Flood Risk Assessment & SuDS Strategy

Project: **XXXX**
Reference: **XXXX**
Prepared for: **XXXX**
28 April 2025
Project number: **XXXX**

EXECUTIVE SUMMARY

This Flood Risk Assessment (FRA) and SuDS Strategy has been prepared in accordance with the requirements set out in the National Planning Policy Framework (NPPF) and the associated Planning Practice Guidance. It has been produced on behalf of **XXXX** in support of a planning application for a proposed dwelling at **XXXX**.

This report demonstrates that the proposed development is at an **acceptable** level of flood risk, subject to the recommended flood mitigation measures being implemented.

The site is located within Flood Zone **1**, as identified on the Environment Agency's Flood Map for Planning. It is also assessed to be the following flood sources:

- River and sea (Fluvial) - **Low** risk
- Surface Water (Pluvial) - **Low** risk
- Groundwater - **Low** risk
- Sewer Flooding - **Low** risk
- Artificial Sources - **Low** Risk

Surface water drainage from the site will be appropriately managed through the installation of a new surface water drainage system. Runoff will be directed to a below-ground geocellular attenuation tank designed to temporarily store stormwater. Flow from the attenuation system will be controlled by a Hydro-brake or similar flow control device, discharging to the local public surface water sewer.

In line with the NPPF requirements, and subject to the mitigation measures outlined within this report, the proposed development can proceed without being subject to significant flood risk. Furthermore, through the implementation of suitable surface water management techniques, the development will not increase flood risk to the surrounding area.

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INTRODUCTION

Background

The purpose of this Flood Risk Assessment (FRA) is to evaluate the flood risks associated with the proposed development at **XXXX**. The FRA seeks to ensure that future occupants of the development will remain safe throughout the lifetime of the development, that the proposals will not increase flood risk either on-site or elsewhere, and, where practicable, that opportunities to reduce overall flood risk are incorporated. This assessment addresses flood risk in accordance with the requirements set out in national and local planning policies, and includes recommendations for appropriate mitigation measures where necessary.

Site Proposals

The proposed development consists of the **full demolition of existing dwelling and rebuilding of dwelling with associated works**. A copy of the proposed development plans is included within Appendix A.

National and Local Planning Policy

The National Planning Policy Framework (NPPF) outlines the Government's national approach to land use planning in England, specifically in relation to flood risk. It requires that flood risk be taken into account at all stages of the planning process. The accompanying Planning Practice Guidance (PPG) provides detailed technical direction and is available online.

The PPG classifies the vulnerability of different land uses to flooding and guides planning decisions accordingly. It promotes the siting of development in areas of lowest flood risk wherever feasible and emphasises the need to avoid any increase in flood risk beyond the site boundary, ensuring that flood risk to the wider catchment is not exacerbated.

The National Planning Policy Framework (NPPF) outlines the requirements for site-specific Flood Risk Assessments. A FRA is required for proposals that:

A. Are greater than 1 hectare in area within Flood Zone 1;
B. Involve new development (including minor development and changes of use) within Flood Zones 2 and 3;
C. Are located in an area within Flood Zone 1 that has been identified as having critical drainage problems; and where proposed development or a change of use to a more vulnerable class may be subject to other sources of flooding;
D. Are located in an area in Flood Zone 1 identified in a Strategic Flood Risk Assessment as being at increased future flood risk or subject to other sources of flooding.
E. In an area in Flood Zone 1 that may be subject to other sources of flooding, where its development would introduce a more vulnerable use.

This FRA has been prepared to provide sufficient information to demonstrate compliance with the requirements of the NPPF, Planning Practice Guidance (PPG), and relevant regional and local government policies.

The assessment evaluates the risk of flooding from all sources, including tidal, fluvial, surface water, groundwater, sewer, and artificial sources. It also proposes mitigation measures to ensure that flood risk to the site is minimised and that flood risk elsewhere is not increased as a result of the proposed development.

Sources of Information

This FRA has been based on the following sources of information:

- NPPF
- NPPF-PPG
- Site Layout Plan
- Ordnance Survey mapping
- Site Topographical Survey
- DEFRA Magic mapping
- Environment Agency mapping, consultation and model information
- Web Based Soil Mapping
- British Geological Survey Drift & Geology Maps
- **West London Strategic Flood Risk Assessment (2018)**
- **Thames Water Sewer Records**

EXISTING SITE & HYDROLOGY CHARACTERISTICS

Site Location

The site is located at **XXXX,** within the R**oyal Borough of Kensington and Chelsea**. It lies within a predominantly **residential** area characterised by **traditional terraced housing and small-scale private gardens.**

The site comprises previously **developed brownfield land and is currently occupied by a residential building**. It is bounded by **existing dwellings on all sides and is well integrated into the urban fabric of the surrounding neighbourhood.**

The site location is approximately shown outlined in yellow in Figure below. The approximate central grid reference for the site is E: **527329**; N: **178784**.

Topography

LiDAR data indicates that ground levels across the site are relatively uniform. (see Figure below). **Flat level of site is consistent with the surrounding urban landscape and does not indicate any notable low-lying areas that may be prone to surface water accumulation.**

Ground Conditions

Geological mapping from the British Geological Survey (BGS) indicates that the site is underlain by the **London Clay Formation**, a widespread bedrock geology across much of Greater London. **Kempton Park Gravel Member** was recorded as superficial deposit predominantly consisting of **sand and gravel**. Nearby borehole data—sourced from approximately 140 metres east of the site (reference **TQ27NE1670**)—suggests **gravel and sand with occasional clay up to 8-9 meters and clay with occasional silt and sand below**.

Soilscapes mapping indicates that the site is characterised by **freely draining slightly acid loamy soils**. These characteristics suggest that surface water infiltration may be **possible**.

Existing Drainage & Hydrology

The site at **XXXX**, located within a **fully urbanised setting** in the **Royal Borough of Kensington and Chelsea**, is not in proximity to **any main rivers, ordinary watercourses, or open drainage channels. There are no known ordinary watercourses or surface channels adjacent to the site.**

SUDS - Roof drawing prepared by END Studio (Ref am250-DAS-AR-060201-R00) confirms existing connection at the from of the property to a combined sewer.

DEFRA's Magic Map (England and Wales) confirms there are **no nearby designated sites of hydrological significance (e.g. SSSIs or flood storage reservoirs) in close proximity to the site. As such, the**

development is not anticipated to impact any environmentally sensitive receptors in terms of hydrological connectivity.

DEVELOPMENT VULNERABILITY & FLOOD ZONE CLASSIFICATION

National Planning Policy Framework

Local Planning Authorities (LPAs) have a statutory duty to consult the Environment Agency (EA) on relevant planning applications where flood risk may be a concern. The EA will review such applications in line with the National Planning Policy Framework (NPPF).

