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ENVIRONMENTAL CONSULTING , SOFTWARE & TRAINING

Surface Water Drainage Strategy

Site Address
Sutton United Football Club
The Borough Sports Ground
Gander Green Lane
Sutton
SM1 2EY

Client
Planning Consent UK Ltd

Report Reference
SWDS – 2021 – 000022

Prepared By
STM Environmental Consultants Ltd

Date
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1 Document Control

Surface Water Drainage Strategy

Site Address:	Sutton United Football Club The Borough Sports Ground Gander Green Lane Sutton SM1 2EY
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Report Author:	Matthew Ashdown (BSc) **Environmental Consultant**
Checked By:	Nick Roebuck (MSc, BSc) **Junior Environmental Consultant**
Authorised by:	Simon Makoni (BSc, MSc) **GeoEnvironmental Engineer, Director**

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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, Tolulene, Ethylene, Xylene
PAH	Poly-Aromatic Hydrocarbons

4 Disclaimer

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5 Executive Summary

Location	**Sutton United Football Club, The Borough Sports Ground, Gander Green Ln, Sutton, SM1 2EY Grid reference: 525100, 164699**		
Proposed Development	Provision of new grandstand to eastern end of ground, new turnstiles to replace existing and replacement of artificial grass with real grass.		
Current Site and Surrounding Uses	Sutton United Football stadium and associated outbuildings and car parking.		
Topography	38.9mAOD (NW) to 42.6mAOD (E).		
Hydrology	Pyl Brook located 510m north east of the site.		
Geology	The BGS indicates that there are no superficial deposits whilst the bedrock is classified as the London Clay Formation.		
Hydrogeology	The BGS indicates that bedrock aquifer is classified as unproductive.		
Permeability	The BGS indicates bedrock is poorly draining.		
Infiltration Potential	The BGS indicates that there are significant constraints against the use of infiltration.		
Fluvial Flood Risk	Very low - Flood Zone 1.		
Surface Water Flood Risk	Low to medium – the majority of the site remains dry during the 1 in 100-year event, though the site may experience flood depths up to 900m along the south east boundary during the 1 in 1000-year event.		
Groundwater Flood Risk	Some areas of the site may have potential for flooding below ground level and/or at the surface.		
Site Area	24,432m^2		
Existing and Proposed Site Layout	**Ground Cover**	**Existing**	**Proposed (Without SuDS)**
	Buildings	2511	2639
	Driveways/Patio	8632	8568
	Gardens/ Soft landscaping	13,289	13,225
	Total Impermeable Area	**11,143**	**11, 207**

Changes in Impermeable Area	The proposed is a minor development that will increase the impermeable area of the site by 0.2% (64m^2).		
Run-Off Rates	Greenfield (GF) (l/s)	Pre - Development (PD) (l/s)	Post Development (PD) (l/s)
Qbar	4.1215	8.6930	8.7341
1 in 1	3.5033	7.3890	7.4240
1 in 30	9.4795	19.9938	20.0885
1 in 100	13.1477	27.7305	27.8619
1 in 100 + CC (40%)	19.4903	41.1081	41.3029
SuDS Target Requirement	The LLFA does not set any specific targets for minor developments. The proposal is predominately for a like for like replacement of artificial pitch to grass, that will utilise the existing land drainage. The proposed new grandstand forms a total area of 128m^2, the proposal will to attenuate the increase in surface water runoff.		
Storage Required to meet Planning Requirement	Using the Microdrainage quick storage estimate method, the total storage volume required to match greenfield discharges or pre-development rate was calculated to be 905 - 1209m^3. As it is a minor development, the proposal provides attenuation storage for 12m^3, which ensures there is no increase in the post development runoff rates.		
Infiltration Testing	A site investigation was undertaken on the 14th of April 2021 by STM Environmental. 3no. trial pits (TP01, TP02, TP03) were excavated on site. The geology encountered consisted of shallow topsoil with made ground and bedrock of London Clay. Groundwater was present at 0.9m below ground level in TP02. Infiltration tests were undertaken in TP01 and TP03. The infiltration tests failed to reach the 50% infiltration benchmark volume during the 1st test run. The tests were abandoned.		
SuDS Strategy	The proposed development will utilise the existing land drainage that's in place for the artificial pitch. It is considered to be a like for like replacement. It will provide an additional storage medium, within the imported topsoil and sand substrate, and it will provide a reduction in surface water runoff rate.		

	A new underground permeable sub-base drainage channel will be excavated to the south of the grass pitch. The drainage channel will consist of 300mm thick permeable aggregate providing an additional 12m^3 of attenuation storage and creating a new conveyance feature within the site. Consequently, this will reduce the runoff velocity without the need for flow control devices.
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 Planning Consents UK Ltd to undertake a Surface Water Drainage Strategy for a proposed development at Sutton United Football Club, The Borough Sports Ground, Gander Green Ln, Sutton, SM1 2EY.

6.1 Proposed Development

The SWDS is required to support a planning application for the provision of a new grandstand at the eastern end of the ground, new turnstiles to replace the existing, and replacement of artificial grass with real grass.

Copies of the development plans 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 should be read in conjunction with the following report also prepared for the site by STM:

- Flood Risk Assessment – Ref: FRA – 2021 – 000059 – May 2021

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

> When determining planning applications, local planning authorities should ensure flood risk is not increased elsewhere and only consider development appropriate in areas at risk of flooding where, informed by a site-specific flood risk assessment following the Sequential Test, and if required the Exception Test, 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
> - development is appropriately flood resilient and resistant, including safe access and escape routes where required, and that any residual risk can be safely managed, including by emergency planning; and it gives priority to the use of sustainable drainage systems.

Paragraph 165 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.

Evidence that sustainable drainage (SuDS) has been considered should be submitted for Minor Developments.

In addition, the requirements of this report are laid out in the London Plan [2] and the LBOS website:

All major planning applications should be supported by a completed Drainage Assessment Form (DAF) in order to demonstrate that the Council's minimum performance standards for sustainable drainage (SUDS) have been met in line with Policy 5.12 of the London Plan, the Mayor's Supplementary Planning Guidance (SPG) on Sustainable Design and Construction and Policy Policy 32 of the 2018 Local Plan.

All major residential and non-residential developments should aim to achieve greenfield runoff rates and volumes for all storm events up to and including the 1 in 100-year 6-hr storm event (taking account of climate change) through application of the Mayor's drainage hierarchy.

7 Site Characteristics

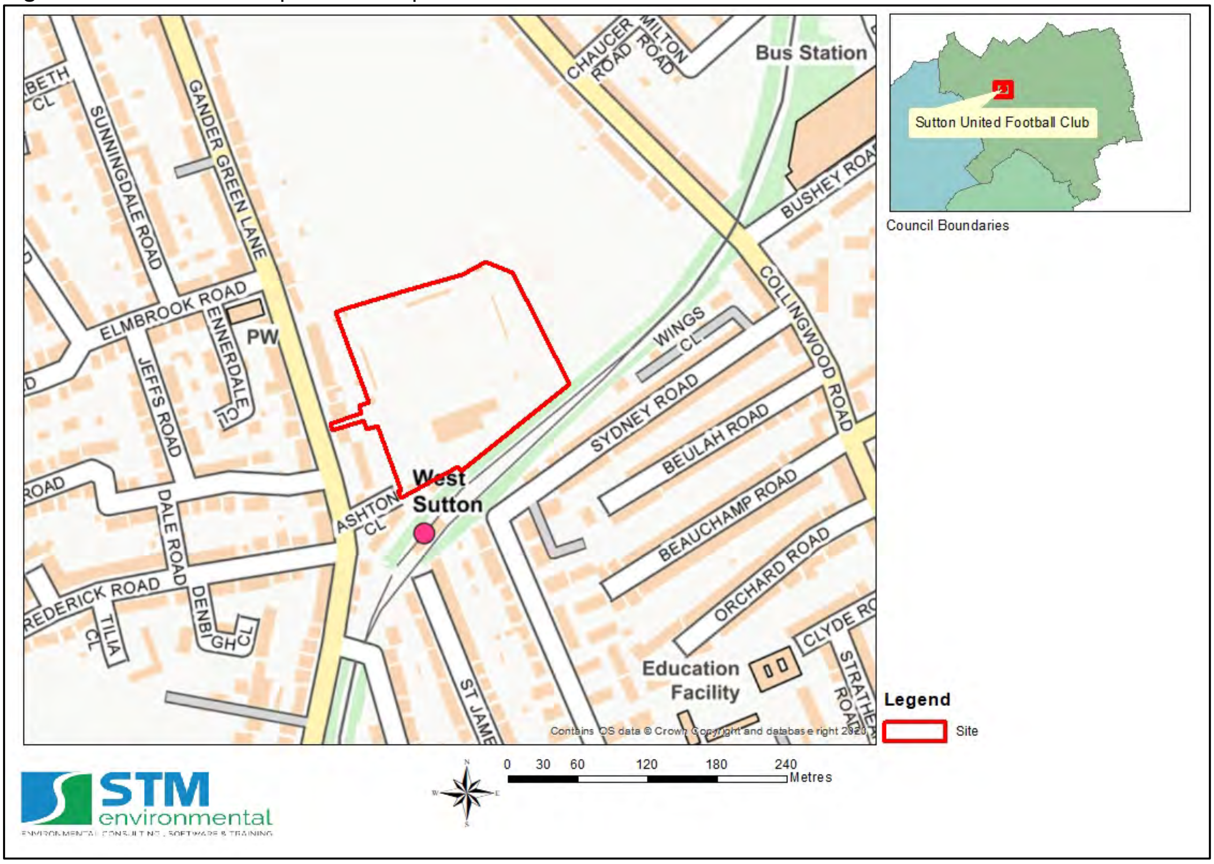
7.1 Location and Area

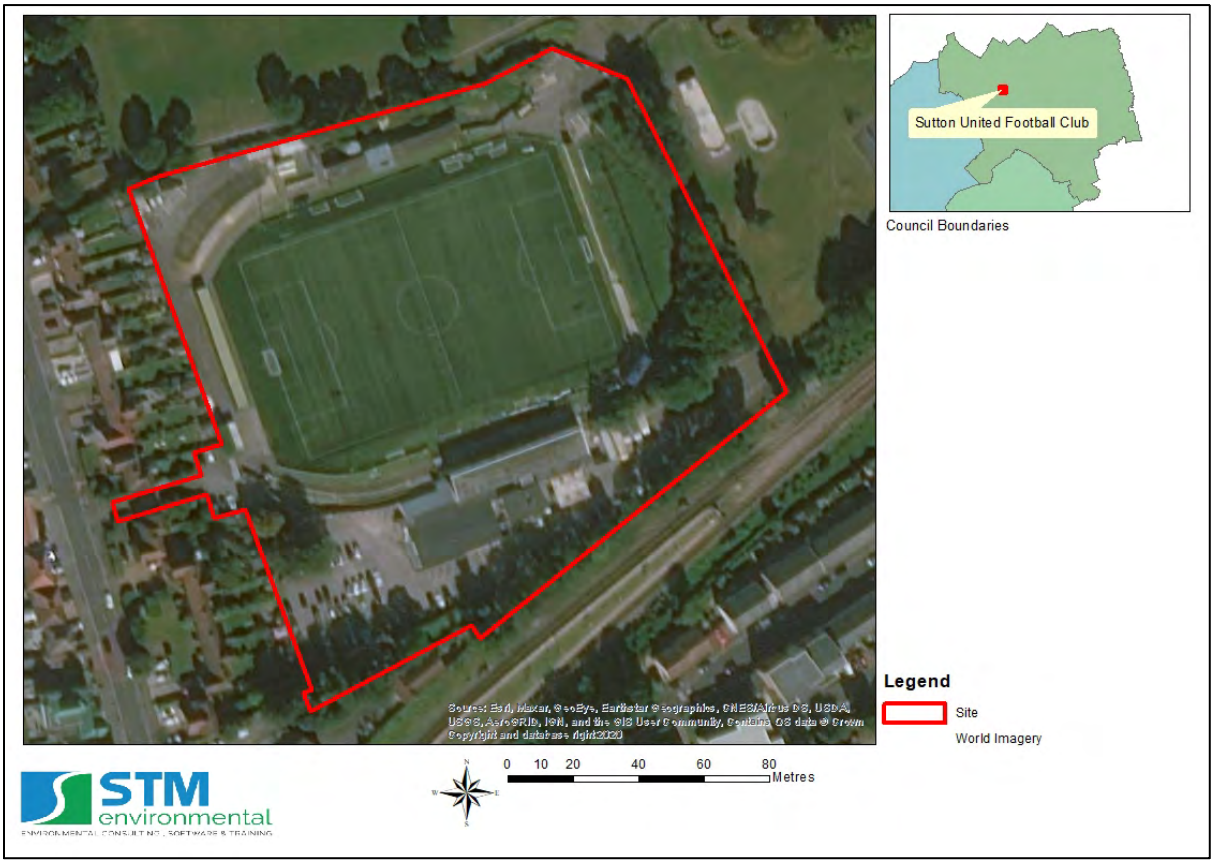
The site is centred at national grid reference 525100, 164699 and has a total area of 24,432m^2.

It falls within the jurisdiction of the London Borough of Sutton in terms of the planning consultation process on flood risk and surface water management. The LLFA is Sutton Council.

Figure 1 provides the site location map and aerial imagery.

Figure 1: Site location map and aerial photo





7.2 Current Site and Surrounding Uses

The site is currently used as recreational. The surrounding area consists of residential and transport.

7.3 Site Topography

The mapping provided in Appendix 2 shows that the topography within the site.

Due to the site's requirement for recreational use, the majority of the site sits at approximately 38.5mAOD. This increases in the east of the site at the existing Collingwood Stand to approximately 42.2mAOD, and also in the south west of the site to 41mAOD.

7.4 Hydrology

The nearest main watercourse is the Pyl Brook which is located 510m in the north east direction.

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 were no superficial deposits identified at the site. The bedrock is classified as belonging to the London Clay Formation (Clay).

The permeability of the bedrock geology is considered to be poorly draining.

The BGS infiltration potential map suggests that there are significant constraints across the majority of the site.

The maps also indicate that the groundwater table is less than 5mbgl.

The site lies upon an Unproductive bedrock aquifer. The site lies within a groundwater Source Protection Zones 1, 2, and 3.

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 designated as being within Flood Zone 1 and is therefore considered to have a less than 1 in 1000 annual 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 very low risk across the majority of the site. Whilst the north west of the site is as at medium risk 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 there is potential for groundwater flooding to occur at the surface in the north west of the site, while in the east and south, there is potential for flooding below ground level.

7.7 Existing Drainage

Drainage plans showing the existing surface water drainage system at the site were not available at the time of writing, however, a connection into the surface water sewers is known to exist on site.

Thames Water operates the sewerage network.

There are two surface water sewer runs that originate close to, or within, Sutton United football club.

A cycle path separates Collingwood Recreation Ground (to the north) and Sutton United Football Club (to the south). A surface water sewer is located at the west end of the cycle path that leads onto Ganders Green Lane. The asset ID is 9703 - no cover levels or invert levels are known.

A second sewer run originates central, just west of the entrance way to the club ground on Ganders Green Lane. The asset ID is 9605 - no cover levels or invert levels are known.

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 and 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	2511	10	2639	11	128
Hard Standing	8632	35	8568	35	-64
Soft landscaping	13289	54	13225	54	-64
Total	24432	100	24432	100	

Table 2: Summary of Permeable and Impermeable Areas

	Impermeable Area		Permeable Area		Total Area
	m^2	%	m2	%	m^2
Existing Site	11143	46	13289	54	24432
Proposed Site	11207	46	13225	54	24432
Difference	64	0	-64	0	

The proposal will have a relatively small change in the impermeable area as the changes are taking place on already development land that is hardstanding or a like for like replacement. In general, the proposal will promote a return to normal condition by replacing the artificial pitch with grass.

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 Policy 5.13 states that developers should aim for a Greenfield runoff rate from their developments. 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 4. Table 3 and Table 4 below give a summary of the results.

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

	Greenfield (l/s)	Greenfield + CC	Pre - Development	Pre - Development + CC	Post Development	Post Development + CC
Qbar	4.1215	6.1098	8.6930	12.8866	8.7341	12.9476
1 in 1	3.5033	5.1933	7.3890	10.9536	7.4240	11.0055
1 in 30	9.4795	14.0525	19.9938	29.6391	20.0885	29.7795
1 in 100	13.1477	19.4903	27.7305	41.1081	27.8619	41.3029

As the development is taking place on a previously developed site S3 (peak flow) and S5 and S6 (volume controls) apply. Therefore Qbar (4.1l/s) for the green field runoff scenario was used as the target runoff rate for the development for all storm events.

The quick storage estimate tool in Microdrainage was used to estimate the approximate storage required. The storage volume required is estimated to be **915 - 1,207m^3** when assessing the entire site of 2.4ha.

However, given that the proposal will only increase the impermeable area of the site by 64m^2 (less than 1%), it is proposed to provide 12m^3 attenuation to mitigate this minor increase in impermeable area.

The proposed drainage strategy primary objective is attenuate the surface waters generated from the new stand and to ensure suitable drainage within the new pitch.

Screenshots of the quick storage estimate and variables are available in Appendix 4.

10 Site Investigation

10.1 Infiltration Testing

Infiltration testing in general accordance with the methodology outlined in BRE Digest 365 was conducted on the 14th of April 2021 by STM.

3no. trial pit were excavated to 1.0m in depth across the site. The underlying geology consisted of made ground and bedrock of London Clay.

