OPTION TWO DEVELOPMENT LTD

Civil & Structural Engineering Consultants

LAND AT COURTHOUSE FARM, COPTHORNE COMMON ROAD COPTHORNE, WEST SUSSEX [RESIDENTIAL]

FLOOD RISK ASSESSMENT & DRAINAGE STRATEGY

Reference: 25-0093

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Date: 03/09/25

DRAINAGE
- Drainage Strategies
- S104 Drainage Design
- SUDS
- Flood Risk Assessments
- CSH SUR1

HIGHWAYS
- Transportation Assessments
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- Traffic & Parking Surveys
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STRUCTURAL ENGINEERING
- All Structural Design
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SPECIALIST SERVICES
- Site Assessments
- CDM 2015 Support
- TEKLA - Steelwork Fabrication drawings
- Expert Witness

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Document Control Sheet

Issue	Status	Prepared / Revised by	Verified By	Date
1.0	FINAL	S Garnes	C J Mellett	03/09/25

Contents

1.0 Introduction

1.1 BdR has been appointed by Option Two Development Ltd (the Client) to undertake a Flood Risk Assessment and Drainage Strategy for the proposed residential development comprising 86 units at Land at Courthouse Farm, Copthorne Common Road, Copthorne, West Sussex RH10 3LA.

1.2 This assessment has been prepared in accordance with the provisions of the National Planning Policy Framework (NPPF) December 2024, The Non-Statutory Technical Standards For Sustainable Drainage (NSTSSD), Practice Guide, BS8582:2013 Code of Practice for Surface Water Management for Development Sites, BS 8533:2011 Assessing and Managing Flood Risk in Development Code of Practice, CIRIA C753 The SuDS Manual 2015 and West Sussex County Council's SuDS Design Guide – Water, People, Places, prepared by the Lead Local Flood Authorities [LLFA] of South East England.

1.3 The NPPF sets out the criteria for development and flood risk by stating that inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, but where development is necessary, making it is safe without increasing flood risk elsewhere. The key definitions are:

- "Areas at risk of flooding" means land within Flood Zones 2 and 3; or land within Flood Zone 1 which has critical drainage problems, and which has been notified to the local planning authority by the Environment Agency;
- "Flood risk" means risk from all sources of flooding - including from rivers and the sea, directly from rainfall on the ground surface and rising groundwater, overwhelmed sewers and drainage systems, and from reservoirs, canals and lakes and other artificial sources.

1.4 The objectives of this assessment are;

- Identify and assess the risks of all forms of flooding to and from the development.
- Demonstrate how these flood risks will be managed so that the development and elsewhere remains safe throughout its lifetime, taking climate change into account.
- Meeting the requirements of the key stakeholders.

2.0 Existing Site

2.1 Location

2.1.1 The site is located is located on the south side of Copthorne Common Road, Copthorne, approximately 2km east of J10 of the M23 and sits outside of the defined settlement confines of Copthorne. The northern boundary adjoins the A264. The eastern boundary adjoins the access road to Courthouse Farm, this boundary is heavily wooded and within this, there is a second access road to residential properties. The southern boundary abuts an area of dense mature mixed deciduous woodland. This returns along the western boundary of the site as a substantial belt of mature trees,

2.1.2 The site is centered at National Grid Reference 532402 , 139032.

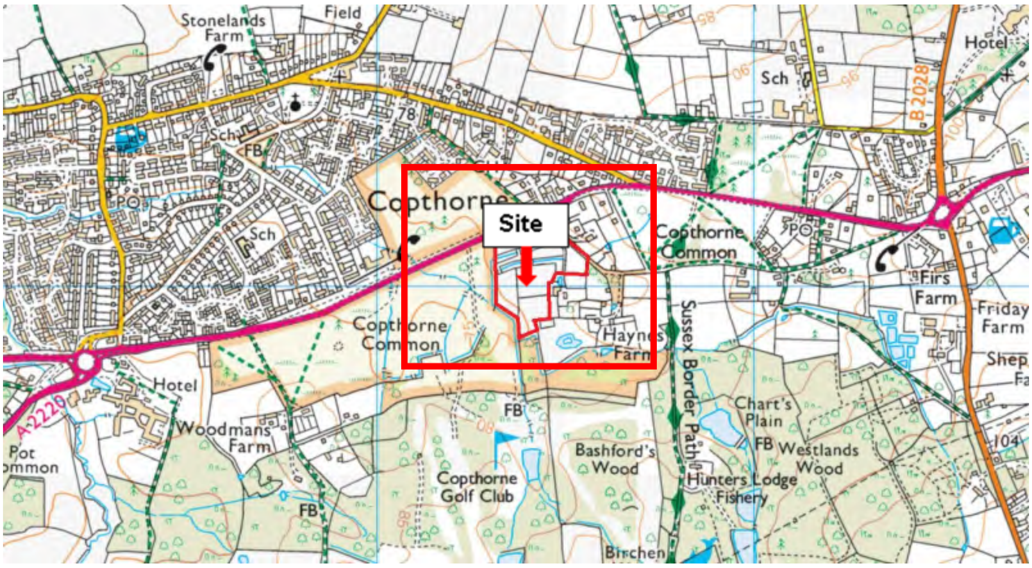


Fig.2.1 Site Identification

Fig 2.2 Aerial View

2.2 Existing Development

2.2.1 The site is a greenfield site currently used as grazing land.

2.2.2 The existing areas are;

- Total site area = 4.339 ha
- Roof Areas = 0 ha
- External Hardstanding Areas = 0 ha
- Soft Landscaped Area = 4.339 ha
- Site Impermeability = 0 %.

2.3 Topography

2.3.1 The site slopes gently from east to west. Levels range between 77.6m Above Ordnance Datum [AOD] along the eastern boundary to 74.4m AOD in the far south west corner. Average gradient is approximately 1 in 150.

2.3.2 A copy of the topographical survey is included in Appendix 1.

2.4 Geology

2.4.1 No intrusive Geotechnical Investigation has been undertaken to date. Reference to the British Geological Survey (BGS) Map indicates the site to be underlain by Upper Tunbridge Wells Sand - Sandstone and siltstone, interbedded - Sedimentary Bedrock.

2.5 Soils

2.5.1 Soil type provides a generic description of the drainage characteristics of the soil i.e. susceptibility to water logging or capacity of soil to freely drain. Reference to the Land Information System [LandIS] Soilscapes Viewer describes the soils in this area as “slightly acid loamy and clayey soils with impeded drainage”.

2.6 Hydrology

2.6.1 There are two ditches crossing the middle of the site and ditches immediately adjacent the site running along the western and southern boundaries. These converge in the far south west corner before heading west across the golf course.

2.7 Hydrogeology

2.7.1 The Department of Food & Rural Affairs [DEFRA] Multi-Agency Geographic Information for the Countryside [MAGIC] map indicates the site is not within a Source Protection Zone.

2.7.2 The Aquifer Map – Superficial & Bedrock designation indicates a Secondary A Aquifer (Bedrock) underlying the site. Secondary A Aquifers are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.

2.7.3 Extracts from the BGS, LandIS & MAGIC websites are included within Appendix 2.

2.8 Surface Water Site Drainage

2.8.1 The site is a greenfield site and surface water drainage is via natural infiltration / evaporation / evapotranspiration and natural runoff. Due to the local topography runoff from the site is intercepted by the existing ditches crossing the site and those immediately to the west and south.

2.9 Foul Water Site Drainage

2.9.1 The site is a greenfield site and consequently there are no existing foul sewers serving the site.

2.10 Public Sewerage Network

2.10.1 The sewer records show the following public sewers close to the site;

- 375mm dia. foul water sewer approximately 3m deep heading north along the access drive leading to Court House Farm.
- 375mm dia. surface water sewer approximately 1.7m deep heading west along Copthorne Common Road.

2.10.2 It should be noted that whilst the sewer records show the Sewerage Company's recorded assets, there may be other adopted sewers in the vicinity which are not shown on the records. These assets were automatically transferred to the Sewerage Company in October 2011 as part of the first phase of sewer asset transfers.

2.10.3 A copy of the sewer record is included in Appendix 2.

3.0 Proposed Development

3.1 The proposed development comprises 86 no. residential dwellings with associated access roads, parking areas, public open spaces, private drives, and private garden areas.

3.1.1 The proposed development areas are;

- Total site area = 4.339 ha
- Roof Area = 0.567 ha
- External Hardstanding Areas = 0.841 ha
- Soft Landscaped areas = 2.909 ha
- Site Impermeability = 32.5%.

3.1.2 Details of the proposed development are included in Appendix 3.

3.2 Vulnerability Classification

3.2.1 The development is classed as residential. The Vulnerability Classification in accordance with Table 2 of the Technical Guidance to the NPPF is ‘More Vulnerable’.

3.3 Sequential Test

3.3.1 As set out in the NPPF, the aim of the Sequential Test is to steer new development to areas with the lowest probability of flooding. The flood zones are the starting point for this sequential approach. Zones 2 and 3 are shown on the Environment Agency [EA] flood map with Flood Zone 1 being all the land falling outside Zones 2 and 3. These flood zones refer to the probability of flooding from any source, ignoring the presence of existing defenses.

Zone 1 – Low Probability

This Zone comprises land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%).

Zone 2 – Medium Probability

This Zone comprises land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1%-0.1%) or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5%-0.1%) in any year.

Zone 3a – High Probability

This Zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (0.5%) in any year.

Zone 3b – The Functional Floodplain

This Zone comprises land where water has to flow or be stored in times of flood. Generally, this is land which would flood with a annual probability of 1 in 20 (5%) or greater in any year, or is designed to flood in an extreme (0.1%) flood.

3.3.2 Reference to the EA Flood Map for Planning indicates the site is located in Zone 1 – Low Probability. In accordance with Table 3 of the Technical Guidance to the NPPF (August 2022) all development in Flood Zone 1 is appropriate.

Flood Zones	Flood Risk Vulnerability Classification				
	Essential Infrastructure	**Highly Vulnerable**	**More Vulnerable**	**Less Vulnerable**	**Water Comparable**
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test Required	✓	✓	✓
Zone 3a	Exception Test Required	×	Exception Test Required	✓	✓
Zone 3b	Exception Test Required	×	×	×	✓

Table 3.1: Flood Risk Vulnerability and Flood Zone ‘Compatibility’

4.0 Climate Change

4.1 The EA published updated guidance on climate change allowances on the 10th May 2022. Table 4.1 below shows the updated allowances. The predicted flood levels and surface water management strategy for the proposed development takes account potential increases in rainfall intensities and flood flows/levels predicted to occur in the future over the lifetime of the development.

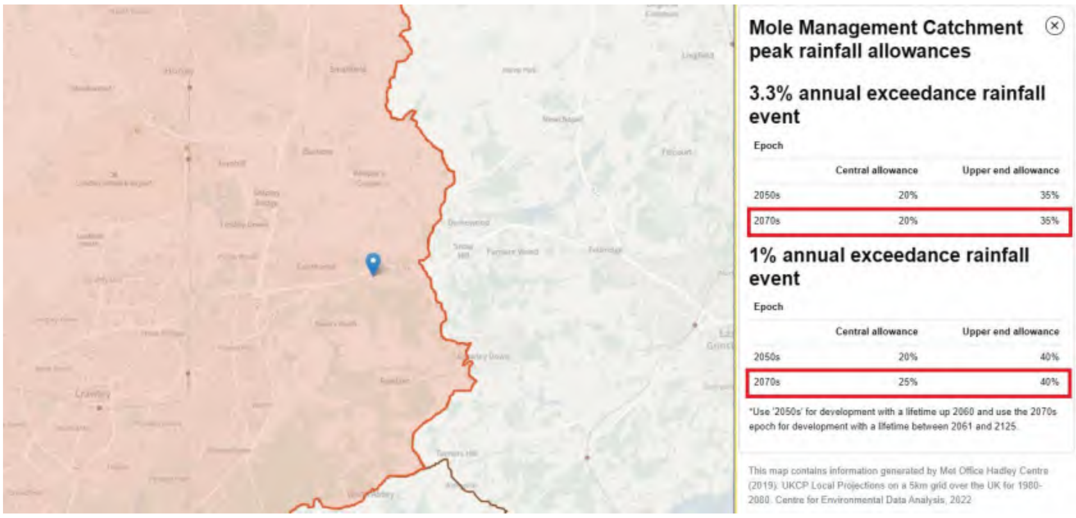


Table 4.1: Peak Rainfall Allowances

5.0 Flood Risk

5.1 Potential Sources of Flooding

5.1.1 The main sources of flooding which could potentially affect the development site are listed below. An assessment of how these forms of flooding may affect the site and details on how they will be managed safely within the development proposal are also considered.

5.1.2 The main sources of flooding and the level of risk associated with each are;

- Flooding from Rivers [Fluvial] - None
- Flooding from the Sea [Tidal] - None
- Flooding from Land [Surface Water] - Low
- Flooding from Groundwater - Low
- Flooding from Sewers - Low
- Flooding from Other Artificial Sources [Infrastructure] - None

5.2 Flooding from Rivers [Fluvial]

5.2.1 The site is located within Flood Zone 1 – Low Probability There is consequently no risk of flooding from rivers.

5.3 Flooding from the Sea [Tidal]

5.3.1 The site is located within Flood Zone 1 – Low Probability There is consequently no risk of flooding from the sea.

5.4 Flooding from Land [Surface Water]

5.4.1 Surface water flooding is the term used to describe flooding which occurs when intense, often short duration rainfall is unable to soak into the ground or to enter drainage systems and therefore runs over the land surface causing flooding. It is most likely to occur when soils are saturated and unable to infiltrate any additional water or in urban areas where buildings tarmac and concrete prevent water soaking into the ground. The excess water can pond (collect) in low points and result in the development of flow pathways often along roads but also through built up areas and open spaces. This type of flooding is usually short lived and associated with heavy downpours of rain.

5.4.2 There are four levels of surface water flood risk;

Very Low Risk
Each year, the area has a chance of flooding of less than 1 in 1000 (0.1%).

Low Risk
Each year, the area has a chance of flooding of between 1 in 1000 (0.1%) and 1 in 100 (1%).

Medium Risk
Each year, the area has a chance of flooding of between 1 in 100 (1%) and 1 in 30 (3.3%).

High Risk
Each year, the area has a chance of flooding of greater than 1 in 30 (3.3%).

5.4.3 Reference to the Governments Long Term Flood Risk Map for Surface Water shows one small area within the site located to the west between the ditches at high risk of flooding and two small areas within the site located to the east and west between the ditches at Medium risk of flooding. Reference to the topographical survey shows both these areas to be relatively flat, however there is a fall towards the western boundary. Therefore, these areas are unlikely to flood. There is consequently a low risk of flooding from surface water.

5.5 **Flooding from Groundwater**

5.5.1 Groundwater flooding occurs when water levels in the ground rise above surface elevations. It is most likely to occur in low-lying areas underlain by permeable rocks (aquifers). Water levels below the ground rise during the wet winter months and fall again in the summer as water flows out into rivers. In very wet winters, rising groundwater levels may lead to flooding of normally dry land, as well as reactivating flow in "bournes" (streams that only flow for part of the time). Groundwater floods tend to be long in duration developing over weeks or months and prevailing for days or weeks.

5.5.2 The predominant solid geology underlying the site is the Upper Tunbridge Wells Sand - Sandstone and siltstone, interbedded - Sedimentary Bedrock. Reference to the Mid Sussex County Council Strategic Flood Risk Assessment (SFRA) indicates the area to have a limited potential for groundwater flooding. The risk of groundwater flooding is therefore considered to be low.

5.6 **Flooding from Sewers**

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

5.6.2 Reference to the Mid Sussex County Council SFRA indicates there have been no reported incidents of foul or surface water flooding in the immediate area. Due to the local topography the risk of flooding from sewers is considered very low.

5.7 Flooding from Artificial Sources

5.7.1 Non-natural or artificial sources of flooding can include reservoirs, canals and lakes where water is retained above natural ground level, operation and redundant industrial processes including mining, quarrying and sand and gravel extraction, as they may increase floodwater depths and velocities in adjacent areas.

5.7.2 Reference to the Governments Long Term Flood Risk Map for Surface Water shows the site is not at risk of flooding from artificial sources.

6.0 Flood Risk Management

6.1 In view of the inherent uncertainties in predicting flooding from surface water and sewers the following flood risk management measures are proposed to safeguard the development and to ensure no increase in flood risk to surrounding areas;

- Ground floor finished floor levels will be set a minimum 150mm above existing ground levels.
- On-site surface water drainage design will meet the design standards required of Approved Document H of the Building Regulations, The National Standards For Sustainable Drainage Systems June 2025 and best practice guidance given in C753 the SUDS Manual 2015.

7.0 Off-Site Impacts

7.1 The proposed development will have no impact on flood risk elsewhere.

7.2 Refer to Section 10.0 and 11.0 for details of the proposed drainage strategy for the development.

8.0 Residual Risks

8.1 Flooding from extreme storm events which overwhelm on-site/off site drainage systems is the only residual risks which could result in flooding on the development site.

9.0 Access & Egress

9.1 A safe dry access route is available to and from the site during the 100 year event.

10.0 Proposed Surface Water Drainage

10.1 Runoff Rates & Volumes

10.1.1 The peak surface water runoff rates and volumes generated for the pre and post development conditions have been calculated using the Causeway Flow design and analysis suite for a variety of storm events of critical duration including for a 40% increase in rainfall intensity to account for climate change in line with EA guidance.

10.1.2 For previously developed sites, site runoff rates should be reduced to the greenfield rates wherever possible. Allowable discharge rates should not be greater than for the pre-development scenario.

10.1.3 The method currently adopted for determining greenfield runoff rates for sites between 0-50 ha is the Institute of Hydrology Report 124 'Flood Estimation for Small Catchments'. This determines the mean annual flood flow for Greenfield sites (Qbar). Greenfield peak flow rates for other probabilities can be estimated using the appropriate growth curve contained in the Flood Studies Supplementary Report (FSSR) 14.

10.1.4 The runoff volume for the 100 year storm has been calculated based on a 6 hour event in line with CIRIA C753 The SuDS Manual 2015.guidance and BS8582:2013 Code of Practice for Surface Water Management for Development Sites. A summary of the results is given in the table below;

RP (Years)	Pre Dev [Greenfield] Rate (l/s)	Post Dev (l/s) (no mitigation)	Pre Dev [Greenfield] Vol (m^3)	Post Dev Vol (m^3) (no mitigation)
1	15.8	127.4		
Qbar (2yr)	18.6	194.0		
30	44.6	686.7		
100	59.3	898.1	387.0	996.8

Table 10.1

10.1.5 Copies of the Causeway Flow results are included in Appendix 4.

10.2 Surface Water Management

10.2.1 The surface water drainage arrangements for any development site need to be such that the peak flow rates and volumes of surface water leaving the developed site are no greater than the rates and volumes prior to the proposed development. Runoff rates and volumes should also be reduced wherever possible using infiltration and attenuation techniques.

10.2.2 The NPPF requires the use of Sustainable Drainage Systems (SuDS) on all new developments wherever possible. This requirement is supported by Building Regulations Part H and The National Standards For Sustainable Drainage Systems June 2025 which sets out a hierarchy for surface water disposal listed in order of priority;

- Collected for non-portable use.
- An infiltration system, or where that is not reasonably practicable,
- A watercourse, or where that is not reasonably practicable,
- A sewer.

10.2.3 From the figures shown in Table 10.1 the proposed development will significantly increase peak flow rates and runoff volumes for the 1, Qbar, 30 and 100 year events if no surface water management is incorporated.

10.3 Sustainable Drainage Systems

10.3.1 SuDS are a varied collection of techniques designed to manage storm water in a sustainable manner. SuDS achieve this by seeking to manage surface water from new developments as close to its source as possible and by mimicking the surface water flow regime present on the site prior to development. The key objectives of SuDS are;

- To minimise the impacts from the development on the quantity of runoff.
- To minimise the impacts from the development on the quality of runoff.
- Maximise amenity and biodiversity opportunities.

10.3.2 There are several processes that can be used to manage and control the runoff from development areas. These can be defined as;

- Infiltration – This is the soaking of water into the ground.
- Detention/attenuation – Detention or attenuation is the slowing down of surface water flows before transfer downstream.
- Conveyance – This is the transfer of surface water runoff from one place to another.
- Water harvesting – This is the direct capture and use of runoff on site.

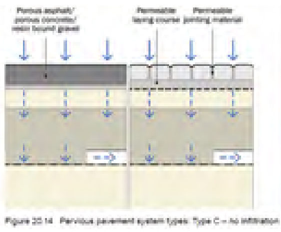
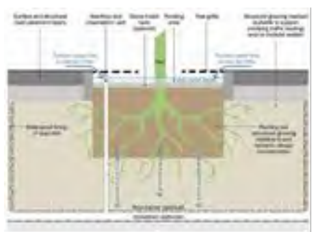
10.3.3 The effectiveness of SuDS utilising infiltration relies on the suitability of the underlying soils to receive and disperse the runoff rates. At the time of preparing this report no BRE DG365 soakage tests had been undertaken. Reference to the British Geological Survey (BGS) Map indicates the site to be underlain by Upper Tunbridge Wells Sand - Sandstone and siltstone, interbedded - Sedimentary Bedrock. This strata is known to exhibit poor soakage potential, together with the LandIS Soilscapes description “slightly acid loamy and clayey soils with impeded drainage” it is therefore unlikely that infiltration SuDS will work effectively on this site.

10.3.4 This drainage strategy assumes that infiltration SuDS is not a feasible option for the disposal of surface water runoff, however BRE DG365 soakage tests will be undertaken at the start of re-development and should the results prove infiltration is a viable option the detailed drainage design will incorporate SuDS infiltration into the final scheme.

10.3.5 SuDS techniques which are considered appropriate for this development are listed below. An operation and maintenance sheet for each SuDS component is included in Appendix 5.

SuDS Component	Area Served
Rainwater Harvesting - Basic	Roofs
Pervious Pavement – Type C (No Infiltration)	Roads / Private Drives / Parking Areas
Bio-Retention Areas [Tree Pits]	Private Roads / Parking Areas
Sub-surface Storage	Roofs / Roads / Private Drives / Parking Areas
Pond	Roofs / Roads / Private Drives / Parking Areas

Table 10.2

SUDS Component	Description	Examples
Rainwater Harvesting - Basic	Includes simple water butts	
Pervious Pavement – Type C – No Infiltration	Pervious surfaces allow rainwater to infiltrate through the surface into an underlying storage layer, where water is stored before infiltration to the ground, re-use, or release to surface water	
Bioretention [Tree Pits]	Bioretention areas are shallow landscaped depressions which are typically underdrained and rely on engineered soils and enhanced vegetation and filtration to remove pollution and reduce runoff downstream. They are aimed at managing and treating runoff from frequent rainfall events.	

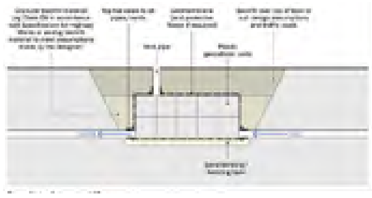
Sub-surface storage	Storage of run-off in underground tanks or other structures such as oversized pipes. Tanks can take the form of oversized pipes, concrete tanks, corrugated steel pipes and plastic modular geocellular tank systems.	
Pond	Ponds are basins that have a permanent pool of water for water quality treatment. They provide temporary storage for additional storm runoff above the permanent water level. Wet ponds may also provide amenity and wildlife benefits.	

Table 10.3

10.3.6 The following SuDS techniques were considered for this development but have been discounted for the following reasons;

SuDS Component	**Reasons for not implementing**
Green roofs	Traditional pitched roof construction.
Rainwater Harvesting [Complex]	Other water saving devices within the building are considered to provide greater sustainability than expensive complex rainwater harvesting systems.
Rain Garden	Unable to guarantee future maintenance.
Swales	Insufficient space due to presence of …. Site topography too steep.
Infiltration Basin	Insufficient room. Poor subsoil soakage potential.
Detention Basin	Insufficient room / safety concerns.
Pervious Pavement	Poor subsoil soakage potential.

Table 10.4

10.3.7 SUDS components will be designed in accordance with CIRIA C753 The SuDS Manual 2015.

10.3.8 Detailed Causeway Flow SuDS analysis has been undertaken to determine the on-site storage volumes required for the 1 in 100 year return period event including an allowance of 40% climate change in line with the NPPF. The peak outflow rate has been restricted to the existing greenfield Qbar runoff rate or 3 l/s/ha whichever is the greater in accordance with The National Standards For Sustainable Drainage Systems June 2025 for storms up to the 1 in 100 year plus climate change. The runoff rate for the 1 year event will be restricted to the 1 year greenfield rate.

A summary of the SuDS analysis is given in the table below;

Rp (Year)	Pre-Dev Runoff Rate (l/s)	Post-Dev Runoff Rate (l/s)	Storage Volume (m^3)
100	1 yr = 15.8	15.8	729.6

Table 10.5

10.3.9 The volume of on-site storage resulting from the 100 year event + 40% CC can be accommodated within the following SuDS components;

SuDS Component	Size
Attenuation Crates	20m x 16m x 2.4m effective depth.

