WH179

January 2023

Anglia Square, Norwich
Proposed Surface Water Drainage Strategy
Rev C

Weston Homes

EAS

Document History

JOB NUMBER: 3831/2022
DOCUMENT REF: SUDS/3831/2022

REVISIONS: F – REV C SUBMISSION

Revision	Comments	By	Checked	Authorised	Date
A	Client Draft	MD/JP	SA	SA	07.03.2022
B	Final	MD	MD	SA	01.04.2022
C	REV A SUBMISSION	MD	MD	SA	14.07.2022
D	REV A SUBMISSION	MD	MD	SA	15.07.2022
E	REV B SUBMISSION	MD	MD	SA	22.09.2022
F	REV C SUBMISSION	MD	MD	SA	27.01.2023

This document has been prepared for the sole use of Weston Homes. Its content should not be relied upon by others without the written authority of EAS Transport Planning Ltd. If any unauthorised third party makes use of this report they do so at their own risk and EAS Transport Planning Ltd owe them no duty of care or skill.

The content of this report is based on information available as of September 2022, the validity of the statements made may therefore vary over time as planning guidance / policies and the evidence base change.

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG **Tel 01920 871 777** **e: contact@eastp.co.uk** **www.eastp.co.uk**

EAS

Contents

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG **Tel 01920 871 777** **e: contact@eastp.co.uk** **www.eastp.co.uk**

EAS

1 Introduction

1.1 A hybrid planning application (Ref. 22/00434/F) (the Application) was submitted by Weston Homes (the Applicant) to Norwich City Council (NCC) on 1st April 2022 for the comprehensive redevelopment of Anglia Square and various parcels of mostly open surrounding land, (the Site), as shown within a red line on drawing 'ZZ-00-DR-A-01-0200'. The Application comprised a full set of technical documents to assess the potential impacts of the proposals, including an EIA which covered a number of topics. In respect of SuDS Drainage Strategy, this was described and explained in the Surface Water Drainage Strategy Report (Rev B dated 01.04.2022). Please refer to the original documents for further details. NB: this version of the Surface Water Drainage Strategy Report supersedes previous issues and any Addendum letters and should be read in conjunction with the Flood Risk Assessment by Royal Haskoning DHV.

1.2 Application Ref. 22/00434/F follows a previous application on a somewhat smaller development parcel, (NCC Ref. 18/00330/F) made jointly by Weston Homes Plc as development partner and Columbia Threadneedle Investments, (CTI), the Site's owner, for a residential-led mixed use scheme consisting of up to 1,250 dwellings with decked parking, and 11,000 sqm GEA flexible ground floor retail/commercial/non-residential institution floorspace, hotel, cinema, multi-storey public car park, place of worship, and associated public realm and highway works. This was subject to a Call-in by the Secretary of State (PINS Ref. APP/G2625/V/19/3225505) who refused planning permission on 12th November 2020, (the 'Call in Scheme').

1.3 Following submission of the Application Ref. 22/00434/F, and completion of the statutory consultation exercise, amended application material (RevA) was submitted in July 2022 in response to consultation comments. Following completion of the second statutory consultation on the RevA material, the Applicant has worked with NCC to review the consultation responses received to identify an appropriate response where considered relevant. As a result of consideration of these comments, as well as ongoing discussions with NCC, some further minor amendments are now proposed which are summarised in the Planning Statement Addendum. The Amended Application material (RevB) submitted in September 2022 continues to seek consent for up to 1,100 dwellings and up to 8,000 Sqm (NIA) non-residential floorspace and associated development. However, since the amendments result in minor changes to the full development description, an updated version of the full Amended Application description is contained in **Appendix A** along with the Site Location Plan.

1.4 This update to the Surface Water Drainage Strategy Report sets out where necessary a response to the drainage related comments received on the Rev-A application material, then describes how the design has been developed and adapted as a result of these and other comments, and finally considers the implications of the changes to the scheme now proposed.

1.5 The proposed Outline/Full Planning Application Boundaries and Development Proposals are contained in **Appendix B.**

1.6 A summary of the drainage related comments on the Application are contained in **Appendix C**.

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG **Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk**

1.7 A separate report, undertaken by Royal Haskoning DHV, deals with the flood risk assessment, hydraulic modelling study and impact assessment and should be read in conjunction with this report.

1.8 The Application Description and Location Plan are contained in **Appendix A**.

2 Policy Framework and Pre-Application Comments

Local Policy

Greater Norwich Local Plan

2.1 The GNLP was submitted to the Secretary of Stage for independent examination on 30th July 2021. The emerging plan allocates the Anglia Square site (GNLP0506) for Mixed Use Allocation.

2.2 Emerging Policy: GNLP Policy 2 would be anticipated to reduce the risk of fluvial flooding that may arise as a result of development, through the requirement to carry out flood risk assessments, and incorporate sustainable drainage measures.

2.3 Emerging Policy : GNLP Policy 2 would be anticipated to mitigate the risk of surface water flooding that may arise as a result of development, through the requirement for development to incorporate sustainable drainage measures and contribute to the green infrastructure cover.

2.4 A SuDS drainage plan incorporating sustainable drainage (SuDS) is included in Section 7, detailing how surface water will be managed on the site and the rationale for the approaches used. Surface water runoff from the site will be restricted as far as possible to ensure that the risk of flooding both to the site and elsewhere is minimised, taking into account the effects of climate change.

2.5 This section sets out the policy context. This FRA is based on the advice set out in the National Planning Policy Framework (NPPF) published in July 2021, the Planning Practice Guidance (PPG) published March 2014, which is updated on an ad hoc basis and Annex 3: Flood risk vulnerability classification.

Development Management Policies Local Plan

2.6 The Development Management Policies Plan (DM policies) sets out policies which will apply across the whole city, as well as policies which apply in designated areas.

Policy DM5 – Planning effectively for flood resilience' details the policy for flooding, sustainable drainage and surface water flooding and surface treatment. The policy states:

"*Developers will be required to show that the proposed development:*

> *-would not increase the vulnerability of the site, or the wider catchment, to flooding from surface water run-off from existing or predicted water flows; and*
>
> *-would, wherever practicable, have a positive impact on the risk of surface water flooding in the wider area.*

Development must, as appropriate, incorporate mitigation measures to reduce surface water runoff, manage surface water flood risk to the development itself and to others, maximise the use of permeable materials to increase infiltration capacity, incorporate on-site water storage and make use of green roofs and walls wherever reasonably practicable.

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk

The use of permeable materials, on-site rainwater storage, green roofs and walls will be required unless the developer can provide justification to demonstrate that this would not be practicable or feasible within the constraints or configuration of the site, or would compromise wider regeneration objectives."

2.7 The landscaping of the development in terms of surface water management is also considered in Policy DM5. This states:

"Development proposals will be required to maximise the use of soft landscaping and permeable surfacing materials unless the developer can provide justification to demonstrate that this is not feasible.

Where permission is required, proposals involving the provision of new or replacement paved and other impermeable surfaced areas will only be permitted:

-in areas of impermeable soils as identified in Appendix 1;

-in other areas where it can be demonstrated that permeable surfaces are not practicable due to poor soil infiltration capacity, high groundwater levels or risk of subsidence; and

-in areas with soils with average or good infiltration capacity, where it can be demonstrated that there is an exceptional and overriding justification for such surfaces.

In cases where poor soil infiltration capacity or other factors preclude the use of permeable surfacing materials, development proposals should seek to manage and minimise the impact of surface water run-off by suitable measures for water storage on-site."

2.8 A SuDS drainage plan incorporating sustainable drainage (SuDS) is included in Section 7, detailing how surface water will be managed on the site and the rationale for the approaches used. Surface water runoff from the site will be restricted as far as possible to ensure that the risk of flooding both to the site and elsewhere is minimised, taking into account the effects of climate change.

Natural England and Nutrient Neutrality Assessments

2.9 In In March 2022, Natural England issued a letter to Local Planning Authorities, Environment Agency and all Heads of Planning and Chief Executives to give advice for development proposals with the potential to affect water quality resulting in adverse nutrient impacts on habitats and sites. The letter provides advice on the assessment of new plans and projects under Regulation 63 of the Habitats Regulations. The purpose of that assessment is to avoid adverse effects occurring on habitats sites as a result of the nutrients released by those plans and projects. This advice does not address the positive measures that will need to be implemented to reduce nutrient impacts from existing sources, such as existing developments, agriculture, and the treatment and disposal of wastewater. It proposes that nutrient neutrality might be an approach that planning authorities wish to explore.

2.10 The following background is given:

"In freshwater habitats and estuaries, poor water quality due to nutrient enrichment from elevated nitrogen and phosphorus levels is one of the primary reasons for habitats sites being in unfavourable condition. Excessive levels of nutrients can cause the rapid growth of certain plants through the process of eutrophication. The effects of this look different depending on the habitat, however in each case, there is a loss of biodiversity, leading to sites

being in 'unfavourable condition'. To achieve the necessary improvements in water quality, it is becoming increasingly evident that in many cases substantial reductions in nutrients are needed. In addition, for habitats sites that are unfavourable due to nutrients, and where there is considerable development pressure, mitigation solutions are likely to be needed to enable new development to proceed without causing further harm.