Groundwater was encountered in TP02 at depths of 0.85m. Infiltration testing was not undertaken in this locations due to the elevated groundwater table.

Infiltration testing was undertaken in TP01 & TP03. The rate was not sufficient as it did not achieve the 50% infiltration benchmark volume during the 1st test run.

Due to high groundwater and poor infiltration, it is not advisable to incorporate infiltration SuDS on site.

Full details including photos, graphs, location map and results of the infiltration testing are available in Appendix 9.

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

Most Sustainable	*SUDS technique*	*Flood Reduction*	*Pollution Reduction*	*Landscape & Wildlife Benefit*
	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 on the suitability of a range of potential SuDS techniques that could be implemented. The results of the assessment are summarised in Appendix 5 and are further discussed below.

11.2.1 Living Roofs

The new stadium rooftop will have an area of 128m^2, however a green roof would not be suitable for this particular structure because of the additional weight it would add.

11.2.2 Basins, Ponds, Filter Strips and Swales

Basins, ponds, filters strips and swales are not considered suitable due to limited space; as they would take up valuable space that would prevent further development.

11.2.3 Infiltration Devices

Due to the elevated groundwater and poor infiltration, it is not advisable to incorporate infiltration SuDS.

11.2.4 Permeable Surfaces and Filter Drains

The majority of the proposal is the alteration of the football pitch from artificial grass to grass. This will be designed to be permeable with land drainage.

11.2.5 Tanked Systems

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

11.2.6 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.

11.2.7 Summary of results of SuDS Options Assessment

A summary of the results of the SuDS Options Assessment is presented in Table 5 below. Full details of the options assessment along with descriptions of the SuDS options are presented in Appendix 5 and Appendix 6.

Table 4: Summary of Results of SuDS Options Assessment

SuDS Technique	Potential Suitability
Rainwater Harvesting	Suitable - Limited
Infiltration: Soakaways Infiltrations trenches and basins	Unsuitable

SuDS Technique	Potential Suitability
Green/brown /blue roofs	Unsuitable
Rain Gardens	Unsuitable
Permeable Pavements / Surfaces	Suitable - Not required.
Swales	Suitable
Detention basin/ponds	Unsuitable
Storage tanks/ Geocellular storage	Suitable
Oversized piping	Suitable

12 SuDS Implementation

12.1 SuDS Constraints

Due to high groundwater and poor infiltration, it is not advisable to incorporate infiltration SuDS on site.

12.2 Proposed Drainage System

The proposal will introduce permeable soft landscaping (football pitch) that will continue to use the existing land drainage that underlies the artificial pitch.

The new grandstand will have a rooftop area of 128m^2, to mitigate this increase in impermeable area, during the alteration to from artificial pitch to a grass pitch, additional drainage sub-base will be installed to the south of the pitch.

12.2.1 Grass Pitch

The football pitch covers a total area of 9,220m2 which accounts for the pitch, touch line, and behind goal areas.

The existing artificial pitch is due to be replaced by grass. The existing pitch is assumed to have a land drainage system in place to ensure water logging does not occur on the pitch during heavy rainfall.

The construction of the grass turfed pitch will require suitable mixture of topsoil that will ensure drainage of rainwater away from the surface. This is typically achieved through a mixture of topsoil and sand (150 - 450mm), a geotextile membrane above lateral drainage channels if required (in poorly drainage soils).

The installation of the new pitch will utilise the existing drainage system, though will require a new transition layer (or membrane) between the mixture of sand and topsoil and the existing underlying drainage.

12.2.2 Grandstand Stadium

The development of the eastern grandstand will increase the impermeable area of the site by 128m^2. To mitigate this increase, additional below ground drainage substrate will be introduce to the southern extent of the pitch (touch line / subs area).

This can easily be added during the introduction of the new grass turf with minimal impact to the development area.

The proposal will introduce a 90m long permeable (MOT Type 3) sub-base that is a 1.5m wide and 0.3m deep and formed from a gravel aggregate that has a porosity of 0.3. This will provide a total attenuation of 12.15m^3. The surface of which will be like for like with the new grass playing field.

The surface water runoff from the rooftop will be conveyed via 100mm perforated piping into the sub-base structure.

A perforated pipe will run the length of the drainage sub-base and it will connect directly into the existing surface water drainage connection that is located on the driveway to Sutton Football Club.

12.2.3 Discharge Control Device

Due to the minor increase, and the use of permeable sub-base as a conveyance feature and storage, no additional control device is required. A maximum discharge rate of 1.6l/s will be witnessed during all storm events into the existing connection.

12.2.4 Microdrainage Modelling

Microdrainage calculations have been carried out for this proposal and no flooding was indicated during any of the modelled scenarios, including the 1 in 100-year plus 40% climate change.

Full results, drainage layout including the proposed discharge point and exceedance flows of this are available in Appendix 10.

12.2.5 Surface Water Discharge Points

As there is no nearby watercourse and infiltration into the ground is deemed unsuitable, run-off from the development will be conveyed into the existing surface water sewer connection on site.

A copy drainage asset search is available in Appendix 8.

12.2.6 Treatment of Run-off

Treatment of roof water runoff will be provided through the provision of permeable sub-base that will intercept gross solids and sediment; guidance will be provided to householders on appropriate maintenance requirements including regular cleaning of gullies.

12.2.7 Exceedance Flows

The site is largely flat. If an exceedance event was to occur, surface waters would pool around the site in the low-lying areas prior to entering the drainage network as levels recede.

It can be seen from the design proposals; the proposed system includes approximately 12m^3 of additional storage capacity. 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 10.

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.

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.

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 8.

13 Conclusion and Recommendations

The proposed drainage strategy will ensure that there is no increase in surface water runoff rates from the site post-development.

The grass pitch will utilise the existing surface water drainage that is below the artificial pitch. The grass pitch will be underlain by a mixture of topsoil and sand, providing a suitable infiltration medium away from the surface.

The increase surface water runoff will be mitigated through the introduction of a new sub-base drainage channel. It will be placed just south of the new grass pitch, below the import sand and topsoil mix. The drainage channel will provide a further $12m^3$ attenuation and will convey the excess surface water runoff from the new grandstand toward the existing surface water drainage connection.

With the proposed SuDS mitigation measures in place, it is considered that the proposed development will ensure that there is no increase in local flood risk or runoff rates from the site. It will provide a betterment with the introduction of more soft landscaping.

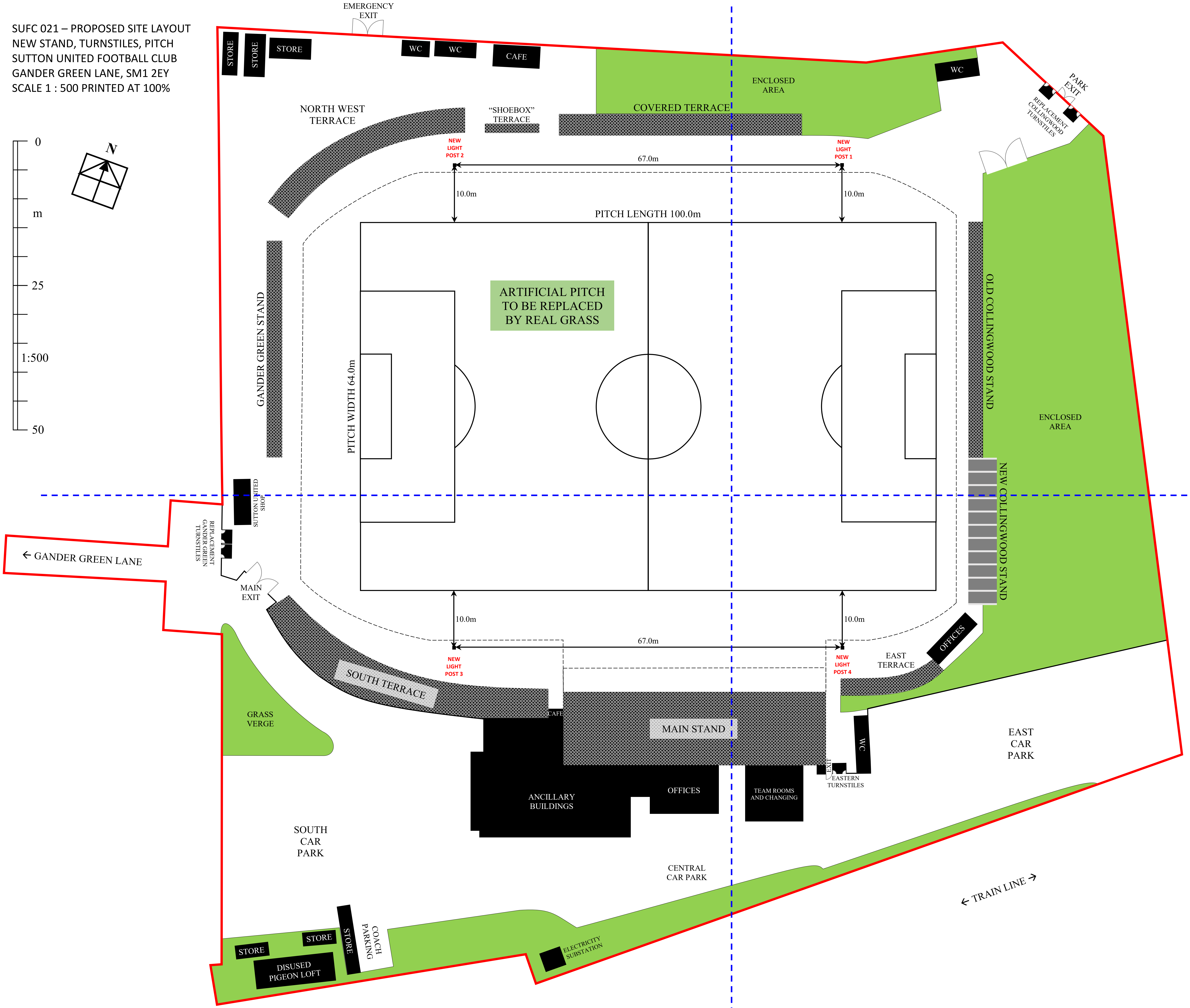
14 References

1. Communities and Local Government - National Planning Policy Framework NPPF, March 2012.
2. Greater London Authority – London Sustainable Drainage Action Plan, 2015.
3. CIRIA, Defra, Environment Agency – UK SuDS Manual, 2015.
4. Greater London Authority – London Sustainable Drainage Action Plan, 2015.

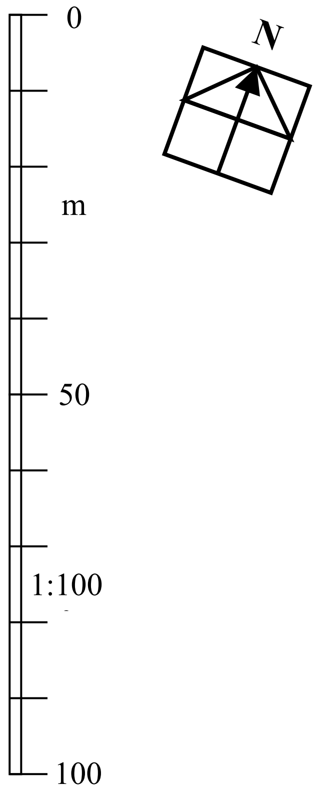
15 Appendices

15.1 Appendix 1 – Development Plans

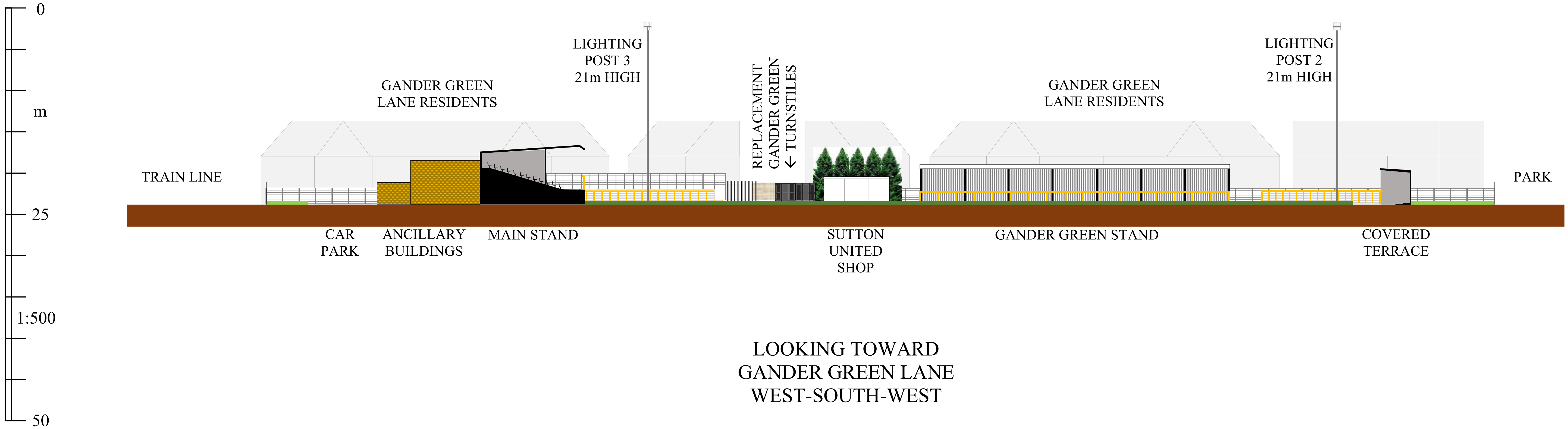
SUFC 021 – PROPOSED SITE LAYOUT
NEW STAND, TURNSTILES, PITCH
SUTTON UNITED FOOTBALL CLUB
GANDER GREEN LANE, SM1 2EY
SCALE 1 : 500 PRINTED AT 100%



SUFC 022 – PROPOSED BLOCK SITE PLAN – NEW STAND
SUTTON UNITED FOOTBALL CLUB
GANDER GREEN LANE, SM1 2EY
SCALE 1 : 1000 PRINTED AT 100%



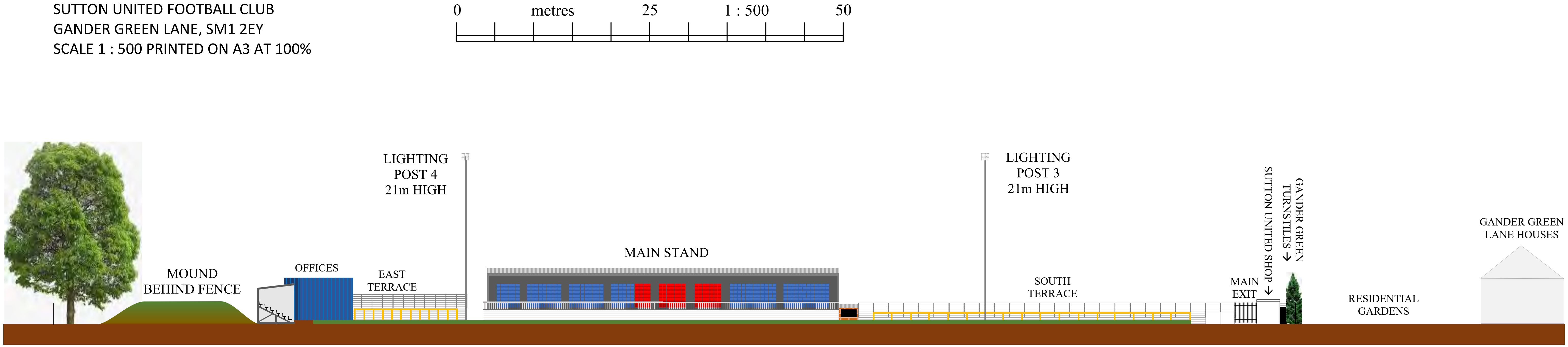
SUFC 024 – PROPOSED NORTH-SOUTH SECTION PLAN – NEW STAND
SUTTON UNITED FOOTBALL CLUB
GANDER GREEN LANE, SM1 2EY
SCALE 1 : 500 PRINTED ON A3 AT 100%



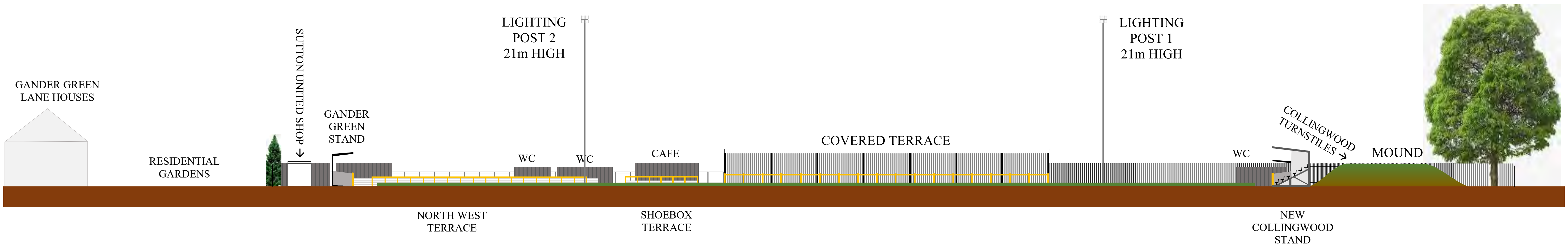
LOOKING TOWARD
GANDER GREEN LANE
WEST-SOUTH-WEST

LOOKING TOWARD PARK
EAST-NORTH-EAST

SUFC 025 – PROPOSED EAST-WEST SECTION PLAN – NEW STAND
SUTTON UNITED FOOTBALL CLUB
GANDER GREEN LANE, SM1 2EY
SCALE 1 : 500 PRINTED ON A3 AT 100%

