

# Waterfront Square Reading

## Drainage Strategy

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**Waterfront Square, Reading**  
Drainage Strategy

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## 1.0 Introduction & Executive Summary

Hexa Consulting have been commissioned by Packaged Living Ltd to undertake a Drainage Strategy for a proposed new residential development (the “Development”) at Waterfront Square, Reading RG1 8DA (the “Site”).

The Site lies within the district of Reading Borough Council as Local Planning Authority (LPA) and Lead Local Flood Authority (LLFA) and Thames Water as Water and Sewerage Company. The Site is not within the catchment of an Internal Drainage Board (IDB).

The existing Site is occupied by a commercial building located approximately centrally, a surface level car park to the south and an area of open space to the north. The River Thames abuts the site to the north, with the public highways of Norman Place and Vastern Road to the western and southern boundaries, respectively. To the east is the Thames Water headquarters. A topographic survey is contained in **Appendix A**.

The proposal for the Development is the Demolition of the former Covea Insurance building and construction of residential-led development, access from Norman Place and associated car parking, infrastructure and landscaping. Development proposals are contained in **Appendix B**.

Sustainable Drainage Systems (SuDS) are proposed for the management of surface water runoff in accordance with local and national guidance. Surface water discharge is proposed to be restricted to achieve at least 50% betterment compared to the existing conditions and to discharge to the culverted watercourse along the southern boundary of the Site. SuDS are proposed to manage runoff rate and volume, as well as providing water quality, biodiversity and amenity benefits.

The culverted watercourse will need to be retained in its current position in perpetuity. A piled foundation solution will result in all loads being taken below the lowest level of the culverted watercourse and no additional loading will be placed on the structure.

Thames Water have advised that there are no legal easements associated with the sewer in Norman Place and that a formal build over agreement can be entered into for building close to the sewer.

Foul water is proposed to be managed and disposed of to the Thames Water public foul sewer.

Thames Water have confirmed that there is sufficient capacity within the public foul sewerage network to accept flows from the Development.

In addition to the above, this report also provides:

- Outline drainage drawings.
- Summary hydraulic calculations.
- An assessment of SuDS features and a description of their inclusion in the design scheme.
- An assessment of water quality and demonstration of the inclusion of SuDS to meet the water quality requirements.
- Outline operation and maintenance strategy for SuDS features.

The drainage strategy presented complies with Policy EN18 (Flooding and Sustainable Drainage Systems) of the Reading Borough Local Plan 2019.

## 2.0 Drainage Strategy

### 2.1 Existing Drainage

The existing Site is served by formal drainage systems for surface and foul water. The Site drains surface water to a culverted watercourse adjacent to Vastern Road and foul water to the Thames Water public foul sewer within Norman Place.

Surveys have been undertaken at the Site to confirm positive discharges of surface and foul water to the culverted watercourse and the Thames Water public foul sewer, respectively. These surveys include a topographic survey (**Appendix A**), a buried services survey (**Appendix C**), and a CCTV drainage survey (**Appendix D**).

Rainwater pipes are evident on all elevations of the commercial building and surface water gullies and linear drains are present within the external hardstanding. These connect to private drains within the Site, which then connect to the culverted watercourse, which lies between the car park and the edge of footway of Vastern Road.

The pre-development brownfield discharge rate contributing to the culverted watercourse has been calculated as 52l/s based on a positively drained roof and hardstanding area of 3,770m<sup>2</sup>.

The culverted watercourse runs alongside Vastern Road from a point approximately 750m northeast of the Site at Richfield Avenue and continues almost parallel to Vastern Road, passing under George Street approximately 100m southwest of the Site. The culvert structure appears to be a concrete box section along the Site boundary.

To date, the information received pertaining to the culverted watercourse consists of the following:

- Thames Water public sewer records (ref: ALS/ALS Standard/2023\_4830743, received 22/05/2023) illustrate the presence of a culverted watercourse to the northern side of Vastern Road (**Appendix E**). The records do not provide any indication of depth, size, or material composition.
- Survey Solutions Topographic survey (ref: 60390BDLS-01, received 30/08/2023) illustrates manhole covers within Norman Place, at least one of which appears to correspond to the culverted watercourse.
- Survey Solutions GPR survey (ref: 60390BWUG-01, received 19/09/2023) illustrates a culverted watercourse. This is an assumed route based on the Thames Water sewer records and multiple traced incoming connections towards the suspected line of the culverted watercourse.
- Survey Solutions CCTV survey (ref: 60390CCTV-01, received 19/06/2023) illustrates video footage and photographs of the culverted watercourse from connecting drainage pipes.
- Email from Reading Borough Council Highways (received 18/10/2023) confirms the presence of a culverted watercourse and that the section directly beneath Norman Place is a concrete box culvert with an internal width of approximately 3m (**Appendix F**). There is no information beyond the highway extent, however confirmation has been provided that the culverted watercourse continues almost parallel to Vastern Road along the site.

- Omnia Consulting intrusive investigation (ref: B11101, received 19/12/2023) indicates an extensive concrete slab overlying the suspected route of the culverted watercourse and extending into the existing car park within the site (**Appendix G**).

The culverted watercourse will need to be retained in its current position in perpetuity. A piled foundation solution will result in all loads being taken below the lowest level of the culverted watercourse and no additional loading will be placed on the structure.

The Thames Water public foul sewer flows from Norman Place to meet with the wider public sewer network in Vastern Road. The sewer measures 150mm diameter within Norman Place and becomes 300mm in Vastern Road.