In light of this serious nutrient issue, Natural England has recently reviewed its advice on the impact of nutrients on habitats sites which are already in unfavourable condition. Natural England is now advising that there is a risk of significant effects in more cases where habitats sites are in unfavourable condition due to exceeded nutrient thresholds. More plans and projects are therefore likely to proceed to appropriate assessment.

The principles underpinning HRAs are well established. At the screening stage, plans and projects should only be granted consent where it is possible to exclude, on the basis of objective information, that the plan or project will have significant effects on the sites concerned. Where it is not possible to rule out likely significant effects, plans and projects should be subject to an appropriate assessment. That appropriate assessment must contain complete, precise and definitive findings which are capable of removing all reasonable scientific doubt as to the absence of adverse effects on the integrity of the site.

Appropriate assessments should be made in light of the characteristics and specific environmental conditions of the habitats site. Where sites are already in unfavourable condition due to elevated nutrient levels, Natural England considers that competent authorities will need to carefully justify how further inputs from new plans or projects, either alone or in combination, will not adversely affect the integrity of the site in view of the conservation objectives. This should be assessed on a case-by-case basis through appropriate assessment of the effects of the plan or project. In Natural England's view, the circumstances in which a Competent Authority can allow such plans or projects may be limited. Developments that contribute water quality effects at habitats sites may not meet the no adverse effect on site integrity test without mitigation.

Mitigation through nutrient neutrality offers a potential solution. Nutrient neutrality is an approach which enables decision makers to assess and quantify mitigation requirements of new developments. It allows new developments to be approved with no net increase in nutrient loading within the catchments of the affected habitats site.

Where properly applied, Natural England considers that nutrient neutrality is an acceptable means of counterbalancing nutrient impacts from development to demonstrate no adverse effect on the integrity of habitats sites and we have provided guidance and tools to enable you to do this."

2.11 A Nutrient Neutrality Assessment is to be undertaken by others and will be submitted as part of this planning application.

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG **Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk**

3 Existing Site Assessment

Existing Site Description

3.1 The site is located at Anglia Square, Norwich and consists of a shopping precinct including stores such as Iceland and Boots and a former cinema. Large office blocks are also present at the site; the disused seven-storey Sovereign House which runs north-south along Botolph Street previously housed Her Majesty's Stationary Office (HMSO) and the under-utilised six-storey Gildengate House, built over shops underneath. The Full and Outline Application boundaries cover a combined area of 4.65ha – which also includes some areas of adopted highway.

3.2 The existing site is almost entirely impermeable and is served by both private and adopted foul and surface water sewers. Surface water run-off is unrestricted and untreated and ultimately outfalls to the adopted sewer network to the south-east of the site. This is further evidenced and discussed below.

Site Levels

3.3 A site-specific topographical survey (including a utilities/drainage survey) is included in Appendix D. For the main Anglia Square site, levels vary between 5.09m AOD in the north west corner to 2.40m AOD at the existing access road from St Crispin's Road to the south of the site. Away from this low spot, levels in the south east corner of the site are in the region of 3.08m AOD. For the existing Anglia Square shopping centre, levels are around 3.51m AOD. The site slopes in a generally south easterly direction at a gradient of approximately 1:125.

3.4 The parcel north west of New Botolph Street slopes in a southerly direction, at a gradient of approximately 1:185 with the highest level to the north west of the site at 5.40m AOD and the lowest level at 5.11m AOD at the southern extent of the parcel. The site is approximately 0.35-0.4m higher than the carriageway of New Botolph Street/ Edward Street.

3.5 North of Edward Street the site slopes towards the north, at a gradient of approximately 1:100, with the highest point in the south west corner at a level of 4.27m AOD and the lowest point in the north at 3.87m AOD.

Sewer Network

3.6 Sewer records, obtained from Anglian Water and included in Appendix E, show there to be a 850mm/24" surface water sewer and 300mm foul sewer flowing in a south westerly direction through the site. It should be noted that a drainage survey of the surface water sewer crossing Anglia Square shows this to be a 675dia sewer and not 850dia/24" as indicated on the sewer records. For ease and in line with the gathered survey data, this sewer shall be referred to as 675dia throughout the remainder of this report.

3.7 A 300mm surface water sewer and 225mm foul sewer also run west to east with Edward Street, to the north of the main portion of the site. Both sewers connect to the respective foul and surface water sewers in Magdalen Street before flowing southwards with surface water sewers discharging into the River between Fye Bridge Street and Whitefriars Bridge.

3.8 A further 525mm combined sewer flows southwards along Magdalen Street. It is highly likely that surface water flows from the Dalymond Dyke flow within this sewer, given the location of the sewer and the available information on the Dalymond Dyke.

3.9 The sewer locations and sizes within the site boundary are shown in more detail on the topographical survey contained in Appendix D.

Pre-Development Run-off Rate

3.10 The total site area covers 4.65ha and is entirely brownfield comprising a shopping centre, office block, paved open spaces and car parks with some areas of landscaping and planting. The existing impermeable area (not including adopted highway) has been measured at 4.1768ha.

3.11 In order to calculate the brownfield (existing) surface water runoff rates from the proposed development site, a review of the Anglian Water sewer mapping, the topographical survey (including utility and drainage survey data) and CCTV drainage surveys was undertaken to determine the existing catchment areas and existing drainage features that serve the site.

3.12 The topographical survey is contained in Appendix D and Anglian Water Sewer Mapping is contained in Appendix E. A CCTV drainage survey, undertaken by Draincare Environmental Ltd is contained in Appendix F.

3.13 The CCTV drainage survey of the 675dia sewer crossing Anglia Square shows a number of incoming connections from the north and south of the sewer. These are summarised below and for ease, are clearly indicated on the last page of Appendix F.

- Ex. Connection 1 – outfall to 225dia sewer in Edward Street – Edward Street Area 1 and page 48 of the cctv survey report in Appendix F.
- Ex. Connection 2 – outfall to 300dia sewer in Edward Street via 0458 – Edward Street Area 2 and page 56 of the cctv survey report.
- Ex. Connection 3 – outfall to 675dia sewer at mh 0453 – Plan 1 and page 32 of the cctv survey report in Appendix F.
- Ex. Connections 4 to 9 – outfalls to 675dia sewer between mhs 9460 and 9459 – shown as junctions on page 45 of the cctv survey report.
- Ex. Connection 10 – outfall to 675dia sewer – shown as junction on page 33 of the cctv survey report in Appendix F.
- Ex. Connection 11 – outfall to 675dia sewer - see Plan 2, Plan 4 and page 13 of the cctv survey report in Appendix F.
- Ex. Connection 12 – outfall to 675dia sewer - see Plan 3 and shown as junction on page 39 of the cctv survey report in Appendix F.

3.14 The CCTV drainage survey connections, when compared against the topographical/drainage survey verifies these connections and proves that the site is served by a private surface water drainage system that freely outfalls to the adopted sewer network, aside from the brown-coloured car park area shown on SK01-D in Appendix G.

3.15 In order to calculate the existing outfall rates, the LLFA in their consultation comments (ref FW2022_0423), requested that FEH Methods in line with CIRIA SuDS Manual C753 should be applied. Section 24.5 in the CIRIA SuDS Manual C753 discusses Peak Run-of Rates for Previously Developed Sites as below:

Runoff characteristics for a previously developed site can be estimated in a number of ways:

1 Any land that has been previously developed is likely to have had a system in place to drain surface water runoff from the site. This drainage system may or may not have included storage and flow control systems. Where any drainage system is still operational, peak flow rates at the outfall for the relevant return periods (usually 1:1 year, 1:30 year and 1:100 year) can be demonstrated by producing a simulation model that includes an accurate representation of the drainage system and site area contributions – thus allowing derivation of an appropriate head–discharge relationship at the outfall.

It is recognised that existing drainage systems will probably be overwhelmed for the 1:30 and 1:100 year events and therefore the actual rate of discharge from the site in such scenarios is likely to be increased by overland flow contributions or surcharging. However, these effects should not be accounted for, and the discharge limit should be based solely on the flow rate from the piped system (thus providing a conservative estimate).

3.16 As the topographical survey contains details of the existing drainage system, it is possible to produce a simulation model that includes an accurate representation of the drainage system and site area contributions – thus allowing derivation of an appropriate head-discharge relationship at the outfall.

3.17 SK01-D in Appendix G shows the existing impermeable and permeable areas as well as the existing drainage systems serving the site and their catchment areas. The site is split into 8no. catchments areas. In their consultation comments (ref FW2022_0703) the LLFA requested that a section of landscaped area to the west of Area 4 (395m²) should be included in the brownfield runoff rates, as such, the greenfield runoff rate for this area shall be added to the calculations.

