SuDS Drainage Strategy

November 2023

EAS

The White Hart, St Albans Road, South Mimms EN6 3PJ

Griggs (South Mimms) Limited

Document History

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The content of this report is based on information available as of November 2023, the validity of the statements made may therefore vary over time as planning guidance / policies and the evidence base change.

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1 Introduction

1.1 EAS have been commissioned to prepare a SuDS Drainage Report to accompany a planning application at The White Hart, St Albans Road, South Mimms, EN6 3PJ. The site location plan is included in **Appendix A**.

1.2 The proposals are for: "*Conversion and extension of the former public house into six apartments, conversion of outbuilding into a two-bedroom apartment and construction of a detached infill dwelling, along with associated landscaping, bin store, cycle storage and vehicle parking*." The proposed development plans are in **Appendix B**.

1.3 The site under 1ha, is located in Flood Zone 1 and is at very low to low risk of all other sources of flooding therefore a full flood risk assessment is not required. The focus of this report will be the SuDS strategy.

1.4 The contents of this SuDS report is based on the advice set out in the National Planning Policy Framework (NPPF) published in September 2023, Annex 3: Flood risk vulnerability classification, also from the NPPF and PPG 'Guidance for Flood Risk and Coastal Change', updated in August 2022.

1.5 This report is based on the Flood Map for Planning, geology mapping, site-specific ground investigations, OS mapping, topographic survey, Strategic Flood Risk Assessment and local policy.

1.6 This document includes the following sections:

Section 2 - describes the relevant policy;

Section 3 - site description, including site levels, proximity to watercourses etc.;

Section 4 - outlines potential sources of flooding;

Section 5 – details the proposed drainage strategy;

Section 6 – details maintenance tasks for the chosen SuDS features;

Section 7 – concludes the report.

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2 Policy Context

Introduction

2.1 This section sets out the policy context. This report is based on the advice set out in the National Planning Policy Framework (NPPF) published in September 2023 and the Planning Practice Guidance (PPG) updated in August 2022.

National Planning Policy Framework

2.2 Paragraph 167 footnote 55 of the NPPF states:

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

The flood zones are defined as:

- Flood Zone 1 – Land assessed as having a less than 1 in 1,000 (<0.1%) annual probability of flooding from fluvial sources;
- Flood Zone 2 – Land assessed as having between a 1 in a 100 and 1 in 1,000 (1% to 0.1%) annual probability of flooding from fluvial sources;
- Flood Zone 3a – Land assessed as having a 1 in 100 or greater (>1%) annual probability of flooding from fluvial sources, or at least 0.5% annual probability of tidal flooding;
- Flood Zone 3b – Land where water has to flow or be stored in times of flood.

2.3 Paragraph 159 discusses the suitability of development location, particularly with regards to future risks induced by climate change:

"Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk (whether existing or future). Where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere".

2.4 Paragraph 160 of the National Planning Policy Framework (NPPF) sets out how:

"Strategic policies should be informed by a strategic flood risk assessment, and should manage flood risk from all sources. They should consider cumulative impacts in, or affecting, local areas susceptible to flooding, and take account of advice from the Environment Agency and other relevant flood risk management authorities, such as lead local flood authorities and internal drainage boards".

2.5 Paragraphs 169 NPPF discusses the application of sustainable drainage systems:

"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 of the lifetime of the development; and*
- *Where possible, provide multifunctional benefits."*

2.6 The Flood Map for Planning has been enclosed in **Appendix C**. The site is located in Flood Zone 1 with an annual probability of flooding from fluvial sources of less than 0.1%.

Local Policy

Hertsmere Core Strategy Development Planning Document

2.7 The Hertsmere Core Strategy was adopted in January 2013. The relevant policy is CS16.

2.8 Policy CS16 Environmental impact of development

"The Council will work with key partners, including the Environment Agency and Natural England, to ensure that development proposals do not create an unacceptable level of risk to occupiers of a site, the local community and the wider environment. Development proposals should take account of the policy recommendations of the Council's SFRA and the guidance set out in the jointly produced guidance of the Hertfordshire Planning Authorities 'Building Futures' the Hertfordshire Guide to Promoting Sustainability in Development. Proposals will be required to incorporate sustainability principles, minimising their impact on the environment and ensuring prudent use of natural resources by measures including:

i) Avoiding development in the floodplain and close to river corridors unless the requirements of the sequential and exceptions tests have been met and flood prevention/mitigation measures are in place as required by the Environment Agency;

ii) Improving water efficiency by reducing water consumption through measures such as water saving devices in line with the Code for Sustainable Homes and BREEAM as a minimum requirement;

iii) Incorporating the use of Sustainable Urban Drainage Systems (SUDS) where appropriate and where required by the Flood and Water Management Act 2010 to help reduce the risk of flooding; ..."

Hertsmere Site Allocations and Development Management Policies Plan 2016

2.9 This document provides a balance between the Borough's housing and economic development needs, social welfare and protection of the environment.

2.10 Policy SADM14- Flood Risk

The risk of flooding will be avoided and reduced by:

i) locating development within areas of lower flood risk through the application of the sequential test and then applying an exception test in line with the National Planning Policy Framework (NPPF); and

ii) ensuring that development proposals in flood risk areas actively manage and reduce flood risk by applying the sequential approach at site level.

iii) Where new development is proposed in a flood risk area, a site specific Flood Risk Assessment will be required. This must take into account the risk associated with all types of flooding.

Development must satisfy the following principles:

i) It must not increase the risk of flooding elsewhere.

ii) Within sites at risk of flooding, the most vulnerable parts of the proposed development should be located in areas of lowest flood risk, unless there are overriding reasons to prefer different locations.

iii) Floor levels of development in Flood Zones 2 and 3 should be situated above the 1% (1 in 100 years) plus climate change predicted maximum water level, plus a minimum watertight depth of 300mm above the normal water level.

iv) Development at risk from any form of flooding should be flood resilient and resistant, with safe access and escape routes: it should also be demonstrated that residual risks can be safely managed.

v) Development should incorporate appropriate flood resilient features and flood mitigation measures.

vi) Where possible the footprint of existing buildings should be reduced.

vii) Any necessary flood protection or mitigation measure should not have an undue impact on nature conservation, landscape character, recreation or other important matter.

viii) There should be no net loss in flood storage on site.

ix) Flood flow routes should be preserved.

x) Where possible, flood storage should be maximised through the use of green infrastructure and sustainable drainage systems.

xi) The risk from all types of flooding should be reduced as a consequence of development, wherever possible.

Where necessary, planning permission will be conditional upon flood protection and/or runoff control measures being operative before other site works.

2.11 The site is located in Flood Zone 1 and is at very low risk of surface water flooding.

2.12 Policy SADM15 - Sustainable Drainage Systems

The design of new development should include sustainable drainage measures.

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In particular, the Council will require the introduction of sustainable drainage (SuDS) on all major developments (as defined in the Town and Country Planning (Development Management Procedure) (England) Order 2015 and any subsequent order). The drainage scheme should provide the most sustainable option from the SuDS hierarchy. Measures should attenuate water runoff at source (e.g., through attenuation ponds, filter strips, swales) and achieve multiple benefits (including management of flood risk and surface water pollution, amenity and biodiversity). The drainage scheme will:

i) achieve the green field runoff rate, or as close to it as practicable;

ii) provide a 1 in 100 year attenuation taking into account climate change;

iii) provide arrangements for future maintenance and management

2.13 The proposed SuDS strategy has been hydraulically modelled for the 100yr plus 40% climate change and a post development outfall rate matching the greenfield runoff rate has been achieved. Management schedules associated with the chosen SuDS devices are detailed in Section 6.

Hertsmere Borough Council Strategic Flood Risk Assessment (SFRA)

2.14 The Hertsmere SFRA prepared by AECOM was published in May 2018 to produce suitable guidance and mapping to inform development control decisions.

2.15 The SFRA contains mapping which includes, historic flood outlines, fluvial flood zones, and the location of recorded drainage infrastructure / land drainage flooding / groundwater flooding. The summary map includes data from Hertsmere Borough Council, Hertfordshire County Council, and the EA.

2.16 Figure 05.0 confirms the site is located in Flood Zone 1.

2.17 Figure 09 shows the location of recorded flood events across the district. To the south of the site, this figure shows that a Land Drainage Flood Event and a Highways Drainage Flood Event occurred, though no other specific information regarding these events is given. Taking into consideration that the surface water flood mapping for the site indicated no flooding on site, but shows some flooding within Blanche Lane, it is more likely that these noted flood events occurred in the carriageway.

2.18 Figure 10.3, showing Flooding from Surface Water, shows the site is not at risk of surface water flooding. Some flooding is showing in Blanche Road to the south of the site – further supporting that the flood events shown in Figure 09 occurred in the carriageway.

2.19 Figure 11 identifies the site to be located in an area not considered to be prone to groundwater flooding.

2.20 Figure 12 identifies the site to be located in an area with 11-40 recorded incidents of sewer flooding.

2.21 Figure 13 confirms the site is not at risk of flooding from artificial sources such as reservoir.

2.22 Figure 14 shows the site is in an area that is "Probably compatible for infiltration SuDS", indicating that infiltration may be viable. An assessment of the underlying strata should therefore be undertaken to determine if testing is worthwhile.

2.23 Paragraph 6.5.1. of the SFRA sets out what is expected from a SuDS Drainage Strategy in the Borough:

"Flood risk outside the development

S1 Where the drainage system discharges to a surface water body that can accommodate uncontrolled surface water discharges without any impact on flood risk from that surface water body (e.g., the sea or large estuary) the peak flow control standards (S2 and S3 below) and volume control standards (S4 and S6 below) need not apply.

Peak flow control

S2 For greenfield developments, the peak runoff rate from the development to any highway drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event should never exceed the peak greenfield runoff rate for the same event.

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.

Volume control

S4 Where reasonably practicable, for Greenfield development, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event should never exceed the Greenfield runoff volume for the same event.

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.

Flood risk within the development

S7 The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the site for a 1 in 30 year rainfall event.

S8 The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur during a 1 in 100 year rainfall event in any part of: a building (including a basement); or in any utility plant susceptible to water (e.g., pumping station or electricity substation) within the development.

S9 The design of the site must ensure that, so far as is reasonably practicable, flows resulting from rainfall in excess of a 1 in 100 year rainfall event are managed in exceedance routes that minimise the risks to people and property. All major developments and other development should not result in an increase in surface water runoff, and where possible, should demonstrate betterment in terms of rate and volumes of surface water runoff. Sustainable Drainage Systems (SuDS) should be used to reduce and manage surface water run-off to and from proposed developments as near to source as possible in accordance with the requirements of the Technical Standards and supporting guidance published by DCLG and Defra."

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3 Existing Site Assessment

Site Description

3.1 The site is located at The White Hart, St Albans Road, South Mimms, EN6 3PJ and covers a total area of 0.272 hectares. A location plan is included at **Appendix A**.

3.2 It can be seen the site is approximately triangular in shape with Blanche Lane running along the south-western boundary, St Albans Road along the north-eastern boundary and residential properties to the south.

3.3 The site currently comprises The White Hart Public House, associated outhouse and parking area. A grassed space with a war memorial occupies the north-corner of the site.

Local Watercourses

3.4 An unnamed watercourse is located in land to the south of Blanche Lane. This flows in a northerly direction and looks to be culverted under Black Horse Lane to then outfall to EA Main River the Catharine Bourne approx. 180m to the north of the site.

Site Levels

3.5 The topographical survey is included in **Appendix D**. The site falls in a northerly direction with levels along the southern boundary at 93.8 – 94.8mAOD falling to 90.8mAOD in the north close to the war memorial.

Geology

3.6 The online British Geological Survey resource (www.bgs.ac.uk) shows the site to be underlain by Lambeth Group Formation – Clay, Silt and Sand. No superficial deposits recorded. Nearby historic borehole records show layers of firm to stiff clays up to a depth of 38m below ground level (ref. BH TL20SW). Although the SFRA indicates probable infiltration compatibility in the area, taking the above BGS and Borehole data into consideration, surface water disposal to ground is not considered to be viable.

Sewers

3.7 The Thames Water Asset Location Plan is included in **Appendix E**. A 150dia surface water is present in St Albans Road, heading northwards and outfalling into the unnamed watercourse in land to the south of Blanche Lane. Two surface water sewers (300dia and 150dia) run alongside Blanche Lane, also outfalling to the unnamed watercourse. A 300dia foul water sewer runs in

Blanche Lane, heading northwards and crosses the northern corner of the site to head towards Gascoyne Close to the north of the site.

Existing Drainage

3.8 The topographical survey and existing elevations show a number of rainwater downpipes serving The White Hart. The rainwater downpipes on the west and north side of the building run into below ground drainage which is likely to outfall directly to the existing 300dia adopted foul water sewer which crosses the site. Rainwater downpipes on the south and east side of the building look to outfall to a private combined system which outfalls to the adopted foul water network. Rainwater downpipes serving the outbuilding outfall directly to ground via rainwater-shoes, this water is then collected in a private surface water drainage system, also collecting runoff from the car park area. This looks to ultimately outfall to the 150dia adopted surface water sewer in St Albans Road or a highway drain.

3.9 The White Hart is a historic building, dating to the 1800's. Rainwater down-pipes serving the roof-area would likely have been directed to ground before then being directed to sewers (when these were built). In the case for rainwater down-pipes on the western face of the building, it is unlikely that these could be redirected to a new private drainage system as the red-line ownership boundary is close up against the building, preventing new drainage runs. It is therefore proposed to allow the rainwater downpipes on the western face of the building to continue to drain as per the existing situation – which has been in operation for decades. For all other downpipes, where space is available to run a new private drainage system alongside the building, runoff shall be included in the hydraulic calculations.

4 Potential Sources of Flooding

Fluvial

4.1 A copy of the Environment Agency's Flood Map for Planning is enclosed in **Appendix C**. This shows that the main development site is located in Flood Zone 1.

4.2 Flood Zone 1 indicates an annual probability of flooding <0.1%.

Surface Water

4.3 Surface water flooding refers to flooding caused when the intensity of rainfall, particularly in urban areas, can create runoff which temporarily overwhelms the capacity of the local drainage systems or does not infiltrate into the ground. The water ponds on the ground and flows towards low-lying land. This source of flood risk is also known as 'pluvial'.

4.4 The EA's surface water flood map is included in **Appendix F** (Source: https://flood-warning-information.service.gov.uk/long-term-flood-risk/map). This shows the site is not at risk of surface water flooding in all scenarios.

Reservoir

4.5 The EA long term risk maps confirms the site is not located in a reservoir flood extent.

Groundwater

4.6 The MAGIC Map website (https://magic.defra.gov.uk/MagicMap.aspx) shows that the site lies within an Inner Source Protection Zone and within an area of High Groundwater Vulnerability.

4.7 Looking at the Aquifer Designation for bedrock, the site is shown to be underlain by a Secondary A aquifer. In terms of the Aquifer Designation for superficial deposits, the site is underlain by an unproductive aquifer.

4.8 Historic Borehole Logs in the vicinity of the site do not show groundwater strike.

4.9 Based on the above data and considering the mapping provided in the Hertsmere SFRA, the risk of flooding from groundwater is considered to be low.

Sewer

4.10 Sewer flooding would occur if the capacity of the sewer was overwhelmed and a nearby manhole surcharged. This could occur after a long period of heavy rainfall, or if there was a blockage in the sewer.

4.11 Thames Water sewer records show surface and foul water sewers in St Albans Road and Blanche Lane. Levels fall in a northerly direction at a gradient of around 1:25 as such should flooding of adopted sewers occur, it is likely that waters would head in a northerly direction within the carriageway. The risk of flooding to the site from sewers is considered to be low.

5 Proposed Drainage Strategy

Relevant SuDS Policy

5.1 SuDS mimic natural drainage patterns and provide a method of surface water drainage which can decrease the quantity of water discharged, and hence reduce the risk of flooding. SuDS design should meet the “four pillars” of SuDS of: water quantity, water quality, amenity and biodiversity, wherever possible.

5.2 In decreasing order of preference, the preferred means of disposal of surface water runoff is:

- Discharge to ground.
- Discharge to a surface water body.
- Discharge to a surface water sewer.
- Discharge to a combined sewer.

Site-Specific SuDS

5.3 The various SuDS methods need to be considered in relation to site-specific constraints. Several SuDS options are available to reduce or temporarily hold back the discharge of surface water runoff. Table 5.1 outlines the constraints and opportunities to each of the SUDS devices in accordance with the hierarchical approach outlined in The SuDS Manual CIRIA C753. It also indicates what could and could not be incorporated within the development, based upon site-specific criteria.

