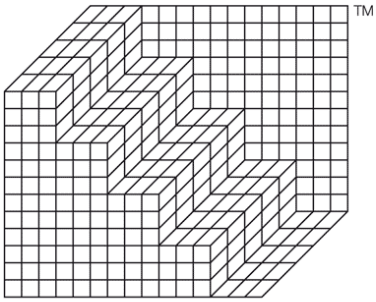

Buro Happold

# Islington Borough Energy Mapping

## Phase 2 Borough Wide Heat Mapping

**032725**

22 April 2014

Revision 01

| Revision | Description | Issued by | Date | Checked |
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| 00 | Draft for client review | CG | 08/04/13 | AY |
| 01 | Final report for issue | CG | 22/04/13 | AY |
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| author | **Chris Grainger** |
| date | **22/04/13** |
| approved | **Alasdair Young** |
| signature |  |
| date | **22/04/13** |

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# Executive summary

Buro Happold Ltd has been commissioned by London Borough of Islington (LBI) to carry out a review of district heating potential across the Borough. The Phase 2 study comprises Borough Wide Heat Mapping, the second of three phases of work. The other related works are as follows:

| | |
|---|---|
| Phase 1A | Highbury West: District Heating Feasibility Study |
| Phase 1B | Highbury West: Technical Design |
| Phase 2 | Borough Wide Energy Mapping |
| Phase 3 | Development of a Strategic Vision |

The council undertook heat mapping of the Borough in 2009 and identified 14 heat 'clusters' which represented opportunities for heat network development. This study updates the heat mapping work and will be followed Phase 3 of the project which will set out a new strategic vision for the Borough's decentralised energy planning.

The purpose of this study is to revisit the network opportunities across the Borough, refreshing the heat mapping to include changes in demand across the Borough based on new development and new data sources. The study also considers other heat sources such as secondary waste heat. Cross borough opportunities are also considered.

The study has identified 15no. clusters which represent promising opportunities for establishing heat networks:

| Cluster no. | Cluster name | Description | Key stakeholders |
|---|---|---|---|
| 1 | Archway and Ethorne Estate | High density of existing heat demands, large communally heated estate (Ethorne) and an area for development in Islington Local Plan | Whittington Hospital, LBI Housing, LBI Leisure, Essential Living (Archway Tower ) |
| 2 | Highbury West | Scheme connecting the Harvist Estate to Sobell Leisure Centre. Fuel poverty drivers for estate heating system conversion | Sobell Leisure Centre, LBI Housing |
| 3 | Aubert Court | Scheme focused on the communally heated Aubert Court Estate, with future connection to Highbury Square residential development and surrounding LBI assets | LBI housing, Highbury Square |
| 4 | LMU | Consolidation of heating systems across LMU's Holloway Campus and connection to new student housing development across Holloway Rd | London Metropolitan University |
| 5 | LMU Extension | Extension to LMU scheme connecting Queenland Rd residential development, new student residential and Emitates Stadium | London Metropolitan University, |
| 6 | Central Library | Connection of Highbury Pool to the Central Library and LMU Spring House. Future connection to the mixed use redevelopment of Highbury Corner (Islington site allocation) | LBI Leisure, LMU, LBI CLL, Highbury House |
| 7 | Pentonville | High density of heat demands focused on HM Prison, Islington Waste Transfer Station and Mallet and Porter House (new build student accommodation) | HM Prisons, LBI CLL, Mortar Developments Ltd (student accommodation) |
| 8 | Halton Mansions | Consolidation of the council owned Halton Mansions Estate | LBI Housing |
| 9 | Kings Cross Extension | Extension to the existing Kings Cross district heating network including Dehli Outram Estate, Bemerton Estate and Caledonian Road Pool | Argent, LBI Housing, LBI Leisure |
| 10 | Kings Cross South | Southern extension to Kings Cross extension scheme connecting Belvin Court Estate, Half Moon Crescent Estate, 3 schools and 2 schools currently in planning. | LBI Housing, LBI CLL, Hyde Housing, Whitbread PLC |
| 11 | Bunhill | Existing CHP district network in the south of the Borough | LBI Housing, LBI Energy |

| Cluster no. | Cluster name | Description | Key stakeholders |
|---|---|---|---|
| | Existing Scheme | supplying council tenants. Includes loads due to connect as part of Bunhill Phase 2. | Services, LBI Leisure |
| 12a | Bunhill Extension (Cluster A) | Southern extension to Bunhill scheme connecting Royal Mail House and surrounding residential. Scheme is extended to include Moorefield Eye Hospital (formerly cluster B) | Moorefield Eye Hospital, LBI Housing, LBI Energy Services |
| 12b | Bunhill Extension (Cluster G) | Extension connecting Golden Lane Estate and Golden Lane Leisure Centre to the Bunhill scheme. | LBI Energy Services, LBI Housing, LBI Leisure |
| 12c | Bunhill Extension – C and E | Northern extension to the existing Bunhill scheme connecting two potential clusters form the new City Forum development in the east to Finsbury Estate in the West | Berkeley Homes, LBI Housing, LBI Energy Services |
| 13 | Whitecross | Connection of Citigen district network to Bunhill Row council offices, Cass Business School and Shire House (new mixed use development) | Citigen (Eon), LBI, Cass Buisness School, London City Shopping Centre Ltd |

Together these clusters represent a significant investment pipeline and could save 34,500 $tCO_2$/yr. The demands that could connect to heat network clusters (161 GWh/yr.) is equivalent to 17MW of CHP plant capacity and ~10% of the Boroughs total heat demand.[1] The indicative cumulative cost of developing all clusters would be in the region of £69m.

These clusters will be further developed during Phase 3 of the project and a number will be selected in order to develop more detailed energy masterplans.

[1] 2010 predicted heat demand https://www.london.gov.uk/sites/default/files/130220%20031250%20GLA%20Low%20Carbon%20Heat%20Study%20Report%20Phase%201%20-%20Rev01.pdf

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# 1 Introduction

## 1.1 Context

Buro Happold Ltd has been commissioned by LBI to carry out a review of district heating potential across the Borough. The Borough Wide Heat Mapping study comprises the second of three phases of work. The other related works are as follows:

| | |
|---|---|
| Phase 1A | Highbury West: District Heating Feasibility Study |
| Phase 1B | Highbury West: Technical Design |
| Phase 2 | Borough Wide Energy Mapping |
| Phase 3 | Development of a Strategic Vision |

## 1.1 Introduction and scope

The council undertook heat mapping of the Borough in 2009 and identified 14 heat 'clusters' which represented opportunities for heat network development. This study (Phase 2) updates the heat mapping work. This work then set out a strategic vision for the Borough based on connecting clusters to three heat network 'corridors'. Phase 3 of this commission will update this Strategic Vision (Phase 3).

The purpose of this study is to revisit the network opportunities across the Borough, refreshing the heat mapping to include changes in demand across the Borough based on new development and new data sources. The study also considers other heat sources such as secondary waste heat. Cross borough opportunities are also to be considered particularly existing networks and heat source opportunities adjacent to Islington.

The heat mapping includes:

- Identification of heat loads
- Existing heat networks
- Existing and future low and zero carbon energy sources
- Major physical barriers and constraints to heat network development
- Regeneration and development data form the council
- Refresh of heat network clusters
- Estimation of potential for low carbon energy sources based on identified clusters.

# 2 Background

## 2.1 Previous heat mapping studies

**UK heat map**

The National Heat Map was commissioned by the Department of Energy and Climate Change and created by The Centre for Sustainable Energy. The purpose of the Map is to support planning and deployment of local low-carbon energy projects in England. It aims to achieve this by providing publicly accessible high-resolution web-based maps of heat demand by area.

The National Heat Map is built from a bottom-up address level model of heat demand in England. The model estimates the total heat demand of every address in England, but based on published sub-national energy consumption statistics and without making use of metered energy readings. **London heat map**

The London heat map is an interactive online tool used by DEPDU to compile data collected across all London boroughs for 16 priority building types. The map is populated with individual building data as well as a raster overlay based on benchmarked predications for the heating demand of all buildings (irrespective of connection viability). An extract of this heat density raster shown in Figure 2—1 below, and serves to highlight Islington as a borough with one of the highest heat demand densities of the capital.

Results from this study will be categorised for compatibility with the London heat map, so that the data can be embedded in the map for future heat mapping exercises.

