

# Conceptual SuDS strategy report

For the proposed development at  
**9 Priory Avenue, Harefield,  
UB9 6AP**

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# 1 Executive Summary

- A All surface water arising can be managed on site.
- B All surface water arising from roofed areas is managed on site by either direct infiltration through soakaways or by rain-gardens.
- C All areas of hard standing on the site will be constructed using a permeable medium.
- D There is no design exceedence outfall away from the site.
- E All SuDS on site will be installed with full consideration to long term maintenance.
- F Exceedence flows and flows arising from system failure can be managed on site.
- G The use of SuDS techniques on site will mitigate and treat the run-off volumes.
- H An alternative option has been provided in infiltration is not found viable.

## 2 Introduction

### 2.1 Site location

The development is at 9 Priory Avenue, Harefield, UB9 6AP (see Figure 1).



Figure 1: Site location plan, as indicated (source: EA flood mapping)

## **2.2 Proposed development description**

The proposal is for a 55m<sup>2</sup> plan area two storey extension to an existing dwelling, see proposal plans at Appendix A, following the demolition of a single garage of 24m<sup>2</sup> plan area.

The curtilment of the entire site encloses an area of approximately 550m<sup>2</sup> of which, pre-development, 157m<sup>2</sup> is classed as being impermeable (77m<sup>2</sup> roofs, 80m<sup>2</sup> impermeable hard-standing and paths), with the remaining 393m<sup>2</sup> classed as permeable planting. The new development increases the impermeable area from 157m<sup>2</sup> to 168m<sup>2</sup> (108m<sup>2</sup> roof area).

Nett increase in drained roof area equals 31m<sup>2</sup>.

## **2.3 Site geology**

With reference to BGS mapping and bore hole data within the vicinity the site appears to sit on the Seaford Chalk Formation And Newhaven Chalk Formation (undifferentiated) - Chalk. This will require confirmation on site.

### **2.3.1 Infiltration rates**

Infiltration rates for the site are assumed for initial design as  $1.4 \times 10^{-5} \text{ ms}^{-1}$  (50mm.hr<sup>-1</sup>). Testing to BRE 365 will be required at some stage to confirm this.

### **2.3.2 Water table**

Unknown at this stage, however there is unlikely to be water perched on the chalk. To be confirmed on site.

## 2.4 Existing surface water disposal strategy

The existing site is drained directly to the Thames Water surface water, possibly combined, network by means of rainwater pipes and surface gulleys. The location, and internal layout of the surveyed inspection chambers on site indicate that the surface water outfalls towards the main road.



Figure 2: Existing front elevation (Google images). This shows a single outfall pipe serves the pair of semi-detached dwellings.

## 2.5 Site constraints impacting on SuDS

- Pitched roof design
- No access to adjacent water courses or ditches.
- Previously developed site.

## 2.6 Estimation of existing peak run-off rate

The Wallingford Procedure<sup>[2]</sup> is used as the basis for the following calculation by using a site specific IDF curve to establish  $i_1$  and  $i_{100}$  rainfall intensities. Hence for the upper limit on flow from the site:

### 2.6.1 Variables

$$i_1 = 50.4^1 \text{ mm hr}^{-1}$$

---

<sup>1</sup>50.4mm hr<sup>-1</sup> is the mean intensity of a 1 in 1yr 6min duration summer storm, calculated to be the worst case, using standard IDF formula.

$$i_{100} = 153 \text{ mm hr}^{-1}$$

$$A = 157 \text{ m}^2$$

## 2.6.2 Impermeable area run-off rate for pre-developed site

$$\begin{aligned} Q_{BF1} &= \frac{0.95 * 50.4 * 157}{3600} \\ &= 2.1 \text{ l s}^{-1} \end{aligned}$$

$$\begin{aligned} Q_{BF100} &= \frac{0.95 * 153 * 157}{3600} \\ &= 6.3 \text{ l s}^{-1} \end{aligned}$$

Existing runff rates from the impermeable areas of the site are calculated as  $2.09 \text{ l s}^{-1}$  (based on  $50.4 \text{ mm hr}^{-1}$ , 1 in 1 yr summer storm).

## 3 SuDS Principles

In line with the SuDS management train, the following hierarchy has been considered in applying the use of SuDS into the proposed development scheme.

### 3.1 SuDS design philosophy

The CIRIA SuDS<sup>[1]</sup> manual provides the design philosophy:

“SuDS design should, as much as possible, be based around the following:

- using surface water run-off as a resource
- managing rainwater close to where it falls
- managing run-off at the surface
- allowing rainwater to soak into the ground
- promoting evapotranspiration
- slowing and storing run-off to mimic natural run-off characteristics
- reducing contamination of run-off through pollution prevention and controlling the run-off at source
- treating run-off to reduce the risk of urban contaminants causing environmental pollution.”

### 3.2 Source control

- Sedum roofing.
- Infiltration devices. Typically soakaways.
- Rainwater harvesting.
- Bio-retention planting, rain gardens.
- Permeable paving, porous asphalt. These provide both infiltration and short term storage volumes thus reducing overall un-mitigated run-off volumes.

### **3.3 “End of pipe” solutions**

To be considered only after implementation of the above options.

- Retention tanks with outfall controlled by hydraulic means to limiting discharge rates and volumes to discharge to existing SW flow pathways.

Sections 4.1 to 4.6 consider the viability of a range of these SuDS devices.

#### **3.3.1 Statutory requirements - Building Regulations**

Part H defines in general terms the hierarchy for SW disposal which is to be considered in the following order:

- Infiltration
- Adjacent water course or ditch
- Sewer

All drainage on site, both foul and SW will be subject to compliance with Part H of the Building Regulations. Hence all SW runs, pipe diameters etc. will comply in full with the requirements of Part H, be designed following the guidance of Approved Document H, and be inspected and approved by the Building Control body at the time of construction.

## 4 Appraisal of SuDS options

The primary aim is to meet the requirements of the Local Plan core policies and the SuDS hierarchy so as to manage SW on site.

### 4.1 Infiltration devices

With reference to Section 3.1, soakaways promote the following SuDS design criteria:

- manages rainwater close to where it falls
- allows rainwater to soak into the ground
- slows and stores run-off to mimic natural run-off characteristics
- treats run-off to reduce the risk of urban contaminants causing environmental pollution.

Due to the reasonable infiltration rates expected with the local chalk geology, Section 2.3, infiltration devices appear suited for this site and can be designed to accommodate design rainfall events (designed in line with BRE365 and Part H of the Building Regulations and at least 5m away from any structure).

### 4.2 Bio-retention

With reference to Section 3.1, rain garden planters promotes the following SuDS design criteria:

- manages rainwater close to where it falls
- manages run-off at the surface
- promotes evapotranspiration
- slows and stores run-off to mimic natural run-off characteristics
- treats run-off to reduce the risk of urban contaminants causing environmental pollution.

and also

- Promotes bio-diversity
- Provides amenity

## 4.3 Permeable hard standing

With reference to Section 3.1, permeable paving promotes the following SuDS design criteria:

- manages rainwater close to where it falls
- manages runoff at the surface
- allows rainwater to soak into the ground
- slows and stores run-off to mimic natural run-off characteristics
- treats run-off to reduce the risk of urban contaminants causing environmental pollution.

### 4.3.1 Permeable paving

A 30% void ratio is assumed through a 350mm sub-base. This is appropriate for a DOT Type 3 Sub-base hence the storage capacity equates to circa 105mm per 1m<sup>2</sup> therefore based on a M6 100hr + cc storm of 87mm rainfall the paving offers, without any allowance for infiltration, a circa 1:1.2 drained volume:storage volume capacity. Hence there is no anticipated exceedence flow from the areas of permeable paving.

Note: where attenuation cells or soakaways are located under areas of permeable paving the perimeter of each attenuation tank or soakaway will be bunded within the sub-base with an appropriate up-stand or kerbing so as to prevent the sub-base draining directly into the attenuation tanks or soakaways.

TSS 0.7, Metals 0.6, Hydrocarbons 0.7 = suitable for trafficked areas

All permeable paving offers sufficient storage volume to accommodate the 5mm event.

The areas of permeable paving are primarily disconnected from the proposed SW network, i.e. they are not primarily designed to drain to the network. Surface water retained in the sub-base matrix is lost through evaporation and infiltration, at shallow depths, into the surrounding naturally fissured sub-soils (due to action of freeze-thaw, roots, earthworms and the proposed local re-grading following any site clearance). In doing so it mimics as close as possible the natural hydrological process of water falling onto the ground and finding natural flow paths for dispersion.

Exceedence flows (flows over the 1.2 x M1006hr + CC event) will be conveyed at the surface via channels (e.g. "ACO" channels) to the existing SW network.

## 4.4 Rainwater harvesting

With reference to Section 3.1, Rainwater harvesting promotes the following SuDS design criteria:

- uses surface water run-off as a resource
- manages rainwater close to where it falls

Also,

- reduces potable water demand

### 4.4.1 For external use

Rain water harvesting / water butts: These provide additional, “off line” SuDS, and are deemed a suitable SuDS component for small plots<sup>[1]</sup>. The collection and re-use of water can reduce run off volumes arising from roofs. The collected water, via readily available diverters (e.g. Web link: [Standard diverter example](#)), being used for external uses.

Rainwater butts can, in part, accommodate the 5mm event dependent on manual drawdown and evaporation.

## 4.5 Sedum/green roofs.

Due to site constraints, as Section 2.5, Sedum roofs are not viable on this project.

## 4.6 “End of pipe” solutions

To be considered only after implementation of the above options.

- Retention tanks with outfall controlled by hydraulic means (e.g. hydrobrakes, pipe sizing, orifice plate etc.) to limiting rates and volumes to discharge to existing flow pathways.

## 5 Proposed surface water disposal strategy

The following sections consider the strategy for water arising from the roof areas, driveways and hard standing and areas of landscaping.

### 5.1 If infiltration is viable to allow soakaways

All surface water arising from roofed areas is controlled by direct infiltration through a soakaway. Notes:

- For this report the drained area to the soakaway(s) arises from the area of roof plus a 1 allowance for urban creep.
- The soakaway is designed for all events up to and including the M100 6hr event.
- An allowance of x1.4 is made for climate change in line with current best practice.

