The Gateway to the Campus

Legibility is the core function of this area therefore the plaza space needs to balance the needs of pedestrians, cyclists and vehicles. This need for balance is illustrated on the adjacent plan through;

- The provision of vehicular drop-off zones,
- The creation of safe pedestrian routes and crossing points.
- Creating a dedicated cycle lane which links through to the cycle hub/cycle parking facilities located within the new hospital building.

1. Arrival plaza
2. Pedestrian crossing / shared space
3. Cycle Lane
4. SUDs
5. Seating space
6. Drop-off areas
7. Feature trees
8. Street trees

6.5.6 Biodiversity Net Gain

Any development within the site is required to achieve a net gain in biodiversity, the percentage net gain is to be agreed with the Council in advance of any planning application. This will be achieved through the design and implementation of planted areas within the masterplan, designing spaces which harbour native species for the enhancement of regional wildlife.

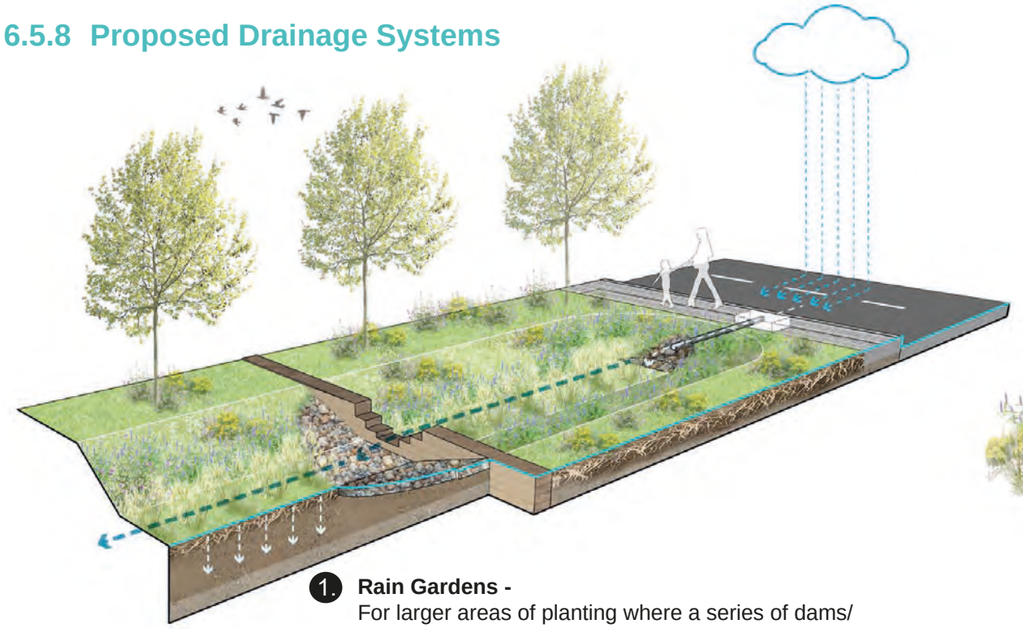
If the required gain is not achievable a suitable strategy for offsetting must be agreed with the Local Authority. This strategy must be agreed prior to any planning submission and implemented prior to construction work commencing.

6.5.7 Planting for Water

The masterplan, and the delivery of its public space, should emphasise nature-based solutions in order to combat the effects of climate change and reduce storm-water flooding. Its ability to capture surface water and help alleviate surface water flooding is a core design principle. Therefore consideration should be given to the management of rainwater into a sustainable urban drainage system (SuDS) to help prevent flooding and overloading of the active drainage network.

To achieve this the design of the landscaped areas should be coordinated with the drainage strategy and civil engineering in order for these objectives to be realised. If designed correctly SuDS and planting can mutually support each other.

6.5.8 Proposed Drainage Systems

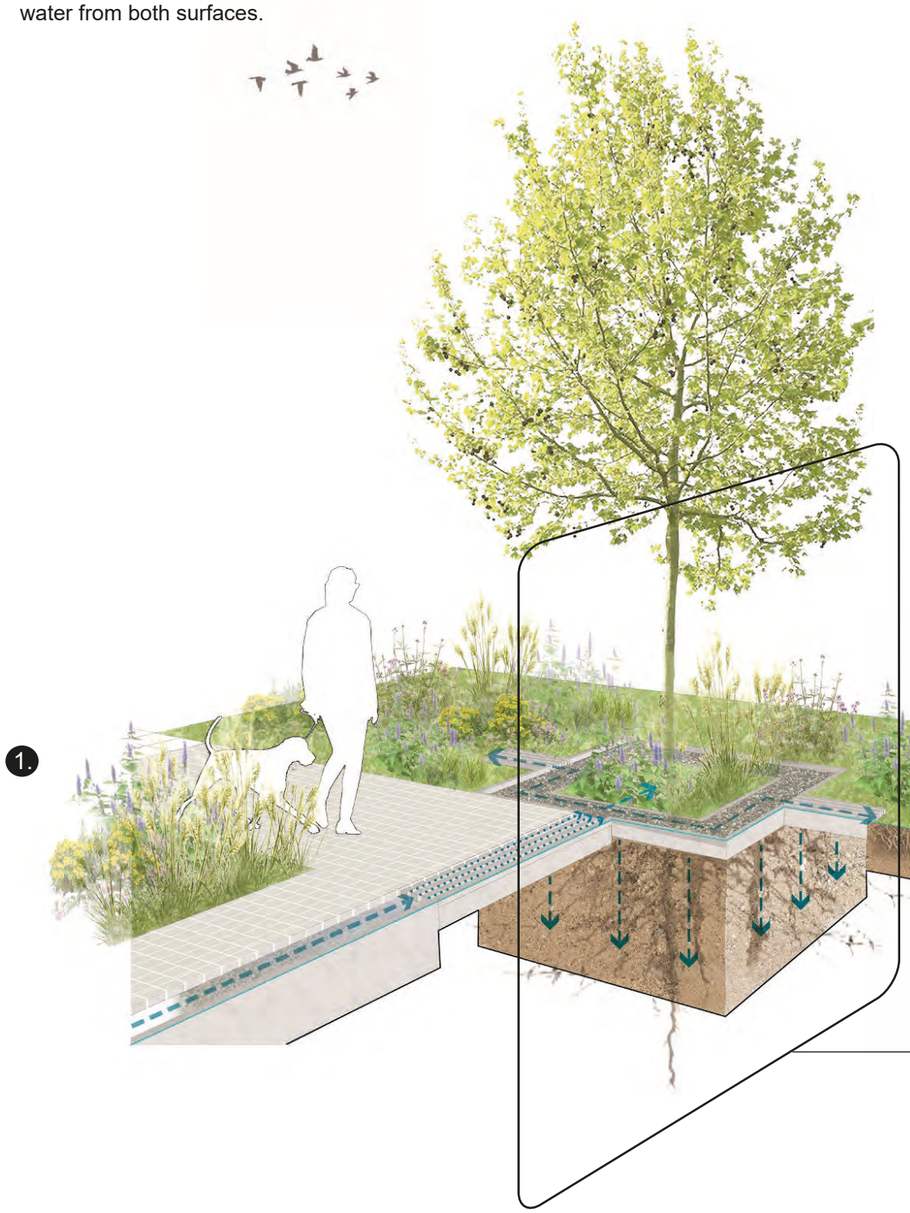


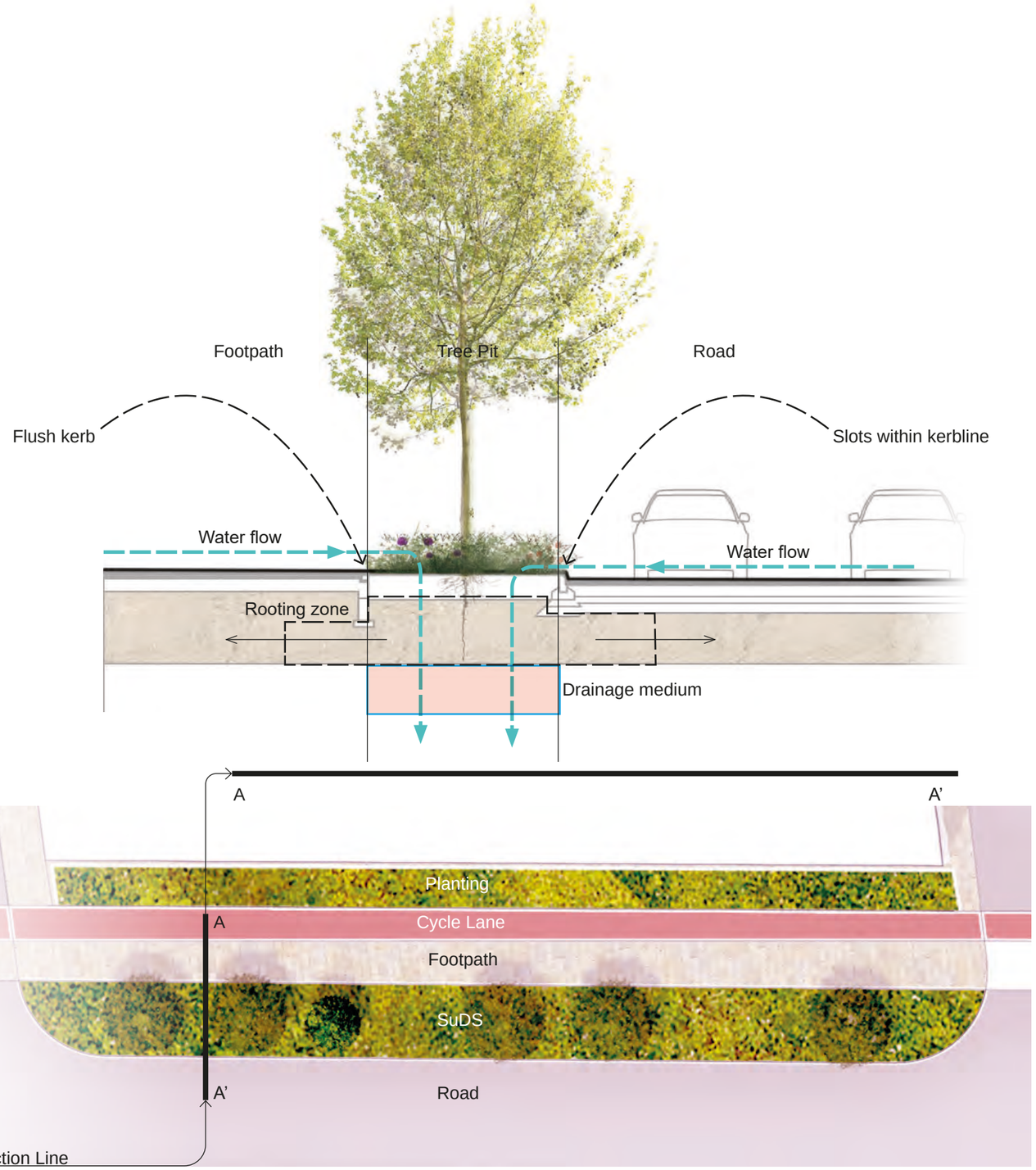
1. Rain Gardens -
For larger areas of planting where a series of dams/ edges retain water and reduce the flow rate, with the water guided by the levels design to gravel areas. This gravel area is where the water will percolate into the water-table or drainage network.

