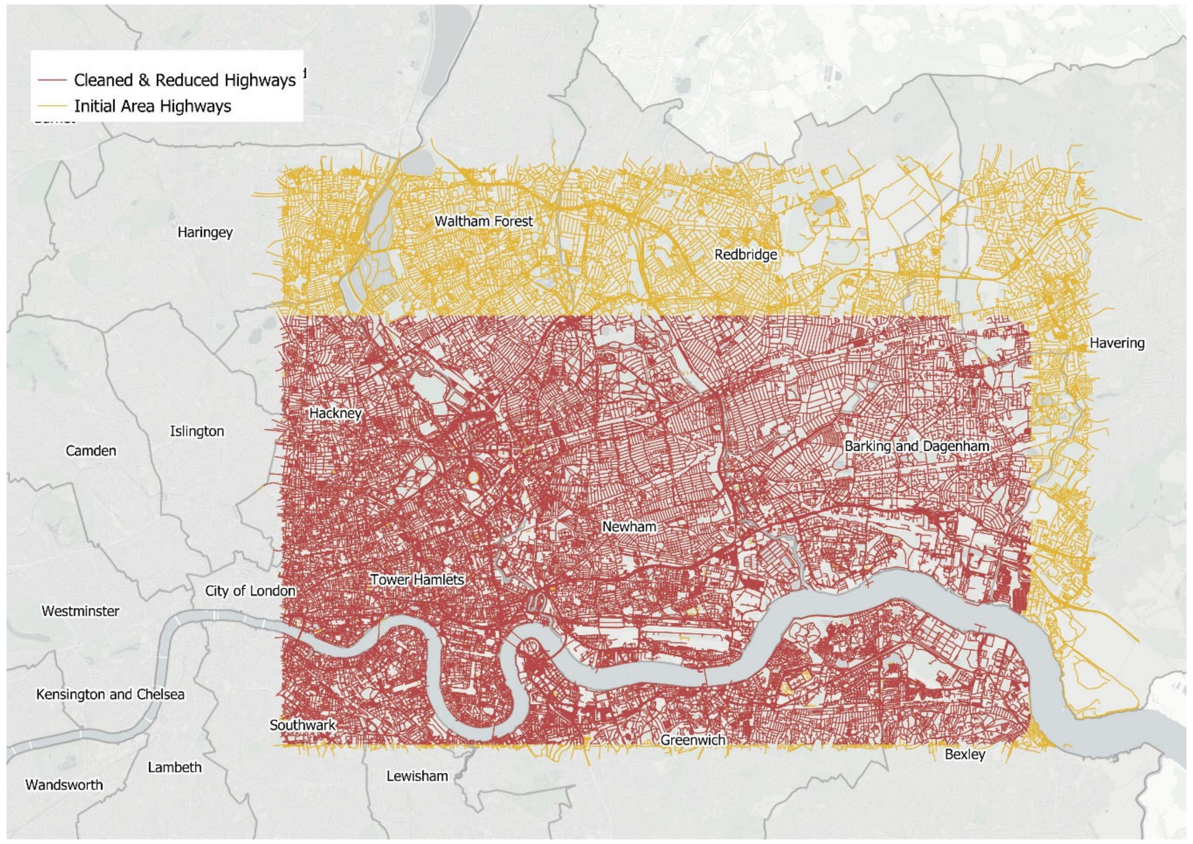


Figure 4-5 Potential Highways for Connection

Figure 4-6 Pipe Route Cluster Connection

After an initial network was produced from the Steiner tool, an additional internal FME processing tool was utilised in order to give the anticipated linear density of the different pipelines of the potential network. This processing tool uses the summed heat loads of the clusters to determine the linear density of that pipe branch. An example of the visual output shown in Figure 4-7. This sized the pipework for the network and classified it into linear heat densities of either:

- 0-2 MWh/yr/m
- 2-4 MWh/yr/m
- 4-8 MWh/yr/m
- 8+ MWh/yr/m.

From this outputted linear density network, only the pipework with a linear heat density of 8+ MWh/yr/m is carried forward to be used in the final network. Then each strategic area is analysed on a case-by-case basis with necessary manual alterations required as a result of incorporating any existing or proposed heat networks (from London Heat Map).

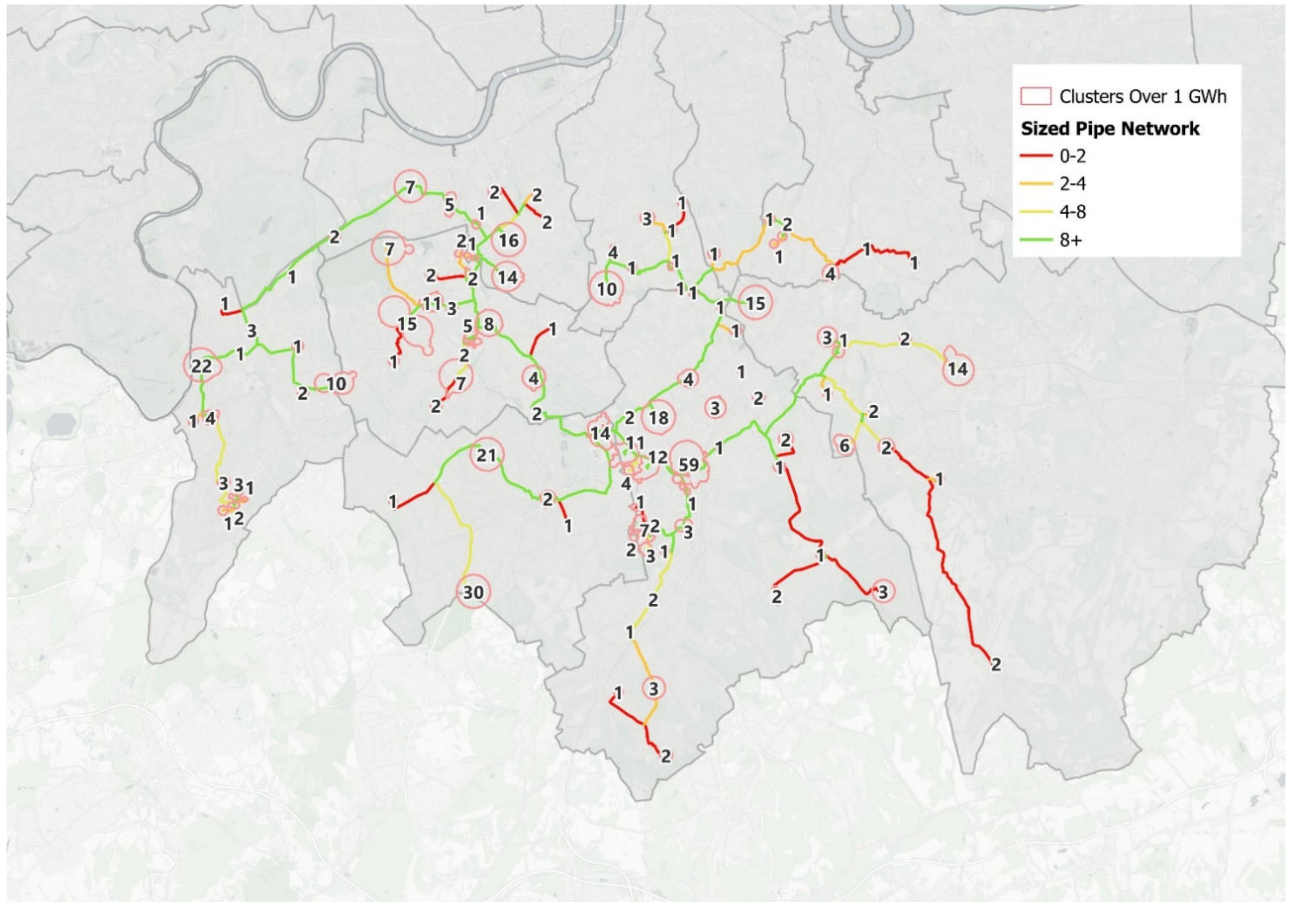


Figure 4-7 Output of Linear Density Tool

4.5 Correlation of Strategic Areas with GLA Potential District Heat Network (DHN) Project Areas

A study carried out on behalf of the GLA by the Centre for Sustainable Energy (CSE), the organisation who designed the London Heat Map, using their cost optimisation and heat network model was run to produce a London-wide map of areas with potential savings from heat supply through a heat network over heat supply through an individual building-level Air Sourced Heat Pump (ASHP), which was the counterfactual scenario. This cost optimisation and heat network model quantified the savings over the ASHP counterfactual from high to low and they are illustrated by the set of shapes (areas) illustrated in Figure 4-8. The model indicated areas where heat networks may be a highly viable approach for the decarbonisation of heat in the area compared to a building level ASHP, using a similar approach to the DESNZ National Zoning Model, and where there would be value in investigating the opportunity in these heat network project areas further. All the coloured project areas indicate a saving compared to the counterfactual scenario with the 'red' coloured areas indicating the highest savings and the blue areas the lower savings.

The strategic areas examined within this study have been reviewed for alignment with these higher saving areas and the analysis shows a good correlation with the outputs of the CSE cost optimisation and heat network model.

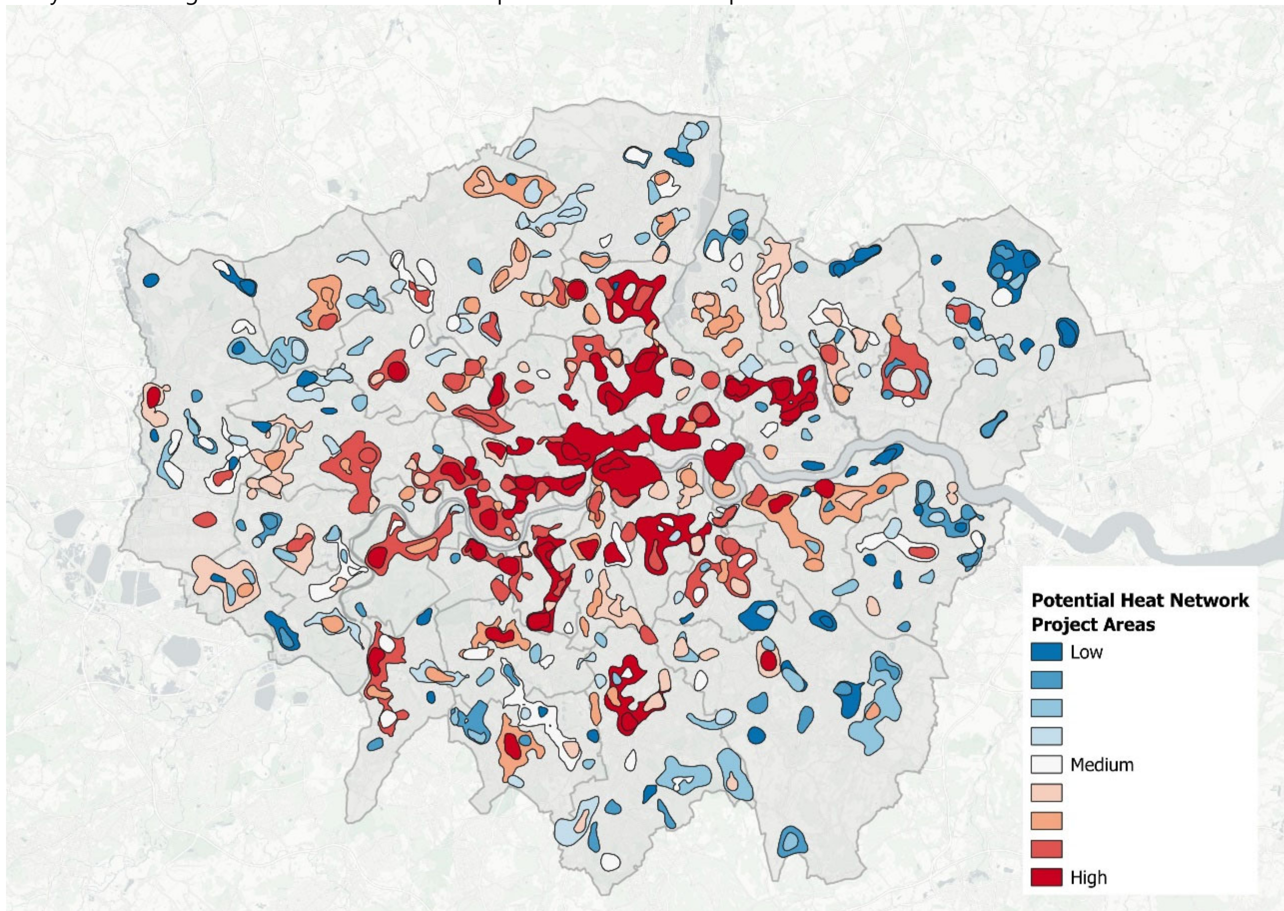


Figure 4-8 Potential Heat Network Project Areas

4.6 Costing

The costings and values used are similar to those previously used in the North London Heat Networ Study. These are very high-level costings intended to give an order of magnitude, but they are likely to change as more in-depth costing analysis is undertaken.

The assumptions for CAPEX and Replacement Expenditure (REPEX) are shown in Table 4—1. The heat grade associated with the type of waste heat source determines the anticipated CAPEX. High grade heat sources use recovered heat costs whereas, low grade heat sources use water source heat pump costs, as they are required to boost temperatures for supplying into the network. The CAPEX costs associated for pipework and civils only includes the main pipe trunk costs, not the localised pipework which would involve additional costs.

Table 4—1 CAPEX and REPEX Assumptions

Variable	Value	Lifetime (years)	Notes
Recovered heat	£0.75m/MW	60	DESNZ Assumption
Water Source Heat Pump	£1m/MW	20	DESNZ Assumption
Pipework and civils	3000 £/m	60	Buro Happold (BH) Project Experience
Plant and energy centre	£1m/km	35	DESNZ Assumption

4.7 Carbon

Carbon emissions of each of the proposed cluster networks have been assessed over the 40 year project lifetime.

4.7.1 Counterfactual Carbon Calculation Methodology

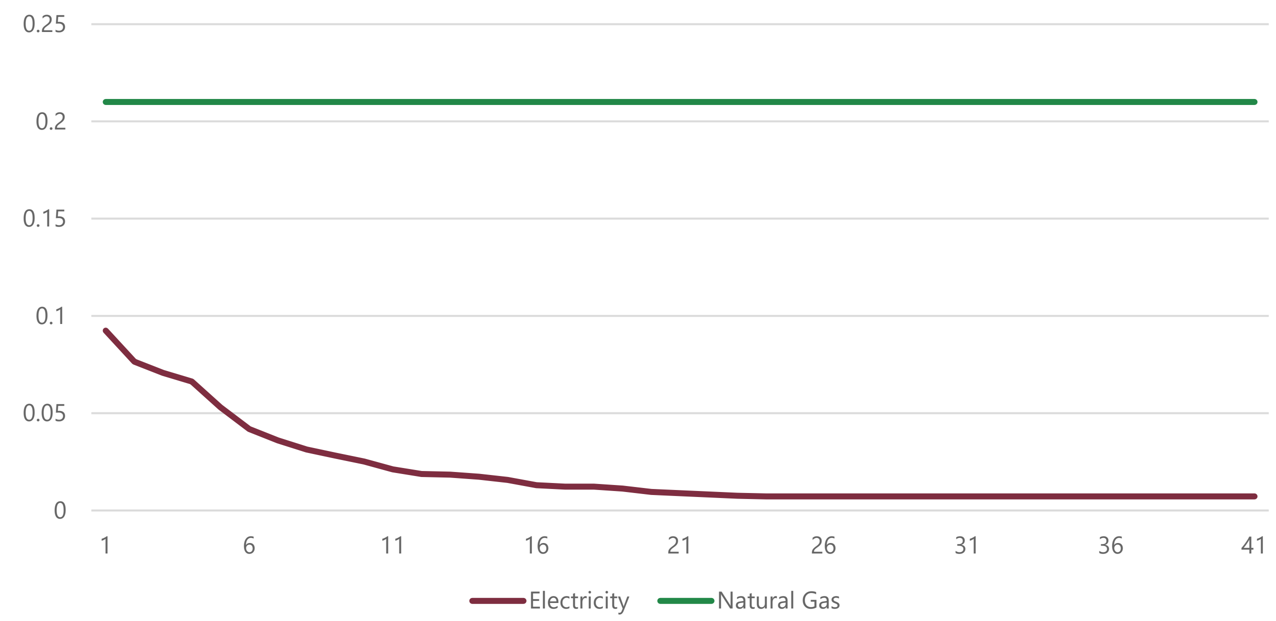


Figure 4-9 DESNZ Grid Carbon Factor Forecast

Carbon emissions of each of the proposed cluster networks have been assessed over the project lifetimes. Given that all the proposed schemes generate heat via electrified sources, this assessment has used the Grid Average consumption based commercial/public sector carbon factors of UK grid electricity published by DESNZ. Gas fuel carbon factors have been used for the existing buildings in the counterfactual options that may retain gas boilers. The gas grid carbon factor, also forecast by DESNZ, remains at a constant 0.184 kgCO2/kWh for the lifetime of the project. Figure 4-9 shows the predicted carbon factor of grid electricity and gas from 2025-2065 from the Government valuation of energy use and greenhouse gas emissions published in 2022. The electricity carbon factor is forecast to decrease significantly overtime due to the increased feed of renewable power generation into the grid.

For all the strategic areas the counterfactual option is a fully gas boiler scenario that has a 85% efficiency and meets 100% of the heat load. The Carbon Factors are shown graphically for grid electricity and natural gas in are applied to the different strategic areas over a 40 year period.

4.7.2 Waste Heat Carbon Calculation Methodology

The waste heat sources utilised in this study vary in heat grade. The only high grade heat sources utilised in this study was EfW with all other heat sources falling under the low grade heat classification. These different heat grade classifications have different associated carbon emission factors.

Low Grade Waste Heat Sources: The heat is available at temperatures too low to be supplied directly into the heat network. In order to use this heat it must be elevated to a higher temperature, usually using a heat pump, with an associated input of electricity. Therefore, the carbon associated with the low grade heat source is the carbon produced from the electricity required to upgrade the temperature of the heat source to meet the district network's operating temperatures so that it can be supplied into the network. A COP of 3.2 was applied to upgrade electricity and the electricity carbon factor presented in Figure 4-9 was used to give the projected annual carbon emissions.

High Grade Waste Heat Sources: As the heat is already at a high temperature, therefore there is no need for energy to be expended to upgrade the heat source. To calculate the carbon factor a 'Displaced Electricity Method' methodology was used as replicated in the Standard Assessment Procedure (SAP) 10.2[1].

The z-factor, the number of units of heat gained for every unit of electricity, has been used to define the carbon content of the heat. Heat is available at low temperatures with almost no losses in electricity output whereas when heat is available at higher temperatures more electricity output is 'lost' for the same fuel input. For the energy from waste facilities, that are the high grade heat sources used in this study the z-factor is considered to be 5. Equation 1 shows the calculation of the 2026 high grade waste heat calculation. As the electricity displaced from grid value changes year on year based on the DESNZ UK Grid Electricity published figures, the carbon factor is recalculated annually.

Equation 1 High Grade Waste Heat Carbon Factor Calculation (2026)

$$\textit{Electricity displaced from grid}\ (0.09248 kgCO2e/kWhe) \times \textit{Electricity reduced output}\ \left(\frac{1}{5}\right)$$
$$= \textbf{Carbon factor of heat}(\mathbf{0.01849 kgCO2e/kWh})¶$$

The resultant 40 year carbon factors for both types of waste heat grade sources are shown in Figure 4-10.

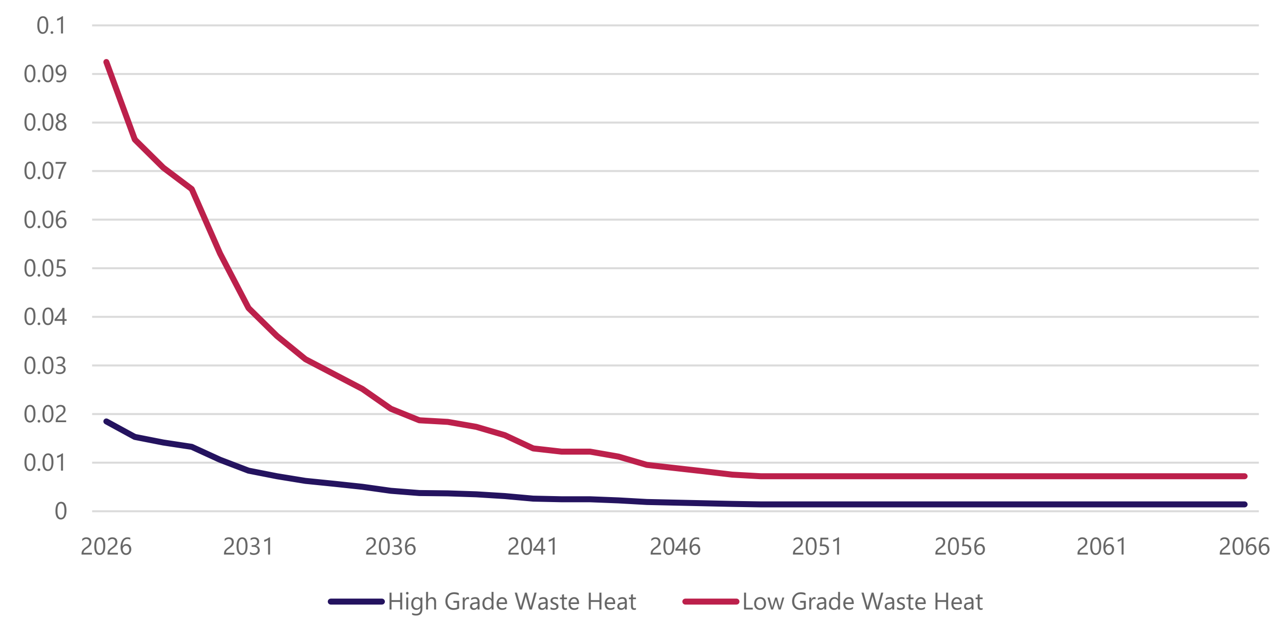


Figure 4-10 High and Low Grade Heat Factors from 2026 to 2066

[1] SAP 10.2 - 11-04-2023.pdf (bregroup.com)

5 Strategic Area A: North London Waste Authority (NLWA)

Note: Analysis of the North London Waste Authority Waste Heat Study area was completed as part of a separate, more detailed study funded by DESNZ, the North London Heat Network Study.

As such, the analysis for this area varies slightly in methodology and the level of detail of results is greater than that for the other areas. For example, this area includes several routing options, and a more detailed Techno-Economic Model assessment compared to the others, which have only had a high level CAPEX assessment undertaken as part of their initial feasibility work.

5.1 Overview

The North London Heat Network Study found that there is sufficient waste heat available in the NLWA area to support at least 1004 GWh/yr of heat demand across the 7 boroughs. There are network routing options that run through the boroughs considered and connect to demand clusters that could enable access to surplus waste heat from sources primarily in Enfield. To achieve this significant multi-borough heat network that utilises waste sources in north London there are a range of technical, political, and commercial challenges that will have to be overcome by partnership working across the boroughs through which the network would run.

The scope of this study looked at the possibility of utilising waste heat sources across North London (and further afield if necessary) to develop multi-borough strategic heat networks that can provide low carbon, affordable heat to homes and businesses. This involved reviewing existing energy masterplans and studies, engagement with relevant London Boroughs and other stakeholders, heat demand and heat source mapping, energy modelling, network design, techno-economic modelling, costing, and a summary of potential options.

A summary of the North London Heat Network study report will be included in this report to give a further case study on a multi-borough district heating network involving the clustering methodology.

The difference between the North London Heat Network Study method and the method used for the other strategic areas is that it tiered the heat loads (into the categories below) and all loads below 0.5 GWh/a have been removed:

- **Tier 1:** 10 GWh /a – 100,000 GWh /a
- **Tier 2:** 2 GWh /a – 10 GWh /a
- **Tier 3:** 0.5 GWh /a – 2 GWh /a.

Tier 1 includes possible anchor loads with a high annual heat demand. Tier 2 are loads with a potential to contribute to an established network. Note: future site allocations with no indication of heat load have been classed as Tier 2 because they present an opportunity which should be investigated further. Finally, Tier 3 are loads that are unlikely to facilitate district heat network development but have potential to connect to a network in the future once it is built out.

5.2 Waste Heat Sources and Heat Loads

This study was completed before waste heat data had been added to the London Heat Map. As such, data was collected from the DESNZ waste heat tool, European Waste Heat Map, Baxel, and National Grid substation waste heat data.

5.2.1 Heat Sources

The top opportunities have been highlighted in Table 5—1 and were the focus of this study.

Table 5—1 Waste Heat Opportunities

Heat Source	Available Waste Heat (GWh/yr)	Available Heat Offtake (MW)
Enfield Power Station	~1,200 (not included in modelling)	Unknown
Edmonton's EfW Facility	~440	60MW
Deepham Sewage Treatment Works	~310	Unknown
Ark Meridian data centre	~60	Unknown
HACK1 National Grid electric substation	~16	Unknown
Virtus London 1	~16	Unknown
Sainsburys supermarket (Northumberland Park)	~5	Unknown
TOTT1 National Grid electric substation	~5	Unknown
Sainsburys supermarket (Walthamstow Avenue)	~5	Unknown
Total	**2,050**	**-**

5.2.2 Excluded Heat Sources

Enfield Power Station has been excluded due to uncertainties around it's future due to it being a fossil fuel power station and its ownership. It should be noted that Enfield are understood to have had some positive engagement with the owners/operators around the potential for heat offtake which depending on thew longevity of the plant might mean that there is far more heat available in this area than has been estimated in this study.

A 2020 study, conducted by Arup, looked at quantifying the opportunity that exists from harnessing waste heat from ventilation shafts on the London Underground system. The study analysed 55 ventilation shafts and 20 pumped groundwater locations to assess the technical, economic, operational, construction and deliverability. The study found that theoretically 38% of the city's heat demand could be met from the waste heat available. The Bunhill 2 Energy Centre uses the recovery of waste heat from the London Underground Northern line to supply its heat network. The opportunity presented from the London Underground sites, due to their size, means that they are better suited to supporting local heat networks as opposed to being of the size required for initiating the development of these multi-borough strategic heat networks. As such, this analysis has not been included in this study and therefore no engagement with Arup or Transport for London (TfL).

As part of the London Borough of Waltham Forest Heat Mapping and Energy Masterplan, Coppermills Water Treatment Plant was identified as having large potential for waste heat. E.ON conducted a high level study that estimated the opportunity could be as high as 100MW, however this was based on some high level assumptions and a delta T of 2^0C. Further engagement with Thames Water concluded that any opportunity is far from realisation, and therefore this has been excluded, however it should be investigated further in the future.

Additionally, there are many parks, sports pitches and rivers located across the boroughs that could be used to utilise low grade heat via a ground source heat pump. Given the scale of this study, these have not been considered for these multi-borough strategic heat networks but could be utilised for the local networks.

5.2.3 Heat Loads

The heat load opportunities in Figure 5-1 were used to identify the key clusters of anchor loads, which informed potential opportunities. The background heat map density layer further illustrates areas with high energy density and more favourable areas for connection.

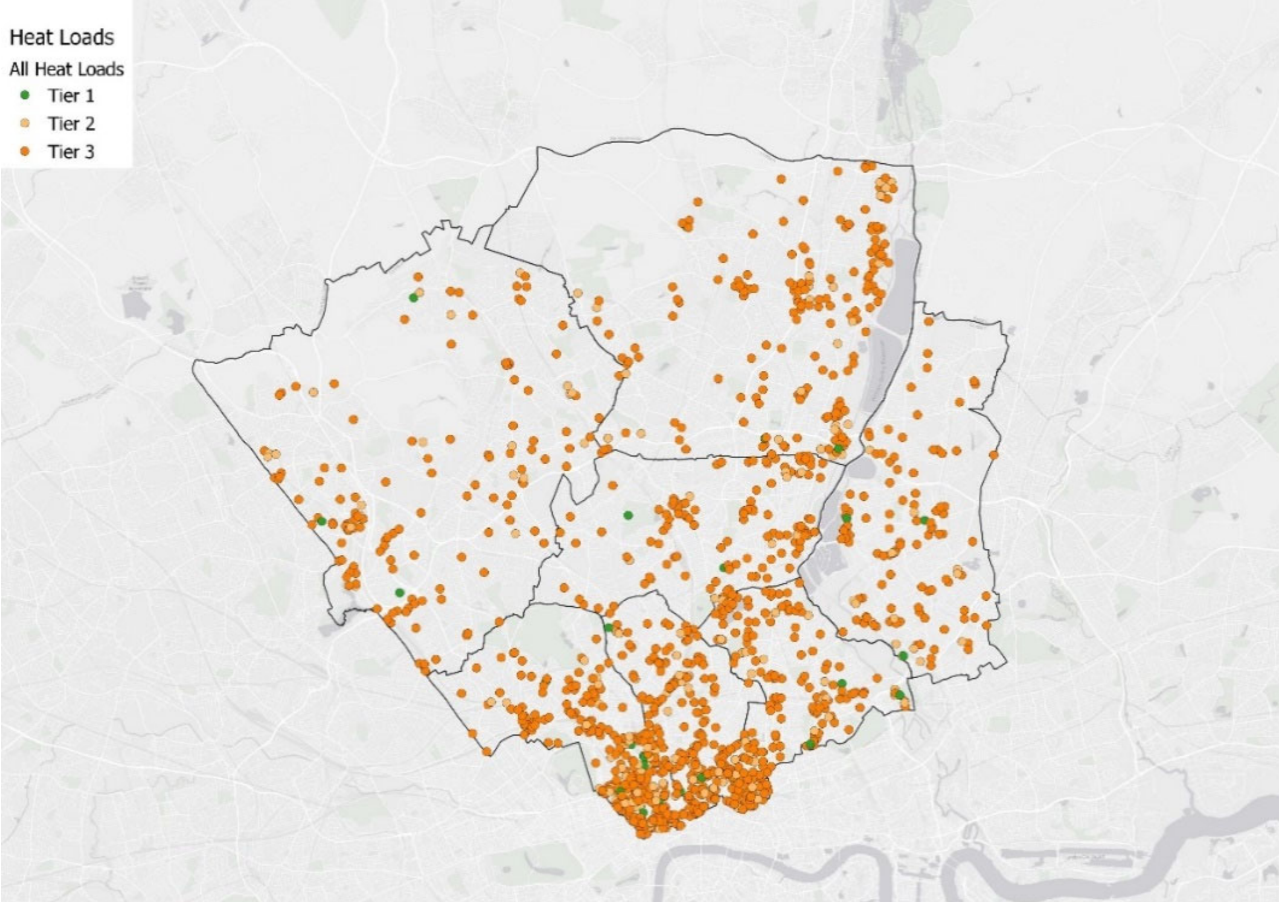


Figure 5-1 Tiered Loads Heat Demand Map

Clustering was performed, as per the methodology described in section 4.3, but with the additional tiering system as to prioritise the larger loads that the heat sources should serve when there is greater demand in the area than available supply.

Tier 1 and Tier 2 loads have been analysed together to find the large and main clusters. Separately Tier 3 loads have been analysed to indicate where clusters of Tier 3 may have been missed in the initial Tier 1 and Tier 2 cluster analysis. For example, in Figure 5-2 there is an 8 GWh/a Tier 3 cluster in Hackney, which is larger than some of the Tier 1 and Tier 2 clusters, this could therefore be considered in further analysis. Along with this many of the Tier 3 clusters lie within Tiers 1 and 2 clusters increasing the argument for taking these areas forward into further analysis.

Clusters below 3 GWh/year were removed giving the final clustering to be taken forward into the routing analysis.

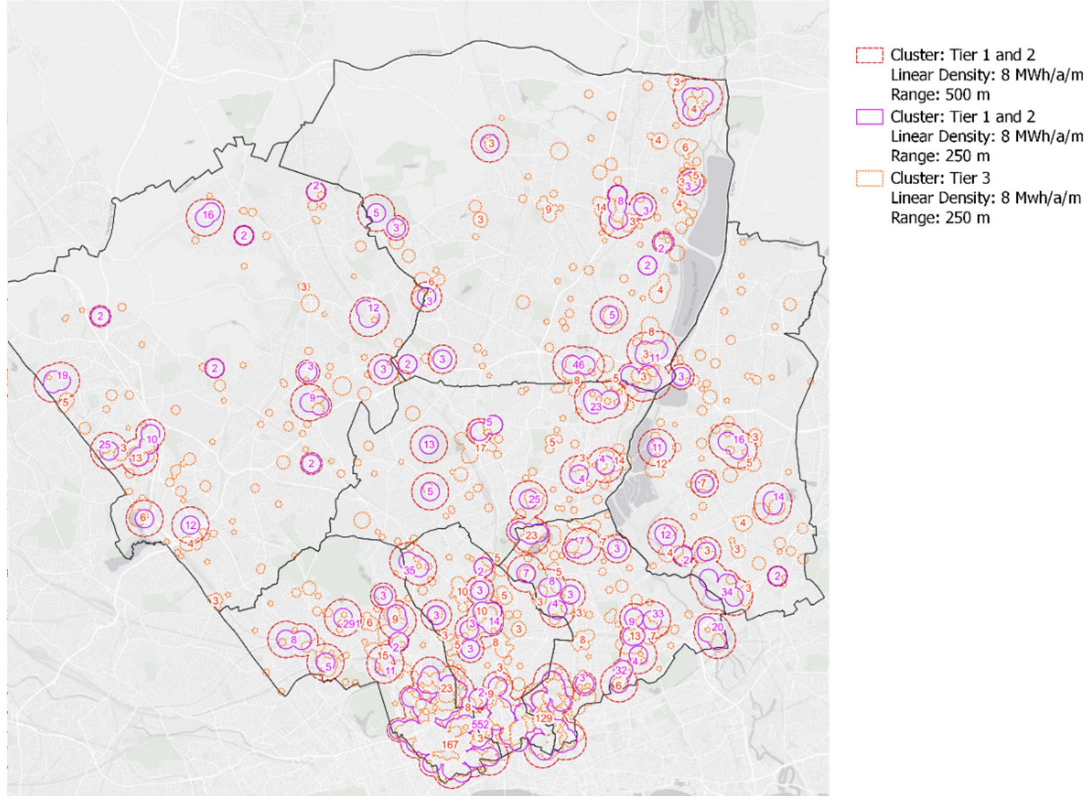


Figure 5-2 Initial Clustering, numbers shown are cluster annual demand in GWh/a

Clusters across the study were generated using the mentioned methodology with resulted shown in Figure 5-3.

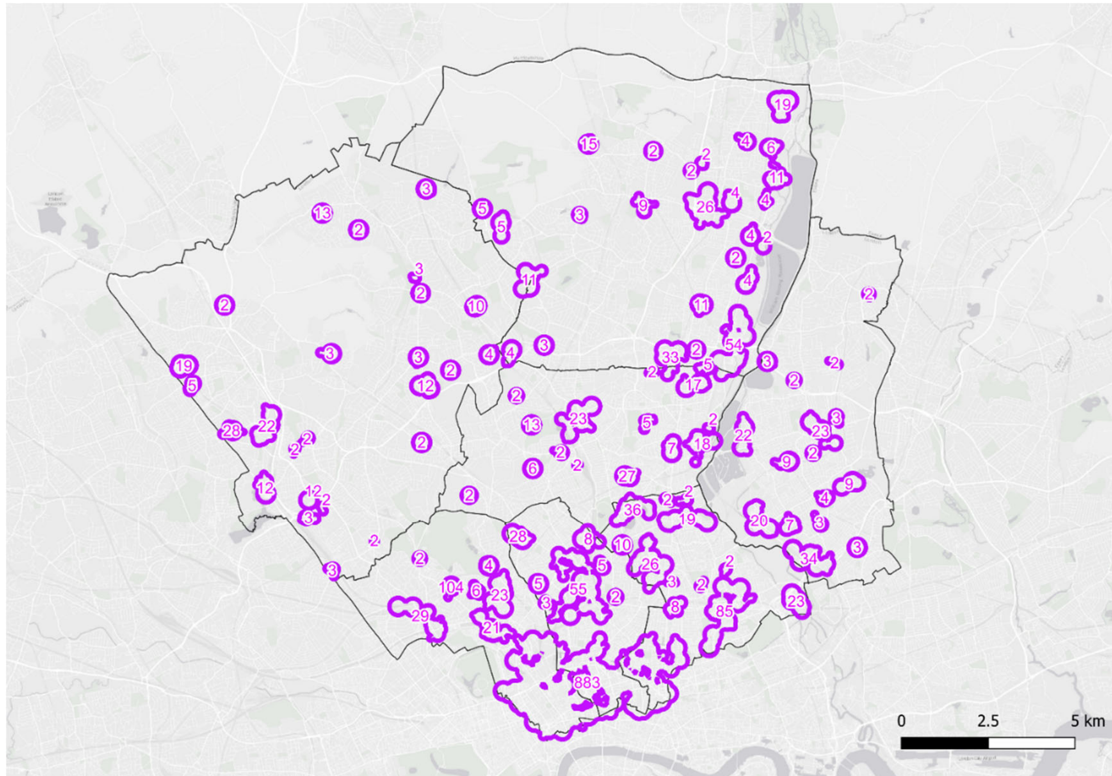


Figure 5-3 Resultant Clusters, numbers shown are cluster annual demand in GWh/a

5.3 Potential Network & Mapping

Given the difference between heat demand and available heat supply, a methodology to prioritise which clusters to connect has been developed. A description of the four different prioritisation methods can be seen in Table 5—2 below.