Designed to BRE365, and to accommodate all surface water arising from a drained area of 55m<sup>2</sup> requires 1 , open void (i.e. 95%), soakaway(s) of 1.5m wide x 2.1m long with a 1.2m effective depth. See Table 1.

|                       |          |                  |
|-----------------------|----------|------------------|
| Permeability          | 1.40E-05 | ms <sup>-1</sup> |
| Urban Creep           | 1        |                  |
| Drained area          | 55       | m <sup>2</sup>   |
| Designed drained area | 55       | m <sup>2</sup>   |
| Return Period         | 100      | yr               |
| % voids               | 95       | %                |
| Climate change        | 1.4      |                  |

|                                 |     |
|---------------------------------|-----|
| Design Width, m                 | 1.5 |
| Design Depth <sub>eff</sub> , m | 1.2 |
| Design Qty                      | 1   |

|                           |      |      |      |      |      |      |      |      |      |       |
|---------------------------|------|------|------|------|------|------|------|------|------|-------|
| Duration, mins            | 5    | 10   | 15   | 30   | 60   | 120  | 240  | 360  | 600  | 1440  |
| Rainfall, mm              | 19.1 | 28.6 | 34.5 | 45.4 | 56.7 | 68.5 | 80.3 | 87.5 | 97.4 | 116.1 |
| Volume in, m <sup>3</sup> | 1.1  | 1.6  | 1.9  | 2.5  | 3.1  | 3.8  | 4.4  | 4.8  | 5.4  | 6.4   |
| Length req'd, m           | 0.6  | 0.9  | 1.1  | 1.4  | 1.7  | 2    | 2.1  | 2.1  | 1.9  | 1.3   |

|                     |      |
|---------------------|------|
| Crit Length, m      | 2.1  |
| Crit Duration, mins | 240  |
| Empty to 50%, hrs   | 8.19 |

Table 1: BRE 365 Calculation results

#### 5.1.1 Sedimentation risk

Domestic roofing carries a very low sediment loading. Worst case 216 kg.ha<sup>-1</sup>yr<sup>-1</sup> - so for this site that equates to circa 2.3kg.yr<sup>-1</sup> in the worst case. Generally this would reduce the attenuation capacity by circa 2% over 50yrs (all data from the SuDS manual).

The design allows for this amount with extra capacity provided to a 100yr design life. The BRE 365 method acknowledges this sedimentation and hence the base area is not considered in the sizing calculations.

### **5.1.2 Minimising sedimentation risk**

However, the developer will fit accessible sumped rainwater gulleys at the base of all RWP's so as to reduce the amount of any sediment entering the soakaway.

The developer will also fit downpipe leaf guards to all outfalls from the roof (or "hedgehog" gutter guards).

## **5.2 If infiltration is not viable to allow soakaways**

### **5.2.1 Rain-garden planter**

Water from an equivalent nett area of circa 55m<sup>2</sup> of additional new roof area will flow to a raised rainwater planter "rain garden" to offer a level of pre-treatment, attenuation and flow control, Figure 3 with planting and soil guide at Appendix B. Flows will be apportioned by the rainwater gutter arrangement.

Outfall from the planter will be taken to the existing surface water provision.

All planters offer sufficient storage volume to accommodate the 1 in 1yr, 5mm event.

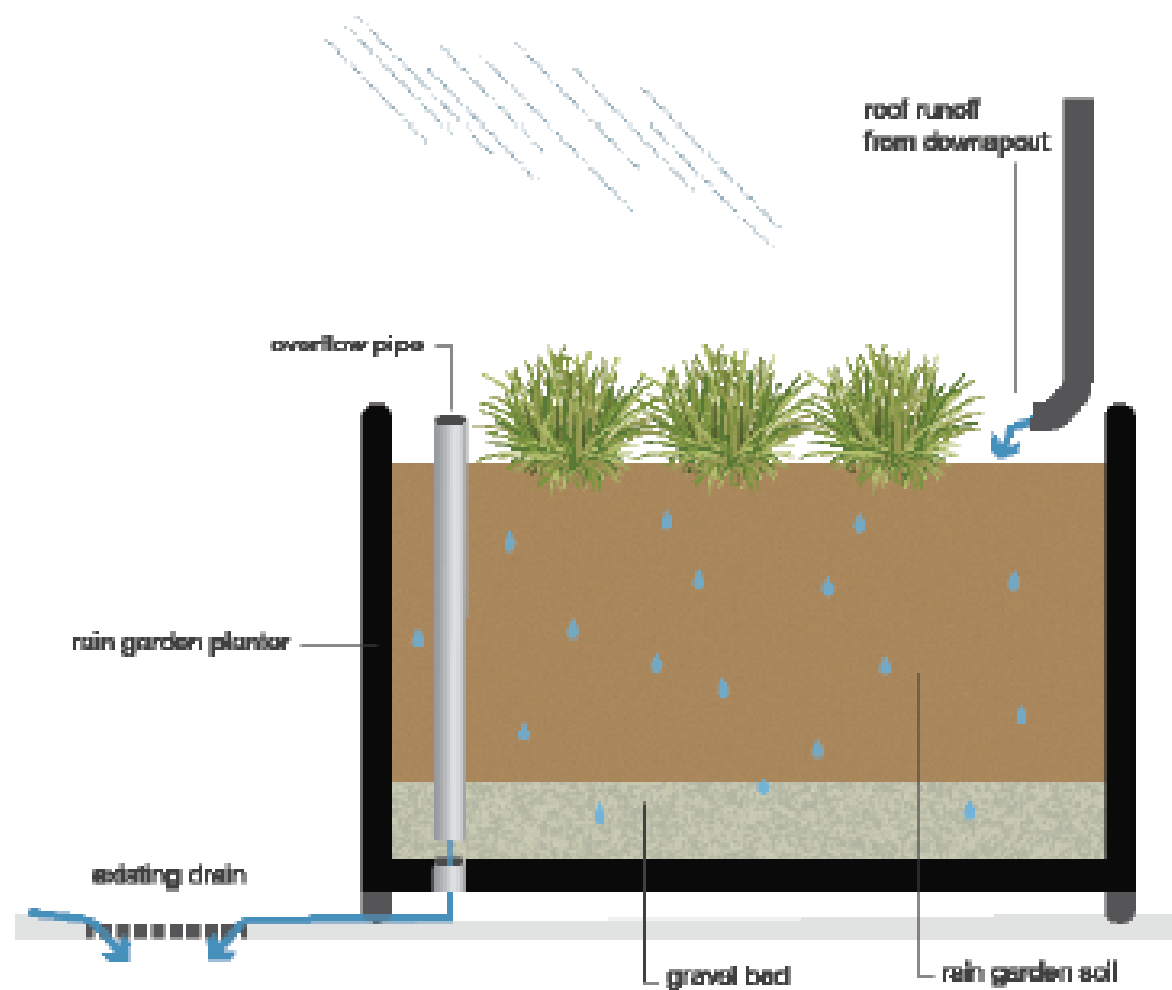


Figure 3: Typical rain garden/bio retention section

Planter design based on 2yr return period

Climate change factor = 1.4

Urban Creep factor = 1

$C_v = 0.95$

Engineered, rootzone soil, infiltration rate =  $100\text{mmhr}^{-1}$ .

Drained area =  $55\text{m}^2$

Design width of 1.2m, length of 4.10m and depth of 0.6m

Design planter area =  $4.92\text{m}^2$

### Critical Duration

Critical storm duration has calculated by considering the inflow rate minus the outflow rate of storm durations from 5 minutes and increasing in 1 minute intervals. From this

the critical storm duration for this planter is 41 minutes.

M2 41 min rainfall depth = 14mm

### Storm capacity check

Required capacity:  $V_t = \frac{55*1*1.4*21.1*41}{60*1000} = 0.7m^3$

Required ponding depth above planter =  $0.7/4.9 = 150mm$ .

### Drain down check

Saturated drain down time, t =

$$\frac{V_t L}{k (h + L) A_f}$$

where:

Critical duration = 41 mins

1 in 2yr, 41min mean intensity =  $21.1 \text{ mmhr}^{-1}$

L (planter depth) = 0.6m

h = 0.075m

Engineered k =  $100 \text{ mmhr}^{-1}$ . For design 50% of this rate is used.

$$\frac{0.7 * 0.6 * 1000}{50 (0.075 + 0.6) 4.9} = 2.59$$

Planter design draindown time = 2.59hrs.

### Max design outfall flow rate

The max design outfall rate from the underdrain is based on the 100 yr design storm event entering the system when fully saturated.

$$Q_{max} = \frac{k A_f (h + L)}{L} m^3 s^{-1}$$

For this planter, peak outfall is given as:

$$Q_{max} = \frac{100 * 4.9 (0.075 + 0.6)}{0.6 * 3600} = 0.15 l s^{-1}$$

## **Thames water consent to discharge**

Thames water consent may be required. Application forms are provided in Appendix C.

### **5.3 Rainwater harvesting**

Primarily designed in the scheme to reduce potable water demand, this will also provide an additional SuDS component.

The project team have detailed “off line” rainwater butts to collect water for external use. Since these are in off-line configuration any exceedence flows are automatically directed back to the downpipes.

### **5.4 Driveways and hard standing**

All new areas of hard standing on the site will be constructed using a permeable medium on a DOT/MOT 3 sub-base of 350mm depth (refer to Section 4.3).

The perimeter of these areas will be considered for Bio retention planting to accommodate any exceedence flows.

Based on a nominal infiltration rate of 3.6mm.hr the following is based on a 100m<sup>2</sup> area of paving. This can be increased or decreased pro rata.