NPPF requires that, as part of the planning process:

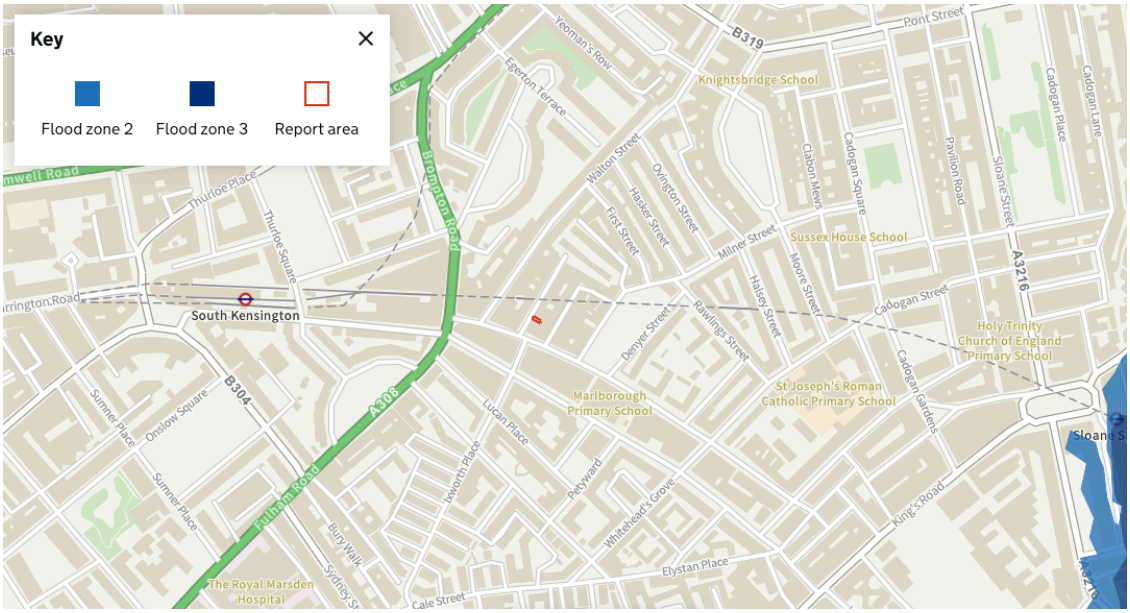
A. A 'site specific' Flood Risk Assessment will be undertaken for any site that has a flood risk potential.
B. Flood risk potential is minimised by applying a 'sequential approach' to locating 'vulnerable' land uses.
C. Sustainable drainage systems are used for surface water disposal where practical.
D. Flood risk is managed through the use of flood resilient and resistant techniques.
E. Residual risk is identified and safely managed.

Table 1 of NPPF, categorises flood zones into:

- Zone 1- Low risk, less than 0.1% Annual Event Probability (AEP) (< 1 in 1000 years)
- Zone 2- Medium risk, 0.1% AEP (1 in 1000 - 1 in 100 years)
- Zone 3a- High risk, 1% AEP (> 1 in 100 years)
- Zone 3b- High risk - Functional Floodplain, 3.33% AEP (>1 in 30 years)

Environment Agency Flood Map for Planning

The Environment Agency's Flood Map for Planning provides the most up-to-date representation of flood risk from rivers and the sea, assuming the absence of existing flood defences. These maps serve as a planning tool to determine whether sites fall within designated flood risk zones and inform the need for further assessment.



The site at **XXXX** is located within **Flood Zone 1**, as identified on the Environment Agency's Flood Map for Planning (see Figure above). **Flood Zone 1 is defined as land at low probability of fluvial or tidal flooding, with an annual probability of flooding of less than 0.1%.**

As such, the Sequential and Exception Tests are not required for this development.

SITE SPECIFIC FLOOD RISK ASSESSMENT

National Planning Policy Framework (NPPF)

In line with the NPPF, this Flood Risk Assessment (FRA) considers all potential sources of flooding, including:

A. Tidal flooding – from the sea;
B. Fluvial flooding – from rivers and streams;
C. Pluvial flooding – from surface water runoff and exceedance flows;
D. Groundwater flooding – from elevated groundwater tables or springs;
E. Flooding from sewers – including surcharge from combined or surface water systems;
F. Artificial sources – such as reservoirs, canals or infrastructure failure.

Historic Flooding

Review of the RBKC Strategic Flood Risk Assessment (SFRA) (2022) and local authority records confirms that there no historic flooding in the area, apart from a number of sewer flood incidents in 2007. The site is not adjacent to any main river, and no incidents of riverine flooding have been reported within the vicinity. There are no Environment Agency records of past flood events at this location.

Tidal Flooding

Tidal flooding typically results from extreme sea levels due to high tides, storm surges or wind-driven wave action, and affects areas that are hydraulically connected to the tidal Thames. The site is located at an elevation well above tidal influence and is not situated near the Thames tidal floodplain. There are no tidal waterbodies in the immediate area that present a risk to the site.

The risk of tidal flooding at this location is therefore negligible.

Fluvial Flooding

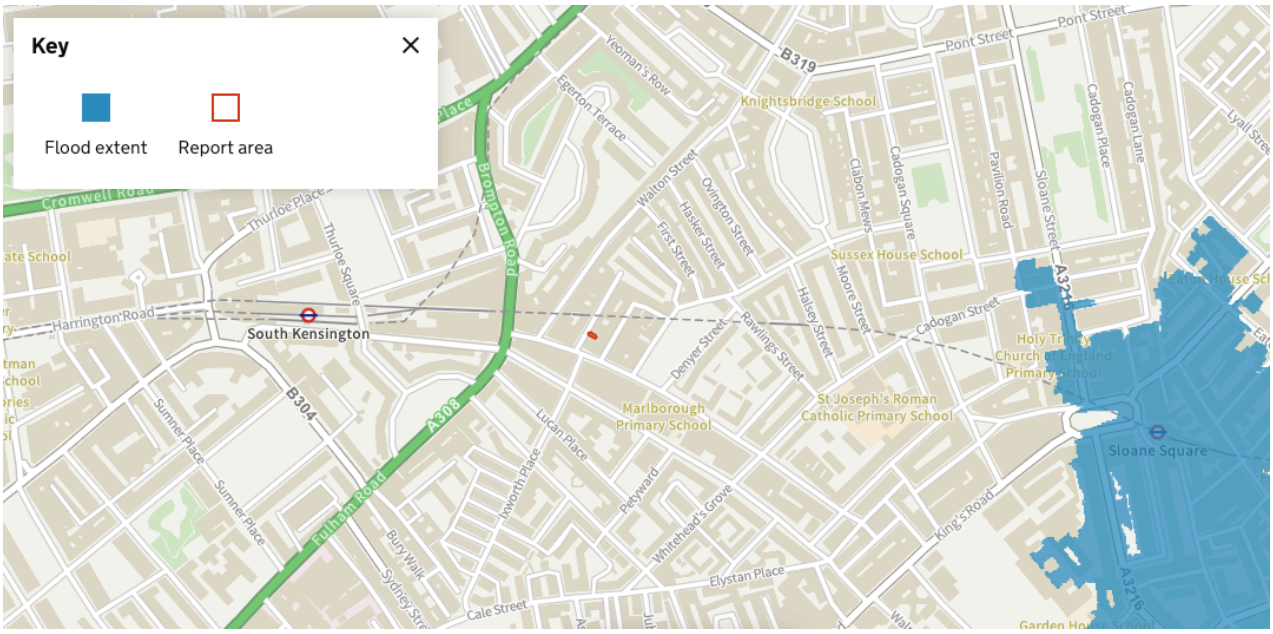
Fluvial flooding occurs when watercourses exceed their capacity and overflow into adjacent land. This process can be exacerbated when debris is mobilised by high flows and accumulates at structures.

