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ENVIRONMENTAL CONSULTING , SOFTWARE & TRAINING

Sustainable Drainage System Strategy

Site Address
59 Elm Avenue
Ruislip
HA4 8PE

Client
B12 Development

Report Reference
SWDS - 2022 - 00007

Prepared By
STM Environmental Consultants Ltd

Date
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1 Document Control

Sustainable Drainage System Strategy

Site Address:	59 Elm Avenue Ruislip HA4 8PE
National Grid Reference:	510807, 187544
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3 Abbreviations

Abbreviation	Description
STM	STM Environmental Consultants Limited
BGS	British Geological Survey
EA	Environment Agency
OS	Ordnance Survey of Great Britain
FRA	Flood Risk Assessment
NPPF	National Planning Policy Framework
FWD	Floodline Warning Direct
FRMS	Flood Risk Management Strategy
LLFA	Lead Local Flood Authority
SWMP	Surface Water Management Plan
SFRA	Strategic Flood Risk Assessment
CDA	Critical Drainage Area
SuDS	Sustainable Drainage Systems
GWSPZ	Groundwater Source Protection Zone
TPH	Total Petroleum Hydrocarbons
BTEX	Benzene, Toluene, Ethylene, Xylene
PAH	Poly-Aromatic Hydrocarbons

4 Disclaimer

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5 Executive Summary

BACKGROUND			
Location	59 Elm Avenue, Ruislip, HA4 8PE Grid reference: 510807, 187544		
Site Area	542m^2		
Proposed Development	The demolition of existing dwelling and the erection of a residential building, housing 6no. flats; with associated bins, cycle provision and access.		
Current Site and Surrounding Uses	Predominantly residential. Railway line to the south.		
Topography	The elevations within the Site range from 52.74mAOD (S / SE) to 54.54mAOD (W).		
Hydrology	No main watercourses identified within 250m of the Site.		
Geology	BGS data has no records of superficial deposits at the site. The bedrock is classified as belonging to the Lambeth Group (Clay, Silt and Sand).		
Hydrogeology	BGS data indicates that the site is situated upon an Unproductive bedrock aquifer.		
Permeability	BGS data indicates that the bedrock has highly variable permeability.		
Infiltration Potential	BGS data indicates that there is good potential for the use of infiltration SuDS.		
Fluvial Flood Risk	Low – The site lies within EA Flood Zone 1.		
Surface Water Flood Risk	Low - the site is not impacted by the EA modelled surface water flood scenarios.		
Groundwater Flood Risk	Low - the EA indicates there is very limited potential for groundwater flooding on site. Groundwater is indicated to potentially be 3 - 5m below ground.		
Existing and Proposed Site Layout	**Ground Cover**	**Existing (m^2)**	**Proposed (m^2) (Without SuDS)**
	Buildings	114	178
	Driveways/Patio	250	134
	Gardens/ Soft landscaping	178	230
	Total Impermeable Area	364	312
Changes in Impermeable Area Without SuDS	Even without SuDS, the proposed development will reduce the impermeable area of the site by 10% (i.e. 52m^2).		

PROPOSED SUDS				
Run-Off Rates	Greenfield (GF) (l/s)	Pre - Development (l/s)	Post Development Without SuDS (l/s)	Post Development With SuDS (l/s)
Qbar	0.24	0.29	0.28	
1 in 1	0.20	0.24	0.24	0.2
1 in 30	0.55	0.66	0.64	0.3
1 in 100	0.76	0.92	0.89	0.3
1 in 100 + CC (40%)	1.13	1.36	1.32	0.3
SuDS Target Requirement	As the development is taking place on a previously developed site the non-statutory technical standards for sustainable drainage systems S3 (peak flow) and S5 and S6 (volume controls) apply. The target discharge rate was therefore set to between 0.2l/s and 1.3l/s for all storm events.			
Storage Required to meet Planning Requirement	Using the Microdrainage quick storage estimate method the total storage volume required to match greenfield discharges. The results indicate that 27m^3 of storage is likely to be required.			
Infiltration Testing	A site investigation was undertaken on the 14th and 15th of March 2022 for the purposes of undertaking infiltration testing in line with BRE DG 365 guidance and geotechnical assessments. 2no. trial pits (TP01 & TP02) were excavated to depths of 1.2mbgl & 0.7mbgl respectively. The geology encountered within the trial pits consisted of Made Ground consisting of dark brown Silty CLAY, to a depth of 0.2mbgl, underlain by light brown very silty CLAY to 1.2mbgl. The water level failed to drain more than 50% of its original volume during the 1st test run in both trial pits. Testing was therefore terminated and Infiltration SuDS methods concluded to be unsuitable for the Site.			
SuDS Strategy	The proposed SuDS will comprise of rainwater harvesting tanks in combination with permeable paving and an orifice flow control device which will limit the rate of discharge of excess run-off to the nearby surface water sewer. 3no. 7.5m^3 rainwater harvesting tanks will be used to manage run-off from the building rooftop. These tanks will provide 15m^3 for rainwater re-use and 7.5m^3 for stormwater attenuation. The permeable paving will be laid across 134m^2 of pathways and car parking, providing approximately 12.6m^3 of attenuation storage. The orifice flow control chamber will be installed within the permeable car parking area closest to the Thames Water Asset 7205. It will limit the discharge rate from the site into the Thames Water surface water sewer to 0.5l/s.			
Water Efficiency	The daily water consumption will be below 105 litre/day due to the implementation of rainwater harvesting and water efficient appliances.			
Conclusion	With the proposed SuDS mitigation measures in place, we believe that the proposed development will reduce local flood risk and therefore be in compliance with the LLFA's current planning policy and the NPPF.			

6 Introduction

STM Environmental Consultants Limited have been appointment by B12 Development to undertake a Sustainable Drainage System (SuDS) Strategy for a proposed development at 59 Elm Avenue, Ruislip, HA4 8PE.

6.1 Proposed Development

The SuDS strategy is required to discharge Condition 6 associated with the planning application ref.60130/APP/2021/4249. The proposed development involves the demolition of existing dwelling and the erection of a residential building, housing 6no. flats; with associated bins and cycle provision. The proposal also includes the removal of an existing corner drop kerb, and the creation and widening of new and existing kerbs.

The planning condition No. 6 states:

No development approved by this permission shall be commenced until a scheme for the provision of sustainable water management and water efficiency has been submitted to and approved in writing by the Local Planning Authority. The scheme shall:

- Provide information about the design storm period and intensity, the method employed to delay and control the surface water discharged from the site and the measures taken to prevent pollution of the receiving groundwater and/or surface waters;
- Include a timetable for its implementation; and
- Provide a management and maintenance plan for the lifetime of the development which shall include the arrangements for adoption by any public authority or statutory undertaker and any other arrangements to secure the operation of the scheme throughout its lifetime.

The scheme shall also demonstrate the use of methods to minimise the use of potable water through water collection, reuse and recycling and will:

- Provide details of water collection facilities to capture excess rainwater;
- Provide details of how rain and grey water will be recycled and reused in the development;

- Provide details of how the dwellings will achieve a water efficiency standard of no more than 110 litres per person per day maximum water consumption.

Thereafter the development shall be implemented and retained/maintained in accordance with these details for as long as the development remains in existence.
REASON

To ensure the development does not increase the risk of flooding in accordance with Policy DMEI 10 of the Hillingdon Local Plan Part 2 (2020) and Policies SI2 and SI 13 of the London Plan (2021).

Copies of the development plans and decision notice are presented in Appendix 1.

6.2 Report Aims and Objectives

This report sets out the proposed drainage strategy that will be employed in the designs to meet the requirements of the planning condition and the National Planning Policy Framework.

This report can be read in conjunction with the following reports also prepared for the site by STM:

- Geotechnical Site Investigation Report – Ref: GT-2022-000020 – April 2022

6.3 Legislative and Policy Context

6.3.1 Legislative Context

Section H3 of the Building Regulations 2010 requires that adequate provision is made for rainwater to be carried from the building roofs and paved areas. and be preferentially discharged to soakaways or some other adequate infiltration system. Where that is not reasonably practicable, a watercourse; or sewer can be used.

The Flood and Water Management Act was introduced in 2010. The Act defines the role of lead local flood authority (LLFA) for an area. All LLFA are required to develop,

maintain, apply and monitor a strategy for local flood risk management in its area, called “local flood risk management strategy”.

Alongside the Act, Flood Risk Regulations (2009) outline the roles and responsibilities of the various authorities, which include preparing Flood Risk Management Plans and identifying how significant flood risks are to be mitigated.

6.3.2 Policy Context

The National Planning Policy Framework (NPPF) sets out the Government's economic, environmental and social planning policies for England. The policies set out in this framework apply to the preparation of local and neighbourhood plans and to decisions on planning applications.

Paragraph 167 of the National Planning Policy Framework (NPPF) states that:

> When determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood-risk assessment (See Note 1) Development should only be allowed in areas at risk of flooding where, in the light of this assessment (and the sequential and exception tests, as applicable) it can be demonstrated that:
>
> - within the site, the most vulnerable development is located in areas of lowest flood risk unless there are overriding reasons to prefer a different location
> - the development is appropriately flood resistant and resilient such that, in the event of a flood, it could be quickly brought back into use without significant refurbishment;
> - it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate;
> - any residual risk can be safely managed; and
> - safe access and escape routes are included where appropriate, as part of an agreed emergency plan.

Applications for some minor development and changes of use (See Note.2) should not be subject to the sequential or exception tests but should still meet the requirements for site-specific flood risk assessments set out in (See Note 1).

Paragraph 169 states that:

Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate. The systems used should:

- take account of advice from the lead local flood authority;
- have appropriate proposed minimum operational standards;
- have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development; and
- where possible, provide multifunctional benefits.

A major development is defined as:

- a residential development: 10 dwellings or more or residential development with a site area of 0.5 hectares or more where the number of dwellings is not yet known
- a non-residential development: provision of a building or buildings where the total floor space to be created is 1000 square metres or more or where the floor area is not yet known, a site area of 1 hectare or more.

Note. 1 - A site-specific flood risk assessment should be provided for all development in Flood Zones 2 and 3. In Flood Zone 1, an assessment should accompany all proposals involving: sites of 1 hectare or more; land which has been identified by the Environment Agency as having critical drainage problems; land identified in a strategic flood risk assessment as being at increased flood risk in future; or land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use.

Note. 2 - This includes householder development, small non-residential extensions (with a footprint of less than 250m^2) and changes of use; except for changes of use to

a caravan, camping or chalet site, or to a mobile home or park home site, where the sequential and exception tests should be applied as appropriate.

6.3.3 The London Plan - Policy SI 13 Sustainable drainage

Lead Local Flood Authorities should identify – through their Local Flood Risk Management Strategies and Surface Water Management Plans – areas where there are particular surface water management issues and aim to reduce these risks. Increases in surface water run-off outside these areas also need to be identified and addressed.

Development proposals should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible. There should also be a preference for green over grey features, in line with the following drainage hierarchy:

- rainwater use as a resource (for example rainwater harvesting, blue roofs for irrigation);
- rainwater infiltration to ground at or close to source;
- rainwater attenuation in green infrastructure features for gradual release (for example green roofs, rain gardens);
- rainwater discharge direct to a watercourse (unless not appropriate);
- controlled rainwater discharge to a surface water sewer or drain;
- controlled rainwater discharge to a combined sewer;

Development proposals for impermeable surfacing should normally be resisted unless they can be shown to be unavoidable, including on small surfaces such as front gardens and driveways.

Drainage should be designed and implemented in ways that promote multiple benefits including increased water use efficiency, improved water quality, and enhanced biodiversity, urban greening, amenity and recreation (2).

6.4 The London Borough of Hillingdon

6.4.1 Policy EM6: Flood Risk Management

The Council will require new development to be directed away from Flood Zones 2 and 3 in accordance with the principles of the National Planning Policy Framework (NPPF).

The subsequent Hillingdon Local Plan: Part 2 -Site Specific Allocations LDD will be subjected to the Sequential Test in accordance with the NPPF. Sites will only be allocated within Flood Zones 2 or 3 where there are overriding issues that outweigh flood risk. In these instances, policy criteria will be set requiring future applicants of these sites to demonstrate that flood risk can be suitably mitigated.

The Council will require all development across the borough to use sustainable urban drainage systems (SUDS) unless demonstrated that it is not viable. The Council will encourage SUDS to be linked to water efficiency methods. The Council may require developer contributions to guarantee the long-term maintenance and performance of SUDS is to an appropriate standard.

6.4.2 Policy DMEI 10: Water Management, Efficiency, and Quality

A) Applications for all new build developments (not conversions, change of use, or refurbishment) are required to include a drainage assessment demonstrating that appropriate sustainable drainage systems (SuDS) have been incorporated in accordance with the London Plan Hierarchy (Policy 5.13: Sustainable drainage).

B) All major new build developments, as well as minor developments in Critical Drainage Areas or an area identified at risk from surface water flooding must be designed to reduce surface water run-off rates to no higher than the pre-development greenfield run-off rate in a 1:100 year storm scenario, plus an appropriate allowance for climate change for the worst storm duration. The assessment is required regardless of the changes in impermeable areas and the fact that a site has an existing high run-off rate will not constitute justification.

C) Rain Gardens and non householder development should be designed to reduce surface water run-off rates to Greenfield run-off rates.

D) Schemes for the use of SuDS must be accompanied by adequate arrangements for the management and maintenance of the measures used, with appropriate contributions made to the Council where necessary.

E) Proposals that would fail to make adequate provision for the control and reduction of surface water run-off rates will be refused.

F) Developments should be drained by a SuDs system and must include appropriate methods to avoid pollution of the water environment. Preference should be given to utilising the drainage options in the SuDS hierarchy which remove the key pollutants that hinder improving water quality in Hillingdon. Major development should adopt a 'treatment train' approach where water flows through different SuDS to ensure resilience in the system.

Water Efficiency

G) All new development proposals (including refurbishments and conversions) will be required to include water efficiency measures, including the collection and reuse of rain water and grey water.

H) All new residential development should demonstrate water usage rates of no more than 105 litres/person/day.

I) It is expected that major development proposals will provide an integrated approach to surface water run-off attenuation, water collection, recycling and reuse.

Water and Wastewater Infrastructure

J) All new development proposals will be required to demonstrate that there is sufficient capacity in the water and wastewater infrastructure network to support the proposed development. Where there is a capacity constraint the local planning authority will require the developer to provide a detailed water and/or drainage strategy to inform what infrastructure is required, where, when and how it will be delivered.

6.4.3 The London Plan

The Sustainable Drainage Hierarchy set out in Policy SI.13 of The London Plan GLA) London Plan (2011) [2] stipulates those developments should utilize Sustainable Drainage Systems (SuDS), unless there are particle reasons for not doing so; and should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close as possible in line with the following drainage hierarchy:

- Store rainwater for later use;
- Use infiltration techniques, such as porous surfaces in non-clay areas;
- Attenuate rainwater in ponds or open water features for gradual release;
- Attenuate rainwater by storing in tanks or sealed water features for gradual release;
- Discharge directly to a water course;
- Discharge rainwater directly to a surface water sewer/drain;
- Discharge to a combined sewer.

- Major developments must implement SuDS to enable a reduction in peak run-off to greenfield rates for a 1 in 100 event + CC;
- Major developments will be required to provide a sustainable drainage strategy that demonstrates how SuDS will be integrated to reduce peak flow volumes and rates in line with the requirements of this policy;
- All other developments must maximize attenuation levels, achieving greenfield rates where possible;
- All new car parks and hard standing areas should be rainwater permeable with no run-off directed in to the sewer network;
- All flat roofs should be green or brown roofs to contribute to reducing surface water run-off.

The well-established Sustainable Drainage Hierarchy set out in Policy SI.13 of the Greater London Authority's (GLA) London Plan (2021) [3] stipulates those developments should utilize Sustainable Drainage Systems (SuDS), unless there are particle reasons for not doing so; and should aim to achieve greenfield run-off rates

and ensure that surface water run-off is managed as close as possible in line with the following drainage hierarchy and there is a strong push to move towards green infrastructure away from grey features (impermeable).

7 Site Characteristics

7.1 Location and Area

The site is centred at national grid reference 510807, 187544 and has an area of 542m^2.

It falls within the jurisdiction of London Borough of Hillingdon in terms of the planning consultation process on flood risk and surface water management. The LLFA is also Hillingdon council. Figure 1 provides the site location map and aerial imagery.

7.2 Current Site and Surrounding Uses

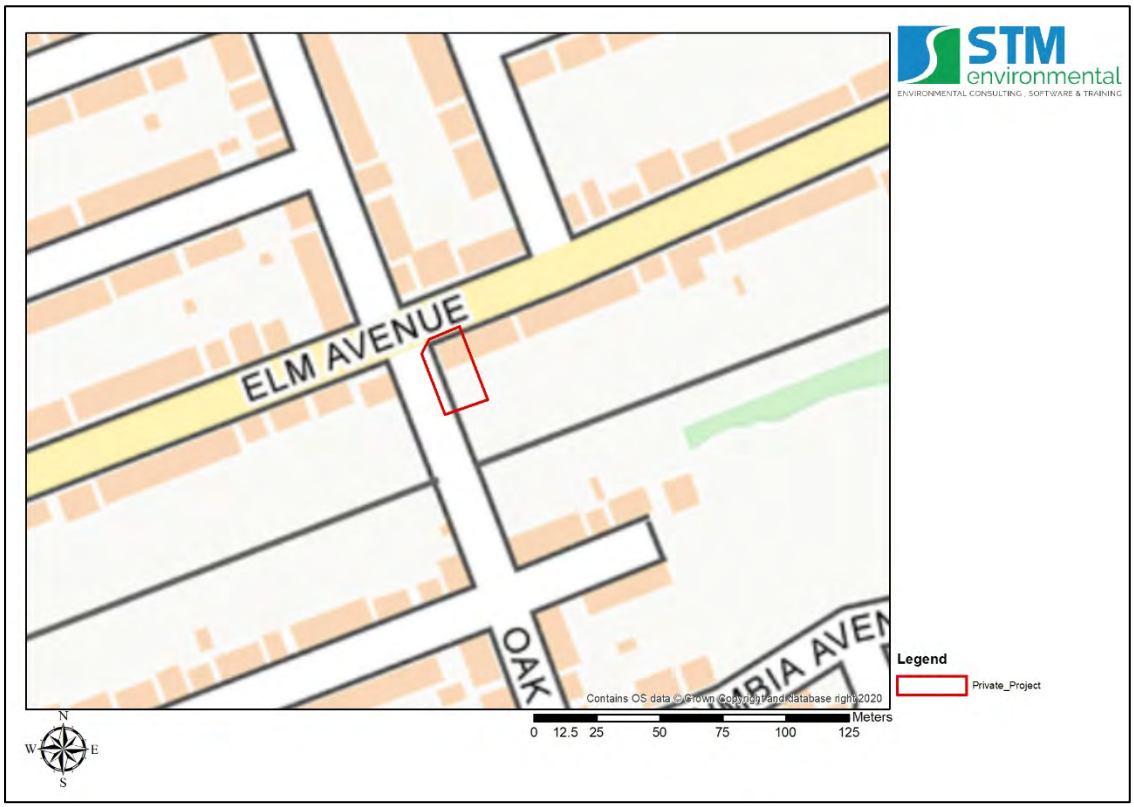
The site is currently used as a residential dwelling with associated hard and soft landscaping. The surrounding area is predominately residential and the Metropolitan / Piccadilly train line lies just south of the site.

7.3 Site Topography

The mapping provided in Appendix 2 shows 1m DTM LiDAR and the topographical survey of the Site showing the topography.

The elevations within the site range from 52.74mAOD (S / SE) to 54.54mAOD (W). The existing property and garden are predominately flat situated at 52.8 - 53.3mAOD, south to north. The western boundary forms a steep embankment connecting the site to the pavement, along Oak Grove, via steps from the rear garden.

Figure 1: Site location map and aerial photo


ELM AVENUE
OAK
Contains OS data © Crown Copyright and database right 2020
Meters
0 12.5 25 50 75 100 125
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Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Meters
0 4.75 9.5 19 28.5 38 47.5
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The site itself is situated close to the central point along Elm Avenue, which forms part of a gradual western facing slope. The elevations peak at 55.8mAOD to the east (towards Park Road) and drop to 51.0mAOD at the cross roads with Field End Road.

7.4 Hydrology

There were no main watercourses identified within 250m of the Site.

7.5 Geology and Hydrogeology

BGS mapping showing the geological and hydrogeological characteristics of the site are presented in Appendix 2.

The BGS information indicates that there are no superficial deposits at the site while the bedrock is classified as belonging to the Lambeth Group (Clay, Silt and Sand).

The permeability of the bedrock geology is considered to be highly variable.

The BGS infiltration potential map suggests that there is good potential for the use of for infiltration methods at the site.

The maps also indicate that the groundwater table is likely to be more than 5 m below the ground surface throughout the year.

The site lies upon a Secondary A bedrock aquifer. The site does not lie within a groundwater Source Protection Zone.

7.6 Flood Risk

7.6.1 Fluvial Flood Risk

Fluvial and tidal risk is assessed using flooding maps produced by the Environment Agency (EA). These maps use available historic data and hydraulic modelling to define zones of flood risk. The maps allow a site to be defined in terms of its Flood Zone (e.g. 1, 2, 3a or 3b) and in terms of the overall flood risk (very low, low, medium or high).

The EA Flood Zones are defined as:

- Flood Zone 1: Less than a 1 in 1000 annual probability of fluvial and/or tidal flooding;
- Flood Zone 2: Between 1 in 100 and 1 in 1000 annual probability of fluvial flooding and/or between 1 in 200 and 1 in 1000 annual probability of tidal flooding;
- Flood Zone 3a: Greater than 1 in 100 annual probability of fluvial flooding and/or greater than 1 in 200 annual probability of tidal flooding;
- Flood Zone 3b: functional flood plain (definition specific to the LLFA). Less than a 1 in 20 annual probability of fluvial and/or tidal flooding.

The site is located within Flood Zone 1 and is therefore considered to have a low risk of flooding. This equates to a potential yearly risk of flooding of less than 0.1% Annual Expected Probability.

7.6.2 Surface Water Flood Risk

Surface water flooding occurs when high intensity rainfall leads to run-off which flows over the ground surface, causing ponding in low-lying areas when the precipitation rate or overland flow rate is greater than the rate of infiltration, or return into watercourses. Surface water flooding can be exacerbated when the underlying soil and geology is saturated (as a result of prolonged precipitation or a high-water table) or when the drainage network has insufficient capacity.

The chief mechanisms for flooding can be divided into the following categories:

- Runoff from higher topography – the areas of greatest flood depths tend to be at the base of the steeper land;
- Localised surface water runoff – within the central parts of the borough, surface water flooding tends to be a result of localised ponding of surface water;

- Sewer Flooding – areas where extensive and deep surface water flooding is likely to be influenced by sewer flooding. Where the sewer network has reached capacity, and surcharged, this will exacerbate the flood risk in these areas.
- Low Lying Areas – areas such as underpasses, subways and lowered roads beneath railway lines are more susceptible to surface water flooding;
- Railway Cuttings – leading to internal ponding and transport disruption;
- Railway Embankments – discrete surface water flooding locations along the up-stream side of the raised network rail embankments where water flows are interrupted and ponding can occur.

A map showing the site and the modelled prediction of surface water flood risk and depth provided by the EA is available in Appendix 3. This indicates that the site is at low risk of flooding.

The Site is impacted by the 1 in 1000 year rainfall return period. The extent is limited to a small area, 15m^2 of the driveway, which will witness up to 300mm of surface water flooding.

7.6.3 Groundwater Flood Risk

Groundwater flooding occurs when water rises from the underlying aquifer at the location of a spring – where the underlying impermeable geology meets the ground surface. This tends to occur after much longer periods of intense precipitation, in often low-lying areas where the water table is likely to be at a shallow depth. Groundwater flooding is known to occur in areas underlain by principal aquifers, although increasingly it is also being associated with more localised floodplain sands and gravels.

Groundwater susceptibility mapping provided by BGS is presented in Appendix 3. This indicates that is no significant potential for groundwater flooding to occur at the surface.

7.7 Existing Drainage

Drainage plans showing the existing surface water drainage system at the site were not available at the time of writing.

A CCTV survey has not been undertaken.

A topographic survey has been undertaken and established that there is an existing foul manhole on Site. It is assumed it is connected to the Thames Water foul sewer asset ID 7501. No evidence of a surface water connection was established during this survey.

A utility search was undertaken which identified Thames Water as the sewage operator in the local area. The Asset map is available in Appendix 4.

8 Hydrological Run-off Assessment

To minimise the impact of the new development on local flood risk, the NPPF requires that post development surface water run-off volumes and peak flow rates are improved upon those of the existing conditions. The following section provides an assessment of greenfield as well as pre- and post-development run-off rates.

8.1 Existing and Proposed Ground Cover

A summary of the existing and proposed site ground cover is shown below in Table 1 and Table 2 below. These tables assume all hardstanding will remain as impermeable surfaces.

Table 1: Breakdown of Ground Cover in the Proposed Development

Ground Cover	Existing Development Area		Proposed Development Area		Difference (m2)
	m^2	%	m^2	%	
Buildings	114	21	178	33	64

Ground Cover	Existing Development Area		Proposed Development Area		Difference (m2)
	m²	%	m²	%	
Hard Standing	250	46	134	25	-116
Soft landscaping	178	33	230	42	-52
Total	**542**	**100**	**542**	**100**	

Table 2: Summary of Permeable and Impermeable Areas

	Impermeable Area		Permeable Area		Total Area
	m²	%	m2	%	m²
Existing Site	364	67	178	33	542
Proposed Site	312	58	230	42	542
Difference	**-52**	**-10**	**52**	**10**	

The introduction of the soft landscaping reduces the impermeable area of the site by 10% (52m^2).

9 SuDS Requirements

9.1 Peak Flow Control

With regard to peak flow control, the non-statutory technical standards for sustainable drainage systems state that:

- S3 For developments which were previously developed, the peak runoff rate from the development to any drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event must be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event.

The London Plan SI.13 states that development proposals should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible. The London Plan Sustainable Design and Construction SPG (section 3.4.10) states that all developments on Greenfield sites must maintain Greenfield runoff rates. On previously developed sites, runoff rates should not be more than three times the calculated Greenfield rate.

9.2 Volume Control Requirements

With regard to volume control, the non-statutory technical standards for sustainable drainage systems state that:

- S5 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.
- S6 Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with S4 or S5 above, the runoff volume must be discharged at a rate that does not adversely affect flood risk.

9.3 Run-off and Storage Calculations

The IH124 method was applied to calculate the Greenfield and post-development run-off rates that include the 40% allowances for climate change. The full results are presented in Appendix 5. Table 3 below give a summary of the results.

Table 3: Calculation of post-development run-off rates for the site.

Parameter	Greenfield (l/s)	Pre - Development (l/s)	Post Development (l/s)
Qbar	0.24	0.29	0.28

Parameter	Greenfield (l/s)	Pre - Development (l/s)	Post Development (l/s)
1 in 1	0.20	0.24	0.24
1 in 30	0.55	0.66	0.64
1 in 100	0.76	0.92	0.89
1 in 100 + CC	1.13	1.36	1.32

As the development is taking place on a previously developed site S3 (peak flow) and S5 and S6 (volume controls) apply.

The target discharge rate was therefore set to between 0.2l/s and 1.3l/s. The aim is to achieve greenfield runoff rates wherever possible, and to never exceed the pre-development peak runoff rate.

The quick storage estimate tool in Microdrainage was used to estimate the approximate storage required. The storage volume required is estimated to be up to **27m^3**. Screenshots of the quick storage estimate and variables are available in Appendix 5.

10 Site Investigation

10.1 Site Investigation

A site investigation was undertaken on the 14th and 15th of March 2022 for the purposes of undertaking infiltration testing in line with BRE DG 365 guidance and geotechnical assessments.

2no. trial pits (TP01 & TP02) were excavated to depths of 1.2mbgl & 0.7mbgl respectively for the purpose of undertaking infiltration testing. The trial pits were excavated using a JCB Microlite.

Additionally, as part of a geoenvironmental investigation, 1no. boreholes (BH01) was excavated to a depth of 6mbgl using a dynamic windowless sampler rig for geotechnical in-situ testing and sampling.

10.2 Ground Conditions Encountered

The investigation encountered ground conditions that were generally consistent with the published geological records of the area. The trial pits encountered shallow Made Ground deposits, consisting of dark brown Silty CLAY, with occasional fragments of brick and concrete to a maximum depth of 0.2mbgl. This was underlain by soft to very soft very silty CLAY to a depth of 1.2mbgl.

10.3 Infiltration Testing

Infiltration testing in accordance with the methodology outlined in BRE Digest 365 was conducted in the two trial pits. The trial pits were rapidly filled with water from a 1.2m^3 water bowser and left to drain for a 24-hour period. The water levels were continuously monitored using a water level logger.

The water levels drained slowly within both trial pits. Both failed to drain more than 50% of their original volume within 24 hours. The testing was therefore abandoned.

Based on these findings, infiltration SuDS methods are considered to be unsuitable for the site.

Full details including photos, graphs, location map and results of the infiltration testing are available in Appendix 6.