Thames Water have advised that there are no legal easements associated with the sewer in Norman Place and that a formal build over agreement can be entered into for building close to the sewer. As with the culverted watercourse, the piled foundation solution will result in all loads being taken below the lowest level of sewer and no additional loading will be placed on the sewer.

## **2.2 Foul Water Drainage Strategy**

Foul water is proposed to discharge to the existing Thames Water public foul sewer within Norman Place. Existing connections to the sewer are proposed to be retained wherever practicable.

Thames Water have responded to a Pre-Planning Sewerage Enquiry (**Appendix E**) and have confirmed that there is sufficient capacity within the public foul sewerage network to accept flows from the Development.

The majority of foul effluent will be of a domestic nature (from toilets, showers, wash hand basins etc), which requires no treatment prior to entering the Thames Water public foul sewer.

Any proposals for restaurants or commercial food preparation within the Development will likely result in elevated amounts of fat and grease (in comparison to normal domestic waste) being disposed of through the new foul drainage system. As such, there would be a requirement for suitably sized fat and grease traps to be included within the drainage system. If these are required, it is suggested that these are located above ground level to provide easy access for inspection, emptying and maintenance.

The foul water drainage proposals are illustrated in the drawings within **Appendix H**.

## **2.3 Surface Water Drainage Strategy**

In accordance with the Building Regulations Approved Document H and the DEFRA Non-Statutory Technical Standards for Sustainable Drainage Systems, disposal options for surface water are required to be investigated in the following hierarchy of sustainability:

- Infiltration of collected surface water to ground.
- Disposal to a watercourse or waterbody.
- Disposal to a surface water sewer, highway drain or other drain.
- Disposal to a combined sewer.

Infiltration should only be considered a viable method of surface water disposal if:

- The soil permeability has the capacity to accept surface water flows.

- There are no geotechnical risks of infiltrating surface water (such as dissolution of soluble rocks, running sands, undermining of foundations etc).
- That there is at least 1m depth of unsaturated soil between the winter groundwater table and the underside of an infiltration system.

A ground investigation at the Site has not yet been undertaken. In lieu of a Site specific investigation, nearby British Geological Survey (BGS) borehole records have been interrogated, which demonstrate the following:

- Made ground to approximately 1.8m below ground level.
- Clay superficial deposits below this to approximately 2.4-3.4m below ground level.
- Sand and gravel below this to approximately 10m below ground level.
- Water strikes with groundwater rising to the underside of the clay deposits.

The above suggests that the shallow soils will be essentially impermeable. The more permeable deposits below appear to be allowing lateral and upward migration of groundwater and may be closely linked to the level of the nearby River Thames. As such, infiltration is not considered to be a viable option for the disposal of surface water.

A culverted watercourse is present along the southern boundary of the Site. The existing surface water drainage system connects to the culverted watercourse and this philosophy will be retained for the Development. The existing connection point to the culverted watercourse is proposed to be retained.

As a viable method of disposal is presented above, disposal to all other receptors does not require investigation.

Surface water discharge will be restricted to a maximum rate of 8l/s for the design storm events.

The restriction to the discharge rate has been calculated by providing at least 50% betterment to the pre-development 1 in 1 year discharge rate (using the Modified Rational Method) based on a catchment area of 0.377ha and controlling the discharge volume, as discussed below.

The surface water drainage proposals are illustrated in the drawings within **Appendix H**.

### 2.3.1 Hydraulic Design

A new surface water drainage system will be required to comply with current legislation and building control standards, including the following hydraulic standards:

- No surcharge of the proposed drainage system should be experienced during storms up to and including 1 in 2 year return period (50% AEP). Exceptions should be made for the flow control chamber.
- No flooding should be experienced during storms up to and including 1 in 30 year return period (3.33% AEP) plus an allowance for climate change.
- Any flooding should be contained within the Site for storms in excess of 1 in 30 year return period up to and including 1 in 100 year return period (1% AEP) plus an allowance for climate change.

Climate change allowance for peak rainfall intensity over the lifetime of new development at the site is 40% for 1% AEP storms.

The proposed surface water drainage system will serve a total catchment of 4,800m<sup>2</sup>. Controlling runoff to the above restricted discharge rate for the most onerous design storm return period, using an efficient vortex flow control device, requires approximately 210m<sup>3</sup> of attenuation volume, which is proposed to be provided within cellular storage, rain gardens, permeable paving sub-base and the piped surface water drainage network.

In accordance with the Non-Statutory Technical Standards for SuDS, the runoff volume for the post-development 1 in 100 year, 6 hour rainfall event should be constrained to not exceed the pre-development greenfield runoff volume for the same event and the same contributing area. Where this cannot be achieved, the runoff volume should never exceed the runoff volume from the development site prior to redevelopment for that event.

Hydraulic calculations have been undertaken, demonstrating that the post-development 1 in 100 year, 6 hour rainfall event runoff volume would be 169m<sup>3</sup> (Appendix I). This is the volume of surface water runoff that would leave the Site using the restricted discharge rate. The same event under equivalent pre-development conditions results in a runoff volume of 172m<sup>3</sup>.

| Pre-development discharge       |            |
|---------------------------------|------------|
| Site Makeup                     | Brownfield |
| Brownfield Method               | MRM        |
| Contributing Area (ha)          | 0.377      |
| PIMP (%)                        | 100        |
| CV                              | 0.840      |
| Return Period (years)           | 100        |
| Climate Change (%)              | 0          |
| Storm Duration (mins)           | 360        |
| Betterment (%)                  | 0          |
|                                 | Calc       |
| PR                              | 0.840      |
| Runoff Volume (m <sup>3</sup> ) | 172        |

**Figure 2-1: Pre-development brownfield runoff volume**

Hydraulic calculations are contained in **Appendix I**.