Table 5—2 Cluster Prioritisation Options

Cluster option	Description
1. Geographic	Look to serve clusters radially outwards from the largest heat supply opportunities (found in Edmonton, Enfield) until no waste heat remains.
2. Geographic weighted	Look to serve clusters radially outwards from the largest heat supply opportunities (found in Edmonton, Enfield) until no waste heat remains, however omits Barnet which has low density connections.
3. Central	Considers that it would be best to focus the heat supply opportunities to serve the harder to decarbonise Central London area from the largest heat supply opportunities (found in Edmonton, Enfield)– this reduces numbers of connections and pipework and reduces service in those boroughs it crosses.
4. Eastern Strategic Main (ESM)	Takes into account the existing plans for a 35MW offtake from the EcoPark by Energetik, currently planned to serve demands in Enfield, Haringey, and North Hackney. In this option the 35MW of heat has been excluded, as well as the clusters planned for connection to this network to give a more realistic view of the opportunity with remaining waste heat.

As this report is not NLWA or DESNZ focused, an overview of the **'Geographic'** route is presented in detail as this is most similar to the methodologies used for the other strategic areas. The other strategic areas in this study all have a sufficient amount of heat sources to meet the heat demand in the area the network is modelled in. The Geographic cluster prioritisation method has been used to model these clusters within each of the strategic areas. Please refer to the full NLWA report for greater detail on all the network routing options.

The loads used for the Steiner network processing tool are shown in Figure 5-4, with the outputted network shown in Figure 5-5. The proposed route begins in Edmonton and serves clusters in Enfield whilst also traveling downwards with a main trunk passing through Haringey, Hackney, Islington, and Camden before branching into Barnet and back into Haringey. There is also a branch to serve Waltham Forest.

Figure 5-4 Geographic clusters

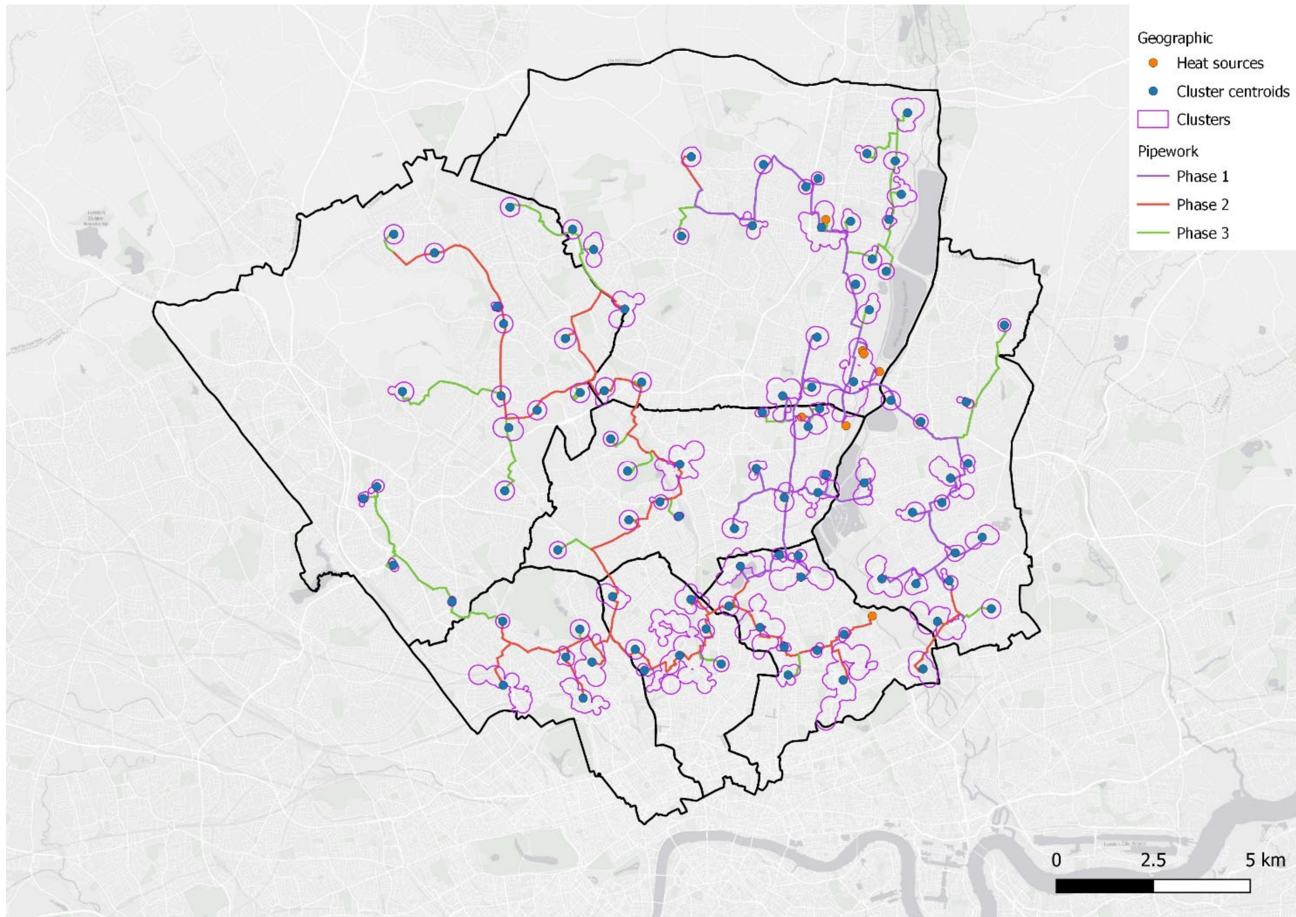


Figure 5-5 Geographic route

5.3.1 Phasing

As shown in Figure 5-5 there has been phasing included. This is for the benefit of the high-level techno-economic analysis, each route has been split into 3 phases. These are presented in Figure 5-6.

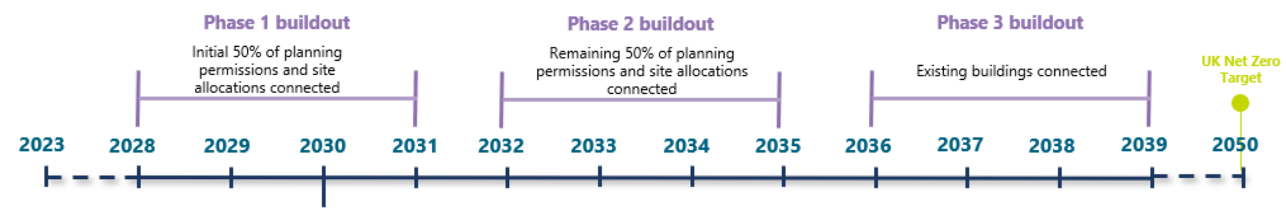


Figure 5-6 Phasing Methodology

5.4 Potential Scale of Investment

This study is further developed than the other strategic areas and therefore has further in-depth costing and a techno-economic model.

A simple technoeconomic cashflow model (TEM) has been produced to assess the scenario. The model looks at the project over a 40-year period from the perspective of an Energy Servicing Company (ESCo) operating the network between the connections to heat sources and cluster level heat substations.

The TEM was built in Microsoft Excel, using the DESNZ economic model as a template. The model combines technical details of the network, such as CAPEX and Operational Expenditure (OPEX), with revenue and cost inputs to generate annual cashflow. This allows for an assessment of viability and means of comparison between the scenarios.

The cost of waste heat from the various sources split between high grade and low-grade heat, with difference waste heat costs for each. With these fixed, the heat sales price to the clusters was changed until the scenarios achieved a 10% Internal Rate of Return (IRR). The scenario with the lowest heat sales price would be deemed the most economically viable. To make this possible, grant funding equalling 30% of the scenario CAPEX was assumed in each case.

All results presented are pre-tax. The assumptions for this modelled are further details in the full North London Heat Network study report.

Table 5—3 Geographic Route TEM results

Variable	Value
Net Present Value (NPV) @40years	£453,900,000
IRR @40years	10%
Lifetime CAPEX	£582,000,000
Lifetime CAPEX (assuming 30% grant funding)	£407,400,000
Heat sales price to achieve 10% IRR@40 years	13.46p/kWh

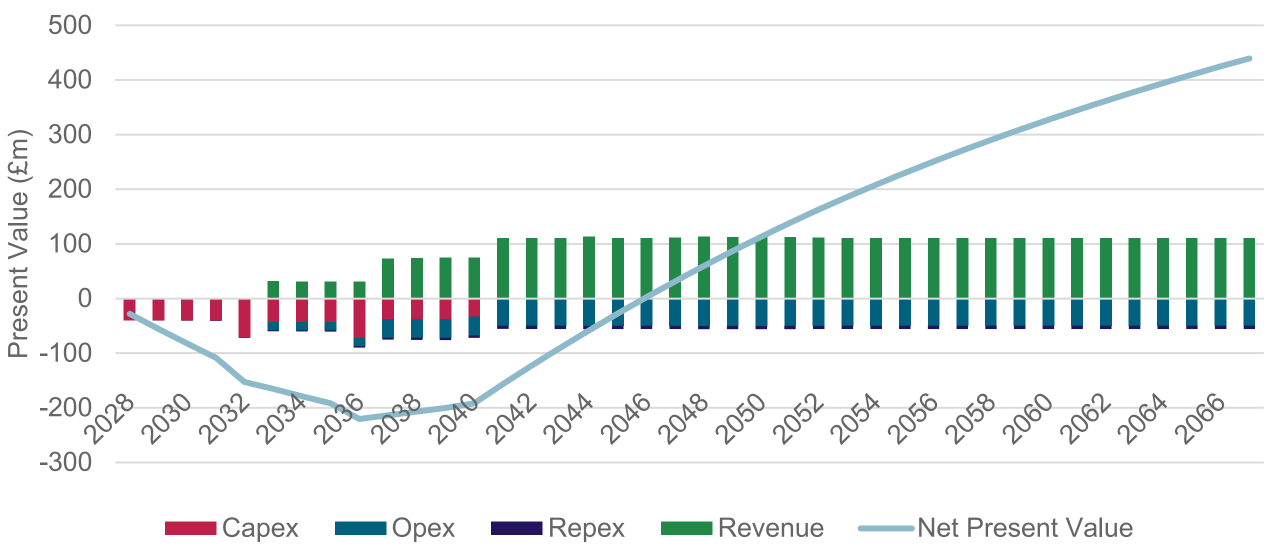


Figure 5-7 Geographic Route NPV Line

5.5 Carbon Results

Carbon reduction realised by connecting the proposed clusters to the final network for NLWA, calculated as set out in the methodology (4.7) are presented in Table 5—4 below. These carbon results are over a 40 year lifetime.

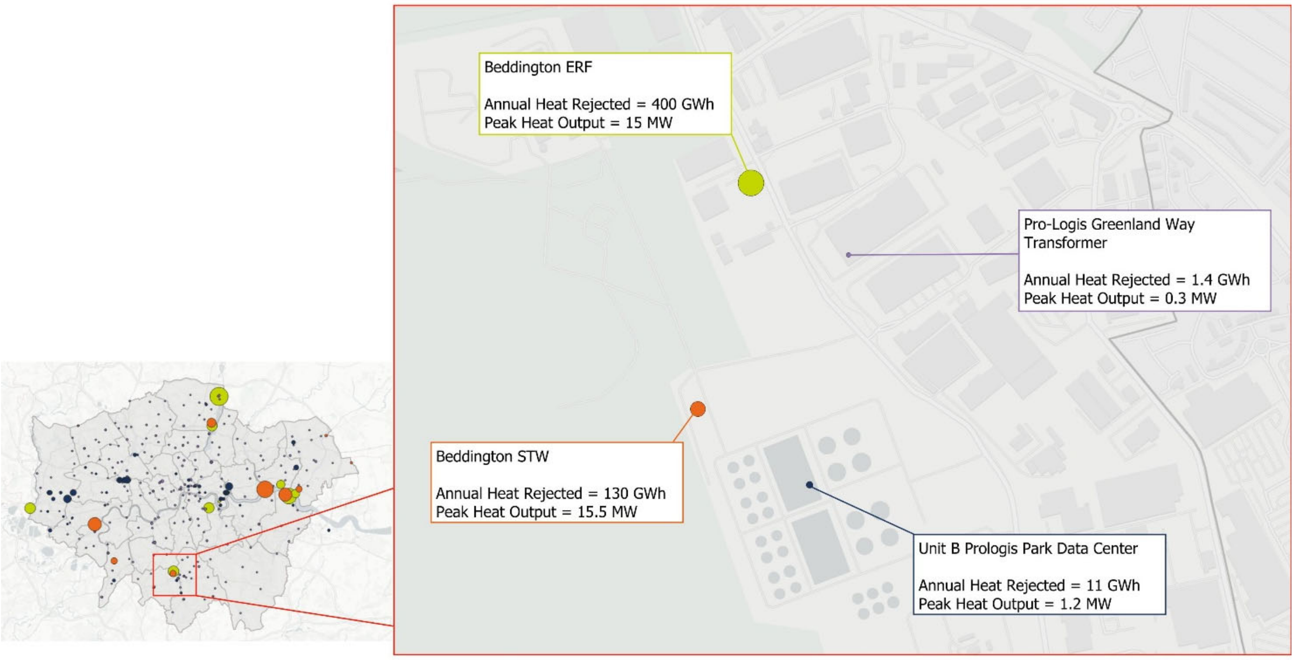
Table 5—4 Carbon Results

Counterfactual carbon emissions (tCO2)	Proposed solution carbon emissions (tCO2)	Carbon emissions reduction (tCO2)	Percentage reduction
11,187,000	232,000	10,955,000	98%

6 Strategic Area B: Beddington Waste Heat Strategic Area

6.1 Waste Heat Sources and Heat Loads

The Beddington Waste Heat Strategic Area is located in South West London, in the London Borough of Sutton near the boundary with the London Borough of Croydon. It has been identified as a waste heat Strategic Area as it has four waste heat sources available within a close proximity as well as some large heat loads in the surrounding area. The four main heat sources are detailed below in Table 6—1 with their geographical location shown.



Note: Only Sources with a potential to reject more than 1 GWh of waste heat are presented

Figure 6-1 Waste heat sources in the Beddington Strategic Area

Due to the proximity of the four waste heat sources, for modelling purposes they have been summed together and considered as one large heat source. Table 6—1 shows the breakdown of each of these sources.

Table 6—1 Beddington Main Heat Sources

Heat Source	Type	Annual Heat Rejected (GWh/yr)	Peak Heat Output (MW)
Beddington Sewage Treatment Works (STW)	Sewage Treatment	130	15.5
Beddington Energy Recovery Facility (ERF)	Energy Recovery	400*	15
Unit B Prologis Park Data Centre	Data Centre	11	1.2
Pro-Logis Greenland Way Transformer	Transformer	1.4	0.3
Total	**Total**	**542**	**32**

*Note this value is in question as Sutton have indicated that only 15MW is thought to be available which may limit output.

6.2 Potential Connections and Network

The clustering methodology, explained in 4.3, was utilised with the heat loads that fell within the Beddington area that totalled to less than the annual heat rejected from the chosen heat sources for the Strategic Area. Due to the scale of annual heat rejected from the waste sources, 542 GWh, there is potential to serve a large area. Figure 6-2 shows the geographical location of the Beddington Strategic Area with the clusters with a total over 1 GWh demands alongside an indication of the location of the main waste heat sources to be utilised.

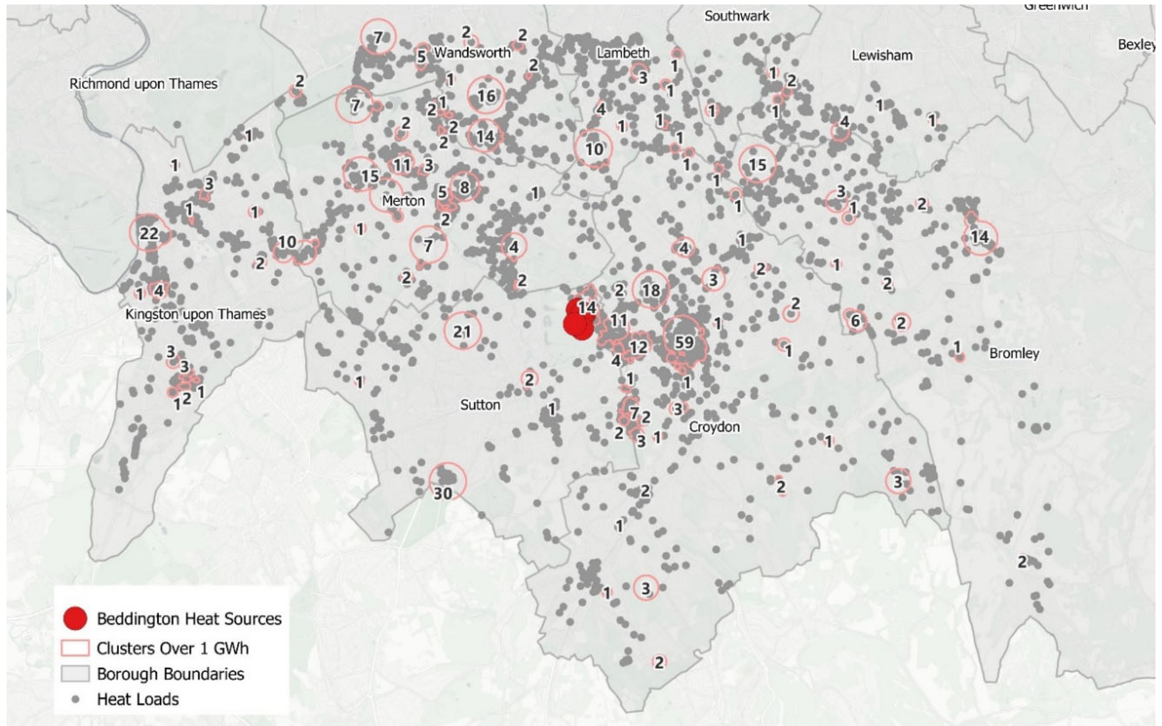


Figure 6-2 Beddington Area with potential Heat Loads and Clusters over 1 GWh

A network has been identified by running Steiner Tree analysis to connect up clusters via the shortest route and shortlisting only pipework with a linear density of **8+ MWh/yr/m**. Exceptions to this were based around a combination of factors such as cluster proximity (that was not picked up as a result of the processing speed limitation over a large area), large individual heat load size and whether there are any existing or proposed heat networks in the immediate area. The final output showing the network between connected clusters and waste heat sources, as well as existing and proposed networks is presented in Figure 6-3 The heat load of this potential network is **~ 386 GWh/yr**.

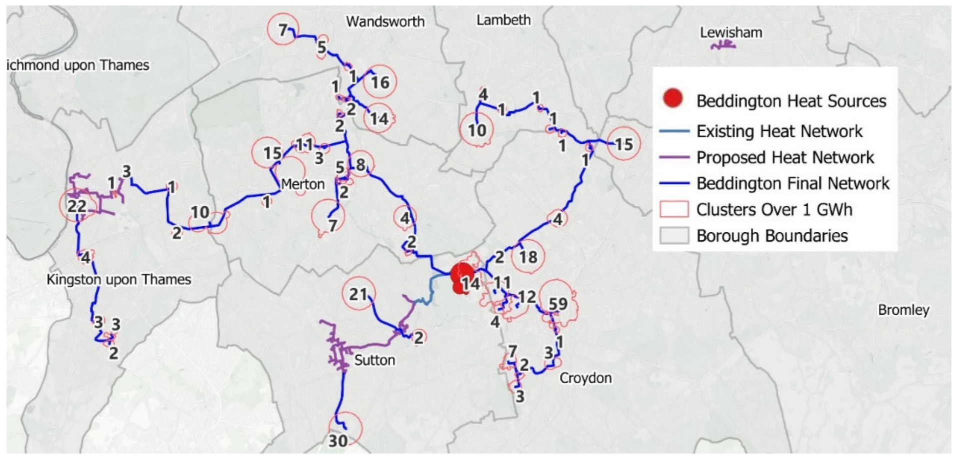


Figure 6-3 Final Network based off linear density and existing/proposed networks

A map showing existing heat networks in the area, the initial Steiner Tree outputs, explicit results of the linear heat assessment, and alignment of the final network with the GLA's Potential District Heat Network (DHN) Project Areas can be found in B.4.

6.3 Connection Opportunities

The proposed network will be a cross-borough network reaching all the largest heat clusters. It will cover the London Boroughs of Croydon, Merton, Sutton, Kingston, Wandsworth and Lambeth. Looking at the 20 largest loads connected in the area gives an understanding of the main stakeholders that need to be involved in the potential network.

Table 6—2 shows the geographical location of these points identified in numerical order dependent on their annual heat demand.

Table 6—2 20 Largest Heat Loads in the Potential Beddington Network

	High Demand Load	Borough	Typology	Heat Demand (MWh/yr)	Peak Demand (kW)	Pipe Linear Density	Included in Network
1	The Royal Marsden Hospital	Sutton	Hospital	27100	13500	4-8	Included
2	St. Helier Hospital	Sutton	Hospital	18600	9300	8+	Included
3	Crystal Palace National Sports Centre	Bromley	Sports Centre	13500	6700	8+	Included
4	Vernon House	Wandsworth	Office Building	11800	5900	8+	Included
5	Croydon University Hospital	Croydon	Hospital	7500	3800	8+	Included
6	Lunar House	Croydon	Office Building	5100	2600	8+	Included
7	Streatham Ice & Leisure Centre	Lambeth	Leisure Centre	4700	2400	8+	Included
8	Merton Civic Centre	Merton	Government Building	4700	2400	4-8	Included
9	Parkside Hospital	Merton	Hospital	4200	2100	2-4	Not Included
10	Kingston-upon-Thames Crown Court	Kingston-upon-Thames	Courthouse	4100	2100	8+	Included
11	Royal Hospital for Neuro Disability	Wandsworth	Hospital	3800	1900	8+	Included
12	Wimbledon College	Merton	Education	3700	1900	8+	Included
13	Bromley Police Station	Bromley	Police Station	3700	1800	4-8	Not Included
14	Wimbledon College of Arts	Merton	Education	3600	1800	8+	Included
15	St Georges Hospital	Wandsworth	Hospital	3500	1800	8+	Included
16	1 Merton High Street	Merton	Commercial Building	3100	1600	8+	Included
17	Canons Leisure Centre 18	Merton	Leisure Centre	2700	1400	8+	Included
18	New Addington Leisure Centre	Croydon	Leisure Centre	2700	1400	0-2	Not Included
19	Reedham Park Av	Croydon	Residential	2700	1400	2-4	Not Included
20	Shannon Commercial Centre	Merton	Commercial Centre	2600	1300	8+	Included

Table 6—2 indicates that 16 of the 20 loads all have high linear heat densities indicating that these loads should be prioritised for connection to the final network. Only 3 of the loads have linear heat densities under 4 MWh/yr/m. Figure 6-4 shows the geographical location of all the top 20 loads in the Beddington area.

Note that the proposed Kingston heat network is also looking at waste heat from a waste water treatment plant and this site could add another >50 GWh/yr of heat to the network which would allow for further expansion and may be required if the Beddington ERF heat output is less than currently modelled.

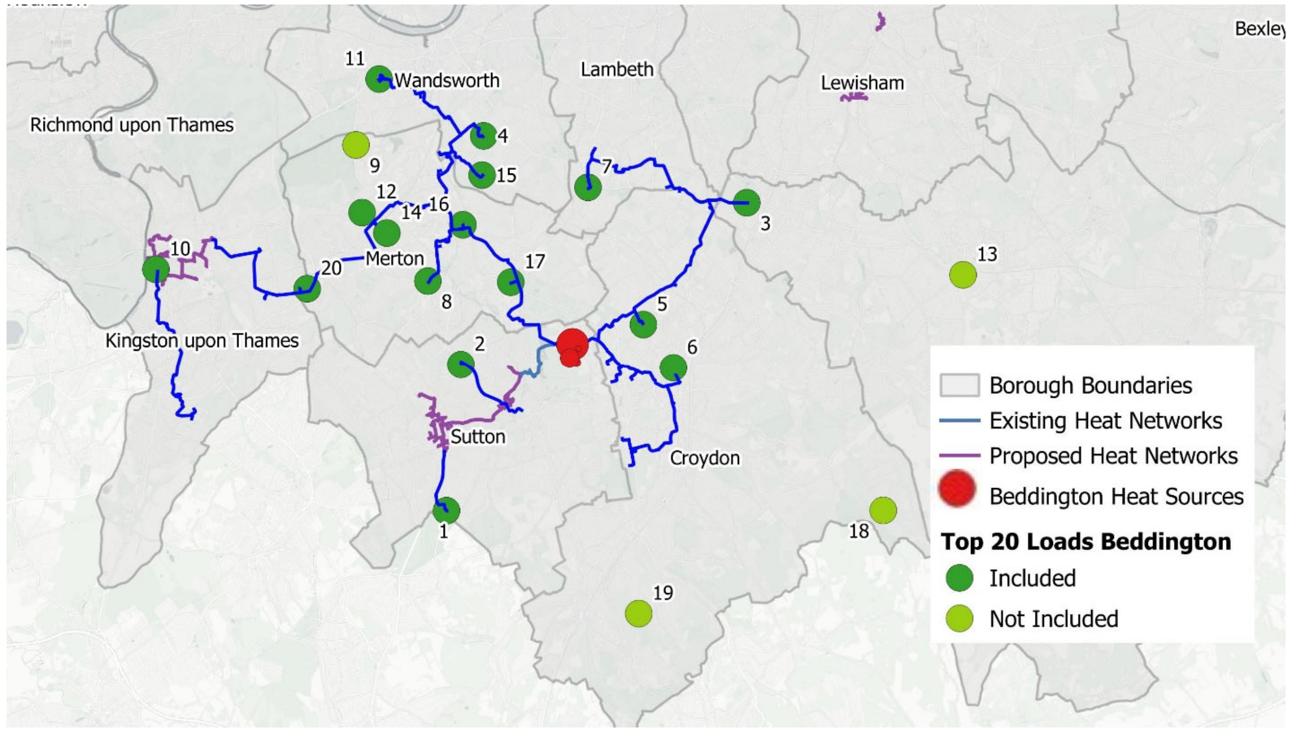


Figure 6-4 Final Network with Top Loads

6.3.1 High Social Housing Areas and NHS Trust Sites

Figure 5-5 shows the Lower Layer Super Output Area (LSOA) areas where there are high densities of social housing. The darkest regions indicate the densest areas of social housing (rented from local authority or other) in each LSOA across the Beddington Strategic Area. This data is from the 2021 ward and LSOA estimates (London Datastore).

This shows a general correlation with the proposed network routing which indicates that building out the network to these areas could support the decarbonisation of social housing as well as the major non-domestic loads in the area that were identified within the Top 20 loads. This figure also indicates the locations of NHS (National Health Service) Trust sites and these are included within the proposed heat networks to show the potential for the heat network to support the NHS in decarbonising these sites.

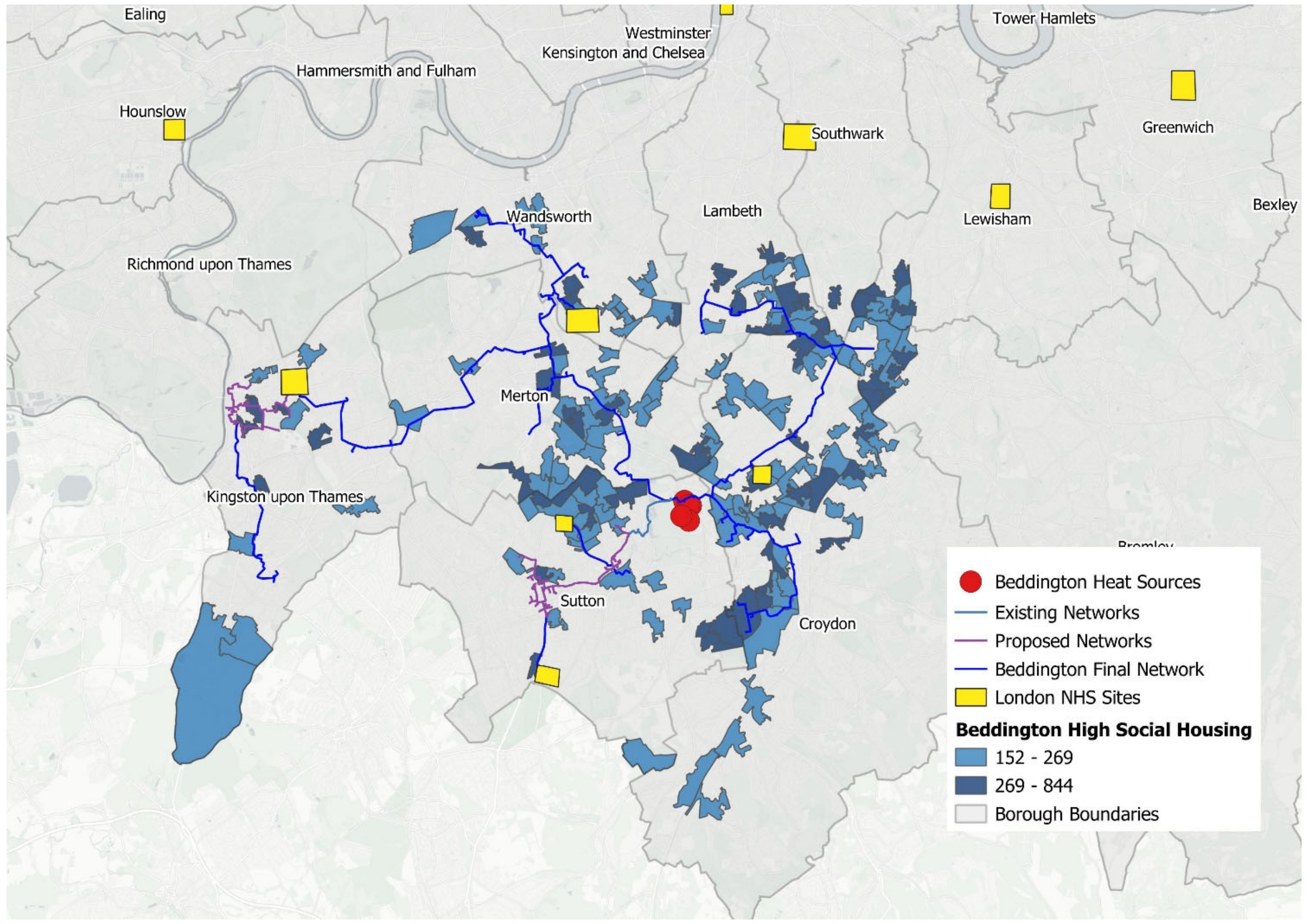


Figure 6-5 Areas of high LSOA Social Housing Density and NHS Trust Site Locations

6.4 Potential Scale of Investment

In total this multi-borough heat network would have a total pipework length of ~70km and the estimated costs for the proposed network are outlined in Table 6—3 with a total of circa £309m.

Table 6—3 Capex

	Unit	Unit Cost	Total Cost
Pipework and Civils	70 km	3,000 £/m	£210m
Water Source Heat Pump	17MW	£1m/MW	£17m
Recovered Heat	15MW	£0.75m/MW	£12m
Plant and Energy Centre	70 km	£1m/km	£70m
Total			**£309m**

6.5 Carbon Results

Carbon reductions realised by connecting the proposed clusters to the final Beddington network, calculated as set out in the methodology (4.7), are presented in Table 6—4 below and these carbon results are over a 40 year lifetime.

Table 6—4 Carbon Results Summary

Counterfactual carbon emissions (tCO2)	Proposed solution carbon emissions (tCO2)	Carbon emissions reduction (tCO2)	Percentage reduction
4301000	104000	4,197,000	98%

6.6 Key Next Steps

London Boroughs: Croydon, Kingston, Lambeth, Merton, Sutton and Wandsworth

- Engage with LB Sutton and Sutton District Energy Network (SDEN) to highlight the scale of the opportunity and gauge initial thoughts/appetite to explore additional heat sources and expansion of the network.
- Communicate the opportunity to relevant boroughs that could benefit from this Strategic Area heat network to establish their interest for developing a partnership and undertaking a more detailed feasibility study, as well as understanding any other local elements that can contribute to network opportunities.

Major Heat Loads/connections:

- Using local knowledge verify the major heat loads listed, add additional information and contacts and update with any other major heat loads.

Waste Heat Sources:

- Using local knowledge verify the major heat sources listed, add additional information and contacts and update with any other known major heat loads.
- Engage with Trinsic and/or Thames Water on the potential for heat offtake at Beddington STW.

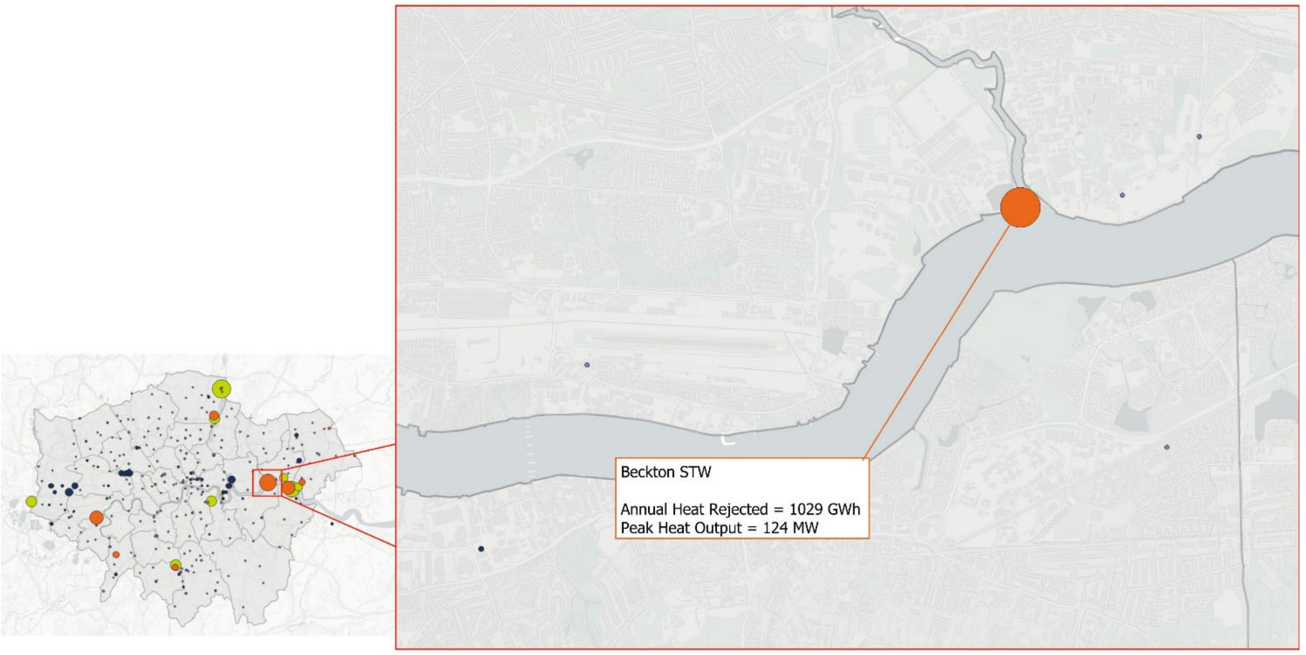
Further development work and partnership building:

- Where interest exists develop the partnership between interested London Boroughs and spec out a more detailed feasibility study develop the project proposal and engage with major heat loads and the important heat sources.