11 SuDS Options

As mentioned above, planning policies require that SuDS strategies consider source control (i.e. disposal of runoff within the plot boundary), followed by site control (site wide disposal) and then regional control (appropriate for larger development with strategic drainage infrastructure). They also require that that those methods that give the most benefits in terms of sustainability are prioritised for employment (generally known as the SuDS Hierarchy) as further described below.

11.1 SuDS Hierarchy

The SuDS Hierarchy sets out the preferred method of selecting which Sustainable Drainage System should be used. Generally, 'soft SuDS' such as ponds and swales are the preferred drainage systems as they mimic natural drainage and provide a number of benefits including attenuation of surface water flows and flow rates as well as pollution.

Smaller developments which may not have the physical room for pond and swales would need to consider other options. In these cases, preference should be given to infiltration systems. However, care should be taken if implementing infiltration systems near aquifer protection zones, close to buildings or structural foundations or in areas where soils may be polluted.

The SuDS hierarchy is summarised in Figure 2 below.

Figure 2: SuDS Hierarchy

	SUDS technique	*Flood Reduction*	*Pollution Reduction*	*Landscape & Wildlife Benefit*
Most Sustainable	**Living roofs**	✔	✔	✔
	Basins and ponds - Constructed wetlands - Balancing ponds - Detention basins - Retention ponds	✔	✔	✔
	Filter strips and swales	✔	✔	✔
	Infiltration devices - soakaways - infiltration trenches and basins	✔	✔	✔
	Permeable surfaces and filter drains - gravelled areas - solid paving blocks - porous paviors	✔	✔	
Least Sustainable	**Tanked systems** - over-sized pipes/tanks - storms cells	✔		

11.2 Assessment of SuDS Options

An assessment was made of the suitability of a range of potential SuDS techniques that could be implemented as part of the development. The results of the assessment are summarised in Appendix 7 and are further discussed below.

Ground Cover	Existing Development Area		Proposed Development Area		Difference (m2)
	m^2	%	m^2	%	
Buildings	114	21	178	33	64
Hard Standing	250	46	134	25	-116
Soft landscaping	178	33	230	42	-52
Total	542	100	542	100	

11.2.1 Rainwater Harvesting

The use of rainwater butts and/or harvesting tanks could be employed within each individual building and patios, although they would have a limited storage capacity and will be required to be an active system.

The rainwater harvesting calculator tool in Microdrainage was run to establish the suitability of installed an active rainwater harvesting system. The entire rooftop is a suitable catchment area to provide an active rainwater harvesting system is viable for storm water control.

An active system allows for water attenuation and water reuse storage. Print screen calculations are present in Appendix 5.

11.2.2 Living Roofs

As buildings will cover more than 33% (178m^2) of the site, living roofs are considered to be a partially suitable SuDS technique, due to the proposed mixture of flat and pitched roofs.

11.2.3 Basins, Ponds, Filter Strips and Swales

Basins, ponds, filters strips and swales are not considered suitable due to limited space.

11.2.4 Infiltration Devices

Infiltration techniques should be given priority in any SuDS design as they deal with discharge on the site returning water to the aquifer and subsequently rivers via baseflow.

However, care must be taken to ensure that contamination of groundwater is prevented. The Environment Agency publication 'Groundwater protection: Policy and practice (GP3) Section G, 2012, states that the Environment Agency will support sustainable drainage systems for new discharges to ground subject to an appropriate risk assessment to demonstrate that ground conditions are suitable and infiltration systems do not present an unacceptable risk of promoting mobilisation of contaminants or creating new pathways for contaminant migration.

As discussed in Section 10, infiltration SuDS are not a suitable method to use on site.

11.2.5 Permeable Surfaces and Filter Drains

Over 25% (134m^2) of the development will consist of car parking and driveways which could be designed to be permeable.

11.2.6 Tanked Systems

A tanked system incorporating a hydro brake restricting flow to the sewer would be a viable option if infiltration is not suitable. However, this option is ranked as being the least sustainable in the SuDS hierarchy.

11.2.7 Summary of results of SuDS Options Assessment

A summary of the results of the SuDS Options Assessment is presented in Table 4 below. Full details of the options assessment along with descriptions of the SuDS options are presented in Appendix 7 and Appendix 8.

Table 4: Summary of Results of SuDS Options Assessment

SuDS Technique	Potential Suitability
Rainwater Harvesting	Suitable
Infiltration: Soakaways Infiltrations trenches and basins	Unsuitable
Green/brown/blue roofs	Partially Suitable
Rain Gardens	Suitable - Attenuation only
Permeable Pavements / Surfaces	Suitable - Attenuation only
Swales	Unsuitable
Detention basin/ponds	Unsuitable
Storage tanks/ Geocellular storage	Suitable
Oversized piping	Suitable

12 SuDS Implementation

12.1 SuDS Constraints

The main constraint to the SuDS used on site is the poor infiltration rate, as demonstrated during the site investigation.

12.2 Proposed SuDS

Run-off from the building rooftop catchment will be collected in rainwater harvesting tanks. These will allow for rainwater re-use within the dwelling and gardens and provide storm water attenuation.

Excess run-off from the tanks will be discharged into the permeable paving sub-base which will be laid across 134m^2 of pathways and car parking spaces. The permeable paving will provide attenuation storage and allow for some infiltration. Excess run-off from the permeable paving will be discharged to the Thames Water Surface Water sewer via orifice flow control devices that will limit the total discharge rate to the greenfield rate.

Examples of the proposed products are available in Appendix 8.

The proposed SuDS is further detailed below. A detailed drainage layout is available in Appendix 9.

12.2.1 Rainwater Harvesting Tanks

As mentioned in Section 11.6.1, the demand for non-potable water within the development will outstrip the average annual rainfall yield for the rooftop catchment area (178m^2). Therefore, a rainwater harvesting tank is considered appropriate for stormwater volume control.

To ensure the maximum efficiency of the tank during all seasons, and to ensure a reduction in water consumption, it should be designed with drought protection as well as the required attenuation in mind.

The daily non-potable water consumption of the proposed dwellings is estimated to be 0.85m^3. To offer suitable drought protection, the system should be designed with 18 - 21 days of drought protection. We can therefore assume a required volume of 15.3 -

17.85m^3, assuming a daily consumption rate of 50 litres of non-potable water use per person. See Table 5 below.

Table 5: Non-Potable Water Consumption

	People (No.)	Daily Consumption (Litres / day)	*Drought Protection Volume (m^3)
Flat 1 - 2 Bed	3	150	2.7 - 3.15
Flat 2 - 3 Bed	4	200	3.6 - 4.2
Flat 3 - 2 bed	3	150	2.7 - 3.15
Flat 4 - 2 Bed	3	150	2.7 - 3.15
Flat 5 - 1 bed	2	100	1.8 - 2.1
Flat 6 - 1 Bed	2	100	1.8 - 2.1
Total	17	850	15.3 - 17.85

** Drought protection calculation based off 18 - 21 days' worth of non-potable water supply.*

As shown in Appendix 5, the attenuation storage required for the rooftop catchment is up to 8.6m^3. We can therefore size an appropriate rainwater harvesting tank when considering all rainwater non-potable use and the requirement for storm water volume control.

Table 6: Rainwater Harvesting and Rooftop Attenuation

		Attenuation Required (m^3)		Storm Water Volume and Drought Protection (m^3)	
	Catchment (m^2)	Min	Max	Min	Max (m^3)
Apartment Block	178	5.6	8.6	20.9	26.45
Total	178				

Three 7.5m^3 rainwater harvesting tanks will be installed to form a combined total tank storage volume of 22.5m^3.

The combined total will provide 15m^3 of rainwater re-use, ensuring drought protection for approximately 18 days and 7.5m^3 of dedicated storm water attenuation.

Water levels within the tank will be controlled using a pump. Once the water levels exceed the storage level required for reuse, excess run-off will be pumped out into the permeable paving sub-base.

An example of the type of proposed rainwater harvesting unit to be installed is available in Appendix 8.

The remaining storm water attenuation will be provided within the permeable paving sub-based described in more detailed below.

Thames Water offer Environmental Discounts on infrastructure cost incurred from developments during the period of April 2022 to March 2023. There are potential savings of £1800 per property if all criteria are met [5].

The installation of the proposed rainwater harvesting tank will ensure criteria of Tier 2 of the Environmental Discount is achieved. To achieve Tier 2 of their discount, Tier 1 must be meet as well, this is discussed in Section 14.

12.2.2 Permeable Block Paving

The car parking areas and pathways account for 134m^2. Runoff from this area will be managed using permeable block paving.

Permeable Paving (Marshalls Prior or similar) combines hardstanding with SuDS and works in a very different way to traditional pavement. It is designed to allow rainfall to percolate immediately through the surface near to where the raindrop lands – so surface ponding is completely eradicated without the need for an additional channel drainage system.

The construction will consist of 80mm interlocking concrete blocks with jointing, with a 50mm underlying bedding layer with a 300mm sub-base consisting of a graded aggregate (Marshalls Priora Aggregates or similar) with a porosity of 0.30. This

400mm construction depth will provide CBR value of <5% which will be designed for cars and light vans. This construction over 134m^2 will provide approximately 12.6m^3 of interception, attenuation, and treatment storage, and it will allow some infiltration.

The water flows into a specially prepared sub-base, where the voids between the stones which make up the structure act as a temporary reservoir. During a rainstorm, the water is collected in the sub-base (‘attenuated‘) before it is slowly released either by natural infiltration into the ground beneath the pavement or toward the discharge point.

12.2.3 Discharge Control Device

An orifice flow-brake flow control chamber will be used to limit the discharge from the site into the Thames Water surface water sewer to 0.5l/s.

Details and examples of product specification sheets are available in Appendix 8.

12.2.4 Microdrainage Modelling

Microdrainage Modelling was carried out to assess the performance of the proposed drainage system under a variety of modelled storm events. The designed system including the proposed attenuation storage, provides a total storage of 37m^3 when including all pipes, manholes and storage structures.

No flooding was indicated during any of the modelled scenarios, including the 1 in 100 years plus 40% climate change.

Full results, drainage layout including the proposed discharge point and exceedance flows of this are available in Appendix 9.

12.2.5 Surface Water Discharge Points

As infiltration is not suitable and there are no nearby watercourses, run-off from the development will be conveyed via 150mm diameter lateral drains to the surface water sewer on Elm Avenue.

The closest surface water asset identified is 7502, it has a cover level of 53.5mAOD and invert level of 51.52mAOD. It is 10m north west of the Site. A copy drainage asset search is available in Appendix 4

A capacity check with Thames Water has been undertaken with regards to the surface water discharge. No response was available at the time of writing.

12.2.6 Treatment of Run-off

Treatment of roof water runoff will be provided through the provision of trapped gullies, filtration system within downpipes and rainwater harvesting tank in additional to the permeable paving to intercept gross solids and sediment.

The guidance will be provided to householders on appropriate maintenance requirements.

12.2.7 Exceedance Flows

The elevations within the site range from 52.74mAOD (S / SE) to 54.54mAOD (W). The existing property and garden are predominately flat situated at 52.8 - 53.3mAOD, south to north.

The elevation review of the proposal indicates that in the event of exceedance on the site, that overland flows would pool within the gardens or driveways of the development. Excess flows have potential to flow onto Elm Avenue, during extreme events, and stream towards the east before entering the road drainage.

It can be seen from the design proposals; the proposed system includes approximately 20.1m^3 of storm water storage capacity and 15m^3 storage dedicate to rainwater harvesting (not including pipes and manholes). In addition, a safety factor of 2 was applied to the Microdrainage modelling, which gives a further degree of confidence that exceedance flows are unlikely to occur. Nonetheless, appropriate level design will

be employed to ensure that flood waters are directed away from buildings in the unlikely event that an inundation of the proposed system results in overland flows.

A map displaying the exceedance flow is available in Appendix 9.

12.3 Maintenance and Adoption of SuDS

All SuDS features will be properly installed by competent persons. They will be maintained regularly to ensure that their design capacity and attenuation characteristics provide the required storage volume.

Landscaping and adjacent areas will be designed such that they do not cause soil, mulch and other materials to be washed onto the permeable surfaces and into drains causing clogging.
The maintenance will be carried out (under guarantee) by the drainage contractors responsible for installing it in the first 1 or 2 years of operation (dependent upon the contract specification) after which the responsibility will be transferred to the Property Management Company.

Owners of the properties/persons responsible for maintenance of SuDS components will be provided with operation and maintenance manuals which will include information such as:

- the location of SuDS components;
- an explanation of design intent and objective of the SuDS;
- the requirements for regular and occasional inspection and maintenance;
- visual indicators that may trigger maintenance.

An inspection checklist should be generated based on the maintenance strategy to facilitate consistent inspection of the condition of the system and as a method for recording inspections. Inspections should also be accompanied by photographic records to assist with the monitoring of the system. It is recommended that an annual

maintenance report should be prepared and retained within the Operation and Maintenance Manual.

Regular maintenance of SuDS components is relatively straightforward with the main tasks consisting of:

- Regular visual inspections – checking inlets are not blocked and verifying that clogging has not occurred;
- Litter and debris removal;
- Grass cutting;
- Preventive sweeping;
- Weeding and invasive plant control;
- Oil and stain removal.

Occasional maintenance activities to ensure the long-term performance of the SuDS features include:

- Sediment removal
- Vegetation and plant replacement

These simple measures will ensure that the storage capacity of the system is maintained and that the need for reconstruction and replacement of components is minimised.

Further details on SuDS maintenance measures that will be employed at the site can be found in Appendix 10.

13 Timetable for Implementation

An indicative timetable for implementation of the SuDS and other elements of the development are outlined in Appendix 11.

14 Water Efficiency

14.1.1 Water Consumption

The average UK daily consumption of water is 140 litres per day [5].

The introduction of the rainwater harvesting tanks will significantly reduce the water consumption per person within the proposal. As discussed in Section 12.1.1, the daily non-potable water consumption is 50 litres per day, per person.

The introduction of the rainwater harvesting tank will reduce the average daily water usage to below the target value of 110 litres per day. Above and beyond this, the newly developed flats will introduce modernised fittings and appliances that will reduce the daily water consumption further still.

The developer will implement some or all of the following:

- Water-efficient showerhead - Reduces water consumption to 8 / 9 litres per minute
- Dual Flush Toilets or High Efficiency Toilet (HET);
- Taps - inexpensive aerators add air into the water – using less and the flow feels the same
- Garden - Drought resistance plant
- Appliances - choose energy and water efficient washing machines and dishwashers
- Greywater or rainwater harvesting; both these can generate water to flush the loo, wash the car or water the garden. They are much more efficient and cost effective when installed during construction.

Building Control Regulations outline the maximum optional requirement level to achieve the 110 litres per day reduction.

Table 2.2 Maximum fittings consumption optional requirement level	
Water fitting	**Maximum consumption**
WC	4/2.6 litres dual flush
Shower	8 l/min
Bath	170 litres
Basin taps	5 l/min
Sink taps	6 l/min
Dishwasher	1.25 l/place setting
Washing machine	8.17 l/kilogram

Figure 3: Building Control Regulation Table 2.2 Part G

The installation of the above fittings within each apartment would ensure the discharge of part of the attached conditions, but would also allow for the meeting of Tier 1 of the Thames Water Environmental Discount, assuming suitable evidence is provided.

15 Conclusion and Recommendations

With the proposed SuDS mitigation measures in place, it is considered that the proposed development will reduce local flood risk and enhance the local environment and will therefore be in compliance with the LLFA's current planning policy and the NPPF.

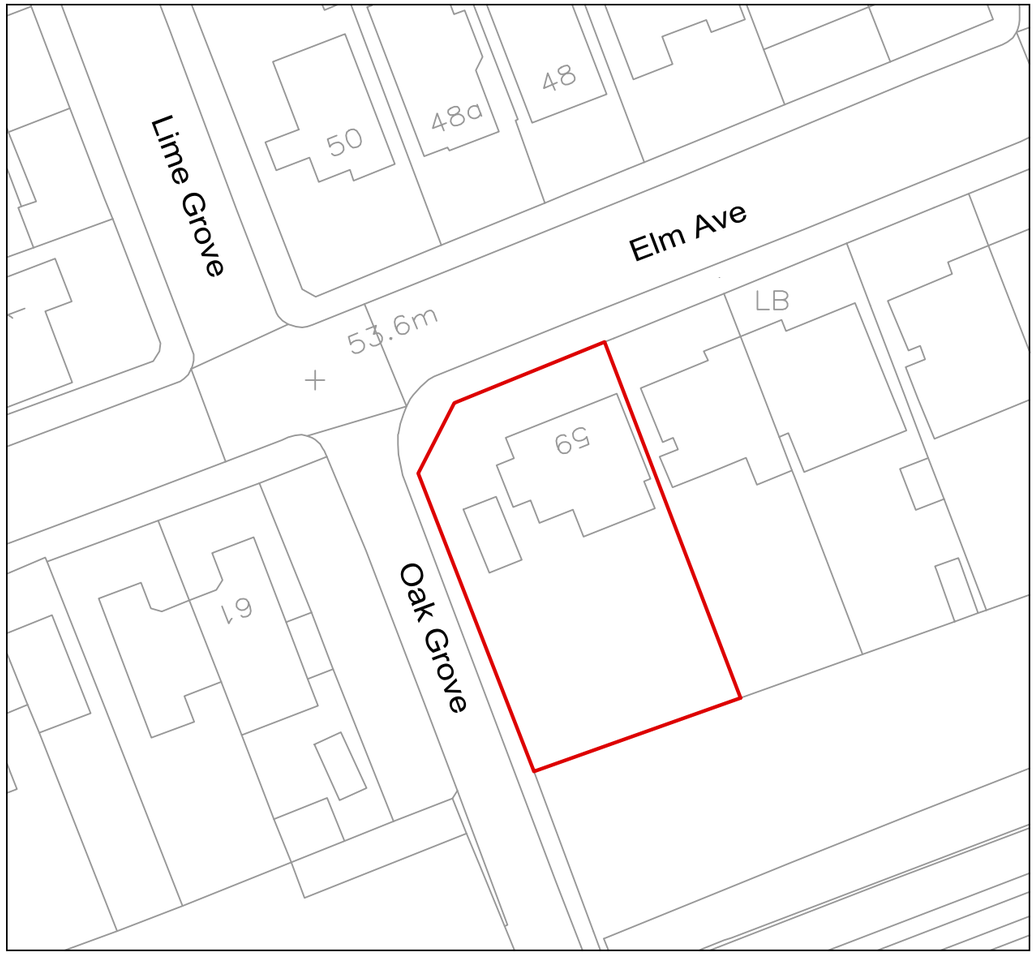
16 References

1. Communities and Local Government - National Planning Policy Framework NPPF, 2019.
2. The London Plan – The Spatial Development Strategy for Greater London - March 2021
3. CIRIA, Defra, Environment Agency – UK SuDS Manual, 2015.
4. London Borough of Hillingdon - Local Plan Part 2 - Development Management Polices – Adopted version January 2020.
5. Charging arrangements for new connection services - 1 April 2022 to 31 March 2023 Version 1 - Thames Water 2022
6. Sanitation, hot water safety and water efficiency. The Building Regulations 2010 - Online Version - Access 05/04/22 online here.

17 Appendices

17.1 Appendix 1 – Issued Documents

17.1.1 Development Plans



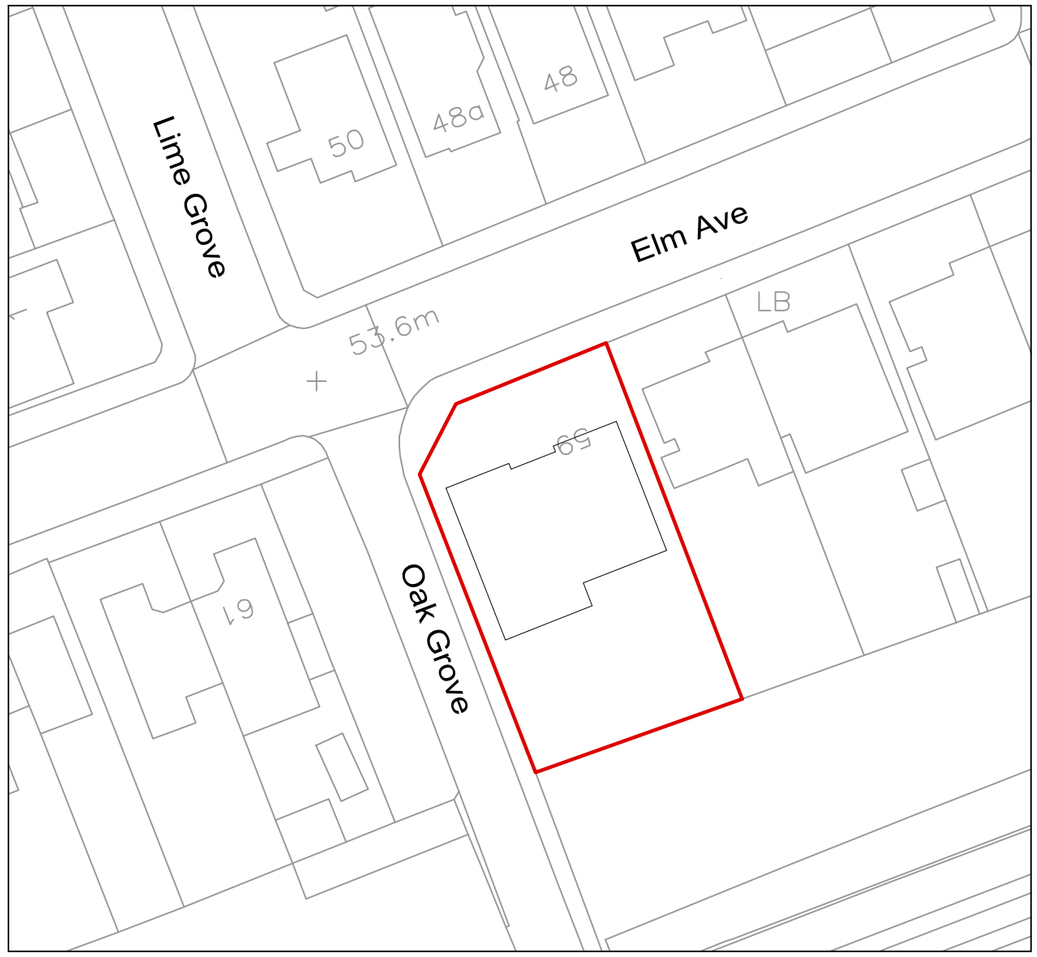
25000

0 5 10 25m 50m

Existing Site Plan Scale 1:500

10000

NORTH



25000

0 5 10 25m 50m

Proposed Site Plan Scale 1:500

10000

NORTH

Revision	Date	Description

important general note
the specification is to be read in conjunction with the plans/section details, and other associated structural details as may be provided.
all work is to be carried out to the local authority planning and building regulations approval, and the codes of practice and british standards as necessary.
all dimensions, levels, sizes, positions and locations of particulars as indicated on drawings are to be verified by the appointed contractor on site prior to engaging in works. any discrepancies must be reported to the architect/surveyor/engineer or responsible person/s immediately.
the contractor is responsible for ensuring compliance with the cdm regulations, and appropriate health & safety on site precautions.
the client/building owner must obtain any necessary party wall agreements, prior to engaging in the works on site.

3. this drawing is to be read in conjunction with all relevant architect's, service engineer's and drawings and specifications.

Paper Size: A3

Scale: 1:500

Revision: 1st

Nov-21

Drawn By/Checked By: ----

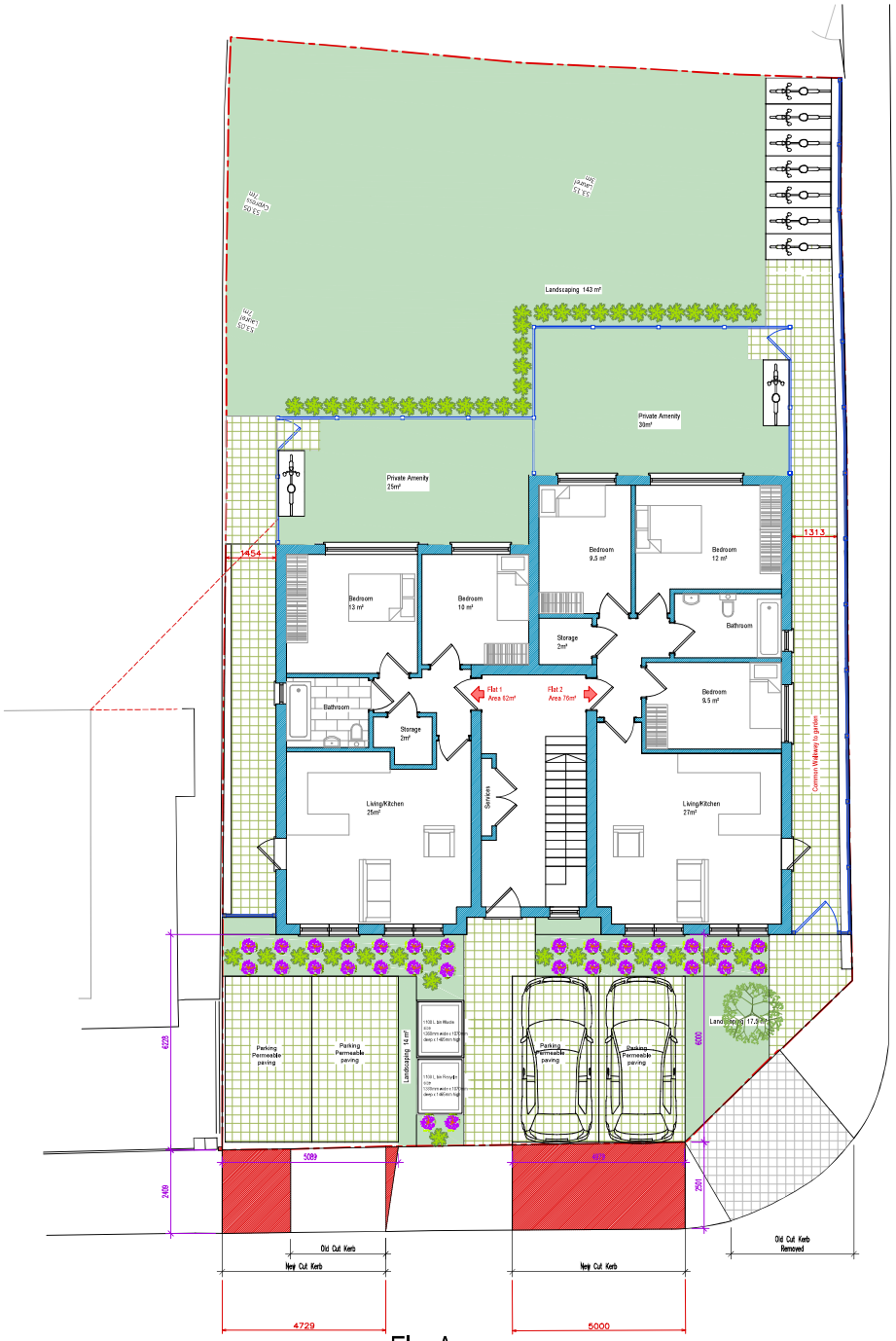
B-12 Development ®

Architectural consultancy

Site Address: 59 Elm Ave, Ruslip, HA4 8PE

Existing & Proposed Site Plan

Drawing Number: EA59-AP3-1002



Proposed Ground Floor Plan
Scale 1:100

Oak Grove

Revision	Date	Description

Important general note:
the specification is to be read in conjunction with the planirection details and other associated structural details as may be provided,
all work is to be carried out to the local authority planning and building regulations approval and the codes of practice and british standards as necessary,
all dimensions, levels, sizes, positions and locations of particulars as indicated on drawings are to be verified by the appointed contractor or sub-contractor engaging in works, any discrepancies must be reported to the architecture/engineer or responsible persons immediately,
the contractor is responsible for ensuring compliance with the cdm regulations, and appropriate health & safety on-site precautions,
the client building owner must obtain any necessary party wall agreements, prior to engaging in the works on site,

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Scale 1:100

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0 1 2 3 4 5 10m

Revision 1st

Nov-21

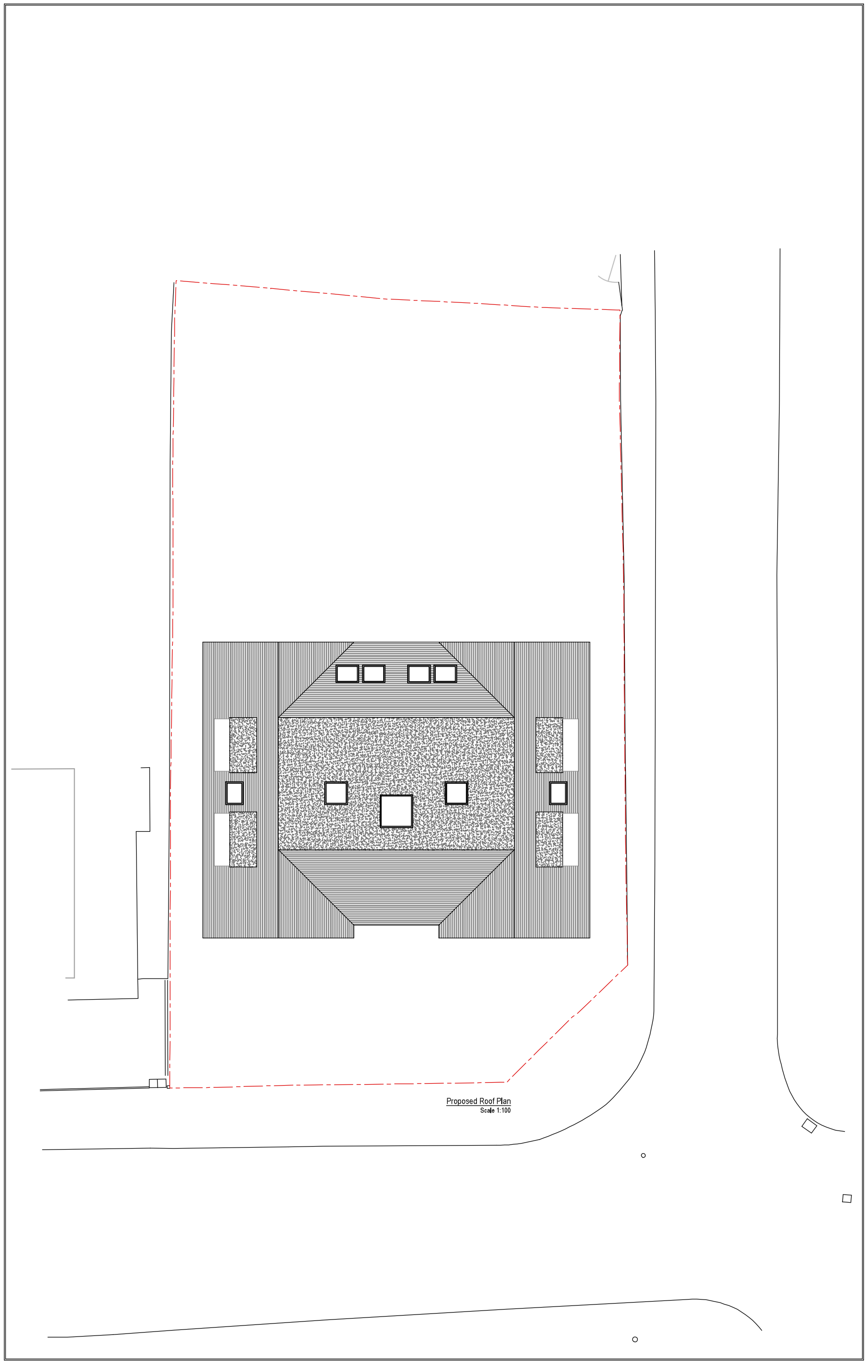
Drawn By/Checked By ----

B-12 Development
Architectural consultancy

Site Address
59 Elm Ave
Ruislip
HA4 8PE

Block Plan Showing Vehicular Crossover

Drawing Number EA59-AP3-1009



Proposed Roof Plan
Scale 1:100

Revision	Date	Description
A	25.11.21	Dormer Revised

important general note
the specification is to be read in conjunction with the plans/section details, and other associated structural details as may be provided.
all work is to be carried out to the local authority planning and building regulations approval, and the codes of practice and british standards as necessary.
all dimensions, levels, sizes, positions and locations of particulars as indicated on drawings are to be verified by the appointed contractor on site prior to engaging in works. any discrepancies must be reported to the architect/surveyor/engineer or responsible person/s immediately.
the contractor is responsible for ensuring compliance with the cdm regulations, and appropriate health & safety on site precautions.
the client/building owner must obtain any necessary party wall agreements, prior to engaging in the works on site.