### 2.3.2 SuDS Management Train

The overarching aim of SuDS is to encourage and mimic natural processes for the disposal of surface water. This is further subdivided into the four pillars of SuDS:

- Reduce flood risk through reducing the quantity of disposed water.
- Improve the quality of disposed water to improve watercourse, waterbody, and groundwater quality.
- Provide increased biodiversity benefits.
- Provide amenity benefits.

Source control (the control of surface water as close to the source as possible) is also encouraged to avoid reliance on a single SuDS feature, to slow the flow and to improve awareness of a drainage system, which will help to identify maintenance requirements.

Site control (the control of surface water at the interface between a site and a receptor) is required for final discharges. Traditionally, these features tended to be large and heavily

engineered, however a shift towards SuDS will almost always reduce the size, complexity, and costs of end of pipe systems.

A SuDS management train should seek to adhere to the four pillars of SuDS using source control features prior to final flow restriction at site control features.

Source control features have been assessed specifically for this Development. Potential options are presented in Table 2-1 and discussed in further detail below.

**Table 2-1: Assessment of SuDS features**

| <b>Feature</b>            | <b>Reduced runoff volume &amp; velocity</b> | <b>Improved water quality</b> | <b>Improved biodiversity</b> | <b>Improved amenity</b> | <b>Inclusion in design scheme</b>                                                                                                                            |
|---------------------------|---------------------------------------------|-------------------------------|------------------------------|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Rainwater harvesting      | ✓                                           |                               |                              | ✓                       | Active rainwater harvesting should be investigated and included depending on water demand and viability.                                                     |
| Blue/green roofs          | ✓                                           | ✓                             | ✓                            | ✓                       | Green roofs are proposed over much of the new Development roofs.                                                                                             |
| Bioretention rain gardens | ✓                                           | ✓                             | ✓                            | ✓                       | Rain gardens are proposed to collect surface water runoff from hardstanding.                                                                                 |
| Tree pits                 | ✓                                           | ✓                             | ✓                            | ✓                       | Tree pits could be used for attenuation volume, reduced runoff volume, improved biodiversity and improved amenity value.                                     |
| Filter strips             | ✓                                           | ✓                             | ✓                            |                         | Filter strips are not considered suitable for this Development due to the minimal number of roads.                                                           |
| Filter drains             | ✓                                           | ✓                             | ✓                            |                         | Filter drains would be included beneath permeable surfaces and rain gardens to enable conveyance of surface water runoff.                                    |
| Swales                    | ✓                                           | ✓                             | ✓                            | ✓                       | There are no suitable areas for the provision of swales within the Development.                                                                              |
| Permeable pavement        | ✓                                           | ✓                             |                              | ✓                       | Permeable pavement could be provided to lightly trafficked or pedestrianised areas. Permeable sub-base can provide attenuation and water quality benefits.   |
| Basin/pond                | ✓                                           | ✓                             | ✓                            | ✓                       | Basins and ponds cannot be accommodated due to spatial constraints.                                                                                          |
| Attenuation storage tanks | ✓                                           |                               |                              |                         | Attenuation storage tanks will be required to provide the attenuation requirement resulting from restricting the discharge rate.                             |
| Flow control              | ✓                                           |                               |                              |                         | A flow control device will be required to control runoff rate and volume. A vortex flow control device is considered the most suitable for this Development. |

## Rainwater harvesting

The communal nature of the Development and the open space, coupled with the large roof area means that rainwater butts will not be an effective means of rainwater harvesting.

Active rainwater harvesting systems should be investigated and included, depending on water demand and viability. Rainwater harvesting systems can be integrally linked to blue green roofs and attenuation storage to minimise the volume of water discharging off Site receptors.

## Green roofs

Green roofs provide high-quality amenity benefit in their thermal insulation properties as well as being visually attractive. Green roofs can be extensive (shallow depth planting and soil substrate) or intensive (deeper soil substrate and larger/taller planting), both of which provide biodiversity benefits by providing habitats for invertebrates. The filtration of surface water through the planting and soil substrate will provide improved runoff water quality.