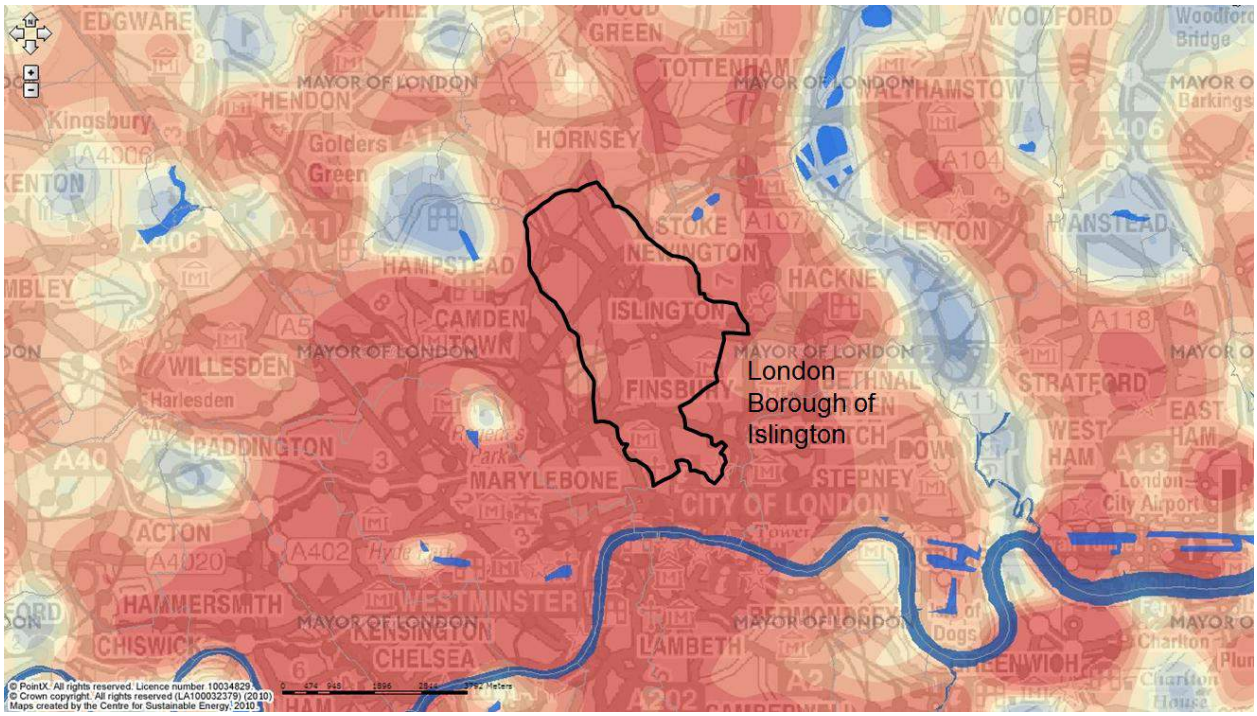


**Figure 2—1 London heat map extract**

**PB Study – Borough Wide Decentralised Energy Strategy**

In 2009 Parsons Brinckerhoff Ltd were commissioned by LBI to undertake heat mapping and develop a strategy for establishing heat networks within the Borough. This study established 14no. heat demand clusters which would be suitable for heat networks. It was envisaged that these clusters would be interconnected linearly to form 3no. larger district schemes connected along 'spines'. Each of these clusters would include within their initial design a section of the 'spine' which, when connected, would form the main connection between clusters.

The strategy developed from the heat load clustering is shown in Figure 2—2.

**DEPDU Study – Bunhill and Shoreditch Schemes, Feasibility for Expansion**

As part of the GLA's Decentralised Energy Programme Delivery Unit (DEPDU) Arup were commissioned in 2013 to undertake an energy masterplan for the area around the existing Bunhill heat network and CHP scheme, with a possible link to the Shoreditch heat network across the Borough boundary in Hackney. This work included a detailed investigation into stakeholders who were likely to be interested in making a connection to an expanded heat network in this area. The loads and network identified in this study have been incorporated into this study.

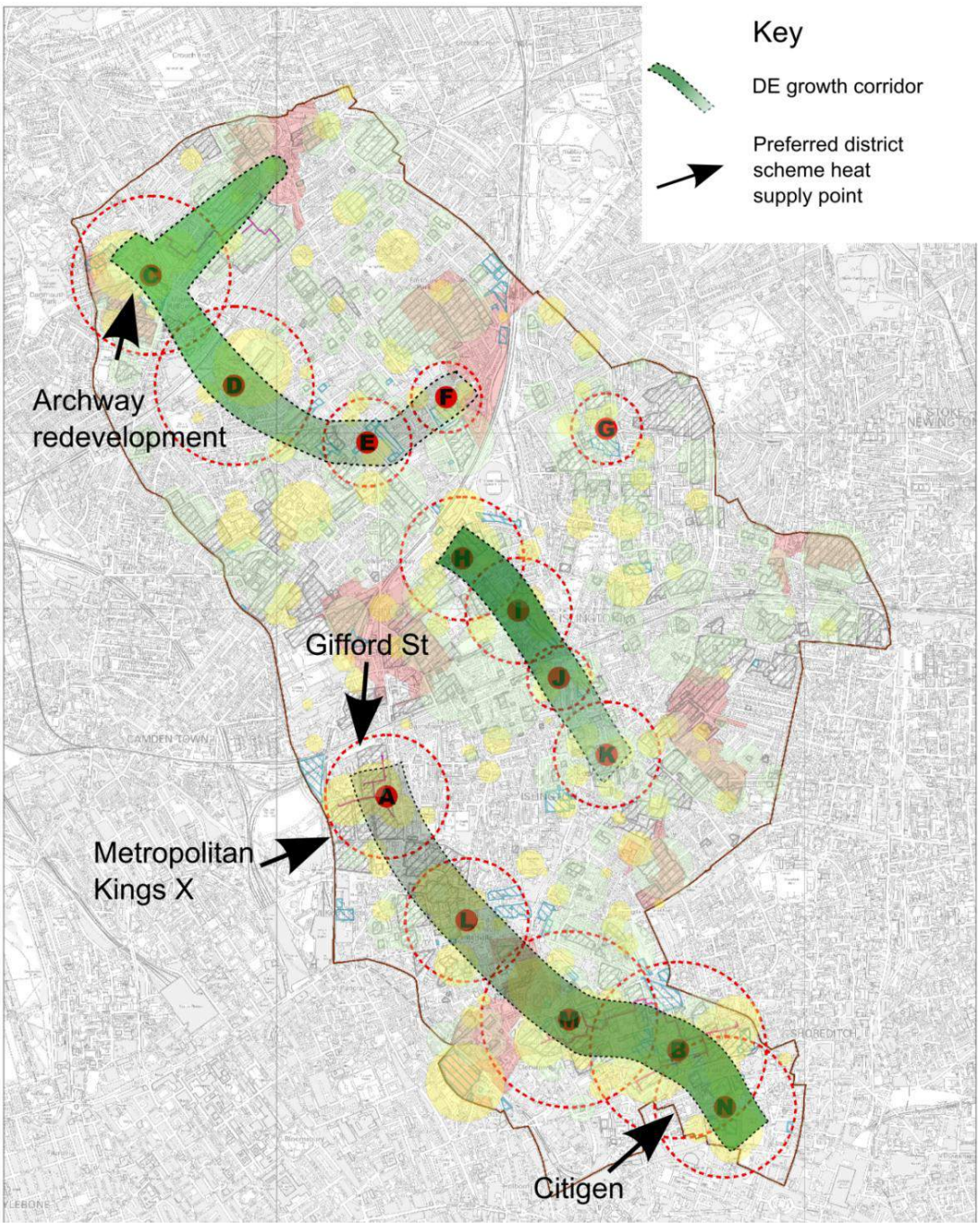


**Figure 2—2 Islington context and previous heat mapping (© Parson Brinckerhoff Ltd[2])**

[2] London Borough of Islington: DECENTRALISED ENERGY PROJECT – STAGE 3, Work stream 3: Borough Wide DE strategy, REVC, 27th April 2010)

# 3 Approach

## 3.1 Methodology

This mapping exercise sets out to highlight the major anchor heat and supply loads across Islington and develop a list of local clusters for further investigation in Phase 3 of this project. Prioritisation of demands follows the methodology used in previous heat mapping of the Borough, with a focus on connecting to council assets particularly estates which are communally heated. Current and future developments have been included in selecting clusters, as well as the availability of heat supply sources across the Borough.

The focus of heat mapping is on buildings served with large centralised plant. These buildings are typically the most viable typology to connect to a district system as there is minimal need for internal system retrofit. Smaller, individually heated buildings are mapped in this study for consideration of overall heart density, but are not used for the purpose of forming potential district heating clusters.


## 3.2 Data inputs

**Table 3—1 Data Inputs for Anchor Heat Demand Mapping**

| Dataset | Use In Model |
|---|---|
| LBI Schools Database | Annual gas data for communally heated council owned schools |
| LBI Housing database | Annual gas data for communally heated council owned housing estates |
| LBI Corporate Landlord (CLL) | Annual gas data for communally heated council owned community buildings |
| Islington Sustainable Energy Partnership (ISEP, formerly ICCP) | Annual gas data for major non-domestic loads |
| Planning Application Tracker | Predicted heat demand for residential developments > 100 units<br>Predicted heat demand for non-domestic developments > 10,000 $m^2$ |
| Site Allocations Development Plan | Predicted heat demand for residential developments > 100 units<br>Predicted heat demand for non-domestic developments > 10,000 $m^2$ |
| OS Address Level 2 Database | Mapping of address data by post code where unique reference not available |
| BH Benchmarking Database | Best practice heating benchmarks per $m^2$ for new build benchmarking |

**Table 3—2 Data Inputs for Cluster Gap Analysis**

| Dataset | Use In Model |
|---|---|
| London Heat Map | Gap analysis for loads in proximity to DE clusters |
| VOA commercial floorspace database | Comparative analysis of all commercial heat loads in the borough |
| LBI Borough Council Property List | Comparative analysis of all LBI domestic tenant heat loads in the borough |
| CIBSE TM 46 | Annual gas demands per $m^2$ for VOA benchmarking |

**Table 3—3 Data Inputs for Primary Heat Supply Mapping**

| Dataset | Use in Model |
|---|---|
| Renewable Energy Foundation REGO<br>London Heat Map<br>DECC Digest of UK energy statistic | Location and installed power for primary heat supply<br>Predicted secondary heat supply (where relevant) |
| London Atmospheric Emissions Inventory (LAEI) | Location and predicted primary heat supply from major Industrial heating plant |
| LBI datasets (various as above) | Location of communally heated estates (existing centralised heating plant) |

**Table 3—4 Data Inputs for Secondary Heat Supply Mapping**

| Dataset | Use In Model |
|---|---|
| Renewable Energy Foundation REGO<br>London Heat Map<br>DECC Digest of UK energy statistic | Location and predicted secondary heat supply |
| London Atmospheric Emissions Inventory (LAEI) | Location and predicted secondary heat supply from major Industrial processes |
| TFL Ventilation Shaft s | Approximate location (centre of MSOA containing shaft), recoverable heat at 70°C |
| www.datacentermap.com | Location and recoverable heat for known commercial data centres |
| Point of interest (POI) location data | Location and recoverable heat for major supermarkets |
| Thames Water Trunk Sewer Map | Polyline in GIS modelling to highlight areas for potential heat abstraction |
| Environment Agency Rivers and Canals | Polyline in GIS modelling to highlight areas for potential heat abstraction |
| VOA commercial floorspace database | Building cooling system heat rejection for non-domestic developments > 10,000 $m^2$ |

**Table 3—5 Data Inputs for Heat Network Mapping**

| | |
|---|---|
| London Heat Map | Existing and proposed heat networks for LBI |
| Bunhill Opportunities Map | Existing and expansion options for Bunhill heat network |

Where datasets provide consumption of gas rather than demand for heating and hot water, a conversion efficiency of 80% has been assumed.

