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Client: Noah's Ark Children's Hospice

Flood Risk Assessment and Sustainable Drainage Strategy for the Proposed Development at 25 Manor Road, Barnet

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Flood Risk Assessment and Sustainable Drainage Strategy for the Proposed Development at 25 Manor Road, Barnet

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Contents Page

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1 Scope of Appraisal

Herrington Consulting has been commissioned by **Noah's Ark Children's Hospice** to prepare a Flood Risk and Sustainable Drainage Assessment for the proposed development at **25 Manor Road, Barnet, EN5 2LE.**

A Flood Risk Assessment (FRA) appraises the risk of flooding to development at a site-specific scale and recommends appropriate mitigation measures to reduce the impact of flooding to both the site and the surrounding area. New development has the potential to increase the risk of flooding to neighbouring sites and properties through increased surface water runoff and as such, an assessment of the proposed site drainage can help to accurately quantify the runoff rates, flow pathways and the potential for infiltration at the site. This assessment considers the practicality of incorporating Sustainable Drainage Systems (SuDS) into the scheme design, with the aim of reducing the risk of flooding by actively managing surface water runoff.

New developments are also required to undertake an assessment to identify how the foul water from the site will be managed. This assessment considers how foul water is expected to be discharged from the proposed development and whether there are any appropriate connection points, such as nearby sewers or treatment plants.

This report has been prepared to supplement a full planning application and has been prepared in accordance with the requirements of both national and local planning policy. To ensure that due account is taken of industry best practice, reference has also been made to CIRIA Report C753 'The SuDS Manual' and any relevant local planning policy guidance. The surface water management strategy included within this report is not intended to constitute a detailed drainage design.

2 Background Information

2.1 Site Location and Existing Use

The site is located at Ordnance Survey (OS) coordinates 524331 95972, off Manor Road in Barnet. The site covers an area of approximately 364m² and currently comprises a single three-storey dwelling and vacant land. The location of the site in relation to the surrounding area is shown in Figure 2.1 below.

Figure 2.1 – Location map (contains Ordnance Survey data © Crown copyright and database right 2024).

2.2 Proposed Development

The development proposals comprise the construction of a single dwelling, adjacent to the existing dwellinghouse on the currently vacant land.

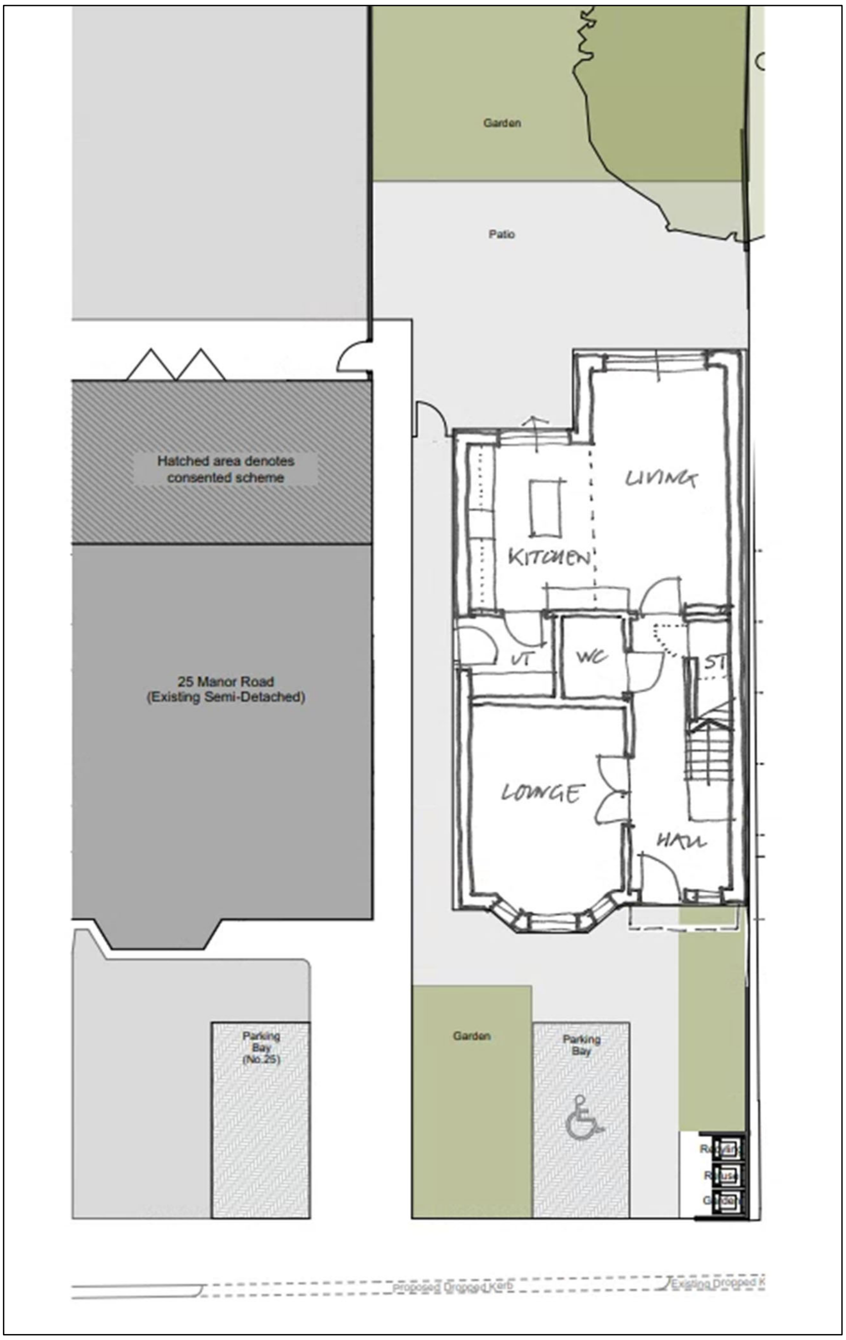


Figure 2.2 – Proposed ground floor layout.

Further drawings of the proposed scheme are included in Appendix A.1 of this report.

2.3 Planning Policy and Context

For any new development situated within Flood Zones 2 and 3 of a main river or the sea, or for sites greater than 1ha in size, the National Planning Policy Framework (NPPF) requires a detailed FRA to be undertaken. Inspection of the Environment Agency's (EA) 'Flood Map for Planning' shows that the site is located within Flood Zone 1 and is smaller than 1ha in size. Consequently, a FRA would not typically be required.

Notwithstanding this, in certain circumstances the Local Planning Authority (LPA) can request that a FRA is submitted if the development site is thought to be at risk of flooding from other sources, such as surface water runoff, overland flow and groundwater flooding. In this case, correspondence with the Barnet Council has confirmed that the site is located in a Critical Drainage Area (CDA) and therefore, a FRA is required to be submitted as part of the planning application.

In addition to the above, the general requirement for all new development is to ensure that the runoff is managed sustainably, and that the development does not increase the risk of flooding at the site, or within the surrounding area.

The Non-statutory Technical Standards for Sustainable Drainage Systems (NTSS) specify criteria to ensure sustainable drainage is included within developments classified as 'major' as set out in Article 2(1) of the Town and Country Planning (Development Management Procedure) (England) Order 2010). However, in this instance, the proposed development is for the construction of a single residential unit with a total floor space less than 1000m^2. As a result, the proposals are not classified as 'major' development and therefore, the NTSS will not apply.

Nonetheless, Barnet Borough Council Local Plan (2021) requires all new developments to utilise Sustainable Drainage Systems (SuDS) where applicable.

In addition to the London Barnet Borough Council Local Plan, Policy SI 13 of the London Plan (2021) states that proposals should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible. There should also be a preference for green over grey features, in line with the following drainage hierarchy:

1. Rainwater use as a resource (for example rainwater harvesting, blue roofs for irrigation).
2. Rainwater infiltration to ground at or close to source.
3. Rainwater attenuation in green infrastructure features for gradual release (for example green roofs, rain gardens).
4. Rainwater discharge direct to a watercourse (unless not appropriate).
5. Controlled rainwater discharge to a surface water sewer or drain.
6. Controlled rainwater discharge to a combined sewer.

2.4 Site Specific Information

Information from a wide range of sources has been referenced to appraise the true risk of flooding at this location. This section summarises the additional information collected as part of this FRA.

Information contained within the Strategic Flood Risk Assessment (SFRA) – The Barnet Council SFRA (2018) contains detailed mapping showing historic flood records for a wide range of sources. This document has been referenced as part of this site-specific FRA.

Information on localised flooding contained within the Surface Water Management Plan (SWMP) – A SWMP is a study to understand the risk of flooding that arises from local surface water flooding, which is defined by the Flood and Water Management Act 2010 as flooding from surface runoff, groundwater, and ordinary watercourses. Such a document has been prepared for Barnet Council (2011) and has therefore been referenced as part of this site-specific FRA.

Information provided by Thames Water – Thames Water has provided the results of an asset location search for the site. The response is included in Appendix A.2.

Site specific topographic surveys – A site-specific topographic survey has not been undertaken at this stage; however, inspection of aerial height data (LiDAR) records show that the land levels of the site vary between 102.75m and 100.78m Above Ordnance Datum Newlyn (AODN). Generally, land levels gradually fall towards the east.

Geology – Reference to the British Geological Survey (BGS) map shows that the underlying solid geology in the location of the subject site is London Clay Formation (clay and silt). There are no overlying superficial deposits.

Historic flooding – Information provided by the SFRA, SWMP and the EA's Historic Flood Map GIS data shows that there are no recorded incidents of flooding at the site or immediate surrounding area.

2.5 Climate Change

The global climate is constantly changing but it is widely recognised that we are now entering a period of accelerating change. Over the last few decades there have been numerous studies into the impact of potential future changes in the climate and there is now an increasing body of scientific evidence which supports the fact that the global climate is changing as a result of human activity. Past, present and future emissions of greenhouse gases are expected to cause significant global climate change during this century.

The nature of climate change at a regional level will vary. For the UK, projections of future climate change indicate that more frequent short-duration, high-intensity rainfall, and more frequent periods of long-duration rainfall (of the type responsible for the recent UK flooding), could be expected.

These effects will tend to increase the size of flood zones associated with rivers and the amount of flooding experienced from other inland sources. Consequently, the following section of this report takes into consideration the impacts of climate change and references the most contemporary guidance that is applicable to the development site.

Planning Horizon

To ensure that any recommended mitigation measures are sustainable and effective throughout the lifetime of the development, it is necessary to base the appraisal on climate change predictions that are commensurate with the planning horizon for the proposed development. The NPPF and supporting Planning Practice Guidance Suite (August 2022) state that residential development should be considered for a minimum of 100 years, but that the lifetime of a non-residential development depends on the characteristics of the development. The development that is the subject of this assessment is classified as residential and therefore, a design life of 100 years has been assumed.

Potential Changes in Climate

Recognising that the impact of climate change will vary across the UK, the allowances were updated in May 2022 to show the anticipated changes to peak rainfall across a series of management catchments. The proposed development site is located in the **London Management Catchment**, as defined by the 'Peak Rainfall Allowance' maps, hosted by the Department for Environment, Food and Rural Affairs. Guidance provided by the EA states that this mapping should be used for site-scale applications (e.g. drainage design), in small catchments (less than 5km^2), or urbanised drainage catchments. For large rural catchments, the peak river flow allowances should be used.

The proposed development lies within an urbanised drainage catchment and will include a surface water management strategy. The Peak Rainfall Allowances for the London Management Catchment should be applied to the hydraulic calculations undertaken as part of this.

For each Management Catchment, a range of climate change allowances are provided for two time epochs and for each epoch, there are two climate change allowances defined. These represent different levels of statistical confidence in the possible scenarios on which they are calculated. The two levels are as follows:

- Central: based on the 50th percentile
- Upper End: based on the 90th percentile

The EA has provided guidance regarding the application of the climate change allowances and how they should be applied in the planning process. The range of allowances for the Management Catchment in which the development site is located are shown in Table 2.1 below.

Management Catchment Name	Annual exceedance probability	Allowance Category	2050s	2070s
London	3.3 %	Central	20%	20%
		Upper End	35%	35%
	1 %	Central	20%	25%
		Upper End	40%	40%

Table 2.1 – Recommended peak rainfall intensity allowances for each epoch for the London Management Catchment.

For a development with a design life of 100 years the Upper End climate change allowance is recommended to assesses whether:

- there is no increase in flood risk elsewhere, and;
- the development will be safe from surface water flooding.

From Table 2.1 above, it can be seen that the recommended climate change allowance for this site is a 40% increase in peak rainfall. Therefore, this increase has been applied to the hydraulic drainage model constructed to inform the surface water management strategy. Where this allowance has been applied the abbreviation "+40%cc" has been used.

3 Potential Sources of Flooding

The main sources of flooding have been assessed as part of this appraisal. The specific issues relating to each one and its impact on this development are discussed below. Table 3.1 at the end of this section summarises the risks associated with each of the sources of flooding.

3.1 Flooding from Rivers, Ordinary or Man-Made Watercourses

Natural watercourses that have not been enmained and man-made drainage systems such as irrigation drains, sewers or ditches could potentially cause flooding.

Inspection of OS mapping identifies that there are no watercourses nearby and the site is not located within an area identified by the EA's 'Flood Map for Planning' as being at risk of flooding from a main river. Consequently, the risk of flooding to the site from rivers is considered to be *low.*

3.2 Flooding from the Sea

The site is located a significant distance inland and is elevated above predicted extreme tide levels. Consequently, the risk of flooding from this source is considered to be *low.*

3.3 Flooding from Surface Water

Surface water, or overland flooding, typically occurs in natural valley bottoms as normally dry areas become covered in flowing water and in low spots where water may pond. This mechanism of flooding can occur almost anywhere but is likely to be of particular concern in any topographical low spot, or where the pathway for runoff is restricted by terrain or man-made obstructions.

The EA's 'Flood Risk from Surface Water' map (Figure 3.1) shows the development site is located in an area classified as having a 'very low' risk of surface water flooding.

Probability of Flooding

High – Extent of flooding from surface water that has a 3.3% (1 in 30) or greater chance of happening each year.

Medium - Extent of flooding from surface water that has between a 3.3% (1 in 30) and 1% (1 in 100) chance of happening each year.

Low - Extent of flooding from surface water that has between a 1% (1 in 100) and 0.1% (1 in 1000) chance of happening each year.

Location of Development Site

Figure 3.1 – EA's 'Flood Risk from Surface Water' map (© Environment Agency).

Inspection of aerial height data for the site reveals that there are no topographic depressions within the site that would encourage surface water to pond. In addition, land levels within the surrounding area and adjacent road fall towards the south. Therefore, any rainwater accumulating within the highway following an extreme rainfall event, is considered to be contained within the highway and directed away from the site.

Taking the above into consideration and the fact that there are no records of surface water flooding contained within the SFRA and SWMP. The risk of flooding from this source is therefore considered to be *low*.

Nevertheless, the development will include a sustainable drainage system which will be designed to manage surface water runoff from the site up to and including the design rainfall event. These SuDS will reduce the risk of surface water flooding to the proposed development, whilst limiting the risk of flooding to the surrounding area (refer to Section 5).

3.4 Flooding from Groundwater

Water levels below the ground rise during wet winter months, and fall again in the summer as water flows out into rivers. In very wet winters, rising water levels may lead to the flooding of normally dry land, as well as reactivating flow in ‘bournes’ (streams that only flow for part of the year).

Groundwater flooding is most likely to occur in low-lying areas that are underlain by permeable rock (aquifers). The underlying geology in this area is London Clay, which is not typically associated with groundwater flooding. This is supported by BGS groundwater flood risk mapping data which shows that the general area in which the development site lies is identified as being at low risk from groundwater flooding.

Mapping on groundwater emergence provided as part of the Defra Groundwater Flood Scoping Study (May 2004), shows that no groundwater flooding events were recorded near the site during the very wet periods of 2000/01 or 2002/03. The mapping also identifies that the site itself is not located within an area where groundwater emergence is predicted. Consequently, the risk of flooding from this source is considered to be *low*.

3.5 Flooding from Sewers

In urban areas, rainwater is typically drained into surface water sewers or sewers containing both surface and wastewater known as “combined sewers”. Flooding can result when the sewer is overwhelmed by heavy rainfall, becomes blocked, or has inadequate capacity; this will continue until the water drains away.

Inspection of the asset location mapping provided by Thames Water (Figure 3.2) identifies that the sewers in this area are separate foul and surface water sewers.