7 Strategic Area C: Royal Docks Strategic Area

7.1 Waste Heat Sources and Heat Loads

This Strategic Area utilises one main heat source shown in Figure 7-1. The potential heat loads for this Strategic Area were bound by the borough boundaries of Tower Hamlets, Redbridge, Newham and Barking and Dagenham.



Note: Only Sources with a potential to reject more than 1 GWh of waste heat are presented

Figure 7-1 Waste heat sources in the Royal Docks Strategic Area

In this Strategic Area there are a significant number of waste heat sources, however one waste heat source is substantially larger than the others in the area and therefore to simplify the modelling for the area only this one large waste heat source was used. Figure 7-1 shows this selected heat source.

Table 7—1 Docks Waste Heat Source

Heat Source	Type	Annual Heat Rejected (GWh/yr)	Peak Heat Output (MW)
Beckton STW	Sewage Treatment	1029	124

7.2 Potential Connections and Network

The clustering methodology, explained in 4.3, was utilised with the heat loads that fell within the Royal Docks area totalling less than the annual heat available from the chosen heat source in the Strategic Area. Figure 6-2 shows the geographical location of the Royal Docks Strategic Area with over 0.5 GWh clusters of heat demands alongside a representation of the waste heat source to be utilised.

The clustering methodology, explained in 4.3, was utilised with the heat loads that fell within the Royal Docks area totalling less than the annual heat available from the chosen heat source in the Strategic Area. Figure 6-2 shows the geographical location of the Royal Docks Strategic Area with over 1 GWh of heat demands alongside a representation of the waste heat source to be utilised.

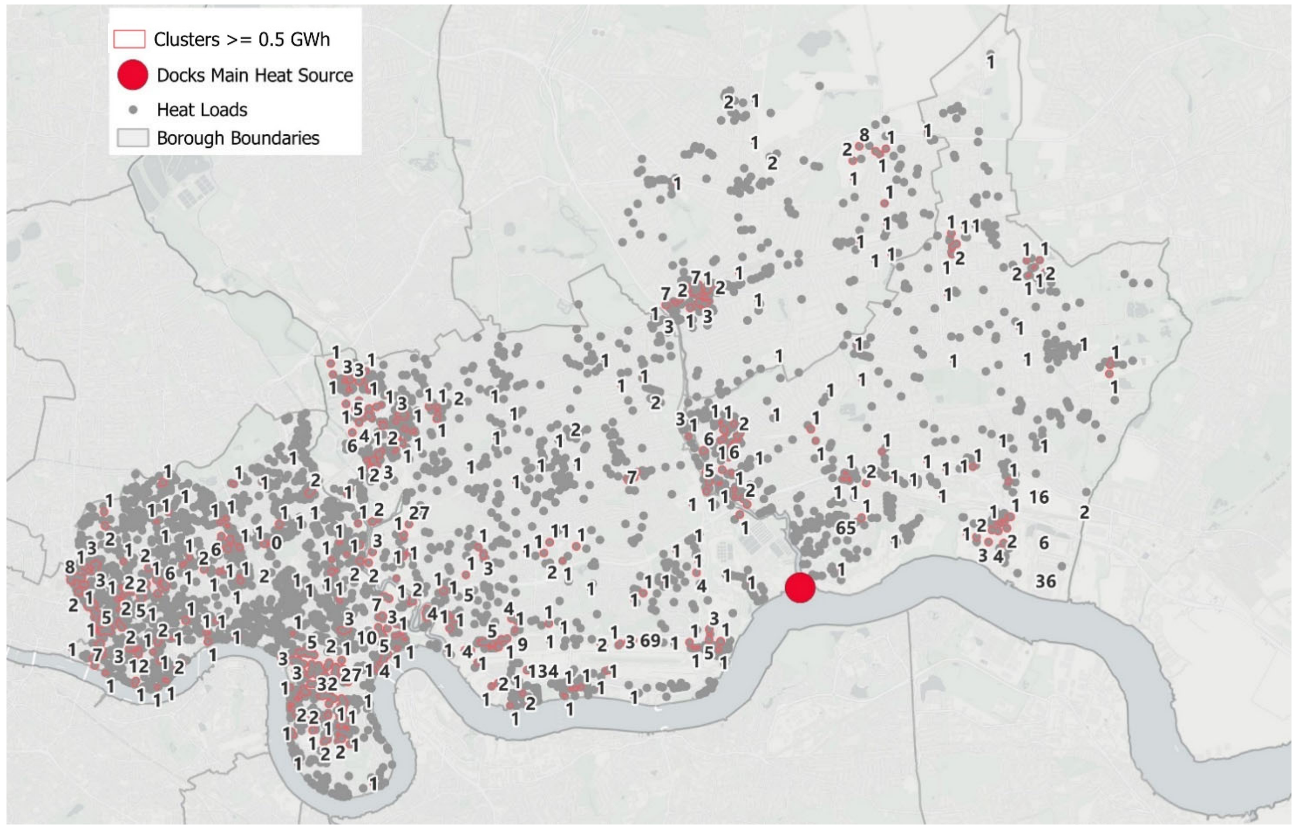


Figure 7-2 Royal Docks Area with potential Heat Loads and Clusters over 0.5 GWh

This network is an output from the Steiner tree analysis, connecting the clusters and the heat source via the highways and paths network through the shortest route. Linear density of the pipework was calculated to shortlist a network with a linear density of **8+ MWh/yr/m**. The Royal Docks Strategic Area has 4 existing heat networks (Olympic Park, Barkantine, Gascoigne East/Barking Town and Excel D Exhibition Centre (EDEC) alongside 7 proposed networks (or network extensions). Where these existing and proposed networks are located, the output of the final network was manually altered to integrate with these heat networks.

The final network is shown in Figure 7-3. The total annual heat demand of the network, from the cluster totals is **~1011GWh/yr**. Of this 1011 GWh/yr of potential heat load there is ~326 GWh/yr of loads that are included in either existing or proposed heat networks (these are on the London Heat Map). Whilst some of these heat networks may be currently installing other on-site heat sources as part of their decarbonisation strategy (e.g. heat pumps and heat recovery from cooling towers on the Olympic Park), the modelling assumes that the waste heat source is used in full to create a decarbonised heat network.

Since the clustered total heat load for this area seeks to utilise 98% of the identified waste heat source, there are other important waste heat sources in the area (e.g. several data centres and Tate and Lyle sugar factory) that should be investigated as part of further work on this Strategic Area to supplement the heat network with additional waste heat that can be used to expand and grow the heat network.

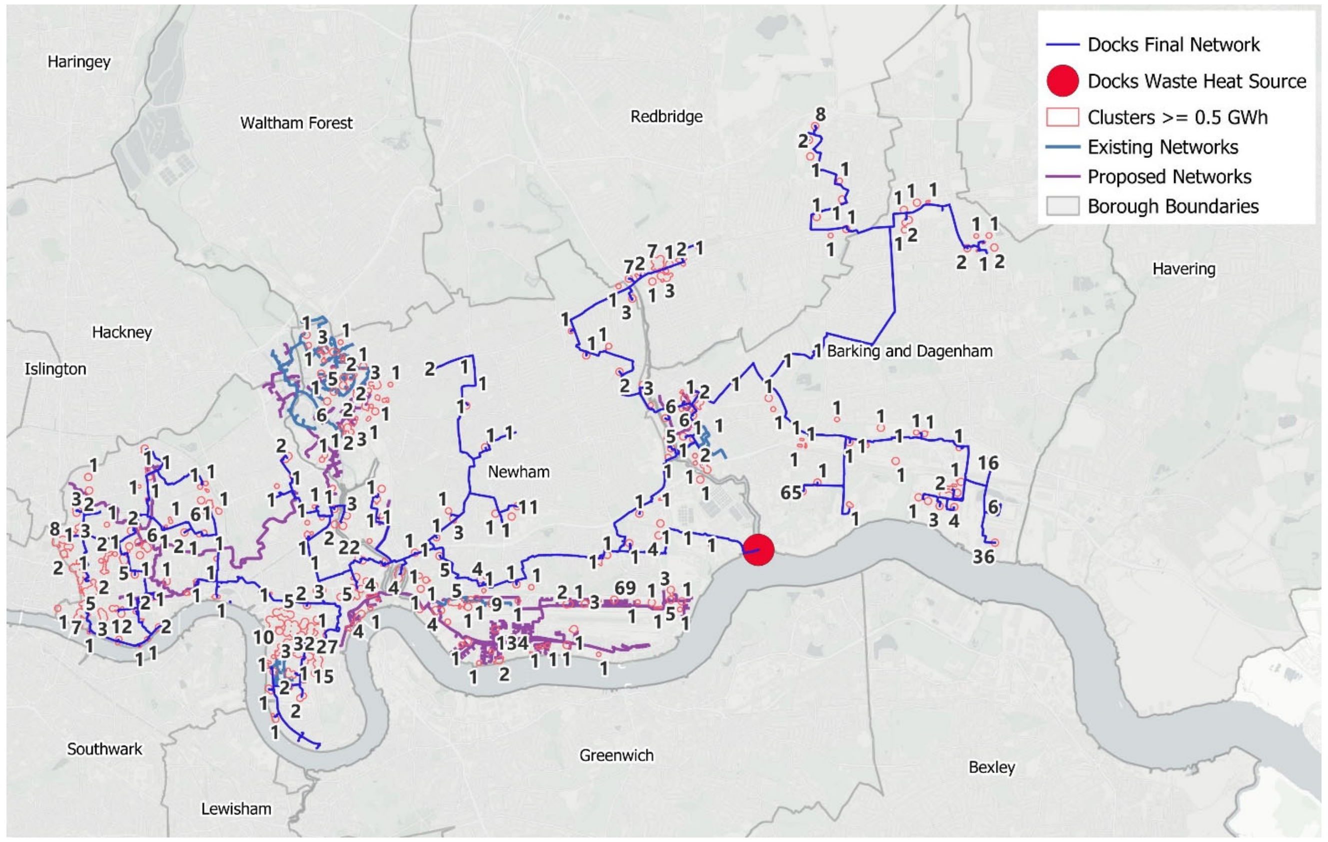


Figure 7-3 Final Network based off linear density and existing/proposed networks

7.3 Connection Opportunities

The proposed network will be a multi-borough heat network that will reach all the main heat clusters. It will cover the London Boroughs of Tower Hamlets, Redbridge, Newham and Barking and Dagenham. Looking at the 20 largest loads to be connected gives an understanding of the main stakeholders that will need to be engaged and involved in the heat network. Figure 6-4 shows the geographical location of these points identified in numerical order dependent on annual heat demand.

Table 7—2 20 Largest Heat Loads in the Potential Royal Docks Network

	High Demand Load	Borough	Typology	Heat Demand (MWh/yr)	Peak Demand (kW)	Pipe Linear Density	Included in Network
1	Silvertown Quays	Newham	Industrial Site	133500	66300	Proposed Network	Included
2	Royal Albert Dock	Newham	Dock	68800	34200	Proposed Network	Included
3	Multiple Companies Industrial Site	Barking and Dagenham	Industrial Site	65400	32500	8+	Included
4	Dagenham Engine Plant	Barking and Dagenham	Engine Plant	35800	17800	8+	Included
5	TwelveTrees Park	Newham	Development	27400	13600	8+	Included
6	Poplar Riverside	Tower Hamlets	Riverside Development	17200	8600	8+	Included
7	We–tfield - Stratford City	Newham	Shopping Mall	16600	8200	Existing Network	Included
8	Dagenham Green (Peabody) School	Barking and Dagenham	School	16100	8000	8+	Included
9	Newham University Hospital	Newham	Hospital	11200	5600	8+	Included
10	Pennington Warehouse London Docks	Tower Hamlets	Warehouse	10900	5400	8+	Included
11	CitiBank	Tower Hamlets	Office Building	10800	5400	8+	Included
12	Blackwall Reach	Tower Hamlets	Residential Development	9500	4800	8+	Included
13	BGC Brokers	Tower Hamlets	Financial Institution	9000	4500	8+	Included
14	ExCel Centre	Newham	Convention Centre	8800	4400	Existing Network	Included
15	Bank of America / HSBC	Tower Hamlets	Office Building	8700	4400	8+	Included
16	King George Hospital	Redbridge	Hospital	7500	3800	8+	Included
17	Travelodge London City / Hub Club / Hayloft Point	Tower Hamlets	Hotel	6800	3400	8+	Included
18	Cordwainer House / Pattern Makers Court	Tower Hamlets	Residential Buildings	6700	3300	8+	Included
19	BT	Redbridge	Office Building	6500	3200	8+	Included
20	Mile End Hospital	Tower Hamlets	Hospital	6400	3200	8+	Included

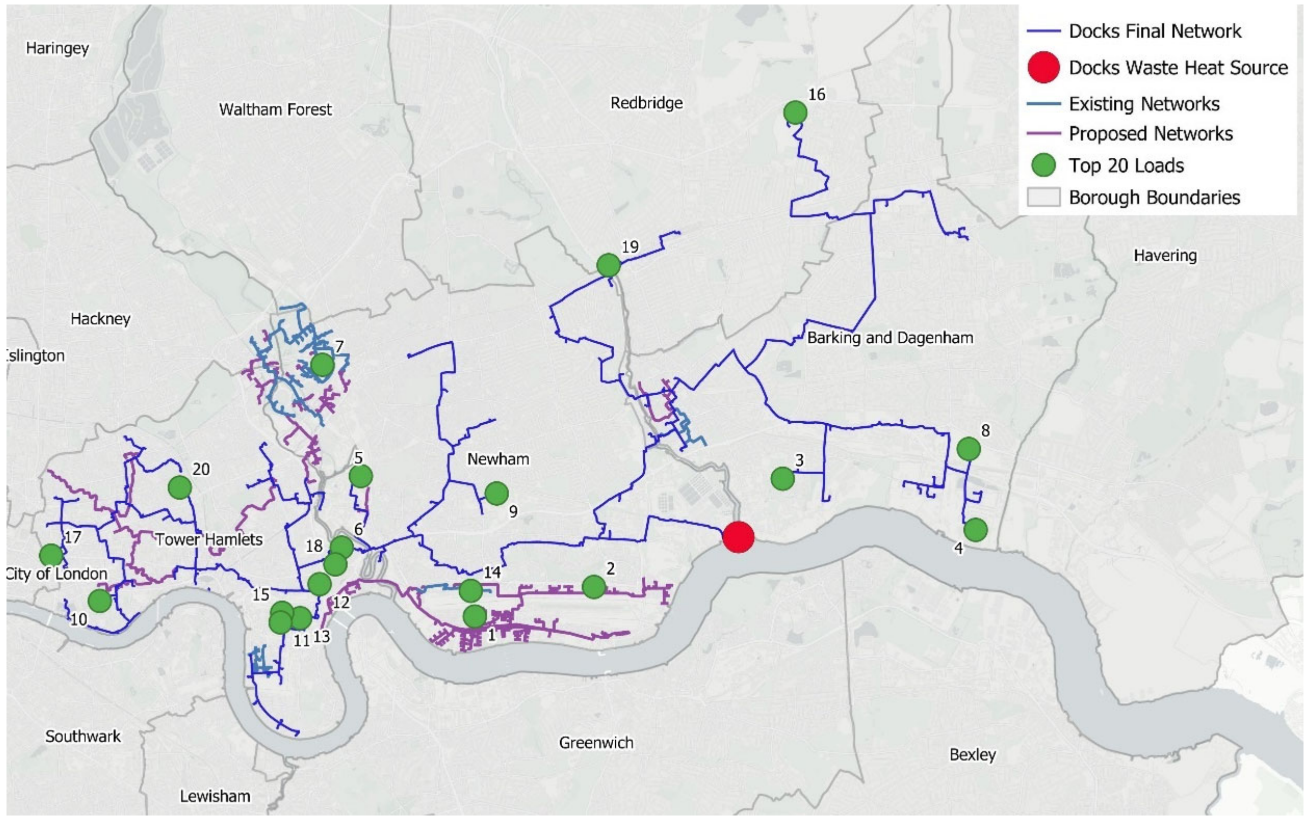


Figure 7-4 Final Network with Top Loads

7.3.1 High Social Housing Areas and NHS Trust Sites

Figure 7-5 shows the LSOA areas where there are high densities of social housing. The darkest regions indicate the densest areas of social housing (rented from local authority or other) in each LSOA across the Royal Docks Strategic Area. This data is from the 2021 ward and LSOA estimates (London Datastore).

This shows a general correlation with the proposed network routing which indicates that building out the network to these areas could support the decarbonisation of social housing as well as the major non-domestic loads in the area that were identified within the Top 20 loads. This figure also indicates the locations of NHS Trust sites and these are included within the proposed heat networks to show the potential for the heat network to support the NHS in decarbonising these sites.

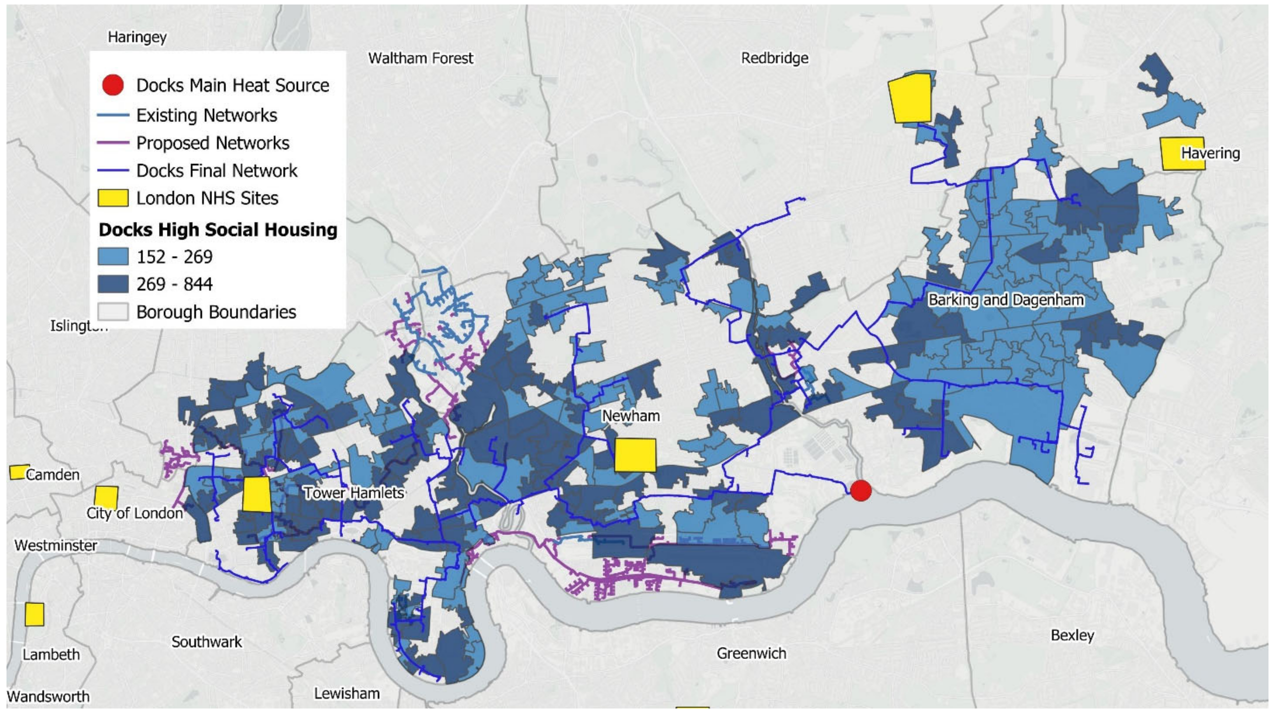


Figure 7-5 Areas of high LSOA Social Housing Density and NHS Trust Site Locations

7.4 Potential Scale of Investment

In this study, the estimated cost for the pipework is produced from a 3000 £/m estimate and Section 4.6 gives detail on the assumed costs used. Overall, this multi-borough heat network would have a total pipework length of **~90km** and the estimated costs for the proposed heat network, which has one waste heat source, are outlined in Table 6—3 with a total of circa £394m.

Table 7—3 Capex

	Unit	Unit Cost	Total Cost
Pipework and Civils	90 km	3,000 £/m	£180m
Water Source Heat Pump	124 MW	£1m/MW	£124m
Plant and Energy Centre	90 km	£1m/km	£90m
Total			**£394m**

7.5 Carbon Results

The carbon reduction realised by connecting the proposed clusters to the heat network for the Royal Docks, calculated as set out in the methodology (3.7), are presented in Table 7—4 below. These carbon results are over a 40 year lifetime.

Table 7—4 Carbon Results Summary

Counterfactual carbon emissions (tCO2)	Proposed solution carbon emissions (tCO2)	Carbon emissions reduction (tCO2)	Percentage reduction
11265000	287000	10,978,000	97%

7.6 Key Next Steps

London Boroughs: Barking & Dagenham, Newham, Redbridge and Tower Hamlets.

- Communicate the opportunity to relevant boroughs that could benefit from this Strategic Area heat network to establish their interest for developing a partnership and undertaking a more detailed feasibility study, as well as understanding any other local elements that can contribute to network opportunities.
- Maintain contact with LB Barking and Dagenham and LB Newham who are currently undertaking coordinated studies looking at the Beckton STW with Thames Water and the opportunity it provides.

Major Heat Loads/connections:

- Using local knowledge verify the major heat loads listed, add additional information and contacts and update with any other major heat loads.

Waste Heat Sources:

- Using local knowledge verify the major heat sources listed, add additional information and contacts and update with any other known major heat loads.

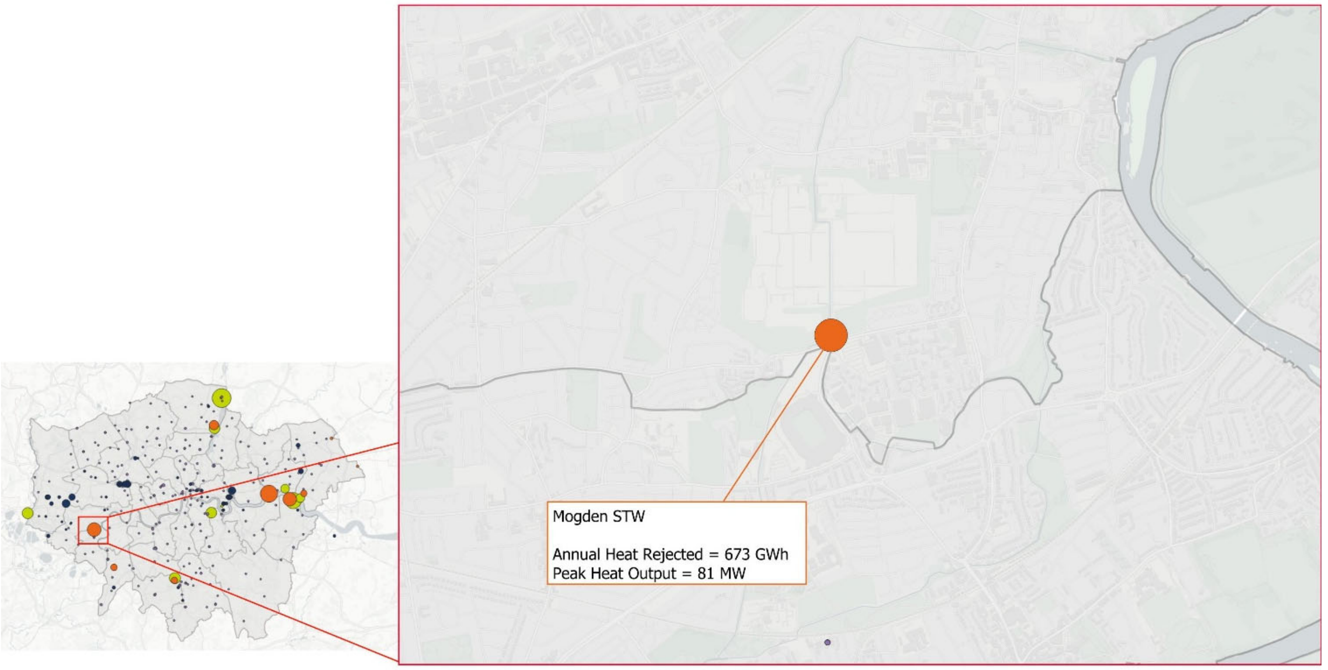
Further development work and partnership building:

- Where interest exists develop the partnership between interested London Boroughs and spec out a more detailed feasibility study develop the project proposal and engage with major heat loads and the important heat sources.

8 Strategic Area D: Mogden & Twickenham Strategic Area

8.1 Waste Heat Sources and Heat Loads

In the Mogden and Twickenham Strategic Area there has been one major waste heat source identified and that is the Mogden STW. The selection of the heat loads considered in this analysis were limited to the London Boroughs of Ealing, Hounslow and Richmond upon Thames . The geographical location of the clusters and the heat source details are shown in Table 8—1 and Figure 8-1.



Note: Only Sources with a potential to reject more than 1 GWh of waste heat are presented

Figure 8-1 Waste heat source in the Mogden & Twickenham Strategic Area

Table 8—1 Mogden & Twickenham Heat Sources

Heat Source	Type	Annual Heat Rejected (GWh/yr)	Peak Heat Output (MW)
Mogden STW	Sewage Treatment	673	81

8.2 Potential Network

The clustering methodology, explained in 3.3, was utilised for the heat loads that fell within the Mogden & Twickenham area and they totalled less than the annual heat available from the selected heat sources for this Strategic Area. The clusters and heat loads assessed along with their geographic location are shown in Figure 7-2.

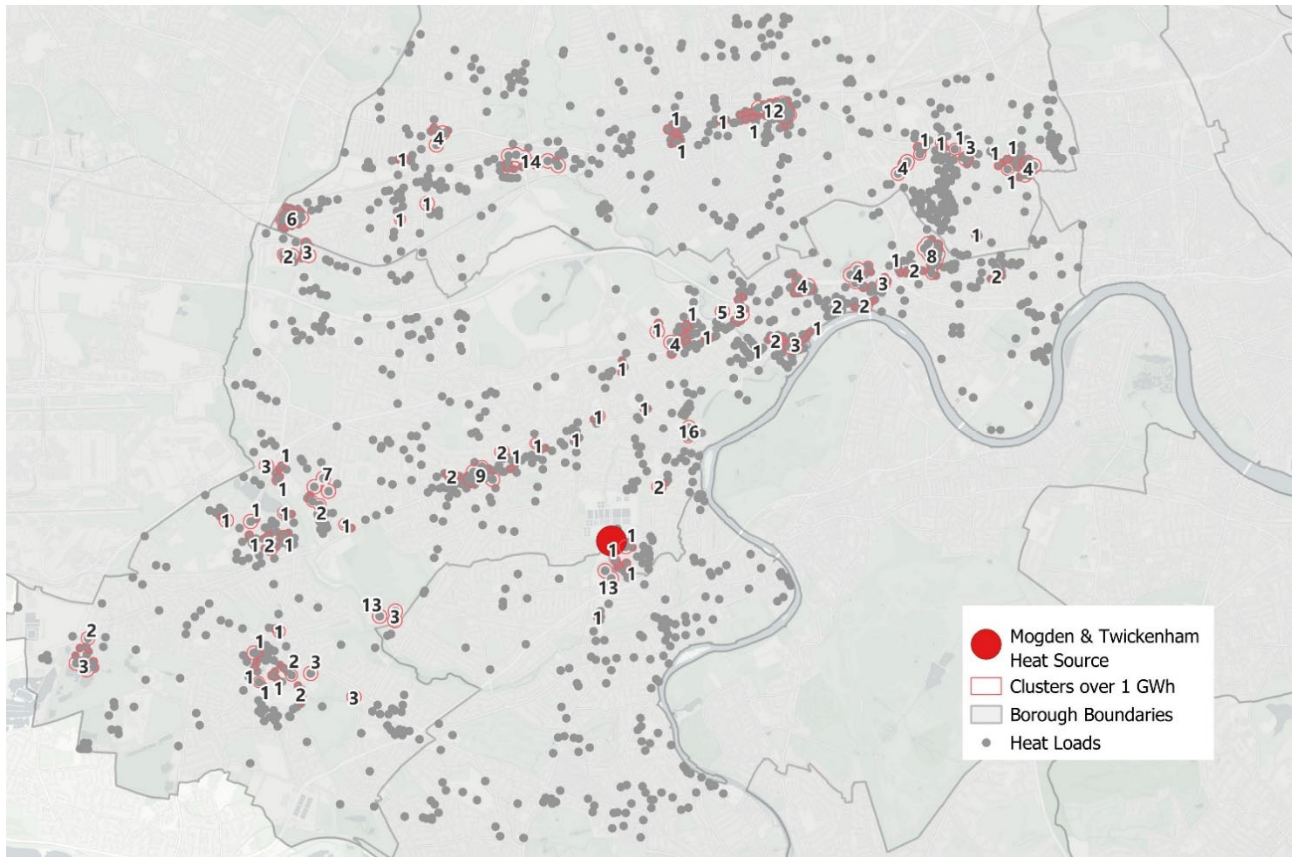


Figure 8-2 Mogden & Twickenham Area with potential Heat Loads and Clusters over 0.5 GWh

The final network is shown in Figure 7-3. The total annual heat demand of the heat network, calculated from the cluster totals, is **~ 222 GWh/yr.** This suggest that there is still significant surplus waste heat that might be able to be captured and supplied into the heat network as future loads come forward.

The network analysis carried out only shortlists pipework routes with a linear density of 8+ MWh/yr/m. The potential heat network in Ealing town centre area, shown in grey in Figure 8-3, has been included as part of the Strategic Area heat network with associated heat loads.

A map showing existing heat networks in the area, the initial Steiner Tree outputs, explicit results of the linear heat assessment, and alignment of the final network with the GLA's Potential Project Areas can be found in Appendix C.

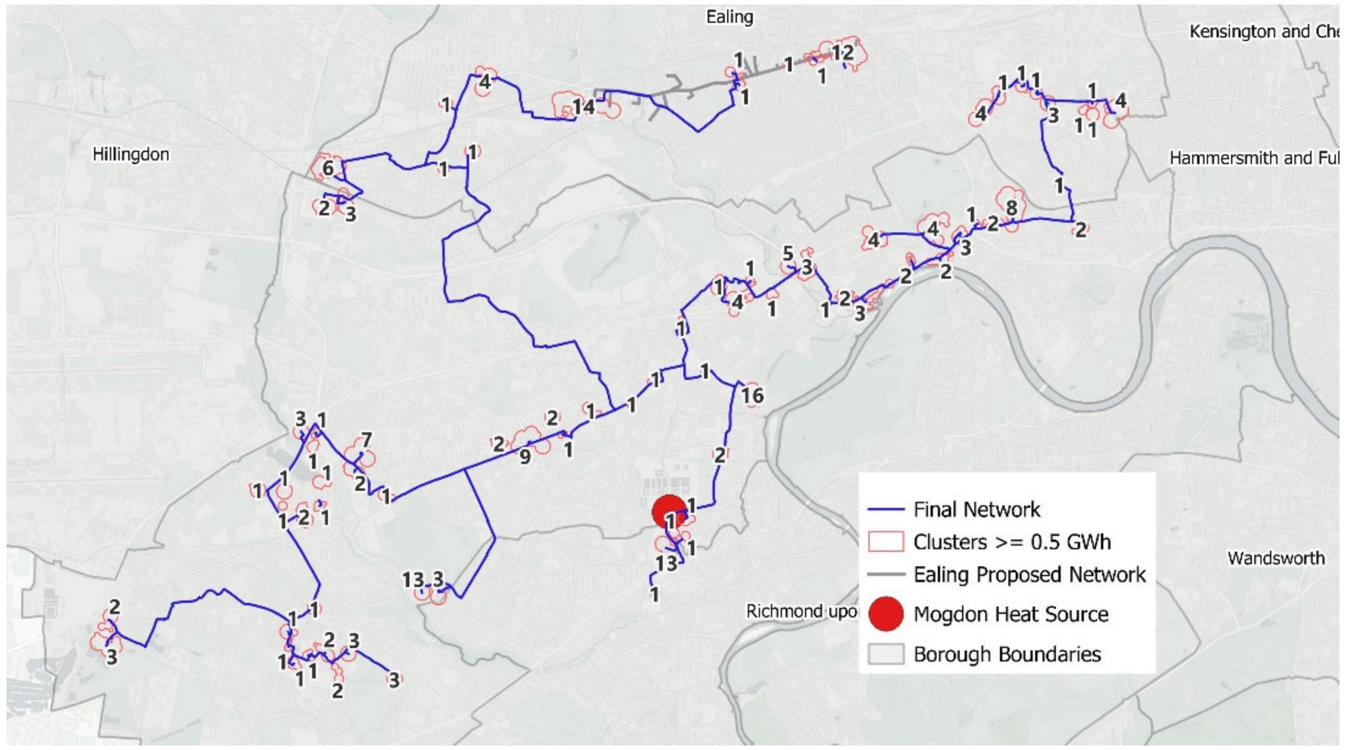


Figure 8-3 Final Network based off linear density and existing/proposed networks

8.3 Connection Opportunities

The proposed network will be a multi-borough heat network that will reach all the main heat clusters. It will cover London Boroughs of Hounslow, Richmond and Ealing. Looking at the 20 largest loads to be connected gives an understanding of the main stakeholders that will need to be involved in the heat network. Figure 8-2 details the Top 20 heat loads.

Only 1 of the 20 heat loads has a linear density less that 8+ MWh/yr/m. Figure 8-4 shows the 20 largest potential heat loads in the Mogden & Twickenham Area.