Table 10.6

10.3.10 Surface Water runoff from roofs, access roads and driveways connects to the underground drainage network. A flow control chamber restricts peak flows to a maximum rate of 15.8 l/s during the 100 year event. Flows back-up and utilize the storage volume within the geocellular crates located underneath the pond. The surface water pumping station pumps flow at a maximum rate of 15.8 l/s to the pond. The outlet from the pond connects to the existing ditch.

10.3.11 The drainage network has been designed not to flood up to and including the 1 in 100 year plus climate change event.

10.3.12 A 10% urban creep uplift factor has been applied to the impermeable area within the property curtilages.

10.3.13 Copies of the SuDS hydraulic analysis are included in Appendix 5.

10.3.14 A Conceptual Drainage Layout is included in Appendix 6.

10.4 Water Quality Management

10.4.1 Managing the quality of surface water runoff so that receiving surface waters and / or groundwater are protected is strongly linked to the hydraulic control of runoff. The risk posed by surface water runoff to groundwater is often low because of the protection afforded by the layers of unsaturated soils that lie between the infiltration surface and the groundwater receptor. The risk posed is a function of;

- The pollution hazard at a particular site (i.e the pollutant source)
- The effectiveness of SuDS treatment components in reducing levels of pollutants to environmentally acceptable levels, and / or the effectiveness of underlying soil layers in protecting the receiving groundwater (i.e the pollutant pathway)
- The sensitivity of the receiving environment (i.e the environmental receptor)

The effect of the proposed development on local water quality has been assessed using the simple qualitative method as set out in Ciria Report C753 The SuDS Manual 2015 (Chapter 26).

Box 26.2. Steps of the Simple Index Approach

Step 1	Allocate suitable pollution hazard indices for the proposed land use
Step 2	Select SuDS with a total pollution mitigation index that equals or exceeds the pollution hazard index
Step 3	Where the discharge is to protected[1] surface waters or groundwater, consider the need for more precautionary approach

1 Designated as those for the supply drinking water (table 4.3)

Table 10.6 - Extract from CIRIA Report C753 – Steps of the simple index approach.

TABLE 26.2. Pollution Hazard Indices for Different Land Use Classifications

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydro-carbons
Residential Roofs	Very Low	0.2	0.2	0.05
Other Roofs (Typically Commercial/Industrial Roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual Property Driveways, Residential Car Parks, Low Traffic Roads (eg Cul de Sac, Homezones and General Access Roads) and Non-residential Car Parking with Infrequent Change (eg Schools) ie<300 Traffic Movements/Day	Low	0.5	0.4	0.4

Table 10.7 - Extract from CIRIA Report C753 – Pollution hazard indices for different land use classifications.

TABLE 26.3. Indicative SuDS Mitigation Indices for Discharges to Surface Water

Type of SuDS Components	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Filter Strip	0.4	0.4	0.5
Filter Drain	0.4	0.4	0.4
Swale	0.5	0.6	0.6
Bioretention System	0.8	0.8	0.8
Permeable Pavement	0.7	0.6	0.7

Detention Basin	0.5	0.5	0.6
Pond	0.7	0.7	0.5
Wetland	0.8	0.8	0.8
Proprietary Treatment Systems	These must demonstrate that they can address each of the contaminnat types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.		

Table 10.8 - Extract from CIRIA Report C753 – Indicative SuDS mitigation indices for discharge to surface waters.

10.4.2 Based on the incorporation of permeable paving and a pond with 300mm depth of soil it can been seen that the total pollution mitigation index for this SuDS component exceeds the pollution hazard index from access road / private parking areas.

10.5 Management of Runoff from Construction

10.5.1 During the stages of site preparation, earthworks, and construction there is the potential for contaminants and/or suspended sediments in surface water runoff entering the surrounding watercourses and existing drainage.

10.5.2 A strategy for managing surface water runoff during the construction phase, including specific measures tailored to the level of risk should be developed and agreed with West Sussex County Council. The extent of sediment/contaminant runoff will vary across the construction cycle, and a strategy should be developed to encompass potential pollution from all stages of construction.

10.5.3 The strategy should include details of how during the earthworks and site preparation stages the contracting engineer will employ the approaches outlined in CIRIA C532 Control of Water Pollution from Construction Sites. This will require a proper understanding of the sensitivity of the downstream watercourses in terms of existing water quality and the potential impact of change. It is expected potential mitigation measures will include;

- Avoiding mass overburden stripping at the site; exposing only that part of the site essential for operation.
- Placing silt fences of geo-fabric or similar material around open or exposed ground and stockpiles.
- Re-seeding any exposed ground and stockpiles to stabilise the ground and reduce erosion and gullying of such features.

10.5.4 The strategy should be developed and agreed during detailed design and should be implemented prior to the commencement of any enabling and/or construction works onsite.

10.6 A strategy for managing surface water runoff during the construction phase, including specific measures tailored to the level of risk at the site should be developed and agreed with West Sussex County Council during the detailed design.

10.7 **Private & Adopted Sewers**

10.7.1 Private surface water drainage will be designed in accordance with BS EN 752:2008 'Drain & Sewer Systems Outside Buildings' and Building Regulations Part H.

10.7.2 Sewers to be adopted will be designed in accordance with the current national Design and Construction Guidance document and offered for adoption under S104 of the Water Industry Act 1991.

10.7.3 Ordinary Water Course Consent will be obtained from the Council for the pond outlet to the existing ditch.

10.8 **Exceedance Flood Routing**

10.8.1 During extreme rainfall events i.e (in excess of the 1 in 100 year event plus climate change) when the design performance criteria for the drainage system is likely to be exceeded, the surface water drainage network capacity may become overwhelmed resulting in surface flooding and overland flows. These flood flows are referred to as exceedance flows. Flooding of properties can occur if these flows are not managed or controlled effectively.

10.8.2 An assessment of the exceedance flood routes has been undertaken and in the event of overland flood flows occurring, these will be routed away from the proposed dwellings and directed along the main access roads and towards the ditch networks along the western and southern boundaries.

10.8.3 The exceedance flood routes are shown on the Conceptual Drainage Layout included in Appendix 6.

11.0 Proposed Foul Water Drainage

11.1 Flow Rates

11.1.1 Foul flows from the development site have been calculated based on the hydraulic design requirements set out in the current national design and construction guidance document November 2023.

Development Type	No. of units	Peak Loading (l/unit/day)	Peak Flow (l/s)
Residential	86	4000	4
Total	**86**		**4**

Table 11.1

11.2 Private & Adopted Systems

11.2.1 Private foul water drainage will be designed in accordance with BS EN 752:2008 'Drain & Sewer Systems Outside Buildings' and Building Regulations Part H.

11.2.2 Sewers to be adopted will be designed in accordance with the current national Design and Construction Guidance document and offered for adoption under S104 of the Water Industry Act 1991.

11.2.3 Foul water from the proposed development will connect by gravity to the on-site pumping station. Flows will be pumped to the site entrance where a short length of gravity sewer will connect to the existing public foul sewer in Copthorne Common Road.

11.2.4 A Pre-Planning Enquiry to Thames Water. confirms capacity is available within the existing sewerage network to serve the proposed development. A copy of Thames Water's response is included in Appendix 8.

11.2.5 An application under Section 106 of the WIA 1991 – Connection to Public Sewer, will be submitted to Thames Water prior to works commencing.

11.2.6 A Conceptual Drainage Layout is included in Appendix 6.

12.0 Operation and Maintenance

12.1 The operation and maintenance of the development's drainage infrastructure needs to be agreed with the various parties early in the planning and design stage to ensure all elements of the system work effectively to achieve the design standards over the lifetime of the development. The following stakeholders are considered most appropriate to undertake this task;

System	Responsibility
Private Plot Foul / SW drains	Property Owners
Adopted Foul / SW Sewers	Water Company
SuDS systems	Water Company / Management Company

Table12.1

12.2 The Management Company will receive annual contributions from all Owners / Tenants for maintenance of private foul and surface water drainage systems, including SuDS. A part of these contributions will go towards a "sinking fund" for future works.

12.3 SuDS operational and maintenance requirements are included in Appendix 5.

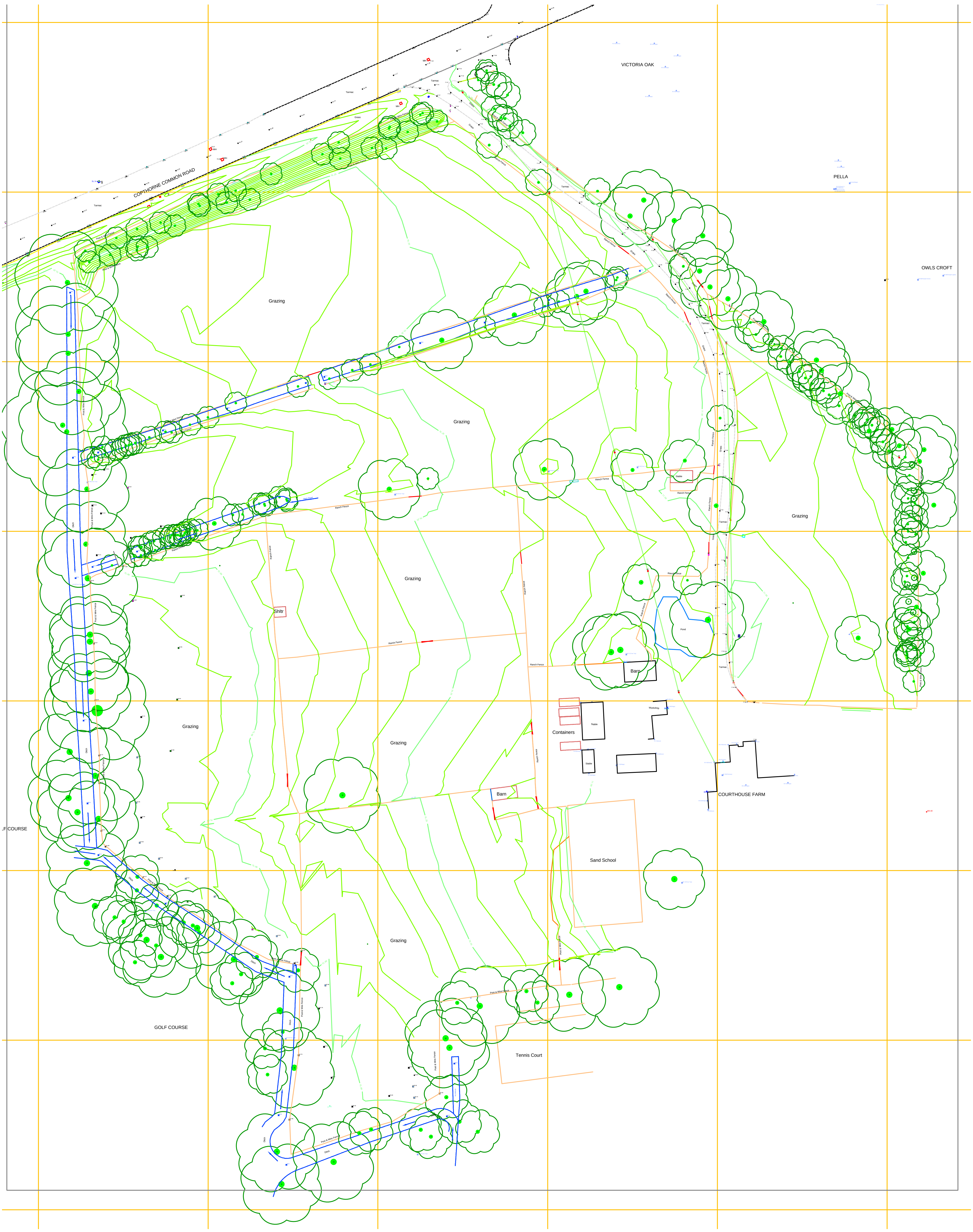
13.0 Conclusions

13.1 This Flood Risk Assessment and Drainage Strategy has concluded the following;

- The site lies within Flood Zone 1 – Low Probability.
- The risk of flooding from other sources is low/negligible.
- Surface water runoff from the proposed development will be managed utilising SuDS attenuation techniques to reduce runoff rates and volumes. Surface water will be pumped to the existing ditch on-site.
- Foul water will be pumped to the existing public foul sewer in Copthorne Common Road.
- Thames Water has confirmed capacity is available in the public foul sewerage network to serve the proposed development.
- The development does not increase flood risk either on site or elsewhere.
- The drainage strategy meets with the Government, County Council and District Council's Policy Objectives concerning development and flood risk within its district.

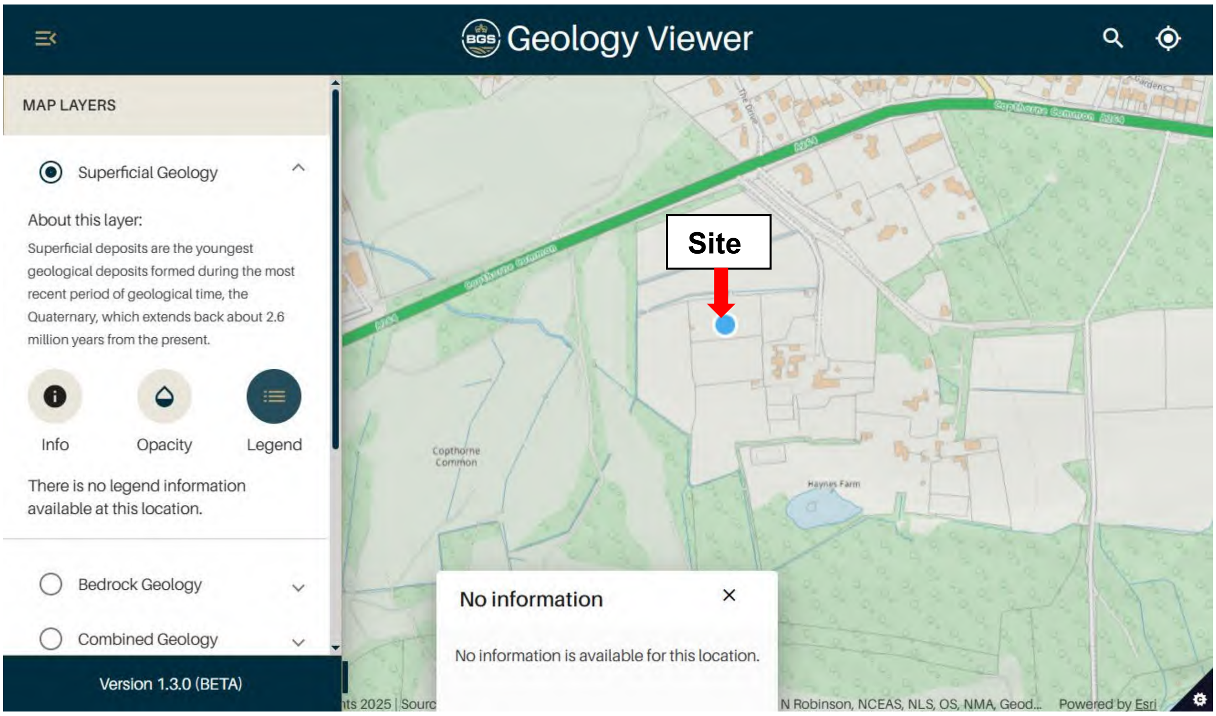
13.2 The flood risk assessment and drainage strategy has established that appropriate surface water management arrangements can be incorporated within the proposed development such that there will be no increase in flood risk either on or off site for a range of storm events up to the 1 in 100 year event (1% annual probability) including an allowance of 40% for climate change. The proposals are consistent with the Government's National Planning Policy Framework and it has been demonstrated that the occupants and buildings will remain safe for the lifetime of the development.

Appendix 1
Topographical Survey

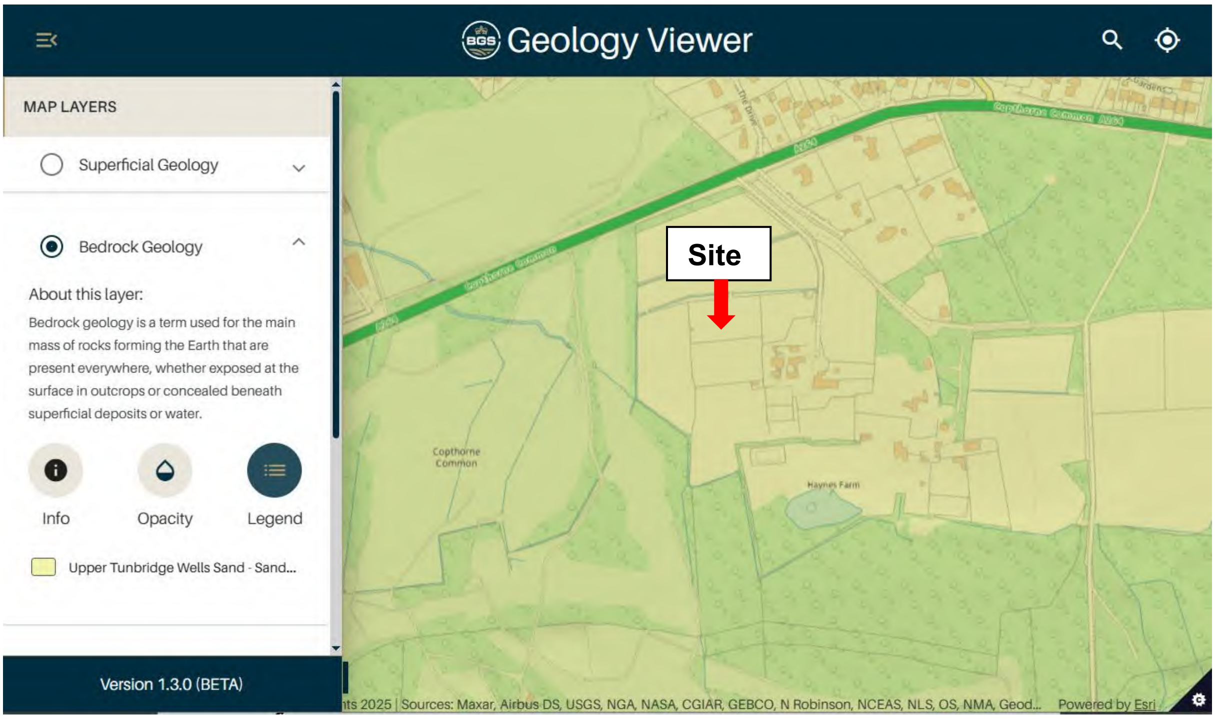

COPTHORNE COMMON ROAD
VICTORIA OAK
PELLA
OWLS CROFT
Grazing
Grazing
Grazing
Grazing
Grazing
Grazing
Grazing
Grazing
Shltr
Barn
Containers
Barn
COURTHOUSE FARM
Sand School
Tennis Court
GOLF COURSE
F COURSE
Pond

KEY
MH Manhole Inspection Cover
IC Inspection Cover
IC(E) Inspection Cover (Electricity)
IC(G) Inspection Cover (Gas)
IC(W) Inspection Cover (Water)
CATV Cable Television Inspection Cover
RG Road Gully
RS Road Name Sign
DG Drainage Gully
DP Down Pipe
RE Rodding Eye
LP Lamp Post
TP Telegraph Pole
SP Services Pole
BS Bus Stop
BT British Telecom
MC Mercury Communications
TCB Telephone Call Box
WV Water Valve
SC Stopcock
GV Gas Valves
TCSU Traffic Control Signal Unit
B Bollard
IB Illuminated Bollard
P Post
IS Illuminated Sign
Levels
Grid
GRID NORTH
GREENMANTLE
THE DRIVE
A264
COPTHORNE COMMON ROAD
Notes:
All levels are related to Ordnance Datum
Based on OS GPS Active Network
Grid marks are at 50 metre intervals.
TITLE:
COURTHOUSE FARM
COPTHORNE COMMON RD
COPTHORNE RH10 3LA
RECORD OF SURVEY
SCALE 1:500
DATE JANUARY 2019
CLIENT: Domus
SURVEYED BY:
MULTI-LIMN
M.J.K. BEACH CHARTERED LAND SURVEYOR
THE OLD EXCHANGE
THE STREET
SELLING
NR FAVERSHAM
KENT ME13 9RQ
TELEPHONE: 01227 751184
RICS
VICTORIA OAK
PELLA
OWLS CROFT
Grazing
Shltr
Barn
Containers
Stable
Workshop
Pond
COURTHOUSE FARM
Sand School
Tennis Court
GOLF COURSE
COURSE

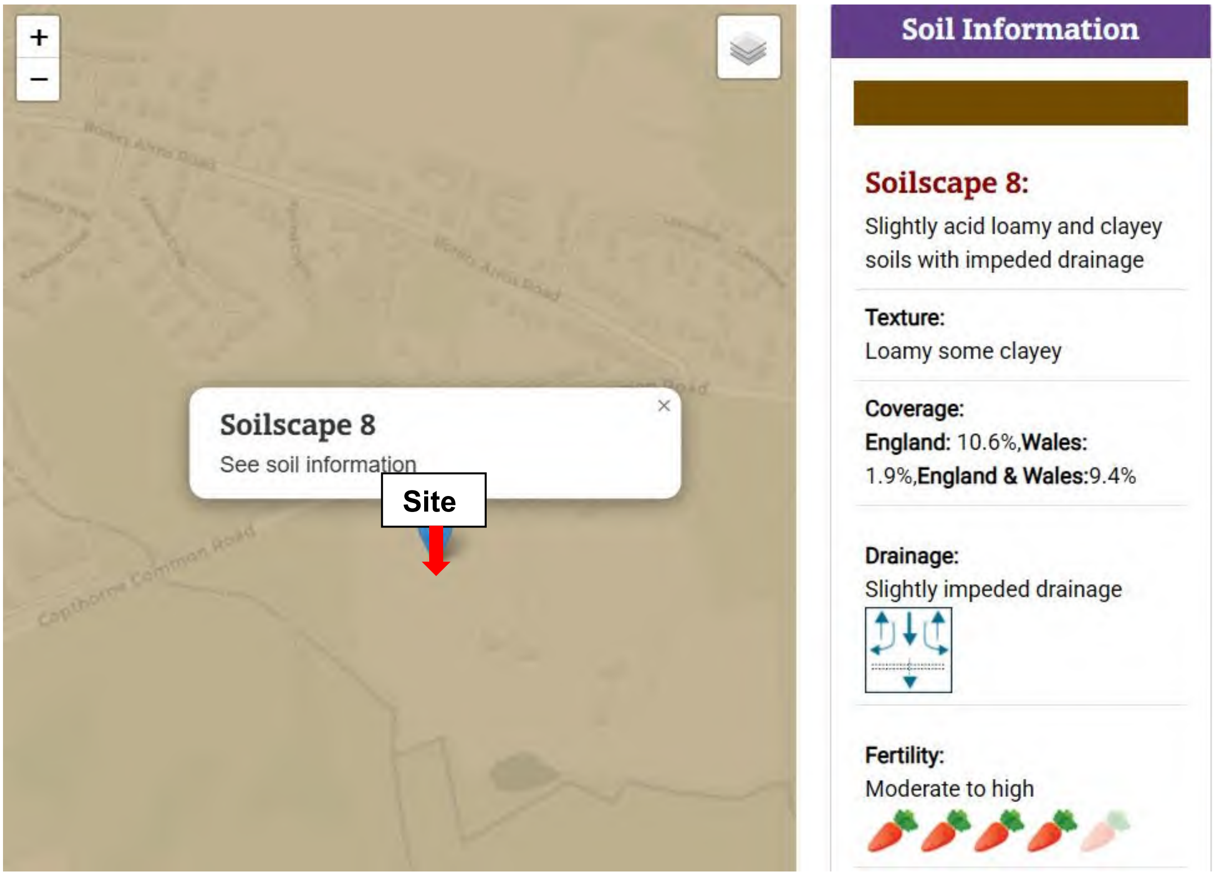
Appendix 2
Extracts from the BGS, LandIS Soilscapes, EA websites
Sewer Record



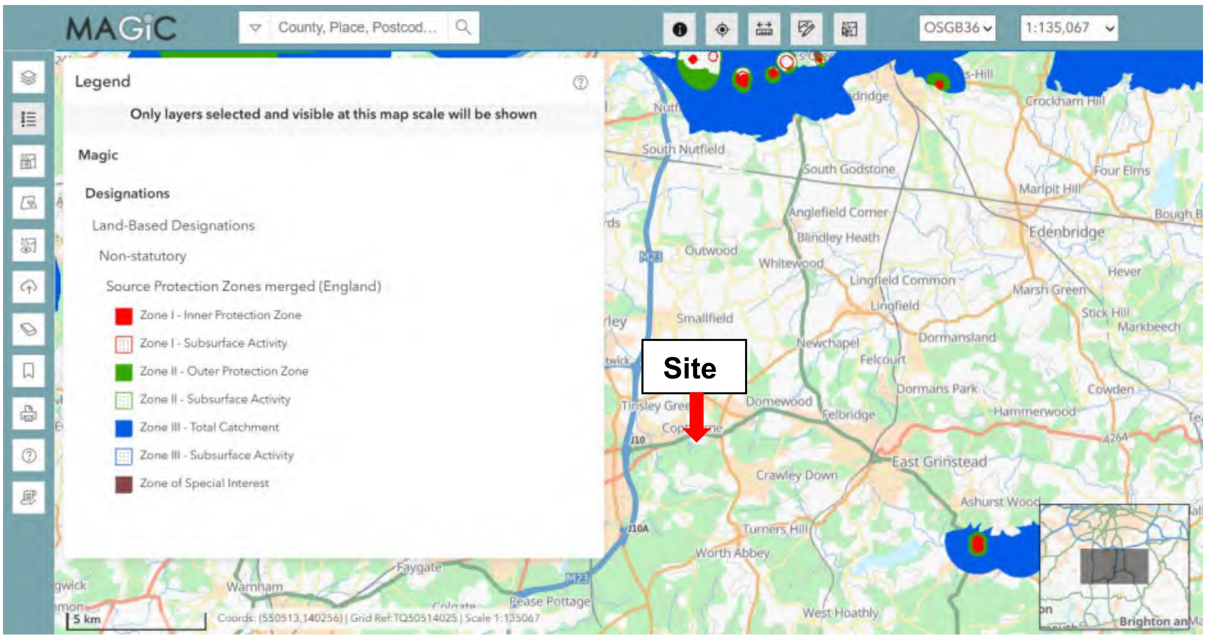
Extract from BGS Geology Viewer (Superficial).