## 3.3 Clustering approach

A first tier of local clusters for heat networks have been generated based on the supply and demand mapping carried out. Clusters have been chosen based on a 'circle of influence' approach, where the influence of individual sites is weighted based on a simplified hierarchy:

1. Housing estates with existing communal heating
2. Large single loads under LBI control
3. New large developments
4. Proximity to primary and secondary heat supply sources
5. Large public sector buildings not under LBI control
6. Future large developments
7. Large private sector buildings.

### 3.3.1 Heat demand 'tiers'

Heat demands across the Borough have been prioritised based on their feasibility of connecting to a district heating scheme. This prioritisation is based on 3 tiers of priority as outlined below. These demands do not represent all heat demands of the Borough, rather those that may be significant because of scale of demand, heating system type or ownership, for connection to a heat network. As such these loads are deemed the 'anchor loads' of the Borough and are used as catalysts for determining possible heat network clusters across the Borough.

Additional maps have been proved in this report to verify the choice of clusters in relation to additional data sources. These are listed as 'other' below and will have a further role in determining the prioritisation of clusters in Phase 3.

**Tier 1**

1. Annually metered gas data for housing estates with existing communal heating
2. Annually metered gas data for large single loads under LBI control
3. Annually metered gas data for key ISEP buildings
4. Predicted heat demand for significant public buildings e.g. prisons, police stations etc (source: London Heat Map)

**Tier 2**

5. Predicted heat demands for new large developments currently active in the planning system
6. Predicted heat demands for large developments likely to have communal heating (>1,000m$^2$ commercial or 100 homes) constructed since 2009 (date of PB report issue)

**Tier 3**

7. Predicted heat demands for major site allocations from LBI Local Plan site allocations

**Other**

a. Proximity to primary and secondary heat supply sources
b. Physical constraints (road, rail, conservations areas etc)
c. All commercial buildings with a predicted heat demand over 100 MWh/yr.[3]

### 3.3.2 Cluster Mapping

Heat demands have been used in this study as a proxy for the viability of heat networks. A heat density map of tier 1 demands has then been produced and used as a boundary for all areas that may be viable for the initial development of heat networks in the Borough. Clusters have been selected within these areas by looking at all 3 tiers of demands initially, following a 'circles of influence approach' discussed below.

**Comparisons to the PB clustering approach**

This cluster approach is similar to that used by PB in the previous borough heat mapping study. Differences in methodology are set out below:

- The current methodology uses heat demand density as a proxy for cluster viability, the PB methodology used pipe diameter required to supply loads.

[3] 100MWh has been selected as the minimum size of commercial heat demand likely to connect to a heat network, equivalent to the heat demand of ~6 flats of an existing estate.

- The tier 2 and 3 loads (although not used to influence cluster areas) have been included in the demands of each cluster.

**Heat Density Mapping**

A heat density map has been produced for all mapped tier 1 heat demands. Heat density is a good indication of the potential viability of heat networks. The mapping produces a raster of heat demand density by considering all tier 1 demands with a 500m radius, divided by the area of search. The scale has been set to allow for the identification of priority areas and follows the methodology used in the London Heat Map. A minimum heat demand density of 10kWh/$m^2$ has been selected for clustering areas. It is noted that though this is lower than would be typical for a district network, it only considers the tier 1 loads in the Borough, not all loads which could ultimately connect to a cluster. For this reason, a second 'circles of influence' approach has been used to select clusters from the most dense regions.

**Circles of Influence**

Following the approach used in the previous PB study it is assumed that the larger the energy demand or supply, the greater the distance that it would be deemed viable to build a heat network between them. 'Circles of influence' have been generated in GIS around all loads categorised in all 3 tiers of demands. The annual heat demand for each site is used a proxy for the diameter of each circle of influence. Clusters of individual loads are then formed where multiple circles of influence overlap and fall within a region of >10kWh/$m^2$ tier 1 heat demand density.

Physical constraints and significant commercial heat loads have also been considered in this study (see section 7.2) but do not influence the primary selection of clusters.

An approximate estimate of heating plant and carbon savings for each cluster has been made. Assumptions for this analysis are given in Appendix A.

### 3.3.3 Cluster Prioritisation

The viability of DE for each cluster is will be assessed further in Phase 3 of this project (see section 9). Phase 3 analysis will include a shortlist and prioritisation of clusters based on both technical and commercial criteria.

# 4 Heat Demands

## 4.1 Heat demands

In total, ~211GWh of heat demands have been mapped, equating to approximately 13% of the total heat demand of the Borough. This is equivalent to around 14kWh/m$^2$/yr out of an average heat demand density of around 110kWh/m$^2$/yr. The remaining demand is associated with individually heated residential and commercial premises which have not been considered likely to form part of any initial heat network clusters, but could be connected to a more widely developed heat network over the long term.

**Table 4—1 Summary heat demands of borough anchor loads**

| Anchor load demand tier | Annual heat demand (MWh/yr.) | % of borough heat demand |
|---|---|---|
| Tier 1 | 160,300 | 9.8% |
| Tier 2 | 42,800 | 2.6% |
| Tier 3 | 8,200 | 0.5% |
| **Total** | **211,300** | **12.9%** |

The categorisation of heat demands in line with London Heat Map typologies is given below for each tier of demands. Note that for compatibility with the format of the London Heat Map all social housing has been included in the private residential typology. As tier 3 is populated by local plan site allocations, it is unclear what the preferred building use is for many sites at this stage.

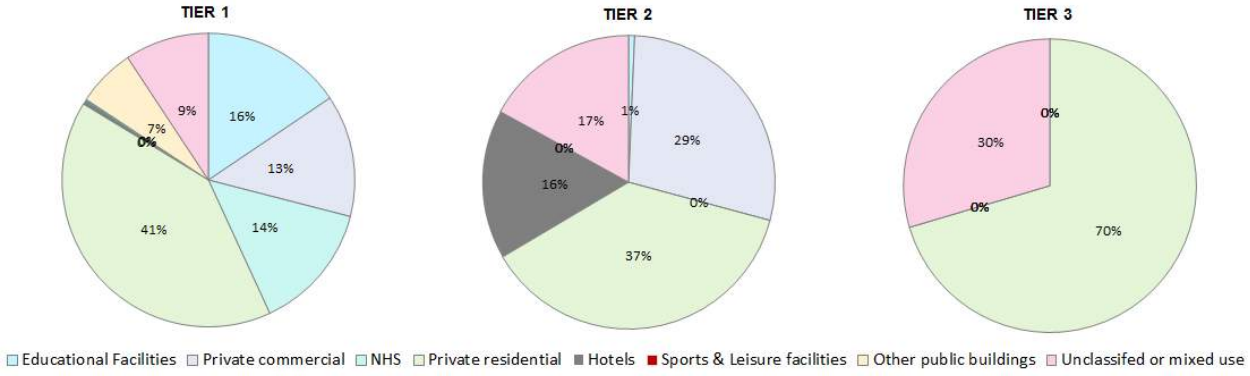


**Figure 4—1 Categorisation of heat demands**

## 4.2 Borough heat mapping – anchor heat loads

Figure 4—2 shows all anchor loads within the Borough, and is colour coded for current energy demands (tier 1), demands in planning (tier 2) and future site allocation demands (tier 3). Where information of heating demands in surrounding boroughs is known (London Heat Map or Arup Bunhill study) these have been included on the maps as grey points. The area occupied by all LBI housing estates is checked with grey boxes, site allocation areas relating to tier 3 demands are checked in purple boxes. A full list of the demands considered for each tier is given in section 3.3.1.

