SuDS strategy report

For the Approved development at

103 Shenley Avenue, Ruslip.

Prepared by

Dr Robin Saunders CEng

Innervision Design Ltd

August 2019

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D All SuDS on site will be installed with full consideration to long term maintenance.

2 Introduction

2.1 Site location

The development is at 103, Shenley Avenue, Ruislip, HA4 6BT (see Figure 1).

Figure 1: Site location plan, in red (source: As provided by Client)

2.2 Proposed development description

The Approved development is for a pair of new semi-detached dwelling. (Approved plans at Appendix A).

2.3 Planning Conditions to 20004/APP/2017/2989

Condition 6

See Figure 2.

6 No development approved by this permission shall be commenced until a scheme for the provision of sustainable water management has been submitted to and approved in writing by the Local Planning Authority. The scheme shall clearly demonstrate that sustainable drainage systems (SUDS) have been incorporated into the designs of the development in accordance with the hierarchy set out in accordance with Policy 5.15 of the London Plan and will:
i. provide information about the design storm period and intensity, the method employed to delay and control the surface water discharged from the site and the measures taken to prevent pollution of the receiving groundwater and/or surface waters;
ii. include a timetable for its implementation; and
iii. provide a management and maintenance plan for the lifetime of the development which shall include the arrangements for adoption by any public authority or statutory undertaker and any other arrangements to secure the operation of the scheme throughout its lifetime.
The scheme shall also demonstrate the use of methods to minimise the use of potable water through water collection, reuse and recycling and will:
iv. provide details of water collection facilities to capture excess rainwater;
v. provide details of how rain and grey water will be recycled and reused in the development.
Thereafter the development shall be implemented and retained/maintained in accordance with these details for as long as the development remains in existence.

REASON
To ensure the development does not increase the risk of flooding in accordance with Policy OE8 Hillingdon Local Plan: Part Two Saved UDP Policies (November 2012) and London Plan (2016) Policy 5.12.

Figure 2: Condition 6

2.4 Geology

With reference to BGS mapping the site lies on the London Clay formation. This has been verbally confirmed from site.

2.4.1 Water table

Not expected within the London Clay.

2.4.2 Infiltration rates

The London clay formation is classed as virtually impermeable which typically rules at soakaways. At shallow depths where there is an interaction with surface soils limited infiltration is generally available.

3 Existing surface water disposal strategy

The existing site drains surface water direct to the Thames Water dedicated Surface Water drain in the adjacent highway.

3.1 Estimation of existing peak run-off rates to the network

3.1.1 Variables

i_1 = 50.4[1] mm hr^{-1}

i_{100} = 153 mm hr^{-1}

A = 202 m^2

Cr = 1.3

Cv = 0.9

3.1.2 Impermeable area run-off rate for pre-developed site

$$Q_{BF1} = \frac{1.17 * 50.4 * 202}{3600}$$
$$= 3.3 ls^{-1}$$

$$Q_{BF100} = \frac{1.17 * 153 * 202}{3600}$$
$$= 10.0 ls^{-1}$$

Existing runff rates from the impermeable areas of the site are calculated as 3.31ls^{-1} (based on 50.4mm hr^{-1}, 1 in 1 yr summer storm).

3.2 Greenfield estimation of peak rate of run-off

3.2.1 Methodology

For the lower limit, consider this is a greenfield site and is less than 50 ha therefore run-off rate calculations have been carried out in accordance with the IH Report 124 'Flood

[1] 50.4mm hr^{-1} is the mean intensity of a 1 in 1yr 6min duration summer storm, calculated to be the worst case, using standard IDF formula.

estimation for small catchments'[1]. The pro rata method on the size of catchment has been used.

3.2.2 Formula

For catchments less than 50ha:

$$Q_{BAR50ha} = 1.08\,(50/100)^{0.89} * SAAR^{1.17} * SPR^{2.17} \quad (1)$$

$$Q_{BAR} = Q_{BAR50ha} * \frac{A}{50} \quad (2)$$

$$Q_{1yr} = Q_{BAR} * 0.85 \quad (3)$$

$$Q_{100yr} = Q_{BAR} * GC_{100} \quad (4)$$

3.2.3 Variables

Qbar/Qmed =0.85

SAAR = 616mm

Hydrological Region 6

Growth curve factors: 30 yr = 2.3; 100 yr = 3.19

SPR = 0.47

3.2.4 Calculations

$$\begin{aligned} Q_{BAR50ha} =& 1.08 * 0.5^{0.89} * 616^{1.17} * 0.47^{2.17} \\ =& 0.58 * 1835.73 * 0.19 \\ =& 207.86 \end{aligned}$$

Using Equation 2:

$$\begin{aligned} Q_{BAR} =& \frac{207.86 * 0.06}{50} \\ =& 0.23 ls^{-1} \end{aligned}$$

Using Equation 3:

$$Q_1 = 0.23 * 0.85$$
$$= 0.19 ls^{-1}$$

Using Equation 4:

$$Q_{100} = 0.23 * 3.19$$
$$= 0.73 ls^{-1}$$

3.2.5 Peak run-off rates

For the 1 year Return Period event the peak runoff calculates to 0.19 ls^{-1}
For the 30 year Return Period event the peak runoff calculates to 0.53 ls^{-1}
For the 100 year Return Period event the peak runoff calculates to 0.73 ls^{-1}

3.3 Practicable discharge rates

> "A practicable minimum limit on the discharge rate from a flow attenuation device is often a compromise between attenuating to a satisfactorily low flow rate while keeping the risk of blockage to an acceptable level. This limit is set at 5 litres per second, using an appropriate vortex or other flow control device. Where sedimentation could be an issue, the minimum size of orifice for controlling flow from an attenuation device should normally be 150mm laid at a gradient not flatter than 1 in 150, which meets the requirements of Sewers for Adoption 7th Edition" [3].

Note: This is considered now to be dated guidance and far lower rates can be achieved for smaller developments. for this site the limiting discharge rate will be as close to greenfield rates as practicable.

3.4 Limiting discharge rate

By considering out fall rates as derived in Sections 3.2 a 1 in 1yr limiting discharge rate for the site is 0.5 ls^{-1}as being the lowest practicable value achievable.

4 SuDS Principles

4.1 SuDS design philosophy

The CIRIA SuDS[2] 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."