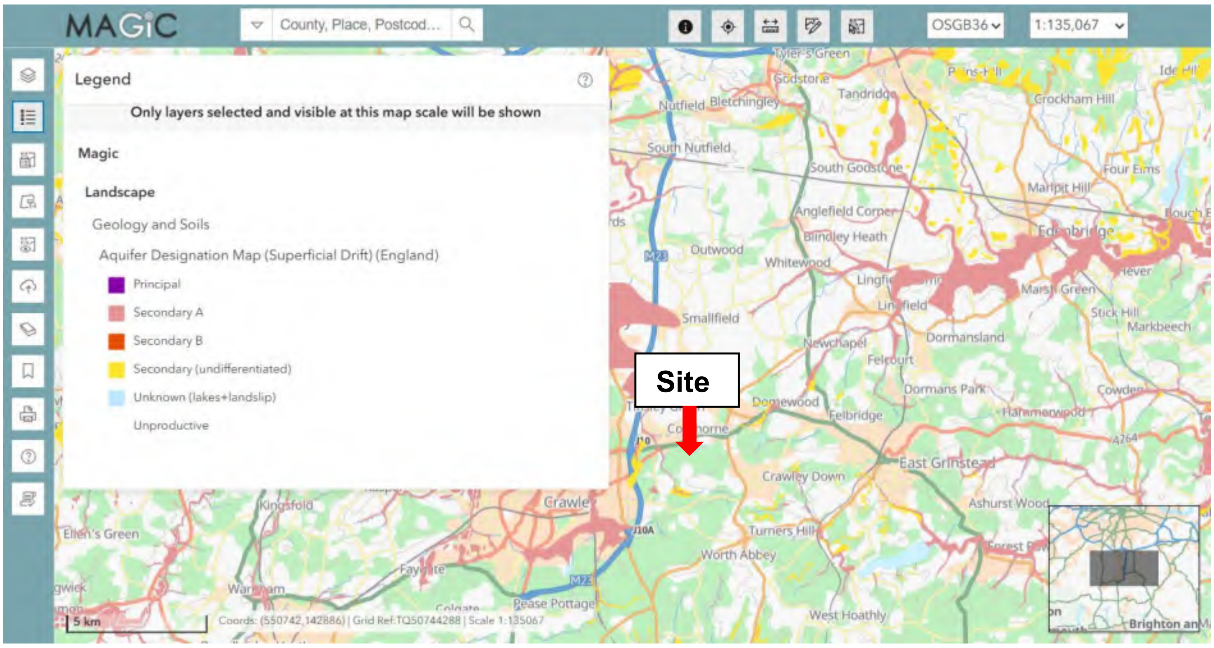
Extract from BGS Geology Viewer (Bedrock).



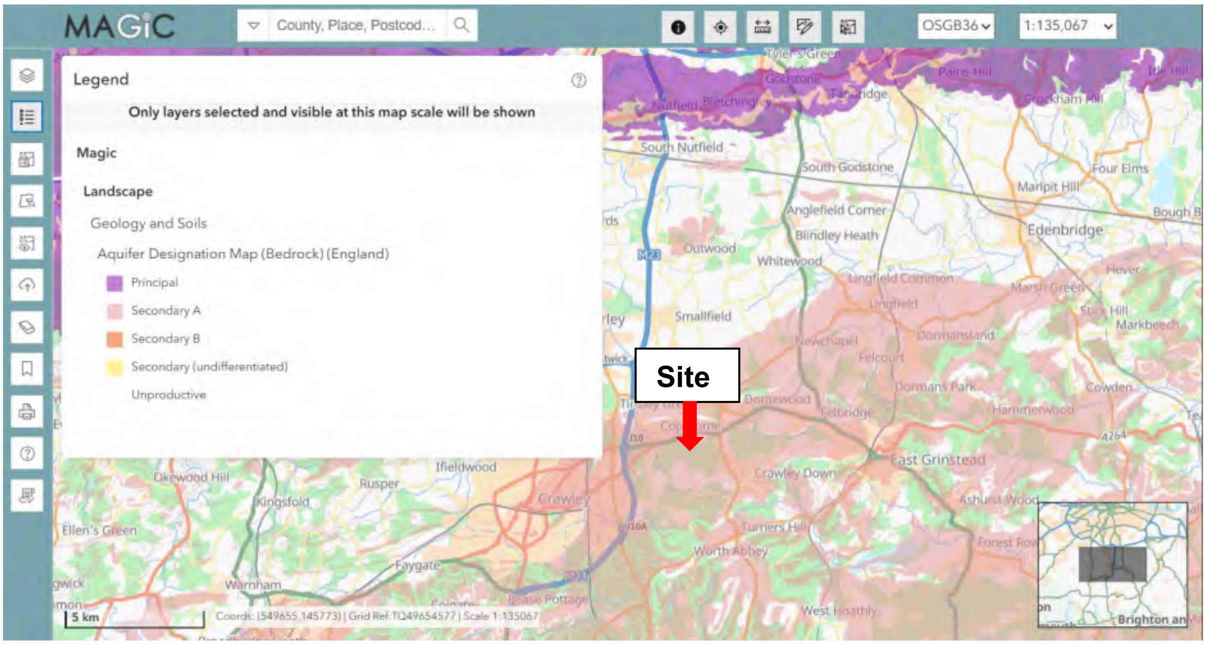
Extract from LandIS Soilscape Map.



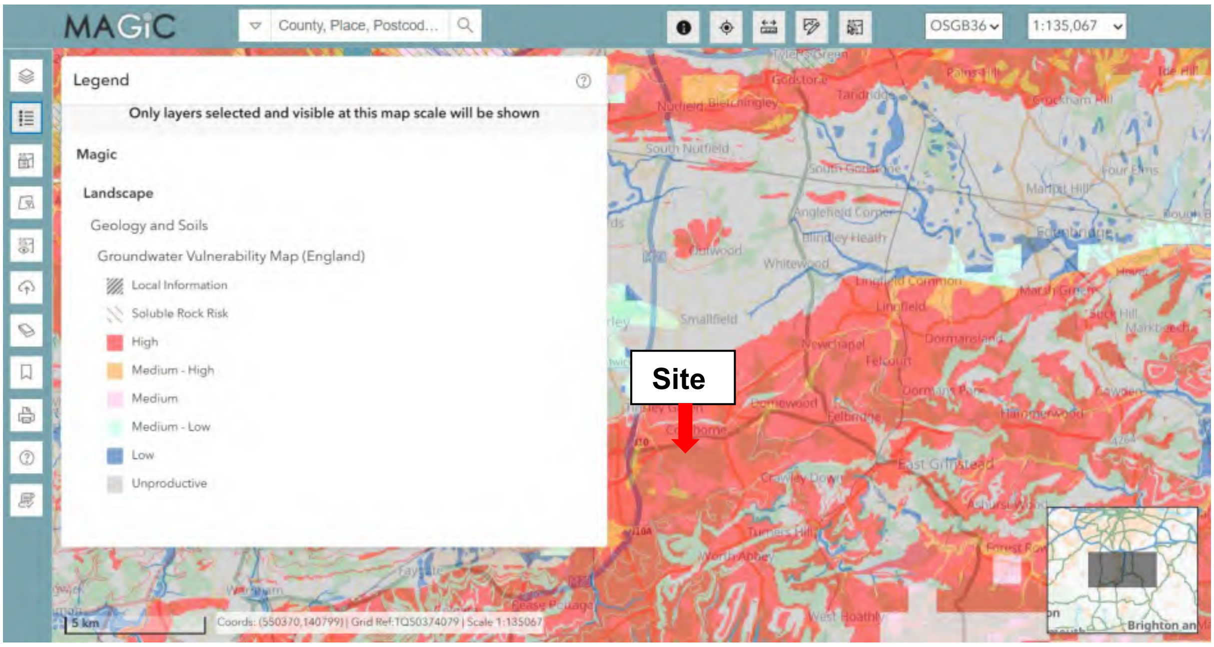
Extract from Magic Maps - Groundwater Source Protection Zones



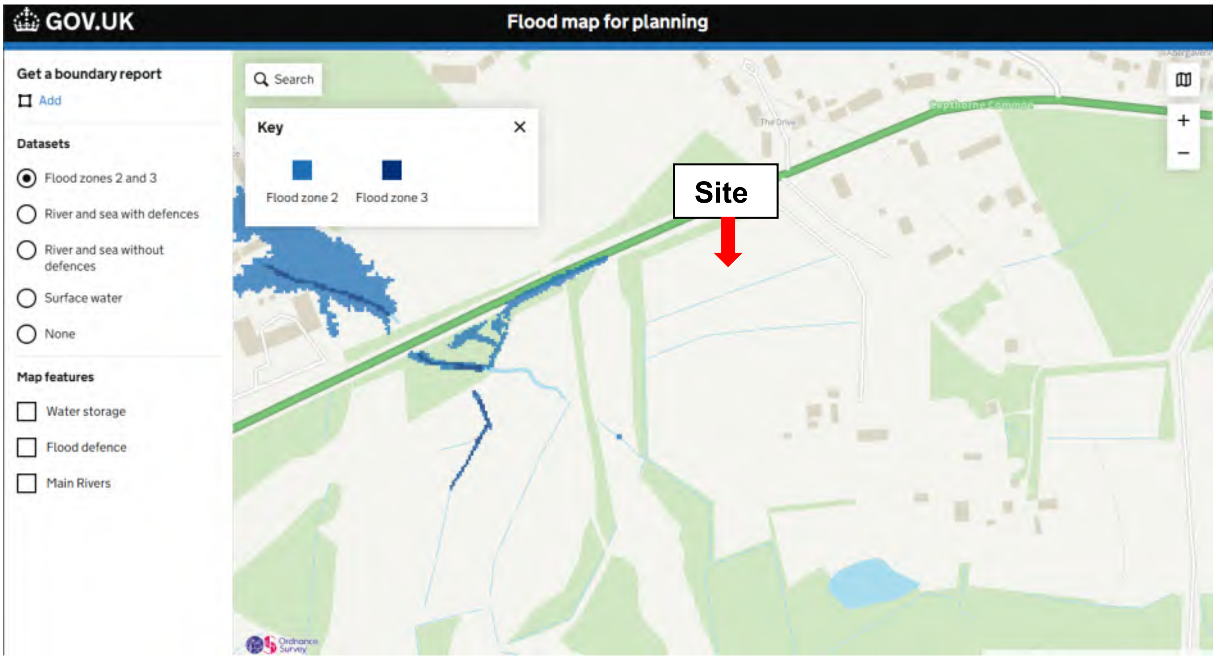
Extract from Magic Maps – Aquifer Designation [Superficial]



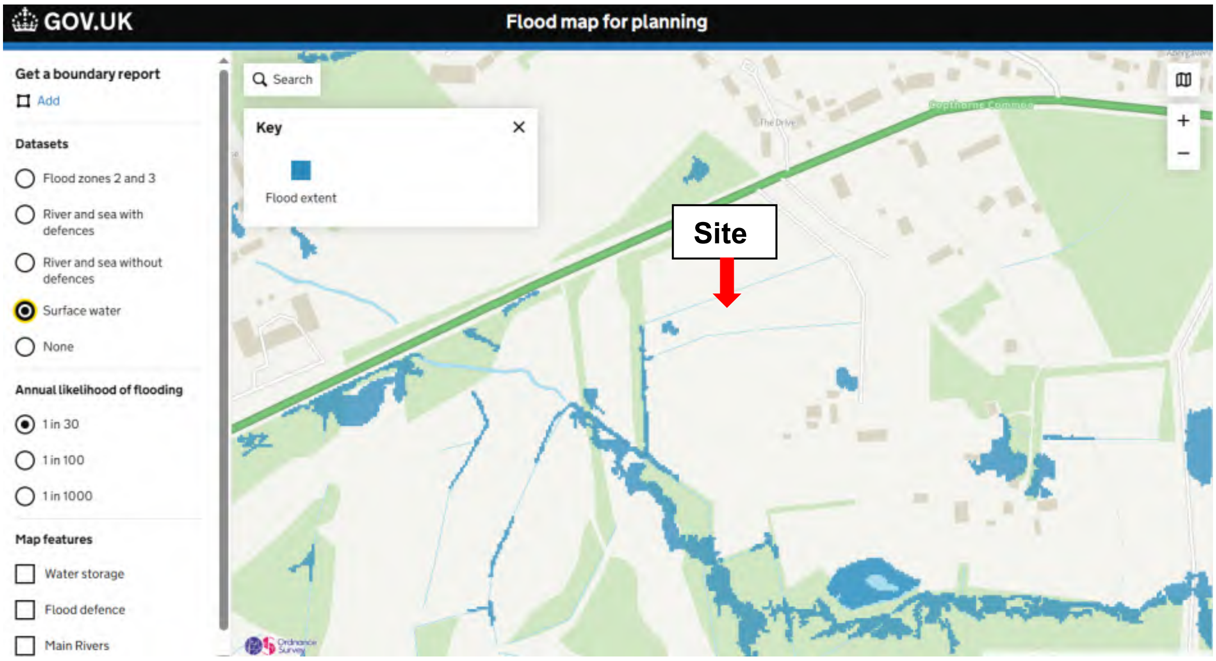
Extract from Magic Maps – Aquifer Designation [Bedrock]



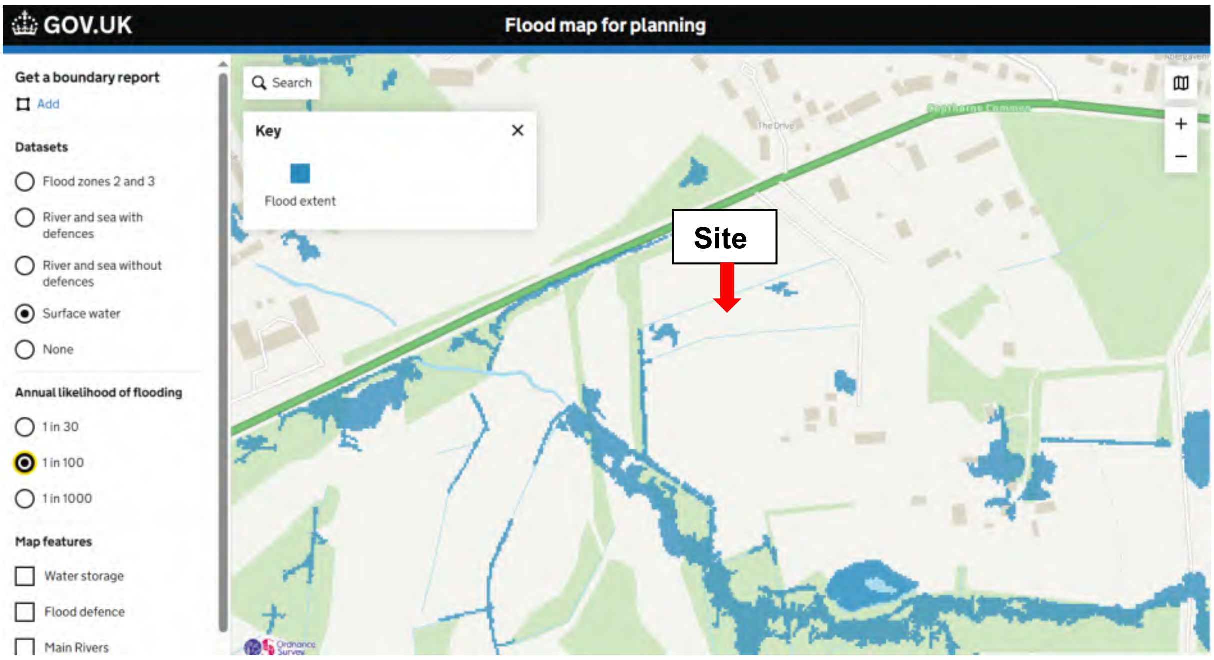
Extract from Magic Maps -Groundwater Vulnerability



Extract from EA Flood Map for Planning (Rivers & Sea)



Extract from EA Flood Map for Planning [Surface Water] – High Risk



Extract from EA Flood Map for Planning [Surface Water] – Medium Risk

Extract from EA Flood Map for Planning [Surface Water] – Low Risk

Extract from EA Flood Map for Planning [Reservoirs]

Asset Location Search

Property Searches

BdR Civil and Structural Engineering Ltd
UNIT 1 THE OLD ENGINE HOUSE, G
TONBRIDGE
TN11 0DP

Search address supplied	Courthouse Farm Copthorne Common Copthorne Crawley RH10 3LA
Your reference	25-0093 Court House Farm
Our reference	ALS/ALS Standard/2025_5153137
Search date	29 April 2025

Keeping you up-to-date

We have a new website and email address

Website URL: thameswater.co.uk/propertysearches

Email address: property.searches@thameswater.co.uk

Please do get in contact with us if you have any questions.

Thames Water Utilities Ltd
Property Searches,
Clearwater Court, Vastern Road, Reading RG1 8DB

property.searches@thameswater.co.uk
thameswater.co.uk/propertysearches

0800 009 4540

Search address supplied: Courthouse Farm, Copthorne Common, Copthorne, Crawley, RH10 3LA

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 search provides maps showing the position and 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 contact details below:

Thames Water Utilities Ltd
Property Searches
Clearwater Court
Vastern Road
Reading
RG1 8DB

Email: property.searches@thameswater.co.uk
Web: thameswater.co.uk/propertysearches

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. The public sewer map 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:

South East Water

Rocfort Road
Snodland
Kent
ME6 5AH

Tel: 0845 301 0845

www.southeastwater.co.uk.

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.

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. You can do this by emailing customer.feedback@thameswater.co.uk with the email subject header 'Enquiry – TWOSA', along with details of the request.

If you have any questions regarding sewer connections, budget estimates, diversions or building over 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

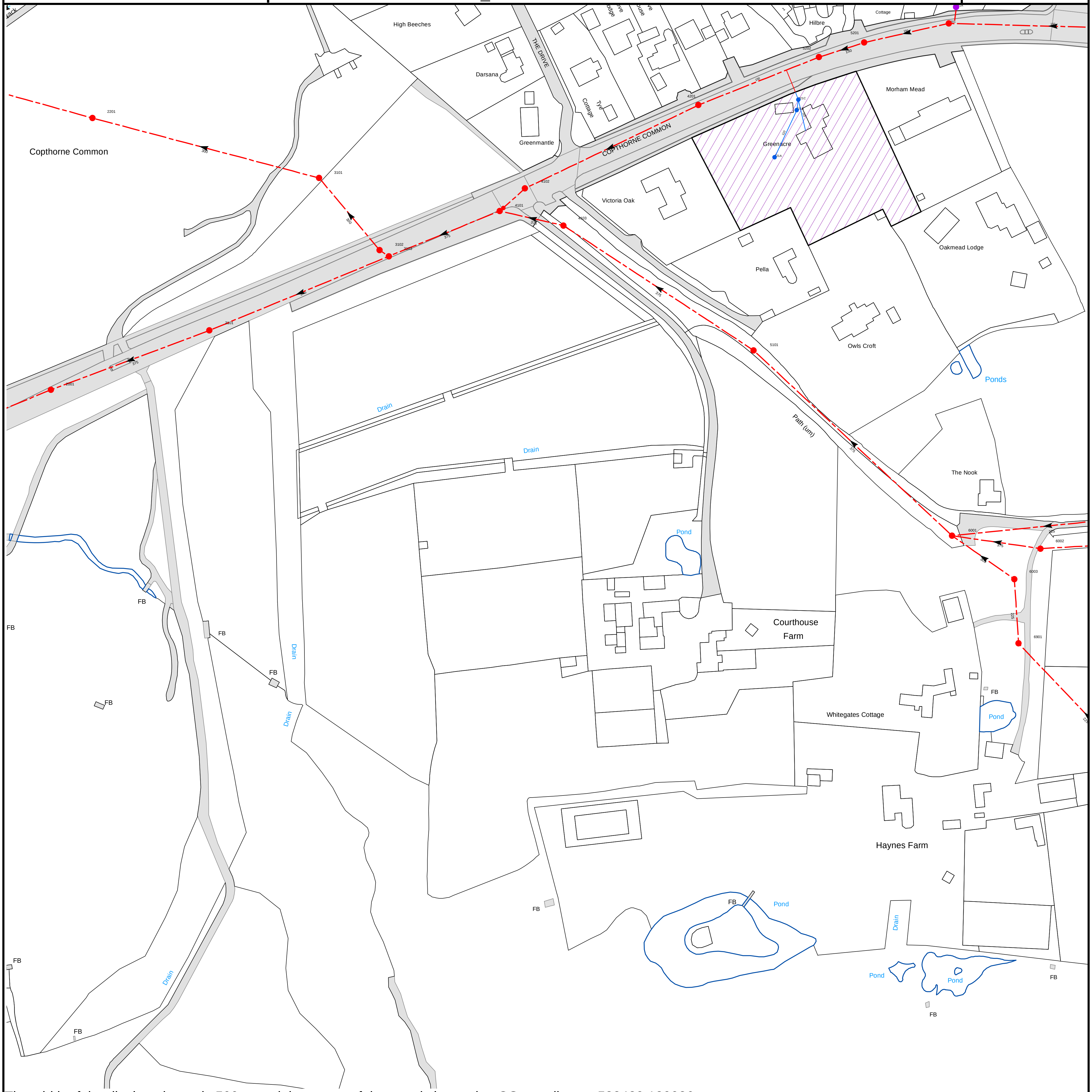
Clean Water queries

Should you require any advice concerning clean water 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/2025_5153137



The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 532429,139026

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
5201	83.89	81.92
6201	86.06	84.03
621A	n/a	n/a
6901	79.93	77.1
6003	n/a	n/a
6002	81.59	80.41
6001	79.51	77.63
5101	78.31	75.66
3103	76.17	74.47
4103	77.89	74.96
4101	77.31	74.83
4102	77.81	76.08
521A	n/a	n/a
521B	n/a	n/a
4201	80.81	79.13
521C	n/a	n/a
5202	82.97	82
2001	74.02	71.77
2101	75.07	72.92
3102	76.16	74.16
3101	n/a	n/a
2201	74.51	73.06

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.