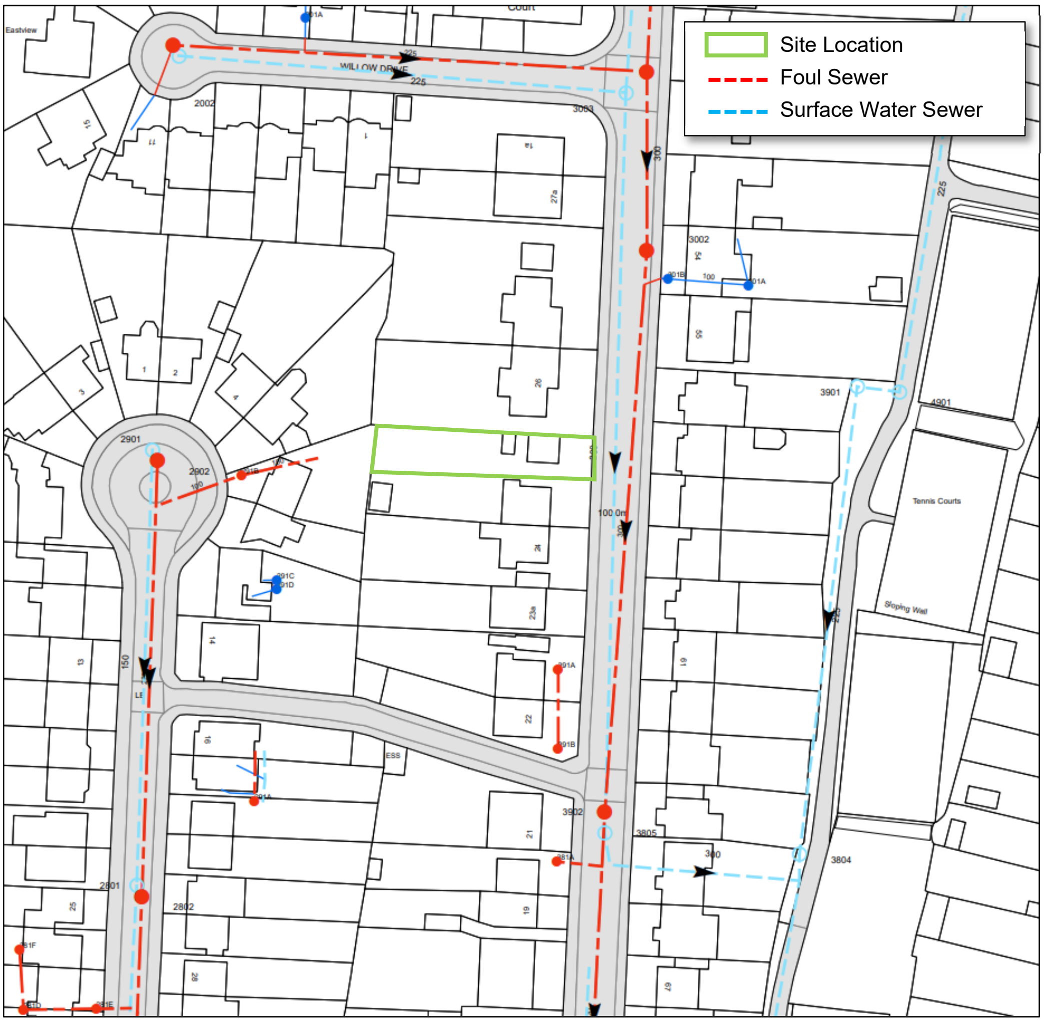


Figure 3.2 - Asset location mapping provided by Thames Water (a full scale copy can be found in Appendix A.2).

Inspection of aerial height data and the asset location data indicates that if water was to exit the sewer network i.e., as a result of a blockage or exceedance of capacity, it would occur further to the south, where land levels are lower. Floodwater would be channelled and contained within the highway and continue to flow south following the natural topography of the land. This is supported by the Barnet Council SFRA and SWMP, which shows there are no known records of flooding from sewers in this area. Consequently, the risk of flooding from this source is considered to be *low*.

3.6 Flooding from Reservoirs, Canals and Other Artificial Sources

Non-natural or artificial sources of flooding can include reservoirs, canals, and lakes, where water is retained above natural ground level. In addition, operational and redundant industrial processes including mining, quarrying, sand and/or gravel extraction, may also increase the depth of floodwater in areas adjacent to these features.

The potential effects of flood risk management infrastructure and other structures also needs to be considered. For example, reservoir or canal flooding may occur as a result of the facility being overwhelmed and/or as a result of dam or bank failure.

Inspection of the OS mapping for the area shows that there are no artificial sources of flooding within close proximity to the site. In addition, the EA's 'Flood Risk from Reservoirs' map shows that the site is not within an area considered to be at risk of flooding from reservoirs. Consequently, the risk of flooding is considered to be *low*.

3.7 Summary of Flood Risk

A summary of the overall risk of flooding from each source is provided in Table 3.1 below.

Source of Flooding	Initial Level of Risk	Appraisal method applied at the initial flood risk assessment stage
Rivers, Ordinary and Man-Made Watercourses	Low	OS mapping and the EA's 'Flood Map for Planning'
Sea	Low	OS mapping
Surface Water	Low	EA's 'Flood Risk from Surface Water' map, historic records contained within the Barnet Council SFRA and SWMP, aerial height data, and OS mapping
Groundwater	Low	BGS groundwater flood hazard maps, Defra Groundwater Flood Scoping Study, site-specific geological data, and OS mapping,
Sewers	Low	Aerial height data, OS mapping, asset location data provided by Thames Water and historic sewer records contained within the SFRA and SWMP
Reservoirs, Canals and Other Artificial Sources	Low	OS mapping and EA's 'Flood Risk from Reservoirs' map

Table 3.1 – Summary of flood sources and risks.

From the analysis above, it can be seen that **the risk of flooding to the site from all sources is low.** Notwithstanding this, to ensure that the development meets the requirements of the NPPF, the following section of the report recommends mitigation measures, where appropriate, to ensure the risk of flooding offsite does not increase as a result of the proposals.

4 Existing Drainage

4.1 Existing Surface Water Drainage

The existing site drainage has not been surveyed and as such, it is unknown how the existing buildings at the site currently drain. However, it is assumed that the roofs of the existing buildings drain into the public surface water sewer system, whilst some hardstanding areas drain informally towards the road, where runoff is intercepted by the highway drainage.

Surface water runoff is discharged at an unrestricted rate from the existing site and this rate of discharge has been calculated for a range of rainfall events with varying return periods. These rates are outlined in Table 4.1 below. These hydrological calculations have been undertaken using the Modified Rational Method and synthetic rainfall data derived using the variables obtained from the Flood Estimation Handbook (FEH) online web service.

Return Period (years)	Peak runoff from the existing site (l/s)
2	2.8
30	8.4
100	11.0

Table 4.1 – Summary of peak runoff rates for the existing site.

Thames Water has provided sewer mapping as part of their asset location data for the site and surrounding area. An extract of this mapping is provided in Figure 3.2 and shows the location of public sewers in close proximity to the site.

From Figure 3.2, it is evident that the sewers in this area are typically separated into dedicated surface water and foul water networks. The nearest surface water sewer to the site is located to the east of the site, within the adjacent highway of Manor Road.

5 Sustainable Drainage Assessment

5.1 Site Characteristics

The important characteristics of the site, which have the potential to influence the surface water drainage strategy, are summarised in Table 5.1 below.

Site Characteristic	Development Site	
Total area of site	~364m^2	
Current site condition	Developed (brownfield)	
Greenfield runoff rates (based on the FEH methodology)	1:1 yr = 5.19 l/s/ha Qbar = 6.11 l/s/ha 1:30 yr = 14.05 l/s/ha 1:100 yr = 19.49 l/s/ha	
Infiltration	Assumed negligible based on underlying geology and typical soil conditions	
Current surface water discharge method	Assumed connection into public surface water sewer on Manor Road and some areas of hardstanding to drain informally towards the highway	
Is there a watercourse nearby?	No	
Impermeable area	**Existing** **~ 146 m^2**	**Proposed** **~ 190 m^2**

Table 5.1 - Site characteristics affecting rainfall runoff.

Based on Table 5.1 above, it is evident that the development proposals will increase the total impermeable area across the site. As a result, the rate at which the surface water runoff is discharged from the site is likely to increase. Consequently, measures will need to be put in place to ensure that the impact of this additional surface water runoff is appropriately managed. Furthermore, the potential use of SuDS within the proposed development will be considered to assess the practicality of better replicating greenfield behaviour.

5.2 Opportunities to Discharge Surface Water Runoff

Part H of the Building Regulations summarises a hierarchy of options for discharging surface water runoff from developments. The preferred option is to **infiltrate** water into the ground, as this deals with the water at source and serves to replenish groundwater. If this option is not viable, the next option is for the runoff to be discharged into a **watercourse**. The water should only be conducted into the **public sewer** system if neither of the previous options are possible.

Policy SI 13 of the London Plan (2021) summaries a hierarchy of options for discharging surface water runoff from developments. Policy SI 13 favours managing surface water runoff at source, by either storing it for later **re-use** or allowing it to **infiltrate** into the ground. If this option is not viable, the next option of preference is for the runoff to be discharged into a **watercourse.** Only if neither of these options are possible, the water should be conducted into a **public sewer** system, with a connection into a surface water sewer being preferred over the discharge into either a combined or foul sewer.

The following opportunities for managing the surface water runoff discharged from the development site are listed in order of preference:

Water Re-Use – Water re-use systems should ideally be considered to reduce the reliance on the demand for potable water. However, such systems can rarely manage 100% of the surface water runoff discharged from a development, as this requires the yield from the building and hardstanding area to balance perfectly with the demand from the proposed development. Consequently, whilst rainwater recycling systems can be considered for inclusion within the scheme, an alternative solution for attenuating storm water will still be required.

Infiltration – Reference to BGS mapping shows that the bedrock geology of the site is made up of London Clay Formation (Clay and Silt), with no superficial deposits. As a result, the site is unlikely to be sufficiently permeable to support the use of infiltration SuDS as the primary solution for draining surface water runoff from the site.

Discharge to Watercourses – There are no watercourses located within close proximity to the site, which show onward connectivity to a main river, the sea, or any other large surface water body. As a result, there is no opportunity to discharge surface water runoff from the development to an existing watercourse.

Discharge to Public Sewer System – With no alternative options available, it is assumed that a connection to the public sewer system will present the most viable solution for managing the surface water runoff discharged from the development.

5.3 Constraints and Further Considerations

The key constraints that are relevant to this development are listed below:

- There is limited open space to incorporate SuDS that require very large areas of land, such as wetlands and large infiltration basins.
- Due to the poor infiltration rate, it will not be possible to reduce or maintain the volume of surface water runoff discharged from the development site.
- If additional surface water runoff is to be discharged into the public sewer system, or if a new connection is required, it will be necessary to gain consent for this connection from the sewerage undertaker (Thames Water).

- Ideally post development runoff rates should be restricted to greenfield runoff rates. However, on small sites where discharge rates are exceptionally low higher rates are generally considered acceptable, due to the technical limitations of flow control devices. In this case a limiting discharge rate of 2.0l/s is likely to be acceptable by the LPA and Thames Water.

5.4 Proposed Surface Water Management Strategy

The drainage strategy set out below discusses each of the different elements of the proposed scheme, along with the results from a numerical drainage model constructed for the site, which can be used to demonstrate how the overall objectives can be achieved. This does not represent a detailed surface water drainage design; it is simply an assessment to demonstrate that the objectives and requirements of the NPPF can be met at the planning stage.

Water Butts

To reduce the developments reliance on potable water supplies for external use, there is the potential to incorporate water butts within the communal garden area. Typical sizes and dimensions of water butts are outlined below.

Typical house water butt options	Dimensions of a typical house water butt	Volume of storage provided (litres)
Type 1 (wall mounted – small)	1.22m high x 0.46m x 0.23m	100
Type 2 (standard house water butt)	0.9m high x 0.68m diameter	210
Type 3 (large house water butt)	1.26m high x 1.24m x 0.8m	510
Type 4 (column tank – very large)	2.23m high x 1.28m diameter	2,000

Table 5.2 - Estimated storage capacity of available water butts.

In this case, the demand for potable water from the garden is likely to be relatively small and as a result, standard water butts (typical 210 litre units) are likely to be the most appropriate size for inclusion within the scheme.

It is recognised that each of the water butts will need to overflow into the main drainage system for the site, to ensure that in the event the water butt is full prior to the onset of the design rainfall event, water can be discharged away from the properties without increasing the risk of flooding.

Permeable Surfacing

Runoff from the roof and hardstanding areas across the site will be directed via underground pipes into a layer of open graded subbase material, located beneath permeable surfacing. The rate at which runoff is permitted to exit the permeable surfacing system will be restricted through the use of a vortex flow control device (hydro-brake or similar). If ground conditions permit, the base of the permeable surfacing system can be underlain with a permeable geotextile liner, to maximise the volume of water discharged to the ground via infiltration. The permeable surfacing system can contain an overflow pipe that will direct water from the top of the paving system directly into the public sewer system, in the event that the flow control device fails or becomes blocked. Check valves should be specified to prevent backflow into the drainage system, should the public sewer system surcharge. A summary of the Causeway Flow+ analysis for permeable surfacing is shown in Table 5.3 below.

Parameter	**Value (1:100yr+40%cc event)**
SuDS	Permeable Surfacing
Total area draining to permeable surfacing, including a 10% allowance for urban creep	~209 m^2
Area of permeable surfacing	~ 23.5 m^2
Sub-base depth	800 mm
Sub-base porosity	30%
Flow control device	Vortex flow control device (Hydro-Brake or similar)
Limiting discharge rate	2.0 l/s
Critical storm duration	30 minutes
Overflow device	Pipe

Table 5.3 – Summary of permeable surfacing SuDS.

Runoff rates have been calculated for a range of annual return probabilities, including the 100-year return period event with a 40% increase in rainfall intensity, to account for future climatic changes. These values are summarised below in Table 5.4.

Return Period	**Existing Discharge Rates**	**Proposed Discharge Rates (including a 10% allowance for urban creep)**	**% Betterment**
1 in 2yr	2.8 l/s	1.5 l/s	46 %
1 in 30yr	8.4 l/s	1.6 l/s	80 %
1 in 100yr	11.0 l/s	1.8 l/s	83 %
1 in 100yr + 40%cc	15.3 l/s	2.0 l/s	86 %

Table 5.4 - Summary of Causeway Flow+ analysis for the permeable surfacing and peak discharge rates for a range of return period events.

It is evident that with the inclusion of the proposed SuDS, there is the potential to accommodate all the surface water runoff from the site, up to and including, the design rainfall event. This assumes the rate at which water is discharged to the public sewer system will be attenuated to a rate that is no greater than 2.0 l/s.

5.5 Indicative Drainage Layout Plan

Figure 5.1 below is an indicative drainage layout plan delineating how the proposed SuDS can be incorporated into the scheme proposals.

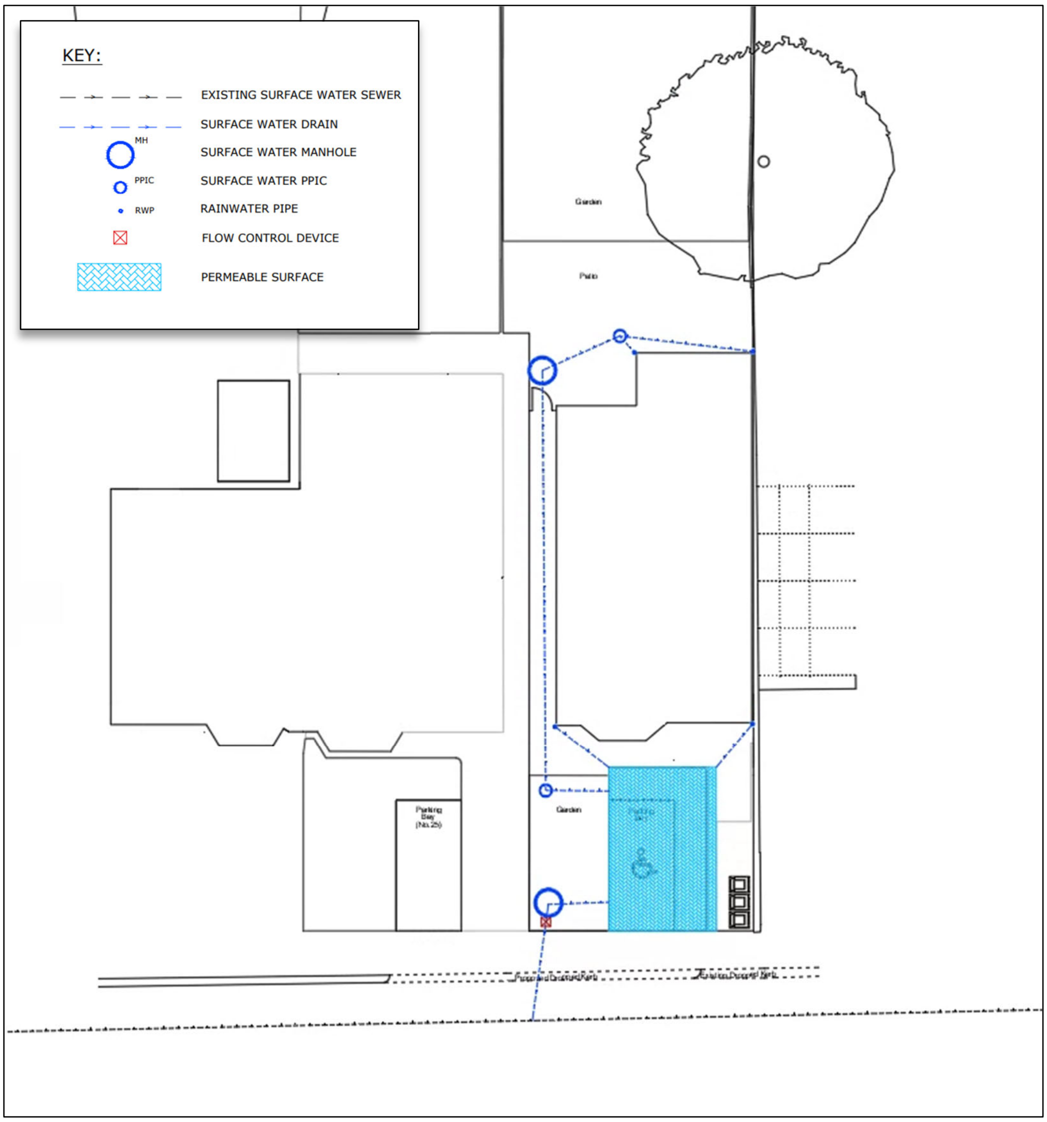


Figure 5.1 - Indicative drainage layout plan showing the proposed location of SuDS.