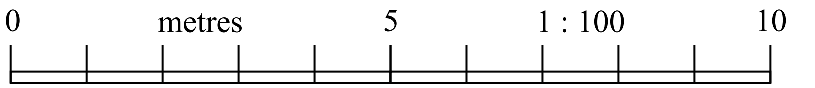


LOOKING TOWARD
TRAIN LINE
SOUTH-SOUTH-EAST



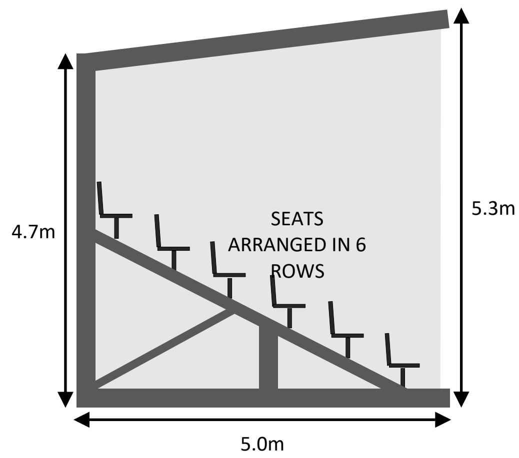
LOOKING TOWARD PARK
NORTH-NORTH-WEST

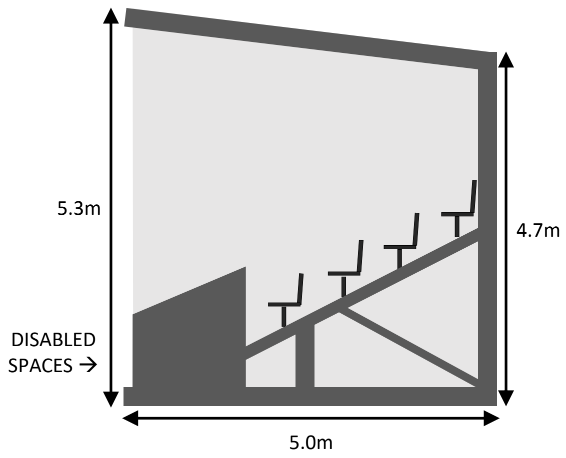
SUFC 026 – PROPOSED DETAILS – NEW STAND
SUTTON UNITED FOOTBALL CLUB
GANDER GREEN LANE, SM1 2EY
SCALE 1 : 100 PRINTED ON A4 AT 100%

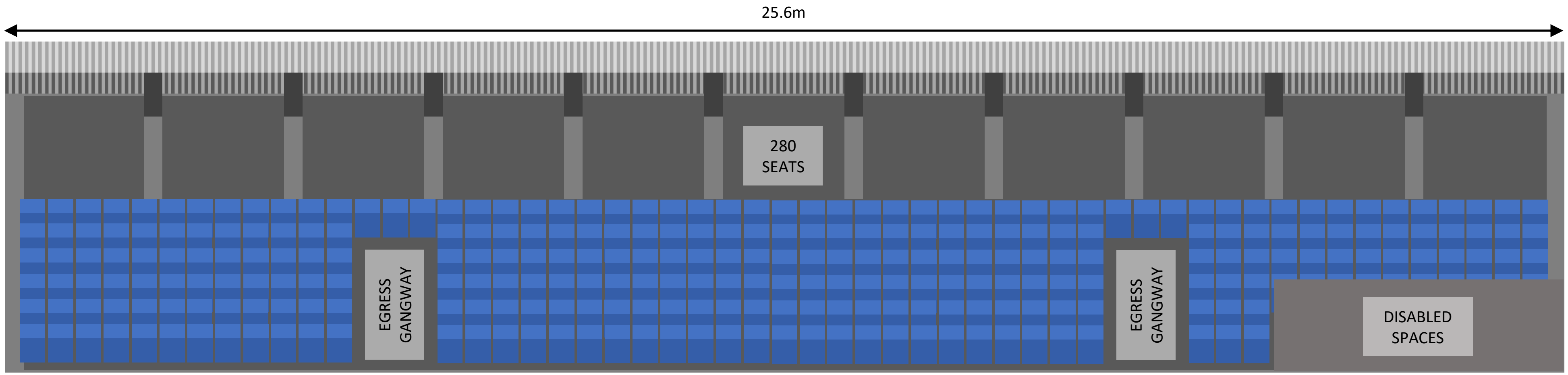


Please note that all dimensions are approximate as the supplied building is assembled on site and could be different if seats, pillars or gangways dictate. Any significant deviation from these drawings will be dealt with by minor amendment or full planning application as appropriate.

Please also note that the arrangement of seats over the 6 rows could vary from that shown below as required for safety or manufacturing reasons but the overall dimensions will be broadly similar to those shown here.

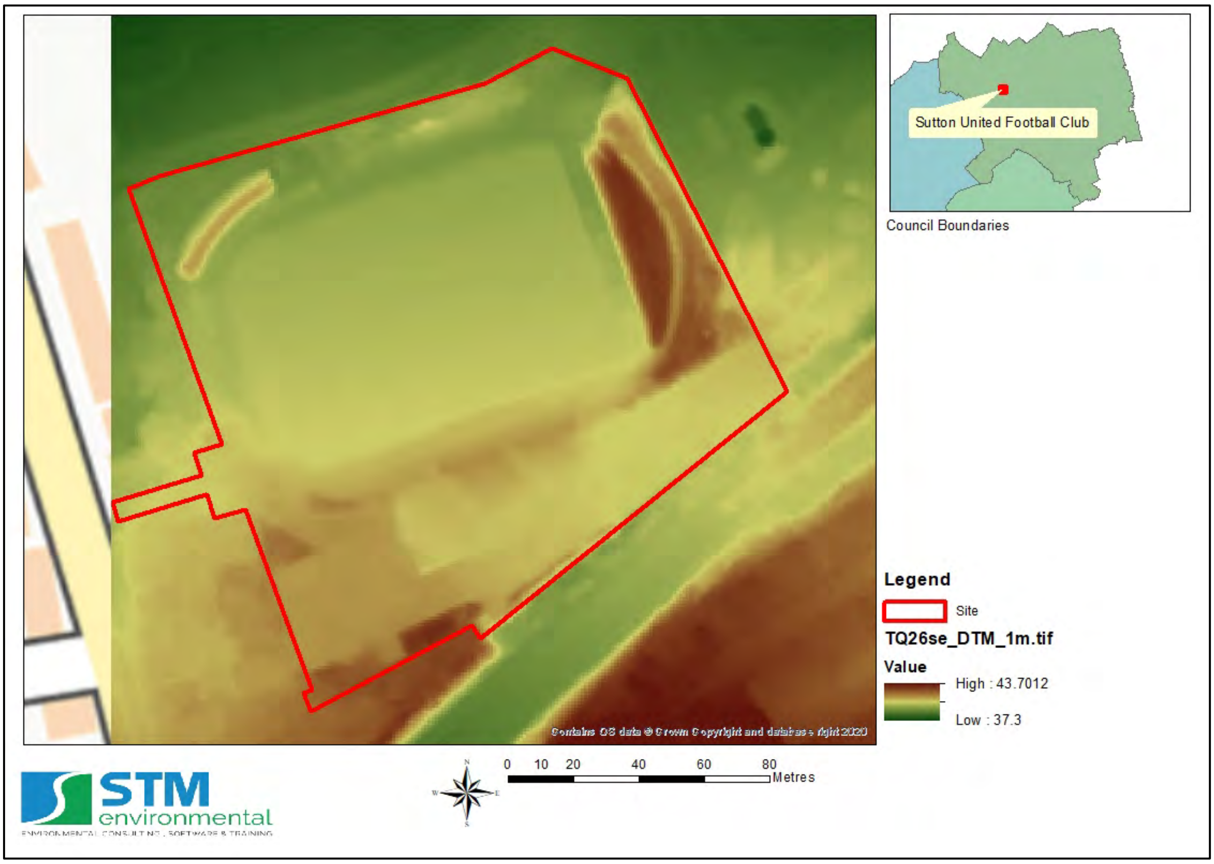






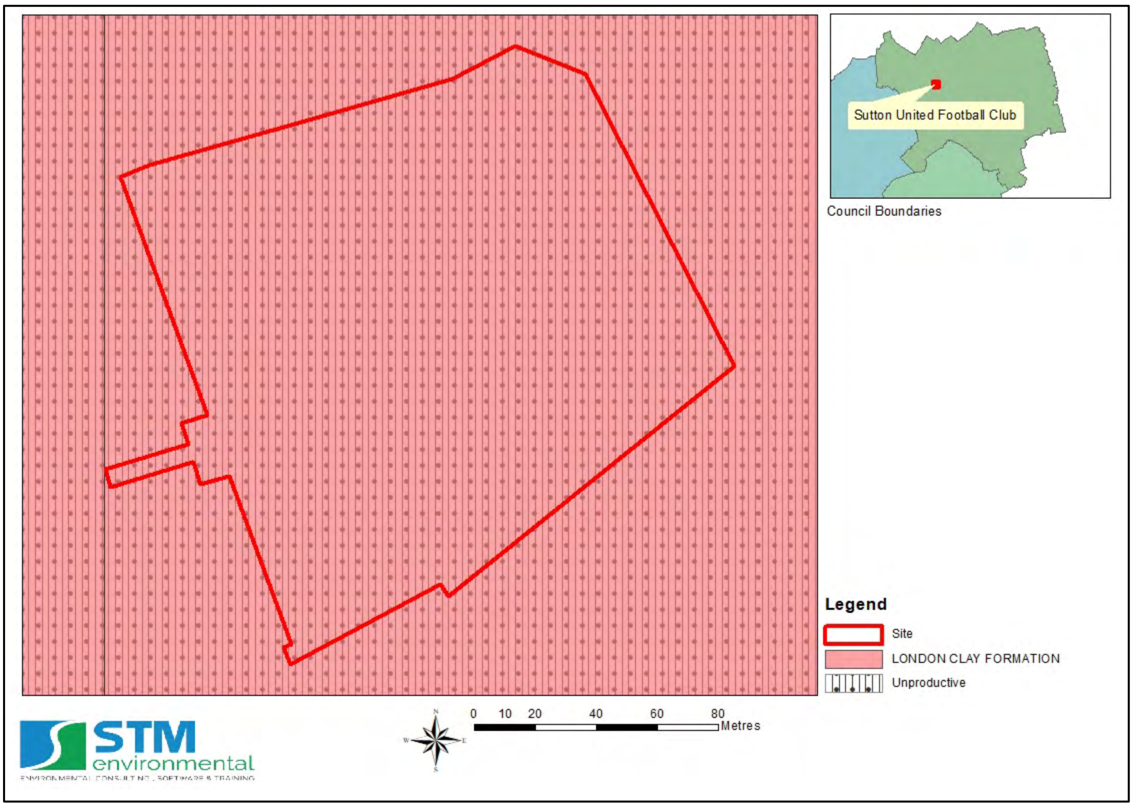
15.2 Appendix 2– Site Topography and Drainage Characteristics

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

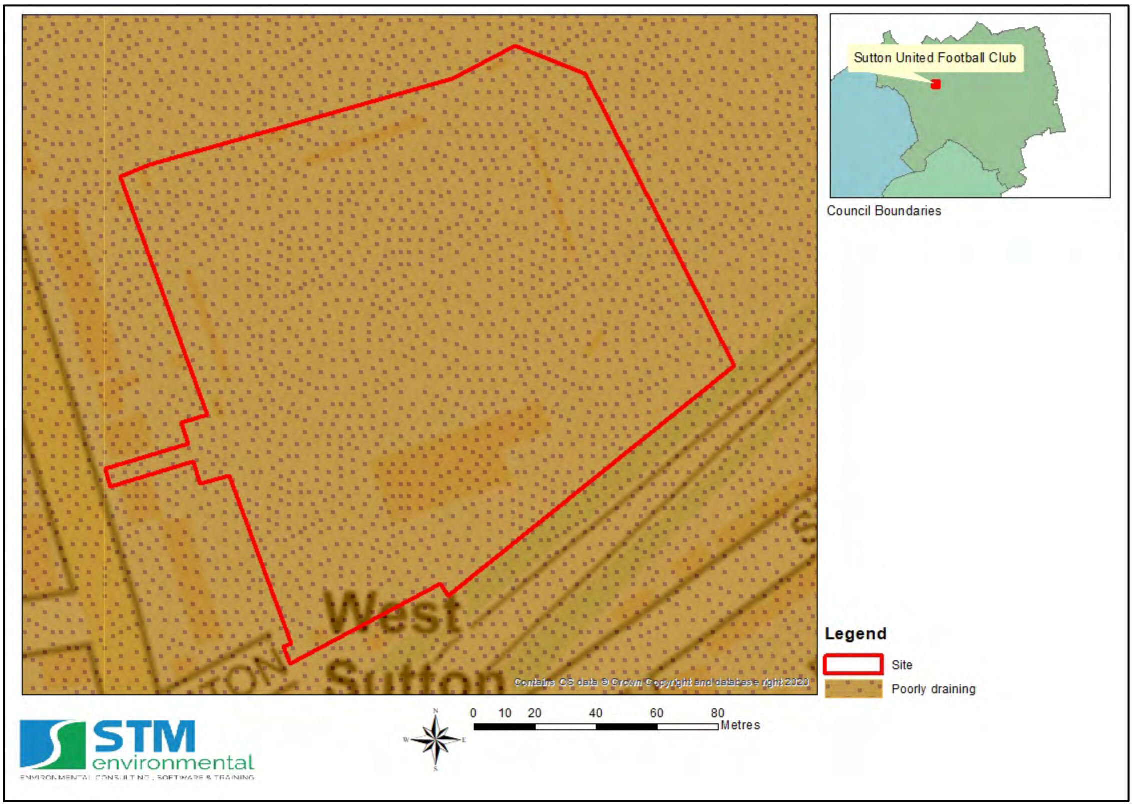


15.2.2 Topographic Survey

15.2.3 Bedrock Hydrogeology (Source: BGS, 2016)

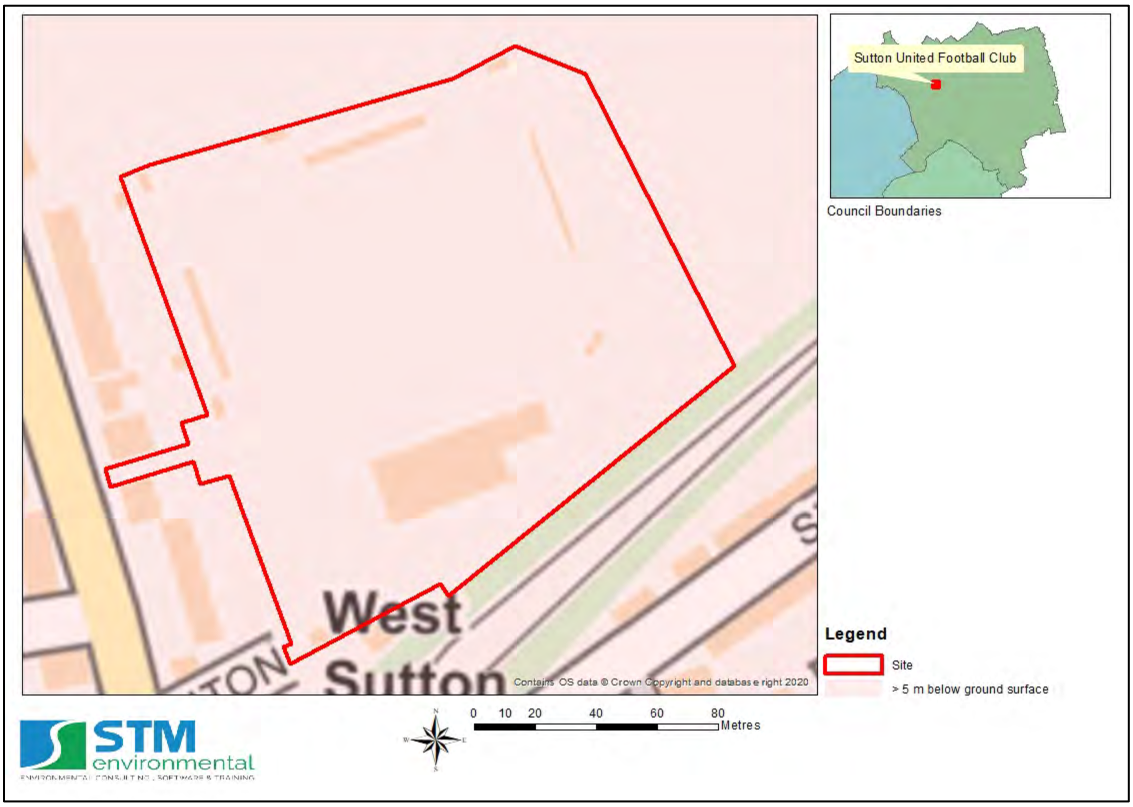


15.2.4 Bedrock Permeability (Source BGS 2016)



15.2.5 Infiltration Drainage Potential (Source: BGS, 2016)

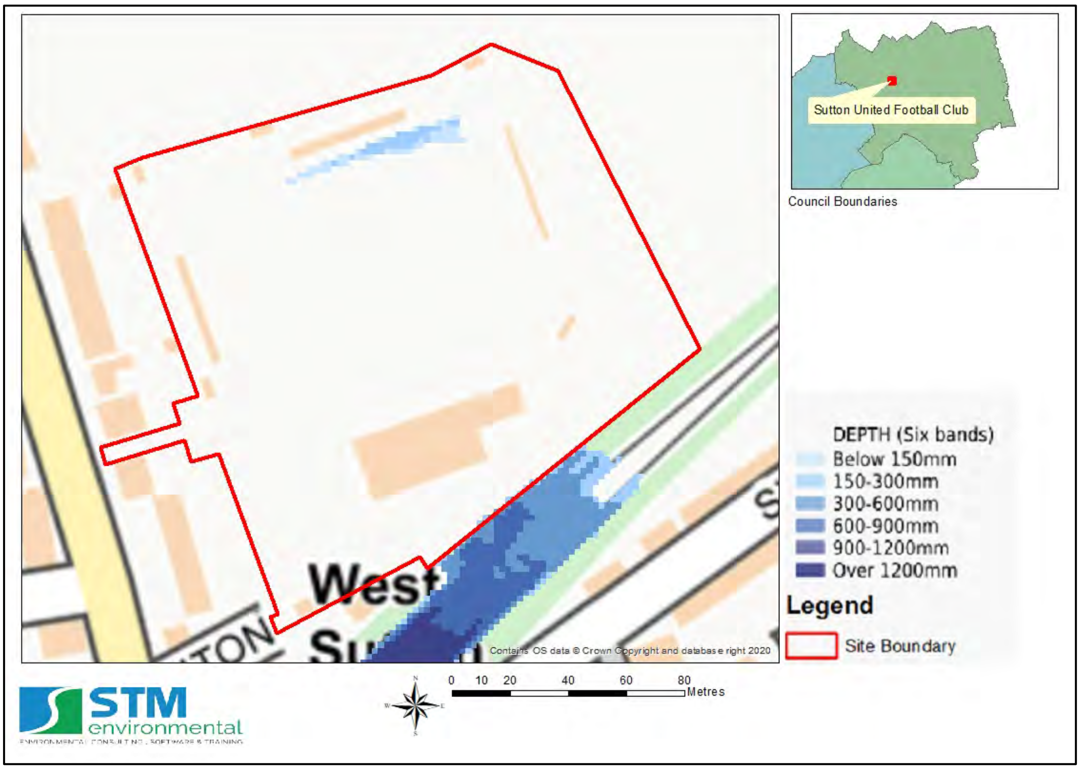
15.2.6 Groundwater Table Depth (Source: BGS 2016)