Appendix 3
Details of Proposed Development

1B4P- Aff Apartment
2B3P- Aff Apartment
2B4P-Aff
3B5P-Aff
3B5P-Mkt
3B6P-Aff
3B6P-Bay
3B6P-Mkt
4B8P-Aff
4B8P-Mkt

Development Site
Root protection zones
Badger Sett protection zone

Proposed Accommodation Schedule

Occupancy	Affordable	Area per Type	Total Unit Count	Total Area	Comments
1B4P- Aff Apartment	Affordable	51.4 m²	4	205.8 m²	2 Storey Flats
2B3P- Aff Apartment	Affordable	68.7 m²	4	274.7 m²	2 Storey Flats
2B4P-Aff	Affordable	<varies>	15	1099.8 m²	
3B5P-Aff	Affordable	93.7 m²	8	749.8 m²	
3B5P-Mkt	Private	<varies>	27	2532.0 m²	
3B6P-Aff	Affordable	112.7 m²	3	338.1 m²	
3B6P-Bay	Private	124.2 m²	2	248.4 m²	
3B6P-Mkt	Private	112.7 m²	16	1802.7 m²	
4B8P-Aff	Affordable	141.1 m²	3	423.4 m²	
4B8P-Mkt	Private	141.1 m²	4	564.3 m²	
Grand total			86	8239.0 m²	

Parking Schedule-Master

Comments	Parking-Quat
Affordable	48
Private	106
Visitors	12
	166

REV	DATE	DESCRIPTION	CHK
M	01.08.25	Garages omitted, parkings adjusted and plots 44-46 moved to avoid RPA of trees T27 and T28	
L	25.07.25	Plots around Badger Sett omitted and re-arranged	
K	10.07.25	Adjustmentys made to observe critical tree protection area	
J	30.06.25	Amendments made to co-ordinate with tree locations	PT
I	26.06.25	Revised to relocate play area. Additional houses types added.	PT
H	19.06.25	RPA comments assessed. Pumping Stations re-positioned	PT
G	16.06.25	Pumping Station and Pond relocated	PT
F	13.06.25	Tree protection areas added	PT
E	12.06.25	Pumping Station added	PT
D	10.06.25	Works in progress	PT
C	21.05.25	Area schedule updated	PT
B	16.05.25	Revised Scheme	PT
A	30.04.25	First Issue	PT

jane duncan
architects+
interiors

The Old Warehouse
Chalfont Station Road
Little Chalfont, Amersham
Bucks HP7 9PN

+44 (0)1494 766 999
info@janeduncanarchitects.co.uk
janeduncanarchitects.co.uk

CLIENT
Option Two Development Ltd

ADDRESS
Copthorne Common Rd
Copthorne, RH10 3LA

PROJECT
Court House Farm. Copthorne

DRAWING TITLE
Option D - 100% Residential

DRAWING NO.	REV
ECF485_101	M

SCALE	DATE	DRAWN	CHECKED
1 : 500	30.04.25	BB	PT

0m 10m 20m 30m 40m 50m
Drawing Scale 1:500

REV	DATE	DESCRIPTION	CHK

jane duncan architects+ interiors

The Old Warehouse
Chalfont Station Road
Little Chalfont, Amersham
Bucks HP7 9PN

+44 (0)1494 766 999
info@janeduncanarchitects.co.uk
janeduncanarchitects.co.uk

CLIENT
Option Two Development Ltd

ADDRESS
Copthorne Common Rd
Copthorne, RH10 3LA

PROJECT
Court House Farm. Copthorne

DRAWING TITLE
Option D - 100% Residential Roof Plan

DRAWING NO. ECF485_102
REV

SCALE	DATE	DRAWN	CHECKED
1 : 500	08.08.25	BB	PT

Appendix 4
Runoff Rates & Volumes

Appendix 4/1
Greenfield Runoff Rates & Volumes

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	1	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	0.750	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	200.0		

Links (Results)

Name	US Node	DS Node	Σ Area (ha)	Pro Velocity (m/s)
1.000	S47.0	S47.1	0.013	0.575
1.001	S47.1	SW2.0	0.034	0.759
1.002	SW2.0	SW2.1	0.188	1.213
1.003	SW2.1	SW2.3	0.202	1.595
1.004	SW2.3	SW2.4	0.231	2.465
2.000	S57-59.0	S57-59.1	0.040	0.802
2.001	S57-59.1	SW2.4	0.040	0.789
1.005	SW2.4	SW2.5	0.346	1.238
1.006	SW2.5	SW2.6	0.471	1.881
1.007	SW2.6	FC	0.511	0.823
3.000	S26-29.0	S26-29.1	0.036	0.942
3.001	S26-29.1	SW1.0	0.084	1.340
3.002	SW1.0	SW1.1	0.134	1.498
4.000	S5-16.0	S5-16.1	0.085	1.400
4.001	S5-16.1	SW1.1	0.118	1.613
3.003	SW1.1	SW1.2	0.295	1.733
5.000	S20-25.0	S20-25.1	0.085	0.704
5.001	S20-25.1	SW1.2	0.085	0.701
3.004	SW1.2	SW1.3	0.379	1.057
6.000	S82-86.0	S82-86.1	0.074	0.798
6.001	S82-86.1	SW1.3	0.074	1.090
3.005	SW1.3	SW1.4	0.492	1.119
7.000	S33-42.0	S33-42.1	0.091	1.162
7.001	S33-42.1	S33-42.2	0.091	1.048
7.002	S33-42.2	SW1.4	0.131	2.882
3.006	SW1.4	SW1.5	0.631	1.170
3.007	SW1.5	SW1.6	0.631	1.173
8.000	S43-46.0	S43-46.1	0.037	1.310
8.001	S43-46.1	SW1.6	0.066	1.925
3.008	SW1.6	SW1.8	0.748	1.226
3.009	SW1.8	SW1.9	0.810	1.233
3.010	SW1.9	SW1.10	0.874	2.784
3.011	SW1.10	SW1.11	0.874	2.850
9.000	CATH PIT	SW1.11	0.000	0.000
3.012	SW1.11	FC	0.898	0.990
1.008	FC	SW PUMP	1.409	1.630

Simulation Settings

Rainfall Methodology	FEH-22	Drain Down Time (mins)	1440	10 year (l/s)	30.1
Rainfall Events	Singular	Additional Storage (m³/ha)	20.0	30 year (l/s)	44.6
Summer CV	0.750	Starting Level (m)		100 year (l/s)	59.3
Winter CV	0.840	Check Discharge Rate(s)	✓	Check Discharge Volume	✓
Analysis Speed	Detailed	1 year (l/s)	15.8	100 year 360 minute (m³)	387
Skip Steady State	x	2 year (l/s)	16.4		

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
10	0	0	0
30	35	0	0
100	40	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	2.40
Greenfield Method	FEH	Growth Factor 100 year	3.19
Positively Drained Area (ha)	4.339	Betterment (%)	0
SAAR (mm)	793	QMed	16.4
Host	1	QBar	18.6
BFIHost	0.520	Q 1 year (l/s)	15.8
Region	6	Q 2 year (l/s)	16.4
QBar/QMed conversion factor	1.136	Q 10 year (l/s)	30.1
Growth Factor 1 year	0.85	Q 30 year (l/s)	44.6
Growth Factor 2 year	0.88	Q 100 year (l/s)	59.3
Growth Factor 10 year	1.62		

Pre-development Discharge Volume

Site Makeup	Greenfield	Return Period (years)	100
Greenfield Method	FSR/FEH	Climate Change (%)	0
Positively Drained Area (ha)	4.339	Storm Duration (mins)	360
Soil Index	1	Betterment (%)	0
SPR	0.10	PR	0.131
CWI	118.963	Runoff Volume (m³)	387

Appendix 4/2
Post-Development Runoff Rates & Volumes [No Mitigation]

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	1	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	0.750	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	200.0		

Links (Results)

Name	US Node	DS Node	Σ Area (ha)	Pro Velocity (m/s)
1.000	S1	S2	0.470	1.173
1.001	S2	S3	0.940	1.423
1.002	S3	S4	1.400	1.574
1.003	S4	S5	1.400	1.564

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	0.750	Drain Down Time (mins)	1440	Check Discharge Volume	x
Winter CV	0.840	Additional Storage (m³/ha)	20.0		

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
2	0	0	0
10	0	0	0
30	35	0	0
100	40	0	0

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
1 year 15 minute summer	74.487	21.077	1 year 480 minute summer	10.990	2.904
1 year 15 minute winter	52.272	21.077	1 year 480 minute winter	7.302	2.904
1 year 30 minute summer	48.175	13.632	1 year 600 minute summer	9.130	2.497
1 year 30 minute winter	33.807	13.632	1 year 600 minute winter	6.238	2.497
1 year 60 minute summer	32.865	8.685	1 year 720 minute summer	8.216	2.202
1 year 60 minute winter	21.835	8.685	1 year 720 minute winter	5.522	2.202
1 year 120 minute summer	24.674	6.521	1 year 960 minute summer	6.833	1.799
1 year 120 minute winter	16.393	6.521	1 year 960 minute winter	4.527	1.799
1 year 180 minute summer	20.547	5.288	1 year 1440 minute summer	5.054	1.354
1 year 180 minute winter	13.356	5.288	1 year 1440 minute winter	3.397	1.354
1 year 240 minute summer	16.999	4.492	2 year 15 minute summer	112.108	31.723
1 year 240 minute winter	11.294	4.492	2 year 15 minute winter	78.672	31.723
1 year 360 minute summer	13.626	3.506	2 year 30 minute summer	73.507	20.800
1 year 360 minute winter	8.857	3.506	2 year 30 minute winter	51.584	20.800

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
2 year 60 minute summer	49.676	13.128	30 year +35% CC 30 minute summer	261.280	73.933
2 year 60 minute winter	33.004	13.128	30 year +35% CC 30 minute winter	183.355	73.933
2 year 120 minute summer	34.404	9.092	30 year +35% CC 60 minute summer	177.950	47.027
2 year 120 minute winter	22.857	9.092	30 year +35% CC 60 minute winter	118.226	47.027
2 year 180 minute summer	27.755	7.142	30 year +35% CC 120 minute summer	106.911	28.253
2 year 180 minute winter	18.042	7.142	30 year +35% CC 120 minute winter	71.029	28.253
2 year 240 minute summer	22.526	5.953	30 year +35% CC 180 minute summer	81.078	20.864
2 year 240 minute winter	14.966	5.953	30 year +35% CC 180 minute winter	52.703	20.864
2 year 360 minute summer	17.615	4.533	30 year +35% CC 240 minute summer	63.499	16.781
2 year 360 minute winter	11.450	4.533	30 year +35% CC 240 minute winter	42.187	16.781
2 year 480 minute summer	14.021	3.705	30 year +35% CC 360 minute summer	47.752	12.288
2 year 480 minute winter	9.315	3.705	30 year +35% CC 360 minute winter	31.040	12.288
2 year 600 minute summer	11.548	3.159	30 year +35% CC 480 minute summer	37.187	9.828
2 year 600 minute winter	7.890	3.159	30 year +35% CC 480 minute winter	24.706	9.828
2 year 720 minute summer	10.326	2.767	30 year +35% CC 600 minute summer	30.207	8.262
2 year 720 minute winter	6.940	2.767	30 year +35% CC 600 minute winter	20.640	8.262
2 year 960 minute summer	8.512	2.241	30 year +35% CC 720 minute summer	26.762	7.172
2 year 960 minute winter	5.638	2.241	30 year +35% CC 720 minute winter	17.985	7.172
2 year 1440 minute summer	6.211	1.665	30 year +35% CC 960 minute summer	21.834	5.749
2 year 1440 minute winter	4.174	1.665	30 year +35% CC 960 minute winter	14.463	5.749
10 year 15 minute summer	221.352	62.635	30 year +35% CC 1440 minute summer	15.744	4.220
10 year 15 minute winter	155.335	62.635	30 year +35% CC 1440 minute winter	10.581	4.220
10 year 30 minute summer	145.903	41.286	100 year +40% CC 15 minute summer	516.534	146.161
10 year 30 minute winter	102.388	41.286	100 year +40% CC 15 minute winter	362.480	146.161
10 year 60 minute summer	98.924	26.143	100 year +40% CC 30 minute summer	346.638	98.087
10 year 60 minute winter	65.723	26.143	100 year +40% CC 30 minute winter	243.255	98.087
10 year 120 minute summer	61.541	16.263	100 year +40% CC 60 minute summer	237.723	62.823
10 year 120 minute winter	40.886	16.263	100 year +40% CC 60 minute winter	157.937	62.823
10 year 180 minute summer	47.340	12.182	100 year +40% CC 120 minute summer	139.815	36.949
10 year 180 minute winter	30.772	12.182	100 year +40% CC 120 minute winter	92.890	36.949
10 year 240 minute summer	37.363	9.874	100 year +40% CC 180 minute summer	105.070	27.038
10 year 240 minute winter	24.823	9.874	100 year +40% CC 180 minute winter	68.298	27.038
10 year 360 minute summer	28.319	7.287	100 year +40% CC 240 minute summer	81.976	21.664
10 year 360 minute winter	18.408	7.287	100 year +40% CC 240 minute winter	54.463	21.664
10 year 480 minute summer	22.129	5.848	100 year +40% CC 360 minute summer	61.667	15.869
10 year 480 minute winter	14.702	5.848	100 year +40% CC 360 minute winter	40.085	15.869
10 year 600 minute summer	17.999	4.923	100 year +40% CC 480 minute summer	48.256	12.753
10 year 600 minute winter	12.298	4.923	100 year +40% CC 480 minute winter	32.060	12.753
10 year 720 minute summer	15.949	4.275	100 year +40% CC 600 minute summer	39.417	10.781
10 year 720 minute winter	10.719	4.275	100 year +40% CC 600 minute winter	26.932	10.781
10 year 960 minute summer	12.988	3.420	100 year +40% CC 720 minute summer	35.114	9.411
10 year 960 minute winter	8.603	3.420	100 year +40% CC 720 minute winter	23.599	9.411
10 year 1440 minute summer	9.338	2.503	100 year +40% CC 960 minute summer	28.928	7.617
10 year 1440 minute winter	6.276	2.503	100 year +40% CC 960 minute winter	19.162	7.617
30 year +35% CC 15 minute summer	392.752	111.135	100 year +40% CC 1440 minute summer	21.163	5.672
30 year +35% CC 15 minute winter	275.616	111.135	100 year +40% CC 1440 minute winter	14.223	5.672

Results for 1 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 winter	S1	11	73.773	0.104	44.9	0.6169	0.0000	OK
15 minute winter	S2	11	73.201	0.146	87.6	1.1334	0.0000	OK
15 minute winter	S3	11	72.772	0.182	128.1	1.2996	0.0000	OK
15 minute winter	S4	12	72.350	0.185	125.8	0.4698	0.0000	OK
15 minute winter	S5	12	72.008	0.175	127.4	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 winter	S1	1.000	S2	43.5	0.917	0.043	4.4585	
15 minute winter	S2	1.001	S3	86.4	1.215	0.086	4.9754	
15 minute winter	S3	1.002	S4	125.8	1.530	0.125	5.2507	
15 minute winter	S4	1.003	S5	127.4	1.572	0.126	4.0409	61.9

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 winter	S1	11	73.795	0.126	67.5	0.7522	0.0000	OK
15 minute winter	S2	11	73.237	0.182	132.4	1.4132	0.0000	OK
15 minute winter	S3	11	72.819	0.229	194.3	1.6284	0.0000	OK
15 minute winter	S4	12	72.396	0.231	192.9	0.5867	0.0000	OK
15 minute winter	S5	12	72.050	0.217	194.0	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 winter	S1	1.000	S2	65.6	1.019	0.065	6.0453	
15 minute winter	S2	1.001	S3	131.5	1.347	0.130	6.8225	
15 minute winter	S3	1.002	S4	192.9	1.697	0.191	7.2554	
15 minute winter	S4	1.003	S5	194.0	1.762	0.192	5.4859	93.2

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 (m³)	Flood (m³)	Status
15 minute winter	S1	10	73.846	0.177	133.3	1.0549	0.0000	OK
15 minute winter	S2	11	73.323	0.268	263.0	2.0812	0.0000	OK
15 minute winter	S3	11	72.930	0.340	386.6	2.4204	0.0000	OK
15 minute winter	S4	11	72.508	0.343	388.0	0.8725	0.0000	OK
15 minute winter	S5	12	72.145	0.312	385.4	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 winter	S1	1.000	S2	129.8	1.199	0.129	10.1420	
15 minute winter	S2	1.001	S3	262.5	1.571	0.260	11.6771	
15 minute winter	S3	1.002	S4	388.0	1.990	0.385	12.4432	
15 minute winter	S4	1.003	S5	385.4	2.105	0.382	9.1720	183.9

Results for 30 year +35% 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 winter	S1	10	73.907	0.238	236.5	1.4167	0.0000	OK
15 minute winter	S2	11	73.434	0.379	468.1	2.9402	0.0000	OK
15 minute winter	S3	11	73.087	0.497	686.5	3.5413	0.0000	OK
15 minute winter	S4	11	72.662	0.497	692.0	1.2643	0.0000	OK
15 minute winter	S5	11	72.271	0.438	686.7	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 winter	S1	1.000	S2	231.6	1.364	0.230	15.7348	
15 minute winter	S2	1.001	S3	466.5	1.748	0.462	18.5664	
15 minute winter	S3	1.002	S4	692.0	2.235	0.687	19.7676	
15 minute winter	S4	1.003	S5	686.7	2.402	0.681	14.3678	326.3

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 winter	S1	10	73.944	0.275	311.1	1.6379	0.0000	OK
15 minute winter	S2	11	73.507	0.452	616.3	3.5105	0.0000	OK
15 minute winter	S3	11	73.218	0.628	902.9	4.4727	0.0000	OK
15 minute winter	S4	11	72.776	0.611	905.5	1.5552	0.0000	OK
15 minute winter	S5	11	72.361	0.528	898.1	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 winter	S1	1.000	S2	305.2	1.447	0.303	19.4633	
15 minute winter	S2	1.001	S3	613.4	1.807	0.608	23.3917	
15 minute winter	S3	1.002	S4	905.5	2.328	0.899	24.8283	
15 minute winter	S4	1.003	S5	898.1	2.526	0.891	17.8227	429.1

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	1	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	0.750	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	200.0		

Links (Results)

Name	US Node	DS Node	Σ Area (ha)	Pro Velocity (m/s)
1.000	S1	S2	0.470	1.173
1.001	S2	S3	0.940	1.423
1.002	S3	S4	1.400	1.574
1.003	S4	S5	1.400	1.564

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	0.750	Drain Down Time (mins)	1440	Check Discharge Volume	x
Winter CV	0.840	Additional Storage (m³/ha)	20.0		

Storm Durations

360

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

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year +40% CC 360 minute summer	61.667	15.869	100 year +40% CC 360 minute winter	40.085	15.869

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
360 minute summer	S1	184	73.790	0.121	60.3	0.7197	0.0000	OK
360 minute summer	S2	184	73.227	0.172	120.1	1.3373	0.0000	OK
360 minute summer	S3	184	72.807	0.217	177.6	1.5428	0.0000	OK
360 minute summer	S4	184	72.384	0.219	175.8	0.5566	0.0000	OK
360 minute summer	S5	184	72.038	0.205	174.4	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)
360 minute summer	S1	1.000	S2	59.8	0.988	0.059	5.6218	
360 minute summer	S2	1.001	S3	118.5	1.311	0.118	6.3215	
360 minute summer	S3	1.002	S4	175.8	1.660	0.174	6.7606	
360 minute summer	S4	1.003	S5	174.4	1.708	0.173	5.0914	996.8

Appendix 5
SuDS Design, SuDS O&M Requirements

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	1	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	0.750	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	200.0		

Links (Results)

Name	US Node	DS Node	Σ Area (ha)	Pro Velocity (m/s)
1.000	S47.0	S47.1	0.013	0.575
1.001	S47.1	SW2.0	0.034	0.759
1.002	SW2.0	SW2.1	0.188	1.213
1.003	SW2.1	SW2.3	0.202	1.595
1.004	SW2.3	SW2.4	0.231	2.465
2.000	S57-59.0	S57-59.1	0.040	0.802
2.001	S57-59.1	SW2.4	0.040	0.789
1.005	SW2.4	SW2.5	0.346	1.238
1.006	SW2.5	SW2.6	0.471	1.881
1.007	SW2.6	FC	0.511	0.823
3.000	S26-29.0	S26-29.1	0.036	0.942
3.001	S26-29.1	SW1.0	0.084	1.340
3.002	SW1.0	SW1.1	0.134	1.498
4.000	S5-16.0	S5-16.1	0.085	1.400
4.001	S5-16.1	SW1.1	0.118	1.613
3.003	SW1.1	SW1.2	0.295	1.733
5.000	S20-25.0	S20-25.1	0.085	0.704
5.001	S20-25.1	SW1.2	0.085	0.701
3.004	SW1.2	SW1.3	0.379	1.057
6.000	S82-86.0	S82-86.1	0.074	0.798
6.001	S82-86.1	SW1.3	0.074	1.090
3.005	SW1.3	SW1.4	0.492	1.119
7.000	S33-42.0	S33-42.1	0.091	1.162
7.001	S33-42.1	S33-42.2	0.091	1.048
7.002	S33-42.2	SW1.4	0.131	2.882
3.006	SW1.4	SW1.5	0.631	1.170
3.007	SW1.5	SW1.6	0.631	1.173
8.000	S43-46.0	S43-46.1	0.037	1.310
8.001	S43-46.1	SW1.6	0.066	1.925
3.008	SW1.6	SW1.8	0.748	1.226
3.009	SW1.8	SW1.9	0.810	1.233
3.010	SW1.9	SW1.10	0.874	2.784
3.011	SW1.10	SW1.11	0.874	2.850
9.000	GEOCELLULAR STORAGE	SW1.11	0.000	0.000
3.012	SW1.11	FC	0.898	0.990
1.008	FC	SW PUMP	1.409	1.630

Simulation Settings

Rainfall Methodology	FEH-22	Drain Down Time (mins)	1440	10 year (l/s)	30.1
Rainfall Events	Singular	Additional Storage (m³/ha)	20.0	30 year (l/s)	44.6
Summer CV	0.750	Starting Level (m)		100 year (l/s)	59.3
Winter CV	0.840	Check Discharge Rate(s)	✓	Check Discharge Volume	✓
Analysis Speed	Detailed	1 year (l/s)	15.8	100 year 360 minute (m³)	387
Skip Steady State	x	2 year (l/s)	16.4		

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
10	0	0	0
30	35	0	0
100	40	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	2.40
Greenfield Method	FEH	Growth Factor 100 year	3.19
Positively Drained Area (ha)	4.339	Betterment (%)	0
SAAR (mm)	793	QMed	16.4
Host	1	QBar	18.6
BFIHost	0.520	Q 1 year (l/s)	15.8
Region	6	Q 2 year (l/s)	16.4
QBar/QMed conversion factor	1.136	Q 10 year (l/s)	30.1
Growth Factor 1 year	0.85	Q 30 year (l/s)	44.6
Growth Factor 2 year	0.88	Q 100 year (l/s)	59.3
Growth Factor 10 year	1.62		

Pre-development Discharge Volume

Site Makeup	Greenfield	Return Period (years)	100
Greenfield Method	FSR/FEH	Climate Change (%)	0
Positively Drained Area (ha)	4.339	Storm Duration (mins)	360
Soil Index	1	Betterment (%)	0
SPR	0.10	PR	0.131
CWI	118.963	Runoff Volume (m³)	387

Node FC Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	70.861	Product Number	CTL-SHE-0146-1580-3400-1580
Design Depth (m)	3.400	Min Outlet Diameter (m)	0.225
Design Flow (l/s)	15.8	Min Node Diameter (mm)	1800

Node GEOCELLULAR STORAGE Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	70.900
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	608

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	320.0	0.0	2.400	320.7	0.0	2.401	0.0	0.0

Approval Settings

Node Size	x	Coordinates	x	Full Bore Velocity	x	Time to Half Empty	✓
Node Losses	x	Crossings	x	Proportional Velocity	x	Return Period (years)	30
Link Size	x	Cover Depth	x	Surcharged Depth	x	Discharge Rates	x
Link Length	x	Backdrops	x	Flooding	x	Discharge Volume	x

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
1 year 15 minute summer	74.487	21.077	10 year 600 minute winter	12.298	4.923
1 year 15 minute winter	52.272	21.077	10 year 720 minute summer	15.949	4.275
1 year 30 minute summer	48.175	13.632	10 year 720 minute winter	10.719	4.275
1 year 30 minute winter	33.807	13.632	10 year 960 minute summer	12.988	3.420
1 year 60 minute summer	32.865	8.685	10 year 960 minute winter	8.603	3.420
1 year 60 minute winter	21.835	8.685	10 year 1440 minute summer	9.338	2.503
1 year 120 minute summer	24.674	6.521	10 year 1440 minute winter	6.276	2.503
1 year 120 minute winter	16.393	6.521	30 year +35% CC 15 minute summer	392.752	111.135
1 year 180 minute summer	20.547	5.288	30 year +35% CC 15 minute winter	275.616	111.135
1 year 180 minute winter	13.356	5.288	30 year +35% CC 30 minute summer	261.280	73.933
1 year 240 minute summer	16.999	4.492	30 year +35% CC 30 minute winter	183.355	73.933
1 year 240 minute winter	11.294	4.492	30 year +35% CC 60 minute summer	177.950	47.027
1 year 360 minute summer	13.626	3.506	30 year +35% CC 60 minute winter	118.226	47.027
1 year 360 minute winter	8.857	3.506	30 year +35% CC 120 minute summer	106.911	28.253
1 year 480 minute summer	10.990	2.904	30 year +35% CC 120 minute winter	71.029	28.253
1 year 480 minute winter	7.302	2.904	30 year +35% CC 180 minute summer	81.078	20.864
1 year 600 minute summer	9.130	2.497	30 year +35% CC 180 minute winter	52.703	20.864
1 year 600 minute winter	6.238	2.497	30 year +35% CC 240 minute summer	63.499	16.781
1 year 720 minute summer	8.216	2.202	30 year +35% CC 240 minute winter	42.187	16.781
1 year 720 minute winter	5.522	2.202	30 year +35% CC 360 minute summer	47.752	12.288
1 year 960 minute summer	6.833	1.799	30 year +35% CC 360 minute winter	31.040	12.288
1 year 960 minute winter	4.527	1.799	30 year +35% CC 480 minute summer	37.187	9.828
1 year 1440 minute summer	5.054	1.354	30 year +35% CC 480 minute winter	24.706	9.828
1 year 1440 minute winter	3.397	1.354	30 year +35% CC 600 minute summer	30.207	8.262
10 year 15 minute summer	221.352	62.635	30 year +35% CC 600 minute winter	20.640	8.262
10 year 15 minute winter	155.335	62.635	30 year +35% CC 720 minute summer	26.762	7.172
10 year 30 minute summer	145.903	41.286	30 year +35% CC 720 minute winter	17.985	7.172
10 year 30 minute winter	102.388	41.286	30 year +35% CC 960 minute summer	21.834	5.749
10 year 60 minute summer	98.924	26.143	30 year +35% CC 960 minute winter	14.463	5.749
10 year 60 minute winter	65.723	26.143	30 year +35% CC 1440 minute summer	15.744	4.220
10 year 120 minute summer	61.541	16.263	30 year +35% CC 1440 minute winter	10.581	4.220
10 year 120 minute winter	40.886	16.263	100 year +40% CC 15 minute summer	516.534	146.161
10 year 180 minute summer	47.340	12.182	100 year +40% CC 15 minute winter	362.480	146.161
10 year 180 minute winter	30.772	12.182	100 year +40% CC 30 minute summer	346.638	98.087
10 year 240 minute summer	37.363	9.874	100 year +40% CC 30 minute winter	243.255	98.087
10 year 240 minute winter	24.823	9.874	100 year +40% CC 60 minute summer	237.723	62.823
10 year 360 minute summer	28.319	7.287	100 year +40% CC 60 minute winter	157.937	62.823
10 year 360 minute winter	18.408	7.287	100 year +40% CC 120 minute summer	139.815	36.949
10 year 480 minute summer	22.129	5.848	100 year +40% CC 120 minute winter	92.890	36.949
10 year 480 minute winter	14.702	5.848	100 year +40% CC 180 minute summer	105.070	27.038
10 year 600 minute summer	17.999	4.923	100 year +40% CC 180 minute winter	68.298	27.038