3.18 Greenfield Run-off Rates are discussed below. In order to avoid overestimation of brownfield runoff rates and provide a robust calculation, a brown-coloured car park area to the west of Area 3 (2814m²) is not included in the impermeable area as the drainage survey is incomplete and does not confirm where this area drains to. It would therefore be inappropriate to include this within the following calculations. The total contributing area for brownfield runoff is therefore 3.9577ha (including 395m² of landscaped area).

3.19 The CCTV Drainage survey and topographical drainage survey show that surface water runoff from the existing site (with the exception of the brown-coloured car park area of 2814m and landscaped areas of 1845m²) is directed adopted surface water sewers in Edward Street, the 675dia sewer crossing Anglia Square and the 36” sewer in Magdalen Street. Looking at SK01-D in Appendix G it can be determined:

- Outfalls to Edward Street Sewer:
  Area 1 (around 50% of this catchment) to AWMH 0452
  Area 2 (via a sewer in Beckham Place) to AWMH 0459
  Area 3 to AWMH 0451
  Area 4 to AWMH 0452

- Outfalls to 675dia Sewer:
  Area 1 (around 50% of this catchment) via AWMH 9462 in St Augustin Street
  Area 5 to AWMH 1352
  Area 7 to AWMH 0354
  Area 8 to AWMH 9459

- Outfalls to Magdalen Street sewer:

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG **Tel 01920 871 777** **e: contact@eastp.co.uk** **www.eastp.co.uk**

Area 6 to AWMH 1357

3.20 It is not possible to model a 1:1yr storm event with FEH data therefore, to ascertain what the equivalent 1:1yr outfall rate would be for an FEH storm, it is deemed appropriate to apply a percentage to the FEH calculated runoff. This percentage shall be based on runoff rates for a 1:1yr and 1:2yr storm event generated using FSR rainfall data using the formula below:

A FSR 1:1yr storm runoff is 20 l/s

A FSR 1:2yr storm runoff is 25 l/s

$20 \div 25 = 0.8$

As such, the 1:1yr runoff rate is 80% of the 1:2yr runoff rate

- If the FEH 1:2yr storm runoff is 23 l/s – the 1:1yr equivalent is 18.4 l/s

3.21 WINDES Microdrainage was used to model each existing catchment using FEH data for a range of storm events (whilst applying a MADD Factor of 0 as requested by the LLFA). As described above, FSR data was used to generate runoff rates for 1:1yr and 1:2yr storm events as a means to calculate a 1:1yr FEH equivalent. The hydraulic model results are contained in Appendix H and show brownfield runoff rate calculations for 1:1yr, 1:2yr, 1:30yr, 1:30yr+45%CC, 1:100yr and 1:100yr+45%CC rates.

3.22 1:1yr Brownfield Runoff Rates are summarised below and includes the greenfield runoff rate for the 395m² of landscaped area:

	Contributing Area (ha)	1:2 FEH l/s	1:1 FSR l/s	1:2 FSR l/s	% 1:1 to 1:2 FSR	1:1 FEH Equivalent l/s
Area 1	0.239	32.9	29.5	34.3	86.0	28.29
Area 2	0.125	25.1	18.5	24.1	76.8	19.27
Area 3	0.170	30.0	22.3	28.7	77.8	23.31
Area 4	0.352	61.0	45.4	58.1	78.1	47.67
Area 5	0.251	44.9	33.2	42.9	77.4	34.75
Area 6	0.105	16.4	12.7	15.8	80.4	13.18
Area 7	1.197	194.5	145.1	186.5	77.8	151.32
Area 8	1.479	209.1	164.1	200.8	81.7	170.88
395m2 landscape area	0.0395					(REFH2 0.9 l/s/ha) 0.036
Total	3.957	**613.9**	**470.8**	**591.2**		**488.706**

3.23 The 1:1yr brownfield runoff rate for the site is therefore **488.706 l/s.**

3.24 The 1:1yr brownfield runoff rate directed to the Edward Street Sewer is: 104.395 l/s.

3.25 The 1:1yr brownfield runoff rate directed to the 675dia sewer is: 371.131 l/s (including the green landscaped area).

3.26 The 1:1yr brownfield runoff rate directed to the Magdalen Street sewer is:13.18 l/s.

Pre-Development Storage Volumes

3.27 A simple analysis was carried out based on the topographical survey. The various sewers serving the existing site along with the diameters are shown on the topographic survey. These were measured and the available capacity in each sewer has been calculated. This analysis identified only the private sewers which outfall from the existing development to the adopted sewers but does not include the adopted sewers themselves or any outfall pipes from gullies or rainwater pipes. It is noted that there could be additional private sewers which haven't been picked up on the topographical survey so were not included in this analysis.

3.28 The storage volume available in the pipe network serving the existing brownfield site is as follows:

150dia @ 335.4m = 6.04m3
225dia @ 296.4m = 11.86m3
300dia @ 71.5m = 5.08m3
375dia @ 34.9m = 3.84m3

Assume 1m3 volume for each manhole. 37 x manholes = 37m^3

3.29 The total 'storage' volume available in the surface water sewers on the existing site is therefore approximately 63.82m3.

Existing Sewers, Diversions and Build-Overs

3.30 The proposals will require the adopted surface and foul water sewers which cross the site to be diverted. It is anticipated that a S185 Sewer diversion Application shall be made to Anglian Water which will preclude the need for any Build-Over Agreements. Further information on sewer diversions are contained in Section 4.

3.31 A number of private surface and foul water sewers serve the existing site. These sewers are not anticipated to be retained as part of the proposed surface water drainage strategy and will therefore be removed and new surface and foul water sewers provided. Removal/divestment of any sewers shall be agreed with Anglian Water as part of a S185 Application.

Greenfield Run-off Rates

3.32 The LLFA in their consultation comments (ref FW2022_0423 and FW2022_0703) request that greenfield runoff rates are provided and calculation using FEH rainfall data methods. Using hydraulic modelling software Causeway Flow, greenfield runoff rates for 1:1yr, 1:2yr, 1:30yr and 1:100yr storm events were calculated using FEH rainfall data and also using ReFH2 rainfall data. The results of which are contained in Appendix I, and show runoff rates for each proposed discrete drainage system – as outlined in Section 4 of this report.

3.33 Causeway Flow (and also MicroDrainage) hydraulic modeling software does not generate greenfield runoff rates including Climate Change Allowance. Causeway Flow were contacted to ascertain how a Climate Change Allowance could be applied to the generated greenfield flow rate, but they were unable to confirm how this could be done. For the purpose of discussion, it is proposed to apply a growth-factor to the greenfield run-off rates. As such, for 45% Climate Change Allowance, for that storm event, the greenfield runoff rate shall be multiplied by 1.45. So for a 1:100yr greenfield runoff rate of 1.0 l/s – to calculate a 1:100yr + 45% Climate Change event, 1.0 l/s shall be multiplied by 1.45 – giving a rate of 1.45 l/s.

3.34 Applying the 1:100yr + 45% Climate Change Event greenfield runoff rate, ReFH2 methods (5.9 litres per second per hectare), to the total application boundary (4.65ha) results in a rate of 27.435 l/s.

3.35 Applying the 1:100yr + 45% Climate Change Event greenfield runoff rate, ReFH2 methods (5.9 litres per second per hectare), to the total proposed contributing area (4.7ha) results in a rate of 27.73 l/s (NB Total contributiong area includes some off-site adopteable highway for robustness).

3.36 Applying the 1:100yr + 45% Climate Change Event greenfield runoff rate, FEH methods (2.9 litres per second per hectare), to the total application boundary (4.65ha) results in a rate of 13.485 l/s.

3.37 Applying the 1:100yr + 45% Climate Change Event greenfield runoff rate, FEH methods (2.9 litres per second per hectare), to the total proposed contributing area (4.7ha) results in a rate of 13.63 l/s (NB Total contributiong area includes some off-site adopteable highway for robustness).

3.38 Outfall rates to be applied to the proposed surface water drainage strategy are discussed below.

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS

Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG **Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk**

4 Proposed Drainage Strategy

Relevant SuDS Policy

4.1 The NPPF states that, "using opportunities provided by new development and improvements in green and other infrastructure to reduce the causes and impacts of flooding, (making as much use as possible of natural flood management techniques as part of an integrated approach to flood risk management)".

4.2 SuDS mimic the natural drainage system and provide a method of surface water drainage which can decrease the quantity of water discharged, and hence reduce the risk of flooding. In addition to reducing flood.

4.3 The SuDS management train incorporates a hierarchy of techniques and considers all three SuDS criteria of flood reduction, pollution reduction, and landscape and wildlife benefit. 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.

4.4 The philosophy of SuDS is to replicate as closely as possible the natural drainage from a site pre-development and to treat runoff to remove pollutants, resulting in a reduced impact on the receiving watercourses. The benefits of this approach are as follows:

- Reducing runoff rates, thus reducing the flood risk downstream.
- Reducing pollutant concentrations, thus protecting the quality of the receiving water body
- Groundwater recharge
- Contributing to the enhanced amenity and aesthetic value of development areas.
- Providing habitats for wildlife in developed areas, and opportunity for biodiversity enhancement.