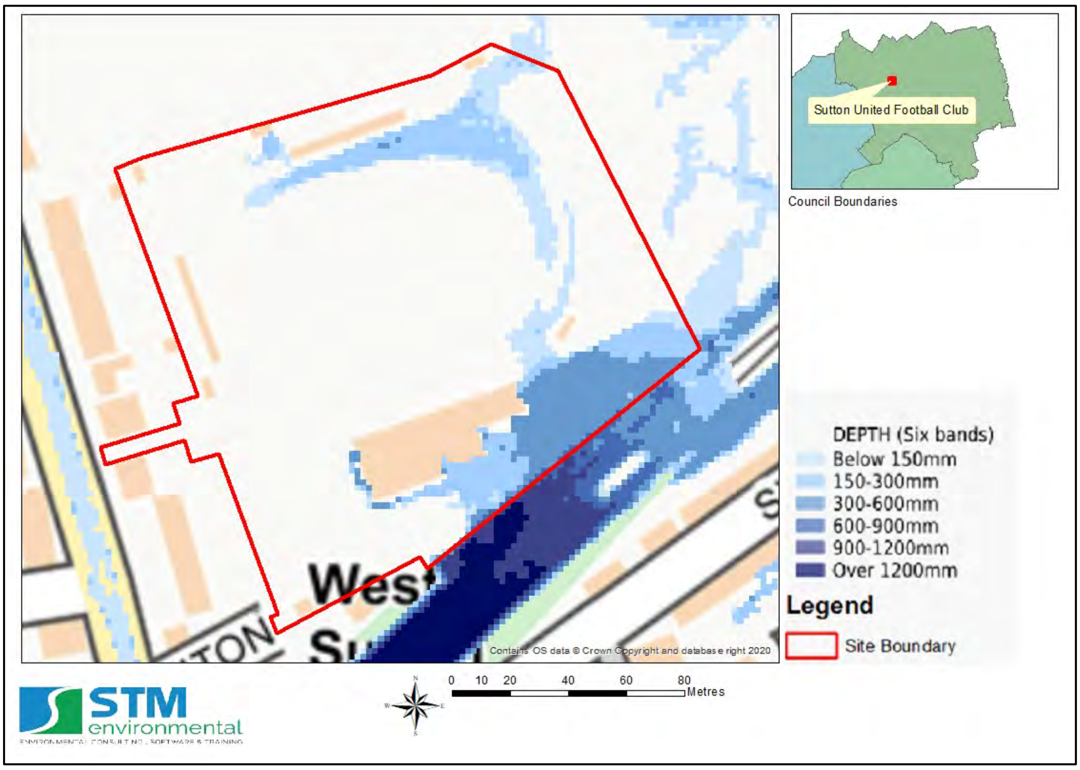
15.3 Appendix 3 – Flood Risk Mapping

15.3.1 Long Term Pluvial Flood Risk Map (EA)

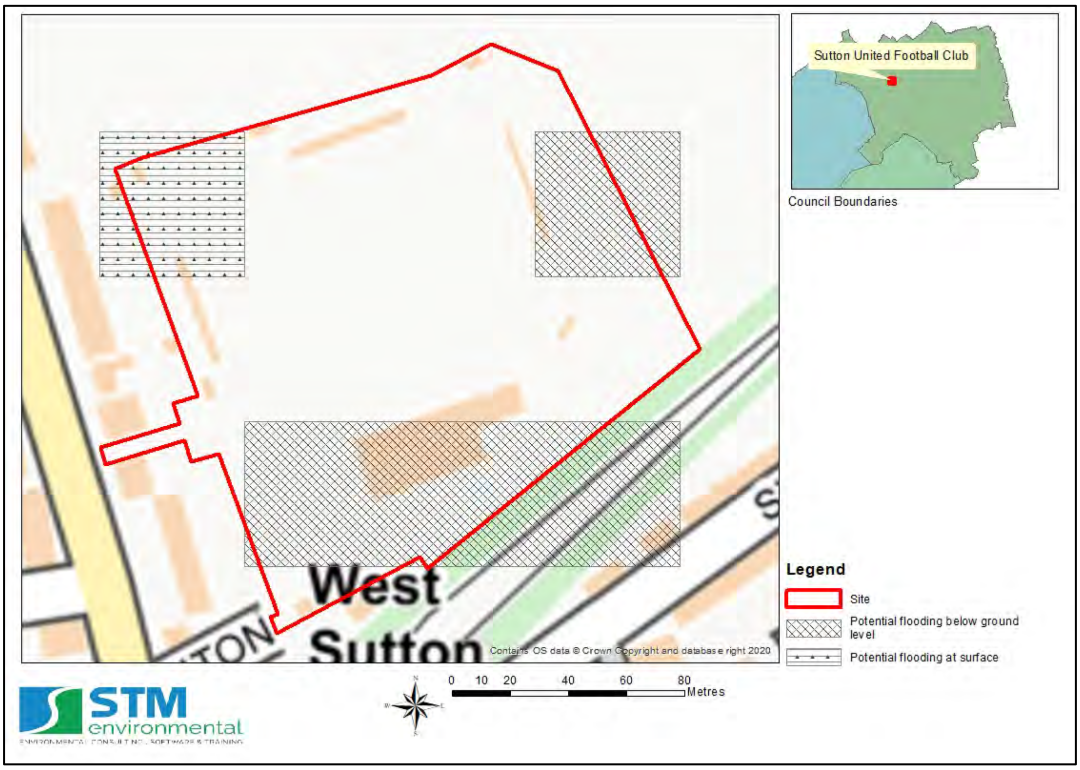
15.3.2 Surface water flood depth during the 1 in 100-year rainfall return periods (Source: EA, 2016).



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



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



15.4 Appendix 4 – Run-Off Rate and Storage Calculations

15.4.1 UK SuDS

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Nick Roebuck
Site name:	Sutton United FC
Site location:	Sutton United FC, Gander Green Lane

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:	51.36753° N
Longitude:	0.20438° W
Reference:	1174636545
Date:	May 17 2021 10:12

Runoff estimation approach: IH124

Site characteristics

Total site area (ha): 2.44

Methodology

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

Soil characteristics

	Default	Edited
SOIL type:	2	2
HOST class:	N/A	N/A
SPR/SPRHOST:	0.3	0.3

Hydrological characteristics

	Default	Edited
SAAR (mm):	656	656
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):	4.12	4.12
1 in 1 year (l/s):	3.5	3.5
1 in 30 years (l/s):	9.48	9.48
1 in 100 year (l/s):	13.15	13.15
1 in 200 years (l/s):	15.41	15.41

HR Wallingford
Working with water

Surface water storage requirements for sites

www.uksuds.com | Storage estimation tool

Calculated by:	Nick Roebuck
Site name:	Sutton United FC
Site location:	Sutton United FC, Gander Green Ln

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:	51.36756° N
Longitude:	0.20438° W
Reference:	335357317
Date:	May 17 2021 10:14

Site characteristics

Total site area (ha):	2.44
Significant public open space (ha):	0
Area positively drained (ha):	2.44
Impermeable area (ha):	0
Percentage of drained area that is impermeable (%):	0
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
Net impermable area for storage volume design (ha):	0
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:	2	2
SPR:	0.3	0.3

Hydrological characteristics

	Default	Edited
Rainfall 100 yrs 6 hrs:	–	--
Rainfall 100 yrs 12 hrs:	–	--
FEH / FSR conversion factor:	1.27	1.27
SAAR (mm):	656	656
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):	–	--
Q_{BAR} for net site area (l/s):	–	--

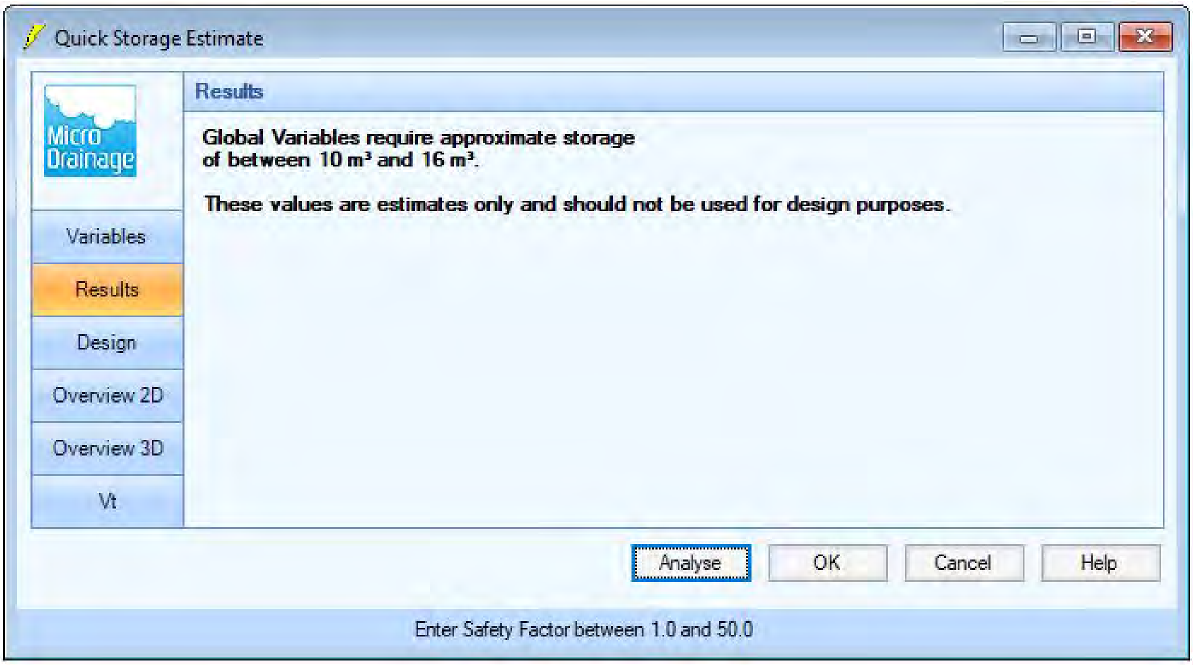
Site discharge rates

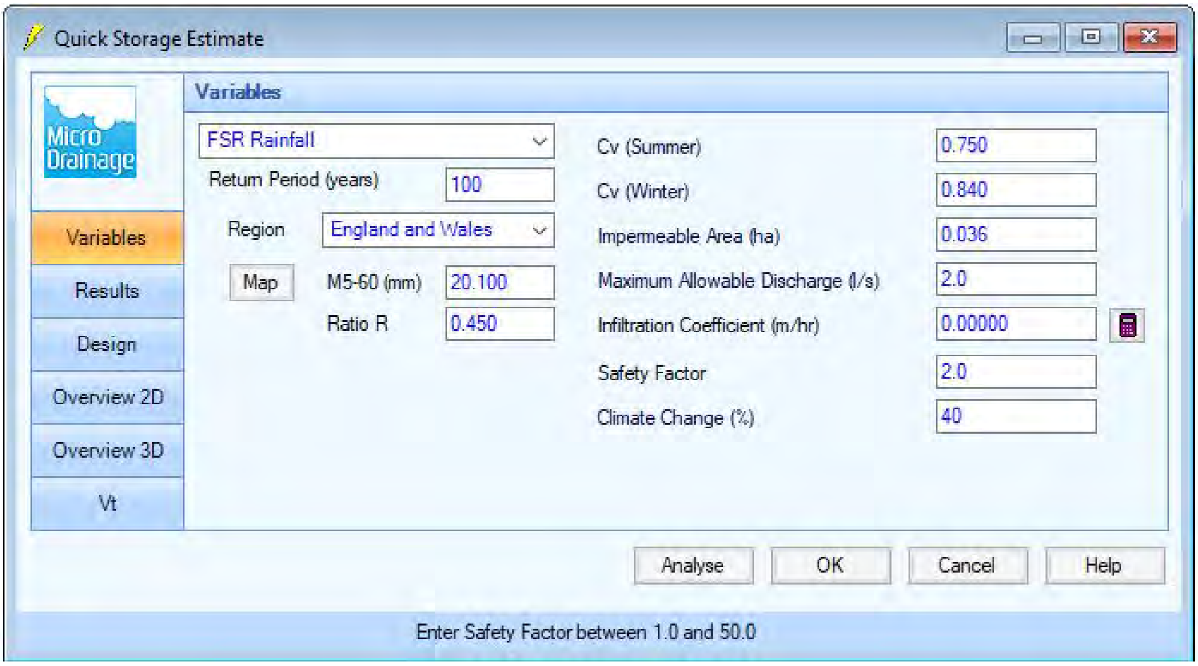
	Default	Edited
1 in 1 year (l/s):	--	–
1 in 30 years (l/s):	--	–
1 in 100 year (l/s):	--	–

Estimated storage volumes

	Default	Edited
Attenuation storage 1/100 years (m³):	--	--
Long term storage 1/100 years (m³):	--	--
Total storage 1/100 years (m³):	--	--

15.4.2 Microdrainage Quick Storage Estimates





15.5 Appendix 5 – SuDS Suitability Assessment

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 on small scale for interception storage
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.	Poorly draining bedrock but groundwater table is potentially < 3m below surface. Could increase flood risk.	Unsuitable - Poor infiltration and elevated groundwater

Suds Technique	Typical Uses	Potential Issues	Potential Suitability
		Maintenance	
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	Unsuitable
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
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 considered. May require extensive use of impermeable membranes and under-drainage. Maintenance required.	Suitable
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

Suds Technique	Typical Uses	Potential Issues	Potential Suitability
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
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	Suitable
Oversized Piping	Using larger than necessary pipework creates additional space to store rainwater.	Lacks the wider benefits of the green infrastructure-based techniques	Suitable

15.6 Appendix 6 – Descriptions Of SuDS Techniques

15.6.1 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 3 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.

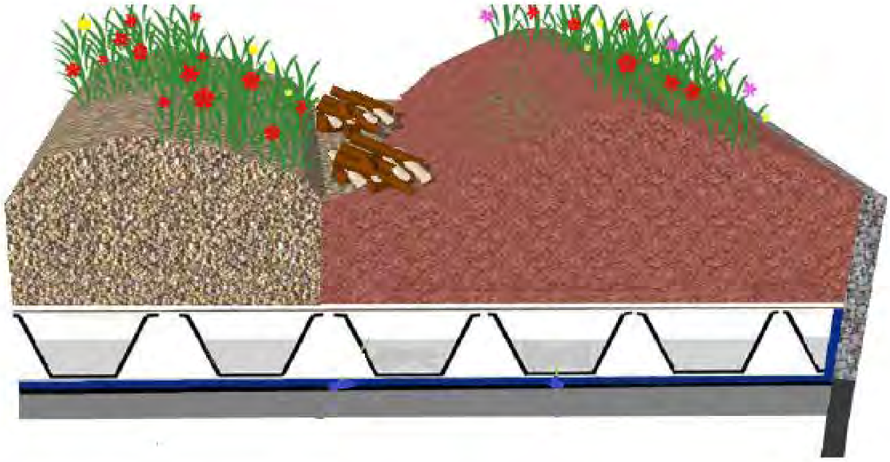


Figure 4 Biodiverse green roof diagram (University of East London)

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.

