Executive Summary – Strategic Heat Network Analysis for Edinburgh

City of Edinburgh Council

30 July 2025

1. Executive Summary

We propose the development of a city-wide heat network across 11 prospective heat network zones in Edinburgh, covering 67% (3.5 TWh) of Edinburgh's total annual heat demand and becoming available for connection to approximately 178,000 properties. Our feasibility review indicates that heat networks can deliver low carbon heat at a competitive cost, particularly with the grant funding currently available. We recommend a phased delivery strategy. This involves the continued development of the Granton heat network and starting two additional 'Gateway Zones' – first in Northeast Edinburgh and subsequently in Southeast Edinburgh – which have access to scalable low carbon heat sources. We recommend expansion from these zones into the city centre and western Edinburgh. The city-wide heat network can be supplied by developing several large-scale heat sources serving up to ten zones via spinal routes, and multiple small-scale heat sources supplying zonal networks. Altogether, this infrastructure represents total capital investments exceeding £1.5bn over the coming decades, supporting low carbon skills and jobs across the region. We have identified this to be the most practical way for providing the lowest cost low carbon heat to decarbonise Edinburgh's buildings and help reduce fuel poverty. We found strong backing for a major heat network rollout via engagement with potential customers, investors/developers, public bodies, utilities, regulators and the national Heat Network Support Unit (HNSU).

1.1 Context

The City of Edinburgh Council is advancing its proposals for a city-wide heat network (or 'network of networks'). The Council proposed a potential city-wide heat network in its 2023 Local Heat and Energy Efficiency Strategy (LHEES), a statutory document which defines how Edinburgh will decarbonise its built environment and tackle fuel poverty.

This analysis progresses the LHEES work via four objectives:

- Investigate available **heat sources**.
- **Update zones**.
- Conduct a **feasibility review** of these zones.
- Provide an indication of possible **spinal routes** to supply heat to these zones via large-scale primary heat sources.

The Council appointed Turner & Townsend and WSP to conduct this study. The results underpin the Council's current working strategy to develop of heat networks, solidifying the intentions for heat networks as a utility-scale generational investment for Edinburgh.

Several policy drivers are backing heat network developments in Scotland. The primary driver is the Heat Networks (Scotland) Act 2021, with further updates expected in the upcoming Heat in Building Bill and the heat networks regulatory regime. While there are several outstanding uncertainties on policy specifics, we consider their progress to be encouraging on the whole. This has allowed us to take an optimistic view for our analysis.

Edinburgh already has dozens of small-scale heat networks. The Council is also actively procuring a heat network for its major development at Granton Waterfront. Midlothian Council are expanding and operating heat networks proximate to Edinburgh's boundary while East Lothian Council also develops its heat network plans. Our analysis builds on these efforts to support scale and opportunities for collaboration.

1.2 Heat sources

We appraised all current heat sources before prioritising potential sources for our analysis of heat supply. This assessment included greenspaces, water bodies, waste heat, mines, and other sources. We categorised selected sources into two types:

- **Primary** (city-scale) heat sources are major strategic heat assets which could potentially supply heat for multiple zones and are suited to supply a spinal route.
- **Secondary** (zonal-scale) heat sources are those which could cover part or most of the heat demand for a zone.

We identified eight potential heat sources:

Primary heat sources

Port of Leith sea source heat pump

Cockenzie sea source heat pump

Monktonhall Colliery ground source heat pump

Secondary heat sources

Sewer source heat

Millerhill Recycling & Energy Recovery Centre

Seafield Waste Water Treatment Works

North British Distillery

Closed loop ground source heat pumps

This list is not exhaustive as new sources may arise and others may become more viable, like waste heat from data centres and hydrogen.

1.3 Updated zones

The Edinburgh LHEES identified 17 prospective heat network zones. We utilised various data sources and methods to consolidate these into 11 refined zones, shown in Figure 1. We developed these with due regard to heat demand, constraints, fuel poverty, and stakeholder input. This refinement intended to provide more robust prospective zones with a clearer view of the opportunity.

They consolidate most original zones into larger, more commercially attractive investment opportunities, follow more strategic boundaries, better reflect physical constraints, and offer a more even distribution of heat demand across major zones. This reflects stakeholder input calling for larger zones with a clearly defined delivery strategy.

The updated zones represent an overall annual heat demand of 3.5 TWh[1] from 177,944 potential loads (i.e. buildings), and an anchor load[2] annual heat demand of almost 1 TWh from 515 potential loads. This represents 67% of overall heat demand and 84% of anchor load heat demand in Edinburgh.