Site Specific SuDS

4.5 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 4.1 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.

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk

Device	Description	Constraints / Comments	Appropriate
Living roofs (source control)	Provide soft landscaping at roof level which reduces surface water runoff.	Roof Terraces and Roof Gardens are proposed as part of this development.	Yes
Infiltration devices & Soakaways (source control)	Store runoff and allow water to percolate into the ground via natural infiltration.	Potential for high groundwater and contamination indicated due to brownfield site.	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.	Potential for high groundwater and contamination indicated due to brownfield site. Lined permeable paving is proposed in some pedestrian areas which are outside the main thoroughfares.	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.	Water butts are proposed for Block C and rainwater recycling for landlord use to wash-down bin stores is also proposed.	Yes
Swales (permeable conveyance)	Broad shallow channels that convey / store runoff, and allow infiltration (ground conditions permitting).	Due to spatial constraints, swales are not proposed for conveyance and due to potential for high groundwater not proposed for infiltration.	No
Bioretention System	Shallow landscaped depression that can reduce runoff rates and volumes and treat pollution through engineered soils and vegetation.	Bioretention systems and tree-pits are proposed throughout the public realm and alongside highways where possible and where spatial constraints allow.	Yes
Filter drains & perforated pipes (permeable conveyance)	Trenches filled with granular materials (to take flows from adjacent impermeable areas) that convey runoff while allowing infiltration.	Some areas of the site may be suitable for use of filter drains, however no infiltration is expected to be viable due to contamination. Filter drains would therefore be lined and used for Water Quality purposes to filter waters prior to outfall.	Yes
Filter Strips (permeable conveyance)	Wide gently sloping areas of grass or dense vegetation that remove pollutants from run-off from adjacent areas.	Potential for high groundwater and contamination indicated due to brownfield site.	No
Infiltration basins (end of pipe treatment)	Depressions in the surface designed to store runoff and allow infiltration.	High density city centre site Potential for high groundwater and contamination indicated due to brownfield site.	No
Wet ponds & constructed wetlands (end of pipe treatment)	Provide water quality treatment & temporary storage above the permanent water level.	High density city centre site so no landscaped areas for ponds and wetlands.	No
Attenuation Underground (end of pipe treatment)	Oversized pipes or geo-cellular tanks designed to store water below ground level.	These are proposed as the SuDS listed above will not achieve sufficient volumes to restrict to the required rate. This is likely to be used alongside other means of attenuation at the site to provide the required storage volume.	Yes

Table 4.1: Site Specific Sustainable Drainage

Site Specific SuDS

4.6 Where possible, rainwater harvesting features shall be incorporated in the proposals where it is suitable to do so. The suitability of rainwater harvesting features has been considered against the Environment Agency's Energy and carbon implications of rainwater harvesting and greywater recycling (Report: SC090018), available here: scho0610bsmq-e-e.pdf (publishing.service.gov.uk), which summarises its key findings as follows:

1. Buildings using harvested rainwater or treated greywater typically increase greenhouse gas emissions compared to using mains water, where total cradle to gate embodied and operational carbon are considered. For example over 30 years, where an 'average' 90m2 house has a RWH system with a polyethylene tank, the total carbon footprint is approximately 1.25 – 2 tonnes of carbon dioxide equivalent (CO2e). This is similar to one year of energy-related emissions from a house built to Code for Sustainable Homes Level 3 energy efficiency standards. The footprints of systems applied to commercial buildings vary widely, but over a 30 year lifespan were found to represent around one month's operational energy-related emissions in the hotel, office and schools studied.

2. With one exception, the operational energy and carbon intensities of the systems studied were higher than for mains water by around 40 per cent for a typical rainwater application, and over 100 per cent for most greywater applications. The exception is short retention greywater systems which are around 40 per cent less carbon intensive than mains water supply. The assumed operational intensities of rainwater and greywater systems are based on the limited measured data and information available to this study.

3. There is scope to improve the efficiency and design of systems to reduce their carbon footprints. Storage tanks account for a large proportion of the embodied carbon footprint of rainwater systems; slightly less so for greywater. Pumps also make up a large proportion of rainwater and greywater embodied carbon and pumping determines net operational carbon. Direct feed rainwater systems have a large operational footprint because both rainwater and mains backup are pumped to end uses via the storage tank. Innovation in these and other areas could reduce carbon footprints. Manufacturers and suppliers should work quickly to reduce the footprints of their systems, and particularly to reduce the energy intensity of pumps and treatment systems."

4.7 Taking the above into consideration, the proposals do not allow for rainwater harvesting for mixed-use areas as rainwater harvesting would need to be pumped for re-use. There is scope to provide suitable rainwater harvesting where the use of pumps is not required, this will be in the form of water-butts for individual properties and for above ground tanks to serve bin-wash down areas for mixed-use buildings.

4.8 The developer was asked to consider rainwater re-use for toilets in the Community Centre in Block D. An assessment on required tank size was undertaken using the calculator on www.rainwaterharvesting.co.uk/tank-size-calcuator/. Based on an average 25 flushes per day (considered to be a conservative estimate of use) and a contributing roof area of 265m2 (the non-green-roof-area of Block D), it is concluded that not enough rainwater is generated to make this viable, see screen-shot below. This also concludes that a rainwater harvesting

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG **Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk**

tank of volume 15,000 litres would be required (or 15m3) for which there is not space to provide within the community centre.

RainWater Harvesting

HOME | INFORMATION | PRODUCTS | RAINWATER SYSTEMS | ATTENUATION | CONTACT US | SHOP | CART: £0.00

HOW CAN RAINWATER HARVESTING HELP WITH HOSEPIPE BANS

WATER NEUTRALITY AND RAINWATER HARVESTING

SHALLOW VS DEEP DIG – CONSIDERATIONS WHEN INSTALLING YOUR RAINWATER HARVESTING TANK

WILL WE LEARN FROM THE ENERGY CRISIS OF TODAY?

RAINWATER HARVESTING REGULATIONS IN THE UK – WHAT YOU NEED TO KNOW BEFORE INSTALLATION

COLLECTABLE ROOF AREA (M²)

Main Building	Width:	26.5	Length:	10	Rain Collection Area:	265	m²
Extension one	Width:		Length:		Rain Collection Area:	0	m²
Extension Two	Width:		Length:		Rain Collection Area:	0	m²
Extension Three	Width:		Length:		Rain Collection Area:	0	m²
Or the total roof area, if you already know it:				0	Total area of collectable roof space:	265	m²
Select Your Region		England			Average rainfall per year in your region:	71	L
Collectable rainwater per annum in litres - discounted by 20% to account for water loss						**150520**	**L**

USE OF RAINWATER IN THE BUILDING

	people:	bedrooms:	
Number of people or bedrooms in the building -	25	0	
☐ Number of clothes washing cycles per day (*50 litres each*)	0.00 Cycles	0.00	L
✓ Number of toilet flushes per day (*4.42 flushes per person, average 5 litres each*)	110.50 Flushes	552.50	L
Outdoor use in litres, per person per day (*recommended 5 litres per person per day*)	0	0.00	L
Amount of water you require every day		552.5	L
Amount of water you require every year	**DEMAND**	**201662**	**L**

FINAL FIGURES

How many days drought protection do you need? Typically 21 (18 minimum)	21	
Capacity of water storage in litres required for drought protection	11602.50	L
The lesser of YIELD (blue) or DEMAND (green) per annum	150520	L
Therefore, volume of rainwater storage required	**8660**	**L**

CONCLUSION

Is there sufficient roof water available:		NOT ENOUGH RAINWATER
Recommended tank size from our shallow dig range:	F-Line Range:	USE MULTIPLE F-LINE TANKS [15,000 LITRES +]

4.9 The following assessment therefore forms the basis of Rainwater Harvesting features that could be viable at the proposed development site for each Block:

Block	Description	Constraints / Comments	Appropriate
Block A – Commercial and Residential. (Full Planning)	The use of filtered rainwater for reuse in toilets and washing machines.	Given the complex split of usages for the Blocks (residential vs commercial) the infrastructure needed to manage this and the possible risk/concern of maintenance and management of a system to serve private, communal and public use toilet water would be difficult to deliver effectively. The use of pumps would be unavoidable and would therefore contribute to the carbon footprint of the development.	No
	The use of filtered rainwater for reuse at outside taps.	Rainwater harvesting tanks to be incorporated for land- lord bin wash-down, which shall be fed by rainwater downpipes and managed and maintained solely by the landlord or elected Management and Maintenance Company. These rainwater harvesting tanks shall be located within the ground-floor bin stores and shall be fed by a nearby rainwater downpipe. Overflow from rainwater harvesting tank shall be directed back into the private surface water drainage network. NB: Gully from bin-wash-down area shall be directed to private foul water drainage network.	Yes
Block B – Residential. (Full Planning)	The use of filtered rainwater for reuse in toilets and washing machines.	There is potential for individual owners of the terraced houses within this Block to install a system in the future, however for commercial reasons it is not proposed for these residential units at this planning stage. It is not expected there will be opportunity for the leaseholder of the apartment block in Block B to retrofit rainwater harvesting however.	No
	The use of filtered rainwater for reuse at outside taps.	Rainwater Water-Butts are to be incorporated for the terraced houses along the northern boundary of Block B.	Yes
Block C – Residential. (Full Planning)	The use of filtered rainwater for reuse in toilets and washing machines.	For commercial and maintenance/management reasons it is not proposed to provide rainwater reuse for toilets for the apartment units at this planning stage.	No
	The use of filtered rainwater for reuse at outside taps.	Not possible for this Block due to possible leaseholder issues.	No
Block D – Commercial and Residential. (Full Planning)	The use of filtered rainwater for reuse in toilets and washing machines.	Given the complex split of usages for the Blocks (residential vs commercial) the infrastructure needed to manage this and the possible risk/concern of maintenance and management of a system to serve private, communal and public use toilet water would be difficult to deliver effectively. The use of pumps would be unavoidable and would therefore contribute to the carbon footprint of the development.	No
	The use of filtered rainwater for reuse at outside taps.	Rainwater harvesting tanks to be incorporated for land- lord bin wash-down, which shall be fed by rainwater downpipes and managed and maintained solely by the landlord or elected Management and Maintenance Company. These rainwater harvesting tanks shall be located within the ground-floor bin stores and shall be fed by a nearby rainwater downpipe. Overflow from rainwater harvesting tank shall be directed back into the private surface water drainage network. NB: Gully from bin-wash-down area shall be directed to private foul water drainage network.	Yes
	The use of filtered rainwater for reuse in toilets and washing machines.	Given the complex split of usages for the Blocks (residential vs commercial) the infrastructure needed to manage this and the possible risk/concern of maintenance and management of a system to serve private, communal and public use toilet water would be difficult to deliver effectively. The use of pumps would be unavoidable and would therefore contribute to the carbon footprint of the development.	No

Block E – Commercial and Residential. (Outline Planning)	The use of filtered rainwater for reuse at outside taps.	Rainwater harvesting tanks to be incorporated for land- lord bin wash-down, which shall be fed by rainwater downpipes and managed and maintained solely by the landlord or elected Management and Maintenance Company. These rainwater harvesting tanks shall be located within the ground-floor bin stores and shall be fed by a nearby rainwater downpipe. Overflow from rainwater harvesting tank shall be directed back into the private surface water drainage network. NB: Gully from bin-wash-down area shall be directed to private foul water drainage network.	Yes
Block F – Commercial and Residential. (Outline Planning)	The use of filtered rainwater for reuse in toilets and washing machines.	Given the complex split of usages for the Blocks (residential vs commercial) the infrastructure needed to manage this and the possible risk/concern of maintenance and management of a system to serve private, communal and public use toilet water would be difficult to deliver effectively. The use of pumps would be unavoidable and would therefore contribute to the carbon footprint of the development.	No
	The use of filtered rainwater for reuse at outside taps.	Rainwater harvesting tanks to be incorporated for land- lord bin wash-down, which shall be fed by rainwater downpipes and managed and maintained solely by the landlord or elected Management and Maintenance Company. These rainwater harvesting tanks shall be located within the ground-floor bin stores and shall be fed by a nearby rainwater downpipe. Overflow from rainwater harvesting tank shall be directed back into the private surface water drainage network. NB: Gully from bin-wash-down area shall be directed to private foul water drainage network.	Yes
Block G – Commercial and Residential. (Outline Planning)	The use of filtered rainwater for reuse in toilets and washing machines.	Given the complex split of usages for the Blocks (residential vs commercial) the infrastructure needed to manage this and the possible risk/concern of maintenance and management of a system to serve private, communal and public use toilet water would be difficult to deliver effectively. The use of pumps would be unavoidable and would therefore contribute to the carbon footprint of the development.	No
	The use of filtered rainwater for reuse at outside taps.	Rainwater harvesting tanks to be incorporated for land- lord bin wash-down, which shall be fed by rainwater downpipes and managed and maintained solely by the landlord or elected Management and Maintenance Company. These rainwater harvesting tanks shall be located within the ground-floor bin stores and shall be fed by a nearby rainwater downpipe. Overflow from rainwater harvesting tank shall be directed back into the private surface water drainage network. NB: Gully from bin-wash-down area shall be directed to private foul water drainage network.	Yes
Block H – Commercial and Residential. (Outline Planning)	The use of filtered rainwater for reuse in toilets and washing machines.	Given the complex split of usages for the Blocks (residential vs commercial) the infrastructure needed to manage this and the possible risk/concern of maintenance and management of a system to serve private, communal and public use toilet water would be difficult to deliver effectively. The use of pumps would be unavoidable and would therefore contribute to the carbon footprint of the development.	No
	The use of filtered rainwater for reuse at outside taps.	Rainwater harvesting tanks to be incorporated for land- lord bin wash-down, which shall be fed by rainwater downpipes and managed and maintained solely by the landlord or elected Management and Maintenance Company. These rainwater harvesting tanks shall be located within the ground-floor bin stores and shall be fed by a nearby rainwater downpipe. Overflow from rainwater harvesting tank shall be directed back into the private surface water drainage network. NB: Gully from bin-wash-down area shall be directed to private foul water drainage network.	Yes
	The use of filtered rainwater for reuse in toilets and washing machines.	Given the complex split of usages for the Blocks (residential vs commercial) the infrastructure needed to manage this and the possible risk/concern of maintenance and management of a system to serve private, communal and public use toilet water would be difficult to	No

Block J – Commercial and Residential. (Outline Planning)		deliver effectively. The use of pumps would be unavoidable and would therefore contribute to the carbon footprint of the development.	
	The use of filtered rainwater for reuse at outside taps.	Rainwater harvesting tanks to be incorporated for land- lord bin wash-down, which shall be fed by rainwater downpipes and managed and maintained solely by the landlord or elected Management and Maintenance Company. These rainwater harvesting tanks shall be located within the ground-floor bin stores and shall be fed by a nearby rainwater downpipe. Overflow from rainwater harvesting tank shall be directed back into the private surface water drainage network. NB: Gully from bin-wash-down area shall be directed to private foul water drainage network.	Yes
Block J3 – Commercial and Residential. (Full Planning)	The use of filtered rainwater for reuse in toilets and washing machines.	Given the complex split of usages for the Blocks (residential vs commercial) the infrastructure needed to manage this and the possible risk/concern of maintenance and management of a system to serve private, communal and public use toilet water would be difficult to deliver effectively. The use of pumps would be unavoidable and would therefore contribute to the carbon footprint of the development.	No
	The use of filtered rainwater for reuse at outside taps.	Rainwater harvesting tanks to be incorporated for land- lord bin wash-down, which shall be fed by rainwater downpipes and managed and maintained solely by the landlord or elected Management and Maintenance Company. These rainwater harvesting tanks shall be located within the ground-floor bin stores and shall be fed by a nearby rainwater downpipe. Overflow from rainwater harvesting tank shall be directed back into the private surface water drainage network. NB: Gully from bin-wash-down area shall be directed to private foul water drainage network.	Yes
Block K/L – Commercial and Residential. (Full Planning)	The use of filtered rainwater for reuse in toilets and washing machines.	Given the complex split of usages for the Blocks (residential vs commercial) the infrastructure needed to manage this and the possible risk/concern of maintenance and management of a system to serve private, communal and public use toilet water would be difficult to deliver effectively. The use of pumps would be unavoidable and would therefore contribute to the carbon footprint of the development.	No
	The use of filtered rainwater for reuse at outside taps.	Rainwater harvesting tanks to be incorporated for land- lord bin wash-down, which shall be fed by rainwater downpipes and managed and maintained solely by the landlord or elected Management and Maintenance Company. These rainwater harvesting tanks shall be located within the ground-floor bin stores and shall be fed by a nearby rainwater downpipe. Overflow from rainwater harvesting tank shall be directed back into the private surface water drainage network. NB: Gully from bin-wash-down area shall be directed to private foul water drainage network.	Yes
Block M – Commercial and Residential. (Full Planning)	The use of filtered rainwater for reuse in toilets and washing machines.	Given the complex split of usages for the Blocks (residential vs commercial) the infrastructure needed to manage this and the possible risk/concern of maintenance and management of a system to serve private, communal and public use toilet water would be difficult to deliver effectively. The use of pumps would be unavoidable and would therefore contribute to the carbon footprint of the development.	No
	The use of filtered rainwater for reuse at outside taps.	Rainwater harvesting tanks to be incorporated for land- lord bin wash-down, which shall be fed by rainwater downpipes and managed and maintained solely by the landlord or elected Management and Maintenance Company. These rainwater harvesting tanks shall be located within the ground-floor bin stores and shall be fed by a nearby rainwater downpipe. Overflow from rainwater harvesting tank shall be directed back into the private surface water drainage network. NB: Gully from bin-wash-down area shall be directed to private foul water drainage network.	Yes

Table 4.2: Site Specific Rainwater Harvesting

Post- Development Run-off Rate

4.10 Given the potentially high groundwater and contamination of the site, infiltration is not recommended. The Royal Haskoning DHV FRA Report (Section 7.11, Table 5) discusses borehole data and shows historic groundwater borehole information showing a winter (January 1993) groundwater level of 2.40m bgl and a spring (May 1993) groundwater level of 4.40m bgl. The relatively high groundwater levels precludes the use of infiltration devices. There are no nearby watercourses to which a connection could be made, and therefore it is proposed that the development will drain to the existing Anglian Water surface water network in the vicinity of the site (matching the existing situation), however at a restricted discharge rate in order to provide a betterment.