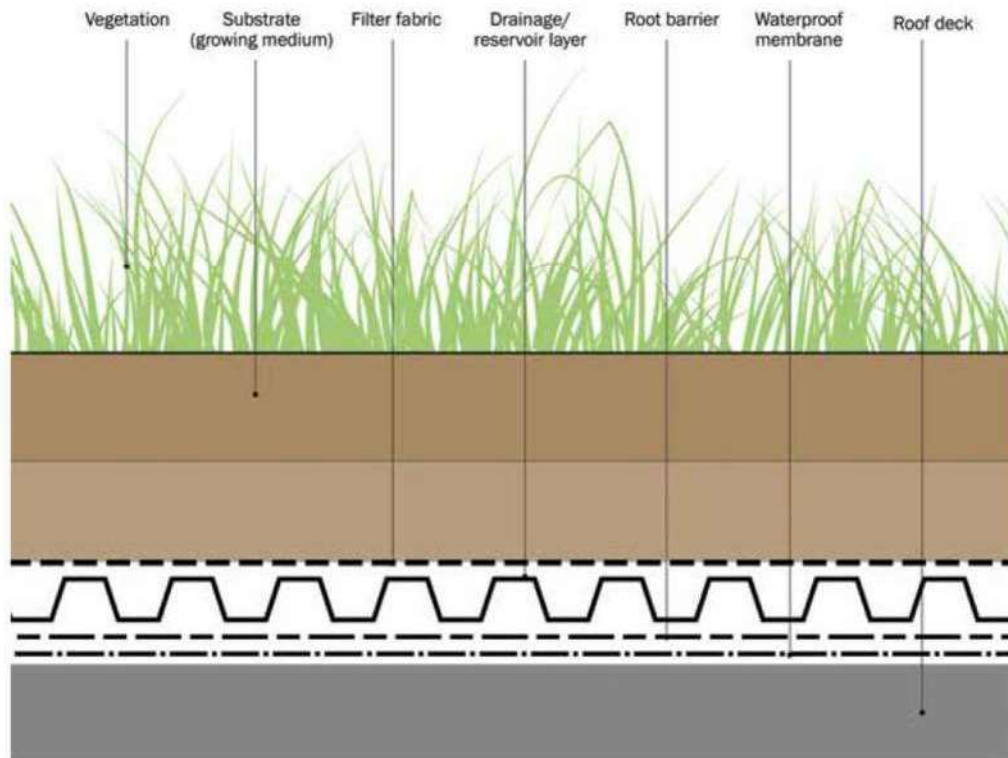


**Figure 2-2: Section showing typical extensive green roof components (courtesy of The SuDS Manual CIRIA C753)**

### Bioretention rain gardens

Bioretention rain gardens are planted areas that enable surface water runoff to be collected and filtered through a planting and soil substrate prior to being conveyed to the wider drainage system. Passing water through a bioretention rain garden encourages the uptake of water by vegetation roots and evapotranspiration, as well as filtering out potential contaminants that have been mobilised from rainwater landing on engineered surfaces.

Bioretention rain gardens are proposed at surface level and will include an underdrain to dispose of excess water to the wider drainage system. The underdrain also allows backflow of surface water to enable these features to be used for attenuation in extreme storm events.

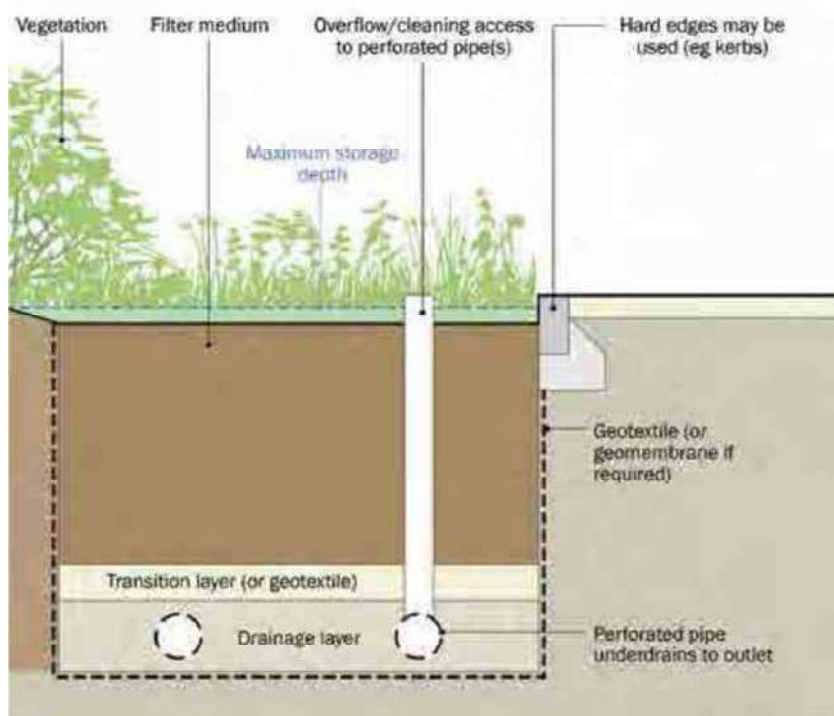


**Figure 2-3: Typical bioretention rain garden (courtesy of The SuDS Manual CIRIA C753)**

Bioretention rain gardens provide biodiversity benefits by providing habitats for invertebrates, and the planting scheme should be visually pleasing. Planting advice for these features should be sought from a landscape architect.

## Tree pits

Tree pits can contain a large volume of aerated soil to enable the passage of water and air to the root system. The aerated nature of the soil provides capacity for surface water to pass through and be stored without impacting the tree requirements. Passing water through a tree pit encourages the uptake of water by roots and evapotranspiration, as well as filtering out potential contaminants that have been mobilised from rainwater landing on engineered surfaces.

Tree pits can include an underdrain to dispose of excess water to the wider drainage system and can include voided cellular storage units to increase the water attenuation capacity. The underdrain also allows backflow of surface water to enable these features to be used for attenuation in extreme storm events. Trees, in their very nature, provide high biodiversity and amenity benefits. Planting advice for these features should be sought from a landscape architect.