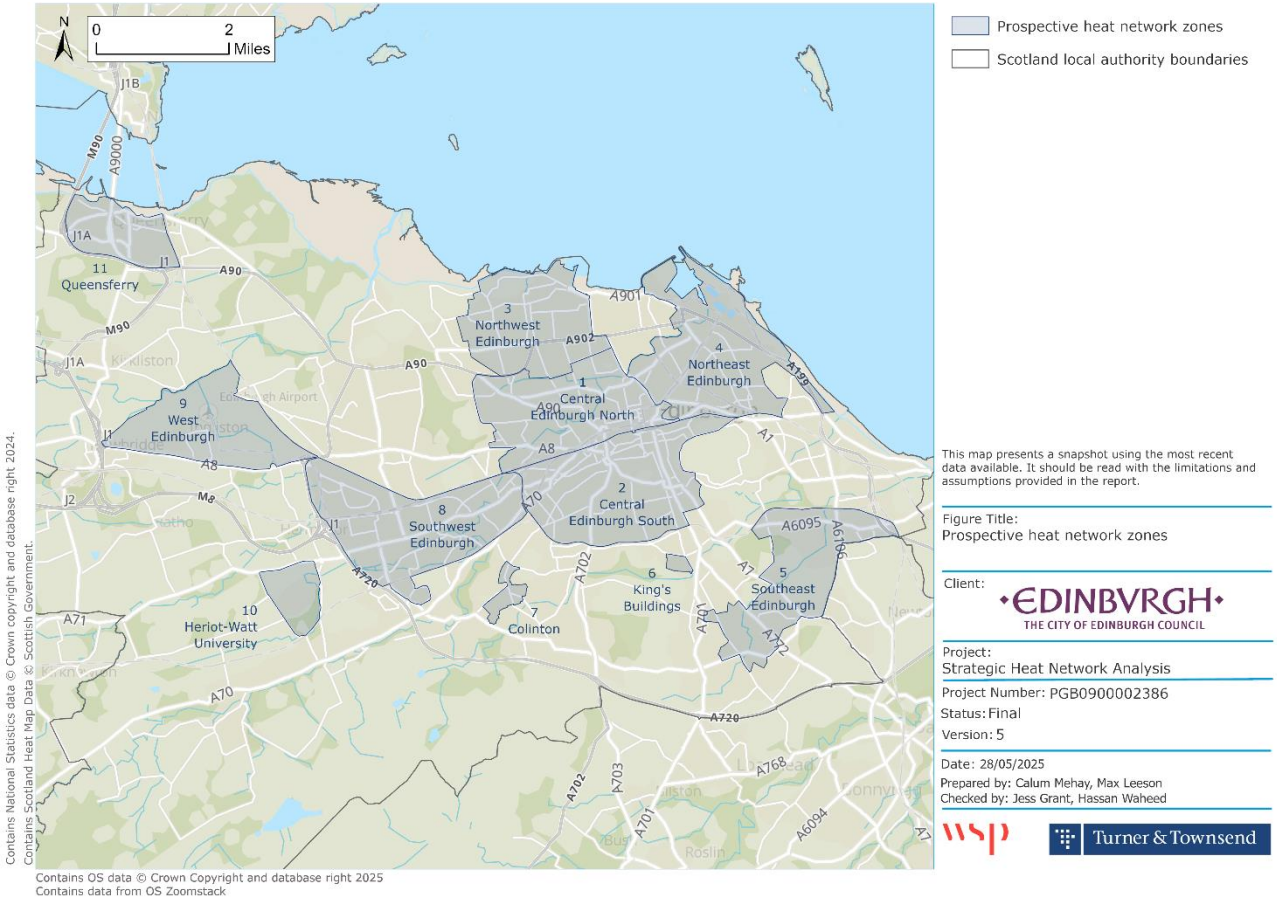


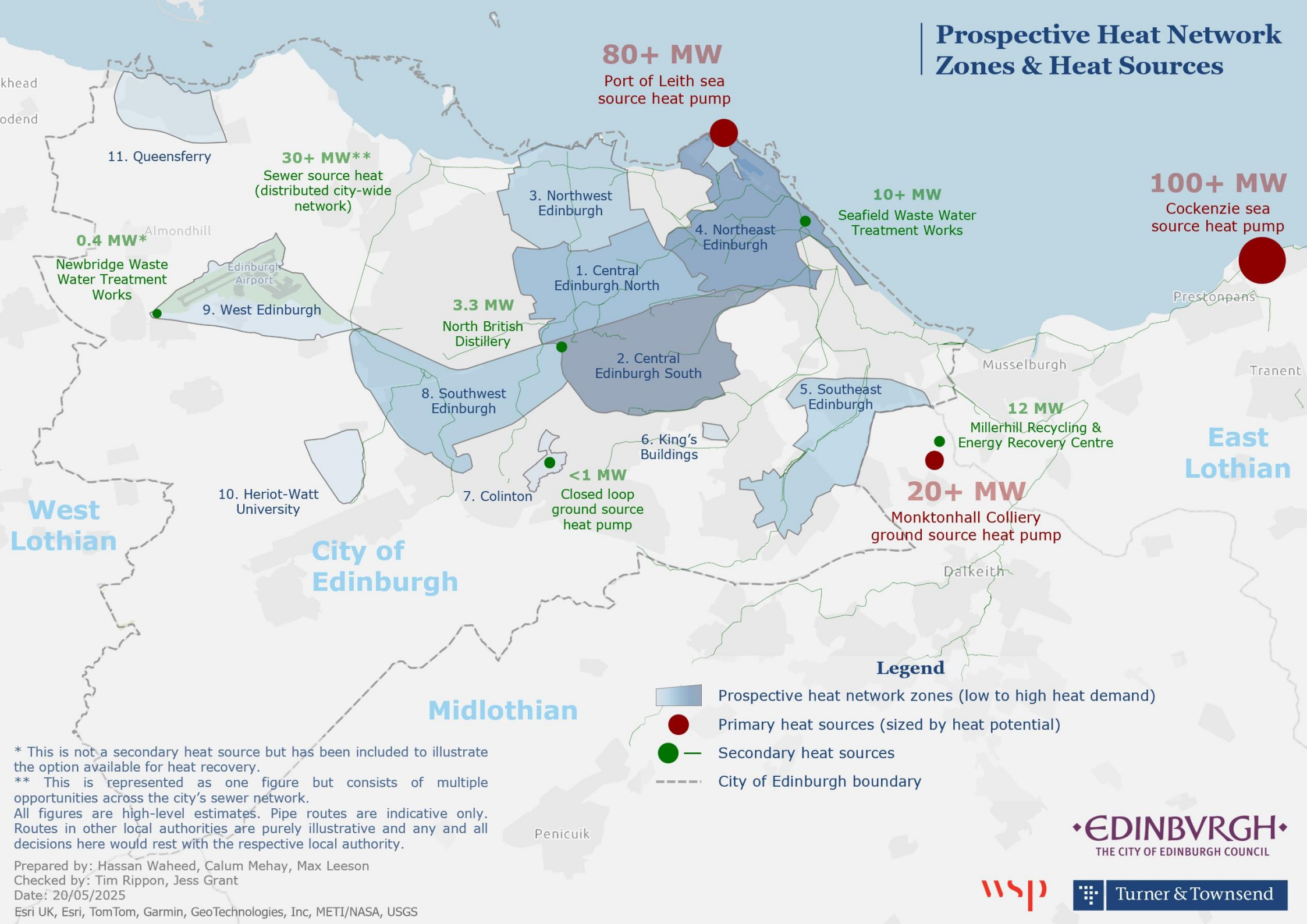
Figure 1: Prospective heat network zones for the City of Edinburgh.

The zones provide clarity on leadership and roles, identifying the party primarily responsible for leading heat network development in each zone and the role of the Council and other stakeholders. However, we do not consider our outputs to be designation-ready zones at this stage. They may well be suited to designation after the regulatory environment has been created and it supports the zones as we defined them. Equally, they may require modifications depending on central government decisions on any number of the upcoming regulations. In the following page, we present the zones and heat sources.

[1] This equates to 3,503 GWh, 3.5 million MWh, or 3.5 billion kWh. The mean annual heat demand of Scottish homes heated via mains gas is 12,354 kWh.

[2] Defined as loads with total annual heat demand exceeding 500 MWh/year.

Prospective Heat Network Zones & Heat Sources



* This is not a secondary heat source but has been included to illustrate the option available for heat recovery.
** This is represented as one figure but consists of multiple opportunities across the city's sewer network.
All figures are high-level estimates. Pipe routes are indicative only. Routes in other local authorities are purely illustrative and any and all decisions here would rest with the respective local authority.

Prepared by: Hassan Waheed, Calum Mehay, Max Leeson
Checked by: Tim Rippon, Jess Grant

Date: 20/05/2025

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1.4 Spinal route

Edinburgh's heat demand far exceeds what is readily available from local heat sources. Much of the low carbon supply for zonal heat networks needs to be imported. Air source heat pumps (ASHPs) are an attractive low carbon technology for energy centres, but the scale required comes with challenges such as grid upgrade costs, a lack of space for large ASHPs arrays in or near zones, noise, and the unsuitability of central Edinburgh for large-scale industrial energy installations.