15.6.2 Soakaways

Soakaways are square or circular excavations either filled with rubble or lined with brickwork, pre-cast concrete or polyethylene rings/perforated storage structures surrounded by granular backfill. They can be grouped and linked together to drain large areas including highways. The supporting structure and backfill can be substituted by modular or geocellular units.

Soakaways provide stormwater attenuation, stormwater treatment and groundwater recharge:

- The hole where the soakaway will be placed has to be at least 300 mm away from any pipe and cable ducts.
- The base of the soakaway must be at least 1.0m above the water table.
- The soakaway must be placed at least 5m away from any building.

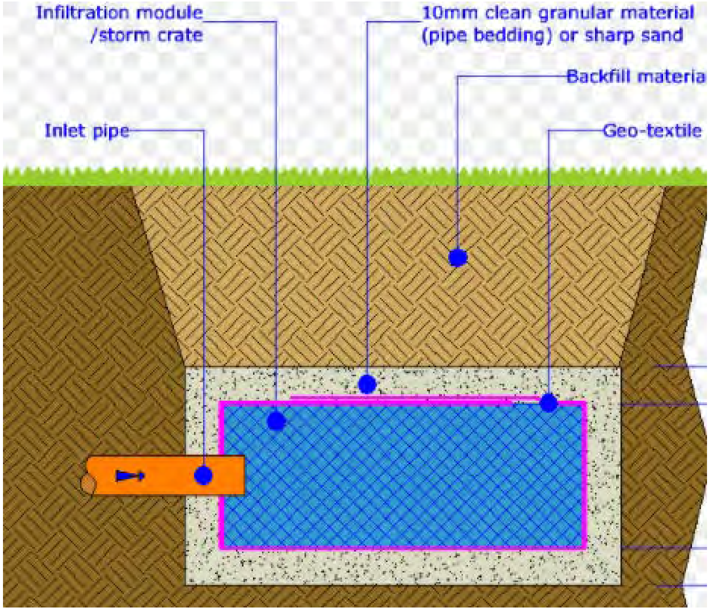
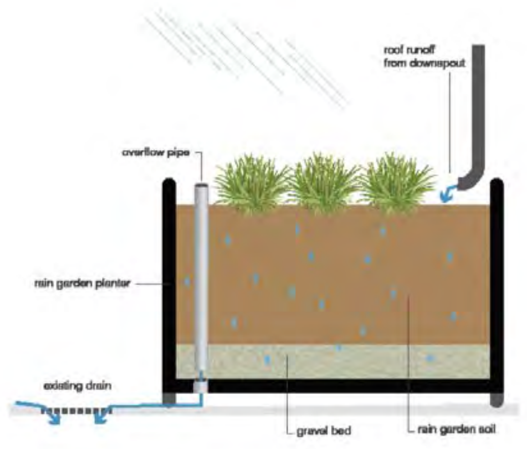


Figure 5 Cross section of a soakaway.

15.6.3 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.

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.

15.6.4 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.

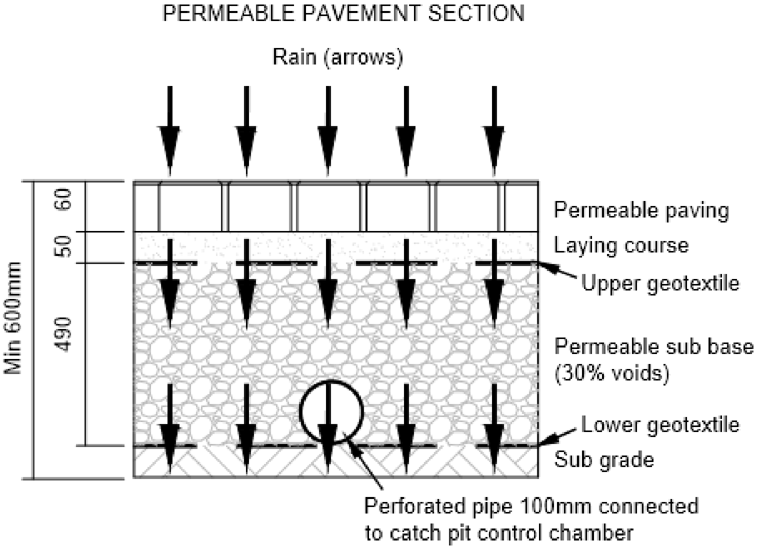


Figure 6 Block Permeable Paving with sub-base

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

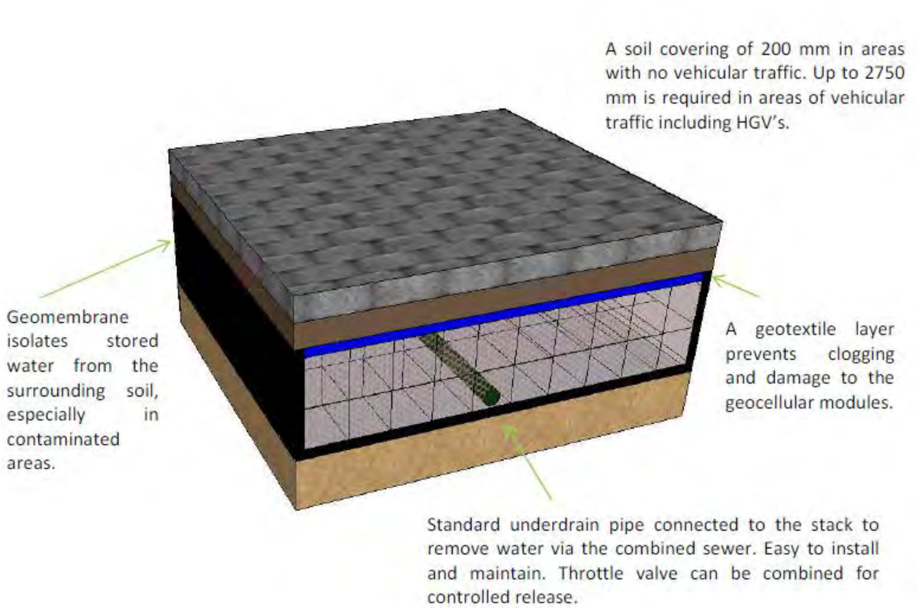


Figure 7 Block Permeable Paving with Geocellular Module

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.

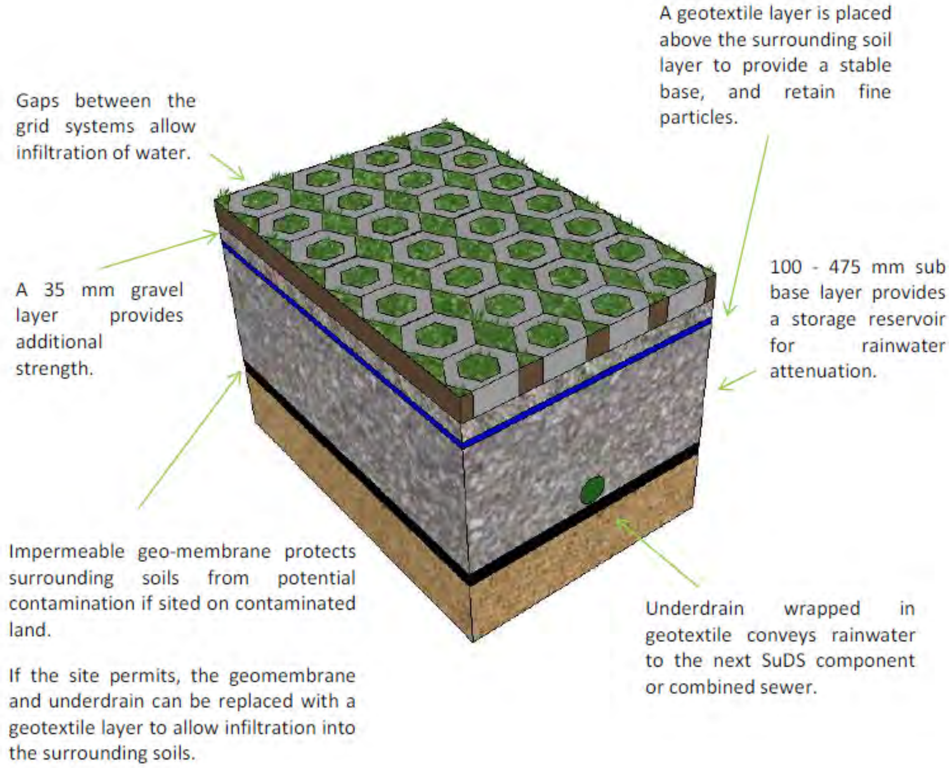


Figure 8 Plastic or Grid Permeable Paving with Sub-base

15.6.5 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.

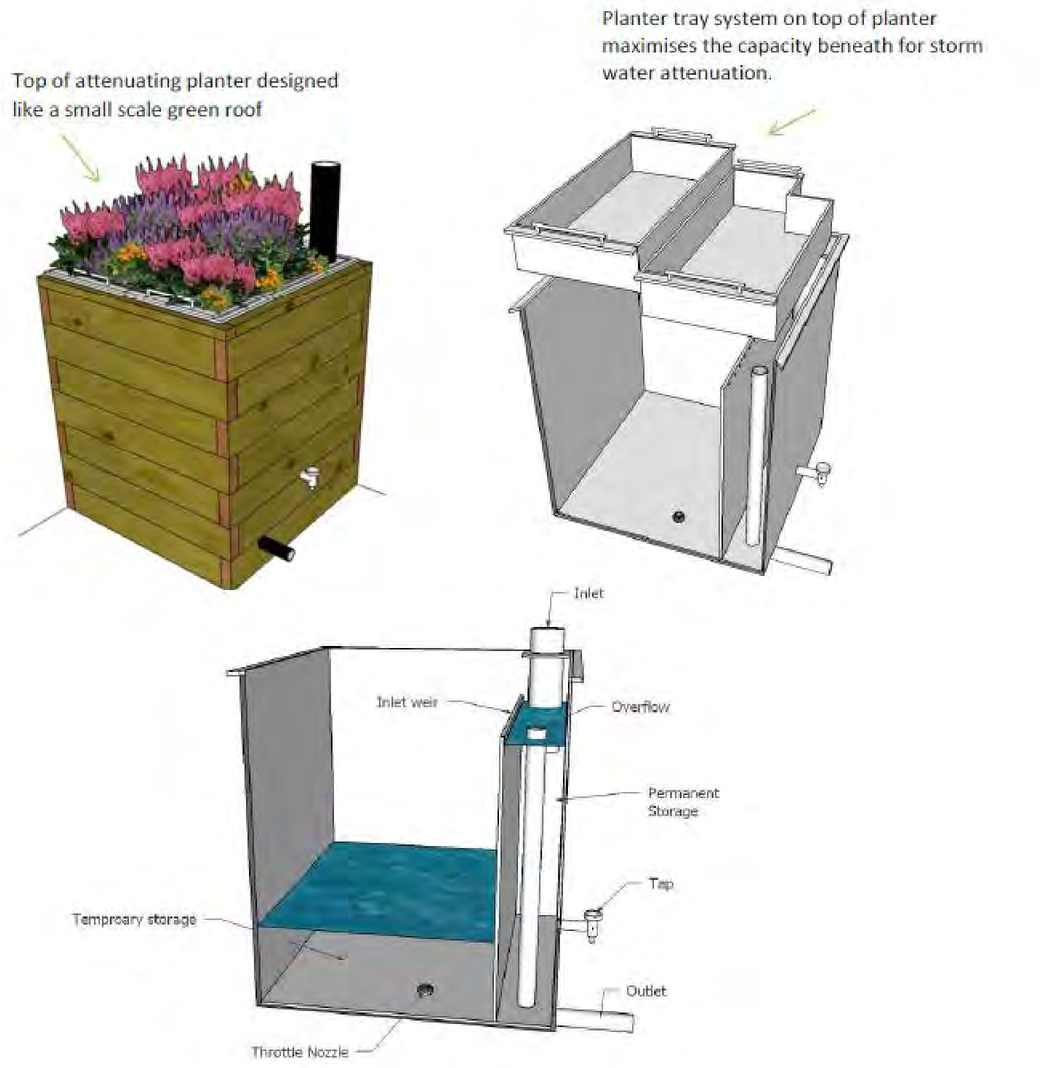


Figure 9 SuDS Planter with attenuation storage (Thames Water)

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.

15.6.6 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.

15.7 Appendix 7 – SuDS Maintenance Manual

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

15.7.1 Drainage Channel

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, alter autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations - pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional maintenance	Stabilise and mow contributing and areas	As required
	Removal of weeds or management using Weed killer applied directly into the weeds rather than spraying.	As required -once per year on less frequently used pavements
	Remediate any landscaping which, through vegetation maintenance or	As required

Maintenance Schedule	Required Action	Typical Frequency
Remedial actions	soil slip, has been raised to within 50 mm of the level of the paving.	
	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
	Rehabilitation of surface and upper substructure by remedial sweeping.	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial Inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth -if required, take remedial action	Three-monthly, 48 h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor Inspection chambers	Annually

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) and therefore, if litter management is already required at site, this should have marginal cost implications.

15.8 Appendix 8 - Asset Mapping

Asset location search

Thames Water Property Searches

STM Environmental
TWICKENHAM
TW2 6RS

Search address supplied

Sutton United Football Club
Borough Sports Ground
Gander Green Lane
Sutton
SM1 2EY

Your reference Sutton United

Our reference ALS/ALS Standard/2021_4430086

Search date 17 May 2021

Knowledge of features below the surface is essential for every development

The benefits of this knowledge not only include ensuring due diligence and avoiding risk, but also being able to ascertain the feasibility of any development.

Did you know that Thames Water Property Searches can also provide a variety of utility searches including a more comprehensive view of utility providers' assets (across up to 35-45 different providers), as well as more focused searches relating to specific major utility companies such as National Grid (gas and electric).

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

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

0800 009 4540

Search address supplied: Sutton United Football Club, Borough Sports Ground, Gander Green Lane, Sutton, SM1 2EY

Dear Sir / Madam

An Asset Location Search is recommended when undertaking a site development. It is essential to obtain information on the size and location of clean water and sewerage assets to safeguard against expensive damage and allow cost-effective service design.

The following records were searched in compiling this report: - the map of public sewers & the map of waterworks. Thames Water Utilities Ltd (TWUL) holds all of these.

This searchprovides maps showing the position, size of Thames Water assets close to the proposed development and also manhole cover and invert levels, where available.

Please note that none of the charges made for this report relate to the provision of Ordnance Survey mapping information. The replies contained in this letter are given following inspection of the public service records available to this company. No responsibility can be accepted for any error or omission in the replies.

You should be aware that the information contained on these plans is current only on the day that the plans are issued. The plans should only be used for the duration of the work that is being carried out at the present time. Under no circumstances should this data be copied or transmitted to parties other than those for whom the current work is being carried out.

Thames Water do update these service plans on a regular basis and failure to observe the above conditions could lead to damage arising to new or diverted services at a later date.

Contact Us

If you have any further queries regarding this enquiry please feel free to contact a member of the team on 0800 009 4540, or use the address below:

Thames Water Utilities Ltd
Property Searches
PO Box 3189
Slough
SL1 4WW

Email: searches@thameswater.co.uk
Web: www.thameswater-propertysearches.co.uk

Waste Water Services

Please provide a copy extract from the public sewer map.

Enclosed is a map showing the approximate lines of our sewers. Our plans do not show sewer connections from individual properties or any sewers not owned by Thames Water unless specifically annotated otherwise. Records such as "private" pipework are in some cases available from the Building Control Department of the relevant Local Authority.

Where the Local Authority does not hold such plans it might be advisable to consult the property deeds for the site or contact neighbouring landowners.

This report relates only to sewerage apparatus of Thames Water Utilities Ltd, it does not disclose details of cables and or communications equipment that may be running through or around such apparatus.

The sewer level information contained in this response represents all of the level data available in our existing records. Should you require any further Information, please refer to the relevant section within the 'Further Contacts' page found later in this document.

For your guidance:

- The Company is not generally responsible for rivers, watercourses, ponds, culverts or highway drains. If any of these are shown on the copy extract they are shown for information only.
- Any private sewers or lateral drains which are indicated on the extract of the public sewer map as being subject to an agreement under Section 104 of the Water Industry Act 1991 are not an 'as constructed' record. It is recommended these details be checked with the developer.

Clean Water Services

Please provide a copy extract from the public water main map.

With regard to the fresh water supply, this site falls within the boundary of another water company. For more information, please redirect your enquiry to the following address:

Sutton & East Surrey Water
London Road
Redhill

Surrey
RH1 1LJ

Tel: 01737 772 000
Fax: 01737 766 807

For your guidance:

- Assets other than vested water mains may be shown on the plan, for information only.
- If an extract of the public water main record is enclosed, this will show known public water mains in the vicinity of the property. It should be possible to estimate the likely length and route of any private water supply pipe connecting the property to the public water network.

Payment for this Search

A charge will be added to your suppliers account.

Further contacts:

Waste Water queries

Should you require verification of the invert levels of public sewers, by site measurement, you will need to approach the relevant Thames Water Area Network Office for permission to lift the appropriate covers. This permission will usually involve you completing a TWOSA form. For further information please contact our Customer Centre on Tel: 0845 920 0800. Alternatively, a survey can be arranged, for a fee, through our Customer Centre on the above number.

