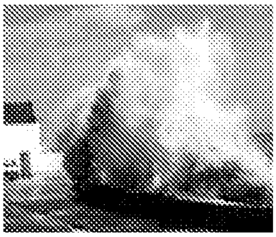
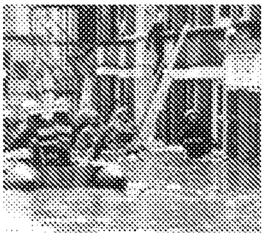
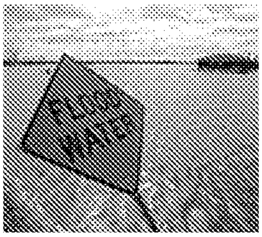
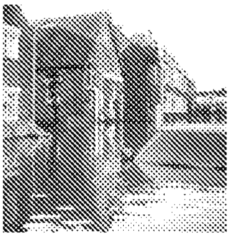
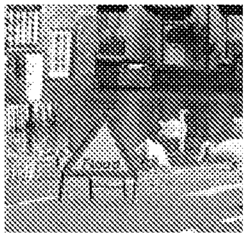
herrington

Part of eps

Client: The Baird Farming Partnership

Flood Risk Assessment and Drainage Strategy for the Proposed Development at The Old Butcher's Block, Littlehampton

April 2025

CANTERBURY ⁞ LONDON ⁞ CAMBRIDGE ⁞ BRISTOL ⁞ LEEDS

[redacted]
www.herringtonconsulting.co.uk

Project Reference: 4274

Client: The Baird Farming Partnership

Flood Risk Assessment and Drainage Strategy for the Proposed Development at The Old Butcher's Block, Climping Street, Littlehampton

Contents Amendment Record

This report has been issued and amended as follows:

Issue	Revision	Description	Date
1	0	Draft report issued by email	19 March 2025
2	1	Final report issued by email	01 April 2025

Document Verification

Issue	Revision	Date:	19 March 2025	
1	0	Author(s):	AB	HA
		Checked By:	AW	EC
2	1	Author(s):	AB	HA
		Checked By:	AW	EC

Contents Page

This page is left intentionally blank

1 Scope of Appraisal

Herrington Consulting has been commissioned by **The Baird Farming Partnership** to prepare a Flood Risk Assessment and Drainage Strategy for the proposed development at **The Old Butcher's Block, Climping Street, Climping, Littlehampton, West Sussex, BN17 5RQ.**

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 500158, 101513 off Climping Street in Climping, Littlehampton and covers an area of approximately 0.24 hectares (ha). The site previously contained a butcher's shop and more recently comprised an estate office. The building onsite is currently being used as a dwelling house. The location of the site, in relation to the surrounding area and Ryebank Rife, is shown in Figure 2.1 below.

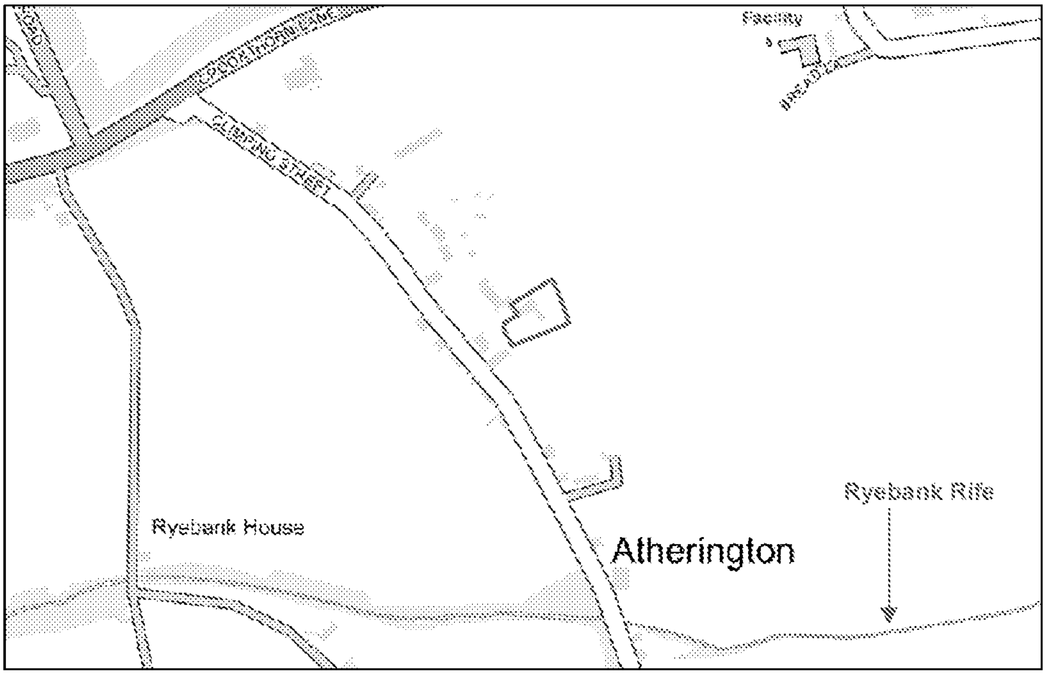


Figure 2.1 – Location map (contains Ordnance Survey data © Crown copyright and database right 2025).

2.2 Proposed Development

The development proposals comprise a replacement two-storey dwelling.