Therefore, we have carried out high-level analysis to illustrate how it might be feasible to transport heat from further afield into the zones, and whether that heat could be economically attractive.

We suggest two spinal routes to be able to collect heat from all three primary heat sources, to serve up to ten zones, and to avoid crossing railway lines wherever possible. This route is expected to evolve significantly over time following more detailed analysis.

The Northern Spinal Route could serve three zones from Port of Leith sea source heat pumps. The Southern Spinal Route could serve up to seven zones from Cockenzie sea source heat pumps and Monktonhall Colliery ground source heat pumps. The concept spinal architecture is presented in Figure 2 and the route is presented in the following page.

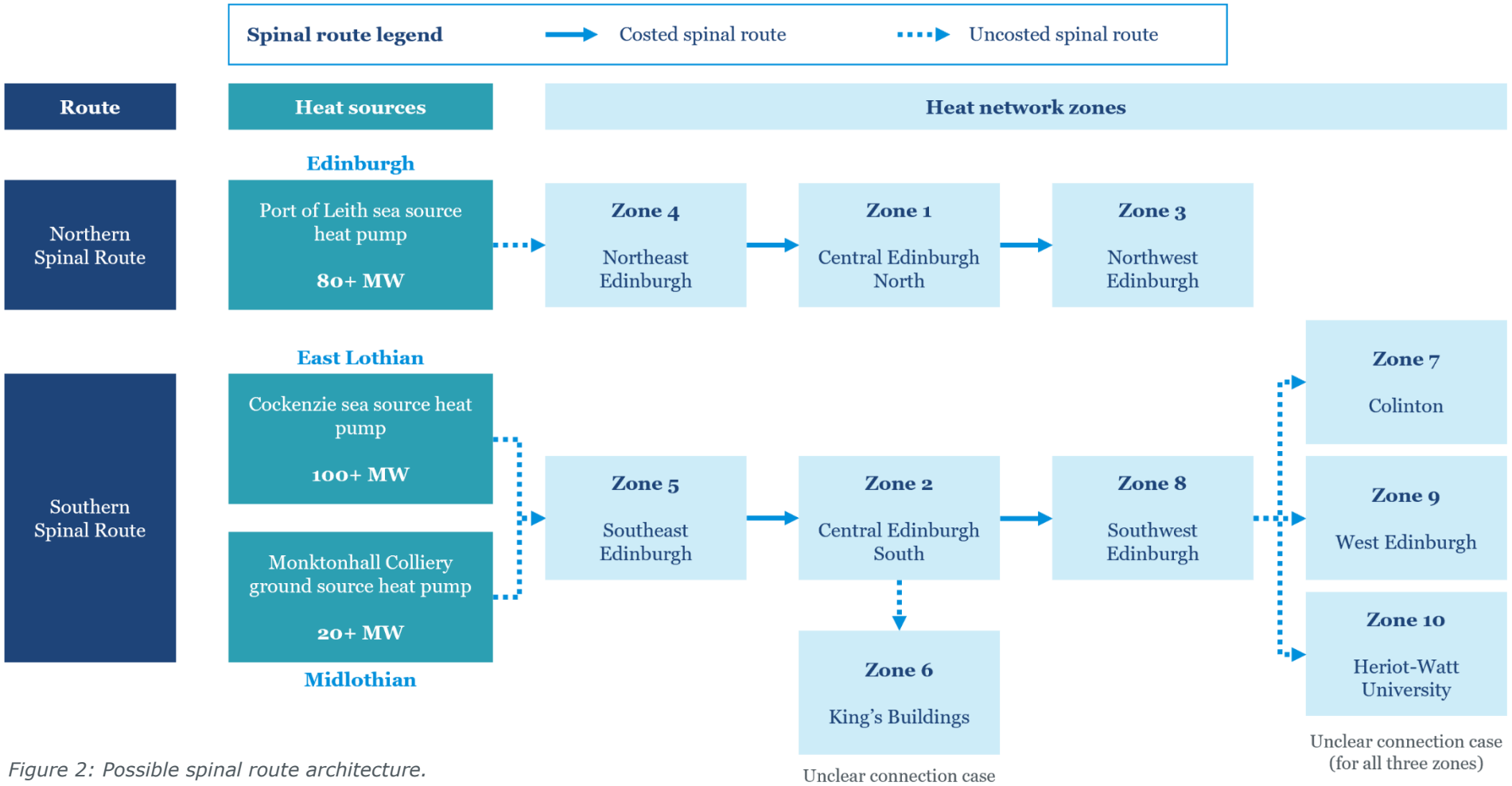
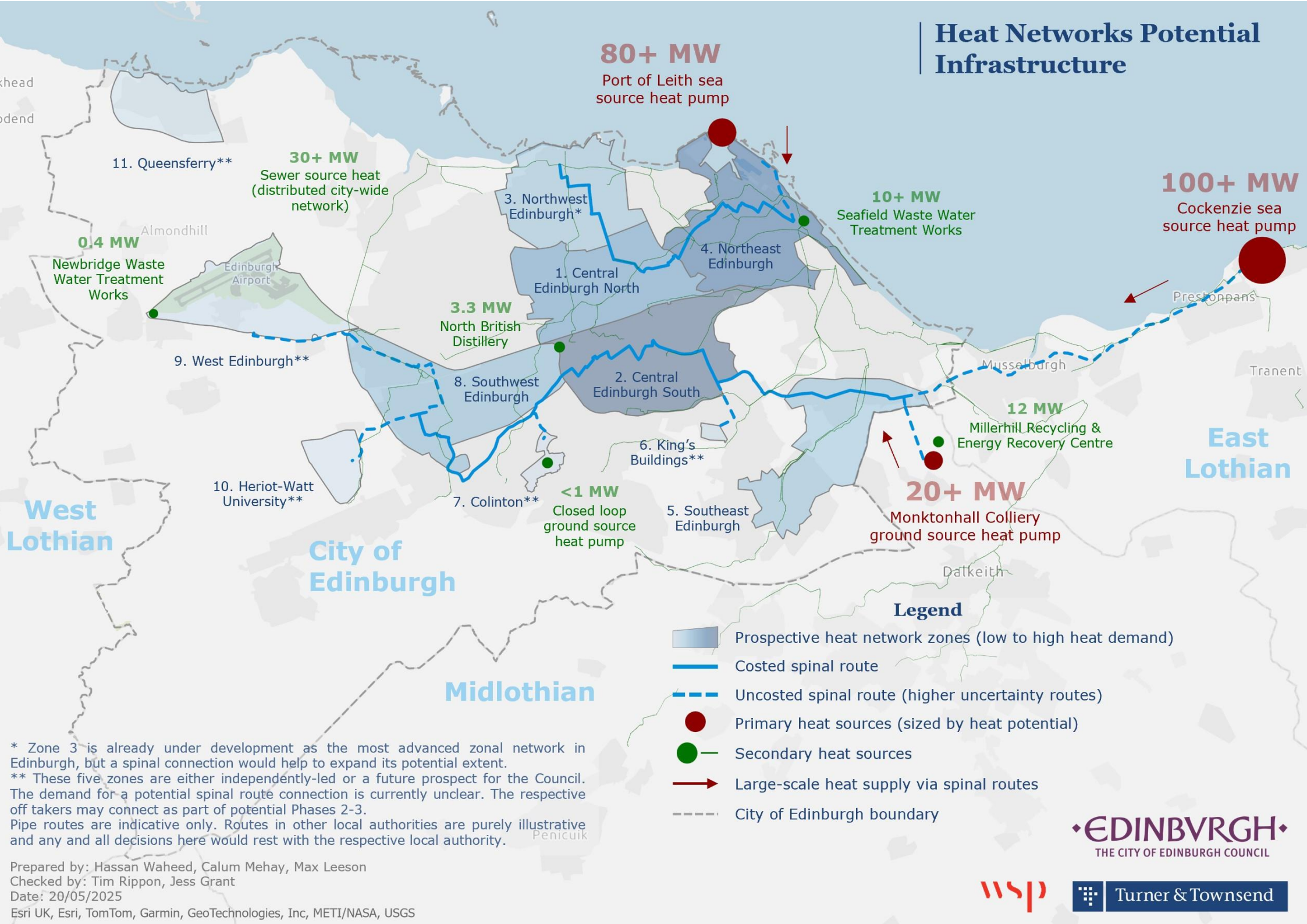


Figure 2: Possible spinal route architecture.



* Zone 3 is already under development as the most advanced zonal network in Edinburgh, but a spinal connection would help to expand its potential extent.
** These five zones are either independently-led or a future prospect for the Council. The demand for a potential spinal route connection is currently unclear. The respective off takers may connect as part of potential Phases 2-3.
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1.5 Feasibility review of zones

We carried out a high-level feasibility review of several heat network zones. This process involved developing a heat load profile for the anchor loads in each zone, energy modelling to estimate energy centre primary plant requirements and a zonal heat network route connecting all anchor loads. This enabled initial cost models to be developed, and basic economic viability tests applied.