A full-scale copy of this layout is located in Appendix A.3 of this report.

5.6 Management and Maintenance

In order for any surface water drainage system to operate as originally designed, it is necessary to ensure that it is adequately maintained throughout its lifetime. Therefore, over the lifetime of a development there is a possibility that the performance of the system could be reduced or could fail if it is not correctly maintained. This is even more important when SuDS form a part of the surface water management system, as these require a more onerous maintenance regime than a typical piped network.

The key requirements of any management regime are routine inspection and maintenance. When the development is taken forward to the detailed design stage, an 'owner's manual' will need to be prepared. This should include:

- A description of the drainage scheme.
- A location plan showing all of the SuDS features and equipment, such as flow control devices etc.
- Maintenance requirements for each element, including any manufacturer-specific requirements.
- An explanation of the consequences of not carrying out the specified maintenance.
- Details of who will be responsible for the ongoing maintenance of the drainage system.

For the SuDS recommended by this assessment, the most obvious maintenance tasks will be the regular brushing and cleaning of the permeable. General maintenance schedules have been included within Appendix A.6 of this report, which demonstrate the maintenance requirements of the proposed SuDS.

For developments such as this, that to some extent rely on the ongoing inspection and maintenance of SuDS, it will be necessary to ensure that measures are in place to maintain the system for the lifetime of the development. In this case, it is likely that maintenance will be the responsibility of the individual property owner / occupant.

Further details of the maintenance and management strategy should be confirmed, following the completion of a detailed drainage design for the development.

5.7 Sensitivity Testing and Residual Risk

When considering residual risk, it is necessary to consider the impact of a flood event that exceeds the design event, or the implications if the proposed drainage system was to become blocked.

For the water butts, there is the potential for a small amount of localised flooding to occur if the overflows from these features were to become blocked. Given the small catchment area draining to each of these features, the volume of floodwater will be relatively small, and it is unlikely to present a risk to the properties or occupants.

To minimise the risk of the uncontrolled discharge of floodwater from the permeable surfacing system, an overflow pipe has been incorporated into the design of this drainage feature. If the primary flow control device becomes blocked, this pipe will be used to bypass the flow control device, allowing excess water to drain directly to the public sewer system.

Furthermore, the topographic survey shows that the levels to the front of the house fall towards the highway and away from the building. Therefore, any water overflowing from the permeable surfacing system will fall in this direction and will be picked up by the highway drainage system.

Based on the analysis above, it is therefore concluded that the proposed drainage system outlined within this strategy will not result in an increased risk of flooding to properties at the site or within the surrounding area.

6 Foul Water Management Strategy

6.1 Background

The objective of this foul water drainage strategy is to ensure a viable solution is available for managing foul effluent discharged from the proposed development site.

In general, there are two methods for draining effluent from proposed developments. The preferred solution is a connection to the public sewer network, which is controlled by the sewerage undertaker. Nonetheless, if there are no sewers near to the development site or there are particular reasons why a connection to the public sewer system would not be possible i.e., topography, cost, environmental concerns, then the use of package treatment systems or cesspits is permitted.

The Environment Agency's "Binding Rules" control the use of package treatment systems and require the development to connect to the public sewer system if the site boundary is located within 30m of an existing sewer (plus an additional 30 meters for every proposed unit). In this case, the proposed development, is located within close proximity of a public foul sewer. Therefore, the use of package treatment systems is unlikely to be considered appropriate for this development.

6.2 Sewer Connection

As indicated in Figure 3.2, there is an existing public foul sewer to the east of the site. It is anticipated that the proposed development will connect into the existing sewer network, as shown in Figure 6.1 below.

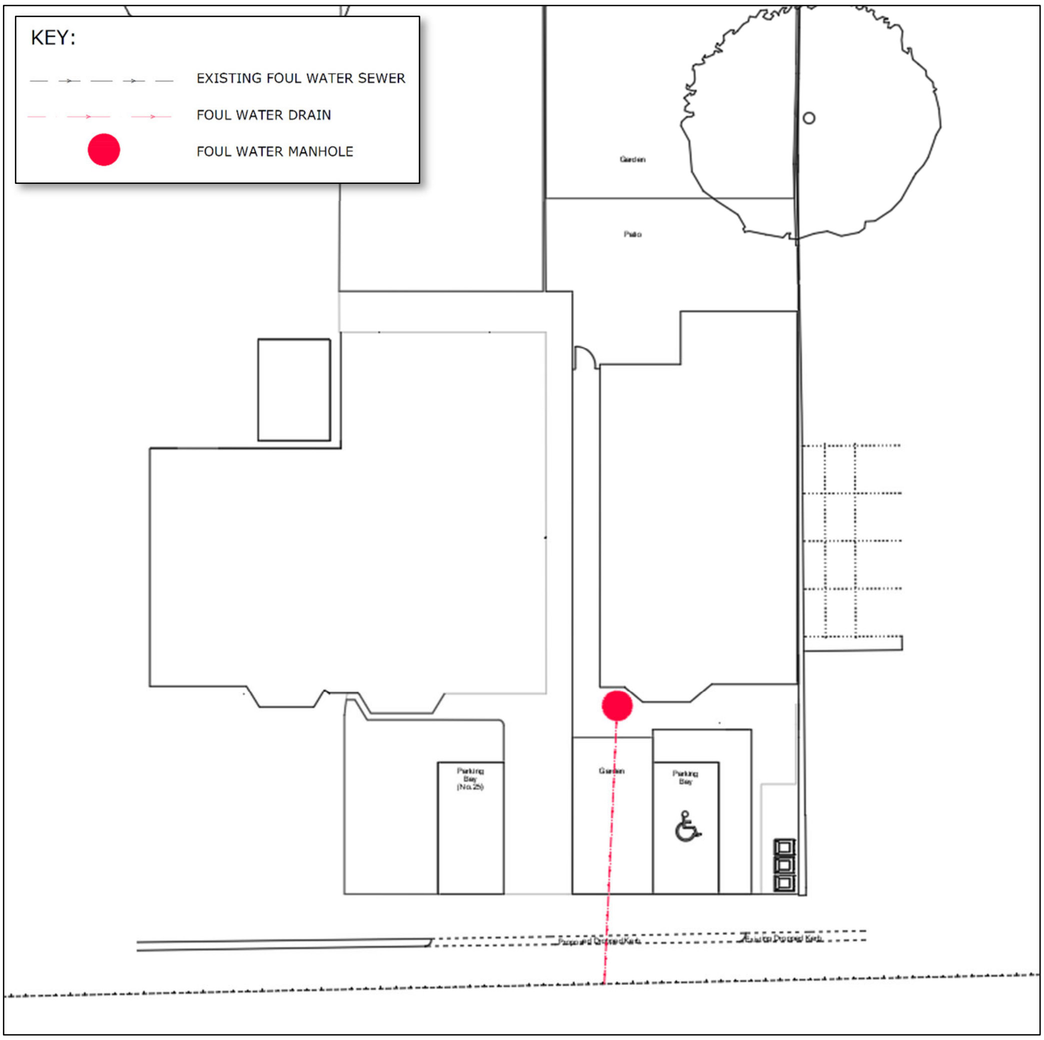


Figure 6.1 - Proposed connection to the foul sewer network.

In accordance with the Design and Construction Guidance (DCG), the design peak flow rate for foul water discharged from the proposed development has been calculated as 0.05 l/s. It is recommended that a sewer capacity check is undertaken at the detailed design stage to allow the sewerage undertaker to confirm whether there is sufficient capacity within the existing public foul sewer and to confirm whether the proposed increase in the discharge rate from the new development is acceptable.

6.3 The Water Industry Act

The Water Industry Act 1991 provides developers with a mechanism for connecting to the public sewerage infrastructure. The type of connection depends on the type and location of the sewers in relation to the site and third-party land.

As the nearest sewers to the site are located outside of the development site boundary, the developer must requisition a new length of sewer from the sewerage undertaker, through a Section 98 application.

As part of the Section 98 process, it is necessary to determine whether the existing sewer network requires any upgrades to accommodate effluent from the development site. If upgrades to the sewerage system are required these will be requisitioned under the same Section 98 application. In this case, it is likely additional offsite works will be required and these will therefore be included within the Section 98 application. It is acknowledged that the cost of a new connection and any additional works which are required to upgrade the public sewer system (to accommodate the additional foul effluent from the development) can be charged to the developer.

Under Section 101, the sewerage undertaker must undertake any works as part of this process within a reasonable timeframe, which is typically 6 months following the agreement being made. Mitigating circumstances and Grampian planning conditions can, however, result in different timescales.

6.4 Summary

The opportunities for managing foul effluent discharged from the development site have been analysed and it is concluded that a new connection to the public sewer system, located to the east of the site, is likely to present the most viable solution.

Following the award of planning permission, a full detailed design of the site layout and foul drainage system will be required as part of the Section 98 application, which will require a new connection to be requisitioned and any necessary upgrades made to the public sewer system. These upgrades are likely to be economically proportionate to the size of the development, however, it is recognised that a solution for managing foul wastewater from the proposed development will be available.

7 Conclusions and Recommendations

The overarching objective of this report is to appraise the risk of flooding at 25 Manor Road, Barnet to ensure that the proposals for development are acceptable in this location and that the risk of flooding offsite will not increase as a result of the development. This report has therefore been prepared to appraise the risk of flooding from all sources and to provide a sustainable solution for managing the surface water runoff discharged from the development site, in accordance with the NPPF local planning policy.

The risk of flooding has been considered for a wide range of sources and it has been identified that the risk to the proposed development is *low*. Notwithstanding this, in order to minimise the impact that the building could have with respect to an increase is surface water runoff, the opportunities for managing surface water at the site have been further analysed.

It is concluded that the most viable solution for managing all of the surface water runoff discharged from the proposed development will be via a connection to the public surface water sewer system (located to the east of the site).

In order to restrict the rate at which surface water runoff is discharged offsite, a permeable surfacing system has been proposed. The permeable surfacing system will be used to store water onsite, before it is discharged to the public sewer system. A vortex flow control device has been specified to attenuate the rate at which surface water runoff is discharged from the site, limiting the rate to a maximum of 2.0 l/s. This is considered to be as close as reasonably practicable to the calculated greenfield runoff rates for the site.

Details of the typical maintenance and management requirements for each element of the drainage system have been provided to ensure that the proposed drainage solution can be maintained and will continue to operate over the lifetime of the development. It is, however, recommended that an "owner's manual" containing additional product specific maintenance requirements is produced as part of the detailed design for the site.

The opportunities for discharging foul effluent from the site have also been considered and the appraisal demonstrates that the most viable solution is to connect into the existing public foul sewer network.

In conclusion, it is evident that the development is at low risk of flooding and a sustainable solution for managing both the surface water runoff and wastewater discharged from the proposed development at the development site is available. Consequently, the proposals will meet the requirements of the NPPF and local planning policy.

8 Appendices

Appendix A.1 – Drawings

Appendix A.2 – Thames Water Asset Location Data

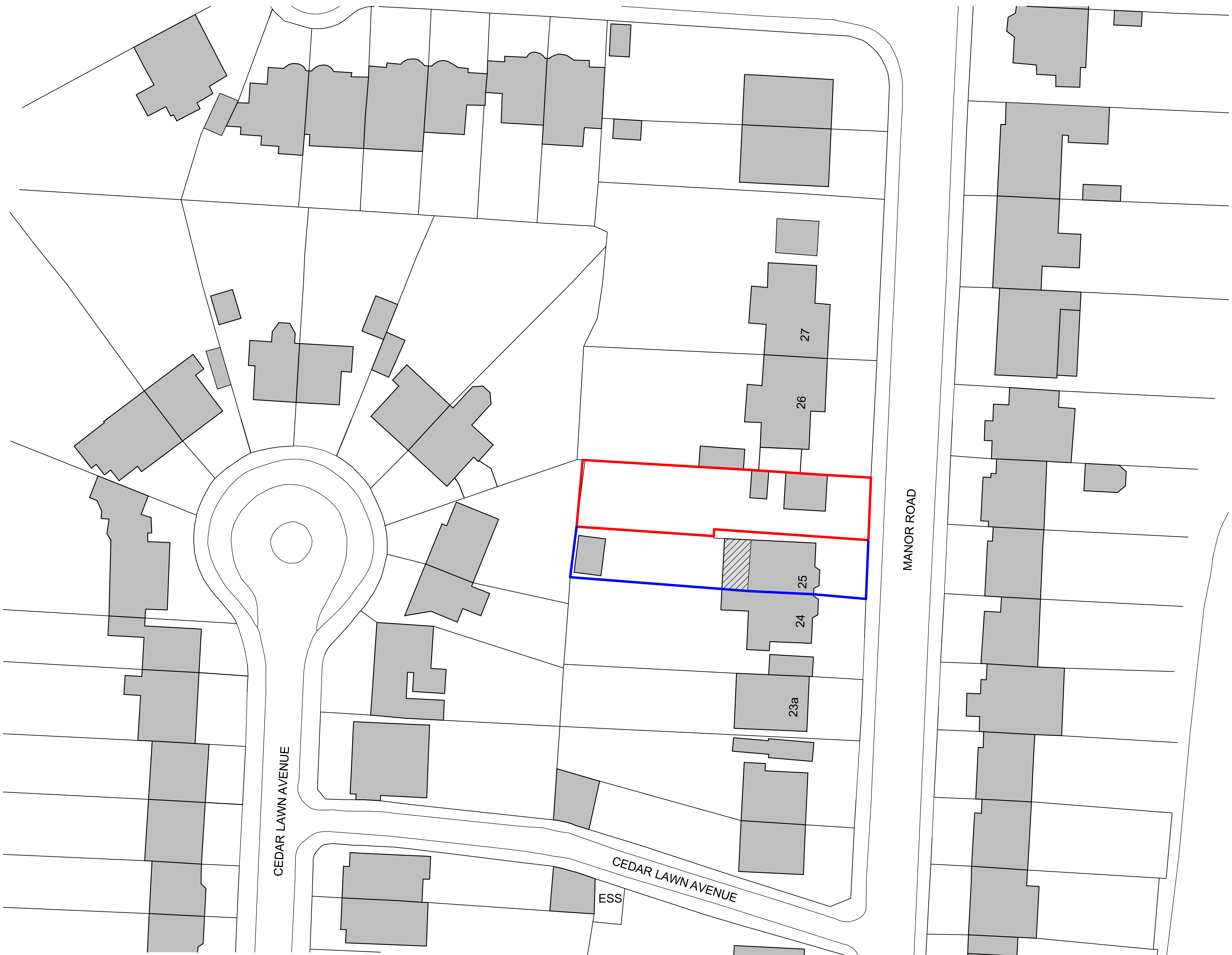
Appendix A.3 – Indicative Drainage Layout Plan

Appendix A.4 – Greenfield Runoff Rates

Appendix A.5 – Surface Water Management Calculations

Appendix A.6 – Maintenance Schedules

Appendix A.1 – Drawings



LSI Ref **21245**	21245-LSI-MRB-ZZ-FE-A-0001_Manor Road_Feasability Model_AC21_230317.pln

All dimensions are to be checked on site and the Contract Administrator notified of any discrepancies.

