Drainage Strategy

Garage Site between 26 & 28 Ash Grove, Harefield, UB9 6EX

Reference: 481 -Rev - V1

Date: May-24

Appendices

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Purpose of this report

1.1 The purpose of this statement is to accompany the technical drawings and details showing the proposed Surface Water drainage system as part of the planning application for this development.

Site Characteristics

2.1 The site background is clearly identified through answers to the questions in table 1 below.

Table 1: Site Characteristics . See appendix B for support documentation

TOPIC	QUESTION	ANSWER
Protected species or habitat	Is the site near to designated sites and priority habitats?	No
Flood Plain	Is the site located in the flood plain?	No
Soils and Geology	Soil permeability? - See appendix B for results	No
Space constraints	Space for SuDS components?	Yes
Topography	Sited on a flat site?	Yes
	Sited on a steep slope (5-15%)	No
	Sited on a very steep slope (>15%)	No
Groundwater	Is the site at groundwater flood risk?	No
Contaminated land	Are there contaminated soils on site?	Unknown
Source Protection Zone	Is the site within a SPZ 3?	No
Runoff characteristics	Is the development in a high risk flooding area?	No

Existing and Proposed Site

2.2 The distribution of catchment areas for existing and proposed site is as per table 2 below. See appendix A for details

Table 2 : Existing and Proposed catchment areas in hectares

Description		Existing Site	Proposed Site
Impermeable Areas		0.027	0.010
Permeable Areas	Connected to Drainage	0.000	0.006
	Self Draining Areas	0.000	0.000
Areas Draining Away from drainage System		0.000	0.011
	Total Development Area	0.027	0.027

2.3 It has been assumed that the positively drained areas will have different runoff coefficients depending on the type of surface as follow:

Impermeable Surface	1.0
Permeable Surfaces	0.5
Grass Areas	0.3

Evaluation of Discharge Point

3.1 The SuDS design takes into account Building Regulations Section H3 and the National Planning Practice Guidance. The aim is to discharge surface water run-off as high up the drainage hierarchy, as reasonably practicable:

1. into the ground (infiltration);
2. to a surface water body;
3. to a surface water sewer, highway drain, or another drainage system;
4. to a combined sewer.

3.2 The discharge point has been evaluated following the NPPG and Building regulations. The findings are in table 3 below.

Table 3: Drainage Hierarchy evaluation

Superficial geology classification	The British Geological Society records show that the superficial deposits are Gerrards Cross Gravel - Sand and Gravel.
Bedrock geology classification	The British Geological Society records of the site show that it is located within the London Clay Formation - Clay, Silt and Sand.
Landis Top Soil Infiltration	The SOILSCAPE's records of the site show that it is located within an area of impeded drainage soils.
Groundwater	The British Geological Survey's flood risk susceptibility maps show that the development has potential for groundwater flooding below ground level. Groundwater levels would tend to vary seasonally and are influenced by ground and meteorological conditions and proximity to water features.
Is infiltration feasible?	Infiltration is not possible on this site due to the findings on groundwater and soils within the site.
Is a discharge to a watercourse possible?	There are no watercourses in the proximity to the site.
Is a discharge to a surface water sewer possible?	There is a surface water sewer in the proximity to the site. It is possible to connect to the surface water sewer.
Is a discharge to a combined sewer possible?	There is no combined water sewers in the proximity to the site.

Existing and Proposed Peak Run-off Calculations

4.1 The current site is a Brownfield. The peak runoff rate for the existing site was calculated as per table 4 and discharge rates as per table 5.

Table 4: Peak run-off rate calculation method for existing site

Method Used	Calculation Method
	Report 124 Flood Estimation for Small Catchments method has been used to estimate the site peak flow rates
X	This is a brownfield site, runoff rates are calculated in accordance with best practice simulation modelling and using the modified rational method
	This is a brownfield site where the pre-development drainage isn't known. The runoff rates are calculated using the Greenfield model with soil type 5

4.2 The runoff flow produced by the development will be controlled as per table 5.

Table 5: Runoff discharge rate control

Control Used	Description of runoff discharge
	Water will be discharged into the ground via a SuDS as described in table 6 below
	The peak discharge rate has been reduced to Greenfield Qbar flow
	The peak discharge rate has been taken as 0.7 l/s as it is not possible to reduce it to the Greenfield Qbar rate
	The peak discharge rate has been reduced to Brownfield pre-development 1 in 1 flow
X	The peak discharge rate has been reduced by 60% from the existing Brownfield pre-development 1 in 2 flow rate

Run-off flows

4.3 The size of the SuDS has been calculated for all events up to the 1 in 100 including an allowance for climate change of 40%. As per tables above, it is proposed to discharge at a rate of 2.52 l/s. See table 6 for values and appendix C for calculations.

Table 6: Peak discharge rates for SuDS

Return Period Event	Discharge Rate (l/s)			Infiltration Rate (m/hr)
	Existing Greenfield	Existing Brownfield	Proposed	
Qbar	0.10	N/A	N/A	0.0000
1 in 1	0.10	4.90	2.5	0.0000
1 in 2	0.10	6.30	2.5	0.0000
1 in 30	0.30	11.70	2.5	0.0000
1 in 30 + CC	N/A	N/A	2.5	0.0000
1 in 100	0.40	14.90	2.5	0.0000
1 in 100 + CC	N/A	N/A	2.5	0.0000

Proposed Sustainable Drainage System

5.1 The following sustainable drainage systems have been used for this site. The drainage design uses these drainage system through out the site. See table 7 for details.

Table 7: Proposed Drainage System

SuDS Proposed	Feasible	Proposed
Use of green roofs	No	No
Store rainwater for later use	No	No
Use infiltration techniques, for instance soakaways, permeable surfaces	No	No
Attenuate rainwater in ponds or open water features for gradual release	No	No
Attenuate rainwater by storing in tanks or sealed water features for gradual release	Yes	Yes
Discharge Point Proposed		
Discharge rainwater direct to a watercourse	No	No
Discharge rainwater to a surface water sewer/drain	Yes	Yes
Discharge rainwater to the combined sewer	No	No

5.2 The location and details of the SuDS can be seen drainage layouts in appendix D. Calculations are in appendix C.

5.3 The drainage calculations demonstrate:
- No flooding occurs for the 1 in 30 storm events.
- Any flooding for the 1 in 100 year + 40% climate change event can be safely contained on site

5.4 The proposed drainage strategy presents one possible solution to demonstrate that the development can be sustainably drained, to comply with the requirements of the NPPF. Other solutions may be feasible and may prove to be better suited to the site. These will become apparent during the detailed design stage. The strategy above should not therefore be interpreted as the definitive scheme solution.

Management of Exceedance Flows

5.5 The drainage network has been designed to attenuate surface runoff for all events up to and including the 1% AEP + CC(1 in 100 years). However consideration has been given to what may happen when the design capacity of the surface water drainage network is exceeded. Surface water will flow to the lowest points within the site. The flood risk to the buildings would therefore remain low. See appendix D.

Maintenance and Management plan responsibility

6.1 The SuDS will be maintained by The Owner the property

Maintenance and Management plan for proposed SuDS

6.2 The maintenance and Management Plan Guidance from the SuDS Manual, CIRIA C753 (CIRIA, 2015) is to be followed for the effective maintenance of the proposed SuDS techniques outlined above. The maintenance for SuDS structures are as follow:

INLETS, OUTLETS, CONTROLS AND INSPECTION CHAMBERS	
Regular Maintenance	**Frequency**
Inlets, outlets and surface control structures	
Inspect surface structures removing obstructions and silt as necessary. Check there is no physical damage.	Monthly
Strim vegetation 1m min. surround to structures and keep hard aprons free from silt and debris	Monthly
Inspection chambers and below ground control chambers	
Remove cover and inspect ensuring water is flowing freely and that the exit route for water is unobstructed. Remove debris and silt. Undertake inspection after leaf fall in autumn	Annually
Occasional Maintenance	
Check topsoil levels are 20mm above edges of baskets and chambers to avoid mower damage	As necessary
Remedial work	**Frequency**
Unpack stone in basket features and unblock or repair and repack stone as design detail as necessary.	As required
Repair physical damage if necessary.	As required

