South Seaham Garden Village District Heat Network

Client: Heat Network Delivery Unit

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Feasibility project scope

- Energy demand and supply assessment
- Energy centre and central plant options based around mine water source heat pump
- Concept design for energy centre, energy distribution systems and network connections
- Techno-economic cash flow modelling
- HNIP application
- *Currently in commercialisation phase*

Scheme summary

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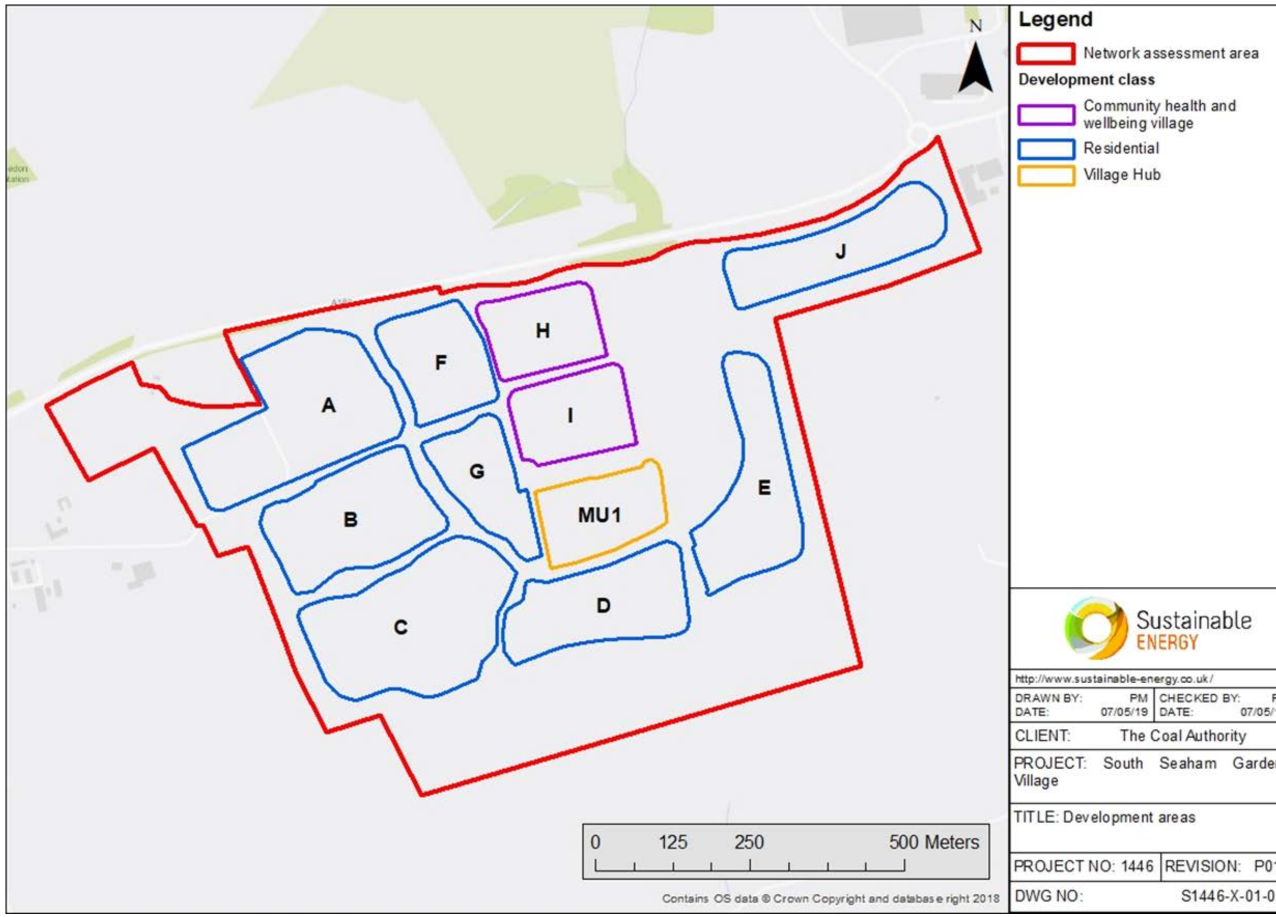
Demand assessment

- 1,500 houses
- Primary school
- Local Centre
- Health and Wellbeing Hub
- Innovation Hub
- Assumed site to be built out over next 10 years (2030 completion)
- ~15,000 MWh heat demand (>70% residential)
- <5 MW peak heat demand (at EC)