Designed to accommodate all surface water arising from a design drained area of 100m<sup>2</sup> requires a minimum attenuation volume of 7 m<sup>3</sup>. This can be achieved using an overall storage volume of 10.5 m<sup>3</sup> formed within a 100m<sup>2</sup> x 0.35m deep 30% void ratio sub-base. See Table 2.

|                                     |                                                                                  |                                   |
|-------------------------------------|----------------------------------------------------------------------------------|-----------------------------------|
| Drained area                        | 100m <sup>2</sup>                                                                |                                   |
| Urban Creep                         | 1                                                                                |                                   |
| Designed drained area               | 100m <sup>2</sup>                                                                |                                   |
| Return periods considered           | 1yr, 30yr, 100yr                                                                 |                                   |
| Storm profiles used                 | 50% Summer                                                                       | 75% Winter                        |
| Storm coeffs                        | a = 0.1, b = 0.815                                                               | a = 0.06, b = 1.026               |
| Storm range, storm increments       | From 5 minutes duration in further 2 min. intervals until critical storm reached |                                   |
| M5-60                               | 20mm                                                                             |                                   |
| r                                   | 0.4                                                                              |                                   |
| Rainfall model                      | FSR                                                                              |                                   |
| Critical design storm               | 325 mins, Winter                                                                 |                                   |
| Climate change                      | 1.4                                                                              |                                   |
| Storm mean intensity                | 11.2mm.hr <sup>-1</sup>                                                          |                                   |
| Design mean intensity               | 15.7mm.hr <sup>-1</sup>                                                          |                                   |
| Storm peak intensity                | 29.8mm.hr <sup>-1</sup>                                                          |                                   |
| Design peak intensity               | 41.7mm.hr <sup>-1</sup>                                                          |                                   |
| Design maximum head                 | 0.22m                                                                            |                                   |
| Calculated maximum head             | 0.22m                                                                            |                                   |
| Minimum attenuation volume required | 6.56m <sup>3</sup>                                                               |                                   |
| Void ratio                          | 30%                                                                              |                                   |
| Design attenuation volume           | 7m <sup>3</sup>                                                                  | (0.3 × 100m <sup>2</sup> × 0.22m) |
| Provided attenuation volume         | 11m <sup>3</sup>                                                                 | (0.3 × 100m <sup>2</sup> × 0.35m) |
| 1 in 1yr maximum outfall rate       | 0.1ls <sup>-1</sup>                                                              | (See Figure 4.)                   |
| 1 in 30yr maximum outfall rate      | 0.1ls <sup>-1</sup>                                                              | (See Figure 5.)                   |
| 1 in 100yr maximum outfall rate     | 0.1ls <sup>-1</sup>                                                              | (See Figure 6.)                   |
| 1 in 100yr Time to peak             | 311 mins                                                                         |                                   |
| Design head: Time to drop to 50%    | 9.11 hrs                                                                         |                                   |
| Time to 50% total capacity          | 3.75 hrs                                                                         |                                   |
| Outfall control method              | Nominal GF outflow                                                               |                                   |

Table 2: Storage volume design summary

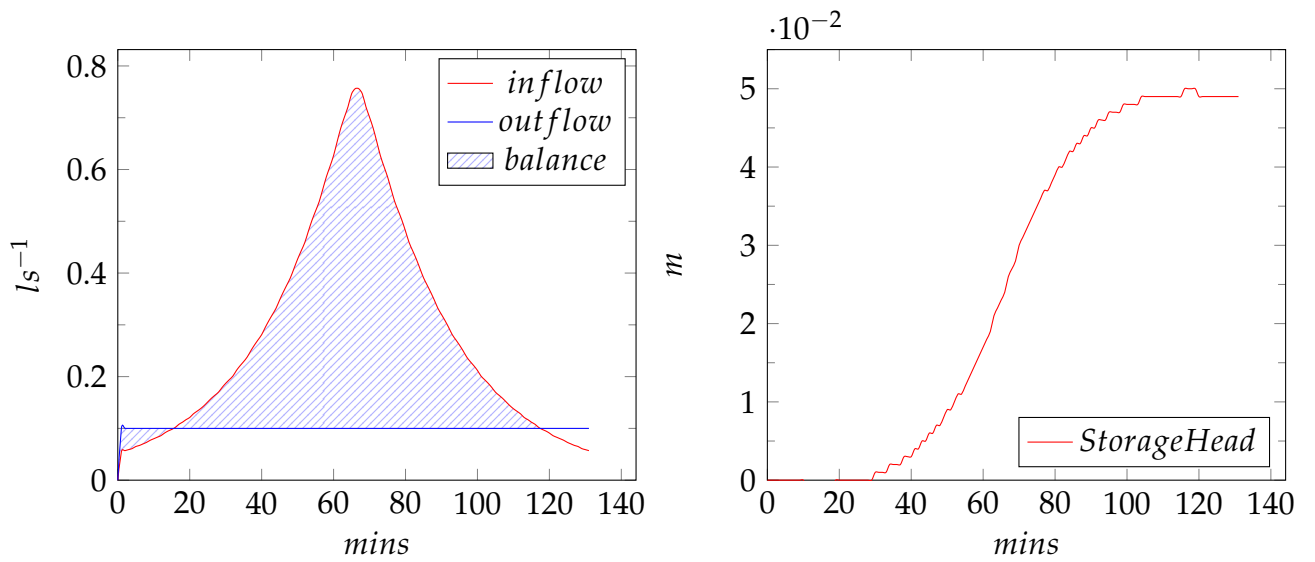


Figure 4: 1 in 1 year critical storm event

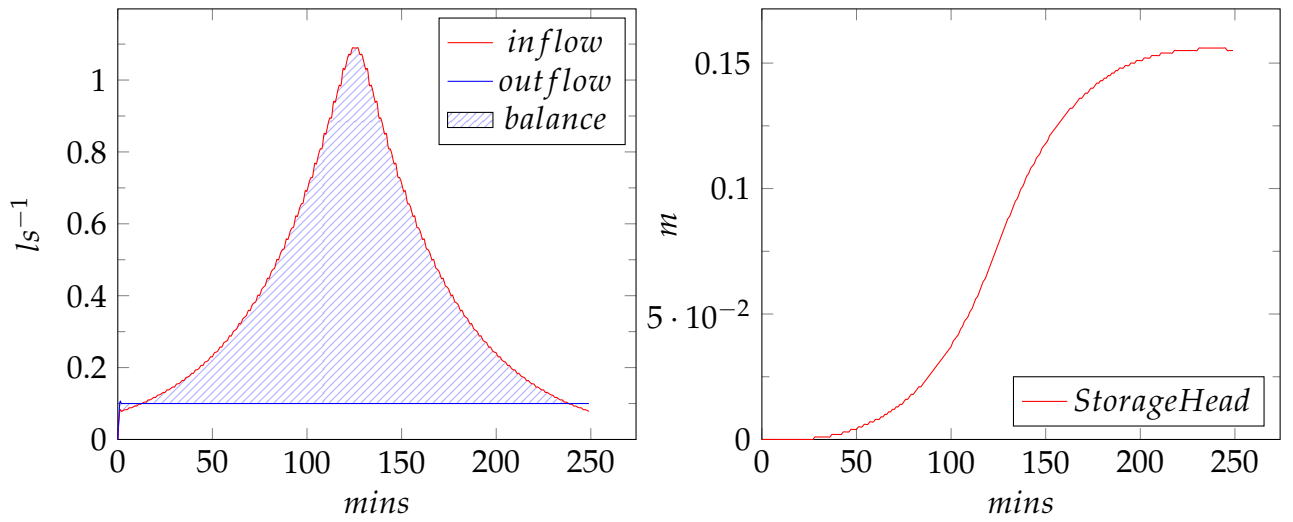


Figure 5: 1 in 30 year critical storm event

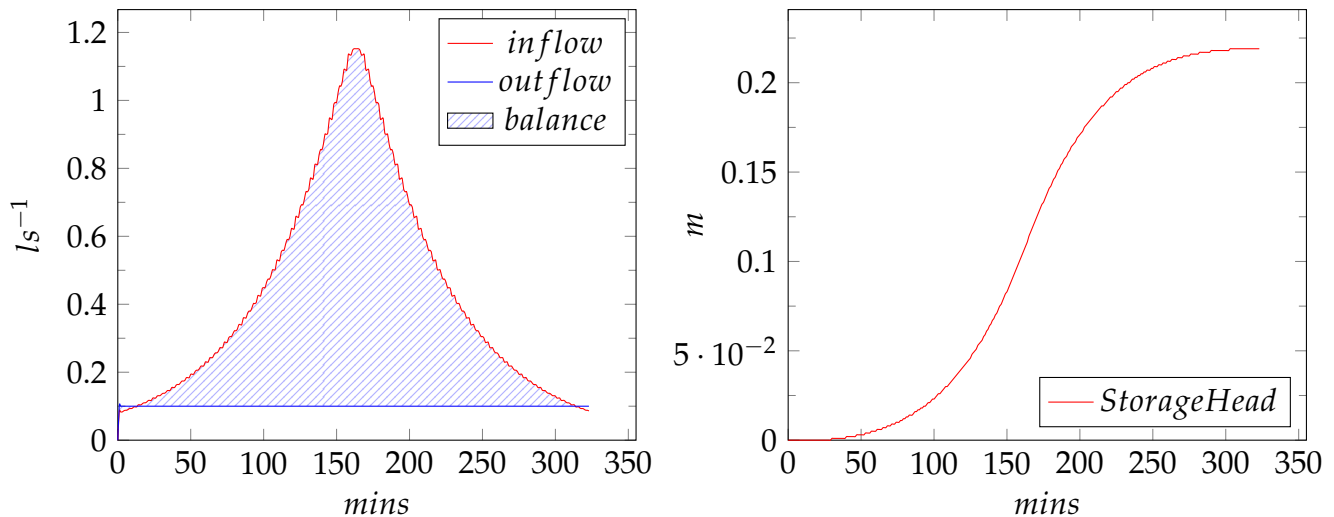


Figure 6: 1 in 100 year critical storm event

## 5.5 Landscaped areas

Typical domestic planting.

## 5.6 Schematic

The proposal plan at Appendix A shows two options:

- the location of the soakaway if infiltration is viable and
- space allocated for the raised planter in the event that infiltration at depth is not viable.

## 5.7 Overland flow

While there is no design exceedence flows, a surface mounted channel will be used adjacent to the site's entrance to intercept exceedence surface flows. The outfall from this will be directed to the existing SW network.

## 5.8 Exceedence flows

Water butt(s) - when full, the water is diverted to the existing surface water drainage on site.

Rain garden planters - when saturated, the water is directed back to the existing surface water drainage on site.

Soakaways - Designed to 100yr +40% climate change + 10% urban creep hence no design exceedence.

Permeable paving - Any exceedence flows at the surface will be channelled to the proposed SW network via silt traps.

There are no design overland exceedence flow paths other than as noted above.

## **5.9 Timetable for implementation**

### **5.9.1 Construction phase**

During the garage demolition phase, rainwater will be managed in line with the requirements under the CDM regulations using existing SW gullies with measures in place to prevent contaminants entering the network.

Soakaway cells will be installed early in the project under the remit of the groundworks operations with access retained for post construction cleaning.

Rain-garden planters will be constructed with the landscaping.

Areas of landscaping and boundary planting will be undertaken as the project nears completion.

Permeable paving will only be installed when all construction activities are either complete, or near completion so as to minimise blockage of the surface.

### **5.9.2 Post construction phase**

Water butts will be installed prior to final completion as part of the final landscaping.

Soakaway cells pumped and cleaned out.

## 6 Maintenance of SuDS

Ultimate responsibility for the long term maintenance with SuDS in this environment lay with the property owner.

All SuDS on site will be installed with full consideration to long term maintenance. The following guidance applies:

### 6.1 Soakaways (and pre treatment sediment sumps)

Figure 7<sup>[1]</sup> provides details maintenance operations required for a soakaway system.

| 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                                       |

Figure 7: Maintenance operations for soakaway

### 6.2 Permeable pavements

The maintenance plan for pervious pavements will include:

- Monthly litter removal;
- Bi-Annual suction sweeping.
- Annual inspection and repairs as/if required.