We carried out a levelised cost of heat (LCOH) assessment (Table 1). LCOH is the average cost of heat per kWh over the system's lifetime, including capital, operation, maintenance and fuel costs. LCOH is not a heat tariff but can help compare the cost of alternative methods of energy production.

Zone number & name	LCOH (p/kWh) – 50% grant	LCOH (p/kWh)
Zone 1 – Central Edinburgh North	12.3	16.7
Zone 2 – Central Edinburgh South	11.1	14.6
Zone 4 – Northeast Edinburgh	13.2	19.6
Zone 5 – Southeast Edinburgh	10.2	13.3
Zone 7 – Colinton	14.6	21.3
Zone 8 – Southwest Edinburgh	12.8	17.6
Zone 11 – Queensferry	13.8	20.8
Total	**N/A**	**N/A**
Building-level ASHP counterfactual	15.6	

Table 1: LCOH across all zones assuming current maximum level of grants for heat networks, compared with individual ASHPs.

Our analysis is high-level and indicative, relying on several assumptions where real-world conditions could not be fully accounted for. A key limitation is that zonal networks are modelled using theoretical ASHP-based energy centres, without factoring in heat from a spinal route due to data gaps and scope limitations. Incorporating spinal heat could significantly improve feasibility. Additionally, our analysis uses only anchor loads, excluding other potential connections, which could raise or lower the LCOH based on factors such as heat density and connection costs. Outputs should be refined through detailed feasibility studies.

An example anchor network (*Zone 1 – Central Edinburgh North*) is presented in Figure 3. In the following page, we provide an overview of the potential £1.5bn capital investment opportunity for heat network infrastructure, across three phases.