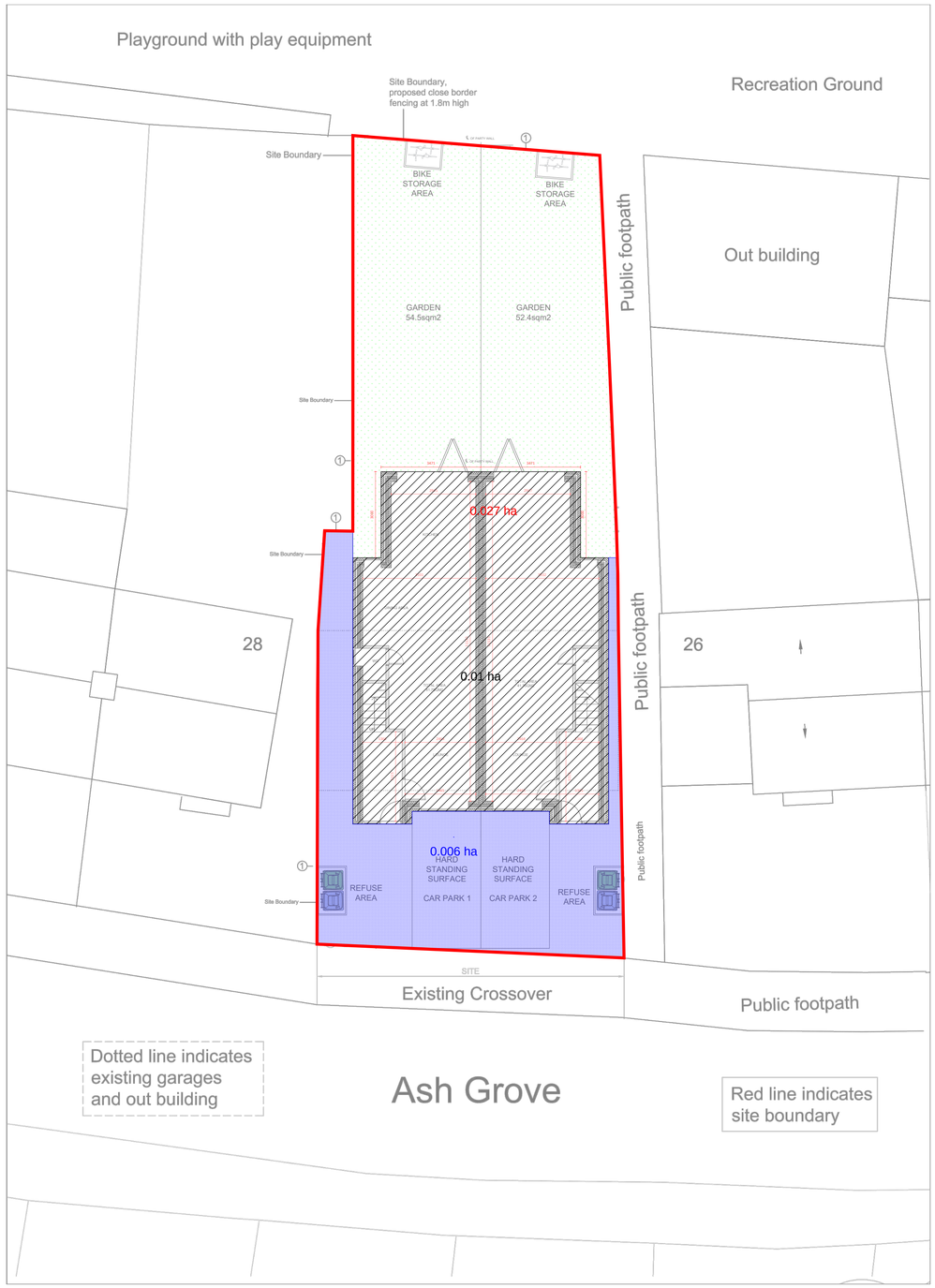
Operation and maintenance requirements for attenuation storage tanks

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then annually
	Remove debris from the catchment surface (where it may cause risks to performance)	Monthly
	For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae or other matter; remove and replace surface infiltration medium as necessary.	Annually
	Remove sediment from pre-treatment structures and/ or internal forebays	Annually, or as required
Remedial actions	Repair/rehabilitate inlets, outlet, overflows and vents	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually
	Survey inside of tank for sediment build-up and remove if necessary	Every 5 years or as required

Operation and maintenance requirements for pervious pavements		
Maintenance schedule	**Required action**	**Typical frequency**
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphospate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48 h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

Appendix A

EXISTING SITE 1:100



PROPOSED SITE 1:100

Drawing Scale Bar

Drawing scale	Line length	Drawing scale	Line length
1:5 =	0.25 metres	1:200 =	10.0 metres
1:10 =	0.5 metres	1:250 =	12.5 metres
1:20 =	1.0 metres	1:500 =	25.0 metres
1:25 =	1.25 metres	1:1000 =	50.0 metres
1:50 =	2.5 metres	1:1250 =	62.5 metres
1:100 =	5.0 metres	1:2500 =	125 metres

Measure length of line above for checking of scale

GENERAL NOTES

KEY

PERMEABLE AREAS

IMPERMEABLE AREAS

STUDY AREA

Rev	Details	Date	By	Chd

Drawing Status:
PRELIMINARY

URBANWATER

Client:

Project:
Garage Site between 26 & 28 Ash Grove, Harefield, UB9 6EX

Drawing:
Existing and Proposed Areas
Permeable and Impermeable

Print Size:	Project No:	Drawing No:	Revision:
A1	0481	002	P1

Appendix B

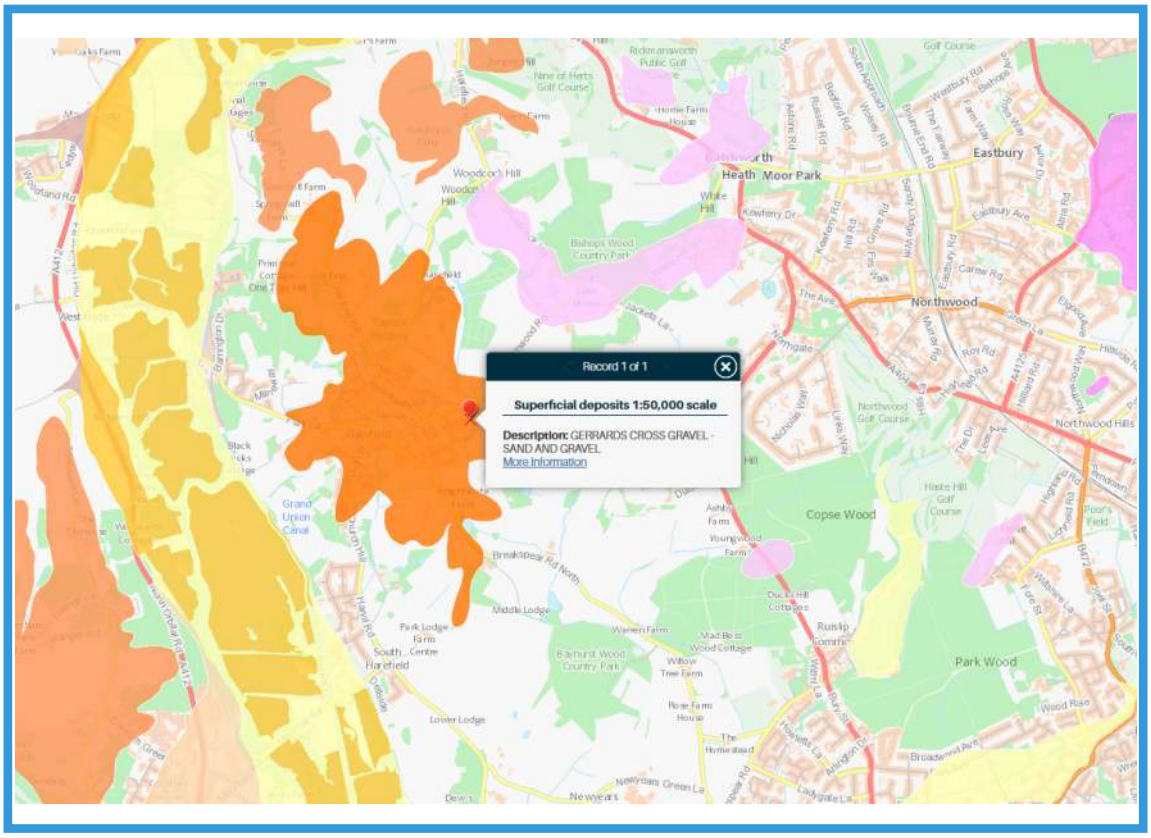
SITE GEOLOGY

GEOINDEX ONSHORE

GEOLOGY - BEDROCK - LONDON CLAY FORMATION - CLAY, SILT AND SAND

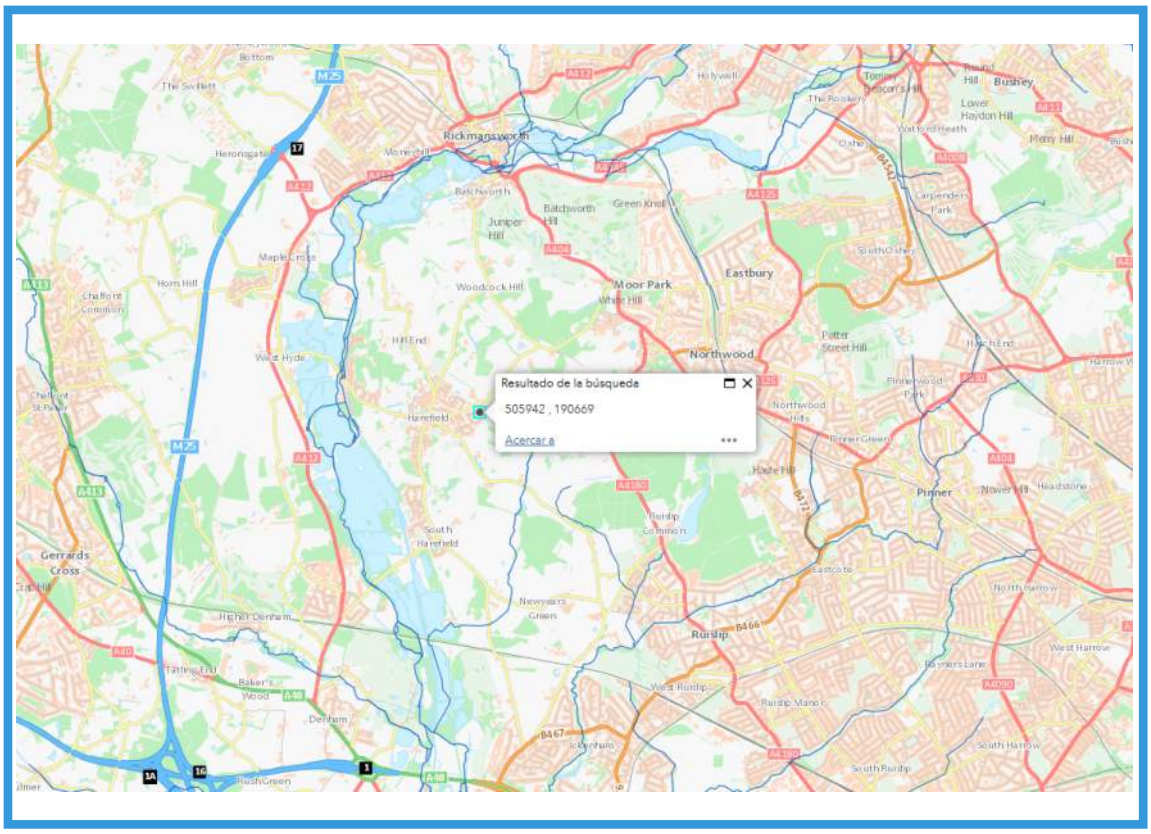
GEOINDEX ONSHORE

GEOLOGY - SUPERFICIAL DEPOSITS - GERRARDS CROSS GRAVEL - SAND AND GRAVEL



SITE HYDROGEOLOGY

Environment Agency Main River Map



SITE SURFACE WATER FLOOD RISK

Flood risk from surface water

Extent of flooding

High risk means a chance of flooding greater than 3.3% (1:30)
Medium risk means a chance of flooding of btw 1% (1:100) and 3.3%
Low risk means a chance of flooding of btw 0.1% (1:1000) and 1%
Flooding from surface water is difficult to predict as rainfall location and volume are difficult to forecast. In addition, local features can greatly affect the chance and severity of flooding

High risk
More than 3.3% chance each year

Medium risk
Between 1% and 3.3% chance each year

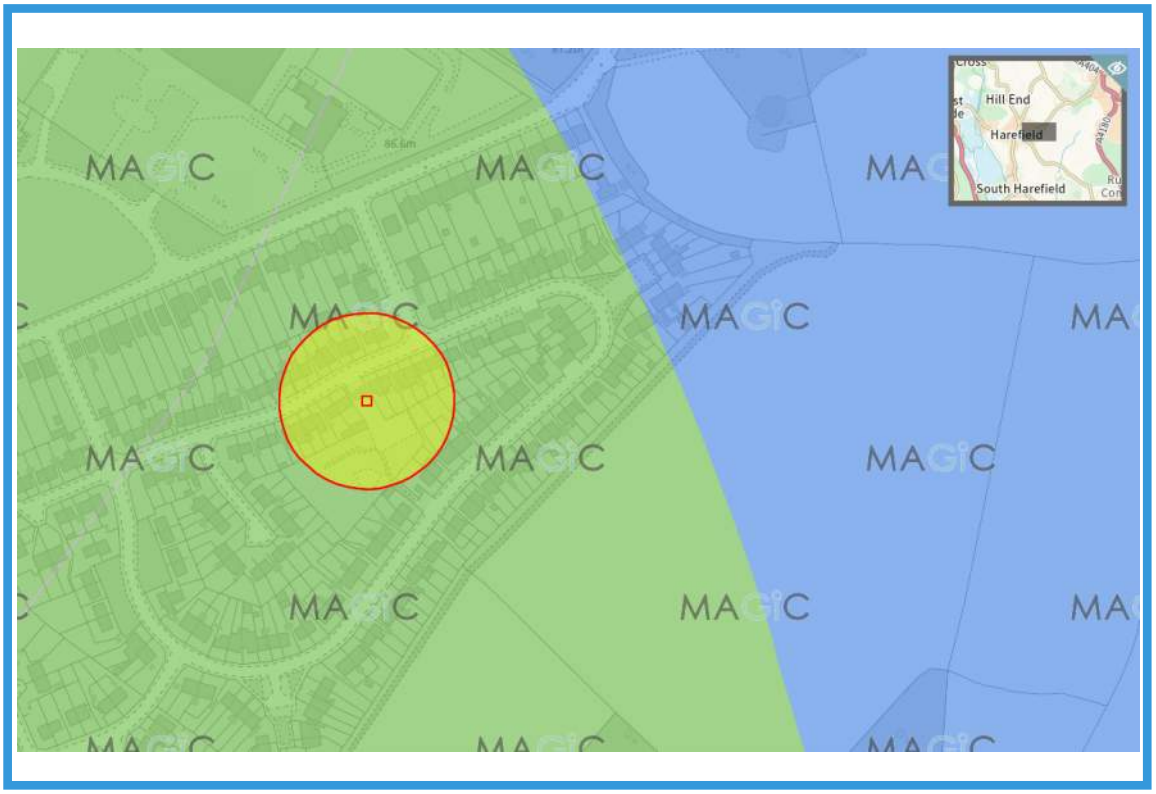
Low risk
Between 0.1% and 1% chance each year

Above 90cm

30cm to 90cm

Below 30cm

MAGIC RESULTS



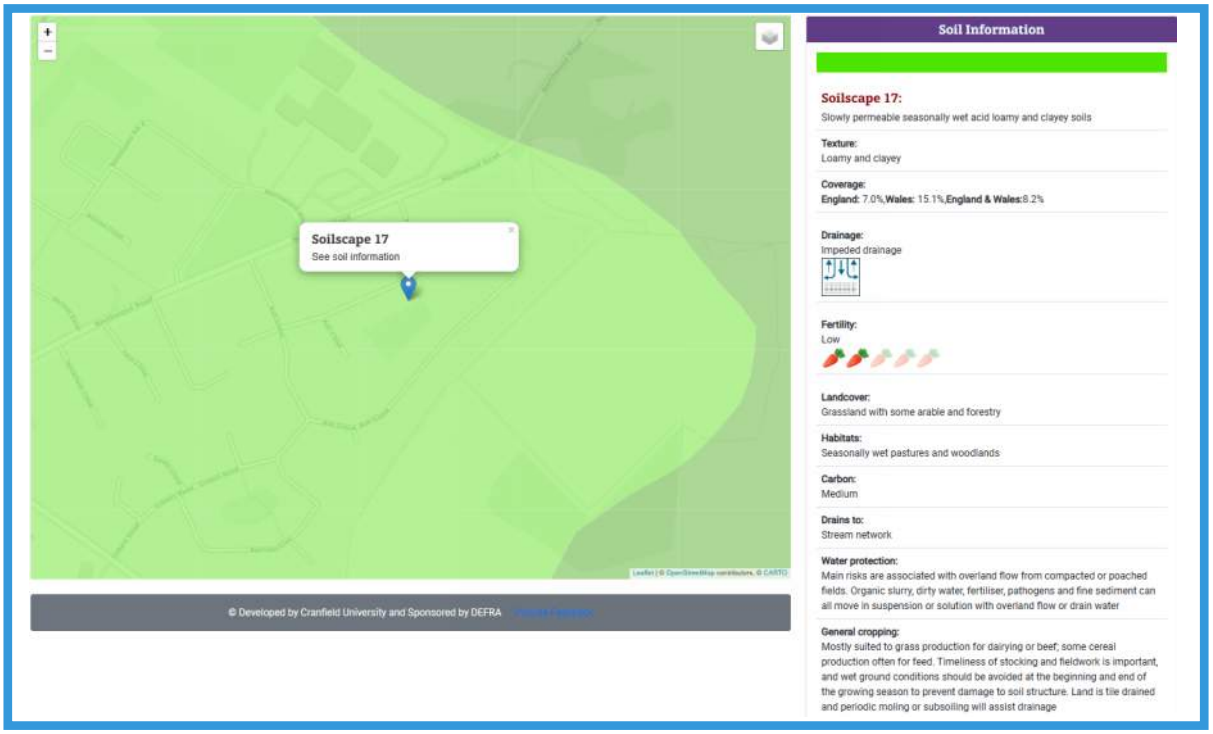
Site Check Results

Site Check Report Report generated on Wed Apr 10 2024
You selected the location: Centroid Grid Ref: TQ05939067
The following features have been found in your search area:

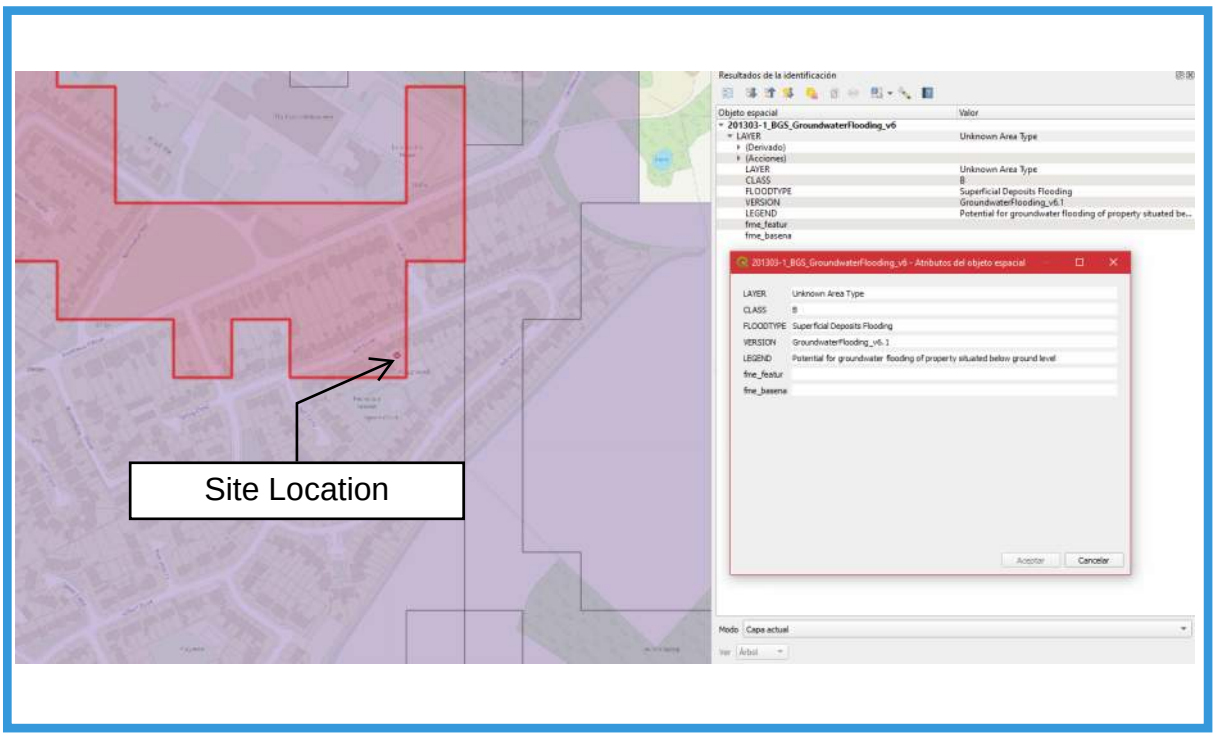
Source Protection Zones merged (England)	
Zone	3
Zone	2
Aquifer Designation Map (Bedrock) (England)	
Typology	Unproductive
Aquifer Designation Map (Superficial Drift) (England)	
Typology	Secondary A

OK Cancel Export to CSV Print

SOILSCAPES MAP



GROUND WATER FLOOD RISK



Flood map for planning

Your reference	Location (easting/northing)	Created
<Unspecified>	**505939/190671**	**10 Apr 2024 15:57**

Your selected location is in flood zone 1, an area with a low probability of flooding.

You will need to do a flood risk assessment if your site is **any of the following:**

- bigger that 1 hectare (ha)
- In an area with critical drainage problems as notified by the Environment Agency
- identified as being at increased flood risk in future by the local authority's strategic flood risk assessment
- at risk from other sources of flooding (such as surface water or reservoirs) and its development would increase the vulnerability of its use (such as constructing an office on an undeveloped site or converting a shop to a dwelling)

Notes

The flood map for planning shows river and sea flooding data only. It doesn't include other sources of flooding. It is for use in development planning and flood risk assessments.

This information relates to the selected location and is not specific to any property within it. The map is updated regularly and is correct at the time of printing.

Environment Agency

Flood map for planning

Your reference
<Unspecified>

Location (easting/northing)
505939/190671

Scale
1:2500

Created
10 Apr 2024 15:57

- Selected area
- Flood zone 3
- Flood zone 2
- Flood zone 1
- Flood defence
- Main river
- Water storage area

0 20 40 60m

Site Check Report Report generated on Wed Apr 10 2024
You selected the location: Centroid Grid Ref: TQ05949067
The following features have been found in your search area:

SSSI Impact Risk Zones - to assess planning applications for likely impacts on SSSIs/SACs/SPAs & Ramsar sites (England)

1. DOES PLANNING PROPOSAL FALL INTO ONE OR MORE OF THE CATEGORIES BELOW?	2. IF YES, CHECK THE CORRESPONDING DESCRIPTION(S) BELOW. LPA SHOULD CONSULT NATURAL ENGLAND ON LIKELY RISKS FROM THE FOLLOWING:
All Planning Applications	
Infrastructure	Pipelines and underground cables, pylons and overhead cables. Any transport proposal including road, rail and by water (excluding routine maintenance). Airports, helipads and other aviation proposals.
Wind & Solar Energy	
Minerals, Oil & Gas	Planning applications for quarries, including: new proposals, Review of Minerals Permissions (ROMP), extensions, variations to conditions etc. Oil & gas exploration/extraction.
Rural Non Residential	Large non residential developments outside existing settlements/urban areas where footprint exceeds 1ha.
Residential	
Rural Residential	Any residential development of 100 or more houses outside existing settlements/urban areas.
Air Pollution	Any industrial/agricultural development that could cause AIR POLLUTION (incl: industrial processes, livestock & poultry units with floorspace > 500m², slurry lagoons & digestate stores > 200m², manure stores > 250t).
Combustion	General combustion processes >20MW energy input. Incl: energy from waste incineration, other incineration, landfill gas generation plant, pyrolysis/gasification, anaerobic digestion, sewage treatment works, other incineration/ combustion.
Waste	Landfill. Incl: inert landfill, non-hazardous landfill, hazardous landfill.
Composting	Any composting proposal with more than 75000 tonnes maximum annual operational throughput. Incl: open windrow composting, in-vessel composting, anaerobic digestion, other waste management.
Discharges	Any discharge of water or liquid waste of more than 5m³/day to ground (ie to seep away) or to surface water, such as a beck or stream.
Water Supply	Large infrastructure such as warehousing / industry where total net additional gross internal floorspace following development is 1,000m² or more.
Notes 1	
Notes 2	
GUIDANCE - How to use the Impact Risk Zones	/Metadata_for_magic/SSSI IRZ User Guidance MAGIC.pdf

Source Protection Zones merged (England)

Zone	3
Zone	2

Aquifer Designation Map (Bedrock) (England)

Typology	Unproductive

Aquifer Designation Map (Superficial Drift) (England)

Typology	Secondary A

Soilscape (England)

Reference	17
Name	SLOWLY PERMEABLE SEASONALLY WET ACID LOAMY AND CLAYEY SOILS
Main Surface Texture Class	LOAMY
Natural Drainage Type	IMPEDED DRAINAGE
Natural Fertility	LOW
Characteristic Semi-natural Habitats	SEASONALLY WET PASTURES AND WOODLANDS MAINLY, BUT NOT EXCLUSIVELY, ON THE UPLAND FRINGE
Main Land Cover	GRASSLAND WITH SOME ARABLE AND FORESTRY
Hyperlink	/Metadata_for_magic/soilscape_summary.pdf