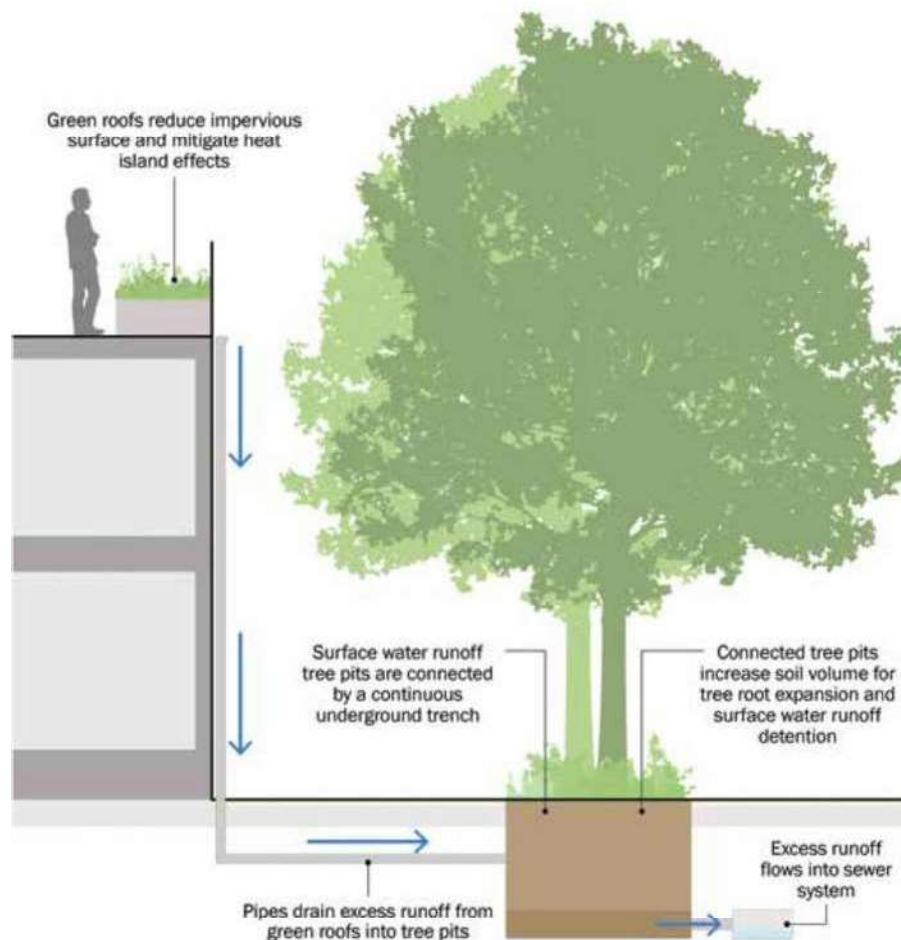


Figure 2-4: Typical tree pit interaction with wider drainage system

## Filter drains

Filter drains are shallow trenches filled with stone or gravel that provide collection, conveyance, treatment and storage of surface water runoff. Filter drains provide collection of surface water from ground level and are designed to be shallow to aid with maintaining the SuDS management train at or near surface level. Surface water runoff passes through the filter drain media, allowing filtration of runoff to remove fine sediments, hydrocarbons and heavy metals. Clean surface water can then be conveyed, either through a perforated pipe near the base of the trench or through the voids between the filter media.

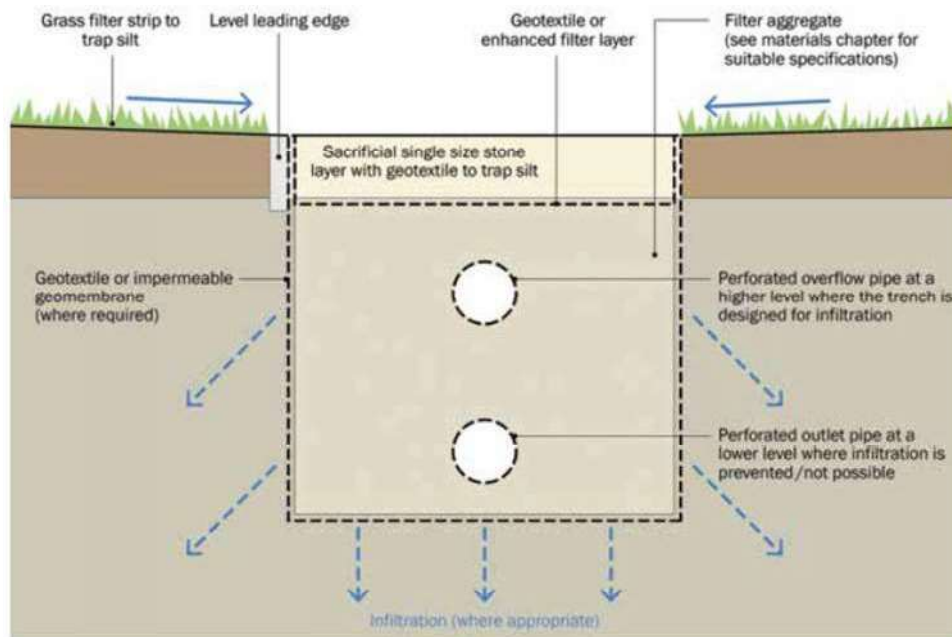


**Figure 2-5: Typical filter drain**

Filter drains can be designed to coordinate with wider landscaping proposals to create attractive boundaries and can use decorative gravel within the top layer of filter media to provide amenity benefits. The filter media can also provide habitats for microorganisms, insects and amphibians and can link well with surrounding filter strips to create larger habitat spaces for improved biodiversity.

## Permeable pavement

Permeable pavement provides direct runoff collection, treatment, conveyance and storage of surface water without the requirement for engineered drainage items, such as gullies and linear drains. Contaminants are generally trapped in the top 100mm layer, which allows for adequate treatment through aerobic digestion and exposure to sunlight. Permeable pavement can take the form of loose gravel, bound aggregate, block paving or porous tarmac. Whichever surface material is used, it must provide adequate permeability and be linked to a permeable sub-base for the pavement foundation.