The site is located within Flood Zone 1. This classification identifies the land as being at low risk of fluvial or tidal flooding, with an annual probability of flooding from rivers or the sea of less than 0.1%.

The Environment Agency flood mapping (see Appendix B) confirms that the site does not benefit from any formal flood defences providing protection up to a 1 in 100-year (1%) annual probability event. However, the site lies well outside the areas expected to be impacted by such events.

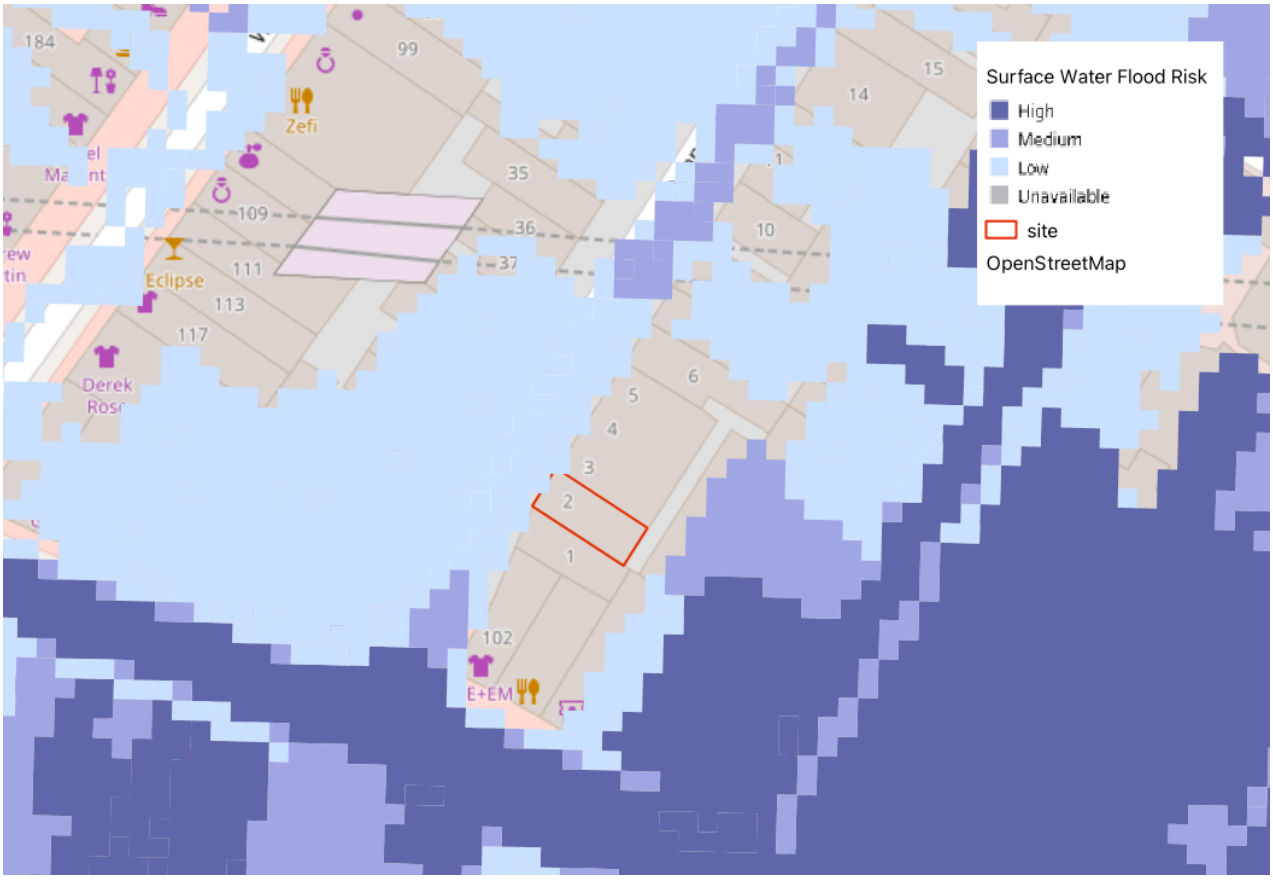
Figure demonstrates that the site lies outside the design flood extent for the 1 in 100-year plus climate change event. As a result, the development will not encroach upon or reduce the floodplain storage associated with any modelled design event and will not lead to increased flood risk elsewhere.

Given that the site is located entirely within Flood Zone 1, as defined by the Environment Agency's Flood Map for Planning, the fluvial flood risk is considered to be low.



Pluvial Flooding

Pluvial flooding arises when intense or prolonged rainfall events exceed the infiltration capacity of the ground or overwhelm the local drainage infrastructure, leading to the accumulation of surface water and the formation of overland flow paths.



Surface water flood risk mapping from the Environment Agency (Figure above) shows the modelled extent of potential surface water flooding for 1 in 30-year, 1 in 100-year, and 1 in 1000-year events. The mapping indicates that the site lies outside any identified areas of elevated surface water flood risk, with front of the development facing **Low Risk area.**

While some localised surface water risk is indicated in the wider area, including adjacent roads and footways, these risks are not directly affecting the site at **XXXX**. This is supported by the fact that the site occupies relatively flat ground and is bordered by road gullies and established drainage infrastructure which will intercept surface flows.