4.2 Source control

The following are widely recognised as source control SuDS.

- 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.

4.3 "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 5.2.1 to 5.2.4 consider the viability of a range of these SuDS devices.

4.4 Design Criteria

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

- Source control
- Site control
- Outfall control

4.4.1 Storm period

All SW drainage shall be designed to a 1 in 100 year storm event allowing for climate change of + 40%.

4.4.2 Building Regulations

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.

4.4.3 Consent to discharge

Thames Water consents may be required.

4.4.4 Design standards

All SuDS on site will be designed and installed in accordance with CIRIA 753 & CIRIA 768.

5 Appraisal of SuDS options

The primary aim is to meet the requirements of the Local Plan core policies.

5.1 Site constraints impacting on SuDS

- Small site.
- No viable infiltration at soakaway depth in areas outside a 5m distance of the building footprint.
- Low pro-rata greenfield run-off rates given the size of the site.
- Approved pitched roof design.
- Approved site layout.

5.2 Source control devices

5.2.1 Sedum roofs

Due to site constraints, Section 5.1, these are not viable for this site.

5.2.2 Infiltration devices

Due to site constraints, Section 5.1, these are not viable for this site.

5.2.3 Rainwater harvesting

With reference to Section 4.1, Rainwater harvesting promotes the following SuDS design criteria:

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

For external use

Rain water harvesting / water butts: These provide additional, "off line[2]" SuDS, and are deemed a suitable SuDS component for small plots[2], extract at Figure 3. The image shows a water butt in "off-line" configuration using a standard diverter.

Figure 3: Slim-line wall mounted water butt

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, as per Figure 4), being used for external uses.

[2]The term "off-line" refers to the fact that a water butt is a harvesting device that is not "in-line" in the same manner that a pipe is in-line. Water is collected (harvested) until the water butt is full. When full, the rainwater continues down the rainwater pipe. Outflow from the tank is not "automatic" since this would negate the reason to harvest rainwater. Instead, manual drawdown occurs with the harvested water being used for external uses. Since a water butt may be full, the useful volume is not accounted for in storage and run-off calculations.

Figure 4: Standard rainwater diverter

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

5.2.4 Rain gardens/Raised planters

Due to site constraints, Section 5.1, such planters are not suited for this site.

5.2.5 Pervious paving

With reference to Section 4.1, pervious paving promotes the following SuDS design criteria:

- manages rainwater close to where it falls
- manages run-off 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.

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^2 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 (= 20% space capacity). Hence there is no anticipated exceedence flow from the areas of permeable paving.

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.

Treatment potential: 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.

5.2.6 "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.

6 Proposed surface water disposal strategy

6.1 Roof area

All surface water from the roof areas will be taken to the existing Thames Water provision via attenuation and hydraulic control (See Appendix B for the Thames Water Asset map).

This can be achieved using a commercially available orifice control device - see Appendix C. This unit incorporates a higher level 100mm diameter overflow pipe to route exceedence flows under system failure events.

The attenuation volume required is then:

Designed to accomodate all surface water arising from a design drained area of 144.1m^2 requires a minimum attenuation volume of 6 m^3. This can be achieved using an overall cell volume of 7 m^3 formed with 0.4m deep units. See Table 1.

Drained area	$131m^2$	
Urban Creep	1.1	
Designed drained area	$144.1m^2$	
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	83 mins, Winter	
Climate change	1.4	
Storm mean intensity	$28.2mm.hr^{-1}$	
Design mean intensity	$39.5mm.hr^{-1}$	
Storm peak intensity	$83.7mm.hr^{-1}$	
Design peak intensity	$117.2mm.hr^{-1}$	
Design maximum head	0.3m	
Calculated maximum head	0.30m	
Minimum attenuation volume required	$5.68m^3$	
Void ratio	95%	
Design attenuation volume	$5.7m^3$	($0.3m \times 19m^2$)
Provided attenuation volume	$7.6m^3$	($0.95 \times 20m^2 \times 0.4m$)
Factor of Safety	1.33	
1 in 1yr maximum outfall rate	$0.5ls^{-1}$	(See Figure 8.)
1 in 30yr maximum outfall rate	$0.9ls^{-1}$	(See Figure 9.)
1 in 100yr maximum outfall rate	$1.1ls^{-1}$	(See Figure 10.)
1 in 100yr Time to peak	65 mins	
Outfall control method	30mm Orifice	CD = 0.62