Drawing to be read in conjunction with the project specification

Do not scale from this drawing for Constructional purposes

N

Site Boundary

Site Controlled by Applicant

Indicates extent of consented scheme at number 25 Manor Road

Rev	Init	Date	Revision
P04	AJ	01/12/23	Updated site boundary line
P03	AJ	28/11/23	Updated to single occupancy house
P02	LE	25/05/23	Consented scheme indicated
P01	KBC	21/04/22	Preliminary issue - issued for comments

0m 10

Scale 1:500

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LONDON
Floor 2
50-54 Clerkenwell Road
London EC1M 5PS
+44(0)20 7278 1739

www.lsiarchitects.co.uk

Client
Abbeytown Developments Ltd

Project
25 Manor Road, Barnet

Title
New Build Planning
Site Location Plan - Existing

Scale @ A3	Date	Drawn
1:500	20/04/22	KBC

Purpose of issue
Suitable for Planning

Drawing Code	Suit.	Rev.
21245-LSI-AAA-XX-DR-A-1170	S2	P04

LSI Ref **21245**	21245-LSI-MRB-ZZ-FE-A-0001_Manor Road_Feasability Model_AC21_230317.pln

All dimensions are to be checked on site and the Contract Administrator notified of any discrepancies.

Drawing to be read in conjunction with the project specification

Do not scale from this drawing for Constructional purposes

N

Site Boundary

Site Controlled by Applicant

Indicates extent of consented scheme at number 25 Manor Road

Rev	Init	Date	Revision
P05	AJ	01/12/23	Updated site boundary line
P04	AJ	28/11/23	Updated to single occupancy house
P03	LE	25/05/23	Consented scheme indicated
P02	KBC	21/04/22	Updated in line with scheme amendments
P01	KBC	30/03/22	Preliminary issue - issued for comments

0m 10

Scale 1:500

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Title
New Build Planning
Site Location Plan - Proposed

Scale @ A3	Date	Drawn
1:500	29/03/22	KBC

Purpose of issue
Suitable for Planning

Drawing Code	Suit.	Rev.
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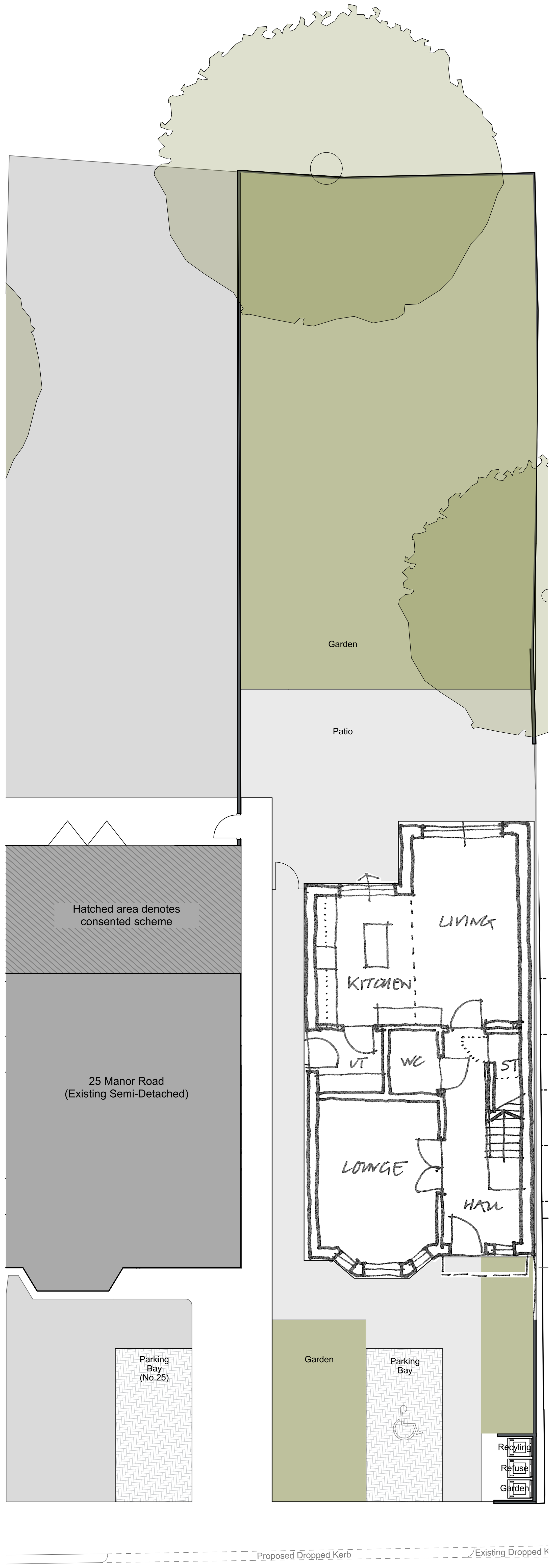
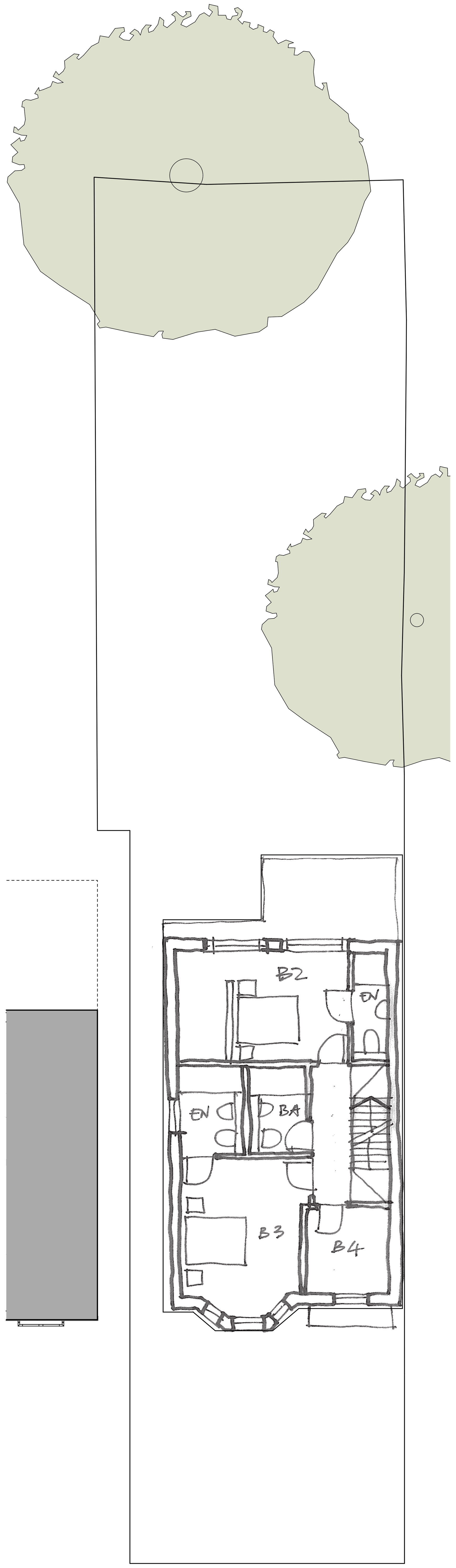
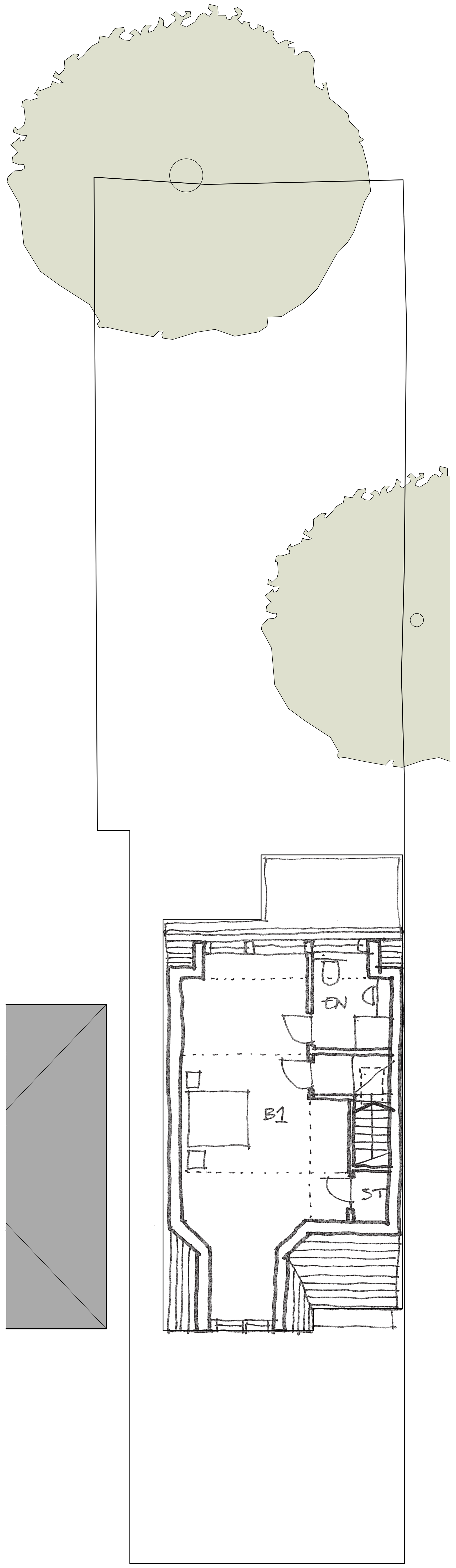


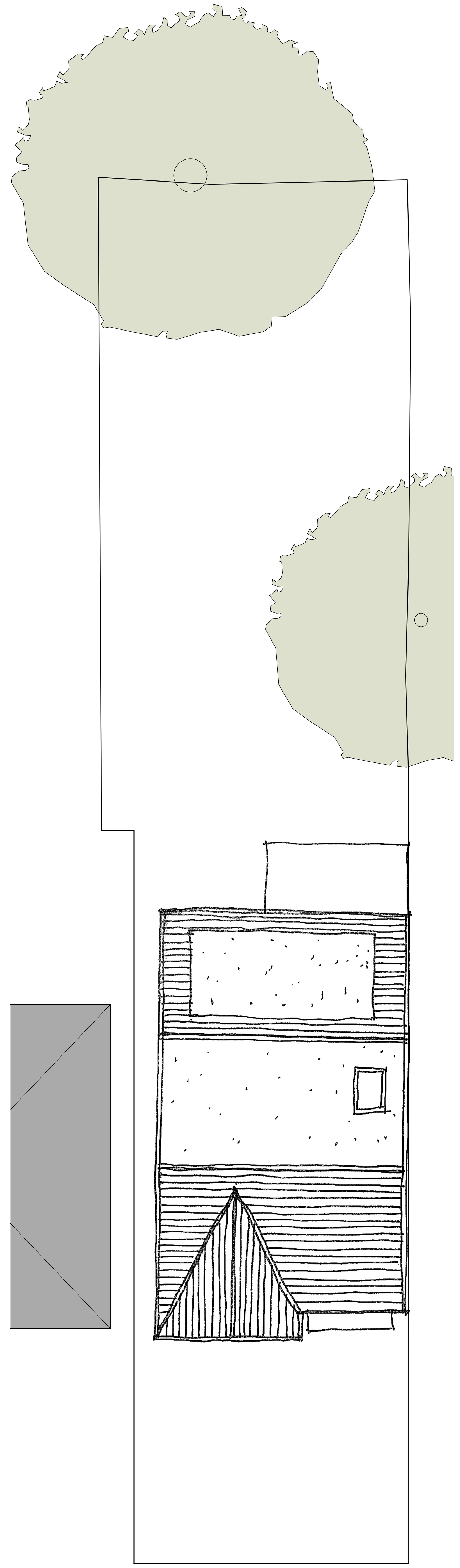
Proposed Ground Floor Plan



Proposed First Floor Plan



Proposed Second Floor Plan



Proposed Roof Plan

LSI Ref **21245** | 21245-LSI-MRB-ZZ-FE-A-0001_Manor Road_Feasability Model_AC21_230317.pln

All dimensions are to be checked on site and the Contract Administrator notified of any discrepancies.

Drawing to be read in conjunction with the project specification

Do not scale from this drawing for Constructional purposes

N

Rev	Init	Date	Revision
P10	AJ	11/01/24	Building footprint and openings dimensioned
P09	AJ	01/12/23	Updated site boundary line and roof plan
P08	AJ	28/11/23	Updated to single occupancy house
P07	LE	15/08/23	Seperate gardens indicated
P06	LE	25/05/23	Consented scheme indicated
P05	HW	20/03/23	Adjustments to car parking arrangement & East facing dormers
P04	HW	05/09/22	Adjustment to dormer widths & rooflight sizes. Parking bays indicated.
P03	KBC	28/04/22	Roof plan amended in line with design updates. Addition of roof lights.
P02	KBC	21/04/22	Roof amended to an asymmetrical pitched roof. Ground floor and first floor layout amended to show 45° natural light splay from the existing neighbouring windows.
P01	KBC	30/03/22	Preliminary issue - issued for comments

0m 1 2 3 4 5 6 7

Scale 1:100

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Title
New Build Planning
Proposed General Arrangement - Floor Plans

Scale @ A1	Date	Drawn
1:100	30/03/22	KBC

Purpose of issue
Suitable for Planning

Drawing Code	Suit.	Rev.
21245-LSI-AAA-XX-DR-A-1300	S2	P10

LSI Ref **21245**	21245-LSI-MRB-ZZ-FE-A-0001_Manor Road_Feasability Model_AC21_230317.pln

All dimensions are to be checked on site and the Contract Administrator notified of any discrepancies.

Drawing to be read in conjunction with the project specification

Do not scale from this drawing for Constructional purposes

Rev	Init	Date	Revision
P04	AJ	28/11/23	Updated to single occupancy house
P03	LE	25/05/23	No. 26 'Garage' notation removed
P02	HW	20/03/23	Added detail to existing context
P01	HW	05/09/22	Initail Issue

0m 1 2 3 4 5 6 7

Scale 1:100

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Title
New Build Planning
Existing Street Elevation

Scale @ A1	Date	Drawn
1:50	05/09/22	HW

Purpose of issue
Suitable for Planning

Drawing Code	Suit.	Rev.
21245-LSI-AAA-ZZ-DR-A-1340	S3	P04

LSI Ref **21245**	21245-LSI-MRB-ZZ-FE-A-0001_Manor Road_Feasability Model_AC21_230317.pln

All dimensions are to be checked on site and the Contract Administrator notified of any discrepancies.