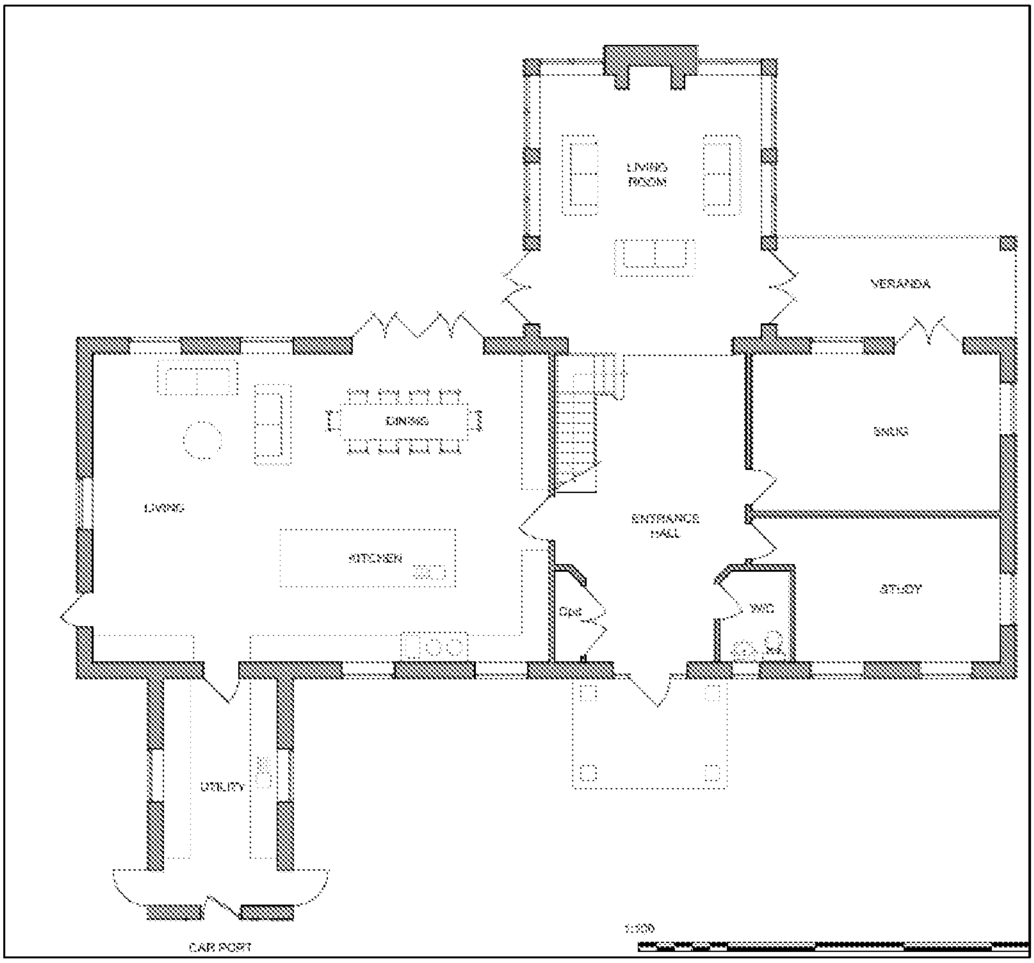


Figure 2.2 – Proposed ground floor layout.

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, 2024) requires a detailed FRA to be undertaken. Whilst the site is located within Flood Zone 1 and is smaller than 1 hectare in size, the development site is located within the Lidsey Wastewater Treatment Catchment Area. Development within the Lidsey Wastewater Treatment area will be required to take account and contribute to the improvement of the existing sewage and drainage network, in line with the actions identified in the West Sussex County Council Surface Water Management Plan (WSCC SWMP). Consequently, a FRA and Drainage Strategy 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. In the case of brownfield sites, drainage proposals are typically measured against the existing performance of the site, although it is preferable (where practicable) to provide runoff characteristics that are similar to greenfield behaviour.

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). It is, however, recognised that SuDS should be designed to ensure that the maintenance and operation requirements are economically proportionate.

In this instance, the proposed development is for a single replacement dwelling with a total floor space less than 1000m². As a result, the proposals are not classified as 'major' development and therefore, the NTSS will not apply.

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 SFRA – The Arun District Council SFRA (2016) 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 SWMP – A Surface Water Management Plan (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 West Sussex Council (2014) which covers the Arun district and has therefore been referenced as part of this site-specific FRA.

Information provided by Southern Water – Southern 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 4.85m and 5.95m Above Ordnance Datum Newlyn (AODN). Generally, land levels fall towards the front of the site (west). However, land levels in the surrounding area fall to the south.

Geology – Reference to the British Geological Survey (BGS) map shows that the underlying solid geology in the location of the subject site is Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation (Undifferentiated – chalk). Overlying this are superficial deposits of Raised Beach Deposits (sand and gravel).

Historic flooding – Information provided by the SFRA shows isolated recorded incidents of surface water flooding near to the site. Notwithstanding this, data provided by the EA's Historic Flood Map GIS data shows there are no recorded incidents of fluvial or tidal flooding at the site or immediate surrounding area.

Existing Flood Risk Management Measures – The site benefits from naturally elevated ground along the Ryebank Rife, which provides a standard of protection of 1 in 5 years.

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 (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 **Arun and Western Streams 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 development site lies within a small drainage catchment and therefore, the Peak Rainfall Allowances for the Arun and Western Streams Management Catchment should be applied.

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
Arun and Western Streams	3.3 %	Central	20%	25%
		Upper End	35%	40%
	1 %	Central	20%	25%
		Upper End	45%	45%

Table 2.1 – Recommended peak rainfall intensity allowances for each epoch for the Arun and Western Streams 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 45% 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 "+45%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

Inspection of OS mapping and the EA's 'Main River' map identifies the Ryebank Rife approximately 300m south of the site, and the River Arun over 1.6km east of the site. However, inspection of the EA's 'Flood Map for Planning' shows the site is located within Flood Zone 1 and not being at risk of flooding from a main river. Furthermore, review of the SFRA climate change mapping, shows the site remains within Flood Zone 1 up to future year 2111. Consequently, the risk of flooding to the site from rivers is considered to be *low.*

3.2 Flooding from 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 the site and surrounding area reveals drainage ditches connecting to the Ryebank Rife south of the site. In addition, there is a drainage network surrounding the River Arun over 1.5km from the site. These are at an elevation that is over 3m below that of the lowest part of the site. In addition, the risk of flooding from the drainage ditches will be almost entirely governed by extreme flows and water levels within the River Arun and Ryebank Rife. It has been identified that the risk of flooding from these rivers is low and therefore, the risk of flooding from the surrounding drainage network is considered to be *low.*

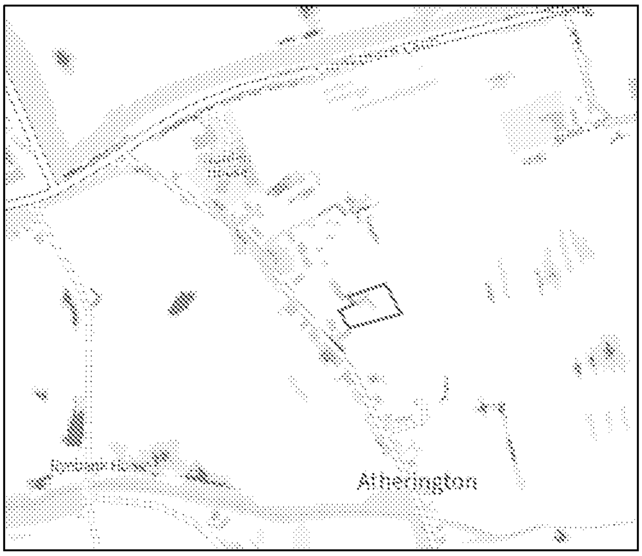
3.3 Flooding from the Sea

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.*

3.4 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. It is therefore considered that flooding through this mechanism is unlikely. Taking the above information into account, it is therefore considered that the risk of flooding from this source to the proposed development is *low*.

3.5 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 chalk. Therefore, there is potential for the groundwater table to become elevated.

Inspection of nearby borehole records shows two boreholes approximately 125m and 230m south of the site. The boreholes are situated on similar geology and are at a ground level of 4.87m AODN and 4.55m AODN respectively. Both boreholes were drilled to 4m below ground level (bgl) and remained dry. The land levels onsite are between 4.86m AODN and 5.95m AODN. Consequently, groundwater levels would have to rise by over 4m before emerging at the site. As such, the proposed development is unlikely to be impacted by groundwater. This is supported by Defra Groundwater Flood Scoping Study (May 2004) shows that no groundwater flooding events were recorded during the very wet periods of 2000/01 or 2002/03.

Taking the above information into account and given there are no recorded incidents of groundwater flooding onsite, it is therefore considered that the risk of groundwater flooding to the proposed development is *low*.

