

1. Executive summary

This report assesses the feasibility of a range of Sustainable Drainage Scheme (SuDS) options in support of the Site development process. A SuDS strategy is proposed to ensure surface water runoff can be managed effectively over the lifetime of the development.

Potential increase in run-off due to the development ^{*1} Minimum attenuation assuming some off-site discharge.	Total run-off including climate change (+40%) ^{*1}	Change in impermeable area on a previously developed / brownfield site (as a % of total area)
 +15.79 m ³	+65.6m ³	 + 16%

Low infiltration potential

The Site has a low potential for infiltration SuDS, according to the GeoSmart infiltration map. Guidance states that if infiltration SuDS are not possible, attenuation SuDS with a controlled discharge into nearby surface water feature or existing surface water drainage is recommended. This may not be practically feasible for this Site.



^{*1} for the 6 hour, 1 in 100 year event excluding mitigation

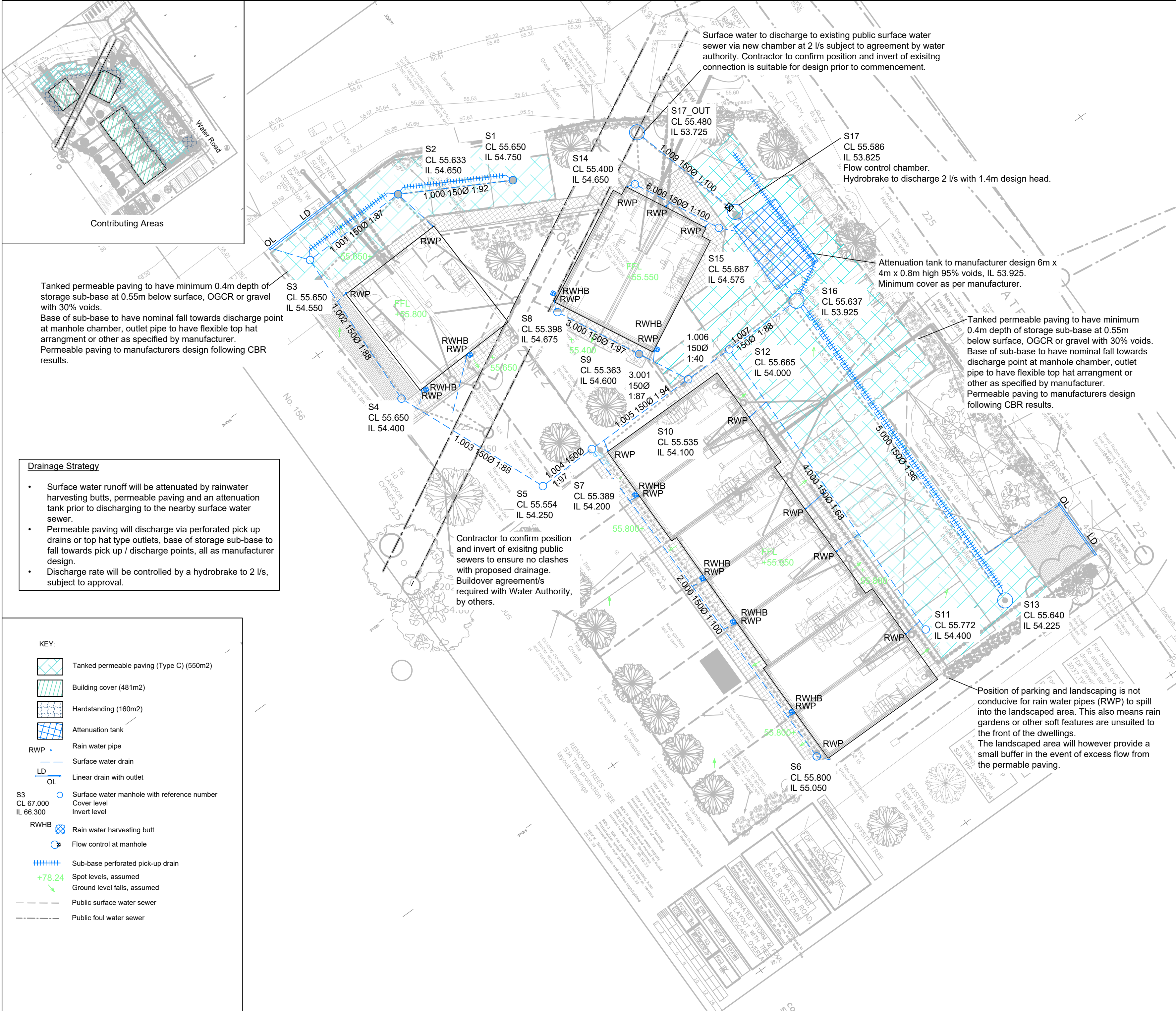
Sustainable Drainage System summary

A total storage volume of 65.6 m³ would be required to achieve attenuation for the critical storm duration, with run-off limited to 2 l/s for a 1 in 100 year rainfall event including an allowance for climate change (40%). This accords with DEFRA non statutory guidance (DEFRA, 2015). The storage would ensure that there is an improvement on existing run-off volumes, as required within Policy CS1 of the Reading Borough Council Core Strategy document.

Based upon the geology of the site, infiltration to ground is unlikely to be feasible due to anticipated low permeability Lambeth Group Bedrock. A controlled discharge (2 l/s) to the existing surface water drainage will ensure the run-off rate does not exceed Local Council requirements. A combination of SuDS features are recommended – these include tanked permeable surfacing and an attenuation tank to attenuate surface run-off and reduce the runoff rate. Once mitigation measures are implemented, the development is considered extremely unlikely to increase flood risk.

Next steps

The capacity of the public sewer network should be confirmed with the utility provider and permission to connect gained where required.



Surface water to discharge to existing public surface water sewer via new chamber at 2 l/s subject to agreement by water authority. Contractor to confirm position and invert of existing connection is suitable for design prior to commencement.

S17
CL 55.586
IL 53.825
Flow control chamber.
Hydrobrake to discharge 2 l/s with 1.4m design head.

Attenuation tank to manufacturer design 6m x 4m x 0.8m high 95% voids, IL 53.925. Minimum cover as per manufacturer.

Tanked permeable paving to have minimum 0.4m depth of storage sub-base at 0.55m below surface, OGCR or gravel with 30% voids. Base of sub-base to have nominal fall towards discharge point at manhole chamber, outlet pipe to have flexible top hat arrangement or other as specified by manufacturer. Permeable paving to manufacturers design following CBR results.

Contractor to confirm position and invert of existing public sewers to ensure no clashes with proposed drainage. Buildover agreement/s required with Water Authority, by others.

Position of parking and landscaping is not conducive for rain water pipes (RWP) to spill into the landscaped area. This also means rain gardens or other soft features are unsuited to the front of the dwellings. The landscaped area will however provide a small buffer in the event of excess flow from the permeable paving.

Tanked permeable paving to have minimum 0.4m depth of storage sub-base at 0.55m below surface, OGCR or gravel with 30% voids. Base of sub-base to have nominal fall towards discharge point at manhole chamber, outlet pipe to have flexible top hat arrangement or other as specified by manufacturer. Permeable paving to manufacturers design following CBR results.

Drainage Strategy

- Surface water runoff will be attenuated by rainwater harvesting butts, permeable paving and an attenuation tank prior to discharging to the nearby surface water sewer.
- Permeable paving will discharge via perforated pick up drains or top hat type outlets, base of storage sub-base to fall towards pick up / discharge points, all as manufacturer design.
- Discharge rate will be controlled by a hydrobrake to 2 l/s, subject to approval.