Table 8—2 20 Largest Heat Loads in the Potential Mogden & Twickenham Network

	High Demand Load	Borough	Typology	Heat Demand (MWh/yr)	Peak Demand (kW)	Pipe Linear Density	Included in Network
1	West Middlesex University Hospital	Hounslow	Hospital	15500	7700	8+	Included
2	Roy–l Mail - Jubilee Mail Centre	Hounslow	Mail Centre	12500	6200	8+	Included
3	Twickenham Stadium	Richmond	Stadium	10900	5400	8+	Included
4	Clerkenwell House & Tulk House	Ealing	Office Buildings	5800	2900	8+	Included
5	G S K House	Hounslow	Office Building	4800	2400	8+	Included
6	Prologis Park – Morgan Stanley	Hounslow	Industrial Park	3700	1800	8+	Included
7	Treaty Centre	Hounslow	Shopping Centre	3200	1600	8+	Included
8	Heathrow Causeway Centre	Hounslow	Office Building	3200	1600	8+	Included
9	Hanworth Air Park Leisure Centre & Library	Hounslow	Leisure Centre and Library	3000	1500	8+	Included
10	Feltham Community College	Hounslow	Education	3000	1500	8+	Included
11	Brentford Fountain Leisure Centre	Hounslow	Leisure Centre	2700	1300	8+	Included
12	Lady Eleanor Holles School	Richmond	Education	2600	1300	4-8	Not Included
13	Ealing Hospital	Ealing	Hospital	2500	1200	8+	Included
14	Hounslow House & Library	Hounslow	Government Building	2400	1200	8+	Included
15	Acton Old Town Hall	Ealing	Historical Building	2200	1100	8+	Included
16	Gilette Corner	Hounslow	Commercial Building	2100	1100	8+	Included
17	Prologis Park – British Airways	Hounslow	Industrial Park	2100	1000	8+	Included
18	Isleworth Leisure Centre and Library	Hounslow	Leisure Centre and Library	2000	1000	8+	Included
19	England Rugby/ World Rugby Museum	Richmond	Museum and Offices	2000	1000	8+	Included
20	Great Western Industrial Park	Ealing	Industrial Park	2000	1000	8+	Included

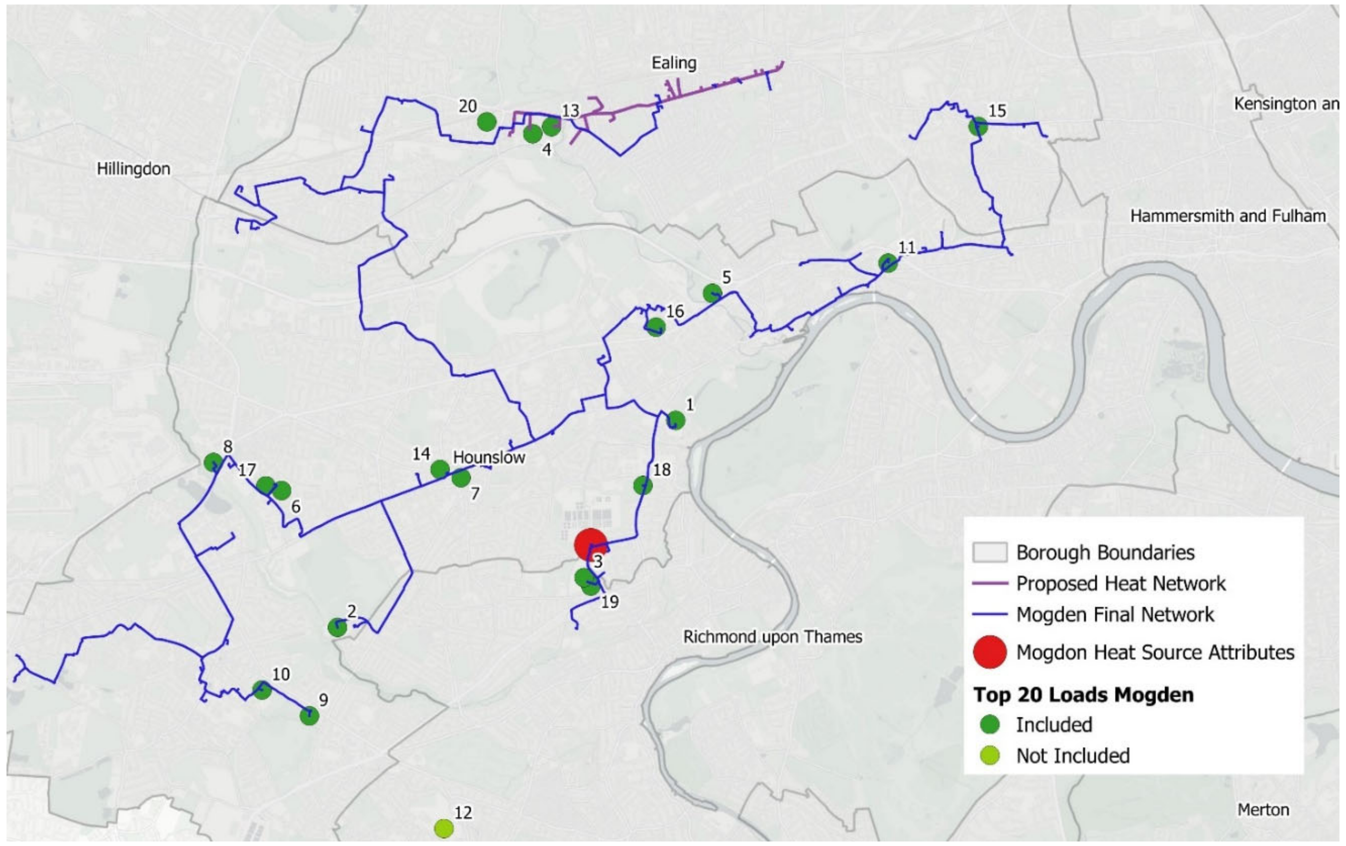


Figure 8-4 Final Network with Top 20 Loads

8.3.1 High Social Housing Areas and NHS Trust Sites

Figure 8-5 shows the LSOA areas where there are high densities of social housing. The darkest regions indicate the densest areas of social housing (rented from local authority or other) in each LSOA across the Mogden & Twickenham Strategic Area. This data is from the 2021 ward and LSOA estimates (London Datastore).

This shows a general correlation with the proposed network routing which indicates that building out the network to these areas could support the decarbonisation of social housing as well as the major non-domestic loads in the area that were identified within the Top 20 loads. This figure also indicates the locations of NHS Trust sites and these are included within the proposed heat networks to show the potential for the heat network to support the NHS in decarbonising these sites.

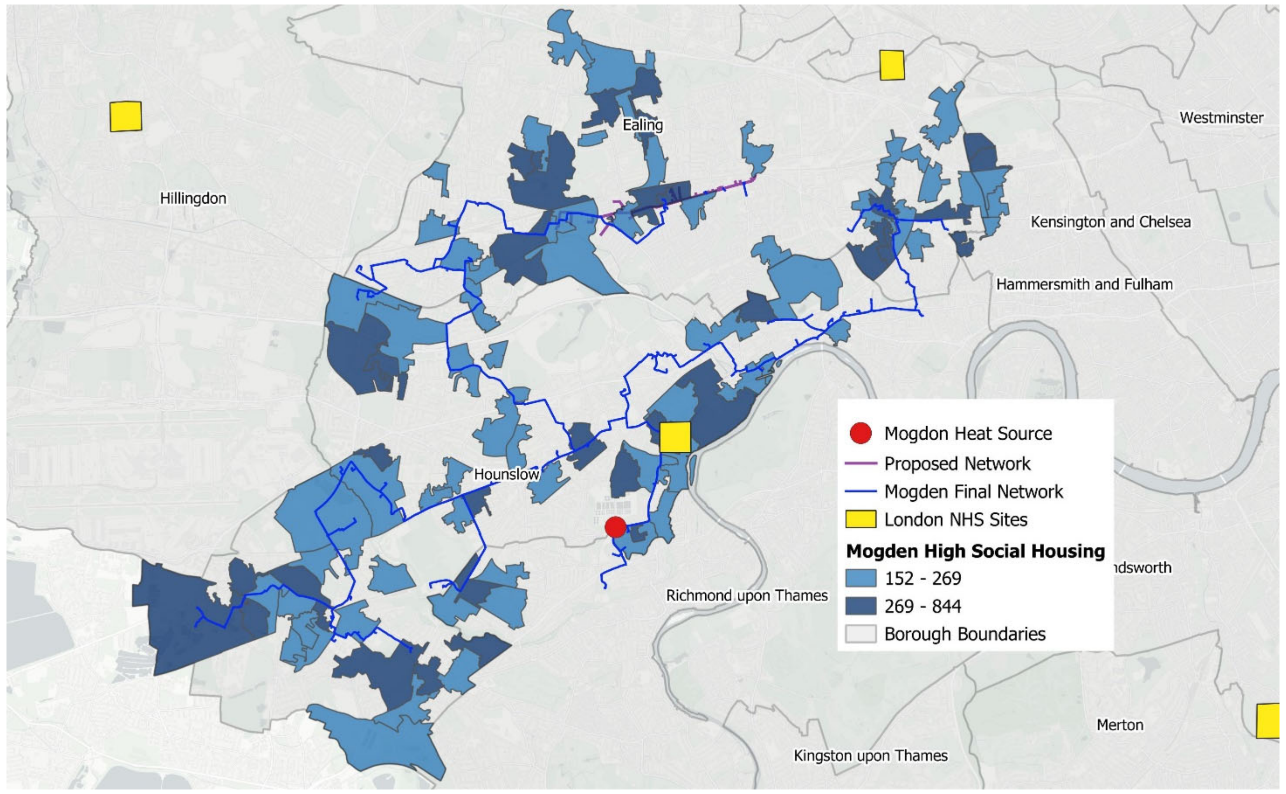


Figure 8-5 Areas of high LSOA Social Housing Density and NHS Trust Site Locations

8.4 Potential Scale of Investment

Overall, this multi-borough heat network would have a total pipework length of **~58km** and the estimated costs which are set out in Figure 8-3 shows the total to be circa **£331m.**

Table 8—3 CAPEX Costs

	Unit	Unit Cost	Total Cost
Pipework and Civils	58 km	3,000 £/m	£ 174m
Water Source Heat Pump	91 MW	£1m/MW	£ 91m
Plant and Energy Centre	58 km	£1m/km	£ 58m
Total			**£331m**

8.5 Carbon Results

The carbon reduction realised by connecting to proposed clusters to the heat network for Mogden & Twickenham, calculated as set out in the methodology (3.7), are presented in Figure 8-4 below. These carbon results are over a 40 year lifetime.

Table 8—4 Carbon Results Summary

Counterfactual carbon emissions (tCO2)	Proposed solution carbon emissions (tCO2)	Carbon emissions reduction (tCO2)	Percentage reduction
2,474,000	63,000	2,411,000	97%

8.6 Key Next Steps

London Boroughs: Ealing, Hounslow and Richmond upon Thames

- Communicate the opportunity to relevant boroughs that could benefit from this Strategic Area Heat Network to establish their interest for developing a partnership and undertaking a more detailed feasibility study, as well as understanding any other local elements that can contribute to network opportunities.
- Maintain contact with LB Barking and Dagenham and LB Newham who are currently undertaking coordinated studies looking at the Beckton STW with Thames Water and the opportunity it provides.

Major Heat Loads/connections:

- Using local knowledge verify the major heat loads listed, add additional information and contacts and update with any other major heat loads.

Waste Heat Sources:

- Using local knowledge verify the major heat sources listed, add additional information and contacts and update with any other known major heat loads.
- Engage Trinsic and/or Thames Water around the opportunities for Mogden STW to be a waste heat source.

Further development work and partnership building:

- Where interest exists develop the partnership between interested London Boroughs and spec out a more detailed feasibility study develop the project proposal and engage with major heat loads and the important heat sources.
- Consider the proximity of the neighbouring Strategic Area Hayes & West Drayton there is the possibility for a combined larger heat network (see section 9).
- It is understood (since this analysis) that Hounslow undertook a Feasibility study for a heat network in the borough which shows strong correlation with that shown from our analysis. Discussions with Hounslow should initially be held to understand their planned next steps and the next steps for this study.

9 Strategic Area E: Hayes & West Drayton Strategic Area

9.1 Waste Heat Source and Heat Loads

There are understood to be 6 data centres in the LB of Hillingdon which could provide waste heat to the Borough and beyond, including supporting extensions into Ealing. The six main waste heat sources, associated with three companies, are detailed below in Table 9—1 with their geographical location shown in Figure 9-1. The six Data Centres combined are estimated to reject up to 515 GWh/yr of waste heat (see Table 9—1).

Note: Only Sources with a potential to reject more than 1 GWh of waste heat are presented

Figure 9-1 Waste heat sources in the Hayes & West Drayton Strategic Area

Table 9—1 Waste Heat Sources in the Hayes & West Drayton Strategic Area

Heat Source	Type	Annual Heat Rejected (GWh/yr)	Peak Heat Output (MW)
Virtus London 5,6,7,8	Data Centre	180	20
Union Park	Data Centre	210	24
Colt London 4	Data Centre	125	12
Total		**515**	**56**

9.2 Potential Connections and Network

The clustering methodology, explained in 3.3, was utilised to identify potential heat network connections that fell within the Hayes & West Drayton area, totalling less than the annual heat available from the identified heat sources. Only cluster loads that were equal or greater than 0.5 GWh were assumed as potentially viable at this stage for the strategic network.

Figure 9-2 shows the resultant clusters and their heat loads.

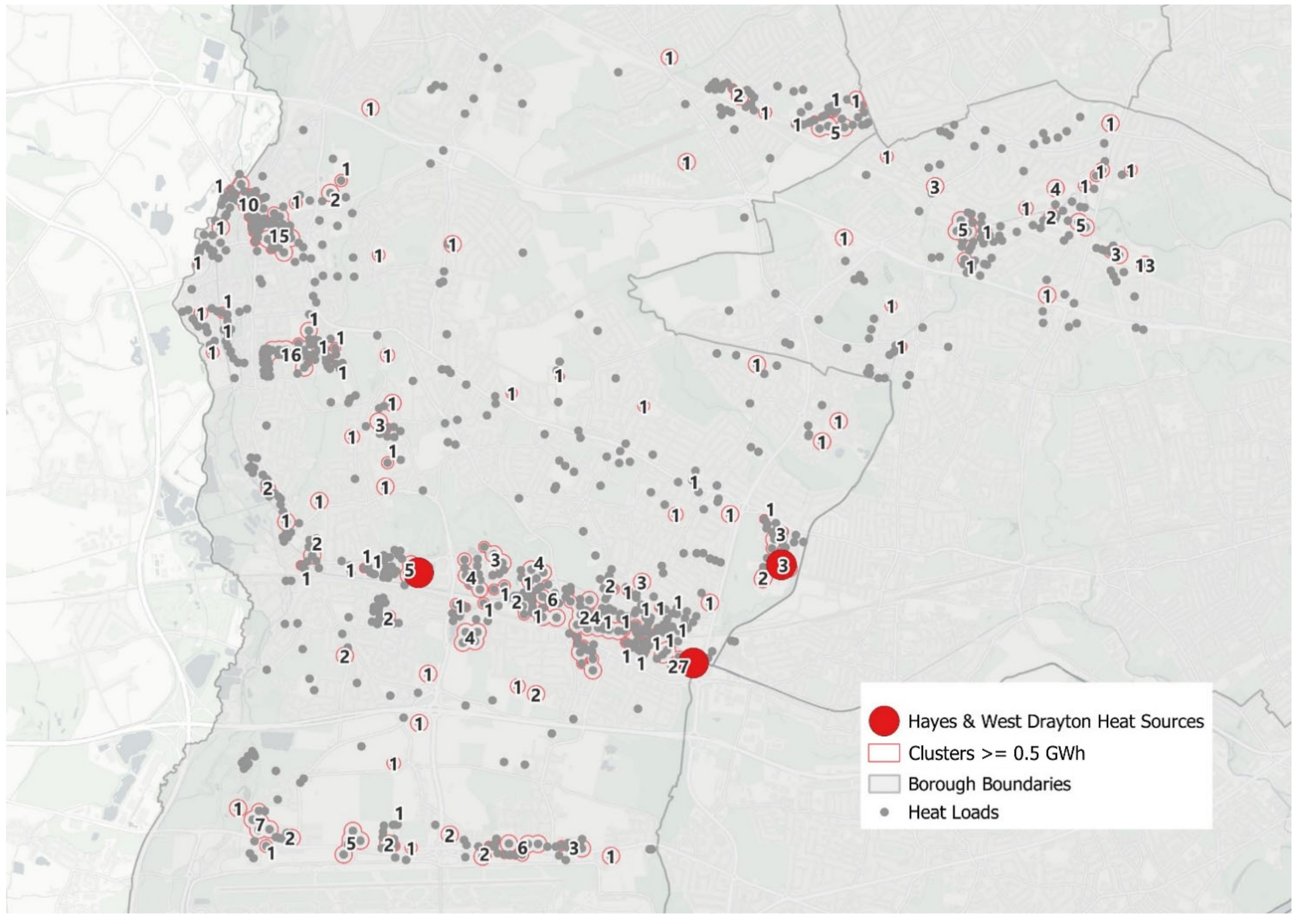


Figure 9-2 Hayes & West Drayton Area with potential Heat Loads and Clusters over 0.5 GWh

Modelling has been carried out to identify potential networks to interconnect these clusters with the final heat network only built up of pipework with a linear density of 8+ MWh/yr/m. For the proposed heat networks in the area, identified from the London Heat Map and shown in grey in Figure 9-3, the proposed pipework from the model that overlapped with the proposed networks already in the London Heat Map was removed from the analysis to avoid duplication.

The final network is shown in Figure 8-3. The total annual heat demand of the network, from the clusters total **~ 218 GWh/yr.** This suggests that there is significant amount of surplus waste heat that could be supplied into the heat network in the area as it expands and grows to connect future loads as they come forward.

A map showing existing heat networks in the area, the initial Steiner Tree outputs, explicit results of the linear heat density assessment, and alignment of the final network with the GLA's Potential DHN Project Areas can be found in Appendix E.

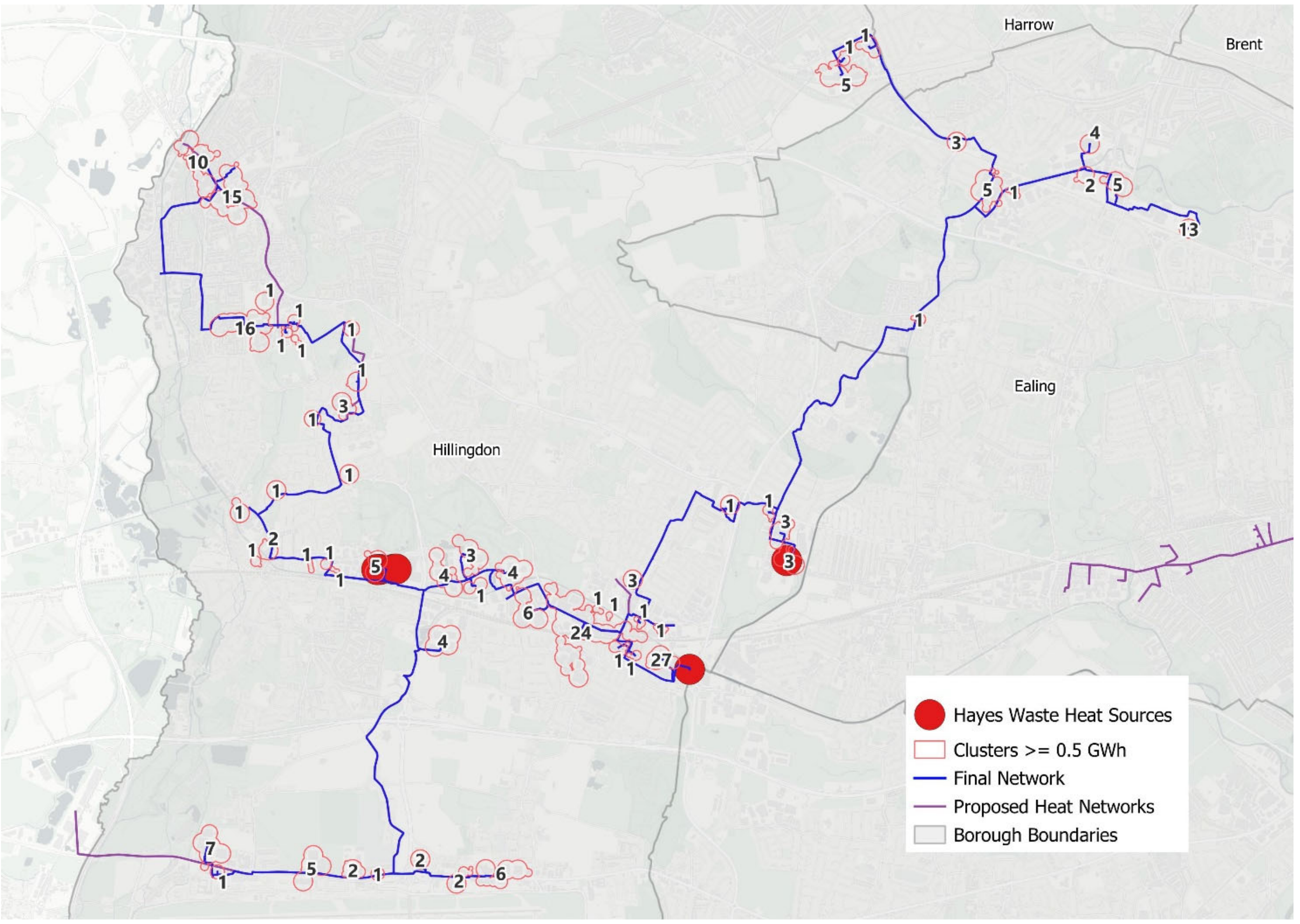


Figure 9-3 Final Network based off linear density and existing/proposed networks

9.3 Connection Opportunities

The proposed network will be a multi-borough heat network that will reach all the main heat clusters. It will cover the London Boroughs of Hillingdon and Ealing. Looking at the 20 largest loads to be connected gives an understanding of the main stakeholders that will need to be involved in the potential network. Note the analysis currently excludes Heathrow Airport which could be a major load if they are interested but currently it is understood that they are looking at on-site solutions for decarbonisation.

Table 9—2 indicates that 18 of the 20 loads all have linear densities of 8+ MWh/yr/m indicating that the pipelines connecting these have greater opportunity for inclusion in an overall network. Figure 9-4 shows the geographic location of all the potential highest loads in the Hayes & West Drayton Area. A large number of the loads in close proximity to the data centres appear to be industrial which is a typically challenging typology in estimating loads – therefore these would need to be confirmed early in any further work as there is a risk that loads in this area may vary considerably.

The London Heat Map appears to suggest that there are large heat demands at 2 of the data centre sites (8, 17), this may be an anomaly and again requires verification through stakeholder engagement in any future work.

Table 9—2 20 Largest Heat Loads in the Potential Hayes & West Drayton Network

	High Demand Load	Borough	Typology	Heat Demand (MWh/yr)	Peak Demand (kW)	Pipe Linear Density	Included
1	Truscon House	Hillingdon	Office Building	24700	12300	8+	Included
2	Royal Mail Greenford Mail Centre	Ealing	Mail Centre	13000	6500	8+	Included
3	Hillingdon Civic Centre	Hillingdon	Government Building	5600	2800	8+	Included
4	Brunel University London	Hillingdon	Education	5100	2600	8+	Included
5	Sainsburys Greenford Distribution Centre	Ealing	Distribution Centre	3700	1900	8+	Included
6	Northolt Leisure Centre Library	Ealing	Leisure Centre and Library	3300	1600	8+	Included
7	Colnbrook Immigration Removal Centre	Hillingdon	Immigration Removal Centre	2700	1400	8+	Included
8	Virtus London 7	Hillingdon	Data Centre	2700	1400	8+	Included
9	Wincanton Plc	Ealing	Retail/Commercial Building	2700	1300	8+	Included
10	Botwell Green Sports & Leisure Centre	Hillingdon	Sports and Leisure Centre	2600	1300	8+	Included
11	DHL	Hillingdon	Logistics Company	2500	1300	8+	Included
12	Hillingdon Hospital	Hillingdon	Hospital	2500	1300	8+	Included
13	Brunel University	Hillingdon	Education	2200	1100	8+	Included
14	Greenford Green Business Park	Ealing	Business Park	2100	1100	8+	Included
15	Wincanton Plc	Ealing	Entertainment Venue	2100	1100	8+	Included
16	Lufthansa Technik	Hillingdon	Aircraft Maintenance Facility	2000	1000	8+	Included
17	Virtus London 8	Hillingdon	Data Centre	2000	1000	8+	Included
18	Uxbridge College	Hillingdon	Education	1900	1000	8+	Included
19	Platinum Jubilee Leisure Centre	Hillingdon	Leisure Centre	1800	900	2-4	Not Included
20	Harlington School	Hillingdon	Education	1800	900	2-4	Not Included

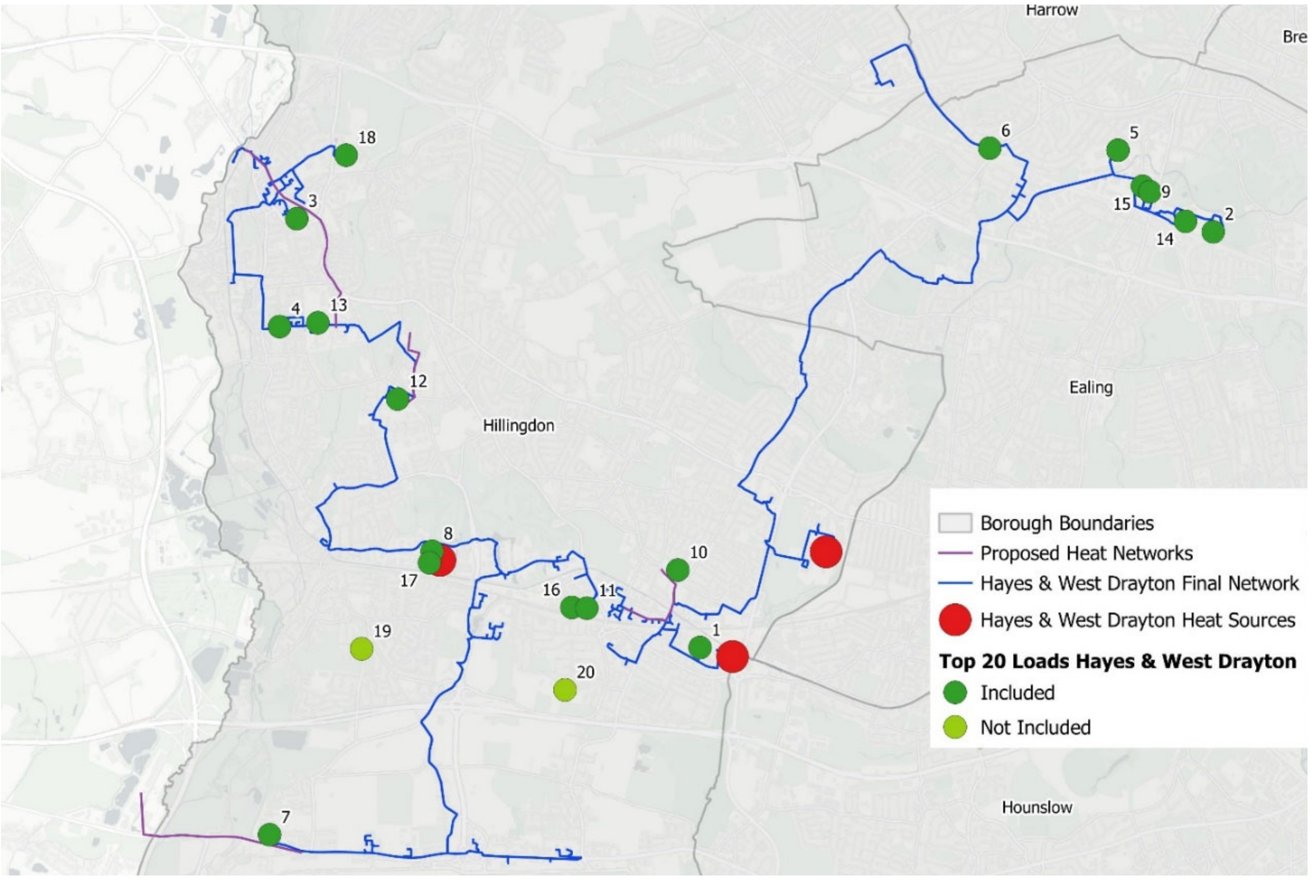


Figure 9-4 Final Network with Top Loads

9.3.1 High Social Housing Areas and NHS Trust Sites

Figure 9-5 shows the LSOA areas where there are high densities of social housing. The darkest regions indicate the densest areas of social housing (rented from local authority or other) in each LSOA across the Hayes & West Drayton Strategic Area. This data is from the 2021 ward and LSOA estimates (London Datastore).

This shows a general correlation with the proposed network routing which indicates that building out the network to these areas could support the decarbonisation of social housing as well as the major non-domestic loads in the area that were identified within the Top 20 loads. This figure also indicates the locations of NHS Trust sites and these are included within the proposed heat networks to show the potential for the heat network to support the NHS in decarbonising these sites.

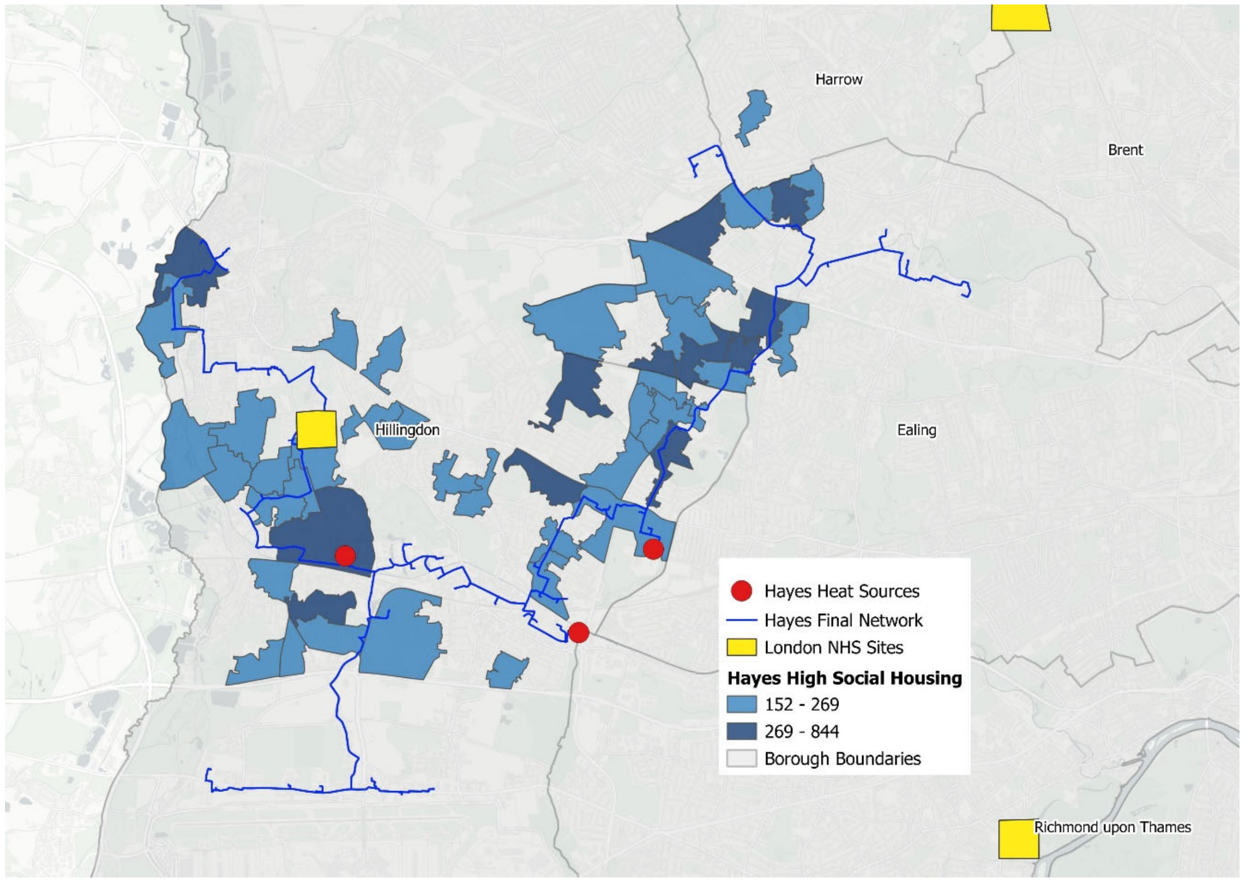


Figure 9-5 Areas of high LSOA Social Housing Density

9.4 Potential Scale of Investment

Overall this network gives a total pipework required of **~43km.** As all the heat sources utilised in this strategic area are data centres which are low grade heat sources therefore they are costed as water source heat pumps with a total build out cost estimated in the region of **£225m**. Table 9—3 shows the estimated costs.

Table 9—3 CAPEX Costs

	Unit	Unit Cost	Total Cost
Pipework and Civils	43 km	3,000 £/m	£126m
Water Source Heat Pump	56 MW	£1m/MW	£56m
Plant and Energy Centre	43 km	£1m/km	£43m
Total			**£225m**

9.5 Carbon Results

The carbon reduction realised by connecting the proposed clusters to the proposed heat network for Hayes & West Drayton, calculated as set out in the methodology (3.7), are presented in Table 9—4 below. These carbon results are over a 40 year lifetime.

Table 9—4 Carbon Results Summary

Counterfactual carbon emissions (tCO2)	Proposed solution carbon emissions (tCO2)	Carbon emissions reduction (tCO2)	Percentage reduction
2429000	62000	2367000	97%

9.6 Key Next Steps

London Boroughs: Ealing and Hillingdon.

- Communicate the opportunity to relevant boroughs that could benefit from this Strategic Area heat network to establish their interest for developing a partnership and undertaking a more detailed feasibility study, as well as understanding any other local elements that can contribute to network opportunities.

Major Heat Loads/connections:

- Using local knowledge verify the major heat loads listed, add additional information and contacts and update with any other major heat loads.

Waste Heat Sources:

- Using local knowledge verify the major heat sources listed, add additional information and contacts and update with any other known major heat loads.
- Engage with Lakeside EfW to understand their plans and opportunity as an additional waste heat source.
- Engage with the data centres in this area to establish longer term plans for the site and validate current estimates for heat availability.

Further development work and partnership building:

- Where interest exists develop the partnership between interested London Boroughs and spec out a more detailed feasibility study develop the project proposal and engage with major heat loads and the important heat sources.
- Carry out a more detailed feasibility in the Hillingdon area to verify load estimates (as many are industrial which are hard to accurately estimate) and also impact of constraints such as the canals and major roads in the area.

10 West London: Combined Strategic Areas D and E & Lakeside EFW Heat Source Sensitivity.

10.1 Combining Strategic Areas D and E

Due to the close proximity of areas D (Mogden & Twickenham) and E (Hayes & West Drayton) there is the ability to see the large scale potential network that encompasses the majority of west London.

The benefit of this includes sharing of waste heat sources which may provide heat at different times.