Drawing to be read in conjunction with the project specification

Do not scale from this drawing for Constructional purposes

Rev	Init	Date	Revision
P06	AJ	01/12/23	Roof level amended
P06	AJ	28/11/23	Updated to single occupancy house
P05	LE	25/05/23	No. 26 'Garage' notation removed
P04	HW	20/03/23	Added detail to existing context
P03	KBC	28/04/22	Roof amended in line with design updates. Addition of roof lights.
P02	KBC	21/04/22	Roof amended to an asymmetrical pitched roof
P01	KBC	30/03/22	Preliminary issue - issued for comments

0m 1 2 3 4 5 6 7

Scale 1:100

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Project
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Title
New Build Planning
Proposed Street Elevation

Scale @ A1	Date	Drawn
1:50, 1:100	30/03/22	KBC

Purpose of issue
Suitable for Planning

Drawing Code	Suit.	Rev.
21245-LSI-AAA-ZZ-DR-A-1350	S2	P06

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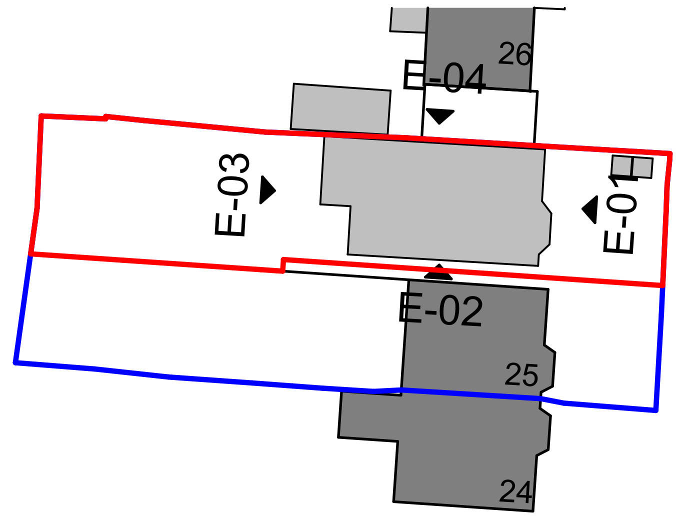
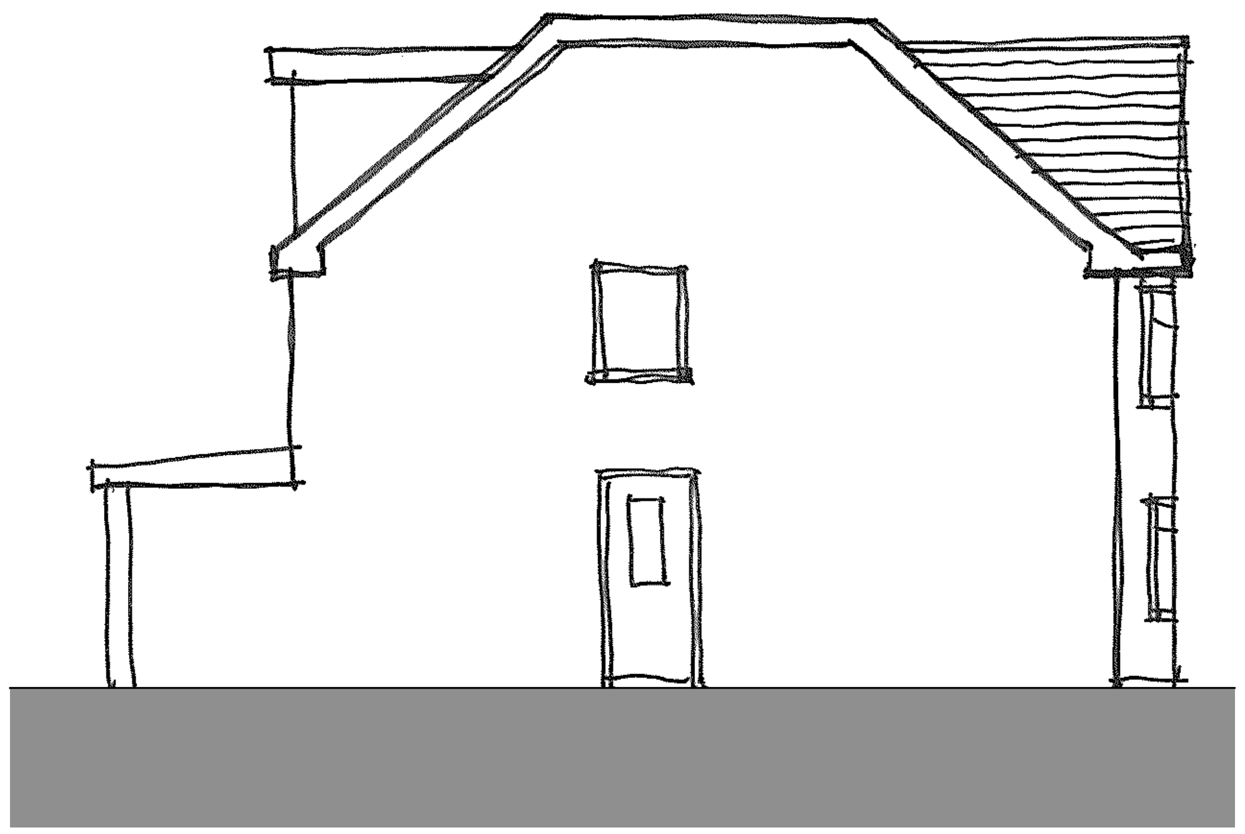
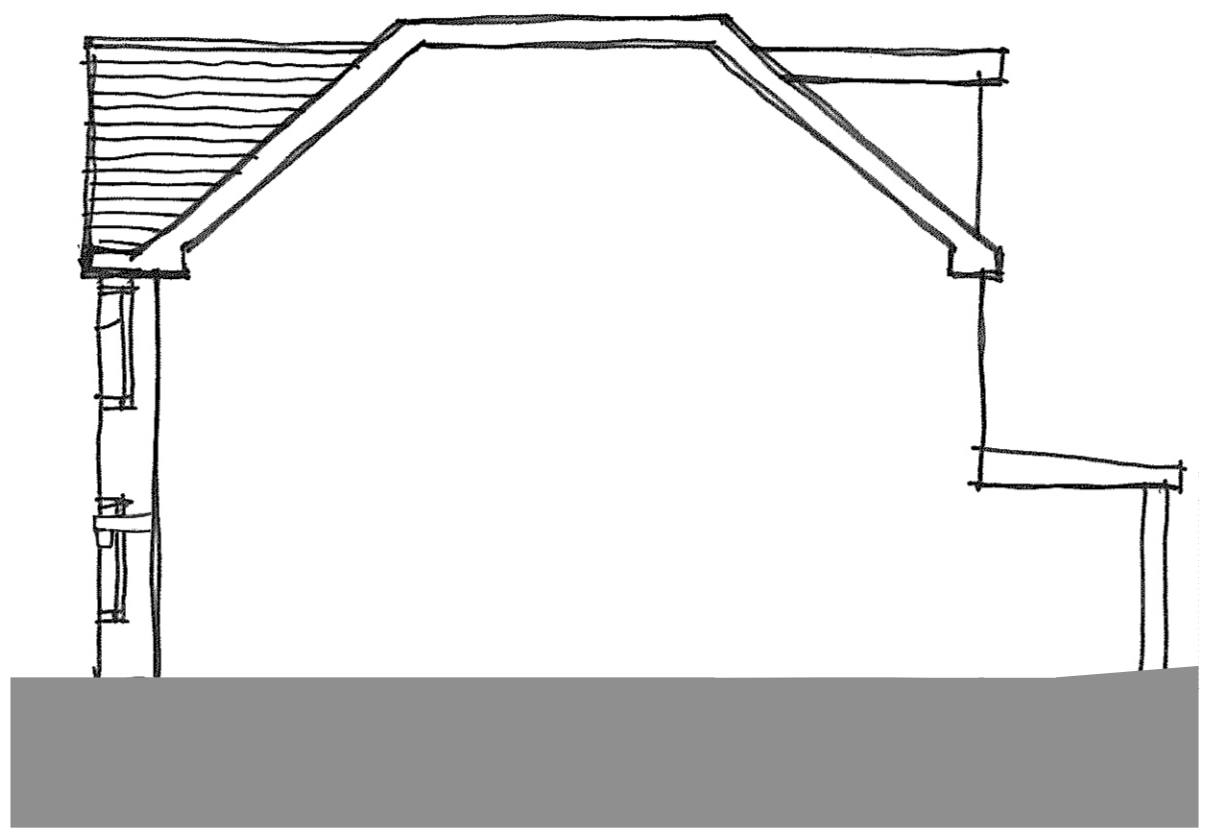


Key Plan



Elevation E-02

Elevation E-03



Elevation E-04

LSI Ref 21245 | 21245-LSI-MRB-ZZ-FE-A-0001_Manor Road_Feasability Model_AC21_230317.pln

All dimensions are to be checked on site and the Contract Administrator notified of any discrepancies.

Drawing to be read in conjunction with the project specification

Do not scale from this drawing for Constructional purposes

Rev	Init	Date	Revision
P08	AJ	01/12/23	Roof level amended
P07	AJ	28/11/23	Updated to single occupancy house
P06	LE	25/05/23	No. 26 'Garage' notation removed
P05	HW	20/03/23	E-01 windows updated & soldier coursing added
P04	HW	05/09/22	Adjustments made to dormers & roof lights. Eaves increased and roof ridge reduced in height.
P03	KBC	28/04/22	Roof amended in line with design updates. Addition of roof lights.

0m 1 2 3 4 5 6 7

Scale 1:100

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Title
New Build Planning
Proposed General Arrangement Elevations

Scale @ A2	Date	Drawn
1:100	30/03/22	KBC

Purpose of issue
Suitable for Planning

Drawing Code	Suit.	Rev.
21245-LSI-AAA-ZZ-DR-A-1351	S2	P08

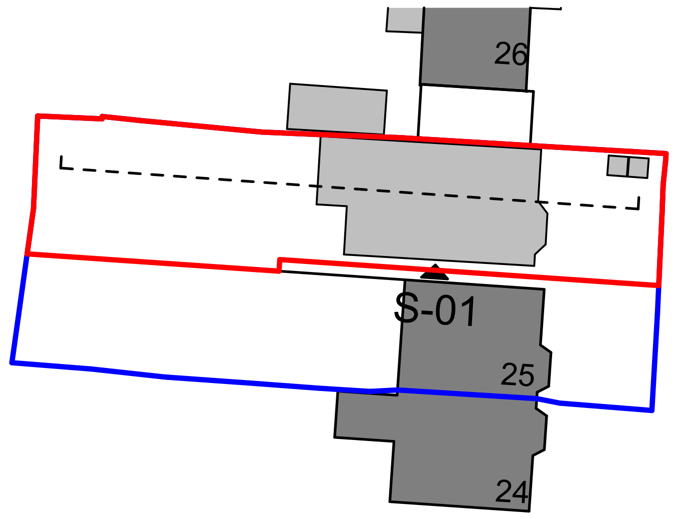
LSI Ref | 21245-LSI-MRB-ZZ-FE-A-0001_Manor Road_Feasability Model_AC21_230317.pln
21245

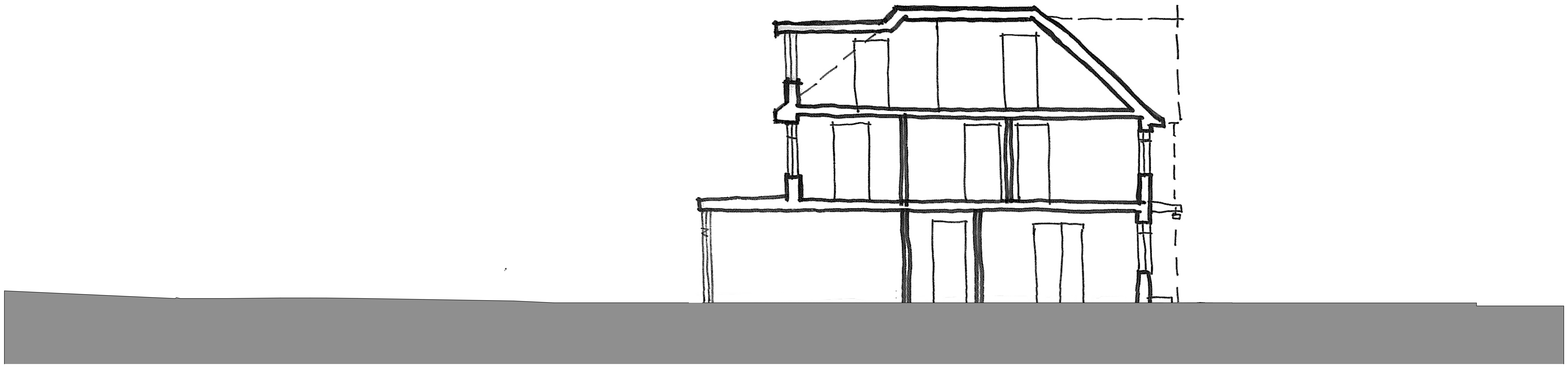
All dimensions are to be checked on site and the Contract Administrator notified of any discrepancies.

Drawing to be read in conjunction with the project specification

Do not scale from this drawing for Constructional purposes

Key Plan





Section S-01

Rev	Init	Date	Revision
P07	AJ	16/01/24	Dimensions added
P06	AJ	11/01/24	Dimensions added
P05	AJ	01/12/23	Roof level and section line amended
P04	AJ	28/11/23	Updated to single occupancy house
P03	LE	25/05/23	No. 26 'Garage' notation removed
P02	HW	20/03/23	Revised East elevation
P01	HW	06/09/22	Initial Issue

0m 1 2 3 4 5 6 7

Scale 1:100

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Client
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Project
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Title
New Build Planning
Proposed General Arrangement Sections

Scale @ A2	Date	Drawn
1:100	06/09/22	HW

Purpose of issue
Suitable for Planning

Drawing Code	Suit.	Rev.
21245-LSI-AAA-ZZ-DR-A-1370	S3	P07

Appendix A.2 –Thames Water Asset Location Data

Asset location search

Property Searches

Herrington Consulting Limited
Barham Business Park
Unit 6Elham Valley Road
CANTERBURY
CT4 6DQ

Search address supplied 25
Manor Road
Barnet
EN5 2LE

Your reference NA/3699

Our reference ALS/ALS Standard/2023_4792456

Search date 28 February 2023

Notification of Price Changes

From 1st April 2023 Thames water Property Searches will be increasing the prices of its CON29DW, CommercialDW Drainage & Water Enquiries and Asset Location Searches. Historically costs would rise in line with RPI but as this currently sits at 14.2%, we are capping it at 10%.

Customers will be emailed with the new prices by January 1st 2023.

Any orders received with a higher payment prior to the 1st April 2023 will be non-refundable. For further details on the price increase please visit our website at www.thameswater-propertysearches.co.uk

Thames Water Utilities Ltd
Property Searches, PO Box 3189, Slough SL1 4WW
DX 151280 Slough 13

searches@thameswater.co.uk
www.thameswater-propertysearches.co.uk

0800 009 4540

Asset location search

Thames Water Property Searches

Search address supplied: 25, Manor Road, Barnet, EN5 2LE

Dear Sir / Madam

An Asset Location Search is recommended when undertaking a site development. It is essential to obtain information on the size and location of clean water and sewerage assets to safeguard against expensive damage and allow cost-effective service design.

The following records were searched in compiling this report: - the map of public sewers & the map of waterworks. Thames Water Utilities Ltd (TWUL) holds all of these.

This searchprovides maps showing the position, size of Thames Water assets close to the proposed development and also manhole cover and invert levels, where available.

Please note that none of the charges made for this report relate to the provision of Ordnance Survey mapping information. The replies contained in this letter are given following inspection of the public service records available to this company. No responsibility can be accepted for any error or omission in the replies.

You should be aware that the information contained on these plans is current only on the day that the plans are issued. The plans should only be used for the duration of the work that is being carried out at the present time. Under no circumstances should this data be copied or transmitted to parties other than those for whom the current work is being carried out.

Thames Water do update these service plans on a regular basis and failure to observe the above conditions could lead to damage arising to new or diverted services at a later date.

Contact Us

If you have any further queries regarding this enquiry please feel free to contact a member of the team on 0800 009 4540, or use the address below:

Thames Water Utilities Ltd
Property Searches
PO Box 3189
Slough
SL1 4WW

Email: searches@thameswater.co.uk
Web: www.thameswater-propertysearches.co.uk

Waste Water Services

Please provide a copy extract from the public sewer map.

Enclosed is a map showing the approximate lines of our sewers. Our plans do not show sewer connections from individual properties or any sewers not owned by Thames Water unless specifically annotated otherwise. Records such as "private" pipework are in some cases available from the Building Control Department of the relevant Local Authority.

Where the Local Authority does not hold such plans it might be advisable to consult the property deeds for the site or contact neighbouring landowners.

This report relates only to sewerage apparatus of Thames Water Utilities Ltd, it does not disclose details of cables and or communications equipment that may be running through or around such apparatus.

The sewer level information contained in this response represents all of the level data available in our existing records. Should you require any further Information, please refer to the relevant section within the 'Further Contacts' page found later in this document.

For your guidance:

- The Company is not generally responsible for rivers, watercourses, ponds, culverts or highway drains. If any of these are shown on the copy extract they are shown for information only.
- Any private sewers or lateral drains which are indicated on the extract of the public sewer map as being subject to an agreement under Section 104 of the Water Industry Act 1991 are not an 'as constructed' record. It is recommended these details be checked with the developer.

Clean Water Services

Please provide a copy extract from the public water main map.

With regard to the fresh water supply, this site falls within the boundary of another water company. For more information, please redirect your enquiry to the following address:

Affinity Water Ltd
Tamblin Way
Hatfield
AL10 9EZ
Tel: 0345 3572401

For your guidance:

- Assets other than vested water mains may be shown on the plan, for information only.
- If an extract of the public water main record is enclosed, this will show known public water mains in the vicinity of the property. It should be possible to estimate the likely length and route of any private water supply pipe connecting the property to the public water network.

Payment for this Search

A charge will be added to your suppliers account.

Further contacts:

Waste Water queries

Should you require verification of the invert levels of public sewers, by site measurement, you will need to approach the relevant Thames Water Area Network Office for permission to lift the appropriate covers. This permission will usually involve you completing a TWOSA form. For further information please contact our Customer Centre on Tel: 0845 920 0800. Alternatively, a survey can be arranged, for a fee, through our Customer Centre on the above number.