If you have any questions regarding sewer connections, budget estimates, diversions, building over issues or any other questions regarding operational issues please direct them to our service desk. Which can be contacted by writing to:

Developer Services (Waste Water)
Thames Water
Clearwater Court
Vastern Road
Reading
RG1 8DB

Tel: 0800 009 3921
Email: developer.services@thameswater.co.uk

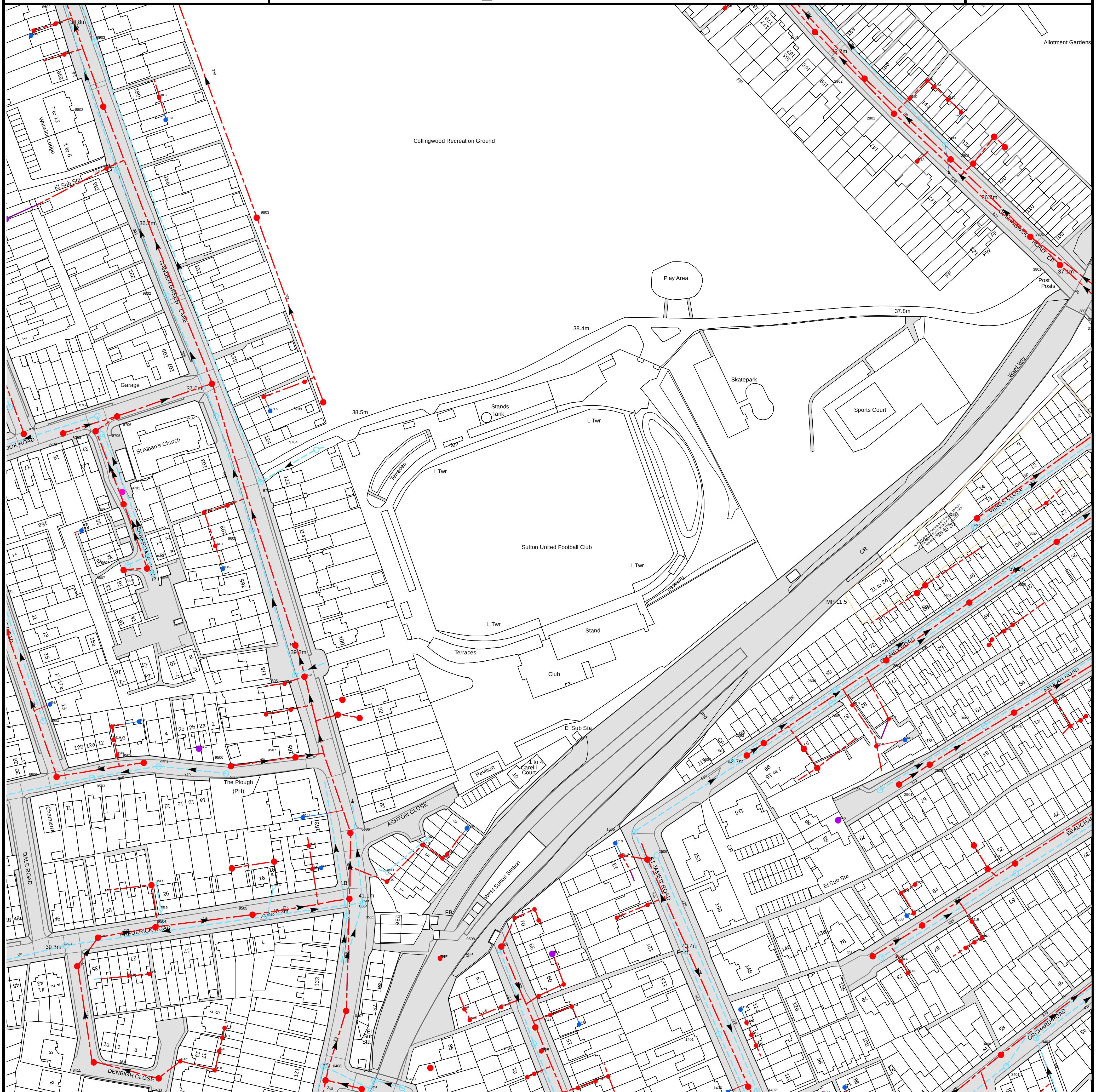
Clean Water queries

Should you require any advice concerning clean water operational issues or clean water connections, please contact:

Developer Services (Clean Water)
Thames Water
Clearwater Court
Vastern Road
Reading
RG1 8DB

Tel: 0800 009 3921
Email: developer.services@thameswater.co.uk

Asset Location Search Sewer Map - ALS/ALS Standard/2021_4430086



The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 525104,164690

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

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

Manhole Reference	Manhole Cover Level	Manhole Invert Level
371C	37.424	35.669
371E	37.65	36.6
3802	n/a	n/a
3801	36.73	27.09
28AF	n/a	n/a
281A	n/a	n/a
2802	n/a	n/a
38AG	n/a	n/a
2803	n/a	n/a
38AH	n/a	n/a
191C	n/a	n/a
2901	35.28	26.11
2902	n/a	n/a
2801	36.02	26.58
281D	n/a	n/a
291B	n/a	n/a
291A	n/a	n/a
281C	n/a	n/a
281B	n/a	n/a
06AB	n/a	n/a
06AC	n/a	n/a
06AD	n/a	n/a
9610	n/a	n/a
9609	n/a	n/a
9704	n/a	n/a
9709	n/a	n/a
971C	n/a	n/a
191B	n/a	n/a
881B	n/a	n/a
891L	n/a	n/a
891A	n/a	n/a
891B	n/a	n/a
891K	n/a	n/a
8903	n/a	n/a
8803	35.181	33.101
981C	n/a	n/a
9801	n/a	n/a
981B	n/a	n/a
981A	n/a	n/a
9802	n/a	n/a
9803	n/a	n/a
141A	n/a	n/a
1402	n/a	n/a
14AI	n/a	n/a
1405	n/a	n/a
141H	n/a	n/a
041A	n/a	n/a
14AH	n/a	n/a
041B	n/a	n/a
041H	n/a	n/a
041G	n/a	n/a
041I	n/a	n/a
141G	n/a	n/a
0404	n/a	n/a
141F	n/a	n/a
051A	n/a	n/a
051G	n/a	n/a
041E	n/a	n/a
051H	n/a	n/a
041C	n/a	n/a
0508	n/a	n/a
041D	n/a	n/a
0501	n/a	n/a
0516	n/a	n/a
0515	n/a	n/a
0412	n/a	n/a
0517	n/a	n/a
0413	n/a	n/a
141J	n/a	n/a
151A	n/a	n/a
1406	n/a	n/a
141I	n/a	n/a
141K	n/a	n/a
151G	n/a	n/a
151C	n/a	n/a
151B	n/a	n/a
1505	n/a	n/a
151D	n/a	n/a
1506	n/a	n/a
1504	n/a	n/a
141D	n/a	n/a
141E	n/a	n/a
1501	n/a	n/a
2603	n/a	n/a
0409	n/a	n/a
0401	n/a	n/a
0403	n/a	n/a
0408	n/a	n/a
0402	n/a	n/a
04BE	n/a	n/a
9401	40.233	39.503

Manhole Reference	Manhole Cover Level	Manhole Invert Level
0407	n/a	n/a
051F	n/a	n/a
051E	n/a	n/a
051D	n/a	n/a
0511	n/a	n/a
0514	n/a	n/a
0504	n/a	n/a
051C	n/a	n/a
051J	n/a	n/a
951E	n/a	n/a
951F	n/a	n/a
951H	n/a	n/a
051B	n/a	n/a
051I	n/a	n/a
0506	n/a	n/a
951J	n/a	n/a
9507	n/a	n/a
8606	n/a	n/a
8702	n/a	n/a
8707	n/a	n/a
8708	n/a	n/a
861B	n/a	n/a
8709	n/a	n/a
8704	n/a	n/a
8705	n/a	n/a
9706	n/a	n/a
9701	n/a	n/a
9607	n/a	n/a
9707	n/a	n/a
9602	n/a	n/a
9608	n/a	n/a
9604	n/a	n/a
9603	n/a	n/a
971D	n/a	n/a
9708	n/a	n/a
961D	n/a	n/a
9702	n/a	n/a
961C	n/a	n/a
971E	n/a	n/a
9601	n/a	n/a
9703	n/a	n/a
971B	n/a	n/a
971A	n/a	n/a
8504	n/a	n/a
8410	n/a	n/a
8411	n/a	n/a
8510	n/a	n/a
941A	n/a	n/a
941E	n/a	n/a
9509	n/a	n/a
9504	n/a	n/a
951A	n/a	n/a
9403	n/a	n/a
951B	n/a	n/a
941C	n/a	n/a
941B	n/a	n/a
941F	n/a	n/a
941H	n/a	n/a
941G	n/a	n/a
95AI	n/a	n/a
9505	n/a	n/a
951D	n/a	n/a
951C	n/a	n/a
95AJ	n/a	n/a
8503	n/a	n/a
8509	n/a	n/a
9502	n/a	n/a
9501	n/a	n/a
9506	n/a	n/a
9503	n/a	n/a
951K	n/a	n/a
951G	n/a	n/a
961H	n/a	n/a
961G	n/a	n/a
961F	n/a	n/a
8602	n/a	n/a
961A	n/a	n/a
961B	n/a	n/a
861A	n/a	n/a
961E	n/a	n/a
9605	n/a	n/a
3409	n/a	n/a
3401	n/a	n/a
3402	n/a	n/a
2605	n/a	n/a
2606	n/a	n/a
261D	n/a	n/a
2602	n/a	n/a
261B	n/a	n/a
2607	n/a	n/a
2608	n/a	n/a
2604	n/a	n/a
2601	n/a	n/a

Manhole Reference	Manhole Cover Level	Manhole Invert Level
261A	38.357	36.367
271A	38.49	37.14
36BF	n/a	n/a
36BE	n/a	n/a
361E	n/a	n/a
3606	n/a	n/a
361C	n/a	n/a
3603	n/a	n/a
3718	n/a	n/a
36BB	n/a	n/a
3602	n/a	n/a
36AJ	n/a	n/a
36AI	n/a	n/a
241J	n/a	n/a
241C	n/a	n/a
1503	n/a	n/a
1401	n/a	n/a
25AJ	n/a	n/a
25AI	n/a	n/a
251Q	n/a	n/a
2504	n/a	n/a
251C	n/a	n/a
2505	n/a	n/a
2506	n/a	n/a
2501	n/a	n/a
251E	n/a	n/a
251N	n/a	n/a
261C	n/a	n/a
251P	n/a	n/a
241B	n/a	n/a
251M	n/a	n/a
251O	n/a	n/a
2503	n/a	n/a
2502	n/a	n/a
251D	n/a	n/a
251B	n/a	n/a
25AH	n/a	n/a
251A	n/a	n/a
351A	n/a	n/a
3607	n/a	n/a
35AI	n/a	n/a
3501	n/a	n/a
3503	n/a	n/a
36BA	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.

ALS Sewer Map Key

Public Sewer Types (Operated & Maintained by Thames Water)

Foul: A sewer designed to convey waste water from domestic and industrial sources to a treatment works.

Surface Water: A sewer designed to convey surface water (e.g. rain water from roofs, yards and car parks) to rivers or watercourses.

Combined: A sewer designed to convey both waste water and surface water from domestic and industrial sources to a treatment works.

Trunk Surface Water

Trunk Foul

Storm Relief

Trunk Combined

Vent Pipe

Bio-solids (Sludge)

Proposed Thames Surface Water Sewer

Proposed Thames Water Foul Sewer

Gallery

Foul Rising Main

Surface Water Rising Main

Combined Rising Main

Sludge Rising Main

Proposed Thames Water Rising Main

Vacuum

Sewer Fittings

A feature in a sewer that does not affect the flow in the pipe. Example: a vent is a fitting as the function of a vent is to release excess gas.

Air Valve

Dam Chase

Fitting

Meter

Vent Column

Operational Controls

A feature in a sewer that changes or diverts the flow in the sewer. Example: A hydrobrake limits the flow passing downstream.

Control Valve

Drop Pipe

Ancillary

Weir

End Items

End symbols appear at the start or end of a sewer pipe. Examples: an Undefined End at the start of a sewer indicates that Thames Water has no knowledge of the position of the sewer upstream of that symbol, Outfall on a surface water sewer indicates that the pipe discharges into a stream or river.

Outfall

Undefined End

Inlet

Other Symbols

Symbols used on maps which do not fall under other general categories

Public/Private Pumping Station

Change of characteristic indicator (C.O.C.I.)

Invert Level

Summit

Areas

Lines denoting areas of underground surveys, etc.

Agreement

Operational Site

Chamber

Tunnel

Conduit Bridge

Other Sewer Types (Not Operated or Maintained by Thames Water)

Foul Sewer

Surface Water Sewer

Combined Sewer

Gulley

Culverted Watercourse

Proposed

Abandoned Sewer

Notes:

1) All levels associated with the plans are to Ordnance Datum Newlyn.
2) All measurements on the plans are metric.
3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate direction of flow.
4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.
5) 'na' or '0' on a manhole level indicates that data is unavailable.
6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in milimetres. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology present on the plan, please contact a member of Property Searches on 0800 009 4540.

Terms and Conditions

All sales are made in accordance with Thames Water Utilities Limited (TWUL) standard terms and conditions unless previously agreed in writing.

1. All goods remain in the property of Thames Water Utilities Ltd until full payment is received.
2. Provision of service will be in accordance with all legal requirements and published TWUL policies.
3. All invoices are strictly due for payment 14 days from due date of the invoice. Any other terms must be accepted/agreed in writing prior to provision of goods or service, or will be held to be invalid.
4. Thames Water does not accept post-dated cheques-any cheques received will be processed for payment on date of receipt.
5. In case of dispute TWUL`s terms and conditions shall apply.
6. Penalty interest may be invoked by TWUL in the event of unjustifiable payment delay. Interest charges will be in line with UK Statute Law 'The Late Payment of Commercial Debts (Interest) Act 1998'.
7. Interest will be charged in line with current Court Interest Charges, if legal action is taken.
8. A charge may be made at the discretion of the company for increased administration costs.

A copy of Thames Water's standard terms and conditions are available from the Commercial Billing Team (cashoperations@thameswater.co.uk).

We publish several Codes of Practice including a guaranteed standards scheme. You can obtain copies of these leaflets by calling us on 0800 316 9800

If you are unhappy with our service you can speak to your original goods or customer service provider. If you are not satisfied with the response, your complaint will be reviewed by the Customer Services Director. You can write to her at: Thames Water Utilities Ltd. PO Box 492, Swindon, SN38 8TU.

If the Goods or Services covered by this invoice falls under the regulation of the 1991 Water Industry Act, and you remain dissatisfied you can refer your complaint to Consumer Council for Water on 0121 345 1000 or write to them at Consumer Council for Water, 1st Floor, Victoria Square House, Victoria Square, Birmingham, B2 4AJ.

Ways to pay your bill

Credit Card	BACS Payment	Telephone Banking	Cheque
Call **0800 009 4540** quoting your invoice number starting CBA or ADS / OSS	Account number **90478703** Sort code **60-00-01** A remittance advice must be sent to: **Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW.** or email **ps.billing@thameswater.co.uk**	By calling your bank and quoting: Account number **90478703** Sort code **60-00-01** and your invoice number	Made payable to '**Thames Water Utilities Ltd**' Write your Thames Water account number on the back. Send to: **Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW** or by DX to **151280 Slough 13**

Thames Water Utilities Ltd Registered in England & Wales No. 2366661 Registered Office Clearwater Court, Vastern Rd, Reading, Berks, RG1 8DB.

15.9 Appendix 9 - Infiltration Testing

15.9.1 Infiltration Testing

Infiltration testing in general accordance with the methodology outlined in BRE Digest 365 was conducted on the 14th of April 2021 by STM.

A total of 3no. trial pit were excavated to 1.0m in depth in three area at the site.

The underlying geology consisted of made ground and bedrock of London Clay.

Groundwater was encountered in TP02 at 0.9mbgl respectively. Infiltration testing was not undertaken in these locations due to the elevated groundwater table.