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0 1 2 3 4 5 10m

Scale: 1:100
Revision: A
Nov-21
Drawn By/Checked By: ----

B-12 Development ®
Architectural consultancy

Site Address: 59 Elm Ave, Ruslip, HA4 8PE

Proposed Roof Plan

Drawing Number: EA59-AP3-1005

17.1.2 Decision Notice

[redacted]

Mr Rajan Patel
2 Juniper Road
Cove
Farnborough
GU14 9XU

Application Ref:
60130/APP/2021/4249

TOWN AND COUNTRY PLANNINGACT 1990 (AS AMENDED)

GRANT OF PLANNING PERMISSION

The Council of the London Borough of Hillingdon as the Local Planning Authority within the meaning of the above Act and associated Orders **GRANTS** permission for the following:-

Description of development:

Demolition of existing dwelling and erection a residential building housing 6 flats with associated bins and cycle provision. Removal of corner drop kerb and creation of new drop kerb and widening of front drop kerb

Location of development: 59 Elm Avenue Eastcote

Date of application: 17 November 2021

Plan Numbers: See attached Schedule of plans

Permission is subject to the condition(s) listed on the attached schedule:-

[redacted]

Head of Planning, Transportation and Regeneration

Date: 7 March 2022

NOTES: (i) Please also see the informatives included in the Schedule of Conditions.

(ii) Should you wish to appeal against any of the conditions please read the attached sheet which explains the procedure.

(iii) This decision does not convey any approval or consent which may be required under any by-laws, building regulations or under any Act other than the Town and Country Planning Act 1990 (as amended).

TOWN AND COUNTRY PLANNINGACT 1990 (AS AMENDED)

GRANT OF PLANNING PERMISSION

Application Ref: 60130/APP/2021/4249

SCHEDULE OF CONDITIONS

1 · The development hereby permitted shall be begun before the expiration of three years from the date of this permission.

REASON
To comply with Section 91 of the Town and Country Planning Act 1990.

2 · The development hereby permitted shall not be carried out except in complete accordance with the details shown on the submitted plans, titled 'Survey Rev. 1st ' and numbered EA59-AP3-1001 Rev. 1, EA59-AP3-1002 Rev. 1st, EA59-AP3-1003 Rev. C, EA59-AP3-1004 Rev. A, EA59-AP3-1005 Rev. A, EA59-AP3-1005 Rev. A, EA59-AP3-1007 Rev. A, EA59-AP3-1008 Rev. A, EA59-AP3-1009 Rev. A and EA59-AP3-1011 Rev. A (all received on 26.01.2022) and shall thereafter be retained/maintained for as long as the development remains in existence.

REASON
To ensure the development complies with the provisions of the Hillingdon Local Plan Part 1 (2012), Part 2 (2020) and the London Plan (2021).

3 · No development shall take place until details of all materials and external surfaces have been submitted to and approved in writing by the Local Planning Authority. Thereafter the development shall be constructed in accordance with the approved details and be retained as such.

Details should include information relating to make, product/type, colour and photographs/images.

REASON
To ensure that the development presents a satisfactory appearance in accordance with Policy DMHB 11 of the Hillingdon Local Plan Part 2 (2020).

SCHEDULE OF CONDITIONS

4 · Prior to the commencement of any site clearance, demolition or construction work, the applicant shall submit a demolition and construction management plan to the Local Planning Authority for its approval. The plan shall detail:

(a) The phasing of development works
(b) The hours during which development works will occur (please refer to informative I15 for maximum permitted working hours)
(c) Measures to prevent mud and dirt tracking onto footways and adjoining roads (including wheel washing facilities)
(d) Traffic management and access arrangements (vehicular and pedestrian) and parking provisions for contractors during the development process (including measures to reduce the numbers of construction vehicles accessing the site during peak hours)
(e) Measures to reduce the impact of the development on local air quality and dust through minimising emissions throughout the demolition and construction process
(f) The storage of demolition/construction materials on site.

The approved details shall be implemented and maintained throughout the duration of the demolition and construction process.

REASON
To safeguard the amenity of surrounding areas in accordance with Policy DMHB 11 of the Hillingdon Local Plan Part 2 (2020).

5 · The development hereby permitted shall not be commenced until a detailed design and method statement (in consultation with London Underground), has been submitted to and approved in writing by the Local Planning Authority. The design and method statement shall:

i) Provide demolition and construction details on all structures;
ii) Provide details on the use of scaffolding and tall plant; and
iii) Mitigate the effects of noise and vibration arising from the adjoining operations within the structures and tunnels.

The development shall thereafter be carried out in all respects in accordance with the approved design and method statement, and all structures and works comprised within the development hereby permitted which are required by the approved design statement in order to procure the matters mentioned in the above paragraphs of this condition shall be completed, in their entirety, before any part of the building hereby permitted is occupied.

REASON
To ensure that the development does not impact on existing London Underground transport infrastructure, in accordance with Policy T3 of the London Plan (2021).

SCHEDULE OF CONDITIONS

6 · No development approved by this permission shall be commenced until a scheme for the provision of sustainable water management and water efficiency has been submitted to and approved in writing by the Local Planning Authority. The scheme shall:

i. Provide information about the design storm period and intensity, the method employed to delay and control the surface water discharged from the site and the measures taken to prevent pollution of the receiving groundwater and/or surface waters;
ii. Include a timetable for its implementation; and
iii. Provide a management and maintenance plan for the lifetime of the development which shall include the arrangements for adoption by any public authority or statutory undertaker and any other arrangements to secure the operation of the scheme throughout its lifetime.

The scheme shall also demonstrate the use of methods to minimise the use of potable water through water collection, reuse and recycling and will:
iv. Provide details of water collection facilities to capture excess rainwater;
v. Provide details of how rain and grey water will be recycled and reused in the development;
vi. Provide details of how the dwellings will achieve a water efficiency standard of no more than 110 litres per person per day maximum water consumption.

Thereafter the development shall be implemented and retained/maintained in accordance with these details for as long as the development remains in existence.

REASON
To ensure the development does not increase the risk of flooding in accordance with Policy DMEI 10 of the Hillingdon Local Plan Part 2 (2020) and Policies SI2 and SI 13 of the London Plan (2021).

7 · Prior to the commencement of the development hereby approved, a sustainability and energy statement shall be submitted to and approved in writing by the Local Planning Authority. The sustainability and energy statement shall demonstrate how a 10% reduction in carbon dioxide emissions beyond Building Regulations requirement Part L 2013 (TER Baseline) has been achieved including full technology specifications and locations.

REASON
To ensure the development contributes to minimising the effects of, and can adapt to a changing climate in accordance with Policies DMEI 2 and DMEI 10 of the Hillingdon Local Plan: Part 2- Development Management Policies (2020) and Policy SI 2 of the London Plan (2021).

SCHEDULE OF CONDITIONS

8 · Notwithstanding the approved drawings and prior to any works on site above damp proof course level, a landscape scheme shall be submitted to and approved in writing by the Local Planning Authority. The scheme shall include: -

1. Details of Soft Landscaping
1.a Planting plans (at not less than a scale of 1:100)
1.b Written specification of planting and cultivation works to be undertaken
1.c Schedule of plants giving species, plant sizes, and proposed numbers/densities where appropriate

2. Details of Hard Landscaping
2.a Refuse Storage (including dimensions, external finishes and design)
2.b Cycle Storage
2.c Means of enclosure/boundary treatments
2.d Car Parking Layouts (including details of how the parking spaces will be allocated and details of provision of one 'active' and three 'passive' electric vehicle charging points)
2.e Hard Permeable Surfacing Materials
2.f External Lighting

4. Details of Landscape Maintenance
4.a Landscape Maintenance Schedule for a minimum period of 5 years
4.b Proposals for the replacement of any tree, shrub, or area of turfing/seeding within the landscaping scheme which dies or in the opinion of the Local Planning Authority becomes seriously damaged or diseased

5. Schedule for Implementation

6. Other
6.a Proposed finishing levels or contours
6.b. Details of ecological enhancements

Thereafter the development shall be carried out and maintained in full accordance with the approved details.

REASON
To ensure that the proposed development will preserve and enhance the visual amenities and ecology of the locality and provide adequate facilities in compliance with policies DMHB 11, DMHB 12, DMHB 14, DEMI 7 and DMT 2 of the Hillingdon Local Plan Part 2 (2020) and Policies G5 and G6 of the London Plan (2021).

SCHEDULE OF CONDITIONS

9 · No site clearance or construction work shall take place until the details have been submitted to, and approved in writing by, the Local Planning Authority with respect to:

1. A method statement outlining the sequence of development on the site including demolition, building works and tree protection measures.

2. Detailed drawings showing the position and type of fencing to protect the entire root areas/crown spread of trees, hedges and other vegetation to be retained shall be submitted to the Local Planning Authority for approval. No site clearance works or development shall be commenced until these drawings have been approved and the fencing has been erected in accordance with the details approved. Unless otherwise agreed in writing by the Local Planning Authority. Such fencing should be a minimum height of 1.5 metres.

Thereafter, the development shall be implemented in accordance with the approved details.
The fencing shall be retained in position until development is completed.
The area within the approved protective fencing shall remain undisturbed during the course of the works and in particular in these areas:
2.a There shall be no changes in ground levels;
2.b No materials or plant shall be stored;
2.c No buildings or temporary buildings shall be erected or stationed;
2.d No materials or waste shall be burnt; and
2.e No drain runs or other trenches shall be dug or otherwise created, without the prior written consent of the Local Planning Authority.

3. Where the arboricultural method statement recommends that the tree protection measures for a site will be monitored and supervised by an arboricultural consultant at key stages of the development, records of the site inspections / meetings shall be submitted to the Local Planning Authority.

REASON
To ensure that trees and other vegetation can and will be retained on site and not damaged during construction work and to ensure that the development conforms with policy DMHB 14 of the Hillingdon Local Plan Part 2 (2020).

10 · Prior to the occupation of the development hereby approved, information shall be submitted to and approved in writing by the Local Planning Authority detailing how the development would adhere to the principles of Secure by Design. The development shall be carried out and retained in accordance with the agreed details.

REASON
To ensure that the development meets Secure By Design principles in accordance with Policy D11 of the London Plan (2021).

SCHEDULE OF CONDITIONS

11 · Prior to the occupation of the development hereby approved, the timber features on the front and rear gables as detailed on approved drawing number EA59-AP3-1006 Rev. A (received on 26.01.2022) shall be installed in accordance with the material and external surface details approved as part of Condition 3 of this permission.

REASON
To ensure that the development presents a satisfactory appearance in accordance with Policy DMHB 11 of the Hillingdon Local Plan Part 2 (2020).

12 · Prior to any works on site above damp proof course level, details of step free access via all points of entry and exit shall be submitted to, and approved in writing, by the Local Planning Authority. Such provision shall remain in place for the life of the building.

REASON
To ensure housing of an inclusive design is achieved and maintained in accordance with Policies D5 and D7 of the London Plan (2021).

13 · Prior to the occupation of the development hereby approved, the two ground floor flats labelled as Flats 1 and 2 on drawing number EA59-AP3-1011 Rev. A (received on 26.01.2022) shall be constructed to meet the standards for a Category 3, M4(3)(2)(a) Wheelchair Adaptable Standard dwelling, as set out in Approved Document M to the Building Regulations (2010) 2015, with all such provisions remaining in place for the life of the building.

REASON
To allow the Building Control body to check compliance of the development against the optional Building Regulations standards, and ensure an appropriate standard of housing, in accordance with policy D7 of London Plan (2021).

14 · No development shall take place until plans of the site showing the existing and proposed ground levels and the proposed finished floor levels of all proposed buildings have been submitted to and approved in writing by the Local Planning Authority. Such levels shall be shown in relation to a fixed and known datum point and the internal floor level of the development shall be set at a minimum 300mm above natural ground level in accordance with the recommendation of paragraph 9.2 of the Flood Risk Assessment dated 5th January 2021 (reference: WTFR-FRA-2020/12/Q22).

Thereafter the development shall not be carried out other than in accordance with the approved details.

REASON
To ensure that the development relates satisfactorily to adjoining properties and to limit the risk of surface water flooding in accordance with Policies DMHB 11 and DMEI 9 of the Hillingdon Local Plan: Part 2 - Development Management Policies (2020) and Policy SI 12 of the London Plan (2021).

SCHEDULE OF CONDITIONS

15 · No additional windows, doors or other openings shall be constructed in the walls or roof slopes of the development hereby approved.

REASON
To prevent overlooking to adjoining properties in accordance with policy DMHB 11 of the Hillingdon Local Plan Part 2 (2020).

16 · Notwithstanding the approved drawings, the first floor windows, and second floor dormer windows and roof lights facing number 57 Elm Avenue as detailed on approved drawing number EA59-AP3-1004 Rev. A (received on 26.01.2022) shall be glazed with permanently obscured glass to at least scale 4 on the Pilkington scale and be non-opening below a height of 1.8 metres taken from internal finished floor level for so long as the development remains in existence.

REASON
To prevent overlooking to adjoining properties in accordance with policy DMHB 11 of the Hillingdon Local Plan Part 2 (2020).

17 · The side bedroom window serving Flat 2 as detailed on approved drawing number EA59-AP3-1003 Rev. C (received on 26.01.2022) shall be obscure glazed to at least scale 4 on the Pilkington scale up to 1.5 metres taken from the internal floor level for so long as the development remains in existence.

REASON
To protect the privacy of the future occupants of Flat 2 in accordance with policy DMHB 11of the Hillingdon Local Plan Part 2 (2020).

18 · Prior to the occupation of the development hereby approved, the redundant existing vehicular crossovers from the site to Elm Avenue as shown on approved drawing number EA59-AP3-1003 Rev. C, EA59-AP3-1009 Rev. A and EA59-AP3-1011 Rev. A (all received on 26.01.20222) shall be permanently closed. The crossover perpendicular to Elm Avenue shall have new kerb stones and surfacing to tie in with the existing but the crossover at the junction of Elm Avenue and Oak Grove shall have kerb stones of sufficient height to deflect vehicles that would otherwise over run the footway. All works are to be reinstated in a manner to be agreed in writing by the Local Planning Authority.

REASON
In the interest of highway safety and the visual amenity of the area in accordance with Policies DMT 2 and DMT 6 of the Hillingdon Local Plan: Part Two - Development Management Policies (2020).

19 · Nothing shall be erected, retained, planted and/or allowed to grow at or above a height of 0.6 metres along the front boundary of the site adjacent to Elm Avenue.

REASON
In the interest of highway safety and the visual amenity of the area in accordance with Policies DMT 2 and DMT 6 of the Hillingdon Local Plan: Part Two - Development Management Policies (2020).

SCHEDULE OF CONDITIONS

20 · Notwithstanding the approved drawings the vehicle crossovers shall be constructed to dimensions of 5.4m flat kerbs stones with 0.6m tapers with a minimum of 4.8m at back of footway. Each double crossover must be separated as an absolute minimum by one 0.9m full kerb face to accord with the Council's Domestic Vehicle Footway Crossover Policy 2021.

REASON
In the interest of highway safety and the visual amenity of the area in accordance with Policies DMT 2 and DMT 6 of the Hillingdon Local Plan: Part Two - Development Management Policies (2020).

21 · Prior to commencement, details of the proposed works to the embankment, including any excavation, shall be confirmed in writing to the Local Planning Authority. This shall include a conditions survey of the adjoining footway on Oak Grove, details of how the integrity of this foot way will be maintained, and a commitment to the repair of any damage to this footway as a result of adjacent works during the construction and operation of the development.

REASON
To ensure that the development does not compromise the structural integrity of the embankment adjoining Oak Grove and does not in turn compromise the safety of pedestrians or highway users, in accordance with Policies DMT 2 and DMT 5 of the Hillingdon Local Plan: Part 2 (2020).

INFORMATIVES:

1 . In dealing with the application the Council has implemented the requirement in the National Planning Policy Framework to work with the applicant in a positive and proactive way. We have made available detailed advice in the form of our statutory policies from Local Plan Part 1, Local Plan Part 2, Supplementary Planning Documents, Planning Briefs and other informal written guidance, as well as offering a full pre-application advice service, in order to ensure that the applicant has been given every opportunity to submit an application which is likely to be considered favourably.

2 . The decision to GRANT planning permission has been taken having regard to all relevant planning legislation, regulations, guidance, circulars and Council policies, including The Human Rights Act (1998) (HRA 1998) which makes it unlawful for the Council to act incompatibly with Convention rights, specifically Article 6 (right to a fair hearing); Article 8 (right to respect for private and family life); Article 1 of the First Protocol (protection of property) and Article 14 (prohibition of discrimination).

3 . The decision to GRANT planning permission has been taken having regard to the policies and proposals in the Hillingdon Local Plan Part 1 (2012) and Part 2 (2020) set out below, including Supplementary Planning Guidance, and to all relevant material considerations, including The London Plan (2021) and national guidance.

Part 1 Policies:

PT1.BE1 (2012) Built Environment

Part 2 Policies

DMCI 7 Planning Obligations and Community Infrastructure Levy

SCHEDULE OF CONDITIONS

DMEI 2	Reducing Carbon Emissions
DMEI 7	Biodiversity Protection and Enhancement
DMEI 9	Management of Flood Risk
DMEI 10	Water Management, Efficiency and Quality
DMH 1	Safeguarding Existing Housing
DMH 2	Housing Mix
DMH 4	Residential Conversions and Redevelopment
DMHB 11	Design of New Development
DMHB 12	Streets and Public Realm
DMHB 14	Trees and Landscaping
DMHB 15	Planning for Safer Places
DMHB 16	Housing Standards
DMHB 17	Residential Density
DMHB 18	Private Outdoor Amenity Space
DMT 1	Managing Transport Impacts
DMT 2	Highways Impacts
DMT 5	Pedestrians and Cyclists
DMT 6	Vehicle Parking
LPP D1	(2021) London's form, character and capacity for growth
LPP D3	(2021) Optimising site capacity through the design-led approach
LPP D4	(2021) Delivering good design
LPP D5	(2021) Inclusive design
LPP D6	(2021) Housing quality and standards
LPP D7	(2021) Accessible housing
LPP G1	(2021) Green infrastructure
LPP G5	(2021) Urban greening
LPP G6	(2021) Biodiversity and access to nature
LPP H1	(2021) Increasing housing supply
LPP H2	(2021) Small sites
LPP H10	(2021) Housing size mix
LPP SI12	(2021) Flood risk management
LPP SI13	(2021) Sustainable drainage
LPP SI2	(2021) Minimising greenhouse gas emissions
LPP T5	(2021) Cycling
LPP T6	(2021) Car parking
LPP T6.1	(2021) Residential parking
NPPF11	NPPF 2021 - Making effective use of land
NPPF12	NPPF 2021 - Achieving well-designed places
NPPF15	NPPF 2021 - Conserving and enhancing the natural environment

SCHEDULE OF CONDITIONS

NPPF2	NPPF 2021 - Achieving sustainable development
NPPF4	NPPF 2021 - Decision-Making
NPPF5	NPPF 2021 - Delivering a sufficient supply of homes
NPPF6	NPPF 2021 - Building a strong, competitive economy
NPPF9	NPPF 2021 - Promoting sustainable transport

4 . Under the terms of the Planning Act 2008 (as amended) and Community Infrastructure Levy Regulations 2010 (as amended), this development is liable to pay the London Borough of Hillingdon Community Infrastructure Levy (CIL) and the Mayor of London's Community Infrastructure Levy (CIL). This will be calculated in accordance with the London Borough of Hillingdon CIL Charging Schedule 2014 and the Mayor of London's CIL Charging Schedule 2012. Before commencement of works the development parties must notify the London Borough of Hillingdon of the commencement date for the construction works (by submitting a Commencement Notice) and assume liability to pay CIL (by submitting an Assumption of Liability Notice) to the Council at planning@hillingdon.gov.uk. The Council will then issue a Demand Notice setting out the date and the amount of CIL that is payable. Failure to submit a valid Assumption of Liability Notice and Commencement Notice prior to commencement of the development may result in surcharges being imposed.

The above forms can be found on the planning portal at: www.planningportal.gov.uk/planning/applications/howtoapply/whattosubmit/cil

Pre-Commencement Conditions: These conditions are important from a CIL liability perspective as a scheme will not become CIL liable until all of the pre-commencement conditions have been discharged/complied with.

5 . Nuisance from demolition and construction works is subject to control under The Control of Pollution Act 1974, the Clean Air Acts and other related legislation. In particular, you should ensure that the following are complied with:-

A. Demolition and construction works which are audible at the site boundary shall only be carried out between the hours of 08.00 and 18.00 hours Monday to Friday and between the hours of 08.00 hours and 13.00 hours on Saturday. No works shall be carried out on Sundays, Bank or Public Holidays.

B. All noise generated during such works shall be controlled in compliance with British Standard Code of Practice BS 5228:2009.

C. Dust emissions shall be controlled in compliance with the Mayor of London's Best Practice Guidance' The Control of dust and emissions from construction and demolition.

D. No bonfires that create dark smoke or nuisance to local residents.

You are advised to consult the Council's Environmental Protection Unit (www.hillingdon.gov.uk/noise Tel. 01895 250155) or to seek prior approval under Section 61 of the Control of Pollution Act if you anticipate any difficulty in carrying out construction other than within the normal working hours set out in (A) above, and by

SCHEDULE OF CONDITIONS

means that would minimise disturbance to adjoining premises.

6 . All proposed new street names must be notified to and approved by the Council. Building names and numbers, and proposed changes of street names must also be notified to the Council. For further information and advice, contact - The Street Naming and Numbering Officer, Planning & Community Services, 3 North Civic Centre, High Street, Uxbridge, UB8 1UW (Tel. 01895 250557).

7 . The development requires the formation of a vehicular crossover, which will be constructed by the Council. This work is also subject to the issuing of a separate licence to obstruct or open up the public highway. For further information and advice contact: - Highways Maintenance Operations, 4W/07, Civic Centre, Uxbridge, UB8 1UW.

8 . You are advised by London Borough of Hillingdon, Highways Management, that any works on the Highway, in relation to the reinstatement of any existing vehicle access, must be carried out with approval from the Highway Authority. Failure to reinstate an existing vehicle access will result in the Highway Authority completing the works, and the developer may be responsible for the costs incurred. Enquiries should be addressed to: Highways Maintenance, 4W/07, Civic Centre, Uxbridge, UB8 1UW.

9 . The Council will recover from the applicant the cost of highway and footway repairs, including damage to grass verges.

Care should be taken during the building works hereby approved to ensure no damage occurs to the verge or footpaths during construction. Vehicles delivering materials to this development shall not override or cause damage to the public footway. Any damage will require to be made good to the satisfaction of the Council and at the applicant's expense.

For further information and advice contact - Highways Maintenance Operations, Central Depot - Block K, Harlington Road Depot, 128 Harlington Road, Hillingdon, Middlesex, UB3 3EU (Tel: 01895 277524).

For Private Roads: Care should be taken during the building works hereby approved to ensure no damage occurs to the verge of footpaths on private roads during construction. Vehicles delivering materials to this development shall not override or cause damage to a private road and where possible alternative routes should be taken to avoid private roads. The applicant may be required to make good any damage caused.

10 . Your attention is drawn to the fact that the planning permission does not override property rights and any ancient rights of light that may exist. This permission does not empower you to enter onto land not in your ownership without the specific consent of the owner. If you require further information or advice, you should consult a solicitor.

SCHEDULE OF CONDITIONS

11 . Wildlife and Countryside Act 1981: Note that it is an offence under this act to disturb roosting bats, nesting birds or any other protected species. Therefore, if applicable, it is advisable to consult your tree surgeon / consultant to agree an acceptable time for carrying out the approved works.

END OF SCHEDULE

Address:
Residents Services
London Borough of Hillingdon
3 North Civic Centre, High Street, Uxbridge UB8 1UW
Tel: 01895 250230
www.hillingdon.gov.uk

GRANT OF PLANNING PERMISSION

Application Ref.No.: 60130/APP/2021/4249

SCHEDULE OF PLANS

Flood Risk Assessment dated 5th January 2021, Ref: WTFR-FRA-2020/12/Q22 - received 17 Nov 2021

Parking Survey dated December 2020 - received 17 Nov 2021

Daylight and Sunlight Assessment for Planning Issued: December 2020, Issue: 1, Job No: 3647 - received 17 Nov 2021

EA59-AP3-1010 Rev. 1st - received 26 Jan 2022

EA59-AP3-1011 Rev. A - received 26 Jan 2022

Planning, Design and Access Statement - received 17 Nov 2021

Survey Rev. 1st - received 26 Jan 2022

EA59-AP3-1001 Rev. 1st - received 26 Jan 2022

EA59-AP3-1002 Rev. 1st - received 26 Jan 2022

EA59-AP3-1003 Rev. C - received 26 Jan 2022

EA59-AP3-1004 Rev. A - received 26 Jan 2022

EA59-AP3-1005 Rev. A - received 26 Jan 2022

EA59-AP3-1006 Rev. A - received 26 Jan 2022

EA59-AP3-1007 Rev. A - received 26 Jan 2022

EA59-AP3-1008 Rev. A - received 26 Jan 2022

EA59-AP3-1009 Rev. A - received 26 Jan 2022

RIGHTS OF APPLICANTS AGGRIEVED BY DECISION OF LOCAL PLANNING AUTHORITY

TOWN AND COUNTRY PLANNING ACT 1990 (AS AMENDED)

If you are aggrieved by the decision of your local planning authority to refuse permission for the proposed development or to grant it subject to conditions, then you can appeal to the office of the First Secretary of State under Section 78 of hte Town and Country Planning Act 1990.

If you want to appeal, then you must do so within six months of the date of this notice, using a form which you can get from the Planning Inspecorate at Customer Support Unit, Room 3/15 Eagle Wing, Temple Quay House, 2 The Square, Temple Quay, Bristol, BS1 6PN (Tel 0117 372 8424) Appeal forms can be downloaded from the Planning Inspectorate's website at **www.Planning-inspectorate.gov.uk**

If you intend to submit an appeal that you would like examined by inquiry then you must notify the Local Planning Authority and Planning Inspectorate (inquiryappeals@planninginspectorate.gov.uk) at least 10 days before submitting the appeal.
Further details are available at **www.gov.uk/government/collections/casework-dealt-with-by-inquiries**

The Secretary of State can allow a longer period for giving notice of an appeal, but he will not normally be prepared to use this power inless there are special circumstances, which excuse the deploy in giving notice of an appeal.