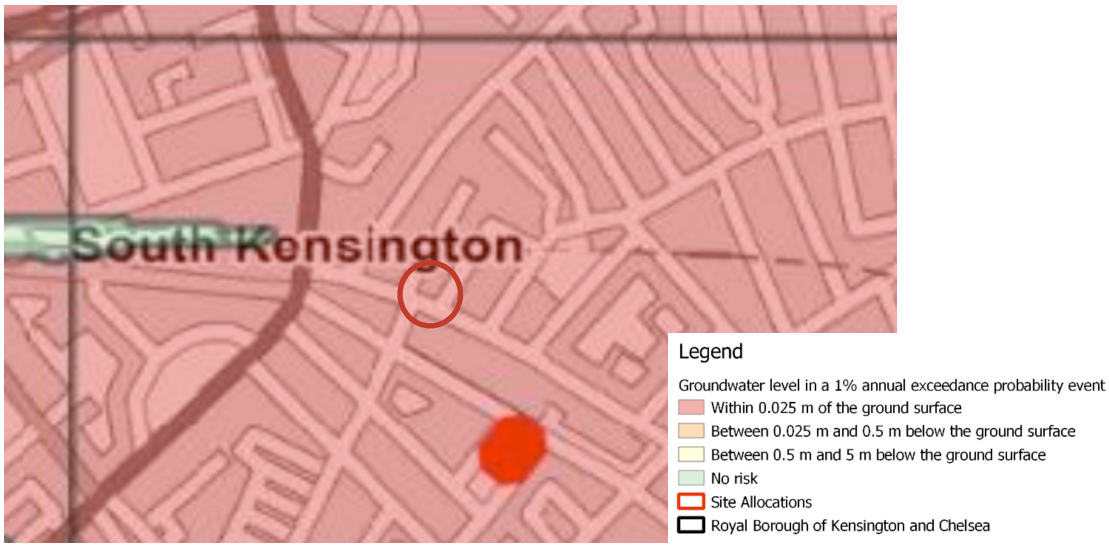
The proposed dwelling is to be situated on land that remains outside the modelled extents of pluvial flood risk. As such, the risk of pluvial flooding to the proposed development is considered to be low.

Groundwater Flooding

Groundwater flooding occurs when the water table rises above the surface, typically in low-lying areas underlain by permeable geology such as chalk or sand and gravel aquifers. These events are usually prolonged and can result in widespread disruption where poorly drained soils coincide with rising groundwater levels.

At **XXXX**, the underlying geology comprises London Clay Formation, a low-permeability bedrock that typically limits the risk of groundwater emergence at the surface.

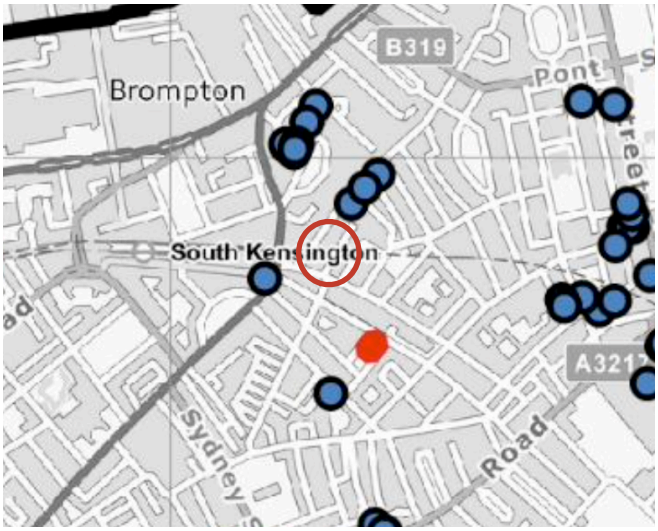
According to the RBKC Strategic Flood Risk Assessment (2022) groundwater flood mapping (see Figure below), the site lies within an area within of groundwater level to reach within 0.025m of the ground surface in a 1% annual exceedance probability event. This indicates a high likelihood of groundwater flood risk. No site-specific records or historical incidents of groundwater flooding have been identified within or adjacent to the site.



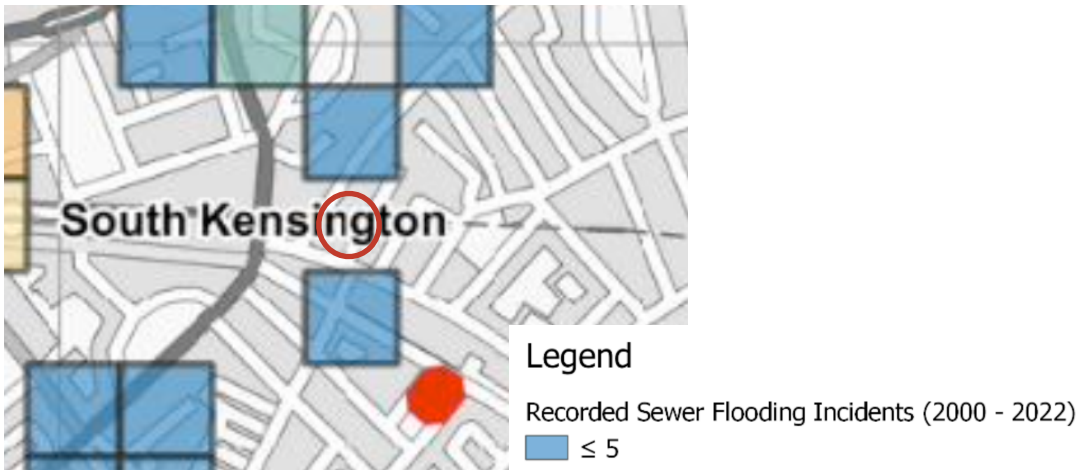
The risk of groundwater flooding is therefore considered to be high.

Sewer Flooding

According to SFRA report by Royal Borough of Kensington and Chelsea (2022) there were 94 sewer flood incidents recorded at the postcode SW3 since 2000. The site is in one of the areas of risk near South Kensington. Historic Flood Map confirms flood incidents in the near proximity of the site in 2007.



Thames Water Sewer Flooding History Database mapping (Figure below) confirms a number of properties affected by sewer flooding within 2000-2022, although not at the development address.