Areas of Outstanding Natural Beauty (England)
No Features found

Limestone Pavement Orders (England)
No Features found

Local Nature Reserves (England) - points
No Features found

Local Nature Reserves (England)
No Features found

Moorland Line (England)
No Features found

National Nature Reserves (England) - points
No Features found

National Nature Reserves (England)
No Features found

National Parks (England)
No Features found

Ramsar Sites (England) - points
No Features found

Ramsar Sites (England)
No Features found

Proposed Ramsar Sites (England) - points
No Features found

Proposed Ramsar Sites (England)
No Features found

Sites of Special Scientific Interest Units (England) - points
No Features found

Sites of Special Scientific Interest Units (England)
No Features found

Sites of Special Scientific Interest (England) - points
No Features found

Sites of Special Scientific Interest (England)
No Features found

Special Areas of Conservation (England) - points
No Features found

Special Areas of Conservation (England)
No Features found

Possible Special Areas of Conservation (England) - points
No Features found

Possible Special Areas of Conservation (England)
No Features found

Special Protection Areas (England) - points
No Features found

Special Protection Areas (England)
No Features found

Potential Special Protection Areas (England) - points
No Features found

Potential Special Protection Areas (England)
No Features found

Biosphere Reserves (England) - points
No Features found

Biosphere Reserves (England)
No Features found

Less Favoured Areas (England)
No Features found

Nitrate Vulnerable Zones 2017 Designations (England)
No Features found

Wild Bird General Licence Protected Sites Condition Zone (England)
No Features found

Appendix C

CAUSEWAY	Urban Water	File: Garage Site between 26 & Network: Storm Network Mario Mora 11/04/2024	Page 1

Simulation Settings

Rainfall Methodology	FSR	Drain Down Time (mins)	240
FSR Region	England and Wales	Additional Storage (m³/ha)	0.0
M5-60 (mm)	20.000	Check Discharge Rate(s)	✓
Ratio-R	0.400	1 year (l/s)	0.1
Summer CV	1.000	2 year (l/s)	0.1
Winter CV	1.000	30 year (l/s)	0.3
Analysis Speed	Normal	100 year (l/s)	0.4
Skip Steady State	x	Check Discharge Volume	x

Storm Durations

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

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
2	0	0	0
30	0	0	0
30	40	0	0
100	0	0	0
100	40	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	2.40
Greenfield Method	IH124	Growth Factor 100 year	3.19
Positively Drained Area (ha)	0.027	Betterment (%)	0
SAAR (mm)	669	QBar	0.1
Soil Index	4	Q 1 year (l/s)	0.1
SPR	0.47	Q 2 year (l/s)	0.1
Region	6	Q 30 year (l/s)	0.3
Growth Factor 1 year	0.85	Q 100 year (l/s)	0.4
Growth Factor 2 year	0.88		

CAUSEWAY	Urban Water	File: Garage Site between 26 & Network: Storm Network Mario Mora 11/04/2024	Page 1

Simulation Settings

Rainfall Methodology	FSR	Drain Down Time (mins)	240
FSR Region	England and Wales	Additional Storage (m³/ha)	0.0
M5-60 (mm)	20.000	Check Discharge Rate(s)	✓
Ratio-R	0.400	1 year (l/s)	4.9
Summer CV	1.000	2 year (l/s)	6.3
Winter CV	1.000	30 year (l/s)	11.7
Analysis Speed	Normal	100 year (l/s)	14.9
Skip Steady State	x	Check Discharge Volume	x

Storm Durations

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

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
2	0	0	0
30	0	0	0
30	40	0	0
100	0	0	0
100	40	0	0

Pre-development Discharge Rate

Site Makeup	Brownfield	Betterment (%)	0
Brownfield Method	MRM	Q 1 year (l/s)	4.9
Contributing Area (ha)	0.027	Q 2 year (l/s)	6.3
PIMP (%)	100	Q 30 year (l/s)	11.7
CV	1.000	Q 100 year (l/s)	14.9
Time of Concentration (mins)	6.00		

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	2	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Inverts
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	1.200
CV	1.000	Include Intermediate Ground	✓
Time of Entry (mins)	6.00	Enforce best practice design rules	✓

Circular Link Type

Shape	Circular	Auto Increment (mm)	75
Barrels	1	Follow Ground	x

Available Diameters (mm)

100 | 150

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
RE1	0.006	6.00	86.750	450	-0.078	0.090	0.500
RE2	0.006	6.00	86.750	450	0.000	20.080	0.500
Perm Surf Atten	0.003	6.00	86.650		20.023	19.826	0.500
Tank			86.600		19.794	9.410	1.100
Outfall			86.550	450	29.957	9.427	1.200

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	RE1	Tank	20.000	0.600	86.250	85.500	0.750	26.7	100	6.22	50.0
2.000	RE2	Tank	20.000	0.600	86.250	85.500	0.750	26.7	100	6.22	50.0
3.000	Perm Surf Atten	Tank	10.000	0.600	86.150	85.500	0.650	15.4	100	6.08	50.0
1.001	Tank	Outfall	10.000	0.600	85.500	85.350	0.150	66.7	100	6.40	50.0

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	1.500	11.8	1.1	0.400	1.000	0.006	0.0	21	0.938
2.000	1.500	11.8	1.1	0.400	1.000	0.006	0.0	21	0.938
3.000	1.979	15.5	0.5	0.400	1.000	0.003	0.0	13	0.920
1.001	0.944	7.4	2.7	1.000	1.100	0.015	0.0	42	0.870

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	20.000	26.7	100	Circular	86.750	86.250	0.400	86.600	85.500	1.000
2.000	20.000	26.7	100	Circular	86.750	86.250	0.400	86.600	85.500	1.000
3.000	10.000	15.4	100	Circular	86.650	86.150	0.400	86.600	85.500	1.000
1.001	10.000	66.7	100	Circular	86.600	85.500	1.000	86.550	85.350	1.100

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	RE1	450	Manhole	Adoptable	Tank		Junction	
2.000	RE2	450	Manhole	Adoptable	Tank		Junction	
3.000	Perm Surf Atten		Junction		Tank		Junction	
1.001	Tank		Junction		Outfall	450	Manhole	Adoptable

Node Tank Online Orifice Control

Flap Valve	x	Invert Level (m)	85.500	Diameter (m)	0.033
Downstream Link	1.001	Design Depth (m)	1.100	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Design Flow (l/s)	2.5		

Node Tank Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	85.500
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	52

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	6.0	0.0	0.200	6.0	0.0	0.400	6.0	0.0	0.401	0.0	0.0

Node Perm Surf Atten Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	86.150	Slope (1:X)	400.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	18	Depth (m)	0.350
Safety Factor	2.0	Width (m)	7.746	Inf Depth (m)	
Porosity	0.30	Length (m)	7.746		

Approval Settings

Node Size	x	Coordinates	x	Full Bore Velocity	x	Time to Half Empty	✓
Node Losses	x	Crossings	x	Proportional Velocity	x	Return Period (years)	10
Link Size	x	Cover Depth	x	Surcharged Depth	x	Discharge Rates	x
Link Length	x	Backdrops	x	Flooding	x	Discharge Volume	x

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
1 year 15 minute summer	109.521	30.991	1 year 120 minute winter	19.966	7.942
1 year 15 minute winter	76.857	30.991	1 year 180 minute summer	23.233	5.979
1 year 30 minute summer	71.439	20.215	1 year 180 minute winter	15.102	5.979
1 year 30 minute winter	50.133	20.215	1 year 240 minute summer	18.475	4.882
1 year 60 minute summer	48.435	12.800	1 year 240 minute winter	12.274	4.882
1 year 60 minute winter	32.179	12.800	1 year 360 minute summer	14.169	3.646
1 year 120 minute summer	30.053	7.942	1 year 360 minute winter	9.210	3.646