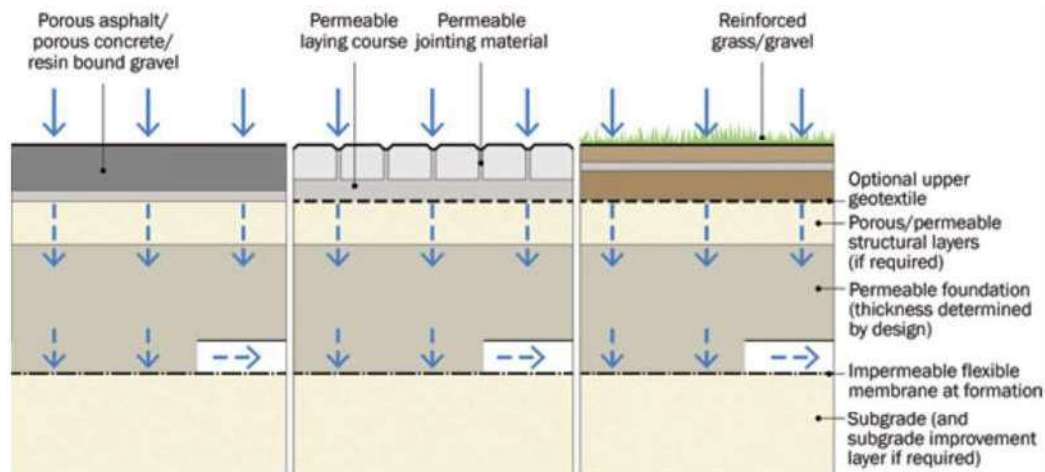


**Figure 2-6: Typical permeable pavement detail – no infiltration (courtesy of The SuDS Manual CIRIA C753)**

Permeable pavement should include a filter drain to provide connectivity to the wider drainage network. The filter drain also allows backflow of surface water to enable these features to be used for attenuation in extreme storm events. Permeable pavement does not provide any biodiversity benefits but can be aesthetically pleasing with well-designed surfacing.

Permeable paving can also be linked to a cellular storage layer to provide further attenuation volume. Cellular storage provides an effective means of storing large volumes of water below ground level and, in most cases, can be laid within open or trafficked areas, subject to an assessment of structural loading. Cellular storage rarely provides any other benefits and should not be relied upon as the sole means of managing surface water runoff.

## Attenuation storage tanks

Attenuation storage tanks are large cellular systems with a high void ratio to enable relatively obstacle free storage of collected runoff such that flows can be discharged at a low rate and be stored within the Development without causing flooding to the Site.

Attenuation storage tanks are buried elements and require the input of specialist suppliers to ensure that the cellular systems have the structural properties to withstand vertical and lateral pressures from the ground and from vehicular loading. Attenuation storage tanks should be provided with access points to enable CCTV camera surveying for monitoring of the condition and performance, as well as enabling jetting to clear any debris and silt accumulations.

Prior to flows entering into an attenuation storage tank, silt and debris should be intercepted through permeable pavement, filter drains, bioretention rain gardens, silt traps or hydrodynamic vortex separators. This will prevent the ingress and accumulation of silt which would otherwise reduce the available capacity for volume storage.

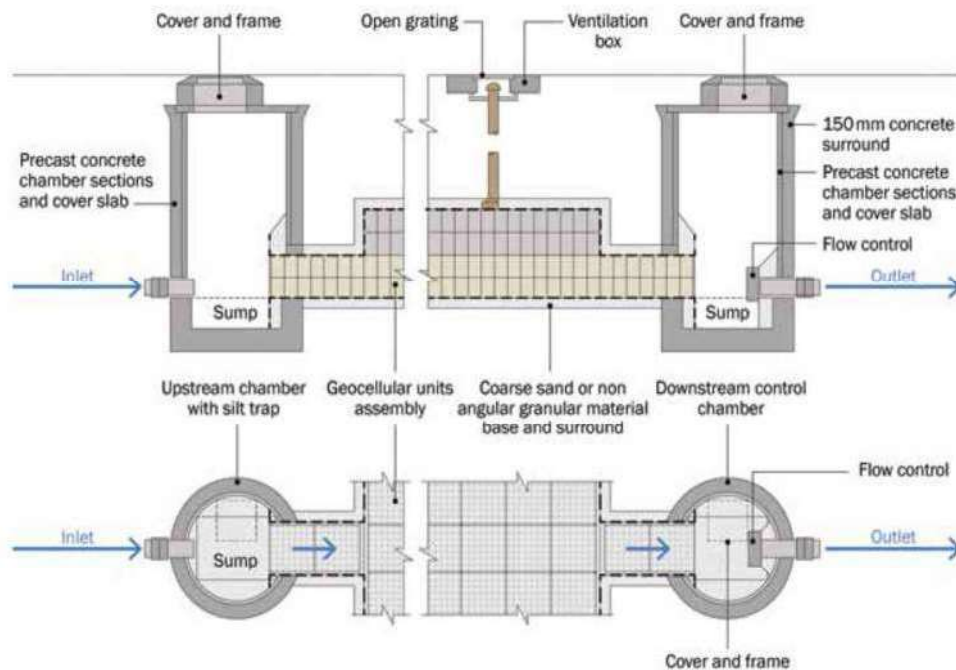


Figure 2-7: Typical attenuation storage tank section (courtesy of The SuDS Manual CIRIA C753)

## Flow control

Flow control devices are generally the last element of the SuDS management train, however, can be used at intermediate stages within larger developments, particularly where space and steep gradients constrain attenuation features. For this Development, a single flow control device will be suitable for managing the final runoff rate and runoff volume during storm events.