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year +40% CC 240 minute summer	81.976	21.664
100 year +40% CC 240 minute winter	54.463	21.664
100 year +40% CC 360 minute summer	61.667	15.869
100 year +40% CC 360 minute winter	40.085	15.869
100 year +40% CC 480 minute summer	48.256	12.753
100 year +40% CC 480 minute winter	32.060	12.753
100 year +40% CC 600 minute summer	39.417	10.781

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year +40% CC 600 minute winter	26.932	10.781
100 year +40% CC 720 minute summer	35.114	9.411
100 year +40% CC 720 minute winter	23.599	9.411
100 year +40% CC 960 minute summer	28.928	7.617
100 year +40% CC 960 minute winter	19.162	7.617
100 year +40% CC 1440 minute summer	21.163	5.672
100 year +40% CC 1440 minute winter	14.223	5.672

Results for 1 year Critical Storm Duration. Lowest mass balance: 99.81%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S47.0	10	75.346	0.027	1.3	0.0096	0.0000	OK
15 minute winter	S47.1	11	75.080	0.045	3.3	0.0206	0.0000	OK
15 minute winter	SW2.0	10	74.886	0.080	17.8	0.2766	0.0000	OK
15 minute winter	SW2.1	11	74.254	0.071	18.8	0.1147	0.0000	OK
15 minute winter	SW2.3	11	73.779	0.059	21.6	0.0848	0.0000	OK
15 minute winter	S57-59.0	10	73.634	0.047	3.8	0.0356	0.0000	OK
15 minute winter	S57-59.1	11	73.402	0.050	3.7	0.0079	0.0000	OK
15 minute winter	SW2.4	11	73.082	0.102	32.1	0.2071	0.0000	OK
15 minute winter	SW2.5	11	72.706	0.090	43.6	0.2196	0.0000	OK
15 minute winter	SW2.6	11	71.377	0.247	46.9	0.4116	0.0000	OK
15 minute winter	S26-29.0	11	75.789	0.038	3.4	0.0319	0.0000	OK
15 minute winter	S26-29.1	10	74.826	0.049	7.8	0.0404	0.0000	OK
15 minute winter	SW1.0	10	74.563	0.053	12.5	0.1065	0.0000	OK
15 minute winter	S5-16.0	10	75.695	0.046	8.1	0.0613	0.0000	OK
15 minute winter	S5-16.1	10	74.305	0.055	11.1	0.0287	0.0000	OK
15 minute winter	SW1.1	11	74.016	0.086	27.3	0.1343	0.0000	OK
15 minute winter	S20-25.0	10	73.917	0.073	8.1	0.0979	0.0000	OK
15 minute winter	S20-25.1	11	73.673	0.078	7.9	0.0124	0.0000	OK
15 minute winter	SW1.2	11	73.554	0.136	35.2	0.1943	0.0000	OK
15 minute winter	S82-86.0	10	74.059	0.063	7.1	0.0928	0.0000	OK
15 minute winter	S82-86.1	11	73.662	0.052	6.9	0.0083	0.0000	OK
15 minute winter	SW1.3	11	73.412	0.144	45.6	0.2479	0.0000	OK
15 minute winter	S33-42.0	10	75.791	0.054	8.7	0.0788	0.0000	OK
15 minute winter	S33-42.1	11	75.144	0.063	8.5	0.0100	0.0000	OK
15 minute winter	S33-42.2	11	74.856	0.038	12.1	0.0284	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 winter	S47.0	1.000	S47.1	1.3	0.387	0.071	0.0940	
15 minute winter	S47.1	1.001	SW2.0	3.2	0.736	0.182	0.0351	
15 minute winter	SW2.0	1.002	SW2.1	17.5	1.271	0.146	0.7422	
15 minute winter	SW2.1	1.003	SW2.3	18.9	1.691	0.111	0.2211	
15 minute winter	SW2.3	1.004	SW2.4	21.7	2.364	0.072	0.0753	
15 minute winter	S57-59.0	2.000	S57-59.1	3.7	0.764	0.211	0.1155	
15 minute winter	S57-59.1	2.001	SW2.4	3.7	0.759	0.214	0.0369	
15 minute winter	SW2.4	1.005	SW2.5	32.2	1.311	0.107	1.0281	
15 minute winter	SW2.5	1.006	SW2.6	43.3	1.144	0.089	3.6704	
15 minute winter	SW2.6	1.007	FC	55.0	0.985	0.364	1.8525	
15 minute winter	S26-29.0	3.000	S26-29.1	3.3	0.932	0.140	0.1826	
15 minute winter	S26-29.1	3.001	SW1.0	7.7	1.271	0.091	0.0444	
15 minute winter	SW1.0	3.002	SW1.1	12.3	1.007	0.068	0.2721	
15 minute winter	S5-16.0	4.000	S5-16.1	7.9	1.198	0.090	0.3260	
15 minute winter	S5-16.1	4.001	SW1.1	10.9	1.519	0.116	0.0539	
15 minute winter	SW1.1	3.003	SW1.2	27.4	1.689	0.167	0.3273	
15 minute winter	S20-25.0	5.000	S20-25.1	7.9	0.689	0.229	0.6519	
15 minute winter	S20-25.1	5.001	SW1.2	7.8	0.673	0.226	0.0706	
15 minute winter	SW1.2	3.004	SW1.3	35.2	1.031	0.250	0.5133	
15 minute winter	S82-86.0	6.000	S82-86.1	6.9	0.875	0.161	0.4492	
15 minute winter	S82-86.1	6.001	SW1.3	6.9	1.050	0.103	0.0464	
15 minute winter	SW1.3	3.005	SW1.4	45.4	1.096	0.198	0.7890	
15 minute winter	S33-42.0	7.000	S33-42.1	8.5	1.046	0.129	0.3315	
15 minute winter	S33-42.1	7.001	S33-42.2	8.5	1.266	0.147	0.1452	
15 minute winter	S33-42.2	7.002	SW1.4	12.1	2.791	0.058	0.0390	

Results for 1 year Critical Storm Duration. Lowest mass balance: 99.81%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SW1.4	11	73.265	0.168	58.2	0.3057	0.0000	OK
15 minute winter	SW1.5	11	73.211	0.168	58.0	0.2966	0.0000	OK
15 minute winter	S43-46.0	10	76.074	0.032	3.6	0.0224	0.0000	OK
15 minute winter	S43-46.1	10	74.025	0.038	6.3	0.0145	0.0000	OK
15 minute winter	SW1.6	11	73.158	0.168	68.2	0.3464	0.0000	OK
15 minute winter	SW1.8	12	72.981	0.165	72.7	0.3533	0.0000	OK
15 minute winter	SW1.9	12	72.720	0.093	78.3	0.2088	0.0000	OK
15 minute winter	SW1.10	12	71.549	0.087	78.5	0.1542	0.0000	OK
360 minute winter	GEOCELLULAR STORAGE	256	71.254	0.354	17.4	108.2746	0.0000	OK
15 minute winter	SW1.11	11	71.350	0.474	143.8	0.9798	0.0000	OK
15 minute winter	FC	11	71.352	0.491	55.0	1.2487	0.0000	OK
15 minute winter	SW PUMP	11	70.847	0.057	12.4	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 winter	SW1.4	3.006	SW1.5	58.0	0.976	0.171	0.6524	
15 minute winter	SW1.5	3.007	SW1.6	57.5	0.972	0.168	0.6297	
15 minute winter	S43-46.0	8.000	S43-46.1	3.5	1.144	0.097	0.1548	
15 minute winter	S43-46.1	8.001	SW1.6	6.2	1.851	0.125	0.0272	
15 minute winter	SW1.6	3.008	SW1.8	67.8	1.206	0.198	1.1137	
15 minute winter	SW1.8	3.009	SW1.9	73.5	1.223	0.151	1.3651	
15 minute winter	SW1.9	3.010	SW1.10	78.5	2.780	0.038	0.6946	
15 minute winter	SW1.10	3.011	SW1.11	78.7	0.898	0.037	1.7022	
360 minute winter	GEOCELLULAR STORAGE	9.000	SW1.11	-17.4	-0.300	-0.049	3.2092	
15 minute winter	SW1.11	3.012	FC	-63.3	0.331	-0.132	1.5523	
15 minute winter	FC	1.008	SW PUMP	12.4	0.819	0.015	0.1458	61.2

Results for 10 year Critical Storm Duration. Lowest mass balance: 99.85%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S47.0	10	75.365	0.046	3.7	0.0163	0.0000	OK
15 minute winter	S47.1	10	75.120	0.085	9.6	0.0386	0.0000	OK
15 minute winter	SW2.0	10	74.950	0.144	53.1	0.5019	0.0000	OK
15 minute winter	SW2.1	11	74.311	0.128	56.3	0.2061	0.0000	OK
15 minute winter	SW2.3	11	73.828	0.108	64.1	0.1563	0.0000	OK
15 minute winter	S57-59.0	10	73.677	0.090	11.4	0.0674	0.0000	OK
15 minute winter	S57-59.1	10	73.447	0.095	11.2	0.0152	0.0000	OK
15 minute winter	SW2.4	11	73.163	0.183	95.5	0.3706	0.0000	OK
15 minute winter	SW2.5	11	72.773	0.157	130.0	0.3844	0.0000	OK
240 minute winter	SW2.6	232	71.869	0.739	29.5	1.2323	0.0000	SURCHARGED
15 minute winter	S26-29.0	11	75.819	0.068	10.1	0.0572	0.0000	OK
15 minute winter	S26-29.1	10	74.867	0.090	23.3	0.0747	0.0000	OK
15 minute winter	SW1.0	10	74.601	0.091	37.6	0.1850	0.0000	OK
15 minute winter	S5-16.0	10	75.728	0.079	24.1	0.1070	0.0000	OK
15 minute winter	S5-16.1	10	74.354	0.104	33.3	0.0539	0.0000	OK
15 minute winter	SW1.1	10	74.091	0.161	82.2	0.2494	0.0000	OK
15 minute winter	S20-25.0	10	73.982	0.138	24.1	0.1849	0.0000	OK
15 minute winter	S20-25.1	11	73.743	0.148	23.5	0.0236	0.0000	OK
15 minute winter	SW1.2	11	73.686	0.268	104.8	0.3833	0.0000	OK
15 minute winter	S82-86.0	10	74.110	0.114	21.0	0.1673	0.0000	OK
15 minute winter	S82-86.1	11	73.705	0.095	20.5	0.0152	0.0000	OK
15 minute winter	SW1.3	11	73.551	0.283	136.7	0.4883	0.0000	OK
15 minute winter	S33-42.0	10	75.834	0.097	26.0	0.1408	0.0000	OK
15 minute winter	S33-42.1	10	75.195	0.114	25.6	0.0182	0.0000	OK
15 minute winter	S33-42.2	10	74.887	0.069	36.4	0.0509	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 winter	S47.0	1.000	S47.1	3.6	0.493	0.205	0.2112	
15 minute winter	S47.1	1.001	SW2.0	9.4	0.965	0.536	0.0790	
15 minute winter	SW2.0	1.002	SW2.1	52.2	1.684	0.436	1.6683	
15 minute winter	SW2.1	1.003	SW2.3	56.2	2.186	0.329	0.5072	
15 minute winter	SW2.3	1.004	SW2.4	64.4	3.100	0.215	0.1709	
15 minute winter	S57-59.0	2.000	S57-59.1	11.2	0.985	0.633	0.2683	
15 minute winter	S57-59.1	2.001	SW2.4	11.1	0.992	0.638	0.0841	
15 minute winter	SW2.4	1.005	SW2.5	96.4	1.764	0.319	2.2836	
15 minute winter	SW2.5	1.006	SW2.6	130.6	1.423	0.269	6.6251	
240 minute winter	SW2.6	1.007	FC	25.6	0.724	0.170	3.1502	
15 minute winter	S26-29.0	3.000	S26-29.1	9.7	1.259	0.417	0.4042	
15 minute winter	S26-29.1	3.001	SW1.0	23.2	1.683	0.275	0.1012	
15 minute winter	SW1.0	3.002	SW1.1	37.3	1.329	0.205	0.6143	
15 minute winter	S5-16.0	4.000	S5-16.1	23.8	1.563	0.270	0.7476	
15 minute winter	S5-16.1	4.001	SW1.1	32.8	1.986	0.347	0.1235	
15 minute winter	SW1.1	3.003	SW1.2	81.4	1.987	0.496	0.8642	
15 minute winter	S20-25.0	5.000	S20-25.1	23.5	0.897	0.681	1.4788	
15 minute winter	S20-25.1	5.001	SW1.2	23.6	0.923	0.687	0.1562	
15 minute winter	SW1.2	3.004	SW1.3	105.7	1.340	0.750	1.1835	
15 minute winter	S82-86.0	6.000	S82-86.1	20.5	1.147	0.478	1.0087	
15 minute winter	S82-86.1	6.001	SW1.3	20.6	1.387	0.307	0.1045	
15 minute winter	SW1.3	3.005	SW1.4	137.1	1.365	0.599	1.9351	
15 minute winter	S33-42.0	7.000	S33-42.1	25.6	1.402	0.387	0.7420	
15 minute winter	S33-42.1	7.001	S33-42.2	25.2	1.673	0.437	0.3261	
15 minute winter	S33-42.2	7.002	SW1.4	36.2	3.738	0.174	0.0872	

Results for 10 year Critical Storm Duration. Lowest mass balance: 99.85%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SW1.4	11	73.440	0.343	175.3	0.6229	0.0000	OK
15 minute winter	SW1.5	11	73.378	0.335	175.2	0.5925	0.0000	OK
15 minute winter	S43-46.0	10	76.097	0.055	10.6	0.0392	0.0000	OK
15 minute winter	S43-46.1	10	74.057	0.070	18.8	0.0268	0.0000	OK
15 minute winter	SW1.6	11	73.312	0.322	206.5	0.6631	0.0000	OK
15 minute winter	SW1.8	11	73.125	0.309	222.2	0.6606	0.0000	OK
15 minute winter	SW1.9	11	72.795	0.168	237.9	0.3757	0.0000	OK
240 minute winter	SW1.10	232	71.869	0.407	50.3	0.7188	0.0000	OK
240 minute winter	GEOCELLULAR STORAGE	232	71.869	0.969	61.1	296.5313	0.0000	SURCHARGED
240 minute winter	SW1.11	232	71.869	0.993	63.1	2.0519	0.0000	SURCHARGED
240 minute winter	FC	232	71.869	1.008	25.6	2.5644	0.0000	SURCHARGED
960 minute summer	SW PUMP	660	70.848	0.058	12.7	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 winter	SW1.4	3.006	SW1.5	175.2	1.189	0.516	1.6167	
15 minute winter	SW1.5	3.007	SW1.6	174.7	1.230	0.511	1.5053	
15 minute winter	S43-46.0	8.000	S43-46.1	10.5	1.508	0.290	0.3502	
15 minute winter	S43-46.1	8.001	SW1.6	18.5	2.451	0.375	0.0617	
15 minute winter	SW1.6	3.008	SW1.8	205.3	1.588	0.600	2.5591	
15 minute winter	SW1.8	3.009	SW1.9	220.6	1.624	0.453	3.0988	
15 minute winter	SW1.9	3.010	SW1.10	237.4	3.730	0.116	1.6044	
240 minute winter	SW1.10	3.011	SW1.11	50.3	0.520	0.024	3.3676	
240 minute winter	GEOCELLULAR STORAGE	9.000	SW1.11	-61.1	-0.472	-0.171	5.8034	
240 minute winter	SW1.11	3.012	FC	12.3	0.109	0.026	2.0308	
240 minute winter	FC	1.008	SW PUMP	12.7	0.825	0.016	0.1488	465.1

Results for 30 year +35% CC Critical Storm Duration. Lowest mass balance: 99.93%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S47.0	10	75.382	0.063	6.6	0.0223	0.0000	OK
15 minute winter	S47.1	11	75.169	0.134	17.1	0.0606	0.0000	OK
15 minute winter	SW2.0	10	75.015	0.209	94.0	0.7280	0.0000	OK
15 minute winter	SW2.1	11	74.366	0.183	99.6	0.2937	0.0000	OK
15 minute winter	SW2.3	11	73.875	0.155	113.6	0.2244	0.0000	OK
15 minute winter	S57-59.0	11	73.855	0.268	20.2	0.2015	0.0000	SURCHARGED
15 minute winter	S57-59.1	11	73.529	0.177	19.2	0.0282	0.0000	SURCHARGED
15 minute winter	SW2.4	11	73.236	0.256	168.9	0.5201	0.0000	OK
360 minute winter	SW2.5	352	72.851	0.235	33.9	0.5766	0.0000	OK
360 minute winter	SW2.6	352	72.851	1.721	36.8	2.8708	0.0000	SURCHARGED
15 minute winter	S26-29.0	10	75.849	0.098	18.0	0.0823	0.0000	OK
15 minute winter	S26-29.1	10	74.907	0.130	41.5	0.1073	0.0000	OK
15 minute winter	SW1.0	10	74.634	0.124	66.8	0.2514	0.0000	OK
15 minute winter	S5-16.0	10	75.758	0.109	42.8	0.1471	0.0000	OK
15 minute winter	S5-16.1	11	74.494	0.244	59.1	0.1262	0.0000	SURCHARGED
15 minute winter	SW1.1	11	74.369	0.439	144.3	0.6813	0.0000	SURCHARGED
15 minute winter	S20-25.0	11	74.402	0.558	42.8	0.7449	0.0000	SURCHARGED
15 minute winter	S20-25.1	11	74.029	0.434	40.0	0.0690	0.0000	SURCHARGED
15 minute winter	SW1.2	11	73.967	0.549	174.0	0.7858	0.0000	SURCHARGED
15 minute winter	S82-86.0	10	74.161	0.165	37.3	0.2429	0.0000	OK
15 minute winter	S82-86.1	11	73.843	0.233	36.5	0.0370	0.0000	SURCHARGED
15 minute winter	SW1.3	11	73.790	0.522	224.9	0.9001	0.0000	SURCHARGED
15 minute winter	S33-42.0	10	75.876	0.139	46.1	0.2015	0.0000	OK
15 minute winter	S33-42.1	10	75.249	0.168	45.5	0.0267	0.0000	OK
15 minute winter	S33-42.2	10	74.904	0.085	64.8	0.0632	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 winter	S47.0	1.000	S47.1	6.5	0.543	0.367	0.3333	
15 minute winter	S47.1	1.001	SW2.0	16.7	1.063	0.950	0.1262	
15 minute winter	SW2.0	1.002	SW2.1	92.4	1.902	0.772	2.6138	
15 minute winter	SW2.1	1.003	SW2.3	99.5	2.440	0.583	0.8034	
15 minute winter	SW2.3	1.004	SW2.4	114.1	3.506	0.381	0.2677	
15 minute winter	S57-59.0	2.000	S57-59.1	19.2	1.092	1.083	0.4142	
15 minute winter	S57-59.1	2.001	SW2.4	19.2	1.100	1.108	0.1261	
15 minute winter	SW2.4	1.005	SW2.5	170.1	2.029	0.564	3.4991	
360 minute winter	SW2.5	1.006	SW2.6	33.9	0.827	0.070	7.9861	
360 minute winter	SW2.6	1.007	FC	34.4	0.653	0.228	3.1502	
15 minute winter	S26-29.0	3.000	S26-29.1	17.4	1.439	0.743	0.6300	
15 minute winter	S26-29.1	3.001	SW1.0	41.3	1.917	0.489	0.1581	
15 minute winter	SW1.0	3.002	SW1.1	66.4	1.406	0.365	1.0649	
15 minute winter	S5-16.0	4.000	S5-16.1	42.3	1.749	0.480	1.4292	
15 minute winter	S5-16.1	4.001	SW1.1	56.2	1.972	0.595	0.2977	
15 minute winter	SW1.1	3.003	SW1.2	134.5	2.020	0.820	1.4207	
15 minute winter	S20-25.0	5.000	S20-25.1	40.0	1.006	1.160	2.2266	
15 minute winter	S20-25.1	5.001	SW1.2	39.5	1.043	1.149	0.2432	
15 minute winter	SW1.2	3.004	SW1.3	173.6	1.574	1.231	1.6563	
15 minute winter	S82-86.0	6.000	S82-86.1	36.5	1.246	0.850	1.9553	
15 minute winter	S82-86.1	6.001	SW1.3	35.2	1.409	0.524	0.2795	
15 minute winter	SW1.3	3.005	SW1.4	225.8	1.425	0.986	3.0158	
15 minute winter	S33-42.0	7.000	S33-42.1	45.5	1.581	0.687	1.1648	
15 minute winter	S33-42.1	7.001	S33-42.2	44.9	1.964	0.778	0.4870	
15 minute winter	S33-42.2	7.002	SW1.4	64.6	3.939	0.310	0.2403	

Results for 30 year +35% CC Critical Storm Duration. Lowest mass balance: 99.93%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SW1.4	11	73.646	0.549	291.4	0.9974	0.0000	SURCHARGED
15 minute winter	SW1.5	11	73.561	0.518	290.8	0.9156	0.0000	OK
15 minute winter	S43-46.0	10	76.118	0.076	18.8	0.0541	0.0000	OK
15 minute winter	S43-46.1	10	74.090	0.103	33.4	0.0396	0.0000	OK
15 minute winter	SW1.6	11	73.477	0.487	346.6	1.0043	0.0000	OK
15 minute winter	SW1.8	11	73.253	0.437	375.0	0.9340	0.0000	OK
360 minute winter	SW1.9	352	72.851	0.224	62.9	0.5019	0.0000	OK
360 minute winter	SW1.10	352	72.851	1.389	62.9	2.4546	0.0000	SURCHARGED
360 minute winter	GEOCELLULAR STORAGE	352	72.851	1.951	81.8	597.4707	0.0000	SURCHARGED
360 minute winter	SW1.11	352	72.851	1.975	82.5	4.0825	0.0000	SURCHARGED
360 minute winter	FC	352	72.851	1.990	34.4	5.0648	0.0000	SURCHARGED
15 minute summer	SW PUMP	9	70.848	0.058	12.7	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 winter	SW1.4	3.006	SW1.5	290.8	1.346	0.857	2.3660	
15 minute winter	SW1.5	3.007	SW1.6	290.1	1.369	0.848	2.2483	
15 minute winter	S43-46.0	8.000	S43-46.1	18.6	1.721	0.515	0.5510	
15 minute winter	S43-46.1	8.001	SW1.6	33.2	2.713	0.671	0.1067	
15 minute winter	SW1.6	3.008	SW1.8	345.1	1.776	1.009	3.8085	
15 minute winter	SW1.8	3.009	SW1.9	373.6	1.829	0.768	4.6450	
360 minute winter	SW1.9	3.010	SW1.10	62.9	2.481	0.031	5.6556	
360 minute winter	SW1.10	3.011	SW1.11	59.2	0.468	0.028	4.1334	
360 minute winter	GEOCELLULAR STORAGE	9.000	SW1.11	-81.8	-0.506	-0.229	5.8034	
360 minute winter	SW1.11	3.012	FC	-21.6	0.106	-0.045	2.0308	
360 minute winter	FC	1.008	SW PUMP	12.7	0.825	0.016	0.1488	869.6