3.6 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 Southern Water (Figure 3.2) identifies that the sewers in this area are separate foul and surface water sewers.

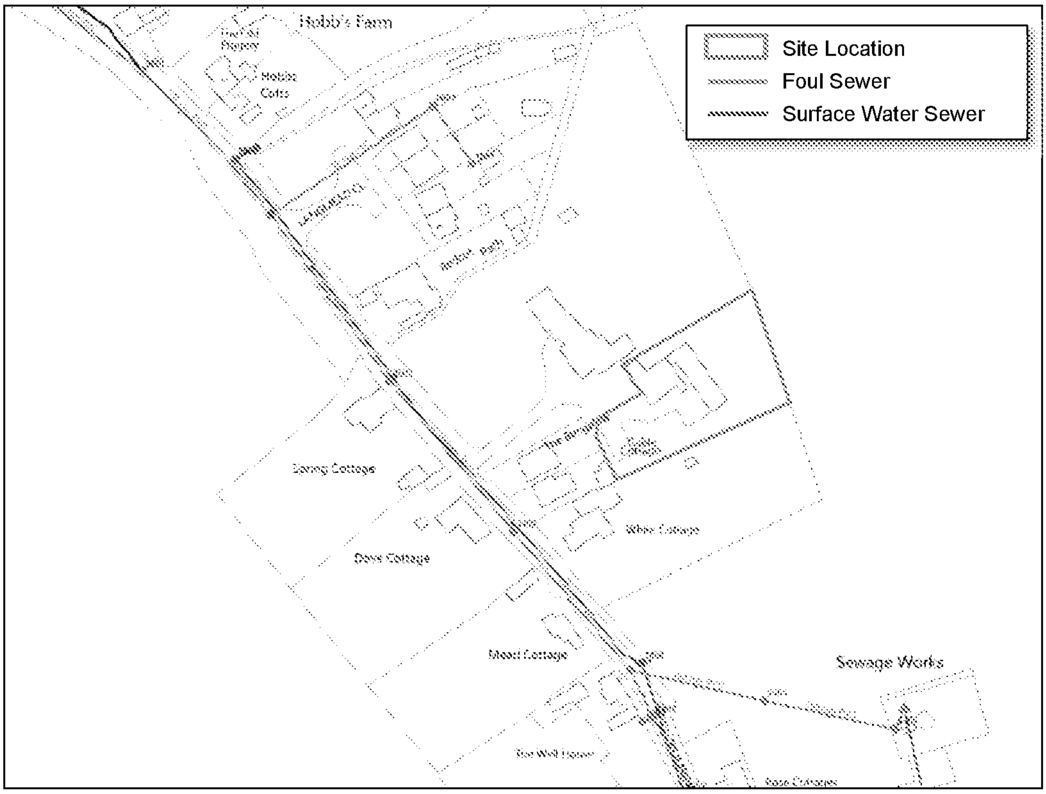


Figure 3.2 - Asset location mapping provided by Southern Water (a full scale copy can be found in Appendix A.2).

Inspection of the asset location data and aerial height data for the surrounding area 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 of the site, where land levels are lower. Water would continue to flow south along Climping Street following the natural topography, away from the proposed development. Taking this into consideration and the fact that there are no known records of the site being affected by sewer flooding in the past, the risk of flooding from this source is considered to be *low*.

3.7 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*.

3.8 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	Low	OS mapping and the EA's 'Flood Map for Planning'
Ordinary and Man-Made Watercourses	Low	OS mapping and aerial height data
Sea	Low	OS mapping
Surface Water	Low	EA's 'Flood Risk from Surface Water' map, aerial height data, OS mapping and site-specific topographic survey
Groundwater	Low	Defra Groundwater Flood Scoping Study, site-specific geological data, aerial height data, OS mapping, site-specific topographic survey, historic records contained within the SFRA, and BGS Borehole survey records
Sewers	Low	Aerial height data, OS mapping, site-specific topographic survey, asset location data provided by Southern Water and historic sewer records contained within the SFRA
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 Flood Mitigation Measures

4.1 Application of the Sequential Approach at a Local Scale

The sequential approach to flood risk management can also be adopted on a site based scale and this can often be the most effective form of mitigation. For example, on a large scheme this would mean locating the more vulnerable dwellings on the higher parts of the site and placing parking, recreational land or commercial buildings in the lower lying and higher risk areas.

Whilst it has been identified that the proposed development is at low risk of flooding from all sources, it can be seen that this approach has been applied. Inspection of the scheme drawings shows that less vulnerable uses (i.e., kitchen, dining and living accommodation) are located on the ground flood, with more vulnerable uses (i.e., sleeping accommodation) being located on the first floor.

4.2 Raising Floor Levels

The site and proposed dwellings have been shown to be at low risk of flooding from all sources. Consequently, floor raising is not considered to be a necessary form of mitigation at this site. Nevertheless, inspection of the scheme drawings shows the front door to the replacement dwelling is raised above ground level. As such, the internal floor levels of the dwelling will be raised above ground level.

4.3 Flood Resistance and Resilience

During a flood event, floodwater can find its way into properties through a variety of routes including:

- Ingress around closed doorways.
- Ingress through airbricks and up through the ground floor.
- Backflow through overloaded sewers discharging inside the property through ground floor toilets and sinks.
- Seepage through the external walls.
- Seepage through the ground and up through the ground floor.
- Ingress around cable services through external walls.

Since flood management measures only manage the risk of flooding rather than eliminate it completely, flood resilience and resistance measures may need to be incorporated into the design of the buildings. The two possible alternatives are:

Flood Resistance or 'dry proofing', where flood water is prevented from entering the building. For example, using flood barriers across doorways and airbricks, or raising floor levels. These measures are considered appropriate for 'more vulnerable' development where recovery from internal flooding is not considered to be practical.

Flood Resilience or 'wet proofing', accepts that flood water will enter the building and allows for this situation through careful internal design for example raising electrical sockets and fitting tiled floors. The finishes and services are such that the building can quickly be returned to use after the flood. Such measures are generally only considered appropriate for some 'less vulnerable' uses and where the use of an existing building is to be changed and it can be demonstrated that no other measure is practicable.

It has been shown that the proposed development is at low risk of flooding from all sources. Nevertheless, as the proposed development is for a replacement dwelling, there is an opportunity to provide a betterment to the site. Therefore, in line with best practice, it is recommended to incorporate flood resilience measures into the design as a precautionary measure only.

Details of flood resilience and flood resistance construction techniques can be found in the document '*Improving the Flood Performance of New Buildings; Flood Resilient Construction'*, which can be downloaded from www.gov.uk.

A Code of Practice (CoP) for Property Flood Resilience (PFR) has been put in place to provide a standardised approach for the delivery and management of PFR. Further information on the CoP and guidance on how to make a property more flood resilient can be accessed, and downloaded, from the Construction Industry Research and Information Association (CIRIA) Website:

https://www.ciria.org/Resources/Free_publications/CoP_for_PFR_resource.aspx

5 Existing Drainage

5.1 Existing Surface Water Drainage

The existing site drainage has not been surveyed, and it is unknown how the existing buildings at the site currently drain.

Southern 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 immediately west of the site entrance, within Climping Street.