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
1 year 480 minute summer	11.185	2.956
1 year 480 minute winter	7.431	2.956
1 year 600 minute summer	9.182	2.511
1 year 600 minute winter	6.274	2.511
1 year 720 minute summer	8.203	2.199
1 year 720 minute winter	5.513	2.199
1 year 960 minute summer	6.768	1.782
1 year 960 minute winter	4.483	1.782
1 year 1440 minute summer	4.949	1.326
1 year 1440 minute winter	3.326	1.326
2 year 15 minute summer	141.566	40.058
2 year 15 minute winter	99.345	40.058
2 year 30 minute summer	91.753	25.963
2 year 30 minute winter	64.388	25.963
2 year 60 minute summer	61.301	16.200
2 year 60 minute winter	40.727	16.200
2 year 120 minute summer	37.449	9.897
2 year 120 minute winter	24.880	9.897
2 year 180 minute summer	28.672	7.378
2 year 180 minute winter	18.637	7.378
2 year 240 minute summer	22.636	5.982
2 year 240 minute winter	15.039	5.982
2 year 360 minute summer	17.235	4.435
2 year 360 minute winter	11.203	4.435
2 year 480 minute summer	13.550	3.581
2 year 480 minute winter	9.003	3.581
2 year 600 minute summer	11.088	3.033
2 year 600 minute winter	7.576	3.033
2 year 720 minute summer	9.878	2.647
2 year 720 minute winter	6.639	2.647
2 year 960 minute summer	8.113	2.136
2 year 960 minute winter	5.374	2.136
2 year 1440 minute summer	5.891	1.579
2 year 1440 minute winter	3.959	1.579
30 year 15 minute summer	268.706	76.035
30 year 15 minute winter	188.566	76.035
30 year 30 minute summer	174.929	49.499
30 year 30 minute winter	122.757	49.499
30 year 60 minute summer	116.589	30.811
30 year 60 minute winter	77.459	30.811
30 year 120 minute summer	70.438	18.615
30 year 120 minute winter	46.797	18.615
30 year 180 minute summer	53.298	13.715
30 year 180 minute winter	34.645	13.715
30 year 240 minute summer	41.604	10.995
30 year 240 minute winter	27.641	10.995
30 year 360 minute summer	31.221	8.034
30 year 360 minute winter	20.295	8.034
30 year 480 minute summer	24.324	6.428
30 year 480 minute winter	16.160	6.428
30 year 600 minute summer	19.756	5.404
30 year 600 minute winter	13.498	5.404

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
30 year 720 minute summer	17.490	4.687
30 year 720 minute winter	11.754	4.687
30 year 960 minute summer	14.215	3.743
30 year 960 minute winter	9.416	3.743
30 year 1440 minute summer	10.161	2.723
30 year 1440 minute winter	6.829	2.723
30 year +40% CC 15 minute summer	376.189	106.449
30 year +40% CC 15 minute winter	263.992	106.449
30 year +40% CC 30 minute summer	244.900	69.298
30 year +40% CC 30 minute winter	171.860	69.298
30 year +40% CC 60 minute summer	163.225	43.136
30 year +40% CC 60 minute winter	108.443	43.136
30 year +40% CC 120 minute summer	98.613	26.061
30 year +40% CC 120 minute winter	65.516	26.061
30 year +40% CC 180 minute summer	74.617	19.202
30 year +40% CC 180 minute winter	48.503	19.202
30 year +40% CC 240 minute summer	58.245	15.393
30 year +40% CC 240 minute winter	38.697	15.393
30 year +40% CC 360 minute summer	43.710	11.248
30 year +40% CC 360 minute winter	28.413	11.248
30 year +40% CC 480 minute summer	34.053	8.999
30 year +40% CC 480 minute winter	22.624	8.999
30 year +40% CC 600 minute summer	27.658	7.565
30 year +40% CC 600 minute winter	18.898	7.565
30 year +40% CC 720 minute summer	24.485	6.562
30 year +40% CC 720 minute winter	16.456	6.562
30 year +40% CC 960 minute summer	19.901	5.240
30 year +40% CC 960 minute winter	13.183	5.240
30 year +40% CC 1440 minute summer	14.225	3.812
30 year +40% CC 1440 minute winter	9.560	3.812
100 year 15 minute summer	348.738	98.681
100 year 15 minute winter	244.728	98.681
100 year 30 minute summer	228.965	64.789
100 year 30 minute winter	160.677	64.789
100 year 60 minute summer	153.288	40.510
100 year 60 minute winter	101.841	40.510
100 year 120 minute summer	92.562	24.461
100 year 120 minute winter	61.496	24.461
100 year 180 minute summer	69.806	17.964
100 year 180 minute winter	45.376	17.964
100 year 240 minute summer	54.269	14.342
100 year 240 minute winter	36.055	14.342
100 year 360 minute summer	40.484	10.418
100 year 360 minute winter	26.315	10.418
100 year 480 minute summer	31.414	8.302
100 year 480 minute winter	20.871	8.302
100 year 600 minute summer	25.431	6.956
100 year 600 minute winter	17.376	6.956
100 year 720 minute summer	22.452	6.017
100 year 720 minute winter	15.089	6.017
100 year 960 minute summer	18.166	4.784
100 year 960 minute winter	12.033	4.784

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year 1440 minute summer	12.896	3.456	100 year +40% CC 240 minute winter	50.477	20.078
100 year 1440 minute winter	8.667	3.456	100 year +40% CC 360 minute summer	56.677	14.585
100 year +40% CC 15 minute summer	488.233	138.153	100 year +40% CC 360 minute winter	36.841	14.585
100 year +40% CC 15 minute winter	342.620	138.153	100 year +40% CC 480 minute summer	43.979	11.622
100 year +40% CC 30 minute summer	320.551	90.705	100 year +40% CC 480 minute winter	29.219	11.622
100 year +40% CC 30 minute winter	224.948	90.705	100 year +40% CC 600 minute summer	35.604	9.738
100 year +40% CC 60 minute summer	214.603	56.713	100 year +40% CC 600 minute winter	24.327	9.738
100 year +40% CC 60 minute winter	142.577	56.713	100 year +40% CC 720 minute summer	31.433	8.424
100 year +40% CC 120 minute summer	129.587	34.246	100 year +40% CC 720 minute winter	21.125	8.424
100 year +40% CC 120 minute winter	86.094	34.246	100 year +40% CC 960 minute summer	25.432	6.697
100 year +40% CC 180 minute summer	97.729	25.149	100 year +40% CC 960 minute winter	16.847	6.697
100 year +40% CC 180 minute winter	63.526	25.149	100 year +40% CC 1440 minute summer	18.055	4.839
100 year +40% CC 240 minute summer	75.977	20.078	100 year +40% CC 1440 minute winter	12.134	4.839

Results for 1 year Critical Storm Duration. Lowest mass balance: 98.30%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	RE1	11	86.270	0.020	1.0	0.0031	0.0000	OK
15 minute summer	RE2	11	86.270	0.020	1.0	0.0031	0.0000	OK
15 minute winter	Perm Surf Atten	12	86.161	0.011	0.5	0.0590	0.0000	OK
60 minute summer	Tank	42	85.616	0.116	1.7	0.6622	0.0000	SURCHARGED
15 minute summer	Outfall	1	85.350	0.000	0.7	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)
15 minute summer	RE1	1.000	Tank	1.0	0.707	0.085	0.0837	
15 minute summer	RE2	2.000	Tank	1.0	0.707	0.085	0.0837	
15 minute winter	Perm Surf Atten	3.000	Tank	0.4	0.379	0.026	0.0408	
60 minute summer	Tank	Orifice	Outfall	0.7				1.9

Results for 2 year Critical Storm Duration. Lowest mass balance: 98.30%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	RE1	11	86.272	0.022	1.2	0.0034	0.0000	OK
15 minute summer	RE2	11	86.272	0.022	1.2	0.0034	0.0000	OK
15 minute summer	Perm Surf Atten	13	86.163	0.013	0.6	0.0769	0.0000	OK
30 minute summer	Tank	25	85.654	0.154	2.8	0.8804	0.0000	SURCHARGED
15 minute summer	Outfall	1	85.350	0.000	0.8	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 summer	RE1	1.000	Tank	1.2	0.784	0.102	0.0900	
15 minute summer	RE2	2.000	Tank	1.2	0.784	0.102	0.0900	
15 minute summer	Perm Surf Atten	3.000	Tank	0.5	0.379	0.035	0.0420	
30 minute summer	Tank	Orifice	Outfall	0.8				1.9

Results for 30 year Critical Storm Duration. Lowest mass balance: 98.30%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	RE1	11	86.280	0.030	2.3	0.0048	0.0000	OK
15 minute summer	RE2	11	86.280	0.030	2.3	0.0048	0.0000	OK
15 minute summer	Perm Surf Atten	12	86.168	0.018	1.2	0.1436	0.0000	OK
60 minute summer	Tank	43	85.844	0.344	4.1	1.9614	0.0000	SURCHARGED
15 minute summer	Outfall	1	85.350	0.000	1.2	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 summer	RE1	1.000	Tank	2.3	0.817	0.195	0.0980	
15 minute summer	RE2	2.000	Tank	2.3	0.817	0.195	0.0980	
15 minute summer	Perm Surf Atten	3.000	Tank	1.0	0.505	0.066	0.0437	
60 minute summer	Tank	Orifice	Outfall	1.3				4.6