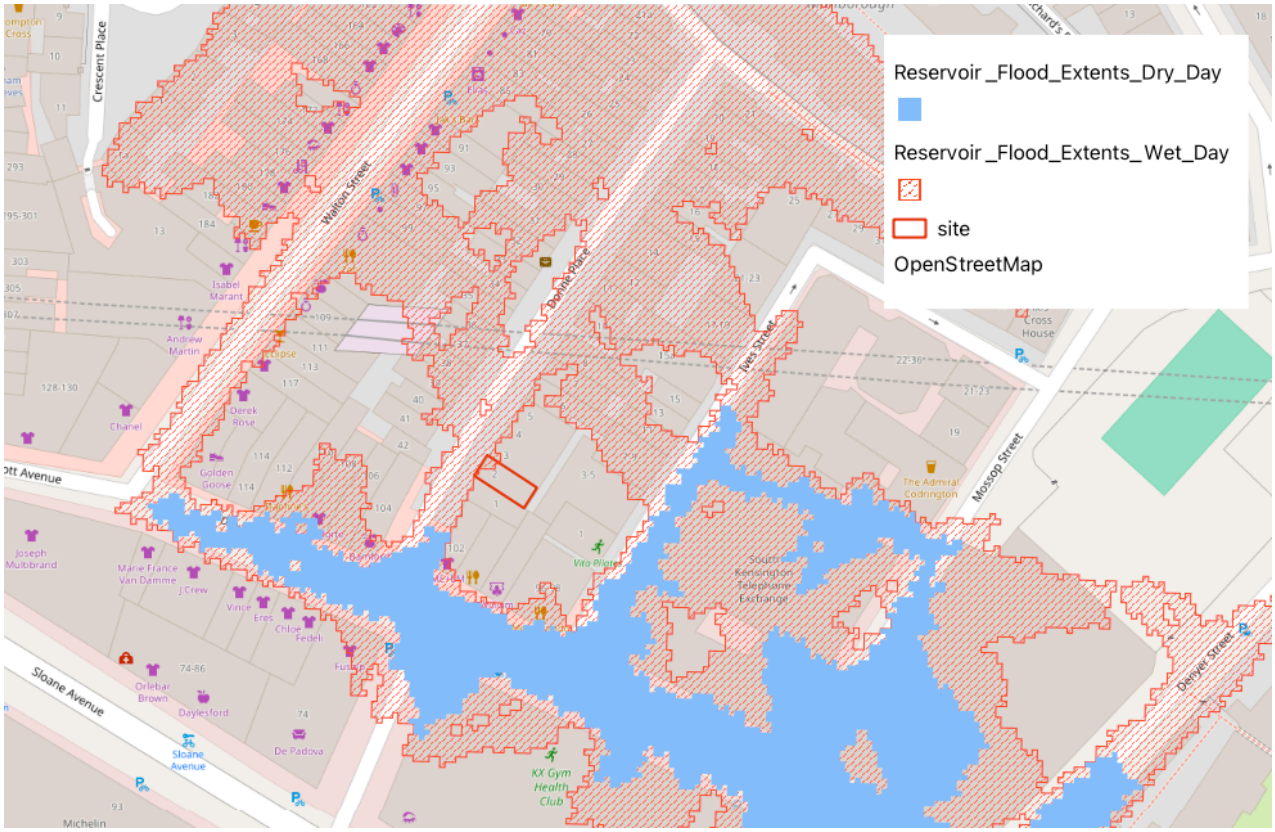


As such, the risk of sewer flooding to the proposed development is considered to be medium.

Flooding from Artificial Sources

Flooding from artificial sources can occur as a result of structural failure of large waterbodies or reservoirs, particularly those retained above natural ground levels. While such events are highly unlikely due to stringent regulation and maintenance standards, they are considered in flood risk assessments as a precautionary measure due to the potentially significant consequences.

To evaluate this residual risk, the Environment Agency provides reservoir breach flood risk mapping, which identifies areas that may be inundated in the unlikely event of reservoir failure. There are 2 flooding scenarios shown on the reservoir flood maps. They are a 'dry-day' and a 'wet-day'. The 'dry-day' scenario predicts the flooding that would occur if the dam or reservoir failed when rivers are at normal levels. The 'wet day' scenario predicts how much worse the flooding might be if a river is already experiencing an extreme natural flood.



Review of the reservoir failure flood risk map (see Figure above) confirms that **XXXX** partially lies inside of flood extent from a reservoir on a wet day.

The risk of flooding from reservoirs or other artificial sources is therefore considered to be medium.

FLOOD MITIGATION AND RESILIENCE MEASURES

It is critical to ensure that future users of the development are not exposed to flood hazards throughout the building's lifetime and that flood risk is not increased elsewhere. The following measures are proposed, categorised by the primary flood risk types defined under the National Planning Policy Framework (NPPF):

1. Tidal Flooding – from the sea

Although the site at XXXX is not at risk of tidal flooding, the following generic measures are applicable where this risk is present:

- Use of flood-resistant glazing for patio doors and ground-floor windows to withstand hydrostatic pressure from tidal surges.
- Where practicable, raise finished floor levels above the design tidal flood level, accounting for climate change sea level rise.
- Apply sealants around door and window frames to prevent ingress under pressure.
- Sign up to the EA Flood Warning and Alert service to receive advance warnings of tidal surge events.

2. Fluvial Flooding – from rivers and streams

Although the site lies within Flood Zone 1 and fluvial risk is low, the following precautionary measures are adopted:

- Set Finished Floor Levels (FFLs) at least 600mm above the 1 in 100-year plus 20% climate change flood level, proposed at 42.86m AOD.
- Profile external ground levels to direct overland flow away from building entrances and toward attenuation infrastructure.
- Construct floors using solid concrete with resilient finishes (e.g., moisture-resistant tiles, grout, and plaster).
- Use resilient materials for skirtings, doorframes, and window sills on the ground floor.
- Ensure that service entry points, such as utility conduits, are sealed against water ingress.

3. Pluvial Flooding – from surface water runoff and exceedance flows

To manage the risk of surface water flooding resulting from intense storm events:

- Design ground profiles to eliminate local depressions and direct runoff toward drains.
- Ensure rainwater runoff is captured using geocellular attenuation systems with flow control devices (e.g., Hydro-brake).
- **Install sealed thresholds for doors and windows, and raise air bricks where feasible.**
- **Use moisture-resistant building materials, including:**
    - **Resilient plaster or moisture-resistant plasterboard;**
    - **Appropriate insulation with low water absorption;**
    - **Well-sealed pipework and minimal service voids.**
- Raise electrical sockets at least 1.0 m above finished floor level.

4. Groundwater Flooding – from elevated groundwater tables or springs

Groundwater levels in London Clay can rise during prolonged wet periods, although the site is in a low susceptibility zone. Recommended measures include:

- **Construct all below-ground structures (e.g., foundations, retaining walls) with waterproof concrete and sealants.**
- **Monitor groundwater levels during construction, especially during excavation phases.**
- **If groundwater ingress is observed, deploy sump pumps or positive dewatering systems.**
- **Avoid creating basements unless waterproofing and pumping provisions are in place.**

5. Flooding from Sewers – including surcharge from combined or surface water systems

To prevent sewer-related flooding due to surcharge or backflow:

- **Install a basement positive pump device or non-return valve to protect against backflow.**
- **Ensure all new connections to public sewers include backflow prevention measures.**
- **Provide sealed manhole covers or raise them above known surcharge levels.**
- **Design plumbing layouts to minimise low-level entry points for foul water.**

6. Artificial Sources – reservoirs, canals, infrastructure failure

While the site is not in the path of any identified reservoir failure route, the following good practice measures are relevant where this risk applies:

- **Maintain double-glazing and reinforced frames for doors/windows exposed to potential high-energy flows.**
- **Ensure that residual cavities are minimised, and any floodwater can easily drain.**
- **Select robust, moisture-tolerant materials for internal finishes and insulation.**
- **Maintain good communication links and sign up to the EA flood alerts for artificial source monitoring.**

SUDS STRATEGY

Introduction

Sustainable Drainage Systems (SuDS) are designed to replicate the natural drainage processes of a site prior to development. By managing rainfall close to where it falls, SuDS reduce both the quantity and rate of surface water runoff and, in doing so, lower the risk of flooding. Additionally, they enhance water quality and provide wider environmental benefits including amenity and biodiversity gains.