2. Streetscape SuDS Solution -
Tree pits specifically designed to receive and manage storm-water, this alongside planted areas which supplement the water capacity held within the pits.

6.5.9 SuDS Systems to Roads

Section showing the SuDS treatment along key roads. The SuDS system will sit between the pavement and road in order to capture surface water from both surfaces.





6.6 Civil and Structural Engineering Considerations

6.6.1 Masterplan Structural Appraisal

As part of the healthcare proposals, two new blocks of wards are proposed to be constructed within the centre of the site, replacing some of the older structures. The existing structures will have to be carefully demolished. If these existing structures are sat on shallow foundations, these will be required to be grubbed out, however if the existing buildings are sat on piles, which considering the weak ground conditions, is quite likely, a survey of the existing pile locations will be required so new foundations can be coordinated with the existing and avoid clashes with the existing piles.

Care will have to be taken during construction of these new structures due to the proximity to the other existing buildings, so that no original structures are damaged. A series of trial pits may be required to be carried out at column locations of the existing buildings in the proximity to determine the foundation solution of these buildings to ensure that the new constructions do not undermine the existing building foundations. Any new basement structures will also have to be situated sufficiently far away to minimise any impact on the existing structures.

There is also some anecdotal evidence of some wind tunnelling issues within the current hospital site. As part of the structural developments, a full wind tunnel assessment will have to be carried out to quantify the problem and ensure the effects of this, if any, are not aggravated by the new proposals.

Within the residential site, a series of different buildings, ranging from traditional town houses to apartment blocks are proposed.

Two new multi-storey car parks are also proposed to be constructed on the site. A variety of floor systems can be used in multi storey car park construction, with the ultimate choice depending on many factors including height restriction and structural layout. Some of the most common types of floor construction in multi-storey car parks include steel frame with composite beams, steel frame with precast concrete slabs or concrete frame with double T precast slabs.

The site is bounded by the north by an active railway track. Conversations with Network Rail will be required early on in the process in order to agree an acceptable easement zone to ensure any effect on the railway is minimised. Sufficient time should be allowed in the programme to obtain necessary approval from the railway company. Other aspects that will have to be taken into account during design and construction will include noise, vibration, access, and any necessary protection of signalling equipment, controls and communications.

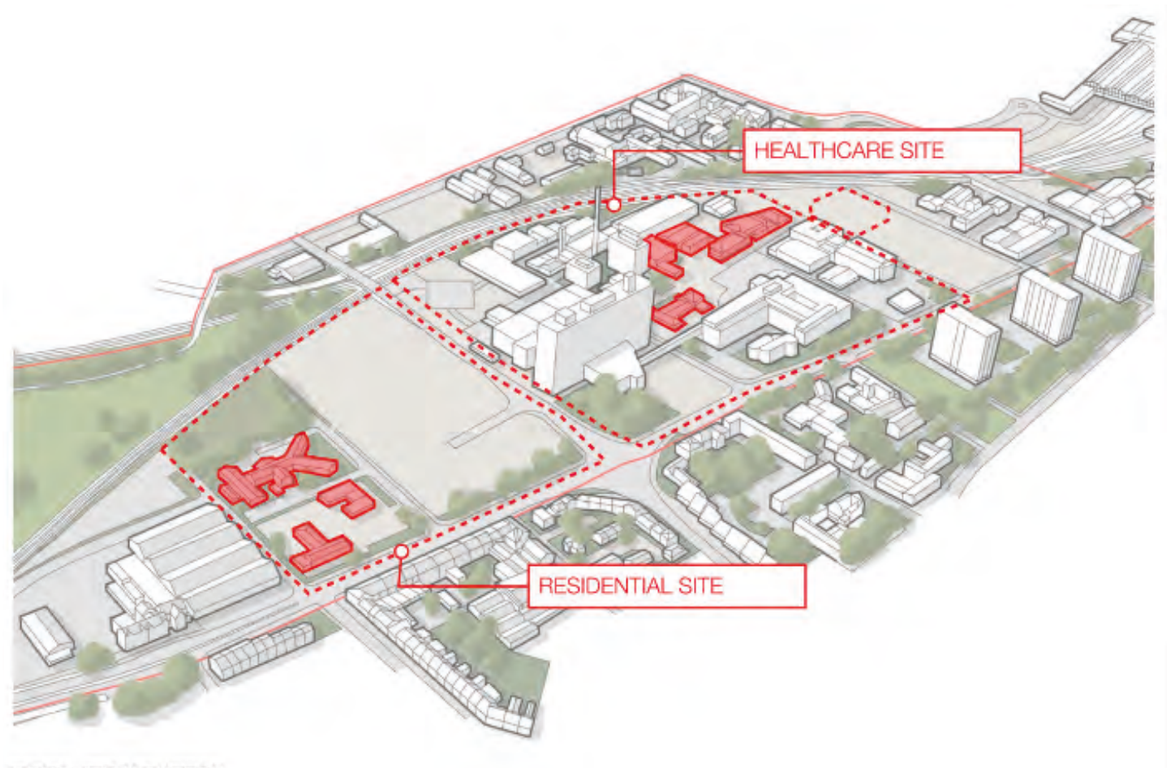


Figure 6.8: Demolition Masterplan Sketch

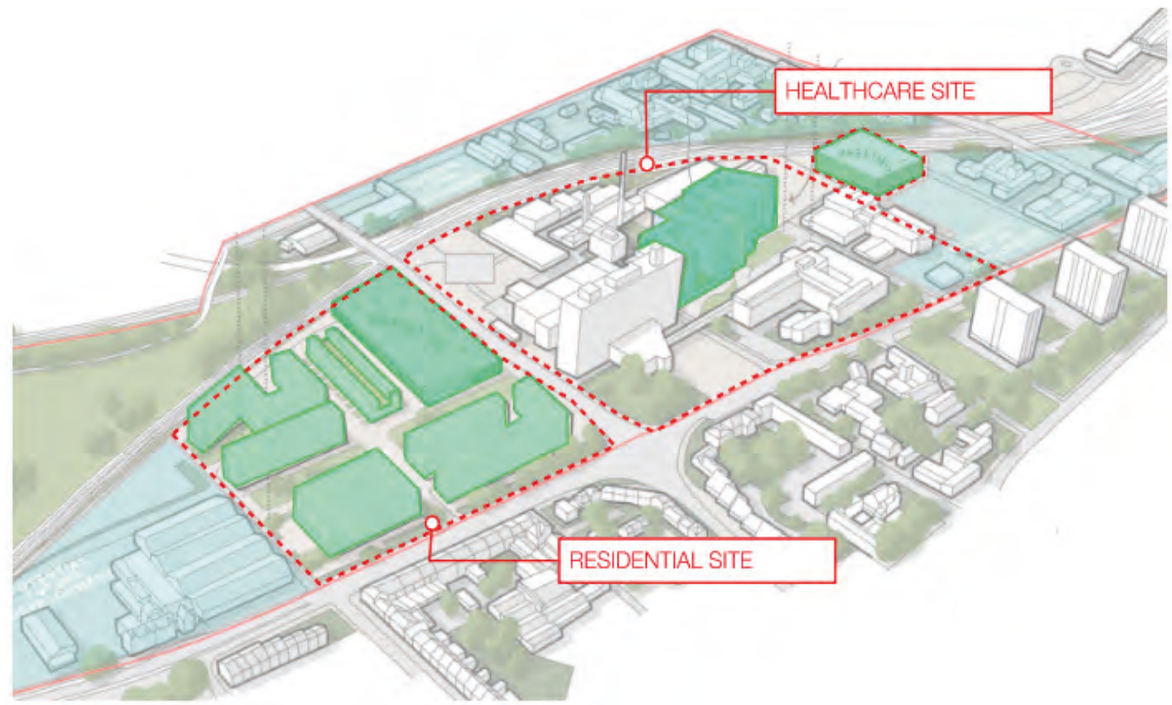


Figure 6.9: New Build Proposals Masterplan Sketch

6.6.2 Proposed Drainage Strategy- Surface Water Drainage

In accordance with Building Regulations and the NPPF Drainage Hierarchy the management and discharge of surface water from a development should be applied in the order of priority as listed.

1. Disposal to ground via infiltration, and where this is not practicable;
2. Disposal to a watercourse, and where this is not practicable;
3. Disposal to a surface water sewer or highway drain, and where this is not practicable;
4. Disposal to a combined sewer.

However, after a review of the surrounding area, underlying geology and local sewer records, the only feasible outfall location is to a public combined sewer. Consultation with the Lead Local Flood Authority (LLFA) and local Water Authority (Yorkshire Water) should be undertaken to confirm post-development discharge rates and outfall locations.

In accordance with local policy a 50% betterment on existing rates should be applied to brownfield sites and the use of SuDS should be incorporated into the proposed drainage strategy, where appropriate.

A variety of SuDS methods have been summarised in the table below to assess and establish which are most feasible within the proposed masterplan layout.