### **6.3 Inspection/control chambers**

The maintenance plan for areas of geocellular systems will include:

- Regular inspection of silt traps, IC's, pipework and pre-treatment devices (safe access provision required)
- Removal of sediments and debris as required.

Access points are required so as to be able to use a suction tanker on an annual basis.

### **6.4 Vegetation expansion and bio-retention**

The maintenance plan for areas of vegetation will include:

- Monthly inspections until vegetation is established;
- Six monthly inspections after the vegetation has become established;
- Monthly litter removal;
- Any filter strip will require mowing during the growing season.
- Occasional weeding during the first two years;
- Removal of any dead or unwanted plants in winter (other than leaving seed heads for wildlife).
- Other possible tasks will include replacement of dead vegetation, erosion repair and mulch replenishment.

### **6.5 Summary**

All surface water arising can be managed on site using SuDS. There is no design exceedence outfall away from the site. Exceedence flows and flows arising from system failure can be accommodated on site within the soakaway crates and the sub-base to the hard standing.

In the event that infiltration is not viable, run-off rates are controlled to as low an outfall rate as is currently technically feasible using green SuDS.

The use of SuDS techniques on site, as detailed above and when installed in line with best practice (I.e. CIRIA 753 & CIRIA 768), will mitigate and treat the run-off volumes in line with the core policies.

Signed:



Dr Robin Saunders C. Build E, MCABE, BEng(Hons), PhD

Date: 14<sup>th</sup> January, 2019

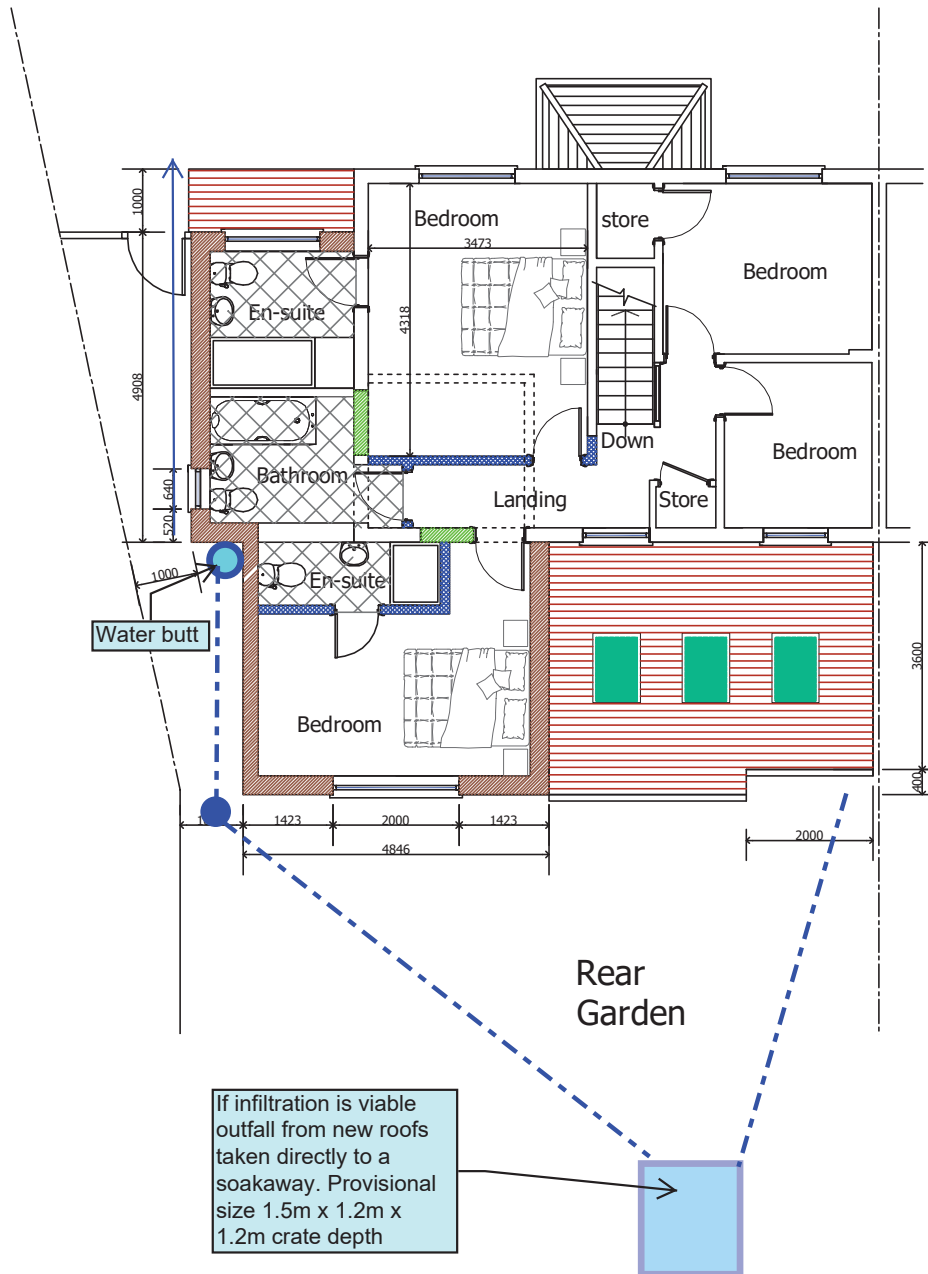
## References

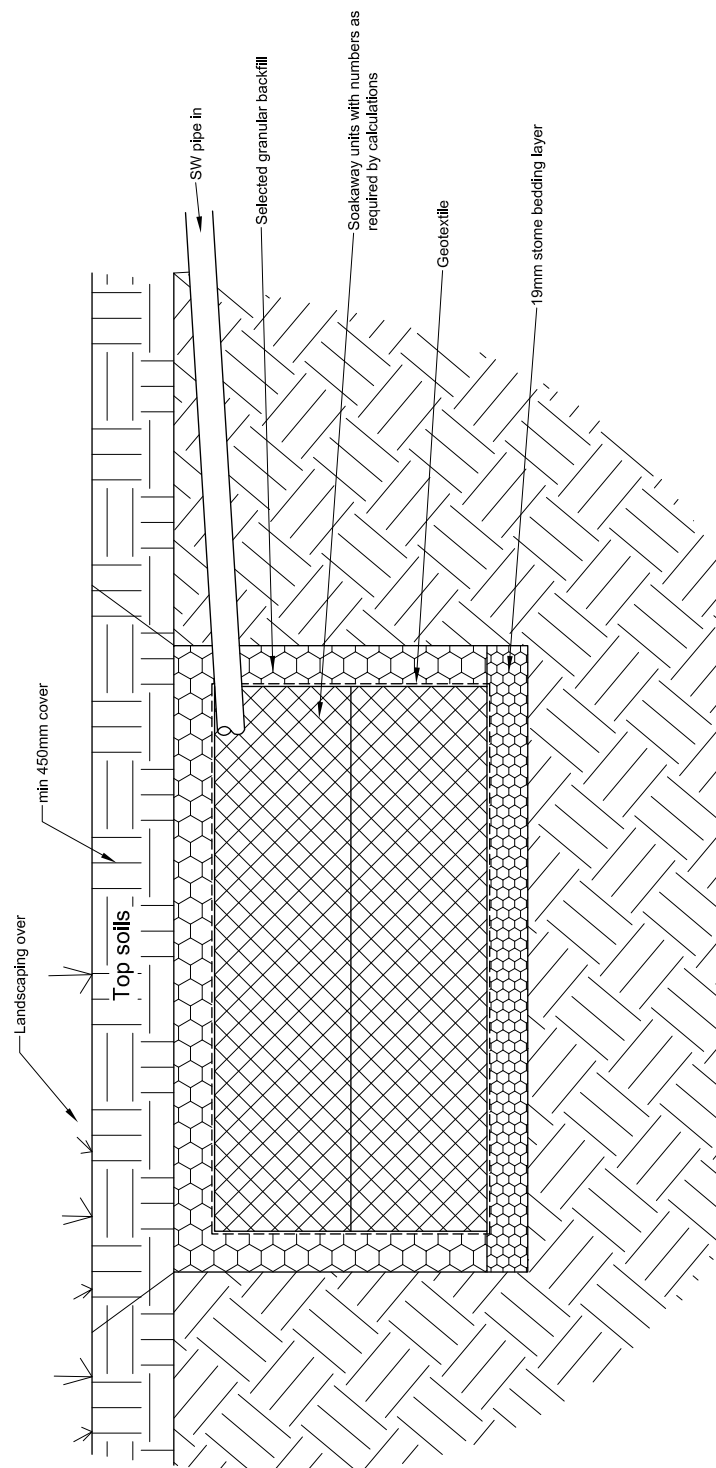
- [1] CIRIA. The SUDS manual. Technical report, CIRIA, 2015.
- [2] H R Wallingford, Howbery Park, Wallingford, Oxfordshire. *The Wallingford Procedure*, volume 1 edition, 1981.