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.82%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S47.0	10	75.392	0.073	8.7	0.0261	0.0000	OK
15 minute winter	S47.1	10	75.256	0.221	22.6	0.1004	0.0000	SURCHARGED
15 minute winter	SW2.0	10	75.078	0.272	123.9	0.9443	0.0000	OK
15 minute winter	SW2.1	11	74.407	0.224	130.1	0.3607	0.0000	OK
480 minute winter	SW2.3	456	74.339	0.619	17.4	0.8972	0.0000	SURCHARGED
480 minute winter	S57-59.0	456	74.339	0.752	3.0	0.5650	0.0000	SURCHARGED
480 minute winter	S57-59.1	456	74.339	0.987	3.0	0.1570	0.0000	SURCHARGED
480 minute winter	SW2.4	456	74.339	1.359	26.0	2.7591	0.0000	SURCHARGED
480 minute winter	SW2.5	456	74.339	1.723	35.4	4.2267	0.0000	SURCHARGED
480 minute winter	SW2.6	456	74.339	3.209	38.4	5.3524	0.0000	FLOOD RISK
15 minute winter	S26-29.0	11	75.878	0.127	23.6	0.1059	0.0000	OK
15 minute winter	S26-29.1	12	75.236	0.459	54.4	0.3797	0.0000	SURCHARGED
15 minute winter	SW1.0	12	75.138	0.628	86.1	1.2718	0.0000	SURCHARGED
15 minute winter	S5-16.0	11	75.796	0.147	56.2	0.1975	0.0000	OK
15 minute winter	S5-16.1	12	75.210	0.960	75.7	0.4965	0.0000	SURCHARGED
15 minute winter	SW1.1	12	75.006	1.076	167.1	1.6704	0.0000	SURCHARGED
15 minute winter	S20-25.0	11	75.070	1.226	56.2	1.6385	0.0000	FLOOD RISK
15 minute winter	S20-25.1	12	74.487	0.892	50.9	0.1419	0.0000	SURCHARGED
15 minute winter	SW1.2	12	74.391	0.973	215.6	1.3930	0.0000	SURCHARGED
15 minute winter	S82-86.0	11	74.651	0.655	49.0	0.9624	0.0000	SURCHARGED
480 minute winter	S82-86.1	456	74.339	0.729	5.5	0.1160	0.0000	SURCHARGED
480 minute winter	SW1.3	456	74.339	1.071	36.8	1.8468	0.0000	SURCHARGED
15 minute winter	S33-42.0	10	75.910	0.173	60.5	0.2511	0.0000	OK
15 minute winter	S33-42.1	11	75.350	0.269	59.7	0.0427	0.0000	SURCHARGED
15 minute winter	S33-42.2	11	74.922	0.104	83.9	0.0768	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 winter	S47.0	1.000	S47.1	8.6	0.573	0.484	0.3718	
15 minute winter	S47.1	1.001	SW2.0	21.9	1.247	1.250	0.1382	
15 minute winter	SW2.0	1.002	SW2.1	121.2	1.954	1.013	3.3163	
15 minute winter	SW2.1	1.003	SW2.3	130.8	2.552	0.766	1.0074	
480 minute winter	SW2.3	1.004	SW2.4	17.4	2.229	0.058	0.5788	
480 minute winter	S57-59.0	2.000	S57-59.1	3.0	0.718	0.169	0.4142	
480 minute winter	S57-59.1	2.001	SW2.4	3.0	0.716	0.173	0.1325	
480 minute winter	SW2.4	1.005	SW2.5	26.0	1.228	0.086	6.6160	
480 minute winter	SW2.5	1.006	SW2.6	35.4	0.766	0.073	10.4492	
480 minute winter	SW2.6	1.007	FC	35.8	0.596	0.237	3.1502	
15 minute winter	S26-29.0	3.000	S26-29.1	22.5	1.460	0.964	0.8733	
15 minute winter	S26-29.1	3.001	SW1.0	52.6	1.981	0.623	0.2921	
15 minute winter	SW1.0	3.002	SW1.1	76.9	1.413	0.422	1.5311	
15 minute winter	S5-16.0	4.000	S5-16.1	53.6	1.778	0.608	1.6462	
15 minute winter	S5-16.1	4.001	SW1.1	67.4	1.986	0.714	0.2977	
15 minute winter	SW1.1	3.003	SW1.2	166.4	2.363	1.015	1.4207	
15 minute winter	S20-25.0	5.000	S20-25.1	50.9	1.281	1.476	2.2266	
15 minute winter	S20-25.1	5.001	SW1.2	49.2	1.238	1.432	0.2432	
15 minute winter	SW1.2	3.004	SW1.3	217.0	1.967	1.539	1.6563	
15 minute winter	S82-86.0	6.000	S82-86.1	44.4	1.259	1.035	2.2420	
480 minute winter	S82-86.1	6.001	SW1.3	5.5	0.987	0.082	0.2795	
480 minute winter	SW1.3	3.005	SW1.4	36.8	1.038	0.161	3.0158	
15 minute winter	S33-42.0	7.000	S33-42.1	59.7	1.640	0.902	1.4672	
15 minute winter	S33-42.1	7.001	S33-42.2	58.6	1.991	1.015	0.6166	
15 minute winter	S33-42.2	7.002	SW1.4	83.6	3.882	0.401	0.2592	

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.82%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
480 minute winter	SW1.4	456	74.339	1.242	47.2	2.2582	0.0000	SURCHARGED
480 minute winter	SW1.5	456	74.339	1.296	47.2	2.2902	0.0000	SURCHARGED
15 minute winter	S43-46.0	10	76.132	0.090	24.7	0.0641	0.0000	OK
480 minute winter	S43-46.1	456	74.339	0.352	5.0	0.1356	0.0000	SURCHARGED
480 minute winter	SW1.6	456	74.339	1.349	56.0	2.7817	0.0000	SURCHARGED
480 minute winter	SW1.8	456	74.339	1.523	60.7	3.2515	0.0000	SURCHARGED
480 minute winter	SW1.9	456	74.339	1.712	65.5	3.8346	0.0000	SURCHARGED
480 minute winter	SW1.10	456	74.339	2.877	65.5	5.0833	0.0000	SURCHARGED
480 minute winter	GEOCELLULAR STORAGE	456	74.339	3.439	89.6	737.2491	0.0000	SURCHARGED
480 minute winter	SW1.11	456	74.339	3.463	90.2	7.1576	0.0000	SURCHARGED
480 minute winter	FC	456	74.339	3.478	35.8	8.8509	0.0000	SURCHARGED
480 minute winter	SW PUMP	456	70.854	0.064	15.8	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)
480 minute winter	SW1.4	3.006	SW1.5	47.2	0.936	0.139	2.3692	
480 minute winter	SW1.5	3.007	SW1.6	47.2	0.925	0.138	2.2884	
15 minute winter	S43-46.0	8.000	S43-46.1	24.4	1.762	0.677	0.7143	
480 minute winter	S43-46.1	8.001	SW1.6	5.0	1.750	0.101	0.1437	
480 minute winter	SW1.6	3.008	SW1.8	56.0	1.143	0.164	4.2755	
480 minute winter	SW1.8	3.009	SW1.9	60.7	1.160	0.125	6.3960	
480 minute winter	SW1.9	3.010	SW1.10	65.5	2.359	0.032	8.7706	
480 minute winter	SW1.10	3.011	SW1.11	63.8	0.475	0.030	4.1334	
480 minute winter	GEOCELLULAR STORAGE	9.000	SW1.11	-89.6	-0.505	-0.251	5.8034	
480 minute winter	SW1.11	3.012	FC	-24.6	0.106	-0.051	2.0308	
480 minute winter	FC	1.008	SW PUMP	15.8	0.875	0.020	0.1743	1202.3

Manholes and Inspection Chambers

Schedule	Action Required	Frequency
Regular maintenance	Lift covers and ensure there are no blockages. Inspect and identify any parts that are not operating correctly and rectify.	For 3 months following installation
	Ensure covers are in a good state of repair.	Monthly
	Inspect manholes, and inspection chambers, to ensure that the drainage system is running freely.	Six monthly and every Autumn after leaf fall
Occasional maintenance	High pressure jetting (to Water Jetting Associationstandards) and CCTV where necessary.	Every 2 – 4 years
Remedial maintenance	• Silt removal. • Inlet/outlet repair. • Erosion repair. • System rehabilitation following a pollution event. • Manhole cover replacement. • Repairs to brickwork or concrete. • Channel repair.	As required (tasks to repair problems due towear, damage or vandalism).

Catchpits

Schedule	Action Required	Frequency
Regular maintenance	Lift covers and ensure there are no blockages. Inspect and identify any parts that are not operating correctly and rectify. Inspect silt storage in sump. Remove silt as required using sub-contractor with vacuum suction plant.	For 3 months following installation
	Ensure covers are in a good state of repair. Repair/replace as necessary.	Monthly
	Inspect catchpits to ensure that the drainage is running freely, and free of debris. Inspect silt storage in sump. Remove silt as required using sub-contractor with vacuum suction plant.	Six Monthly and every autumn after leaf fall
Occasional maintenance	High pressure jetting (to Water Jetting Associationstandards) and CCTV where necessary. Remediate any chamber structural defects, or any defects that may reduce the free flow of water.	Every 2 – 4 Years
Remedial maintenance	• Silt removal. • Inlet/outlet repair. • Erosion repair. • System rehabilitation following a pollution event. • Manhole cover replacement. • Repairs to brickwork or concrete.	As required (tasks to repair problems due to wear, damage or vandalism).

Linear Drains

Schedule	Action Required	Frequency
Regular maintenance	Inspect linear drains to ensure there are no blockages at surface level. Lift covers to outflow sumps and check for blockages or siltation. Inspect and identify any parts that are not operating correctly and rectify.	For 3 months following installation
	Inspect linear drains to ensure that there are no blockages at surface level.	Monthly
	Lift covers to outflow sumps and check for blockages or siltation.	Six Monthly and every autumn after leaf fall
Occasional maintenance	Jetting of linear drains and vacuum suction of outlet sumps (toWater Jetting Association standards). CCTV where necessary.	Every 1 – 2 Years
Remedial maintenance	• Silt removal. • Inlet/outlet repair. • Erosion repair. • System rehabilitation following a pollution event. • Linear drain cover replacement. • Channel repair. • Ensure that impermeable surfaces surrounding linear drains have not settled below top of linear drain level, causing ponding.	As required (tasks to repair problems due to wear, damage or vandalism).

Gullies

Schedule	Action Required	Frequency
Regular maintenance	Inspect to ensure that there are no blockages at surface level, and that the outfall is operating effectively. Inspect and identify any parts that are not operating correctly and rectify.	For 3 months following installation
	Ensure that there are no blockages at surface level.	Monthly
	Lift covers to check for blockages or siltation.	Six Monthly and every autumn after leaf fall
Occasional maintenance	Remove oil and silt using specialist vacuum suction plant.	Every 1 – 2 Years
Remedial maintenance	• Silt removal. • Inlet/outlet repair. • Erosion repair. • System rehabilitation following a pollution event. • Cover replacement. • Structural failure of gully pot. • Ensure that impermeable surfaces surrounding linear drains have not settled below top of gully cover level, causing ponding.	As required (tasks to repair problems due to wear, damage or vandalism).

Pipework

Schedule	Action Required	Frequency
Regular maintenance	Refer to manufacturer's specification. Inspect and identify any parts that are not operating correctly, consult supplier and rectify as required.	For 3 months following installation
	Monitor working of drainage at ground level. If there is localised flooding check the condition of all system elements.	Monthly
	Lift manholes covers to check for blockages. Remove sediment from pre-treatment structures, gullies, catchpits etc.	Six Monthly and every autumn after leaf fall
Occasional maintenance	Jetting of pipe runs (to Water Jetting Association standards). Remediate as necessary.	Every 1 – 2 Years
Remedial maintenance	Inspect, and carry out remediation works to ensure that the features are in fully working order.	As required (tasks to repair problems due to wear, damage or vandalism).

Vortex Flow Controls

Schedule	Action Required	Frequency
Regular maintenance	Refer to manufacturer's specification. Inspect and identify any parts that are not operating correctly, consult supplier and rectify as required.	For 3 months following installation
	Monitor working of drainage at ground level. If there is localised flooding check the condition of all system elements.	Monthly
	Lift manholes covers to check for blockages. Remove sediment from pre-treatment structures, gullies, catchpits.	Six monthly and every autumn after leaf fall
Occasional maintenance	Jetting of pipe runs (to Water Jetting Association standards). Remediate as necessary.	Every 1 – 2 Years
Remedial maintenance	Inspect, and carry out remediation works to ensure that the components are in full working order.	As required (tasks to repair problems due to wear, damage or vandalism).

Rainwater Harvesting

Any property with an RWH system installed should be provided with appropriate information as to what equipment has been installed, its purpose, its operation and maintenance requirements, the actions needed to address any potential failure and the expected performance of the system. Information on the options for external maintenance support should also be provided.

Most systems require periodic checking and maintenance to ensure trouble-free and reliable operation. There are wide differences in the extent of maintenance required for different systems, and manufacturers' guidelines should always be followed. The table provides guidance on the type of operational and maintenance requirements that may be appropriate. The list of actions is not exhaustive and some actions may not always be required.

Maintenance requirements are largely dependent on the runoff source and the runoff use (and thus treatment processes provided). This will range from weekly input through to rare intervention. Routine inspection of the filter system at quarterly annual intervals is advised, even if they do not appear to need specific intervention. Pumps need very little attention, but their design life is generally regarded as only being 10 years. Where automatic provision of potable water occurs (if and when rainwater is either not available or the system has failed), it is useful to have sensor warnings relayed in such a manner as to inform the user of the current status of the system.

RWH systems should be designed so that when there is an absence of rain, or a need to disconnect the system for maintenance or repair, that potable water is safely available for all appliances to avoid inconvenience.

Tanks should be accessible for internal inspection, and the cover should preferably be lockable. For more guidance on operation and maintenance of RWH systems, see BS 8515:2009+A1:2013.

Activity	Action Required	Frequency
Regular maintenance	Inspection of the tank for debris and sediment build-up, inlets/outlets/withdrawal devices, overflow areas, pumps, filters. Cleaning of tank, inlets, outlets, withdrawal devices and roof drain filters of silts and other debris.	Annually (and following poor performance)
Occasional maintenance	Cleaning and/or replacement of any filters.	3 Monthly (or as required)
Remedial maintenance	Repair of overflow erosion damage or damage to tank. Pump repairs.	As required

The maintenance responsibility for an RWH system is usually with the owner of the property, but any communal systems require the participating community to be informed of the system, as detailed, but also be provided with information of who the organization is that is maintaining the system and any financial commitments and any legally binding maintenance agreement.

Trees

Maintenance requirements of trees will be greatest during the first few years, when the tree is becoming established. Early maintenance should involve regular inspection, removal of invasive vegetation and possibly irrigation during long dry periods, particularly in soils with high void ratios. Tree roots need to establish good root–soil contact before they can efficiently extract water from the soil. The expertise of an arboriculturist/landscape architect with local knowledge should be sought regarding appropriate irrigation schedules. Maintenance responsibility for a tree pit or planter should always be placed with an appropriate organization.

Activity	Action Required	Frequency
Regular maintenance	Remove litter and debris Manage other vegetation and remove nuisance plants Inspect inlets and outlets	Monthly
Occasional maintenance	Check tree health and manage tree appropriately Remove silt build-up from inlets and surface and replace mulch as necessary	Annually or as required
	Water	As required
Monitoring	Inspect silt accumulation rates and establish appropriate removal frequencies	Half year

Sediments excavated from a tree pit or planter that receive runoff from residential or standard road and roof areas are generally not toxic or hazardous material and can therefore be safely disposed of by either land application or landfilling. However, consultation should take place with the environmental regulator to confirm appropriate protocols. Sediment testing may be required before sediment excavation to determine its classification and appropriate disposal methods. For runoff, from busy streets with high vehicle traffic sediment testing will be essential.

Further detail on waste management is provided in ***Chapter 33 of CIRIA SuDS Manual 2015.***

Maintenance Plans and schedules should be developed during the design phase. Specific maintenance needs of the tree pits/planters should be monitored and maintenance schedules adjusted to suit requirements.

Many of the specific maintenance activities for trees can be undertaken as part of a general landscaping or specific tree maintenance contracts.

CDM 2015 requires designers to ensure that all maintenance risks have been identified, eliminated, reduced and/or controlled where appropriate. This information will be required as part of the health and safety file.

Pervious Pavements

Regular inspection and maintenance is important for the effective operation of pervious pavements. Maintenance responsibility for a pervious pavement and its surrounding area should be placed with an appropriate responsible organization. Before handing over the pavement to the client, it should

be inspected for clogging, litter, weeds and water ponding, and all failures should be rectified. After handover, the pavement should be inspected regularly, preferably during and after heavy rainfall to check effective operation and to identify any areas of ponding.

Pervious pavements need to be regularly cleaned of silt and other sediments to preserve their infiltration capacity. Extensive experience suggests that sweeping once per year should be sufficient to maintain an acceptable infiltration rate on most sites. However, in some instances, more or less sweeping may be required and the frequency should be adjusted to suit site-specific circumstances and should be informed by inspection reports.

A brush and suction cleaner (which can be a lorry-mounted device or a smaller precinct sweeper) should be used for regular sweeping. Care should be taken in adjusting vacuuming equipment to avoid removal of jointing material. Any lost material should be replaced. It is also possible to clean the surface using lightweight rotating brush cleaners combined with power spraying using hot water, as shown in ***Figure 20.30 of CIRIA SuDS Manual 2015***. This is done every two years at the site shown.

If the surface has clogged then a more specialist sweeper with water jetting and oscillating and rotating brushes may be required, especially for porous asphalt surfaces, to restore the surface infiltration rate to an acceptable level. The specialist equipment should be adjusted so that it does not strip binder from the aggregate in the asphalt. The likely design life of grass reinforcement will be dictated by trafficking and is likely to be about 20 years if designed correctly. For concrete block permeable paving the design life should be no different from standard paving, assuming that an effective maintenance regime is in place to minimize risks of infiltration clogging. Porous asphalt will lose strength and begin to fatigue due to oxidation of the binder. This is likely to occur slightly faster in porous asphalt than normal asphalt, so the design life will be reduced slightly. Porous concrete should have a similar design life to a normal concrete slab.

The reconstruction of failed areas of concrete block pavement should be less costly and disruptive than the rehabilitation of continuous concrete or asphalt porous surfaces due to the reduced area that is likely to be affected. Materials removed from the voids or the layers below the surface may contain heavy metals and hydrocarbons and may need to be disposed of as controlled waste. Sediment testing should be carried out before disposal to confirm its classification and appropriate disposal methods.

The table provides guidance on the type of operational and maintenance requirements that may be appropriate. The list of actions is not exhaustive and some actions may not always be required.

Maintenance Plans and schedules should be prepared during the design phase. Specific maintenance needs of the pervious pavement should be monitored, and maintenance schedules adjusted to suit requirements.

Many of the specific maintenance activities for pervious pavements can be undertaken as part of a general site cleaning contract (many car parks or roads are swept to remove litter and for visual reasons to keep them tidy) and therefore, if litter management is already required at site, this should have marginal cost implications.

Generally, pervious pavements require less frequent gritting in winter to prevent ice formation. There is also less risk of ice formation after snow melt, as the melt water drains directly into the underlying sub-base and does not have chance to refreeze. A slight frost may occur more frequently on the surface of pervious pavements compared to adjacent impermeable surfaces, but this is only likely to last for a few hours. It does not happen in all installations and, if necessary, this can be dealt with by application of salt. It is not likely to pose a hazard to vehicle movements.

Activity	Action Required	Frequency
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention 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. Removal of weeds or management using glyphospate applied directly into weeds by an applicator rather than spraying.	As required
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. Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material.	As required
	Rehabilitation of surface and upper substructure by remedial sweeping.	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
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 hr after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies. Monitor inspection chambers	Annually

CDM 2015 requires designers to ensure that all maintenance risks have been identified, eliminated, reduced and/or controlled where appropriate. This information will be required as part of the health and safety file.

Geocellular Attenuation Storage Tanks

Regular inspection and maintenance is required to ensure the effective long-term operation of below-ground storage systems. Maintenance responsibility for systems should be placed with a responsible organization. The table provides guidance on the type of operational and maintenance requirements that may be appropriate. The list of actions is not exhaustive and some actions may not always be required.

Schedule	Action Required	Frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months, then annually.
	Remove debris from the catchment surface (where it may cause a risk to performance).	Monthly
	For systems where rainfall infiltrates into the tank from above, check surface of filter geotextile for blockage by sediment, algae or other matter; remove and replace surface infiltration medium as necessary.	Annually
	Remove sediment from pre-treatment structures and/or internal forebays.	Annual, or as required
Remedial actions	Repair/rehabilitate inlets, outlets, overflows and vents.	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure they are in good condition and operating as designed.	Annually
	Survey inside of tank for sediment build-up and remove if necessary.	Every five years or as required

Maintenance Plans and schedules should be developed during the design phase and will be specific to the type of tank that is adopted. Specific maintenance needs of the system should be monitored, and maintenance schedules adjusted to suit requirements. Further detail on the preparation of maintenance specifications and schedules of work is given in ***Chapter 32 of CIRIA SuDS Manual 2015.***

CDM 2015 requires designers to ensure that all maintenance risks have been identified, eliminated, reduced and/or controlled where appropriate. This information will be required as part of the health and safety file.

Ponds and Wetlands

Ponds and wetlands will require regular maintenance to ensure continuing operation to design performance standards, and all designers should provide detailed specifications and frequencies for the required maintenance activities, along with likely machinery requirements and typical annual costs – within the Maintenance Plan. The treatment performance of ponds and wetlands is dependent on maintenance, and robust management plans will be required to ensure maintenance is carried out in the long term. Different designs will have different operation and maintenance requirements, but this section gives some generic guidance.

Maintenance of ponds is relatively straightforward for landscape contractors, and typically there should only be a small amount of extra work required for a SuDS pond or wetland feature over and above what is necessary for standard public open space.

Regular inspection and maintenance is important for the effective operation of ponds as designed. Maintenance responsibility for a pond and its surrounding area should always be placed with a responsible organization. Litter and debris removal should be undertaken as part of general landscape maintenance for the site and before any other SuDS management task. All litter should be removed from site.

Any invasive maintenance work such as silt or vegetation removal is only required intermittently, but it should be planned to be sympathetic to the requirements of wildlife in a pond. Care should be taken to avoid disturbance to nesting birds during the breeding season and habitats of target species (eg great crested newt and water voles) at critical times. The window for carrying out maintenance to achieve this is usually towards the end of the growing season (typically September/October), although this will vary with species). Invasive silt and vegetation removal should only be carried out to limited areas at any one time (25–30% of the pond area on one occasion each year to minimize the impact on biodiversity. Plant management, to achieve particular desired habitat effects, should be clearly specified in a maintenance schedule.

Site vegetation should be trimmed as necessary to keep the pond free of leaves and to maintain the aesthetic appearance of the site. Slope areas that have become bare should be re-vegetated and any eroded areas should be regraded before replanting. Maintenance access (or “easement”) should be provided to the pond from a public or private road. An assessment should be made at the planning stage regarding the maintenance and associated access requirements. Ideally, access should be at least 3.5 m wide, have a maximum cross fall of 1 in 7, and be sufficiently robust to withstand maintenance equipment and vehicles. However, temporary access routes for infrequent operations could be considered where permanent routes are not appropriate. The access should extend to any forebay, safety and aquatic benches, inlet and outlet infrastructure. Consideration should be given as to whether maintenance vehicles will need to turn around. Wherever possible SuDS ponds and wetlands should be designed so that special machinery is not required to undertake maintenance.

The table provides guidance on the type of operational and maintenance requirements that may be appropriate. The list of actions is not exhaustive and some actions may not always be required. Consideration should be given to the need to control risks to biosecurity during maintenance operations and guidance is provided in ***Chapter 29 of CIRIA SuDS Manual 2015***.

Sediments excavated from ponds or forebays that receive runoff from residential or standard road and roof areas should be safely disposed of in accordance with current waste management legislation. However, consultation should take place with the environmental regulator to confirm appropriate protocols. Chemical testing of the sediment may be required, before sediment excavation, to determine its classification and appropriate disposal methods. For industrial site runoff, sediment testing will be essential. In the majority of cases on low-risk sites with source control and a Management Train, it will be acceptable to distribute the sediment on site, if there is an appropriate safe and acceptable location to do so. Further detail on waste management is provided in ***Chapter 33 of CIRIA SuDS Manual 2015***. If ponds are to be drawn down, care should be taken to prevent downstream discharge of sediments and anoxic water. The environmental regulator should be notified before such activities.