Suds Method	Comments	Feasible
Green & Blue Roof	Vegetated or hardstanding roof designed to store water, which can be used for irrigation, cooling water or non-potable use within the building. Flat roofs associated with Hospital buildings could be designed with this feature if structural capacity, extra loadings and waterproofing are taken into consideration within the design.	Yes
Basins and Ponds	Basins and ponds increase biodiversity and amenity of the area, provide attenuation and improve water quality. These could be included within the green spaces in the Masterplan.	Yes
Filter Strips, Swales and Raingardens	Filter Strip, swales and raingardens can be used within private or public areas to reduce and treat runoff. These could be incorporated into the amenity areas or around the hospital building to provide attenuation from rainwater pipes.	Yes
Permeable Paving	Permeable paving provides at source treatment and surface water storage within underlying sub grade. This can be applied to proposed public or private highways, footways and car parking areas.	Yes
Infiltration SuDS	Based on the underlying geology, infiltration is unlikely to be feasible at the site and has been discounted at this stage.	No
Tanked/Geocellular attenuation systems	Below-ground attenuation systems that can be designed for use under trafficked or landscaped areas. Tank systems can provide high storage capacity but do not provide runoff treatment or improve amenity and biodiversity.	Yes

Figure 6.10: SuDS Methods & Feasibility Study

Figure 6.11: Example Rain Garden

Figure 6.12: Example of Green Roof – Alder Hey Hospital

Figure 6.13: Example of Permeable Paving

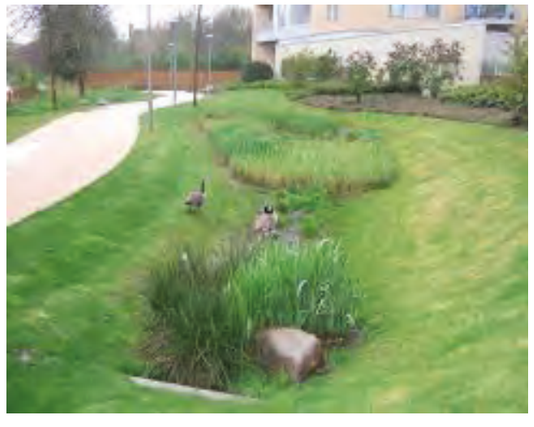


Figure 6.14: Example Swale

6.7 MEP Engineering Considerations

6.7.1 Overview

This section covers the energy and water strategies for the new residential development, adjacent and west of Hull Royal Infirmary on Anlaby Road.

The first wave of development (H) will comprise of up to 868 apartments and homes distributed over several blocks of varying height, from two to six storeys.

The design challenge is to put forward a strategy for the new development that is responsive to future changes to climate, energy production, water use and carbon emissions legislation, without limiting the use of the current technologies and energy sources.

This section covers the building service engineering systems, from the incoming utilities to future, zero carbon site wide heating and power production to serve the housing and hospital.

The purpose of this section is to establish an energy strategy, taking into account the development's anticipated usage, architecture, and HVAC servicing strategy.

6.7.2 The Challenge

The challenge is to design a development that has:

- Goes far beyond the requirements of Building Regulations in a quest for zero carbon
- Building envelopes that are as energy efficient as is possible.
- Residential apartments will be constructed to provide healthy, naturally lit, comfortable living environments that can respond to changes in life styles over the decades.
- Building engineering systems that are as efficient as commercially possible now.
- The Hull Royal Infirmary to support and be supported by the developed energy and water strategies to the benefit of the NHS Trust and residents in terms of energy and water savings resulting in cost savings.
- Infrastructure serving the development that is adaptable to future changes in technology.
- Renewable energy sources that are the base source of energy to the development.

6.7.3 The Strategy

The Strategy is to design a development that has:

- Building envelopes that use the most onerous envelope performance as is commercially available at construction.
- Residential apartments constructed with the minimum air permeability, be mechanically ventilated, with appropriately sized and shaded windows.
- Mechanically ventilate generally, with openable windows as required by the residents.
- Efficient building engineering systems with heat recovery where possible to minimise resource consumption and pollution.
- To reduce wasted energy and water wherever feasibly possible.
- Simple, adaptable, resilient central plant, using development wide infrastructure that serves each apartment.
- On-site and off-site renewable energy sources.
- Provide centralised residential facilities including laundries and home working offices.

6.7.4 Energy and Carbon Targets for Residential Blocks

The following are a wide range of different criteria that have been considered when the design criteria for the residential buildings have been established.

Hull City Council

Hull City Council have established a target for Hull to become a carbon neutral economy for both production and consumption of emissions by 2030.

Building Regulations

The new residential buildings will comply the recently updated Building regulations, specifically Building Regulations, specifically Approved Document L, Conservation of Fuel and Power, and the new Approved Document O, Overheating Mitigation.

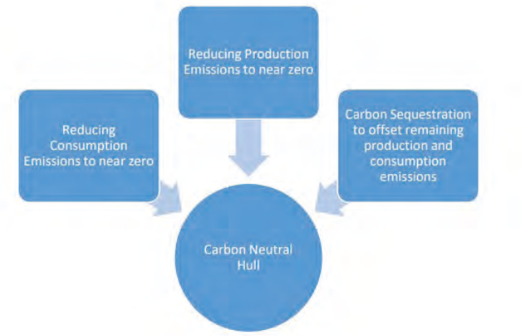


Figure 6.15: Hull City Council Three Actions for Carbon Neutrality

Table 1.1 Summary of notional dwelling specification for new dwelling[1]

Element or system	Reference value for target setting
Opening areas (windows, roof windows, rooflights and doors)	Same as for actual dwelling not exceeding a total area of openings of 25% of total floor area[2]
External walls including semi-exposed walls	U = 0.18 W/(m²·K)
Party walls	U = 0
Floors	U = 0.13 W/(m²·K)
Roofs	U = 0.11 W/(m²·K)
Opaque door (less than 30% glazed area)	U = 1.0 W/(m²·K)
Semi-glazed door (30–60% glazed area)	U = 1.0 W/(m²·K)
Windows and glazed doors with greater than 60% glazed area	U = 1.2 W/(m²·K) Frame factor = 0.7
Roof windows	U = 1.2 W/(m²·K), when in vertical position (for correction due to angle, see specification in SAP 10 Appendix R)
Rooflights	U = 1.7 W/(m²·K), when in horizontal position (for correction due to angle, see specification in SAP 10 Appendix R)
Ventilation system	Natural ventilation with intermittent extract fans
Air permeability	5 m³/(h·m²) at 50 Pa
Main heating fuel (space and water)	Mains gas
Heating system	Boiler and radiators Central heating pump 2013 or later, in heated space Design flow temperature = 55 °C
Boiler	Efficiency: SEDBUK 2009 = 89.5%
Heating system controls	Boiler interlock, ErP Class V Either: – single storey dwelling in which the living area is greater than 70% of the total floor area: programmer and room thermostat – any other dwelling: time and temperature zone control, thermostatic radiator valves
Hot water system	Heated by boiler (regular or combi as above) Separate time control for space and water heating
Wastewater heat recovery (WWHR)	All showers connected to WWHR, including showers over baths Instantaneous WWHR with 36% recovery efficiency utilisation of 0.98
Hot water cylinder	If cylinder, declared loss factor = 0.85 × (0.2 + 0.051 $V^{2/3}$) kWh/day where V is the volume of the cylinder in litres
Lighting	Fixed lighting capacity (lm) = 185 × total floor area Efficacy of all fixed lighting = 80 lm/W
Air conditioning	None
Photovoltaic (PV) system	For houses: kWp = 40% of ground floor area, including unheated spaces / 6.5 For flats: kWp = 40% of dwelling floor area / (6.5 × number of storeys in block) System facing south-east or south-west

NOTE:
1. For a dwelling connected to an existing district heat network, an alternative notional building is used. See paragraph 1.8 and SAP 10.
2. See SAP 10 for details.

Figure 6.16: Building Regulations, Part L Design Summary

LETI

The London Energy Transformation Initiative (LETI) is a voluntary group made up of housing associations, construction professions, facilities managers and developers, support and input provided by the GLA and London boroughs and other organisations to put the UK on the path to a zero carbon future.

LETI have launched the Climate Emergency Design Guides, which outlines requirements of new buildings to ensure the UK's climate change targets are met.

LETI has more onerous building envelope targets compared to the updated Part L, in particular air tightness. It also removes the use of gas or any fossil fuels.

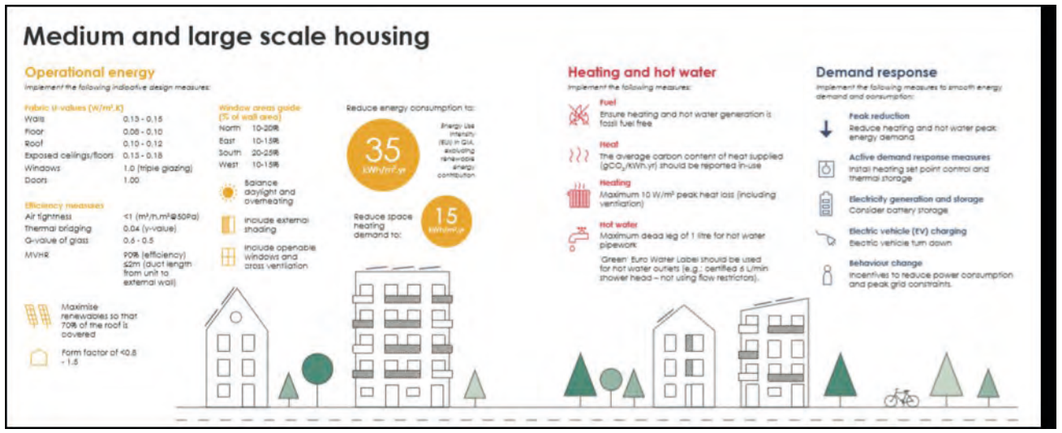


Figure 6.17: LETI Design Guide

Passivhaus

Passivhaus is driven by air quality and comfort:

> "A Passivhaus is a building in which thermal comfort can be achieved solely by post-heating or post-cooling the fresh air flow required for a good indoor air quality, without the need for additional recirculation of air."