- KEY:
- Tanked permeable paving (Type C) (550m2)
 - Building cover (481m2)
 - Hardstanding (160m2)
 - Attenuation tank
 - RWP Rain water pipe
 - Surface water drain
 - LD Linear drain with outlet
 - OL
 - S3 CL 67.000 IL 66.300
 - Surface water manhole with reference number
 - Cover level
 - Invert level
 - RWHB Rain water harvesting butt
 - Flow control at manhole
 - Sub-base perforated pick-up drain
 - Spot levels, assumed
 - Ground level falls, assumed
 - Public surface water sewer
 - Public foul water sewer

- Notes.
1. Do not scale from this drawing.
 2. All dimensions are in millimeters unless otherwise stated.
 3. This drawing to be read in conjunction with all other relevant drawings and documents.
 4. All drainage to be constructed to Civil Engineering Specification for Water Industry 7th Edition, current british standards and building regulations and other relevant standards.
 5. Exact locations of rain water downpipes and other internal drainage down pipes to be confirmed by architect. Rain water pipe connections to have rodding access, sump and grated cover.
 6. Contractor to confirm locations of existing services prior to commencement on site and to arrange for any necessary diversions, lowering or protection works as required.
 7. All specialist drainage components such as attenuation tanks, flow control and pumping stations to be designed and installed as per manufacturers requirements.
 8. Cover levels to be confirmed by landscape architect. Cover levels and invert levels are in meters unless otherwise stated. If cover levels change from assumed then drainage design should be re-assessed, especially in regards to extreme events.
 9. Extent of linear drainage channel to perimeter of building to be confirmed by architect, design as per manufacturer.
 10. Private surface water pipes to be 100Ø with minimum fall of 1:100 unless otherwise stated.
 11. Permeable paving and outlets to be as manufacturer design and recommendations.
 12. Proposed ground levels will influence the storage capacity of the permeable paving and the position of the drainage pick up features. When proposed ground levels are complete the permeable paving design should be reviewed to ensure sufficient storage is provided and that the drainage pick up features are positioned correctly.
 13. Minimum cover to thermoplastic pipes in garden or patio areas 0.6m, in driveway 0.9m, in road 1.2m, otherwise concrete protection will be required.
 14. Access chamber cover class A15 for garden and patio, B125 for driveway, C250 for lightly trafficked roads or small private carparks.
 15. * assumed levels and gradients, to be confirmed.
 16. Assumed patio areas to drain towards garden.
 17. Design is for planning purposes only and not for construction. Design should be confirmed prior to construction to ensure all available information is considered and any assumed information should be verified.
 18. The invert level of the existing sewer should be checked to ensure a connection is suitable.
 19. Exceedance routes to be confirmed following external levels design.

P04	17.05.24	Amended to suit comments	MG	MG
P03	22.03.24	Added to manhole to avoid tree	MG	MG
P02	21.03.24	Tank moved	MG	JR
P01	17.01.22	Initial issue	DS	MG
Rev	Date	Detail	Drawn	Chkd

Client:
Mrs K Baker

Project:
65283.01 Water Road

Drawing Title:
Proposed Surface Drainage



Suite 9-11, 1st Floor, Old Bank Buildings, Bellstone, Shrewsbury, SY1 1HU		
Drawn by: DS	Checked by: MG	Date: Jan 2022
Scale: 1:200 @ A2		Status: Preliminary
Drawing No: 65283.01.100		Issue: P04

2. SuDS Infiltration Suitability Map (SD50)

The GeoSmart SuDS Infiltration Suitability Map (SD50) screens the suitability for infiltration drainage in different parts of the site and indicates where further assessment is recommended. The map combines information on the thickness and permeability of the underlying material and the depth to the high groundwater table.



Potential suitability for infiltration SuDS

(Based on the GeoSmart SuDS Infiltration Suitability Map (SD50))

Low infiltration potential There is a low potential for infiltration SuDS in parts of the Site. Comments: It is likely that the underlying geology at the Site, or in areas of the site, is relatively impermeable which would limit the effectiveness of a proposed infiltration SuDS scheme.	✓
Moderate infiltration potential There is a moderate potential for infiltration SuDS in parts of the Site. Comments: It is likely that the permeability of the underlying material at the site would be suitable for infiltration drainage. However, there may be constraints on the use of infiltration SuDS as a result of any of the following: a high water table, the limited thickness of the receiving formation, the potential for a significant range in permeability in the underlying geology and confirmation of the infiltration capacity is recommended. Recommendations: A site investigation is recommended to investigate groundwater levels and formation thickness and to confirm that infiltration rates at the Site are sufficient to accommodate an infiltration SuDS feature. If a site investigation confirms that infiltration SuDS are possible at the Site then various options can be considered for infiltration SuDS and these include infiltration trenches, soakaways, swales, permeable pavements and infiltration basins without outlets.	x
High infiltration potential There is a high potential for infiltration SuDS in parts of the Site. Comments: It is likely that the underlying geology at the Site is highly permeable and an infiltration SuDS scheme should be possible at the Site. Groundwater levels are expected to be sufficiently deep at the site. Recommendations: A site investigation is recommended to confirm the high infiltration capacity and the depth of the winter water table. Various options can be considered for infiltration SuDS and these include infiltration trenches, soakaways, swales, permeable pavements and infiltration basins without outlets.	x

Underlying geology at the site

Geology present		Potentially permeable?
Superficial Geology	None recorded	N/A
Bedrock Geology	Lambeth Group (LMBE) (Clay, Silt and Sand)	x

3. Site analysis



Site information

The purpose of this report is to assess the potential for disposing of surface water through a sustainable drainage system (SuDS) for the site of 2, 4, and 6 Water Road and 158 Dee Road, Reading, RG30 2NN (the Site). The Site is located southwest of Norcot, Reading in a setting of residential land use.

The ground levels on-Site fall to the north east from 56.61 to 55.50 mAOD along the north eastern boundary. This is based upon EA LiDAR elevation data obtained for the Site to a 1 m resolution with a vertical accuracy of ± 150 mm.

Development

The Site is currently used within a residential capacity. At present there are four residential dwellings on the Site with associated car parking and landscaped areas. The proposals for the Site comprise the development of twelve new 4 x bedroom properties including associated car parking and landscaping. Site plans and drawings are provided in Appendix A.



Geology, permeability and thickness

According to British Geological Survey (BGS) records, the permeability of the underlying material at the site is low and therefore confirmation of the infiltration capacity is recommended. The soil infiltration coefficient must be sufficient to accommodate any constraints on the dimensions of focused infiltration features such as soakaways and their emptying time.

Based on BGS borehole records for a property 170m west of the Site, a layer of firm brown silty, sandy clay is located 0.5 metres below ground level (mbgl) under a layer of tarmac and concrete (Made Ground). Beneath this layer, is a firm brown grey, clayey sandy silt layer with layers of firm brown silty sand (1.30 mbgl). A layer of dense brown gray coarse sand is located approximately 2.5 mbgl before transitioning into a firm to stiff brown grey silty, very sandy clay. (Borehole record: SU67SE626) (BGS, 2024). Conditions on site may differ and therefore a Site Investigation is recommended.



Depth to groundwater

Nearby borehole records indicate the water table to be at least 6 m below ground level (Borehole record: SU67SE626) (BGS, 2024). The base of an infiltration or attenuation system should be at least 1m above the expected seasonal high water table. Passage through unsaturated soil is important for improving the quality of infiltrating water before it reaches the water table. The infiltration system should be designed to operate in periods of extreme groundwater levels.



'It is essential that the consideration of sustainable drainage takes place at the land acquisition due diligence stage'

LASOO (2015), Practice Guidance, Local Authority SUDS Officer Organisation.

Ground conditions



A site specific review of underlying ground conditions is recommended to ensure focused infiltration does not cause ground instability as a result of landslide or collapse associated with dissolution or shallow mining. Hazards that should be considered include soluble rocks, landslides, compressible ground, collapsible ground, shrink-swell clays, running sand and shallow mining.

Soakaways (if feasible) should be a minimum of 5m away from the foundations of a building and local guidance may recommend a greater distance. A detailed ground assessment is recommended on steep slopes where infiltrating water would produce saturation and instability downslope; or within layered geology, where infiltrating water would produce springs down gradient.

Attenuation features such as ponds and detention basins should be located at least 2m from buildings and where possible, should be lined to minimize flood risk and to reduce the impacts on surrounding foundations and building structures. Health and safety should also be considered in terms of the space required to provide appropriate gradients required on the sides of these features.



Water quality

The EA's groundwater Source Protection Zone (SPZ) mapping confirms that the Site does not lie within an SPZ. According to the EA's aquifer designation mapping the Site is located above a Bedrock Secondary (A) Aquifer (EA, 2024). In this case, an assessment of the quality of infiltrating runoff and the possibilities for pre-treatment is not likely to be required. Consultation with the Local Authority and examination of historical land uses would enable early indication of the likelihood of contamination.

Hydrology and drainage

According to OS mapping, there are no known watercourses within the vicinity of the Site that could feasibly be discharged to.



Flood risk

According to Environment Agency's Flood Map for Planning Purposes, the Site is located within Flood Zone 1, and therefore has a low probability of fluvial flooding (EA, 2024). The northern and eastern parts of the Site are at risk from pluvial flooding, as such these areas are at moderate to high risk of pluvial (surface water) flooding (EA, 2024). This flood risk should be considered when siting SuDS features and setting finished floor levels of the proposed development. According to the GeoSmart GW5 flood risk map, the Site has a negligible risk of groundwater flooding (GeoSmart, 2024).

4. Storage, volume, and peak flow rate

Suggested minimum and aspirational storage requirements for an attenuation SuDS scheme for the development footprint are set out below with more detail provided in subsequent sections.