Energy supply

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- 2 MW mine water source heat pump the primary energy source
  - Availability of 150 l/s of 19 - 20°C water at surface
  - Phase 1 peak abstraction 75 l/s @ ΔT 3 °C (SPF_{H2} ~4)
  - Phase 3 peak abstraction 152 l/s @ ΔT 3 °C (SPF_{H2} ~4)
  - Phase 3 peak abstraction 91 l/s @ ΔT 5 °C (SPF_{H2} ~3.8)
- Numerous options assessed including gas CHP for self supply and gas peak and reserve boilers
- The optimised 'no gas' solution includes:
  - Mine water source heat pumps (phase 1 potentially 1 MW MWSHP)
  - 120,000 litres thermal storage
  - Electric peak and reserve boilers
  - ~350 m^2 energy centre

Network summary

- ~2 km of low temperature network spine (EC to development cells)
- >10 km of low temperature network within development cells
- Tolent are scheduled to begin the installation of site infrastructure in 2020
- Pipes to be installed in a utility trench as part of a coordinated approach
- If timelines are not aligned, DH pipes to be installed in safeguarded routes along the roadway verges with sleeving installed where appropriate (to futureproof road crossings, roundabouts etc)

LTHW versus ultra low temperature network assessment

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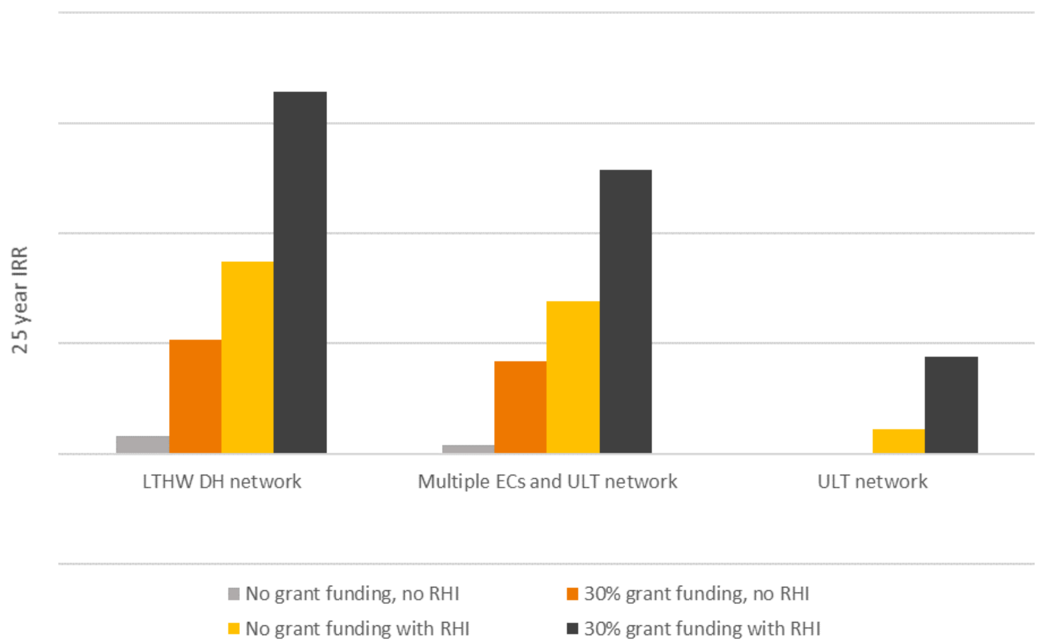
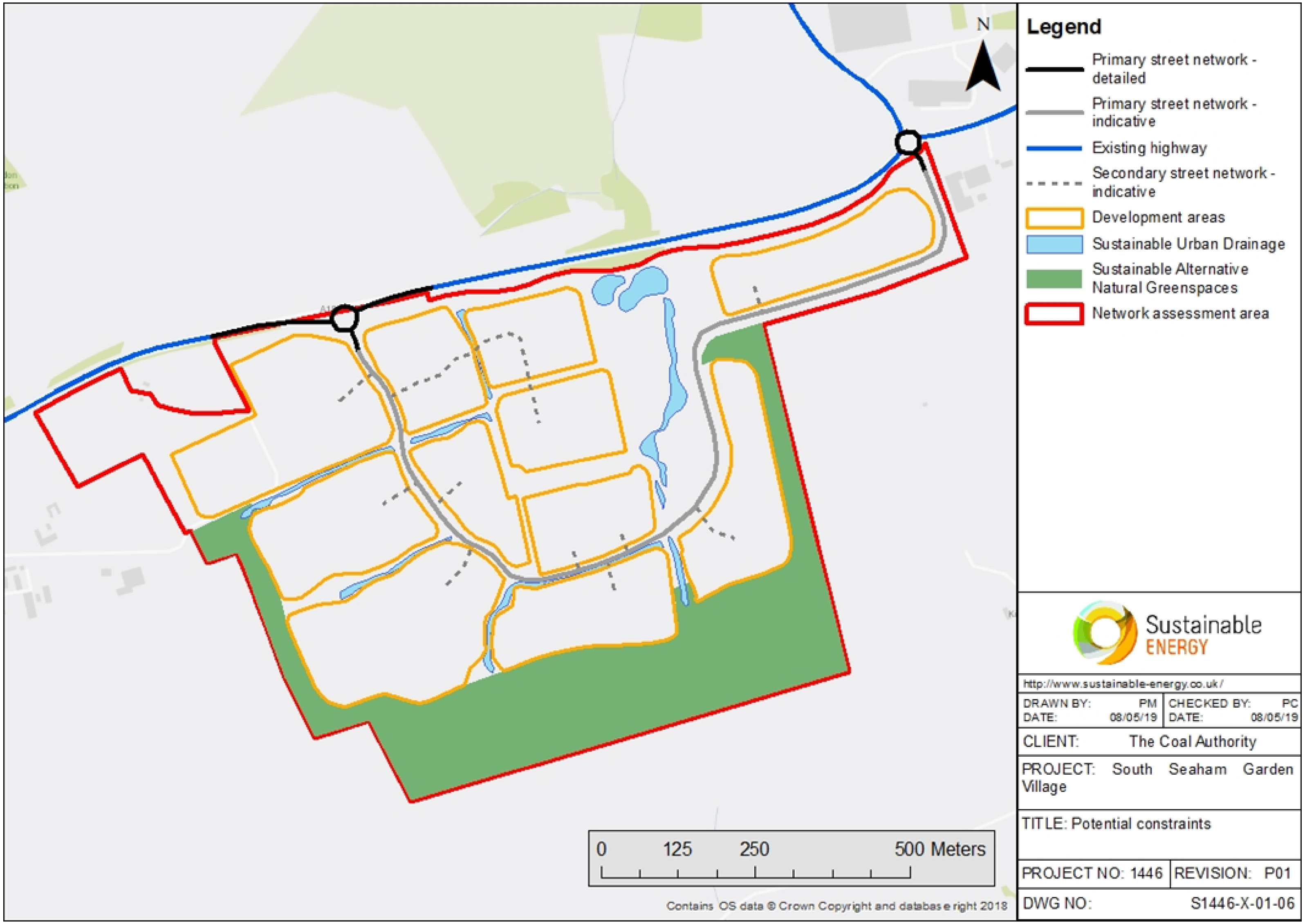
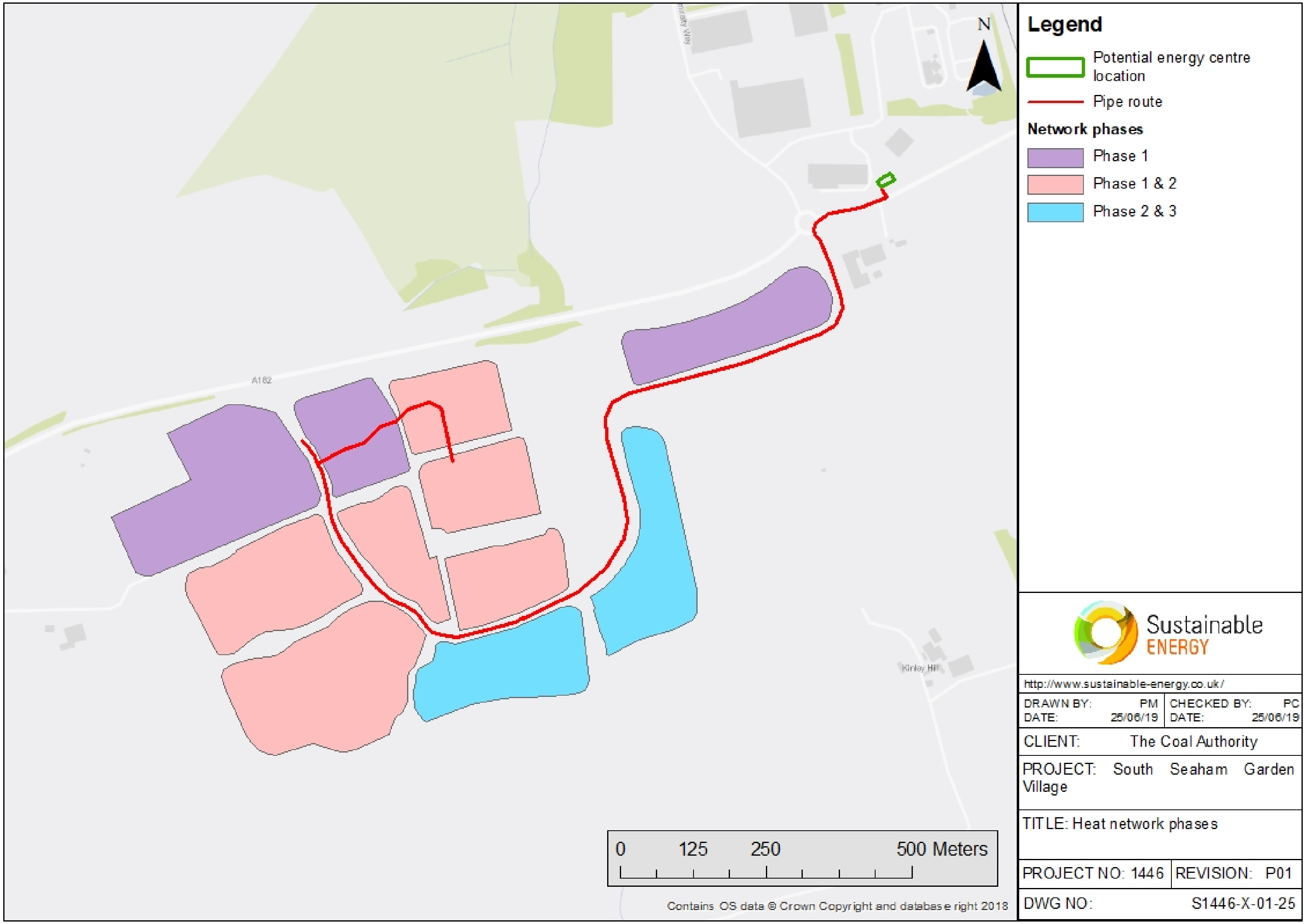
- Ultra low temperature network options were assessed and compared with LTHW district heat network options (with a single energy centre)
- Options assessed:
  - LTHW DH network with single energy centre
  - Full ultra low temperature network with heat pumps in each house / building
  - Intermediate ambient loop option with multiple energy centres serving different development cells
- The LTHW DH network has the best economics and provided significant environmental benefits