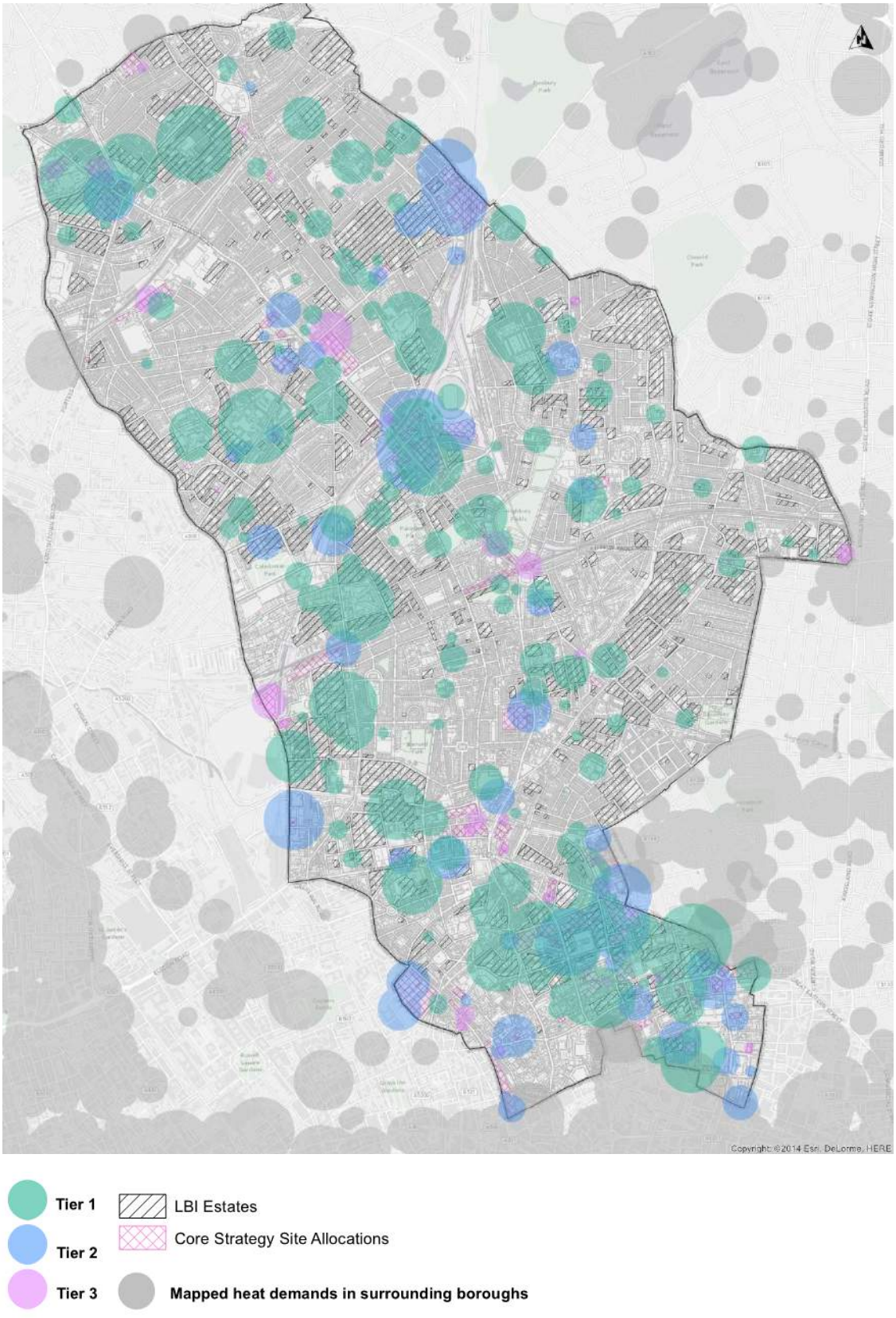


**Figure 4—2 Anchor load heat demands**

The map in Figure 4—3 separates out the communally heated residential loads in tier 1 for clarity (red circles). Added to this map for comparison are other significant multi-address residential buildings in the borough (grey circles) with over 100 dwellings. These addition loads are not mapped as part of the tiered system for clustering because the type of heating system has not been confirmed and where these buildings are electrically heated or have individual gas fired boilers there is a likely need for significant retrofit to connect to district heating. Individually heated buildings such as these will be considered for future connection in Phase 3 where in close proximity to identified clusters.

A map showing the density of all LBI owned residences in the borough is included in Appendix D. This shows a high density of loads in the west and north of the borough, however these areas are formed from a number of buildings with less than 100 units and so are not significant for consideration as district heating clusters.

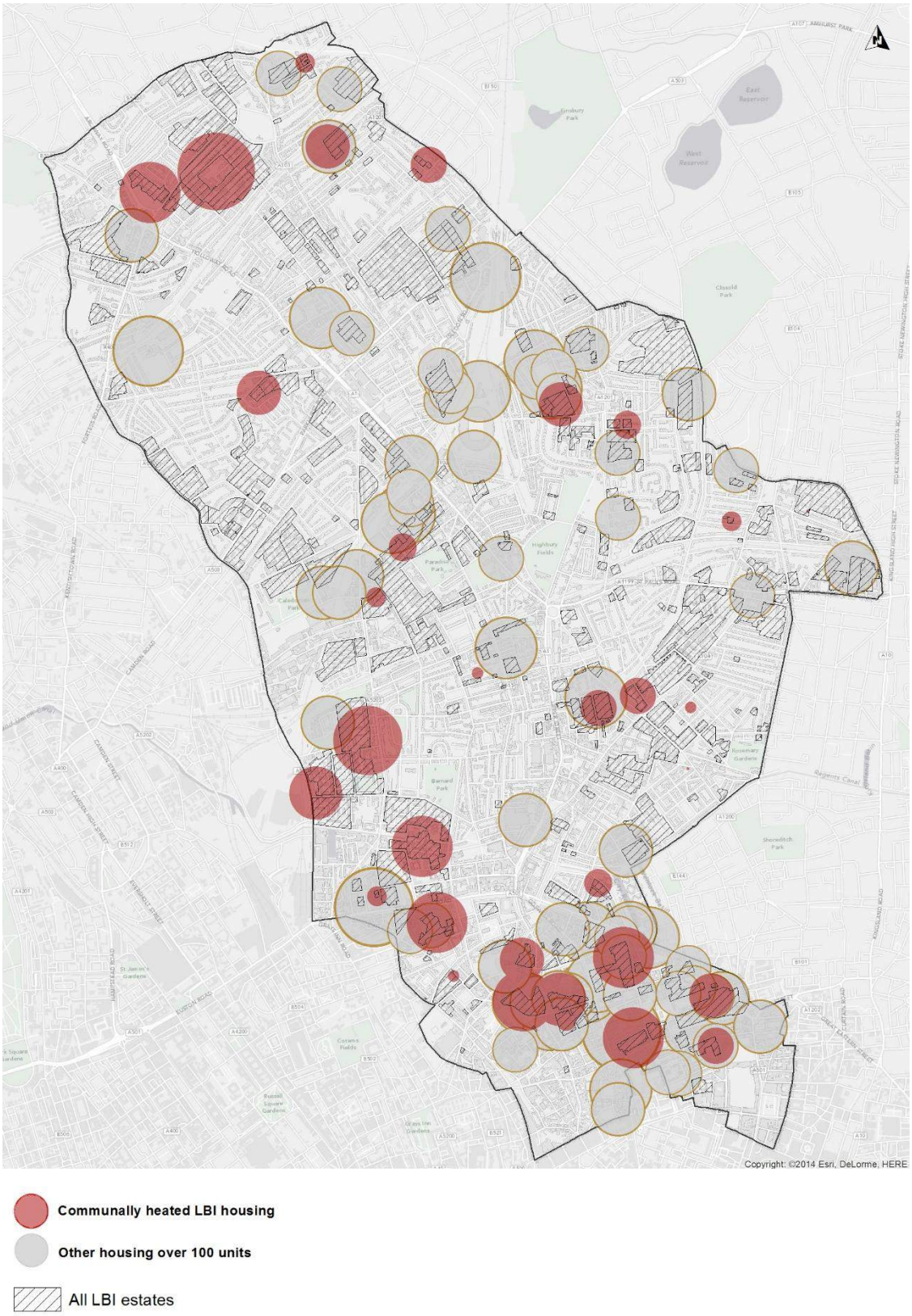


**Figure 4—3 Significant residential buildings including communally heated estates**

# 5 Cluster Mapping

## 5.1 Overview of clusters

Clusters for heat network consideration have been selected following the methodology set out in section 3. These clusters are shown visually in Figure 5—1, overlaid on the heat demand density map of tier 1 demands.

Cluster 8 has been included as a cluster despite falling below the tier 1 density threshold described in the methodology section. This is included as there are three tier 1 demands in this location which have a high linear density, but their spatial density is not sufficient to be picked up ion the heat mapping exercise.

An area of high density is observed between the Archway and Pentonville clusters. This density is due to a large single source (HM Prison Holloway) in relative isolation and so has not been conserved as a cluster in itself.

The table below gives a brief description of each cluster. An analysis of cluster demands is given in section 8.

**Table 5—1 Brief descriptions of the heat clusters**

| Cluster no. | Cluster name | Description | Key stakeholders |
|---|---|---|---|
| 1 | Archway and Ethorne Estate | High density of existing heat demands, large communally heated estate (Ethorne) and an area for development in Islington Local Plan | Whittington Hospital, LBI Housing, LBI Leisure, Essential Living (Archway Tower ) |
| 2 | Highbury West | Scheme connecting the Harvist Estate to Sobell Leisure Centre. Fuel poverty drivers for estate heating system conversion | Sobell Leisure Centre, LBI Housing |
| 3 | Aubert Court | Scheme focused on the communally heated Aubert Court Estate, with future connection to Highbury Square residential development and surrounding LBI assets | LBI Housing, Highbury Square |
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| 6 | Central Library | Connection of Highbury Pool to the Central Library and LMU Spring House. Future connection to the mixed use redevelopment of Highbury Corner (Islington site allocation) | LBI Leisure, LMU, LBI CLL, Highbury House |
| 7 | Pentonville | High density of heat demands focused on HM Prison, Islington Waste Transfer Station and Mallet and Porter House (new build student accommodation) | HM Prisons, LBI CLL, Mortar Developments Ltd (student accommodation) |
| 8 | Halton Mansions | Consolidation of the council owned Halton Mansions Estate | LBI Housing |
| 9 | Kings Cross Extension | Extension to the existing Kings Cross district heating network including Dehli Outram Estate, Bemerton Estate and Caledonian Road Pool | Argent, LBI Housing, LBI Leisure |
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| 12c | Bunhill Extension – C | Northern extension to the existing Bunhill scheme connecting two potential clusters form the new City Forum development in the east | Berkeley Homes, LBI Housing, LBI Energy Services |

| Cluster no. | Cluster name | Description | Key stakeholders |
|---|---|---|---|
| | and E | to Finsbury Estate in the West | |
| 13 | Whitecross | Connection of Citigen district network to Bunhill Row council offices, Cass Business School and Shire House (new mixed use development) | Citigen (Eon), LBI, Cass Buisness School, London City Shopping Centre Ltd |