Device	Description	Constraints / Comments	Appropriate
Living roofs (source control)	Provide soft landscaping at roof level which reduces surface water runoff.	Proposed for bin and cycle stores.	Yes
Infiltration devices & Soakaways (source control)	Store runoff and allow water to percolate into the ground via natural infiltration.	The underlying geology is Lambeth Group Clay with historic borehole data showing firm to stiff clay to 30mbgl. Geology not considered suitable for infiltration.	No
Pervious surfaces (source control)	Storm water is allowed to infiltrate through the surface into a storage layer, from which it can either infiltrate and/or slowly release to sewers.	Lined permeable paving is proposed for all suitable external hardstanding areas.	Yes

Rainwater harvesting (source control)	Reduces the annual average rate of runoff from the Site by reusing water for non-potable uses e.g. toilet flushing, recycling processes.	Rainwater harvesting proposed for new-build single dwelling and converted outbuilding to single dwelling. Not proposed for flatted development in converted public house.	Yes
Swales (permeable conveyance)	Broad shallow channels that convey / store runoff, and allow infiltration (ground conditions permitting).	No suitable location onsite	No
Filter drains & perforated pipes (permeable conveyance)	Trenches filled with granular materials (to take flows from adjacent impermeable areas) that convey runoff while allowing infiltration.	Infiltration is not viable	No
Filter Strips (permeable conveyance)	Wide gently sloping areas of grass or dense vegetation that remove pollutants from run-off from adjacent areas.	Infiltration is not viable	No
Infiltration basins (end of pipe treatment)	Depressions in the surface designed to store runoff and allow infiltration.	Infiltration is not viable	No
Wet ponds & constructed wetlands (end of pipe treatment)	Provide water quality treatment & temporary storage above the permanent water level.	Brownfield site with spatial constraints.	No
Attenuation Underground (end of pipe treatment)	Oversized pipes or geo-cellular tanks designed to store water below ground level.	Due to spatial constraints on this brownfield site, it is necessary to utilize a geocellular attenuation device.	Yes
Raingardens	Rain gardens are relatively small depressions in the ground that can act as infiltration points for roof water and other 'clean' surface water.	Raingarden Planter proposed for flatted development	Yes

Table 5.1 Site Specific SuDS

Consideration of SuDS Hierarchy

5.4 The site is brownfield comprising a public house, outbuilding and associated parking area. Currently, surface water runoff from the site outfalls unrestricted and untreated to the nearby adopted foul and surface water sewers. Review of the underlying geology and Historic Borehole logs determine that the site is underlain by layers of firm to stiff clay. It is clear that infiltration is not viable. There are no watercourses in the vicinity which could offer a suitable outfall.

5.5 Taking the above into consideration, it is proposed to utilise SuDS Features to attenuate surface water runoff from the proposed development and outfall at a restricted rate to the adopted surface water sewer network.

5.6 The proposed surface water drainage strategy will provide a significant betterment to the existing situation whilst restricting runoff to as close to greenfield runoff rates as is practicable.

5.7 The existing adopted surface water drainage network is shallow, however. The sewer in St Albans Road is approximately 800mm below ground level and the adopted surface water sewers to the west of Blanche Lane are also shallow, at around 1.0m deep. In order to outfall to the closest sewer in St Albans Road, it will therefore be necessary to pump surface water flows from the site to a demarcation chamber with a gravity connection to the adopted surface water sewer.

5.8 Thames Water have been consulted under a pre-development enquiry to check the capacity of the surface water sewer in St Albans Road to accept a restricted outfall from the proposed development. Their response is contained in **Appendix G** and confirms a maximum outfall rate of 3.5 l/s to manage all storms up to and including the 1:100yr + 40% Climate Change Event is acceptable. It should be noted that 3.5 l/s is the equivalent of 20% of the existing 1:2yr outfall rate from the site that is directed to surface water sewers. A further review of existing outfall rates is discussed below. The response also confirms that foul water capacity exists for the proposed development, including acceptance that some existing roof area will continue to drain to the adopted foul network.

Surface Water Drainage Design Parameters

5.9 Climate Change Allowance – The 2070s 'Upper End' Climate Change for Colne Management Catchment peak rainfall allowance is 40% and shall be applied to the hydraulic drainage network design.

5.10 Storm Events - The Hydraulic Model shall be run for a 1:2yr Storm Event, 1:30yr Storm Event, 1:30yr + 40% Climate Change Event, 1:100yr Storm Event and 1:100yr + 40% Climate Change Storm Event.

5.11 Rainfall Data – FEH2022 Rainfall Data has been used in this assessment.

5.12 CV (Coefficient of volumetric run-off) – The CV Value for Winter and Summer Storms has been set to 1.0 to represent 100% of runoff from impermeable areas entering the proposed drainage system. A robust approach.

5.13 Time of Entry – a standard 5min time of entry is used. Surface water runoff from green roof areas has been modelled with a Time-Step.

5.14 Pre-and Post Runoff Rates – Non-Statutory Technical Guidance Policy S3 States: "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 site is Brownfield. Due to site constraints, a maximum outfall rate of 3.5 l/s is necessary to prevent pump failure, increased maintenance costs and reduce the electricity demand. Lower outfall rates increase the risk of pump failure and also require pumps to run for longer time periods during and after storm events. It is usually recommended by manufacturers that a minimum pump rate of 3.5 l/s is used. It should be noted – 3.5 l/s is the equivalent of 20% of the existing unrestricted surface water outfall rate (directed to the adopted surface water sewer) from the site in a 1:2yr storm event. This proposed outfall rate is therefore considered to be suitable for this brownfield development and in line with Policy S3 as the rate of discharge is significantly lower than the existing.

5.15 Pre and Post Discharge Volumes and Long Term Storage – Non-Statutory Technical Guidance Policy S5 States: "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." This is discussed below.

5.16 Half-Drain Time – In line with Hertfordshire's LLFA Guidelines, unlined storage devices should drain within 24hrs (1440mins), lined devices (tanks and lined ponds, lined permeable paving) to half-drain within 48hrs (2880mins). If this is not achieved, the storage device shall be sized to accommodate a further 1:30yr + 40% Climate Change Storm Event.

5.17 Consent for Outfall – An agreement in principle is being sought from Thames Water for the proposed maximum 3.5 l/s to manage all storms up to and including the 1:100yr + 40% Climate Change Event. 3.5 l/s is the equivalent of 20% of the existing unrestricted surface water runoff from the development site that enters the adopted surface water sewers in a 1:2yr Storm Event (17.9l/s).

5.18 Exceedance Routes – Exceedance routes shall be demonstrated.

5.19 Urban Creep – Has not been applied for this scheme – the proposals are for extension and conversion of existing public house to flats and conversion of existing outhouse to a single dwelling and provision of one new-build single dwelling.

5.20 Temporary Drainage Measures during Construction - A high-level assessment of how water quantity and water quality will be managed during the construction phase is required. Identifying high level assumptions such as need to discharge to a sewer or watercourse will appropriate pollution measures. This shall be discussed.

Pre-Development Runoff Rates and Discharge Volumes

5.21 The site currently comprises 1321m² of impermeable area. Surface water runoff from the site outfalls unrestricted and untreated to the Thames Water foul and surface water sewers in

Blanche Lane and St Albans Road. The topographical survey has been interrogated to ascertain which impermeable areas drain to the adopted foul water sewer and which areas drain to the adopted surface water sewer. SK02-SUDS in **Appendix H** shows the existing impermeable areas.

5.22 In order to calculate the existing runoff rates, a 'dummy' existing drainage network, based on information from the topographical survey, has been modelled for a range of storm events using Causeway Flow. The runoff rates results are contained in **Appendix I** and include the brownfield runoff volume for a 1:100yr 360min Storm Event**.** The results are summarised below:

Storm Events	Pre-development runoff rate for 288m2 impermeable area draining to adopted Foul Water Sewer (l/s)	Pre-development runoff rate for 1033m2 impermeable area draining to adopted Surface Water Sewer (l/s)	**Total Pre-Development Surface Water Outfall Rate**
1 in 2 year	4.9	17.6	**22.5**
1 in 30 year	9.7	39.4	**49.1**
1 in 100 year	11.3	43.0	**54.3**

Table 5.2 – Pre-Development Runoff Rates

Storm Events	Pre-development runoff Volume for 288m2 impermeable area draining to adopted Foul Water Sewer	Pre-development runoff Volume for 1033m2 impermeable area draining to adopted Surface Water Sewer	**Total Pre-Development Runoff Volume**
1 in 100yr 360min Storm	19.9 m^3	70.4 m^3	**90.3 m^3**

Table 5.3 – Pre-Development Discharge Volumes

Post Development Runoff Rate

5.23 The proposals seek to restrict surface water runoff from the site to as much as is practicable. As described above, the site is brownfield and currently outfalls unrestricted and untreated to both adopted foul and surface water sewers.

5.24 For a small area of existing roof (which is to remain) it is not possible to redirect runoff to a new private surface water drainage system and as such, this roof area of 42m^2 and its down-pipes shall be retained and will drain as per the existing situation. It should be noted that all other existing impermeable and roof areas that currently drain to an adopted foul water sewer shall now be redirected into the proposed private surface water drainage system. This shall remove approximately 246m^2 of area that currently drains to the foul network, thus creating a significant betterment to the adopted foul sewer network and reducing the volume of water that would otherwise be directed to sewerage treatment works.

5.25 Due to site constraints, a maximum outfall rate of 3.5 l/s is necessary to prevent pump failure, increased maintenance costs and reduce the electricity demand. Lower outfall rates increase the risk of pump failure and also require pumps to run for longer time periods during and after storm events. It is usually recommended by manufacturers that a minimum pump rate of 3.5 l/s is used. It should be noted – 3.5 l/s is the equivalent of 20% of the existing unrestricted surface water outfall rate (directed to the adopted surface water sewer) from the site in a 1:2yr storm event (17.9 l/s). Thames Water have been contacted to undertake a capacity check, their response is awaited.

Proposed SuDS Strategy

5.26 As outlined in Table 5.1 above, a number of SuDS Features shall be utilised to form the Surface Water Drainage Strategy in order to meet the 4 Pillars of SuDS.

Water Quantity – Raingarden Planters and Rainwater Harvesting Butts;

Water Quality – Permeable Paving and Raingarden Planters;

Biodiversity – Raingarden Planters and Green Roofs;

Amenity – Raingarden Planters and Green Roofs

5.27 The proposed SuDS Layout is included in **Appendix J** and Causeway Flow Hydraulic Model Outputs are contained in **Appendix K**.

5.28 The proposed impermeable area is: 1127m², comprising roofs, car park, patios and footpaths. This does not include the 42m² of existing roof area which will continue to drain as per the existing situation due to site constraints.

5.29 It can be seen it is proposed to utilise a number of SuDS Attenuation Features to serve the development site. Raingarden Planters have been proposed for rainwater down pipes serving the former public house and the former outbuilding. Rainwater harvesting butts shall be provided for the new-build individual dwelling and the former outhouse (to be single dwelling) for garden use. Lined Permeable Paving shall collect surface water run-off in the car park area.

5.30 Surface water runoff from impermeable areas, via the SuDS Features where possible, will collect in a 'main' private surface water drainage network which outfalls to a Geocellular Attenuation Device via a Proprietary Klargester (or similar) Treatment Device. A surface water pump will restrict flows from the Geocellular Attenuation Device to a maximum 3.5 l/s, pumping flows to a Demarcation Chamber close to Thames Water manhole ref: 1252 in St Albans Road.

5.31 The Permeable Paving, Raingarden Planters, Green Roofs and Geocelluar Attenuation Device shall provide the required storage volumes for storms up to and including the 1 in 100 year + 40% Climate Change Event.

5.32 A Geocellular Storage Device is sized at 54.4m2 x 0.66m deep and allows for a 95% void ratio. Lined Permeable Paving, covering an area of 480m² shall have a minimum subbase of 327mm and allows for 30% void ratio. The results are contained in **Appendix K** show a maximum storage volume of 34.13m³ within the Geocellular Storage Device and a maximum storage volume of 51.32m³ in the Permeable Paving. The maximum outfall rate for the 1:100yr + 40% Climate Change Event is 3.5 l/s.

5.1 The hydraulic outputs in **Appendix K** show the half-drain down times for each proposed attenuation feature. The half-drain-time for the Geocellular Attenuation Device is 196 mins; the half-drain time for the Permeable Paving is 3900mins - well below the required 48hrs for lined features as per Hertfordshire Lead Local Authority requirements.

Long Term Storage

5.2 The site currently comprises 1321m² of impermeable area. Surface water runoff from the site outfalls unrestricted and untreated to the Thames Water foul and surface water sewers in Blanche Lane and St Albans Road. As shown in Table 5.3 above, the existing discharge volume in a 1:100yr 360min storm event has been calculated at: 90.3m³. As discussed above, 42m² of existing roof area shall continue to drain as per the existing situation due to site constraints. It is estimated that 2.9m³ (90.3/1321 x 42) of the discharge volume is attributed to this roof area. As such to compare a pre and post development discharge volume, 2.9³ should be subtracted from 90.3m³. The comparable pre-development discharge volume is therefore 87.4m³.

5.3 The post-development impermeable area is 1127m². It should be noted that some area of existing car park and hardstanding area is to be converted to garden space (permeable). The hydraulic outputs in **Appendix K** show the post-development discharge volume for a 1:100yr + 360min storm event is: 86.2m³.

5.4 The post-development discharge volume is lower than the pre-development volume and as such Long Term Storage is not required.

Exceedance Event

5.5 The proposed surface water drainage strategy is designed to accommodate a 1:100yr + 40% Climate Change Storm Event. In the unlikely event that an exceedance event occurs, any flood waters would flow in a westerly direction towards the unnamed watercourse to the west of Blanche Lane. An Exceedance Route Plan is included in **Appendix L**.

Surface Water Pump Alarm System

5.6 It is proposed to install a secondary back-up pump as well as a telemetry alarm system. The telemetry alarm system shall be linked to the elected Management Company to alert in case of pump failure. In the event of primary pump failure, the secondary pump shall manage flows until the primary pump is repaired or replaced. In the unlikely event that the secondary pump fails before the primary pump is repaired, the telemetry alarm system will alert the Maintenance Company who shall install a temporary pump. The surface water pump control panels shall be located within a kiosk close to the Geocellular Storage.

5.7 The risk of pump failure is low, however in the very unlikely event that primary, secondary and temporary pumps all fail, waters would follow the routes as shown on the Exceedance Plan in **Appendix L**.

Water Quality

5.8 The drainage system has been designed to meet the water quality requirements set out by Table 26.2 of the CIRIA SuDS Manual C753 which sets out the specific pollution hazard indices for residential roofs and low traffic roads in Table 5.4 below.

Land Use	Hazard Level	Pollution Hazard Indices		
		Suspended Solids	Metals	Hydrocarbons
Residential roofs	Very low	0.2	0.2	0.05
Individual property driveways and low traffic roads	Low	0.5	0.4	0.4
Pollution Mitigation Required		0.5	0.4	0.4

Table 5.4 Land Use Pollution Hazard Ratings. Extracted from the CIRIA SuDS Manual C753 Simple Index Approach Tool.

5.9 Table 5.4 demonstrates that the proposed SuDS strategy exceeds the required treatment stages. In addition to the permeable paving, the raingardens will also provide a treatment stage.

5.10 Relating to runoff from the Proposed Green Roofs: CIRIA 763 SuDS Manual Table 26.14 shows Residential Roofs have: Total Suspended Solids Pollution index of 0.4-0.5, Organic Pollution Index of 0.6-0.7, Hydrocarbon Pollution Index of 0.1 and Metals Pollution Index of 0.2-0.5. Table 26.15, SuDS mitigation indices, shows that Green Roofs alone provides mitigation for Total Suspended Solids Pollution at 0.8-0.9, Organic Pollution Index at 0.5, Hydrocarbon Pollution Index at 0.9 and Metals Pollution Index at 0.7-0.9. Surface water run-off from the green roof areas is more than sufficiently mitigated by use of the green roof itself.

5.11 Relating to runoff from 'standard' roofs: CIRIA 763 SuDS Manual Table 26.2 shows Residential Roofs have a Pollution Hazard Level of LOW. Runoff from 'standard' roofs shall be treated via a Raingarden Planters prior to outfall to the permeable paving subbase. Raingarden Planters shall be assessed as Green-Roofs as the engineered soils are comparable to those used in green-roofs. Table 26.2 shows Residential Roofs have TSS of 0.2 Metals 0.2 and Hydrocarbons 0.05. Table 26.15, SuDS mitigation indices, shows that Green Roofs provide mitigation for Total Suspended Solids Pollution at 0.8-0.9, Organic Pollution Index at 0.5, Hydrocarbon Pollution Index at 0.9 and Metals Pollution Index at 0.7-0.9. Surface water run-off from the green roof areas is more than sufficiently mitigated by use of Raingarden Planters. In any rate it should be noted that waters would be cleansed by the permeable paving subbase, then treated by a proprietary treatment device prior to outfall to the adopted surface water network.