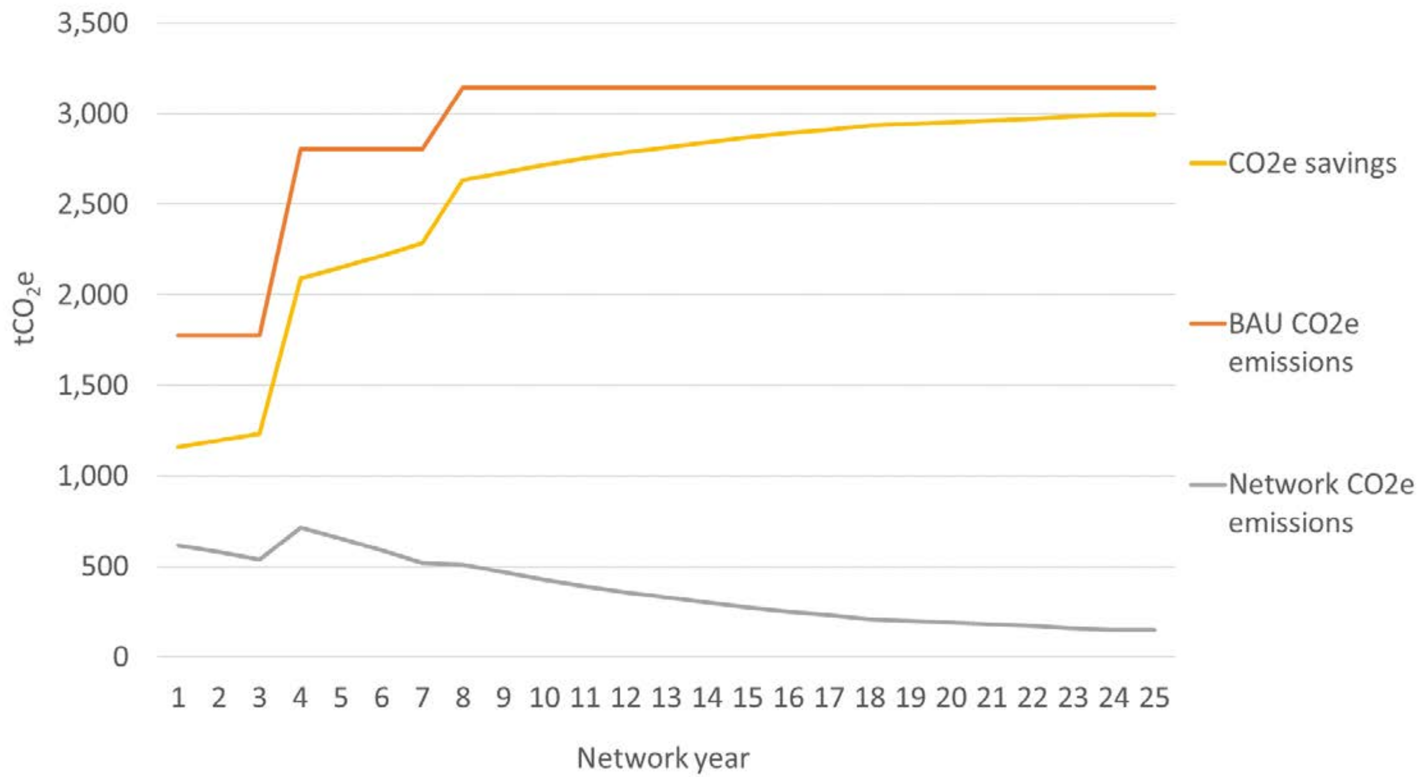
Network constraints



Network layout and network connection phasing assumptions



CO_2e savings



- The carbon intensity of heat from the phase 1 DH network (year 1) - **85 g/kWh**
- The carbon intensity of heat from gas boilers (year 1) - **245 g/kWh**
- The carbon intensity of heat from ASHPs at building level (year 1) - **136 g/kWh**

Concept design

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Energy centre general arrangement