## 5.2 Heat mapping – clustering

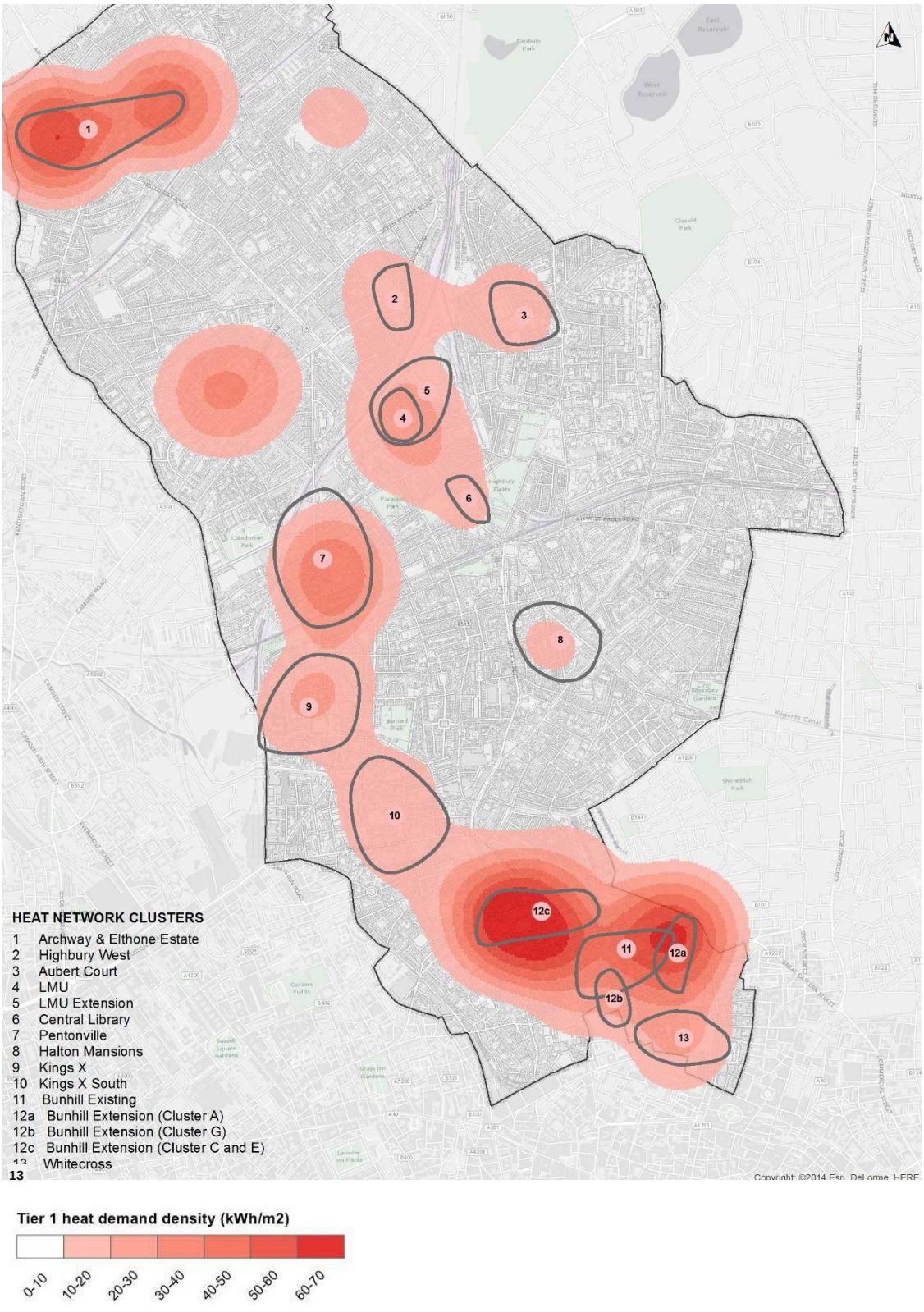


**Figure 5—1 Heat mapping - cluster identification**

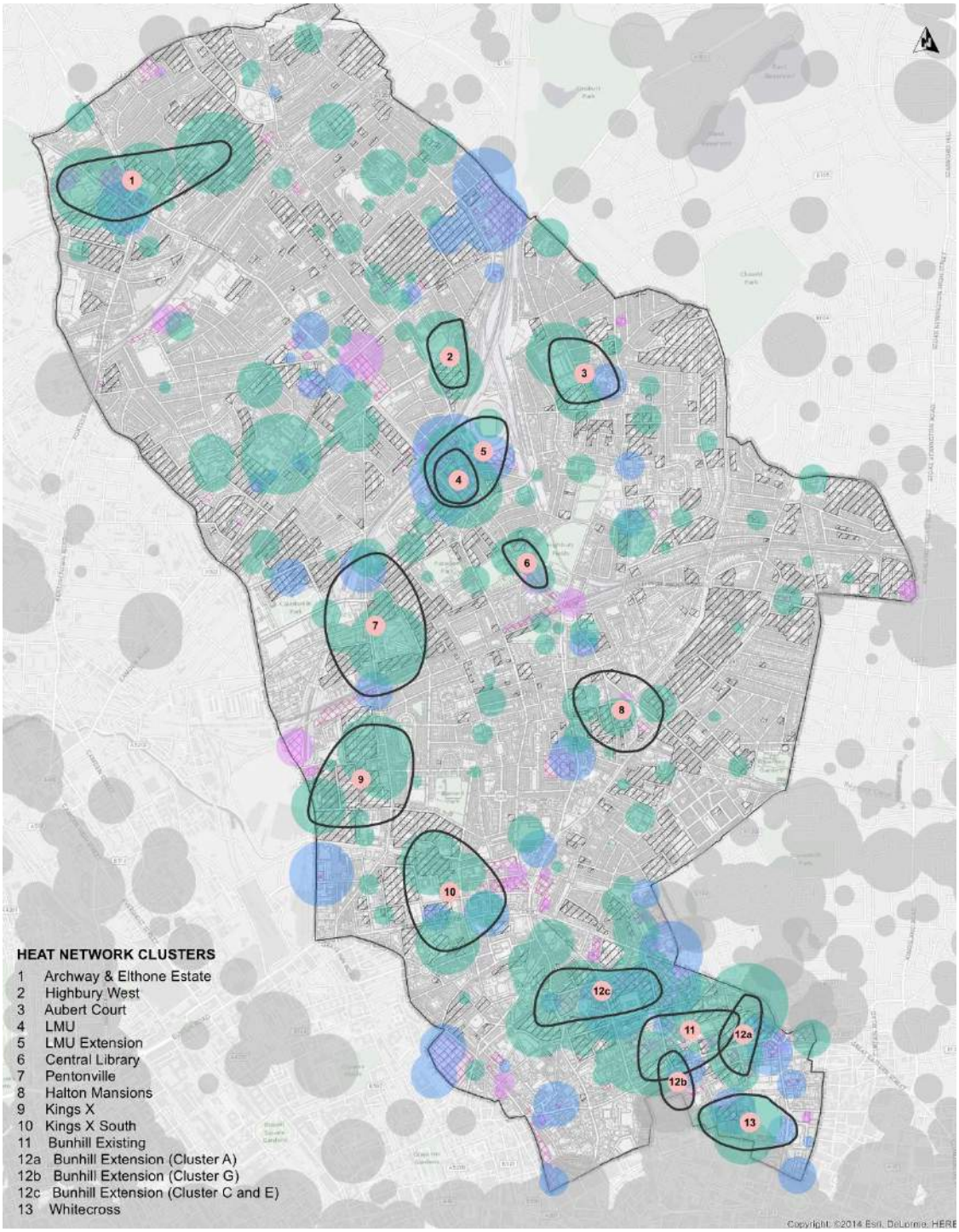


**Figure 5—2 Demand map cluster overlay**

# 6 Heat Supply

## 6.1 Primary heat supply

All existing major CHP has been considered as a potential supply to the heat network clusters. There are 7 such CHP plants in the Borough, these are mapped and labelled in Figure 6—2. Other significant gas boiler heating plant can also be considered as potential supply sources; communally heated buildings have been included as potential supply sources in Figure 6—2. Where these sources are in proximity to potential clusters they will be investigated further in Phase 3.

## 6.2 Secondary heat supply

Secondary heat supply is heat that can be recovered as waste from environmental, industrial or commercial activities. Heat from secondary sources is typically at a low temperate and requires upgrading via heat pumps to connect to conventional district heating networks.

The mapping of secondary sources has focused on the key sources listed below. Air source and ground source heart sources have not been mapped as they are not restricted to a specific location in the Borough. There are no rivers in the Borough and so water source heat recovery is limited to Regents Canal.

The only significant industrial processes in the Borough are related to fuel storage terminals, the loading of cement and the repairing of road vehicles. None of these processes are associated with secondary heat sources and so these have also not been mapped.

The following secondary heat sources exist in the Borough and have been mapped for all known locations;

- Sewer heat recovery
- Tube ventilation shafts
- Industrial processes
- Data centres
- National Grid substation transformers
- UKPN substation transformers
- Canal heat recovery
- Supermarkets (refrigeration heat recovery).