For a building to be Passivhaus certified, it is required to meet the principles shown in the adjacent diagram:

Passivhaus focuses on the air quality and ventilation of the apartments and houses, and is much more onerous that the current Building Regulations.

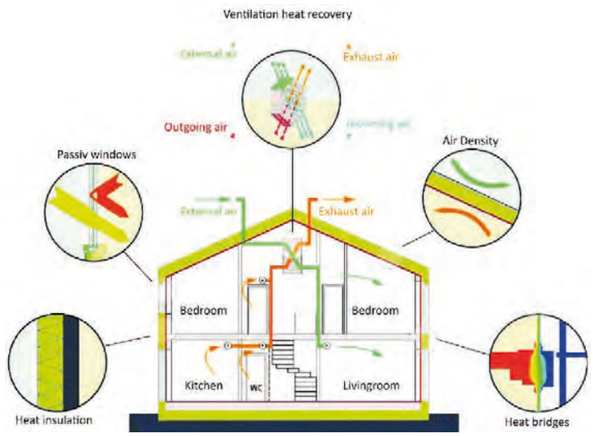


Figure 6.18: Passivhaus Five Basic Principles

Recommendation for Residential Blocks:

The following is the recommendation for the Residential buildings design criteria:

- Follow LETI for the building Envelope as far as is practical.
- Target Passivhaus ventilation standards.

6.7.5 Energy and Carbon Targets for Hull Royal Infirmary

All new and refurbished hospital building will comply with the current Building Regulations, along with appropriate NHS Health Technical Memoranda (HTM)
NHS Zero Carbon

The NHS report 'Delivering a 'net-zero' National Health Service' sets out the following targets:

- Net zero carbon by 2040 for the NHS Carbon Footprint, with an ambition for an 80% reduction (compared with a 1990 baseline) by 2028 to 2032
- Net zero carbon by 2045 for the NHS Carbon Footprint Plus, with an ambition for an 80% reduction (compared with a 1990 baseline) by 2036 to 2039. (NHS Carbon Footprint Plus includes the carbon emissions from medicines, medical equipment and other supply chain)

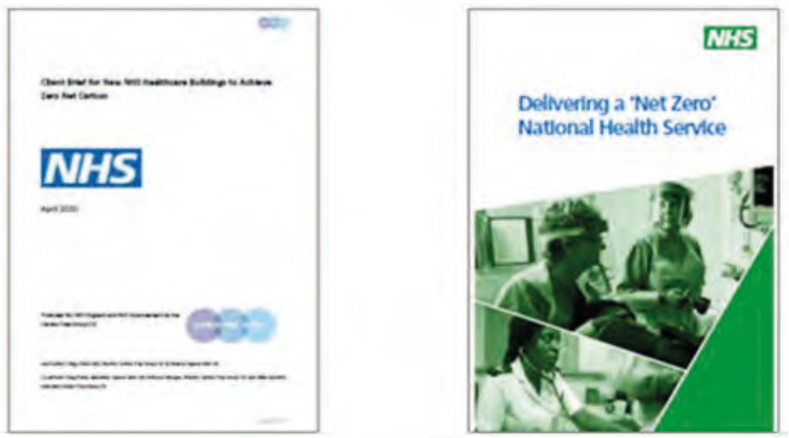


Figure 6.19: NHS Delivering Zero Carbon Document

6.7.6 Proposals for MEP - Residential Blocks

The following describes the building services systems proposed for the residential masterplan, the new ward block and the overall HRI estate. The focus is on the residential masterplan with an overview given for the HRI element of the works.

Residential Area

The description of the building services systems proposed for the residential masterplan is followed by suggestions how these systems could interlink with adjacent HRI estate.

Power

New single phase consumer units will be installed in each property with individual metering, supplied from a BEMCO unit installed on each floor of each block which is supplied from mains utility fuses at the ground floor.

Each individual block will have separate BEMCO unit. A landlord's board will also be installed to supply the areas outside of the tenanted areas.

Data

New connections will be taken from the openreach/ cityfibre networks present in the area to provide fibre infrastructure to the properties including data, wifi, telephone etc. to the residential blocks. Blank boxes will be installed to allow tenant the choice of their provider.

Mains Water

A new water connections will be taken off the water mains in Anlaby Road. The new water mains will run around the first phase of the masterplan, supplying each building. The new ring will allow for future connections from and to the following phases for future resilience of supply.

There are two options to distribute water to the blocks:

- The more typical solution is to that located in each apartment block there will be a break tank and booster set to distribute the water to all floors. The break tanks will be sized to provide 6 hours potable water storage.
- Alternative central water storage and boosting could supply each block off a central boosted ring.

Limiting the mains water connections to the central storage. This reduces the number of booster sets and storage tanks that will require maintenance.

From the booster the mains water will be routed through risers and ceiling voids to each apartment.

The Water Strategy

The water strategy for will apply the flowing hierarchy

- Use Less Water (Be Mean)
- Use Recycled Water (Be Grey)

Use Less Water

The dwellings will be designed to achieve a cold water use target of not more than 125 litres per person per day.

This will be achieved by sub-metering each apartment, installing only low water outlets and appliances throughout.

The semi-instantaneous hot water (HWS) will be provided by the individual Heat interface Unit (HIU), with a small buffer allowed for each unit. This is the most energy and water efficient method of HWS.

Wherever practical, shared facilities will be accommodated such as laundries, wash down for cars and bikes, allotments, gardens and play areas.

All water use will be sub-metered allowing each apartment to be billed for use directly, and monitored for over-consumption.

Use Recycled Water

Rainwater

Rainwater will be collected, filtered, stored and re used for WC flushing. All rainwater down pipes for each block will be collected to one point and distributed to storage tanks across the development.

Each block will include a WC flush booster set, taking recycled rain water to each apartment.

A separate booster set, with a dedicated break tank, will serve any external outlets for wash down and irrigation. Use of recycled water for washing, particularly where there is a central shared laundry facility, will also be considered.

Foul Waste and Grey Water

Each apartment will accommodate separation of foul and grey waste water.

The WCs will be discharged into a dedicated foul water system. This allows for the potential anaerobic digestion of the foul waste for biogas production, in the future.

This separation also allows for the potential storage and reuse of the grey water from showers, appliances and sinks to central tanks, either as part of the initial water strategy for the development or to be added at a later stage.

Centralised laundry facilities allow for the collection of laundry waste water without impact on the residents. This also provides an option, now or in the future, to recover heat from waste hot water.

The grey water will serve the same recycled water system as the rain water.

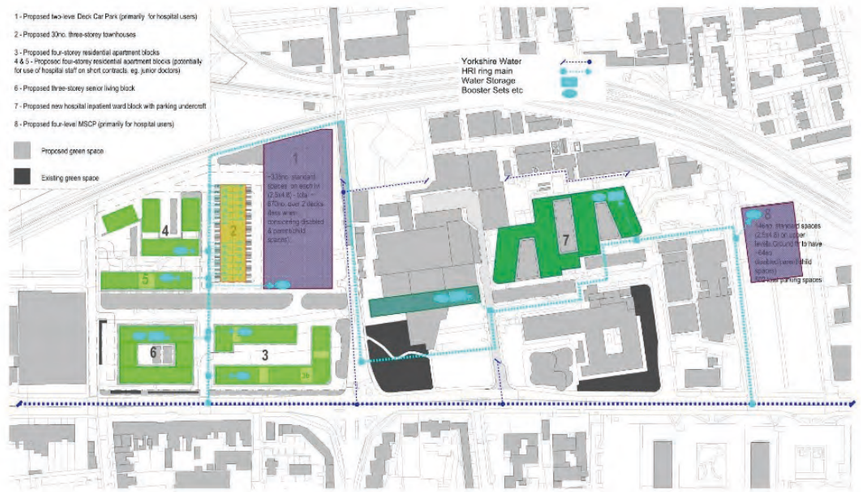


Figure 6.20: Proposed Water Strategy

Heating, Cooling Ventilation

The heating cooling and ventilation will be part of the energy strategy for the new development and will follow this hierarchy:

- Use Less Energy (Be Lean)
- Supply Energy Efficiently (Be Clean)
- Use Renewable Energy (Be Green)
- Monitor Energy Consumption (Be Seen)

Be Lean (Reduce Energy Demand)

The building envelope will use the best performing materials and construction methods as practical, following the LETI guidance as close as possible.

Heating

Initially Air Source Heat Pumps will be located in energy centres allocated to phase or group of blocks. From there the heating will be distributed to each apartment via a Heat Interface Unit (HIU).

Based on the LETI standards, we estimate for the first phase of residential buildings there will be a total heating demand of 800kW provided by a matrix of Heat Pumps requiring a roof area of 125m^2.

Reducing the design standards to Building Regulations will increase the Heat Pump roof area requirements to around 175 m^2.

Each HIU will meter the use of heat by each apartment and distribute 45^{o}C heating to the heat emitters, such as underfloor heating and towel rails that will be selected for this lower water temperature. The advantage of this is that the surface temperatures of the heat emitters will be safe for all residents.

Cooling

The glazing dimensions, locations and external shading will be balanced between good daylighting and minimising overheating.

Active cooling will be eliminated by careful consideration of the glazing, use of heavy weight building materials and the ability to securely ventilate each apartment overnight, taking benefit of the cooler night air to purge each apartment.

Ventilation

Each apartment and house will be fully mechanically ventilated, with dedicated ventilation units with heat recovery as detailed by Passivhaus.

This has the additional benefit of allowing any NHS staff who are working late shifts to be able to sleep peacefully during the day without the usual back ground noise from the adjacent streets.

Where practical equipment will be communal, such as laundry. This has the added benefit of water and space saving.

Be Clean (Supply Energy Efficiently)

Heat Pumps take raw low grade heat from air, ground or water and transfer that heat to high grade heat for space heating and water heating.

Air Source Heat Pumps have been selected as the most easily accommodated option, albeit less efficient. Wherever possible, ground source heat pumps using piles alongside the building foundations will be considered.

The central heating plant will include for large headers and buffer vessels to control the number of units operating at any one time.

The central plant space will be extendable so that the heat sources can be replaced as technology changes over the decades, such as solar thermal panels, fuel cells, anaerobic digesters.