Vortex flow control devices restrict the runoff rate (and, subsequently, the runoff volume) by efficiently throttling flows through an orifice within a chamber. The orifice opening on small developments can become very small, therefore, it is strongly recommended to incorporate pre-treatment of surface water runoff in the upstream SuDS management train to reduce the risk of potential blockages. It is also recommended that an overflow weir or high level overflow pipe is incorporated to allow runoff to continue to discharge in the event of a blockage of the flow control device.



**Figure 2-8: Typical vortex control device with overflow allowances**

## 2.4 Surface Water Quality

The water quality treatment train has been determined based on CIRIA 753 The SuDS Manual. The appraisal of the potential development characteristics and relevant SuDS components is presented below, demonstrating that the relevant indices can be met through the use of the SuDS Management Train.

**Table 2-2 Minimum water quality management requirements for discharges to receiving surface waters and groundwater (The SuDS Manual, 2015, Table 4.3)**

| Land use                                                                                                                                                                                                                                                                                                                                       | Pollution hazard level | Requirement for discharge to surface waters and groundwater |        |              |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-------------------------------------------------------------|--------|--------------|
| Other roofs                                                                                                                                                                                                                                                                                                                                    | Low                    | Simple index approach                                       |        |              |
| Non-residential car parking (<300 traffic movements/day)                                                                                                                                                                                                                                                                                       | Low                    | Simple index approach                                       |        |              |
| Steps in the simple index approach (The SuDS Manual, 2015, Box 26.2):                                                                                                                                                                                                                                                                          |                        |                                                             |        |              |
| <div>1. Allocate suitable pollution hazard indices for the proposed land use.</div> <div>2. Select SuDS with a total pollution mitigation index that equals or exceeds the pollution hazard index.</div> <div>3. Where the discharge is to protected surface waters or groundwater, consider the need for a more precautionary approach.</div> |                        |                                                             |        |              |
| Where the mitigation index of an individual component is insufficient, two components (or more) in series will be required:                                                                                                                                                                                                                    |                        |                                                             |        |              |
| Total SuDs mitigation index = mitigation index 1 + 0.5 * mitigation index 2 etc.                                                                                                                                                                                                                                                               |                        |                                                             |        |              |
| A factor of 0.5 is used to account for the reduced performance of secondary or tertiary components where the discharge is of already reduced inflow concentrations to protected waters.                                                                                                                                                        |                        |                                                             |        |              |
| Pollution hazard indices for different land use classifications (The SuDS Manual, 2015, Table 26.3)                                                                                                                                                                                                                                            |                        |                                                             |        |              |
| Land use                                                                                                                                                                                                                                                                                                                                       | Pollution hazard level | Total suspended solids TSS                                  | Metals | Hydrocarbons |
| Non-residential car parking (<300 traffic movements/day)                                                                                                                                                                                                                                                                                       | Low                    | 0.5                                                         | 0.4    | 0.4          |
| Indicative SuDS mitigation indices for discharges to surface water (SuDS Manual, 2015, Table 26.4)                                                                                                                                                                                                                                             |                        |                                                             |        |              |
| Type of SuDS component                                                                                                                                                                                                                                                                                                                         |                        | TSS                                                         | Metals | Hydrocarbons |
| SuDS management train would direct all roof water runoff through SuDS features or catchpits to remove gross solids and sediments                                                                                                                                                                                                               |                        | N/A                                                         | N/A    | N/A          |
| Green roofs, bioretention rain gardens & tree pits                                                                                                                                                                                                                                                                                             |                        | 0.8                                                         | 0.8    | 0.8          |
| Filter drains                                                                                                                                                                                                                                                                                                                                  |                        | 0.4                                                         | 0.4    | 0.4          |
| Permeable pavement                                                                                                                                                                                                                                                                                                                             |                        | 0.7                                                         | 0.6    | 0.7          |

### **3.0 SuDS Operation & Maintenance**

Maintenance of SuDS is critical to achieve efficient functionality, long lasting performance and reduced contamination risk to the Site and downstream. Regular inspections, checks, corrective maintenance and repairs may need to be undertaken by a competent professional.

On Site drainage systems and SuDS features would remain under private ownership and would be maintained by an estates management company or the owner/occupier in accordance with the following guidance:

The useful life and effective operation of SuDS components is related to the frequency of maintenance and the risk of sediment being introduced into the system.

Maintenance will usually be carried out manually, although suction tankers can be used for sediment and debris removal from large systems. If maintenance is not undertaken for extended periods of time, deposits may become hard-packed and more difficult to remove.

In exceptional circumstances where maintenance is not undertaken regularly, replacement of SuDS may be required at significant cost and disruption and, ultimately, will lead to higher flood risk to the Development and the wider catchment.

#### **3.1 Main Drainage System**

Gutters, rainwater pipes, outlets, gullies, and drainage channels would be inspected and thoroughly cleaned once a year. All manholes would be inspected once a year and where necessary cleaned out at the same time. Any defects to the brickwork, benching cover or frame would be made good. Attention would be made to the Confined Spaces Regulations 1997 and the provisions contained therein for access to confined spaces. Details for entrance to manholes and separator tanks are contained in the above legislation.

#### **3.2 Cleaning of the Drainage System**

The following operations would be carried out during the periodic cleaning of the drainage system.