The SuDS management train considers three core objectives: flood risk reduction, pollution control, and landscape/ecosystem enhancement. Disposal of surface water should follow the SuDS hierarchy, in decreasing order of preference:

- Discharge to ground (infiltration and re-use);
- Discharge to a surface water body;
- Discharge to a surface water sewer;
- Discharge to a combined sewer (as a last resort).

The philosophy of SuDS is to manage runoff as close to source as possible, while also improving water quality prior to discharge. The benefits of this approach include:

- Reduction of runoff rates, thereby reducing downstream flood risk;
- Reduction in pollutant loading to watercourses;
- Support for groundwater recharge where appropriate;
- Improved visual and recreational amenity;
- Creation of ecological niches for biodiversity in developed areas.

Existing Drainage

The site currently comprises a **residential dwelling with all drainage assumed discharging to a combined sewer. The plot includes no soft landscaping or permeable surfaces, with the rear patio fully hard-surfaced.**

Proposed Drainage

In accordance with the National Planning Policy Framework (NPPF) and best practice guidance, the proposed development at **XXXX** will incorporate a Sustainable Drainage System (SuDS). This system has been designed to manage rainfall on-site, reduce surface water runoff, and ensure that flood risk is not increased on or off-site.

The strategy is based on infiltration where feasible, supplemented by SuDS features such as permeable surfacing, soakaways, and deep bore soakaways, all tailored to the site's geological and spatial constraints. Drawings illustrating the proposed drainage layout and features are provided in Appendix D.

Site Specific SUDS

The selection of SuDS features for the development at **XXXX** has been guided by site-specific opportunities and constraints, as well as the principles outlined in the CIRIA SuDS Manual (C753). The objective is to apply the SuDS management hierarchy as far up the hierarchy as possible, while acknowledging feasibility based on site layout, geology, and drainage requirements.

SuDS measures aim to replicate natural drainage processes by managing rainfall at or near the point where it falls. The most effective SuDS features are those that provide source control — intercepting and managing runoff as close to its origin as possible.

As outlined in the CIRIA SuDS Manual (C753), open surface SuDS are generally preferred to subsurface or end-of-pipe solutions because:

- They offer greater visibility, allowing for easier inspection and maintenance;
- Malfunctions can be more readily identified and rectified;
- They often provide added biodiversity, amenity, and aesthetic value to developments.

However, SuDS selection must also account for practical constraints such as site layout, geology, levels, and urban design. The table below provides a high-level assessment of the key SuDS features considered for this development, outlining their description, suitability, and justification based on the site-specific conditions.

Table below provides a summary of the SuDS options considered, along with their suitability for this development:

SuDS Feature	Description	Suitability / Comment
Green roofs	Vegetated roofs that reduce discharge rates and provide ecological benefits.	Sedum roofs are proposed.
Blue roofs	Temporary roof-level stormwater attenuation.	Not suitable due to the proposed roof structure.
Rainwater harvesting	Re-use of rainwater for non-potable use.	280l water butt is proposed to fee basement toilet by gravity.
Trees	Intercept rainfall and promote infiltration via soft landscaping.	Not suitable due to limited space and topographical constraints.
Infiltration systems	Soakaways and boreholes allow runoff to percolate into the ground.	Not suitable due to site layout.
Pervious pavements	Permeable surfacing to allow water to infiltrate through construction layers.	Not suitable due to site layout.
Bioretention systems	Vegetated depressions (e.g., rain gardens) to store and treat runoff.	Not suitable due to site layout and limited available landscaping area.
Swales	Grass channels to convey and treat surface water.	Not suitable due to site topography and density.

Filter drains	Gravel-filled trenches to convey or infiltrate surface water.	Not suitable due to site topography and density.
Detention basins	Temporary storage basins for runoff during storm events.	Not suitable due to limited space and topographical constraints.
Ponds & wetlands	Permanent open water features for amenity and biodiversity.	Not suitable due to health and safety risks and limited green space.
Filter strips	Grass strips that slow runoff, encourage sedimentation.	Not suitable for site layout.
Attenuation storage tanks	Below-ground tanks to hold back runoff.	Not proposed. May be reconsidered if water butt considered to be insufficient.
Proprietary treatment systems	Prefabricated treatment devices (e.g., catchpits, silt traps).	Catchpits will be used; no dedicated treatment unit required due to clean runoff profile.

SuDS Strategy

The site presents some constraints for the implementation of vegetated SuDS features such as swales and rain gardens. This is primarily due to the site's topography and the limited space available for soft landscaping within the development layout.

Green roof and water butt are proposed as main SUDS features in managing surface water.

Surface Water Drainage Strategy

The proposed drainage layout is presented in Appendix D, which includes a detailed plan showing:

- Green roof;
- Water butt;
- Associated SuDS features designed for source control and pollution mitigation.

To prevent sedimentation and maintain system performance, all SuDS elements and associated drainage infrastructure will be protected through the inclusion of catchpits and silt traps, incorporated into inspection chambers, gullies, and connecting pipework.

The runoff risk from hardstanding surfaces is considered low due to the scale and the planned interception systems.

Runoff Calculations

- Total site area: Approx. 50m^2
- Existing impermeable area: Approx. 50m^2
- Proposed impermeable area (pre-green roof): Approx. 50m^2
- Proposed green roof area: 25m^2 (50% of the total roof area)
- Water butt for basement toilet use: 280l

These figures represent the footprint prior to permeable paving being applied. Once permeable surfacing and infiltration features are installed, the overall runoff rates and volumes are expected to match or fall below those associated with the pre-development (brownfield) condition.

Table below compares pre- and post-development runoff rates and volumes, including greenfield runoff baseline. However, given that infiltration SuDS will be implemented, the runoff impact is expected to be negligible.

Pre- and Post-Development Surface Water Runoff

Return Period	Existing Peak Runoff Rate [l/s]	Greenfield Runoff Rate [l/s]	Proposed Peak Runoff Rate [l/s]	Betterment from existing (%)
1 in 1 year	0.9	0.0066	0.45	50%
1 in 30 years	3.51	0.018	1.75	51%
1 in 100 years	4.56	0.025	2.28	50%
1 in 100 years (+40%)	6.58	n/a	3.29	50%

- Existing and Proposed peak runoff rates were calculated using SuDS performance evaluation tool that was built by HR Wallingford as part of the EC StopUP project.
- Greenfield rates are derived using IH124 methodology and UKSUDS Greenfield runoff rate estimation tool.

Water Disposal Hierarchy

The water disposal hierarchy recommended by the Lead Local Flood Authority (LLFA), Thames Water, the SuDS Manual (CIRIA C753), and national planning guidance follows the order:

A. Re-use at source
B. Infiltration to ground
C. Discharge to watercourse
D. Discharge to surface water sewer
E. Discharge to combined sewer (only if no alternatives are available)

This hierarchy ensures surface water runoff is managed as close to its source as possible, mimicking the site's natural (predevelopment) hydrological response.