The Secretary of State need not consider an appeal if it seems to him that the local planning authority could not have granted planning permission for the proposed development or could not have granted it without the conditions imposed, having regard to the statutory requirements, to the provisions of any development order and to any directions given under a development order.

In practice, the Secretary of State does not refuse to consider appeals solely because the local planning authority based their decision on a direction given by him.

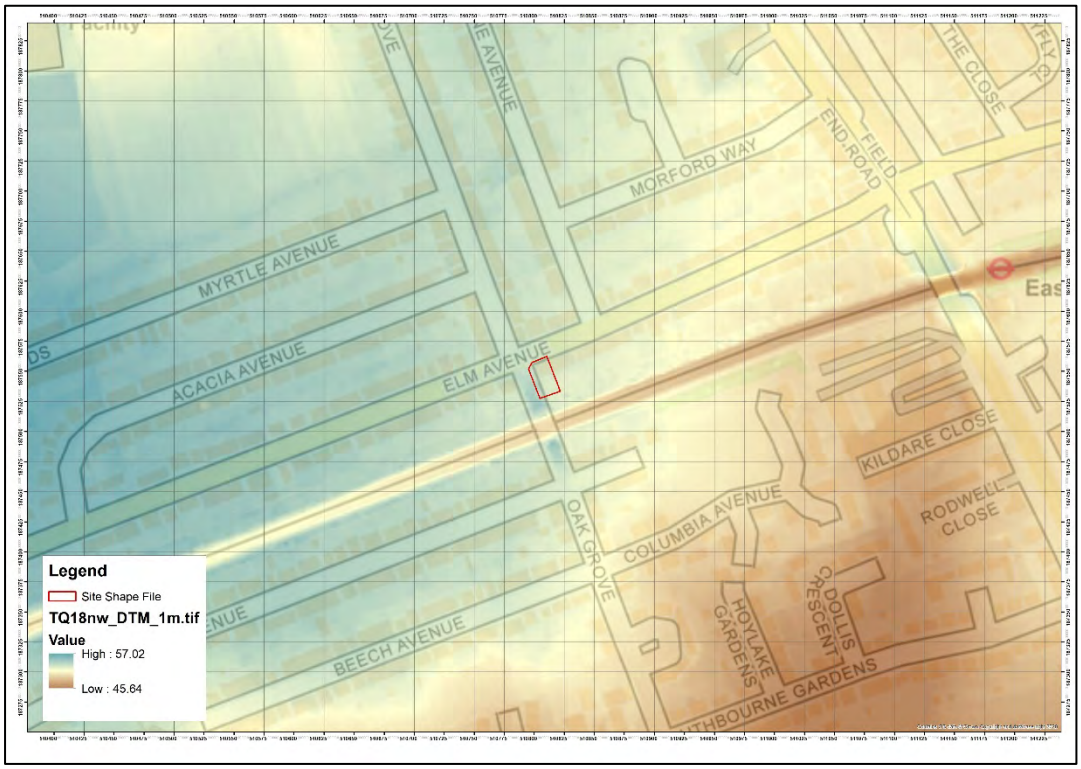
Purchase Notices.

If either the local planning authority or the officer of the First Secretary of State refuses permission to develop land or grants it subject to conditions, the owner may claim that he can neither put the land to a reasonably beneficial use by carrying out of any development which has been or would be permitted.

In these circumstances, the owner may serve a purchase notice on the Council (District Council, London Borough Council or Common Council of the City of London) in whose area the land is situated. This notice will require the Council to purchase his interest in the land in accordance with the provisions of Part VI of the Town and Country Planning Act 1990.

17.2 Appendix 2– Site Topography and Drainage Characteristics

17.2.1 LIDAR Mapping showing Site Topography - (Source: OS 2017)



17.2.2 Site Topographical Survey

NOTES

1. LEVELS ARE RELATED TO ORDNANCE SURVEY BY GPS OBSERVATION.
2. SURVEY ORIENTATED NORTH BY GPS OBSERVATION.
3. GIRTH, SPREADS, HEIGHTS AND SPECIES OF TRESS ARE INDICATIVE ONLY.
4. SURVEY HAS BEEN CARRIED OUT TO AN ACCURACY COMMENSURATE WITH A 1:100 SCALE DRAWING.
5. DETAILS IN ADJACENT PROPERTIES ARE APPROXIMATE WHERE WE HAVE NO ACCESS.
6. LEVELS SHOWN ON KERB LINES ARE ROAD (CHANNEL) LEVELS.

ABBREVIATION LIST

AV	AIR VALVE
B	BOLLARD
CL	COVER LEVEL
DK	DROPPED KERB
DPC	DAMP PROOF COURSE
ECB	ELECTRIC CABLE CABINET
ECP	ELECTRIC CABLE PIT
EP	ELECTICITY POLE
ER	EARTH ROD
FAI	FRESH AIR INLET
FH	FIRE HYDRANT
GC	GAS COCK
GL	GAS LINE
GUS	GULLY SURROUND
IC	INSPECTION COVER
IL	INVERT LEVEL
LC	LAMP COLUMN
M	SERVICE MARKER
MH	MANHOLE COVER
NPV	NO PIPES VISIBLE
OHC	OVERHEAD CABLES
OL	OPTICAL
RWP	RAIN WATER PIPE
SC	STOP COCK
SV	STOP VALVE
SVP	SOIL AND VENT PIPE
TBM	TEMPORARY BENCH MARK
TCB	TELEPHONE CABLE CABINET
TC	TELEPHONE CABLE PIT
TP	TELEPHONE POLE
TOS	TOP OF SILT
TOW	TOP OF WALL
TOW	TOP OF PALLA
TV	CABLE TV PIT
UTL	UNABLE TO LIFT
VP	VENT PIPE
WL	WATER LEVEL
WM	WATER METER
WO	WASH OUT

STATION CO-ORDINATES

NO.	EASTING	NORTHING	LEVEL
1	510795.647	187558.134	53.428
2	510810.152	187539.608	52.994
3	510801.423	187534.756	54.703
4	510809.641	187564.257	53.314

2
122.11 SURVEY STATION

STATIONS IN HARD SURFACES ARE CROSS HEAD GALVANISED BOLTS.

STATIONS IN SOFT GROUND ARE PEGS AT GROUND LEVEL WITH CROSS HEAD GALVANIZED SCREWS.

NO.	DATE	DETAILS

REVISIONS

KND SURVEYS LTD
74 WATCHET LANE
HOLMER GREEN
HIGH WYCOMBE
BUCKINGHAMSHIRE
HP15 6UG
Tel: 01494 718453
Fax: 01494 717576
e-mail: admin.office@kndsurveys.com

CLIENT

SILVER CIRCLE PROPERTY LTD
21 GRASMERE AVENUE
WEMBLEY
HA9 8TB

JOB TITLE

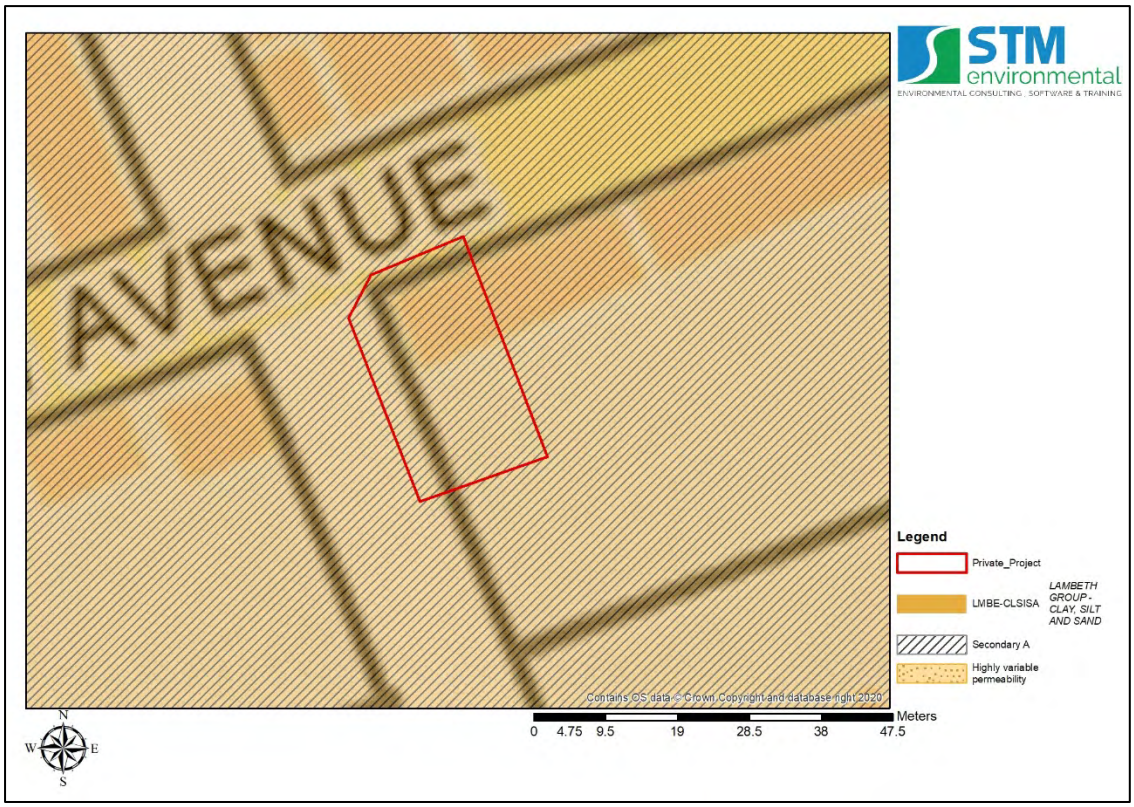
59 ELM AVENUE
RUISLIP
HA4 8PE

DRAWING TITLE

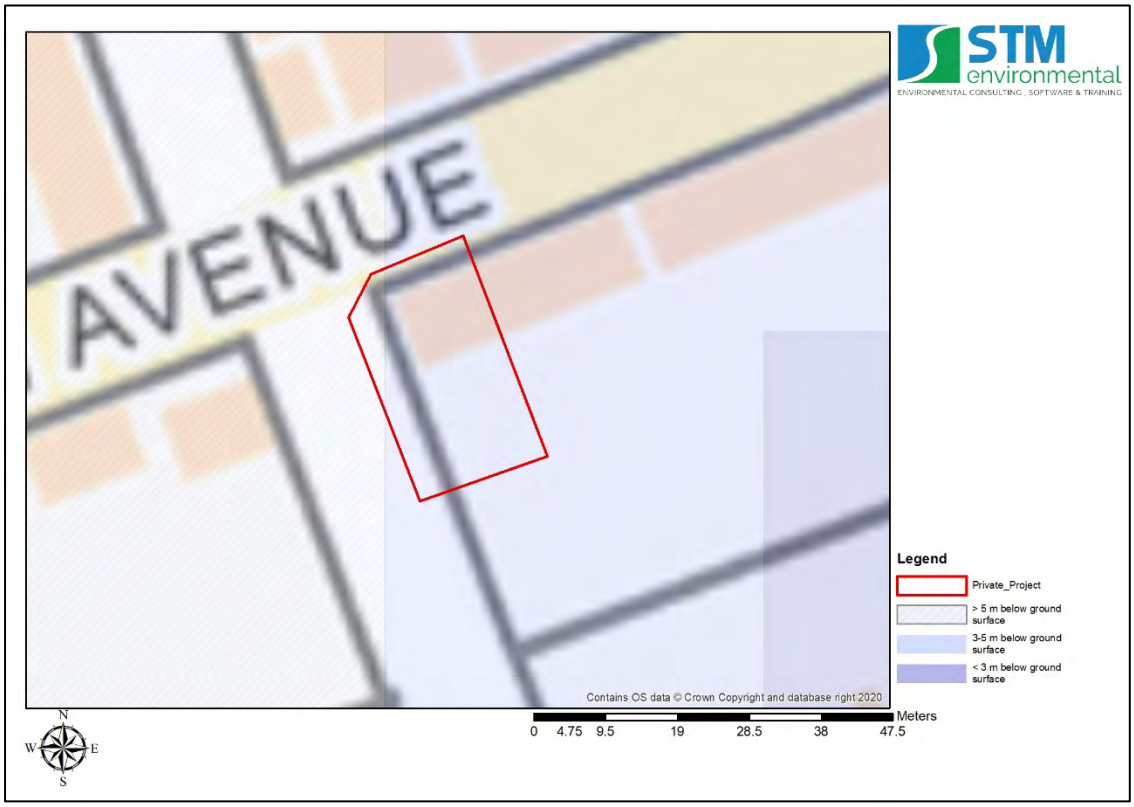
SITE SURVEY

DRAWING No.	DRAWN BY	DATE
H0920 - T	MF	12 AUG 2020
SURVEYED BY		**SCALE**
DJH / ACG		1:100 A0 Sheet

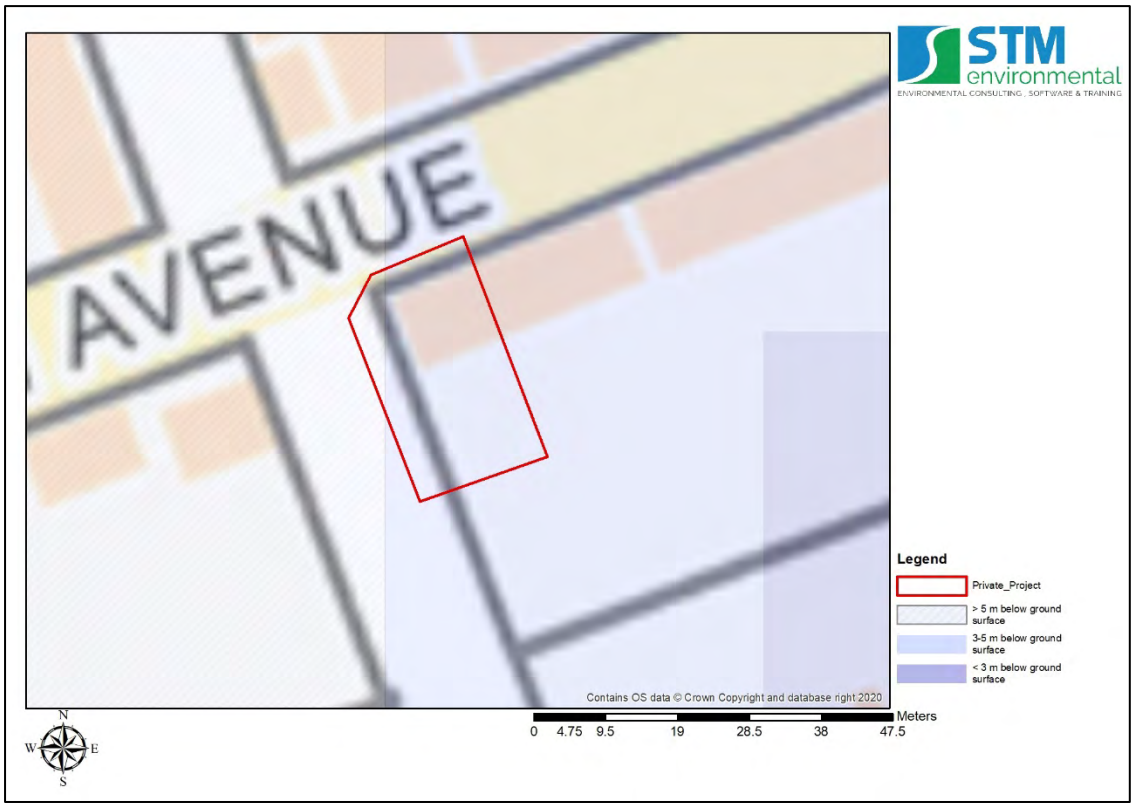
17.2.3 Bedrock Hydrogeology and Permeability (Source: BGS, 2016)



17.2.4 Infiltration Drainage Potential (Source: BGS, 2016)

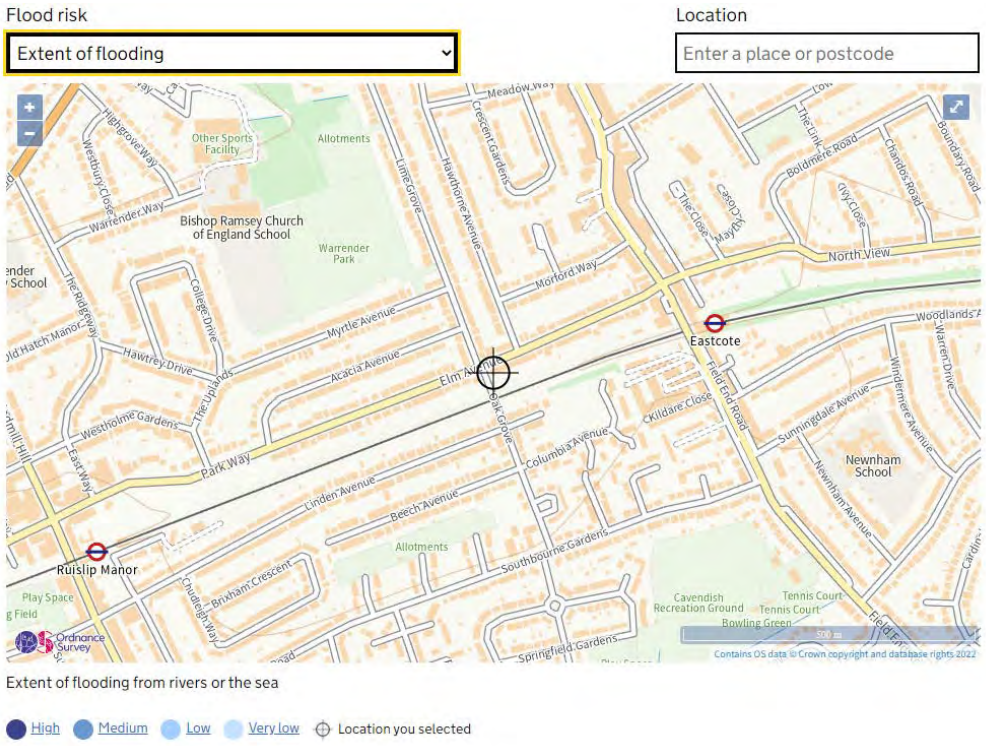


17.2.5 Groundwater Table Depth (Source: BGS 2016)

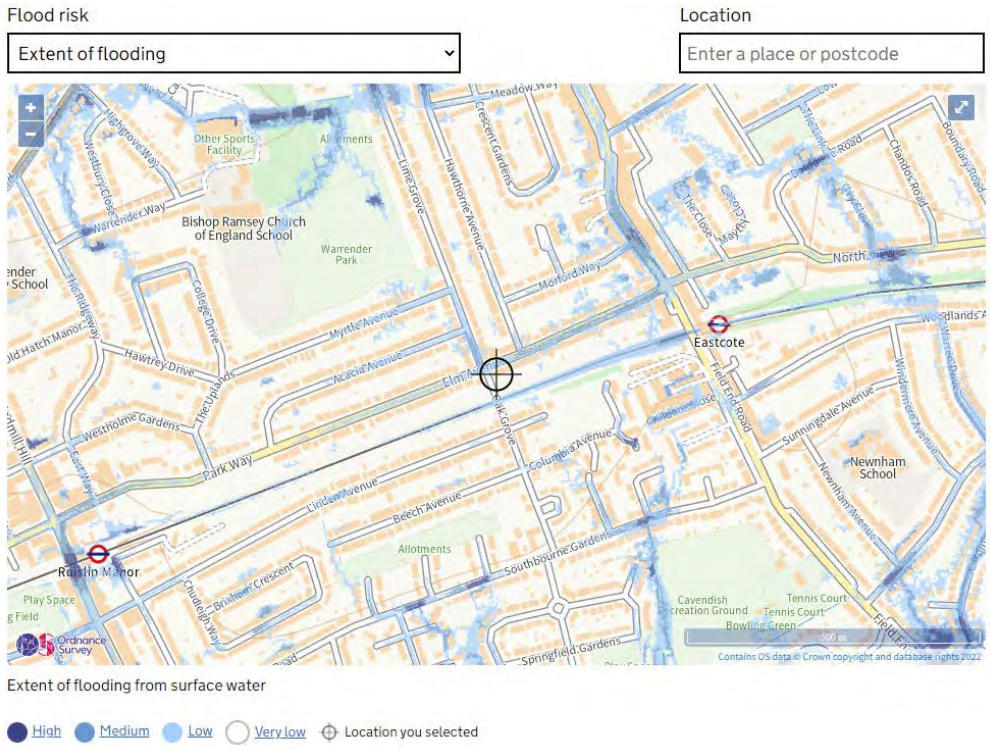


17.3 Appendix 3 – Flood Risk Mapping

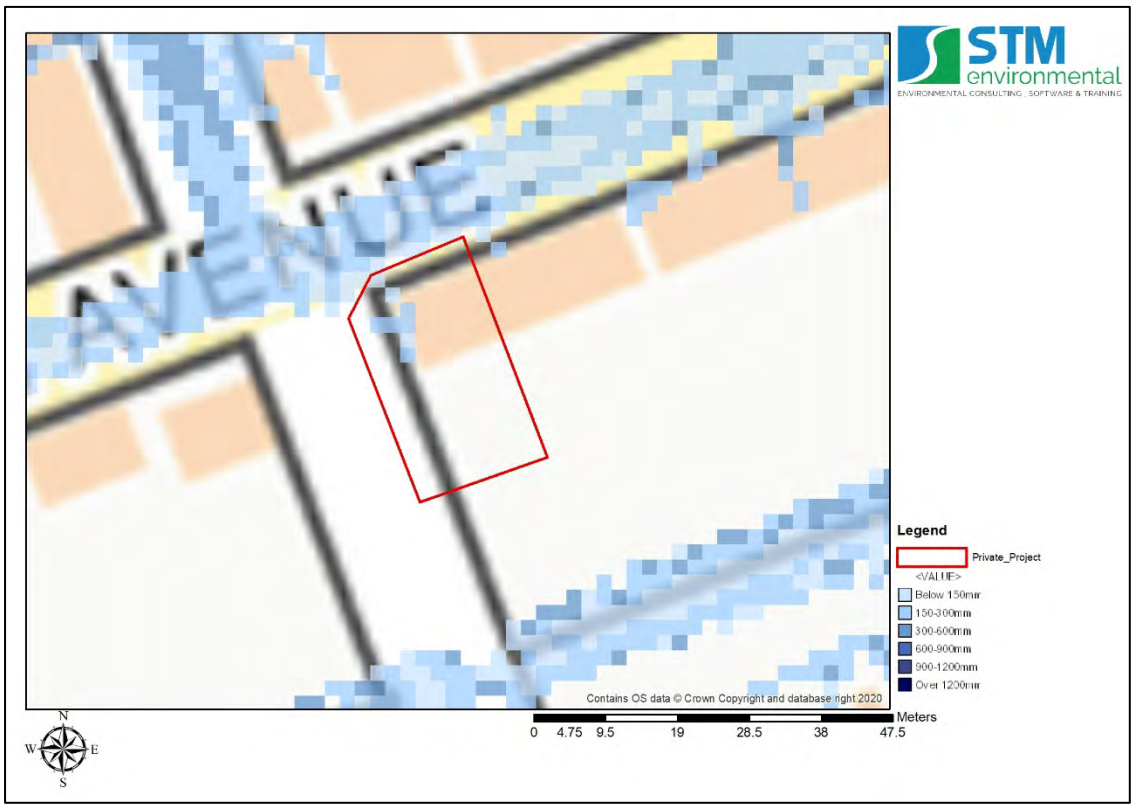
17.3.1 Long Term Fluvial Flood Risk Map (EA)



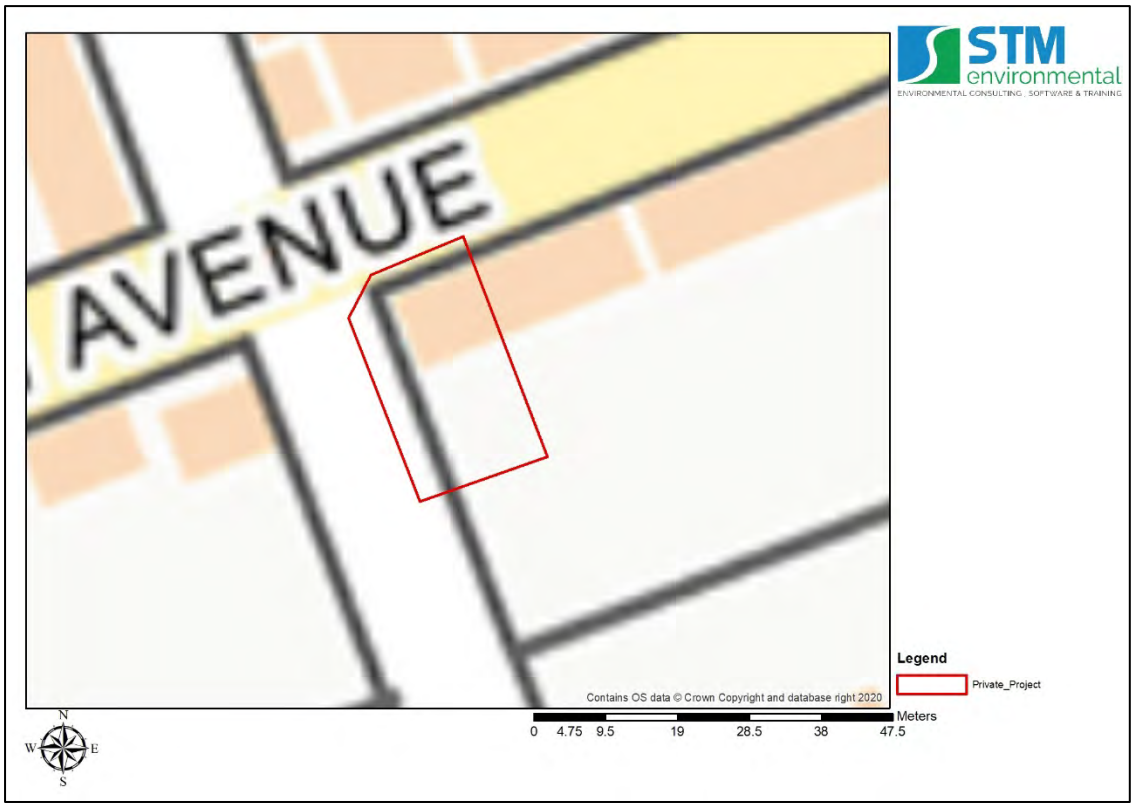
17.3.2 Long Term Pluvial Flood Risk Map (EA)



17.3.3 Surface water flood depth during the 1 in 1000 year rainfall return periods (Source: EA, 2016).



17.3.4 Groundwater flooding susceptibility (Source: BGS, 2016).



17.4 Appendix 4 – Thames Water / Asset Information

17.4.1 Asset Map

17.4.2 Asset Information

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

Manhole Reference	Manhole Cover Level	Manhole Invert Level
7602	53.62	48.28
7603	53.66	51.94
761F	n/a	n/a
751E	n/a	n/a
7501	53.67	48.79
751B	n/a	n/a
751D	n/a	n/a
751C	n/a	n/a
7502	53.5	51.52
761E	n/a	n/a
7503	54.03	48.93
8501	52.77	48.8
8502	52.71	51.25
8403	52.93	49.36
8401	53.06	49.06
8404	52.05	49.67
8402	52.1	49.34
761D	n/a	n/a
751A	n/a	n/a

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

17.5 Appendix 5 – Run-Off Rate and Storage Calculations

17.5.1 UK SuDS

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Matthew Ashdown
Site name:	59 Elm Avenue
Site location:	HA4 8PE

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	51.57585° N
Longitude:	0.40221° W
Reference:	1159227818
Date:	Apr 04 2022 11:55

Runoff estimation approach IH124

Site characteristics

Total site area (ha): 0.1

Methodology

Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics	Default	Edited
SAAR (mm):	648	648
Hydrological region:	6	6
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Growth curve factor 200 years:	3.74	3.74

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates	Default	Edited
Q_{BAR} (l/s):	0.44	0.44
1 in 1 year (l/s):	0.37	0.37
1 in 30 years (l/s):	1.01	1.01
1 in 100 year (l/s):	1.41	1.41
1 in 200 years (l/s):	1.65	1.65

Surface water storage requirements for sites

www.uksuds.com | Storage estimation tool

Calculated by:	Matthew Ashdown
Site name:	59 Elm Avenue
Site location:	HA4 8PE

This is an estimation of the storage volume requirements that are needed to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). It is not to be used for detailed design of drainage systems. It is recommended that hydraulic modelling software is used to calculate volume requirements and design details before finalising the design of the drainage scheme.

Site Details

Latitude:	51.57584° N
Longitude:	0.40221° W
Reference:	2808465581
Date:	Apr 04 2022 11:57

Site characteristics

Total site area (ha):	0.054
Significant public open space (ha):	0
Area positively drained (ha):	0.054
Impermeable area (ha):	0.0325
Percentage of drained area that is impermeable (%):	60
Impervious area drained via infiltration (ha):	0
Return period for infiltration system design (year):	10
Impervious area drained to rainwater harvesting (ha):	0
Return period for rainwater harvesting system (year):	10
Compliance factor for rainwater harvesting system (%):	66
Net site area for storage volume design (ha):	0.05
Net impermable area for storage volume design (ha):	0.04
Pervious area contribution to runoff (%):	30

* where rainwater harvesting or infiltration has been used for managing surface water runoff such that the effective impermeable area is less than 50% of the 'area positively drained', the 'net site area' and the estimates of Q_{BAR} and other flow rates will have been reduced accordingly.