Attenuation scenario		Attenuation required (m ³)	Explanation
Discharge runoff to surface water sewer	1 in 100 year including 40% CC	65.6	Attenuation required to ensure surface water runoff is attenuated in all storm events up to and including the 1 in 100 year (3 hour, Critical Storm Duration) event including a 40% allowance for climate change*.

Surface water run-off

An increase in impermeable area on site will result in greater rainfall run-off. Reduction in run-off will help mitigate flood risk both on and off site. Further information on the surface water run-off calculations is provided in Section 8 'Background Information'.

The Non-Statutory Technical Guidance for SuDS (DEFRA, March 2015) states:

Guidance

"Where reasonably practicable, for Greenfield development, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event should never exceed the Greenfield runoff volume for the same event. Where reasonably practicable, for developments which have been previously developed, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event must be constrained to a value as close as is reasonably practicable to the Greenfield runoff volume for the same event, but should never exceed the runoff volume from the development site prior to redevelopment for that event."

Table 1: Change in impermeable area associated with the development

Total site area

2,085 m²

Impermeable area (and as a percentage of the total area of the proposed development footprint of 2,085 m ²)	
Pre-development	Post-development
863 m ² (41%)	1,191 m ² (57%)
Impermeable land use: 300 m ² driveway 100 m ² patio 100 m ² gravel driveway 363 m ² houses Permeable land use: 1,222 m ² landscaped areas	Impermeable land use: 710 m ² hardstanding* 481 m ² building cover Permeable land use: 655 m ² landscaped areas

* Please note, whilst a 550 m² area of hardstanding will be utilized for permeable paving SuDS, for the calculations these areas will be classed as impermeable in order to assess the potential run-off volumes and rates for the Site post-development and the potential holding capability of the proposed SuDS features.

“The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the site for a 1 in 30 year rainfall event’ and ‘flooding does not occur during a 1 in 100 year rainfall event in any part of: a building (including a basement); or in any utility plant susceptible to water (e.g. pumping station or electricity substation) within the development”

(DEFRA, March 2015, non-statutory guidance).

Peak discharge rates

The table below presents peak discharge rates for a range of storm events used to assess the impact of the proposed development and select the maximum permitted discharge rate. Further information on the calculation and control of peak discharge rates is provided in Section 8 ‘Background Information’.

Table 2: Peak discharge rates associated with the development

Rainfall event	Greenfield run-off rates (l/s)	Existing run-off rates ¹ (l/s)	Potential run-off rates without attenuation	Potential minus existing (l/s)
QBAR	0.35	N/A	N/A	N/A
6 hour 1 in 1 year	0.30	1.37	1.62	0.26
6 hour 1 in 10 year	0.57	2.38	2.81	0.43
6 hour 1 in 30 year	0.78	3.12	3.70	0.58
6 hour 1 in 100 year	1.12	3.92	4.65	0.73
6 hour 1 in 100 year + 20% CC	N/A	N/A	5.58	1.66
6 hour 1 in 100 year + 40% CC	N/A	N/A	6.51	2.59

¹ Assumes 100% run-off from impermeable surfaces. Assumes Greenfield run-off from permeable surfaces calculated using the IoH124 method.

Relevant local and regional plan policy should be consulted to determine restrictions on run-off from previously developed sites. In some cases, greenfield rates may be requested. In practice it is difficult to restrict discharge rates at any one control point to less than 2 l/s.

Total discharge volumes

The table below presents discharge volumes for a range of storm events used to assess the impact of the proposed development and calculate the required storage volumes. Further information on the calculation of total discharge volumes is provided in Section 8 'Background Information'.

Table 3: Total discharge volumes associated with the development

Rainfall event	Greenfield run-off volume (m ³)	Existing run-off volume ² (m ³)	Potential run-off volume without attenuation (m ³)	Potential minus existing (m ³)
QBAR	16.17	N/A	N/A	N/A
6 hour 1 in 1 year	15.02	29.53	35.05	5.51
6 hour 1 in 10 year	26.65	51.36	60.76	9.39
6 hour 1 in 30 year	34.25	67.32	79.89	12.57
6 hour 1 in 100 year	43.02	84.57	100.36	15.79
6 hour 1 in 100 year + 20% CC	N/A	N/A	120.44	35.86
6 hour 1 in 100 year + 40% CC	N/A	N/A	140.51	55.94

² Assumes 100% run-off from impermeable surfaces. Assumes Greenfield run-off from permeable surfaces calculated using the IoH124 method.

Climate change

As of May 2022, the applicable climate change allowance is defined by specific Management Catchment for the 1 in 30 ($\geq 3.3\%$ AEP) and 1 in 100 (< 3.3 to 1% AEP) year event.

As the Site is located within the Thames and South Chilterns Management Catchment, the following climate change allowances are applicable:

Table 4: Thames and South Chilterns Management Catchment peak rainfall allowances

Thames and South Chilterns	3.3% Annual exceedance rainfall event		1% Annual exceedance rainfall event	
	2050s	2070s	2050s	2070s
Central	20%	20%	20%	25%
Upper end	35%	35%	40%	40%

5. Run-off destination

Options for the destination for the run-off generated on-site have been assessed in line with the prioritisation set out in the Building Regulations Part H document (HM Government, 2010) and DEFRA's Non-statutory Technical Standards for SuDS (2015). Flow attenuation using infiltration SuDS (discharge to ground) is generally the preferred option. If discharge to ground is not available, run-off discharge to surface water is the other preferred method. Only if these two options are impractical should discharge to the sewer network be considered.

Discharge to ground

As discussed in Section 2, the Site has low potential for infiltration, with anticipated low permeability underlying bedrock (Lambeth Group). Based on the available borehole information (subject to confirmation by site investigation) and groundwater flood risk mapping, it is unlikely that SuDS features would be impacted by high groundwater levels (See SuDS Infiltration Suitability Map (SD50)). There are no issues identified relating to site contamination or the presence of a source protection zone.

Due to the anticipated low permeability of the underlying geology, infiltration SuDS features are not proposed.

Discharge to surface watercourse

There are no watercourses or surface water features within 200 m of the Site. There is a standing water feature within 700 m of the Site and two surface water drains within 700 m of the Site; however, providing a connection to these would involve crossing into other properties and public areas. Therefore, the Site would be unsuitable for discharge to surface water features.

Discharge to sewer

Discharge to sewer is likely to be the optimum sustainable drainage option for the Site. It is understood that the existing site drainage is to the sewer, and this may continue subject to confirmation from the sewerage provider.

Consultation with the local sewer undertaker (Thames Water) should be undertaken..

Discharge would have to be controlled and on-site attenuation would be required. The Site currently has four separate connections into the sewer water network located along Water Road and Dee Road however, in order to achieve a 2 l/s outfall, only one connection should be utilised for surface water run-off. This makes for much easier operation and maintenance of the surface water runoff flow control feature from the Site.

6. Water quality

A key requirement of any SuDS system is that it protects the receiving water body from the risk of pollution. This can be effectively managed by an appropriate “train” or sequence of SuDS components that are connected in series. The frequent and short duration rainfall events are those that are most loaded with potential contaminants (silts, fines, heavy metals and various organic and inorganic contaminants). Therefore, the first 5-10 mm of rainfall (first flush) should be adequately treated with SuDS.

The minimum number of treatment stages will depend on the sensitivity of the receiving water body and the potential hazard associated with the proposed development SuDS Manual (CIRIA, 2015). The proposed development is a combination of very low (roof water) to low hazard (runoff from car parking and road). The site does not lie within a source protection zone and therefore additional treatment stages are not required.

Table 5: Level of hazard

Hazard	Source of hazard
Very Low	Residential Roof drainage
Low	Residential, amenity uses including low usage car parking spaces and roads, other roof drainage.
Medium	Commercial, industrial uses including car parking spaces and roads (excluding low usage roads, trunk roads and motorways).
High	Areas used for handling and storage of chemicals and fuels, handling of storage and waste (incl. scrap-yards).