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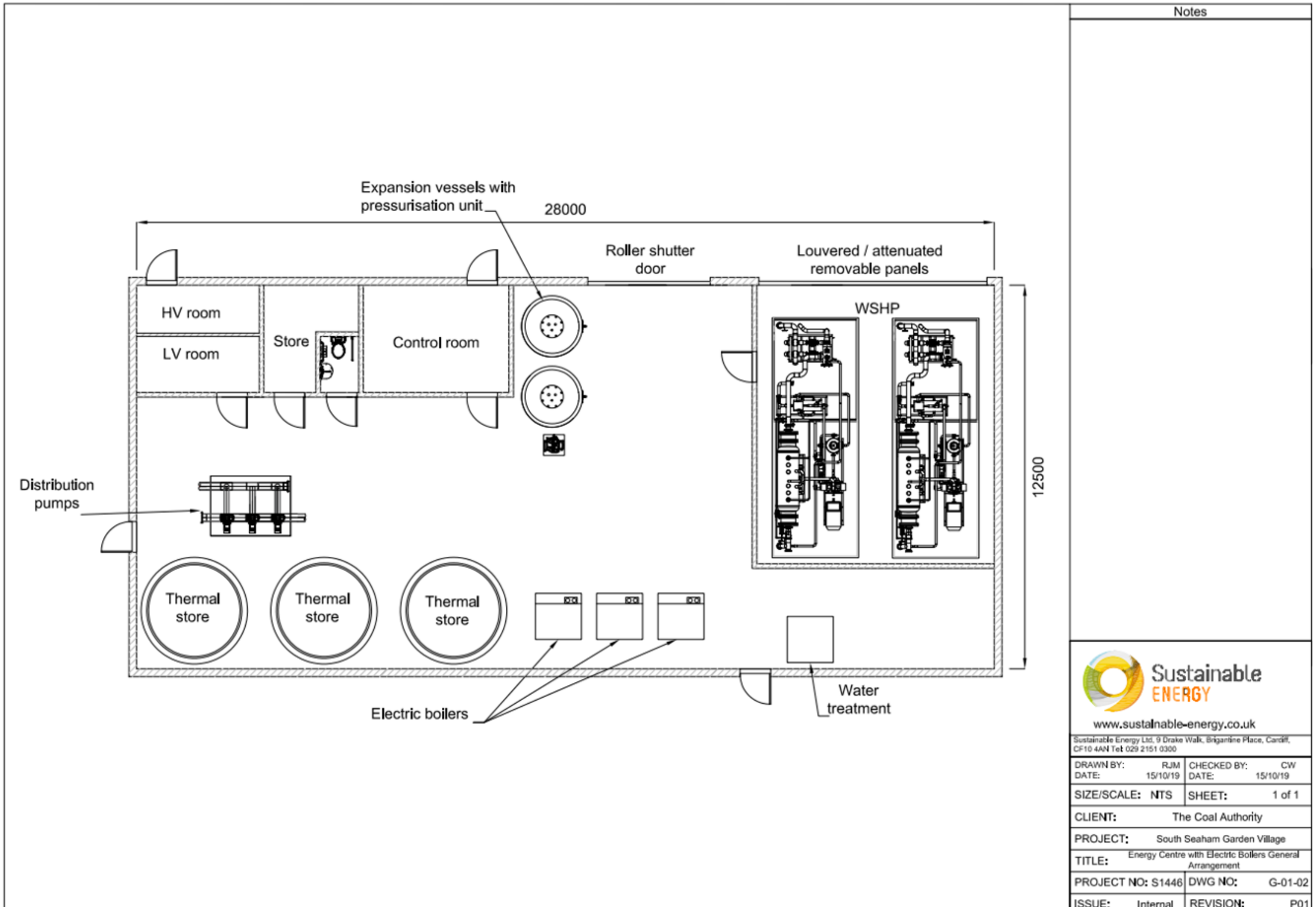
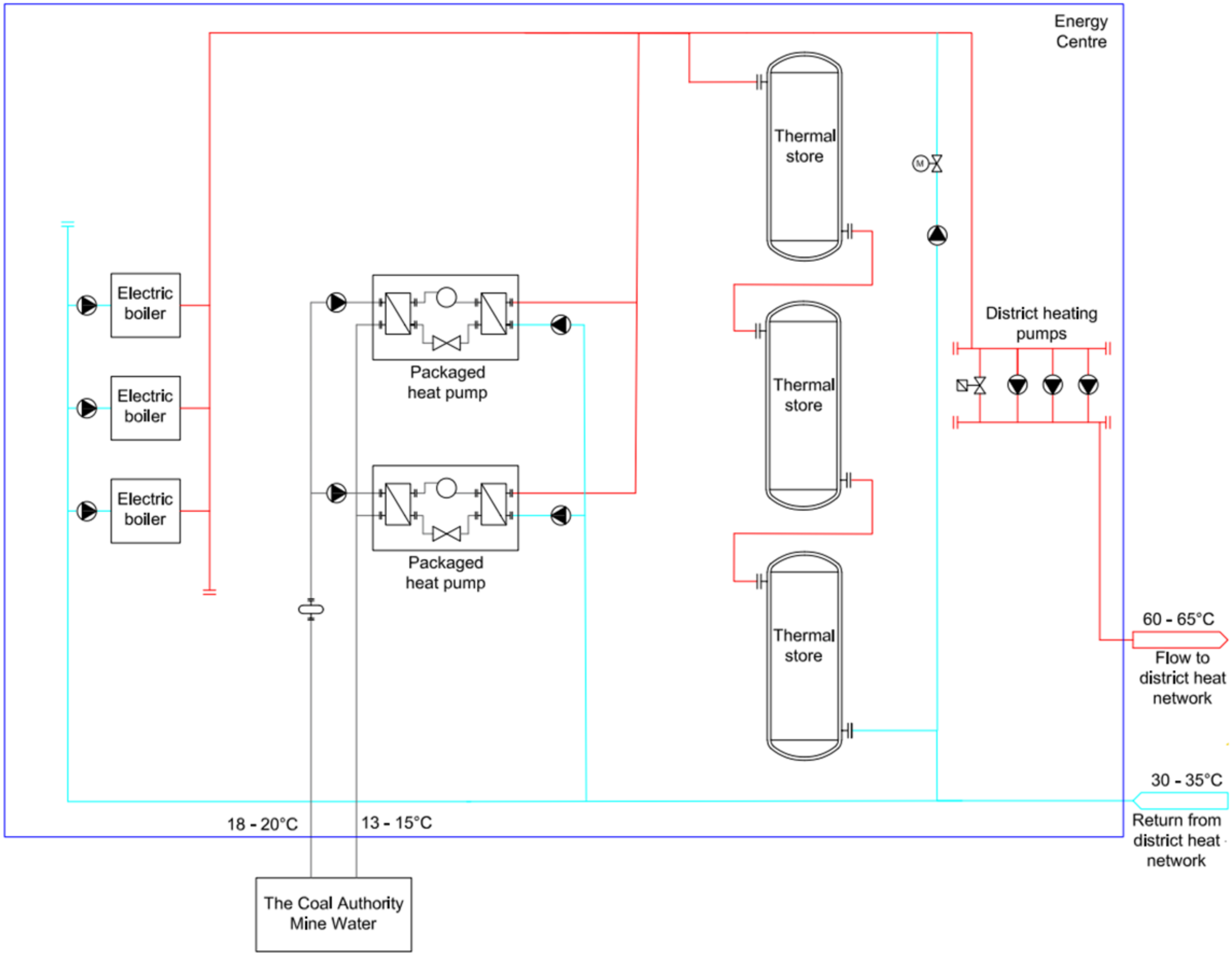