1. Covers of inspection chambers and manholes would be removed and the sides, benching and channels cleaned.
2. Intercepting traps, if fitted, would be plunged and flushed with clean water. Care would be taken to see that the stopper in the rodding eye is securely replaced.
3. Main and branch drains should be cleaned and afterwards would be flushed with clean water. Any obstructions found would be removed and not flushed into the system.
4. Periodically, accumulated deposits in gullies would be removed. The traps would then be plunged and thoroughly flushed out with clean water.
5. Covers of inspection chambers and gullies would be replaced, bedded in suitable grease or other sealing material and/or bolted down as appropriate to the type. Missing bolts and broken items would be renewed.

### **3.3 Methods of Cleaning**

The drainage system would be cleaned, as appropriate, using one or more of the following methods:

a. Rodding.

Appropriate cleaning tools and techniques should be chosen to avoid damage to the pipework to be cleaned. A set of rods with appropriate ends is basic useful equipment. It is important that correctly designed proprietary ends are used on the rods. Makeshift devices attached to the ends of rods should be avoided as they are not as effective as the correctly designed article and could become detached and create a blockage which would be difficult to remove. Furthermore, it is possible that such devices could cause damage to the pipeline. If the rods have brass ferrules, they should be checked to ensure that their fastenings are secure and that there are no protruding shoulders or fastenings as these can cause damage to drain lines, especially when entering through rodding eyes.

b. Jetting.

High pressure jetting techniques are suitable for use with all currently available pipe materials and should also be considered.

c. Hydraulic rams compressed air or other gases.

Equipment is available for use with all sizes of drain likely to be encountered in building drainage and is suitable for use with all currently available pipe materials. The principle of operation is that a shock wave is induced and is transmitted by water to the point of blockage, and the technique is effective where the pipe is surcharged or can be filled with water from the blockage to a point where the equipment can be used.

### **3.4 Green Roofs**

#### **3.4.1 Operation**

Green roofs are intended to be water quality and conveyance features and to be dry, except during rainfall events.

Where applicable the surface shall be designed to be permeable such that rain can flow through the upper construction layers into a drainage substrate and be conveyed to the below ground drainage system.

#### **3.4.2 Inspection and Maintenance Regime**

Regular inspection and maintenance is important for the effective operation of green roofs.

A recommended schedule is detailed in

Table 3-1 overleaf.

**Table 3-1: Green Roof Maintenance Requirements**

| Maintenance Schedule | Required Action                                                                                                                                                                                                 | 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 (ie year on), 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                           |
| 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                                      | As required                                          |
|                      | If drain inlet has settled, cracked or moved, investigate and repair as appropriate                                                                                                                             | As required                                          |

### 3.5 Bioretention Rain Gardens and Tree Pits

#### 3.5.1 Operation

Bioretention rain gardens and tree pits are intended to be surface water conveyance, water quality and attenuation storage features to drain hard landscaping on site. These features are intended to be dry except during and following rainfall events.

The surface water should permeate through the upper layer of the feature in to the permeable soil build-up below. The water is then collected and conveyed in the perforated pipe within the aggregate trench.

Access for maintenance has been provided through inspection chambers.

#### 3.5.2 Inspection and Maintenance Regime

Regular inspection and maintenance is important for the effective operation of bioretention rain gardens and tree pits.

A recommended schedule is detailed in Table 3-2 below.

**Table 3-2: Bioretention Rain Garden and Tree Pit Maintenance Requirements**

| Maintenance Schedule   | Required Action                                                                                                                                                                                         | Frequency                                            |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|
| Regular inspections    | Inspect infiltration surfaces for silting and ponding, record de-watering time of the facility and assess standing water levels in underdrain (if appropriate) to determine if maintenance is necessary | 3-monthly                                            |
|                        | Check operation of underdrains by inspection of flows after rain                                                                                                                                        | Annually                                             |
|                        | Assess plants for disease infection, poor growth, invasive species etc and replace as necessary                                                                                                         | 3-monthly                                            |
|                        | Inspect inlets and outlets for blockage                                                                                                                                                                 | 3-monthly                                            |
| Regular maintenance    | Remove litter and surface debris and weeds                                                                                                                                                              | Quarterly (or more frequently for aesthetic reasons) |
|                        | Replace any plants to maintain planting density                                                                                                                                                         | As required                                          |
|                        | Remove sediment, litter and debris build-up from around inlets or from forebays                                                                                                                         | 3-monthly to 6-monthly                               |
| Occasional maintenance | Infill any holes or scour in the filter medium, improve erosion protection if required                                                                                                                  | As required                                          |
|                        | Check planting and tree health and manage appropriately                                                                                                                                                 | Annually                                             |
|                        | Repair minor accumulations of silt by raking away surface mulch, scarifying surface of medium and replacing mulch                                                                                       | As required                                          |
|                        | Water                                                                                                                                                                                                   | As required (in period of drought)                   |
| Monitoring             | Inspect silt accumulation rates and establish appropriate removal frequencies                                                                                                                           | Half yearly                                          |
| Remedial Actions       | Remove and replace filter medium and vegetation above                                                                                                                                                   | As required but likely to be > 20 years              |

### **3.6 Filter Drains**

#### **3.6.1 Operation**

The filter drains are intended to be surface water conveyance, water quality and attenuation storage features to drain hard landscaping on site. These features are intended to be dry except during rainfall events.

The surface water should permeate through the upper layer of the feature in to the permeable stone below. The water is then collected and conveyed in the perforated pipe within the aggregate trench.

Access for maintenance has been provided through inspection chambers.

#### **3.6.2 Inspection and Maintenance Regime**

Regular inspection and maintenance is important for the effective operation of the features. A recommended schedule is detailed in

Table 3-3 overleaf.

Sediment\material removal should be undertaken in consultation with the guidance provided by environmental regulator.