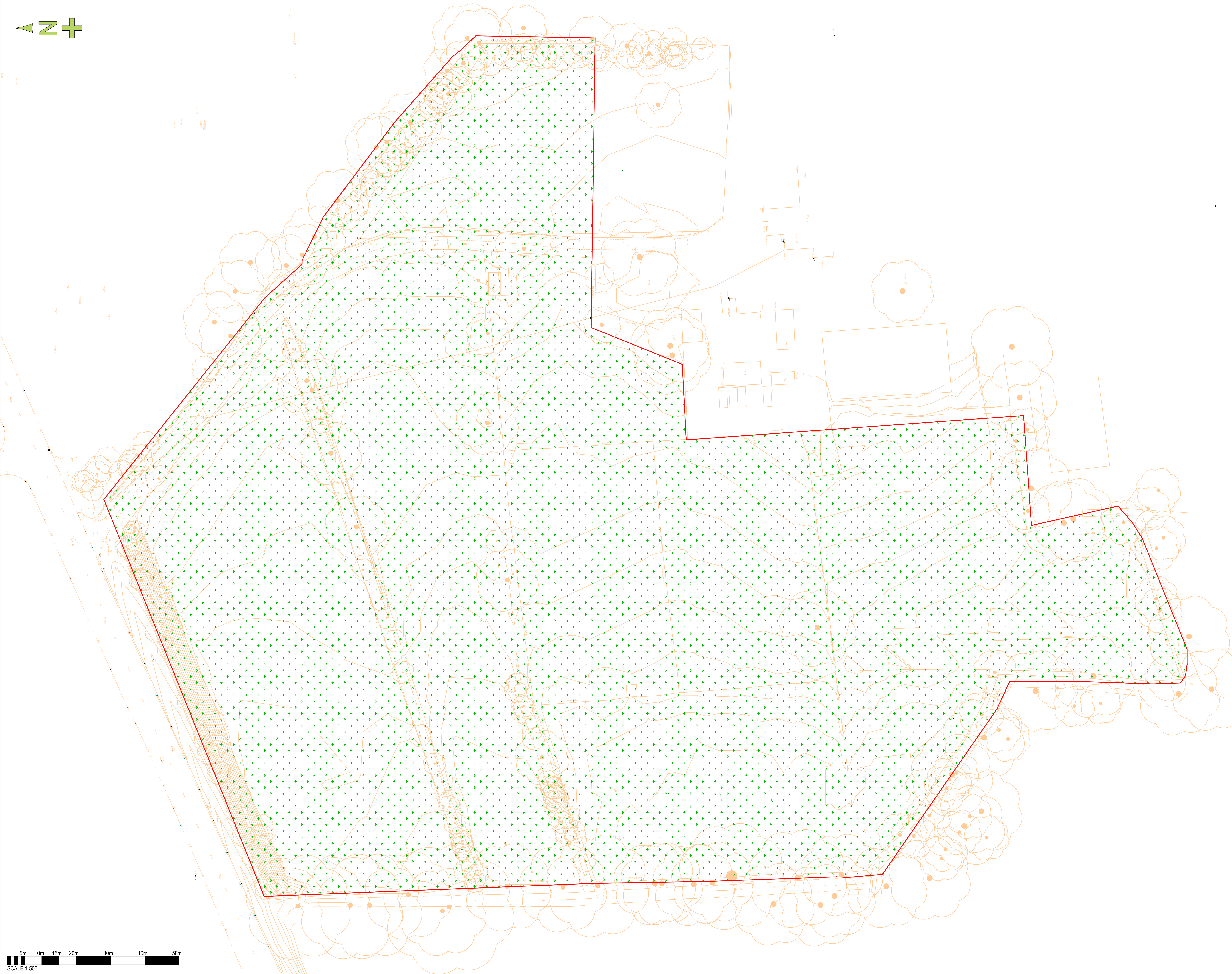
New ponds may become rapidly dominated by invasive native plants, particularly common bulrush (Typha latifolia). As it is not desirable for all new ponds to be bulrush dominated, it should be ensured that in the first five years, while vegetation is establishing, certain plant growth is controlled. After this time, ponds can usually be allowed to develop naturally recognizing that, unless the margins are occasionally managed, they are likely to become dominated by trees and shrubs. Eutrophication of SuDS ponds can occur during the summer months. This is best alleviated by controlling the nutrient source or providing a continuous baseflow to the pond. Unless eutrophication is severe, aeration can be used as a stop-gap measure to save aquatic animal species and reduce risks to receiving waters. However, the addition of barley straw bales, dredging or rendering the nutrients inactive by chemical means can also be successful.

Maintenance Plans and schedules should be developed during the design phase. Specific maintenance needs of the pond should be monitored, and maintenance schedules adjusted to suit requirements. Further detail on the preparation of maintenance specifications and schedules of work is given in ***Chapter 32 of CIRIA SuDS Manual 2015***.

Generic health and safety guidance is provided in ***Chapter 36 of CIRIA SuDS Manual 2015***. CDM 2015 requires designers to ensure that all maintenance risks have been identified, eliminated, reduced and/or controlled where appropriate. This information will be required as part of the health and safety file.

Activity	Action Required	Frequency
Regular maintenance	Remove litter and debris. Inspect inlets, outlets, banksides, structures, pipework etc for evidence of blockage and/or physical damage. Inspect marginal and bankside vegetation and remove nuisance plants	Monthly
	Cut grass – public areas	Monthly during growing season
	Cut the meadow grass	Half yearly (spring – before nesting season and autumn)
	Inspect water body for signs of poor water quality.	Monthly (May-October)
	Check any penstocks and other mechanical devices. Inspect silt accumulation rates in any forebay and in main body of the pond and stablish appropriate removal frequencies; undertake contamination testing once some build-up has occurred, to inform management and disposal options.	Half yearly
	Hand cut submerged and emergent aquatic plants (at minimum of 0.1 m above the pond base; include max. 25% of pond surface) Remove 25% of bank vegetation from water's edge to a minimum of 1 m above water level Tidy all dead growth (scrub clearance) before start of growing season (Note: tree maintenance is usually part of overall landscape management contract)	Annually
	Remove sediment from any forebay.	Every 1-5 years, or as requested
	Remove sediment and planting from one quadrant of the main body of ponds without sediment forebays.	Every 5 years, or as requested
Occasional maintenance	Remove sediment from the main body of big ponds when pool volume is reduced by 20%	With effective pre-treatment, this will only be required rarely, eg every 25-50 years
Remedial actions	Repair erosion or other damage. Replant, where necessary. Aerate pond when signs of eutrophication are detected. Realign rip-rap or repair other damage. Repair/rehabilitation of inlets, outlets and overflows.	As required

Appendix 6
Pre & Post-Development Impermeable Area Plans
Conceptual Drainage Layout



Notes:

1. DO NOT SCALE FROM THIS DRAWING.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER DRAWINGS AND SPECIFICATIONS ASSOCIATED WITH THIS PROJECT.
3. THE SURVEY HAS BEEN TAKEN FROM JANE DUNCAN THE FROM MULTI-LIMN'S TOPOGRAPHICAL LAND SURVEY DATED JANUARY 2019.

KEY

(red line)	SITE BOUNDARY	4.339 HA
(green hatch)	TOTAL SOFT LANDSCAPE AREA	4.339 HA
	TOTAL IMPERMEABLE AREA	0 HA
	SITE IMPERMEABILITY	0%

Rev	Description	Drn	Chk	Date
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COPTHORNE, WEST SUSSEX, RH10 3LA

Drawing
PRE DEVELOPMENT IMPERMEABLE AREA PLAN
RESIDENTIAL

FOR APPROVAL

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KEY

(red line)	SITE BOUNDARY	4.339 HA
(magenta hatch)	TOTAL HARDSTANDING AREA	0.841HA
(blue cross-hatch)	TOTAL ROOF AREA (INC. 10% URBAN CREEP ALLOWANCE)	0.567HA
(green pattern)	TOTAL SOFT LANDSCAPE AREA	2.930HA
	TOTAL IMPERMEABLE AREA	1.408HA
	SITE IMPERMEABILITY	32.5%

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Drawing
POST DEVELOPMENT IMPERMEABLE AREA PLAN
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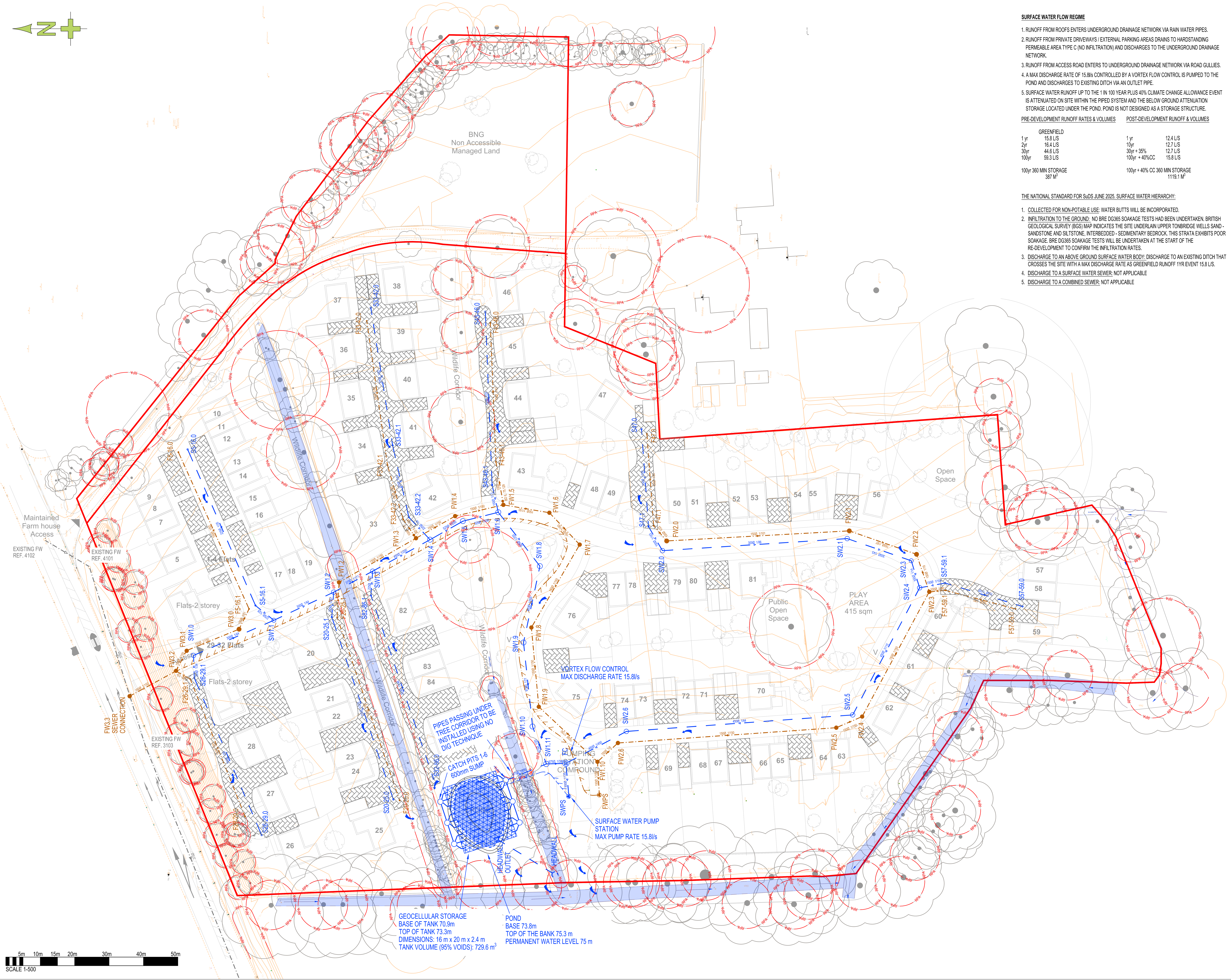
25-0093	C10525	A



SURFACE WATER FLOW REGIME

1. RUNOFF FROM ROOFS ENTERS UNDERGROUND DRAINAGE NETWORK VIA RAIN WATER PIPES.
2. RUNOFF FROM PRIVATE DRIVEWAYS / EXTERNAL PARKING AREAS DRAINS TO HARDSTANDING PERMEABLE AREA TYPE C (NO INFILTRATION) AND DISCHARGES TO THE UNDERGROUND DRAINAGE NETWORK.
3. RUNOFF FROM ACCESS ROAD ENTERS TO UNDERGROUND DRAINAGE NETWORK VIA ROAD GULLIES.
4. A MAX DISCHARGE RATE OF 15.8l/s CONTROLLED BY A VORTEX FLOW CONTROL IS PUMPED TO THE POND AND DISCHARGES TO EXISTING DITCH VIA AN OUTLET PIPE.
5. SURFACE WATER RUNOFF UP TO THE 1 IN 100 YEAR PLUS 40% CLIMATE CHANGE ALLOWANCE EVENT IS ATTENUATED ON SITE WITHIN THE PIPED SYSTEM AND THE BELOW GROUND ATTENUATION STORAGE LOCATED UNDER THE POND. POND IS NOT DESIGNED AS A STORAGE STRUCTURE.

PRE-DEVELOPMENT RUNOFF RATES & VOLUMES

	GREENFIELD
1 yr	15.8 L/S
2yr	16.4 L/S
30yr	44.6 L/S
100yr	59.3 L/S

100yr 360 MIN STORAGE
387 M^3

POST-DEVELOPMENT RUNOFF & VOLUMES

1 yr	12.4 L/S
10yr	12.7 L/S
30yr + 35%	12.7 L/S
100yr + 40%CC	15.8 L/S

100yr + 40% CC 360 MIN STORAGE
1119.1 M^3

THE NATIONAL STANDARD FOR SuDS JUNE 2025. SURFACE WATER HIERARCHY:

1. COLLECTED FOR NON-POTABLE USE: WATER BUTTS WILL BE INCORPORATED.
2. INFILTRATION TO THE GROUND: NO BRE DG365 SOAKAGE TESTS HAD BEEN UNDERTAKEN. BRITISH GEOLOGICAL SURVEY (BGS) MAP INDICATES THE SITE UNDERLAIN UPPER TONBRIDGE WELLS SAND - SANDSTONE AND SILTSTONE, INTERBEDDED - SEDIMENTARY BEDROCK. THIS STRATA EXHIBITS POOR SOAKAGE. BRE DG365 SOAKAGE TESTS WILL BE UNDERTAKEN AT THE START OF THE RE-DEVELOPMENT TO CONFIRM THE INFILTRATION RATES.
3. DISCHARGE TO AN ABOVE GROUND SURFACE WATER BODY: DISCHARGE TO AN EXISTING DITCH THAT CROSSES THE SITE WITH A MAX DISCHARGE RATE AS GREENFIELD RUNOFF 1YR EVENT 15.8 L/S.
4. DISCHARGE TO A SURFACE WATER SEWER: NOT APPLICABLE
5. DISCHARGE TO A COMBINED SEWER: NOT APPLICABLE

Notes:

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KEY

SITE BOUNDARY

EXISTING
- 225Ø 1/80 FOUL WATER SEWER
- EXISTING DITCH / WATERCOURSE

PROPOSED
- 225Ø SURFACE WATER DRAINAGE - DIA GRADIENT
- 225Ø FOUL WATER DRAINAGE - DIA GRADIENT
- RISING MAIN SURFACE WATER
- RISING MAIN FOUL WATER
- GEOCELLULAR STORAGE CRATE
- HEADWALL
- EXCEEDANCE FLOW ROUTE
- SWPS SURFACE WATER PUMPING STATION
- FWPS FOUL WATER PUMPING STATION
- FC FLOW CONTROL
- HARDSTANDING PERMEABLE AREA TYPE C (NO INFILTRATION)
- RPA ROOT PROTECTION AREA

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Drawing
DRAINAGE LAYOUT
RESIDENTIAL

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INDEXES HAVE BEEN OBTAINED FROM THE FOLLOWING TABLES:

BOX 26.2: STEPS OF THE SIMPLE INDEX APPROACH:

STEP 1 - ALLOCATE SUITABLE POLLUTION HAZARD INDICES FOR THE PROPOSED LAND USE

STEP 2 - SELECT SUDS WITH A TOTAL POLLUTION MITIGATION INDEX THAT EQUALS OR EXCEEDS THE POLLUTION HAZARD INDEX

STEP 3 - WHERE THE DISCHARGE IS TO PROTECTED1 SURFACE WATERS OR GROUNDWATER, CONSIDER THE NEED FOR A MORE PRECAUTIONARY APPROACH

NOTE: DESIGNATED AS THOSE PROTECTED FOR THE SUPPLY OF DRINKING WATER (TABLE 4.3).

TABLE 26.2: POLLUTION HAZARD INDICES FOR DIFFERENT LAND USE CLASSIFICATIONS:

LAND USE	POLLUTION HAZARD LEVEL	TOTAL SUSPENDED SOLIDS (TSS)	METALS	HYDROCARBONS
RESIDENTIAL ROOFS	VERY LOW	0.2	0.2	0.05
OTHER ROOF (TYPICALLY COMMERCIAL / INDUSTRIAL ROOFS)	LOW	0.3	0.2 (UP TO 0.8 WHERE THERE IS POTENTIAL FOR METALS TO LEACH FROM THE ROOF)	0.05
INDIVIDUAL PROPERTY DRIVEWAYS, RESIDENTIAL CAR PARKS, LOW TRAFFIC ROADS (EG CUL DE SACS, HOMEZONES AND GENERAL ACCESS ROADS) AND NON-RESIDENTIAL CAR PARKING WITH INFREQUENT CHANGE (EG SCHOOLS, OFFICES) IE < 300 TRAFFIC MOVEMENTS/DAY	LOW	0.5	0.4	0.4
COMMERCIAL YARD AND DELIVERY AREAS, NON-RESIDENTIAL CAR PARKING WITH FREQUENT CHANGE (EG HOSPITALS, RETAIL), ALL ROADS EXCEPT LOW TRAFFIC ROADS AND TRUNK ROADS/MOTORWAYS [1]	LOW	0.7	0.6	0.7
SITES WITH HEAVY POLLUTION (EG HAULAGE YARDS, LORRY PARKS, HIGHLY FREQUENTED LORRY APPROACHES TO INDUSTRIAL ESTATES, WASTE SITES), SITES WHERE CHEMICALS AND FUELS (OTHER THAN DOMESTIC FUEL OIL) ARE TO BE DELIVERED, HANDLED, STORED, USED OR MANUFACTURED; INDUSTRIAL SITES; TRUNK ROADS AND MOTORWAYS[1]	HIGH	0.8[2]	0.8[2]	0.9[2]

NOTES:

1. MOTORWAYS AND TRUNK ROADS SHOULD FOLLOW THE GUIDANCE AND RISK ASSESSMENT PROCESS SET OUT IN HIGHWAYS AGENCY (2009).
2. THESE SHOULD ONLY BE USED IF CONSIDERED APPROPRIATE AS PART OF A DETAILED RISK ASSESSMENT - REQUIRED FOR ALL THESE LAND USE TYPES (TABLE 4.3). WHEN DEALING WITH HIGH HAZARD SITES, THE ENVIRONMENTAL REGULATOR SHOULD FIRST BE CONSULTED FOR PRE-PERMITTING ADVICE. THIS WILL HELP DETERMINE THE MOST APPROPRIATE APPROACH TO THE DEVELOPMENT OF A DESIGN SOLUTION.

TABLE 26.3: INDICATIVE SUDS MITIGATION INDICES FOR DISCHARGES TO SURFACE WATERS

	MITIGATION INDICES[1]		
TYPE OF SUDS COMPONENT	TSS	METALS	HYDROCARBONS
FILTER STRIP	0.4	0.4	0.5
FILTER DRAIN	0.42	0.4	0.4
SWALE	0.5	0.6	0.6
BIORETENTION SYSTEM	0.8	0.8	0.8
PERMEABLE PAVEMENT	0.7	0.6	0.7
DETENTION BASIN	0.5	0.5	0.6
POND[4]	0.73	0.7	0.5
WETLAND	0.83	0.8	0.8
PROPRIETARY TREATMENT SYSTEMS[5,6]	THESE MUST DEMONSTRATE THAT THEY CAN ADDRESS EACH OF THE CONTAMINANT TYPES TO ACCEPTABLE LEVELS FOR FREQUENT EVENTS UP TO APPROXIMATELY THE 1 IN 1 YEAR RETURN PERIOD EVENT, FOR INFLOW CONCENTRATIONS RELEVANT TO THE CONTRIBUTING DRAINAGE AREA.		

NOTES:

1. SUDS COMPONENTS ONLY DELIVER THESE INDICES IF THEY FOLLOW DESIGN GUIDANCE WITH RESPECT TO HYDRAULICS AND TREATMENT SET OUT IN THE RELEVANT TECHNICAL COMPONENT CHAPTERS.
2. FILTER DRAINS CAN REMOVE COARSE SEDIMENTS, BUT THEIR USE FOR THIS PURPOSE WILL HAVE SIGNIFICANT IMPLICATIONS WITH RESPECT TO MAINTENANCE REQUIREMENTS, AND THIS SHOULD BE TAKEN INTO ACCOUNT IN THE DESIGN AND MAINTENANCE PLAN.
3. PONDS AND WETLANDS CAN REMOVE COARSE SEDIMENTS, BUT THEIR USE FOR THIS PURPOSE WILL HAVE SIGNIFICANT IMPLICATIONS WITH RESPECT TO THE MAINTENANCE REQUIREMENTS AND AMENITY VALUE OF THE SYSTEM. SEDIMENT SHOULD NORMALLY BE REMOVED UPSTREAM, UNLESS THEY ARE SPECIFICALLY DESIGNED TO RETAIN SEDIMENT IN A SEPARATE PART OF THE COMPONENT, WHERE IT CANNOT EASILY MIGRATE TO THE MAIN BODY OF WATER.
4. WHERE A WETLAND IS NOT SPECIFICALLY DESIGNED TO PROVIDE SIGNIFICANTLY ENHANCED TREATMENT, IT SHOULD BE CONSIDERED AS HAVING THE SAME MITIGATION INDICES AS A POND.
5. SEE CHAPTER 14 FOR APPROACHES TO DEMONSTRATE PRODUCT PERFORMANCE. A BRITISH WATER/ENVIRONMENT AGENCY ASSESSMENT CODE OF PRACTICE IS CURRENTLY UNDER DEVELOPMENT THAT WILL ALLOW MANUFACTURERS TO COMPLETE AN AGREED TEST PROTOCOL FOR SYSTEMS INTENDED TO TREAT CONTAMINATED SURFACE WATER RUNOFF. FULL DETAILS CAN BE FOUND AT: http://tinyurl.com/qf7yuj7
6. SEPA ONLY CONSIDERS PROPRIETARY TREATMENT SYSTEMS AS APPROPRIATE IN EXCEPTIONAL CIRCUMSTANCES WHERE OTHER TYPES OF SUDS COMPONENT ARE NOT PRACTICABLE. PROPRIETARY TREATMENT SYSTEMS MAY ALSO BE CONSIDERED APPROPRIATE FOR EXISTING SITES THAT ARE CAUSING POLLUTION WHERE THERE IS A REQUIREMENT TO RETROFIT TREATMENT. SEPA (2014) ALSO PROVIDES A FLOWCHART WITH A SUMMARY OF CHECKS ON SUITABILITY OF A PROPRIETARY SYSTEM.

WATER QUALITY MANAGEMENT

THE EFFECT OF THE PROPOSED WORK ON LOCAL WATER QUALITY HAS BEEN ASSESSED USING THE SIMPLE QUALITATIVE METHOD AS SET OUT IN CIRIA REPORT C753 THE SUDS MANUAL 2015 [CHAPTER 26].

RUNOFF FROM ROOFS

	TSS		METALS		HYDROCARBONS	
	POLLUTION INDEX	MITIGATION INDEX	POLLUTION INDEX	MITIGATION INDEX	POLLUTION INDEX	MITIGATION INDEX
POND	0.2	0.7	0.2	0.7	0.05	0.5

RUNOFF FROM DRIVEWAYS AND PARKING AREAS

	TSS		METALS		HYDROCARBONS	
	POLLUTION INDEX	MITIGATION INDEX	POLLUTION INDEX	MITIGATION INDEX	POLLUTION INDEX	MITIGATION INDEX
PERMEABLE PAVEMENT		0.70		0.60		0.70
POND		0.70		0.70		0.50
TOTAL SuDS MITIGATION INDEX	0.50	1.05	0.40	0.95	0.40	0.95

RUNOFF FROM ACCESS ROAD

	TSS		METALS		HYDROCARBONS	
	POLLUTION INDEX	MITIGATION INDEX	POLLUTION INDEX	MITIGATION INDEX	POLLUTION INDEX	MITIGATION INDEX
POND	0.5	0.7	0.4	0.7	0.4	0.5

BASED ON THE INCORPORATION OF PERMEABLE PAVEMENT IN DRIVEWAYS AND PARKING AREAS FOR TREATMENT OF RUNOFF AND THE POND UPSTREAM DISCHARGING TO THE DITCH FOR TREATMENT OF ROOF, DRIVEWAYS, PARKING AREAS AND ACCESS ROAD RUNOFF, THE TOTAL POLLUTION MITIGATION INDEX FOR THESE SUDS COMPONENTS IS HIGHER THAN THE POLLUTION HAZARD INDEX FOR TSS, METALS AND HYDROCARBONS.