Table 6: Minimum number of treatment stages for run-off

		Sensitivity of the receiving water body		
		Low	Medium	High
Hazard	Low	1	1	1
	Med	2	2	2
	High	3	3	3

Table 7: SuDS operation and recommended maintenance requirements

Asset type	Maintenance schedule (and frequency)
Permeable Pavements	Regular maintenance: • Brushing and vacuuming (three times per year). • Trimming any roots and surrounding grass and weeds that may be causing blockages (annually or as required). Monitoring: • Initial inspection (monthly). • Inspect for poor performance and inspection chambers (annually).
Attenuation Tanks	Regular maintenance: • Inspect all components and identify areas that are not operating correctly (monthly for 3 months then annually) • Remove debris from the catchment surface (monthly). • For systems where rainfall infiltrates from above, (annually and after severe storms). • Inspect underside of roof for leakage (annually and after severe storms). Monitoring: • Inspect inlets, outlets and overflows for blockages (monthly). • Inspect banksides, structures and pipework's for blockages (monthly). • Inspect infiltration surfaces for compaction and ponding (monthly).
Hydro-Brake Flow Control	Low amounts of maintenance required as there are no moving parts within the Hydro-Brake® Flow Control. • Initial monthly inspection at the manhole once the construction phase is over. If blockages occur they normally do so at the intake. Hydro-Brake® Flow Controls are fitted with a pivoting by-pass door, which allows the manhole chamber to be drained down should blockages occur. Inspection should be undertaken annually or when a storm event occurs.
Underground Drainage Pipe Network and Manholes	Regular maintenance: • Remove sediment and debris from pre-treatment devices and floor of inspection tube or chamber (annually). • Cleaning of gutters and any filters on downpipes (annually). • Trimming any roots that may be causing blockages (annually or as required). Monitoring: • Inspect silt traps and note rate of sediment accumulation (monthly in the first year and then annually).

Linear Drainage Channel	Regular maintenance: • Remove sediment and debris from grating, channel and sump (monthly or as required). • Trimming any roots and surrounding vegetation that may be causing blockages (as required). Monitoring: • Inspect inlets and outlets for blockages or silt accumulation (monthly or after a heavy storm).
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Health and safety considerations of SuDS

GeoSmart Pro reports may include outline strategies or designs to support with development plans. Any drawings or advice provided do not comprise any form of detailed design. Implementation of any conceptual scheme options may constitute 'Construction Work' as defined by CDM Regulations (2015).

The CDM Regulations place specific Health and Safety duties on those commissioning, planning and undertaking construction works. If you are uncertain what this means you should seek the advice of your architect, builder or other competent professional.

GeoSmart does not provide health and safety advisory services but we are required to advise you of your general responsibilities under CDM (visit <http://geosmartinfo.co.uk/knowledge-hub/cdm-2015/> for more information).

Please remember that detailed design work should be undertaken by a competent professional who might be your engineer, architect, builder or another competent party.

7. Further information and what to do next

Site investigation is necessary to confirm the infiltration capacity and detailed design is required. Further SuDS options can be assessed in conjunction with the developer. The following table includes a list of products by GeoSmart:

Recommendations for next steps		
Additional assessment: FloodSmart Report		The FloodSmart Report range provides clear and pragmatic advice regarding the nature and potential significance of flood hazards which may be present at a site. Our consultants assess available data to determine the level of risk based on professional judgement and years of experience. Please contact info@geosmartinfo.co.uk for further information.
Additional assessment: EnviroSmart Report		Provides a robust desk-based assessment of potential contaminated land issues, taking into account the regulatory perspective. Our EnviroSmart reports are designed to be the most cost effective solution for planning conditions. Each report is individually prepared by a highly experienced consultant conversant with Local Authority requirements. Ideal for pre-planning or for addressing planning conditions for small developments. Can also be used for land transactions. Please contact info@geosmartinfo.co.uk for further information.

Client checklist for limitations to infiltration SuDS

Conditions in Non-Statutory Technical Standards Defra, 2015)	Guidance Do these conditions arise at the site?
Is the surface runoff greater than the rate at which water can infiltrate into the ground?	
Is there an unacceptable risk of ground instability?	
Is there an unacceptable risk of mobilising contaminants?	
Is there an unacceptable risk of pollution to groundwater?	
Is there an unacceptable risk of groundwater flooding?	
Is the infiltration system going to create a high risk of groundwater leakage to the combined sewer?	

According to guidance available in the Draft National Standards for SuDS (Defra, 2011) surface water runoff must not be discharged to the ground where the conditions listed above occur. Should this be the case then attenuation SuDS features are recommended. Please contact GeoSmart for more information.

Client checklist for SuDS design considerations

Confirm that potential flooding on site in excess of the design storm event and exceedance flow routes have been considered.	
Review options for the control of discharge rates (e.g. hydrobrake).	
Confirm the owners/adopters of the drainage system. Consider management options for multiple owners	
Is there an unacceptable risk of pollution to groundwater?	
Review access and way leave requirements.	
Review maintenance requirements.	

8. Background information

What are SuDS?

SuDS are defined as:

A sustainable drainage system (SuDS) is designed to replicate, as closely as possible, the natural drainage from the Site (before development) to ensure that the flood risk downstream of the Site does not increase as a result of the land being developed. SuDS can also significantly improve the quality of water leaving the Site and can enhance the amenity and biodiversity that a site has to offer.

There are a range of SuDS options available to provide effective surface water management that intercept and store excess run-off. When considering these options the destination of the run off should be assessed using the order of preference outlined in the Building Regulations Part H document (HM Government, 2010) and DEFRA's Non-statutory Technical Standards for SuDS (2015):

1. Discharge to the ground
2. Discharge to a surface water body
3. Discharge to a surface water sewer
4. Discharge to a local highway drain
5. Discharge to a combined sewer

For general information on SuDS see www.susdrain.org

Infiltration SuDS

Guidance

Government policy for England is to introduce sustainable drainage systems (SuDS) via conditions in planning approvals. Guidance indicates that capturing rainfall run-off on site and infiltrating it into the ground (infiltration SuDS) is the preferred method for managing surface water without increasing flood risk downstream.

The greatest benefit to general flood risk is if all run-off is infiltrated on site, however, this may not be feasible due to physical and economic constraints in which case infiltration may be considered as a part of an integrated drainage solution. The final design capacity for an infiltration SuDS system depends on the site constraints and the requirements of the individual Planning Authority and the Lead Local Flood Authority.

The capacity of the ground to receive infiltration depends on the nature, thickness and permeability of the underlying material and the depth to the high groundwater table. The final proportion of the site drained by infiltration will depend on topography, outfall levels and a suitable drainage gradient. It is important to note that, even if the whole site cannot be drained by infiltration, the use of partial infiltration is encouraged, with the remainder of run-off discharged via other SuDS systems.

Types of infiltration SuDS

Infiltration components include infiltration trenches, soakaways, swales and infiltration basins without outlets, rain gardens and permeable pavements. These are used to capture surface water runoff and allow it to infiltrate (soak) and filter through to the subsoil layer, before returning it to the water table below.

An infiltration trench is usually filled with permeable granular material and is designed to promote infiltration of surface water to the ground. An infiltration basin is a dry basin or depression designed to promote infiltration of surface water runoff into the ground. Soakaways are the most common type of infiltration device in the UK where drainage is often connected to over-sized square or rectangular, rubble-filled voids sited beneath lawns.

According to the guidance in Building Research Establishment (BRE) Digest 365 (2016) a soakaway must be able to discharge 50% of the run-off generated during a 1 in 10 year storm event within 24 hours in readiness for subsequent storm flow. This is the basic threshold criteria for a soakaway design and the internal surface area of the proposed soakaway design options should be calculated on this basis by taking into account the soil infiltration rate for the Site.

Developers need to ensure their design takes account of the construction, operation and maintenance requirements of both surface and subsurface components, allowing for any machinery access required.

How was surface water run-off estimated from the site?

In accordance with The SuDS Manual (C753) (CIRIA, 2015), the Greenfield run-off from the Site has been calculated using the I_oH124 method and is assumed representative of the run-off generated on the undeveloped surfaces that are affected by the proposed development. The method used for calculating the runoff complies with the NPPF (MHCLG, 2023). For the impermeable surfaces, it has been assumed that 100% runoff will occur (calculations provided in Appendix A). Rainfall data is derived from the Flood Estimation Handbook (FEH) CD-ROM, developed by NERC (2009). Only areas affected by the proposed development are considered in the flow and volume calculations. Permeable areas that remain unchanged are not included in the calculations as it is assumed these will not be actively drained and attenuated.

What is the peak discharge rate?

An estimation of peak run-off flow rate and volume is required to calculate infiltration, storage and discharge requirements. The peak discharge rate is the maximum flow rate at which surface water runoff leaves the site during a particular storm event, without considering the impact of any mitigation such as storage, infiltration or flow control. Proposed discharge rates (with mitigation) should be no greater than existing rates for all corresponding storm events. If all drainage is to infiltration there will be no discharge off site. Discharging all flow from site at the existing 1 in 100 event would increase flood risk during smaller events. Flow restriction is generally required to limit the final discharge from site during all events as a basic minimum to the green field QBAR rate. A more complex flow restriction which varies the final discharge rate from the site depending on the storm event will reduce the volume of storage required on site. Drainage to infiltration SuDS is subtracted from the total discharge off site to achieve a beneficial net affect.