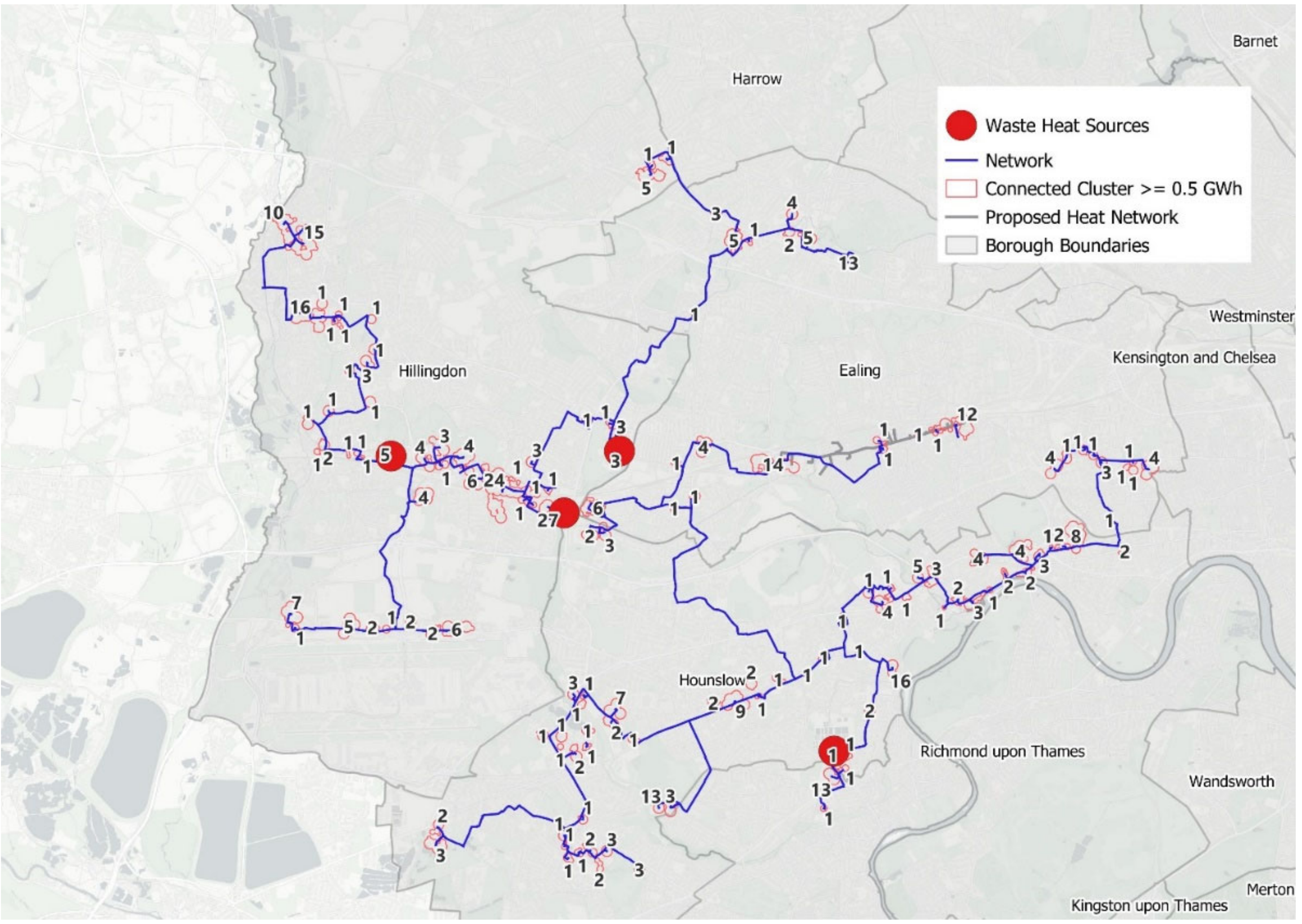
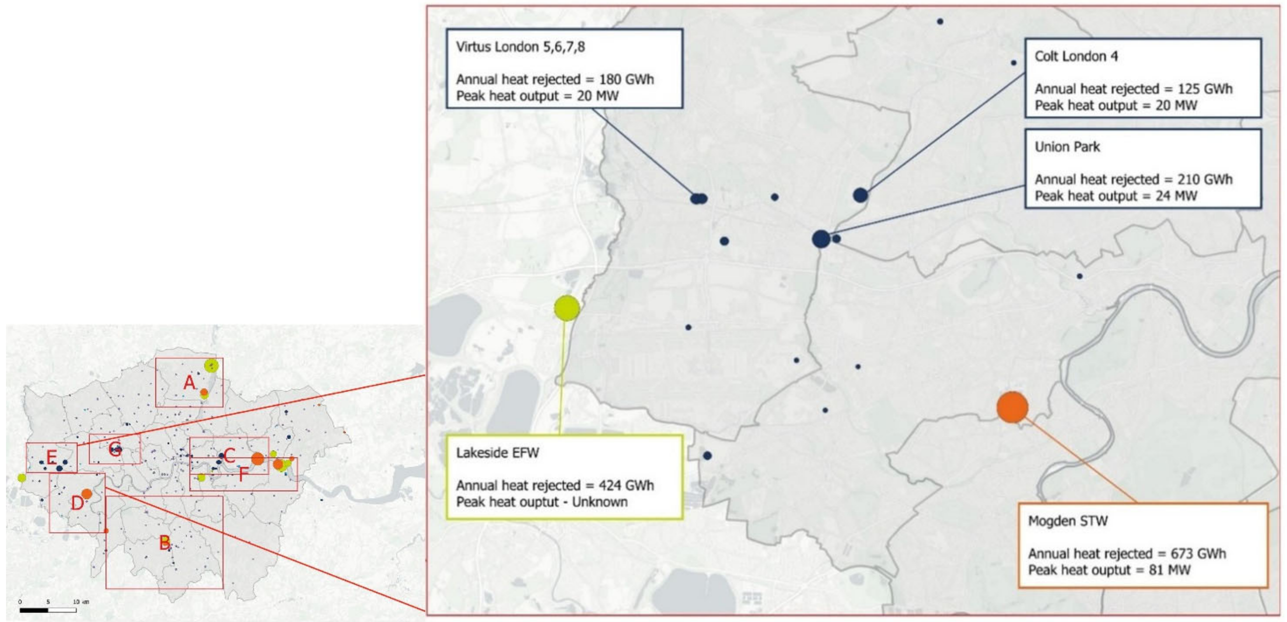


Figure 10-1 Combining two strategic areas to demonstrate the opportunity across West London

10.2 Addition of Lakeside EfW

There is an additional heat source, Lakeside EfW, located near Heathrow Airport just outside of LB Hillingdon to the West. The details on this waste heat source are shown in Figure 10-2 with the geographic location. There is limited understanding on the availability of this as a heat source and therefore a key recommendation is to engage with the operators to understand their plans as it could act as a major high grade heat source in the area.

This section looks at the impact of the inclusion of this additional waste heat source on the amount of load that a west London regional network could serve. In carrying out this sensitivity the heat loads located at Heathrow Airport were included who were discounted in the previous analysis on the basis that they are currently understood to be pursuing an on-site strategy for decarbonisation (to be verified).



Note: Only Sources with a potential to reject more than 1 GWh of waste heat are presented

Figure 10-2 West London – Impact of including the Lakeside EFW Heat Source

The addition of the Lakeside waste heat source increases the available rejected heat by **~36%** and results in a total of ~1612 GWh of annual heat rejected across this entire west London area. Therefore this amount of waste heat could serve additional boroughs such as Brent, Hammersmith & Fulham and potentially further towards central London. Figure 10-3 shows all the loads the waste heat sources could serve limited by proximity to Hillingdon, Ealing, Hounslow and Richmond upon Thames.

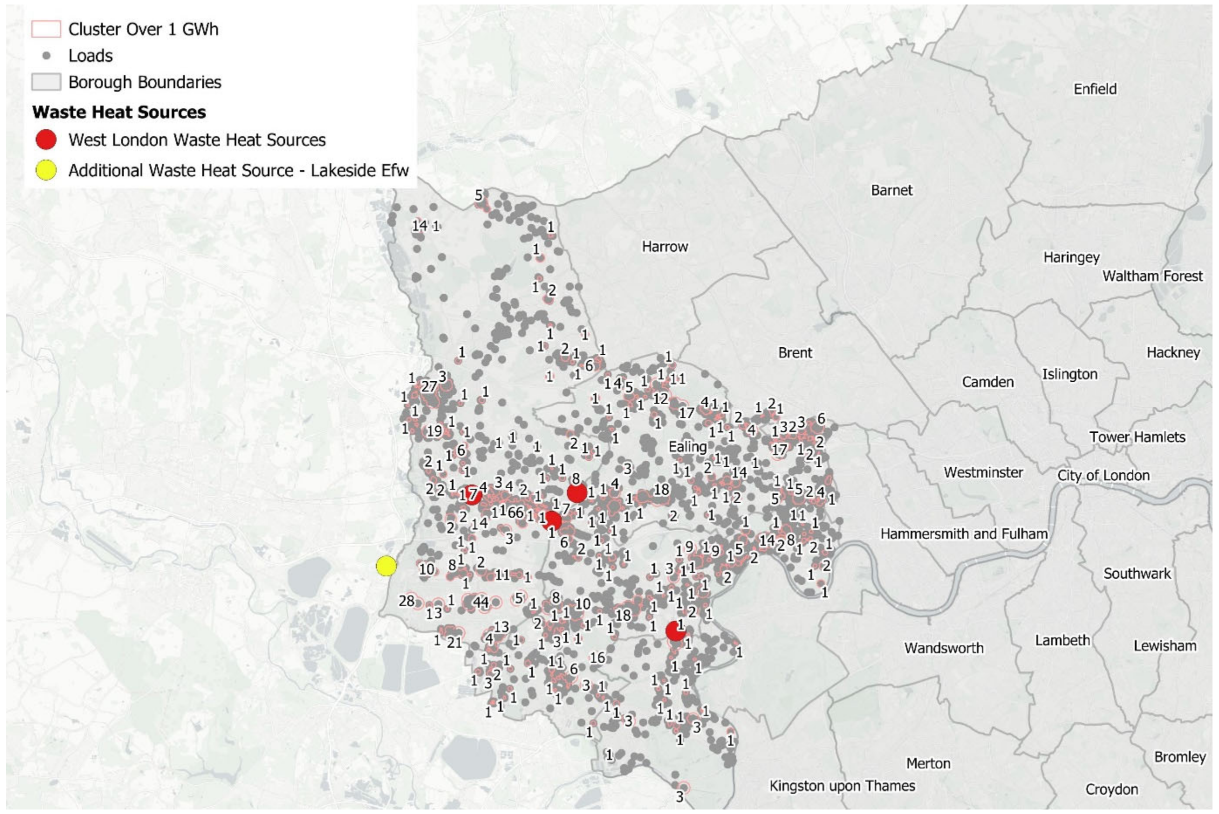
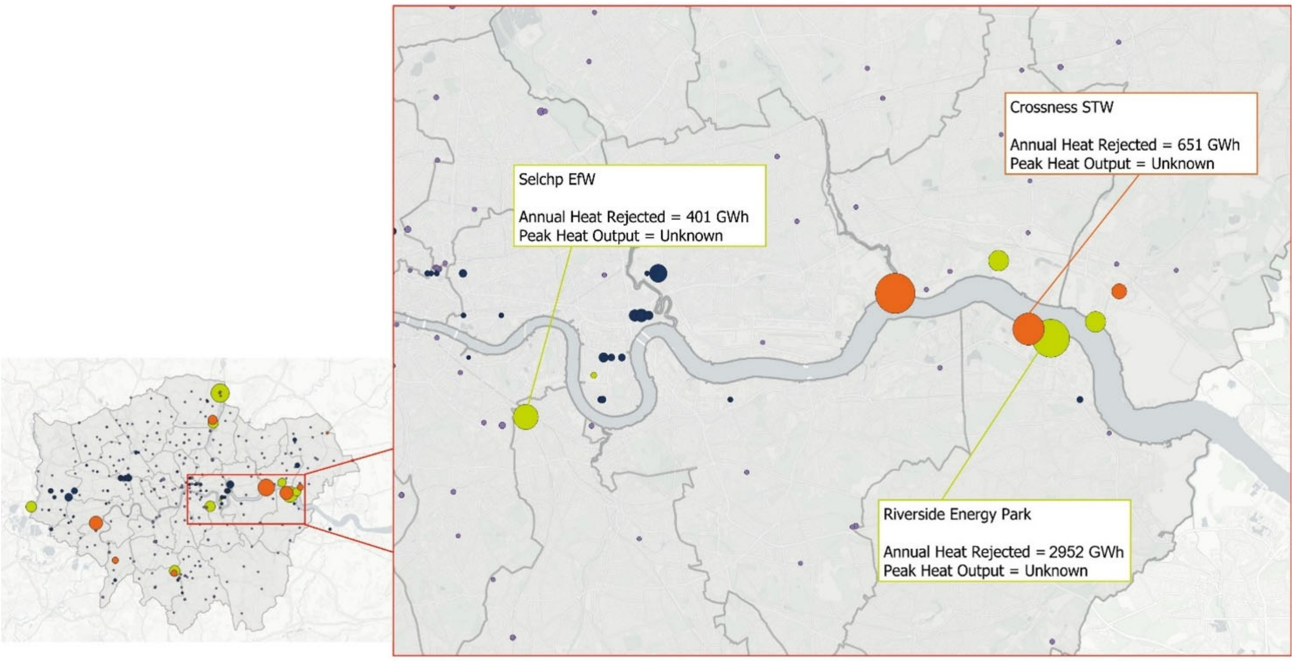


Figure 10-3 Potential Heat Loads in the West London Area with the Additional Heat Source

11 Strategic Area F: Crossness & South Bermondsey Strategic Area

11.1 Waste Heat Sources and Heat Loads

The Crossness & South Bermondsey Strategic Area is located in East London, and it is understood that there are four main waste heat sources which could provide waste heat to the LB of Bromley, Greenwich, Southwark and Lewisham. These four main heat sources are detailed below in Table 11—1 with their geographical locations shown in Figure 11-1.



Note: Only Sources with a potential to reject more than 1 GWh of waste heat are presented

Figure 11-1 Waste Heat Sources in the Crossness & South Bermondsey Strategic Area

There is a lack of data availability for the peak heat output for the majority of these sources, however the annual heat rejected was taken from the London Heat map. Estimates of peak heat have been made for the EfW plants based on previous discussions with operators.

Table 11—1 Crossness & South Bermondsey Waste Heat Sources

Heat Source	Type	Annual Heat Rejected (GWh/yr)	Peak Heat Output (MW)
Riverside Energy Park (Sites 1+2)	Energy Recovery Facility	2952*	369
SELCHP EFW	Energy Recovery Facility	401	60
Crossness Sewage Treatment Works (STW)	Sewage Treatment Plant	652	78
Total		**4,005**	**507**

* Annual heat updated June 2025 after verification with Cory Riverside.

11.2 Potential Connections and Network

The clustering methodology, explained in 4.3, was utilised with the heat loads that fell within the Crossness & South Bermondsey area with clustering applied to the heat loads with a line density of 8 MWh/yr/m. Only clustered loads that were equal or greater to 0.5 GWh were carried forward for analysis. The clusters and heat loads used are shown in Figure 11-2**.**

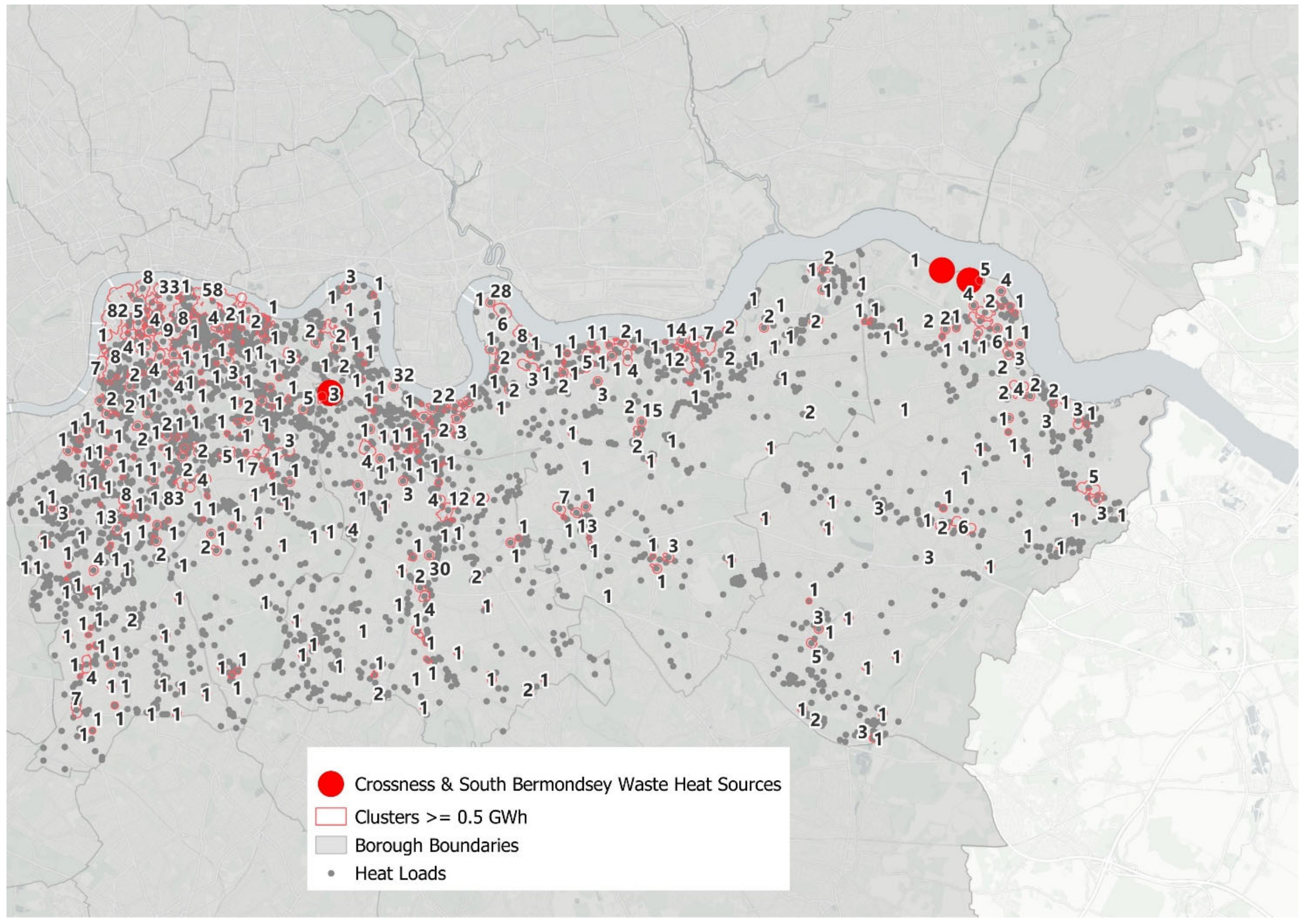


Figure 11-2 Crossness & South Bermondsey Area with potential Heat Loads and Clusters over 0.5 GWh

Modelling has been carried out to identify potential networks to interconnect these clusters with the final network built up of only pipework with a linear density of **8+ MWh/yr/m**. The resulting network is shown in Figure 11-3.

There is a significant number of proposed networks (identified from the London Heat Map and shown in purple), several of these are already planned to utilise two of the waste heat sources modelled in this strategic area. These sources are: s

- **Cory Riverside Heat Network**, which utilises the Riverside Energy from Waste Facility. Vattenfall are currently partners with Cory to bring this heat to the area. The Vattenfall arrangement looks at local export only (the agreement is geographically specific) and they are also working with a range of other ESCOs in other areas.
- A planned network extending into Greenwich has been identified.
- **SELCHP Future Heat Network** which will utilise the SELCHP heat from waste facility with ~7km of new piping. This is being brought forward by Southwark and Veolia. A planned network extending into the North Lewisham area is also planned.

These networks are on a local level but in combination with the two other waste heat sources in the area, the three waste sources could stretch to serve a wider area. This strategic area has been modelled to serve a wider region, and in combination with these heat networks have the potential to be a large sub-regional district heat network which also extends to the northern areas of Southwark and into Lambeth. The heat load of this potential network is **~943 GWh/yr** using less than 25% of the current waste heat estimates from the London Heat Map.

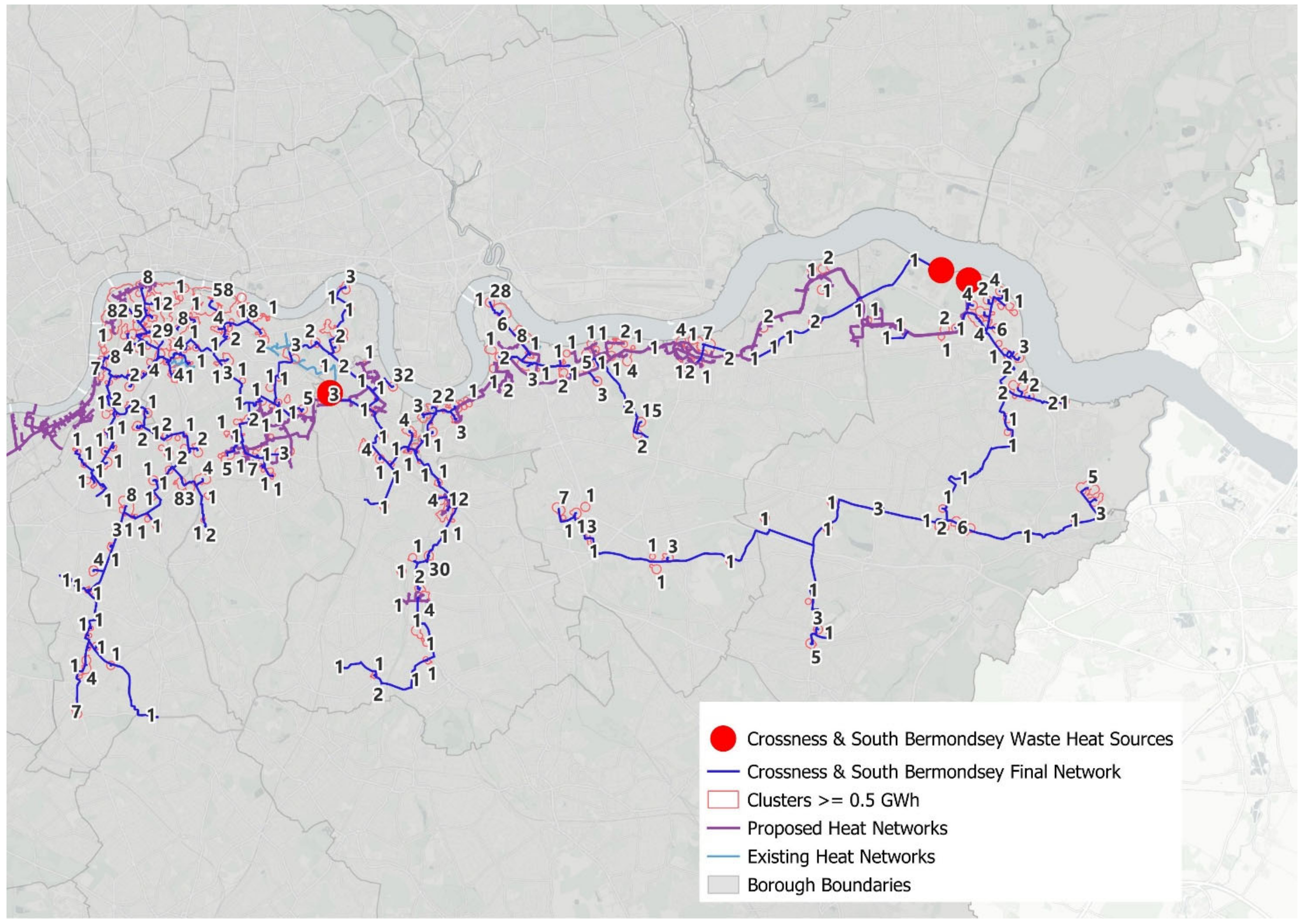


Figure 11-3 Final Network based off linear density and existing/proposed networks

A map showing existing heat networks in the area, the initial Steiner Tree outputs, explicit results of the linear heat density assessment, and alignment of the final network with the GLA's Potential DHN Project Areas can be found in Appendix F.

11.3 Connection Opportunities

The proposed network will be a multi-borough heat network that will reach all the main heat clusters. It will cover the London Boroughs of Bromley, Greenwich, Southwark and Lewisham. Looking at the 20 largest loads to be connected gives an understanding of the main stakeholders that will need to be involved in the potential network.

Table 11—2 indicates that all of them have linear densities of 8+ MWh/yr/m indicating that the pipelines connecting these have a greater opportunity for inclusion in an overall network. Figure 11-4 shows the geographical location of the Top 20 loads in the Crossness & South Bermondsey Area.

Table 11—2 20 Largest Heat Loads in the Potential Crossness & South Bermondsey Network

	High Demand Load	Borough	Typology	Heat Demand (MWh/yr)	Peak Demand (kW)	Pipe Linear Density	Included in Network
1	Kings College Hospital	Lambeth	Hospital	77400	38400	8+	Included
2	Convoys Wharf	Lewisham	Mixed-Use Development	32400	16100	8+	Included
3	University Hospital, Lewisham	Lewisham	Hospital	29600	14700	8+	Included
4	The O2	Greenwich	Entertainment Venue	26700	13300	8+	Included
5	Shell Centre	Lambeth	Office Building	24600	12200	Proposed Network	Included
6	Millwall Football Club	Lewisham	Sports Stadium	24200	12000	8+	Included
7	Queen Elizabeth Hospital	Greenwich	Hospital	14500	7200	8+	Included
8	Harmsworth Quays	Southwark	Office and Commercial Complex	10100	5000	Proposed Network	Included
9	Southbank Centre	Lambeth	Cultural Centre	9300	4600	Proposed Network	Included
10	Palestra House (TFL, Arriva Rail Offices)	Southwark	Office Building	8900	4500	8+	Included
11	Kidbrooke Village	Greenwich	Residential Development	7900	3900	8+	Included
12	Guy's Hospital	Southwark	Hospital	7900	3900	8+	Included
13	London Bridge Hospital	Southwark	Hospital	7100	3600	8+	Included
14	Metropolitan Police Forensic Science Laboratory	Lambeth	Police Facility	6900	3500	8+	Included
15	St. Thomas' Hospital	Lambeth	Hospital	6800	3400	Proposed Network	Included
16	Ocado Customer Fulfilment Centre	Bexley	Distribution Centre	6400	3200	8+	Included
17	Phase 6 Kidbrooke Village	Greenwich	Residential Development	5900	2900	8+	Included
18	Waterloo Station	Lambeth	Transportation Hub	5700	2900	8+	Included
19	Tate Modern	Southwark	Cultural Centre	5100	2600	8+	Included
20	Streatham Ice & Leisure Centre	Lambeth	Leisure Centre	4700	2400	8+	Included

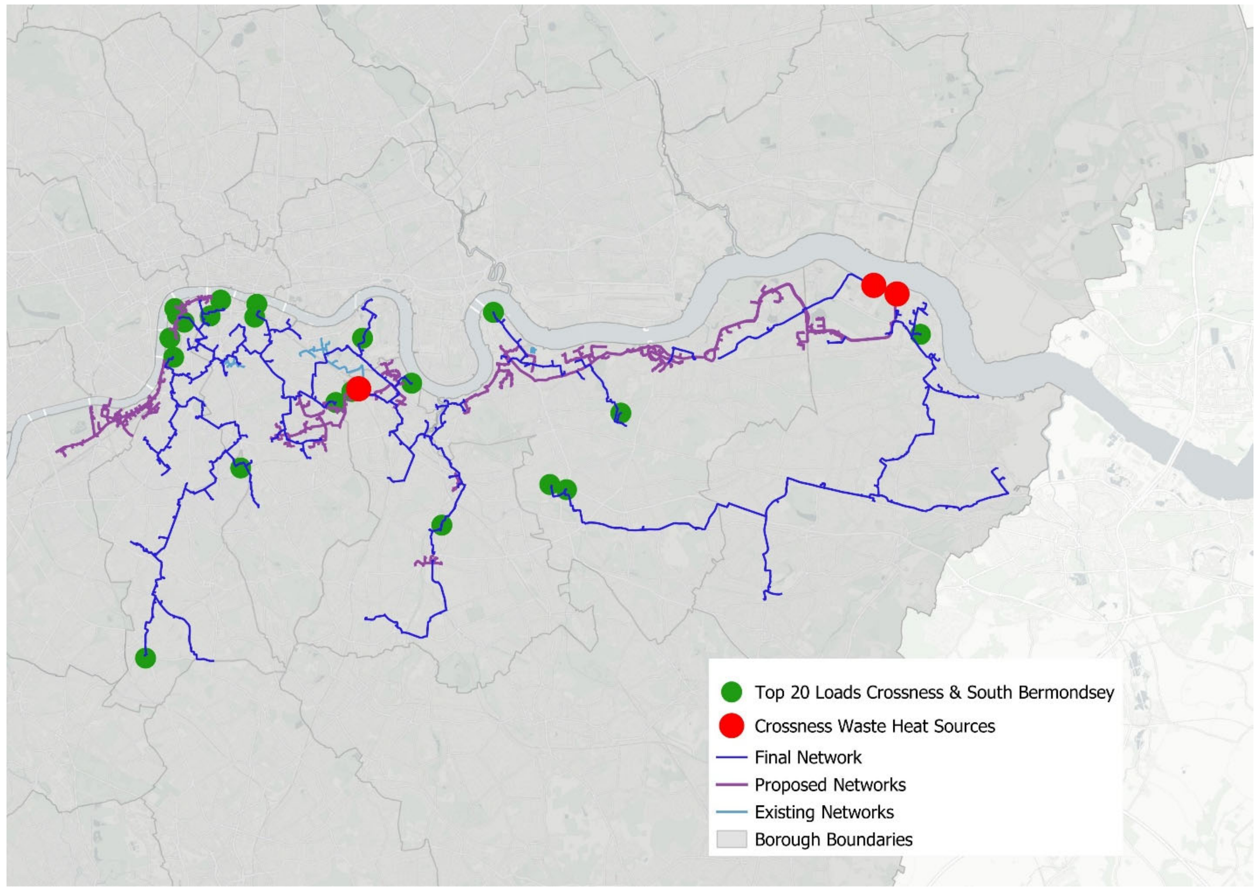


Figure 11-4 Final Network with Top Loads

11.3.1 High Social Housing Areas and NHS Trust Sites

Figure 11-5 shows the LSOA areas where there are high densities of social housing. The darkest areas indicate the densest areas of social housing (rented from local authority or other) in each LLSO Area (LSOA) across the Crossness & South Bermondsey Strategic Area. This data is from the 2021 ward and LSOA estimates (London Datastore).

This shows a general correlation with the proposed network routing which indicates that building out the heat network to these areas could support the decarbonisation of social housing as well as the major non-domestic loads in the area that were identified within the Top 20 loads. This figure indicates that there are also several NHS Trust sites located close to the proposed heat network route and this shows the potential for the heat network to support the NHS in decarbonising these sites

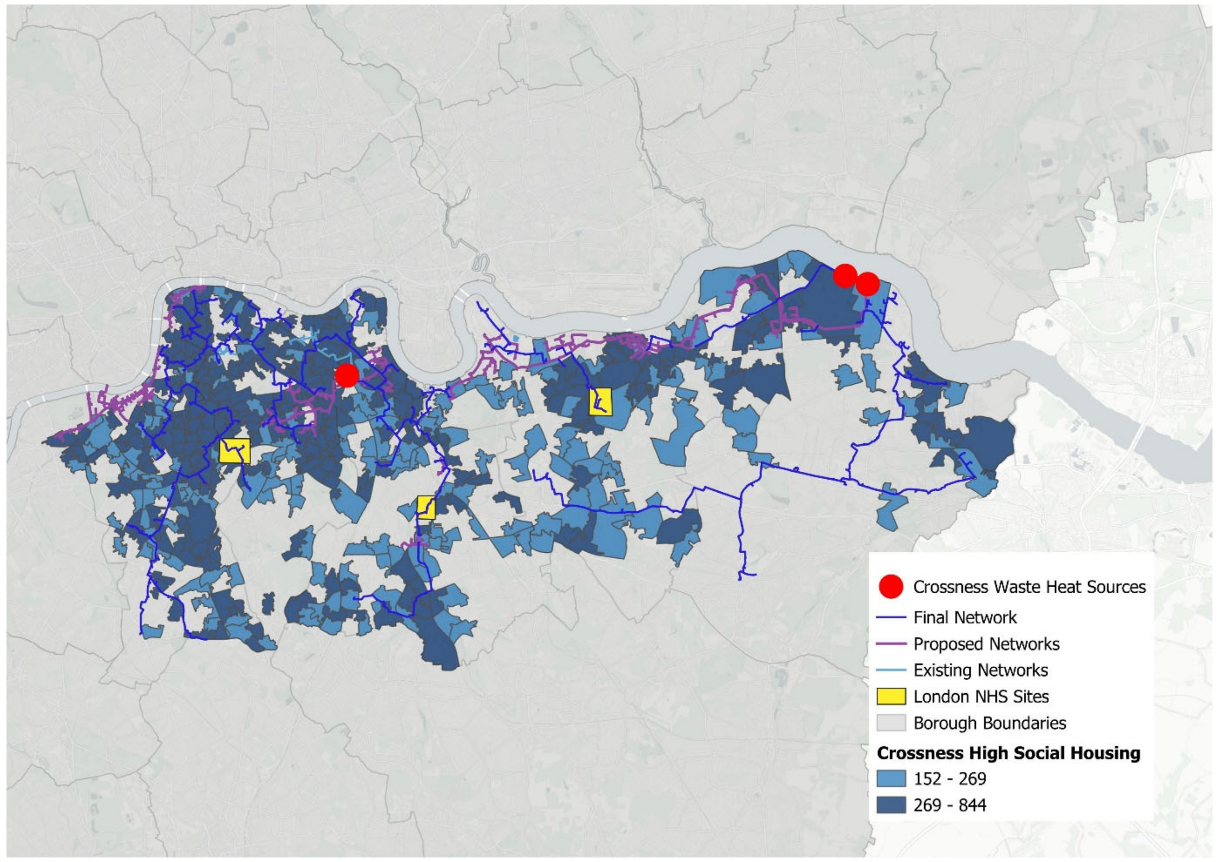


Figure 11-5 Areas of high LSOA Social Housing Density and NHS Trust Site Locations

11.4 Potential Scale of Investment

The amount of pipework required for this network is ~**119 km**. There are 3 heat sources used in this strategic area that are high grade heat source the associated cost estimate is based off the recovered heat costs whereas the fourth heat source is low grade and costed based off the water source heat pump costs. Table 11—3 shows the estimated costs which total circa **£676m**.

Table 11—3 CAPEX

	Unit	Unit Cost	Total Cost
Pipework and Civils	119 km	3,000 £/m	357 m
Recovered Heat	120 MW	£0.75m/MW	90 m
Water Source Heat Pump	78 MW	£1m/MW	78 m
Plant and Energy Centre	119 km	£1m/km	119 m
Total			**£644m**

11.5 Carbon Results

Carbon reduction realised by connecting to proposed clusters to the final network for Crossness & South Bermondsey, calculated as set out in the methodology (4.7), are presented in Table 11—4 below. These carbon results are over a 40 year lifetime.

Table 11—4 Carbon Results Summary

Counterfactual carbon emissions (tCO2)	Proposed solution carbon emissions (tCO2)	Carbon emissions reduction (tCO2)	Percentage reduction
10,507,239	20,3000	10,304,000	98%

11.6 Key Next Steps

London Boroughs: Bromley, Greenwich, Lewisham and Southwark.

- Communicate the opportunity to relevant boroughs that could benefit from this Strategic Area heat network to establish their interest for developing a partnership and undertaking a more detailed feasibility study, as well as understanding any other local elements that can contribute to network opportunities.

Major Heat Loads/connections:

- Using local knowledge verify the major heat loads listed, add additional information and contacts and update with any other major heat loads.
- Establish whether networks which are planned to be installed soon have sufficient capacity to future proof for the wider strategic growth of the network.

Waste Heat Sources:

- Using local knowledge verify the major heat sources listed, add additional information and contacts and update with any other known major heat loads.
- Engage with Veolia and Cory/Vattenfall to communicate the potential, understand their current planned expansions and heat availability and discuss ways to move a network forward.

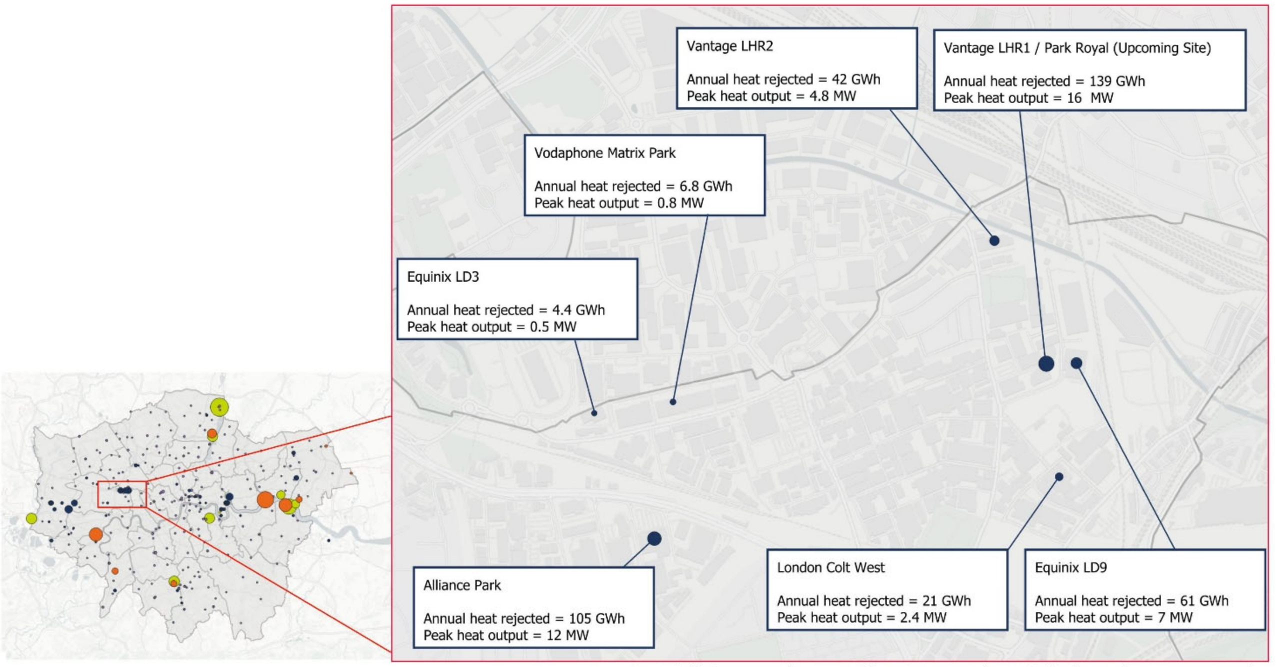
Further development work and partnership building:

- Where interest exists develop the partnership between interested London Boroughs and spec out a more detailed feasibility study develop the project proposal and engage with major heat loads and the important heat sources.
- A feasibility study focussing on serving the areas North East of SELCHP would be recommended as expansion beyond Old Kent Road has not been investigated to our understanding.