## 6.3 Heat networks

A number of heat networks exist in the Borough and have the potential to act as heat supply connections for heat clusters. These are listed in the following tables and are mapped in Figure 6—2. Possible heat network clusters in surrounding boroughs have been included in the map in Figure 6—2 where they are in proximity to the borough boundary with Islington. The location of these boroughs is based on heat mapping done to date by Camden, Hillingdon, Hackney and City of London councils.

**Table 6—1 Existing heat networks within the Borough**

| Name of system | Borough location | Description | Key stakeholder |
|---|---|---|---|
| Islington Bunhill CHP Scheme | Southern | Interconnected CHP scheme linking LBI housing and 2no. leisure sites | LBI |
| Crouch Hill Network | Northern | Interconnected CHP scheme linking Ashmount Primary School, Bowlers Nursery, Cape Youth Centre and Colman Mansions | LBI |
| Queensland Road | Central | Private residentially led development, operated by Eon | Eon |
| ***Key communally heated LBI estates*** | | | |
| Delhi Outram Estate | Western | Communally heated estate bordering Kings Cross regeneration area | LBI |
| Kings Square Estate | Southern | Communally heated estate near City University, (planned to connect to Bunhill Phase 2) | LBI |
| Miranda Estate | Northern | Near Archway | LBI |
| Spa Green Estate | Southern | Communally heated estate near City University | LBI |
| St Lukes Estate | Southern | Communally heated estate near Old Street, connected to Bunhill Phase 1 | LBI |
| Stafford Cripps Estate | Southern | Communally heated estate with refurbished boiler house, connected to Bunhill Phase 1 | LBI |

A map showing the location of all communally heated LBI estates is given in Figure 6—1 below.

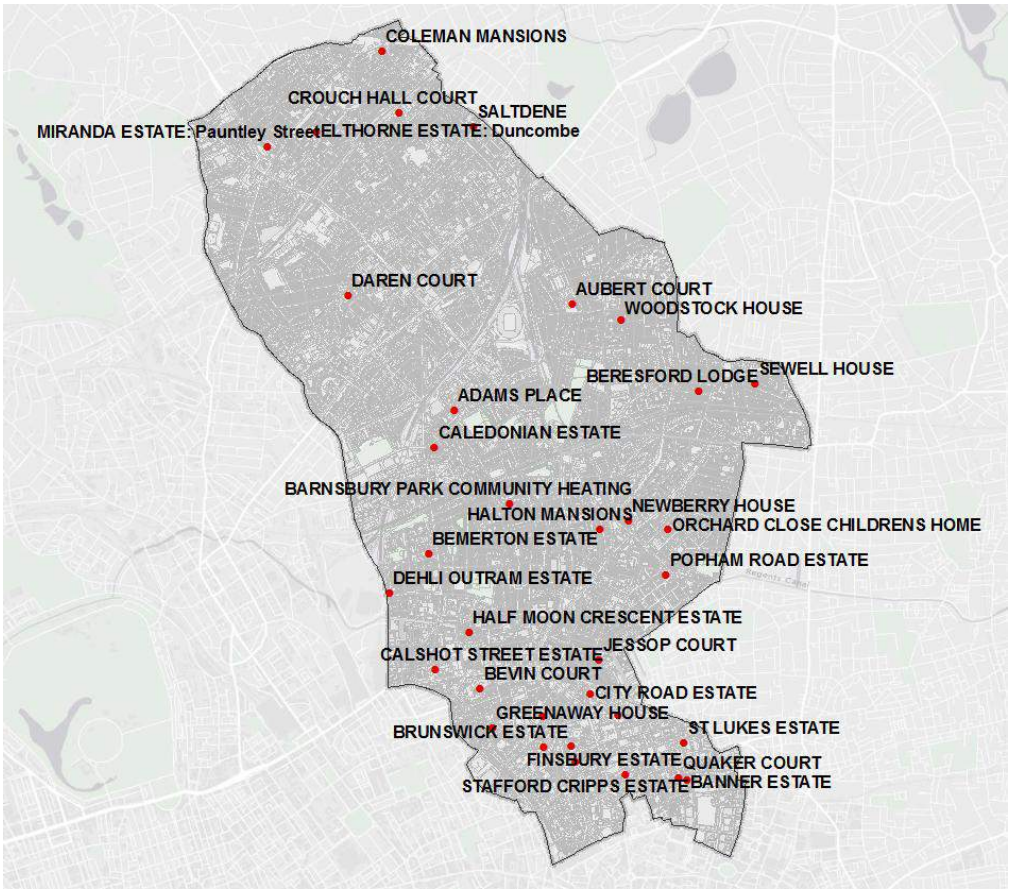


**Figure 6—1 Communally heated LBI estates**

**Table 6—2 Heat network developments in surrounding boroughs**

| Name of system | Location | Description | Key stakeholder |
|---|---|---|---|
| Shoreditch CHP Scheme | Southern border of borough | Replacement of ageing gas boiler in 3 estates (Wenlock Barn, Cranston and Fairbank) with new district heating network serving 464 properties. | London Borough of Hackney |
| Citigen | Southern border of borough | System based at a central power station near Spitafields Market. Scheme provides heat to 10 of the City Corporation's properties. A cooling network also provides chilled water to 6 properties via a separate parallel underground network | Eon |
| Kings Cross Central | Western border of borough | Large mixed use redevelopment project led by Argent with Metropolitan appointed as energy service company for the district energy scheme. | Argent / Metropolitan |

**Table 6—3 Future heat networks**

| Name of system | Location | Description | Key stakeholder |
|---|---|---|---|
| Islington Bunhill CHP Scheme extension (Phase 2) | Southern part of borough | Extension and interconnection to Shoreditch network | LBI, LB Hackney |
| Citigen extension | Southern border of borough | Extension and re-planting of Citigen scheme | EON |
| Kings Cross Central extension | Western border of borough | Build-out and extension of masterplan and connection to neighbouring heat loads | Argent / Metropolitan |

## 6.4 Potential heat supply to clusters

The following primary and secondary heat supply locations have been identified in Figure 6—2 as possible sources of heat for the clusters identified in this study. These are listed below and will be considered quantitatively in Phase 3. Further supply sources may be viable when considering the connection of clusters as part of a borough wide heat network (Phase 3).

**Table 6—4 Potential cluster heat supply sources**

| Cluster | | Significant potential heat supply sources |
|---|---|---|
| 1 | Archway and Ethorne Estate | Communal boiler plant within cluster boundary |
| 2 | Highbury West | Severn Sisters National Grid substation |
| 5 | LMU Extension | Drayton Park TfL ventilation shaft |
| 9 | Kings Cross Extension | Kings Cross district heating network extension |
| 10 | Kings Cross South | Regents Canal heat abstraction<br>Kings Cross district heating network extension<br>Weston Rise TfL ventilation shaft<br>City Road UKPN Substation |
| 12a | Bunhill Extension (Cluster A) | Bunhill district heating network extension<br>Moorefield Eye Hospital CHP |
| 12b | Bunhill Extension (Cluster G) | Bunhill district heating network extension |
| 12c | Bunhill Extension (Cluster C and E) | Bunhill district heating network extension<br>Level 3 data centre |
| 13 | Whitecross | Citigen district heating network extension<br>City Road UKPN substation<br>Telehouse Europe data centre |
| 2 - 13 | | Sewer heat abstraction, known communal boiler plant |