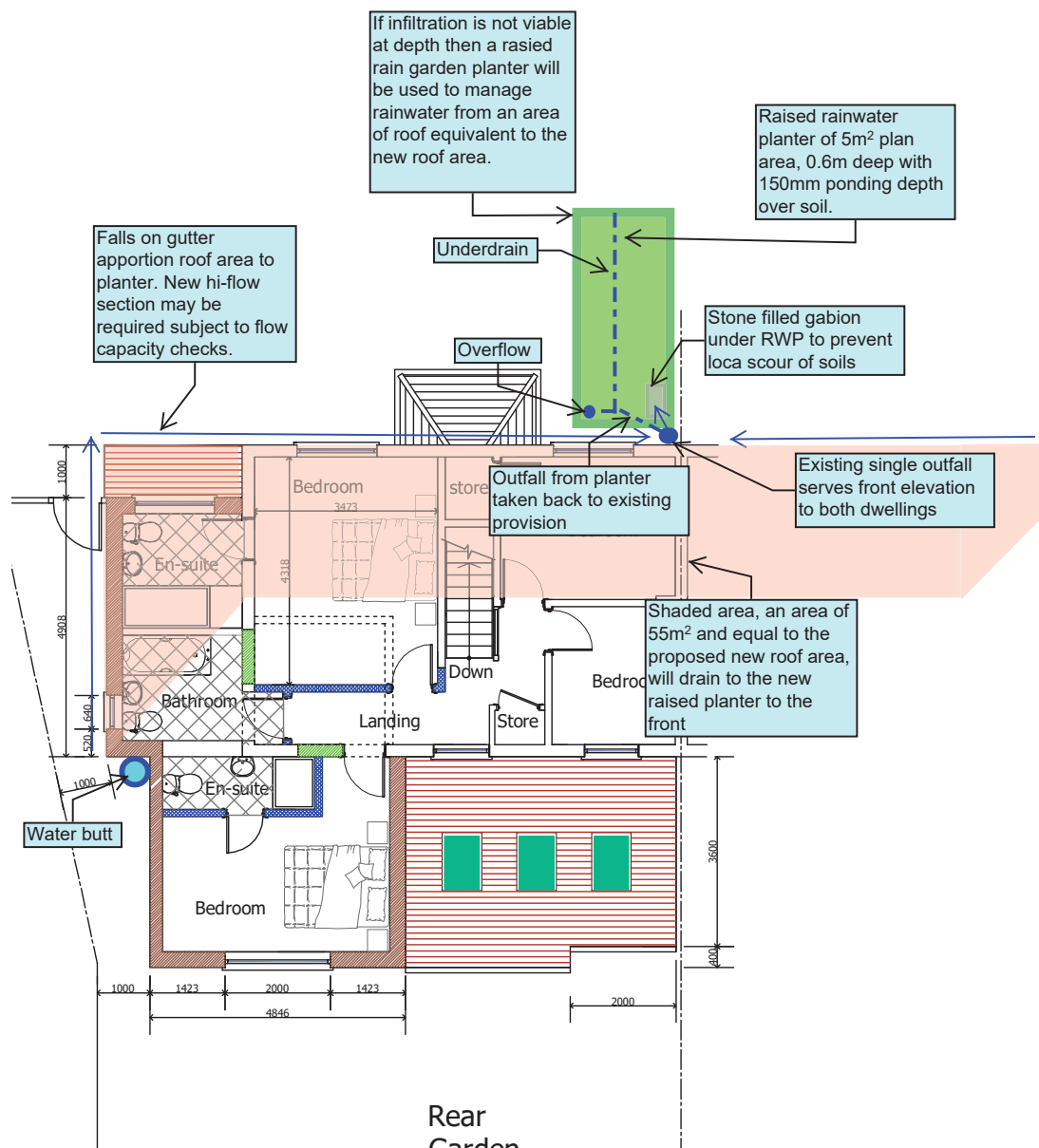
## A.2 Indicative SuDS layout options

### A.2.1 With viable infiltration





## A.2.2 Option without infiltration



## B Rain garden

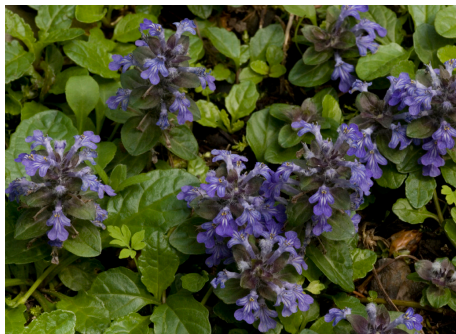
### B.1 Planting guides

#### Planting

Your rain garden is designed to slow surface water run-off and improve water quality. However it is a garden feature and should work for you in terms of the overall design of your property. Like any garden, there is range of possible planting styles: your rain garden might have ornamental, low maintenance ground cover, designed to provide a habitat for wildlife or quirky, perhaps, with stone, gravels or even sculpture – the choice is yours. The English cottage, American prairie or ornamental grass styles are particularly well suited to rain gardens. In larger planters, you may be able to grow fruit and vegetables.

When choosing plants you may want to consider height, colour and flowering period. Taller plants tend to be situated at the centre of the garden and shorter ones around the edges, so that all can be seen and so that deeper-rooted plants can benefit from the deeper soil in the middle of the bed. By grouping plants of various size and texture you will be able to create an interesting looking garden even when few flowers are in bloom. If you wish to create habitat for wildlife, plant native species or plants that are known to attract insects like bees and butterflies and other wildlife. For further information on plants for pollinators see the Royal Horticultural Society's list, and for general advice on wildlife gardening see the Wild About Gardens website (see the Resources section).

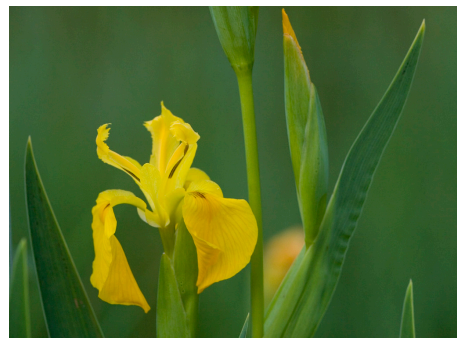
It is recommended that your rain garden is planted with a wide range of species in order to create a densely vegetated, stable and thriving bed with dense and thick root systems which will thrive without frequent maintenance. A typical rain garden is planted with about 10 species planted in 2 to 3 clumps per square metre. By planting several species, you will be creating a rain garden that can still succeed even if one or two species do not thrive. A typical planting density is 6-10 plants per square metre, but you may wish to vary this, depending on the size and nature of the plants chosen.



Bugle, *Ajuga reptans* | Bob Gibbons

Plant the rain garden with nursery-grown stock. Good results have been achieved with one or two year old plugs or potted

plants, which have a strong root system. Before you plant, it is advisable to have a good idea of what goes where, by preparing a planting plan. Excavate a hole for each plant about twice the size of the root ball, place the plant in the hole and press the soil firmly around the roots. The stem should be at the same level relative to the ground as it was in the growing container. Once the garden is planted, you may consider spreading bark mulch across bare soil to suppress weed growth.



Yellow flag iris, *Iris pseudocorus* | Bob Gibbons

The perimeter berm can be seeded with a general purpose wildflower grassland mix, which can be left to grow, or mown as required, in order to match the adjacent garden. Unless it rains, plants should be watered during establishment. During hot weather, the soil loses about 3 litres per square metre per day by evaporation, so it is advisable to replace this if possible. Once established, the plants will not need to be watered unless the weather has been exceptionally dry. Plants can be planted anytime during the growing season, as long as they are watered. If watering is difficult, it may be advisable to plant in autumn.

A very wide range of plants can be planted in rain gardens, however you should avoid using plants that do not withstand occasional flooding - for example species which are usually associated with dry Mediterranean style gardens, like Lavender. Other plants to avoid include those susceptible to root rot including Azalea, Juniper and Chinese privet.

The frequency that the rain garden is inundated will depend on the size of the rain garden and the weather, so it is important to keep an eye on the rain garden, replace any failures and adjust the planting palette to suit the actual conditions. A selection of suggested plants is included in the table. There are many others that will be suitable which are not listed, so feel free to experiment and apply your own plant knowledge if you are a keen gardener. If you have success or notice problems with particular species, please let us know at: [www.raingardens.info](http://www.raingardens.info).

## Planting Suggestions

| Common name        | Scientific name                 | Habit                           | Sunlight and Aspect         | Origin                                                                                                                     |
|--------------------|---------------------------------|---------------------------------|-----------------------------|----------------------------------------------------------------------------------------------------------------------------|
| Gelder rose        | <i>Viburnum opulus</i>          | Perennial shrub                 | Any                         | Native. Flowers attract insects and berries are eaten by birds.                                                            |
| Dogwood            | <i>Cornus sanguinea</i>         | Perennial shrub                 | Any                         | Native. Leaves are larval food for vase bearer moth and berries eaten by birds. Often planted for attractive winter stems. |
| Culvers root       | <i>Veronicastrum virginicum</i> | Herbaceous perennial            | Full sun or partial shade   | Non-native. Tall with long terminal blue flower spikes. On the RHS 'plants for pollinators' list.                          |
| Aster              | <i>Aster spp.</i>               | Herbaceous perennial            | Full sun or partial shade   | Non-native. Often late flowering. Clump forming. Several species on the RHS 'plants for pollinators' list.                 |
| Black eyed susan   | <i>Rudbeckia hirta</i>          | Herbaceous annual or biennial   | Full sun or partial shade   | Non-native. Spectacular yellow and black flowers. On RHS 'plants for pollinators' list.                                    |
| Stinking hellebore | <i>Helleborus foetidus</i>      | Herbaceous perennial            | Full sun or partial shade   | Native. Winter flowers.                                                                                                    |
| Montbretia         | <i>Crocsmia spp.</i>            | Deciduous rhizomatous perennial | Partial shade               | Naturalised. Red flowers. Thrives in most conditions.                                                                      |
| Bugle              | <i>Ajuga reptans</i>            | Rhizomatous perennial           | Partial shade               | Native. Low growing and will form a mat.                                                                                   |
| Columbine          | <i>Aquilegia spp.</i>           | Herbaceous perennial            | Full sun or partial shade   | Non-native. Clump forming with tall flower spikes. On RHS 'plants for pollinators' list.                                   |
| Inula              | <i>Inula hookeri</i>            | Herbaceous perennial            | Partial shade               | Tall clump forming with yellow flowers. On RHS 'plants for pollinators' list.                                              |
| Hemp agrimony      | <i>Eupatorium cannabinum</i>    | Herbaceous perennial            | Full sun or partial shade   | Native. Sub-shrubs with pink flowers.                                                                                      |
| Bellflower         | <i>Campanula glomerata</i>      | Herbaceous perennial            | Full sun or partial shade   | Native. Clumps bearing violet-blue bell shaped flowers.                                                                    |
| Sneezeweed         | <i>Helenium sp.</i>             | Herbaceous perennial            | Full sun                    | Non-native. Clump forming with red flowers. On RHS 'plants for pollinators' list.                                          |
| Lesser periwinkle  | <i>Vinca minor</i>              | Perennial sub-shrub             | Any                         | Non-native. Ground cover with blue flowers.                                                                                |
| Elephants ear      | <i>Bergenia sp.</i>             | Rhizomatous perennial           | Full sun or partial shade   | Non-native. Large leaves and pink flowers.                                                                                 |
| Plantain lilies    | <i>Hosta spp.</i>               | Herbaceous perennial            | Part shade                  | Non-native. Attractive light coloured flowers.                                                                             |
| Yellow flag        | <i>Iris pseudocorus</i>         | Rhizomatous perennial           | Full sun or partial shade   | Native. Likely to prefer wetter areas near inlet.                                                                          |
| Siberian flag      | <i>Iris sibirica</i>            | Rhizomatous perennial           | Full sun or partial shade   | Non-native. Blue flowers. Prefers moist but well drained soil.                                                             |
| Garlic and onions  | <i>Allium spp.</i>              | Bulbous perennials              | Full sun                    | Non-native. On RHS 'plants for pollinators' list.                                                                          |
| Soft rush          | <i>Juncus effusus</i>           | Evergreen perennial             | Full sun or partial shade   | Native. Form tussocks – likely to prefer wetter areas.                                                                     |
| Pendulous sedge    | <i>Carex pendula</i>            | Rhizomatous perennial           | Full sun or partial shade   | Native. Nodding flower spikes. Likely to prefer wetter areas near inlet.                                                   |
| Zebra grass        | <i>Miscanthus sinensis</i>      | Perennial, deciduous grass      | Full sun                    | Non-native. Tussock forming ornamental grass with silky flowers.                                                           |
| Switch grass       | <i>Panicum virgatum</i>         | Deciduous perennial grass       | Full sun                    | Non-native. Tussock forming ornamental grass.                                                                              |
| Royal fern         | <i>Osmunda regalis</i>          | Deciduous fern                  | Any                         | Native. Large clump-forming plants.                                                                                        |
| Male fern          | <i>Dryopteris felix-mas</i>     | Deciduous or evergreen fern     | Partial shade or full shade | Native. Large shuttlecock-like form.                                                                                       |
| Broad buckler fern | <i>Dryopteris dilatata</i>      | Deciduous or evergreen fern     | Partial shade or full shade | Native. Large shuttlecock-like form.                                                                                       |