The infrastructure will also allow for connection to the adjacent HRI and for future connection to a wider community district heating network.

Over time, as the national electricity grid decarbonises, higher flow temperatures from the heat pumps will be possible, contributing to an improved efficiency in distribution. However the distribution to each apartment will be maintained at 45^{o}C, via a heat exchanger in each Heat Interface Unit (HIU).

The heat recovery in the ventilation units will be as efficient as practical. The openable windows will include contacts linked to the associated HIU and ventilation units to stop these units operating whenever the windows have been opened by the residents.

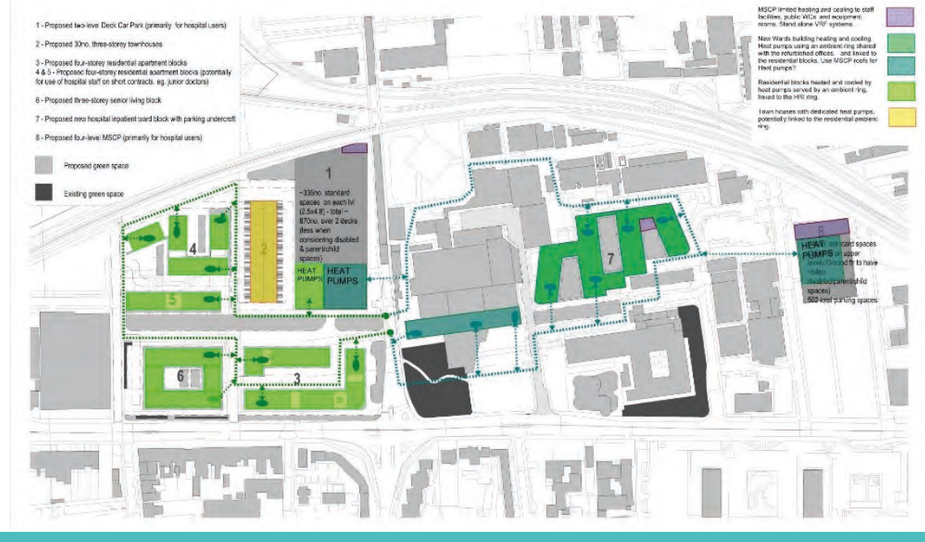


Figure 6.21: Proposed Heating Strategy

Be Green (Use Renewables)

Photovoltaics

As a minimum, roof mounted PV systems will be included in order to achieve a low to zero carbon design. For example, a 1.4MW peak system will require approximately 7000m² of roof area.

Battery Rooms

Space for batteries will be allocated for each apartment either in a central location or in each apartment.
As battery technology improves and costs reduce over the next few years, this future proofs the development to allow for individual power storage, in line with the increase of local power production.
It also allows a buffer against the increasing frequent network failures of the national grid.

Wind Turbines

Roof mounted or off site wind turbines, where appropriate, can provide an additional source of renewable energy but are not currently recommended for this development.

Cogeneration Fuel Cells

Cogeneration Fuel Cells can be used for power and heat production but are not currently recommended for this development.

Biogas CHP

Biogas fuelled CHPs can be considered for power and heat production. The biogas could be sourced from the anaerobic digestion of foul and food waste from the apartment blocks.

Be Seen (Monitor Energy & Water Use)

It is essential to maintain good standards and to improve wherever possible the energy consumption over the life time of the buildings. By sub-metering the energy and water use of each apartment the landlord and the residents can monitor consumption and react quickly to any changes.
Monitoring also confirms the accuracy of the energy modelling during design and will improve the next generation of buildings.

We recommend the following three key stages for energy and water consumption monitoring:

1. Planning stage - estimates of the energy consumption (kWh/m2), carbon emissions (tonnes CO2/m2) and water consumption (m3/yr/m2) estimates should be reported for the development. It is useful to base these figures on two separate methodologies.
2. As-built stage - an update should be provided confirming the estimated performance estimates submitted at planning stage.
3. In-use - the building owner should monitor and report annual energy performance data for at least ten years.

Residential HRI Interlinks

Power

A link between the two parts of the site is possible and could provide some resilience. However, due to the demand of the two areas being significantly different it would be best to take separate new connections from the electrical mains.

Data

Data across the sites can be linked and would provide greater connectivity, this is an advantage and will be considered during design stages.

Water

The water for both the residential area and the HRI will and continue to be served from the same trunk mains in Anlaby Road.

Therefore there is no significant advantage to interlinking the two networks unless the HRI can take in emergency the stored water from the residential blocks and vice versa.

This would only be possible should the residential blocks have central water storage.

Heating

A link between the two adjacent estates, residential and HRI, would provide additional resilience to the heating overall.

However the heating demand of the residential blocks will be so significantly smaller than the current HRI estate means that any resilience advantage is pi to the residential estate only.

Rather, this could provide the HRI as a means of using any waste heat from the CHP or steam boilers. It could also be a way of continuing to use the installed gas fired boilers and CHP alongside the required upgrades to the existing buildings which will reduce the HRI heating demand in time.

This also sets a precedent that the HRI is a heat node for any future district heating network across Hull City.

6.7.7 Proposals for MEP - Hull Royal Infirmary

The existing HRI Ward Block is past its useful life and is in urgent need to be replaced with a new Ward Block. This new building will be constructed alongside the exisitng tower block, which will be refurbished for future office use, or similar.

New Ward Block

Power

A new connection will be taken from the NPG mains to power the HRI new ward. And will have a backup S/S. the load and condition of the generators needs to be determined so a decision can be made whether to connect to the existing or provide new. It is assued that the ward is likely to contain group 1 medical locations, therefore a new UPS and IPS system is to be provided and located in the ward, maximum of 30m from the locations they will supply.

Data

Data is to be provided from a new data cabinet located in the new IT hub room which will provide connections to all the necessary security and wifi systems. Including: access control, CCTV, WiFi, nurse call, telephone lines and redcare lines, also connections for all other equipment that may need a connection such as PCs and televisions.

Water

A new Water connection will be taken from Anlaby Road, to serve new central water storage which will support the existing ring main as well as serve the new Ward Block.

Heating, Cooling and Ventilation

The building envelope will be built to the very highest standards possible to minimise the heating and cooling demands.

Heating – Steam Space Heating
For the first 30 years steam will continue to be available as a heating source for the HRI estate. Whilst this is not a zero carbon heat source it is the pragmatic heating solution taken forward by the HRI for the foreseeable future.

There will be an interface between the steam and new Ward block. The heat exchanger will drop the primary heat source, steam, to a Low LTHW flow temperature, 45°C. This lower water temperature allows for any future heat source such as Heat Pumps, and provide the most adaptable heating distribution network around the new building.

Roof space will be identified for future Heat Pumps or alternatives such as fuel cells. Likewise the risers, plant areas and distribution pipework network will be designed to allow for the heat source to be either via the HRI tunnel below the new Ward Block or from the new Ward Block roof.

Heating – LTHW Hot Water Heating
Similarly to the stem boilers, for the first 30 years LTHW will continue to be available as the hot water heat source for the HRI estate via the CHP and LTHW gas fired boiler. .Again, this is not a zero carbon heat source it is the pragmatic solution taken forward by the HRI for the foreseeable future.

There will be an instantaneous Hot Water Heat exchanger interface between the LTHW and new Ward block. Hot water to the new Ward Block will then be distributed from the heat exchanger via a return loop. Plant space will be identified for future dedicated HWS Cascade Heat Pumps or alternatives such as fuel cells. Likewise the risers, plant areas and distribution pipework network will be designed to allow for the heat source to be either via the HRI tunnel below the new Ward Block or from the new Ward Block roof.

Cooling
Initially active cooling will be provide by roof mounted air cooled chillers.
The plant area will be adaptable to allow for future Heat pump (typically heavier) and any future alternatives.
The distribution pipework from the cooling source to the new Ward Block will be the start of a site wide cooling network.

Ventilation
All ventilation plant will be current HTM compliant with full heat recovery, variable speed and access for maintenance to be internal. All the heating coils will be selected for the lower LTHW temperatures.

Medical Gases
The medical gases will be taken from the existing networks or provided locally as needed.

Tunnels
The existing tunnels under the proposed location of the new Ward Block will I connect the new building with the rest of the HRI site wide services.

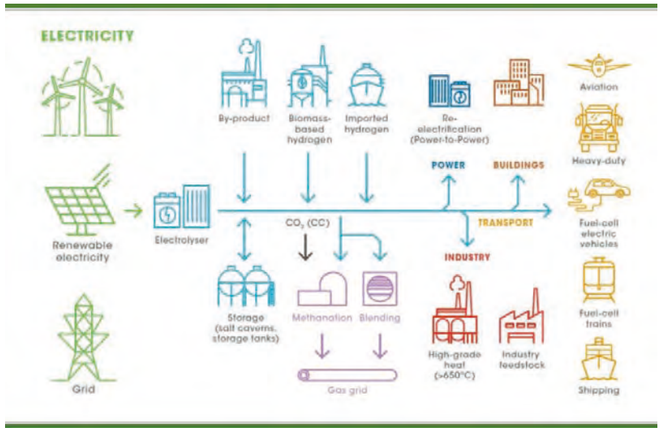


Figure 6.22: Hydrogen Production and Uses Simple Schematic

Green Hydrogen
Hydrogen gas is a versatile energy carrier and feedstock.

The use of hydrogen is expected to increase significantly over the next number of years as it starts replacing other energy sources such as liquid fuels for vehicles and natural gas for power generation and heating purposes.

Currently, around 94% of hydrogen production is from fossil fuels mainly, steam reforming methane, which is generally classed as blue hydrogen. It is expected that the sources of hydrogen will change to include a large portion of green hydrogen which is hydrogen generated from renewable power via water electrolysis.

The electrolysis process is the overall reaction of electrochemical splitting of water into hydrogen and oxygen by supplying electrical (and thermal) energy.

The hydrogen can be utilised by CHP units and boilers mixed with air replacing natural gas. The oxygen can also be utilised due to its high purity, over 99%, which does not require additional purification processes excluding the drying.

HRI
The Hull Royal Infirmary could be future proofed with an estate hydrogen production unit, which would allow a transition before the nation wide gas grid moves towards hydrogen in the future.