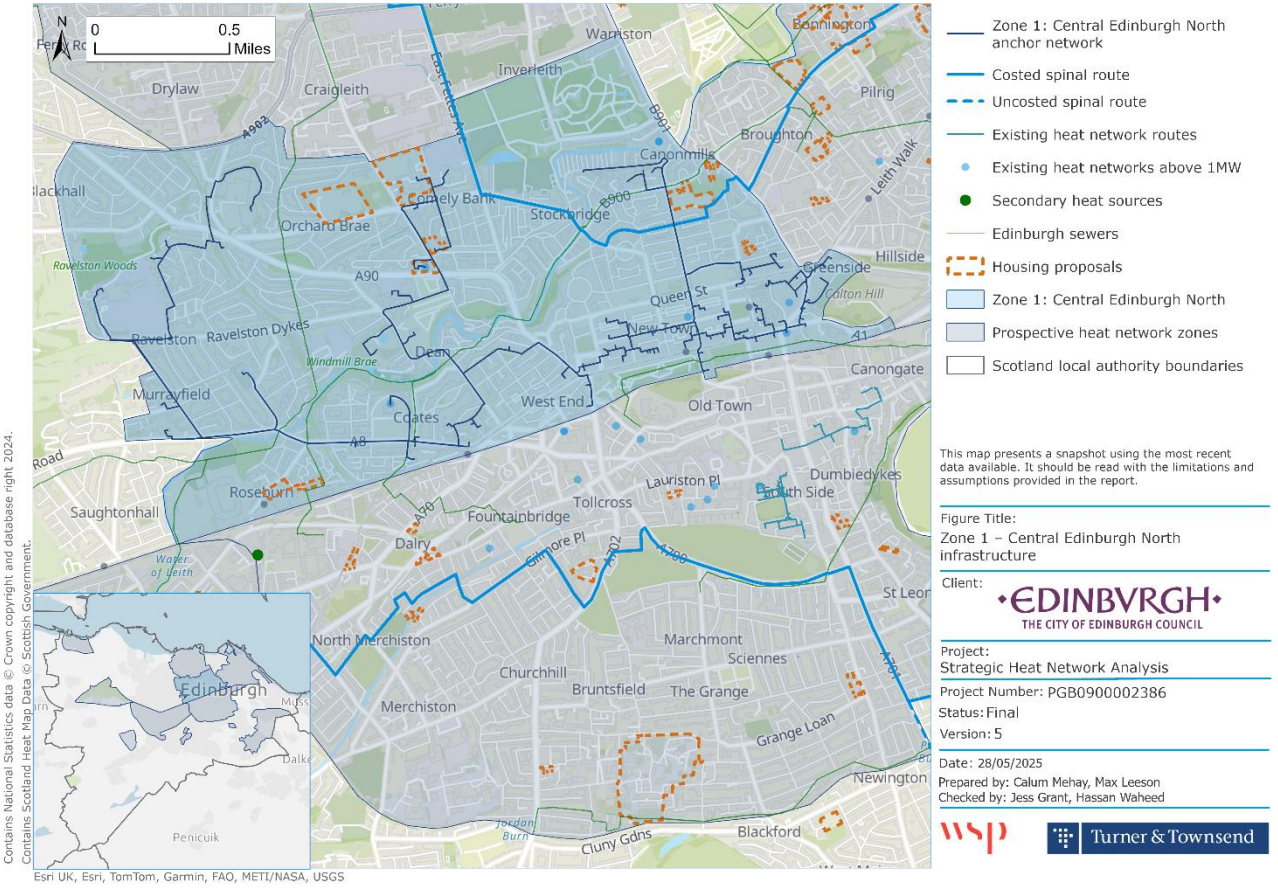
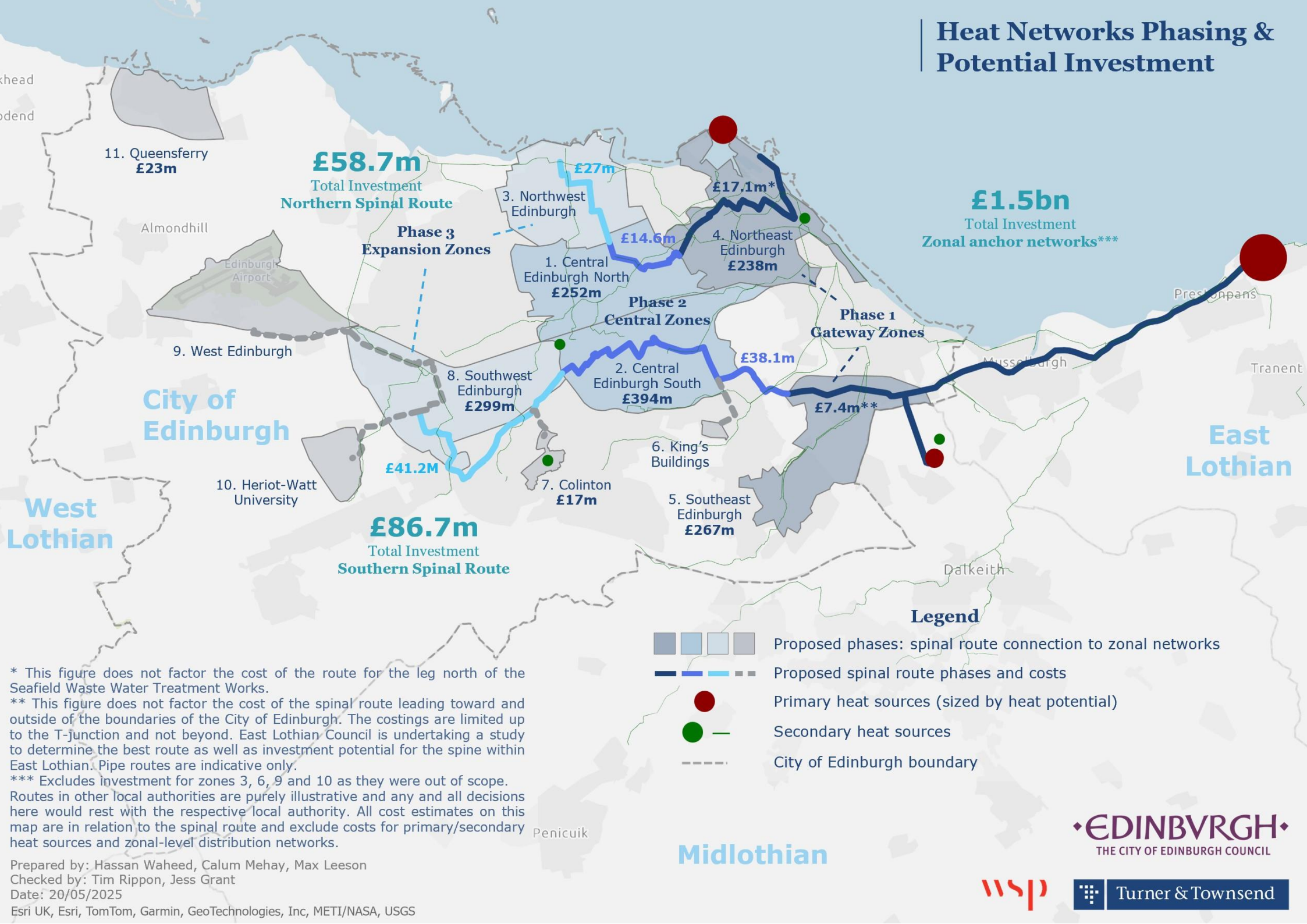