5.12 Relating to runoff from trafficked areas: CIRIA 763 SuDS Manual Table 26.2 shows Low-Traffic Roads have a Pollution Hazard Level of LOW. All low-traffic roads in this catchment are anticipated to comprise lined permeable paving construction with outfall directed to the adopted sewer via the geo-cellular attenuation device. Table 26.2 shows Low-Traffic Roads have TSS of 0.5 Metals, 0.4 and Hydrocarbons 0.4. Table 26.3, SuDS mitigation indices for discharges to surface waters, shows that Permeable Paving alone provides mitigation for TSS at 0.7; Metals at 0.6 and Hydrocarbons at 0.7. Surface water run-off from low-traffic-road areas is more than sufficiently mitigated by use of Permeable Paving.

5.13 Relating to runoff from other hardstanding areas which drain directly to the 'main' surface water drainage system via gullies or channel drains: These areas shall be assessed as Low-Trafficked Roads: CIRIA 763 SuDS Manual Table 26.2 shows Low-Trafficked Roads have a Pollution Hazard Level of LOW. Table 26.2 shows Low-Traffic Roads have TSS of 0.5 Metals, 0.4 and Hydrocarbons 0.4. The 'main' surface water drainage system shall be treated via a Hydro-International Downstream Defender (Advanced Vortex) proprietary treatment system. Hydro-International have provided a specification sheet showing that this device can achieve mitigation for TSS at 0.5; Metals at 0.4 and Hydrocarbons at 0.5. Surface water run-off from these areas is therefore more than sufficiently mitigated by use of the Downstream Defender (Advanced Vortex). Details of the Downstream Defender is contained in **Appendix M** as well as advice from Hydro-International on sizing Downstream Defenders.

5.14 The surface water drainage strategy provides the necessary levels of treatment for the proposed site use.

6 Maintenance of the Proposed Drainage System

6.1 The maintenance of the SuDS features will remain private and the responsibility of the site owner via an appointed management and maintenance company. The site owner/appointed management company will be responsible for maintaining all surface water drainage and SuDS features, even those serving the two individual dwellings.

6.2 Regular inspections and maintenance should be carried out for each of these elements, particularly after periods of heavy rainfall. Maintenance tasks and frequencies for permeable paving and filter drain are detailed in the CIRIA SUDS Manual (C753) and have been summarised below in Tables 6.1 to 6.3 below.

Geocellular Attenuation Device Maintenance Activities

Maintenance Schedule	Required Action	Frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months, then annually.
	Remove debris from the catchment surface (where if may cause risks to performance).	Monthly
	Remove sediment from pre-treatment structures and/or internal forebays.	Annually or as required.
Remedial actions	Repair/rehabilitate inlets, outlet, overflows and vents.	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed.	Annually
	Survey inside of tank/crate system for sediment build-up and remove if necessary.	Every 5 years or as required.

Table 6.1: Maintenance tasks for cellular storage tank (Source: CIRIA C753, The SUDS Manual)

Permeable Paving Maintenance Activities

Maintenance Schedule	Required Action	Frequency
Regular maintenance	Brushing and vacuuming.	Three times per year at end of winter, mid-summer, after autumn leaf fall, or as required based on site specific observations of clogging or manufacturer's recommendations.
Occasional maintenance	Stabilise and mow contributing and adjacent areas. Removal of weeds.	As required. As required.
Remedial actions	Remediate any landscaping which, through vegetation maintenance of soil slip, has been raised to within 50mm of the level of the paving. Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance of a hazard to the user. Rehabilitation of surface and upper sub-surface.	As required As required As required (if infiltration performance is reduced as a result of significant clogging.)
Monitoring	Initial inspection Inspect for evidence of poor operation and/or weed growth. If required, take remedial action. Inspect silt accumulation rates and establish appropriate brushing frequencies. Monitor inspection chambers.	Monthly for 3 months after installation. 3 monthly, 48 hours after large storms. Annually. Annually.

Table 6.2 Maintenance tasks for permeable paving (Source: CIRIA C753, The SUDS Manual)

Raingarden Planters Maintenance Activities

Maintenance Schedule	Required Action	Frequency
Regular Inspections	Inspect infiltration surfaces for silting and ponding, record de-watering time of the facility and assess standing water levels in underdrain (if appropriate) to determine if maintenance is necessary	Quarterly
	Check operation of underdrains by inspection of flows after rain	Annually
	Assess plants for disease infection, poor growth, invasive species etc and replace as necessary	Quarterly
	Inspect inlets and outlets for blockage	Quarterly
Regular Maintenance	Remove litter and surface debris and weeds	Quarterly
	Replace any plants, to maintain planting density	As required
	Remove sediment, littler and debris build up from around inlets or from forebays	Quarterly to biannually
Occasional Maintenance	Infill and holes or scour in the filter medium, improve erosion protection if required	As required
	Repair minor accumulations of silt by raking away surface mulch, scarifying surface of medium and replacing mulch	As required
Remedial actions	Remove and replace filter medium and vegetation above	As required but likely to be >20 years

Table 6.3 Operation and maintenance tasks for bioretention systems (Source: CIRIA C753, The SUDS Manual)

General Maintenance

6.3 It is recommended that during the first 12 months of operation all SuDS and drainage features are visually inspected on a monthly basis to determine any seasonal patterns this includes all SuDS features, inspection chambers, inlets and outlets. This will determine whether or not the recommended service intervals set out by CIRIA in the figures above will be sufficient for maintenance beyond the first year.

6.4 After the first 12 months, the maintenance schedule should be designed to at least meet the requirements set out by CIRIA based on the outcome of the monitoring.

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Manholes, Sewers and Inspection Chambers - Maintenance

6.5 All inspection chambers and manholes, including the orifice plate/hydrobrake chambers, should be inspected on a bi-annual basis with further visual checks carried out throughout the year, such as in November after the heaviest leaf-fall has occurred.

6.6 Should a blockage occur at any time, it is advised to seek professional help to jet the drainage system to clean and clear the system.

Gutters and Downpipes - Maintenance

6.7 It is good practice to ensure that these are occasionally inspected to ensure they are in good order and free of leaves & debris. Once every 6 months should be sufficient.

Surface Water Pumps – Pump Failure Alarm System - Maintenance

6.8 It is recommended that the surface water primary and secondary pumps are tested every 3 months and to manufacturers guidelines. The telemetry alarm system should also be tested to ensure notifications and warnings are received by the Management Company accordingly. Most manufacturers will offer a maintenance service to ensure the pumps and telemetry alarm systems are functioning correctly and effectively. Kiosks containing control panels should be checked for damage and replaced as necessary.

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7 Conclusion

7.1 This FRA and SuDS Report has been prepared in support of a planning application at The White Hart, St Albans Road, South Mimms, EN6 3PJ. The site location plan is included in Appendix A.

7.2 The proposals are for: "*Conversion and extension of the former public house into six apartments, conversion of outbuilding into a two-bedroom apartment and construction of a detached infill dwelling, along with associated landscaping, bin store, cycle storage and vehicle parking*." The proposed development plans are in Appendix B.

7.3 The site is located in Flood Zone 1 of the Flood Map for Planning and is at very low risk of surface water flooding. The site is considered to be at low to very low risk of flooding from all identified sources and no specific mitigation measures are considered necessary.

Surface Water Drainage Strategy Summary

7.4 The site is brownfield comprising a public house, outbuilding and associated parking area. Currently, surface water runoff from the site outfalls unrestricted and untreated to the nearby adopted foul and surface water sewers at a rate of 54.3 l/s in a 1:100yr storm event with an pre-development discharge volume of 87.4m^3.

7.5 Review of the underlying geology and Historic Borehole logs determine that the site is underlain by layers of firm to stiff clay. It is clear that infiltration is not viable. There are no watercourses in the vicinity which could offer a suitable outfall.

7.6 Taking the above into consideration, there are no other viable options than to utilise SuDS Features to attenuate surface water runoff from the proposed development and outfall at a restricted rate to the adopted surface water sewer network. The existing adopted surface water drainage network is shallow, however. The sewer in St Albans Road is approximately 800mm below ground level and the adopted surface water sewers to the west of Blanche Lane are also shallow, at around 1.0m deep. In order to outfall to the closest sewer in St Albans Road, it will therefore be necessary to pump surface water flows from the site to a demarcation chamber with a gravity connection to the adopted surface water sewer.

7.7 SuDS Features have been included where it is possible and these include: Permeable Paving, Green Roofs, Raingarden Planters, Rainwater Harvesting Butts and a Geocellular Attenuation Device.

7.8 Surface water runoff from the site is restricted to a maximum 3.5 l/s to manage all storms up to and including the 1:100yr + 40% Climate Change Event. This flow rate has been agreed in principle with Thames Water and represents 20% of the Brownfield 1:2yr Runoff Rate. The proposals reduce the impermeable area which currently drains to the adopted foul network, by 246m^2, thus creating a significant betterment by reducing the volume of water that would otherwise be directed to sewerage treatment works.

7.9 Water Quality meeting CIRIA SuDS Manual Guidance has been considered and all surface water runoff from the site is suitably treated in line with the Guidance.

7.10 It is proposed that the maintenance of all features of the surface water drainage system within the proposed development will be the responsibility of the site owner and their appointed management company.

Conclusion

7.11 There are no identified Flood Risks which require mitigation. The proposed surface water drainage strategy follows the SuDS Hierarchy and utilises SuDS Features wherever possible. The proposals do not increase flood risk on or off site.

7.12 It is concluded there are no reasons on flood risk or surface water drainage grounds as to why permission should not be granted.

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8 Appendices

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK
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Appendix: A – Location Plan

Appendix: B – Proposed Development Plans

NOTES:

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This drawing is to be read together with the specification and related drawings.

REVISIONS:

Rev:	By:	Check:	Date:	Description:

PLANNING

Project:
The White Hart Pub,
St Albans Road, South Mimms,
Herts, EN6 3PJ.

Title:
Site Plan (Ground Floor Layout)

Drawn:	Checked:	Date:	Scale:	Size:
KAT		Sept 2023	1:200	A1

Project No:	Drawing No:	Revision:
1563	PL020	-

GRIGGS
EST. 1868

Appendix: C – Flood Map for Planning

Environment Agency

Flood map for planning

Your reference	Location (easting/northing)	Created
<Unspecified>	**522213/201253**	**26 Sep 2023 12:04**

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

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

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

Notes

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

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

Environment Agency

Flood map for planning

Your reference
<Unspecified>

Location (easting/northing)
522213/201253

Scale
1:2500

Created
26 Sep 2023 12:04

Selected area

Flood zone 3

Flood zone 2

Flood zone 1

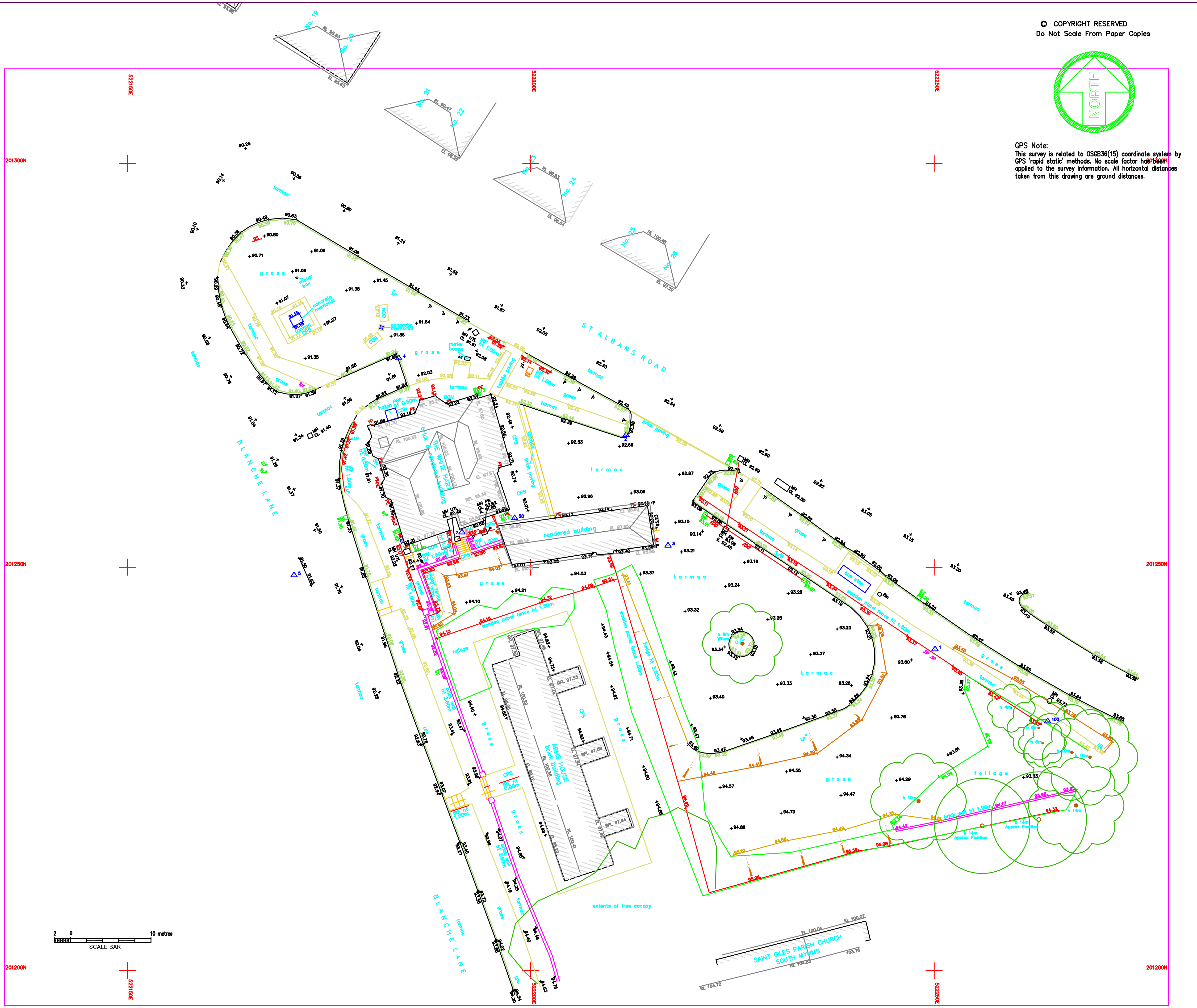
Flood defence

Main river

Water storage area

0 20 40 60m

Appendix: D – Topographical Survey



GPS Note:
This survey is related to OSGB36(15) coordinate system by GPS 'rapid static' methods. No scale factor has been applied to the survey information. All horizontal distances taken from this drawing are ground distances.

Co-ordinate Table

Station	Easting	Northing	Level
1	522250.112	201239.828	93.418
2	522211.825	201266.373	92.668
3	522217.019	201252.680	93.249
4	522183.637	201275.877	91.995
5	522170.658	201248.992	91.713
7	522191.481	201254.310	92.513
20	522198.002	201256.068	92.980
100	522264.079	201230.901	93.449

All levels related to Ordnance Survey active GPS network, at survey station 1.

DISCLAIMERS

Every effort has been made to confirm tree species on site, yet it is advised to confirm these details with an arborist before proceeding with any design.

Every effort has been made to confirm drainage run, type and size on site, yet it is advised to check these details against statutory authority records before proceeding with any design.