What is the total discharge volume?

The total discharge volume is calculated on the basis of the surface water runoff that has the potential to leave the site as a result of the assumed 6 hour duration design storm event. The run-off is related to the underlying soil conditions, impermeable cover, rainfall intensity and duration of the storm event. The total volume generated by the current site is compared to the potential total volume from the developed site (not taking into consideration any mitigation). The difference provides the minimum total volume that will need to be stored and infiltrated on site or released at a controlled rate. Guidance indicates that the total discharge volume should never exceed the runoff volume from the development site prior to redevelopment for that event and should be as close as is reasonably practicable to the Greenfield runoff volume.

GeoSmart SuDS Infiltration Suitability Map (SD50)

In response to the need for national-scale information to support sustainable drainage and land-use planning, GeoSmart have produced the SuDS Infiltration Suitability Map (SD50) for preliminary assessment.

In producing the SuDS Infiltration Suitability Map (SD50), GeoSmart used data from the British Geological Survey on groundwater levels, geology and permeability to screen for areas where infiltration SuDS may be suitable. The map classifies areas into 3 categories of High, Medium and Low suitability for infiltration SuDS which is then informed by additional data on site constraints to give recommendations for SuDS and further investigation.

The primary constraint on infiltration potential is the minimum permeability of the underlying material and in some cases the range in permeability may be considerable, ranging down to low. The map classifies these areas as moderate infiltration suitability requiring further investigation. In cases where the thickness of the receiving permeable horizon is less than 1.5 meters then additional site investigation is recommended. If the site is at risk of groundwater flooding for up to the 1% annual occurrence the map classifies these areas as moderate infiltration suitability requiring further investigation.

The GeoSmart SuDS Infiltration Suitability Map (SD50) is a national screening tool for infiltration SuDS techniques but a site specific assessment should be used before final detailed design is undertaken.

Further details:

- The GeoSmart SuDS Infiltration Suitability Map (SD50) model takes advantage of all the available data and provides a preliminary indication of infiltration SuDS suitability on a 50m grid covering England and Wales. Our approach is consistent with latest best practice for such assessments and based on authoritative science and quality assured methods.
- The map is a general purpose indicative screening tool, and is intended to provide a useful initial view for a wide variety of applications. However, it does not provide an alternative to a proper site-specific assessment.
- Further information on the GeoSmart SuDS Infiltration Suitability Map (SD50) is available at geosmartinfo.co.uk

Data limitations

Guidance

The data and information which GeoSmart interprets in Reports is obtained by GeoSmart from third parties including the British Geological Survey. The data, information and related records supplied can only be indicative and should not be taken as a substitute for specialist interpretations, professional advice and/or detailed site investigations. Geological observations are made according to the prevailing understanding of the subject at the time. The quality of such observations may be affected by subsequent advances in knowledge or improved methods of interpretation.

9. References and glossary

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Glossary³

Attenuation	Reduction of peak flow and increased duration of a flow event.
Combined sewer	A sewer designed to carry foul sewage and surface water in the same pipe.
Detention basin	A vegetated depression, normally is dry except after storm events, constructed to store water temporarily to attenuate flows. May allow infiltration of water to the ground.
Evapotranspiration	The process by which the Earth's surface or soil loses moisture by evaporation of water and by uptake and then transpiration from plants.
FEH	Flood Estimation Handbook, produced by Centre for Ecology and Hydrology, Wallingford (formerly the Institute of Hydrology).
Filter drain or trench	A linear drain consisting of a trench filled with a permeable material, often with a perforated pipe in the base of the trench to assist drainage, to store and conduct water, but may also be designed to permit infiltration.

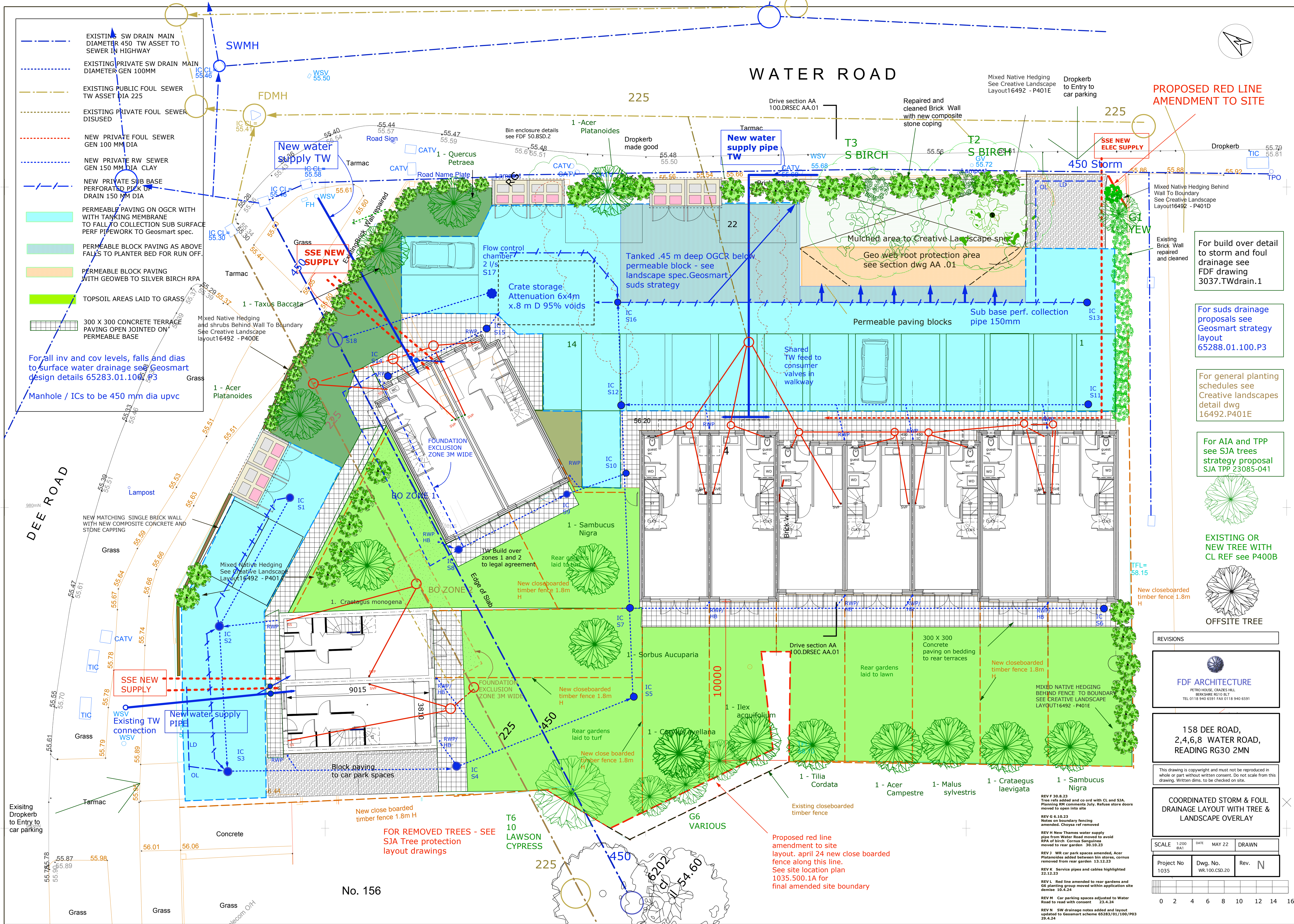
First flush	The initial runoff from a site or catchment following the start of a rainfall event. As runoff travels over a catchment it will collect or dissolve pollutants, and the “first flush” portion of the flow may be the most contaminated as a result. This is especially the case for intense storms and in small or more uniform catchments. In larger or more complex catchments pollution.
Flood plain	Land adjacent to a watercourse that would be subject to repeated flooding under natural conditions (see Environment Agency's Policy and practice for the protection of flood plains for a fuller definition).
Greenfield runoff	This is the surface water runoff regime from a site before development, or the existing site conditions for brownfield redevelopment sites.
Impermeable surface	An artificial non-porous surface that generates a surface water runoff after rainfall.
Permeability	A measure of the ease with which a fluid can flow through a porous medium. It depends on the physical properties of the medium, for example grain size, porosity and pore shape.
Runoff	Water flow over the ground surface to the drainage system. This occurs if the ground is impermeable, is saturated or if rainfall is particularly intense.
Sewerage undertaker	This is a collective term relating to the statutory undertaking of water companies that are responsible for sewerage and sewage disposal including surface water from roofs and yards of premises.
Soakaway	A subsurface structure into which surface water is conveyed to allow infiltration into the ground.
Treatment	Improving the quality of water by physical, chemical and/or biological means.