## 7) Plant Selection

The plants in the lists below are a selection from what is currently grown by well known nurseries or are readily available in the trade. The selection criteria are described on Page 4 in 'planting criteria' and reflect personal preferences to some extent. There are many other plants that can be used in 'bioretention planters' subject to availability, knowledgeable selection and appropriate maintenance. However there is no substitute to being familiar with a particular plant and its behaviour in similar conditions to the 'bioretention planters' that are designed for a SUDS scheme.

Suitable for use in small footprint (< 5 m<sup>2</sup>) pre-fabricated systems.  
eg. Hydro Filleria™ Bioretention System

| Botanical Name                             | Common Name       | Evergreen or Deciduous | Usual Height (m) | Flowers | Berry | Autumn Leaf Colour | Sun | Shade | eg. Hydro Filleria™ |
|--------------------------------------------|-------------------|------------------------|------------------|---------|-------|--------------------|-----|-------|---------------------|
| <b>Native Trees</b>                        |                   |                        |                  |         |       |                    |     |       |                     |
| Acer campestre                             | Field Maple       | D                      | 5 +              | -       | -     | ✓                  | ✓   | ✓     |                     |
| Betula pendula                             | Birch             | D                      | 10 +             | ✓       | ✓     | ✓                  | ✓   | ✓     |                     |
| Malus sylvestris                           | Crab Apple        | D                      | 5 +              | ✓       | ✓     | ✓                  | ✓   | ✓     |                     |
| Pinus sylvestris                           | Pine              | E                      | 10 +             | -       | -     | ✓                  | ✓   | ✓     |                     |
| Sorbus aria                                | Whitebeam         | D                      | 5 +              | ✓       | ✓     | ✓                  | ✓   | ✓     |                     |
| Sorbus aucuparia                           | Rowan             | D                      | 5 +              | ✓       | ✓     | ✓                  | ✓   | ✓     |                     |
| Sorbus torminalis                          | Wild Service Tree | D                      | 5 +              | ✓       | ✓     | ✓                  | ✓   | ✓     |                     |
| <b>Native Shrubs</b>                       |                   |                        |                  |         |       |                    |     |       |                     |
| Buxus sempervirens                         | Box               | E                      | 2-5              | -       | -     | ✓                  | ✓   | ✓     |                     |
| Fraxinus alnus                             | Alder Buckthorn   | D                      | 1-3              | -       | ✓     | ✓                  | ✓   | ✓     |                     |
| Hippophae rhamnoides                       | Sea Buckthorn     | D                      | 2-5              | ✓       | ✓     | ✓                  | ✓   | ✓     |                     |
| Ilex aquifolium                            | Holly             | E                      | 2-5              | -       | ✓     | ✓                  | ✓   | ✓     |                     |
| Ligustrum vulgare                          | Wild Privet       | D                      | 1-3              | ✓       | ✓     | ✓                  | ✓   | ✓     |                     |
| Viburnum lantana                           | Wayfaring Tree    | D                      | 1-3              | ✓       | ✓     | ✓                  | ✓   | ✓     |                     |
| Viburnum opulus                            | Guelder Rose      | D                      | 1-3              | ✓       | ✓     | ✓                  | ✓   | ✓     |                     |
| <b>Native Ground Cover</b>                 |                   |                        |                  |         |       |                    |     |       |                     |
| Hedera helix                               | Ivy               | E                      |                  | -       | -     | ✓                  | ✓   | ✓     |                     |
| <b>Ornamental Trees</b>                    |                   |                        |                  |         |       |                    |     |       |                     |
| Acer capillipes and others                 | Maples            | D                      | 5 +              | -       | -     | ✓                  | ✓   | ✓     |                     |
| Amelanchier lamarckii                      | Snowy Mesquitol   | D                      | 3 +              | ✓       | ✓     | ✓                  | ✓   | ✓     |                     |
| Betula albosinensis and others             | Birch             | D                      | 10 +             | -       | -     | ✓                  | ✓   | ✓     |                     |
| Corylus avellana                           | Judas tree        | D                      | 5 +              | ✓       | -     | ✓                  | ✓   | ✓     |                     |
| Crataegus x lavalleyi and others           | Turkish hazel     | D                      | 5 +              | ✓       | -     | ✓                  | ✓   | ✓     |                     |
| Eucalyptus niphophila                      | Gum tree          | E                      | 5 +              | ✓       | ✓     | ✓                  | ✓   | ✓     |                     |
| Fraxinus angustifolia 'Raywood' and others | Ash               | D                      | 10 +             | -       | -     | ✓                  | ✓   | ✓     |                     |
| Koeleria paniculata                        | Golden Rain Tree  | D                      | 5 +              | ✓       | ✓     | ✓                  | ✓   | ✓     |                     |
| Malus Evereste and others                  | Crab apples       | D                      | 5 +              | ✓       | ✓     | ✓                  | ✓   | ✓     |                     |
| Pinus nigra maritima                       | Pine              | E                      | 10 +             | -       | -     | ✓                  | ✓   | ✓     |                     |

| Botanical Name                            | Common Name            | Evergreen or Deciduous | Usual Height (m) | Flowers | Berry | Autumn Leaf Colour | Sun | Shade | eg. Hydro Filleria™ |
|-------------------------------------------|------------------------|------------------------|------------------|---------|-------|--------------------|-----|-------|---------------------|
| <b>Ornamental Trees Cont ...</b>          |                        |                        |                  |         |       |                    |     |       |                     |
| Prunus 'Acolade' and others               | Cherry                 | D                      | 5 +              | ✓       | -     | ✓                  | ✓   | ✓     |                     |
| Pyrus nivalis                             | Pear                   | D                      | 5 +              | ✓       | ✓     | ✓                  | ✓   | ✓     |                     |
| Sorbus x intermedia                       | Swedish Whitebeam      | D                      | 5 +              | ✓       | ✓     | ✓                  | ✓   | ✓     |                     |
| Sorbus commixta and other varieties       | Rowan                  | D                      | 5 +              | ✓       | ✓     | ✓                  | ✓   | ✓     |                     |
| <b>Ornamental Shrubs</b>                  |                        |                        |                  |         |       |                    |     |       |                     |
| Abelia x grandiflora                      | Abelia                 | E                      | 1.2 x 1.2        | ✓       | -     | ✓                  | ✓   | ✓     |                     |
| Angelica tree                             | Angelica tree          | D                      | 3 x 2.5 +        | ✓       | -     | ✓                  | ✓   | ✓     |                     |
| Arbutus unedo                             | Strawberry tree        | E                      | 2.5 x 2 +        | ✓       | -     | ✓                  | ✓   | ✓     |                     |
| Aucuba japonica                           | Aucuba                 | E                      | 1.2 x 1.2        | -       | ✓     | ✓                  | ✓   | ✓     |                     |
| Aucuba japonica 'Rozanne' and others      | Mexican orange blossom | E                      | 1.5 x 1.5        | ✓       | -     | ✓                  | ✓   | ✓     |                     |
| Chionodoxa 'Aster Pearl' & C. ternata     | Flowering dogwood      | D                      | 3 x 2.5 +        | ✓       | ✓     | ✓                  | ✓   | ✓     |                     |
| Colinus kousa chinensis & C. mas          | Smoke bush             | D                      | 3 x 2 +          | ✓       | -     | ✓                  | ✓   | ✓     |                     |
| Colinus coccineus + other varieties       | Castor oil plant       | E                      | 1.5 x 1.5        | ✓       | ✓     | ✓                  | ✓   | ✓     |                     |
| Fatsia japonica                           | Gaiya                  | E                      | 3 x 2.5          | ✓       | -     | ✓                  | ✓   | ✓     |                     |
| Garrya elliptica                          | St. Johns wort         | D                      | 1.5 x 1.5        | ✓       | -     | ✓                  | ✓   | ✓     |                     |
| Hypericum 'Hidote'                        | Juniper                | E                      | 1.5 x 2          | -       | -     | ✓                  | ✓   | ✓     |                     |
| Juripennis X media 'Pittzeriana' + others | Beauty bush            | D                      | 1.8 x 1.8        | ✓       | -     | ✓                  | ✓   | ✓     |                     |
| Kolkwitzia amabilis 'Pink Cloud'          | Sweet bay              | E                      | 3 x 2            | ✓       | -     | ✓                  | ✓   | ✓     |                     |
| Laurus nobilis                            | Privet                 | E                      | 3 x 2            | ✓       | -     | ✓                  | ✓   | ✓     |                     |
| Ligustrum lucidum + others                | Maltonia               | E                      | 3 x 2            | ✓       | ✓     | ✓                  | ✓   | ✓     |                     |
| Maltonia 'Charly' + others                | Sacred bamboo          | D                      | 2 x 1.5          | ✓       | ✓     | ✓                  | ✓   | ✓     |                     |
| Nandina domestica                         | Osmanthus              | E                      | 2 x 1.5          | ✓       | -     | ✓                  | ✓   | ✓     |                     |
| Osmanthus x burkwoodii + others           | New Zealand flax       | E                      | 1.5 x 1.5        | ✓       | -     | ✓                  | ✓   | ✓     |                     |
| Phormium tenax-cockatoo hybrids           | Philodendron           | E                      | 2.5 x 1.5        | ✓       | -     | ✓                  | ✓   | ✓     |                     |
| Philodendron Red Robin                    | Laurel                 | E                      | varies           | ✓       | -     | ✓                  | ✓   | ✓     |                     |
| Prunus laurocerasus form like P. Etna     | Prunella               | E                      | 3 x 2            | ✓       | ✓     | ✓                  | ✓   | ✓     |                     |
| Prunella 'Teton' + others                 | Slugs Horn             | D                      | 3 x 2            | ✓       | ✓     | ✓                  | ✓   | ✓     |                     |
| Rhus typhina 'Lachlana'                   | Sweet box              | E                      | 0.6-1.2 & spread | ✓       | -     | ✓                  | ✓   | ✓     |                     |
| Sarcococca confusa + nobiliana digna      | Skimmia                | E                      | 0.9 x 0.9        | ✓       | ✓     | ✓                  | ✓   | ✓     |                     |
| Skimmia x Kew Green + others              | Chusan palm            | E                      | 3 x 2            | ✓       | -     | ✓                  | ✓   | ✓     |                     |
| Trachycarpus fortunei                     | Viburnum varieties     | E & D                  | varies           | ✓       | ✓     | ✓                  | ✓   | ✓     |                     |
| Viburnum varieties                        | Yucca                  | E                      | 0.6 x 0.6        | ✓       | -     | ✓                  | ✓   | ✓     |                     |