If you have any questions regarding sewer connections, budget estimates, diversions, building over issues or any other questions regarding operational issues please direct them to our service desk. Which can be contacted by writing to:

Developer Services (Waste Water)
Thames Water
Clearwater Court
Vastern Road
Reading
RG1 8DB

Tel: 0800 009 3921
Email: developer.services@thameswater.co.uk

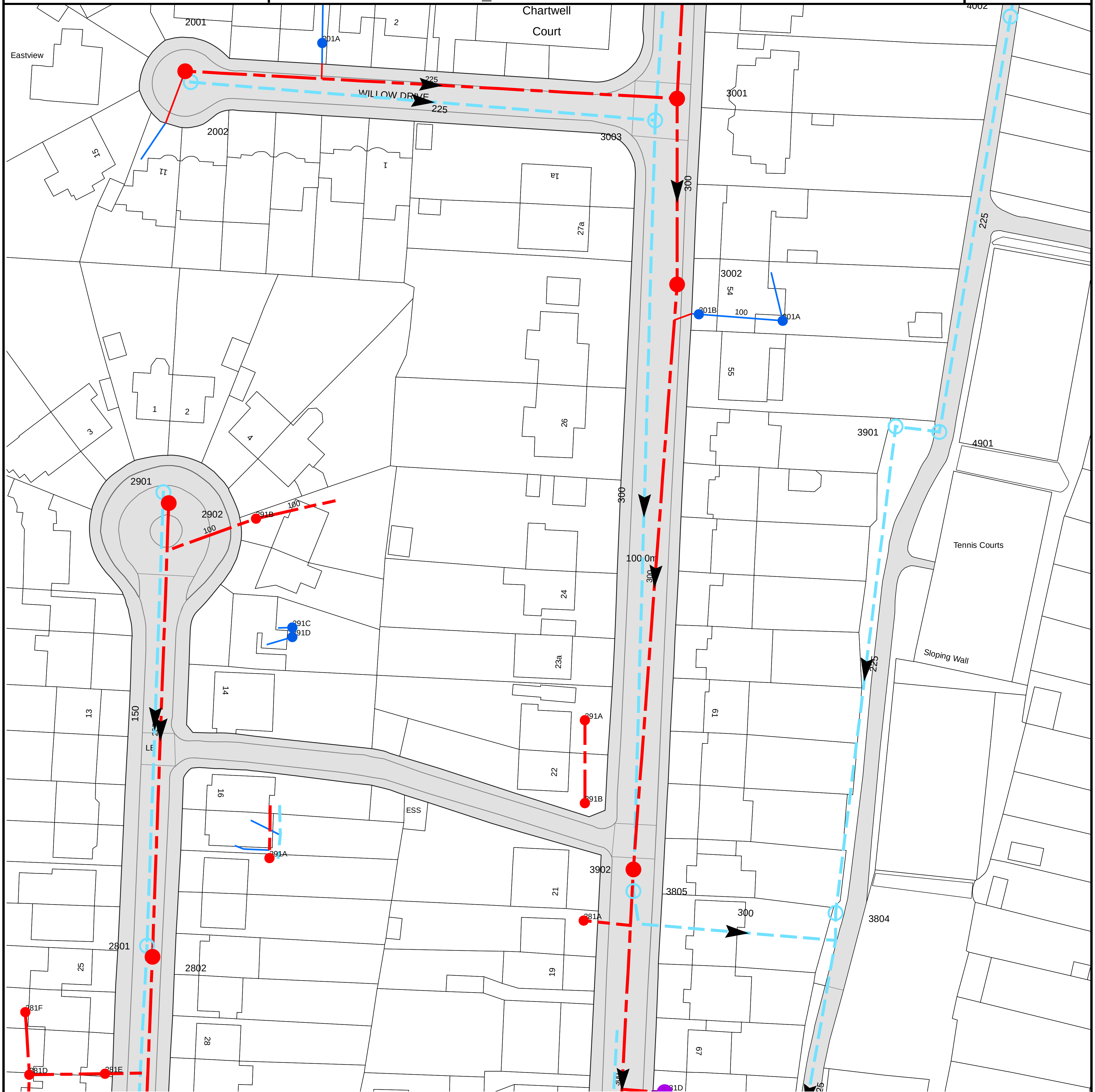
Clean Water queries

Should you require any advice concerning clean water operational issues or clean water connections, please contact:

Developer Services (Clean Water)
Thames Water
Clearwater Court
Vastern Road
Reading
RG1 8DB

Tel: 0800 009 3921
Email: developer.services@thameswater.co.uk

Asset Location Search Sewer Map - ALS/ALS Standard/2023_4792456



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 524331,195960

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

Manhole Reference	Manhole Cover Level	Manhole Invert Level
291D	n/a	n/a
291C	n/a	n/a
3902	97.24	94.65
291A	n/a	n/a
391B	n/a	n/a
391A	n/a	n/a
291B	n/a	n/a
2902	103.6	101.97
2901	103.85	102.02
4901	99.59	98.65
3901	99.31	98.3
301A	n/a	n/a
301B	n/a	n/a
3002	102.51	99.06
3003	104.21	100.67
3001	104.33	101.51
2002	109.68	107.04
2001	109.68	106.55
201A	n/a	n/a
4002	103.88	102.85
281F	n/a	n/a
281D	n/a	n/a
281E	n/a	n/a
2801	99.1	97.35
2802	99.05	97.01
381A	n/a	n/a
3805	96.78	94.83
381D	n/a	n/a
3804	95.49	94.63

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

Asset Location Search - Sewer Key

Public Sewer Types (Operated and maintained by Thames Water)

Foul Sewer: A sewer designed to convey waste water from domestic and industrial sources to a treatment works.

Surface Water Sewer: A sewer designed to convey surface water (e.g. rain water from roofs, yards and car parks) to rivers or watercourses.

Combined Sewer: A sewer designed to convey both waste water and surface water from domestic and industrial sources to a treatment works.

- Storm Sewer
- Sludge Sewer
- Foul Trunk Sewer
- Surface Trunk Sewer
- Combined Trunk Sewer
- Foul Rising Main
- Surface Water Rising Main
- Combined Rising Main
- Vacuum
- Thames Water Proposed
- Vent Pipe
- Gallery

Other Sewer Types (Not operated and maintained by Thames Water)

- Sewer
- Culverted Watercourse
- Proposed
- Decommissioned Sewer
- Content of this drainage network is currently unknown
- Ownership of this drainage network is currently unknown

Sewer Fittings

A feature in a sewer that does not affect the flow in the pipe. Example: a vent is a fitting as the function of a vent is to release excess gas.

- Air Valve
- Meter
- Dam Chase
- Vent
- Fitting

Operational Controls

A feature in a sewer that changes or diverts the flow in the sewer. Example: A hydrobrake limits the flow passing downstream.

- Ancillary
- Drop Pipe
- Control Valve
- Weir

End Items

End symbols appear at the start or end of a sewer pipe. Examples: an Undefined End at the start of a sewer indicates that Thames Water has no knowledge of the position of the sewer upstream of that symbol. Outfall on a surface water sewer indicates that the pipe discharges into a stream or river.

- Inlet
- Outfall
- Undefined End

Other Symbols

Symbols used on maps which do not fall under other general categories.

- Change of Characteristic Indicator
- Public / Private Pumping Station
- Invert Level
- Summit

Areas

Lines denoting areas of underground surveys, etc.

- Agreement
- Chamber
- Operational Site

Ducts or Crossings

- Casement
- Conduit Bridge
- Subway
- Tunnel

Ducts may contain high voltage cables. Please check with Thames Water.

Notes:
1) All levels associated with the plans are to Ordnance Datum Newlyn.
2) All measurements on the plan are metric.
3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate the direction of flow.
4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.
5) 'na' or '0' on a manhole indicates that data is unavailable.
6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in millimeters. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology, please contact Property Searches on 0800 009 4540.

Terms and Conditions

All sales are made in accordance with Thames Water Utilities Limited (TWUL) standard terms and conditions unless previously agreed in writing.

1. All goods remain in the property of Thames Water Utilities Ltd until full payment is received.
2. Provision of service will be in accordance with all legal requirements and published TWUL policies.
3. All invoices are strictly due for payment 14 days from due date of the invoice. Any other terms must be accepted/agreed in writing prior to provision of goods or service, or will be held to be invalid.
4. Thames Water does not accept post-dated cheques-any cheques received will be processed for payment on date of receipt.
5. In case of dispute TWUL`s terms and conditions shall apply.
6. Penalty interest may be invoked by TWUL in the event of unjustifiable payment delay. Interest charges will be in line with UK Statute Law 'The Late Payment of Commercial Debts (Interest) Act 1998'.
7. Interest will be charged in line with current Court Interest Charges, if legal action is taken.
8. A charge may be made at the discretion of the company for increased administration costs.

A copy of Thames Water's standard terms and conditions are available from the Commercial Billing Team (cashoperations@thameswater.co.uk).

We publish several Codes of Practice including a guaranteed standards scheme. You can obtain copies of these leaflets by calling us on 0800 316 9800

If you are unhappy with our service you can speak to your original goods or customer service provider. If you are not satisfied with the response, your complaint will be reviewed by the Customer Services Director. You can write to her at: Thames Water Utilities Ltd. PO Box 492, Swindon, SN38 8TU.

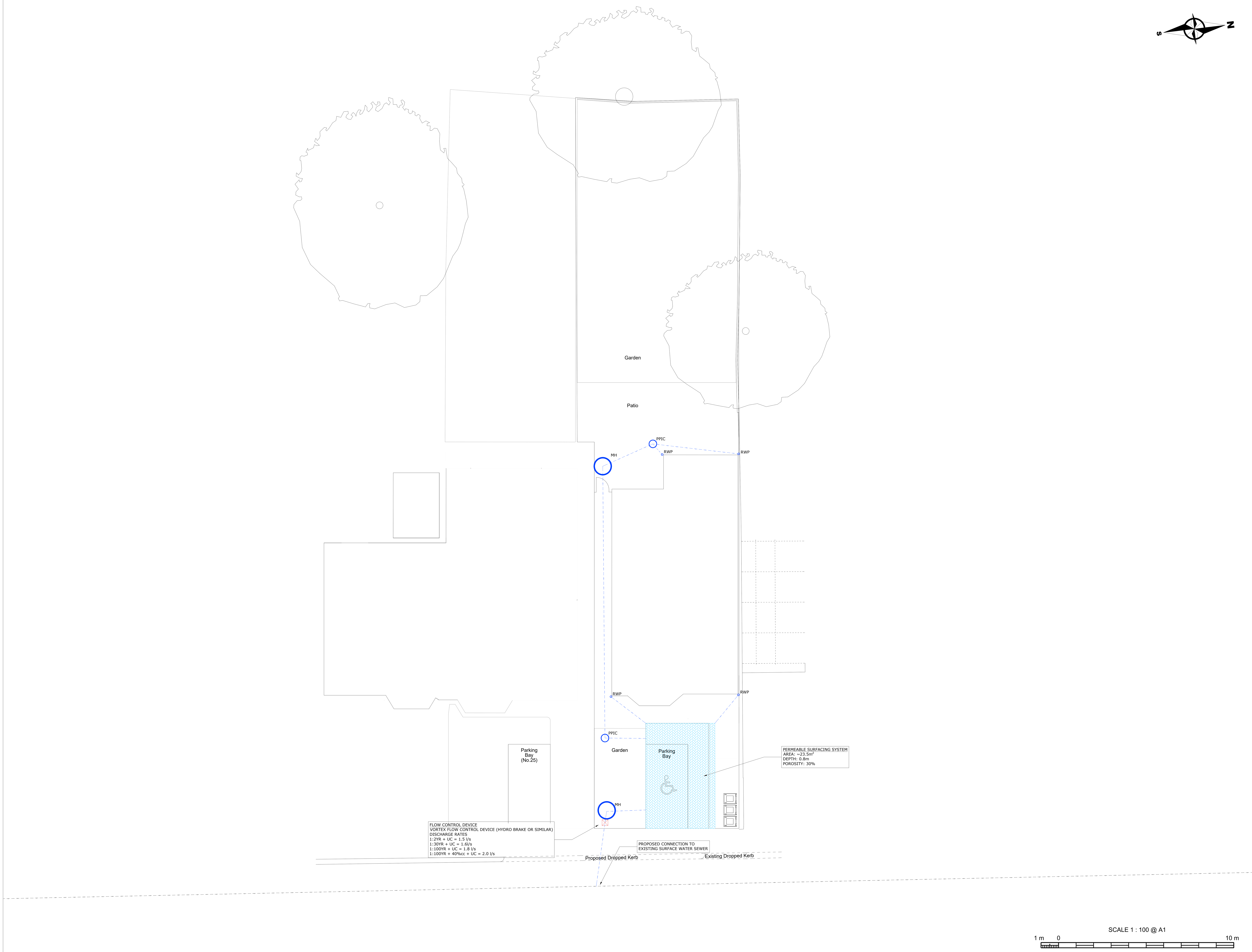
If the Goods or Services covered by this invoice falls under the regulation of the 1991 Water Industry Act, and you remain dissatisfied you can refer your complaint to Consumer Council for Water on 0121 345 1000 or write to them at Consumer Council for Water, 1st Floor, Victoria Square House, Victoria Square, Birmingham, B2 4AJ.

Ways to pay your bill

Credit Card	**BACS Payment**	**Telephone Banking**	**Cheque**
Call **0800 009 4540** quoting your invoice number starting CBA or ADS / OSS	Account number **90478703** Sort code **60-00-01** A remittance advice must be sent to: **Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW.** or email **ps.billing@thameswater.co.uk**	By calling your bank and quoting: Account number **90478703** Sort code **60-00-01** and your invoice number	Made payable to '**Thames Water Utilities Ltd**' Write your Thames Water account number on the back. Send to: **Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW** or by DX to **151280 Slough 13**

Thames Water Utilities Ltd Registered in England & Wales No. 2366661 Registered Office Clearwater Court, Vastern Rd, Reading, Berks, RG1 8DB.

Appendix A.3 – Indicative Drainage Layout Plan



GENERAL NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ENGINEERS, ARCHITECTS AND SPECIALISTS DRAWINGS AND THE SPECIFICATION.
2. ALL WORK IS TO BE CARRIED OUT IN ACCORDANCE WITH THE RELEVANT BRITISH STANDARDS, EUROPEAN NORMS, CODES OF PRACTICE AND BUILDING PRACTICE.
3. ALL DIMENSIONS ARE TO BE CHECKED BY THE CONTRACTOR PRIOR TO STARTING THE WORKS ON SITE. ANY DISCREPANCIES ARE TO BE REPORTED TO THE ENGINEER IMMEDIATELY.
4. ALL DRAINAGE SYSTEMS WILL NEED TO BE INSTALLED AND DESIGNED FOR SUITABLE LOADING REQUIREMENTS.
5. THE CONTRACTOR SHALL OBTAIN PRIOR APPROVAL AND ALL NECESSARY LICENCES FROM THE THE HIGHWAY AUTHORITY AND/OR SEWERAGE UNDERTAKER BEFORE CARRYING OUT ANY WORKS.
6. THIS DRAWING WAS PRODUCED FOR USE IN CONJUNCTION WITH A PLANNING SUBMISSION AND SHOULD NOT BE USED FOR OTHER PURPOSES. A MORE DETAILED DESIGN INCLUDING PRODUCT SPECIFICATIONS WILL NEED TO BE PRODUCED PRIOR TO CONSTRUCTION.