KEY

Survey control station 5
Banking
Gate (single)
Foliage Line
Gate (double)
Drainage run, direction of flow and pipe size 100
Tree Spread and Girth shown to scale
Approximate Position

ABBREVIATIONS

Air Handling Unit	AHU	Water Meter	WM
Belisha Beacon	BB	Eaves Level	EL
Bollard	BD	Ridge Level	RL
Borehole	BH	Roof Level	RFL
BT Inspection Cover	BT	Soffit Level	SFL
Cable Television Cover	CTV	Threshold Level	THL
Drainage Channel	DC	Parapet Wall Level	PWL
Electricity Cover	EC	Finished Floor Level	FFL
Electricity Pole	EP	Head Level	HL
Earth Rod	ER	Sill Level	SL
Fire Hydrant	FH	Cover Level	CL
Gas Valve	GV	Invert Level	IL
Gate Post	GP	No Visible Pipes	NVP
Gully	GY	Unable to Lift	UTL
Inspection Cover	IC	Foul Water	FW
Junction Box	JB	Sump Level	SUL
Kerb Outlet	KO	Surface Water	SW
Lamp Post	LP	Brick Paviors	BP
Manhole	MH	Concrete	CON
Marker Post	MK	Concrete Paving Slabs	CPS
Post	P	Flower Bed	F\B
Pipe	PE	Shrub Bed	S\B
Road Sign	RS	Tactile Paving	TAC
Rodding Eye	RE	Unsurfaced	U\S
Marker Post	MK	Brick Wall	BW
Sign Post	SP	Retaining Wall	RW
Stop Valve	SV	Chainlink Fence	CLF
Stop Tap	ST	Chestnut Paling Fence	CPF
Telegraph Pole	TP	Iron Railing Fence	IRF
Traffic Light	TL	Metal Security Fence	MSF
Vent Pipe	VP	Post and Chain Fence	PCF
Post and Rail Fence	PRF	Post and Wire Fence	PWF
Wooden Panel Fence	WPF		

Client
GRIGGS HOMES

Project
WHITE HART,
SOUTH MIMMS,
EN6 3PJ

Title
TOPOGRAPHICAL SURVEY

Drawing Number
TS21-509-1

Revision	Description	Date
A	Topographical survey extended along front of neighboring properties.	Sept 2021

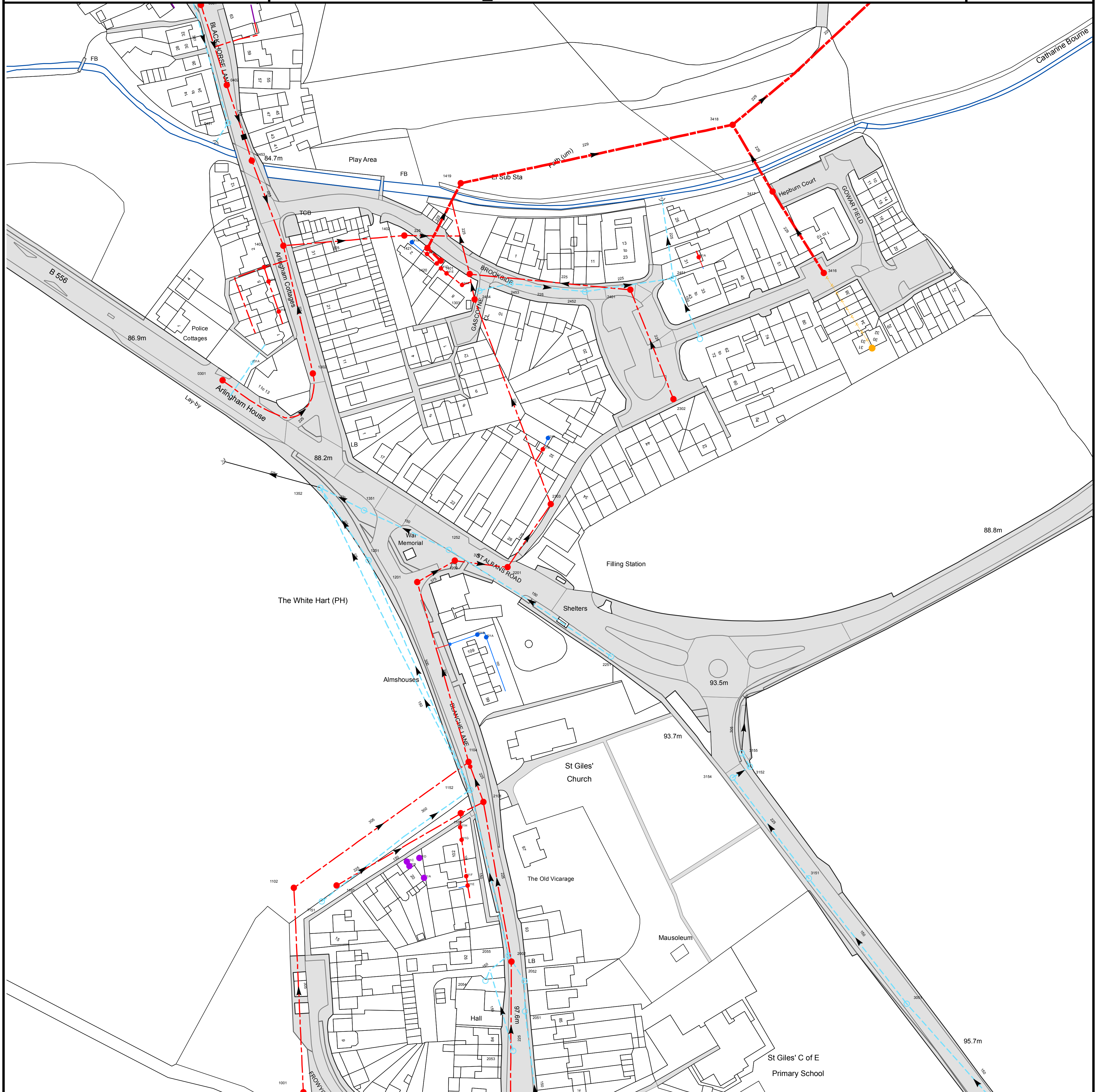
Scale 1:200@A1 — Sheet 1 of 1

Drawn by	Checked by	Date of Survey
MA	PG	JUNE 2021

terrain surveys
Tel: 01438 841300
enquiries@terrainsurveys.co.uk
www.terrainsurveys.co.uk

Appendix: E – Thames Water Asset Location Plan

Asset Location Search Sewer Map - ALS/ALS Standard/2023_4889656



The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 522236,201284

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
111E	n/a	n/a
111F	n/a	n/a
111G	n/a	n/a
111H	n/a	n/a
1103	97.5	95.7
341A	n/a	n/a
231A	n/a	n/a
0301	87.32	85.55
1302	86.58	84.2
031A	n/a	n/a
131B	n/a	n/a
1303	n/a	85.51
2454	86.17	85.33
131A	n/a	n/a
2453	86.2	85.01
141G	n/a	n/a
1401	85.97	83.41
141E	n/a	n/a
141D	n/a	n/a
141F	n/a	n/a
141C	n/a	n/a
1420	85.1	83
141B	n/a	n/a
1421	84.9	81.94
1403	84.88	83.38
141A	n/a	n/a
1402	85.61	83.14
1419	84.24	81.8
0453	87.87	86.49
0451	84.79	83.72
0402	84.54	83.65
0501	84.78	83.7
2051	97.9	96.99
2052	97.88	96.66
2054	98.17	97.41
2002	n/a	n/a
2055	97.75	96.63
1151	98.26	97.21
1102	97.57	92.31
1101	98.22	96.63
111A	n/a	n/a
111B	n/a	n/a
111C	n/a	n/a
111D	n/a	n/a
2101	95.95	93.7
1152	96.12	95.14
1104	95.41	91.7
221A	n/a	n/a
221B	n/a	n/a
1201	91.69	90.65
2201	92.78	90.46
1202	92.1	90.51
1251	91.02	90.46
1252	92	91.22
1351	89.81	88.81
2303	91.74	90.16
1352	89.5	87.95
231B	n/a	n/a
2452	86.68	84.7
2251	n/a	n/a
2401	86.52	83.83
2451	86.26	84.2
2302	89.03	86.89
331A	n/a	n/a
3418	84.23	81.4
3154	94.17	92.19
3155	93.95	91.89
3152	n/a	92
3417	85.49	81.54
3151	94.76	93.8
3416	89.49	87.55
3051	95.6	94.64
1001	99.3	92.81
2053	98	97.36

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.

Asset Location Search - Sewer Key

Public Sewer Types (Operated and maintained by Thames Water)

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

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

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

- Storm Sewer
- Sludge Sewer
- Foul Trunk Sewer
- Surface Trunk Sewer
- Combined Trunk Sewer
- Foul Rising Main
- Surface Water Rising Main
- Combined Rising Main
- Vacuum
- Thames Water Proposed
- Vent Pipe
- Gallery

Other Sewer Types (Not operated and maintained by Thames Water)

- Sewer
- Culverted Watercourse
- Proposed
- Decommissioned Sewer
- Content of this drainage network is currently unknown
- Ownership of this drainage network is currently unknown

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
- Meter
- Dam Chase
- Vent
- Fitting

Operational Controls

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

- Ancillary
- Drop Pipe
- Control Valve
- 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.

- Inlet
- Outfall
- Undefined End

Other Symbols

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

- Change of Characteristic Indicator
- Public / Private Pumping Station
- Invert Level
- Summit

Areas

Lines denoting areas of underground surveys, etc.

- Agreement
- Chamber
- Operational Site

Ducts or Crossings

- Casement
- Conduit Bridge
- Subway
- Tunnel

Ducts may contain high voltage cables. Please check with Thames Water.

Notes:
1) All levels associated with the plans are to Ordnance Datum Newlyn.
2) All measurements on the plan are metric.
3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate the 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 indicates that data is unavailable.
6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in millimeters.
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, please contact Property Searches on 0800 009 4540.

Appendix F – Surface Water Flood Maps

1st Floor Millers House, Roydon Road, Stanstead Abbotts, SG12 8HN. Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk

Flood risk

High risk: depth

Location

en6 3pj

Surface water flood risk: water depth in a high risk scenario

Flood depth (millimetres)

Over 900mm · 300 to 900mm · Below 300mm · Location you selected

Flood risk

Medium risk: depth

Location

en6 3pj

Surface water flood risk: water depth in a medium risk scenario

Flood depth (millimetres)

Over 900mm 300 to 900mm Below 300mm Location you selected

Flood risk

Low risk: depth

Location

en6 3pj

Surface water flood risk: water depth in a low risk scenario

Flood depth (millimetres)

Over 900mm · 300 to 900mm · Below 300mm · Location you selected

Appendix G – Thames Water Pre-Development Enquiry

Mrs Marianna Dyason

EAS
1st Floor Millers House
Roydon Road
Stanstead Abbotts
SG12 8HN

Wastewater pre-planning
Our ref DS6108711

26 October 2023

Pre-planning enquiry: Confirmation of sufficient capacity

Site: THE WHITE HART PH, ST ALBANS RODE, SOUTH MIMMS EN6 3PJ

Dear Mrs Dyason,

Thank you for providing information on your development.

Proposed site: Conversion & extension of existing public house plus 1 no. new build to provide a total of 2 houses and 6 flats

Proposed foul water: To discharge by gravity to 300mm foul sewer, manhole 1202.

Proposed surface water (1148m2): To discharge by pumped flow at 3.5 l/s to manhole 1252. (42m2 of roof area to remain unchanged, discharging to 300mm foul sewer)

We have completed the assessment of the foul water flows and surface water run-off based on the information submitted in your application with the purpose of assessing sewerage capacity within the existing Thames Water sewer network.

Foul Water

Thames Water recognises this catchment is subject to high infiltration flows during certain groundwater conditions. The scale of the proposed development doesn't materially affect the sewer network and as such we have no objection, however care needs to be taken when designing new networks to ensure they don't surcharge and cause flooding. In the longer term Thames Water, along with other partners, are working on a strategy to reduce groundwater entering the sewer networks.

If your proposals progress in line with the details you've provided, we're pleased to confirm that there will be sufficient sewerage capacity in the adjacent foul water sewer network to serve your development.
This confirmation is valid for 12 months or for the life of any planning approval that this information is used to support, to a maximum of three years.

You'll need to keep us informed of any changes to your design – for example, an increase in the number or density of homes. Such changes could mean there is no longer sufficient capacity.

Surface Water

Thames Water recognises this catchment is subject to high infiltration flows during certain groundwater conditions. The developer should liaise with the LLFA to agree an appropriate sustainable surface water strategy following the sequential approach before considering connection to the public sewer network. The scale of the proposed development doesn't materially affect the sewer network and as such we have no objection, however care needs to be taken when designing new networks to ensure they don't surcharge and cause flooding. In the longer term Thames Water, along with other partners, are working on a strategy to reduce groundwater entering the sewer network.

In accordance with the Building Act 2000 Clause H3.3, positive connection of surface water to a public sewer will only be consented when it can be demonstrated that the hierarchy of disposal methods have been examined and proven to be impracticable.
Where connection to the public sewerage network is still required to manage surface water flows, we will accept these flows at a discharge rate in line with CIRIA's best practice guide on SuDS or that stated within the sites planning approval.

If the above surface water hierarchy has been followed and if the flows are restricted to 3.5 l/s total of for all storms up to and including 1:100+40%CC; as described above, then Thames Water would not have any objections to the proposal.

Please see the attached 'Planning your wastewater' leaflet for additional information.

Diversion

Where there are any existing public sewers crossing the site, new buildings will need to be kept between 3 and 6.5m away from existing sewer depending on the size and depth of the sewer. Alternatively, it may be possible for sewers to be diverted around the new development. If you wish us to review a diversion proposal, please submit this via a Section 185 Diversion application. On some occasions it may be possible to abandon existing public sewers. Please contact us for further information on this process.

Source Protection Zone

The development site boundary falls within two Source Protection Zones for groundwater abstraction. These zones may be at particular risk from polluting activities on or below the land surface. To prevent pollution, the Environment Agency and Thames Water (or other local water undertaker) will use a tiered, risk-based approach to regulate activities that may impact groundwater resources, this may potentially affect your drainage or surface water strategies where deep or infiltration systems are proposed. The applicant is encouraged to read the Environment Agency's approach to groundwater protection (available at *https://www.gov.uk/government/publications/groundwater-protection-position-statements* and may wish to discuss the full implications for their development with a suitably qualified environmental consultant.

What happens next?

Please make sure you submit your connection application, giving us at least 21 days' notice of the date you wish to make your new connection/s.

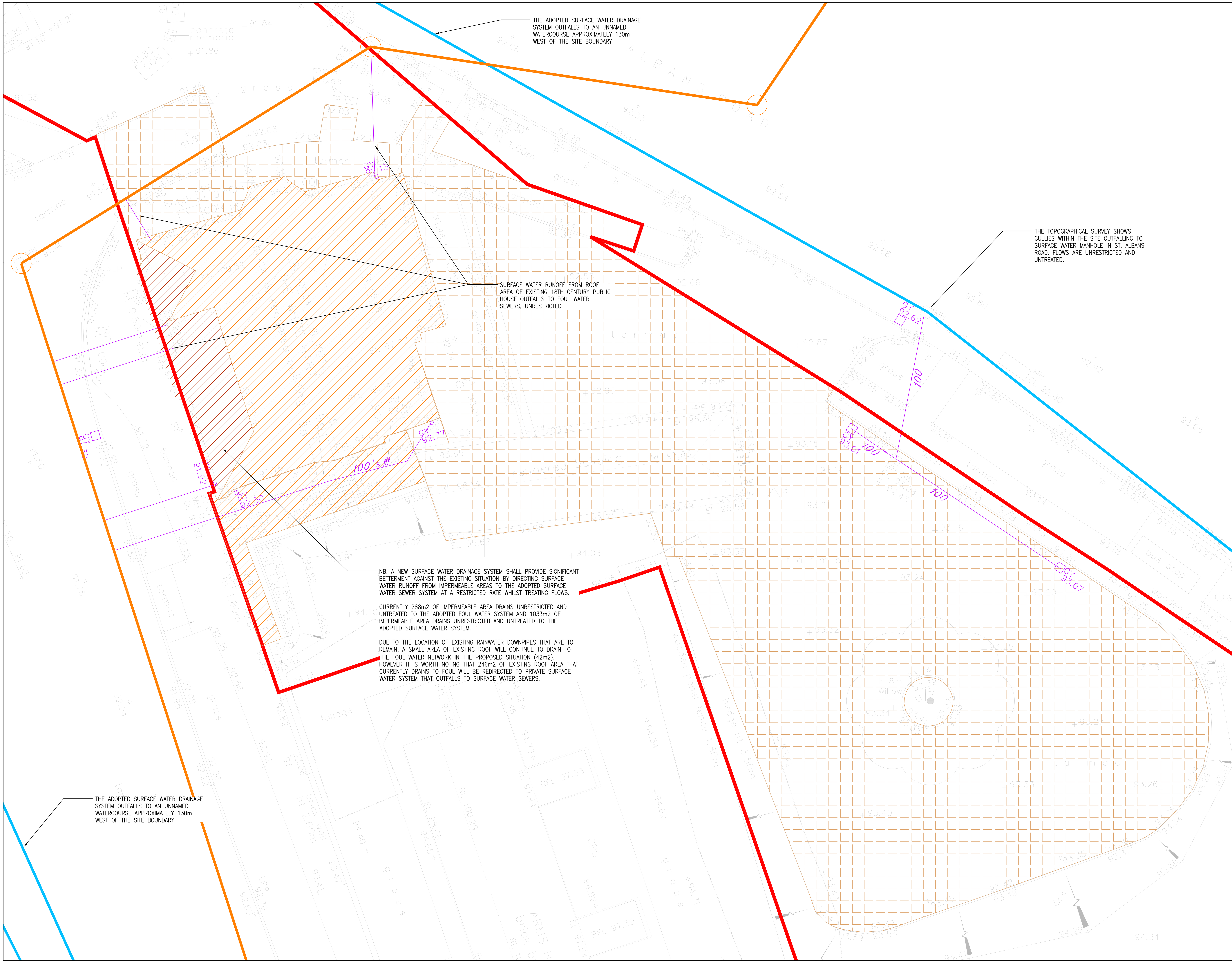
If you have any further questions, please contact me on 0800 009 3921.