12 Strategic Area G: Old Oak and Park Royal Development (OPDC) Strategic Area

12.1 Waste Heat Sources and Heat Loads

The Old Oak and Park Royal Development (OPDC) Strategic Area is located in West London, in the London Boroughs of Brent, Ealing and Hammersmith & Fulham. There is a significant number of waste heat sources in the form of data centres that could provide heat to these boroughs and beyond. Phase 1 of a local network utilising several of these data centres for heat is currently out for procurement of a delivery partner for the first phase – this study looks at a theoretical wider growth in this area.



Note: Only Sources with a potential to reject more than 1 GWh of waste heat are presented

Figure 12-1 Waste heat sources in the OPDC Strategic Area

Several sources were used to estimate the annual heat availability and peak heat output from the data centres. The data presented in Table 12—1 should be further verified. OPDC are already developing a heat network in this area and the heat sources, estimated heat availability and any additional heat sources in the area will need verifying as part of any future work to understand the full expansion opportunity to neighbouring boroughs, including to extend further to the south of this strategic area into the boroughs of Hammersmith & Fulham, Kensington & Chelsea and Westminster.

Table 12—1 OPDC Main Heat Sources

Heat Source	Type	Annual Heat Rejected (GWh/yr)	Peak Heat Output (MW)
Equinix LD3	Data Centre	4.4	0.5
Equinix LD9	Data Centre	61	7
Vantage LHR2	Data Centre	42	4.8
Vantage LHR1 / Park Royal (Upcoming Site)	Data Centre	139	16
Alliance Park	Data Centre	105	12
London Colt West	Data Centre	21	2.4
Vodaphone Matrix Park	Data Centre	6.8	0.8
Total		**379.2**	**43.5**

12.2 Potential Connections and Network

A longlist of heat loads has been identified which have been shortlisted into clusters of heat load equal or greater than 0.5GWh. These clusters have been incorporated into the analysis ensuring that the total is less than the annual heat rejected from the chosen heat sources for the strategic area. The clusters and heat loads used, and their geographic location are shown in Figure 12-2.

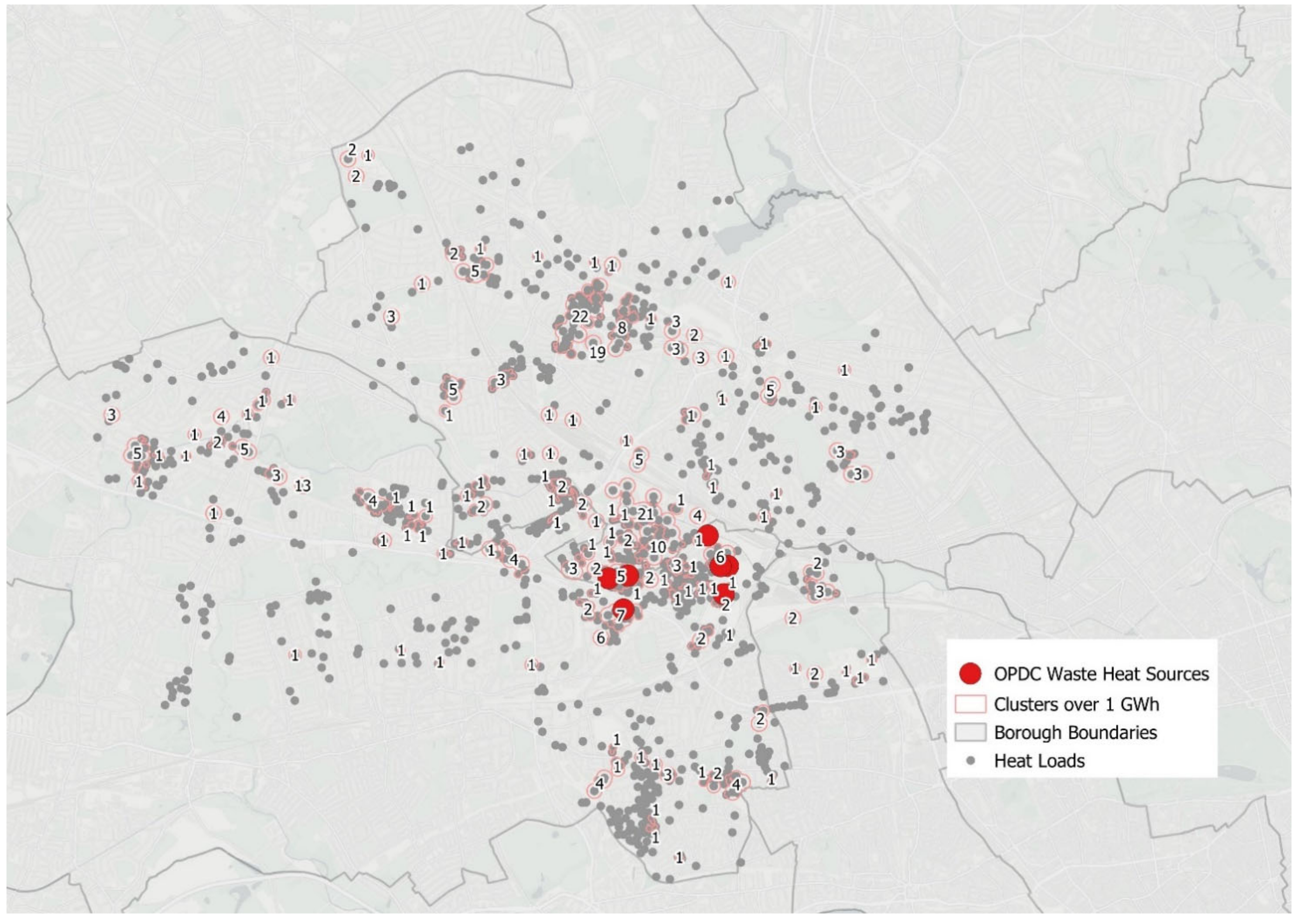


Figure 12-2 OPDC Area with potential Heat Loads and Clusters over 1 GWh

The shortest route to connect clusters and heat sources has been identified using the Steiner tree methodology. The final network identified prioritises only pipework with a linear density of **8+ MWh/yr/m**. Where there was any existing or proposed heat networks in the immediate area, these were manually combined with the resulting network from the processing tool.

The final output showing the network between connected clusters and waste heat sources, as well as existing and proposed networks is presented in Figure 12-3. The network has the potential to cover areas of London Boroughs of Ealing, Brent and Hammersmith & Fulham – potentially linking with other strategic waste heat networks identified in this study. The heat load of this potential network is **~ 276 GWh/yr.** This does not utilise the estimated full potential of the waste heat in the area and therefore may have potential to extend further into Hammersmith & Fulham, Kensington & Chelsea and Westminster.

A map showing existing heat networks in the area, the initial Steiner Tree outputs, explicit results of the linear heat density assessment, and alignment of the final network with the GLA's Potential DHN Project Areas can be found in Appendix G.

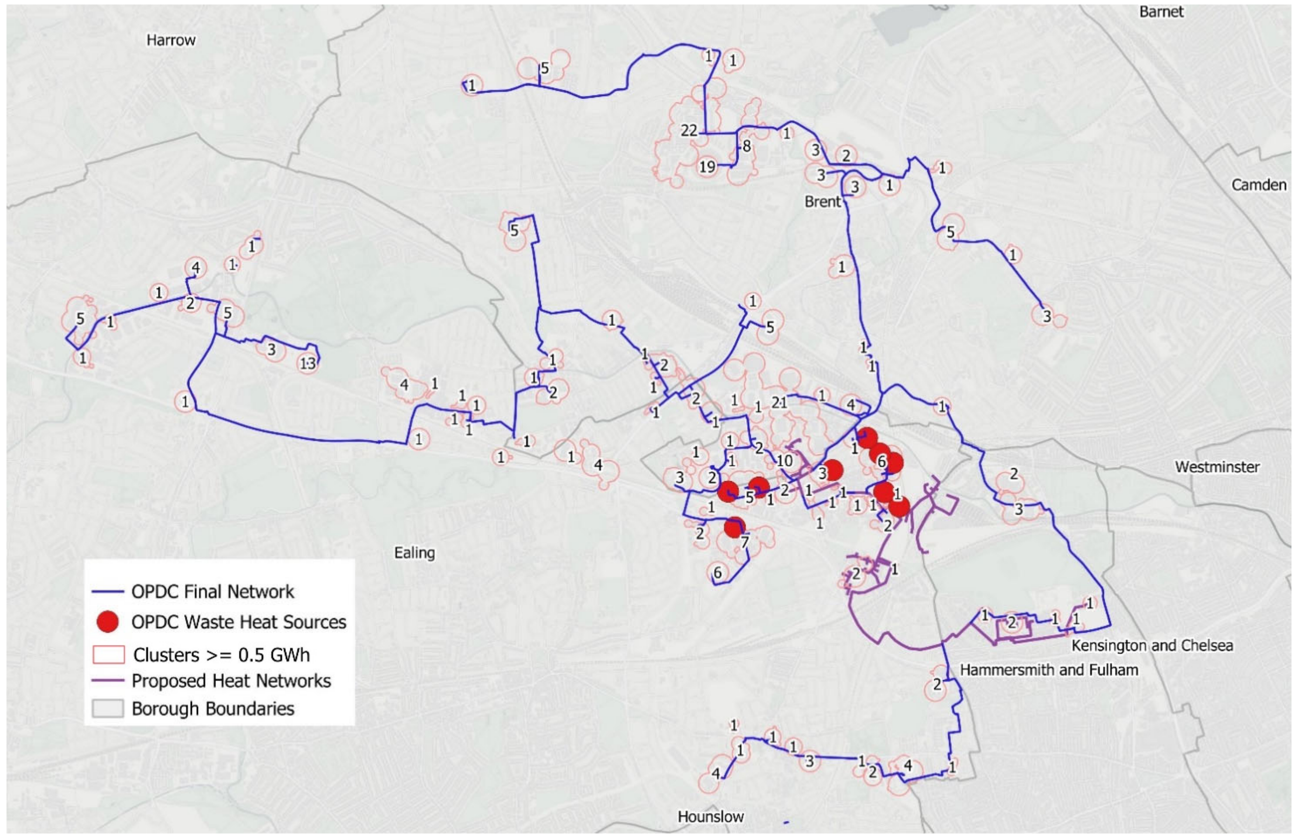


Figure 12-3 Final Network based off linear density and existing/proposed networks

12.3 Connection Opportunities

The proposed network will be a multi-borough heat network that will reach all the main heat clusters. It will cover the London Boroughs of Brent, Ealing and Hammersmith & Fulham. Looking at the 20 largest loads to be connected gives an understanding of the main stakeholders that will need to be involved in the potential network. Table 12—2 shows that 17 of the 20 have linear densities of 8+ MWh/yr/m indicating that the pipelines connecting these have greater opportunity for inclusion in an overall network. Figure 12-4 shows the geographical location of the Top 20 loads across the OPDC area.

Table 12—2 Top 20 Largest Heat Loads in the Potential Beddington Network

	High Demand Load	Borough	Typology	Heat Demand (MWh/yr)	Peak Demand (kW)	Pipe Linear Density	Included in Network
1	Titan Studios	Brent	Film Studio	18700	9300	8+	Included
2	London North West Depot (Parcelforce, Royal Mail)	Ealing	Distribution Centre	13000	6500	8+	Included
3	Royal Mail Greenford Mail Centre	Brent	Mail Sorting Centre	8800	4400	8+	Included
4	Northolt Leisure Centre	Ealing	Leisure Centre	6200	3100	2-4	Not Included
5	Wilesden Magistrates' Court	Brent	Courthouse	3800	1900	8+	Included
6	Vale Farm Sports Centre	Ealing	Sports Centre	3700	1900	2-4	Not Included
7	Brent Civic Centre & Wembley Library	Brent	Civic Centre/Library	3600	1800	8+	Included
8	Wembley Police Station	Ealing	Police Station	3300	1600	8+	Included
9	Princess Royal Distribution Centre	Brent	Distribution Centre	3000	1500	8+	Included
10	HMP Wormwood Scrubs	Brent	Prison	2900	1500	8+	Included
11	Hitachi Depot	Brent	Depot	2900	1400	2-4	Not Included
12	Wincaton	Brent	Distribution Centre	2900	1400	8+	Included
13	Sainsburys Greenford Distribution Centre	Brent	Distribution Centre	2700	1400	8+	Included
14	IKEA	Brent	Retail Store	2700	1400	8+	Included
15	Amazon	Ealing	E-commerce Warehouse	2700	1300	8+	Included
16	Premier Park (GXO Logistics)	Brent	Logistics Park	2600	1300	8+	Included
17	Central Middlesex Hospital	Brent	Hospital	2500	1300	8+	Included
18	Wembley Stadium	Hammersmith and Fulham	Stadium	2500	1200	8+	Included
19	Premier Park (Bestway, Map Trading)	Ealing	Logistics Park	2400	1200	8+	Included
20	McVities	Hammersmith and Fulham	Manufacturing Plant	2300	1200	8+	Included

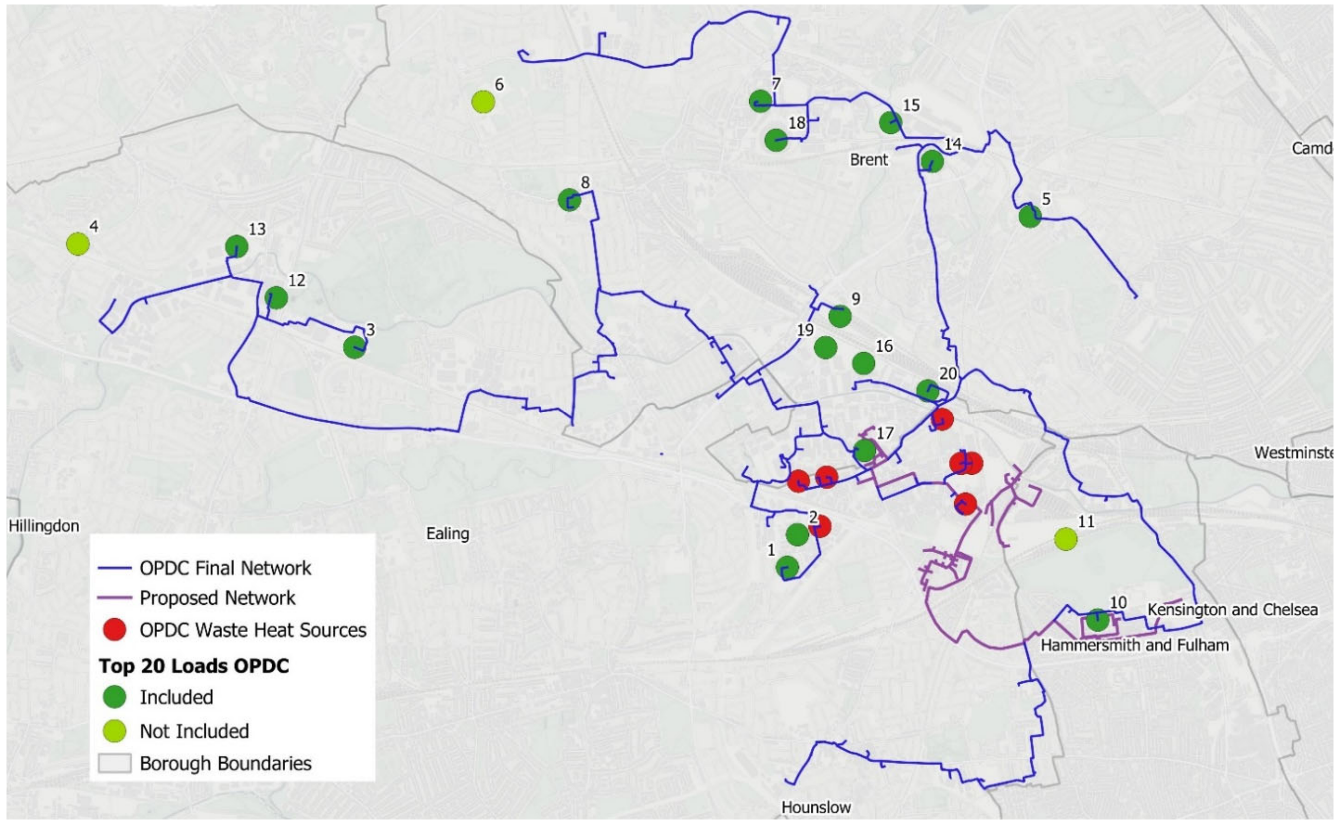


Figure 12-4 Final Network with Top Loads

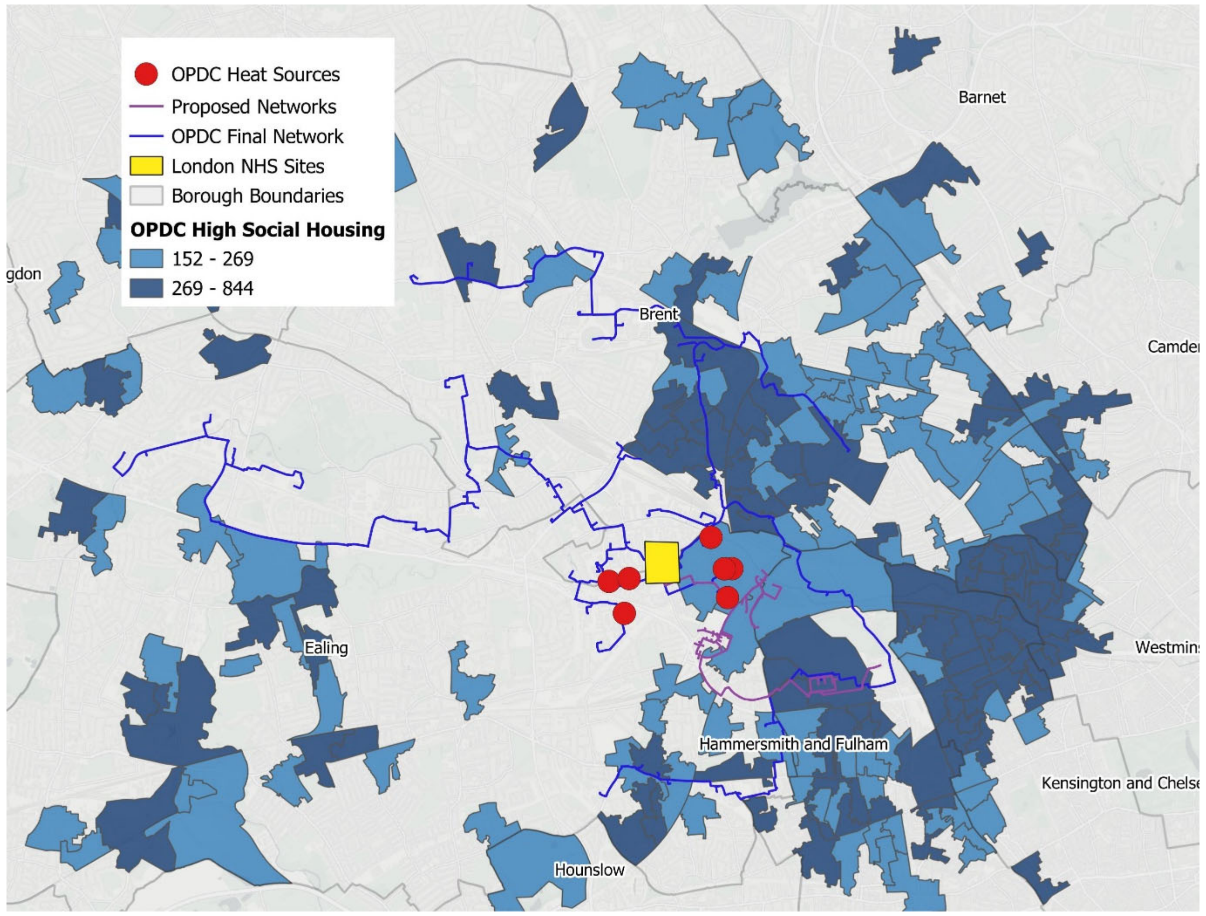


Figure 12-5 Areas of High LSOA Social Housing Density and NHS Trust Site Locations

12.3.1 High Social Housing Areas and NHS Trust Sites

Figure 12-5 shows the LSOA areas where there are high densities of social housing. The darkest areas indicate the densest areas of social housing (rented from local authority or other) in each LSOA across the OPDC area. This data is from the 2021 ward and LSOA estimates (London Datastore).

This shows a general correlation with the proposed network routing which indicates that building out the heat network into these areas support the decarbonisation of social housing as well as the major non-domestic loads identified within the Top 20 loads. This figure indicates that there are also several NHS Trust sites located close to the proposed heat network route and this shows the potential for the heat network to support the NHS decarbonising these sites.

12.4 Potential Scale of Investment

Overall this network gives a total pipework of required of **~48km.** Depending on the type of waste heat, the costs associated depend on whether they are high or low grade heat. In the OPDC area, only data centres have been used as waste heat sources, which are all classified as low grade heat and costed as water-source heat pumps. The total capex is estimated at **£236m**.

Table 12—3 CAPEX

	Unit	Unit Cost	Total Cost
Pipework and Civils	48 km	3,000 £/m	£144m
Water Source Heat Pump	43.5 MW	£1m/MW	£43.5m
Plant and Energy Centre	48 km	£1m/km	£48m
Total			**£236m**

12.5 Carbon Results

Carbon reduction realised by connecting to proposed clusters to the final network for OPDC area, calculated as set out in the methodology (4.7), are presented in Table 12—4. These carbon results are over a 40 year lifetime.

Table 12—4 Carbon Results Methodology

Counterfactual carbon emissions (tCO2)	Proposed solution carbon emissions (tCO2)	Carbon emissions reduction (tCO2)	Percentage reduction
3,075,000	78,000	2,997,000	97%

12.6 Key Next Steps

London Boroughs: Brent, Ealing and Hammersmith & Fulham

- Communicate the opportunity to relevant boroughs that could benefit from this Strategic Area heat network to establish their interest for developing a partnership and undertaking a more detailed feasibility study, as well as understanding any other local elements that can contribute to network opportunities.

Major Heat Loads/connections:

- Using local knowledge verify the major heat loads listed, add additional information and contacts and update with any other major heat loads.

Waste Heat Sources:

- Using local knowledge verify the major heat sources listed, add additional information and contacts and update with any other known major heat loads.

Further development work and partnership building:

- Where interest exists develop the partnership between interested London Boroughs and spec out a more detailed feasibility study develop the project proposal and engage with major heat loads and the important heat sources.

13 Conclusion

This study was commissioned to assess and visualise the opportunity that the diverse range of large-scale waste heat sources provide for developing strategic multi-borough low carbon heat networks that can contribute to decarbonising London's heat supply and support our pursuit of Net Zero. The value of strategic multi-borough district heat networks is that they benefit from the economies of scale that make heat networks such a viable and competitive infrastructure for not only supplying affordable, low carbon heat to homes and businesses but also providing flexibility, balancing and accelerated decarbonisation of the electricity network.

This work wasn't instigated by emerging Heat Network Regulation and Zoning but it certainly will provide intelligence and insight into the opportunities that exist for multi-borough district heat networks in London and support and inform our work around heat network zoning. This work will also feed into the sub-regional LAEPs providing intelligence around the opportunity for developing heat networks to support the decarbonisation of heat and instigate discussions between relevant London Boroughs both within and between sub-regional LAEPs.

This study analysed seven Strategic Areas, all served by significant volumes of waste heat and the potential that provides for the development of strategic multi-borough district heat networks to supply existing and new heat demands. It concludes that there is a significant quantity of waste heat available from a relatively few large waste heat sources across London and they provide a good opportunity to develop out a number of strategic multi-borough district heat networks.

Currently, there are very few examples in London of existing or planned multi-borough district heat networks. Stakeholder engagement with relevant boroughs thinking about these type of heat networks highlighted that there are a number of challenges to the development of such networks, this includes areas such as network ownership, operational structure, and heat sales pricing.

To overcome the technical, political, and financial challenges that are highlighted above requires a partnership approach to be developed for developing multi-borough district heat networks that tackle these issues and create solutions that are acceptable to all the parties.

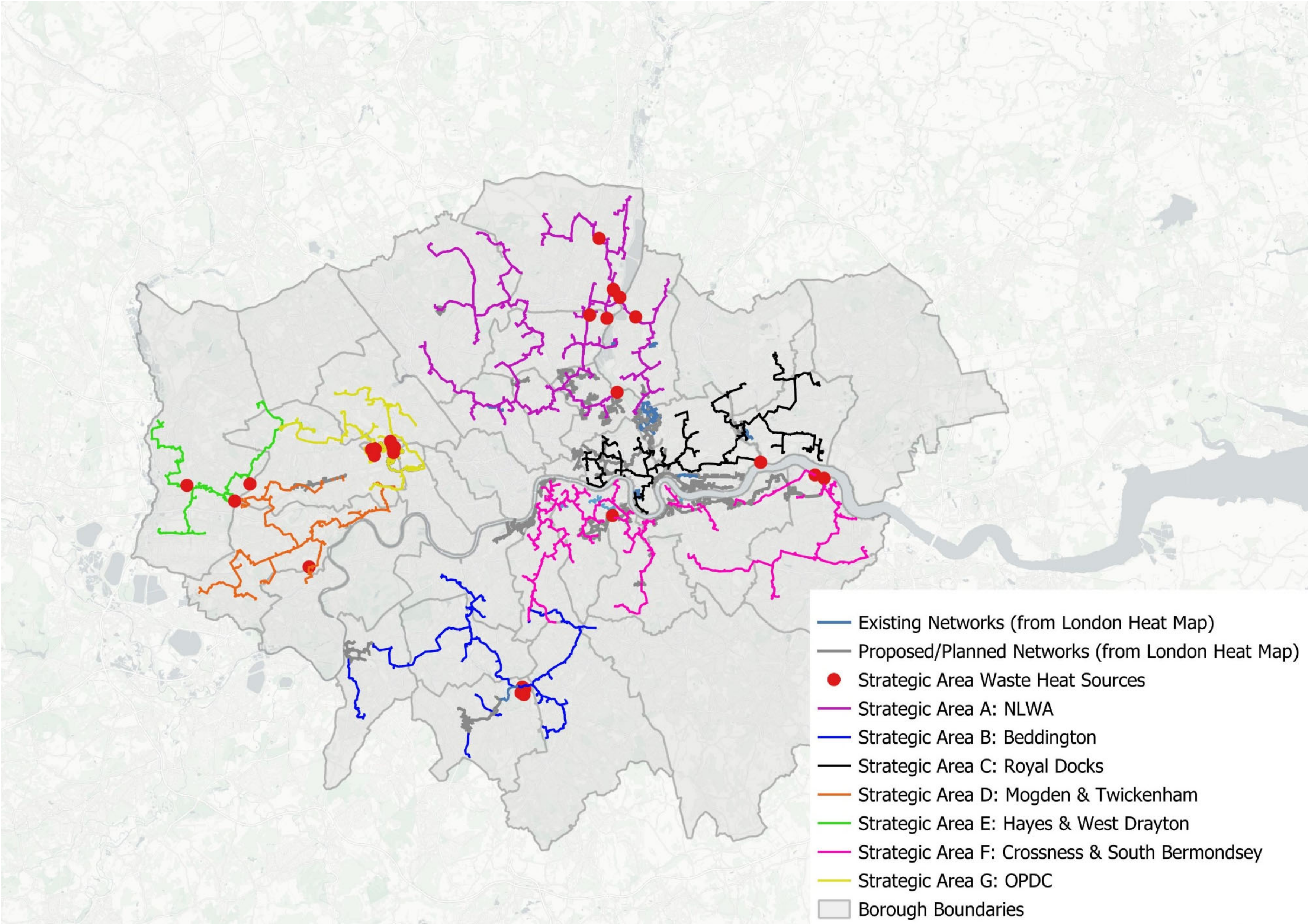


Figure 13-1 Map showing all Strategic Area Networks

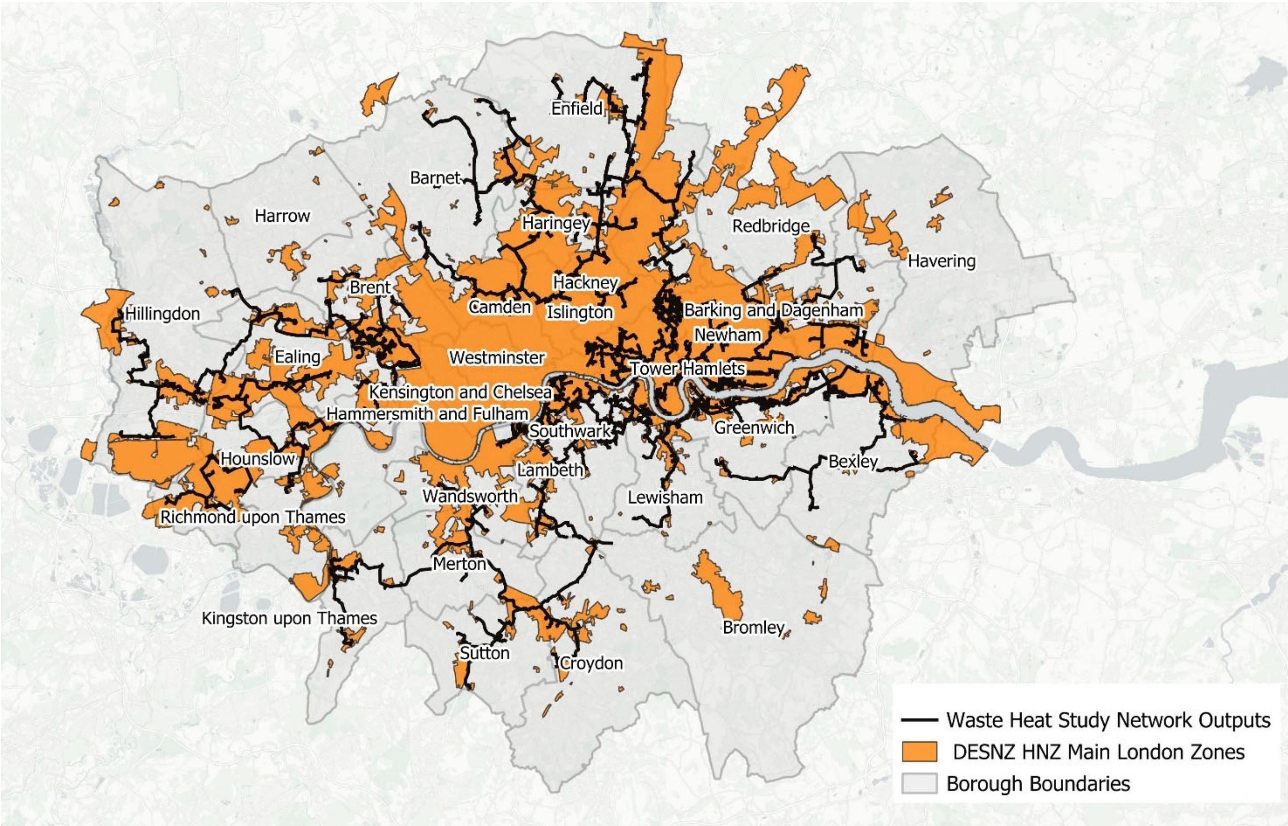
This is a significant departure from the current development model which is largely happening at an individual borough level and led, in most cases, by the relevant London Borough. This is often constraining the ambition and size of London's district heat networks and with the introduction of heat network zoning in 2025, there is real opportunity for London Government – the GLA, London Councils and London Boroughs - to coordinate and develop these strategic opportunities.

Data used in the analysis of these seven Strategic Areas is based on estimates from a variety of sources which are published in the London Heat Map – further validation of this data is recommended as the level of project detail is developed, for example through the sub-regional LAEP process. More detailed techno-economic modelling was only carried out on the NLWA Strategic Area, as that was funded by DESNZ through the North London Heat Network Study, and therefore additional detailed techno-economic modelling work will be needed to help understand and demonstrate the viability of these potential multi-borough district heat networks.

As set out in the 'Key Next Steps' at the end of each Strategic Area section of this report it is suggested that the initial next steps should be the integration of this study into the sub-regional LAEP process and then the resulting engagement of the relevant London Boroughs in each of the Strategic Areas and their respective sub-regional LAEPs. The initial purpose being to present the findings and the opportunity and discuss the level of interest in supporting a multi-borough district heat network and then, if there is interest, how best to develop the opportunity.

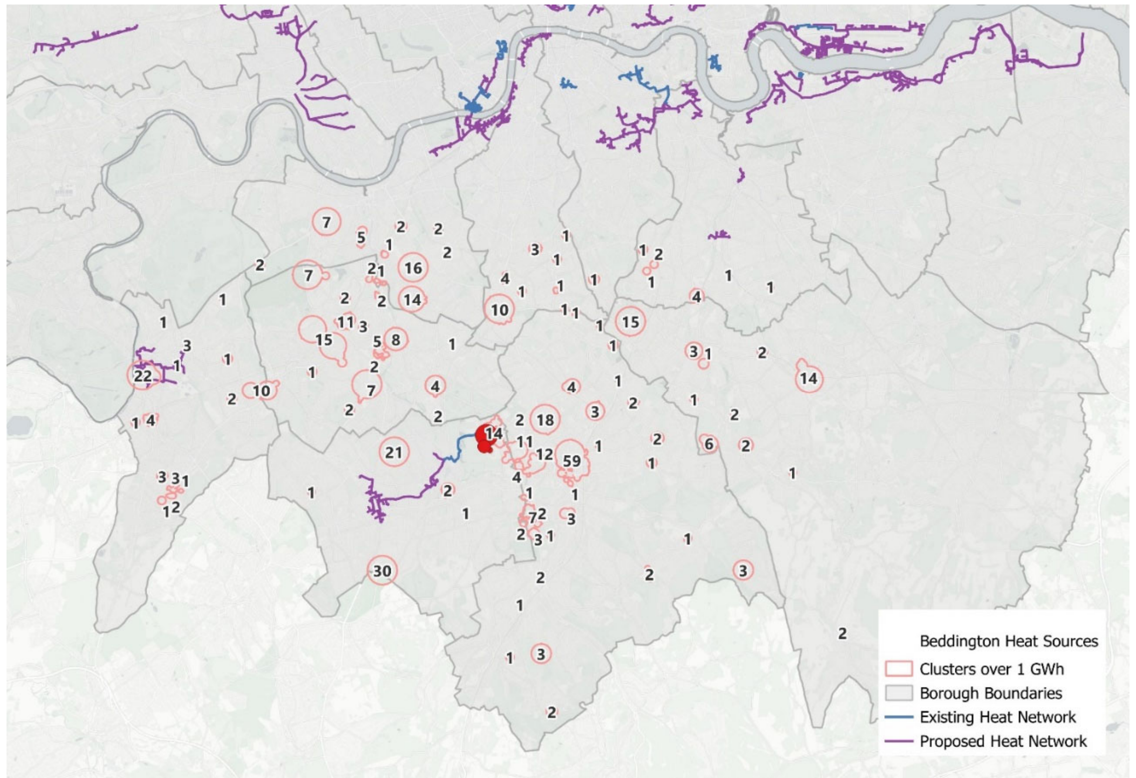
Appendix A National Zoning Model Comparison

A comparison between Heat Network Zones from the first run of the National Zoning Model shows good alignment when compared to the strategic area networks proposed in this study. In most areas, the strategic networks serve clusters that are within Heat Network Zones, with limited scenarios where this is not the case and this is an example of how our local knowledge and heat studies will play an important role in the local zone refinement process which will then lead to zone designation. The fact that the Heat Network Zones and these strategic heat networks show such good alignment having been drawn-up using different methodologies suggests a good level of confidence that the strategic heat network opportunities identified make good use of the waste heat resource across London. It should be noted that subsequent versions of the National Zoning Model have been run as the model has been evolved, however these are currently not publicly available for comparison.