³ The terms included in this glossary have been taken from CIRIA guidance.

Appendices

Appendix A

Site plans (layout and topography)



- EXISTING SW DRAIN MAIN DIAMETER 450 TW ASSET TO SEWER IN HIGHWAY
- EXISTING PRIVATE SW DRAIN MAIN DIAMETER GEN 100MM
- EXISTING PUBLIC FOUL SEWER TW ASSET DIA 225
- EXISTING PRIVATE FOUL SEWER DISUSED
- NEW PRIVATE FOUL SEWER GEN 100 MM DIA
- NEW PRIVATE RW SEWER GEN 150 MM DIA CLAY
- NEW PRIVATE SUB BASE PERFORATED PICK UP DRAIN 150 MM DIA
- PERMEABLE PAVING ON OGCR WITH TANKING MEMBRANE TO FALL TO COLLECTION SUB SURFACE PERF PIPEWORK TO Geosmart spec.
- PERMEABLE BLOCK PAVING AS ABOVE FALLS TO PLANTER BED FOR RUN OFF.
- PERMEABLE BLOCK PAVING WITH GEOWEB TO SILVER BIRCH RPA
- TOPSOIL AREAS LAID TO GRASS
- 300 X 300 CONCRETE TERRACE PAVING OPEN JOINTED ON PERMEABLE BASE

For all inv and cov levels, falls and dias to surface water drainage see Geosmart design details 65283.01.100.P3

Manhole / ICs to be 450 mm dia upvc

PROPOSED RED LINE AMENDMENT TO SITE

For build over detail to storm and foul drainage see FDF drawing 3037.TWdrain.1

For suds drainage proposals see Geosmart strategy layout 65288.01.100.P3

For general planting schedules see Creative landscapes detail dwg 16492.P401E

For AIA and TPP see SJA trees strategy proposal SJA TPP 23085-041



REVISIONS

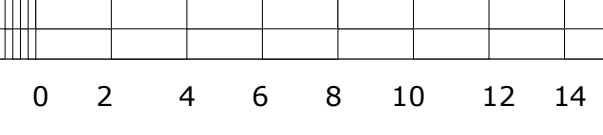
FDF ARCHITECTURE
PETRO HOUSE, CRAZES HILL
BERKSHIRE RG10 8LT
TEL 0118 940 6591 FAX 0118 940 6591

158 DEE ROAD,
2,4,6,8 WATER ROAD,
READING RG30 2MN

This drawing is copyright and must not be reproduced in whole or part without written consent. Do not scale from this drawing. Written dims. to be checked on site.

COORDINATED STORM & FOUL DRAINAGE LAYOUT WITH TREE & LANDSCAPE OVERLAY

SCALE	1:200	DATE	MAY 22	DRAWN	
Project No	1035	Dwg. No.	WR-100.CSD.20	Rev.	N



- REV F 30.8.23 Tree refs added and co ord with CL and SJA. Planning BM comments July. Refuse store doors moved to open into site
- REV G 6.10.23 Notes on boundary fencing amended. Choyra ref removed
- REV H New Thames water supply pipe from Water Road moved to avoid RPA of birch. Cornus Sanguinea moved to rear garden 30.10.23
- REV J WR car park spaces amended, Acer Platanoides added between bin stores, cornus removed from rear garden 13.12.23
- REV K Service pipes and cables highlighted 22.12.23
- REV L Red line amended to rear gardens and G6 planting group moved within application site demise 16.4.24
- REV M Car parking spaces adjusted to Water Road to read with consent 23.4.24
- REV N SW drainage notes added and layout updated to Geosmart scheme 65283/01/100/P03 29.4.24

WATER ROAD

Appendix B

Rainfall run-off calculations

Design Settings

Rainfall Methodology	FEH-13	Minimum Velocity (m/s)	1.00
Return Period (years)	2	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	0.750	Preferred Cover Depth (m)	0.600
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	x
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1	0.007	5.00	55.650	600	468660.561	173348.252	0.900
2	0.010	5.00	55.633	600	468651.475	173347.140	0.983
3	0.005	5.00	55.650	600	468644.506	173341.935	1.100
4	0.004	5.00	55.650	600	468651.748	173330.971	1.250
5			55.554	600	468662.931	173324.052	1.304
6	0.016	5.00	55.800	600	468684.605	173302.661	0.750
7	0.000		55.389	600	468666.806	173326.985	1.189
8	0.005	5.00	55.398	600	468664.085	173337.822	0.723
9	0.000		55.363	600	468670.552	173334.499	0.763
10	0.000		55.535	600	468674.432	173332.508	1.435
11	0.015	5.00	55.772	600	468693.230	173312.710	1.372
12	0.000		55.665	600	468677.687	173334.865	1.665
13	0.038	5.00	55.640	1200	468699.516	173315.009	1.415
14	0.006	5.00	55.400	600	468670.220	173347.930	0.750
15	0.000		55.687	600	468676.860	173344.486	1.112
16	0.015	5.00	55.637	1200	468683.005	173338.716	1.712
17	0.000		55.586	1200	468678.153	173345.751	1.761
17_OUT			55.480	1200	468670.383	173352.044	1.755

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	1	2	9.154	0.600	54.750	54.650	0.100	91.5	150	5.15	50.0
1.001	2	3	8.698	0.600	54.650	54.550	0.100	87.0	150	5.28	50.0
1.002	3	4	13.140	0.600	54.550	54.400	0.150	87.6	150	5.48	50.0
1.003	4	5	13.150	0.600	54.400	54.250	0.150	87.7	150	5.69	50.0
1.004	5	7	4.860	0.600	54.250	54.200	0.050	97.2	150	5.77	49.8
2.000	6	7	30.141	0.600	55.050	54.750	0.300	100.5	150	5.50	50.0
1.005	7	10	9.416	0.600	54.200	54.100	0.100	94.2	150	5.92	49.2

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	1.051	18.6	0.9	0.750	0.833	0.007	0.0	23	0.551
1.001	1.078	19.1	2.3	0.833	0.950	0.017	0.0	35	0.733
1.002	1.074	19.0	3.0	0.950	1.100	0.022	0.0	40	0.785
1.003	1.074	19.0	3.5	1.100	1.154	0.026	0.0	44	0.822
1.004	1.019	18.0	3.5	1.154	1.039	0.026	0.0	45	0.791
2.000	1.002	17.7	2.2	0.600	0.489	0.016	0.0	35	0.681
1.005	1.036	18.3	5.6	1.039	1.285	0.042	0.0	57	0.913

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
3.000	8	9	7.271	0.600	54.675	54.600	0.075	96.9	150	5.12	50.0
3.001	9	10	4.361	0.600	54.600	54.550	0.050	87.2	150	5.19	50.0
1.006	10	12	4.019	0.600	54.100	54.000	0.100	40.2	150	5.96	49.0
4.000	11	12	27.063	0.600	54.400	54.000	0.400	67.7	150	5.37	50.0
1.007	12	16	6.566	0.600	54.000	53.925	0.075	87.5	150	6.06	48.6
5.000	13	16	28.890	0.600	54.225	53.925	0.300	96.3	150	5.47	50.0
6.000	14	15	7.480	0.600	54.650	54.575	0.075	99.7	150	5.12	50.0
6.001	15	16	8.429	0.600	54.575	54.475	0.100	84.3	150	5.25	50.0
1.008	16	17	8.546	0.600	53.925	53.825	0.100	85.5	150	6.19	48.2
1.009	17	17_OUT	9.999	0.600	53.825	53.725	0.100	100.0	150	6.36	47.6

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
3.000	1.021	18.0	0.7	0.573	0.613	0.005	0.0	20	0.482
3.001	1.077	19.0	0.7	0.613	0.835	0.005	0.0	20	0.509
1.006	1.592	28.1	6.2	1.285	1.515	0.047	0.0	48	1.281
4.000	1.224	21.6	2.0	1.222	1.515	0.015	0.0	31	0.766
1.007	1.075	19.0	8.2	1.515	1.562	0.062	0.0	69	1.036
5.000	1.024	18.1	5.1	1.265	1.562	0.038	0.0	55	0.884
6.000	1.006	17.8	0.8	0.600	0.962	0.006	0.0	22	0.511
6.001	1.095	19.4	0.8	0.962	1.012	0.006	0.0	21	0.537
1.008	1.088	19.2	15.8	1.562	1.611	0.121	0.0	104	1.212
1.009	1.005	17.8	15.6	1.611	1.605	0.121	0.0	109	1.131