| Botanical Name                                                                                                                                                                                                                                                                                             | Common Name       | Evergreen or Deciduous | Usual Height (m) | Flowers | Berry | Autumn Leaf Colour | Sun | Shade | sp. Hydro Filiera™ |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|------------------------|------------------|---------|-------|--------------------|-----|-------|--------------------|
| <b>Ornamental Shrubs Cont ...</b>                                                                                                                                                                                                                                                                          |                   |                        |                  |         |       |                    |     |       |                    |
| <b>Cotoneaster Low</b>                                                                                                                                                                                                                                                                                     |                   |                        |                  |         |       |                    |     |       |                    |
| Cotoneaster 'Slosholm' + others                                                                                                                                                                                                                                                                            | Cotoneaster       | E                      | 0.3-0.9 + spread | ✓       | ✓     | -                  | ✓   | ✓     |                    |
| <b>Cotoneaster Erect</b>                                                                                                                                                                                                                                                                                   |                   |                        |                  |         |       |                    |     |       |                    |
| Cotoneaster bullatus + others                                                                                                                                                                                                                                                                              | Cotoneaster       | E & D                  | 1.5 +            | ✓       | ✓     | ✓                  | ✓   | ✓     | ✓                  |
| <b>Euonymus Low</b>                                                                                                                                                                                                                                                                                        |                   |                        |                  |         |       |                    |     |       |                    |
| Euonymus fortunei 'Dart's Blanka' + others                                                                                                                                                                                                                                                                 | Euonymus          | E                      | 0.3-0.6 + spread | -       | -     | -                  | ✓   | ✓     |                    |
| Euonymus japonicus                                                                                                                                                                                                                                                                                         | Evergreen spindle | E                      | 2 x 1.5          | -       | -     | -                  | ✓   | ✓     | ✓                  |
| Escallonia 'Sieve Donard' and other varieties                                                                                                                                                                                                                                                              | Escallonia        | E                      | 1.5-1.5          | ✓       | -     | -                  | ✓   | ✓     | ✓                  |
| <b>Conifers - see Pinus and Junipers. Consider smaller Chamaecyparis vars. and others</b>                                                                                                                                                                                                                  |                   |                        |                  |         |       |                    |     |       |                    |
| <b>Ground Cover</b>                                                                                                                                                                                                                                                                                        |                   |                        |                  |         |       |                    |     |       |                    |
| Acanthus spinosus                                                                                                                                                                                                                                                                                          |                   | D                      | 0.6              | ✓       | -     | -                  | ✓   | -     |                    |
| Alchemilla mollis                                                                                                                                                                                                                                                                                          |                   | D                      | 0.3              | ✓       | -     | ✓                  | ✓   | ✓     |                    |
| Bergenia - varieties                                                                                                                                                                                                                                                                                       |                   | E                      | 0.3              | ✓       | -     | ✓                  | ✓   | ✓     |                    |
| Epimedium varieties eg. E. pinnatum colchicum                                                                                                                                                                                                                                                              |                   | E & D                  | 0.3              | ✓       | -     | -                  | ✓   | ✓     |                    |
| Euphorbia robbiae                                                                                                                                                                                                                                                                                          |                   | E                      | 0.6              | ✓       | -     | -                  | ✓   | ✓     |                    |
| Geranium - varieties eg. endressii & macrorrhizum                                                                                                                                                                                                                                                          |                   | E & D                  | 0.3              | ✓       | -     | ✓                  | ✓   | ✓     |                    |
| Hedera 'Hiemalis' & other varieties                                                                                                                                                                                                                                                                        |                   | E                      | 0.15             | -       | -     | -                  | ✓   | ✓     |                    |
| Hemerocallis - varieties eg. H. citrina & H. fulva                                                                                                                                                                                                                                                         |                   | D                      | 0.9              | ✓       | -     | -                  | ✓   | -     |                    |
| Iris foetidissima 'Crima'                                                                                                                                                                                                                                                                                  |                   | E                      | 0.3              | ✓       | ✓     | -                  | ✓   | ✓     |                    |
| Liriodie muscari                                                                                                                                                                                                                                                                                           |                   | E                      | 0.3              | ✓       | ✓     | -                  | ✓   | ✓     |                    |
| Ophiopogon planiscapus                                                                                                                                                                                                                                                                                     |                   | E                      | 0.15             | ✓       | -     | ✓                  | ✓   | ✓     |                    |
| Pulmonaria saccharatum vars.                                                                                                                                                                                                                                                                               |                   | D                      | 0.3              | ✓       | -     | -                  | ✓   | ✓     |                    |
| Symphitum grandiflorum vars.                                                                                                                                                                                                                                                                               |                   | D                      | 0.3              | ✓       | -     | -                  | ✓   | ✓     |                    |
| Vinca minor varieties                                                                                                                                                                                                                                                                                      |                   | E                      | 0.15             | ✓       | -     | -                  | ✓   | ✓     |                    |
| There are many other low growing plants that will behave as ground cover but each will have a slightly different character and therefore be suitable for different uses. Ivy (Hedera helix) and periwinkle (Vinca minor) are the most generally useful but are a starting point for creative plant design. |                   |                        |                  |         |       |                    |     |       |                    |
| <b>Grasses</b>                                                                                                                                                                                                                                                                                             |                   |                        |                  |         |       |                    |     |       |                    |
| Calamagrostis x acutiflora 'Karl Foerster'                                                                                                                                                                                                                                                                 |                   | D                      | 0.9              | ✓       | -     | -                  | ✓   | -     |                    |
| Carex pendula                                                                                                                                                                                                                                                                                              |                   | E                      | 0.9              | ✓       | -     | -                  | -   | ✓     |                    |
| Dischampsia caespitosa                                                                                                                                                                                                                                                                                     |                   | D                      | 0.6              | -       | -     | -                  | -   | -     |                    |
| Golden Veil                                                                                                                                                                                                                                                                                                |                   | E                      | 0.3              | ✓       | -     | -                  | ✓   | -     |                    |
| Festuca amethystina                                                                                                                                                                                                                                                                                        |                   | E                      | 0.3              | ✓       | -     | -                  | ✓   | -     |                    |
| Helictotrichon sempervirens                                                                                                                                                                                                                                                                                |                   | E                      | 0.6              | ✓       | -     | -                  | ✓   | -     |                    |

| Botanical Name          | Common Name | Evergreen or Deciduous | Usual Height (m) | Flowers | Berry | Autumn Leaf Colour | Sun | Shade | sp. Hydro Filiera™ |
|-------------------------|-------------|------------------------|------------------|---------|-------|--------------------|-----|-------|--------------------|
| <b>Grasses Cont ...</b> |             |                        |                  |         |       |                    |     |       |                    |
| Luzula sylvatica        |             | E                      | 0.6              | ✓       | -     | -                  | ✓   | ✓     |                    |
| Alpecurioides Hamelin   |             | D                      | 0.9              | ✓       | -     | -                  | ✓   | -     |                    |

There are now so many grasses available to the designer that a selection must be made from a specialist supplier or following a personal evaluation of growing examples. The list above is again a starting point for the designer.

\* Due to the rootball containment within the small, pre-fabricated bioretention planters, the plants may not reach the usual height specified and will generally be restricted to 1.2 - 2 m mature height.



Figure 7 - Smoke Bush (Cotinus Coccinea).



Figure 8 - Heavenly Bamboo (Nandina Domestica Richmond).

## B.2 Design parameters for soil filter medium

### B.2.1 Saturated hydraulic conductivity

100mmhr<sup>-1</sup>. This to be checked in-situ using the single ring test method or tested in bulk prior to delivery to ASTM F1815-06.

### B.2.2 Porosity

Should be > 30% when tested in accordance with BS1377-2:1990 (design porosity set lower at 25%).

### B.2.3 Matrix

Indicative PSD or landscapers specification

| Sieve size, mm | % passing                         | equivalent %               |         |
|----------------|-----------------------------------|----------------------------|---------|
| 6              | 100                               | fine gravel (2.0 - 6.0mm)  | >10     |
| 2              | 90 - 100                          | coarse sand (0.6 - 2mm)    | 50 - 60 |
| 0.6            | 40 - 70                           | medium sand (0.2 - 0.6mm)  | 35 - 65 |
| 0.2            | 5 - 20                            | fine sand (0.063 - 0.2mm)  | < 20    |
| 0.063          | < 5                               | clay and silts (< 0.063mm) | < 5     |
| Organic matter | 3 - 5% (w/w)                      |                            |         |
| pH             | 5.5 - 8.5                         |                            |         |
| Salinity       | EC < $\mu$ 3300 Scm <sup>-1</sup> |                            |         |

## C Thames water consent application pack

# Application for a pre- development enquiry

### Application form

You can go to our website [thameswater.co.uk/buildover](https://thameswater.co.uk/buildover)  
and apply online or complete this form and return to  
Thames Water, Developer Services, Clearwater Court,  
Vastern Road, Reading RG1 8DB



# Guidance notes

Pre development enquiries are designed to aid developers and their consultants in understanding the impact of their proposed development on Thames Water sewerage network.

You may also use this application form to enable early discussion/meeting on planning issues such as Flood Risk Assessments, capacity checks, drainage strategies and pre S104 application layouts.

Once we have received your application Thames Water will undertake a simple desktop study to determine your sites impact on our network and identify if any detailed further analysis or modelling is required.