Yours sincerely

James Kitching
Development Engineer
Developer Services – Sewer Adoptions Team

Get advice on making your sewer connection correctly at connectright.org.uk
Clearwater Court, Vastern Road, Reading, RG1 8DB
Find us online at developers.thameswater.co.uk

Appendix H - Existing Impermeable Areas



KEY

- SITE BOUNDARY
- ADOPTED FOUL WATER SEWER
- ADOPTED SURFACE WATER SEWER
- EXISTING IMPERMEABLE AREA DRAINING TO ADOPTED FOUL WATER SYSTEM UNRESTRICTED AND UNTREATED – TOTAL: 288m2
- EXISTING IMPERMEABLE AREA DRAINING TO ADOPTED SURFACE WATER SYSTEM UNRESTRICTED AND UNTREATED – TOTAL: 1033m2

REV	DATE	BY	DESCRIPTION	CHK	APD

DRAWING STATUS: PLANNING APPLICATION

1st Floor Millers House, Roydon Road, Stanstead Abbotts, Hertfordshire, SG12 8HN
Tel: 01920 871777
www.eastp.co.uk

CLIENT: GRIGGS (SOUTH MIMMS) LIMITED

ARCHITECT:

PROJECT: THE WHITE HART, SOUTH MIMMS, HERTSMERE

TITLE: EXISTING IMPERMEABLE AREAS

SCALE @ A1:	DESIGN–DRAWN:	DATE:
1:100	MD	29.09.2023

PROJECT No: 3991

DRAWING No: SK02–SUDS

Appendix I – Pre-Development Runoff Rates and Volumes

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	x
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
EX1F	0.014	5.00	93.160	600	-12.871	61.695	1.710
EX2F	0.015	5.00	93.160	600	24.757	62.034	2.180
OUTFALL F			93.160	1200	60.690	62.034	2.629

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	EX1F	EX2F	37.630	0.600	91.450	90.980	0.470	80.0	100	5.73	50.0
1.001	EX2F	OUTFALL F	35.933	0.600	90.980	90.531	0.449	80.0	100	6.42	50.0

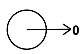
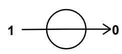
Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.861	6.8	2.5	1.610	2.080	0.014	0.0	43	0.801
1.001	0.861	6.8	5.2	2.080	2.529	0.029	0.0	66	0.950

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	37.630	80.0	100	Circular	93.160	91.450	1.610	93.160	90.980	2.080
1.001	35.933	80.0	100	Circular	93.160	90.980	2.080	93.160	90.531	2.529

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	EX1F	600	Manhole	Adoptable	EX2F	600	Manhole	Adoptable
1.001	EX2F	600	Manhole	Adoptable	OUTFALL F	1200	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
EX1F	-12.871	61.695	93.160	1.710	600					
							0	1.000	91.450	100
EX2F	24.757	62.034	93.160	2.180	600		1	1.000	90.980	100
										
							0	1.001	90.980	100

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
OUTFALL F	60.690	62.034	93.160	2.629	1200	1	1.001	90.531	100

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Additional Storage (m^3/ha)	20.0
Summer CV	1.000	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	1.000	Drain Down Time (mins)	4880	Check Discharge Volume	x

Storm Durations

360

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

Results for 100 year 360 minute summer. 5240 minute analysis at 8 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
360 minute summer	EX1F	184	91.484	0.034	1.7	0.0152	0.0000	OK
360 minute summer	EX2F	184	91.031	0.051	3.5	0.0216	0.0000	OK
360 minute summer	OUTFALL F	184	90.582	0.051	3.5	0.0000	0.0000	OK

Link Event	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
360 minute summer	EX1F	1.000	EX2F	1.7	0.529	0.250	0.1205	
360 minute summer	EX2F	1.001	OUTFALL F	3.5	0.861	0.511	0.1441	19.9

Results for 100 year 360 minute winter. 5240 minute analysis at 8 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
360 minute winter	EX1F	184	91.477	0.027	1.1	0.0122	0.0000	OK
360 minute winter	EX2F	184	91.021	0.041	2.3	0.0171	0.0000	OK
360 minute winter	OUTFALL F	184	90.571	0.040	2.3	0.0000	0.0000	OK

Link Event	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
360 minute winter	EX1F	1.000	EX2F	1.1	0.470	0.163	0.0887	
360 minute winter	EX2F	1.001	OUTFALL F	2.3	0.776	0.340	0.1065	19.7

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	x
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
EX1F	0.004	5.00	93.160	600	-12.871	61.695	1.710
EX2F			93.160	600	24.757	62.034	2.180
OUTFALL F			93.160	1200	60.690	62.034	2.629

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	EX1F	EX2F	37.630	0.600	91.450	90.980	0.470	80.0	100	5.73	50.0
1.001	EX2F	OUTFALL F	35.933	0.600	90.980	90.531	0.449	80.0	100	6.42	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.861	6.8	0.7	1.610	2.080	0.004	0.0	22	0.561
1.001	0.861	6.8	0.7	2.080	2.529	0.004	0.0	22	0.561

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	37.630	80.0	100	Circular	93.160	91.450	1.610	93.160	90.980	2.080
1.001	35.933	80.0	100	Circular	93.160	90.980	2.080	93.160	90.531	2.529

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	EX1F	600	Manhole	Adoptable	EX2F	600	Manhole	Adoptable
1.001	EX2F	600	Manhole	Adoptable	OUTFALL F	1200	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
EX1F	-12.871	61.695	93.160	1.710	600		0	1.000	91.450	100
EX2F	24.757	62.034	93.160	2.180	600		1	1.000	90.980	100
							0	1.001	90.980	100

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
OUTFALL F	60.690	62.034	93.160	2.629	1200	1	1.001	90.531	100

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Additional Storage (m³/ha)	20.0
Summer CV	1.000	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	1.000	Drain Down Time (mins)	4880	Check Discharge Volume	x

Storm Durations

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

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

Results for 2 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	EX1F	10	91.472	0.022	0.7	0.0074	0.0000	OK
15 minute summer	EX2F	12	91.001	0.021	0.7	0.0060	0.0000	OK
15 minute summer	OUTFALL F	12	90.552	0.021	0.7	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	EX1F	1.000	EX2F	0.7	0.600	0.105	0.0463	
15 minute summer	EX2F	1.001	OUTFALL F	0.7	0.547	0.097	0.0432	0.3

Results for 30 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m^3)	Flood (m^3)	Status
15 minute summer	EX1F	10	91.487	0.037	1.9	0.0121	0.0000	OK
15 minute summer	EX2F	11	91.016	0.036	1.9	0.0101	0.0000	OK
15 minute summer	OUTFALL F	11	90.566	0.035	1.8	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m^3)	Discharge Vol (m^3)
15 minute summer	EX1F	1.000	EX2F	1.9	0.757	0.276	0.0952	
15 minute summer	EX2F	1.001	OUTFALL F	1.8	0.728	0.268	0.0896	0.8

Results for 100 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m^3)	Flood (m^3)	Status
15 minute summer	EX1F	10	91.493	0.043	2.5	0.0141	0.0000	OK
15 minute summer	EX2F	11	91.022	0.042	2.5	0.0118	0.0000	OK
15 minute summer	OUTFALL F	11	90.572	0.041	2.4	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m^3)	Discharge Vol (m^3)
15 minute summer	EX1F	1.000	EX2F	2.5	0.810	0.365	0.1172	
15 minute summer	EX2F	1.001	OUTFALL F	2.4	0.786	0.358	0.1106	1.1

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	x
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
EX1F	0.014	5.00	93.160	600	-12.871	61.695	1.710
EX2F	0.015	5.00	93.160	600	24.757	62.034	2.180
OUTFALL F			93.160	1200	60.690	62.034	2.629

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	EX1F	EX2F	37.630	0.600	91.450	90.980	0.470	80.0	100	5.73	50.0
1.001	EX2F	OUTFALL F	35.933	0.600	90.980	90.531	0.449	80.0	100	6.42	50.0

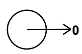
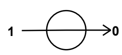
Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.861	6.8	2.5	1.610	2.080	0.014	0.0	43	0.801
1.001	0.861	6.8	5.2	2.080	2.529	0.029	0.0	66	0.950

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	37.630	80.0	100	Circular	93.160	91.450	1.610	93.160	90.980	2.080
1.001	35.933	80.0	100	Circular	93.160	90.980	2.080	93.160	90.531	2.529

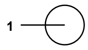
Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	EX1F	600	Manhole	Adoptable	EX2F	600	Manhole	Adoptable
1.001	EX2F	600	Manhole	Adoptable	OUTFALL F	1200	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
EX1F	-12.871	61.695	93.160	1.710	600		0	1.000	91.450	100
EX2F	24.757	62.034	93.160	2.180	600		1	1.000	90.980	100
							0	1.001	90.980	100

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
OUTFALL F	60.690	62.034	93.160	2.629	1200	1	1.001	90.531	100



Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Additional Storage (m³/ha)	20.0
Summer CV	1.000	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	1.000	Drain Down Time (mins)	4880	Check Discharge Volume	x

Storm Durations

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

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

Results for 2 year Critical Storm Duration. Lowest mass balance: 98.74%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m^3)	Flood (m^3)	Status
15 minute summer	EX1F	10	91.491	0.041	2.5	0.0184	0.0000	OK
15 minute summer	EX2F	11	91.044	0.064	5.0	0.0271	0.0000	OK
15 minute summer	OUTFALL F	11	90.594	0.063	4.9	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m^3)	Discharge Vol (m^3)
15 minute summer	EX1F	1.000	EX2F	2.4	0.585	0.355	0.1568	
15 minute summer	EX2F	1.001	OUTFALL F	4.9	0.932	0.726	0.1893	2.2

Results for 30 year Critical Storm Duration. Lowest mass balance: 98.74%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	EX1F	12	91.828	0.378	6.7	0.1687	0.0000	SURCHARGED
15 minute summer	EX2F	12	91.597	0.617	12.6	0.2591	0.0000	SURCHARGED
15 minute summer	OUTFALL F	12	90.625	0.094	9.7	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	EX1F	1.000	EX2F	5.7	0.759	0.846	0.2944	
15 minute summer	EX2F	1.001	OUTFALL F	9.7	1.234	1.427	0.2775	6.1

Results for 100 year Critical Storm Duration. Lowest mass balance: 98.74%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	EX1F	13	92.274	0.824	8.6	0.3674	0.0000	SURCHARGED
15 minute summer	EX2F	12	91.954	0.974	13.6	0.4090	0.0000	SURCHARGED
15 minute summer	OUTFALL F	11	90.626	0.095	11.3	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	EX1F	1.000	EX2F	5.9	0.780	0.866	0.2944	
15 minute summer	EX2F	1.001	OUTFALL F	11.3	1.439	1.665	0.2783	7.8

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	x
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
EX1	0.051	5.00	93.160	600	-12.871	61.695	1.710
EX2	0.052	5.00	93.160	600	24.757	62.034	2.180
OUTFALL			93.160	1200	60.690	62.034	2.629

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	EX1	EX2	37.630	0.600	91.450	90.980	0.470	80.0	150	5.56	50.0
1.001	EX2	OUTFALL	35.933	0.600	90.980	90.531	0.449	80.0	150	6.09	50.0

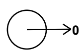
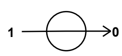
Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	1.125	19.9	9.2	1.560	2.030	0.051	0.0	72	1.104
1.001	1.125	19.9	18.6	2.030	2.479	0.103	0.0	116	1.275

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	37.630	80.0	150	Circular	93.160	91.450	1.560	93.160	90.980	2.030
1.001	35.933	80.0	150	Circular	93.160	90.980	2.030	93.160	90.531	2.479

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	EX1	600	Manhole	Adoptable	EX2	600	Manhole	Adoptable
1.001	EX2	600	Manhole	Adoptable	OUTFALL	1200	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
EX1	-12.871	61.695	93.160	1.710	600	 0	1.000	91.450	150
EX2	24.757	62.034	93.160	2.180	600	1	1.000	90.980	150
						 0	1.001	90.980	150

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
OUTFALL	60.690	62.034	93.160	2.629	1200	1	1.001	90.531	150

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Additional Storage (m³/ha)	20.0
Summer CV	1.000	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	1.000	Drain Down Time (mins)	4880	Check Discharge Volume	x

Storm Durations

360

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

Results for 100 year 360 minute summer. 5240 minute analysis at 8 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
360 minute summer	EX1	184	91.508	0.058	6.3	0.0508	0.0000	OK
360 minute summer	EX2	184	91.069	0.089	12.7	0.0676	0.0000	OK
360 minute summer	OUTFALL	184	90.617	0.086	12.6	0.0000	0.0000	OK

Link Event	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
360 minute summer	EX1	1.000	EX2	6.3	0.732	0.315	0.3223	
360 minute summer	EX2	1.001	OUTFALL	12.6	1.176	0.632	0.3837	70.2

Results for 100 year 360 minute winter. 5240 minute analysis at 8 minute timestep. Mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
360 minute winter	EX1	184	91.496	0.046	4.1	0.0406	0.0000	OK
360 minute winter	EX2	184	91.049	0.069	8.3	0.0523	0.0000	OK
360 minute winter	OUTFALL	184	90.598	0.067	8.3	0.0000	0.0000	OK

Link Event	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
360 minute winter	EX1	1.000	EX2	4.1	0.660	0.206	0.2348	
360 minute winter	EX2	1.001	OUTFALL	8.3	1.066	0.417	0.2794	70.4

Design Settings

Rainfall Methodology	FEH-22
Return Period (years)	100
Additional Flow (%)	0
CV	1.000
Time of Entry (mins)	5.00
Maximum Time of Concentration (mins)	30.00
Maximum Rainfall (mm/hr)	50.0

Minimum Velocity (m/s)	1.00
Connection Type	Level Soffits
Minimum Backdrop Height (m)	0.200
Preferred Cover Depth (m)	1.200
Include Intermediate Ground	✓
Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
EX1	0.051	5.00	93.160	600	-12.871	61.695	1.710
EX2	0.052	5.00	93.160	600	24.757	62.034	2.180
OUTFALL			93.160	1200	60.690	62.034	2.629

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	EX1	EX2	37.630	0.600	91.450	90.980	0.470	80.0	150	5.56	50.0
1.001	EX2	OUTFALL	35.933	0.600	90.980	90.531	0.449	80.0	150	6.09	50.0

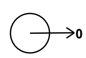
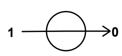
Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	1.125	19.9	9.2	1.560	2.030	0.051	0.0	72	1.104
1.001	1.125	19.9	18.6	2.030	2.479	0.103	0.0	116	1.275

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	37.630	80.0	150	Circular	93.160	91.450	1.560	93.160	90.980	2.030
1.001	35.933	80.0	150	Circular	93.160	90.980	2.030	93.160	90.531	2.479

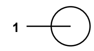
Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	EX1	600	Manhole	Adoptable	EX2	600	Manhole	Adoptable
1.001	EX2	600	Manhole	Adoptable	OUTFALL	1200	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
EX1	-12.871	61.695	93.160	1.710	600		0	1.000	91.450	150
EX2	24.757	62.034	93.160	2.180	600		1	1.000	90.980	150
							0	1.001	90.980	150

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
OUTFALL	60.690	62.034	93.160	2.629	1200	1	1.001	90.531	150



Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Additional Storage (m^3/ha)	20.0
Summer CV	1.000	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	1.000	Drain Down Time (mins)	4880	Check Discharge Volume	x

Storm Durations

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

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

Results for 2 year Critical Storm Duration. Lowest mass balance: 99.60%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	EX1	10	91.520	0.070	8.9	0.0613	0.0000	OK
15 minute summer	EX2	11	91.094	0.114	17.9	0.0866	0.0000	OK
15 minute summer	OUTFALL	11	90.640	0.109	17.6	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	EX1	1.000	EX2	8.8	0.788	0.442	0.4188	
15 minute summer	EX2	1.001	OUTFALL	17.6	1.252	0.885	0.5051	7.8

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.60%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	EX1	12	93.113	1.663	24.5	1.4620	0.0000	FLOOD RISK
15 minute summer	EX2	12	92.600	1.620	42.2	1.2311	0.0000	SURCHARGED
15 minute summer	OUTFALL	9	90.673	0.142	39.4	0.0000	0.0000	OK