Simulation Settings

Rainfall Methodology	FEH-13	Analysis Speed	Normal	Additional Storage (m³/ha)	20.0
Summer CV	0.750	Skip Steady State	✓	Check Discharge Rate(s)	x
Winter CV	0.840	Drain Down Time (mins)	480	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160
30	120	240	480	720	1440	2880

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

Node 17 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	53.825	Product Number	CTL-SHE-0061-2000-1500-2000
Design Depth (m)	1.500	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	2.0	Min Node Diameter (mm)	1200

Node 1 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	55.100	Slope (1:X)	200.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	116	Depth (m)	0.400
Safety Factor	2.0	Width (m)	3.000	Inf Depth (m)	
Porosity	0.30	Length (m)	4.000		

Node 2 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	55.100	Slope (1:X)	200.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	112	Depth (m)	0.400
Safety Factor	2.0	Width (m)	4.500	Inf Depth (m)	
Porosity	0.30	Length (m)	6.500		

Node 3 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	55.100	Slope (1:X)	200.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	108	Depth (m)	0.400
Safety Factor	2.0	Width (m)	4.500	Inf Depth (m)	
Porosity	0.30	Length (m)	10.000		

Node 13 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	55.100	Slope (1:X)	200.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	92	Depth (m)	0.400
Safety Factor	2.0	Width (m)	7.000	Inf Depth (m)	
Porosity	0.30	Length (m)	20.000		

Node 16 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	55.100	Slope (1:X)	200.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	100	Depth (m)	0.400
Safety Factor	2.0	Width (m)	12.000	Inf Depth (m)	
Porosity	0.30	Length (m)	14.000		

Node 16 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	53.925
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	532

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	24.0	0.0	0.800	24.0	0.0	0.801	0.0	0.0

Results for 2 year Critical Storm Duration. Lowest mass balance: 97.62%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	10	54.773	0.023	1.0	0.0102	0.0000	OK
15 minute winter	2	10	54.686	0.036	2.4	0.0176	0.0000	OK
15 minute winter	3	10	54.591	0.041	3.0	0.0152	0.0000	OK
15 minute winter	4	11	54.444	0.044	3.5	0.0154	0.0000	OK
15 minute winter	5	11	54.299	0.049	3.5	0.0139	0.0000	OK
15 minute winter	6	11	55.085	0.035	2.2	0.0252	0.0000	OK
15 minute winter	7	11	54.260	0.060	5.6	0.0170	0.0000	OK
15 minute winter	8	10	54.695	0.020	0.7	0.0085	0.0000	OK
15 minute winter	9	11	54.620	0.020	0.7	0.0056	0.0000	OK
120 minute winter	10	94	54.202	0.102	2.2	0.0288	0.0000	OK
15 minute winter	11	10	54.431	0.031	2.0	0.0153	0.0000	OK
120 minute winter	12	94	54.201	0.201	4.0	0.0570	0.0000	SURCHARGED
15 minute winter	13	10	54.279	0.054	5.2	0.0909	0.0000	OK
15 minute winter	14	10	54.672	0.022	0.8	0.0099	0.0000	OK
15 minute winter	15	11	54.596	0.021	0.8	0.0060	0.0000	OK
120 minute winter	16	94	54.201	0.276	5.6	6.6588	0.0000	SURCHARGED
120 minute winter	17	94	54.200	0.375	2.8	0.4245	0.0000	SURCHARGED
15 minute summer	17_OUT	1	53.725	0.000	1.6	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	1.000	2	1.0	0.393	0.052	0.0229	
15 minute winter	2	1.001	3	2.3	0.651	0.121	0.0309	
15 minute winter	3	1.002	4	3.0	0.724	0.156	0.0537	
15 minute winter	4	1.003	5	3.5	0.749	0.184	0.0614	
15 minute winter	5	1.004	7	3.5	0.599	0.193	0.0282	
15 minute winter	6	2.000	7	2.1	0.677	0.120	0.0951	
15 minute winter	7	1.005	10	5.6	0.915	0.304	0.0573	
15 minute winter	8	3.000	9	0.7	0.488	0.037	0.0099	
15 minute winter	9	3.001	10	0.7	0.494	0.035	0.0058	
120 minute winter	10	1.006	12	3.5	0.706	0.124	0.0610	
15 minute winter	11	4.000	12	2.0	0.544	0.091	0.2299	
120 minute winter	12	1.007	16	2.8	0.501	0.146	0.1156	
15 minute winter	13	5.000	16	5.1	0.944	0.283	0.3171	
15 minute winter	14	6.000	15	0.8	0.514	0.045	0.0117	
15 minute winter	15	6.001	16	0.8	0.534	0.041	0.0126	
120 minute winter	16	1.008	17	2.8	0.326	0.143	0.1505	
120 minute winter	17	Hydro-Brake®	17_OUT	1.6				16.1

Results for 30 year Critical Storm Duration. Lowest mass balance: 97.62%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	10	54.787	0.037	2.5	0.0162	0.0000	OK
120 minute winter	2	118	54.766	0.116	1.9	0.0565	0.0000	OK
120 minute winter	3	118	54.766	0.216	2.5	0.0809	0.0000	SURCHARGED
120 minute winter	4	118	54.766	0.366	2.9	0.1271	0.0000	SURCHARGED
120 minute winter	5	118	54.766	0.516	2.9	0.1462	0.0000	SURCHARGED
15 minute winter	6	10	55.109	0.059	5.8	0.0418	0.0000	OK
120 minute winter	7	118	54.766	0.566	4.3	0.1603	0.0000	SURCHARGED
120 minute winter	8	118	54.766	0.091	0.6	0.0384	0.0000	OK
120 minute winter	9	118	54.766	0.166	0.6	0.0471	0.0000	SURCHARGED
120 minute winter	10	118	54.766	0.666	4.5	0.1886	0.0000	SURCHARGED
120 minute winter	11	118	54.766	0.366	1.7	0.1836	0.0000	SURCHARGED
120 minute winter	12	118	54.766	0.766	5.6	0.2168	0.0000	SURCHARGED
120 minute winter	13	118	54.766	0.541	4.2	0.9025	0.0000	SURCHARGED
120 minute winter	14	118	54.766	0.116	0.7	0.0514	0.0000	OK
120 minute winter	15	118	54.766	0.191	0.8	0.0541	0.0000	SURCHARGED
120 minute winter	16	118	54.766	0.841	10.8	19.3498	0.0000	SURCHARGED
120 minute winter	17	118	54.765	0.940	2.3	1.0632	0.0000	SURCHARGED
15 minute summer	17_OUT	1	53.725	0.000	1.6	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	1.000	2	2.5	0.493	0.134	0.0466	
120 minute winter	2	1.001	3	1.9	0.623	0.100	0.1403	
120 minute winter	3	1.002	4	2.5	0.702	0.132	0.2313	
120 minute winter	4	1.003	5	2.9	0.731	0.153	0.2315	
120 minute winter	5	1.004	7	2.6	0.573	0.144	0.0856	
15 minute winter	6	2.000	7	5.6	0.883	0.314	0.1906	
120 minute winter	7	1.005	10	4.0	0.823	0.218	0.1658	
120 minute winter	8	3.000	9	0.6	0.466	0.033	0.1048	
120 minute winter	9	3.001	10	0.6	0.480	0.032	0.0768	
120 minute winter	10	1.006	12	3.9	0.709	0.139	0.0708	
120 minute winter	11	4.000	12	1.7	0.394	0.079	0.4764	
120 minute winter	12	1.007	16	4.8	0.665	0.255	0.1156	
120 minute winter	13	5.000	16	3.7	0.680	0.202	0.5086	
120 minute winter	14	6.000	15	0.7	0.492	0.039	0.1206	
120 minute winter	15	6.001	16	0.7	0.515	0.036	0.1484	
120 minute winter	16	1.008	17	2.3	0.392	0.122	0.1505	
120 minute winter	17	Hydro-Brake®	17_OUT	1.6				38.6