Design criteria

Climate change allowance factor:	1.4
Urban creep allowance factor:	1.1
Volume control approach	Use long term storage
Interception rainfall depth (mm):	5
Minimum flow rate (l/s):	2

Methodology

esti	IH124
Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	4	4
SPR:	0.47	0.47

Hydrological characteristics

	Default	Edited
Rainfall 100 yrs 6 hrs:	--	63
Rainfall 100 yrs 12 hrs:	--	89.32
FEH / FSR conversion factor:	1.16	1.16
SAAR (mm):	648	648
M5-60 Rainfall Depth (mm):	20	20
'r' Ratio M5-60/M5-2 day:	0.4	0.4
Hydological region:	6	6
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 10 year:	1.62	1.62
Growth curve factor 30 year:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Q_{BAR} for total site area (l/s):	0.24	0.24
Q_{BAR} for net site area (l/s):	0.24	0.24

Site discharge rates	Default	Edited	Estimated storage volumes	Default	Edited
1 in 1 year (l/s):	2	2	Attenuation storage 1/100 years (m^3):	11	11
1 in 30 years (l/s):	2	2	Long term storage 1/100 years (m^3):	0	0
1 in 100 year (l/s):	2	2	Total storage 1/100 years (m^3):	11	11

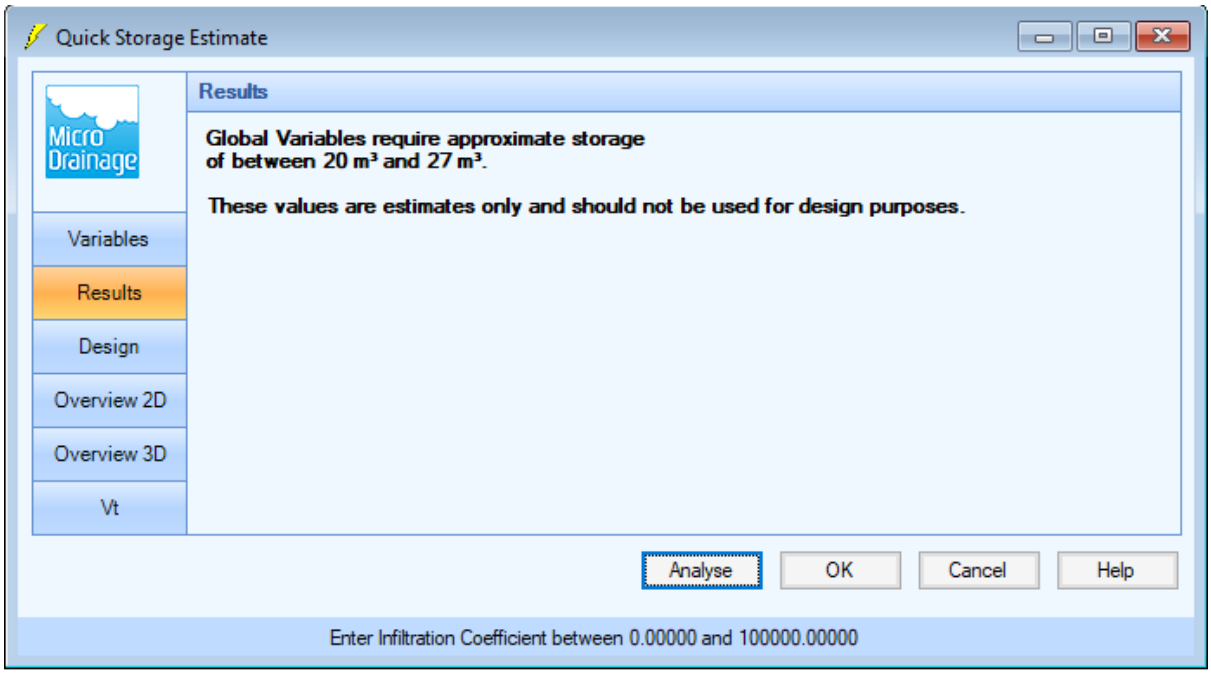
This report was produced using the storage estimation tool developed by HRWallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at http://uksuds.com/terms-and-conditions.htm. The outputs from this tool have been used to estimate storage volume requirements. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of these data in the design or operational characteristics of any drainage scheme.

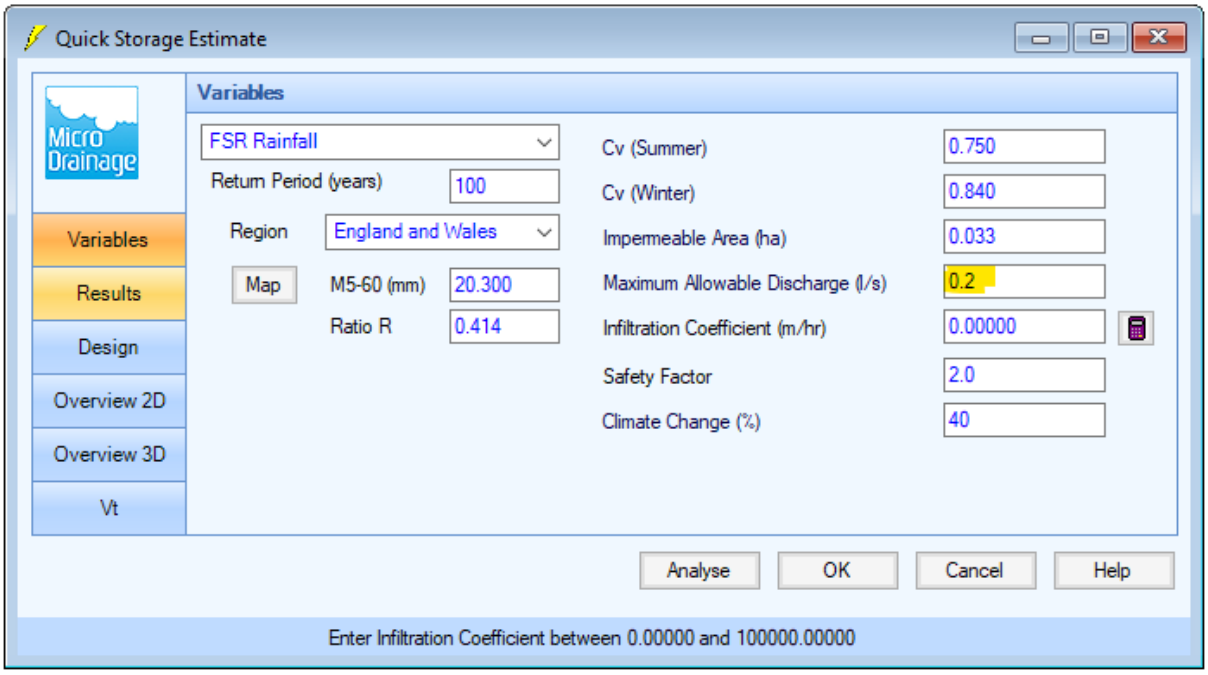
17.5.2 IH124 method

Item	Value				
			Greenfield Run-off Rate -1 in 100 + CC (l/s)	0.8886	
Climate Change Allowance Factor	1.40		Total Post Development Run-off Rate - 1 in 100 + CC (l/s)	1.4927	
SAAR(mm) - Current	822.00		Difference between Greenfield and Post Development Run Off Rates - 1 in 100 + CC (l/s)	0.6042	
SAAR (mm) + CC	1150.80		Volume of Storage Required to meet Greenfield Discharge - Difference between Post Development and Greenfield 1 in 100 + CC volumes (m3)	13.0497	
SPR (Greenfield)	0.37		Difference between 3 * Greenfield and Post Development 1 in 100 + CC Run Off Rates	-1.1730	
SPR (Impermeable)	0.53		Volume of Storage Required to meet 3 * Greenfield Discharge - Difference between Proposed Development and 3 * Greenfield 1 in 100 +CC (m3)	-25.3368	
Site Area (ha)	0.0542				
Impermable Area (Pre Development - ha)	0.03640				
Permeanble Area (Pre Development - ha))	0.0178000		Greenfield (l/s)	Pre - Development (l/s)	Post Development (l/s)
Impermable Area (Post Development - ha)	0.0312000	Qbar	0.19	0.34	0.32
Permeanble Area (Post Development - ha)	0.0230000	1 in 1	0.16	0.29	0.27
GCF (1 in 1)	0.85	1 in 30	0.43	0.77	0.73
GCF (1 in 30)	2.30	1 in 100	0.60	1.07	1.01
GCF (1 in 100)	3.19	1 in 100 + CC	0.89	1.59	1.49
Hyrdological Region	6				
Soil Type	2				
Rainfall 100 Yrs 6 hours mm	63				

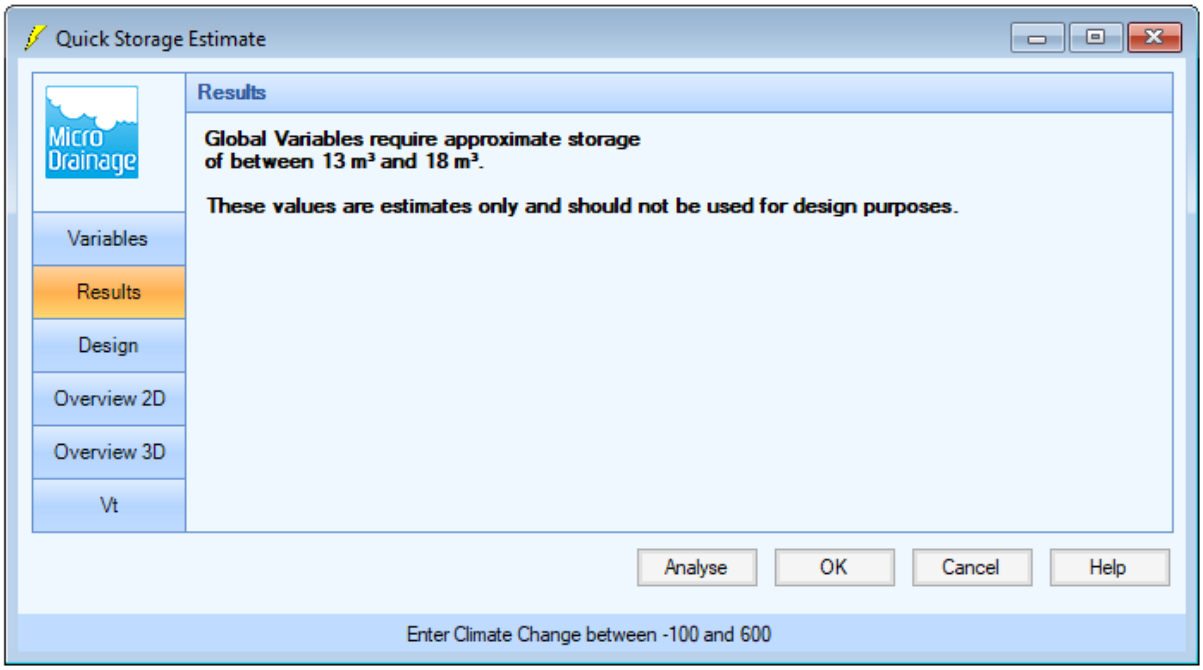
GREENFIELD RUN-OFF	QBAR50	Run-Off Rate l/s	l/s/ha (QBarA)	3 times greenfield (l/s)	Volume (6 hr) - Standard (m3)
Qbar	173.3424	**0.1879**	3.4668		
1 in 1		**0.1597**	2.9468	0.4792	3.4499
1 in 30		**0.4322**	7.9738	1.2965	9.3350
1 in 100		**0.5994**	11.0592	1.7982	12.9473
GREENFIELD RUN-OFF + CC					
Qbar Impermeable	256.9654	0.2786	5.1393	0.8357	6.0167
1 in 1 +CC		0.2368	4.3684	0.7103	5.1142
1 in 30 + CC		0.6407	11.8204	1.9220	13.8384
1 in 100 + CC		**0.8886**	**16.3944**	**2.6657**	**19.1932**
PRE -DEVELOPMENT RUN-OFF (i.e. same rainfall)		**Impermeable Surface Run-Off (l/s/ha (QBarA)**			Volume (6 hr)
Impermeable Surface Calculation					
Qbar Impermeable	378.0818	0.2752	7.5616	0.8257	5.9453
1 in 1		0.2340	6.4274	0.7019	5.0535
1 in 30		0.6331	17.3918	1.8992	13.6741
1 in 100		0.8780	24.1216	**2.6341**	**18.9654**
Permeable Surface Calculation		**Permeable Surface Run-off (l/s)**			
Qbar Permeable	173.3424	0.0617	2.6830	0.1851	
1 in 1		0.0525	2.2806	0.1574	1.1330
1 in 30		0.1419	6.1710	0.4258	3.0657
1 in 100		0.1969	8.5589	**0.5906**	**4.2521**
		Impermeable Surface Calculation + Permeable Surface Calculation			
Qbar	551.4242	0.3370	10.2447	1.0109	5.9453
1 in 1		0.2864	8.7080	0.8592	6.1865
1 in 30		0.7750	23.5628	2.3250	16.7396
1 in 100		1.0749	32.6805	3.2246	23.2174
PRE DEVELOPMENT RUN-OFF + CC (increased rainfall)		**Impermeable Surface Run-Off (l/s)**			
Impermeable Surface Calculation					
Qbar Impermeable	560.4741	0.4080	13.0777		8.8133
1 in 1 +CC		0.3468	11.1161		7.4913
1 in 30 + CC		0.9385	30.0788		20.2707
1 in 100 + CC		**1.3016**	41.7180		**28.1146**
Permeable Surface Calculation		**Permeable Surface Run-off (l/s)**			
Qbar Permeable	256.9654	0.0915	3.9774	0.2744	
1 in 1 +CC		0.0778	3.3808	0.2333	1.6796
1 in 30 + CC		0.2104	9.1480	0.6312	4.5447
1 in 100 + CC		**0.2918**	12.6878	**0.8755**	**6.3033**
		Impermeable Surface Calculation + Permeable Surface Calculation			
Qbar	**817.4395**	**0.4995**	**17.0551**	**0.2744**	**8.8133**
1 in 1 +CC		**0.4246**	**14.4968**	**0.2333**	**9.1709**
1 in 30 + CC		**1.1489**	**39.2267**	**0.6312**	**24.8154**
1 in 100 + CC		**1.5934**	**54.4058**	**0.8755**	**34.4179**
POST DEVELOPMENT RUN-OFF (i.e. same rainfall)		**Impermeable Surface Run-Off (l/s/ha (QBarA)**			Volume (6 hr)
Impermeable Surface Calculation					
Qbar Impermeable	378.0818	0.2359	7.5616	0.7078	
1 in 1		0.2005	6.4274	0.6016	4.3315
1 in 30		0.5426	17.3918	1.6279	11.7207
1 in 100		0.7526	24.1216	**2.2578**	**16.2560**
Permeable Surface Calculation		**Permeable Surface Run-off (l/s)**			
Qbar Permeable	173.3424	0.0797	3.4668	0.2392	
1 in 1		0.0678	2.9468	0.2033	1.4640
1 in 30		0.1834	7.9738	0.5502	3.9614
1 in 100		0.2544	11.0592	**0.7631**	**5.4942**
		Impermeable Surface Calculation + Permeable Surface Calculation			
Qbar Permeable	**551.4242**	**0.3157**	**11.0285**	**0.9470**	
1 in 1	**0.0000**	**0.2683**	**9.3742**	**0.8049**	**5.7955**
1 in 30	**0.0000**	**0.7260**	**25.3655**	**2.1781**	**15.6820**
1 in 100	**0.0000**	**1.0070**	**35.1809**	**3.0209**	**21.7503**
POST DEVELOPMENT RUN-OFF + CC (increased rainfall)		**Impermeable Surface Run-Off (l/s)**			
Impermeable Surface Calculation					
Qbar Impermeable	560.4741	0.3497	11.2095		7.5543
1 in 1 +CC		0.2973	9.5281		6.4211
1 in 30 + CC		0.8044	25.7818		17.3749
1 in 100 + CC		**1.1157**	35.7582		**24.0982**
Permeable Surface Calculation		**Permeable Surface Run-off (l/s)**			
Qbar Permeable	256.9654	0.1182	5.1393	0.3546	
1 in 1 +CC		0.1005	4.3684	0.3014	2.1702
1 in 30 + CC		0.2719	11.8204	0.8156	5.8724
1 in 100 + CC		**0.3771**	16.3944	**1.1312**	**8.1447**
		Impermeable Surface Calculation + Permeable Surface Calculation			
Qbar	**817.4395**	**0.4679**	**16.3488**	**0.3546**	**7.5543**
1 in 1 +CC		**0.3977**	**13.8965**	**0.3014**	**8.5914**
1 in 30 + CC		**1.0763**	**37.6022**	**0.8156**	**23.2473**
1 in 100 + CC		**1.4927**	**52.1526**	**1.1312**	**32.2429**

17.5.3 Microdrainage Quick Storage Estimates - 0.2l/s (Qbar)

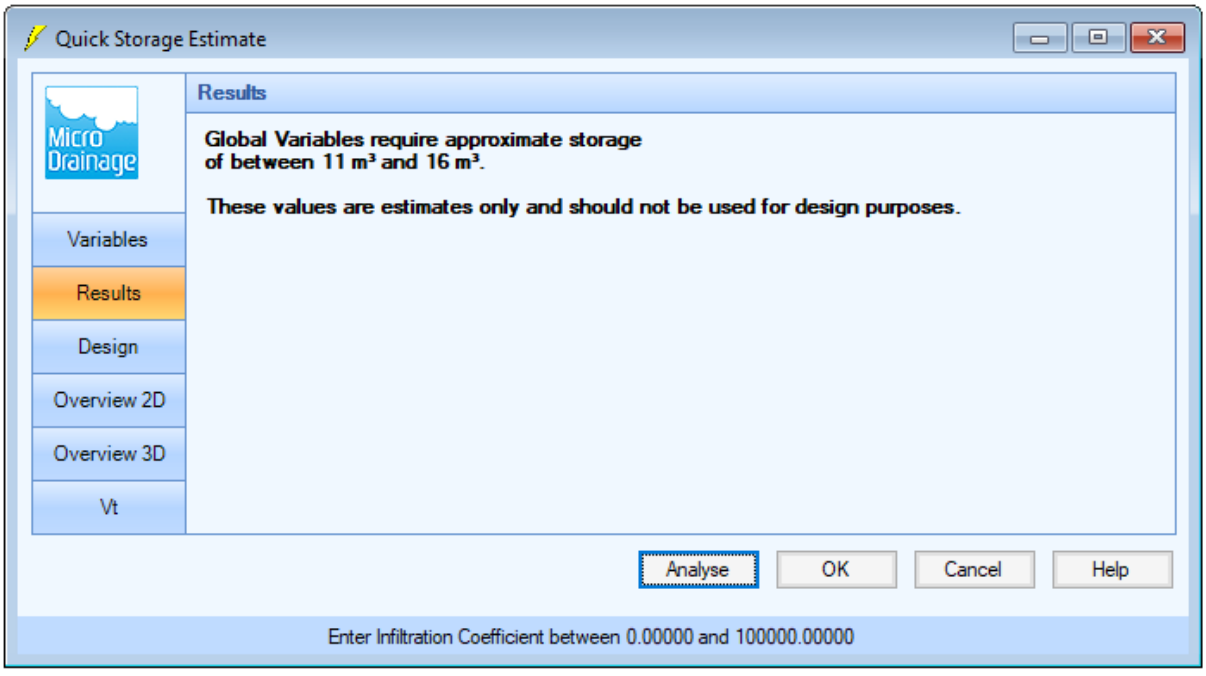




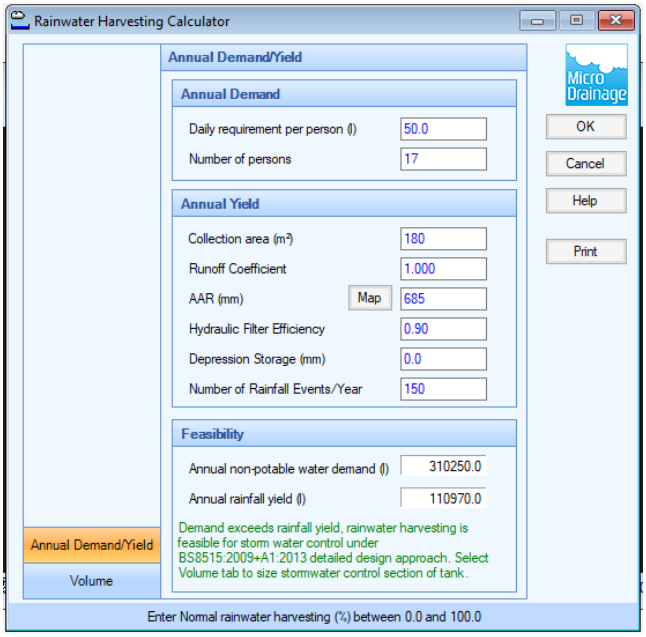
17.5.4 Microdrainage Quick Storage Estimates - 0.9l/s

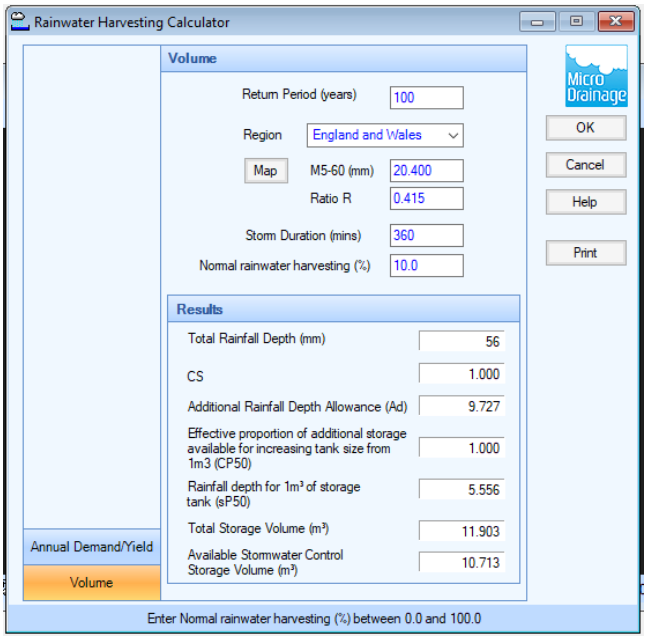


17.5.5 Microdrainage Quick Storage Estimates - 1.6l/s

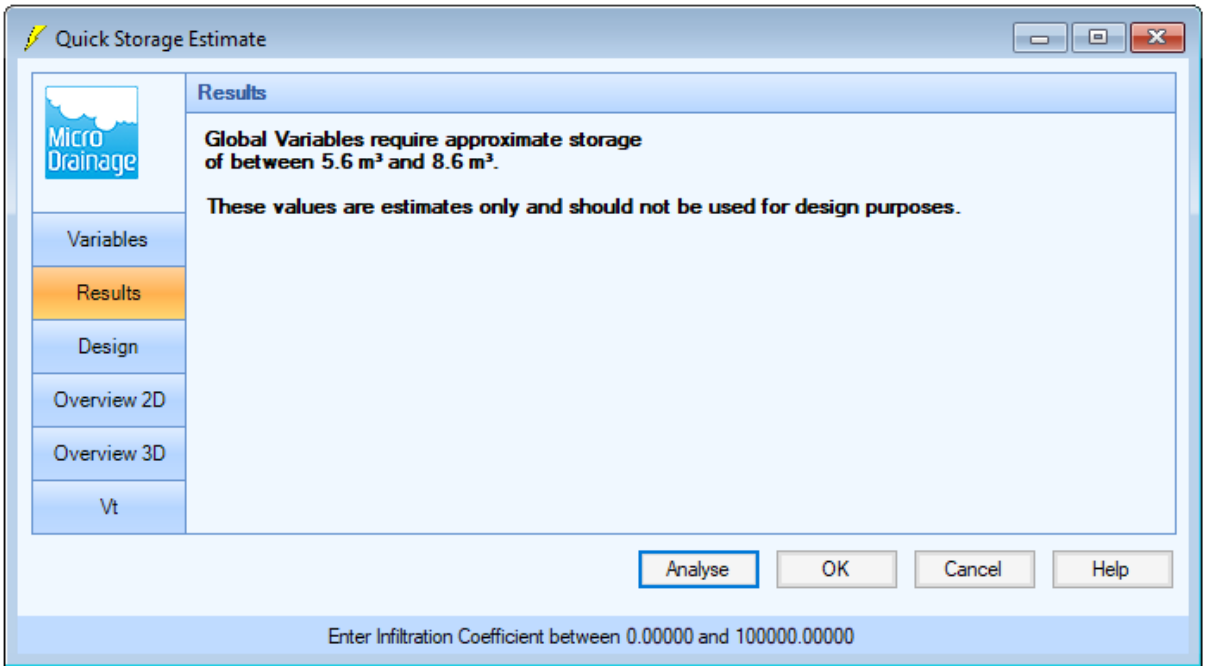


17.5.6 Rainwater Harvesting Calculator - Apartment Block





17.5.7 Storm Water Attenuation Requirement - Apartment Block Catchment



17.6 Appendix 6 - Site Investigation

17.6.1 Site Investigation Photos


2


JCB


2


JCB

17.6.2 Infiltration Testing Results and Graph - TP01

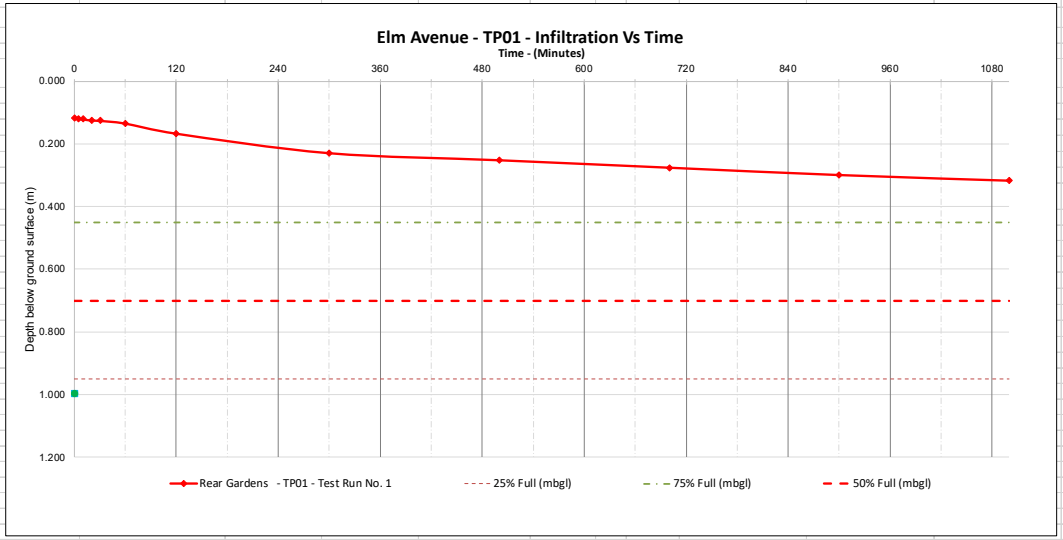
Site Location	Site Name
Area	Rear Gardens
Trial Pit ID	TP01
Test Run	1 2 3 4

Rear Gardens - TP01 - Test Run No. 1

insert time according to the measured units

Dip Readng	Water Level Above Base	Depth (mbgl)	Time (hours)	Time (minutes)	Time (s)	Time	25% Full (mbgl)	50% Full (mbgl)	75% Full (mbgl)
		0.117	0.00	0			0.95	0.70	0.45
		0.120	0.08	5			0.95	0.70	0.45
		0.121	0.17	10			0.95	0.70	0.45
		0.125	0.33	20			0.95	0.70	0.45
		0.126	0.50	30			0.95	0.70	0.45
		0.134	1.00	60			0.95	0.70	0.45
		0.167	2.00	120			0.95	0.70	0.45
		0.230	5.00	300			0.95	0.70	0.45
		0.253	8.33	500.00			0.95	0.70	0.45
		0.277	11.67	700.00			0.95	0.70	0.45
		0.300	15.00	900.00			0.95	0.70	0.45
		0.319	18.33	1100.00			0.95	0.70	0.45
			0.00				0.95	0.70	0.45
							0.95	0.70	0.45
							0.95	0.70	0.45

Reached 25% within 24 hours. Second run undertaken.