Energy centre PFD



Energy centre electricity capacity requirements

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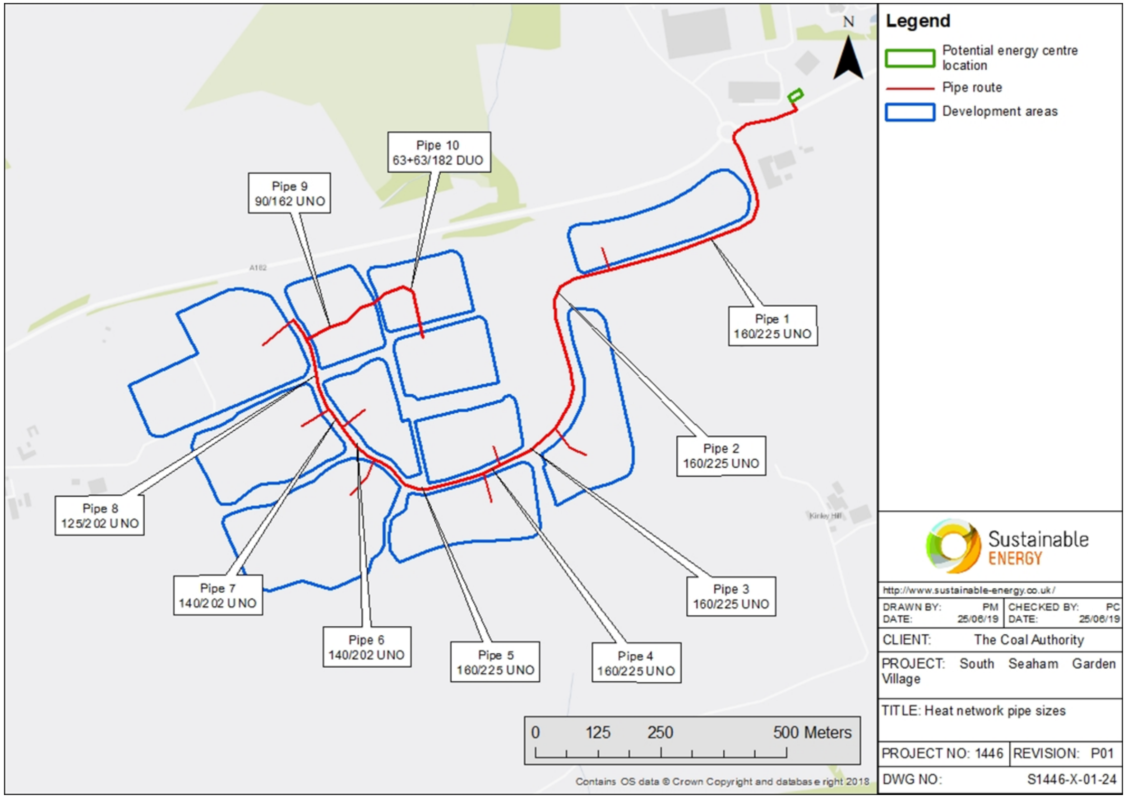
- Work ongoing to assess cost of energy centre electricity connection (5-7 MVA peak capacity)