Results for 100 year Critical Storm Duration. Lowest mass balance: 97.62%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
120 minute winter	1	118	55.149	0.399	1.0	0.3153	0.0000	SURCHARGED
120 minute winter	2	118	55.149	0.499	2.4	0.5273	0.0000	SURCHARGED
120 minute winter	3	118	55.149	0.599	3.1	0.5473	0.0000	SURCHARGED
120 minute winter	4	118	55.149	0.749	3.7	0.2598	0.0000	SURCHARGED
120 minute winter	5	118	55.149	0.899	3.3	0.2543	0.0000	SURCHARGED
120 minute winter	6	118	55.149	0.099	2.2	0.0699	0.0000	OK
120 minute winter	7	118	55.149	0.949	4.6	0.2685	0.0000	FLOOD RISK
120 minute winter	8	118	55.148	0.473	0.7	0.1993	0.0000	FLOOD RISK
120 minute winter	9	118	55.148	0.548	0.9	0.1552	0.0000	FLOOD RISK
120 minute winter	10	118	55.148	1.048	4.8	0.2967	0.0000	SURCHARGED
120 minute winter	11	120	55.148	0.748	2.1	0.3748	0.0000	SURCHARGED
120 minute winter	12	118	55.148	1.148	6.3	0.3249	0.0000	SURCHARGED
120 minute winter	13	118	55.148	0.923	5.3	2.0309	0.0000	SURCHARGED
120 minute winter	14	118	55.148	0.498	1.5	0.2206	0.0000	FLOOD RISK
120 minute winter	15	118	55.148	0.573	1.1	0.1621	0.0000	SURCHARGED
120 minute winter	16	118	55.148	1.223	12.7	20.6776	0.0000	SURCHARGED
120 minute winter	17	118	55.147	1.322	2.4	1.4947	0.0000	SURCHARGED
15 minute summer	17_OUT	1	53.725	0.000	1.6	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
120 minute winter	1	1.000	2	1.0	0.402	0.054	0.1612	
120 minute winter	2	1.001	3	2.4	0.664	0.128	0.1531	
120 minute winter	3	1.002	4	3.1	0.726	0.163	0.2313	
120 minute winter	4	1.003	5	3.3	0.707	0.175	0.2315	
120 minute winter	5	1.004	7	2.7	0.571	0.152	0.0856	
120 minute winter	6	2.000	7	2.2	0.682	0.124	0.4503	
120 minute winter	7	1.005	10	4.1	0.814	0.225	0.1658	
120 minute winter	8	3.000	9	0.7	0.496	0.039	0.1280	
120 minute winter	9	3.001	10	-0.9	0.503	-0.048	0.0768	
120 minute winter	10	1.006	12	4.5	0.698	0.158	0.0708	
120 minute winter	11	4.000	12	2.0	0.452	0.092	0.4764	
120 minute winter	12	1.007	16	5.4	0.692	0.283	0.1156	
120 minute winter	13	5.000	16	4.6	0.714	0.254	0.5086	
120 minute winter	14	6.000	15	-0.9	0.516	-0.049	0.1317	
120 minute winter	15	6.001	16	-0.9	0.535	-0.046	0.1484	
120 minute winter	16	1.008	17	2.4	0.407	0.124	0.1505	
120 minute winter	17	Hydro-Brake®	17_OUT	1.9				49.0

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 97.62%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute winter	1	176	55.298	0.548	1.1	0.9196	0.0000	SURCHARGED
180 minute winter	2	176	55.298	0.648	2.4	1.8985	0.0000	SURCHARGED
180 minute winter	3	176	55.298	0.748	3.1	2.6237	0.0000	SURCHARGED
180 minute winter	4	176	55.298	0.898	3.3	0.3117	0.0000	SURCHARGED
180 minute winter	5	176	55.298	1.048	2.6	0.2967	0.0000	FLOOD RISK
180 minute winter	6	176	55.298	0.248	2.9	0.1760	0.0000	SURCHARGED
180 minute winter	7	176	55.298	1.098	4.2	0.3108	0.0000	FLOOD RISK
180 minute winter	8	176	55.298	0.623	0.7	0.2623	0.0000	FLOOD RISK
180 minute winter	9	176	55.298	0.698	1.5	0.1975	0.0000	FLOOD RISK
180 minute winter	10	176	55.298	1.198	4.3	0.3390	0.0000	FLOOD RISK
180 minute winter	11	176	55.298	0.898	2.1	0.4499	0.0000	SURCHARGED
180 minute winter	12	176	55.298	1.298	5.5	0.3673	0.0000	SURCHARGED
180 minute winter	13	176	55.298	1.073	5.4	8.0027	0.0000	SURCHARGED
180 minute winter	14	176	55.297	0.647	2.3	0.2868	0.0000	FLOOD RISK
180 minute winter	15	176	55.297	0.722	3.2	0.2045	0.0000	SURCHARGED
180 minute winter	16	176	55.297	1.372	11.9	28.2368	0.0000	SURCHARGED
180 minute winter	17	176	55.296	1.471	4.3	1.6637	0.0000	FLOOD RISK
15 minute summer	17_OUT	1	53.725	0.000	1.7	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
180 minute winter	1	1.000	2	1.0	0.403	0.054	0.1612	
180 minute winter	2	1.001	3	2.4	0.650	0.125	0.1531	
180 minute winter	3	1.002	4	2.8	0.670	0.146	0.2313	
180 minute winter	4	1.003	5	2.6	0.663	0.139	0.2315	
180 minute winter	5	1.004	7	2.2	0.525	0.122	0.0856	
180 minute winter	6	2.000	7	2.3	0.689	0.130	0.5306	
180 minute winter	7	1.005	10	3.7	0.727	0.205	0.1658	
180 minute winter	8	3.000	9	0.7	0.465	0.038	0.1280	
180 minute winter	9	3.001	10	-1.4	0.480	-0.075	0.0768	
180 minute winter	10	1.006	12	3.9	0.614	0.139	0.0708	
180 minute winter	11	4.000	12	2.0	0.453	0.091	0.4764	
180 minute winter	12	1.007	16	5.0	0.646	0.265	0.1156	
180 minute winter	13	5.000	16	4.6	0.641	0.252	0.5086	
180 minute winter	14	6.000	15	-1.4	0.516	-0.079	0.1317	
180 minute winter	15	6.001	16	-3.2	0.510	-0.164	0.1484	
180 minute winter	16	1.008	17	4.3	0.409	0.222	0.1505	
180 minute winter	17	Hydro-Brake®	17_OUT	2.0				65.4

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Important consumer protection information

This search has been produced by GeoSmart Information Limited, New Zealand House, 160-162 Abbey Foregate, Shrewsbury, SY2 6FD.

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The Search Code:

- provides protection for homebuyers, sellers, estate agents, conveyancers and mortgage lenders who rely on the information included in property search reports undertaken by subscribers on residential and commercial property within the United Kingdom
- sets out minimum standards which firms compiling and selling search reports have to meet
- promotes the best practice and quality standards within the industry for the benefit of consumers and property professionals
- enables consumers and property professionals to have confidence in firms which subscribe to the code, their products and services.
- By giving you this information, the search firm is confirming that they keep to the principles of the Code. This provides important protection for you.

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Firms which subscribe to the Search Code will:

- display the Search Code logo prominently on their search reports
- act with integrity and carry out work with due skill, care and diligence
- at all times maintain adequate and appropriate insurance to protect consumers
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- monitor their compliance with the Code

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If you have a query or complaint about your search, you should raise it directly with the search firm, and if appropriate ask for any complaint to be considered under their formal internal complaints procedure. If you remain dissatisfied with the firm's final response, after your complaint has been formally considered, or if the firm has exceeded the response timescales, you may refer your complaint for consideration under The Property Ombudsman scheme (TPOs). The Ombudsman can award compensation of up to £5,000 to you if he finds that you have suffered actual loss as a result of your search provider failing to keep to the Code.

Please note that all queries or complaints regarding your search should be directed to your search provider in the first instance, not to TPOs or to the PCCB.

TPOs contact details:

The Property Ombudsman scheme
Milford House
43-55 Milford Street
Salisbury
Wiltshire SP1 2BP
Tel: 01722 333306
Fax: 01722 332296
Email: admin@tpos.co.uk

You can get more information about the PCCB from www.propertycodes.org.uk.

Please ask your search provider if you would like a copy of the search code

Complaints procedure

GeoSmart Information Limited is registered with the Property Codes Compliance Board as a subscriber to the Search Code. A key commitment under the Code is that firms will handle any complaints both speedily and fairly.

If you want to make a complaint, we will:

- Acknowledge it within 5 working days of receipt.
- Normally deal with it fully and provide a final response, in writing, within 20 working days of receipt.
- Keep you informed by letter, telephone or e-mail, as you prefer, if we need more time.
- Provide a final response, in writing, at the latest within 40 working days of receipt.
- Liaise, at your request, with anyone acting formally on your behalf.

If you are not satisfied with our final response, or if we exceed the response timescales, you may refer the complaint to The Property Ombudsman scheme (TPOs): Tel: 01722 333306, E-mail: admin@tpos.co.uk.

We will co-operate fully with the Ombudsman during an investigation and comply with his final decision.

Complaints should be sent to:

Lisa Davies
Operations Manager

GeoSmart Information Limited
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160 Abbey Foregate
Shrewsbury
SY2 6FD

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lisadavies@geosmartinfo.co.uk