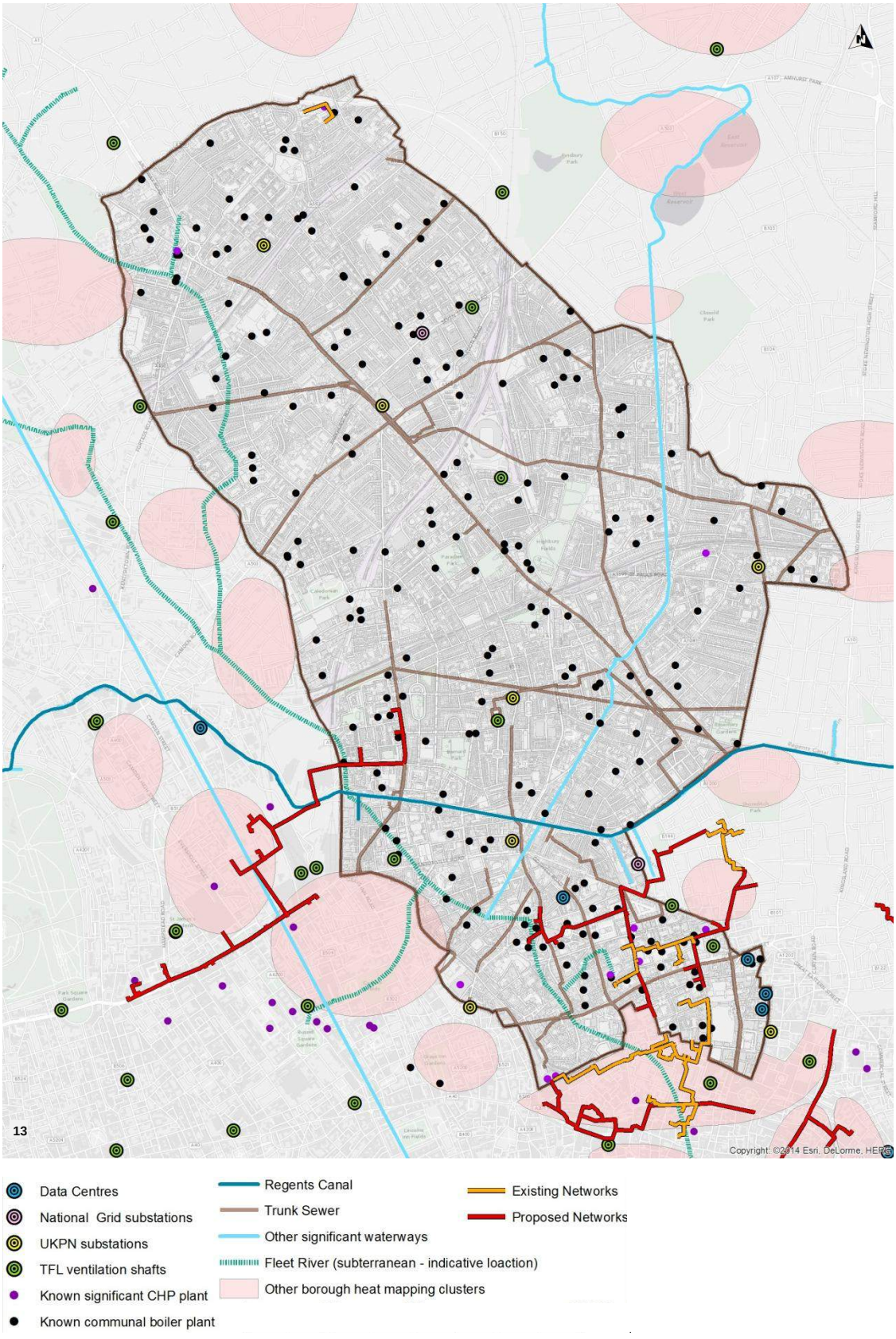


**Figure 6—2 Heat supply sources**

# 7 Other mapping assessments

## 7.1 Heat mapping – non-anchor loads

Heating benchmarks allocated to floor area data available from the Valuation Office Agency has been used to map all commercial heat demands in the Borough over 100 MWh/yr , these have then been aggregated by postcode for visual representation in Figure 7—1. An overlay of heat demand clusters shows how the commercial heat demand of the Borough related to the tiered demands used for the purposes of heat mapping. As with the tiered approach, the highest density of demands is in the south of the Borough.

Four areas of high commercial heat demand density are identified over and above the clusters identified thus far, these are given below (lettering relates to notation on map overleaf). As these demands are not a priority for heat network development (many individual loads, each with different ownership) they do not affect the selection of clusters. Opportunities for the development of wider networks to include some of these loads is considered in Phase 3 of this project.

| | |
|---|---|
| A | Nags Head Shopping Centre |
| B | Brewery Road Industrial sites |
| C | Angel Shopping Centre |
| D | Farringdon |
| E | City Gate |

## 7.2 Physical constraints

Key physical constraints within the Borough have been mapped and are shown in Figure 7—2. These constraints include:

- Canals
- Main trunk sewers
- Railways
- TfL ‘red routes’.

The constraints mapping highlights the following clashes with clusters. The magnitude of these impacts and the consequences for the development of a borough wide heat network will be assessed in Phase 3.

| | |
|---|---|
| Cluster 1 | TfL red route separating Elthorne Estate from the central Archway heat loads |
| Cluster 2 | TfL red route and trunk sewer main separating Sobell Leisure Centre and the Harvist Estate |
| Cluster 6 | Main road connecting loads is a TfL red route. Whole cluster area lies in conservation area |
| Cluster 8 | 2 trunk sewers across cluster area |
| Cluster 10 | North of cluster separated by canal |
| Cluster 12 | East of cluster separated by TfL red route. |