Table 1: Storage volume design summary

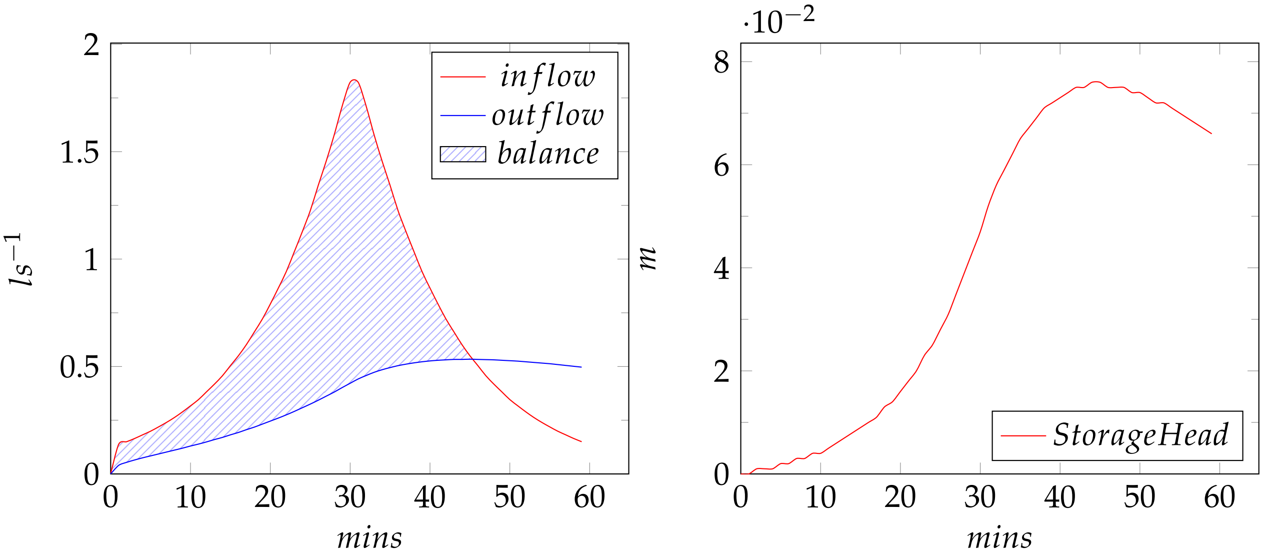


Figure 5: 1 in 1 year critical storm event

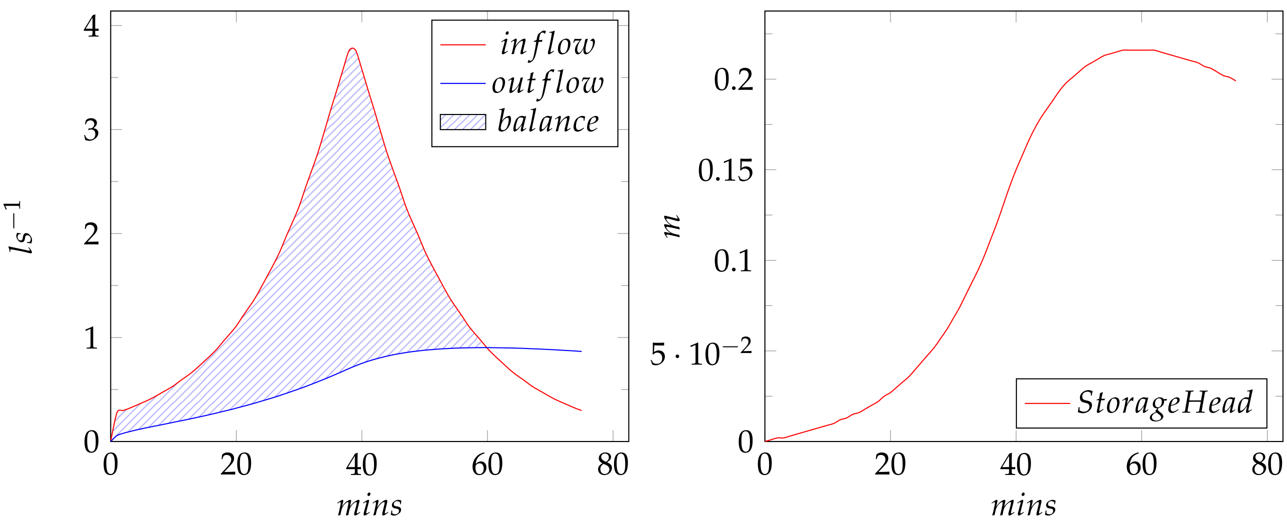


Figure 6: 1 in 30 year critical storm event

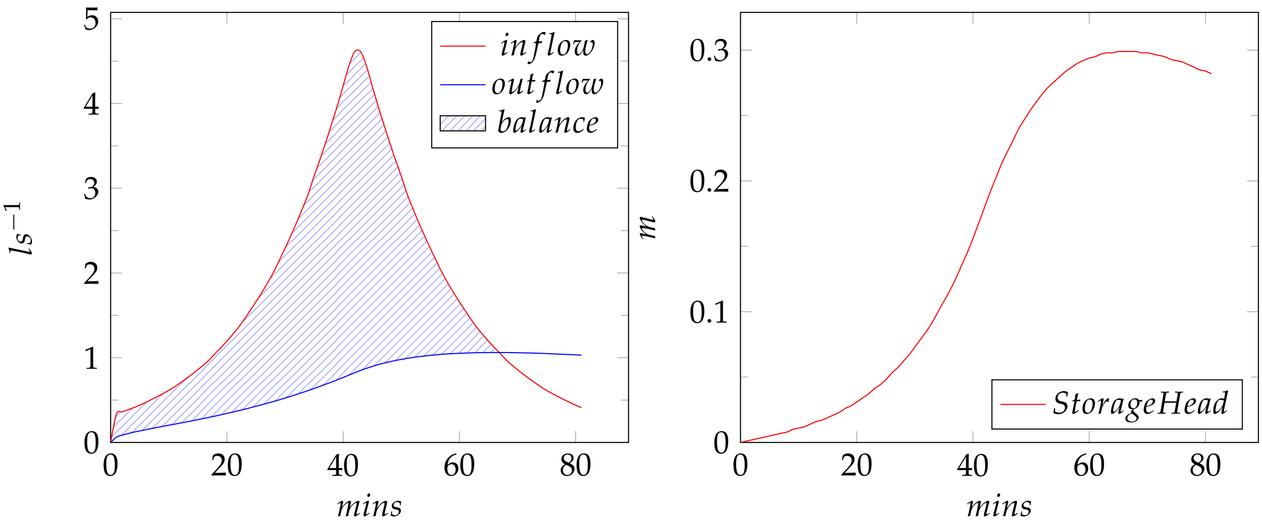


Figure 7: 1 in 100 year critical storm event

Note: Bylaw and or Land drainage consents will be required.

6.2 Driveways and hard standing

All areas of hard standing on the site will be constructed using a pervious medium on a DOT/MOT 3 sub-base of 350mm depth (refer to Section 5.2.5).

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

While infiltration is not viable at soakaway depth inspection of the soakaway tests show that at shallow depths a limited infiltration potential exists. Hence a notional $5mm.hr^{-1}m^{-2}$ outfall rate is assumed in the following. The following is based on a nominal area of $100m^2$ which can be reduced or increased pro rata.

Designed to accomodate all surface water arising from a design drained area of $100m^2$ requires a minimum attenuation volume of 6 m^3. This can be achieved using an overall storage volume of 35.0 m^3 formed within a $100m^2$ x 0.35m deep 30% void ratio sub-base. See Table 2.