Figure 3: Anchor network example: Zone 1 – Central Edinburgh North

Heat Networks Phasing & Potential Investment



Legend

- Proposed phases: spinal route connection to zonal networks
- Proposed spinal route phases and costs
- Primary heat sources (sized by heat potential)
- Secondary heat sources
- City of Edinburgh boundary

* This figure does not factor the cost of the route for the leg north of the Seafield Waste Water Treatment Works.
** This figure does not factor the cost of the spinal route leading toward and outside of the boundaries of the City of Edinburgh. The costings are limited up to the T-junction and not beyond. East Lothian Council is undertaking a study to determine the best route as well as investment potential for the spine within East Lothian. Pipe routes are indicative only.
*** Excludes investment for zones 3, 6, 9 and 10 as they were out of scope. Routes in other local authorities are purely illustrative and any and all decisions here would rest with the respective local authority. All cost estimates on this map are in relation to the spinal route and exclude costs for primary/secondary heat sources and zonal-level distribution networks.

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1.6 Delivery strategy

1.6.1 Strategic energy assets

We consider large-scale primary heat sources and spinal routes as critical infrastructure to fully deliver a city-wide heat network. Further, we also think this approach can drive down the cost of heat for Edinburgh's customers relative to low carbon counterfactuals. This can be achieved by developing primary energy sources into strategic energy assets using one or more of the following approaches:

- At a basic level, a greater scale of electricity demand will allow these sites to negotiate cheaper electricity tariffs.
- A primary heat source could attract a private wire connection to renewable energy sources (e.g. offshore wind). This would provide significantly cheaper electricity than is available via the grid.
- Large-scale heat storage will introduce significant flexibility, allowing storage to be charged from cheap off-peak and private wire electricity when these are available. Heat can be used when electricity costs are high. Storage also provides system resilience and helps to balance the grid. Different forms of storage can help to offset the financial impact of heat demand peaks across the short (hours to days), medium (weeks) and long term (seasonal).
- Economies of scale could allow developers to achieve cost reductions through efficiencies in heat generation equipment, operations, and procurement.
- Other innovative ways to reduce costs and leverage the unique role of primary heat sources include using combined heat and power plants as, backup, peaking assets and export electricity as a revenue stream.

1.6.2 Role of the Council

The Council has multiple statutory obligations which make it the *de facto* coordinator of heat networks in Edinburgh. Its role in administering the city make it a critical partner from a practical perspective. Its actions influence investment intent in a major way, and its decisions define how, where and when developments can happen. Thus, the Council is central to strategic heat network development. We make the following recommendations for progressing with these plans:

- Launch the heat network delivery programme originally envisaged in the LHEES. It should address the decisions, responsibilities and plans deferred within the Edinburgh LHEES. It should include the recommendations of this analysis and be structured to manage the Council's role in/with the selected delivery model. The programme should have clear milestones and time-bound actions to achieve these.
- Engage the HNSU to seek funding for personnel and other means of increasing capacity and skills. This will help progress further studies as well as develop the functions required for the programme.
- Continue engagement with key partners across the public sector, including NHS Lothian, Universities, and other public bodies to solidify support and foster collaboration.
- Decide the preferred delivery model as soon as possible, with details on its implementation across zonal and spinal networks, and primary and secondary heat sources. This will set the foundation for large-scale heat network development.
- With HNSU support, expand the dialogue with East Lothian Council and Midlothian Council to coordinate approaches to analysis, development, financing, and operation of primary heat sources and a spinal route across the region.
- Comply with anticipated Ofgem regulations to support a clear and fair heat price which benefits both developers and customers.

In addition, we make these recommendations in relation to the objectives of this study:

- Heat sources: develop plans to utilise viable primary heat sources, prioritising the Port of Leith sea source heat pumps, with a coalition of partners and continue collating data on secondary heat sources.
- Zone refinement: consider developing pilot zones to test incoming regulations and align to LHEES activities.
- Zone feasibility: prioritise a detailed feasibility study for *Zone 4 – Northeast Edinburgh* followed by *Zone 5 – Southeast Edinburgh*, with support from the HNSU. These should consider, both, primary heat sources and spinal routes alongside secondary heat sources.
- Spinal route: update spinal route(s) based on the most viable route options, constraints and opportunities to deliver heat at scale and cost-effectively.
- Stakeholder engagement: develop a clear strategy which identifies who, when and why the Council will engage on each of the preceding four areas of work.

Hassan Waheed
Associate Director

Turner & Townsend Consulting Limited
Atria One, Level 2
144 Morrison Street, Edinburgh, EH3 8EX

e: hassan.waheed@turntown.co.uk
w: www.turnerandtownsend.com