Results for 30 year +40% CC Critical Storm Duration. Lowest mass balance: 98.30%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	RE1	11	86.286	0.036	3.3	0.0058	0.0000	OK
15 minute summer	RE2	11	86.286	0.036	3.3	0.0058	0.0000	OK
15 minute summer	Perm Surf Atten	12	86.170	0.020	1.6	0.1922	0.0000	OK
60 minute summer	Tank	40	86.176	0.676	5.8	2.2829	0.0000	SURCHARGED
15 minute summer	Outfall	1	85.350	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 summer	RE1	1.000	Tank	3.3	0.895	0.280	0.1039	
15 minute summer	RE2	2.000	Tank	3.3	0.895	0.280	0.1039	
15 minute summer	Perm Surf Atten	3.000	Tank	1.4	0.529	0.090	0.0448	
60 minute summer	Tank	Orifice	Outfall	1.8				6.5

Results for 100 year Critical Storm Duration. Lowest mass balance: 98.30%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	RE1	11	86.285	0.035	3.0	0.0055	0.0000	OK
15 minute summer	RE2	11	86.285	0.035	3.0	0.0055	0.0000	OK
15 minute summer	Perm Surf Atten	12	86.170	0.020	1.5	0.1801	0.0000	OK
60 minute summer	Tank	43	86.116	0.616	5.4	2.2829	0.0000	SURCHARGED
15 minute summer	Outfall	1	85.350	0.000	1.4	0.0000	0.0000	OK

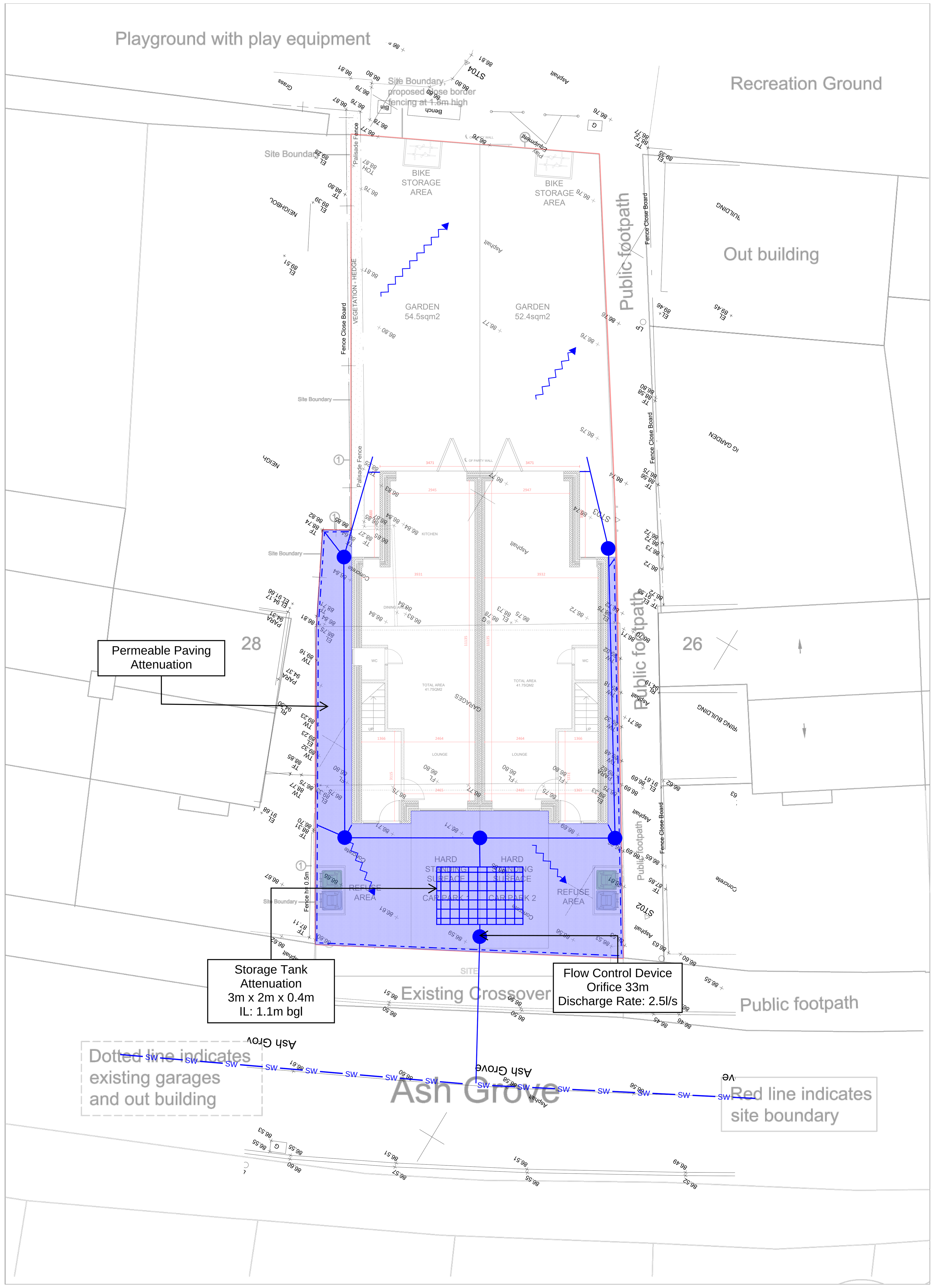
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	RE1	1.000	Tank	3.0	0.895	0.255	0.1022	
15 minute summer	RE2	2.000	Tank	3.0	0.895	0.255	0.1022	
15 minute summer	Perm Surf Atten	3.000	Tank	1.3	0.529	0.084	0.0445	
60 minute summer	Tank	Orifice	Outfall	1.8				6.1

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 98.30%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute summer	RE1	21	86.294	0.044	4.1	0.0070	0.0000	OK
30 minute summer	RE2	21	86.294	0.044	4.1	0.0070	0.0000	OK
60 minute summer	Perm Surf Atten	44	86.239	0.089	4.6	1.4156	0.0000	OK
30 minute summer	Tank	21	86.252	0.752	9.8	2.2829	0.0000	SURCHARGED
15 minute summer	Outfall	1	85.350	0.000	1.9	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)
30 minute summer	RE1	1.000	Tank	4.1	0.897	0.345	0.1115	
30 minute summer	RE2	2.000	Tank	4.1	0.897	0.345	0.1115	
60 minute summer	Perm Surf Atten	3.000	Tank	-3.3	-0.527	-0.214	0.0761	
30 minute summer	Tank	Orifice	Outfall	1.9				6.9

Appendix D



Drawing Scale Bar

Drawing scale	Line length	Drawing scale	Line length
1:5	= 0.25 metres	1:200	= 10.0 metres
1:10	= 0.5 metres	1:250	= 12.5 metres
1:20	= 1.0 metres	1:500	= 25.0 metres
1:25	= 1.25 metres	1:1000	= 50.0 metres
1:50	= 2.5 metres	1:1250	= 62.5 metres
1:100	= 5.0 metres	1:2500	= 125 metres

Measure length of line above for checking of scale

GENERAL NOTES

1. All dimensions are in millimetres and levels in m AOD unless stated otherwise.

2. Do not scale. If in any doubt, consult Engineer.

3. Read in conjunction with the architects and engineers schedule drawings.

4. Check inverts and sizes of existing pipes prior to the commencement of any work. Report any discrepancies to the engineer and await instructions.

5. The location of services is shown as indicative. This drawing should be read in conjunction with the utilities drawings. No warranty to their accuracy can be given. The contractor shall take all necessary measures to satisfy himself as to the location of the existing services and connection points. Excavation should be undertaken in compliance with HSG47.

6. Concrete structures design sulphate class and ACEC concrete class unknown.

7. Pipework to be 110mm Thermoplastics U-PVC (Polypipe or similar) installed at levels marked on this drawing UNO. Pipe bedding should be class Z in pipes within 1.5m of the building or shallower than 700mm below ground level. For all other areas the pipe bedding should be class S.

8. Joints and fittings for gravity sewers shall comply with the relevant provisions of BS EN 1401-1, BS EN 1852 and BS EN 12666-1. Pipes shall have a limit of 6% deformation. Pipes shall be SN8 ring stiffness and stamped accordingly. Pipe sections shall not be longer than 3m.

9. Plastic chambers and rings, including demarcation chambers,shall comply with BS EN 3598-1 or BS EN 13598-2 as appropriate.

10. Inspection chamber covers and frames shall comply with the relevant provisions of BS EN 124 and should be double sealed.