Drained area	$100m^2$	
Urban Creep	1	
Designed drained area	$100m^2$	
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	221 mins, Winter	
Climate change	1.4	
Storm mean intensity	$15.1mm.hr^{-1}$	
Design mean intensity	$21.1mm.hr^{-1}$	
Storm peak intensity	$40.3mm.hr^{-1}$	
Design peak intensity	$56.5mm.hr^{-1}$	
Design maximum head	0.25m	
Calculated maximum head	0.20m	
Minimum attenuation volume required	$5.99m^3$	
Void ratio	30%	
Design attenuation volume	$8m^3$	(0.3 x $100m^2$ x 0.25m)
Provided attenuation volume	$11m^3$	(0.3 x $100m^2$ x 0.35m)
Factor of Safety	1.40	
1 in 1yr maximum outfall rate	$0.1ls^{-1}$	(See Figure 8.)
1 in 30yr maximum outfall rate	$0.1ls^{-1}$	(See Figure 9.)
1 in 100yr maximum outfall rate	$0.1ls^{-1}$	(See Figure 10.)
1 in 100yr Time to peak	211 mins	
Design head: Time to drop to 50%	6.03 hrs	
Time to 50% total capacity	4.53 hrs	
Outfall control method	Nominal GF outflow	

Table 2: Storage volume design summary

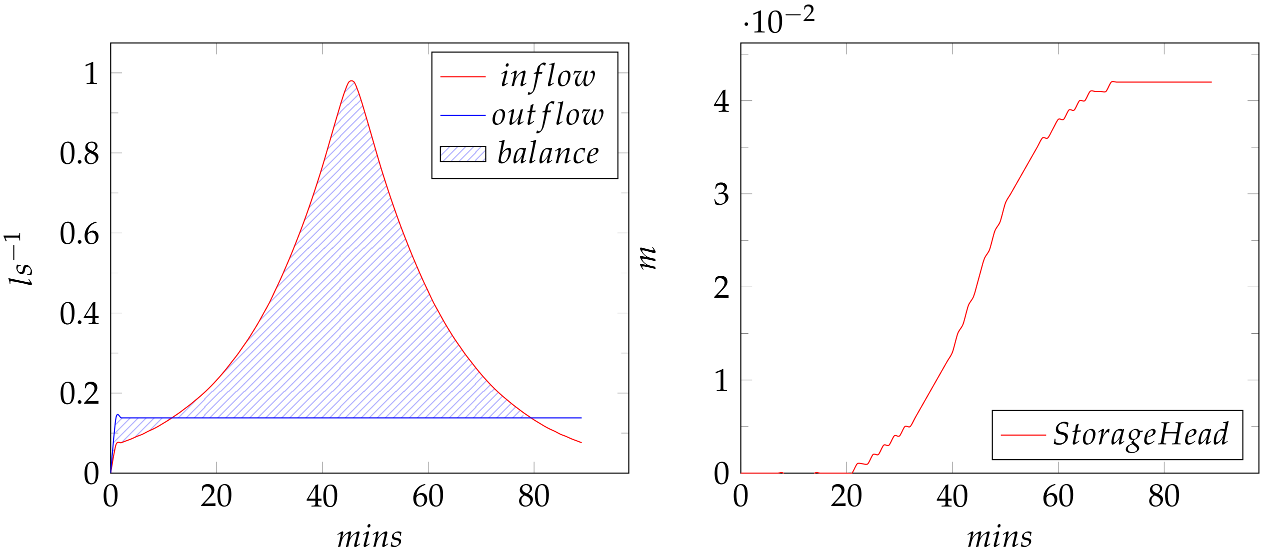


Figure 8: 1 in 1 year critical storm event

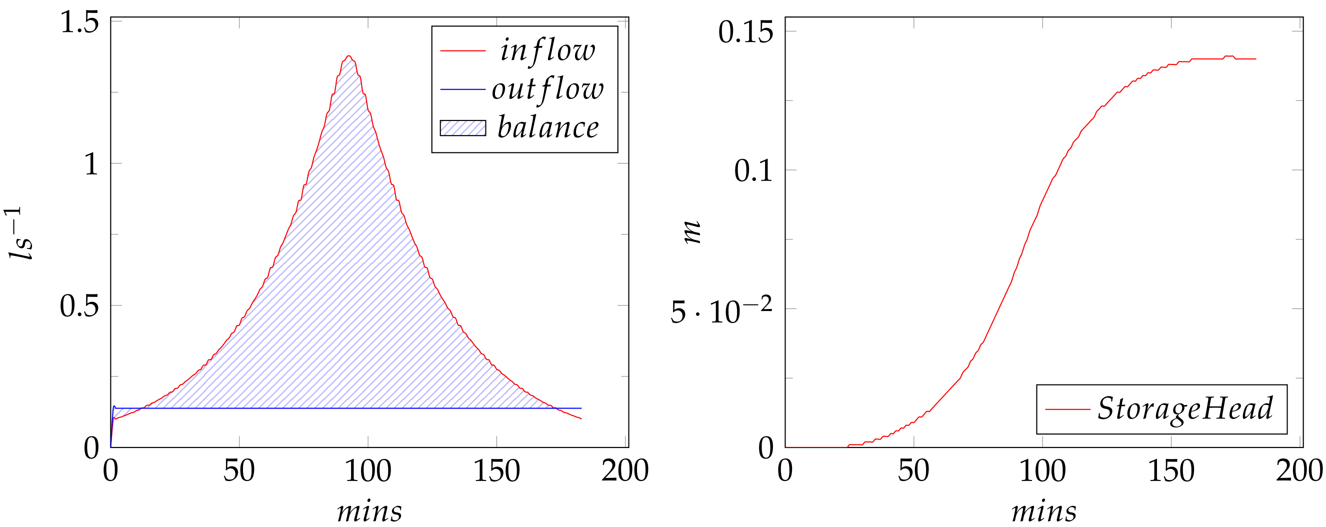


Figure 9: 1 in 30 year critical storm event

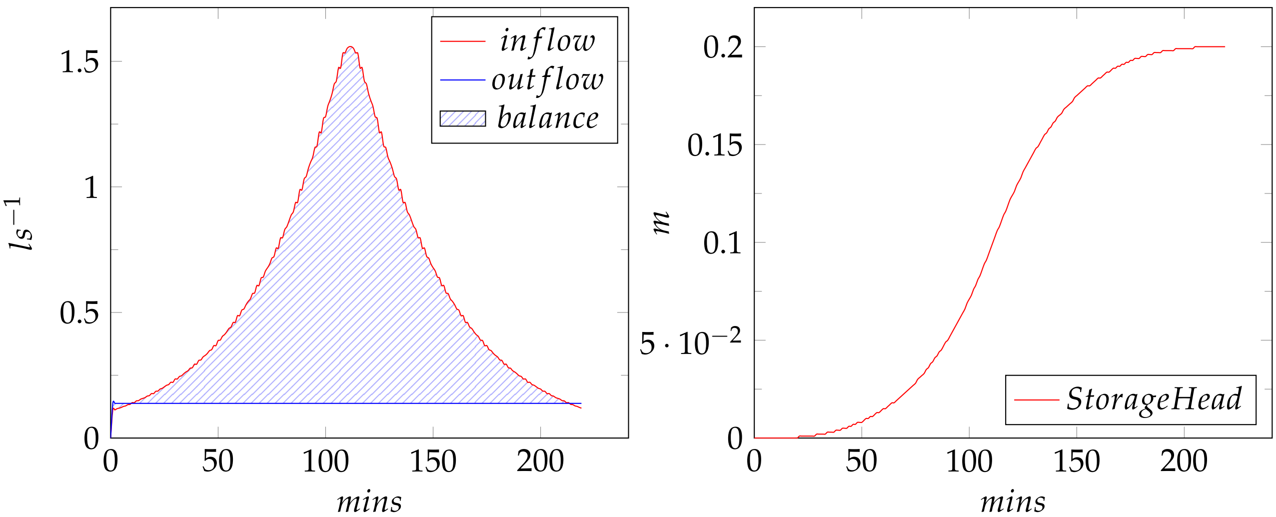


Figure 10: 1 in 100 year critical storm event

6.3 Landscaped areas

There is no anticipated exceedence flows from areas of domestic planting and similar landscaping.

Landscaped areas adjacent to the paved areas will be set 100mm lower than the adjacent paving to allow short term ponding in the event of exceedence flows.

6.4 Indicative scheme

See proposal plans in Appendix A.2

6.5 Exceedence flows

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