HRI could utilise rain water, collected from its own roofs and that of the adjacent master plan site. Space for water storage tanks would be required.

The renewable energy source could be PV panels on the building roofs, incldluding the adjacent residential blocks, with grid green electricity (such as from Hornsea 2 wind farm) incorporated.

The process of electrolysis for HRI could be beneficial for the Hospital, not only would it produce hydrogen to supply the CHP, but also oxygen.

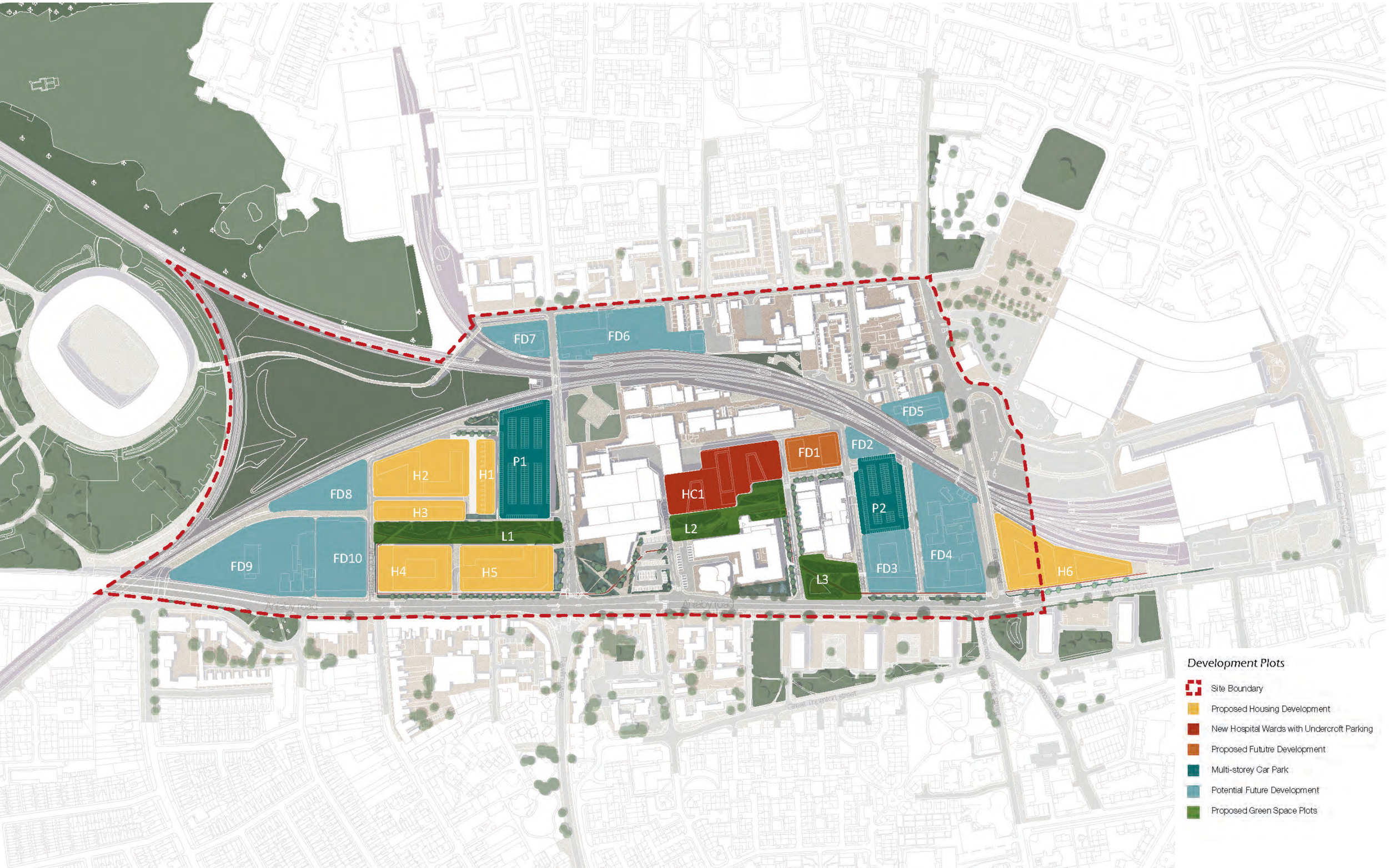
The table below begins to demonstrate the extent of water storage (based 8 hours) and PV panel area required to produce Hydrogen for Heating, along with Oxygen delivered.

Water, kg/hr	Storage Tanks, m^3	Power, kWh	Solar panel area, m^2	Oxygen, kg/hr	Hydrogen, kg/hr	Heating. kW
1000	8000	40300	6800	400	746	1200
700	5600	30300	5100	300	560	900
400	3200	16800	2800	200	311	500

Figure 6.23: Hydrogen Production Table

6.8 Site Plots and Areas

6.8.1 Plot Locations Plan



6.8.2 Indicative Plot Areas

HOUSING	PLOTS	Metres sq.	Hectares	Development Type	Use	Existing building clearance?
	H1	1191	0.12	Townhouses	Residential	No
	H2	6970	0.70	Apartments	NHS staff residential	Yes
	H3	2723	0.27	Apartments	NHS staff residential	Yes
	H4	6305	0.63	Senior Living Complex	Senior residential	Yes
	H5	7078	0.71	Apartments	Residential	Yes
	H6	8316	0.83	Apartments	Residential	Yes
Housing Plots total area		**32583 m²**	**3.26 ha**			

HEALTHCARE	PLOTS	Metres sq.	Hectares	Development Type	Use	Existing building clearance?
	HC1	8159	0.82	Ward Tower	Healthcare	Yes
Healthcare Plots total area		**8159 m²**	**.82 ha**			

LANDSCAPE	PLOTS	Metres sq.	Hectares	Development Type	Use	Existing building clearance?
	L1	6975	0.70	Linear park	Amenity greenspace	Yes
	L2	5600	0.56	Landscaping to ward entrance	Amenity greenspace	Yes
	L3	3045	0.30	Hospital 'gateway' park	Amenity greenspace	Yes
Landscape Plots total area		**15620 m²**	**1.56 ha**			

PARKING	PLOTS	Metres sq.	Hectares	Development Type	Use	Existing building clearance?
	P1	9093	0.91	Deck Car Park	Hospital visitor/staff parking	No
	P2	5698	0.57	Multi-Storey Car Park	Hospital visitor/staff parking	No
Parking Plots total area		**14791 m²**	**1.48 ha**			

FUTURE DEVELOPMENT	PLOTS	Metres sq.	Hectares	Development Type	Use	Existing building clearance?
	FD1	2845	0.28			Yes
	FD2	1502	0.15			No
	FD3	4518	0.45			No
	FD4	10142	1.01			Buildings potentially retained
	FD5	2330	0.23			Yes
	FD6	8022	0.80			Yes
	FD7	2768	0.28			Yes
	FD8	4186	0.42			No
	FD9	11577	1.16			Yes, some retained (Listed buildings)
	FD10	6131	0.61			Buildings potentially retained
Future Plots total area		**54020 m²**	**5.40 ha**			

6.9 Traffic and Transport Analysis

6.9.1 Overview

Transport planning consultants Curtins have produced a traffic and transport feasibility assessment to consider the emerging masterplan and provide commentary in regard to the traffic and transport elements, and to consider the potential impact on the surrounding area from a traffic and transport perspective, should the masterplan come forward.

The report covers the existing conditions relating to traffic and transport around the site of the HRI, reviews existing highway safety and parking arrangements, examines accessibility of the site by sustainable modes of travel, summarises the outcome of traffic modelling and forecasting for the area undertaken for the report, and summarises the potential impacts of the masterplan relating to traffic and transport.

The following summary and conclusion are extracts from the Curtins traffic and transport feasibility assessment document.

6.9.2 Summary

‘Hull City Council (HCC) is currently working with the NHS Hull University Teaching Hospital (HUTH) Trust to realise major investment in acute care provision at the Hull Royal Infirmary (HRI) Site. This is primarily focused on providing new ward-based services by decanting the current tower block.

‘The works also afford related opportunities in the surrounding area which could include building new housing and new multi-storey car park facilities, as part of a wider renewal agenda for land/premises on the western fringes of Hull City Centre.

‘Making the health campus more accessible is also a key priority and this could include greening and making attractive routes from the interchange to the site. A further objective is to make the new buildings more environmentally friendly and to encourage staff and visitors to attend hospital by using the bus or train rather than by car – so called modal shift.

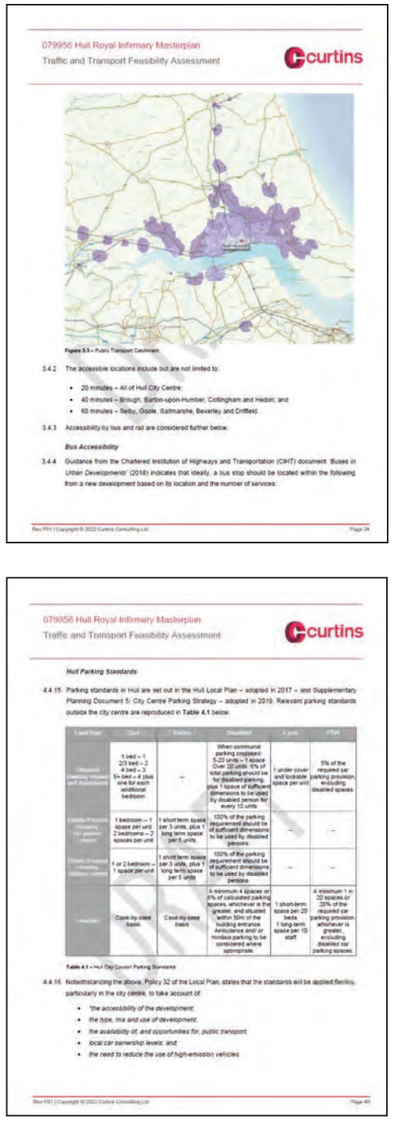
‘To achieve the above aims, HCC has commissioned preparation of a Masterplan that looks to the future of this part of Anlaby Road. The Masterplan is being prepared to ensure development over the long term (up to 15 years) happens in a co-ordinated and well-planned way. The primary author of the Masterplan is the Building Design Partnership (BDP) and Curtins has been appointed to assist them on traffic and transport matters.