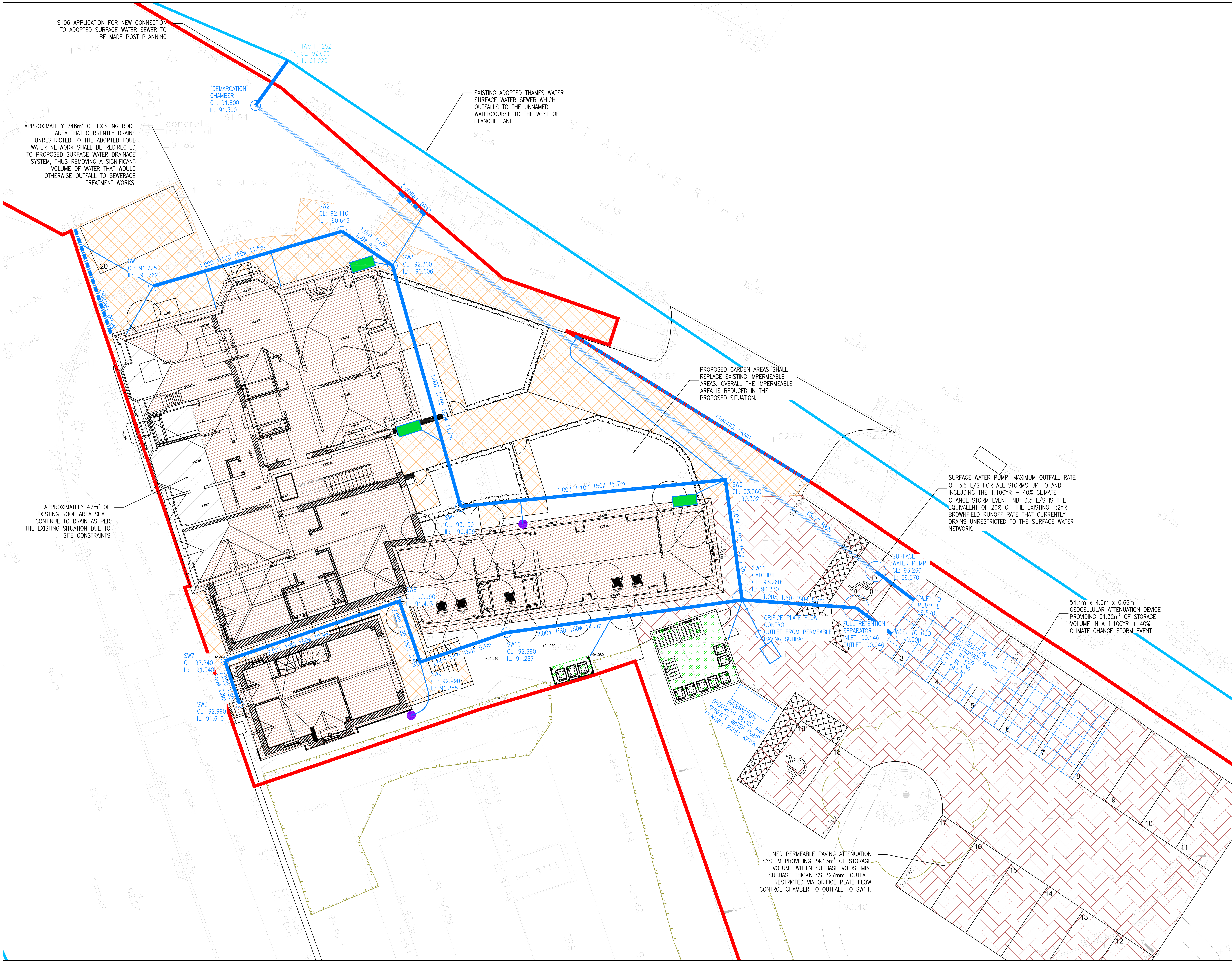
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	EX1	1.000	EX2	19.4	1.100	0.974	0.6625	
15 minute summer	EX2	1.001	OUTFALL	39.4	2.240	1.984	0.6262	21.4

Results for 100 year Critical Storm Duration. Lowest mass balance: 99.60%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	EX1	10	93.160	1.710	31.3	1.5031	2.5799	FLOOD
15 minute summer	EX2	11	92.961	1.981	48.1	1.5052	0.0000	FLOOD RISK
15 minute summer	OUTFALL	9	90.673	0.142	43.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	EX1	1.000	EX2	19.1	1.083	0.959	0.6625	
15 minute summer	EX2	1.001	OUTFALL	43.0	2.441	2.162	0.6262	25.1

Appendix J – Proposed SuDS Layout



PRIVATE FOOTPATH, PATIO AND OTHER HARDSTANDING AREAS

PRIVATE PERMEABLE PAVING CAR PARK CONSTRUCTION

ROOF AREA (EXISTING AND NEW)

ROOF AREA (EXISTING TO CONTINUE TO DRAIN AS PER THE EXISTING SITUATION DUE TO SITE CONSTRAINTS)

PROPOSED GREEN ROOF BIN AND CYCLE STORE

PROPOSED SURFACE WATER DRAINAGE NETWORK

PROPOSED RAINGARDEN PLANTER

PROPOSED RAINWATER HARVESTING BUTT

REV	DATE	BY	DESCRIPTION	CHK	APD

DRAWING STATUS: PLANNING APPLICATION

1st Floor Millers House, Roydon Road, Stanstead Abbotts, Hertfordshire, SG12 8HN
Tel: 01920 871777

www.eastp.co.uk

CLIENT: GRIGGS (SOUTH MIMMS) LIMITED

ARCHITECT:

PROJECT: THE WHITE HART, SOUTH MIMMS, HERTSMERE

TITLE: PROPOSED SUDS LAYOUT

SCALE @ A1:	DESIGN-DRAWN:	DATE:
1:100	MD	29.09.2023
PROJECT No: 3991	DRAWING No: SK03-A-SUDS	

Appendix K - Causeway Flow Hydraulic Model Results

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	x
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
SW1	0.011	5.00	91.730	600	-5.299	67.278	0.968
SW2	0.015	5.00	92.110	600	10.577	67.264	1.464
SW3	0.005	5.00	92.300	600	16.227	65.042	1.694
SW4	0.005	5.00	93.150	600	16.549	53.032	2.691
SW5	0.006	5.00	93.260	600	34.106	52.646	2.958
SW11			93.260	1200	34.390	43.456	3.030
DEFENDER			93.260	1200	45.338	43.532	3.214
SW6	0.005	5.00	92.990	600	-1.272	44.280	1.380
SW7	0.005	5.00	92.240	600	-1.460	51.838	0.700
SW8	0.020	5.00	92.990	600	8.515	51.845	1.587
SW9	0.010	5.00	92.990	600	8.560	43.913	1.635
SW10	0.010	5.00	92.990	600	20.957	43.587	1.703
GEO			93.260		52.911	43.462	3.690
DEMARCATION			91.850	1200	52.503	59.367	0.500
PERM PAVE	0.048	5.00	93.260		34.428	35.772	0.650

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	SW1	SW2	11.600	0.600	90.762	90.646	0.116	100.0	150	5.19	50.0
1.001	SW2	SW3	4.000	0.600	90.646	90.606	0.040	100.0	150	5.26	50.0
1.002	SW3	SW4	14.700	0.600	90.606	90.459	0.147	100.0	150	5.50	50.0
1.003	SW4	SW5	15.700	0.600	90.459	90.302	0.157	100.0	150	5.76	50.0
1.004	SW5	SW11	7.200	0.600	90.302	90.230	0.072	100.0	150	5.88	50.0
1.005	SW11	DEFENDER	6.700	0.600	90.230	90.146	0.084	79.8	150	5.98	50.0
2.000	SW6	SW7	2.800	0.600	91.610	91.540	0.070	40.0	150	5.03	50.0
2.001	SW7	SW8	10.900	0.600	91.540	91.403	0.137	79.6	150	5.19	50.0
2.002	SW8	SW9	3.800	0.600	91.403	91.355	0.048	79.2	150	5.25	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	1.005	17.8	2.0	0.818	1.314	0.011	0.0	34	0.663
1.001	1.005	17.8	4.7	1.314	1.544	0.026	0.0	52	0.848
1.002	1.005	17.8	5.6	1.544	2.541	0.031	0.0	58	0.891
1.003	1.005	17.8	6.5	2.541	2.808	0.036	0.0	63	0.929
1.004	1.005	17.8	7.6	2.808	2.880	0.042	0.0	68	0.964
1.005	1.126	19.9	25.3	2.880	2.964	0.140	0.0	150	1.147
2.000	1.596	28.2	0.9	1.230	0.550	0.005	0.0	18	0.728
2.001	1.128	19.9	1.8	0.550	1.437	0.010	0.0	31	0.705
2.002	1.131	20.0	5.4	1.437	1.485	0.030	0.0	53	0.960

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
2.003	SW9	SW10	5.400	0.600	91.355	91.287	0.068	79.4	150	5.33	50.0
2.004	SW10	SW11	14.000	0.600	91.287	91.112	0.175	80.0	150	5.53	50.0
1.006	DEFENDER	GEO	2.600	0.600	90.046	90.000	0.046	56.5	150	6.01	50.0
1.007	GEO	DEMARCATION	15.910	0.600	89.570	91.350	-1.780	-8.9	100	6.28	50.0
3.000	PERM PAVE	SW11	7.684	0.600	92.610	90.270	2.340	3.3	100	5.03	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
2.003	1.129	19.9	7.2	1.485	1.553	0.040	0.0	62	1.040
2.004	1.125	19.9	9.0	1.553	1.998	0.050	0.0	71	1.100
1.006	1.340	23.7	25.3	3.064	3.110	0.140	0.0	137	1.496
1.007	1.000	7.9	25.3	3.590	0.400	0.140	0.0	100	0.000
3.000	4.299	33.8	8.7	0.550	2.890	0.048	0.0	35	3.617

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	11.600	100.0	150	Circular	91.730	90.762	0.818	92.110	90.646	1.314
1.001	4.000	100.0	150	Circular	92.110	90.646	1.314	92.300	90.606	1.544
1.002	14.700	100.0	150	Circular	92.300	90.606	1.544	93.150	90.459	2.541
1.003	15.700	100.0	150	Circular	93.150	90.459	2.541	93.260	90.302	2.808
1.004	7.200	100.0	150	Circular	93.260	90.302	2.808	93.260	90.230	2.880
1.005	6.700	79.8	150	Circular	93.260	90.230	2.880	93.260	90.146	2.964
2.000	2.800	40.0	150	Circular	92.990	91.610	1.230	92.240	91.540	0.550
2.001	10.900	79.6	150	Circular	92.240	91.540	0.550	92.990	91.403	1.437
2.002	3.800	79.2	150	Circular	92.990	91.403	1.437	92.990	91.355	1.485
2.003	5.400	79.4	150	Circular	92.990	91.355	1.485	92.990	91.287	1.553
2.004	14.000	80.0	150	Circular	92.990	91.287	1.553	93.260	91.112	1.998
1.006	2.600	56.5	150	Circular	93.260	90.046	3.064	93.260	90.000	3.110
1.007	15.910	-8.9	100	Circular	93.260	89.570	3.590	91.850	91.350	0.400
3.000	7.684	3.3	100	Circular	93.260	92.610	0.550	93.260	90.270	2.890

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	SW1	600	Manhole	Adoptable	SW2	600	Manhole	Adoptable
1.001	SW2	600	Manhole	Adoptable	SW3	600	Manhole	Adoptable
1.002	SW3	600	Manhole	Adoptable	SW4	600	Manhole	Adoptable
1.003	SW4	600	Manhole	Adoptable	SW5	600	Manhole	Adoptable
1.004	SW5	600	Manhole	Adoptable	SW11	1200	Manhole	Adoptable
1.005	SW11	1200	Manhole	Adoptable	DEFENDER	1200	Manhole	Adoptable
2.000	SW6	600	Manhole	Adoptable	SW7	600	Manhole	Adoptable
2.001	SW7	600	Manhole	Adoptable	SW8	600	Manhole	Adoptable
2.002	SW8	600	Manhole	Adoptable	SW9	600	Manhole	Adoptable
2.003	SW9	600	Manhole	Adoptable	SW10	600	Manhole	Adoptable
2.004	SW10	600	Manhole	Adoptable	SW11	1200	Manhole	Adoptable
1.006	DEFENDER	1200	Manhole	Adoptable	GEO		Junction	
1.007	GEO		Junction		DEMARCATION	1200	Manhole	Adoptable
3.000	PERM PAVE		Junction		SW11	1200	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
SW1	-5.299	67.278	91.730	0.968	600	0	1.000	90.762	150
SW2	10.577	67.264	92.110	1.464	600	1	1.000	90.646	150
						0	1.001	90.646	150
SW3	16.227	65.042	92.300	1.694	600	1	1.001	90.606	150
						0	1.002	90.606	150
SW4	16.549	53.032	93.150	2.691	600	1	1.002	90.459	150
						0	1.003	90.459	150
SW5	34.106	52.646	93.260	2.958	600	1	1.003	90.302	150
						0	1.004	90.302	150
SW11	34.390	43.456	93.260	3.030	1200	1	3.000	90.270	100
						2	2.004	91.112	150
						3	1.004	90.230	150
						0	1.005	90.230	150
DEFENDER	45.338	43.532	93.260	3.214	1200	1	1.005	90.146	150
						0	1.006	90.046	150
SW6	-1.272	44.280	92.990	1.380	600	0	2.000	91.610	150
SW7	-1.460	51.838	92.240	0.700	600	1	2.000	91.540	150
						0	2.001	91.540	150
SW8	8.515	51.845	92.990	1.587	600	1	2.001	91.403	150
						0	2.002	91.403	150
SW9	8.560	43.913	92.990	1.635	600	1	2.002	91.355	150
						0	2.003	91.355	150
SW10	20.957	43.587	92.990	1.703	600	1	2.003	91.287	150
						0	2.004	91.287	150
GEO	52.911	43.462	93.260	3.690		1	1.006	90.000	150
						0	1.007	89.570	100

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
DEMARCATION	52.503	59.367	91.850	0.500	1200	1	1.007	91.350	100
PERM PAVE	34.428	35.772	93.260	0.650		0	3.000	92.610	100

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Additional Storage (m³/ha)	20.0
Summer CV	1.000	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	1.000	Drain Down Time (mins)	4880	Check Discharge Volume	x

Storm Durations
360

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

Node PERM PAVE Online Orifice Control

Flap Valve	x	Replaces Downstream Link	✓	Diameter (m)	0.010
Downstream Link	3.000	Invert Level (m)	92.610	Discharge Coefficient	0.600

Node GEO Online Pump Control

Flap Valve	x	Replaces Downstream Link	✓	Switch on depth (m)	0.075
Downstream Link	1.007	Invert Level (m)	89.570	Switch off depth (m)	0.050

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.500	0.660	3.500	1.500	3.500	2.500	3.500
0.400	3.500	1.200	3.500	2.000	3.500		

Node GEO Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	89.570
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	80

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	54.4	0.0	0.660	54.4	0.0	0.661	0.0	0.0

Node PERM PAVE Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	92.610	Slope (1:X)	2000.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	800	Depth (m)	
Safety Factor	2.0	Width (m)	21.900	Inf Depth (m)	
Porosity	0.33	Length (m)	21.900		

Results for 100 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
360 minute summer	SW1	184	90.790	0.028	1.4	0.0145	0.0000	OK
360 minute summer	SW2	184	90.693	0.047	3.2	0.0229	0.0000	OK
360 minute summer	SW3	184	90.654	0.048	3.8	0.0164	0.0000	OK
360 minute summer	SW4	184	90.511	0.052	4.4	0.0165	0.0000	OK
360 minute summer	SW5	184	90.358	0.056	5.0	0.0180	0.0000	OK
360 minute summer	SW11	184	90.318	0.088	11.1	0.1000	0.0000	OK
360 minute summer	DEFENDER	184	90.125	0.079	11.1	0.0893	0.0000	OK
360 minute summer	SW6	184	91.625	0.015	0.6	0.0054	0.0000	OK
360 minute summer	SW7	184	91.565	0.025	1.2	0.0106	0.0000	OK
360 minute summer	SW8	184	91.452	0.049	3.7	0.0260	0.0000	OK
360 minute summer	SW9	184	91.410	0.055	4.9	0.0222	0.0000	OK
360 minute summer	SW10	184	91.346	0.059	6.1	0.0236	0.0000	OK
360 minute summer	GEO	232	90.029	0.459	11.0	23.7281	0.0000	SURCHARGED
360 minute summer	DEMARCATION	8	91.350	0.000	3.5	0.0000	0.0000	OK
360 minute winter	PERM PAVE	360	92.815	0.205	3.8	31.8187	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
360 minute summer	SW1	1.000	SW2	1.4	0.402	0.078	0.0408	
360 minute summer	SW2	1.001	SW3	3.2	0.666	0.179	0.0191	
360 minute summer	SW3	1.002	SW4	3.8	0.739	0.212	0.0748	
360 minute summer	SW4	1.003	SW5	4.3	0.769	0.244	0.0886	
360 minute summer	SW5	1.004	SW11	5.0	0.600	0.282	0.0602	
360 minute summer	SW11	1.005	DEFENDER	11.1	1.089	0.555	0.0680	
360 minute summer	DEFENDER	1.006	GEO	11.0	1.245	0.466	0.0230	
360 minute summer	SW6	2.000	SW7	0.6	0.429	0.021	0.0040	
360 minute summer	SW7	2.001	SW8	1.2	0.357	0.060	0.0373	
360 minute summer	SW8	2.002	SW9	3.7	0.683	0.184	0.0204	
360 minute summer	SW9	2.003	SW10	4.9	0.793	0.243	0.0331	
360 minute summer	SW10	2.004	SW11	6.0	0.965	0.303	0.0874	
360 minute summer	GEO	Pump	DEMARCATION	3.5				86.2
360 minute winter	PERM PAVE	Orifice	SW11	0.1				