The proposed development complies with this hierarchy, as summarised below:v

Discharge Method	Comment
Re-use at source	Rainwater will be harvested in a 280l water butt for basement toilet.
Infiltration	No infiltration due to limited space.
Watercourse	No discharge to nearby watercourses.
Surface water sewer	Not used for this development.
Combined sewer	Discharged through the existing connection to a presumed combined sewer.

Peak Flow and Volume Control

This achieves full compliance with national and local policies requiring post-development runoff volumes and peak flows to be equal to or less than pre-development values.

Water Quality

The SuDS strategy incorporates robust source control features to manage and treat water quality. All surfaces will be treated through filtration, infiltration or sediment control structures (e.g. catchpits and silt traps).

The first 5 mm of rainfall — which contains the highest concentration of pollutants — will be fully retained and treated on-site, ensuring that water leaving the site (if ever) meets acceptable quality standards.

In accordance with SuDS Manual guidance, the following levels of treatment have been applied based on surface types:

A. Roofs – 1 level of treatment (e.g. infiltration, filtration through permeable surfaces).
B. Pedestrian areas and lightly trafficked roads – 2 levels of treatment.
C. Distribution roads (if applicable) – 3 levels of treatment (e.g. permeable paving, catchpits, soakaways).

The proposed development includes impermeable roof areas, green roofs and water butt only.

Surface runoff from these areas will receive:

- Primary treatment via sedum green roof, allowing infiltration and filtration of surface water;
- Secondary treatment through trapped gullies and catchpits positioned throughout the surface water network to intercept sediment and debris before entering combined sewer.

Design and Modelling Criteria

The drainage system has been designed to accommodate a 1 in 100-year storm event with a 40% climate change allowance, in line with current DEFRA guidance (upper-end uplift).

Supporting calculations, presented in Appendix C, confirm that the proposed SuDS infrastructure is sufficient to manage all runoff volumes generated by the critical design storm.

Hydraulic modelling assumptions include:

- PAF (Proportion of Area Flowing):
  - 1.0 for impermeable areas;
  - 0.25 for permeable areas (reflecting infiltration loss);
- Catchment runoff coefficient (Cv): 1.0 applied for both winter and summer conditions;
- Urban creep: No additional allowance made, due to application of maximum PAF.

Exceedance Flow Management

In the event that storm intensity exceeds the design capacity of the drainage system exceedance flows will be safely retained within the site boundary.

Maintenance Strategy

All proposed SuDS elements and drainage infrastructure will be maintained for the full lifecycle of the development by the appointed management entity.

A detailed maintenance schedule, in accordance with the CIRIA SuDS Manual (C753), is provided in Appendix E.

CONCLUSIONS

The site is located within Flood Zone **1**, as identified on the Environment Agency's Flood Map for Planning. It is also assessed to be the following flood sources:

- River and sea (Fluvial) - **Low** risk
- Surface Water (Pluvial) - **Low** risk
- Groundwater - **High** risk
- Sewer Flooding - **Medium** risk
- Artificial Sources - **Medium** Risk

Flood risk at the site and surrounding sites is not considered to increase as a result of the development.

Surface water at the site is to harvested in a water butt, treated by green roofs and discharged to a combined sewer through an existing connection.

The proposed surface water network is to be designed to the 1 in 100 year storm event with an allowance of 40% for Climate Change.

APPENDIX A – PROPOSED DEVELOPMENT DRAWINGS

APPENDIX B – FLOOD DATA

APPENDIX C – DRAINAGE CALCULATIONS

APPENDIX D – DRAINAGE STRATEGY

APPENDIX E – SUDS MAINTENANCE PLAN

Operation and Maintenance Requirements for RWH Systems

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Inspection of the tank for debris and sediment build-up, inlets/ outlets/withdrawal devices, overflow areas, pumps, filters	Annually (and following poor performance)
	Cleaning of tank, inlets, outlets, gutters, 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	Three monthly (or as required)
Remedial	Repair of overflow erosion damage or damage to tank	As required
	Pump repairs	As required

Operation and Maintenance Requirements for Green Roofs

Maintenance Schedule	Required Action	Typical Frequency
Regular inspections	Inspect all components including soil substrate, vegetation, drains, irrigation systems (if applicable), membranes and roof structure for proper operation, integrity of waterproofing and structural stability	Annually and after severe storms
	Inspect soil substrate for evidence of erosion channels and identify any sediment sources	Annually and after severe storms
	Inspect drain inlets to ensure unrestricted runoff from the drainage layer to the conveyance or roof drain system	Annually and after severe storms
	Inspect underside of roof for evidence of leakage	Annually and after severe storms
Regular maintenance	Remove debris and litter to prevent clogging of inlet drains and interference with plant growth	Six monthly and annually or as required
	During establishment (i.e. year one), replace dead plants as required	Monthly (but usually responsibility of manufacturer)
	Post-establishment, replace dead plants as required (where > 5% of coverage)	Annually (in autumn)
	Remove fallen leaves and debris from deciduous plant foliage	Six monthly or as required
	Remove nuisance and invasive vegetation, including weeds	Six monthly or as required

	Mow grasses, prune shrubs and manage other planting (if appropriate) as required – clippings should be removed and not allowed to accumulate	Six monthly or as required
Remedial actions	If erosion channels are evident, these should be stabilised with extra soil substrate similar to the original material, and sources of erosion damage should be identified and controlled	As required
	If drain inlet has settled, cracked or moved, investigate and repair as appropriate	As required

Operation and Maintenance Requirements for Soakaways

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Inspect for sediment and debris in pre-treatment components and floor of inspection tube or chamber and inside of concrete manhole rings	Annually
	Cleaning of gutters and any filters on downpipes	Annually (or as required based on inspections)
	Trimming any roots that may be causing blockages	Annually (or as required)
Occasional maintenance	Remove sediment and debris from pre-treatment components and floor of inspection tube or chamber and inside of concrete manhole rings	As required, based on inspections
Remedial actions	Reconstruct soakaway and/or replace or clean void fill, if performance deteriorates or failure occurs	As required
	Replacement of clogged geotextile (will require reconstruction of soakaway)	As required
Monitoring	Inspect silt traps and note rate of sediment accumulation	Monthly in the first year and then annually
	Check soakaway to ensure emptying is occurring	Annually

Operation and Maintenance Requirements for a Proprietary Treatment System

Maintenance Schedule	Required Action	Typical Frequency
Routine maintenance	Remove litter and debris and inspect for sediment, oil and grease accumulation	Six monthly
	Change the filter media	As recommended by manufacturer
	Remove sediment, oil, grease and floatables	As necessary – indicated by system inspections or immediately following significant spill
Remedial actions	Replace malfunctioning parts or structures	As required
Monitoring	Inspect for evidence of poor operation	Six monthly