‘This document contains a thorough review of baseline conditions and highway safety in the vicinity of the site and whilst this demonstrates there have been a number of accidents in the study area, there is nothing to suggest an unusual issue and accident rates appear to be decreasing.

‘The accessibility of the site has been considered in detail and it is concluded that the Masterplan area is well served in terms of pedestrian, cycle, bus and rail modes of travel. This will be further enhanced by opening up new routes between the buildings and the high-quality public realm environment. A range of improvements are proposed to the surrounding area to enhance the environment for all road users, most notably pedestrians, including the mobility impaired, and cyclists.

Modal shift incorporates walking and cycling to encourage active travel and to make use of the pedestrian and cycle infrastructure proposed in the Masterplan.

LTN 1/20 should be referred to as the appropriate design standard for cycle infrastructure as it provides guidance on design, quality and safety.


079956 Hull Royal Infirmary Masterplan
Traffic and Transport Feasibility Assessment
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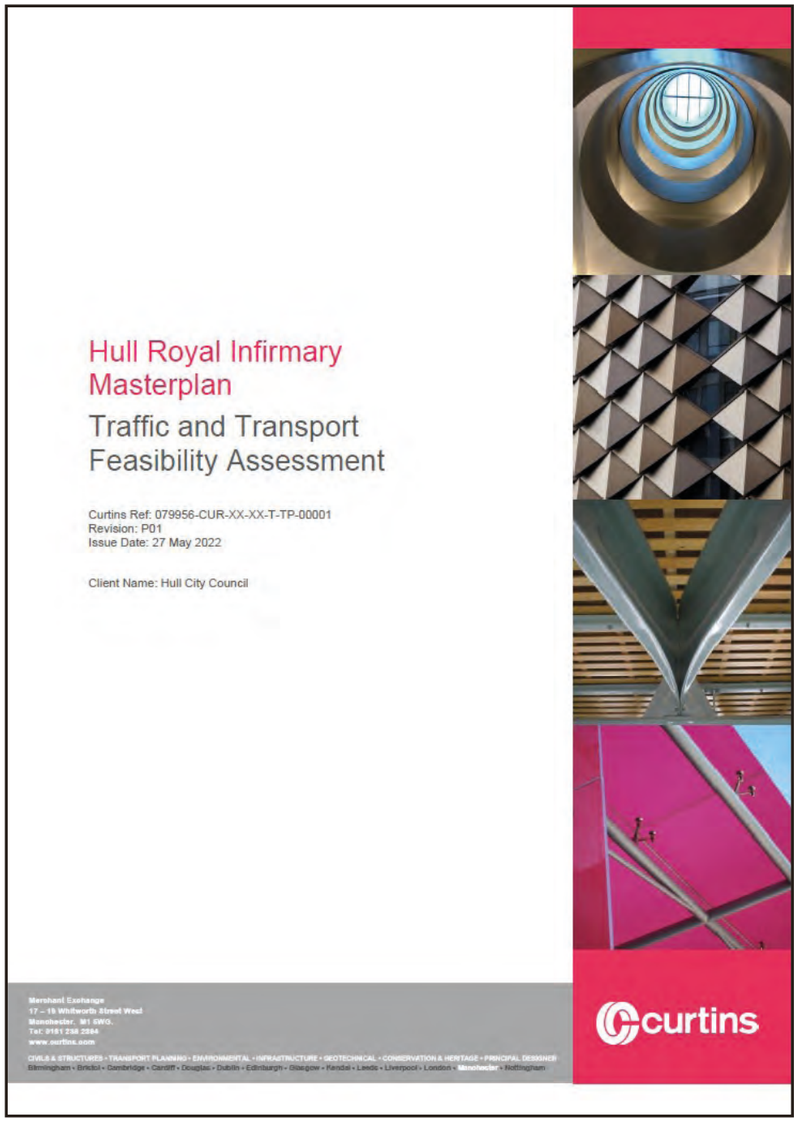

Hull Royal Infirmary Masterplan
Traffic and Transport Feasibility Assessment
Curtins Ref: 079956-CUR-XX-XX-T-TP-00001
Revision: P01
Issue Date: 27 May 2022
Client Name: Hull City Council
curtins

Figure 6.24: Front cover of the Curtins Traffic and Transport Feasibility Assessment and extract pages from the document

‘A detailed parking strategy has been developed that seeks to retain a similar level of parking for the HRI site, but rebalances this between a new MSCP on Fountain Street.

‘A detailed traffic forecasting exercise has been developed in conjunction with HCC and junction capacity assessments have been undertaken using a linked model, for a 2022 base year and 2032 future year.

‘The model demonstrates that the network is busy during the traditional AM and PM peak periods as would be expected in a city centre or edge of city location. Certain junctions such as Anlaby Road/Argyle Street and Derringham Street/Spring bank already operate at or close to capacity.

‘The addition of background traffic growth means that by 2032 some junctions such as Argyle Street/Anlaby Road and Derringham Street/Spring Bank will operate over capacity whether the Masterplan comes forward or not.

‘The addition of the Core Masterplan generally has a negligible impact on the highway network, albeit there are issues at the Anlaby Road/Argyle Street junction and Fountain Street /Anlaby Road junction that require more detailed consideration and mitigation as planning applications start to come forward.
‘When the wider Masterplan comes forward, Fountain Street in particular is predicted to operate significantly over capacity. Mitigation is certainly required in the form of a right turn pocket or signalised junction, and even then the scale of the car park may be too much for the junction.

‘A review of relevant local and national transport planning guidance has been undertaken. It is considered that the proposed development is in general accordance with such policies and guidance.

Further analysis is required to determine precise number and split of parking between the new Argyle Street and Fountain Street MSCPs. This should take into consideration the HRI Travel Plan and Local Plan.

‘From a traffic and transportation perspective, there are no reasons why the Core Masterplan could not be progressed to the next stage. The Wider Masterplan has more significant impacts, particularly at Fountain Street. However, in each scenario, the Argyle Street junction and Fountain Street junction require more detailed assessment and mitigation.’

Within the new proposed residential development, a parking quantity has been applied which sits between the city centre parking standards and the Local Plan guidance for residential areas. As planning proposals come forward, consideration will need to be given on parking control for these areas.

6.9.3 Conclusions

‘From a traffic and transportation perspective, there are no reasons why the Core Masterplan could not be progressed to the next stage. The Wider Masterplan has more significant impacts, particularly at Fountain Street. However, in each scenario, the Argyle Street junction and Fountain Street junction require more detailed assessment and mitigation.’

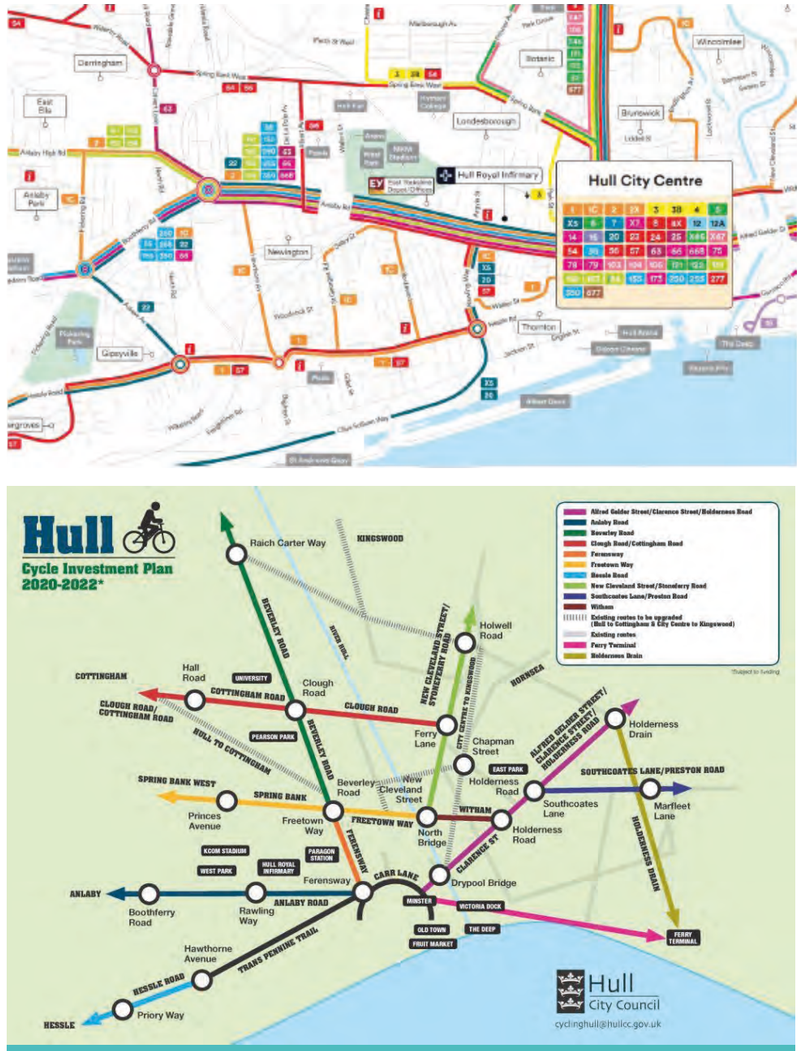
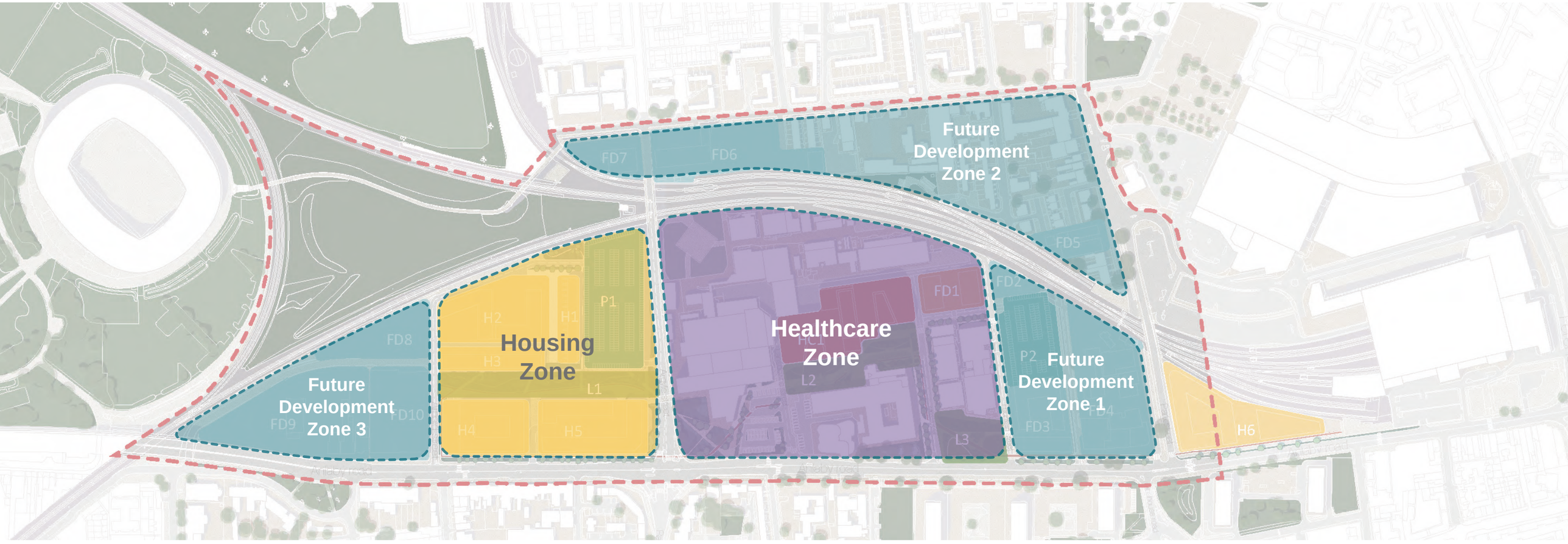