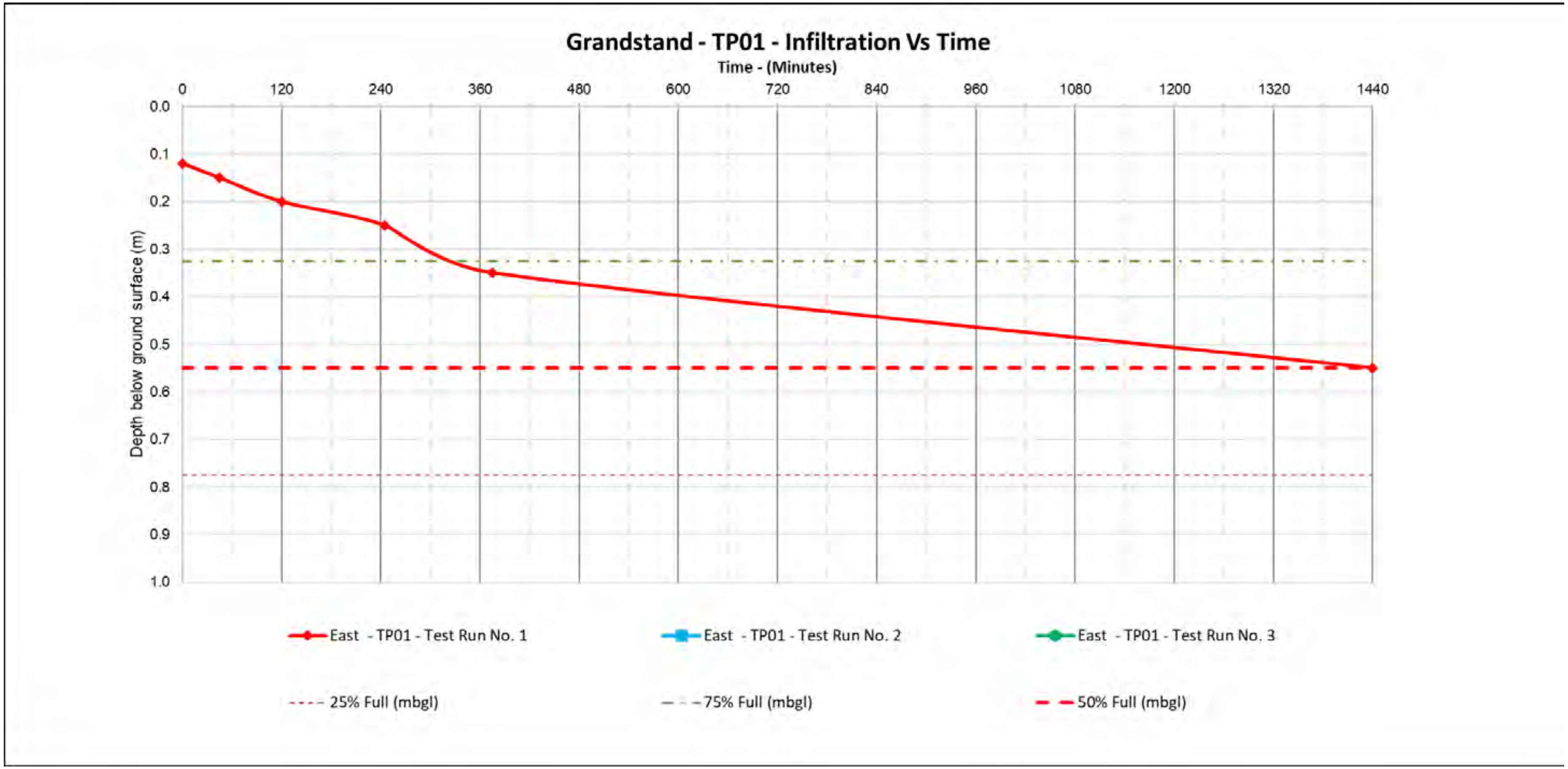
Infiltration testing was undertaken in TP01 and TP03. The rate was not sufficient as it did not achieve the 50% infiltration benchmark volume during the 1st test run.

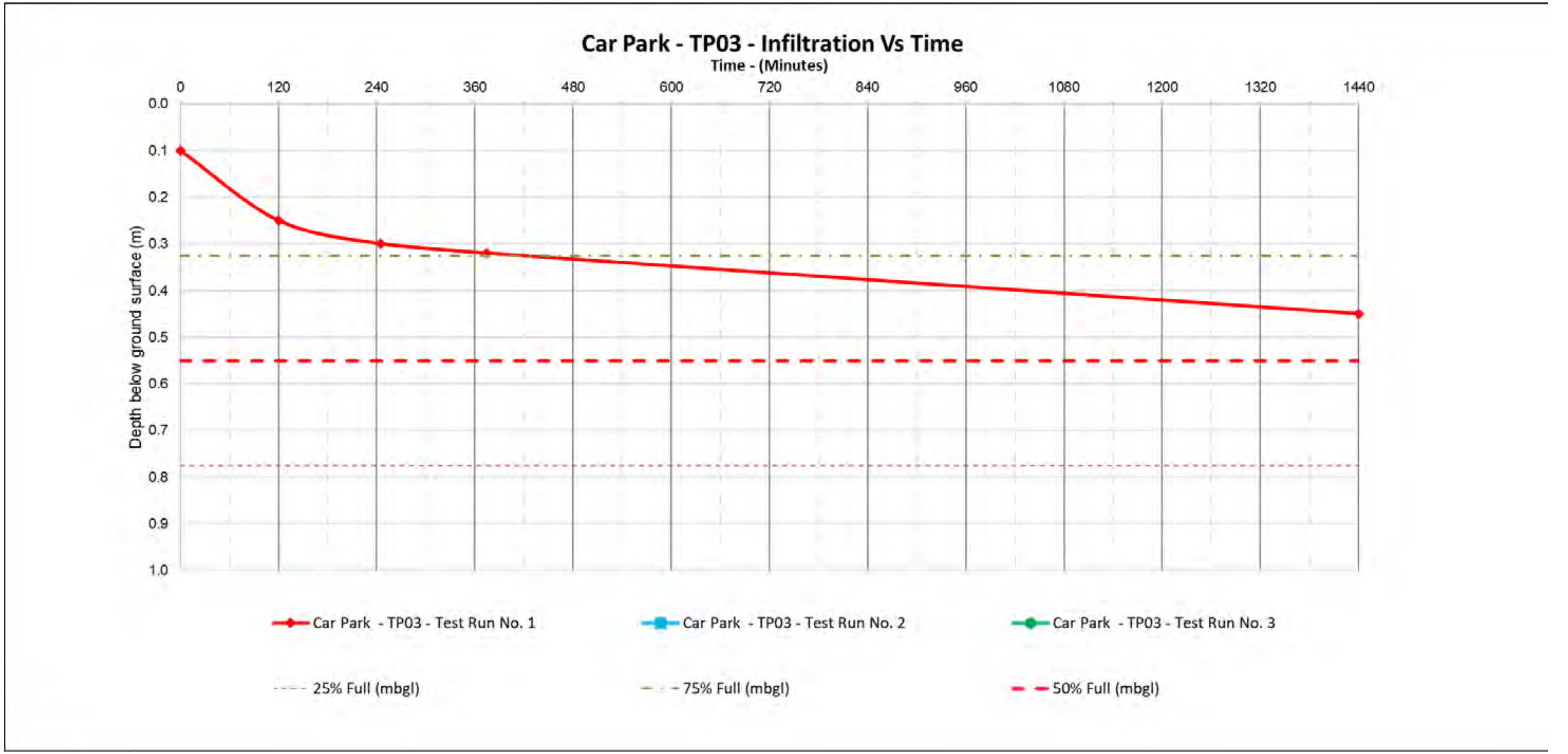
The BREDG 365 Soakaway Design methodology was employed to determine the infiltration coefficient describing the rate of infiltration into the ground at the site.

A map showing the locations of the trail pits is below.

The trial pits were filled with water to 0.9m, or the max level achievable with infiltration occurring, above the base, and were allowed to drain for 24 hours or until 25% volume of water remained. After which the trial pit was then refilled for 2no. subsequent test runs if sufficient infiltration had occurred. A test fails when the infiltration volume doesn't reach the 50% benchmark over 24 hours. Continuous monitoring of the water levels was undertaken using a measuring pole and/or a level logger.

15.9.2 Infiltration Testing Graph





Car Park - TP03 - Infiltration Vs Time
Time - (Minutes)
0
120
240
360
480
600
720
840
960
1080
1200
1320
1440
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Depth below ground surface (m)
Car Park - TP03 - Test Run No. 1
Car Park - TP03 - Test Run No. 2
Car Park - TP03 - Test Run No. 3
25% Full (mbgl)
75% Full (mbgl)
50% Full (mbgl)

15.9.3 Infiltration Data and Results

East - TP01 - Test Run No. 1

insert time according to the measured units

Water Level Above Base	Depth (mbgl)	Time (hours)	Time (minutes)	Time (s)		Time	*25% Full (mbgl)*	*50% Full (mbgl)*	*75% Full (mbgl)*
0.88	0.1	0.00	0	0	0:00	10:45:00	0.775	0.55	0.325
0.85	0.2	0.75	45	2700	0:45	11:30:00	0.775	0.55	0.325
0.8	0.2	2.00	120	7200.00	2:00	12:45:00	0.775	0.55	0.325
0.75	0.3	4.08	245	14700.00	4:05	14:50:00	0.775	0.55	0.325
0.6	0.4	6.25	375	22500.00	6:15	17:00:00	0.775	0.55	0.325
0.45	0.6	24.00	1440	86400.00	00:00	11:09:00	0.775	0.55	0.325

Failed to reach 50% within 24 hours. Second run not undertaken.

East - TP01 - Test Run No. 2

insert time according to the measured units

Water Level Above Base	Depth (mbgl)	Time (hours)	Time (minutes)	Time (s)		Time	*25% Full (mbgl)*	*50% Full (mbgl)*	*75% Full (mbgl)*
1.85	-0.9	0.00	0	0	0:00		0.775	0.55	0.325
1.85	-0.9	0.00	0	0.00	0:00		0.775	0.55	0.325
1.85	-0.9	0.00	0	0.00	0:00		0.775	0.55	0.325
1.85	-0.9	0.00	0	0.00	0:00		0.775	0.55	0.325
1.85	-0.9	0.00	0	0.00	0:00		0.775	0.55	0.325
1.85	-0.9	0.00	0	0.00	0:00		0.775	0.55	0.325
1.85	-0.9	0.00	0	0.00	0:00		0.775	0.55	0.325
1.85	-0.9	0.00	0	0.00	0:00		0.775	0.55	0.325
1.85	-0.9	0.00	0	0.00	0:00		0.775	0.55	0.325

Reached 25% within 24 hours. Second run undertaken.

East - TP01 - Test Run No. 3

insert time according to the measured units

Water Level Above Base	Depth (mbgl)	Time (hours)	Time (minutes)	Time (s)		Time	*25% Full (mbgl)*	*50% Full (mbgl)*	*75% Full (mbgl)*
1.85	-0.9	0.00	0	0	0:00		0.775	0.55	0.325
1.85	-0.9	0.00	0	0.00	0:00		0.775	0.55	0.325
1.85	-0.9	0.00	0	0.00	0:00		0.775	0.55	0.325
1.85	-0.9	0.00	0	0.00	0:00		0.775	0.55	0.325
1.85	-0.9	0.00	0	0.00	0:00		0.775	0.55	0.325
1.85	-0.9	0.00	0	0.00	0:00		0.775	0.55	0.325
1.85	-0.9	0.00	0	0.00	0:00		0.775	0.55	0.325

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

Infiltration Coef. Calculations		
Width	0.30	m
Depth	1.00	m
Length	1.00	m
Total Volume	0.30	m3
Effective Storage Depth	0.90	m
25% Full	0.78	mbgl
50% Full	0.55	mbgl
75% Full	0.33	mbgl
Pipe Depth	**1.85**	
a_{s50}	1.50	m^2
V_{p75-25}	0.14	m^3
t_{p75-25} (read from graph)	0.00	mins
f	**#DIV/0!**	m/s
f	#DIV/0!	mm/hr
f	#DIV/0!	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

Car Park - TP03 - Test Run No. 1

insert time according to the measured units

Water Level Above Base	Depth (mbgl)	Time (hours)	Time (minutes)	Time (s)		Time	*25% Full (mbgl)*	*50% Full (mbgl)*	*75% Full (mbgl)*
0.9	0.1	0.00	0	0	0:00	10:45:00	0.775	0.55	0.325
0.75	0.3	2.00	120	7200.00	2:00	12:45:00	0.775	0.55	0.325
0.7	0.3	4.08	245	14700.00	4:05	14:50:00	0.775	0.55	0.325
0.68	0.3	6.25	375	22500.00	6:15	17:00:00	0.775	0.55	0.325
0.55	0.5	24.00	1440	86400.00	00:00	11:09:00	0.775	0.55	0.325

Failed to reach 50% within 24 hours. Second run not undertaken.

Car Park - TP03 - Test Run No. 2

insert time according to the measured units

Water Level Above Base	Depth (mbgl)	Time (hours)	Time (minutes)	Time (s)		Time	*25% Full (mbgl)*	*50% Full (mbgl)*	*75% Full (mbgl)*
1.85	-0.9	0.00	0	0	0:00		0.775	0.55	0.325
1.85	-0.9	0.00	0	0.00	0:00		0.775	0.55	0.325
1.85	-0.9	0.00	0	0.00	0:00		0.775	0.55	0.325
1.85	-0.9	0.00	0	0.00	0:00		0.775	0.55	0.325
1.85	-0.9	0.00	0	0.00	0:00		0.775	0.55	0.325
1.85	-0.9	0.00	0	0.00	0:00		0.775	0.55	0.325
1.85	-0.9	0.00	0	0.00	0:00		0.775	0.55	0.325
1.85	-0.9	0.00	0	0.00	0:00		0.775	0.55	0.325
1.85	-0.9	0.00	0	0.00	0:00		0.775	0.55	0.325

Reached 25% within 24 hours. Second run undertaken.

Car Park - TP03 - Test Run No. 3

insert time according to the measured units

Water Level Above Base	Depth (mbgl)	Time (hours)	Time (minutes)	Time (s)		Time	*25% Full (mbgl)*	*50% Full (mbgl)*	*75% Full (mbgl)*
1.85	-0.9	0.00	0	0	0:00		0.775	0.55	0.325
1.85	-0.9	0.00	0	0.00	0:00		0.775	0.55	0.325
1.85	-0.9	0.00	0	0.00	0:00		0.775	0.55	0.325
1.85	-0.9	0.00	0	0.00	0:00		0.775	0.55	0.325
1.85	-0.9	0.00	0	0.00	0:00		0.775	0.55	0.325
1.85	-0.9	0.00	0	0.00	0:00		0.775	0.55	0.325
1.85	-0.9	0.00	0	0.00	0:00		0.775	0.55	0.325

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

Infiltration Coef. Calculations

Width	0.30	m
Depth	1.00	m
Length	1.00	m
Total Volume	0.30	m3
Effective Storage Depth	0.90	m
25% Full	0.78	mbgl
50% Full	0.55	mbgl
75% Full	0.33	mbgl
Pipe Depth	**1.85**	
a_{s50}	1.50	m^2
V_{p75-25}	0.14	m^3
t_{p75-25} *(read from graph)*	0.00	mins
f	**#DIV/0!**	m/s
f	#DIV/0!	mm/hr
f	#DIV/0!	m/hr

Infiltration Rate (mm/hr)

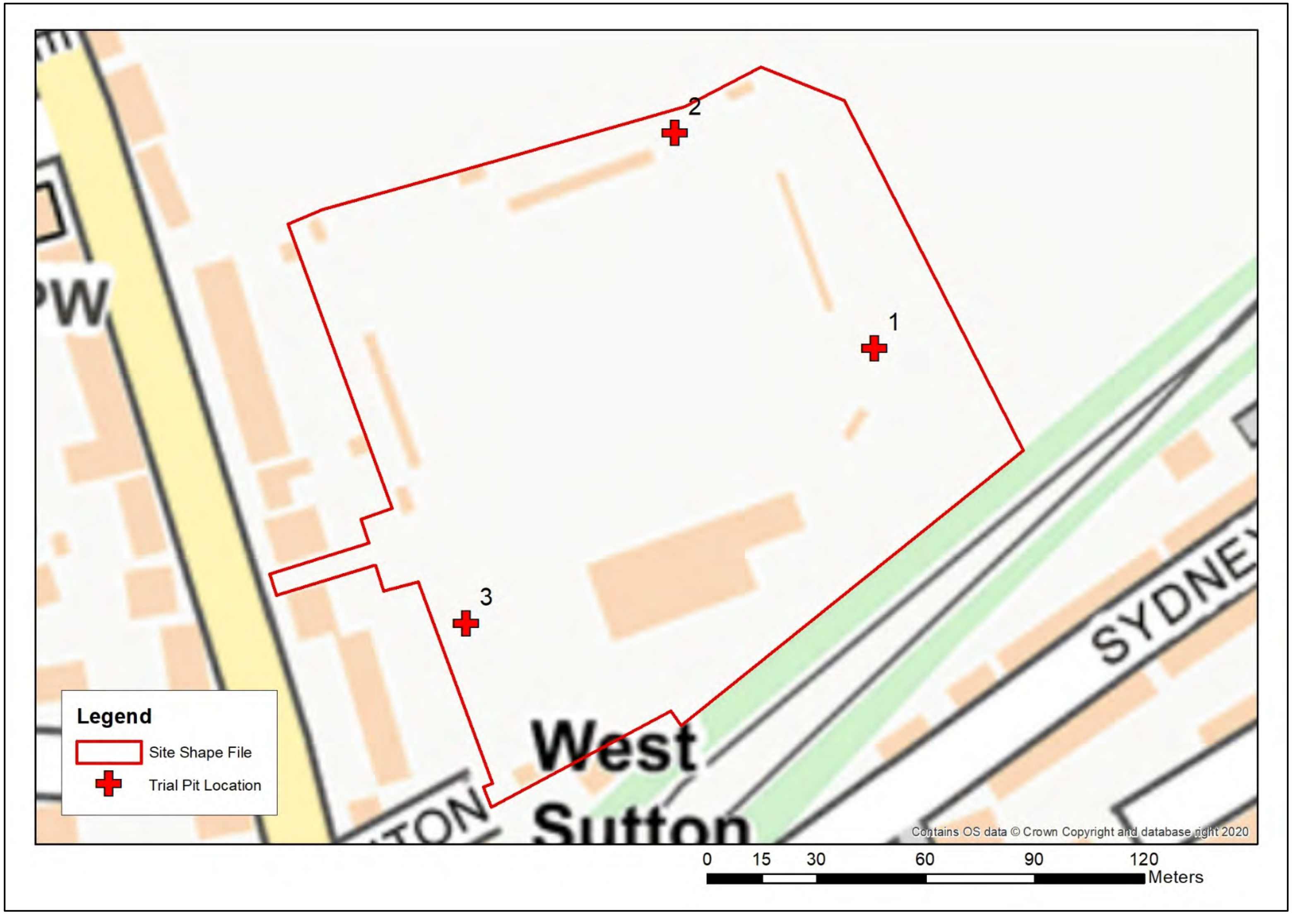
IR < 0.036	IMPERMEABLE
0.036 < IR < 0.38	VERY SLOW
0.38 < IR < 3.7	MODERATELY SLOW
3.7 < IR < 37	MODERATE
37 < IR < 370	MODERATELY RAPID
IR > 370	RAPID