Paved areas - taken to boundary planting beds which are by design 100mm lower to allow short term ponding.

Garden landscaping - No anticipated exceedence flows from these areas.

Attenuation cells - via a high level 100mm diameter pipe in the orifice chamber taken direct to the TW network

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

6.6 Reduction in outfall rates

In providing these solutions the following percentage reductions are achieved:

1 in 1 yr. Reduced from $3.31ls^{-1}$ to $0.53ls^{-1}$ which equates to a circa 84% reduction

1 in 30 yr. Reduced from $7.9ls^{-1}$ to $0.9ls^{-1}$ which equates to a circa 89% reduction

1 in 100 yr. Reduced from $10.0ls^{-1}$ to $1.1ls^{-1}$ which equates to a circa 89% reduction

6.7 Maintenance of SuDS

Ultimate responsibility for the long term maintenance with SuDS in this environment lay with the land owner/management company.

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

6.7.1 Water butts

A maintenance plan for water butts should include:

- Regular inspection of silt traps and filters.
- Removal of sediments and debris as required.

6.7.2 Geocellular systems

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.

6.8 Summary

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 reduce and treat the run-off volumes in line with the core policies.

Signed:

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

Date: 22nd August, 2019

References

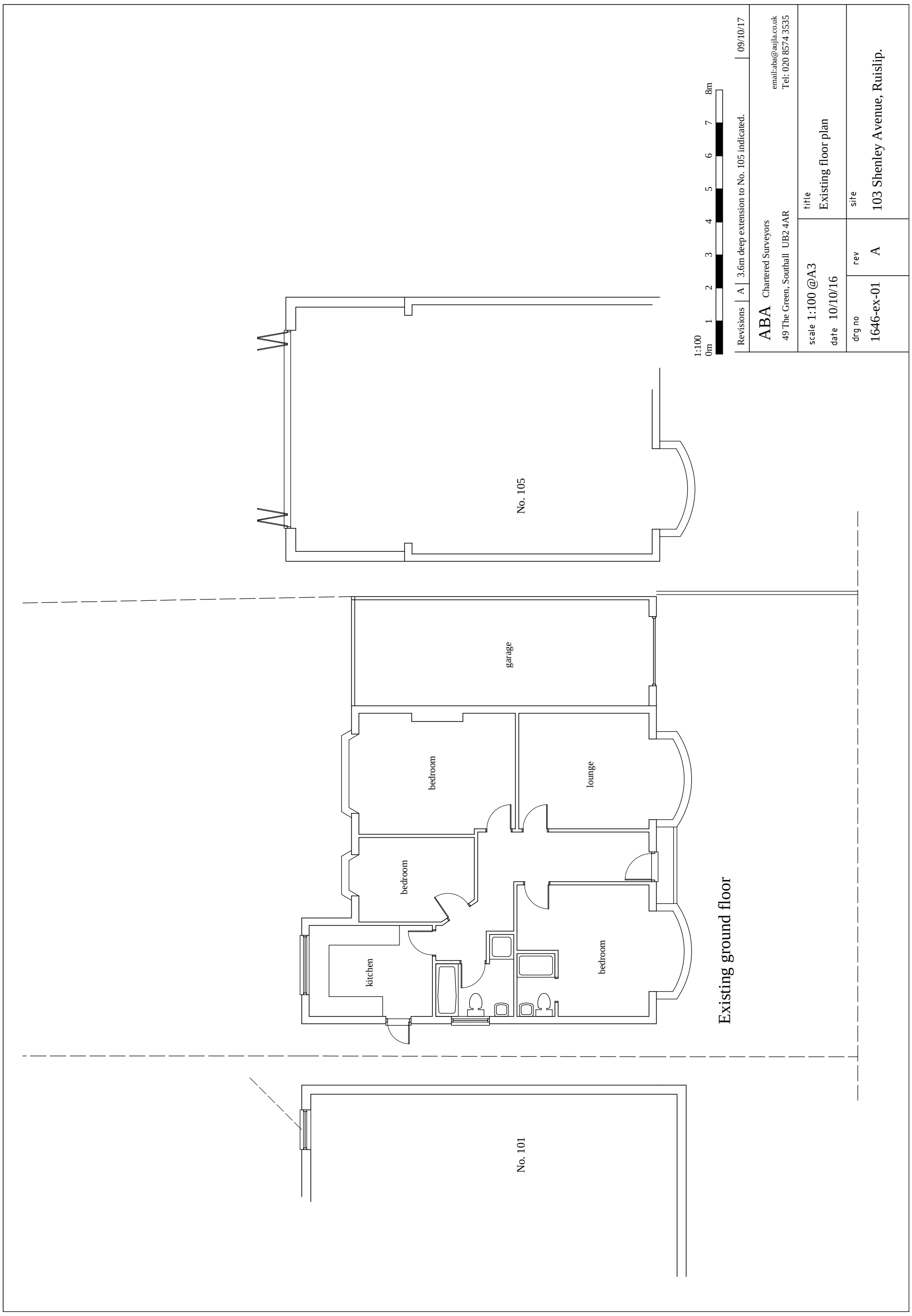
[1] DCW Marshall & AC Bayliss. Flood estimation for small catchments. Technical Report No. 124, Institute of Hydrology, June 1994.