4.11 The greenfield runoff rates provided in Section 3 above are very low due to the local geology of chalk. However, in reality the site is almost entirely impermeable, historical mapping shows the site has been developed since at least 1885 and has been a shopping/town centre for many years. The site is Brownfield and it is therefore considered appropriate to review the existing run-off rates with a view to provide a betterment. Using greenfield run-off rates for a site which has been brownfield for over 137 years is inappropriate and would result in excessive attenuation volumes and therefore tank sizes, which could have impacts on other features such as the local archaeology, groundwater and geology.

4.12 S3 of the Non-Adoptable Technical Standards for Sustainable Drainage Systems (2015) 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."

4.13 As discussed in para. 3.32 above, the 1:100yr + 45% Climate Change greenfield runoff rate for the entire application site (4.65ha) is 27.435 l/s. An assessment of whether it is practicable to restrict flows from the development site to match greenfield runoff rates was undertaken by applying the greenfield runoff rate for the entire application boundary of 27.435 l/s to the largest proposed catchment Block A, M, K/L and J3. Using WINDES Microdrainage Source Control, the storage volume, using greenfield runoff rate was calculated at: <u>832.9m3</u> requiring a geocellular storage device size of 525m2 x 1.67m x 95% voids. When allowing for a proposed outfall rate of 65 l/s (based on a reduced brownfield/existing run-off rate), the storage volume requirement is calculated as 682.2m3 requiring a geocellular storage device size of 430m2 x 1.67m x 95% voids. This is an increase of 150.7m3 of volume that would be required if using the total 1:100yr + 45% CC greenfield run-off rate for a 1:100yr + 45% CC Storm Event. Refer to **Appendix J** for hydraulic calculations and a sketch showing the sizes of attenuation. Taking into consideration that additional storage volume will be required for some proposed catchments which may rely on a pumped outfall, it is clear that spatial constraints prevent the use of greenfield run-off rates being applied. This assessment shows that it is not possible or practicable to apply greenfield runoff rates.

4.14 S3 above concludes that where it is not reasonably practicable to match peak runoff rates that are directed to a drain or sewer to greenfield rates – proposed rates <u>"should never exceed the rate of discharge from the development prior to redevelopment for that event"</u>

4.15 As it is not practicable to restrict flows from the proposed development site to greenfield runoff rates and the proposals are to direct flows to the adopted sewer network (as per existing), in order to determine an appropriate proposed outfall rate, Anglian Water were consulted. A Pre-Development Assessment Report confirmed that a total discharge rate of 242 l/s would be acceptable, see **Appendix K**. Subsequent discussions with Anglian Water during the consultation period addressed the proposed outfall points and outfall rates. Anglian Water provided a further email statement to confirm that the proposed outfall rates (pumped and gravity) and proposed outfall points were acceptable, this email is contained in **Appendix L**.

4.16 In order to confirm the determined maximum outfall rate of 242 l/s shall never exceed the rate of discharge from the development prior to redevelopment for each storm event, the assessment below looks at the brownfield runoff rates for 1:1yr, 1:30yr and 1:100yr events and compares these with the proposed maximum 242 l/s outfall rate:

	Existing Run-off Rate	Proposed Run-off Rate	Reduction
1:1 Yr Storm	488.706 l/s	242 l/s	-246.706 l/s
1:30 Yr Storm	1439.119 l/s	242 l/s	-1197.119 l/s
1:100yr Storm	1781.933 l/s	242 l/s	-1539.933 l/s

4.17 It is clear from the above assessment that the proposed maximum outfall rate of 242 l/s to manage all storms up to and including the 1:100yr + 45% Climate Change Event shall significantly reduce flows from the development site for all storm events. The proposed 242 l/s is the equivalent of 49.5% of the existing 1:1yr brownfield run-off rate and therefore satisfies S3 of the Non-Adoptable Technical Standards for Sustainable Drainage Systems (2015). This rate and the proposed outfall points are acceptable to Anglian Water as discussed in **Appendix L** and shall therefore inform the proposed surface water drainage strategy as follows.

Proposed Drainage Strategy

4.18 In accordance with the Environment Agency's May 2022 published Climate Change Allowances, all surface water drainage is to be designed to a 1:100yr + 45% Climate Change Event. As per LLFA's Developer Guidance, FEH Rainfall Data shall be used within the hydraulic models whilst also applying a MADD Factor of 0. As requested by the LLFA, the hydraulic model assumes that adopted sewers are running at full bore and will be surcharged to the top of pipe.

4.19 The proposed drainage systems shall be hydraulically modelled to test a 1:1yr Storm, 1:30yr Storm, 1:30yr + 40% Climate Change Storm, a 1:100yr Storm and finally a 1:100yr + 45% Climate Change Event.

4.20 As discussed above, the total maximum outfall rate of 242 l/s, to manage all storms up to and including the 1:100yr + 45% Climate Change Event will match 49.5% of the existing 1:1yr brownfield runoff rate – providing a significant betterment to the existing situation for all storm events.

4.21 The former Barclays Bank building in the north east corner of the site and Surrey Chapel in the south-west corner of the site are existing buildings which are outside the Application Boundary. These are to be retained along with the drainage networks which serve them. Run-off from these areas shall not be included within the proposed surface water drainage networks. It is intended to ensure that any drainage pipework serving these buildings that may cross into the Application Boundary will be diverted accordingly if required.

4.22 This maximum outfall rate of 242 l/s shall be proportioned to each proposed catchment area, taking into account the contributing area and spatial constraints whilst ensuring that flow rates to each adopted sewer do not exceed existing 1:1yr Brownfield runoff rates. As discussed in para 3.19 to 3.22 above, 50% of existing Area 1 and the whole of Area 2. Area 3 and Area 4 drain to the Edward Street surface water sewer at a 1:1yr Brownfield rate of 104.395 l/s. In the proposed situation, Blocks B and C (discussed in more detail below) will drain to the Edward Street Sewer at a combined maximum outfall rate of 10 l/s. A significant reduction.

4.23 For the 675dia surface water sewer, in the existing situation 50% of Area 1, and the whole of Area 5, Area 7 and Area 8 drain to this sewer at a 1:1yr Brownfield rate of 371.095 l/s. In the proposed situation, Blocks D, A, M, K/L, J3, E, F, G, J and H (discussed in more detail below), will drain to the diverted 675dia surface water sewer at a combined maximum outfall rate of 232 l/s, again a significant reduction.

4.24 The finished floor levels (FFL's) for each Block have been set following the hydraulic modelling undertaken by Royal Haskoning DHV and are discussed further within their FRA report.

4.25 As described in Section 1, it is proposed to make a Hybrid planning application: Full Planning for Blocks, A, B, C, D, J3, K/L and M and Outline Planning for Blocks E, F, G, H and J.

4.26 The Hybrid site layout precludes the option for completely separating drainage for Outline areas from Full-Planning areas however, largely, the drainage systems serve only Outline or only Full-Planning areas

4.27 development parcels have been split into 9no. drainage catchments:

- System 1 – Serves Block B (Full-Planning)
- System 2 – Serves Block C (Full-Planning)
- System 3 – Serves Block D (Full-Planning)
- System 4 - Serves Block A, M J3 and K/L (Full Planning)
- System 5 – Serves Botolph Street/Public Realm Area (Full Planning)
- System 6 – Serves Block E (Outline Planning)
- System 7 – Serves Block F (Outline Planning)
- System 8 – Serves Blocks G and J (Outline Planning)
- System 9 – Serves Block H (Outline Planning)

System 1 – Block B – Full Planning

4.28 SuDS Feature Selection – This catchment comprises residential dwellings, footpaths, patios and parking areas. The residential apartment block facing New Botolph St has a green roof – the details of which can be seen on the Landscape Masterplan – Roof Level PlanIt drawing in **Appendix M**. It is proposed to utilise lined permeable paving to manage run-off from the trafficked areas. The proposed hard and soft landscaping plans are shown on PlanIt Landscape Masterplan contained in **Appendix N**. Residential rainwater harvesting (water-butts) are to be provided for the terraced houses. A surface water drainage network shall collect run-off from roof, patios and other hardstanding areas with all flows directed to a geo-cellular storage device with outfall to the adopted 225dia surface water sewer in Edward Street (MH AW 0452) via a Downstream Defender (proprietary treatment unit) and Hydrobrake gravity flow control device.