$f = V_{p75-25} * 0.3 / a_{s50} * t_{p75-25}$

Infiltration Coef. Calculations

Width	0.40	m
Depth	1.20	m
Length	1.60	m
Total Volume	0.77	m3
Effective Storage Depth	1.00	m
25% Full	0.95	mbgl
50% Full	0.70	mbgl
75% Full	0.45	mbgl
Pipe Depth		
a_{s50}	2.88	m^2
V_{p75-25}	0.32	m^3
$t_{p75-25\ (read\ from\ graph)}$	N/a	mins
f	**#VALUE!**	m/s
f	#VALUE!	mm/hr
f	#VALUE!	m/hr

Infiltration Rate (mm/hr)

IR < 0.036	IMPERMEABLE
0.036 < IR < 0.38	VERY SLOW
0.38 < IR < 3.7	MODERATELY SLOW
3.7 < IR < 37	MODERATE
37 < IR < 370	MODERATELY RAPID
IR > 370	RAPID

BASIC INFILTRATION RATES FOR VARIOUS SOIL

Soil type	Basic infiltration rate (mm/hour)
sand	less than 30
sandy loam	20 - 30
loam	10 - 20
clay loam	5 - 10
clay	1 - 5

Water level = Pipe Depth - Dip

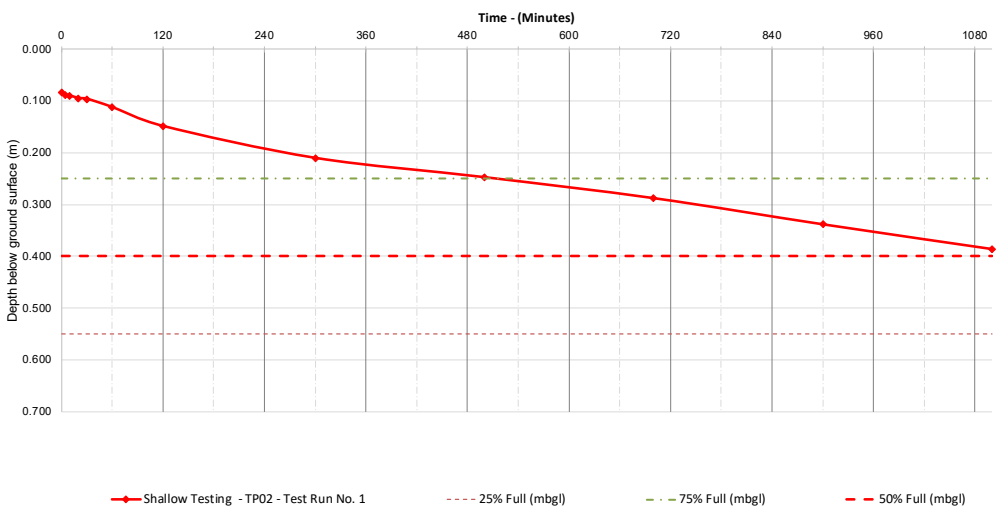
17.6.3 Infiltration Testing Results and Graph - TP02

Site Location	Elm Avenue			
Area	Shallow Testing			
Trial Pit ID	TP02			
Test Run	1	2	3	4

Shallow Testing - TP02 - Test Run No. 1

insert time according to the measured units

Dip Readng	Water Level Above Base	Depth (mbgl)	Time (hours)	Time (minutes)	Time (s)	Time	*25% Full (mbgl)*	*50% Full (mbgl)*	*75% Full (mbgl)*
		0.084	0.00	0			0.55	0.40	0.25
		0.088	0.07	4			0.55	0.40	0.25
		0.090	0.17	10			0.55	0.40	0.25
		0.095	0.33	20			0.55	0.40	0.25
		0.096	0.50	30			0.55	0.40	0.25
		0.112	1.00	60			0.55	0.40	0.25
		0.149	2.00	120			0.55	0.40	0.25
		0.210	5.00	300			0.55	0.40	0.25
		0.247	8.33	500.00			0.55	0.40	0.25
		0.287	11.67	700.00			0.55	0.40	0.25
		0.338	15.00	900.00			0.55	0.40	0.25
		0.385	18.33	1100.00			0.55	0.40	0.25
							0.55	0.40	0.25
							0.55	0.40	0.25
			Reached 25% within 24 hours. Second run undertaken.						



$f = V_{p75-25} * 0.3 / a_{s50} * t_{p75-25}$

Infiltration Coef. Calculations

Width	0.30	m
Depth	0.70	m
Length	1.20	m
Total Volume	0.25	m3
Effective Storage Depth	0.60	m
25% Full	0.55	mbgl
50% Full	0.40	mbgl
75% Full	0.25	mbgl
Pipe Depth		
a_{s50}	1.44	m^2
V_{p75-25}	0.11	m^3
$t_{p75-25\ (read\ from\ graph)}$	N/A	mins
f	**#VALUE!**	m/s
f	#VALUE!	mm/hr
f	#VALUE!	m/hr

Infiltration Rate (mm/hr)

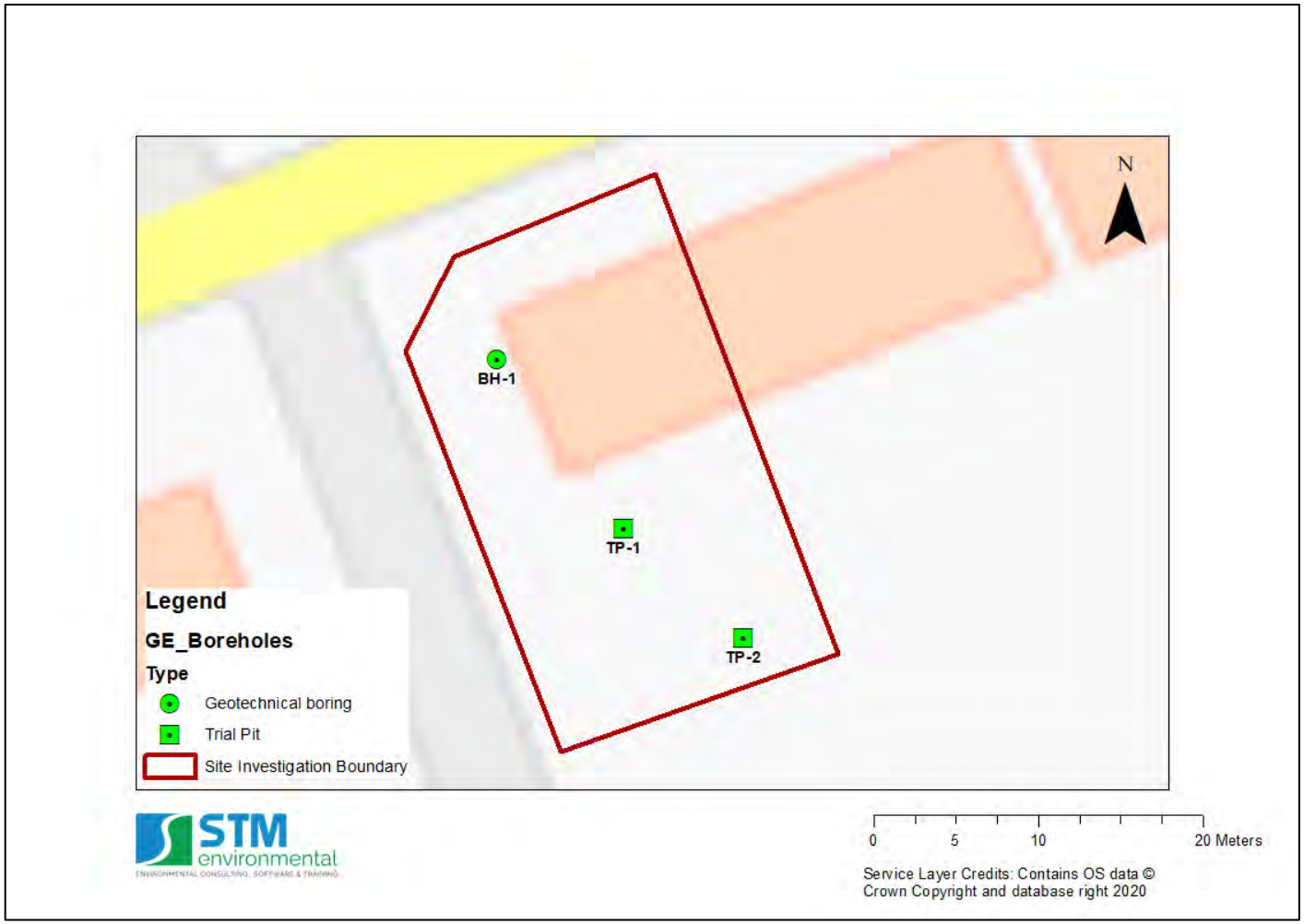
IR < 0.036	IMPERMEABLE
0.036 < IR < 0.38	VERY SLOW
0.38 < IR < 3.7	MODERATELY SLOW
3.7 < IR < 37	MODERATE
37 < IR < 370	MODERATELY RAPID
IR > 370	RAPID

BASIC INFILTRATION RATES FOR VARIOUS SOIL

Soil type	Basic infiltration rate (mm/hour)
sand	less than 30
sandy loam	20 - 30
loam	10 - 20
clay loam	5 - 10
clay	1 - 5

Water level = Pipe Depth - Dip

17.6.4 Soakaway Test Location Map



17.7 Appendix 7 – SuDS Suitability Assessment

17.7.1 SuDS Suitability Table

Suds Technique	Typical Uses	Potential Issues	Potential Suitability
Rainwater Harvesting	Capture of rainwater into a tank(s) for use (usually non-potable) such as irrigation, toilet flushing, vehicle or plant cleansing.	Care is needed to prevent the development of bacteria, algae and insect infestation.	Suitable
Infiltration: Soakaways Infiltration Trenches and Basins	Infiltration components are used to capture surface water runoff and allow it to infiltrate (soak) and filter through to the subsoil layer, into the groundwater.	Highly variable bedrock and groundwater table is potentially >3m below surface. Maintenance	Unsuitable – Following site investigation
Green/Brown /Blue Roofs	Used on flat or shallow pitched roofs to provide a durable roof covering which also provides thermal insulation, amenity space, biodiversity habitat as well as attenuation of rainwater.	Maintenance - Ensuring safe access	Suitable - Limited impact on proposal.
Rain Gardens	Creation of planted landscaped areas to allow the diversion of a portion of rainwater from either downpipes or surrounding paved surfaces. Raingardens can either allow infiltration into the ground or have tanked systems for water retention.	Require maintenance	Suitable - attenuation
Permeable Pavements / Surfaces	Permeable hard surfaces that allow rainwater to pass through either into the ground or to tanked systems. Good as interception storage.	Potential impact of saturation on pavement stability to be	Suitable - some infiltration.

Suds Technique	Typical Uses	Potential Issues	Potential Suitability
		considered. May require extensive use of impermeable membranes and under-drainage. Maintenance required.	
Swales	Dry ditches used as landscape features to allow the storage and infiltration of rainwater. Often used as linear features alongside roads, footpaths or rail lines but capable of being integrated into the design of many open spaces.	Finding available space in proposed site layout	Unsuitable - Space
Detention Basin/Ponds	Landscape features designed to store and in some cases infiltrate rainwater. Detentions basins are usually dry, whereas a pond should retain water. These features need areas of open space but can often be combined with other sustainable drainage techniques.	Potential health and safety issues. Finding available space in proposed site layout	Unsuitable - Space
Storage Tanks/ Geocellular Storage	Usually below ground level, they attenuate rainwater for later slow release back into the drainage system.	Pumping may sometimes be required to empty the tank into the drainage system	Unsuitable
Oversized Piping	Using larger than necessary pipework creates additional space to store rainwater.	Lacks the wider benefits of the green infrastructure-	Suitable

Suds Technique	Typical Uses	Potential Issues	Potential Suitability
		based techniques	

17.8 Appendix 8 – Descriptions Of SuDS Techniques

17.8.1 Living/Green Roofs

Green roofs are multi-layered vegetated systems, built on roof covers. These systems are designed to return the surface water runoff from a building to the sites pre-construction level, and can be built into new build or retrofitted and are suitable for any building with flat to gently sloping roofs providing the existing roof can take the required load.

Figure 4: Green roof at the Queen Elizabeth Olympic Park (University of East London)

The topographical variation is incorporated into the substrate depth. It varies between 75 and 200 mm to create varied microclimates and hydrological regimes increasing habitat heterogeneity.

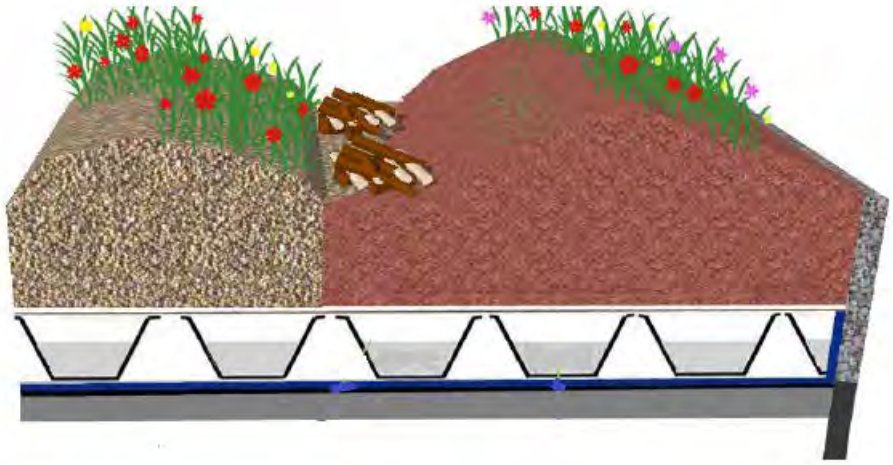


Figure 5: Biodiverse green roof diagram (University of East London)

Above the roof decking lies a standard waterproofing layer. The geocomposite drainage and water attenuation layers provide a water volume of 12 l/m^2. Geotextile filters are then places to act as root barriers and prevent sediments being released from the roof.

The outlet will be sized appropriately in order to cope with storm events.

17.8.2 Rainwater Harvesting

Installation Manual for the F-Line underground tank

1,500 litre
3,000 litre
5,000 litre
7,500 litre

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Tank Dimensions and inverts

With the tank you will have received one of three different shafts dependent on your order. Please note which has been received and refer to the relevant shaft in the grid below :

- VS20 – 235mm shaft and pedestrian lid
- VS60 – 635mm shaft and pedestrian lid - The overall height difference below is because up to 400mm can be cut off the 635mm shaft on site so as to achieve your exact invert level
- Driveable shaft & lid – Steel lid and shaft for vehicle loading

	1500 L	3000 L	5000 L	7500 L
Weight KG	80	170	250	310
Length	2400	2400	2960	3340
Width	1200	2400	2220	2310
Overall Height (VS20 – 235mm shaft)	1015	1015	1350	1415
Overall Height (VS60 – 635mm shaft)	1015 – 1415	1015 – 1415	1350 – 1750	1415 – 1815
Overall Height (Driveable shaft and lid)	1415	1415	1750	1815
Ground to Invert (VS20 – 235mm shaft)	320	320	345	310
Ground to Invert (VS60 – 635mm shaft)	320 – 720	320 – 720	345 – 745	310 – 710
Ground to Invert (Driveable shaft & lid)	720	720	745	710
Invert to Outlet	162	162	162	162

Excavation

	1500 L	3000 L	5000 L	7500 L
Length	2800	2800	3360	3740
Width	1600	2800	2620	2710
***Overall Height VS20**	1115	1115	1450	1515
***Overall Height VS60**	1115 – 1515	1115 – 1515	1450 – 1850	1515 – 1915
***Overall Height Driveable shaft & lid**	1515	1515	1850	1915

***The overall excavated height allows for a base of 100mm compacted aggregate**

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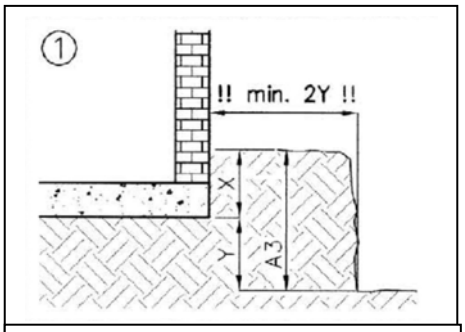
1. Location



Please refer to the table on Page 2. A3 relates to the 'Excavated Overall Height' dependent on shaft and tank type

1.1 Position to the building

- The excavation must not be within the minimum distance to the building. See Image 1.
- The tank may not be built over by any loads greater than vehicle loads.

1.2 Traffic Conditions

- Loading Class A15 e.g pedestrian or cyclist – The standard pedestrian lid is suitable.
- Loading Class B e.g car, minibus, max axle load of 2.2 tonnes – Vehicle loading shaft and lid required. Minimum distance from top of tank body to earth surface must be 600mm

1.3 Ground conditions

- The tanks may lie in ground water and / or surface water up to the top of the body of the tank. Please refer to the table below to see the maximum depth dependent on your tank and shaft type.

	1500 L	3000 L	5000 L	7500 L
Max water table depth (VS20 – 235mm shaft)	365	365	430	290
Max water table depth (VS60 – 635mm shaft)	365 - 765	365 – 765	430 - 830	290 - 690
Max water table depth (Driveable shaft & lid)	765	765	830	690

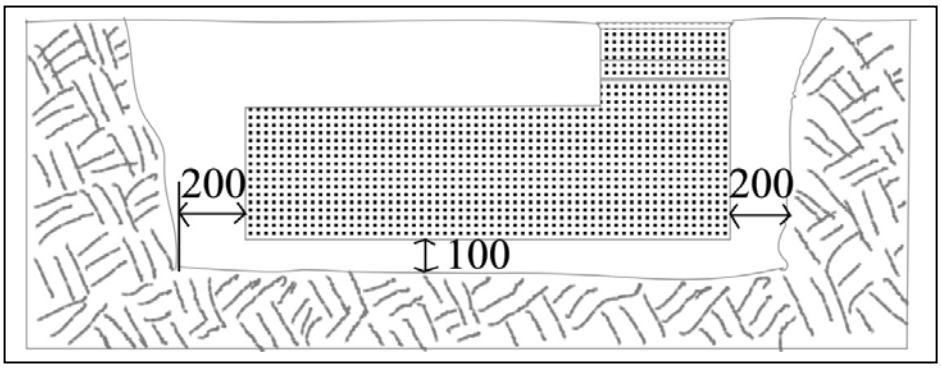
1.4 Hillside location

- The soil within the area where the tank is to be positioned must be checked for possible soil movement (DIN 1054 edition 1/2003, E DIN 4084 edition 11/2002) and if necessary will need to be secured with a supporting structure (eg retaining wall)
- Consultation with local authorities is recommended.

1.5 Installation details

1.51 In clay ground conditions:

- The excavated area should be wide enough to allow the compression of the filling material (200mm) See Image below.



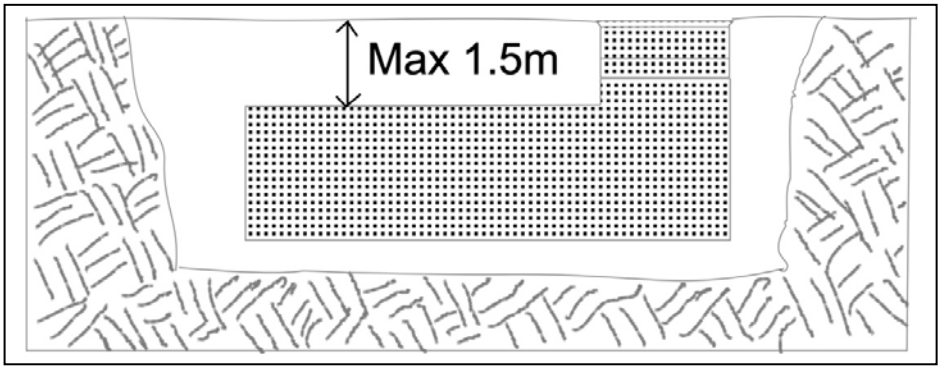
- With installations deeper than 1.75m (ground to base of tank) use 500mm width of the filling material.
- The tank should be covered with at least 300mm of filling material.

1.52 In loose ground conditions:

- Up to 1.75m depth of excavation use 200mm of filling material around the sides of the tank.
- With installations deeper than 1.75m use 500mm width of the filling material
- The tank should be covered with at least 300mm of filling material

1.6 Further criteria

- Existing pipelines, pipes, vegetation and other specifics must be considered so that damage or hazards will be avoided.
- The maximum soil coverage on top of the tank body is 1.5m
- If it is not guaranteed that the ground water level will remain below the permitted maximum level, a drainage system must be installed around the tank, which reliably drains the water. If a drainage system is not possible then contact your supplier about an alternative tank.



2. Installation

2.1 Backfill around and below the tank

- Backfill material around the tank has to be well compacted and permeable to water allowing close packing and no damage to the surface of the tank
- If the filling material contains sharp of sharp-edged components, the wall of the tank must be protected by a sandy coating.

2.1.1
- Gravel mixtures are the preferred filling material. The recommended sizes 8mm-16mm

2.1.2
- Concrete gravel with a particle size of up to 16mm is recommended for use in clay / loam soil conditions with ground water and high water table.
- When ground water and a high water table are present it is important to ensure good compaction when applying the filling material.

2.1.3
- Stone Chippings – crushed rock particles between 4mm and 16mm in size are suitable filling material. However due to the sharp edges the tank must be protected against damage, for example using a sand coating.

2.1.4
- Excavation – sand and gravel mixtures with mixed particle sizes is suitable as a filling material providing they meet the criteria listed under 2.1

2.1.5
- Top soil, clay, loam and other types of cohesive soils are not suitable as filling material.

2.2 Backfill on top of the tank
- Excavated soil or other material can be used if it is stable and permeable

2.3 Backfilling and compaction methods
- The backfilling and compaction methods to be used are described in Section 3 (Installation Instructions)

2.3.1
- Adding water to the filling material is not recommended as this will make the compacting unstable
- The base layer for driveable situations must use a grain size of 2/45

2.4 Pipes
2.4.1
- The feed pipe should be laid with a fall to the tank of greater than 1 degree
- Ensure that underground rainwater pipes come from sealed gullies (do not use open gullies)

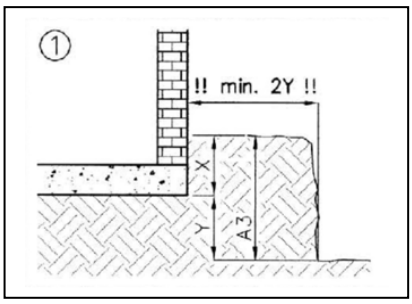
2.4.2
- The overflow pipe / drain pipe should have a deeper fall away from the tank than the fall from the feed pipe to the tank

2.4.3
- The service pipe is to be installed using the provided seals to ensure a tight fixture to avoid contaminants entering the tank. All electrical and other cables are laid through this service pipe back to the property.

2.4.4
- The pipes must be laid in such a way to avoid frost damage.

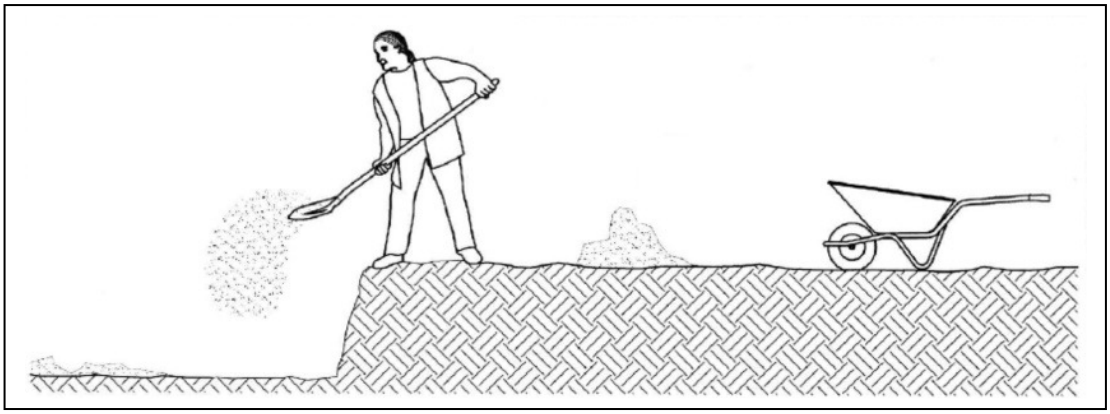
3. Installation Instructions

1. **Establish distance from the property.**

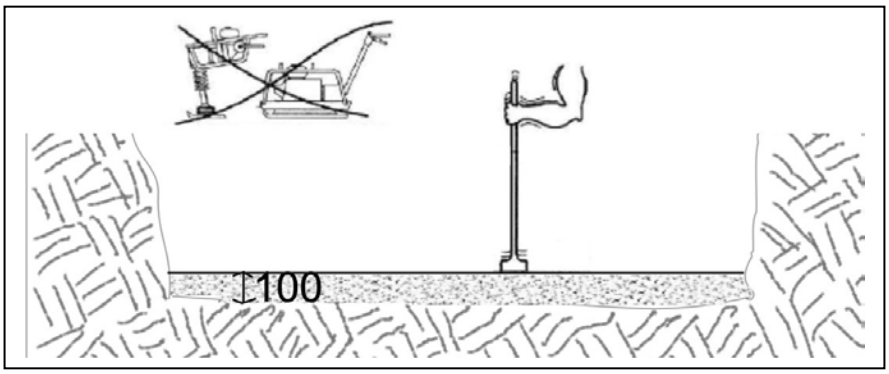


2. **Dig hole**

3. **Lay 100mm base**



4. **Compact the base by hand only. Ensure you have a level base.**



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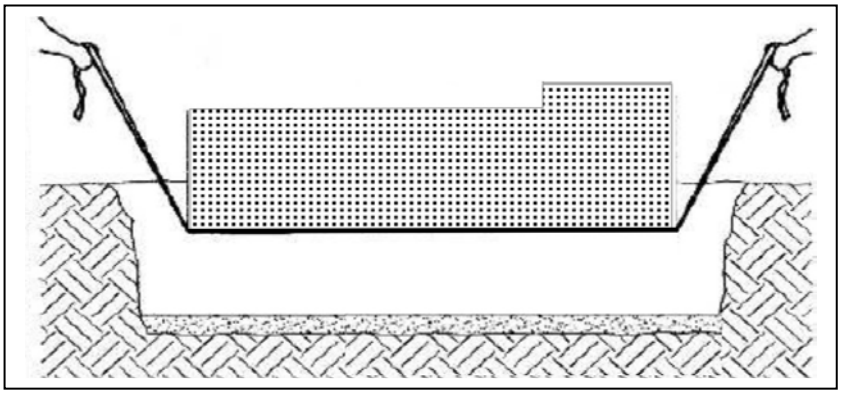
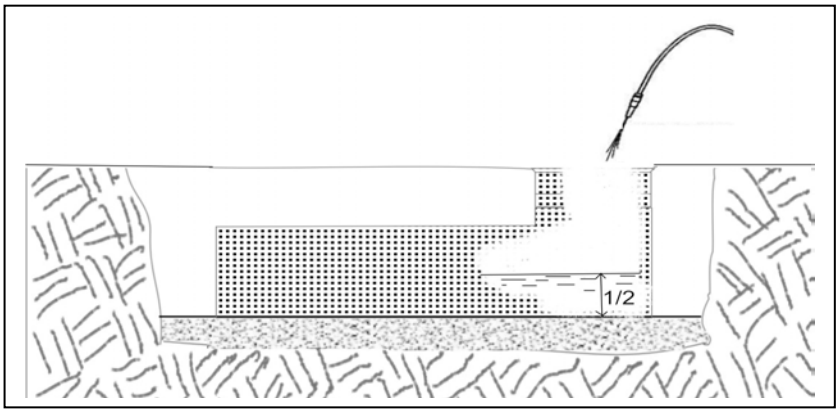
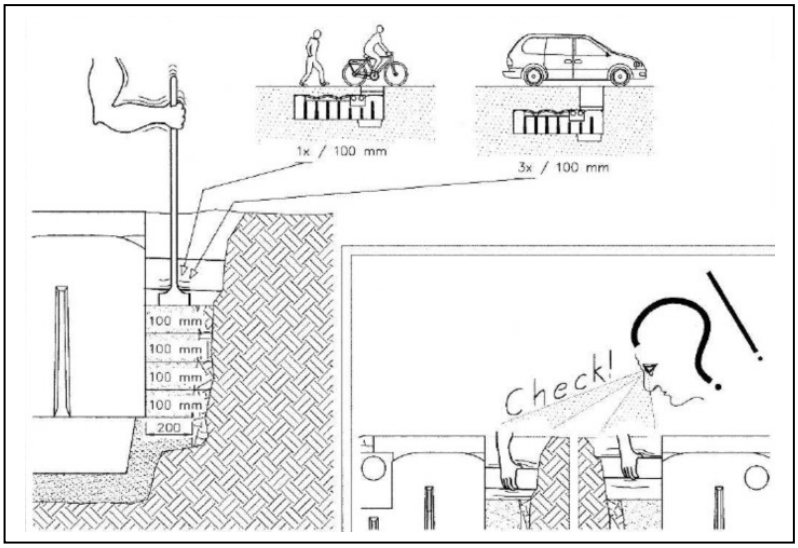
5. **Lower the tank carefully into the hole ensuring that you are achieving the necessary widths around the tank for the filling material.**



6. **Fill the tank with water up to half way**



7. **Apply filling material**



- Do not use a mechanical whacker plate.
- Hand tap the material to compress it.
- Lay in 100mm layers for pedestrian install
- Lay in 300mm layers for driveable install
- Check to ensure the minimum width between the tank and excavation wall is correct (min 200mm)

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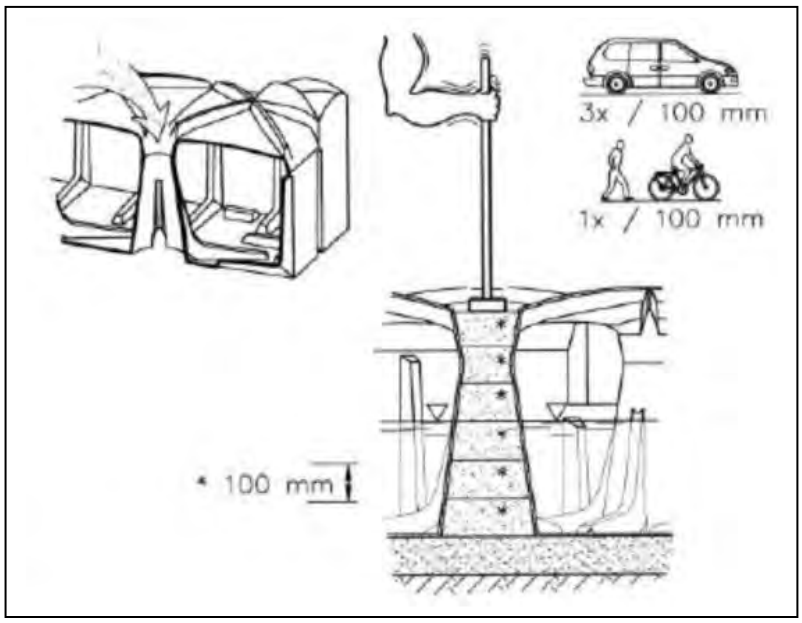
8. Hand compress the filling material into the central columns



To link tanks together do the following:

- Drill a hole using a 127mm drill bit into a flat part of the tank at low level.
- Insert the supplied grommets (seals) into the hole.
- Feed a 4" pipe into the hole allowing at least 500mm to be inside of the tank.
- Use washing up liquid if necessary to assist with pushing the pipe through the grommet.