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	x
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
SW1	0.011	5.00	91.730	600	-5.299	67.278	0.968
SW2	0.015	5.00	92.110	600	10.577	67.264	1.464
SW3	0.005	5.00	92.300	600	16.227	65.042	1.694
SW4	0.005	5.00	93.150	600	16.549	53.032	2.691
SW5	0.006	5.00	93.260	600	34.106	52.646	2.958
SW11			93.260	1200	34.390	43.456	3.030
DEFENDER			93.260	1200	45.338	43.532	3.214
SW6	0.005	5.00	92.990	600	-1.272	44.280	1.380
SW7	0.005	5.00	92.240	600	-1.460	51.838	0.700
SW8	0.020	5.00	92.990	600	8.515	51.845	1.587
SW9	0.010	5.00	92.990	600	8.560	43.913	1.635
SW10	0.010	5.00	92.990	600	20.957	43.587	1.703
GEO			93.260		52.911	43.462	3.690
DEMARCATION			91.850	1200	52.503	59.367	0.500
PERM PAVE	0.048	5.00	93.260		34.428	35.772	0.650

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	SW1	SW2	11.600	0.600	90.762	90.646	0.116	100.0	150	5.19	50.0
1.001	SW2	SW3	4.000	0.600	90.646	90.606	0.040	100.0	150	5.26	50.0
1.002	SW3	SW4	14.700	0.600	90.606	90.459	0.147	100.0	150	5.50	50.0
1.003	SW4	SW5	15.700	0.600	90.459	90.302	0.157	100.0	150	5.76	50.0
1.004	SW5	SW11	7.200	0.600	90.302	90.230	0.072	100.0	150	5.88	50.0
1.005	SW11	DEFENDER	6.700	0.600	90.230	90.146	0.084	79.8	150	5.98	50.0
2.000	SW6	SW7	2.800	0.600	91.610	91.540	0.070	40.0	150	5.03	50.0
2.001	SW7	SW8	10.900	0.600	91.540	91.403	0.137	79.6	150	5.19	50.0
2.002	SW8	SW9	3.800	0.600	91.403	91.355	0.048	79.2	150	5.25	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	1.005	17.8	2.0	0.818	1.314	0.011	0.0	34	0.663
1.001	1.005	17.8	4.7	1.314	1.544	0.026	0.0	52	0.848
1.002	1.005	17.8	5.6	1.544	2.541	0.031	0.0	58	0.891
1.003	1.005	17.8	6.5	2.541	2.808	0.036	0.0	63	0.929
1.004	1.005	17.8	7.6	2.808	2.880	0.042	0.0	68	0.964
1.005	1.126	19.9	25.3	2.880	2.964	0.140	0.0	150	1.147
2.000	1.596	28.2	0.9	1.230	0.550	0.005	0.0	18	0.728
2.001	1.128	19.9	1.8	0.550	1.437	0.010	0.0	31	0.705
2.002	1.131	20.0	5.4	1.437	1.485	0.030	0.0	53	0.960

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
2.003	SW9	SW10	5.400	0.600	91.355	91.287	0.068	79.4	150	5.33	50.0
2.004	SW10	SW11	14.000	0.600	91.287	91.112	0.175	80.0	150	5.53	50.0
1.006	DEFENDER	GEO	2.600	0.600	90.046	90.000	0.046	56.5	150	6.01	50.0
1.007	GEO	DEMARCATION	15.910	0.600	89.570	91.350	-1.780	-8.9	100	6.28	50.0
3.000	PERM PAVE	SW11	7.684	0.600	92.610	90.270	2.340	3.3	100	5.03	50.0

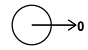
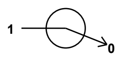
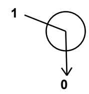
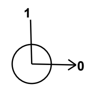
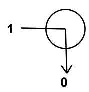
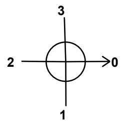
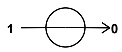
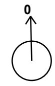
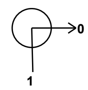
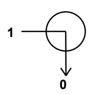
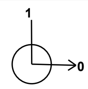
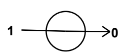
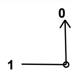
Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
2.003	1.129	19.9	7.2	1.485	1.553	0.040	0.0	62	1.040
2.004	1.125	19.9	9.0	1.553	1.998	0.050	0.0	71	1.100
1.006	1.340	23.7	25.3	3.064	3.110	0.140	0.0	137	1.496
1.007	1.000	7.9	25.3	3.590	0.400	0.140	0.0	100	0.000
3.000	4.299	33.8	8.7	0.550	2.890	0.048	0.0	35	3.617

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	11.600	100.0	150	Circular	91.730	90.762	0.818	92.110	90.646	1.314
1.001	4.000	100.0	150	Circular	92.110	90.646	1.314	92.300	90.606	1.544
1.002	14.700	100.0	150	Circular	92.300	90.606	1.544	93.150	90.459	2.541
1.003	15.700	100.0	150	Circular	93.150	90.459	2.541	93.260	90.302	2.808
1.004	7.200	100.0	150	Circular	93.260	90.302	2.808	93.260	90.230	2.880
1.005	6.700	79.8	150	Circular	93.260	90.230	2.880	93.260	90.146	2.964
2.000	2.800	40.0	150	Circular	92.990	91.610	1.230	92.240	91.540	0.550
2.001	10.900	79.6	150	Circular	92.240	91.540	0.550	92.990	91.403	1.437
2.002	3.800	79.2	150	Circular	92.990	91.403	1.437	92.990	91.355	1.485
2.003	5.400	79.4	150	Circular	92.990	91.355	1.485	92.990	91.287	1.553
2.004	14.000	80.0	150	Circular	92.990	91.287	1.553	93.260	91.112	1.998
1.006	2.600	56.5	150	Circular	93.260	90.046	3.064	93.260	90.000	3.110
1.007	15.910	-8.9	100	Circular	93.260	89.570	3.590	91.850	91.350	0.400
3.000	7.684	3.3	100	Circular	93.260	92.610	0.550	93.260	90.270	2.890

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	SW1	600	Manhole	Adoptable	SW2	600	Manhole	Adoptable
1.001	SW2	600	Manhole	Adoptable	SW3	600	Manhole	Adoptable
1.002	SW3	600	Manhole	Adoptable	SW4	600	Manhole	Adoptable
1.003	SW4	600	Manhole	Adoptable	SW5	600	Manhole	Adoptable
1.004	SW5	600	Manhole	Adoptable	SW11	1200	Manhole	Adoptable
1.005	SW11	1200	Manhole	Adoptable	DEFENDER	1200	Manhole	Adoptable
2.000	SW6	600	Manhole	Adoptable	SW7	600	Manhole	Adoptable
2.001	SW7	600	Manhole	Adoptable	SW8	600	Manhole	Adoptable
2.002	SW8	600	Manhole	Adoptable	SW9	600	Manhole	Adoptable
2.003	SW9	600	Manhole	Adoptable	SW10	600	Manhole	Adoptable
2.004	SW10	600	Manhole	Adoptable	SW11	1200	Manhole	Adoptable
1.006	DEFENDER	1200	Manhole	Adoptable	GEO		Junction	
1.007	GEO		Junction		DEMARCATION	1200	Manhole	Adoptable
3.000	PERM PAVE		Junction		SW11	1200	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
SW1	-5.299	67.278	91.730	0.968	600		0	1.000	90.762	150
SW2	10.577	67.264	92.110	1.464	600		1	1.000	90.646	150
							0	1.001	90.646	150
SW3	16.227	65.042	92.300	1.694	600		1	1.001	90.606	150
							0	1.002	90.606	150
SW4	16.549	53.032	93.150	2.691	600		1	1.002	90.459	150
							0	1.003	90.459	150
SW5	34.106	52.646	93.260	2.958	600		1	1.003	90.302	150
							0	1.004	90.302	150
SW11	34.390	43.456	93.260	3.030	1200		1	3.000	90.270	100
							2	2.004	91.112	150
							3	1.004	90.230	150
							0	1.005	90.230	150
DEFENDER	45.338	43.532	93.260	3.214	1200		1	1.005	90.146	150
							0	1.006	90.046	150
SW6	-1.272	44.280	92.990	1.380	600		0	2.000	91.610	150
SW7	-1.460	51.838	92.240	0.700	600		1	2.000	91.540	150
							0	2.001	91.540	150
SW8	8.515	51.845	92.990	1.587	600		1	2.001	91.403	150
							0	2.002	91.403	150
SW9	8.560	43.913	92.990	1.635	600		1	2.002	91.355	150
							0	2.003	91.355	150
SW10	20.957	43.587	92.990	1.703	600		1	2.003	91.287	150
							0	2.004	91.287	150
GEO	52.911	43.462	93.260	3.690			1	1.006	90.000	150
							0	1.007	89.570	100

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
DEMARCATION	52.503	59.367	91.850	0.500	1200	1	1.007	91.350	100
PERM PAVE	34.428	35.772	93.260	0.650		0	3.000	92.610	100

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Additional Storage (m³/ha)	20.0
Summer CV	1.000	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	1.000	Drain Down Time (mins)	4880	Check Discharge Volume	x

Storm Durations

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

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

Node PERM PAVE Online Orifice Control

Flap Valve	x	Replaces Downstream Link	✓	Diameter (m)	0.010
Downstream Link	3.000	Invert Level (m)	92.610	Discharge Coefficient	0.600

Node GEO Online Pump Control

Flap Valve	x	Replaces Downstream Link	✓	Switch on depth (m)	0.075
Downstream Link	1.007	Invert Level (m)	89.570	Switch off depth (m)	0.050

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.500	0.660	3.500	1.500	3.500	2.500	3.500
0.400	3.500	1.200	3.500	2.000	3.500		

Node GEO Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	89.570
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	196

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	54.4	0.0	0.660	54.4	0.0	0.661	0.0	0.0

Node PERM PAVE Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	92.610	Slope (1:X)	2000.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	3900	Depth (m)	
Safety Factor	2.0	Width (m)	21.900	Inf Depth (m)	
Porosity	0.33	Length (m)	21.900		

Results for 2 year Critical Storm Duration. Lowest mass balance: 99.82%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SW1	10	90.795	0.033	1.9	0.0168	0.0000	OK
15 minute summer	SW2	10	90.702	0.056	4.5	0.0274	0.0000	OK
15 minute summer	SW3	11	90.660	0.054	4.7	0.0184	0.0000	OK
15 minute summer	SW4	12	90.516	0.057	5.3	0.0184	0.0000	OK
30 minute summer	SW5	19	90.364	0.062	6.0	0.0199	0.0000	OK
15 minute summer	SW11	12	90.333	0.103	14.1	0.1169	0.0000	OK
15 minute summer	DEFENDER	12	90.138	0.092	13.9	0.1037	0.0000	OK
15 minute summer	SW6	10	91.628	0.018	0.9	0.0065	0.0000	OK
15 minute summer	SW7	10	91.570	0.030	1.8	0.0127	0.0000	OK
15 minute summer	SW8	10	91.463	0.060	5.2	0.0321	0.0000	OK
15 minute summer	SW9	10	91.423	0.068	6.9	0.0274	0.0000	OK
15 minute summer	SW10	11	91.360	0.073	8.6	0.0290	0.0000	OK
120 minute summer	GEO	78	89.709	0.139	7.8	7.1634	0.0000	SURCHARGED
15 minute summer	DEMARCATION	1	91.350	0.000	3.3	0.0000	0.0000	OK
1440 minute summer	PERM PAVE	1440	92.701	0.091	0.7	13.6750	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SW1	1.000	SW2	1.9	0.429	0.106	0.0513	
15 minute summer	SW2	1.001	SW3	4.4	0.771	0.249	0.0233	
15 minute summer	SW3	1.002	SW4	4.6	0.806	0.261	0.0867	
15 minute summer	SW4	1.003	SW5	5.2	0.816	0.295	0.1013	
30 minute summer	SW5	1.004	SW11	5.9	0.617	0.335	0.0697	
15 minute summer	SW11	1.005	DEFENDER	13.9	1.146	0.700	0.0814	
15 minute summer	DEFENDER	1.006	GEO	14.0	1.317	0.591	0.0276	
15 minute summer	SW6	2.000	SW7	0.9	0.485	0.031	0.0052	
15 minute summer	SW7	2.001	SW8	1.7	0.391	0.087	0.0493	
15 minute summer	SW8	2.002	SW9	5.1	0.719	0.256	0.0271	
15 minute summer	SW9	2.003	SW10	6.8	0.853	0.343	0.0434	
15 minute summer	SW10	2.004	SW11	8.6	1.058	0.434	0.1143	
120 minute summer	GEO	Pump	DEMARCATION	3.5				19.9
1440 minute summer	PERM PAVE	Orifice	SW11	0.1				

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.82%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SW1	12	90.921	0.159	5.3	0.0811	0.0000	SURCHARGED
15 minute summer	SW2	12	90.915	0.269	12.4	0.1314	0.0000	SURCHARGED
15 minute summer	SW3	12	90.898	0.291	13.4	0.0997	0.0000	SURCHARGED
15 minute summer	SW4	12	90.833	0.374	14.9	0.1197	0.0000	SURCHARGED
15 minute summer	SW5	12	90.745	0.443	14.4	0.1430	0.0000	SURCHARGED
15 minute summer	SW11	12	90.681	0.451	35.4	0.5104	0.0000	SURCHARGED
15 minute summer	DEFENDER	12	90.303	0.257	35.2	0.2909	0.0000	SURCHARGED
15 minute summer	SW6	10	91.642	0.032	2.4	0.0113	0.0000	OK
15 minute summer	SW7	11	91.610	0.070	4.8	0.0297	0.0000	OK
15 minute summer	SW8	11	91.604	0.201	14.3	0.1074	0.0000	SURCHARGED
15 minute summer	SW9	11	91.568	0.213	17.7	0.0863	0.0000	SURCHARGED
15 minute summer	SW10	11	91.489	0.202	21.8	0.0806	0.0000	SURCHARGED
120 minute summer	GEO	90	89.999	0.429	18.9	22.1678	0.0000	SURCHARGED
15 minute summer	DEMARCATION	1	91.350	0.000	3.5	0.0000	0.0000	OK
1440 minute winter	PERM PAVE	1410	92.787	0.177	0.9	27.3638	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SW1	1.000	SW2	5.2	0.515	0.296	0.2042	
15 minute summer	SW2	1.001	SW3	11.1	0.869	0.626	0.0704	
15 minute summer	SW3	1.002	SW4	12.6	0.935	0.712	0.2588	
15 minute summer	SW4	1.003	SW5	13.8	0.882	0.776	0.2764	
15 minute summer	SW5	1.004	SW11	16.2	0.920	0.912	0.1268	
15 minute summer	SW11	1.005	DEFENDER	35.2	1.997	1.766	0.1180	
15 minute summer	DEFENDER	1.006	GEO	35.1	1.992	1.481	0.0453	
15 minute summer	SW6	2.000	SW7	2.4	0.617	0.085	0.0146	
15 minute summer	SW7	2.001	SW8	4.8	0.440	0.242	0.1396	
15 minute summer	SW8	2.002	SW9	13.0	0.805	0.650	0.0669	
15 minute summer	SW9	2.003	SW10	17.2	0.979	0.864	0.0951	
15 minute summer	SW10	2.004	SW11	21.7	1.233	1.091	0.2389	
120 minute summer	GEO	Pump	DEMARCATION	3.5				49.8
1440 minute winter	PERM PAVE	Orifice	SW11	0.1				