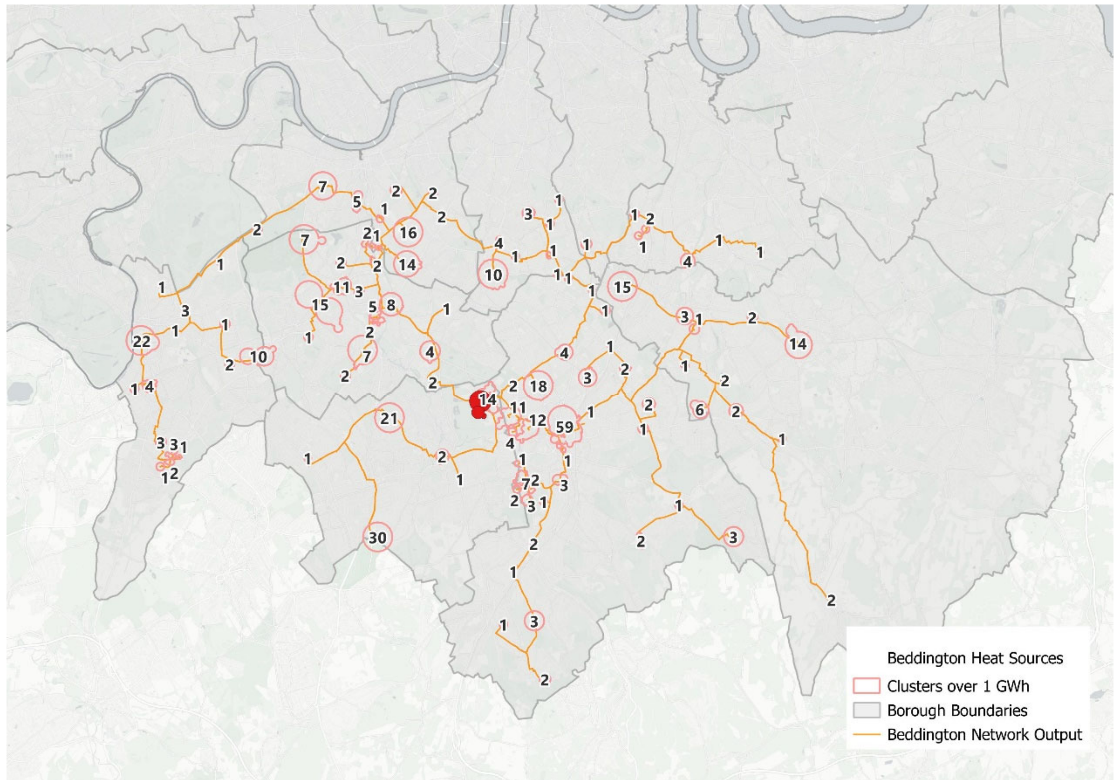


Appendix B Strategic Area B: Beddington

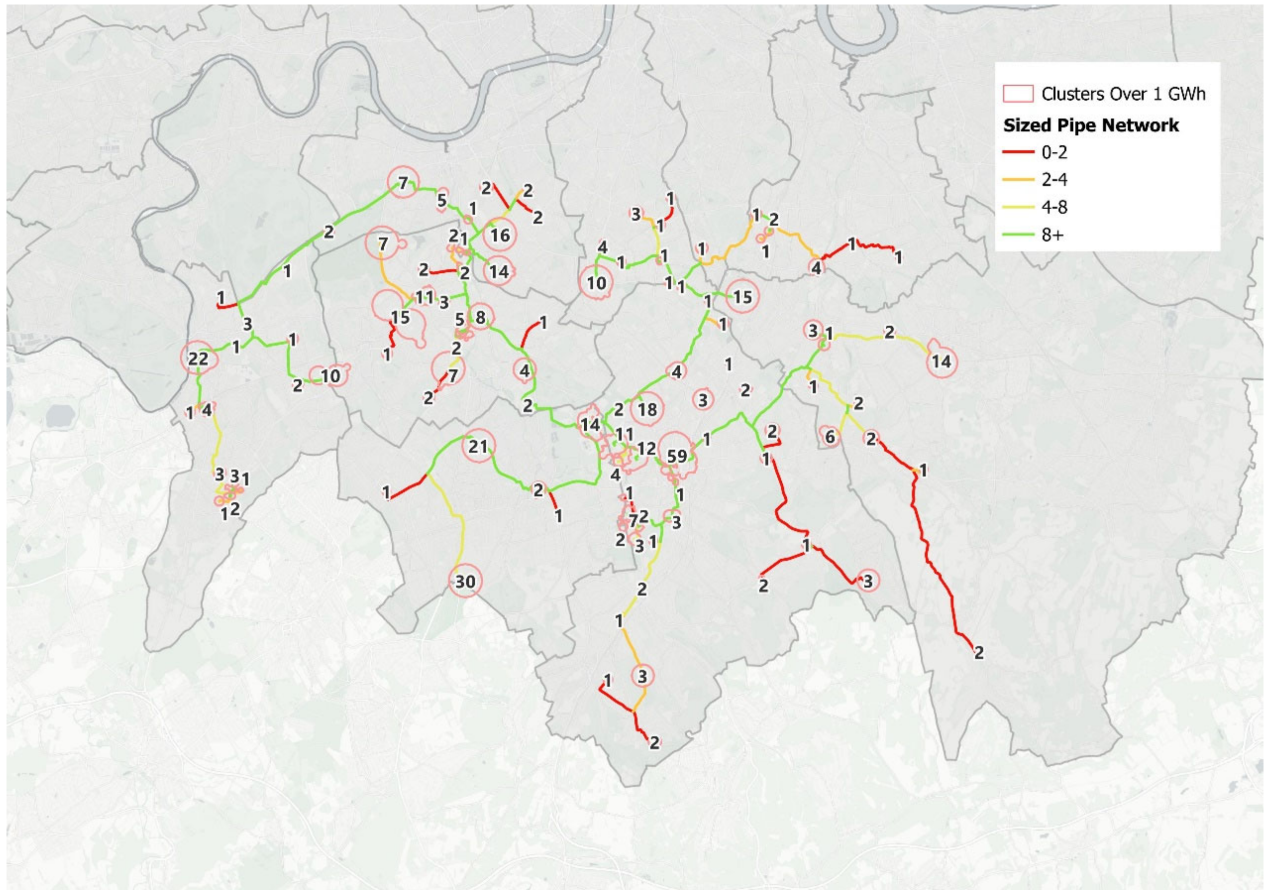
B.1 Existing and proposed networks



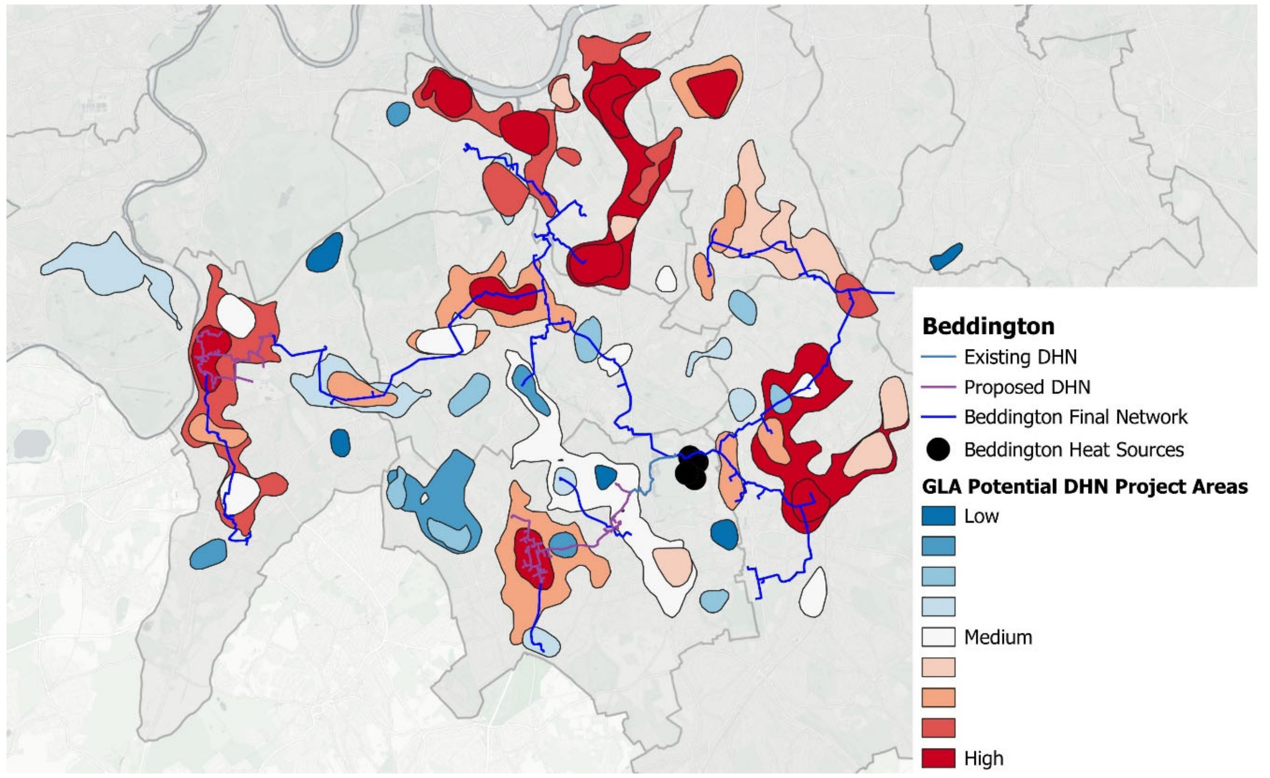
B.2 Initial Steiner Output



B.3 Linear heat density

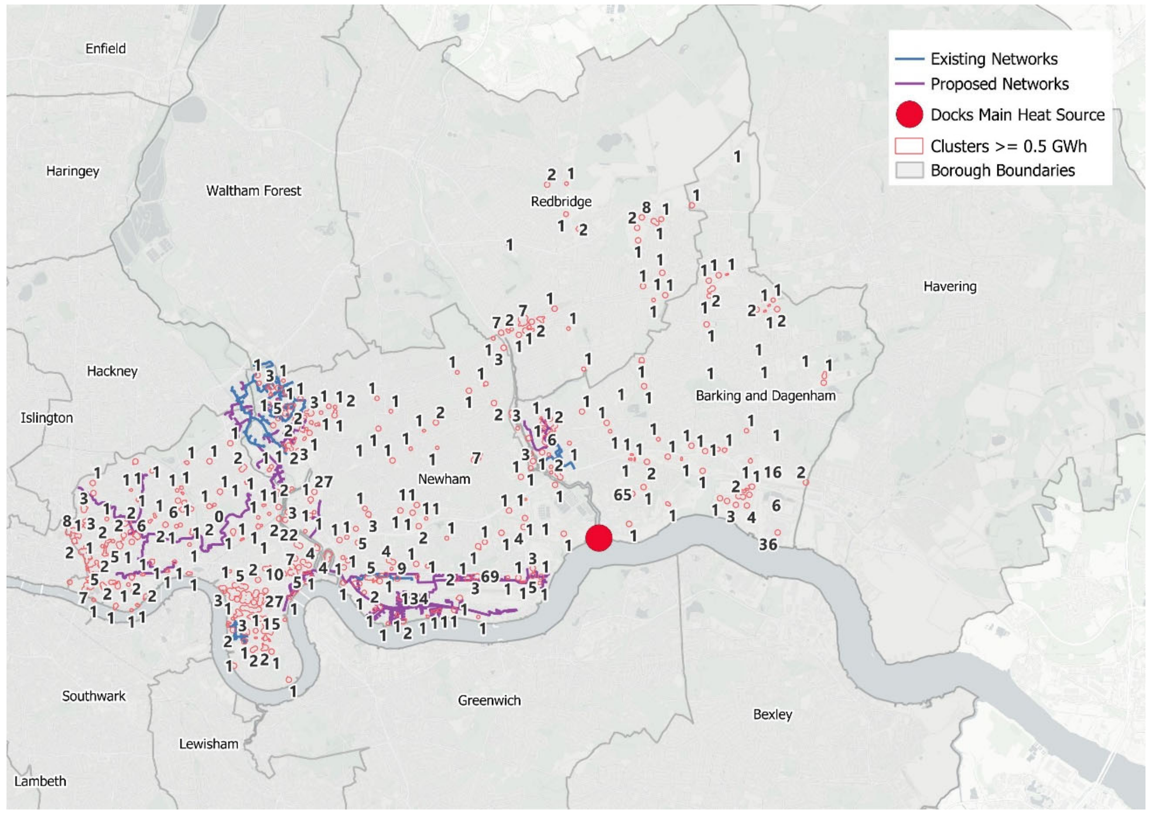


B.4 GLA Potential DHN project areas

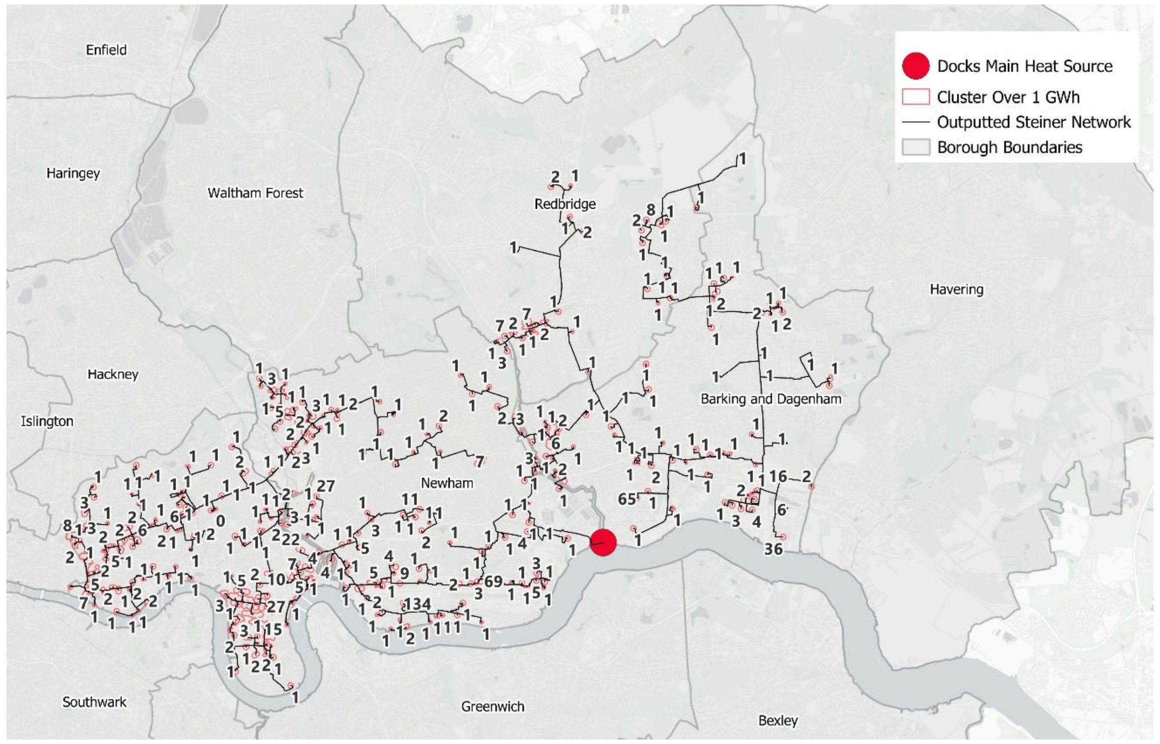


Appendix C Strategic Area C: Royal Docks

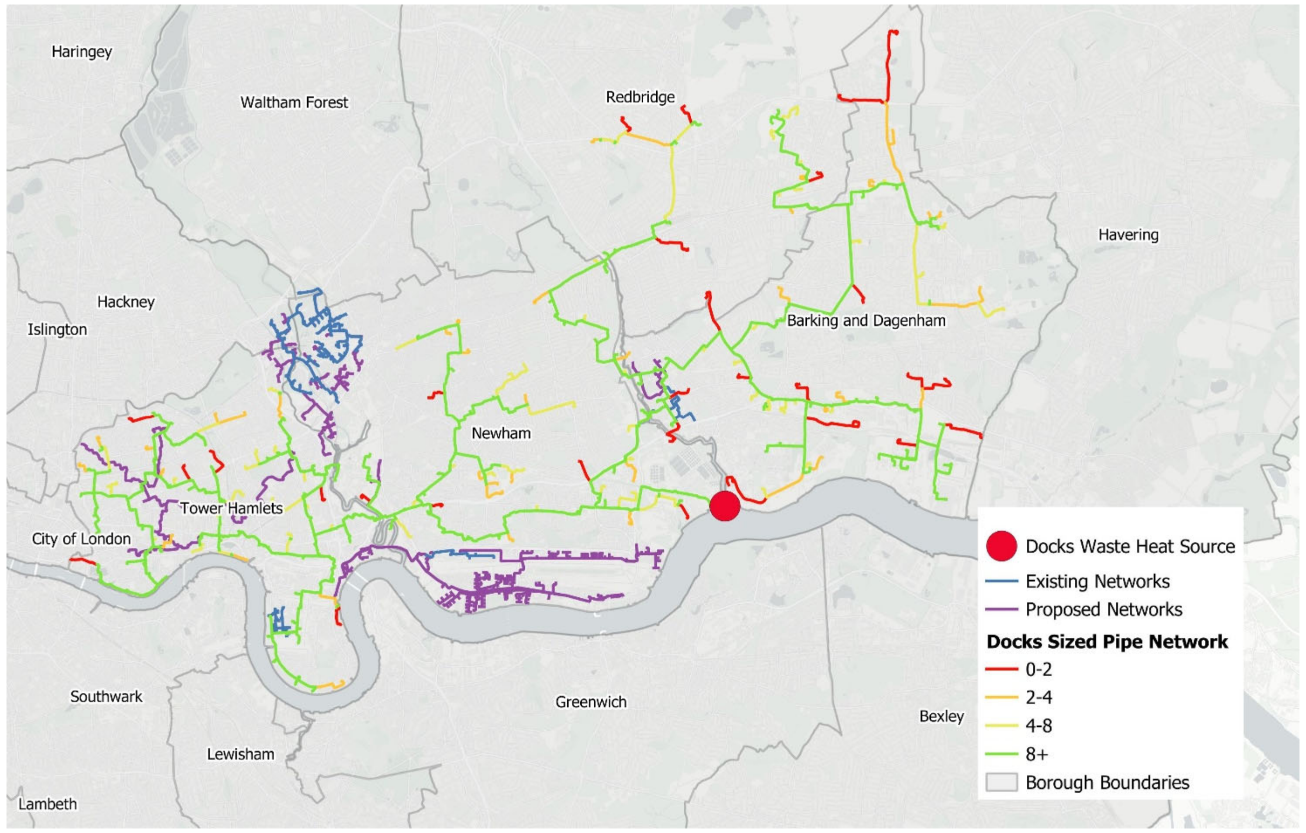
C.1 Existing and proposed networks



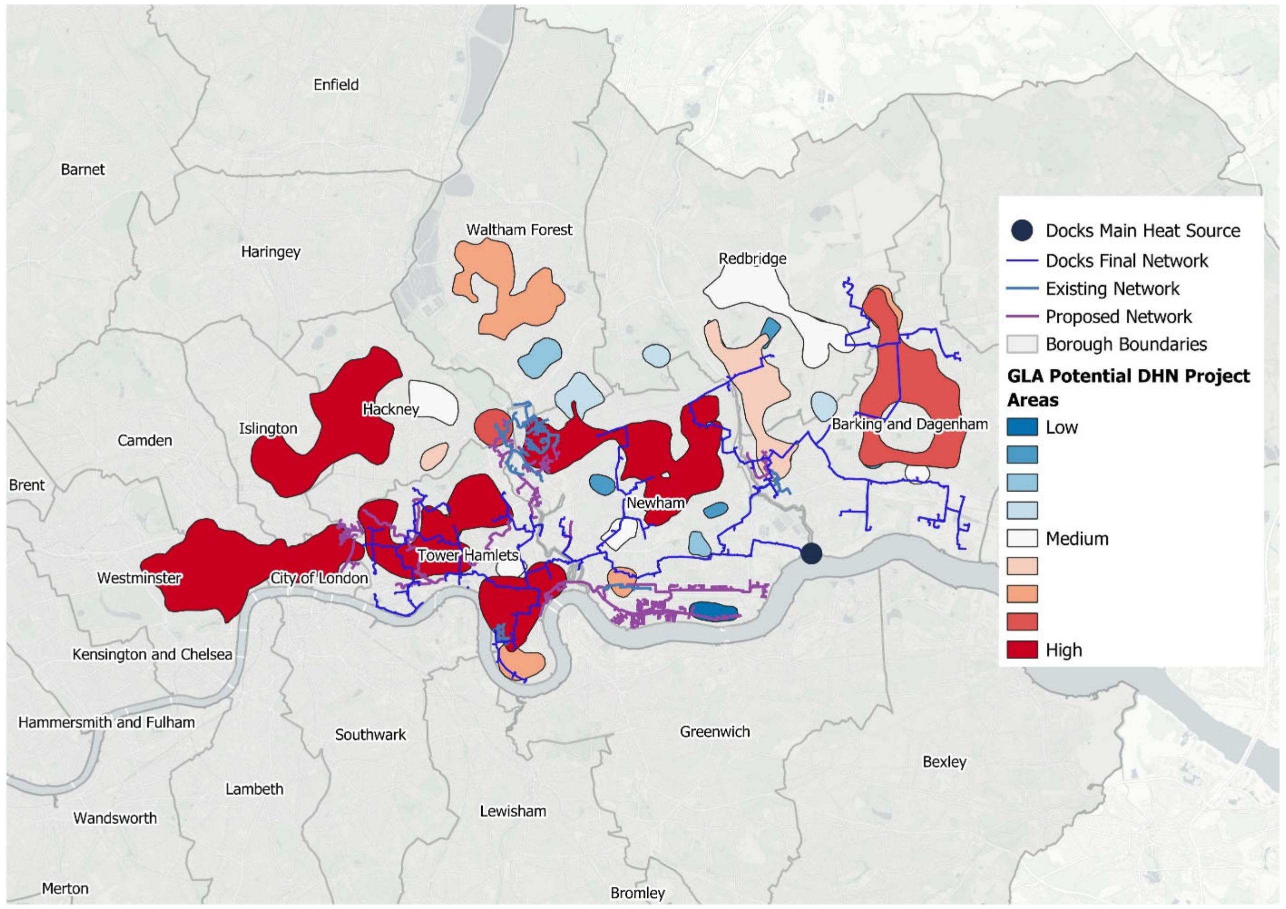
C.2 Initial Steiner Output



C.3 Linear Heat Density

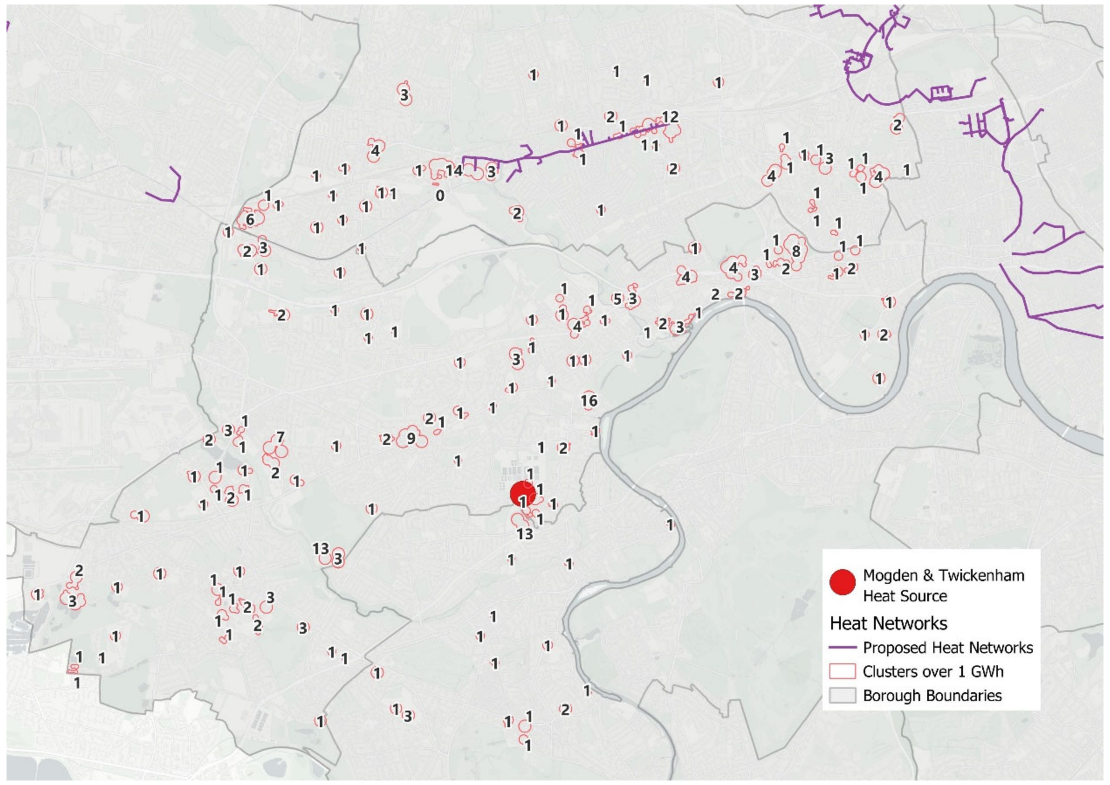


C.4 GLA Potential DHN project areas

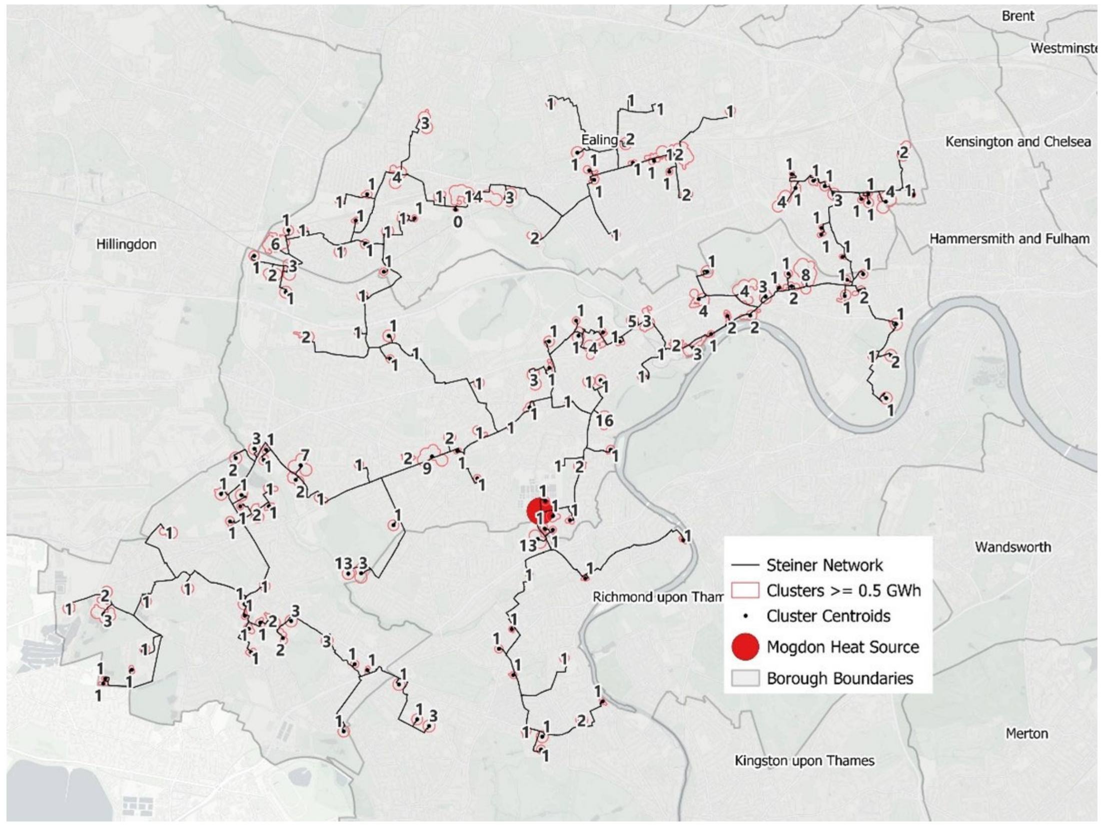


Appendix D Strategic Area D: Mogden & Twickenham

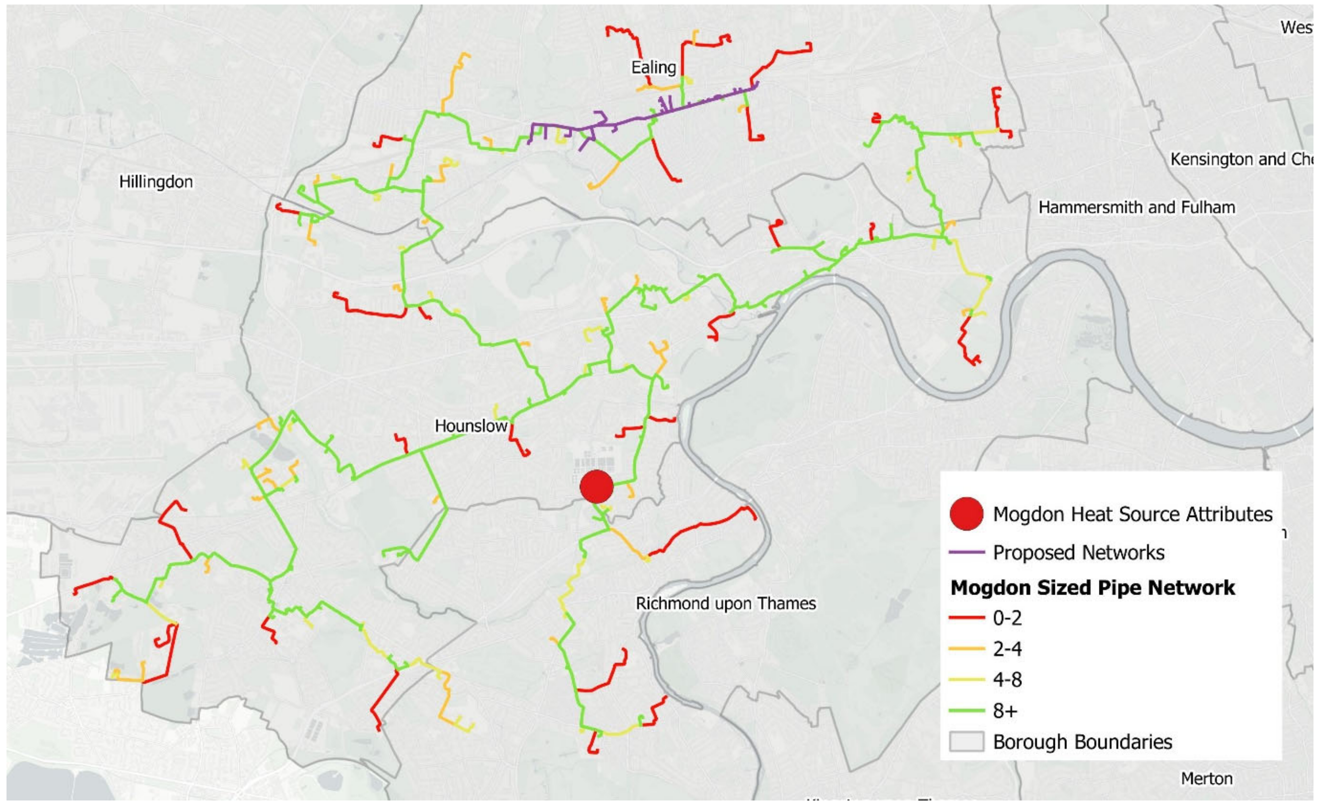
D.1 Existing and proposed networks



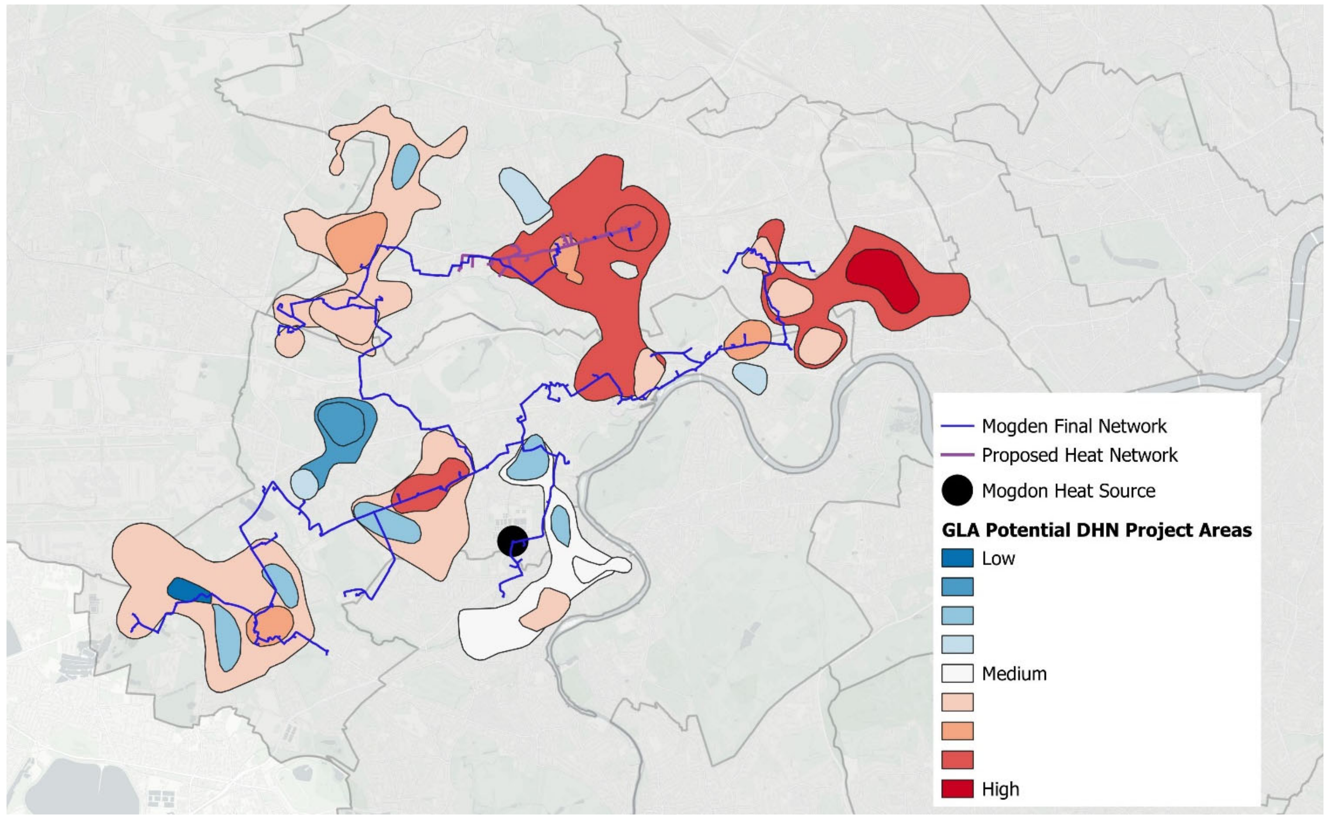
D.2 Initial Steiner Output



D.3 Linear heat density

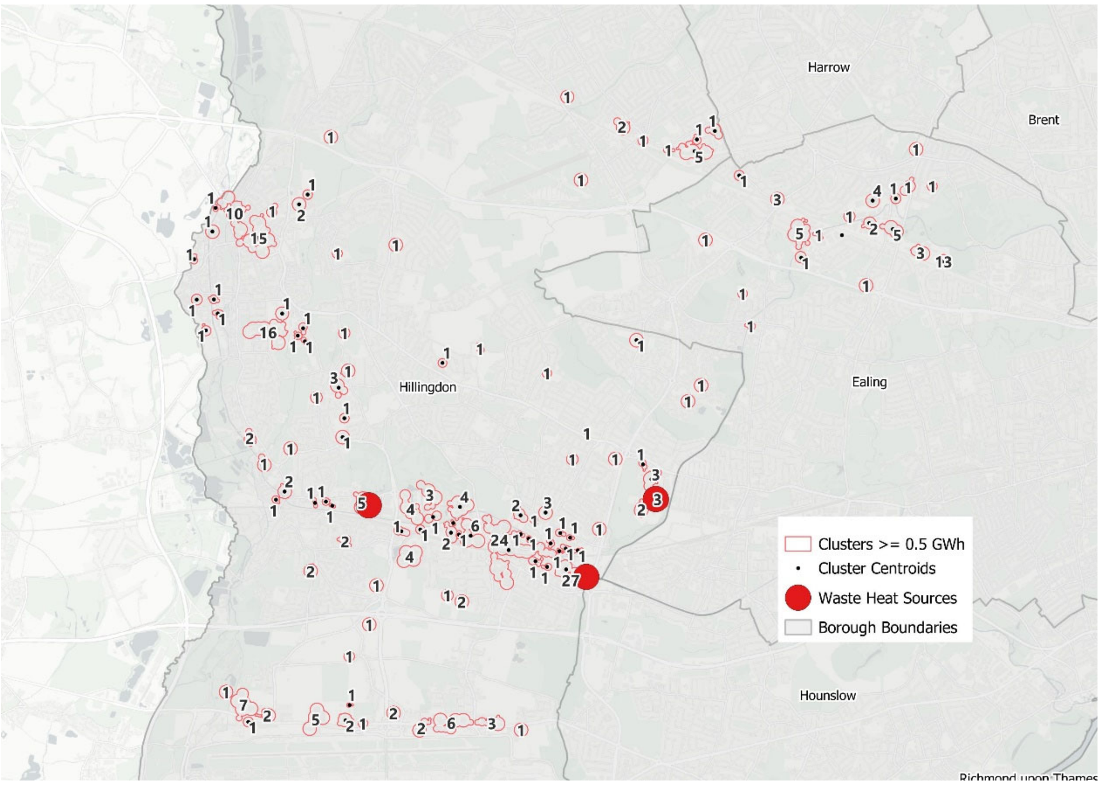


D.4 GLA Potential DHN project areas