The site comprises mostly hardstanding and noting the on-site drainage has not been surveyed, it is assumed that the site drains informally into the adjacent fields and public highway. There may be a connection to the surface water sewer within Climping street, however, additional investigation may be required as part of the detailed design to confirm this.

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. Existing brownfield discharge rates and greenfield runoff rates for the entire site have been calculated and are outlined in Table 5.1(below).

Return Period (years)	Peak greenfield runoff from the existing site (l/s)	Peak brownfield runoff from the existing site (l/s)
2	0.5	23.4
30	1.1	59.6
100	1.5	74.8

Table 5.1 – Summary of peak greenfield and brownfield runoff rates for the existing site.

These hydrological calculations have been undertaken using the Modified Rational Method. Greenfield runoff rates for the site have also been calculated using the HR Wallingford greenfield runoff calculator and the Flood Estimation Handbook (FEH) method. Both brownfield and greenfield runoff rates have been calculated with synthetic rainfall data derived using the variables obtained from the FEH online web service.

6 Sustainable Drainage Assessment

6.1 Site Characteristics

The important characteristics of the site, which have the potential to influence the surface water drainage strategy, are summarised in Table 6.1 below.

Site Characteristic	Development Site	
Total area of site	~0.24 ha	
Current site condition	Developed (brownfield)	
Greenfield runoff rates (based on the FEH methodology and total site area)	1:1 yr = 0.39 l/s Qbar = 0.46 l/s 1:30 yr = 1.05 l/s 1:100 yr = 1.46 l/s	
Infiltration	Available 0.01m/hr (assumed based on underlying geology and typical soil conditions)	
Current surface water discharge method	Unknown	
Is there a watercourse nearby?	No	
Impermeable area	**Existing** **~ 1,120 m^2**	**Proposed** **~ 1,160 m^2**

Table 6.1 – *Site characteristics affecting rainfall runoff.*

Based on Table 6.1 above, it is evident that the development proposals will marginally 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 marginally increase. Measures will need to be put in place to ensure that the impact of any additional surface water runoff is appropriately managed.

Noting that the comparison between impermeable area pre and post development is roughly the same, it is recognised that the impacts of climate change should be considered as part of any new development and it is for this reason, that it is recommended that SuDS are considered. The overall rate at which surface water runoff is discharged from the site should not increase over the lifetime of the development.

Furthermore, the potential use of SuDS within the proposed development will be considered to assess the practicality of better replicating greenfield behaviour, in accordance with Local Planning Policy.

6.2 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.

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 need 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 should be considered within the detailed design, to provide a conservative approach regarding the management of surface water runoff, it has been assumed that any rainwater harvesting system included within the development proposals are at maximum capacity and additional SuDS will be required to manage the surface water runoff generated.

Infiltration – The soil and underlying geology at this location has been analysed using the British Geological Surveys mapping. The geology of the site is made up of Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation (Undifferentiated – chalk). The above-mentioned strata are likely to have a high permeability, capable of discharging surface water runoff.

Whilst site-specific ground investigations have not been carried out at this stage in the development process, infiltration rate details have been assumed using the CIRIA SuDS manual to apply a value that represents the site geology. Notwithstanding this, it is recommended that infiltration testing, and ground water monitoring are carried out at detailed design stage to confirm the suitability of using infiltration to drain 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 – A more preferable solution for managing surface water runoff discharged from the development is available and therefore, it is likely that a connection to the public sewer system will not be required.

If it is later found that infiltration is not a viable option to drain the site, then a connection to the public surface water sewer adjacent to the site can be utilised to discharge runoff.

6.3 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.
- Infiltration SuDS should not be constructed through contaminated material.
- Any infiltration features that result in a concentrated discharge of surface water runoff to the ground should not normally be located within 5.0 metres of any existing or proposed (adjacent) buildings.

6.4 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 garden area. Typical sizes and dimensions of water butts are outlined below.

In this case, the demand for potable water from the garden areas could be relatively large and as a result, a large house water butt (typical 510 litre unit) is 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.

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 6.2 – *Estimated storage capacity of available water butts.*

Raised SuDS Planters/Bio-Retention Cells

Raised SuDS planters can be utilised adjacent to the proposed building. The SuDS planters can be designed to receive rainwater runoff from the building roofs, with downpipes connected to the base of these planters. During low return period events, surface water runoff from the roofs would be stored within the soil/substrate layers of each planter and can be used to irrigate the vegetation. The planters will also contribute to reducing the volume of water discharged offsite via evapotranspiration.

The overflows from the SuDS planters would need to be connected to the permeable surfacing within the driveway/access road area. Any runoff discharged from the planters, via an overflow pipe, would first be treated with pollutants filtered out by the substrate.

Although the incorporation of SuDS planters will provide a benefit to the quality of water discharged from the roof, it is unlikely that they will restrict the rate runoff is discharged from the site under higher return period events. Consequently, other means of storage and attenuation will need to be provided.

Permeable Surfacing

Runoff from the proposed building and hardstanding across the site, in addition to overflow from any water butts, rain gardens, SuDS planters and tree crates will be drained to a permeable surfacing system located within the driveway/car access area on site. This permeable surfacing will be laid on top of a sub-base layer and comprised of porous open graded aggregate. Runoff will be drained into the sub-base via a diffusion system, e.g., diffusion boxes or perforated pipes within the sub-base. A section of the permeable surfacing will be lined with a permeable geotextile liner, designed to permit infiltration into the underlying ground. The area of permitted infiltration will be at least 5 metres from the building, allowing sufficient easement for infiltration discharge to the ground. Areas of permeable surfacing within this easement zone will be lined with impermeable geotextile liner.

It is noted that the inclusion of permeable surfacing will further improve water quality of the surface runoff accumulated on site. As water trickles through the sub-base, pollutants will be filtered out before discharge to the ground.

A summary of the Causeway Flow+ analysis for permeable surfacing is shown in Table 6.3 below.

Parameter	**Value (1:100yr+45%cc event)**
SuDS	Permeable Surfacing
Total site impermeable area draining to permeable surfacing, including overflow from other SuDS and a 10% allowance for urban creep	~ 1280 m^2
Area of permeable surfacing	~ 748 m^2
Infiltration	Permitted – assumed 0.01 m/hour
Area of permitted infiltration	~ 575 m^2
Area of not permitted infiltration	~ 173 m^2
Sub-base depth	550 mm
Sub-base porosity	30%
Volume of stored water under design event	112 m^3
Critical storm duration	720 minutes
Half drain time	19.5 hours

Table 6.3 – *Summary of permeable surfacing SuDS.*

Half drain times for the proposed permeable surfacing for several other return-period rainfall events have been provided in Table 6.4 below.

Return Period	**Half Drain Time**
1:2yr	4.5 hours
1:10yr+40%cc	9.9 hours
1:30yr+40%cc	12.9 hours
1:100yr+45%cc	19.5 hours

Table 6.4 – *Half drain times for the proposed permeable surfacing infiltration system, for a range of return periods, up to and including the design rainfall event.*

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. The use of permeable surfacing will provide sufficient storage to infiltrate all surface water runoff on site. The risk of any surface water flooding as a result of the proposed development has been appropriately mitigated with the inclusion of the SuDS scheme described above.