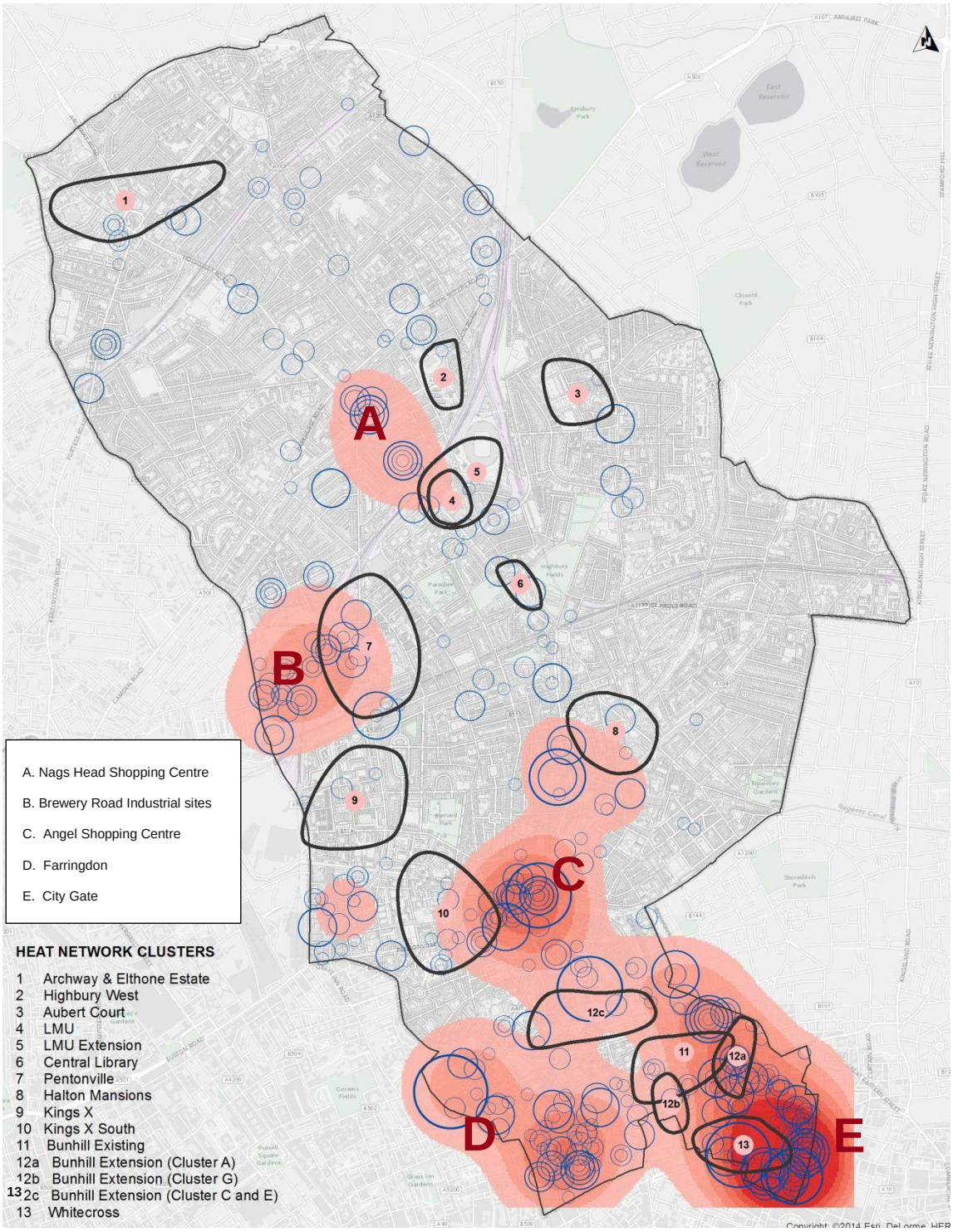


**Figure 7—1 Heat demand based on VOA floor area data and energy consumption benchmarks**

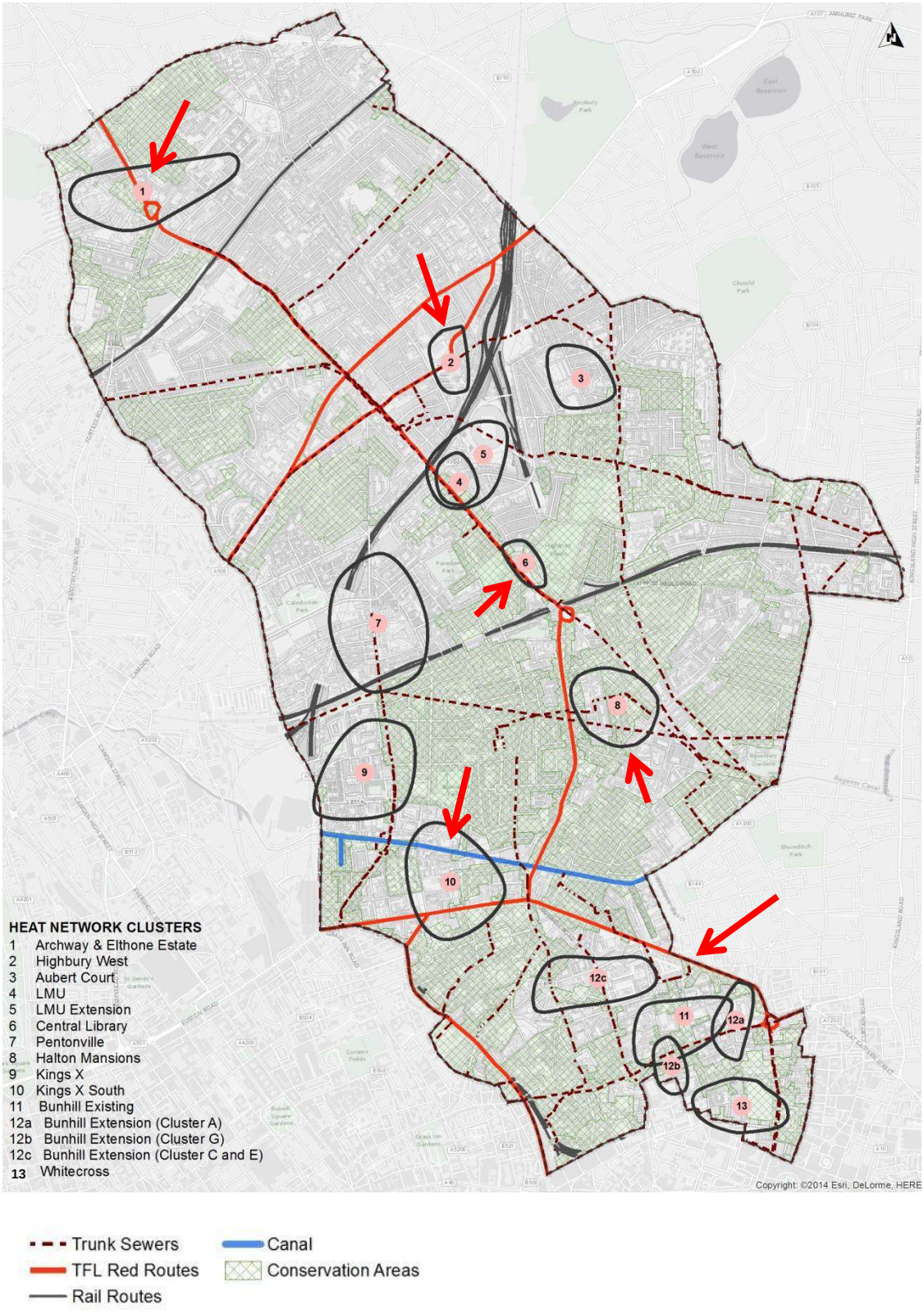


**Figure 7—2 Physical constraints map**

# 8 Cluster analysis

The total heat demand across all clusters is 161 GWh, this is ~10% of the total borough heat demand and approximately equal (102%) to the heat demand of clusters mapped by PB in 2009. The indicative cumulative cost of developing all clusters would be in the region of £69m. A more detailed analysis will be undertaken in Phase 3 to determine the effect of building demand profiles on CHP provision for each cluster, and the optimum sizing of energy centre plant.

Assumptions which inform Table 8—1 are detailed in Appendix A.

**Table 8—1 First Tier Cluster Data**

| Cluster no. | Cluster Name | Annual heat demand (MWh/yr.) | Indicative CHP size (MWth) | Indicative $CO_2$ savings[4] ($tCO_2$/yr.) | Indicative network cost (£m) | Indicative energy centre cost (£m) |
|---|---|---|---|---|---|---|
| 1 | Archway and Ethorne Estate | 31,300 | 3.4 | 6,700 | 6.7 | 6.7 |
| 2 | Highbury West | 4,100 | 0.4 | 900 | 0.9 | 0.9 |
| 3 | Aubert Court | 4,900 | 0.5 | 1,100 | 1.1 | 1.1 |
| 4 | LMU | 9,200 | 1.0 | 2,000 | 2.0 | 2.0 |
| 5 | LMU Extension | 3,200 | 0.3 | 700 | 0.5 | 0.5 |
| 6 | Central Library | 3,300 | 0.4 | 700 | 0.7 | 0.7 |
| 7 | Pentonville | 13,500 | 1.4 | 2,900 | 2.9 | 2.9 |
| 8 | Halton Mansions | 3,100 | 0.3 | 700 | 0.7 | 0.7 |
| 9 | Kings X | 7,600 | 0.8 | 1,600 | 1.6 | 1.6 |
| 10 | Kings X South | 10,900 | 1.2 | 2,300 | 2.4 | 2.4 |
| 11 | Bunhill Existing Scheme | 20,400 | 2.2 | 4,400 | 4.4 | 4.4 |
| 12a | Bunhill Extension (Cluster A) | 11,400 | 1.2 | 2,400 | 2.5 | 2.5 |
| 12b | Bunhill Extension (Cluster G) | 5,400 | 0.6 | 1,200 | 1.2 | 1.2 |
| 12c | Bunhill Extension (Clusters C and E) | 28,200 | 3.0 | 6,100 | 6.1 | 6.1 |
| 13 | Whitecross | 5,100 | 0.6 | 1,100 | 1.1 | 1.1 |
| | **Total** | **161,600** | **17** | **34,800** | **34.6** | **34.6** |

### Comparison with PB clusters

The clusters mapped in this study broadly align with those highlighted in the PB clustering analysis done in 2009. It is understood that Cluster D in the PB study (see Figure 2—2) includes data for the Elthorne Estate with a georeferencing error. This estate has now been included as part of the wider archway cluster. Cluster G from the PB study includes other georeferencing clashes – the main demands from this area are now picked up in the Aubert Court and LMU extension clusters. Other variations on cluster locations are due to the methodology used in this study, such as consideration of future developments and developments since the PB heat mapping exercise in 2009.

[4] Based on a counterfactual case of individual gas boilers heating.

# 9 Next steps

## 9.1 Recommended further work

There are a number of possible future works which might enhance the heat mapping which are out with the scope of works for this phase. These include:

- It will be useful to validate the heat mapping derived from the VOA data against heat demand data from published DECC data on sub-regional energy use available at MSOA
- For the heat supply sources the identification of capacities or available outputs would be useful where these were not available e.g. if LBI undertake an audit of their boiler plant and capacities.
- Map of LBI owned land (if available) onto the clusters to aid energy centre site selection.

## 9.2 Phase 3 development

The development of cluster heat networks and the interconnection of clusters will be assessed in Phase 3. The Borough wide strategic vision for decentralised energy will be developed based on the identified clusters. Priority clusters will be identified in conjunction with LBI and these will be selected for further development into ‘masterplans’ for each cluster. The masterplans will identify the following, per cluster:

- Physical constraints (water, rail, protected areas)
- Connection to current and planned  heat networks in surrounding boroughs
- Potential energy centre locations
- Heat supply source, size and primary energy source
- Carbon savings
- Fuel poverty impact
- Investment required
- Return on investment
- Number of council tenants served.

# Appendix A Benchmarks and Assumptions

Where heat demand data is not available for the datasets being considered, these have been populated using the following benchmarks.

## 10.1 Valuation Office Agency (VOA) commercial floorspace

VOA benchmarks are based on conversion from CIBSE TM46 – Energy benchmarks (2008) assuming all heat is supplied by gas boiler at efficiency of 80%

**Table 9—1 VOA heating benchmarks**

| TM46 Building Category | Predicted heat demand (kWh / $m^2$/yr.) |
|---|---|
| General Office | 96 |
| Large non-food shop | 136 |
| High street agency | 0 |
| Storage facility | 128 |
| Fitness and health centre | 352 |
| Workshop | 144 |
| Clinic | 160 |
| Schools and seasonal public buildings | 120 |
| High street agency | 0 |
| Restaurant | 118 |
| Large food store | 84 |
| Cultural activities | 160 |
| Dry sports and leisure facilities | 264 |

## 10.2 New building benchmarks

New building benchmarks are used for Tier 2 and Tier 3 demands where only floor area data is available.

**Table 9—2 New build benchmarks**

| Typology | Space heating | DHW | Combined | Benchmark reference |
|---|---|---|---|---|
| | (kwh / $m^2$/yr.) | | | |
| Business | 11 | 2 | 13 | Part L 2010 compliance model for predicted office heating |
| Apartments | 21 | 34 | 55 | Part L 2010 SAP compliance model for small apartment |
| Townhouses | 42 | 15 | 57 | Part L 2010 SAP compliance model for mid-terrace house |
| Leisure | 25 | 59 | 84 | Part L 2010 compliance model for multi-use mall |
| Retail | 7 | 1 | 8 | Part L 2010 compliance model for multi-use mall |
| School | 32 | 6 | 38 | Part L 2010 compliance model for secondary school |
| Hotels | 38 | 119 | 157 | Part L 2010 compliance model for hotel (including A/C) |
| Hospital | 108 | 62 | 170 | CIBSE Guide F with 50% notional reduction to heating benchmarks |
| Community | 27 | 4 | 31 | Averaged load based on education and leisure benchmarks |
| Industrial | 85 | 5 | 90 | TM46 with 50% reduction to space heating |

## 10.3 Clustering analysis

The following assumptions have been used for determining high level estimates for the CHP capacity, and carbon savings associated with the clustering analysis.

**Table 9—3 Clustering assumptions**

| Variable | Value | Reference |
|---|---|---|
| Average gas boiler efficiency | 80% | *Best practice assumption* |
| CHP run hours | 6500 | *Best practice assumption* |
| Maximum % of annual demand met by CHP | 70% | Best practice assumption |
| CHP electrical efficiency | 43% | Jenbacher JMS 620 gas CHP engine |
| CHP thermal efficiency | 43% | Jenbacher JMS 620 gas CHP engine |

## 10.4 Modelling Assumptions

**Heat networks**

Heat networks in and around the Borough have been included as part of the supply assessment in Phase 2 as they pose opportunities for the development of larger district networks. Development opportunities for networks will be discussed in more detail in Phase 3 of the study.

**Phasing**

For the purposes of clustering, all demands have been considered together. Prioritisation and phasing of clusters will be considered in Phase 3.

**Energy centres**

An indicative CHP capacity is provided to meet the demands of each cluster identified in this study. Phase 3 will consider the profile of heat loads and the effect of this on CHP sizing to better match CHP size and performance the demands of prioritised clusters. The linking of clusters to consolidate energy centres will also be assessed in Phase 3.

**London Heat Map integration**

Where possible the results of demand and supply mapping have been collated in Excel and GIS in a format compatible with the London Heat Map. In some cases OS co-ordinate data has not been available for each site. In these cases sites have been aggregated by postcode. These sites are highlighted in the Excel output tables provided in support of this document.

Commercial sources for secondary heat supply have not been provided for upload to the London Heat Map because of data protection agreements

**Heat demand prioritisation**

Some heat demands exist in multiple datasets used for heat demand modelling. Where there is a duplication of data, these have been deleted following the tiered prioritisation given in the heat clustering methodology.

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