KEY:

EXISTING SURFACE WATER SEWER
SURFACE WATER DRAIN
MH SURFACE WATER MANHOLE
PPIC SURFACE WATER PPIC
RWP RAINWATER PIPE
FLOW CONTROL DEVICE
PERMEABLE SURFACE

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www.herringtonconsulting.co.uk

Rev	Description	Author	Checked	Date
P2	Updated scheme drawings	NA	EC	18/01/24
P1	Revised issue	NA	EC	06/04/23
P0	First issue	NA	EC	31/03/23

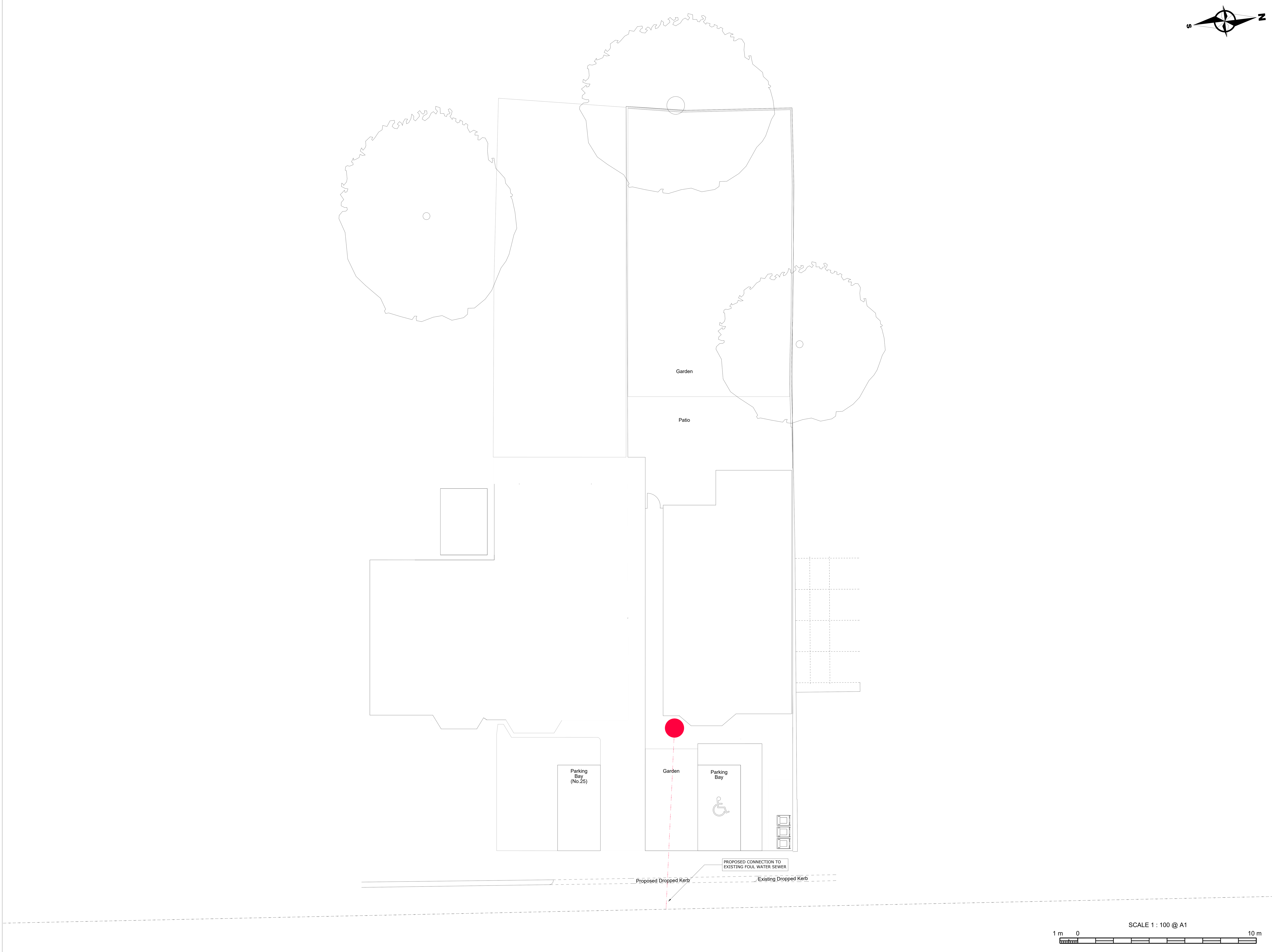
CLIENT
NOAH'S ARK CHILDREN'S HOSPICE

PROJECT
MANOR ROAD, BARNET

SCALE	PROJ REF	ORIGINATOR	CHECKED BY
1:100	3699	NA	EC

HC DWG REF.
3699_DWG_r1

DWG TITLE	DWG No.
INDICATIVE SURFACE WATER DRAINAGE LAYOUT	HC-3699-501



GENERAL NOTES

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KEY:

- EXISTING FOUL WATER SEWER
- FOUL WATER DRAIN
- FOUL WATER MANHOLE

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NOAH'S ARK CHILDREN'S HOSPICE

PROJECT
MANOR ROAD, BARNET

SCALE	PROJ REF	ORIGINATOR	CHECKED BY
1:100	3699	NA	EC

HC DWG REF.
3699_DWG_r1

DWG TITLE
INDICATIVE FOUL WATER DRAINAGE LAYOUT

DWG No.
HC-3699-601

Appendix A.4 –Greenfield Runoff Rates

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Natasha Ames
Site name:	Manor Road
Site location:	Barnet

Site Details

Latitude:	51.64854° N
Longitude:	0.20437° W
Reference:	1874581549
Date:	Mar 21 2023 15:48

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Runoff estimation approach FEH Statistical

Site characteristics

Total site area (ha): 1

Methodology

Q_{MED} estimation method:	Calculate from BFI and SAAR
BFI and SPR method:	Specify BFI manually
HOST class:	N/A
BFI / BFIHOST:	0.217
Q_{MED} (l/s):	
Q_{BAR} / Q_{MED} factor:	1.14

Hydrological characteristics

	Default	Edited
SAAR (mm):	684	695
Hydrological region:	6	6
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Growth curve factor 200 years:	3.74	3.74

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):		6.11
1 in 1 year (l/s):		5.19
1 in 30 years (l/s):		14.05
1 in 100 year (l/s):		19.49
1 in 200 years (l/s):		22.85

Appendix A.5 – Surface Water Management Calculations

Design Settings

Rainfall Methodology	FEH-22	Maximum Time of Concentration (mins)	30.00	Preferred Cover Depth (m)	0.350
Return Period (years)	100	Maximum Rainfall (mm/hr)	200.0	Include Intermediate Ground	x
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00	Enforce best practice design rules	x
CV	1.000	Connection Type	Level Soffits		
Time of Entry (mins)	4.00	Minimum Backdrop Height (m)	0.200		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
Existing	0.015	4.00	10.000	1000	-1.111	6.481	1.000
Existing 1			10.000	1000	10.286	6.147	1.100

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
Existing	Existing	Existing 1	10.000	0.600	9.000	8.900	0.100	100.0	1000	4.05	159.1

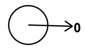
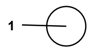
Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
Existing	3.344	2626.2	8.6	0.000	0.100	0.015	0.0	41	0.799

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
Existing	10.000	100.0	1000	Circular	10.000	9.000	0.000	10.000	8.900	0.100

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
Existing	Existing	1000	Manhole	Adoptable	Existing 1	1000	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
Existing	-1.111	6.481	10.000	1.000	1000	 0	Existing	9.000	1000
Existing 1	10.286	6.147	10.000	1.100	1000	1 	Existing	8.900	1000

Simulation Settings

Rainfall Methodology	FEH-22	Skip Steady State	x	2 year (l/s)	0.0	Check Discharge Volume	x
Summer CV	1.000	Drain Down Time (mins)	240	10 year (l/s)	0.0		
Winter CV	1.000	Additional Storage (m³/ha)	0.0	30 year (l/s)	0.0		
Analysis Speed	Detailed	Check Discharge Rate(s)	✓	100 year (l/s)	0.0		

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0	100	0	0	0
30	0	0	0	100	40	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	BFIHost	0.737	Growth Factor 30 year	2.40	Q 2 year (l/s)	
Greenfield Method	FEH	Region	7	Growth Factor 100 year	3.19	Q 10 year (l/s)	
Positively Drained Area (ha)	1.000	QBar/QMed conversion factor	1.136	Betterment (%)	0	Q 30 year (l/s)	
SAAR (mm)	608	Growth Factor 2 year	0.88	QMed		Q 100 year (l/s)	
Host	1	Growth Factor 10 year	1.62	QBar			

Node Existing Time-Area Diagram

Overrides Design Area	x	Depression Storage Area (m²)	0	Evapo-transpiration (mm/day)	0
Overrides Design Additional Inflow	x	Depression Storage Depth (mm)	0		
		Applies to			

Time (mins)	Area (ha)
0-60	0.000

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
2 year 15 minute summer	104.606	29.600	2 year 180 minute winter	16.889	6.686
2 year 15 minute winter	73.408	29.600	2 year 240 minute summer	21.131	5.584
2 year 30 minute summer	66.439	18.800	2 year 240 minute winter	14.039	5.584
2 year 30 minute winter	46.624	18.800	2 year 360 minute summer	16.441	4.231
2 year 60 minute summer	43.138	11.400	2 year 360 minute winter	10.687	4.231
2 year 60 minute winter	28.660	11.400	2 year 480 minute summer	12.959	3.425
2 year 120 minute summer	31.786	8.400	2 year 480 minute winter	8.610	3.425
2 year 120 minute winter	21.118	8.400	2 year 600 minute summer	10.571	2.891
2 year 180 minute summer	25.981	6.686	2 year 600 minute winter	7.223	2.891

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
2 year 720 minute summer	9.369	2.511	30 year 360 minute summer	36.681	9.439
2 year 720 minute winter	6.297	2.511	30 year 360 minute winter	23.844	9.439
2 year 960 minute summer	7.605	2.003	30 year 480 minute summer	28.358	7.494
2 year 960 minute winter	5.038	2.003	30 year 480 minute winter	18.840	7.494
2 year 1440 minute summer	5.435	1.457	30 year 600 minute summer	22.820	6.242
2 year 1440 minute winter	3.653	1.457	30 year 600 minute winter	15.592	6.242
2 year 2160 minute summer	3.851	1.064	30 year 720 minute summer	20.013	5.364
2 year 2160 minute winter	2.654	1.064	30 year 720 minute winter	13.450	5.364
2 year 2880 minute summer	3.202	0.858	30 year 960 minute summer	15.969	4.205
2 year 2880 minute winter	2.152	0.858	30 year 960 minute winter	10.578	4.205
2 year 4320 minute summer	2.475	0.647	30 year 1440 minute summer	11.114	2.979
2 year 4320 minute winter	1.630	0.647	30 year 1440 minute winter	7.469	2.979
2 year 5760 minute summer	2.101	0.538	30 year 2160 minute summer	7.631	2.109
2 year 5760 minute winter	1.360	0.538	30 year 2160 minute winter	5.258	2.109
2 year 7200 minute summer	1.847	0.471	30 year 2880 minute summer	6.182	1.657
2 year 7200 minute winter	1.192	0.471	30 year 2880 minute winter	4.155	1.657
2 year 8640 minute summer	1.670	0.426	30 year 4320 minute summer	4.567	1.194
2 year 8640 minute winter	1.078	0.426	30 year 4320 minute winter	3.008	1.194
2 year 10080 minute summer	1.542	0.393	30 year 5760 minute summer	3.736	0.957
2 year 10080 minute winter	0.995	0.393	30 year 5760 minute winter	2.418	0.957
30 year 15 minute summer	309.214	87.497	30 year 7200 minute summer	3.186	0.813
30 year 15 minute winter	216.993	87.497	30 year 7200 minute winter	2.056	0.813
30 year 30 minute summer	196.492	55.600	30 year 8640 minute summer	2.807	0.716
30 year 30 minute winter	137.889	55.600	30 year 8640 minute winter	1.811	0.716
30 year 60 minute summer	128.124	33.859	30 year 10080 minute summer	2.534	0.647
30 year 60 minute winter	85.122	33.859	30 year 10080 minute winter	1.636	0.647
30 year 120 minute summer	80.678	21.321	100 year 15 minute summer	402.479	113.888
30 year 120 minute winter	53.601	21.321	100 year 15 minute winter	282.441	113.888
30 year 180 minute summer	62.155	15.995	100 year 30 minute summer	258.143	73.046
30 year 180 minute winter	40.402	15.995	100 year 30 minute winter	181.153	73.046
30 year 240 minute summer	48.919	12.928	100 year 60 minute summer	168.315	44.481
30 year 240 minute winter	32.501	12.928	100 year 60 minute winter	111.825	44.481

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year 120 minute summer	105.124	27.781	100 year +40% CC 15 minute summer	563.470	159.443
100 year 120 minute winter	69.842	27.781	100 year +40% CC 15 minute winter	395.418	159.443
100 year 180 minute summer	81.087	20.866	100 year +40% CC 30 minute summer	361.401	102.264
100 year 180 minute winter	52.708	20.866	100 year +40% CC 30 minute winter	253.614	102.264
100 year 240 minute summer	64.059	16.929	100 year +40% CC 60 minute summer	235.641	62.273
100 year 240 minute winter	42.559	16.929	100 year +40% CC 60 minute winter	156.554	62.273
100 year 360 minute summer	48.485	12.477	100 year +40% CC 120 minute summer	147.174	38.894
100 year 360 minute winter	31.516	12.477	100 year +40% CC 120 minute winter	97.779	38.894
100 year 480 minute summer	37.724	9.969	100 year +40% CC 180 minute summer	113.521	29.213
100 year 480 minute winter	25.063	9.969	100 year +40% CC 180 minute winter	73.792	29.213
100 year 600 minute summer	30.475	8.336	100 year +40% CC 240 minute summer	89.683	23.701
100 year 600 minute winter	20.822	8.336	100 year +40% CC 240 minute winter	59.583	23.701
100 year 720 minute summer	26.788	7.180	100 year +40% CC 360 minute summer	67.878	17.467
100 year 720 minute winter	18.004	7.180	100 year +40% CC 360 minute winter	44.123	17.467
100 year 960 minute summer	21.412	5.638	100 year +40% CC 480 minute summer	52.813	13.957
100 year 960 minute winter	14.184	5.638	100 year +40% CC 480 minute winter	35.088	13.957
100 year 1440 minute summer	14.839	3.977	100 year +40% CC 600 minute summer	42.665	11.670
100 year 1440 minute winter	9.973	3.977	100 year +40% CC 600 minute winter	29.151	11.670
100 year 2160 minute summer	10.049	2.777	100 year +40% CC 720 minute summer	37.504	10.051
100 year 2160 minute winter	6.924	2.777	100 year +40% CC 720 minute winter	25.205	10.051
100 year 2880 minute summer	8.028	2.152	100 year +40% CC 960 minute summer	29.977	7.894
100 year 2880 minute winter	5.396	2.152	100 year +40% CC 960 minute winter	19.858	7.894
100 year 4320 minute summer	5.775	1.510	100 year +40% CC 1440 minute summer	20.774	5.568
100 year 4320 minute winter	3.803	1.510	100 year +40% CC 1440 minute winter	13.962	5.568
100 year 5760 minute summer	4.617	1.182	100 year +40% CC 2160 minute summer	14.068	3.888
100 year 5760 minute winter	2.988	1.182	100 year +40% CC 2160 minute winter	9.693	3.888
100 year 7200 minute summer	3.866	0.986	100 year +40% CC 2880 minute summer	11.240	3.012
100 year 7200 minute winter	2.495	0.986	100 year +40% CC 2880 minute winter	7.554	3.012
100 year 8640 minute summer	3.355	0.856	100 year +40% CC 4320 minute summer	8.084	2.114
100 year 8640 minute winter	2.165	0.856	100 year +40% CC 4320 minute winter	5.324	2.114
100 year 10080 minute summer	2.991	0.763	100 year +40% CC 5760 minute summer	6.463	1.655
100 year 10080 minute winter	1.930	0.763	100 year +40% CC 5760 minute winter	4.183	1.655

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year +40% CC 7200 minute summer	5.413	1.381	100 year +40% CC 8640 minute winter	3.032	1.198
100 year +40% CC 7200 minute winter	3.493	1.381	100 year +40% CC 10080 minute summer	4.187	1.068
100 year +40% CC 8640 minute summer	4.697	1.198	100 year +40% CC 10080 minute winter	2.703	1.068

Results for 2 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	Existing	10	9.026	0.026	2.8	0.0208	0.0000	OK
15 minute summer	Existing 1	10	8.920	0.020	2.8	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	Existing	Existing	Existing 1	2.8	0.656	0.001	0.0436	1.1

Results for 30 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	Existing	10	9.043	0.043	8.4	0.0335	0.0000	OK
15 minute summer	Existing 1	10	8.941	0.041	8.4	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	Existing	Existing	Existing 1	8.4	0.778	0.003	0.1079	3.3

Results for 100 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	Existing	10	9.048	0.048	11.0	0.0380	0.0000	OK
15 minute summer	Existing 1	10	8.946	0.046	11.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	Existing	Existing	Existing 1	11.0	0.834	0.004	0.1320	4.3

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	Existing	10	9.057	0.057	15.3	0.0445	0.0000	OK
15 minute summer	Existing 1	10	8.954	0.054	15.3	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	Existing	Existing	Existing 1	15.3	0.913	0.006	0.1677	6.0

Design Settings

Rainfall Methodology	FEH-22	Maximum Time of Concentration (mins)	30.00	Preferred Cover Depth (m)	0.350
Return Period (years)	100	Maximum Rainfall (mm/hr)	200.0	Include Intermediate Ground	x
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00	Enforce best practice design rules	x
CV	1.000	Connection Type	Level Soffits		
Time of Entry (mins)	4.00	Minimum Backdrop Height (m)	0.200		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
Manhole 1	0.009	4.00	10.600	900	-6.382	8.598	0.800
PP1	0.010	4.00	10.070		-1.868	6.045	0.950
Manhole 3			10.070	1200	2.112	7.767	1.700
Outlet			9.370	900	5.400	7.632	1.950

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
2	Manhole 1	Manhole 3	8.535	0.600	9.800	8.370	1.430	6.0	150	4.03	200.0
2.000	PP1	Manhole 3	4.337	0.600	9.120	8.370	0.750	5.8	150	4.02	200.0
1	Manhole 3	Outlet	3.291	0.600	8.370	7.420	0.950	3.5	150	4.04	200.0

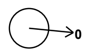
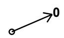
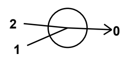
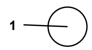
Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
2	4.152	73.4	6.5	0.650	1.550	0.009	0.0	30	2.580
2.000	4.218	74.5	7.2	0.800	1.550	0.010	0.0	31	2.681
1	5.454	96.4	13.7	1.550	1.800	0.019	0.0	38	3.897