6.5 Indicative Drainage Layout Plan

Figure 6.1 below is an indicative drainage layout plan delineating how the proposed SuDS can be incorporated into the scheme proposals.

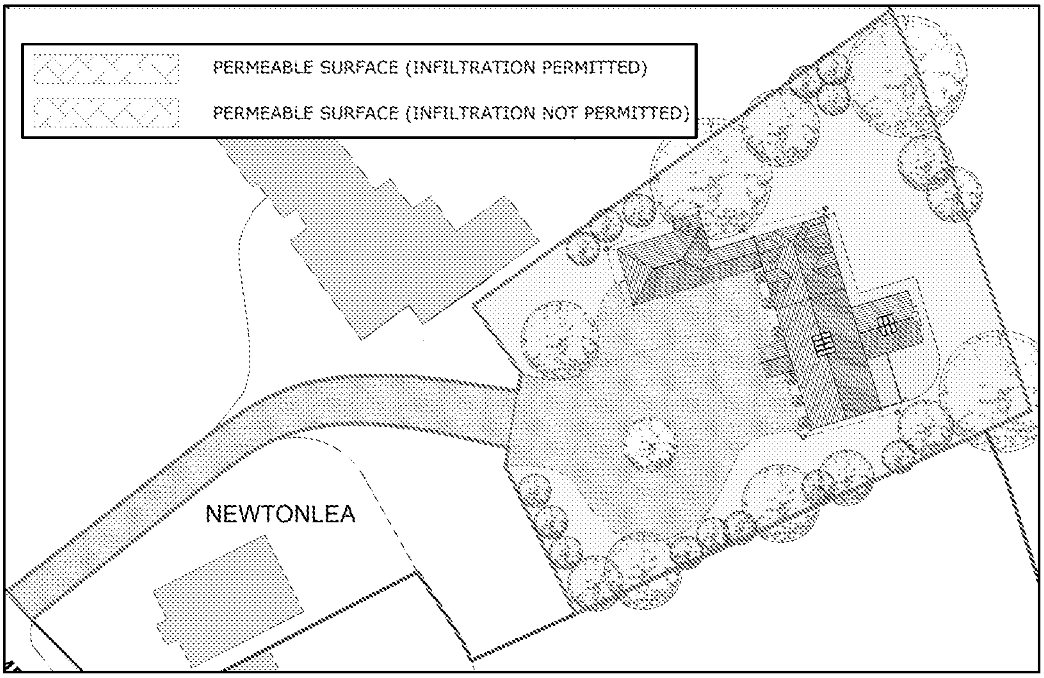


Figure 6.1 – Indicative drainage layout plan showing the proposed location of SuDS.

A full-scale copy of this layout is located in Appendix A.4 of this report.

6.6 Other potential SuDS options

Tree Crates

Geo-cellular tree crates can be located beneath some of the new trees, which are proposed to be located across the site. These tree crates could provide space for the roots to grow, without impacting on the adjacent permeable surfacing. Tree crates can also be used to manage a small volume of runoff from the site, allowing water to be easily adsorbed.

Rain Gardens

Surface water runoff from all roofs across the site can be discharged in various ways. Some runoff from the buildings can be discharged to rain gardens positioned along the northern and southern boundaries of the site. Depressions with vegetated centres can be created to filter water and capture silt and contaminants, improving water quality. These natural sediment traps can minimise maintenance requirements by reducing the spread of silt across the SuDS network on site. Areas of ground within the rain gardens can be left unlined or based with gravel and designed to maximise the potential for infiltration, reducing the pressure on the remainder of the drainage network. Overflows from the rain gardens would need to feed into the permeable surfacing.

6.7 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.

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, the site is for residential use, therefore, the maintenance of the SuDS will be the responsibility of the residents of the proposed dwelling.

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

7 Foul Water Management Strategy

7.1 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 and there is an assumed existing connection. Therefore, the use of package treatment systems is unlikely to be considered appropriate for this development.

7.2 Sewer Connection

As indicated in Figure 3.2, there is an existing public foul sewer to the west of the site, within Climping Street. It is anticipated that the proposed development will connect into the existing foul sewer network.

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.

7.3 Summary

The opportunities for managing foul effluent discharged from the development site have been analysed and it is concluded that the assumed existing connection to the public sewer system, located to the west 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 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.

8 Conclusions and Recommendations

The overarching objective of this report is to appraise the risk of flooding at The Old Butcher's Block, Littlehampton 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 and 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, it has been demonstrated that in line with best practice, a precautionary approach has been adopted and all more vulnerable elements (i.e. sleeping accommodation) has been located on the first floor. In addition, the ground floor is slightly elevated above the existing ground levels, reducing the risk of internal flooding if the proposed drainage system was to become overwhelmed. As the proposed development is for a replacement dwelling, there is also an opportunity to provide a betterment to the site. Therefore, in line with best practice, it is recommended to incorporate flood resilience measures into the design as a precautionary measure only (refer to Section 4.3).

It is concluded that the most viable solution for managing all surface water runoff discharged from the proposed development will be via infiltration on site. Various SuDS have been proposed to manage all the runoff from the proposed development, such as water butts, SuDS planters, and permeable surfacing. The inclusion of permeable surfacing will provide sufficient storage on site to manage and infiltrate all surface water runoff from across the site for all rainfall events, up to and including the design event.

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 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 is available. Consequently, the proposals will meet the requirements of the NPPF, and local planning policy.