[2] CIRIA. The SUDS manual. Technical report, CIRIA, 2015.

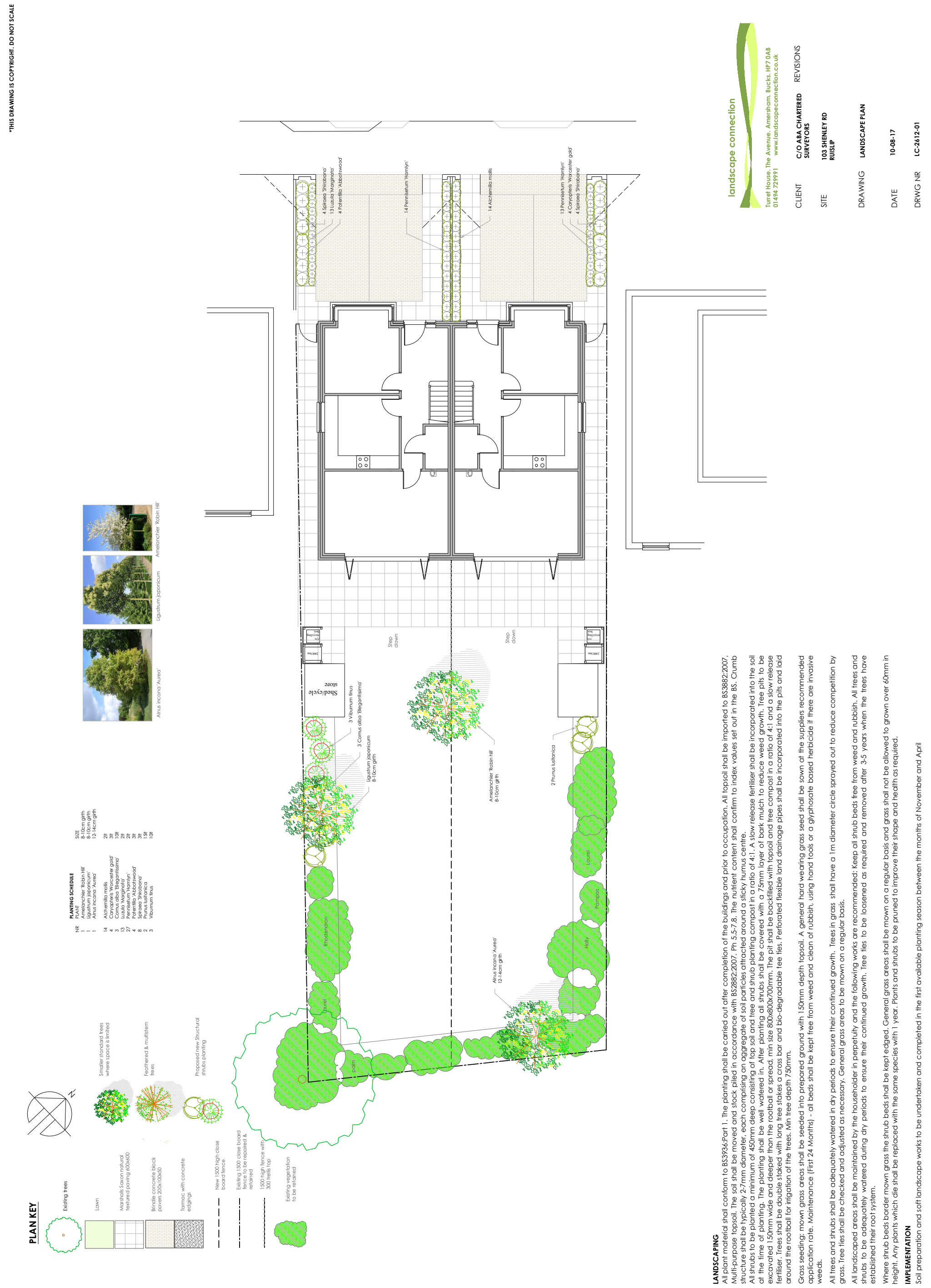
[3] R Kellagher. Rainfall runoff management for developments. Technical report, Department for Environment Food and Rural Affairs, 2013.