11. All inspection chamber covers shall be the non-ventilating type and shall have closed keyways.

12. Testing of pipelines should be as follow:

Gravity Pipework: Air pipe testing. Pipework should withstand a pressure of 100mm water gauge and this should not fall by more than 25mm in a 5minute period. However where traps or gullies are connected they should withstand a pressure of 50mm water gauge and this should not fall by more than 12mm in a 5minute period. It is recommended that pipework installations are tested in sections rather than waiting to complete in one operation.

13. Manhole covers to be set square to the building. Covers of existing manholes to be adjusted to match final ground levels.

14. Granular Bedding for pipes shall be constructed by spreading and compacting granular bedding material over the full width of the pipe trench. After the pipes have been laid, additional granular material shall, if required, be placed and compacted equally on each side of the pipes and, where practicable, this shall be done in sequence with the removal of the trench supports.

Rev	Details	Date	By	Chk'd

Drawing Status:

PRELIMINARY

URBANWATER

KEY

- Proposed Surface Water Sewer Pipe
- Exceedance Flows
- Permeable Surface as per architect's details Sub-base 350mm Type 3
- Silt Trap
- Perforated Pipe
- Existing Surface Water Sewer Pipe

Client:

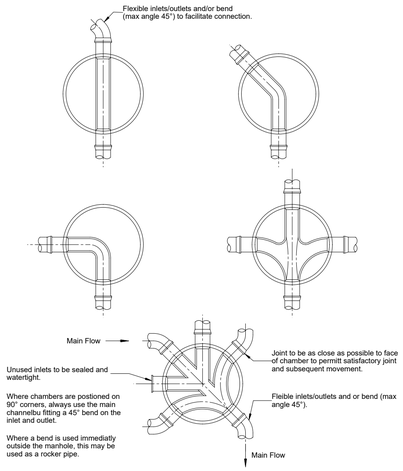
Project:

Garage Site between 26 & 28 Ash Grove, Harefield, UB9 6EX

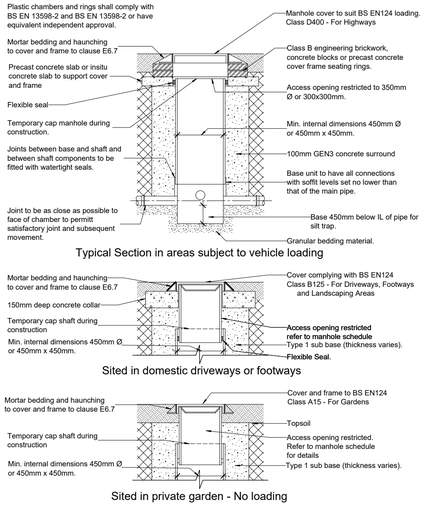
Drawing:

Proposed Drainage Strategy

Print Size:	Scale:	Project No:	Drawing No:	Revision:
A1	1:100	0481	003	P1



Chamber Type 3 Base Layouts



Typical Section in areas subject to vehicle loading

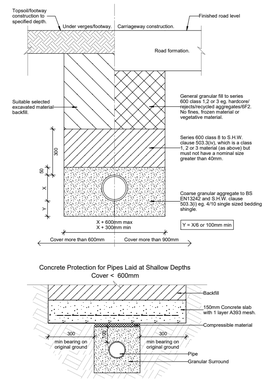
Sited in domestic driveways or footways

Sited in private garden - No loading

Notes:

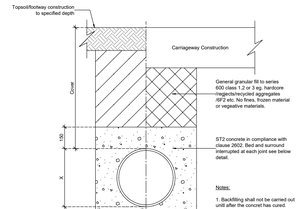
1. Refer to drawing 8193 for base layouts.

Silt Trap Plastic

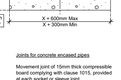


Concrete Protection for Pipes Laid at Shallow Depths
Cover < 600mm

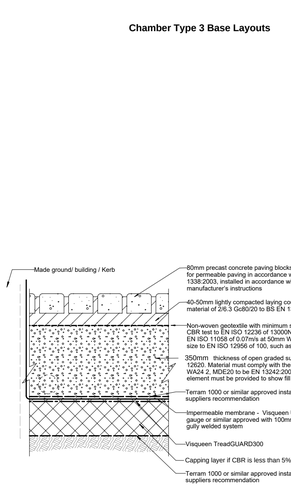
Pipe Bedding Detail Type S



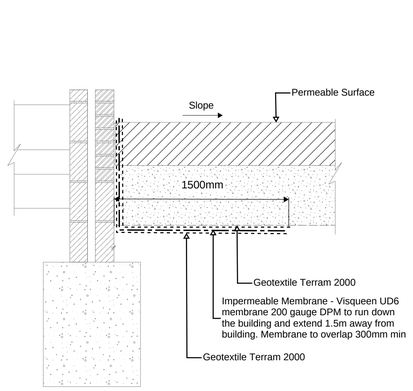
Joints for concrete encased pipes



Pipe Bedding Detail Type Z



Permeable Paving - Attenuation

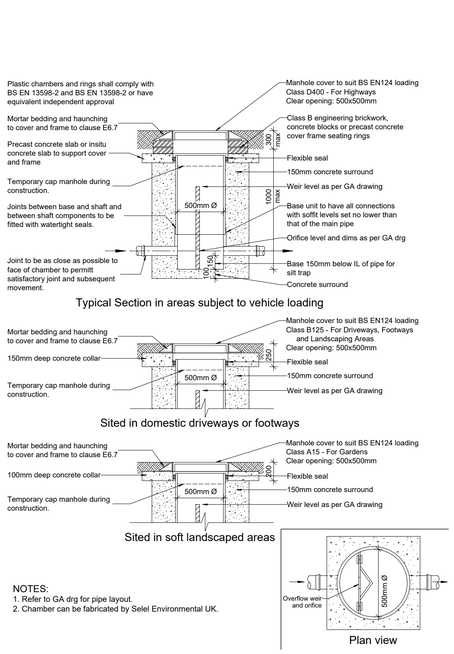


Permeable Surface Against Building

NOTES:

1. Permeable modular storage cell with 95% minimum void ratio. Ultimate compressive strength of 400kN/m² minimum. Resistant to chemicals likely to be found in rain water and durability of a minimum of 40 years.
2. Dimensions as applicable to the manufacturers recommendations for given storage requirement UNO.
3. Air Vents should be provided as per suppliers recommendations
4. See GA drgs for pipe sizes and layout and IL, iLoS, ToS, GL levels.

Cellular Attenuation System - Landscape Area



Typical Section in areas subject to vehicle loading

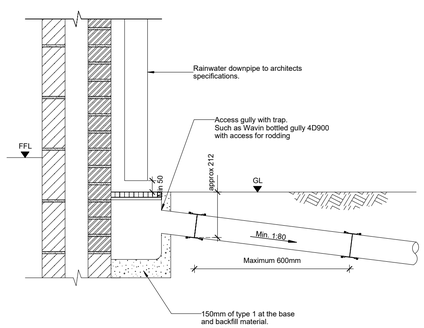
Sited in domestic driveways or footways

Sited in soft landscaped areas

NOTES:
1. Refer to GA drg for pipe layout.
2. Chamber can be fabricated by Selel Environmental UK.

Plan view

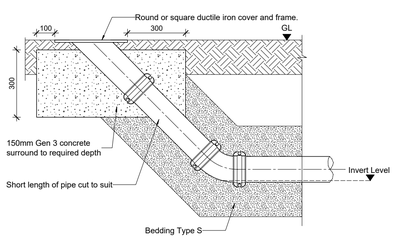
Flow Control -Orifice Plate - Plastic - Type 3



NOTES:

1. This details shows the standard generic arrangement.
2. The pipe and connector details will be different for each manufacturer of the components. They are to be in installed in accordance with the manufacturers recommendations.

8250 - External Rainwater (High Level)



External Rodding Eye Detail

Drawing Scale Bar

Drawing scale	Line length	Drawing scale	Line length
1:5 =	0.25 metres	1:200 =	10.0 metres
1:10 =	0.5 metres	1:250 =	12.5 metres
1:20 =	1.0 metres	1:500 =	25.0 metres
1:25 =	1.25 metres	1:1000 =	50.0 metres
1:50 =	2.5 metres	1:1250 =	62.5 metres
1:100 =	5.0 metres	1:2500 =	125 metres

Measure length of line above for checking of scale

GENERAL NOTES

Rev	Details	Date	By	Chd

Drawing Status:

PRELIMINARY

URBANWATER

Client:

Project:

Garage Site between 26 & 28 Ash Grove, Harefield, UB9 6EX

Drawing:

Standard Details

Print Size:	Scale:	Project No:	Drawing No:	Revision:
A1	NTS	0481	006	P1