9 Appendices

Appendix A.1 – Drawings

Appendix A.2 – Southern Water Asset Location Data

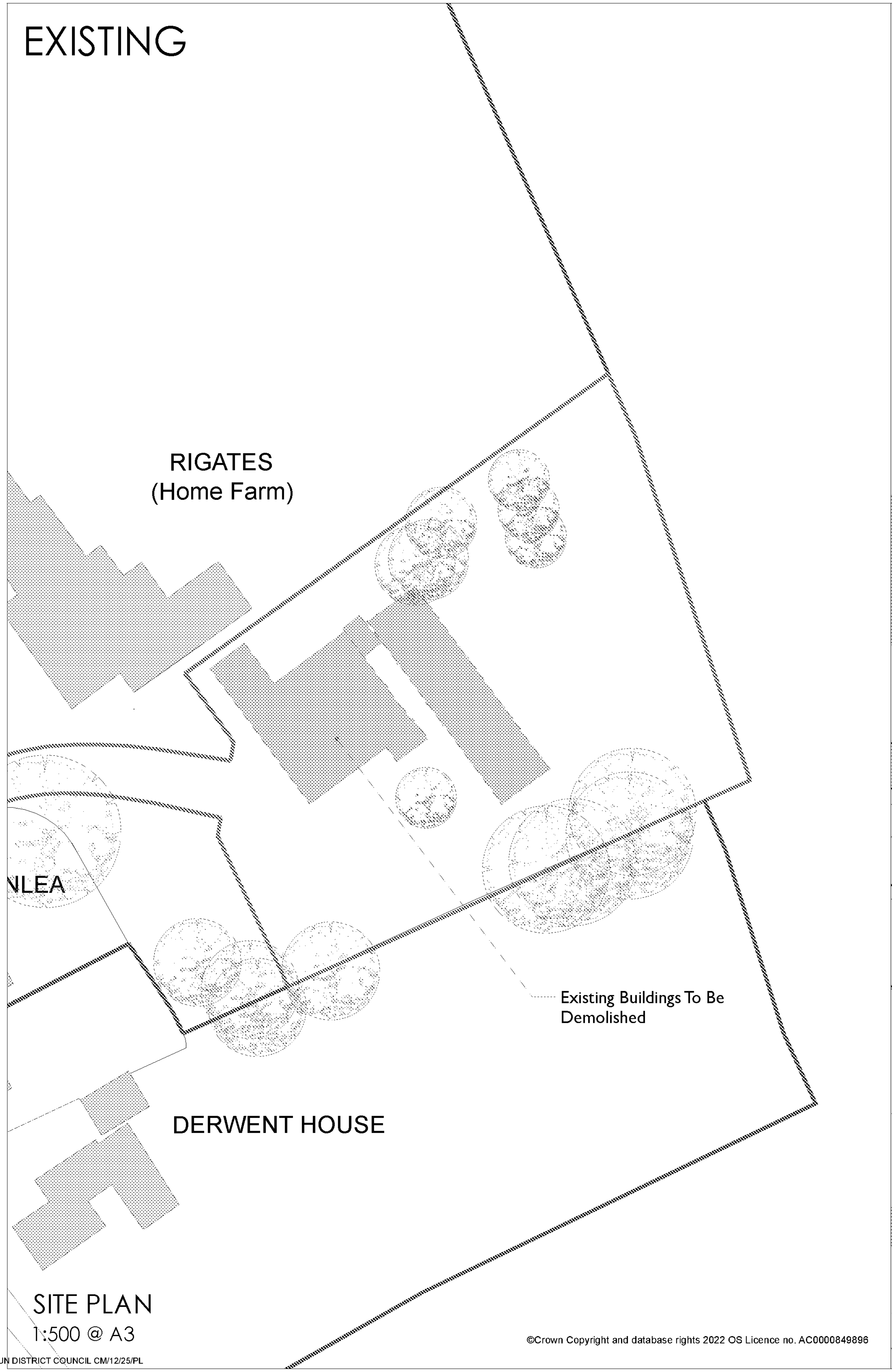
Appendix A.3 – Indicative Drainage Layout Plan

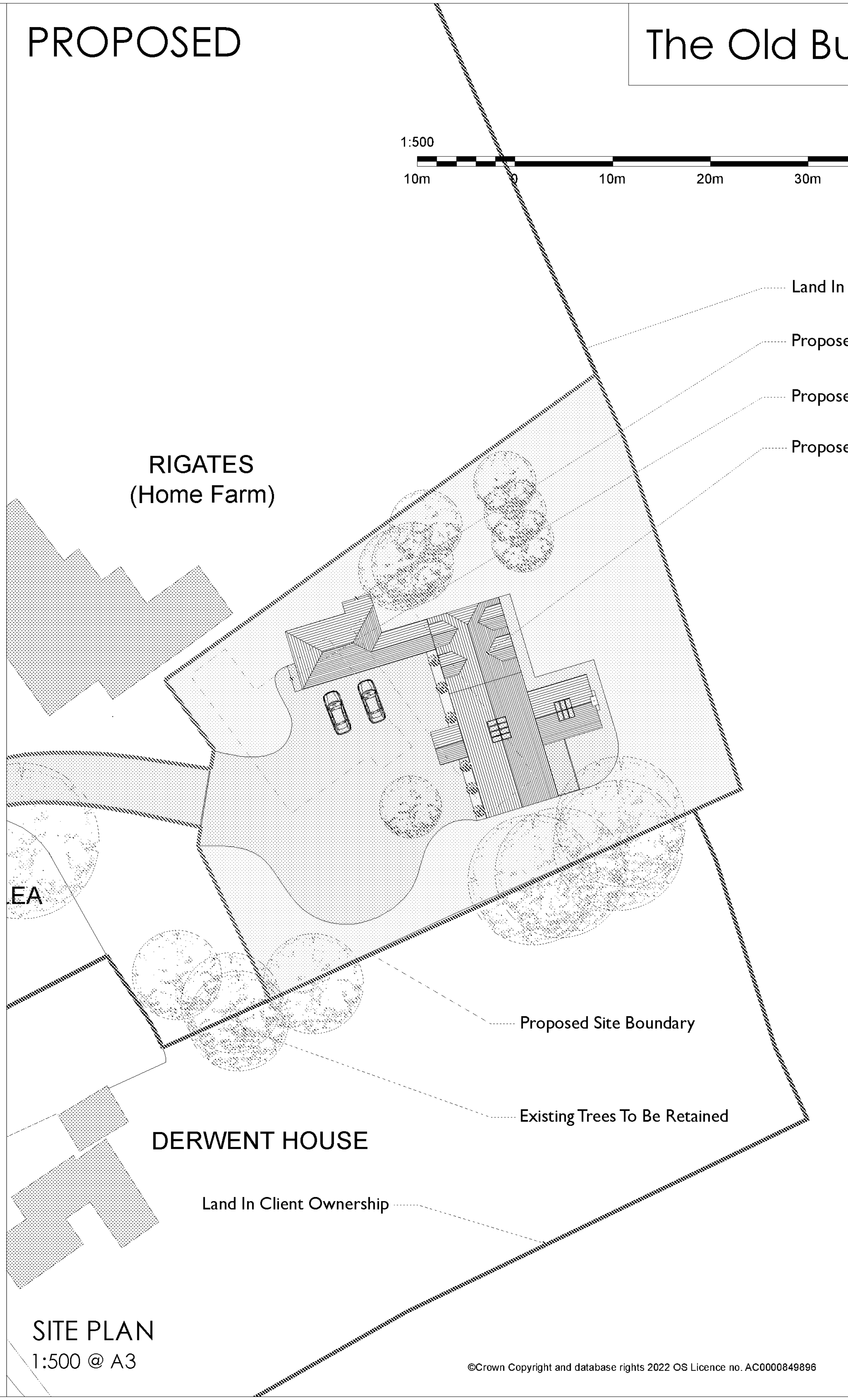
Appendix A.4 – Surface Water Management Calculations

Appendix A.5 – Maintenance Schedules

Appendix A.1 – Drawings

The Old Butchers Flat





Use figured dimensions only.
All dimensions are to be checked on site before any work is carried out. Please contact the Architect immediately regarding any discrepancies discovered on site. .