4.29 The contributing area for this catchment has been calculated as: 1790.5m², comprising:

- Roof Area (515m² x 110% allowing for 10% Urban Creep) – 566.5m²
- Green Roof Area – 290m² (assuming the green roof is saturated and do not provide any storage volume)
- Permeable Paving (trafficked) Area – 580m²
- Patios and Footpaths – 354m²

4.30 The maximum outfall rate for this catchment has been set at 5.0 l/s to manage all storms up to and including the 1 in 100yr + 45% Climate Change Event. The proposed Surface Water Drainage Layouts are contained in **Appendix O** and shows the network serving Block B on drawing DR-001.

4.31 There are two sections of permeable paving attenuation system, PP1 covers an area of 432m² and PP2 covers an area of 150m². Surface water runoff from 240m² of surrounding hardstanding areas will be directed to the permeable paving attenuation system PP1. Surface water attenuation volume in the permeable paving attenuation system is provided within the sub- base voids (usually 30% voids and no-fines). Flows from these permeable paving systems are restricted using orifice-plate flow control chambers – flows are then directed to/cascade to the geo-cellular attenuation device which also collects surface water run-off from the remainder of the contributing area.

4.32 WinDES MicroDrainage modelling software has been used to calculate the required attenuation volume for the permeable paving areas and the geo-cellular storage device whilst restricting flows to a maximum of 5.0 l/s to manage all storms up to and including a 1 in 100 year + 45% Climate Change event. As discussed in para. 4.17 above, the hydraulic model allows for the adopted surface water sewers to be surcharged and as such, the pipe flow in that node will include for this. The maximum flow from proposed Block D should therefore be noted from looking at the Pipe Flow for node/manhole "B-Hydrobrake" in the hydraulic outputs.

4.33 The hydraulic output data shows results for a 1:1yr, 1:30yr, 1:30yr + 40% Climate Change, 1:100yr and 1:100yr + 45% Climate Change events and are contained in **Appendix P**, along with pipe long-sections. For the 1:100yr + 45% Climate Change event an attenuation volume of 39.027m3 in PP1, a volume of 8.117m² in PP2 and a volume of 24.192m3 in the geo-cellular storage device is calculated. This volume can be contained within the sub-base of the permeable paving areas and within a geo-cellular storage device sized 35.2m² x 1.32m deep with 95% voids.

4.34 Half Drain Times – For the 1:100yr + 45% Climate Change event, the hydraulic model demonstrates that Permeable Paving Area 1 has a half-drain time of 369mins, Permeable Paving Area 2 is 229mins and the Geo-cellular storage device half-drains in 116mins. All well within 24hrs.

4.35 Water Quality Assessment – This catchment comprises residential roofs and low-traffic roads only.

4.36 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.

4.37 Relating to runoff from 'standard' roofs and footpaths: CIRIA 763 SuDS Manual Table 26.2 shows Residential Roofs have a Pollution Hazard Level of LOW. Runoff from 'standard' roofs and footpaths shall be treated via a Hydro-International Downstream Defender (Advanced Vortex) proprietary treatment system. Table 26.2 shows Residential Roofs have TSS of 0.2 Metals 0.2 and Hydrocarbons 0.05. 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 Q** as well as advice from Hydro-International on sizing Downstream Defenders

4.38 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.

System 2 – Block C – Full Planning

4.39 SuDS Feature Selection – This catchment comprises a residential apartment block, footpaths and landscaped areas. The residential apartment block utilises a green roof - the details of which can be seen on the Landscape Masterplan - Roof Level PlanIt drawing in **Appendix M**. The proposed hard and soft landscaping plans are shown on PlanIt Landscape Masterplan contained in **Appendix N**. A surface water drainage network shall collect run-off from the green roof and footpaths with all flows directed to a geo-cellular storage device with outfall to the adopted 300dia surface water sewer in Edward Street (new MH AW 0451A) via a Downstream Defender (proprietary treatment unit) and a Hydrobrake gravity flow control device.

4.40 The contributing area for this catchment has been calculated as: 728m², comprising:

- Green Roof Area – 433m² (assuming the green roof is saturated and do not provide any storage volume)
- Footpaths – 295m²

4.41 The maximum outfall rate for this catchment has been set at 5.0 l/s to manage all storms up to and including the 1 in 100yr + 45% Climate Change Event. The proposed Surface Water Drainage Layouts are contained in Appendix M and shows the network serving Block C on drawing DR-001.

4.42 Surface water run-off from the Green Roof and pedestrian hardstanding areas is collected in a surface water drainage network which outfalls to a geo-cellular attenuation device. Flows from the geo-cellular attenuation device are restricted using a Hydrobrake gravity flow control device prior to outfall to the adopted surface water sewer via a proprietary treatment unit.

4.43 WINDES MicroDrainage modelling software has been used to calculate the required attenuation volume for the geo-cellular storage device whilst restricting flows to a maximum of 5.0 l/s to manage all storms up to and including a 1 in 100 year + 45% Climate Change event. As discussed in para. 4.17 above, the hydraulic model allows for the adopted surface water sewers to be surcharged and as such, the pipe flow in that node will include for this. The maximum flow from proposed Block C should therefore be noted from looking at the Pipe Flow for pnode/manhole “C-Hydrobrake” in the hydraulic outputs.

4.44 The hydraulic output data shows results for a 1:1yr, 1:30yr, 1:30yr + 40% Climate Change, 1:100yr and 1:100yr + 45% Climate Change events and are contained in **Appendix P**, along with pipe long-sections. For the 1:100yr + 45% Climate Change event an attenuation volume of 18.983m3 in in the geo-cellular storage device is calculated and can be contained within a geo-cellular storage device sized 62.72m² x 0.66m deep with 95% voids – this provides a maximum attenuation volume of 59.584m3.

4.45 Half Drain Times – The hydraulic model demonstrates the Geo-cellular storage device half-drains in 61mins. Well within 24hrs.

4.46 Water Quality Assessment – This catchment comprises footpaths and residential roofs only.

4.47 Relating to runoff from pedestrian footpaths, as there is no specific reference for hardscaped areas, it is considered prudent to apply a residential roof as comparison: CIRIA 763 SuDS Manual Table 26.2 shows Residential Roofs have a Pollution Hazard Level of LOW. Runoff from the hard landscaping shall be treated via a Hydro-International Downstream Defender (Advanced Vortex) proprietary treatment system. Table 26.2 shows “Residential Roofs” have TSS of 0.2 Metals 0.2 and Hydrocarbons 0.05. 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 the hard landscaping areas is therefore more than sufficiently mitigated by use of the Downstream Defender (Advanced Vortex). Details of the Downstream Defender is contained in **Appendix Q** as well as advice from Hydro-International on sizing Downstream Defenders.

4.48 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.

System 3 – Block D – Full Planning

4.49 SuDS Feature Selection – This catchment comprises public realm area, a commercial unit block with community centre and residential apartments above. A portion of Block D roof area is green-roof – the details of which can be seen on the Landscape Masterplan - Roof Level PlanIt drawing in **Appendix M**. The proposed hard and soft landscaping plans are shown on PlanIt Landscape Masterplan contained in **Appendix N**. A surface water drainage network shall collect run-off from the green roof, other roof areas and public realm areas (via bio-retention systems, channel/slot drains and gullies) with all flows directed to a geo-cellular storage device. As Block D has level-thresholds, levels are designed to fall away from doorways, however as a precaution a slot-drain is also provided around the building line. Outfall is directed to the diverted adopted 675dia surface water sewer which crosses Anglia Square (new MH SW-A-04) via a Downstream Defender (proprietary treatment unit) and a Hydrobrake gravity flow control device.

4.50 The contributing area for this catchment has been calculated as: 2580m², comprising:

- Green Roof Area – 610m² (assuming the green roof is saturated and do not provide any storage volume)
- Roof Area – 265m²
- Public Realm (including bioretention systems which are assumed to be saturated and do not provide any storage volume) – 1705m²

4.51 The maximum outfall rate for this catchment has been set at 12.5 l/s to manage all storms up to and including the 1 in 100yr + 45% Climate Change Event. The proposed Surface Water Drainage Layouts are contained in **Appendix M** and shows the network serving Block D on drawing DR-001.

4.52 Surface water run-off from the Green Roof, Roof and Public Realm areas is collected in a surface water drainage network which outfalls to a geo-cellular attenuation device. Due to spatial constraints, and to ensure a minimum 5m offset from the building line, the geocellular storage device is split into two sections and is linked by a 600dia connector pipe. Flows from the geo-cellular attenuation device are restricted using a Hydrobrake gravity flow control device prior to outfall to the adopted diverted 675dia surface water sewer via a proprietary treatment unit.

4.53 WINDES MicroDrainage modelling software has been used to calculate the required attenuation volume for the geo-cellular storage device whilst restricting flows to a maximum of 12.5 l/s to manage all storms up to and including a 1 in 100 year + 45% Climate Change event. As discussed in para. 4.17 above, the hydraulic model allows for the adopted surface water sewers to be surcharged and as such, the pipe flow in that node will include for this. The maximum flow from proposed Block D should therefore be noted from looking at the Pipe Flow for node/manhole "D-Hydrobrake" in the hydraulic outputs.