NOTES :

- **Please refer to the individual installations documents for the shafts, extension sleeve and driveable shaft and lid.**

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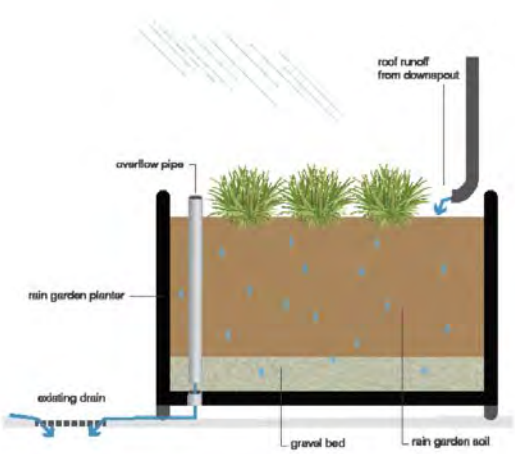
17.8.3 Rain Garden

A rain garden is a shallow depression, with absorbent, yet free draining soil and plants that can withstand occasional temporary flooding. Rain gardens are designed to mimic the natural water retention of undeveloped land and to reduce the volume of rainwater running off into drains from impervious areas and treat low level pollution.

Rain gardens usually absorb all the rainwater that flows into them, but when they do fill up following particularly heavy rainfall, any excess water is redirected to the existing drains. These simple rain gardens do not require any redesign of the existing drainage system and can be installed wherever space permits (see Planning and Design below) and in most soil types.



Rain garden planter

Street rain garden

Rain gardens are usually situated some distance from buildings or site boundaries, although the exact location will depend on the local topography and available space. In order to reduce the likelihood of property damage to insignificant levels, it is recommended that rain gardens are situated at least 3m (10 feet) from any building, or be impermeable lined to protect foundations.

A rain garden 150mm deep and 20% of the area of the area of the roof that it serves will be able to intercept all of the run-off from a typical summer storm where 10-15mm of rain might fall. Rain gardens on more permeable soils will be even more effective. Over the course of an average year, a rain garden of this size will intercept most of the rainfall that it receives, only overflowing after several days of persistent rainfall.

17.8.4 Permeable Paving

Various options are available for the type of permeable paving that can be installed. Permeable block paving allows for infiltration through gaps in the surface. This can be underlain by a geotextile membrane and fine gravel course followed by with a sub-base or geocellular crates as shown in the figures below.

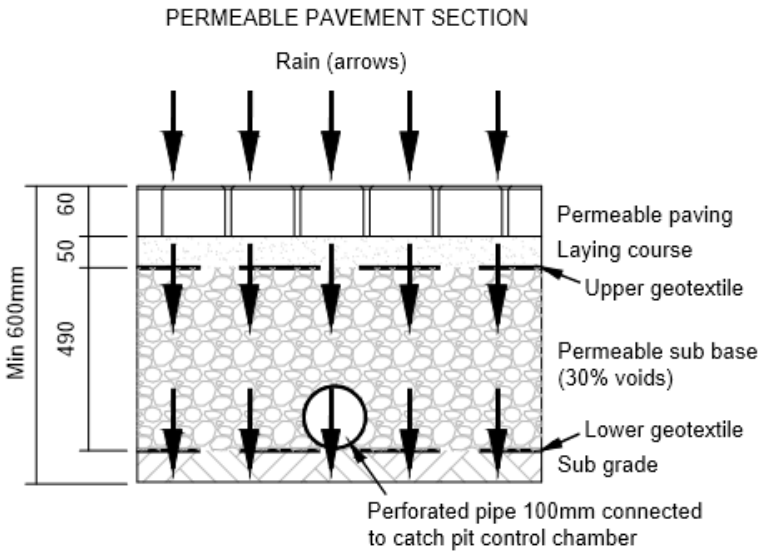


Figure 6 Block Permeable Paving with sub-base

The use of geocellular module storage provides structural strength (up to 400kN/m2) and high-water storage capacity with void space of 95%+.

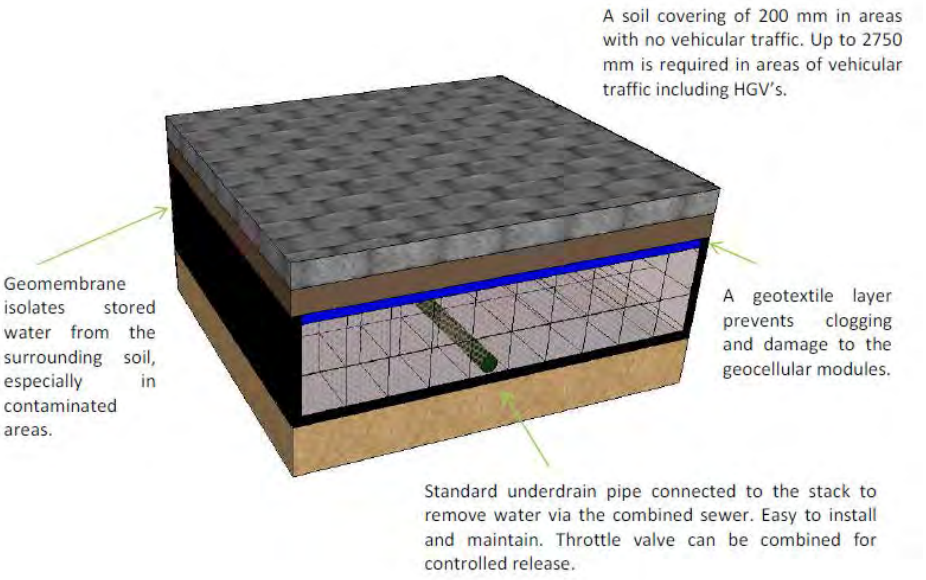


Figure 7: Block Permeable Paving with Geocellular Module

The plastic or concrete grid system is usually installed with a depth of 40 mm, with gaps between filled with an appropriate planting soil and seeded with a turf mix.

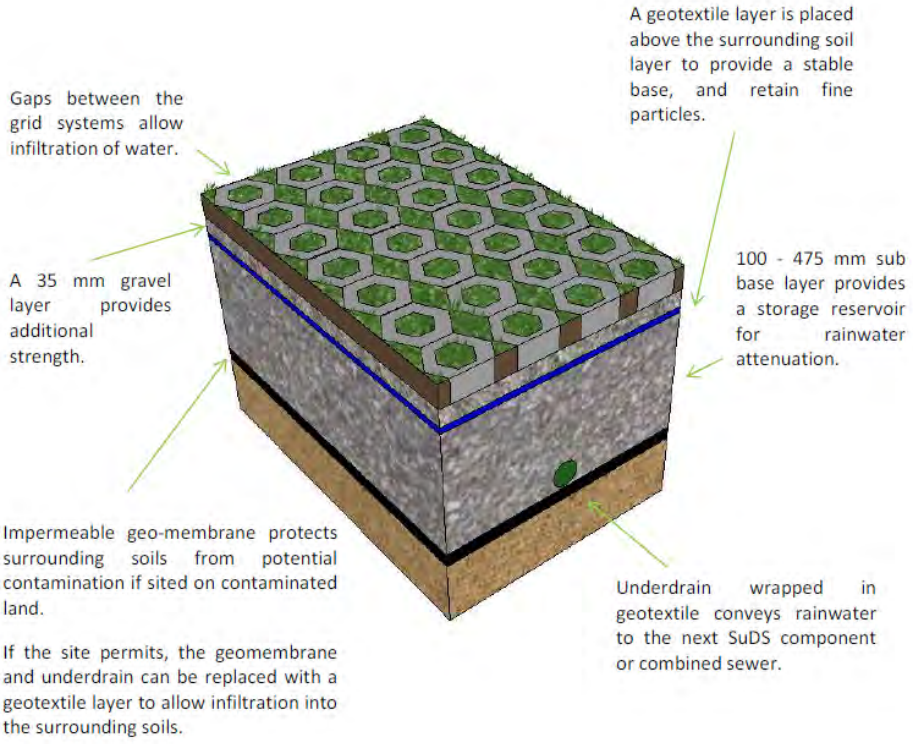


Figure 8: Plastic or Grid Permeable Paving with Sub-base

17.8.5 SuDs Planter Storage Volume/Rain water Harvesting Systems

SuDs planters are an innovative way of increasing the water attenuation, additionally providing an opportunity to green areas where is not practical to remove or break up permeable surfaces. With excellent retro-fit potential SuDs planters can be designed to receive rain water from a drainpipe or other inlet or simply used to receive rainwater falling on them. SuDS planters are best placed where they can be used in conjunction with other SuDS.

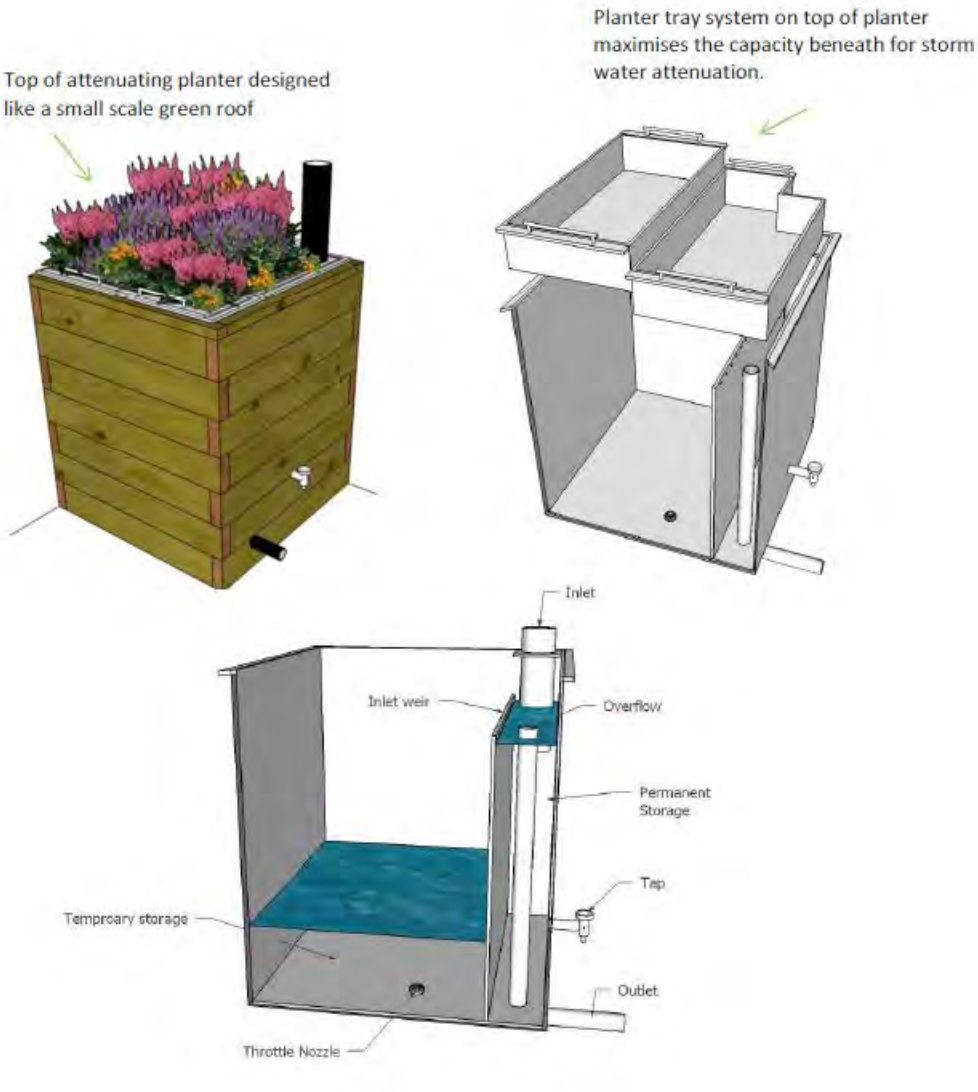


Figure 9: SuDS Planter with attenuation storage (Thames Water)

They offer multi-use benefits such as aesthetic improvements and biodiversity potential. Furthermore, with capacity for water storage, they are well situated in grow

your own schemes, providing a substrate for plant growth and a water storage capacity, for use in watering other plants.

17.8.6 Geocellular structures, oversized pipes and tanks

Modular plastic geocellular structures, with a high void ratio, are a new below ground storage arrangement that can replace underground pipes or tanks that have been used to store water. They can also be used to convey or infiltrate surface water runoff into the ground.

Underground storage features attenuate an agreed volume with a control structure to limit the discharge rate. Structural design must be provided to ensure integrity of the box, pipe or tank under loading. Silt interception and management arrangement is critical to long-term effectiveness of these structures and this must be demonstrated at design stage and confirmed for the design life of the development. It can be implemented either in the form if a modular box system with inlet and outlet pipework connected to the sides of the structure or in the form of a honeycomb structure with perforated pipes running under or through the box. Water is forced into the box when flows increase. There are now shallow, load bearing boxes which can be used under pavements and in particular below permeable pavement which protects the box from silt contamination and provides treatment with enhanced storage. Moreover, geocellular systems can be installed above a high-water table.

17.9 Appendix 9 - Microdrainage Modelling

17.9.1 Layout of Network

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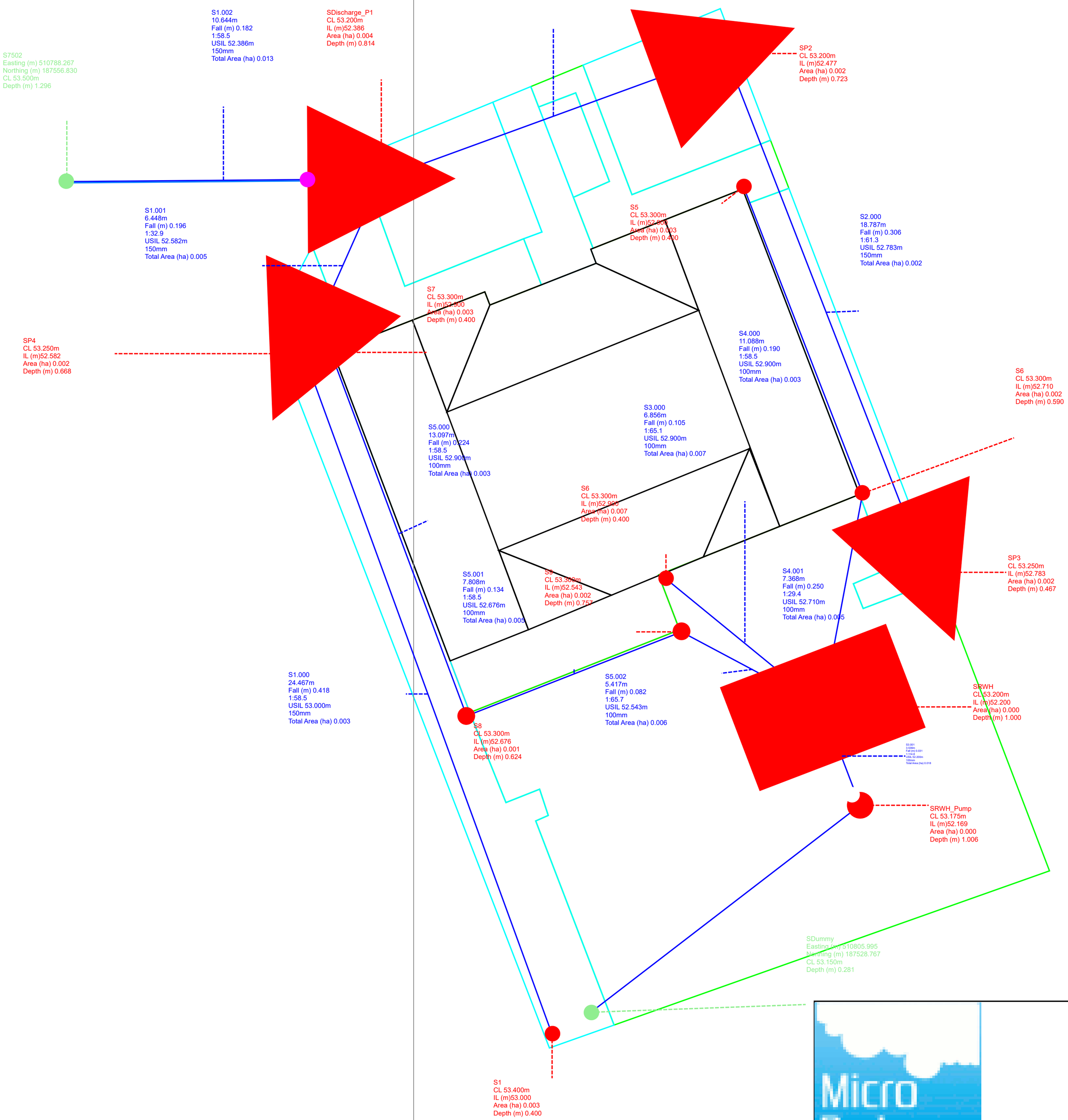

STM Environmental Consultants

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Innovyze

Date : 05/04/2022 14:06

Designed by : DESKTOP-6F5MHDG\Matthew

Filename : G:\BUS_DEVELOPMENT\CLIENTS\CLIENTS - PRIVATE\B12 DEVELOPME

Scale 1: 93

Network 2020.1

17.9.2 Layout of Network - Features, Exceedance flows and Sewer Connection

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Thames Water
Surface Water Sewer Connection
Asset ID - 7502
Invert level at 51.52mAOD

Maxium Discharge rate of 0.5l/s during all storm events

Orifice Flow Control

Discharge Control into Thames Water Sewer.
Maximum discharge rate of 0.5 l/s.

Permeable Paving Patio

Construction
Permeable Block Paving
Permeable Aggregates sub-base; 400mm
Interception and attenuation storage and will allow for some infiltration.

Where permeable paving is close to building foundation, impermeable lining will be used.

Rooftop Discharge
Excess surface water runoff from rooftops, will discharge directly onto the surface of the permeable paving and percolate into the attenuation within the sub-base.

Rooftop Discharge
Excess surface water runoff from rooftops, will discharge into the rainwater harvesting tank via filtration devices.

Rainwater Harvesting Tank
22.5m3 Flat Line Tank (or similar)
15m3 Re-use Storage
7.5m3 Storm Water Storage

Depth sensitive pump - discharge rate of 0.2l/s

Sump and Pump

Variable depth operated pump. Discharges excess surface water collected within the rainwater harvesting tank into the permeable paving.

Permeable Paving

Construction
Permeable Block Paving
Permeable Aggregates sub-base; 400mm
Interception and attenuation storage and will allow for some infiltration.

Where permeable paving is close to building foundation, impermeable lining will be used.

Legend

- Thames Water Surface Water Manhole
- New Surface Water Sewer Connection
- Flow Control
- Building
- Car Parking (Permeable)
- Pathways (Permeable)
- Garden
- Exceedance Flow Route

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17.9.3 Microdrainage results

PDF to follow this page.

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	PIMP (%)	100
M5-60 (mm)	20.400	Add Flow / Climate Change (%)	0
Ratio R	0.415	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	0.300
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm at outfall S7502 (pipe S1.002)

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.011	4-8	0.002

Total Area Contributing (ha) = 0.013

Total Pipe Volume (m³) = 1.285

Time Area Diagram at outfall SDummy (pipe S3.002)

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.012	4-8	0.006

Total Area Contributing (ha) = 0.018

Total Pipe Volume (m³) = 0.523

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	24.467	0.418	58.5	0.003	5.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.31	53.000	0.003	0.0	0.0	0.0	1.32	23.3	0.4

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.001	6.448	0.196	32.9	0.002	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.000	18.787	0.306	61.3	0.002	5.00	0.0	0.600	o	150	Pipe/Conduit	
S2.001	12.355	0.091	135.3	0.002	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.002	10.644	0.182	58.5	0.004	0.00	0.0	0.600	o	150	Pipe/Conduit	
S3.000	6.856	0.105	65.1	0.007	5.00	0.0	0.600	o	100	Pipe/Conduit	
S4.000	11.088	0.190	58.5	0.003	5.00	0.0	0.600	o	100	Pipe/Conduit	
S4.001	7.368	0.250	29.4	0.002	0.00	0.0	0.600	o	100	Pipe/Conduit	
S5.000	13.097	0.224	58.5	0.003	5.00	0.0	0.600	o	100	Pipe/Conduit	
S5.001	7.808	0.134	58.5	0.001	0.00	0.0	0.600	o	100	Pipe/Conduit	
S5.002	5.417	0.082	65.7	0.002	0.00	0.0	0.600	o	100	Pipe/Conduit	
S3.001	3.536	0.031	114.8	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
S3.002	11.456	0.031	371.9	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.001	50.00	5.37	52.582	0.005	0.0	0.0	0.0	1.76	31.1	0.7
S2.000	50.00	5.24	52.783	0.002	0.0	0.0	0.0	1.29	22.7	0.3
S2.001	50.00	5.48	52.477	0.005	0.0	0.0	0.0	0.86	15.2	0.6
S1.002	50.00	5.62	52.386	0.013	0.0	0.0	0.0	1.32	23.3	1.8
S3.000	50.00	5.12	52.900	0.007	0.0	0.0	0.0	0.96	7.5	1.0
S4.000	50.00	5.18	52.900	0.003	0.0	0.0	0.0	1.01	7.9	0.4
S4.001	50.00	5.27	52.710	0.005	0.0	0.0	0.0	1.43	11.2	0.6
S5.000	50.00	5.22	52.900	0.003	0.0	0.0	0.0	1.01	7.9	0.4
S5.001	50.00	5.35	52.676	0.005	0.0	0.0	0.0	1.01	7.9	0.6
S5.002	50.00	5.44	52.543	0.006	0.0	0.0	0.0	0.95	7.5	0.8
S3.001	50.00	5.52	52.200	0.018	0.0	0.0	0.0	0.72	5.6	2.4
S3.002	50.00	6.01	52.900	0.018	0.0	0.0	0.0	0.39	3.1	2.4

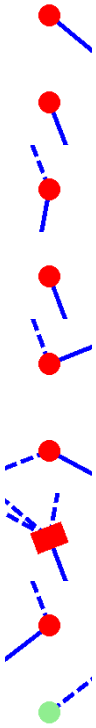
Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)
S1	53.400	0.400	Open Manhole	450	S1.000	53.000	150			
SP4	53.250	0.668	Open Manhole	600	S1.001	52.582	150	S1.000	52.582	150
SP3	53.250	0.467	Open Manhole	450	S2.000	52.783	150			
SP2	53.200	0.723	Open Manhole	600	S2.001	52.477	150	S2.000	52.477	150
SDischarge_P1	53.200	0.814	Open Manhole	950	S1.002	52.386	150	S1.001	52.386	150
								S2.001	52.386	150
S7502	53.500	1.296	Open Manhole	0		OUTFALL		S1.002	52.204	150
S6	53.300	0.400	Open Manhole	450	S3.000	52.900	100			
S5	53.300	0.400	Open Manhole	450	S4.000	52.900	100			
S6	53.300	0.590	Open Manhole	450	S4.001	52.710	100	S4.000	52.710	100
S7	53.300	0.400	Open Manhole	450	S5.000	52.900	100			
S8	53.300	0.624	Open Manhole	600	S5.001	52.676	100	S5.000	52.676	100
S9	53.300	0.757	Open Manhole	600	S5.002	52.543	100	S5.001	52.543	100
SRWH	53.200	1.000	Open Manhole	3750 x 6000	S3.001	52.200	100	S3.000	52.795	100
								S4.001	52.460	100
								S5.002	52.460	100
SRWH_Pump	53.175	1.006	Open Manhole	900	S3.002	52.900	100	S3.001	52.169	100
SDummy	53.150	0.281	Open Manhole	0		OUTFALL		S3.002	52.869	100

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S1	510804.681	187528.053	510804.681	187528.053	Required	
SP4	510796.259	187551.025	510796.259	187551.025	Required	
SP3	510817.341	187543.640	510817.341	187543.640	Required	
SP2	510810.515	187561.144	510810.515	187561.144	Required	
SDischarge_P1	510798.911	187556.902	510798.911	187556.902	Required	
S7502	510788.267	187556.830			No Entry	

Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S6	510808.515	187543.427	510808.515	187543.427	Required	
S5	510811.143	187556.653	510811.143	187556.653	Required	
S6	510815.140	187546.310	510815.140	187546.310	Required	
S7	510797.216	187551.058	510797.216	187551.058	Required	
S8	510801.770	187538.778	510801.770	187538.778	Required	
S9	510809.036	187541.636	510809.036	187541.636	Required	
SRWH	510813.803	187539.064	510813.803	187539.064	Required	
SRWH_Pump	510815.068	187535.762	510815.068	187535.762	Required	
SDummy	510805.995	187528.767			No Entry	



PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	150	S1	53.400	53.000	0.250	Open Manhole	450
S1.001	o	150	SP4	53.250	52.582	0.518	Open Manhole	600
S2.000	o	150	SP3	53.250	52.783	0.317	Open Manhole	450
S2.001	o	150	SP2	53.200	52.477	0.573	Open Manhole	600
S1.002	o	150	SDischarge_P1	53.200	52.386	0.664	Open Manhole	950
S3.000	o	100	S6	53.300	52.900	0.300	Open Manhole	450
S4.000	o	100	S5	53.300	52.900	0.300	Open Manhole	450
S4.001	o	100	S6	53.300	52.710	0.490	Open Manhole	450
S5.000	o	100	S7	53.300	52.900	0.300	Open Manhole	450
S5.001	o	100	S8	53.300	52.676	0.524	Open Manhole	600
S5.002	o	100	S9	53.300	52.543	0.657	Open Manhole	600
S3.001	o	100	SRWH	53.200	52.200	0.900	Open Manhole	3750 x 6000
S3.002	o	100	SRWH_Pump	53.175	52.900	0.175	Open Manhole	900

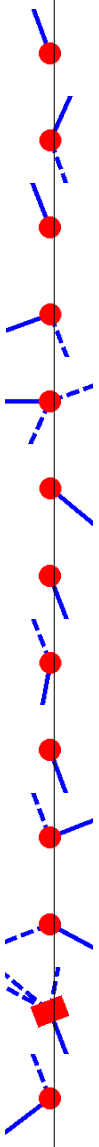
Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	24.467	58.5	SP4	53.250	52.582	0.518	Open Manhole	600
S1.001	6.448	32.9	SDischarge_P1	53.200	52.386	0.664	Open Manhole	950
S2.000	18.787	61.3	SP2	53.200	52.477	0.573	Open Manhole	600
S2.001	12.355	135.3	SDischarge_P1	53.200	52.386	0.664	Open Manhole	950
S1.002	10.644	58.5	S7502	53.500	52.204	1.146	Open Manhole	0
S3.000	6.856	65.1	SRWH	53.200	52.795	0.305	Open Manhole	3750 x 6000
S4.000	11.088	58.5	S6	53.300	52.710	0.490	Open Manhole	450
S4.001	7.368	29.4	SRWH	53.200	52.460	0.640	Open Manhole	3750 x 6000
S5.000	13.097	58.5	S8	53.300	52.676	0.524	Open Manhole	600
S5.001	7.808	58.5	S9	53.300	52.543	0.657	Open Manhole	600
S5.002	5.417	65.7	SRWH	53.200	52.460	0.640	Open Manhole	3750 x 6000
S3.001	3.536	114.8	SRWH_Pump	53.175	52.169	0.906	Open Manhole	900
S3.002	11.456	371.9	SDummy	53.150	52.869	0.181	Open Manhole	0

Setting Out Information - True Coordinates (Storm)