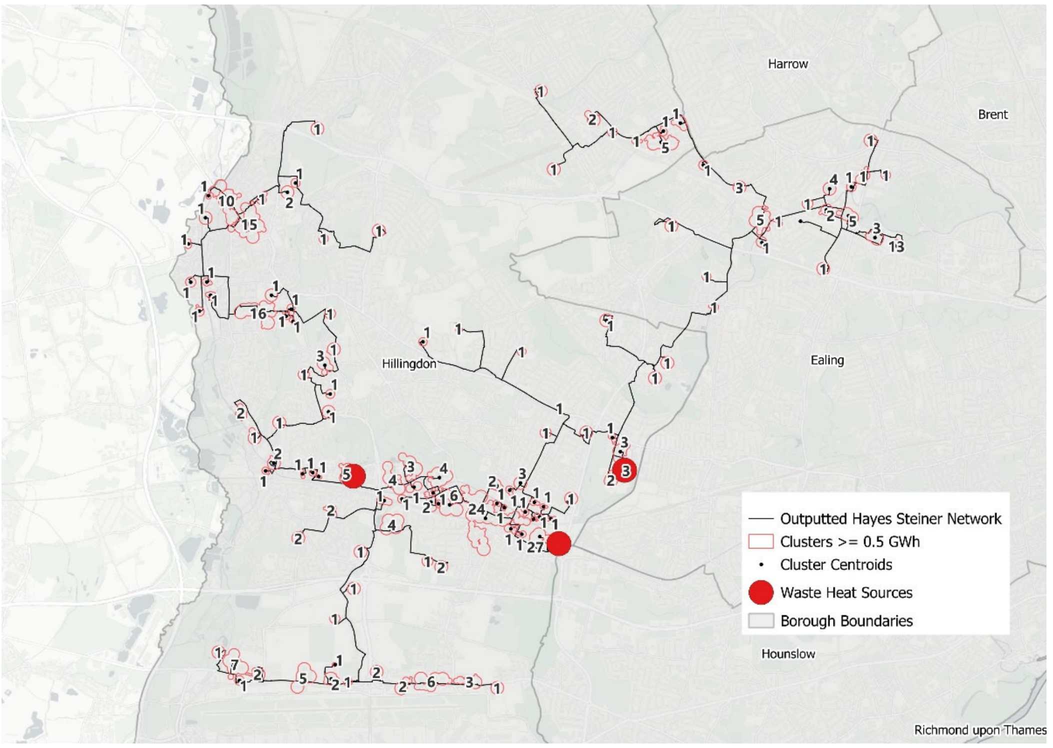


Appendix E Strategic Area E: Hayes & West Drayton

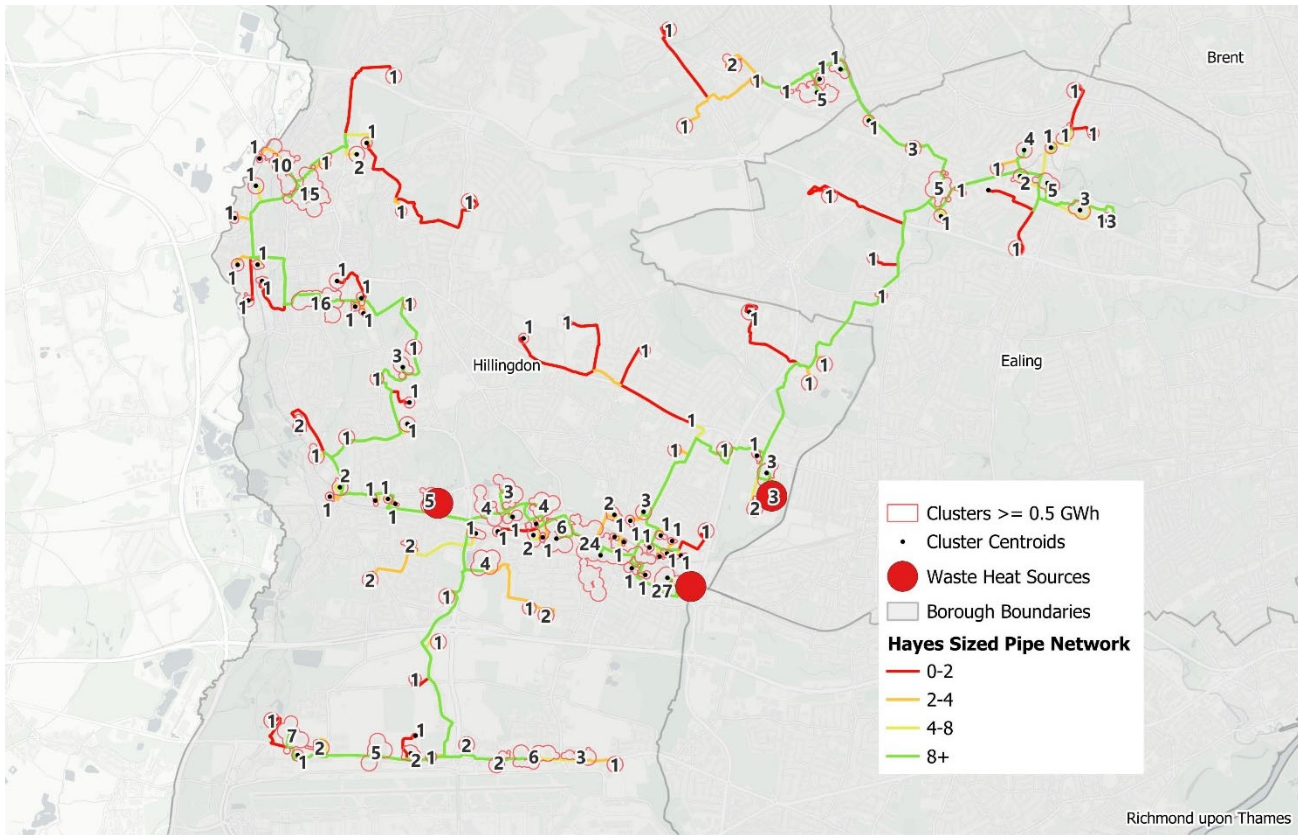
E.1 Existing and proposed networks



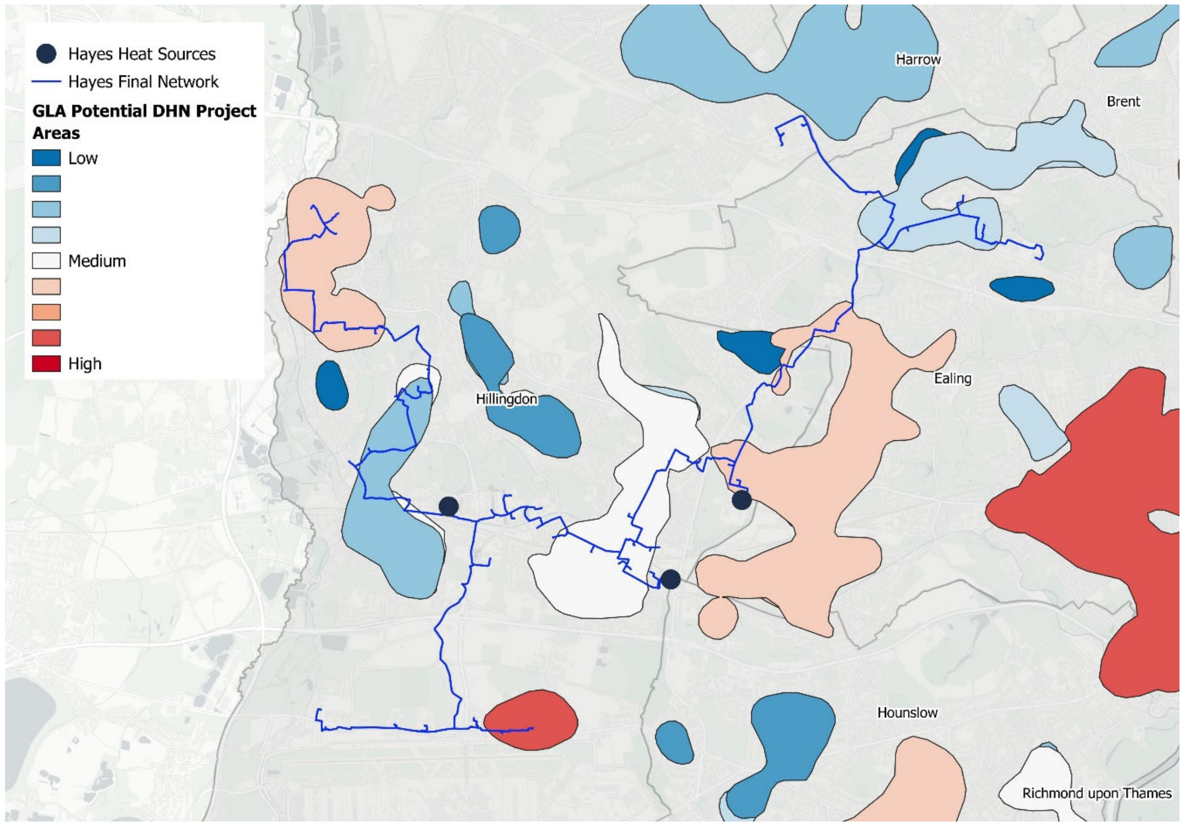
E.2 Initial Steiner Output



E.3 Linear heat density

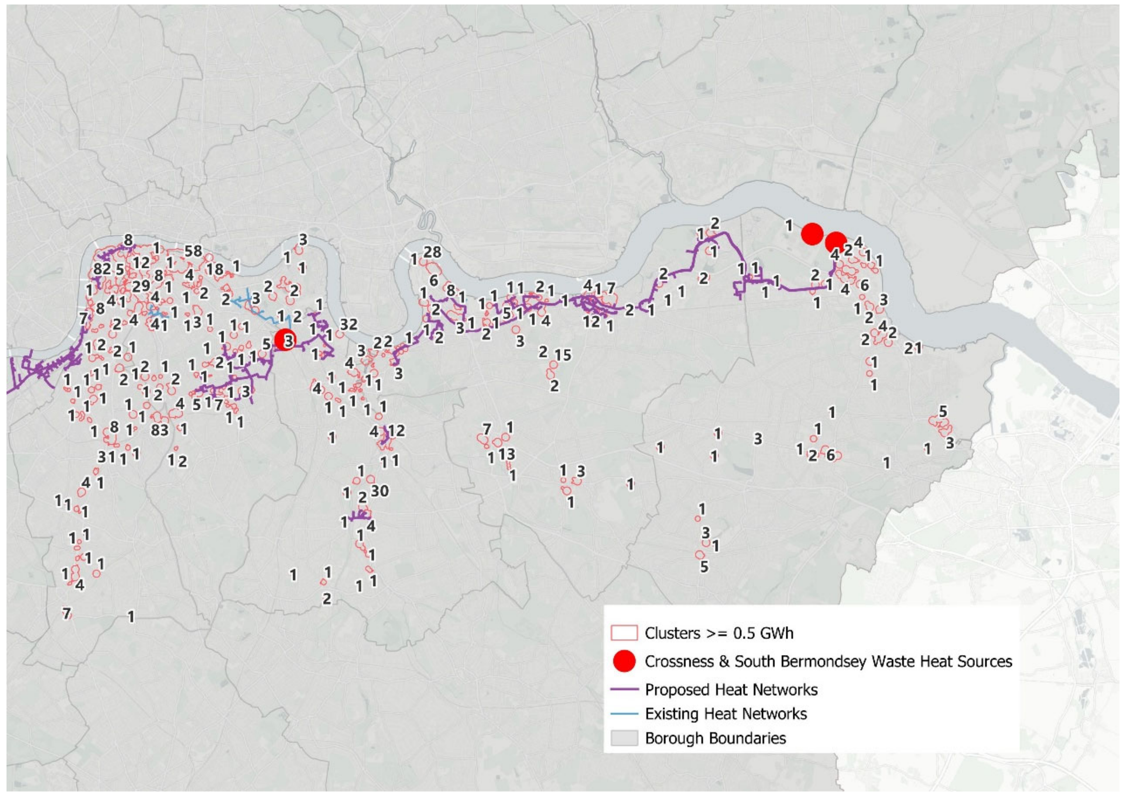


E.4 GLA Potential DHN project areas

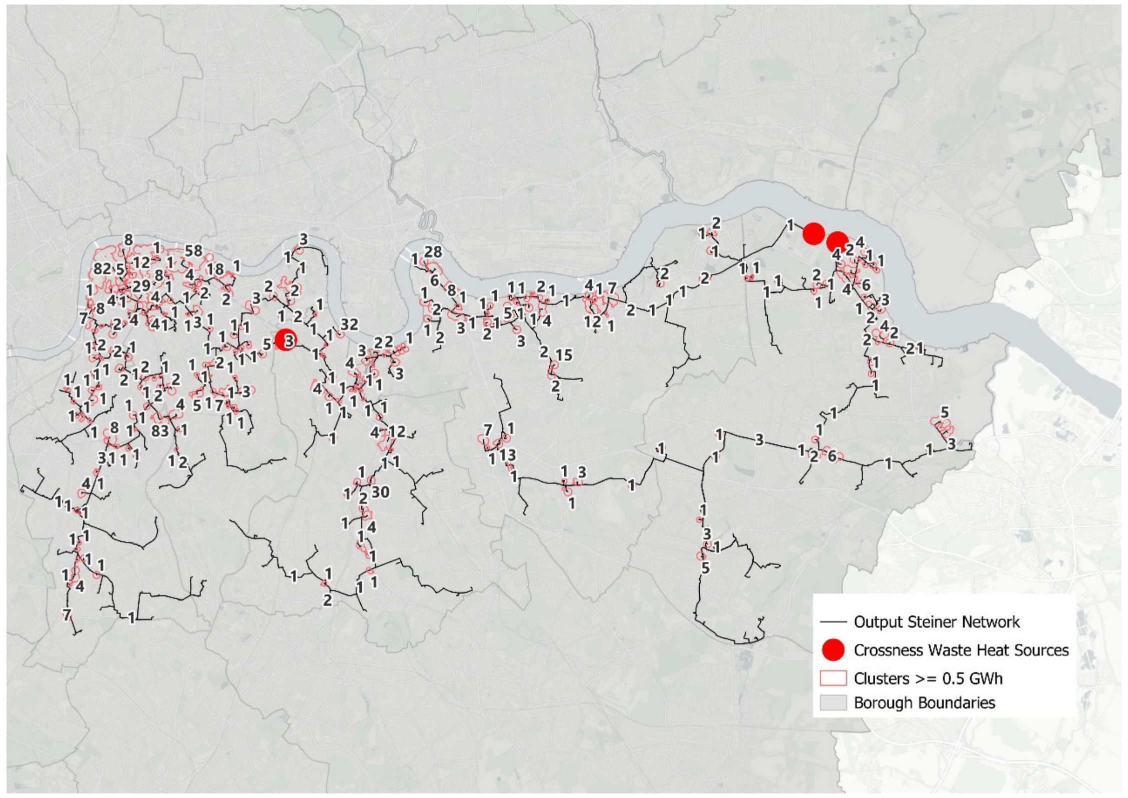


Appendix F Strategic Area F: Crossness & South Bermondsey

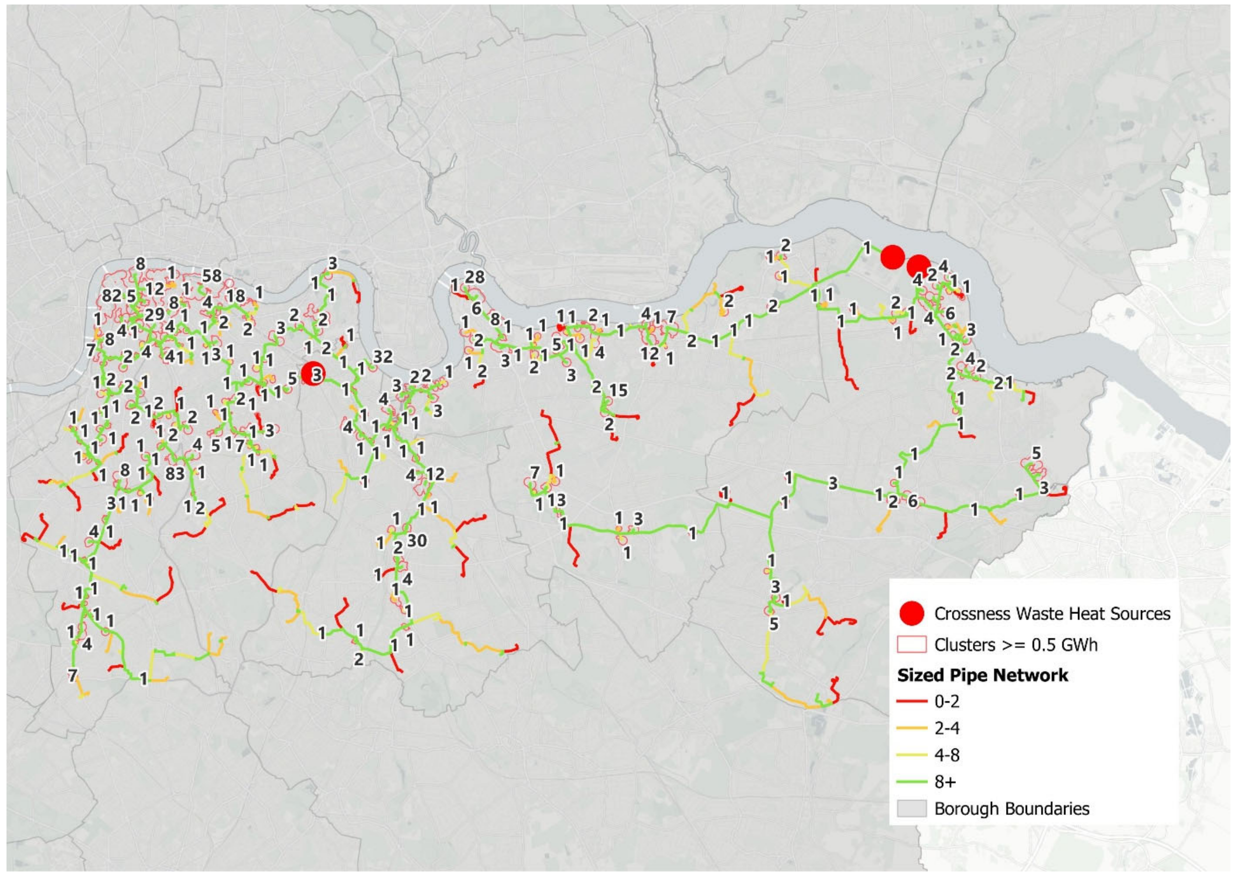
F.1 Existing and proposed networks



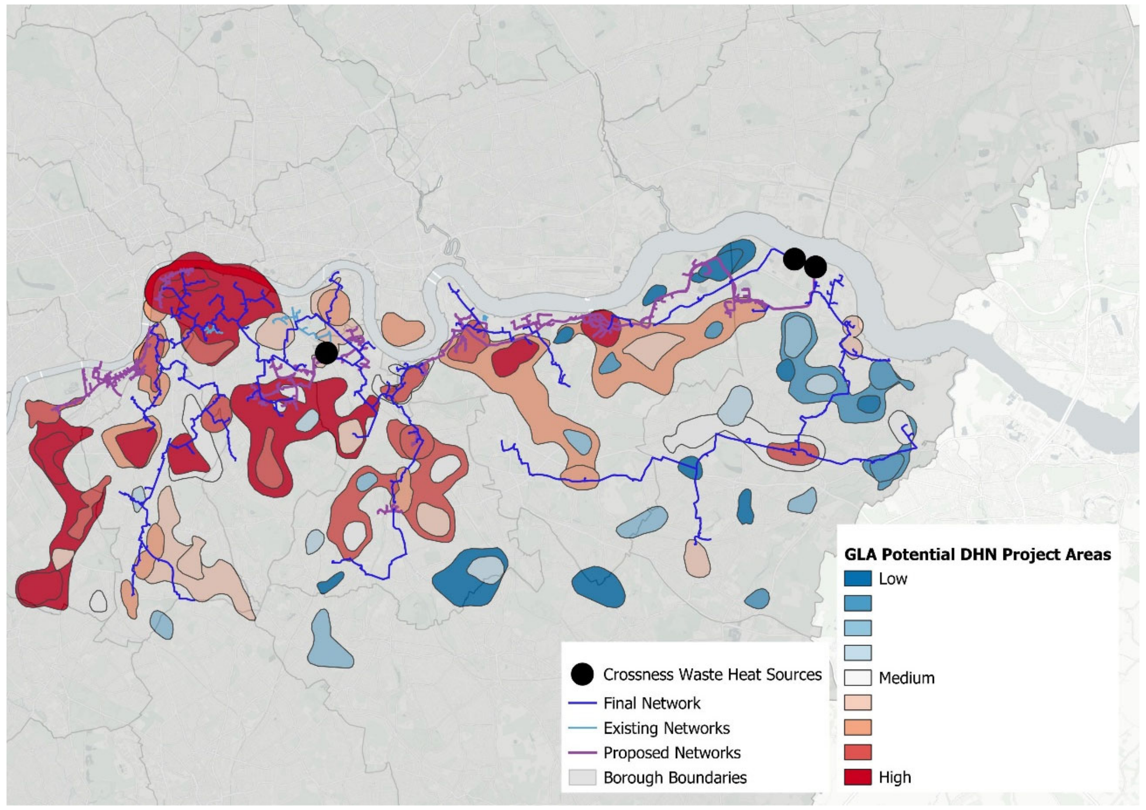
F.2 Initial Steiner Output



F.3 Linear Heat Density

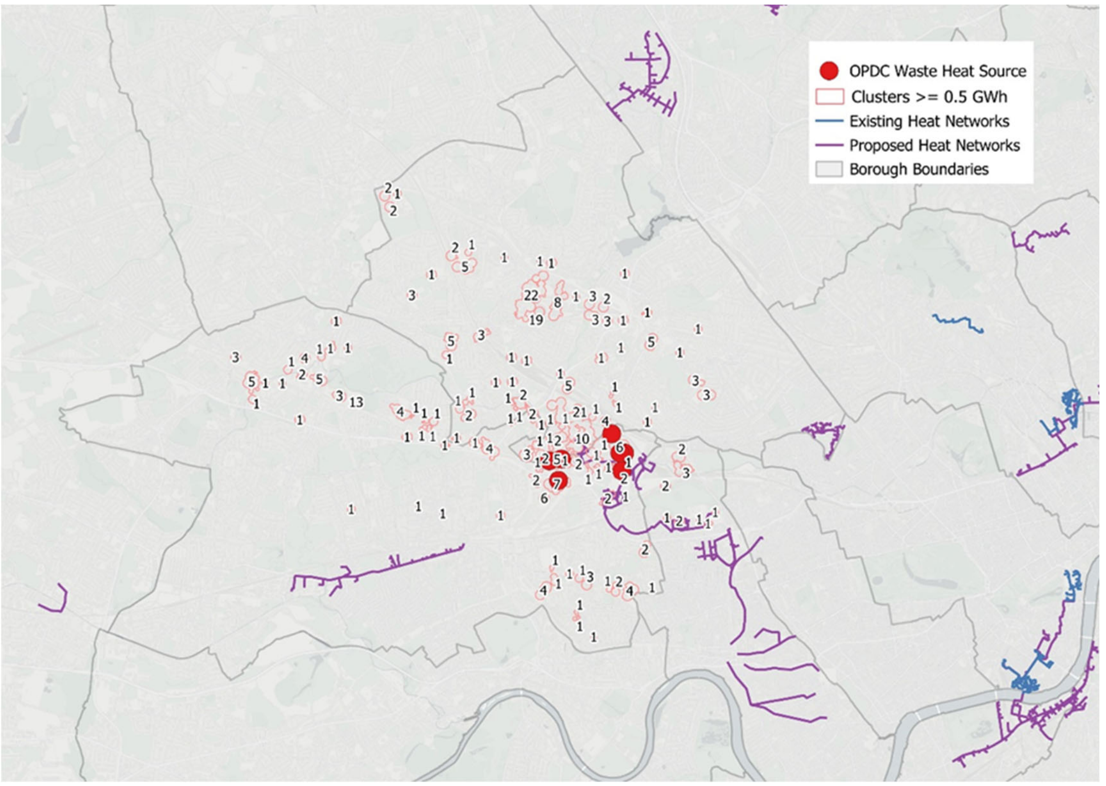


F.4 GLA Potential DHN project areas

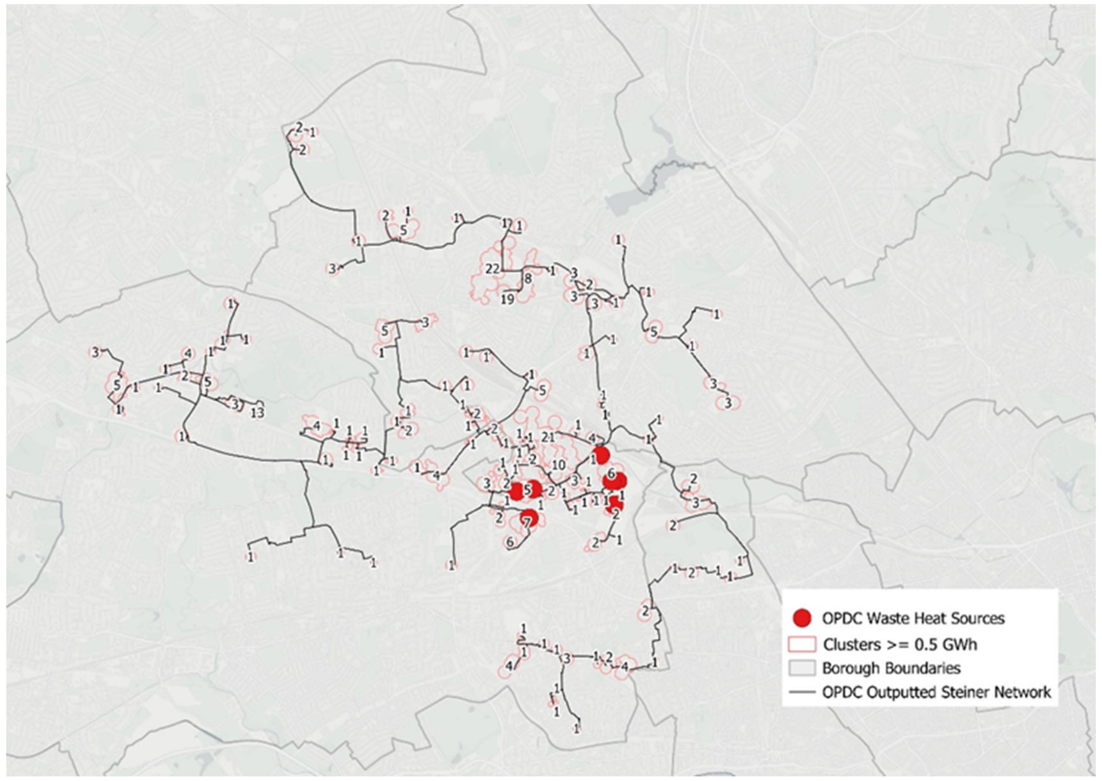


Appendix G Strategic Area G: OPDC

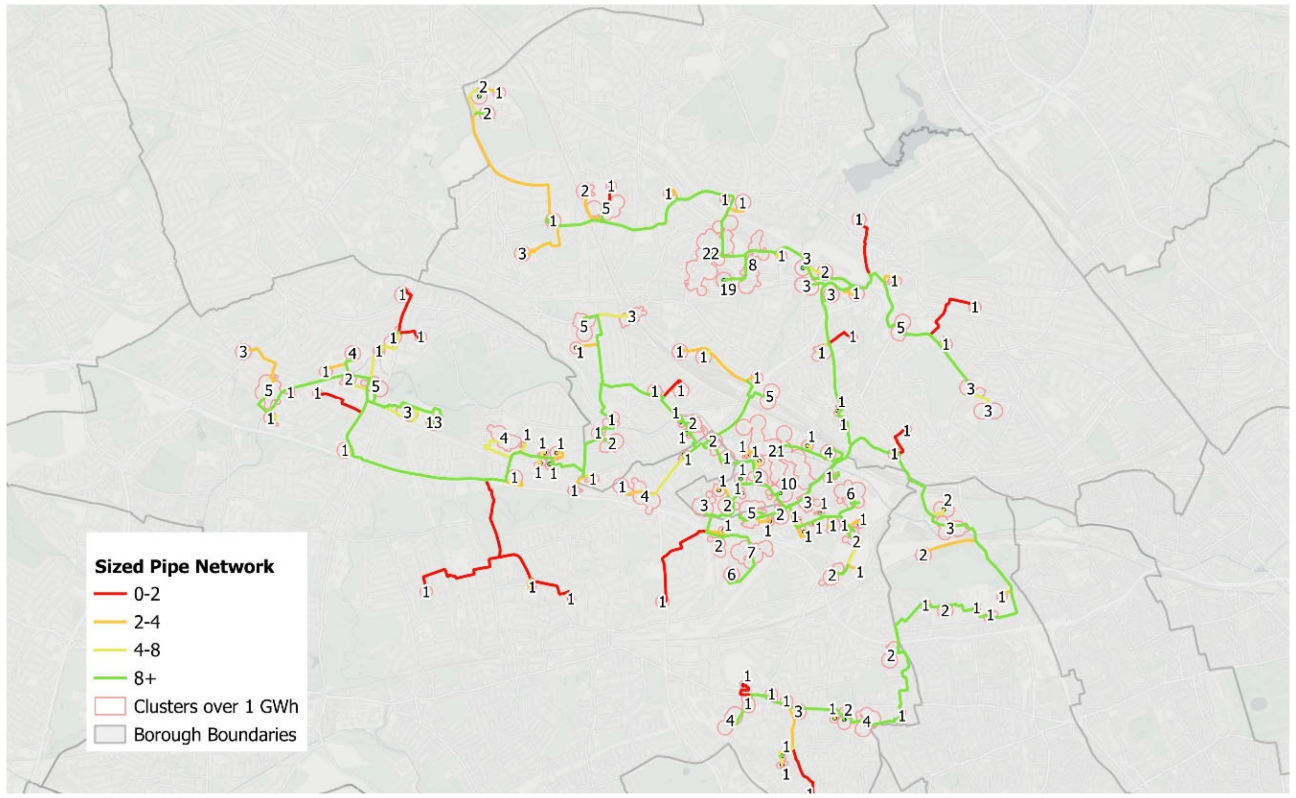
G.1 Existing and proposed networks



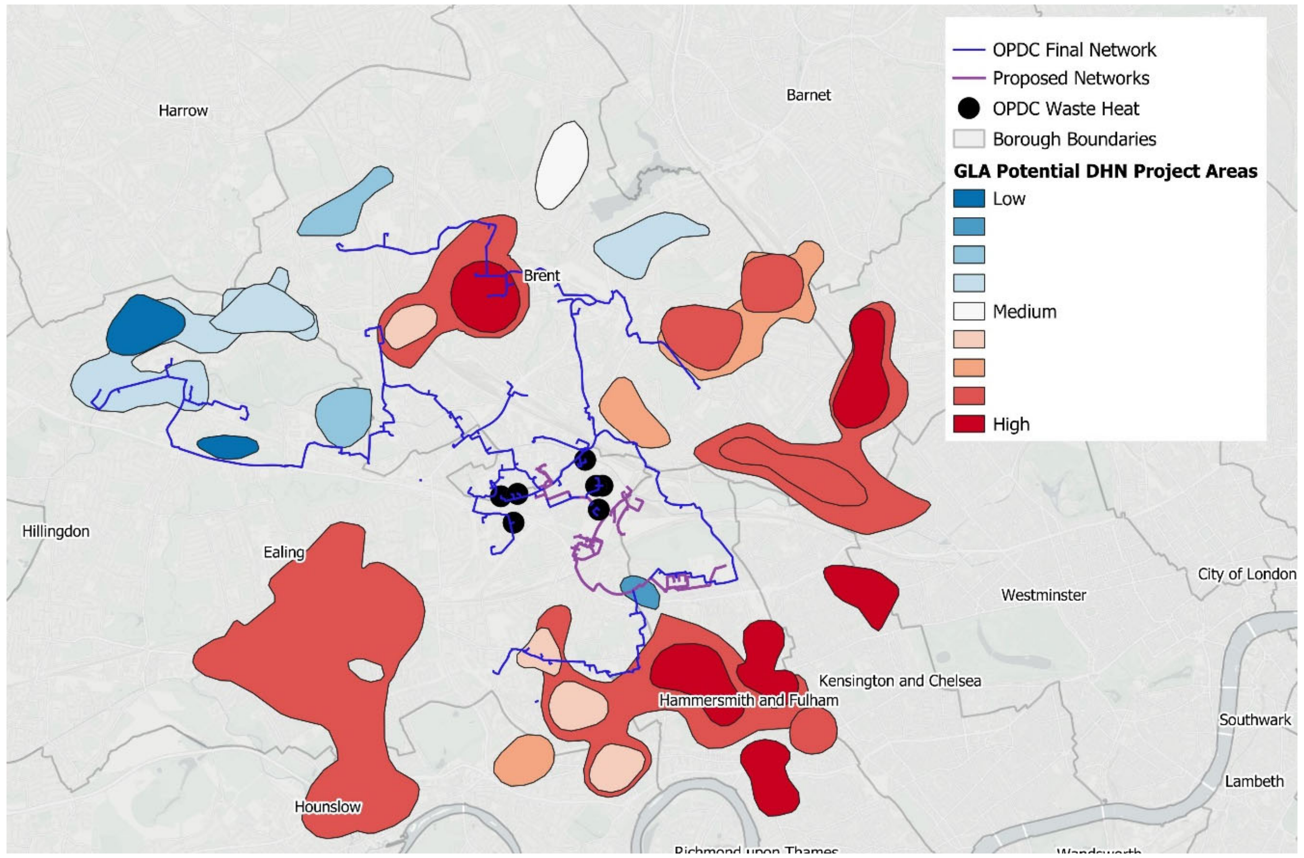
G.2 Initial Steiner Output



G.3 Linear Heat Density



G.4 GLA Potential DHN project areas



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