Rev.	Notes	Date

JB ARCHITECTURE
The Bricks, Manor Farm Barns
Chichester, West Sussex,
PO20 7PL

T: 01243 785342
E: admin@jbarch.co.uk
W: www.jbarch.co.uk

Project
The Old Butchers Flat
Climping Street,
Climping,
BN17 5RQ

Drawing
Existing & Proposed
Site Plans

Drawn By JP	Scale 1:500 @ A3
Date March 2025	Revision
Drawing No. DPA - 002	

Appendix A.2 – Southern Water Asset Location Data

 Date: 10/03/25 Scale: 1:1250 Map Centre: 500122,101492 Data updated: 26/02/25 Our Ref: 1712288 - 1

Wastewater Plan A4
Powered by digdat

The positions of pipes shown on this plan are believed to be correct, but Southern Water Services Ltd accept no responsibility in the event of inaccuracy. The actual positions should be determined on site. This plan is produced by Southern Water Services Ltd (c) Crown copyright and database rights 2025 Ordnance Survey AC0000808122 .This map is to be used for the purposes of viewing the location of Southern Water plant only. Any other uses of the map data or further copies is not permitted.

WARNING: BAC pipes are constructed of Bonded Asbestos Cement.

WARNING: Unknown (UNK) materials may include Bonded Asbestos Cement.

Foul Gravity Sewer
Combined Gravity Sewer
Culverted Water Course or Treated Effluent
Surface Water Gravity Sewer
Rising Main, Vacuum or Syphon
Combined Outfall
Surface Water Outfall
Foul Outfall
Surface Water Inlet
Combined Pumping Station
Surface Water Pumping Station
Foul Pumping Station
Water Treatment Works
Section 104 Area
Building Over Agreement Area
Foul Manhole
Combined Manhole
Surface Water Manhole
Side Entry Manhole, Demarcation Chamber, Dummy Manhole or Surface Water Soakaway

flood@herringtonconsulting.co.uk

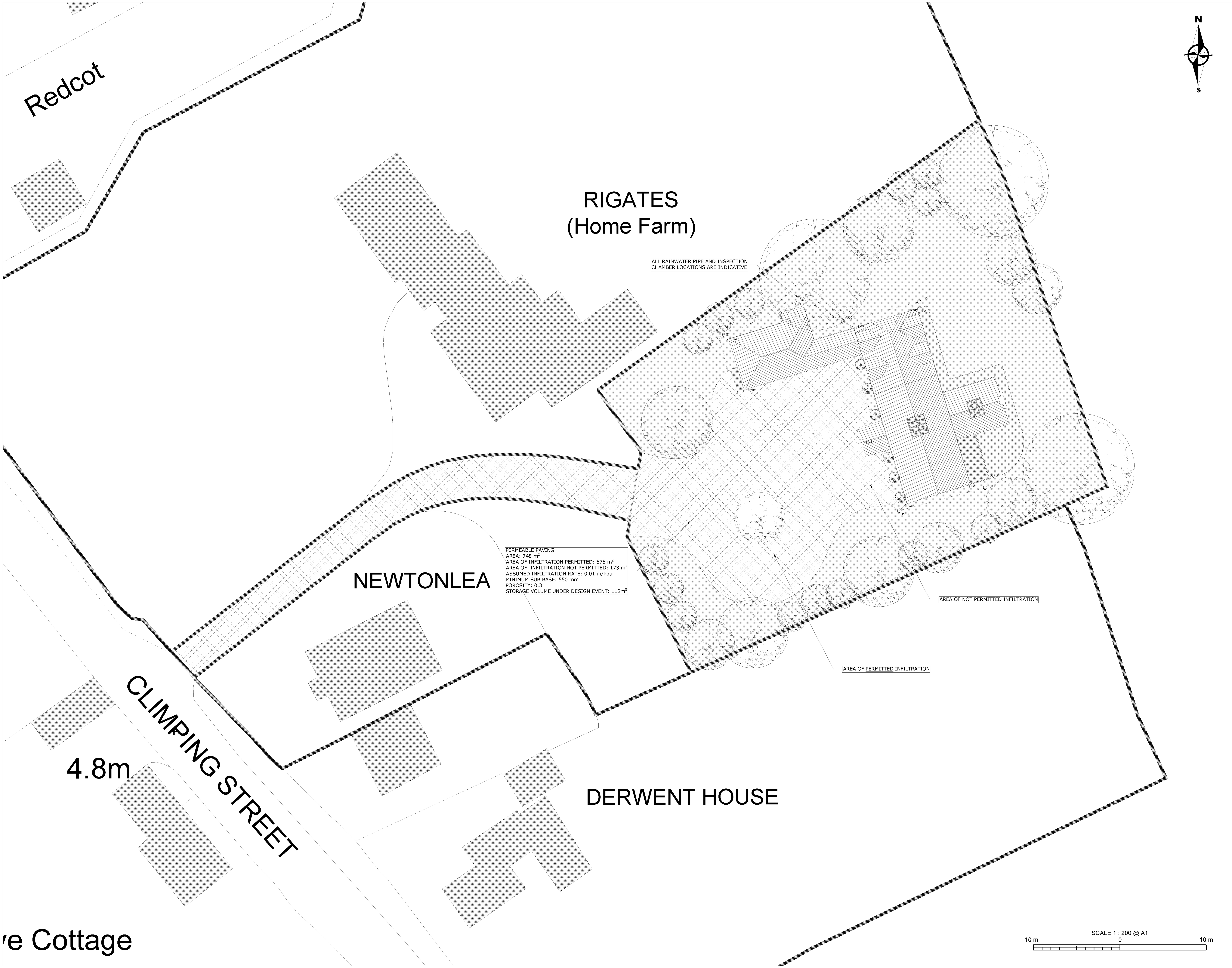
4274/HA

WATER for LIFE
Southern Water

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
0502	F	0.00	0.00	-
1401	F	4.49	0.00	-
1402	F	4.31	2.61	-
1404	F	0.00	0.00	-
1405	F	0.00	0.00	-
2401	F	0.00	0.00	-
2402	F	0.00	0.00	-
1450	S	0.00	0.00	-

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

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. INFILTRATION FEATURES WILL BE SUBJECT TO SITE SPECIFIC INFILTRATION TESTING AND TRIAL HOLES.
5. ALL DRAINAGE SYSTEMS WILL NEED TO BE INSTALLED AND DESIGNED FOR SUITABLE LOADING REQUIREMENTS.
6. THE CONTRACTOR SHALL OBTAIN PRIOR APPROVAL AND ALL NECESSARY LICENCES FROM THE HIGHWAY AUTHORITY AND/OR SEWERAGE UNDERTAKER BEFORE CARRYING OUT ANY WORKS.
7. 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:

- SURFACE WATER DRAIN
- PPIC — SURFACE WATER PPIC
- RWP — RAINWATER PIPE
- YG — YARD GULLY
- PERMEABLE SURFACE (INFILTRATION PERMITTED)
- PERMEABLE SURFACE (INFILTRATION NOT PERMITTED)

herrington
Part of eps

CANTERBURY | LONDON | CAMBRIDGE | BRISTOL | LEEDS

Specialists in the built environment - Coastal, Flood Risk, Drainage, Light Analysis

www.herringtonconsulting.co.uk

Rev	Description	Author	Checked	Date
P0	First issue	HA	EC	18/03/25

CLIENT
The Baird Farming Partnership

PROJECT
The Old Butcher's Block, Climping Street

SCALE	PROJ REF	ORIGINATOR	CHECKED BY
1:200	4274	HA	EC

HC DWG REF.
4274_DWG_r0

DWG TITLE	DWG No.
INDICATIVE SURFACE WATER DRAINAGE LAYOUT	HC-4274-501

Appendix A.4 – Surface Water Management Calculations

hrwallingford

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Hamza Askari
Site name:	The Old Butcher's Block
Site location:	Climping Street, Arun

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.