Notes:

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Drawing
SURFACE WATER QUALITY ANALISYS RESIDENTIAL

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Scale @ A1	Date	Drawn by	Checked
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Appendix 7
WSCC Flood Risk Validation Checklist For Planning Applications
WSCC Surface Water Drainage Proforma

Flood Risk Validation Checklist for Planning Applications

SITE NAME	Land at Courthouse Farm, Copthorne
DATE	03/09/2025

1. Proforma

Description	Document/Drawing Ref and Page No. APPLICANT TO COMPLETE	Submitted? (Yes/No) LPA TO CHECK
Application only be validated by LPA if the LLFA surface water proforma is completed and attached	FRADS Ref 25-0093	

2. Site Surveys (if appropriate)

Description	Document/Drawing Ref and Page No. APPLICANT TO COMPLETE	Submitted? (Yes/No) LPA TO CHECK
Topographic survey	FRADS Appendix 1	
Details of existing site layout, drainage, and catchment areas plus pre- and post-development impermeable areas	FRADS Appendix 3 & 6	
Evidence of % increase for urban creep and how it has been applied to post-development calculations	FRADS Appendix 5 & 6	
Ground investigation including groundwater level information (for seasonally high groundwater level), potential contamination and infiltration testing (to BRE365 or similar)	No Ground Investigation or BRE DG365 testing undertaken to date.	
Existing drainage scheme survey, e.g., CCTV or historic plans	FRADS Appendix 1	
Survey of existing waterbodies, e.g., watercourses, ponds or springs and culverts or bridges	FRADS Appendix 1	

3. Plans and Drawings

Description	Document/Drawing Ref and Page No. APPLICANT TO COMPLETE	Submitted? (Yes/No) LPA TO CHECK
Layout drawing including drainage scheme SuDS and other water features. Including invert levels, cover levels, conveyance systems any pipe gradients, flow directions and labels that match any drainage modelling calculations. Outfall locations, control devices, attenuation systems and water quality treatment features.	FRADS Appendix 6	

Description	Document/Drawing Ref and Page No. APPLICANT TO COMPLETE	Submitted? (Yes/No) LPA TO CHECK
High level construction management plan including phasing access arrangements and operational characteristics. Temporary drainage and water pollution including discharge points and flow controls should be included.	Not applicable	
Landscaping planting scheme for vegetated SuDS	Not applicable	
Maintenance plan and confirmation in principle of adopting authority for the lifetime of the development	FRADS Appendix 5	

4. Assessments

Description	Document/Drawing Ref and Page No. APPLICANT TO COMPLETE	Submitted? (Yes/No) LPA TO CHECK
Evidence that that the SuDS hierarchy and the 4 pillars have been met	FRADS Page 16	
Full supporting calculations for the drainage design including design parameters using FEH and predevelopment greenfield runoff rates/volumes	FRADS Appendix 5	
Critical storm simulation results of the conveyance network by level and discharge for events 100% AEP, 3.33% AEP, 3.33% AEP plus climate change, 1% AEP and 1% AEP plus climate change	FRADS Appendix 5	
Evidence of calculations to support the sizing of storage features to accommodate the 3.33% AEP plus climate change and 1% AEP climate change critical storms	FRADS Apendix 5	
Evidence and drawing of where any flooding would occur during a 1% AEP plus climate change critical storm event would occur. Information should include extent, depth, and velocity of flooding, demonstrating that it would not leave the site boundary.	No flooding	
Flood resistance and resilience measures 300mm above flood levels	Not applicable	
Drawing showing exceedance flows greater than 1% AEP plus climate change or if the drainage system is compromised	FRADS Appendix 6	

5. Supplementary Evidence

Description	Document/Drawing Ref and Page No. APPLICANT TO COMPLETE	Submitted? (Yes/No) LPA TO CHECK
Confirmation of discharge location approval (in principal agreements from third parties if appropriate)	FRADS Appendix 8	
Confirmation of any consents required	FRADS Page 22 & 23	
Evidence of predevelopment discharge capacity analysis (where discharging from an existing pipe)	Not applicable	

Surface Water Drainage Proforma

West Sussex County Council (WSCC) as Lead Local Flood Authority recommends this proforma is completed and submitted to support any planning application for a major development. The information contained in this form will be used by WSCC officers in their role as 'statutory consultee' on surface water drainage. The proforma should accompany the site-specific Flood Risk Assessment and Drainage Strategy submitted as part of the planning application.

1. Site Details

No.	Requirement	Answer	Application Type
1.1	Address including postcode	Land at Courthouse Farm, Copthorne Common Road, Copthorne RH10 3LA	Outline & Full
1.2	OS grid reference (easting and northing)	532402 , 139032	Outline & Full
1.3	Planning application reference	TBA	Outline & Full
1.4	Total site area (hectares)	4.339 ha	Outline & Full
1.5	Pre-development use	Greenfield / Grazing	Outline & Full
1.6	Proposed design life	60 years	Outline & Full
1.7	Have agreements in principle for discharge been provided (where applicable)? (YES/NO)	No	Outline & Full
1.8	Topographic Survey Plan showing existing site layout, site levels and drainage system	Yes included in FRADS Appendix 1	Outline & Full

2. Discharge Hierarchy/Methods of Discharge[1]

No.	Requirement	Answer	Application Type
2.1	Store rainwater for later use (reuse) (YES/NO)	N/A	Full
2.2	Infiltration techniques such as soakaways, permeable paving, etc (YES/NO)	Type C Permeable pavements for private driveways	Outline & Full
2.3	Hybrid (YES/NO)	No	Outline & Full

[1] Runoff may be discharged via one or multiple methods.

No.	Requirement	Answer	Application Type
2.4	Attenuation with restricted discharge to watercourse (YES/NO)	Yes	Outline & Full
2.5	Attenuation with restricted discharge to surface water sewer (YES/NO)	No	Outline & Full
2.6	Attenuation with restricted discharge to combined sewer (YES/NO)	No	Outline & Full

3. Calculation Inputs

No.	Requirement	Answer	Application Type
3.1	Area within site which is drained by SuDS[2] (hectares)	4.339	Outline & Full
3.2	Impermeable area drained pre-development[3] (hectares)	0	Outline & Full
3.3	Impermeable area drained post-development[3] (hectares)	1.408	Outline & Full
3.4	Urban Creep (hectares)	0.051	Outline & Full
3.5	Climate change factor applied (1 in 30 and 1 in 100) (percentage)	1 in 30 = 35% 1 in 100 = 40%	Outline & Full

4. Infiltration Feasibility/Ground Investigations

No.	Requirement	Answer	Application Type
4.1	Has winter groundwater monitoring and infiltration been undertaken? (YES/NO)	No	Outline & Full
4.2	Period of winter groundwater monitoring (from/to)	N/A	Outline & Full
4.3	Depth to highest recorded groundwater level (mAOD)	N/A	Full
4.4	Infiltration rate	N/A	Outline & Full

[2] Impermeable area should be measured pre and post development. Impermeable surfaces include roofs, pavements, driveways and paths, where runoff is conveyed to the drainage system.

[3] 10% Urban Creep should be added to the volumes required for storage and not increase discharge rates.

No.	Requirement	Answer	Application Type
4.5	Depth of infiltration structure (mAOD)	N/A	Full
4.6	Safety factor used for sizing infiltration storage	N/A	Outline & Full

5. Calculation Outputs: Greenfield Runoff Rates[4]

No.	Requirement	Answer	Application Type
5.1	Qbar (l/s)	18.6	Outline & Full
5.2	1 in 1 year rainfall (l/s)	15.8	Outline & Full
5.3	1 in 30 year rainfall (l/s)	44.6	Outline & Full
5.4	1 in 100 year rainfall (l/s)	59.3	Outline & Full

6. Calculation Outputs: Brownfield Runoff Rates (including Urban Creep) (if applicable)

No.	Requirement	Answer	Application Type
6.1	1 in 1 year rainfall (l/s)	N/A	Outline & Full
6.2	1 in 30 year rainfall (l/s)	N/A	Outline & Full
6.3	1 in 100 year rainfall (l/s)	N/A	Outline & Full

7. Calculation Outputs: Volume Control/Infiltration Provision

No.	Requirement	Answer	Application Type
7.1	Infiltration (m^3)	N/A	Outline & Full
7.2	Attenuation (m^3)	729.6	Outline & Full
7.3	Separate volume designated as long-term storage[5] (m^3)	N/A	Full
7.4	Total volume control (sum of inputs for 7.1 to 7.3) (m^3)	N/A	Full

[4] Flows within long term storage areas should be infiltrated to the ground or discharged at low flow rate of maximum 2 litres per second per hectare (l/s/ha).

[5] In calculations and for the avoidance of doubt FEH shall be used FSR is not acceptable, and CV values must equal 1.

8. Calculation Outputs: Attenuation/Restricted Discharge

No.	Requirement		Answer	Application Type
8.1	Proposed discharge rate (critical storm)	1 in 1 (100%) AEP (m/s)	15.8	Outline & Full
		1 in 30 (3.33%) AEP (m/s)	15.8	Outline & Full
		1 in 30 (3.33%) AEP plus climate change (m/s)	15.8	Outline & Full
		1 in 100 (1%) AEP (m/s)	15.8	Outline & Full
		1 in 100 (1%) AEP plus climate change (m/s)	15.8	Outline & Full
8.2	Calculations show critical storm durations (both by max height and max discharge) for 1 in 1, 1 in 30, 1 in 30 plus climate change, 1 in 100 and 1 in 100 year plus climate change allowance can be accommodated on site (YES/NO)		Yes	Outline & Full
8.3	Has treatment of potential contaminants been considered? (YES/NO)		Yes	Outline & Full
8.4	Demonstration of source control features with substantive evidence why these cannot be used if not (YES/NO)		Yes	Full
8.5	If discharging into a watercourse, piped system or the sea, has the proposed drainage network been modelled against predicted top water levels for the 1 in 100 year storm event plus climate change allowance, within the existing system? (YES/NO)		N/A	Full

9. Other Supporting Details

No.	Requirement	Answer	Application Type
9.1	Plan detailing location of groundwater monitoring and infiltration testing	N/A	Outline & Full
9.2	Detailed drainage design layout	FRADS Appendix 6	Full
9.3	Maintenance strategy	FRADS Appendix 5	Full

No.	Requirement	Answer	Application Type
9.4	Detailed development layout	FRADS Appendix 3	Full
9.5	Impermeable area plan	FRADS Appendix 6	Full
9.6	Phasing plan?	N/A	Full
9.7	If ground levels are being raised over 300mm above existing levels and is unavoidable, have detailed plans been provided, together with drainage proposals, to address any potential drainage related issues?	N/A	Full

The above form should be completed using evidence from information which should be appended to this form. The information being submitted should be proportionate to the site conditions, flood risks and magnitude of development. It should serve as a summary of the drainage proposals and should clearly show that the proposed discharge rate and volume as a result of development will not be increasing. Where there is an increase in discharge rate or volume, then the relevant section of this form must be completed with clear evidence demonstrating how the requirements will be met.

This form is completed using factual information and can be used as a summary of the surface water drainage strategy on this site.

Form completed by	C J Mellett
Qualification of person responsible for signing off this proforma	IEng MICE
Company	BdR [Civil & Structural Engineering] Ltd
On behalf of (client's details)	Option Two Developments Ltd
Date	03/09/25

Appendix 8
Pre-Application Advice from WSCC LLFA
Pre-Planning Enquiry Response from Thames Water

Eleanor Read
Flood Risk Management Officer
Flood Risk Management Team, Planning Services
Eleanor.read@westsussex.gov.uk
www.westsussex.gov.uk

Ground Floor,
Northleigh,
County Hall,
Chichester,
PO19 1RH

west sussex county council

Chris Mellett - BdR [Civil & Structural Engineering] Ltd
The Old Engine House
Goblands Farm
Cemetery Lane
Tonbridge
TN11 0DP

Dear Mr Mellett,

4th June 2025

WSCC-714976663 – Court House Farm, Copthorne Common Road, Copthorne, RH10 3LA

WSCC Flood Risk Management Team Level 1 Pre-Application Advice has been sought for an approximately 4.3ha site in Mid Sussex district. It is expected that 93 dwellings will be built.

Flood Risk for Court House Farm

The proposed site does not lie within Flood Zones 2 or 3, however it is over 1ha therefore a Flood Risk Assessment in line with guidance from the Environment Agency (Flood risk assessments: applying for planning permission), NPPF (December 2024 version) and PPG Flood risk and coastal change (August 2022 version; this includes a Site-specific flood risk assessment checklist) will be required. Within the FRA all sources of flooding should be assessed, including flood risk from surface water, ordinary watercourses including ditches, groundwater, artificial sources such as reservoirs and existing drainage infrastructure. The site is not currently located in EA flood warning or alert areas.

The proposed site is in an area of predominantly very low risk of surface water flooding as identified by the Environment Agency Flood Map for Planning. There are areas of low to high risk associated with watercourses along the western and southern site boundaries and two crossing the upper third of the site, along with isolated low spots presenting increased risk. According to our records there are four ordinary watercourses crossing or bordering the site (Appendix A).

According to BGS data the bedrock for the site is Upper Tunbridge Wells Sand. It is noted that winter groundwater monitoring and infiltration testing results have not been provided for our review. These will need to be provided when the application is submitted to the Local Planning Authority. As this is an outline application a preliminary investigation of the soil and geology is acceptable, although ideally we'd need infiltration testing to demonstrate at outline stage that infiltration is not viable. Given the geology of the site, we'd suggest 4 tests are completed across the site. We'll also need winter groundwater monitoring to support the detailed design work, to ensure there is 1m clearance between the highest winter groundwater level and the base of any attenuation features such as basins. Groundwater flood risk details can be found in Appendix B.

On EA mapping there are no records of fluvial flooding. Copthorne is identified as a wet spot in the WSCC Local Flood Risk Management Strategy (2013). Please note this is in the process of being updated. WSCC have no records of surface water or groundwater flood events within the site, however there are events recorded in the surrounding area (Appendix C). Please note, this does not guarantee that no flooding has occurred within the site boundary or as flood events might not have been reported to the Flood Risk Management Team.

SuDS Guidance:
The use of Sustainable Drainage Systems (SuDS) should be considered at an early stage in the design process, to integrate SuDS with road networks and other infrastructure. The drainage system should consider the four pillars of SuDS (water quantity, water quality, amenity, and biodiversity) and follow the surface water discharge hierarchy. We expect that investigation into infiltration potential is undertaken using methods in accordance with BRE365. If infiltration testing and groundwater monitoring results are unfavourable for draining the site using infiltration SuDS, any existing runoff rates/volumes must be controlled to a pre-development greenfield runoff rate (Qbar). We would expect that above ground SuDS are used as much as possible to maximise controlling surface water runoff where if falls (e.g. water reuse, green roofs, bioretention areas, ponds, basins, swales etc.).

The FRA/Drainage Strategy should demonstrate there will be sufficient surface water quality treatment by implementing an appropriate amount of water quality treatment stages through the use of SuDS. Chapter 26 of the CIRIA SuDS Manual has lots of guidance for managing surface water quality, including tables for suitability of different SuDS components and the Simple Index Approach. Interception storage should be used in the beginning of the treatment train to ensure the drainage system manages pollutants as close to the source as possible and remove sediment upstream in the system rather than closer to the discharge location.

We would expect that any proposed surface water drainage scheme takes all opportunities to improve any existing risk of flooding to the surrounding road networks. Opportunities should also be considered on how the development may improve flood risk overall by assessing if any additional flood mitigation can be integrated into the scheme, such as storage areas in blue green corridors.

Any phasing of the development must be shown to be able to be developed with a dedicated drainage infrastructure that does not rely on any other phase to be developed. A drainage phasing timeline will be required to show how each element of the drainage system will be implemented prior to completion of the building phase. Details of the required maintenance of any SuDS features and structures and who will be adopting these features for the lifetime of the development must be provided in accordance with the NPPF.

We require the applicant to submit information and drawings which clearly shows the proposed drainage strategy and exceedance flood flow routes for all areas of development. These plans should include the finished floor levels of all buildings, the proposed finished floor levels and potential exceedance flow route.

Details of the construction phase temporary drainage arrangements are required by the LLFA to ensure there will be no increase in flood risk due to the construction works of the development either onsite or elsewhere. A high-level assessment is required at an initial planning stage. Furthermore, the applicant will also need to submit the proposed construction phasing plans for the development to demonstrate that prior to completing the site there will be no increase in flood risk due to the interim development phases either onsite or elsewhere.

When submitting the application to the Local Planning Authority, please submit the SuDS proforma and validation checklist to assist us in reviewing the application and expedite the process. These can be found here: Flood Risk Management: Pre-application advice .

Further guidance on surface water drainage requirements for planning applications within Mid Sussex District can be found on Flood Risk and Drainage for Planning - Mid Sussex District Council.

Yours sincerely,

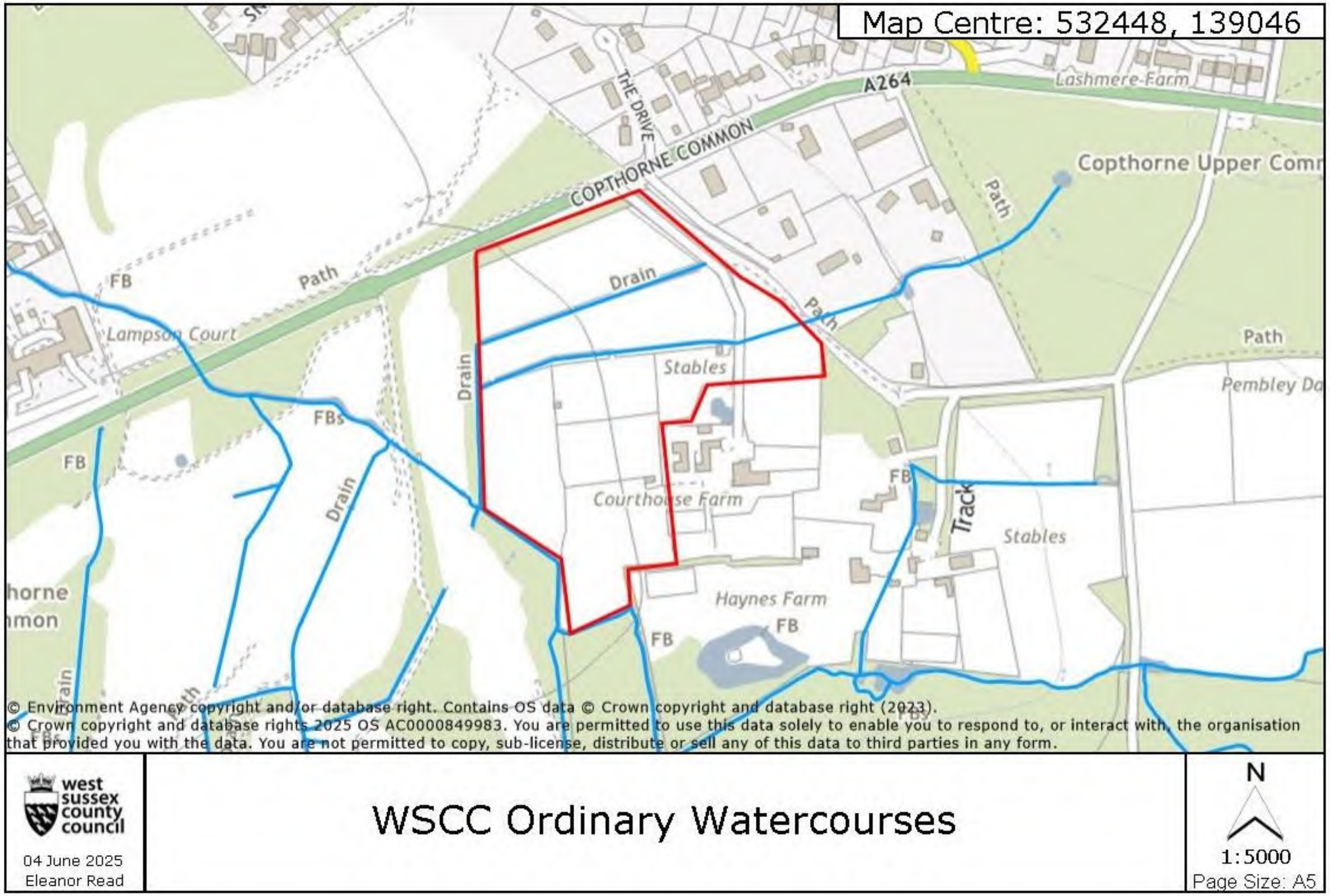
Eleanor Read

Eleanor.read@westsussex.gov.uk

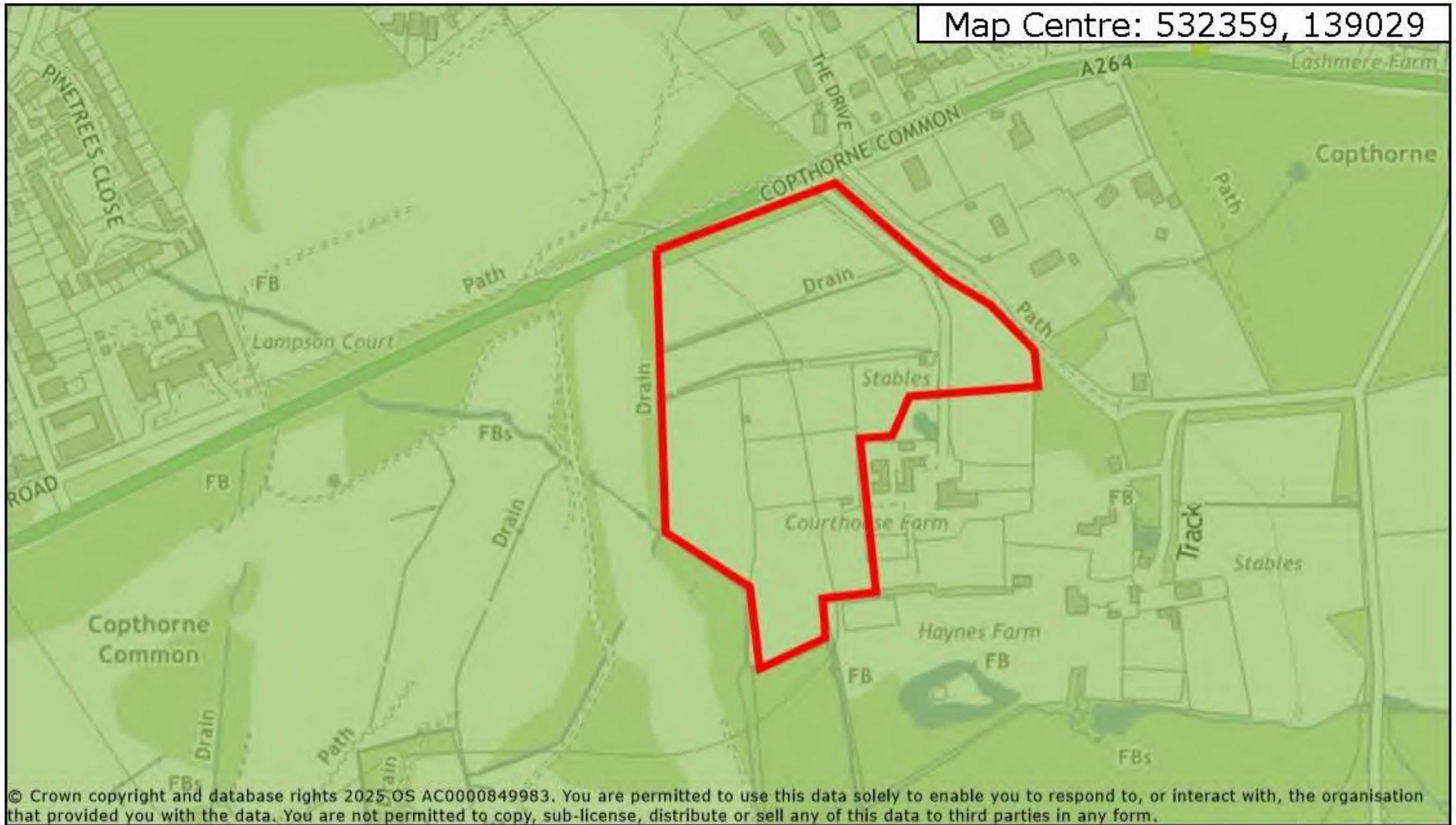
Flood Risk Management Team

Appendices

Appendix A-Ordinary Watercourses



Appendix B-Susceptibility to groundwater flooding



west sussex county council

04 June 2025
Eleanor Read

JBA Groundwater flood risk (Levels at least 5m below the surface)

N
1:5000
Page Size: A5

Appendix C-Historic Flood Incidents (WSCC)

No records within site itself
Flood caused by surface water and/or groundwater on Copthorne Common Road
Floods caused by the ordinary watercourse on Pine Trees Close

Chris Mellett

BdR [Civil & Structural Engineering] Ltd
The Old Engine House
Goblands Farm Business Park
Hadlow
TN11 0DP

Wastewater pre-planning
Our ref DS6141896/DTS79175

24 June 2025

Pre-planning enquiry: Confirmation of sufficient capacity

Site Address: Land at Court House Farm, Copthorne Common Road, Copthorne, RH10 3LA

Dear Chris

Thank you for providing information on your development of the existing greenfield site with two phases of 53 and 40 general housing, totalling 93 general housing at site.

Foul water proposal: foul water to pumped at 5l/s to manhole TQ32393103 serving the 375mm foul water sewer within Copthorne Common Road.

Surface water proposal:

We have completed the assessment of the foul water flows based on the information submitted in your application with the purpose of assessing sewerage capacity within the existing Thames Water sewer network.

Foul Water

If your proposals progress in line with the details you've provided, we're pleased to confirm that there will be sufficient sewerage capacity in the adjacent foul water sewer network to serve your development.

This confirmation is valid for 12 months or for the life of any planning approval that this information is used to support, to a maximum of three years.

You'll need to keep us informed of any changes to your design – for example, an increase in the number or density of homes. Such changes could mean there is no longer sufficient capacity.

Surface Water

In accordance with the Building Act 2000 Clause H3.3, positive connection of surface water to a public sewer will only be consented when it can be demonstrated that the hierarchy of disposal methods have been examined and proven to be impracticable. Before we can consider your surface water needs, you'll need written approval from the lead local flood authority that you have followed the sequential approach to the disposal of surface water and considered all practical means.

The disposal hierarchy being:

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.

Where connection to the public sewerage network is required to manage surface water flows we will accept these flows at a discharge rate in line with CIRIA's best practice guide on SuDS or that stated within the sites planning approval.

Please see our FAQ's leaflet for additional information.

What happens next?
Please make sure you submit your connection application, giving us at least 21 days' notice of the date you wish to make your new connection/s.

If you've any further questions, please contact me on **0800 009 3921**

Yours sincerely

Gemma Connolley

Adoptions & Pre-Planning Engineer
Developer Services