Please note, that all relevant sections of the application must be fully completed, as insufficient information will result in your application being returned to you, which will result in your response being delayed.

## Applicant Details

Please provide the full name, address and contact details of the person or company making the Pre-development enquiry.

All applications must be paid for prior to any response being answered. Please send your cheque, with the amount (including VAT), to Thames Water Limited with the accompanying fully completed application to:

Thames Water  
Developer Services  
Clearwater Court  
Vastern Road  
Reading  
Berkshire RG1 8DB

## Development site details

The site must hold a comprehensive address, scaled location plan and site layout (if available) which will assist in determining the location of proposed connection points. A 12 figure grid reference highlighting the centre point of the site will also be helpful to us if an address is difficult to determine.

The type, number of units and size of the development will assist us.

We require information on the history of the site, therefore, if the site is Brownfield ie. land identified for redevelopment, then please let us know if the site has sewerage connections and what was previously occupying the site.

## Proposed development and flows

Please indicate the proposed discharge rates for surface water and foul discharge in litres per second (l/s).

## Checklist and declaration

Ensure that you have fully completed all relevant sections of the application. Please print your name, sign and date the application form and enclose:

- a scaled location plan
- a scaled site layout
- payment of the required fee of £398 + VAT

## What happens next?

- Once we have received your fully completed application form we will provide you with the following response to your application:
- A preliminary assessment of any restrictions and potential connection points to the existing sewerage network.
- A preliminary assessment of any reinforcement works that will be required to service the development.
- Details of any protective measures for sewerage assets which may require diversion or easements.

We will endeavor to respond to you within 15 working days of receipt of your application providing it is not necessary to carry out further investigation works.

If further analysis is required, involving detailed modelling and site investigation (depth loggers, rain gauges or flow monitors) we are able to provide you with a scope, estimated cost and timeframe for undertaking a formal impact study for the price of £400 + VAT. Once completed this study would include a full report detailing the impact and recommendations/network improvements required to alleviate any increased flood risk.

# Application for a pre-development enquiry

Please complete all sections of this form in BLOCK CAPITALS



## About the person applying

This is the person we'll contact about the application and will receive all correspondence. This can be the property owner or someone acting on their behalf.

Are you applying as?

An individual ☐

or

A company ☐

'An individual' is a homeowner and 'A company' is an agent/architect/builder etc acting on behalf of the homeowner

Company name

Title

Mr ☐

Mrs ☐

Ms ☐

Miss ☐

Dr. ☐

Other:

First name(s)

Last name



## Applicant contact details

We'll use these details to get in touch with you about your application.

Preferred contact number

Alternative number

Email address

Full postal address

Address line 1:

Address line 2:

Town:

County:

Postcode:



## Nominated contact

Who should we contact to process your application?

Applicant ☐  
(Please tick one)

Someone else ☐

If someone else:

Title

Mr ☐

Mrs ☐

Ms ☐

Miss ☐

Dr. ☐

Other:

First name(s)

*Continued...*

|                                 |                                      |                                |
|---------------------------------|--------------------------------------|--------------------------------|
| <b>Last name</b>                | <input type="text"/>                 |                                |
| <b>Preferred contact number</b> | <input type="text"/>                 |                                |
| <b>Alternative number</b>       | <input type="text"/>                 |                                |
| <b>Email address</b>            | <input type="text"/>                 |                                |
| <b>Full postal address</b>      | Address line 1: <input type="text"/> |                                |
|                                 | Address line 2: <input type="text"/> |                                |
|                                 | Town: <input type="text"/>           |                                |
|                                 | County: <input type="text"/>         | Postcode: <input type="text"/> |



## Invoices

**Who should we send invoices to?**

Applicant ☐ Nominated contact ☐ Someone else ☐

**If someone else:**

|                            |                                      |                              |                                |                               |                              |                             |
|----------------------------|--------------------------------------|------------------------------|--------------------------------|-------------------------------|------------------------------|-----------------------------|
| <b>Title</b>               | Mr <input type="checkbox"/>          | Mrs <input type="checkbox"/> | Ms <input type="checkbox"/>    | Miss <input type="checkbox"/> | Dr. <input type="checkbox"/> | Other: <input type="text"/> |
| <b>First name(s)</b>       | <input type="text"/>                 |                              |                                |                               |                              |                             |
| <b>Last name</b>           | <input type="text"/>                 |                              |                                |                               |                              |                             |
| <b>Full postal address</b> | Address line 1: <input type="text"/> |                              |                                |                               |                              |                             |
|                            | Address line 2: <input type="text"/> |                              |                                |                               |                              |                             |
|                            | Town: <input type="text"/>           |                              |                                |                               |                              |                             |
|                            | County: <input type="text"/>         |                              | Postcode: <input type="text"/> |                               |                              |                             |
| <b>Email address</b>       | <input type="text"/>                 |                              |                                |                               |                              |                             |



## Where the work is taking place

**What is the address of the property being connected?**

Same as applicant ☐ Same as the nominated contact ☐ Somewhere else ☐

**If somewhere else:**

|                  |                      |
|------------------|----------------------|
| <b>Site name</b> | <input type="text"/> |
|------------------|----------------------|

*Continued...*

Full postal address

Address line 1:

Address line 2:

Town:

County:

Postcode:



## About the site

What is your local authority?

Ordnance survey grid ref

What is the site currently used for?

Greenfield/agricultural ☐ Industry ☐ Housing ☐ Landfill ☐ Other ☐

VAT development classification

New build house or flat ☐

Relevant residential or charitable ☐

Commercial, existing or other ☐

Listed ☐

Conversion ☐

Mixed ☐



## Location of existing connection

Does the site already have any of these sewerage connections?

Foul water

Yes ☐ No ☐

If yes:

Current discharge rate

Litres per second

Size of existing site

Number of units/hectares

Location of existing connection?

Surface water

Yes ☐ No ☐

If yes:

Current discharge rate

Litres per second

Size of existing site

Number of units/hectares

Location of existing connection?



## Your proposed development

|                                                        |                                                  |                                   |                                     |                                   |                                |
|--------------------------------------------------------|--------------------------------------------------|-----------------------------------|-------------------------------------|-----------------------------------|--------------------------------|
| Type of development                                    | Greenfield/agricultural <input type="checkbox"/> | Industry <input type="checkbox"/> | Housing <input type="checkbox"/>    | Landfill <input type="checkbox"/> | Mixed <input type="checkbox"/> |
| Preferred foul water connection point                  | <input type="text"/>                             |                                   |                                     |                                   |                                |
| Preferred surface water connection point               | <input type="text"/>                             |                                   |                                     |                                   |                                |
| Size of proposed development                           | <input type="text"/>                             | Number of units/hectares          |                                     |                                   |                                |
| Proposed foul water discharge rate                     | <input type="text"/>                             | Litres per second                 |                                     |                                   |                                |
| Proposed surface water discharge rate                  | <input type="text"/>                             | Litres per second                 |                                     |                                   |                                |
| How will development flows reach the connection point? | Pumped <input type="checkbox"/>                  | Gravity <input type="checkbox"/>  |                                     |                                   |                                |
| Trade effluent agreement required?                     | Yes <input type="checkbox"/>                     | No <input type="checkbox"/>       | Don't know <input type="checkbox"/> |                                   |                                |
| If Yes, Trade effluent reference number                | <input type="text"/>                             |                                   |                                     |                                   |                                |



## Planning status

|                                                           |                              |                             |                                     |                          |                      |
|-----------------------------------------------------------|------------------------------|-----------------------------|-------------------------------------|--------------------------|----------------------|
| Is the development identified in the local plan?          | Yes <input type="checkbox"/> | No <input type="checkbox"/> | Don't know <input type="checkbox"/> | If Yes, reference number | <input type="text"/> |
| Does the development have outlined planning permission?   | Yes <input type="checkbox"/> | No <input type="checkbox"/> | Don't know <input type="checkbox"/> | If Yes, reference number | <input type="text"/> |
| Does the development have full planning permission?       | Yes <input type="checkbox"/> | No <input type="checkbox"/> | Don't know <input type="checkbox"/> | If Yes, reference number | <input type="text"/> |
| Does the development have building regulation permission? | Yes <input type="checkbox"/> | No <input type="checkbox"/> | Don't know <input type="checkbox"/> |                          |                      |



## Enclose your documents

All drawings must be of suitable detail and have a drawing reference number on them.

**What we need from you to process your application:**

|                           |                                                                                  |
|---------------------------|----------------------------------------------------------------------------------|
| <b>Site plan</b>          | This should show the site with nearby buildings, roads and any sewers.           |
| <b>Development plan</b>   | This should show proposed layout of new development buildings, roads and sewers. |
| <b>Site drainage plan</b> | This should show all proposed sewers, pipe sizes and gradients.                  |



## Checklist and Declaration

I have completed the application form and enclose the following information:

- Application fee of £398 + VAT
- A scaled location plan ie. site plans showing existing and proposed layouts.
- The development site drainage plan.

### Declaration

I agree, that for the purposes of the Water Industry Act 2003 and the Data Protection Act 1998, the information provided in this form and in any accompanying documents, may be held on a computer and processed by Thames Water Ltd and its servants and agents for all purposes connected with the Company's statutory water and sewerage undertakings.

|                                |                      |
|--------------------------------|----------------------|
| <b>Print name</b>              | <input type="text"/> |
| <b>Position within company</b> | <input type="text"/> |
| <b>Company</b>                 | <input type="text"/> |
| <b>Date</b>                    | <input type="text"/> |
| <b>Signature</b>               | <input type="text"/> |

## Getting in touch with us

For enquiries regarding this application or any other questions relating to your building or development work please contact us on:



[thameswater.co.uk/developerservices](https://thameswater.co.uk/developerservices)



[developer.services@thameswater.co.uk](mailto:developer.services@thameswater.co.uk)



**0800 009 3921**  
Monday - Friday 8.00am-5.00pm



Thames Water, Developer Services, Clearwater Court,  
Vastern Road, Reading, Berkshire RG1 8DB

## If you have any other questions for Thames Water



[thameswater.co.uk](https://thameswater.co.uk)



**0800 980 8800**

- Queries relating to your bill
- Change of address
- Meter readings

Minicom service if you are deaf or hard of hearing 0800 316 6899

**0800 316 9800**

- For emergencies
- Other non-billing enquiries
- Literature

Minicom service if you are deaf or hard of hearing 0800 316 9898

To contact us from abroad +44 1793 366011



Thames Water, PO Box 286, Swindon, SN38 2RA



This leaflet can be supplied in braille or  
audio-tape upon request.

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