Site Details

Latitude:	50.80452° N
Longitude:	0.57996° W
Reference:	1489333946
Date:	Mar 13 2025 14:08

Runoff estimation approach

FEH Statistical

Site characteristics

Total site area (ha):	0.237

Methodology

Q_{MED} estimation method:	Calculate from BFI and SAAR
BFI and SPR method:	Specify BFI manually
HOST class:	N/A
BFI / BFIHOST:	0.671
Q_{MED} (l/s):	
Q_{BAR} / Q_{MED} factor:	1.14

Hydrological characteristics

	Default	Edited
SAAR (mm):	709	718
Hydrological region:	7	7
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):		0.46
1 in 1 year (l/s):		0.39
1 in 30 years (l/s):		1.05
1 in 100 year (l/s):		1.46
1 in 200 years (l/s):		1.71

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	40	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	0.500
Time of Entry (mins)	4.00	Include Intermediate Ground	x
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	x
Maximum Rainfall (mm/hr)	250.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1	0.112	4.00	10.000	1200	15.803	94.614	0.725
2			10.000	1200	24.451	93.033	0.872

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)
1.000	1	2	10.000	0.600	9.275	9.128	0.147	68.0	225	4.10	169.4

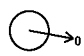
Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	1.588	63.1	96.0	0.500	0.647	0.112	0.0	225	1.617

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)
1.000	10.000	68.0	225	Circular	10.000	9.275	0.500	10.000	9.128	0.647

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	1	1200	Manhole	Adoptable	2	1200	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
1	15.803	94.614	10.000	0.725	1200				
						0	1.000	9.275	225
2	24.451	93.033	10.000	0.872	1200	1	1.000	9.128	225
									

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Starting Level (m)	
Rainfall Events	Singular	Skip Steady State	x	Check Discharge Rate(s)	x
Summer CV	1.000	Drain Down Time (mins)	1500	Check Discharge Volume	x
Winter CV	1.000	Additional Storage (m^3/ha)	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 %)
2	0	0	0
30	0	0	0
100	0	0	0

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 (m^3)	Flood (m^3)	Status
15 minute summer	1	10	9.379	0.104	23.4	0.1175	0.0000	OK
15 minute summer	2	10	9.222	0.094	23.4	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m^3)	Discharge Vol (m^3)
15 minute summer	1	1.000	2	23.4	1.391	0.371	0.1682	9.1

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 (m^3)	Flood (m^3)	Status
15 minute summer	1	10	9.484	0.209	59.6	0.2367	0.0000	OK
15 minute summer	2	10	9.300	0.172	59.6	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m^3)	Discharge Vol (m^3)
15 minute summer	1	1.000	2	59.6	1.662	0.944	0.3553	23.1

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	1	10	9.643	0.368	74.5	0.4157	0.0000	SURCHARGED
15 minute summer	2	10	9.340	0.212	74.8	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	1	1.000	2	74.8	1.880	1.184	0.3928	29.0

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	45	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	0.500
Time of Entry (mins)	4.00	Include Intermediate Ground	x
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	x
Maximum Rainfall (mm/hr)	250.0		

Nodes

Name	Area (ha)	Cover Level (m)	Easting (m)	Northing (m)	Depth (m)
Permeable Surfacing	0.116	10.000	-13.702	97.412	0.700

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Starting Level (m)	
Rainfall Events	Singular	Skip Steady State	x	Check Discharge Rate(s)	x
Summer CV	1.000	Drain Down Time (mins)	1500	Check Discharge Volume	x
Winter CV	1.000	Additional Storage (m³/ha)	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 %)
2	0	0	0
10	0	0	0
10	40	0	0
30	0	0	0
30	40	0	0
100	0	0	0
100	45	10	0

Node Permeable Surfacing Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.01000	Invert Level (m)	9.300	Slope (1:X)	1000.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	720	Depth (m)	0.550
Safety Factor	2.0	Width (m)	23.979	Inf Depth (m)	
Porosity	0.30	Length (m)	23.979		

Node Permeable Surfacing Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	9.300	Slope (1:X)	1000.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)		Depth (m)	0.550
Safety Factor	2.0	Width (m)	13.153	Inf Depth (m)	
Porosity	0.30	Length (m)	13.153		

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 (m^3)	Flood (m^3)	Status
360 minute summer	Permeable Surfacing	272	9.397	0.097	5.5	19.4276	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)
360 minute summer	Permeable Surfacing	Infiltration	0.8

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

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m^3)	Flood (m^3)	Status
240 minute winter	Permeable Surfacing	236	9.476	0.176	8.0	36.9849	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)
240 minute winter	Permeable Surfacing	Infiltration	0.8

Results for 10 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 (m^3)	Flood (m^3)	Status
360 minute winter	Permeable Surfacing	352	9.561	0.261	8.2	56.2139	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)
360 minute winter	Permeable Surfacing	Infiltration	0.8

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 (m^3)	Flood (m^3)	Status
360 minute winter	Permeable Surfacing	352	9.531	0.231	7.4	49.4037	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)
360 minute winter	Permeable Surfacing	Infiltration	0.8

Results for 30 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
360 minute winter	Permeable Surfacing	352	9.639	0.339	10.3	73.6336	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)
360 minute winter	Permeable Surfacing	Infiltration	0.8

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
480 minute winter	Permeable Surfacing	464	9.596	0.296	7.3	64.0349	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)
480 minute winter	Permeable Surfacing	Infiltration	0.8

Results for 100 year +45% 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 (m^3)	Flood (m^3)	Status
720 minute winter	Permeable Surfacing	705	9.811	0.511	8.3	112.2323	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)
720 minute winter	Permeable Surfacing	Infiltration	0.8

Appendix A.5 – Maintenance Schedules

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).

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 – Bioretention Systems		
Maintenance Schedule	**Required Action**	**Typical Frequency**
Regular Inspections	Inspect infiltration surfaces for silting and ponding, record de-watering time of the facility and assess standing water levels in underdrain (if appropriate) to determine if maintenance is necessary	Quarterly
	Check operation of underdrains by inspection of flows after rain	Annually
	Assess plants for disease infection, poor growth, invasive species etc and replace as necessary	Quarterly
	Inspect inlets and outlets for blockage	Quarterly
Regular Maintenance	Remove litter and surface debris and weeds	Quarterly (or more frequently for tidiness or aesthetic reasons)
	Replace any plants, to maintain planting density	As required
	Remove sediment, litter and debris build-up from around inlets or from forebays	Quarterly to biannually
Occasional maintenance	Infill any holes or scour in the filter medium, improve erosion protection if required	As required
	Repair minor accumulations of silt by raking away surface mulch, scarifying surface of medium and replacing mulch	As required
Remedial Actions	Remove and replace filter medium and vegetation above	As required but likely to be > 20 years

General Operation and Maintenance Table for Bioretention Systems in accordance with CIRIA C753 The SuDS Manual.