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

15.9.4 Soakaway Test Location Map



15.9.5 Soakaway Testing

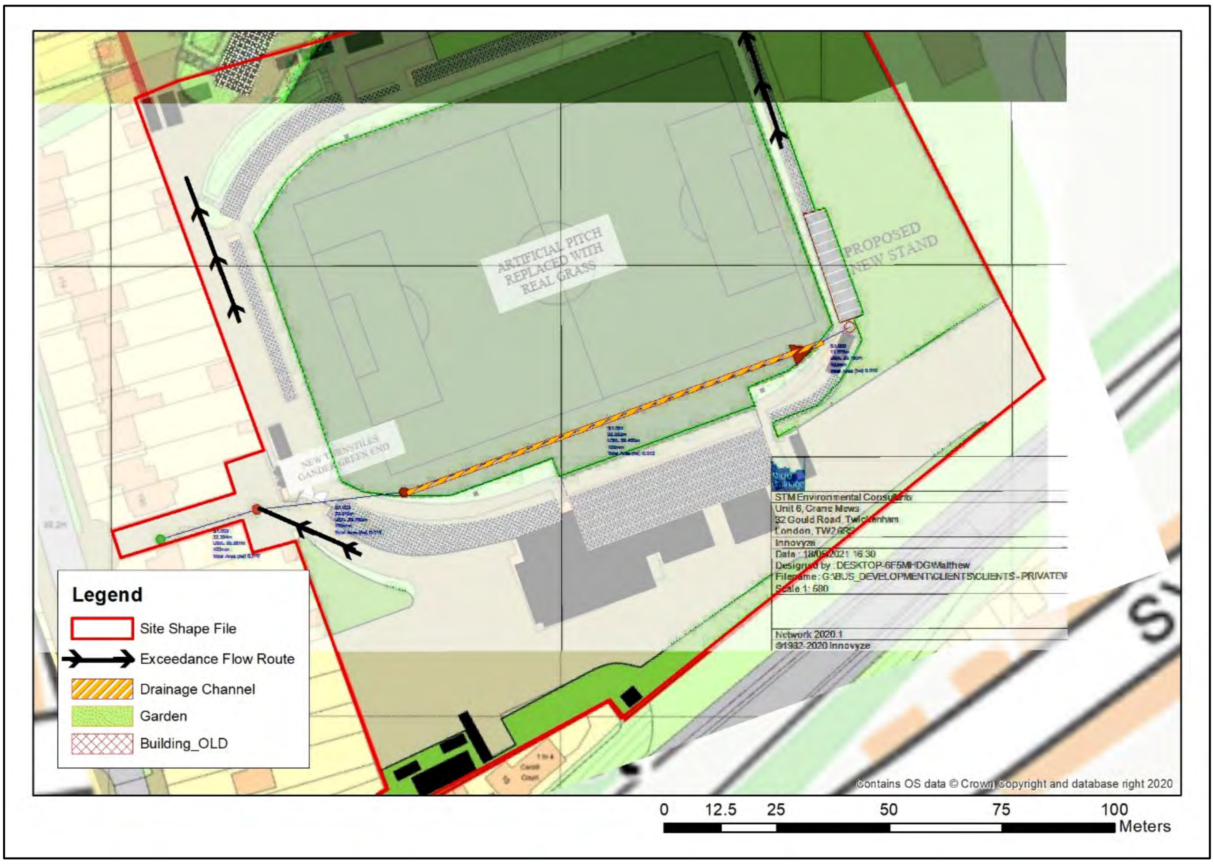
TP01

TP02 - Groundwater

TP03

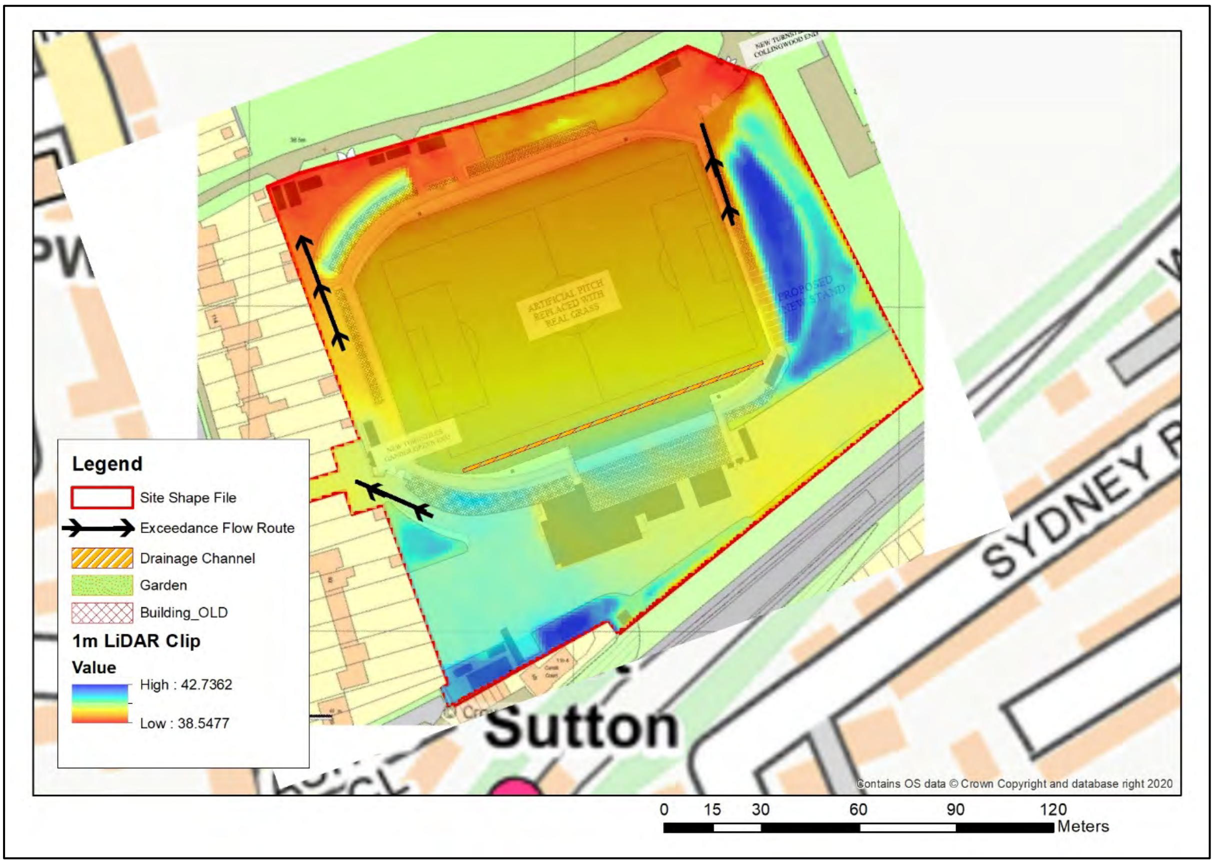
15.10 Appendix 10 - Microdrainage

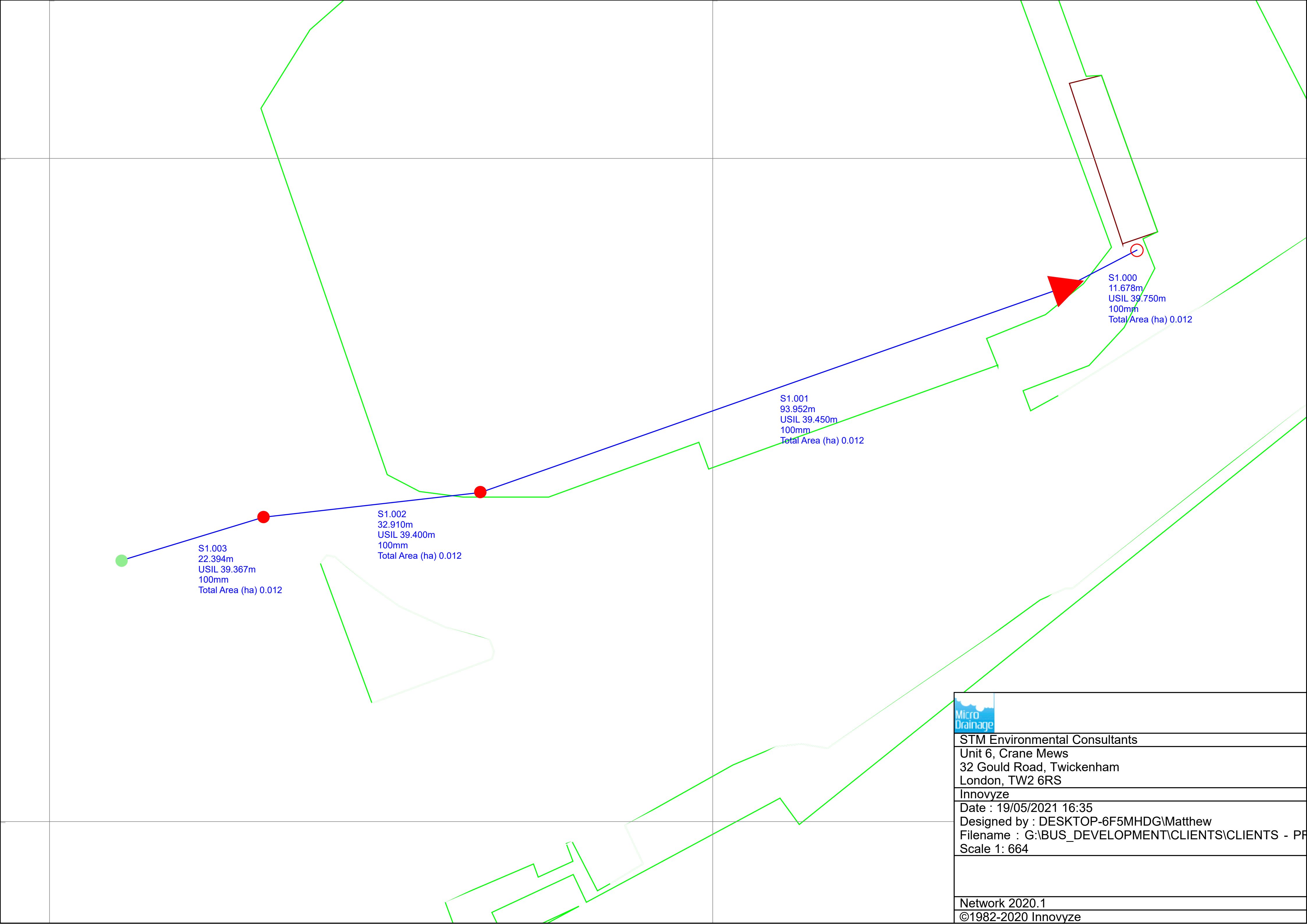
15.10.1 Layout of Network



PDF Copy to follow this page.

15.10.2 Layout of Network - Features, Exceedance flows





Micro Drainage

STM Environmental Consultants

Unit 6, Crane Mews
32 Gould Road, Twickenham
London, TW2 6RS

Innovyze

Date : 19/05/2021 16:35
Designed by : DESKTOP-6F5MHDG\Matthew
Filename : G:\BUS_DEVELOPMENT\CLIENTS\CLIENTS - PF
Scale 1: 664

Network 2020.1

15.10.3 Microdrainage results

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)	20.000	Add Flow / Climate Change (%)	0
Ratio R	0.413	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)	0.150
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

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.000	8-12	0.000	16-20	0.000	24-28	0.006
4-8	0.000	12-16	0.000	20-24	0.000	28-32	0.006

Total Area Contributing (ha) = 0.012

Total Pipe Volume (m³) = 1.264

Network Design Table for Storm

« - Indicates pipe capacity < flow

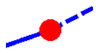
PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	11.678	0.200	58.5	0.012	5.00	0.0	0.600	o	100	Pipe/Conduit	
S1.001	93.952	0.000	0.0	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
S1.002	32.910	0.033	987.3	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
S1.003	22.394	0.383	58.5	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)
S1.000	50.00	5.19	39.750	0.012	0.0	0.0	0.0	1.01	7.9	1.6
S1.001	50.00	27.73	39.450	0.012	0.0	0.0	0.0	0.07	0.5«	1.6
S1.002	50.00	30.00	39.400	0.012	0.0	0.0	0.0	0.24	1.9	1.6
S1.003	50.00	30.00	39.367	0.012	0.0	0.0	0.0	1.01	7.9	1.6

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)	Backdrop (mm)
S1	40.200	0.450	Junction		S1.000	39.750	100				
S2	40.000	0.550	Open Manhole	1050	S1.001	39.450	100	S1.000	39.550	100	100
S3	40.000	0.600	Open Manhole	1050	S1.002	39.400	100	S1.001	39.450	100	50
S4	40.020	0.653	Open Manhole	1050	S1.003	39.367	100	S1.002	39.367	100	
S	40.000	1.016	Open Manhole	0		OUTFALL		S1.003	38.984	100	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S1	525164.033	164686.155			No Entry	
S2	525153.683	164680.745	525153.683	164680.745	Required	
S3	525065.010	164649.698	525065.010	164649.698	Required	
S4	525032.316	164645.935	525032.316	164645.935	Required	
S	525010.912	164639.349			No Entry	

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			525164.033	164686.155			
S1.001	S2	1050		525153.683	164680.745	525153.683	164680.745	
S1.002	S3	1050		525065.010	164649.698	525065.010	164649.698	
S1.003	S4	1050		525032.316	164645.935	525032.316	164645.935	

PN	DSMH Name	Dia/Len (mm)	Width (mm)	DS Easting (m)	DS Northing (m)	Layout (North)
S1.003	S	0		525010.912	164639.349	

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			525164.033	164686.155			
S1.001	S2	1050		525153.683	164680.745	525153.683	164680.745	
S1.002	S3	1050		525065.010	164649.698	525065.010	164649.698	
S1.003	S4	1050		525032.316	164645.935	525032.316	164645.935	

PN	DSMH Name	Dia/Len (mm)	Width (mm)	DS Easting (m)	DS Northing (m)	Layout (North)
S1.003	S	0		525010.912	164639.349	

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.012	0.012	0.012
1.001	-	-	100	0.000	0.000	0.000
1.002	-	-	100	0.000	0.000	0.000
1.003	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.012	0.012	0.012

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)
S1.003	S	40.000	38.984	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	40.000
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	1
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Storm Duration (mins)	30
Ratio R	0.413		

CASDeF Controller for Storm

PN	US/MH Name	Level Not Exceeded	Modify Control	Modify Pipe Size	Max Pipe Diameter	No. Pipe Failures	Add Storage	No. Storage Failures	Use CASDeF
S1.000	S1	40.200	Yes	No	300	0	Yes	0	Yes
S1.001	S2	40.000	Yes	No	400	0	Yes	0	Yes
S1.002	S3	40.000	Yes	No	450	0	Yes	0	Yes
S1.003	S4	40.020	Yes	No	503	0	Yes	0	Yes

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	0.000	0.092	0.000	0.092
S1.001	S2	0.476	0.738	12.150	13.364
S1.002	S3	0.520	0.258	0.000	0.778
S1.003	S4	0.566	0.176	0.000	0.742
Total		1.562	1.264	12.150	14.975

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	0.000	0.088	0.000	0.088
S1.001	S2	0.476	0.730	12.150	13.356
S1.002	S3	0.520	0.250	0.000	0.770
S1.003	S4	0.566	0.172	0.000	0.737
Total		1.562	1.239	12.150	14.951

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	40.000
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	1
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.413
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
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 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	Overflow Act.	Water Level (m)
S1.000	S1	15 Winter	1	+0%					39.788
S1.001	S2	15 Winter	1	+0%	100/15 Summer				39.511
S1.002	S3	15 Winter	1	+0%					39.452
S1.003	S4	15 Winter	1	+0%					39.390

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.062	0.000	0.30			2.3	OK*	
S1.001	S2	-0.039	0.000	0.55		8	1.0	OK	
S1.002	S3	-0.048	0.000	0.54			1.0	OK	
S1.003	S4	-0.076	0.000	0.13			1.0	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	40.000
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	1
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.413
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
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 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	Overflow Act.	Water Level (m)
S1.000	S1	15 Winter	30	+0%					39.814
S1.001	S2	30 Winter	30	+0%	100/15 Summer				39.540
S1.002	S3	30 Winter	30	+0%					39.472
S1.003	S4	30 Winter	30	+0%					39.397

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.036	0.000	0.73			5.8	OK*	
S1.001	S2	-0.010	0.000	0.87		17	1.6	OK	
S1.002	S3	-0.028	0.000	0.86			1.6	OK	
S1.003	S4	-0.069	0.000	0.20			1.6	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	40.000
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	1
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.413
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
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 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	Overflow Act.	Water Level (m)
S1.000	S1	15 Summer	100	+40%					39.850
S1.001	S2	60 Winter	100	+40%	100/15 Summer				39.606
S1.002	S3	240 Summer	100	+40%					39.472
S1.003	S4	240 Summer	100	+40%					39.397

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	0.000	1.19			9.5	SURCHARGED*	
S1.001	S2	0.056	0.000	0.87		65	1.6	SURCHARGED	
S1.002	S3	-0.028	0.000	0.87			1.6	OK	
S1.003	S4	-0.069	0.000	0.21			1.6	OK	