A Approved plans

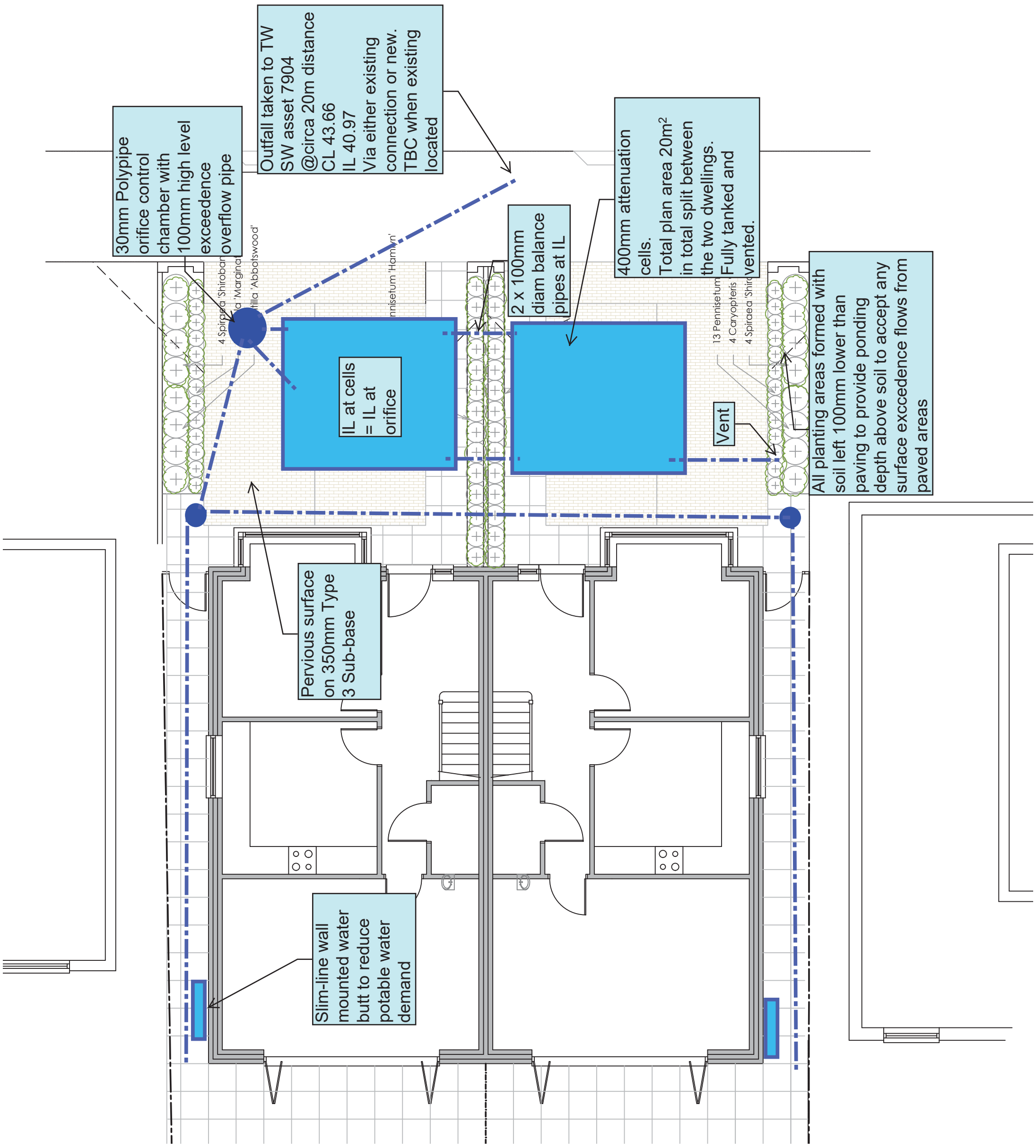
A.1 Existing site plan



A.2 Proposal plans



A.3 SuDS layout



B Thames water asset map

Asset location search

Thames Water Property Searches

ABA Chartered Surveyors Ltd
49

SOUTHALL
UB2 4AR

Search address supplied	103 Shenley Avenue Ruislip HA4 6BT
Your reference	1648
Our reference	ALS/ALS Standard/2019_4050391
Search date	31 July 2019

Keeping you up-to-date

Notification of Price Changes

From 1 September 2018 Thames Water Property Searches will be increasing the price of its Asset Location Search in line with RPI at 3.23%.

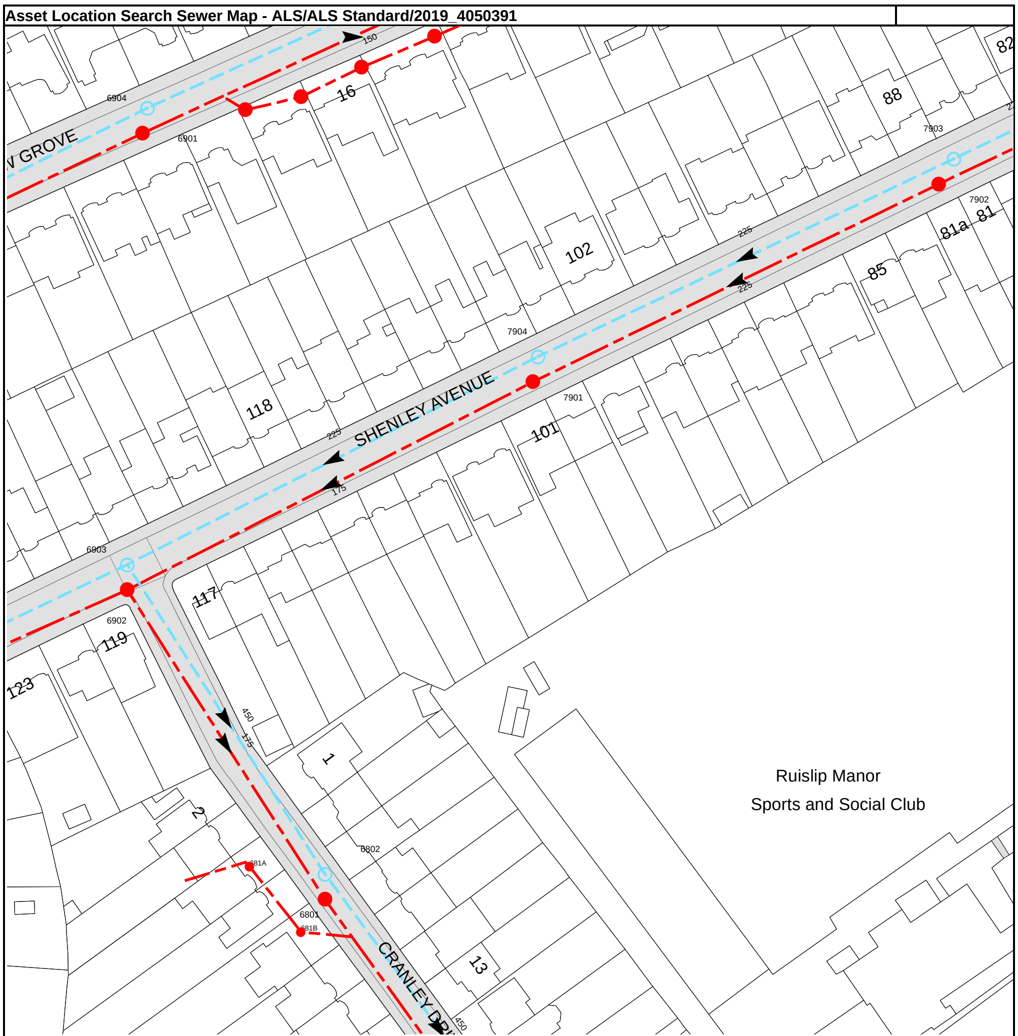
For further details on the price increase please visit our website: www.thameswater-propertysearches.co.uk
Please note that any orders received with a higher payment prior to the 1 September 2018 will be non-refundable.