PN	USMH Name	Dia/Len (mm)	Width (mm)	US Easting (m)	US Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Layout (North)
S1.000	S1	450		510804.681	187528.053	510804.681	187528.053	
S1.001	SP4	600		510796.259	187551.025	510796.259	187551.025	
S2.000	SP3	450		510817.341	187543.640	510817.341	187543.640	
S2.001	SP2	600		510810.515	187561.144	510810.515	187561.144	
S1.002	SDischarge_P1	950		510798.911	187556.902	510798.911	187556.902	
S3.000	S6	450		510808.515	187543.427	510808.515	187543.427	
S4.000	S5	450		510811.143	187556.653	510811.143	187556.653	
S4.001	S6	450		510815.140	187546.310	510815.140	187546.310	
S5.000	S7	450		510797.216	187551.058	510797.216	187551.058	
S5.001	S8	600		510801.770	187538.778	510801.770	187538.778	
S5.002	S9	600		510809.036	187541.636	510809.036	187541.636	
S3.001	SRWH	3750	6000	510813.803	187539.064	510813.803	187539.064	
S3.002	SRWH_Pump	900		510815.068	187535.762	510815.068	187535.762	

PN	DSMH Name	Dia/Len (mm)	Width (mm)	DS Easting (m)	DS Northing (m)	Layout (North)
S1.002	S7502	0		510788.267	187556.830	



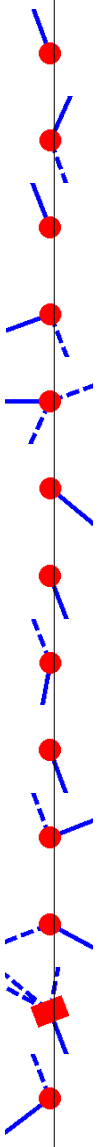
Setting Out Information - True Coordinates (Storm)

PN	DSMH Name	Dia/Len (mm)	Width (mm)	DS Easting (m)	DS Northing (m)	Layout (North)
S3.002	SDummy	0		510805.995	187528.767	

Setting Out Information - Site Coordinates (Storm)

PN	USMH Name	Dia/Len (mm)	Width (mm)	US Easting (m)	US Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Layout (North)
S1.000	S1	450		510804.681	187528.053	510804.681	187528.053	
S1.001	SP4	600		510796.259	187551.025	510796.259	187551.025	
S2.000	SP3	450		510817.341	187543.640	510817.341	187543.640	
S2.001	SP2	600		510810.515	187561.144	510810.515	187561.144	
S1.002	SDischarge_P1	950		510798.911	187556.902	510798.911	187556.902	
S3.000	S6	450		510808.515	187543.427	510808.515	187543.427	
S4.000	S5	450		510811.143	187556.653	510811.143	187556.653	
S4.001	S6	450		510815.140	187546.310	510815.140	187546.310	
S5.000	S7	450		510797.216	187551.058	510797.216	187551.058	
S5.001	S8	600		510801.770	187538.778	510801.770	187538.778	
S5.002	S9	600		510809.036	187541.636	510809.036	187541.636	
S3.001	SRWH	3750	6000	510813.803	187539.064	510813.803	187539.064	
S3.002	SRWH_Pump	900		510815.068	187535.762	510815.068	187535.762	

PN	DSMH Name	Dia/Len (mm)	Width (mm)	DS Easting (m)	DS Northing (m)	Layout (North)
S1.002	S7502	0		510788.267	187556.830	



Setting Out Information - Site Coordinates (Storm)

PN	DSMH Name	Dia/Len (mm)	Width (mm)	DS Easting (m)	DS Northing (m)	Layout (North)
S3.002	SDummy	0		510805.995	187528.767	

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.003	0.003	0.003
1.001	User	-	100	0.002	0.002	0.002
2.000	User	-	100	0.002	0.002	0.002
2.001	User	-	100	0.002	0.002	0.002
1.002	User	-	100	0.004	0.004	0.004
3.000	User	-	100	0.003	0.003	0.003
	User	-	100	0.005	0.005	0.007
4.000	User	-	100	0.001	0.001	0.001
	User	-	100	0.002	0.002	0.003
4.001	User	-	100	0.002	0.002	0.002
5.000	User	-	100	0.001	0.001	0.001
	User	-	100	0.002	0.002	0.003
5.001	User	-	100	0.001	0.001	0.001
5.002	User	-	100	0.002	0.002	0.002
3.001	-	-	100	0.000	0.000	0.000
3.002	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.031	0.031	0.031

Network Classifications for Storm

PN	USMH Name	Pipe Dia (mm)	Min Cover Depth (m)	Max Cover Depth (m)	Pipe Type	MH Dia (mm)	MH Width (mm)	MH Ring Depth (m)	MH Type
S1.000	S1	150	0.250	0.518	Unclassified	450	0	0.250	Unclassified
S1.001	SP4	150	0.518	0.664	Unclassified	600	0	0.518	Unclassified
S2.000	SP3	150	0.317	0.573	Unclassified	450	0	0.317	Unclassified
S2.001	SP2	150	0.573	0.664	Unclassified	600	0	0.573	Unclassified
S1.002	SDischarge_P1	150	0.664	1.146	Unclassified	950	0	0.664	Unclassified
S3.000	S6	100	0.300	0.305	Unclassified	450	0	0.300	Unclassified
S4.000	S5	100	0.300	0.490	Unclassified	450	0	0.300	Unclassified
S4.001	S6	100	0.490	0.640	Unclassified	450	0	0.490	Unclassified
S5.000	S7	100	0.300	0.524	Unclassified	450	0	0.300	Unclassified
S5.001	S8	100	0.524	0.657	Unclassified	600	0	0.524	Unclassified
S5.002	S9	100	0.640	0.657	Unclassified	600	0	0.657	Unclassified
S3.001	SRWH	100	0.900	0.906	Unclassified	3750	6000	0.900	Unclassified
S3.002	SRWH_Pump	100	0.175	0.181	Unclassified	900	0	0.175	Unclassified

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.002	S7502	53.500	52.204	0.000	0	0

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S3.002	SDummy	53.150	52.869	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	4
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	2	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model FSR Return Period (years) 100

Synthetic Rainfall Details

Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.400	Cv (Winter)	0.840
Ratio R	0.415	Storm Duration (mins)	30
Profile Type	Summer		

Online Controls for Storm

Orifice Manhole: SDischarge_P1, DS/PN: S1.002, Volume (m^3): 0.9

Diameter (m) 0.015 Discharge Coefficient 0.600 Invert Level (m) 52.386

Offline Controls for Storm

Pump Manhole: SRWH_Pump, DS/PN: S3.002, Loop to PN: S1.000

Invert Level (m) 52.169

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.0000	0.400	0.0000	0.660	0.0000	0.800	0.2000
0.200	0.0000	0.500	0.0000	0.670	0.2000	0.850	1.0000
0.300	0.0000	0.600	0.0000	0.700	0.2000		

Pipe Manhole: SRWH_Pump, DS/PN: S3.002, Loop to PN: S3.001

Diameter (m)	0.100	Roughness k (mm)	0.600
Section Type	Pipe/Conduit	Entry Loss Coefficient	0.500
Slope (1:X)	28.8	Coefficient of Contraction	0.600
Length (m)	3.600	Upstream Invert Level (m)	52.800

Storage Structures for Storm

Porous Car Park Manhole: SP4, DS/PN: S1.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	2.0
Membrane Percolation (mm/hr)	1000	Length (m)	25.0
Max Percolation (l/s)	13.9	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	52.800	Cap Volume Depth (m)	0.300

Porous Car Park Manhole: SP3, DS/PN: S2.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	2.0
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	5.6	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	52.800	Cap Volume Depth (m)	0.300

Porous Car Park Manhole: SP2, DS/PN: S2.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	4.0
Membrane Percolation (mm/hr)	1000	Length (m)	5.0
Max Percolation (l/s)	5.6	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	52.800	Cap Volume Depth (m)	0.300

Porous Car Park Manhole: SDischarge_P1, DS/PN: S1.002

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	2.0
Membrane Percolation (mm/hr)	1000	Length (m)	25.0
Max Percolation (l/s)	13.9	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	52.800	Cap Volume Depth (m)	0.300

Volume Summary (Static)

Length Calculations based on Centre-Centre

Pipe Number	USMH Name	Manhole Volume (m³)	Pipe Volume (m³)	Storage Structure Volume (m³)	Total Volume (m³)
S1.000	S1	0.064	0.432	0.000	0.496
S1.001	SP4	0.189	0.114	4.500	4.803
S2.000	SP3	0.074	0.332	1.800	2.206
S2.001	SP2	0.204	0.218	1.800	2.223
S1.002	SDischarge_P1	0.577	0.188	4.500	5.265
S3.000	S6	0.064	0.054	0.000	0.117
S4.000	S5	0.064	0.087	0.000	0.151
S4.001	S6	0.094	0.058	0.000	0.152
S5.000	S7	0.064	0.103	0.000	0.166
S5.001	S8	0.176	0.061	0.000	0.238
S5.002	S9	0.214	0.043	0.000	0.257
S3.001	SRWH	22.500	0.028	0.000	22.528
S3.002	SRWH_Pump	0.175	0.090	0.000	0.265
Total		24.459	1.808	12.600	38.867

Volume Summary (Static)

Length Calculations based on True Length

Pipe Number	USMH Name	Manhole Volume (m³)	Pipe Volume (m³)	Storage Structure Volume (m³)	Total Volume (m³)
S1.000	S1	0.064	0.423	0.000	0.487
S1.001	SP4	0.189	0.100	4.500	4.789
S2.000	SP3	0.074	0.323	1.800	2.197
S2.001	SP2	0.204	0.205	1.800	2.209
S1.002	SDischarge_P1	0.577	0.180	4.500	5.257
S3.000	S6	0.064	0.037	0.000	0.101
S4.000	S5	0.064	0.084	0.000	0.147
S4.001	S6	0.094	0.041	0.000	0.135
S5.000	S7	0.064	0.099	0.000	0.162
S5.001	S8	0.176	0.057	0.000	0.233
S5.002	S9	0.214	0.025	0.000	0.240
S3.001	SRWH	22.500	0.010	0.000	22.510
S3.002	SRWH_Pump	0.175	0.086	0.000	0.261
Total		24.459	1.669	12.600	38.728

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	4
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	2	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	ON
Analysis Timestep	Fine	Inertia Status	ON
DTS Status	OFF		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 360, 480, 600, 720, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
S1.000	S1	15 Winter	1	+0%			
S1.001	SP4	15 Winter	1	+0%	30/15 Summer		
S2.000	SP3	15 Winter	1	+0%			
S2.001	SP2	120 Winter	1	+0%	30/15 Summer		
S1.002	SDischarge_P1	120 Winter	1	+0%	1/30 Winter		
S3.000	S6	15 Winter	1	+0%			
S4.000	S5	15 Winter	1	+0%			
S4.001	S6	15 Winter	1	+0%	100/480 Winter		
S5.000	S7	15 Winter	1	+0%			
S5.001	S8	15 Winter	1	+0%	100/480 Winter		
S5.002	S9	480 Summer	1	+0%	1/480 Summer		
S3.001	SRWH	480 Summer	1	+0%	1/120 Winter		
S3.002	SRWH_Pump	1440 Winter	1	+0%			1/480 Summer

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
S1.000	S1		53.014	-0.136	0.000	0.02			0.4
S1.001	SP4		52.593	-0.138	0.000	0.02		4	0.4
S2.000	SP3		52.795	-0.138	0.000	0.01		3	0.3
S2.001	SP2		52.571	-0.056	0.000	0.01		40	0.2
S1.002	SDischarge_P1		52.571	0.035	0.000	0.01		52	0.2
S3.000	S6		52.925	-0.075	0.000	0.14			1.0
S4.000	S5		52.915	-0.085	0.000	0.06			0.4
S4.001	S6		52.726	-0.084	0.000	0.06			0.6
S5.000	S7		52.916	-0.084	0.000	0.06			0.4
S5.001	S8		52.695	-0.081	0.000	0.08			0.6
S5.002	S9		52.645	0.002	0.000	0.02			0.1
S3.001	SRWH		52.643	0.343	0.000	0.05			0.2
S3.002	SRWH_Pump	15	52.838	-0.162	0.000	0.00	0.6		0.0

PN	US/MH Name	Status	Level Exceeded
S1.000	S1	OK	
S1.001	SP4	OK	
S2.000	SP3	OK	
S2.001	SP2	OK	
S1.002	SDischarge_P1	SURCHARGED	
S3.000	S6	OK	
S4.000	S5	OK	
S4.001	S6	OK	
S5.000	S7	OK	
S5.001	S8	OK	
S5.002	S9	SURCHARGED	
S3.001	SRWH	SURCHARGED	
S3.002	SRWH_Pump	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	4
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	2	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	ON
Analysis Timestep	Fine	Inertia Status	ON
DTS Status	OFF		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 360, 480, 600, 720, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
S1.000	S1	15 Winter	30	+0%			
S1.001	SP4	120 Winter	30	+0%	30/15 Summer		
S2.000	SP3	120 Winter	30	+0%			
S2.001	SP2	120 Winter	30	+0%	30/15 Summer		
S1.002	SDischarge_P1	120 Winter	30	+0%	1/30 Winter		
S3.000	S6	15 Winter	30	+0%			
S4.000	S5	15 Winter	30	+0%			
S4.001	S6	15 Winter	30	+0%	100/480 Winter		
S5.000	S7	15 Winter	30	+0%			
S5.001	S8	1440 Winter	30	+0%	100/480 Winter		
S5.002	S9	1440 Winter	30	+0%	1/480 Summer		
S3.001	SRWH	1440 Winter	30	+0%	1/120 Winter		
S3.002	SRWH_Pump	1440 Winter	30	+0%			1/480 Summer

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
S1.000	S1		53.021	-0.129	0.000	0.05			1.0
S1.001	SP4		52.821	0.089	0.000	0.01		64	0.2
S2.000	SP3		52.821	-0.113	0.000	0.01		52	0.2
S2.001	SP2		52.821	0.194	0.000	0.02		92	0.2
S1.002	SDischarge_P1		52.820	0.285	0.000	0.01		108	0.3
S3.000	S6		52.941	-0.059	0.000	0.35			2.4
S4.000	S5		52.925	-0.075	0.000	0.14			1.0
S4.001	S6		52.737	-0.074	0.000	0.15			1.6
S5.000	S7		52.925	-0.075	0.000	0.14			1.1
S5.001	S8		52.729	-0.047	0.000	0.01			0.1
S5.002	S9		52.728	0.086	0.000	0.01			0.1
S3.001	SRWH		52.728	0.428	0.000	0.24			1.1
S3.002	SRWH_Pump	15	52.837	-0.163	0.000	0.00	0.9		0.0

PN	US/MH Name	Status	Level Exceeded
S1.000	S1	OK	
S1.001	SP4	SURCHARGED	
S2.000	SP3	OK	
S2.001	SP2	SURCHARGED	
S1.002	SDischarge_P1	SURCHARGED	
S3.000	S6	OK	
S4.000	S5	OK	
S4.001	S6	OK	
S5.000	S7	OK	
S5.001	S8	OK	
S5.002	S9	SURCHARGED	
S3.001	SRWH	SURCHARGED	
S3.002	SRWH_Pump	OK	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	4
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	2	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	ON
Analysis Timestep	Fine	Inertia Status	ON
DTS Status	OFF		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 360, 480, 600, 720, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
S1.000	S1	15 Winter	100	+40%			
S1.001	SP4	120 Winter	100	+40%	30/15 Summer		
S2.000	SP3	120 Winter	100	+40%			
S2.001	SP2	120 Winter	100	+40%	30/15 Summer		
S1.002	SDischarge_P1	120 Winter	100	+40%	1/30 Winter		
S3.000	S6	15 Winter	100	+40%			
S4.000	S5	15 Winter	100	+40%			
S4.001	S6	1440 Winter	100	+40%	100/480 Winter		
S5.000	S7	15 Winter	100	+40%			
S5.001	S8	1440 Winter	100	+40%	100/480 Winter		
S5.002	S9	1440 Winter	100	+40%	1/480 Summer		
S3.001	SRWH	1440 Winter	100	+40%	1/120 Winter		
S3.002	SRWH_Pump	1440 Winter	100	+40%			1/480 Summer

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
S1.000	S1		53.030	-0.120	0.000	0.08			1.9
S1.001	SP4		52.890	0.158	0.000	0.01		128	0.2
S2.000	SP3		52.890	-0.044	0.000	0.01		112	0.3
S2.001	SP2		52.890	0.263	0.000	0.02		172	0.2
S1.002	SDischarge_P1		52.889	0.354	0.000	0.02		160	0.3
S3.000	S6		52.959	-0.041	0.000	0.64			4.4
S4.000	S5		52.934	-0.066	0.000	0.25			1.8
S4.001	S6		52.871	0.060	0.000	0.01			0.1
S5.000	S7		52.935	-0.065	0.000	0.26			2.0
S5.001	S8		52.871	0.095	0.000	0.02			0.1
S5.002	S9		52.871	0.228	0.000	0.02			0.2
S3.001	SRWH		52.871	0.571	0.000	0.23			1.1
S3.002	SRWH_Pump	15	52.870	-0.130	0.000	0.00	0.9		0.0

PN	US/MH Name	Status	Level Exceeded
S1.000	S1	OK	
S1.001	SP4	SURCHARGED	
S2.000	SP3	OK	
S2.001	SP2	SURCHARGED	
S1.002	SDischarge_P1	SURCHARGED	
S3.000	S6	OK	
S4.000	S5	OK	
S4.001	S6	SURCHARGED	
S5.000	S7	OK	
S5.001	S8	SURCHARGED	
S5.002	S9	SURCHARGED	
S3.001	SRWH	SURCHARGED	
S3.002	SRWH_Pump	OK	

17.10 Appendix 10 – SuDS Maintenance Manual

All maintenance activities will be the responsibility of the developer “B12 Development”. They will appoint a management company to undertake the general maintenance duties within the site and will join service agreements with the suppliers and manufactures of the SuDS/Pumps when required.

The cost of the services and management company will be funded through the service charge fee which will be paid and manged by home owners.

The information presented below is taken from the CIRIA SuDS Manual (Report c753) and SuDS. Further details on installation and maintenance can be found detailed below and online.

17.10.1 Pervious Pavements

Maintenance Schedule	Required Action	Typical Frequency	Responsibility
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.	B12 Development will be responsible for setting up the management company.
Occasional maintenance	Stabilise and mow contributing and areas.	As required.	
	Removal of weeds or manage using weed killer applied directly into the weeds 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 lost material.	As required.	

Maintenance Schedule	Required Action	Typical Frequency	Responsibility
	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).	B12 Development will be responsible for setting up the management company.
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, 48h after large storms in first six months.	
	Inspect silt accumulation rates and establish appropriate brushing frequencies.	Annually.	
	Monitor Inspection chambers.	Annually.	

Many of the specific maintenance activities for pervious pavements can be undertaken as part of a general site cleaning contract (many car parks or roads are swept to remove litter and for visual reasons to keep them tidy). Therefore, if litter management is already required at the site, this should have marginal cost implications.

17.10.2 Rain Water Harvesting Maintenance

Maintenance Schedule	Required Action	Typical Frequency	Responsibility
Regular maintenance	Inspect for sediment and debris in inlet and outlet components;	Monthly;	B12 Development will be responsible for setting up the management company.
	Inspection & Cleaning of gutters and any filters on downpipes feeding into the Rain Water Butts.	Monthly; Increase freq. to weekly during Autumn; After storm events;	
Remedial actions	Cleaning of the rainwater Tanks. Fully drain the clear out debris and enable access; Scrub / Pressure wash out the inside of the tank if accessible, use appropriate cleaning product Rinse with clean water; Cleaning of Gutters; Clean or fit a new filter;	2 - 5 years;	
Monitoring	Check Correct pumping operations; Check volume of water being held in tank after storm events; Replace parts as required; Replace pump as required	Quartlery	

Maintenance will be carried out manually. All monitoring and maintenance will be carried out by the appointed the Owner (Lars Mosesson) who will instruct a management company to undertake the tasks.

17.10.3 Flow Control Maintenance

Maintenance Schedule	Required Action	Typical Frequency	Responsibility
Regular maintenance	Inspect for sediment and debris;	Quarterly; As required. Increase freq. to Monthly during Autumn;	B12 Development will be responsible for setting up the management company.
	Inspection & Cleaning of SuDS components upstream of flow control element.	Quarterly; Increase freq. to Monthly during Autumn;	
Remedial actions	Removal of debris and sediment;	Annually; Or as required.	
Remedial actions	Replacement of parts; Manhole cover, filters or components of flow control device;	As required;	
Monitoring	Ensure flow control device is function correctly during and after storm events; Check water levels up stream and downstream of flow control device	Monthly; During 1st year of installation or during and after storm event; When possible Reduce to Quarterly following the 1st year;	
	Check for damage to flow control components	Annually;	
	Check for securely fitting manhole lid; Ensures debris cannot enter the system unfiltered;	Annually;	

17.11 Appendix 11 - Timeline for Implementation

17.11.1 Timeline

Phase 1 (2 month) : Site clearance & Demolition / Levelling / Foundations

Phase 2 (12 - 18 month) : Construction Phase / Internal Plumbing Connections

Phase 3 (3 months) : Installation of rainwater tanks / Connection to dwelling / Connection of overflow to permeable paving

Permeable Paving Construction;

Construction of flow control / connection to Thames Water Sewer;

The installation of SuDS after Phase 2 will they do not get damaged during construction phase;

Where necessary, drainage connections will be blocked off until suitable filtration of runoff can be provided.

17.12 Appendix 12 - Water Efficiency

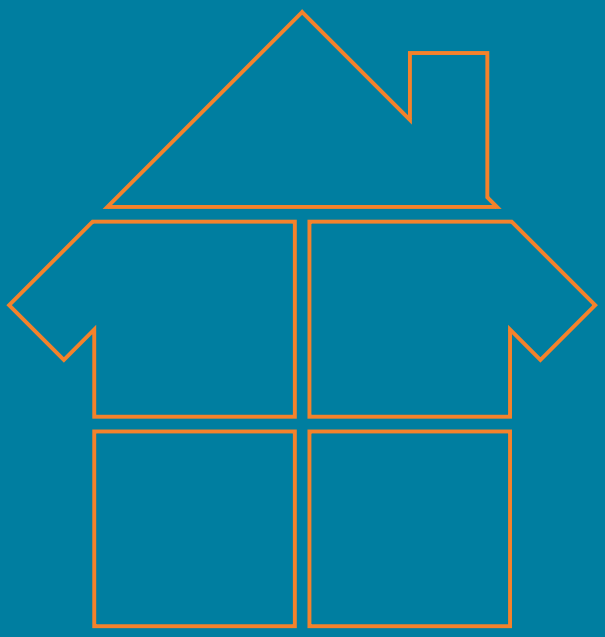
WaterSafe
LOCAL APPROVED PLUMBERS

HBF
HOME BUILDERS FEDERATION

Without action, there is a 1 in 4 chance in the next 30 years that large numbers of households will have their water supply cut off for an extended period because of severe drought.
National Infrastructure Commission report (2018)

We want to see water use in England fall. New homes will be built in a way that reduces demands for water, energy and material resources.
25-Year Environment Plan, launched by the Prime Minister in 2018

Developing water efficient homes



Why build water efficient homes?

Water is vital for our daily lives – for drinking, washing, generating energy and growing the food we eat.

However, this precious resource is coming under growing pressure as we build more homes for more people and feel the effects of climate change and a greater risk of droughts.

If we don't take action to reduce water use now, our daily lives, communities, nature and the wider economy will all suffer.

Here's a few reasons why it's important to make new homes water efficient.

Your customers

All new homes should have a water meter, but some of your customers might not have had one before, so they'll thank you for doing everything you can to help them lower their water and energy bills. Protecting the environment is also important to them – especially for their children's future.

Planning – locally and nationally

Planning authorities expect limits of 125 litres of water per person per day on new developments, as part of the Building Regulations Part G. They can also ask for a lower limit of 110 litres as a planning condition. The Government is currently reviewing water use targets.

Protecting the environment

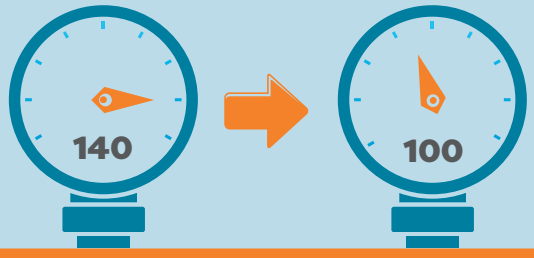
It's the right thing to do for people, nature and the economy. We all need to leave more water in the environment to protect rivers, streams and wildlife. The South East and East of England are already water-stressed and other areas are likely to follow.

Cost savings to you

Many water companies are offering to reduce or waiver water infrastructure charges, if you build water efficient homes. You pay these charges per property when you connect to the water network, to contribute to the cost of providing water services.

Your reputation

Your customers, communities and governing bodies will think more of you and your work if you show their needs and values are important to you.



The average UK water use is about 140 litres per person right now. The National Infrastructure Commission is recommending 118 litres for everyone – new homes and old – and water companies are setting ambitious targets in their long-term plans – some as low as 100.

All new homes must have a water meter – these helpful guidelines share best practice on meters. **water.org.uk/developer-services/guidelines**

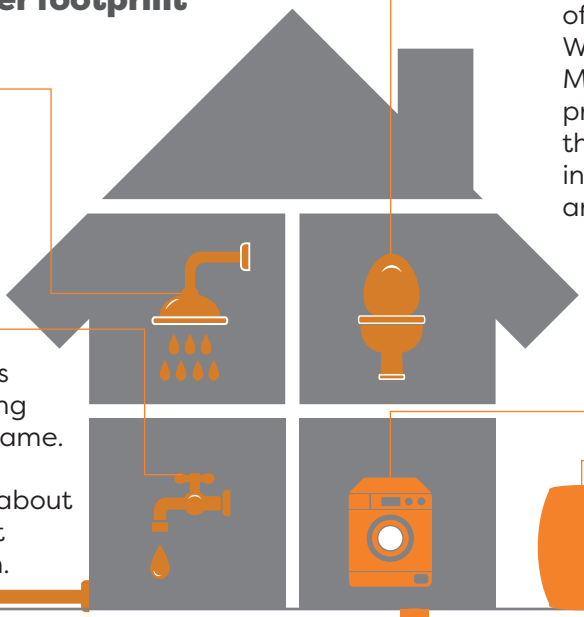
How to create water efficient homes

A few simple choices can make a big difference to the water footprint of a new house.

Showers – water efficient showerheads can save more than a third of water, and the energy to heat it, while still providing a great shower experience.

Taps – inexpensive aerators add air into the water – using less and the flow feels the same.

Gardens – think about drought-resistant plants and mulch.



Toilets – dual flush toilets should have a maximum flush of six litres to comply with the Water Fittings Regulations. Make sure they are installed properly to avoid leaks – one of the biggest causes of water loss in homes. Flushes as low as 4 and 2.6 litres are available.

Appliances – choose energy and water efficient washing machines and dishwashers.

Water butts – installing a water butt on a down pipe is a great gift for new homeowners.

Ask your local water supplier about a **'trickle feed'** before a full connection.

Greywater or rainwater harvesting – both these can generate water to flush the loo, wash the car or water the garden. They are much more efficient and cost effective when installed during construction. Take care to install them correctly so they don't illegally cross-connect to the water supply. Find out more at **watersafe.org.uk/alternativewater.**

Tools to help

Contact your local water supplier - they have lots of advice and incentives to share. Other help includes:

We need more ambitious water efficiency – for customers, the environment, society and the economy. It's perfectly doable to get down to 100 litres per person per day in the next 20 to 25 years.
Nicci Russell, Managing Director, Waterwise

The Water Label

The European Water Label rates bathroom products in terms of their water efficiency. Visit europeanwaterlabel.eu and look for A rated products.

The Calculator

This free calculator helps work out how much water your development will use and how you can reduce it to meet guidelines – you can access it at thewatercalculator.org.uk

Waterwise

Waterwise is an independent, not-for-profit organisation focused on reducing water consumption in the UK. Visit waterwise.org.uk for advice and support.

WaterSafe®
LOCAL APPROVED PLUMBERS

Who can support you?

WaterSafe is the national register of approved plumbers in the UK, supported by all the UK water companies and the drinking water quality regulators.

Plumbing businesses on its register are all trained in the Water Fittings Regulations – the national requirements which govern the design, installation, operation and maintenance of plumbing systems, water fittings and appliances which use water.

As well as protecting the quality of drinking water, the regulations are designed to prevent the 'waste and undue consumption of water'.

For most types of plumbing work, plumbers have a legal duty to notify the local water supplier before they start work and this can lead to delays. Approved plumbers can carry out some work without advanced notification.

Some water companies may also provide incentives if you use an approved plumber or groundworker to carry out work. A 'work completed' certificate issued by a WaterSafe plumber also provides a defence if challenged by a supplier enforcing the Water Fittings Regulations.

Approved products

WaterSafe-approved plumbers can also offer advice on approved plumbing products – both to avoid waste and protect water quality. You should make sure products you use have been tested against appropriate standards.

One easy way to check if a product is suitable is to look for an approval mark from organisations like the Water Regulations Advisory Scheme (WRAS) or Kiwa. Both provide directories of approved products at **wras.co.uk** or **kiwa.co.uk/waterproducts**.

Find WaterSafe plumbers at watersafe.org.uk