Figure 6.25: The assessment examines accessibility to the site by sustainable modes of travel, with consideration given to the traffic and transport elements of BREEAM. Above are map extracts from the document showing Hull cycle map and bus routes.

6.10 Phasing

6.10.1 Phasing Plan



6.10.2 Phasing Strategy

The process to transform the area for this masterplan study is reliant on a number of interdependent funding streams coming forward alongside the priorities of key stakeholders. Below is one phased approach, demonstrating these interdependencies.

Healthcare Zone

Within the core site for the HRI, existing facilities within plots HC1 and L2 such as day surgery and Alderson House would need to be relocated off-site. One approach is to vacate these facilities from west to east with development of a new ward tower in a phased approach also from west to east. This would allow a wider range of funding options to come forward (potentially 2 smaller allocations as opposed to 1 bigger one).

Should a west to east strategy be used for the Healthcare Zone, plot FD1 (future development) would come forward at the end of the timeline. FD1 is the least connected to the clinical centre of gravity (the existing A&E and new critical care), as such, it would be best used for an affiliated clinical activity as opposed to something that requires a key adjacency. For Landscape, plot L2 could come forward sequentially, aligned with plot HC1. Plot L3 has no interdependencies but is in private ownership and as such, sits on its own independent timeline.

Housing Zone

Within this zone, it is the delivery of an MSCP and the relocation of services from Miranda House and Brocklehurst of that unlock redevelopment plots for housing. In order to maintain parking numbers, an initial phase could see the demolition of brocklehurst and/ or the utilisation of the previous heli-pad location as temporary, additional surface parking (plots H2 and H4).

Plot P1 could then be developed as an MSCP to consolidate space required for parking numbers in accordance with the future agreed transport plan. Parking can then be relocated into P1, releasing plots H1, H2, H3, H4, H5 and Landscape plot L1 for development.

Future Development Zone 1

This area is under private ownership. A consolidation of parking into an MSCP would see opportunity to bring forward more plots for commercial use that could be affiliated with the close proximity of the healthcare estate. Increase in travel from additional commercial use has been considered. The scale of new MSCP should be balanced against a desire to reduce road trips via improved public transport and sustainable travel modes. Plots FD2, Fd3, FD4 could be brought forward on their own timescale, independent from the Housing and Healthcare Zones however, more detailed transport analysis is required once development scale in these areas is more certain to ensure the balance of parking numbers between fountain street and argyle street works across all phases of transformation, maintaining healthcare use of fountain street parking spaces as required.

Future Development Zones 2 & 3

These zones are under private ownership and do not interact with the other areas. Whilst there is nothing preventing zones 2 & 3 changing in the near future, it is assumed that change to these areas would come in a later phase, on the back of change happening in the adjacent zones.

6.11 Risk Register

Identified Risk	Expectation this risk will impact scheme outcomes – high, moderate or low risk, and why	Potential solution to mitigate impact
1. Funding from Government under the Hospitals Programme not being made available	Moderate - Public funding will be needed to 'kick-start' regeneration of the area and set in motion various other elements of the plan. HRI is not at its optimum in serving the health needs of local people so some resource will be required in time.	Continue to push for funding via bids to Government and finalise the Masterplan to provide additional support.
2. The hospital need to find a different funding mechanism to the New Hospital Programme and this is broken up into smaller amounts.	Moderate – delays to the NHP programme have stalled progress and the HRI alongside all other trusts in the country are looking towards alternative viable funding routes to speed up the process.	The new wards may need to be delivered in phases, design to accommodate this approach. Additional funding from charities/donors to add to the quality of finish and landscape aspiration if smaller pots of funding limit this potential within the HRI new build areas.
3. NHS Trust not able to release Argyle Street car park for housing and deck parking	Low – NHS Trust anticipate the wider regenerative impacts of HRI renewal to Anlaby Road and much needed modal shift opportunities. 'Business as usual' including retaining the surface car park is not a long-term tenable option.	Need to model alternative design solutions depending on delivery agent interest. Could be a mix of delivery agents (NHS Trust/Council/Extra care provider) so this would require co-ordination and overarching delivery agent to manage initial procurement process.
4. Commercial viability limits regeneration opportunities	Moderate- initial viability based on current commercial conditions is limiting interest.	Masterplan to be aspirational and generate it's own localised market. Alternative delivery agents and funding mechanisms to be sought for key worker housing, aiding carbon reduction – fewer staff trips to site. To act as a catalyst for regeneration alongside hospital upgrades.
5. Fountain Street surface car park in private ownership	High – Current owners of the site are making revenue gains from parking demand but land value is as a car park. Potential Compulsory Purchase Order may be of use but realistic take on land value is required should there be an acceptance of regeneration benefits.	Acquisition of this land is recommended but supported by a Masterplan that promotes a MSCP use in serving the HRI/Eye Hospital, either through negotiation or by CPO, on the back of Local Plan revisions indicating the need for health service parking provision.
6. Car wash site in private ownership to be used as a green space	High – Current owner using the site for car wash and convenience retail use. Potential Compulsory Purchase Order may be of use but realistic take on land value is required should there be an acceptance of regeneration benefits.	Acquisition of this land is recommended but supported by a Masterplan that promotes a green space entrance from Anlaby Road in serving the HRI/Eye Hospital, either through negotiation or by CPO, on the back of Local Plan revisions indicating the need for planned urban greenspace in this location.
7. Flood risks require addressing/mitigation yet to be determined in detail	Moderate – key parts of the HRI are identified as at high risk. Work through more developed design stages required to determine if this can be mitigated through SUDs measures.	Flood risk assessment will be required as part of future planning applications for new ward facilities, in demonstrating how some of the flood risk principles in the MP will be realised in detail.
8. Specific worsening flood risk to A&E due to new developments on the HRI site being built with flood mitigation raised slabs diverting more surface water towards A&E	Moderate – flood risk to wider estate area to be considered as part of overarching masterplan works.	Undercroft parking in new wards to be used instead of raised slab to be sacrificial in order to to mitigate increase risk to A&E. Extensive suds proposed in landscape to help mitigate existing surrounding flood risks. Effect of suds on wider flood risk to be tested in developed design.
9. Transport impacts to be addressed/mitigated to be determined in detail	Low – Junction and route improvements required as per the MP but further detail and delivery measures are needed.	Junction and route improvement details/costs are required to be determined as part of the planning application for new ward facilities along with a Travel Plan in demonstrating modal shift patterns. The Council could also commit to capital funding of highway improvements in support of improved connectivity to HRI. Anlaby Road (north side) footpath 'widening' will be dependent on a new 'building line' (to be established in the Local Plan) and various site owners being amenable to this through re-development proposals.
10. Extent proposals are sustainable to any measurable extent	High – Extent the proposals at HRI are 'sustainable' needs qualifying if only to address NHS Trust net - zero ambitions. Unlikely to get Government funding without highly measurable (BREEAM rated) proposals.	BREEAM rating to form part of the planning application submissions including the 'very good or better' rating after construction phase.
11. The new ward site sits over the existing underground service tunnels and may limit design opportunities	Low – the tunnels are not extensive.	Early indication is that these would mostly be under landscape areas. Coordination required in detail design and abnormals budget to be applied for structure to avoid certain areas.
12. Existing wind tunnel effect and strong wind risk on site may be worsened by new design geometry and proposals.	Moderate – there is a know existing issue on the HRI estate which could be reduced or increased by future developments.	Wind tunnel modelling to be recommended at early stages of design development and facade direction to account for this risk alongside solar gain and other massing and orientation considerations. Specific risk with higher rise ward tower accommodation. Lower buildings of up to 4 stories for housing should mitigate some of this risk but testing still required. Trees and areas of generous landscape should help mitigate this risk, again to be tested in detailed design.
13. The new ward site sits over the existing utilities	Low – the existing utilities are not extensive.	Coordination required in detail design to avoid certain areas.
14. The new ward site requires new utilities	Low – the new utilities have been included for in the recent site wide infrastructure upgrade.	Confirmation required in detail design.
15. Individual or cumulative impact of risks	Any one or combination of risks may affect outcomes but likely the greater combination would result in greater risks.	Minimise and mitigate risks as best able, and/or as outlined above.

BDP.