Thames Water Utilities Ltd
Property Searches, PO Box 3189, Slough SL1 4WW
DX 151280 Slough 13

searches@thameswater.co.uk
www.thameswater-propertysearches.co.uk

0845 070 9148

Asset Location Search Sewer Map - ALS/ALS Standard/2019_4050391



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 509702,186912

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

Manhole Reference	Manhole Cover Level	Manhole Invert Level
6901	44.86	42.61
6904	44.97	43.28
6002	n/a	n/a
6905	n/a	n/a
6002	n/a	n/a
6003	n/a	n/a
7901	43.6	40.57
7904	43.66	40.97
7902	44.87	40.97
7903	44.93	41.27
6902	42.86	39.97
6903	42.95	40.47
681A	n/a	n/a
681B	n/a	n/a
6802	41.54	40.05
6801	41.48	39.63

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

C Main components

C.1 Attenuation cells

Stormcell® Storage System

A cost-effective, modular system that is virtually maintenance free.

Product Profile

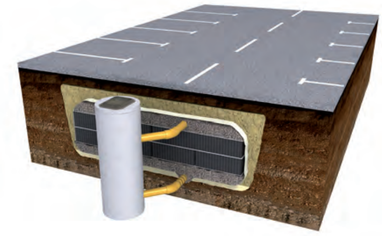
Stormcell® is a cost-effective, versatile modular stormwater storage system providing an environmentally sustainable and economically viable alternative to soft SuDS solutions.

Virtually maintenance free and more effective than conventional systems, Stormcell® is a high capacity stormwater storage system which can be designed to suit shallow, deep or irregular site requirements.

Stormcell® has a proven track record of over 25 years with zero failures.

Advantages

- Modular and flexible.
- Lightweight.
- High structural integrity - suitable for installation below roads, car parks and amenity areas.
- Silt prevention system.
- Woven geotextile on the top and bottom of each block prevents intrusion of fines.
- Simple and quick to install - no assembly or connectors required.
- Shallow 120 mm deep blocks available.
- Stormcell® is manufactured using recycled plastic.



The Stormcell® system demonstrates a major potential reduction in planned maintenance due to the perforated distribution pipes running beneath the storage tank. Any silts, grits or debris are washed through the pipework during the 'first flush' rather than into the tank. The system is therefore effectively maintenance-free. The only part of the system requiring periodic inspection is the distribution pipework which can be easily accessed from the manhole and jetted/rodded in the event of any obstruction.

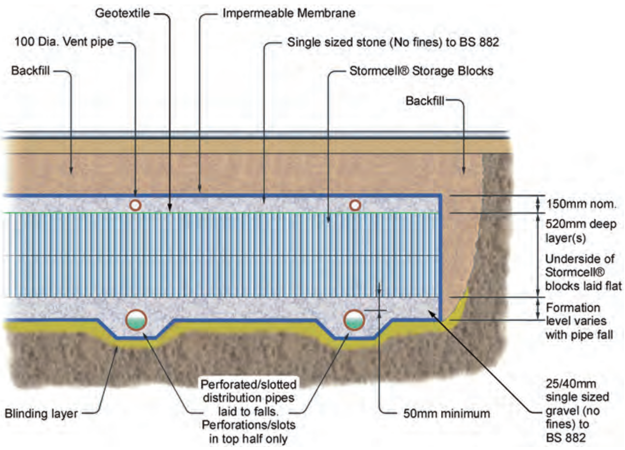
Applications

- Sustainable Drainage (SuDS) schemes.
- Retrofit SuDS schemes.
- Attenuation schemes.
- Highways and infrastructure projects.
- Car parks and Park & Ride schemes.
- Housing developments.
- Commercial developments.
- Schools and Public / Civil schemes.
- Aquifer re-charge.

www.hydro-int.com 01275 337977

Main Elements of the Stormcell® Storage System

The typical Stormcell® Storage System is composed of:



1) 2.4 m x 1.2 m x 0.52 m blocks of Stormcell® (120 mm deep shallow blocks also available).
2) An impermeable membrane wrapped around the Stormcell® blocks which prevents stormwater from escaping into the surrounding ground.
2) Large single size stone as a support base for the Stormcell® blocks which also aids even distribution of stormwater throughout the plan area of the blocks and allows drain down through the outlet.
3) Perforated pipes to further facilitate the stormwater distribution when filling and collection and delivery to the outlet when emptying and to avoid unwanted back pressure to the upstream sewer or drain.
4) Geotextile on the top of the Stormcell® blocks to prevent the migration of fines from above into the vertical voids.
5) Granular backfill to the top of the tank to assist structural loading distribution and the movement of air during filling and emptying.

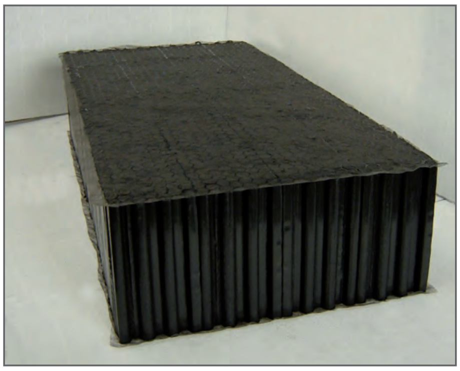
Stormcell® Lite

A lightweight version ideal for installation beneath landscaped areas.

Stormcell® Lite is a lightweight storage system ideally suited towards installation beneath landscaped, non-trafficked areas.

Advantages

- Modular and flexible.
- Lightweight.
- High structural integrity.
- Silt prevention system.
- Woven geotextile on the top and bottom of each block prevents intrusion of fines.
- Simple and quick to install - no assembly or connectors required.
- Shallow 120 mm deep blocks available.



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C.2 Orifice chamber