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
2	8.535	6.0	150	Circular	10.600	9.800	0.650	10.070	8.370	1.550
2.000	4.337	5.8	150	Circular	10.070	9.120	0.800	10.070	8.370	1.550
1	3.291	3.5	150	Circular	10.070	8.370	1.550	9.370	7.420	1.800

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
2	Manhole 1	900	Manhole	Adoptable	Manhole 3	1200	Manhole	Adoptable
2.000	PP1		Junction		Manhole 3	1200	Manhole	Adoptable
1	Manhole 3	1200	Manhole	Adoptable	Outlet	900	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
Manhole 1	-6.382	8.598	10.600	0.800	900	 0	2	9.800	150
PP1	-1.868	6.045	10.070	0.950		 0	2.000	9.120	150
Manhole 3	2.112	7.767	10.070	1.700	1200	 1	2.000	8.370	150
						2	2	8.370	150
						0	1	8.370	150
Outlet	5.400	7.632	9.370	1.950	900	 1	1	7.420	150

Simulation Settings

Rainfall Methodology	FEH-22	Skip Steady State	x	2 year (l/s)	0.0	Check Discharge Volume	x
Summer CV	1.000	Drain Down Time (mins)	1000	10 year (l/s)	0.0		
Winter CV	1.000	Additional Storage (m^3/ha)	0.0	30 year (l/s)	0.0		
Analysis Speed	Detailed	Check Discharge Rate(s)	✓	100 year (l/s)	0.0		

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	10	0	100	0	10	0
30	0	10	0	100	40	10	0

Pre-development Discharge Rate

Site Makeup	Greenfield	BFIHost	0.737	Growth Factor 30 year	2.40	Q 2 year (l/s)	
Greenfield Method	FEH	Region	7	Growth Factor 100 year	3.19	Q 10 year (l/s)	
Positively Drained Area (ha)	1.000	QBar/QMed conversion factor	1.136	Betterment (%)	0	Q 30 year (l/s)	
SAAR (mm)	608	Growth Factor 2 year	0.88	QMed		Q 100 year (l/s)	
Host	1	Growth Factor 10 year	1.62	QBar			

Node Manhole 3 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	8.370	Product Number	CTL-SHE-0060-2000-1600-2000
Design Depth (m)	1.600	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	2.0	Min Node Diameter (mm)	1200

Node PP1 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	0.30	Width (m)	2.350	Depth (m)	0.800
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	9.120	Length (m)	10.000	Inf Depth (m)	
Safety Factor	2.0	Time to half empty (mins)	40	Slope (1:X)	1000.0		

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
2 year +10% A 15 minute summer	104.606	29.600	2 year +10% A 7200 minute summer	1.875	0.478
2 year +10% A 15 minute winter	73.408	29.600	2 year +10% A 7200 minute winter	1.210	0.478
2 year +10% A 30 minute summer	66.065	18.694	2 year +10% A 8640 minute summer	1.689	0.431
2 year +10% A 30 minute winter	46.362	18.694	2 year +10% A 8640 minute winter	1.090	0.431
2 year +10% A 60 minute summer	42.937	11.347	2 year +10% A 10080 minute summer	1.555	0.397
2 year +10% A 60 minute winter	28.527	11.347	2 year +10% A 10080 minute winter	1.004	0.397
2 year +10% A 120 minute summer	31.946	8.442	30 year +10% A 15 minute summer	316.086	89.441
2 year +10% A 120 minute winter	21.224	8.442	30 year +10% A 15 minute winter	221.815	89.441
2 year +10% A 180 minute summer	26.296	6.767	30 year +10% A 30 minute summer	200.922	56.854
2 year +10% A 180 minute winter	17.093	6.767	30 year +10% A 30 minute winter	140.998	56.854
2 year +10% A 240 minute summer	21.482	5.677	30 year +10% A 60 minute summer	131.015	34.623
2 year +10% A 240 minute winter	14.272	5.677	30 year +10% A 60 minute winter	87.043	34.623
2 year +10% A 360 minute summer	16.789	4.320	30 year +10% A 120 minute summer	83.432	22.049
2 year +10% A 360 minute winter	10.913	4.320	30 year +10% A 120 minute winter	55.431	22.049
2 year +10% A 480 minute summer	13.283	3.510	30 year +10% A 180 minute summer	64.683	16.645
2 year +10% A 480 minute winter	8.825	3.510	30 year +10% A 180 minute winter	42.045	16.645
2 year +10% A 600 minute summer	10.863	2.971	30 year +10% A 240 minute summer	51.085	13.500
2 year +10% A 600 minute winter	7.422	2.971	30 year +10% A 240 minute winter	33.940	13.500
2 year +10% A 720 minute summer	9.646	2.585	30 year +10% A 360 minute summer	38.406	9.883
2 year +10% A 720 minute winter	6.483	2.585	30 year +10% A 360 minute winter	24.965	9.883
2 year +10% A 960 minute summer	7.848	2.067	30 year +10% A 480 minute summer	29.691	7.846
2 year +10% A 960 minute winter	5.199	2.067	30 year +10% A 480 minute winter	19.726	7.846
2 year +10% A 1440 minute summer	5.602	1.501	30 year +10% A 600 minute summer	23.888	6.534
2 year +10% A 1440 minute winter	3.765	1.501	30 year +10% A 600 minute winter	16.322	6.534
2 year +10% A 2160 minute summer	3.964	1.095	30 year +10% A 720 minute summer	20.946	5.614
2 year +10% A 2160 minute winter	2.731	1.095	30 year +10% A 720 minute winter	14.077	5.614
2 year +10% A 2880 minute summer	3.291	0.882	30 year +10% A 960 minute summer	16.726	4.404
2 year +10% A 2880 minute winter	2.212	0.882	30 year +10% A 960 minute winter	11.079	4.404
2 year +10% A 4320 minute summer	2.533	0.662	30 year +10% A 1440 minute summer	11.609	3.111
2 year +10% A 4320 minute winter	1.668	0.662	30 year +10% A 1440 minute winter	7.802	3.111
2 year +10% A 5760 minute summer	2.141	0.548	30 year +10% A 2160 minute summer	7.952	2.198
2 year +10% A 5760 minute winter	1.386	0.548	30 year +10% A 2160 minute winter	5.479	2.198

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
30 year +10% A 2880 minute summer	6.431	1.724	100 year +10% A 960 minute summer	22.901	6.030
30 year +10% A 2880 minute winter	4.322	1.724	100 year +10% A 960 minute winter	15.170	6.030
30 year +10% A 4320 minute summer	4.730	1.237	100 year +10% A 1440 minute summer	15.757	4.223
30 year +10% A 4320 minute winter	3.115	1.237	100 year +10% A 1440 minute winter	10.589	4.223
30 year +10% A 5760 minute summer	3.854	0.987	100 year +10% A 2160 minute summer	10.631	2.938
30 year +10% A 5760 minute winter	2.494	0.987	100 year +10% A 2160 minute winter	7.325	2.938
30 year +10% A 7200 minute summer	3.274	0.835	100 year +10% A 2880 minute summer	8.476	2.272
30 year +10% A 7200 minute winter	2.113	0.835	100 year +10% A 2880 minute winter	5.696	2.272
30 year +10% A 8640 minute summer	2.875	0.733	100 year +10% A 4320 minute summer	6.068	1.587
30 year +10% A 8640 minute winter	1.856	0.733	100 year +10% A 4320 minute winter	3.996	1.587
30 year +10% A 10080 minute summer	2.588	0.660	100 year +10% A 5760 minute summer	4.831	1.237
30 year +10% A 10080 minute winter	1.670	0.660	100 year +10% A 5760 minute winter	3.127	1.237
100 year +10% A 15 minute summer	418.486	118.417	100 year +10% A 7200 minute summer	4.029	1.028
100 year +10% A 15 minute winter	293.674	118.417	100 year +10% A 7200 minute winter	2.600	1.028
100 year +10% A 30 minute summer	267.839	75.789	100 year +10% A 8640 minute summer	3.482	0.888
100 year +10% A 30 minute winter	187.957	75.789	100 year +10% A 8640 minute winter	2.247	0.888
100 year +10% A 60 minute summer	174.961	46.237	100 year +10% A 10080 minute summer	3.092	0.789
100 year +10% A 60 minute winter	116.240	46.237	100 year +10% A 10080 minute winter	1.996	0.789
100 year +10% A 120 minute summer	111.500	29.466	100 year +40% CC +10% A 15 minute summer	585.880	165.784
100 year +10% A 120 minute winter	74.078	29.466	100 year +40% CC +10% A 15 minute winter	411.144	165.784
100 year +10% A 180 minute summer	86.994	22.386	100 year +40% CC +10% A 30 minute summer	374.974	106.105
100 year +10% A 180 minute winter	56.548	22.386	100 year +40% CC +10% A 30 minute winter	263.140	106.105
100 year +10% A 240 minute summer	69.112	18.264	100 year +40% CC +10% A 60 minute summer	244.945	64.732
100 year +10% A 240 minute winter	45.916	18.264	100 year +40% CC +10% A 60 minute winter	162.736	64.732
100 year +10% A 360 minute summer	52.406	13.486	100 year +40% CC +10% A 120 minute summer	156.100	41.253
100 year +10% A 360 minute winter	34.065	13.486	100 year +40% CC +10% A 120 minute winter	103.709	41.253
100 year +10% A 480 minute summer	40.694	10.754	100 year +40% CC +10% A 180 minute summer	121.791	31.341
100 year +10% A 480 minute winter	27.036	10.754	100 year +40% CC +10% A 180 minute winter	79.167	31.341
100 year +10% A 600 minute summer	32.792	8.969	100 year +40% CC +10% A 240 minute summer	96.756	25.570
100 year +10% A 600 minute winter	22.406	8.969	100 year +40% CC +10% A 240 minute winter	64.283	25.570
100 year +10% A 720 minute summer	28.756	7.707	100 year +40% CC +10% A 360 minute summer	73.368	18.880
100 year +10% A 720 minute winter	19.326	7.707	100 year +40% CC +10% A 360 minute winter	47.691	18.880

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year +40% CC +10% A 480 minute summer	56.972	15.056	100 year +40% CC +10% A 2880 minute summer	11.866	3.180
100 year +40% CC +10% A 480 minute winter	37.851	15.056	100 year +40% CC +10% A 2880 minute winter	7.975	3.180
100 year +40% CC +10% A 600 minute summer	45.909	12.557	100 year +40% CC +10% A 4320 minute summer	8.496	2.221
100 year +40% CC +10% A 600 minute winter	31.368	12.557	100 year +40% CC +10% A 4320 minute winter	5.595	2.221
100 year +40% CC +10% A 720 minute summer	40.259	10.790	100 year +40% CC +10% A 5760 minute summer	6.764	1.732
100 year +40% CC +10% A 720 minute winter	27.057	10.790	100 year +40% CC +10% A 5760 minute winter	4.378	1.732
100 year +40% CC +10% A 960 minute summer	32.061	8.442	100 year +40% CC +10% A 7200 minute summer	5.641	1.439
100 year +40% CC +10% A 960 minute winter	21.238	8.442	100 year +40% CC +10% A 7200 minute winter	3.640	1.439
100 year +40% CC +10% A 1440 minute summer	22.059	5.912	100 year +40% CC +10% A 8640 minute summer	4.875	1.244
100 year +40% CC +10% A 1440 minute winter	14.825	5.912	100 year +40% CC +10% A 8640 minute winter	3.146	1.244
100 year +40% CC +10% A 2160 minute summer	14.883	4.113	100 year +40% CC +10% A 10080 minute summer	4.329	1.104
100 year +40% CC +10% A 2160 minute winter	10.255	4.113	100 year +40% CC +10% A 10080 minute winter	2.794	1.104

Results for 2 year +10% A Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	Manhole 1	10	9.817	0.017	1.9	0.0106	0.0000	OK
15 minute summer	PP1	10	9.137	0.017	2.1	0.0869	0.0000	OK
15 minute summer	Manhole 3	13	8.769	0.399	4.0	0.4508	0.0000	SURCHARGED
15 minute summer	Outlet	1	7.420	0.000	1.5	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	Manhole 1	2	Manhole 3	1.9	0.826	0.026	0.0797	
15 minute summer	PP1	2.000	Manhole 3	2.1	0.868	0.028	0.0406	
15 minute summer	Manhole 3	Hydro-Brake®	Outlet	1.5				1.5

Results for 30 year +10% A Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	Manhole 1	10	9.828	0.028	5.7	0.0180	0.0000	OK
30 minute winter	PP1	26	9.398	0.278	7.5	1.9244	0.0000	SURCHARGED
30 minute winter	Manhole 3	26	9.398	1.028	6.8	1.1624	0.0000	SURCHARGED
15 minute summer	Outlet	1	7.420	0.000	1.6	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	Manhole 1	2	Manhole 3	5.7	0.939	0.078	0.0849	
30 minute winter	PP1	2.000	Manhole 3	3.5	0.777	0.047	0.0764	
30 minute winter	Manhole 3	Hydro-Brake®	Outlet	1.6				6.0

Results for 100 year +10% A Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	Manhole 1	10	9.832	0.032	7.5	0.0206	0.0000	OK
30 minute winter	PP1	29	9.601	0.481	7.6	3.3577	0.0000	SURCHARGED
30 minute winter	Manhole 3	29	9.601	1.231	7.7	1.3923	0.0000	SURCHARGED
15 minute summer	Outlet	1	7.420	0.000	1.7	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	Manhole 1	2	Manhole 3	7.5	0.848	0.102	0.0870	
30 minute winter	PP1	2.000	Manhole 3	3.9	0.874	0.053	0.0764	
30 minute winter	Manhole 3	Hydro-Brake®	Outlet	1.8				7.9

Results for 100 year +40% CC +10% A Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute winter	Manhole 1	30	9.920	0.120	6.9	0.0761	0.0000	OK
30 minute winter	PP1	30	9.919	0.799	10.7	5.6012	0.0000	FLOOD RISK
30 minute winter	Manhole 3	30	9.919	1.549	7.0	1.7523	0.0000	FLOOD RISK
15 minute summer	Outlet	1	7.420	0.000	1.9	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
30 minute winter	Manhole 1	2	Manhole 3	6.9	1.050	0.094	0.1394	
30 minute winter	PP1	2.000	Manhole 3	3.6	0.869	0.048	0.0764	
30 minute winter	Manhole 3	Hydro-Brake®	Outlet	2.0				11.1

Appendix A.6 – Maintenance Schedules

Operation and Maintenance Schedule – Water Butts		
Maintenance Schedule	**Required Action**	**Typical Frequency**
Regular Inspections and Maintenance	Inspection and cleaning of debris and sedimentation at the base of the tank.	At least once per year and following any noticeable deterioration in performance (e.g. observation of sediment entrained within water).
	Cleaning out of house guttering	As frequently as advised by maintenance plan for the property. Must be cleaned as soon as possible if blockage of guttering occurs.
	Inspection and repair of areas receiving overflow from the tank in the event of erosion	Inspected at least once every 3 months for the first year following installation, reduced inspection frequencies thereafter, at least once per year.
	inspection and repair of the inlet, outlet and overflows.	Inspected at least once every 3 months for the first year following installation, reduced inspection frequencies thereafter, at least once per year.
	cleaning of the tank, inlets, outlets, filters (if present) and removal of debris.	Inspected at least once every 3 months for the first year following installation, reduced inspection frequencies thereafter, at least once per year.
Remedial Maintenance	Repairing of any erosive damage or damage to the tank	As required, whenever damage leaks or erosion is detected.
	Inspection of the tank for debris, leaks or other damage and repair where necessary.	
	Inspection of area receiving overflow from the tank in the event of erosion	
Occasional maintenance	Replacement of any filters	When Required, due to clogging, or manufacturer specific instructions.

Typical Maintenance Requirements for Water Butts.

Operation and Maintenance Schedule – Pervious paving / surfacing		
Maintenance Schedule	**Required Action**	**Typical Frequency**
Regular Maintenance	Brushing and vacuuming (for driveways this can be a standard cosmetic sweep over whole surface).	At minimum once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – particular attention must be payed to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment.
Occasional maintenance	Stabilise and mow contributing and adjacent areas.	As required.
	Removal of weeds or management using a suitable weed killer which will not adversely affect water quality. Weed killer should be applied directly into the weeds by an applicator rather than spraying.	As required – once per year on less frequently used pavements.
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving / surfacing.	As required when damage or erosion is detected following inspection. For block paving systems jointing material to be replaced shortly after installation and subsequently when required.
	Remedial work to any depressions. Rutting and cracked or broken blocks and replace lost jointing material (where block paving is used).	
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48 h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

General Maintenance Requirements for Permeable Surfacing (additional requirements may apply depending on type of surfacing material used).