Results for 30 year +40% CC Critical Storm Duration. Lowest mass balance: 99.82%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SW1	13	91.304	0.542	7.4	0.2764	0.0000	SURCHARGED
15 minute summer	SW2	13	91.295	0.649	14.2	0.3169	0.0000	SURCHARGED
15 minute summer	SW3	13	91.274	0.668	15.0	0.2284	0.0000	SURCHARGED
15 minute summer	SW4	13	91.187	0.728	15.8	0.2329	0.0000	SURCHARGED
15 minute summer	SW5	13	91.059	0.757	17.4	0.2446	0.0000	SURCHARGED
15 minute summer	SW11	13	90.966	0.736	43.9	0.8330	0.0000	SURCHARGED
15 minute summer	DEFENDER	13	90.387	0.341	43.2	0.3861	0.0000	SURCHARGED
15 minute summer	SW6	12	91.865	0.255	3.4	0.0906	0.0000	SURCHARGED
15 minute summer	SW7	12	91.864	0.324	6.5	0.1379	0.0000	SURCHARGED
15 minute summer	SW8	12	91.848	0.445	17.0	0.2383	0.0000	SURCHARGED
15 minute summer	SW9	12	91.791	0.436	22.3	0.1766	0.0000	SURCHARGED
15 minute summer	SW10	12	91.662	0.375	27.8	0.1499	0.0000	SURCHARGED
120 minute winter	GEO	104	90.225	0.655	18.4	33.8412	0.0000	SURCHARGED
15 minute summer	DEMARCATION	1	91.350	0.000	3.5	0.0000	0.0000	OK
1440 minute winter	PERM PAVE	1410	92.860	0.250	1.3	39.1189	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SW1	1.000	SW2	5.4	0.537	0.305	0.2042	
15 minute summer	SW2	1.001	SW3	11.9	0.880	0.670	0.0704	
15 minute summer	SW3	1.002	SW4	12.9	1.002	0.727	0.2588	
15 minute summer	SW4	1.003	SW5	15.4	0.874	0.866	0.2764	
15 minute summer	SW5	1.004	SW11	19.7	1.122	1.112	0.1268	
15 minute summer	SW11	1.005	DEFENDER	43.2	2.455	2.171	0.1180	
15 minute summer	DEFENDER	1.006	GEO	43.3	2.460	1.828	0.0453	
15 minute summer	SW6	2.000	SW7	3.8	0.629	0.133	0.0493	
15 minute summer	SW7	2.001	SW8	8.1	0.466	0.409	0.1919	
15 minute summer	SW8	2.002	SW9	16.5	0.935	0.824	0.0669	
15 minute summer	SW9	2.003	SW10	22.0	1.252	1.105	0.0951	
15 minute summer	SW10	2.004	SW11	27.6	1.567	1.387	0.2437	
120 minute winter	GEO	Pump	DEMARCATION	3.5				67.8
1440 minute winter	PERM PAVE	Orifice	SW11	0.1				

Results for 100 year Critical Storm Duration. Lowest mass balance: 99.82%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SW1	12	91.181	0.419	6.8	0.2135	0.0000	SURCHARGED
15 minute summer	SW2	13	91.172	0.526	15.1	0.2566	0.0000	SURCHARGED
15 minute summer	SW3	13	91.153	0.547	14.0	0.1870	0.0000	SURCHARGED
15 minute summer	SW4	13	91.074	0.615	14.9	0.1967	0.0000	SURCHARGED
15 minute summer	SW5	13	90.957	0.655	16.5	0.2115	0.0000	SURCHARGED
15 minute summer	SW11	13	90.872	0.642	41.3	0.7262	0.0000	SURCHARGED
15 minute summer	DEFENDER	13	90.359	0.313	40.7	0.3546	0.0000	SURCHARGED
15 minute summer	SW6	12	91.783	0.173	4.0	0.0614	0.0000	SURCHARGED
15 minute summer	SW7	12	91.781	0.241	5.7	0.1029	0.0000	SURCHARGED
15 minute summer	SW8	12	91.767	0.364	15.7	0.1948	0.0000	SURCHARGED
15 minute summer	SW9	12	91.717	0.362	20.8	0.1466	0.0000	SURCHARGED
15 minute summer	SW10	12	91.605	0.318	25.9	0.1271	0.0000	SURCHARGED
120 minute summer	GEO	98	90.154	0.584	23.9	30.1879	0.0000	SURCHARGED
15 minute summer	DEMARCATION	1	91.350	0.000	3.5	0.0000	0.0000	OK
1440 minute summer	PERM PAVE	1470	92.841	0.231	1.8	35.9718	0.0000	SURCHARGED

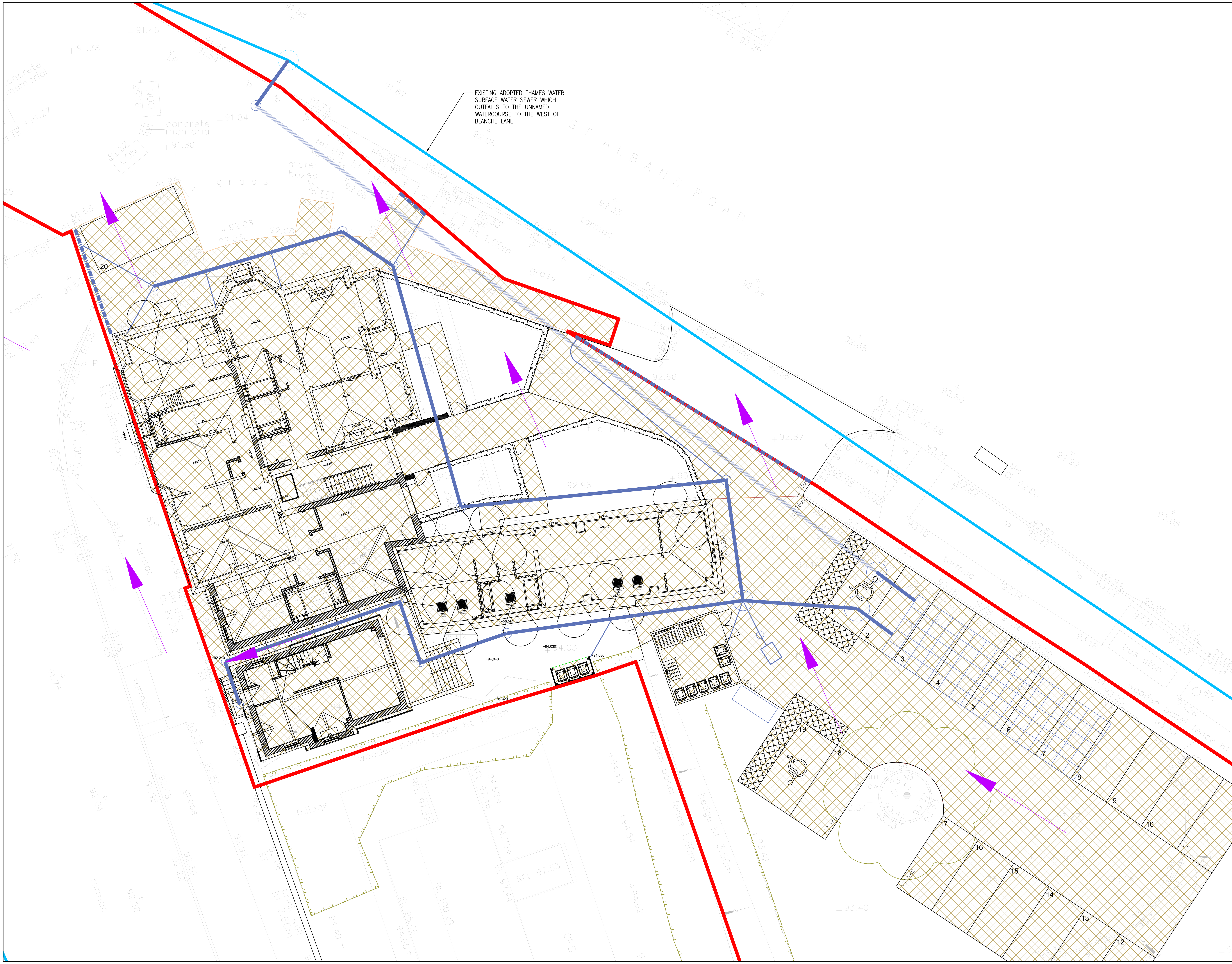
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SW1	1.000	SW2	6.3	0.531	0.355	0.2042	
15 minute summer	SW2	1.001	SW3	11.1	0.868	0.627	0.0704	
15 minute summer	SW3	1.002	SW4	12.2	0.975	0.686	0.2588	
15 minute summer	SW4	1.003	SW5	15.0	0.850	0.843	0.2764	
15 minute summer	SW5	1.004	SW11	17.9	1.017	1.008	0.1268	
15 minute summer	SW11	1.005	DEFENDER	40.7	2.310	2.043	0.1180	
15 minute summer	DEFENDER	1.006	GEO	40.8	2.316	1.721	0.0453	
15 minute summer	SW6	2.000	SW7	3.5	0.618	0.124	0.0493	
15 minute summer	SW7	2.001	SW8	6.8	0.466	0.343	0.1919	
15 minute summer	SW8	2.002	SW9	15.4	0.875	0.771	0.0669	
15 minute summer	SW9	2.003	SW10	20.5	1.167	1.030	0.0951	
15 minute summer	SW10	2.004	SW11	25.6	1.457	1.290	0.2428	
120 minute summer	GEO	Pump	DEMARCATION	3.5				63.0
1440 minute summer	PERM PAVE	Orifice	SW11	0.1				

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.82%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SW1	13	91.730	0.968	9.5	0.4934	0.0000	FLOOD RISK
15 minute summer	SW2	13	91.716	1.070	18.0	0.5221	0.0000	SURCHARGED
15 minute summer	SW3	13	91.687	1.081	18.2	0.3696	0.0000	SURCHARGED
120 minute winter	SW4	116	91.669	1.210	9.2	0.3872	0.0000	SURCHARGED
120 minute winter	SW5	116	91.668	1.366	10.7	0.4411	0.0000	SURCHARGED
120 minute winter	SW11	116	91.667	1.437	23.4	1.6252	0.0000	SURCHARGED
120 minute winter	DEFENDER	116	91.663	1.617	23.4	1.8289	0.0000	SURCHARGED
15 minute summer	SW6	12	92.162	0.552	4.3	0.1961	0.0000	SURCHARGED
15 minute summer	SW7	12	92.160	0.620	6.6	0.2642	0.0000	FLOOD RISK
15 minute summer	SW8	12	92.139	0.736	20.9	0.3939	0.0000	SURCHARGED
15 minute summer	SW9	12	92.055	0.700	27.3	0.2834	0.0000	SURCHARGED
15 minute summer	SW10	12	91.863	0.576	33.9	0.2306	0.0000	SURCHARGED
120 minute winter	GEO	116	91.661	2.091	23.3	34.1346	0.0000	SURCHARGED
15 minute summer	DEMARCATION	1	91.350	0.000	3.5	0.0000	0.0000	OK
1440 minute winter	PERM PAVE	1440	92.937	0.327	1.7	51.3212	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SW1	1.000	SW2	6.9	0.543	0.391	0.2042	
15 minute summer	SW2	1.001	SW3	14.8	0.864	0.834	0.0704	
15 minute summer	SW3	1.002	SW4	14.8	0.949	0.834	0.2588	
120 minute winter	SW4	1.003	SW5	9.2	0.826	0.518	0.2764	
120 minute winter	SW5	1.004	SW11	10.7	0.636	0.600	0.1268	
120 minute winter	SW11	1.005	DEFENDER	23.4	1.330	1.175	0.1180	
120 minute winter	DEFENDER	1.006	GEO	23.3	1.435	0.983	0.0458	
15 minute summer	SW6	2.000	SW7	4.6	0.641	0.163	0.0493	
15 minute summer	SW7	2.001	SW8	9.2	0.524	0.463	0.1919	
15 minute summer	SW8	2.002	SW9	20.0	1.134	0.999	0.0669	
15 minute summer	SW9	2.003	SW10	26.8	1.522	1.343	0.0951	
15 minute summer	SW10	2.004	SW11	33.7	1.913	1.694	0.2465	
120 minute winter	GEO	Pump	DEMARCATION	3.5				85.7
1440 minute winter	PERM PAVE	Orifice	SW11	0.1				

Appendix L – Exceedance Routes



EXCEEDANCE ROUTE – SHOULD A STORM EVENT GREATER THAN 1:100YR + 40% CLIMATE CHANGE EVENT OCCUR, WATERS WOULD HEAD ALONG ST ALBANS ROAD TOWARDS THE UNNAMED WATERCOURSE TO THE WEST OF BLANCHE LANE

REV	DATE	BY	DESCRIPTION	CHK	APD

DRAWING STATUS: PLANNING APPLICATION

1st Floor Millers House, Roydon Road,
Stanstead Abbotts, Hertfordshire, SG12 8HN
Tel: 01920 871777
www.eastp.co.uk

CLIENT: GRIGGS (SOUTH MIMMS) LIMITED

ARCHITECT:

PROJECT: THE WHITE HART, SOUTH MIMMS, HERTSMERE

TITLE: EXCEEDANCE ROUTES

SCALE @ A1:	DESIGN–DRAWN:	DATE:
1:100	MD	29.09.2023

PROJECT No:	DRAWING No:
3991	SK06–SUDS

Appendix M - Klargester Treatment Device Mitigation Indices

Pollutant retention

It is important to ensure that pollutants in a rainfall event are retained throughout subsequent events. The Downstream Defender® Select offers engineers the option of specifying the retention performance of sediments. The **Vortex** and **Vortex Plus** models provide sediment retention up to twice the treatment flow rate, and the **Advanced Vortex**, with its benching skirt creating a calm sediment storage zone, provides sediment retention up to four times the treatment flow rate.

An option for enhancing the retention of hydrocarbons (oils) by storing them as a solid is available, ensuring no wash out during extremely high flows. This option is only is only available for the **Advanced Vortex** and **Vortex Plus** models

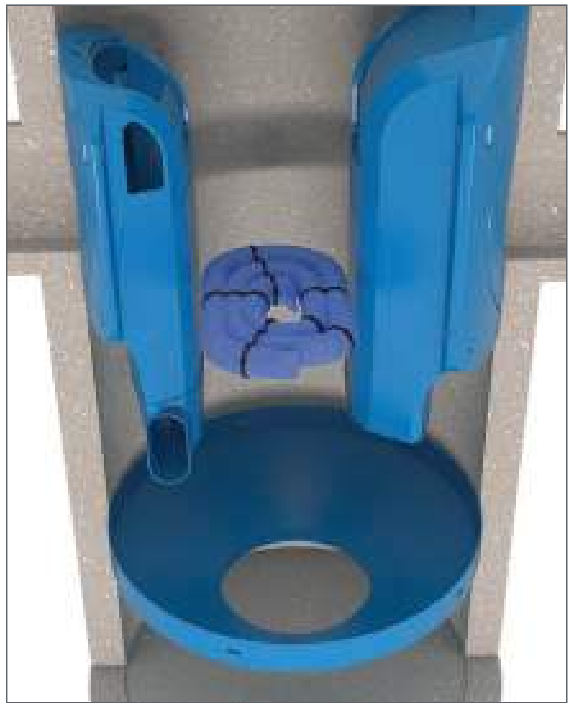


Fig 4. Downstream Defender® Select with enhanced sediment retention and enhanced hydrocarbon (oil) retention options.

The Simple Index Approach (SIA)

The Simple Index Approach outlined in CIRIA C753 The SuDS Manual is a water quality design method for sites with a low to medium risk pollution hazard level. Sites with a high risk pollution hazard level should consider a more precautionary approach.

The approach assigns pollution hazard indices to the given land use for three pollutant groups, total suspended solids (TSS), metals and hydrocarbons. SuDS components are then selected until their combined pollution mitigation index score is greater than the pollution hazard index for each pollutant group.

Model	Downstream Defender® Select Mitigation Indices (a)(b)		
	Total Suspended Solids (TSS)	Metals	Hydrocarbons (Oils)
Vortex	0.3	0.2	0.2
Vortex Plus	0.5	0.4	0.5
Advanced Vortex	0.5	0.4	0.5

Notes:

(a) All mitigation indices supplied by Hydro International Ltd are independently verified and calculated using the methods laid out in the British Water How To Guide: Applying the CIRIA SuDS Manual Simple Index Approach to Proprietary / Manufactured Stormwater Treatment Devices. Performance declarations are available on request or on the British Water website.

(b) Mitigation Indices quoted for the Downstream Defender® Select are valid when the unit is designed according to the Treatment Flow Rate (see Table 3).

Table 2 - SuDS Mitigation Indices for Downstream Defender® Select

Sizing a Downstream Defender® Select

The Downstream Defender® can be sized for different treatment goals and objectives. For design purposes, the selected model's Treatment Flow Rate should be greater than or equal to the site's Water Quality Flow Rate.

The hydraulic capacity of the selected model should be considered with respect to the peak discharge flow rate from the site.

If there is no treatment objective, just betterment, do not use a treatment flow rate and only compare the hydraulic capacity to the peak discharge flow rate.

Model diameter (m)	Treatment flow rate (a)(b) (l/s)	Hydraulic capacity (c) with recommended pipe size (l/s)	Hydraulic capacity (d) with maximum pipe size (l/s)	Maximum catchment area m^2	Maximum headloss at treatment flow rate (mm)
1.0	21	46	70	2800	160
1.2	30	84	107	4000	170
1.5	48	144	170	6400	220
1.8	69	217	278	9200	230
2.1	94	271	355	12500	240
2.4	123	422	529	16400	250
3.0	192	652	787	25600	260

Notes:

(a) The Treatment Flow Rate is based on an annualised removal efficiency of >50% of all particles up to 1000 microns with a mass-median particle size (D50) of 63 microns and a specific gravity of 2.65. The testing was conducted in line with the British Water Code of Practice.

(b) Alternative sizing based on different sediment grades available on request.

(c) Maximum flow rate that can pass through the chamber with a maximum headloss of 500mm. Figures shown are when using the recommended pipe size in Table 5.

(d) Maximum flow rate that can pass through the chamber with a maximum headloss of 500mm. Figures shown are when using the maximum pipe size in Table 5.

Table 3 - Downstream Defender® Select design information.

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