Heat network assumptions

- >50% of network spine <DN150
- Branches to supply each of the cells <DN100
- The individual house connections are duo pipes <DN30



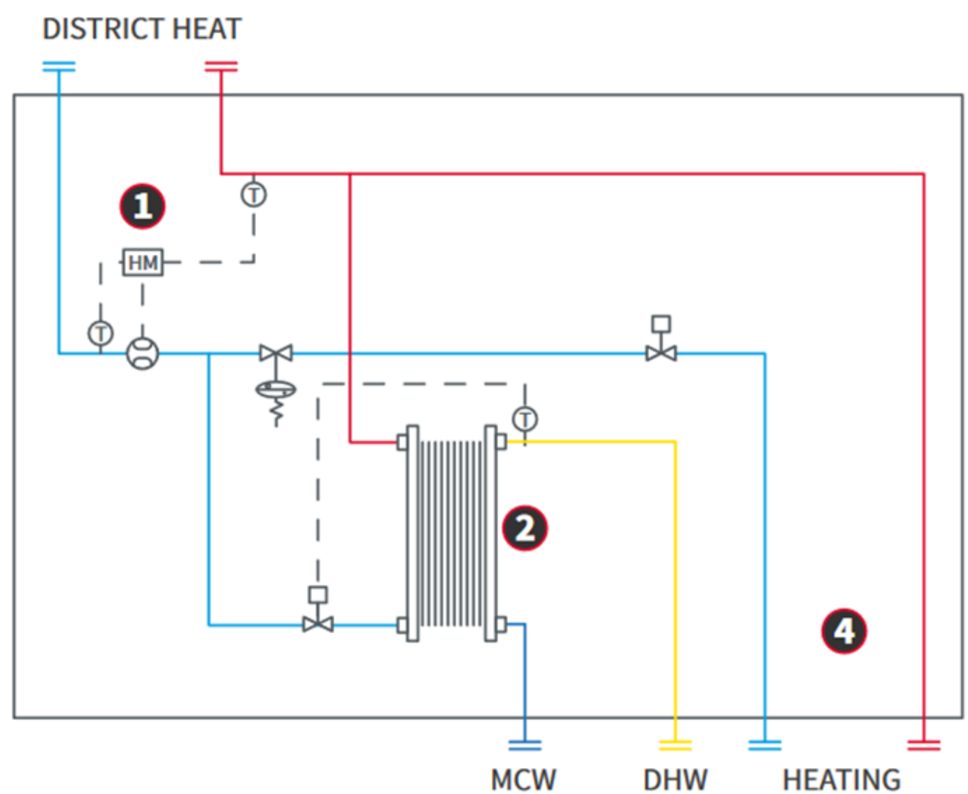
Operating conditions

- Primary network temperatures
  - The primary heat network flow temperature will be circa 60 - 65 °C
  - To maintain effective performance, network flow and return temperatures should be as low as possible
- Secondary system temperatures
  - Target building heating system temperatures are 60 °C flow and 30 °C return
- Operating Pressure
  - Static pressure circa 3 barG
  - Maximum system pressure <9 barG

Building connections

- Residential buildings
  - Connected to the heat network fitted with HIUs
  - Ideally all the network connections to the space heating will be direct allow all radiator circuits to be sized for 60 ° C flow and 30 ° C return
  - DHW will be instantaneous and indirect (no stored hot water in the dwellings)
  - For terraced houses, pipes will be installed through the loft space (or integrated into the building fabric or foundation)

- Commercial buildings
  - Fitted with substations - heat exchanger, control valves and heat metering



Summary

Summary

- The usual risks…
  - CAPEX increase
  - Low linear heat density
  - Volume and connection risk (network heat demand and buildings not connecting)
  - Electricity tariffs
  - Project funding (HNIP confirmation pending)
  - Timing and coordination
- *Missing the opportunity to provide a sustainable community development, delivering renewable heat to the village via a resilient system*
- Innovative exemplar project
- Stakeholder commitment in place
- Accessible, sustainable heat source in proximity of the garden village development

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