	Inspect filter media and establish appropriate replacement frequencies	Six monthly
	Inspect sediment accumulation rates and establish appropriate removal frequencies	Monthly during first half year of operation, then every six months

Operation and Maintenance Requirements for Filter Strips

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Remove litter and debris	Monthly (or as required)
	Cut the grass – to retain grass height within specified design range	Monthly (during growing season), or as required
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspect filter strip surface to identify evidence of erosion, poor vegetation growth, compaction, ponding, sedimentation and contamination (e.g. oils)	Monthly (at start, then half yearly)
	Check flow spreader and filter strip surface for even gradients	Monthly (at start, then half yearly)
	Inspect gravel flow spreader upstream of filter strip for clogging	Monthly (at start, then half yearly)
	Inspect silt accumulation rates and establish appropriate removal frequencies	Monthly (at start, then half yearly)
Occasional maintenance	Reseed areas of poor vegetation growth; alter plant types to better suit conditions, if required	As required or if bare soil is exposed over >10% of area
Remedial actions	Repair erosion or other damage by re-turfing or reseeding	As required
	Relevel uneven surfaces and reinstate design levels	As required
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface	As required
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip	As required
	Remove and dispose of oils or petrol residues using safe standard practices	As required

Operation and Maintenance Requirements for Filter Drains

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Remove litter (including leaf litter) and debris from filter drain surface, access chambers and pre-treatment devices	Monthly (or as required)
	Inspect filter drain surface, inlet/outlet pipework and control systems for blockages, clogging, standing water and structural damage	Monthly
	Inspect pre-treatment systems, inlets and perforated pipework for silt accumulation, and establish appropriate silt removal frequencies	Six monthly
	Remove sediment from pre-treatment devices	Six monthly, or as required
Occasional maintenance	Remove or control tree roots where they are encroaching the sides of the filter drain, using recommended methods (e.g. NJUG, 2007 or BS 3998:2010)	As required
	At locations with high pollution loads, remove surface geotextile and replace, and wash or replace overlying filter medium	Five yearly, or as required
	Clear perforated pipework of blockages	As required

Operation and Maintenance Requirements for Swales

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Remove litter and debris	Monthly, or as required
	Cut grass – to retain grass height within specified design range	Monthly (during growing season), or as required
	Manage other vegetation and remove nuisance plants	Monthly at start, then as required
	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly
	Inspect infiltration surfaces for ponding, compaction, silt accumulation, record areas where water is ponding for > 48 hours	Monthly, or when required
	Inspect vegetation coverage	Monthly for 6 months, quarterly for 2 years, then half yearly
	Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies	Half yearly
Occasional maintenance	Reseed areas of poor vegetation growth, alter plant types to better suit conditions, if required	As required or if bare soil is exposed over 10% or more of the swale treatment area
Remedial actions	Repair erosion or other damage by re-turfing or reseeding	As required
	Relevel uneven surfaces and reinstate design levels	As required

	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface	As required
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip	As required
	Remove and dispose of oils or petrol residues using safe standard practices	As required

Operation and Maintenance Requirements for Bioretention Systems

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

Operation and Maintenance Requirements for Pervious Pavements

Maintenance	Required Action	Typical Frequency
Regular mainten ance	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
Occasio nal	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphosate applied directly into the weeds by an applicator	As required – once per year on less frequently used pavements

Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a	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)
Monitori	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if	Three-monthly, 48 h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing	Annually
	Monitor inspection chambers	Annually

Operation and Maintenance Requirements for Attenuation Storage Tanks

Maintenance Schedule	**Required Action**	**Typical 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 risks to performance)	Monthly
	For systems where rainfall infiltrates into the tank from above, check surface of filter 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	Annually, or as required
Remedial actions	Repair/rehabilitate inlets, outlet, overflows and vents	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually
	Survey inside of tank for sediment build-up and remove if necessary	Every 5 years or as required

Operation and Maintenance Requirements for Detention Basins

Maintenance Schedule	**Required Action**	**Typical Frequency**

Regular maintenance	Remove litter and debris	Monthly
	Cut grass – for spillways and access routes	Monthly (during growing season), or as required
	Cut grass – meadow grass in and around basin	Half yearly (spring – before nesting season, and autumn)
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly
	Inspect banksides, structures, pipework etc for evidence of physical damage	Monthly
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies	Monthly (for first year), then annually or as required
	Check any penstocks and other mechanical devices	Annually
	Tidy all dead growth before start of growing season	Annually
	Remove sediment from inlets, outlet and forebay	Annually (or as required)
	Manage wetland plants in outlet pool – where provided	Annually (as set out in Chapter 23)
Occasional maintenance	Reseed areas of poor vegetation growth	As required
	Prune and trim any trees and remove cuttings	Every 2 years, or as required
	Remove sediment from inlets, outlets, forebay and main basin when required	Every 5 years, or as required (likely to be minimal where effective upstream source control is provided)
Remedial actions	Repair erosion or other damage by reseeding or re-turfing	As required
	Realignment of rip-rap	As required
	Repair/rehabilitation of inlets, outlets and overflows	As required
	Relevel uneven surfaces and reinstate design levels	As required

Operation and Maintenance Requirements for Ponds and Wetlands

Maintenance Schedule	Required Action	Typical Frequency

Regular maintenance	Remove litter and debris	Monthly (or as required)
	Cut the grass – public areas	Monthly (during growing season)
	Cut the meadow grass	Half yearly (spring, before nesting season, and autumn)
	Inspect marginal and bankside vegetation and remove nuisance plants (for first 3 years)	Monthly (at start, then as required)
	Inspect inlets, outlets, banksides, structures, pipework etc for evidence of blockage and/or physical damage	Monthly
	Inspect water body for signs of poor water quality	Monthly (May – October)
	Inspect silt accumulation rates in any forebay and in main body of the pond and establish appropriate removal frequencies; undertake contamination testing once some build-up has occurred, to inform management and disposal options	Half yearly
	Check any mechanical devices, e.g. penstocks	Half yearly
	Hand cut submerged and emergent aquatic plants (at minimum of 0.1 m above pond base; include max 25% of pond surface)	Annually
	Remove 25% of bank vegetation from water's edge to a minimum of 1 m above water level	Annually
	Tidy all dead growth (scrub clearance) before start of growing season	Annually
Occasional maintenance	Remove sediment from any forebay	Every 1–5 years, or as required
	Remove sediment and planting from one quadrant of the main body of ponds without sediment forebays	Every 5 years, or as required
	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	As required
	Replant, where necessary	As required
	Aerate pond when signs of eutrophication are detected	As required
	Realign rip-rap or repair other damage	As required
	Repair / rehabilitate inlets, outlets and overflows	As required

APPENDIX F – SUDS PROFORMA