4.54 The hydraulic output data shows results for a 1:1yr, 1:30yr, 1:30yr + 40% Climate Change, 1:100yr and 1:100yr + 45% Climate Change events and are contained in **Appendix P**, along with pipe long-sections. For the 1:100yr + 45% Climate Change event an attenuation volume of 116.506m3 in in the geo-cellular storage device and 4.864m3 in the 600dia connector pipe is calculated and can be contained within a geo-cellular storage device sized 80m² x 1.32m deep with 95% voids – this provides a maximum attenuation volume of 59.584m3.

4.55 Half Drain Times – The hydraulic model demonstrates the Geo-cellular storage device half-drains in 105mins. All well within 24hrs.

4.56 Water Quality Assessment – This catchment comprises commercial/residential roofs and green roofs as well as pedestrian Public Realm areas.

4.57 Relating to runoff from 'standard' roofs and pedestrian public realm: CIRIA 763 SuDS Manual Table 26.2 shows Residential Roofs have a Pollution Hazard Level of LOW. Runoff from 'standard' roofs and footpaths shall be treated via a Hydro-International Downstream Defender (Advanced Vortex) proprietary treatment system. Table 26.2 shows Residential Roofs have TSS of 0.2 Metals 0.2 and Hydrocarbons 0.05. 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 Q** as well as advice from Hydro-International on sizing Downstream Defenders.

4.58 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.

System 4 – Blocks A, M, J3 and K/L – Full Planning

4.59 SuDS Feature Selection – This catchment comprises public realm area and commercial unit blocks with residential apartments above. Some roof area is green-roof – the details of which can be seen on the Landscape Masterplan - Roof Level PlanIt drawing in **Appendix M**. The proposed hard and soft landscaping plans are shown on PlanIt Landscape Masterplan contained in **Appendix N**. A surface water drainage network shall collect run-off from the green roof, other roof areas and public realm areas (via bio-retention systems, channel/slot drains and gullies) with all flows directed to a geo-cellular storage device. As Blocks in this catchment have level-thresholds, levels are designed to fall away from doorways, however as a precaution a slot-drain is also provided around the building lines. Outfall is directed to the diverted adopted 675dia surface water sewer which crosses Anglia Square (new MH SW-A-07) via a surface water pump flow control device and Downstream Defender (proprietary treatment unit.

4.60 The contributing area for this catchment has been calculated as: 14,850m², comprising:

- Green Roof Area – 2535m² (assuming the green roof is saturated and do not provide any storage volume)
- Roof Area – 6313m²
- Public Realm (including bioretention systems which are assumed to be saturated and do not provide any storage volume) – 6002 m²

4.61 The maximum outfall rate for this catchment has been set at 65.0 l/s to manage all storms up to and including the 1 in 100yr + 45% Climate Change Event. The proposed Surface Water Drainage Layouts are contained in **Appendix O** and shows the network serving Block A, M, K/L and J3 on drawings DR-002 and DR-004.

4.62 Surface water run-off from the Green Roof, Roof and Public Realm areas is collected in a surface water drainage network which outfalls to a geo-cellular attenuation device. Due to spatial constraints, contributing area and the depth of the adopted sewer, it is necessary to pump surface water flows/outfall from this catchment. Flows from the geo-cellular attenuation device are restricted using a surface water flow control device prior to outfall to the adopted diverted 675dia surface water sewer via a proprietary treatment unit.

4.63 WINDES MicroDrainage modelling software has been used to calculate the required attenuation volume for the geo-cellular storage device whilst restricting flows to a maximum of 65.0 l/s to manage all storms up to and including a 1 in 100 year + 45% Climate Change event. As discussed in para. 4.17 above, the hydraulic model allows for the adopted surface water sewers to be surcharged and as such, the pipe flow in that node will include for this. The maximum flow from proposed Block A, M, K/L and J3 should therefore be noted from looking at the Pipe Flow for node/manhole "SW-PUMP" in the hydraulic outputs.

4.64 The hydraulic output data shows results for a 1:1yr, 1:30yr, 1:30yr + 40% Climate Change, 1:100yr and 1:100yr + 45% Climate Change events and are contained in **Appendix P**, along with pipe long-sections. For the 1:100yr + 45% Climate Change event an attenuation volume of 608.287m3 in the geo-cellular storage device and can be contained within a geo-cellular storage device sized 322.6m² x 1.98m deep with 95% voids.

4.65 Half Drain Times – The hydraulic model demonstrates the Geo-cellular storage device half-drains in 103mins. All well within 24hrs.

4.66 Water Quality Assessment – This catchment comprises commercial/residential roofs and green roofs as well as pedestrian Public Realm areas.

4.67 Relating to runoff from 'standard' roofs and pedestrian public realm: CIRIA 763 SuDS Manual Table 26.2 shows Residential Roofs have a Pollution Hazard Level of LOW. Runoff from 'standard' roofs and footpaths shall be treated via a Hydro-International Downstream Defender (Advanced Vortex) proprietary treatment system. Table 26.2 shows Residential Roofs have TSS of 0.2 Metals 0.2 and Hydrocarbons 0.05. 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 Q** as well as advice from Hydro-International on sizing Downstream Defenders.

4.68 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.

4.69 Relating to run-ff from hardstanding areas that is directed to Bioretention Systems. To undertake a water quality assessment, these pedestrian areas have been considered as

Commercial Roof. CIRIA 763 SuDS Manual Table 26.2 Other Roofs have a Pollution Hazard Level of LOW. Table 26.2 shows Other Roofs have TSS of 0.3 Metals, 0.2 and Hydrocarbons 0.05. Table 26.3 shows mitigation indices for discharges to surface waters for Bioretention systems as: TSS of 0.8 Metals, 0.8 and Hydrocarbons 0.8.

System 4 – Blocks A, M, J3 and K/L – Full Planning

4.70 SuDS Feature Selection – This catchment comprises public realm area and a small area of trafficked access road. The proposed hard and soft landscaping plans are shown on PlanIt Landscape Masterplan contained in **Appendix N**. A surface water drainage network shall collect run-off from the paved areas via bioretention systems, channel drains and gullies with all flows directed to an over-sized pipe storage device. Outfall is directed to the diverted adopted 675dia surface water sewer which crosses Anglia Square (new MH SW-A-04) via a Downstream Defender (proprietary treatment unit) and a Hydrobrake gravity flow control device.

4.71 The proposed over-size pipe system will run underneath the bio-retention systems, PlanIt, the landscape architect for this scheme, were consulted to gain confirmation of planting within the bioretention systems and their root depths. It was confirmed that the proposed planting root depth is not expected to exceed 1.0m in depth and in the main will be contained within 0.6m of depth from the cover level of the bio-retention system. As such, the design ensures that the pipe soffit/top-of-pipe is always at least 1.2m in depth from the lowest bio-retention system cover level to allow for a 200mm drainage layer. This ensures that there will be no root ingress to the proposed over-size pipe system and that outlets from the bioretention systems can be directed to the surface water drainage system.

4.72 The contributing area for this catchment has been calculated as: 1630m², comprising:

- Public Realm (including bioretention systems which are assumed to be saturated and do not provide any storage volume) – 1630m²

4.73 The maximum outfall rate for this catchment has been set at 10.0 l/s to manage all storms up to and including the 1 in 100yr + 45% Climate Change Event. The proposed Surface Water Drainage Layouts are contained in **Appendix O** and shows the network serving Block D on drawing DR-003.

4.74 Surface water run-off from the Public Realm area is collected in an oversized pipe surface water drainage network with flows restricted using a Hydrobrake gravity flow control device prior to outfall to the adopted diverted 675dia surface water sewer via a proprietary treatment unit.

4.75 WINDES MicroDrainage modelling software has been used to calculate the required attenuation volume for the oversized-pipe storage/drainage system whilst restricting flows to a maximum of 10.0 l/s to manage all storms up to and including a 1 in 100 year + 45% Climate Change event. As discussed in para. 4.17 above, the hydraulic model allows for the adopted surface water sewers to be surcharged and as such, the pipe flow in that node will include for this. The maximum flow from proposed Block D should therefore be noted from looking at the Pipe Flow for node/manhole “B.ST Hydrobrake” in the hydraulic outputs.

4.76 The hydraulic output data shows results for a 1:1yr, 1:30yr, 1:30yr + 40% Climate Change, 1:100yr and 1:100yr + 45% Climate Change events and are contained in **Appendix P**, along with pipe long-sections. For the 1:100yr + 45% Climate Change event an attenuation volume of 72.557m3 in pipes 1.000 to 1.006.

4.77 Half Drain Times – based on a rate of 10l/s, a volume of 72.557 can be drained in 121mins, well within 24hrs.

4.78 Water Quality Assessment – This catchment comprises Public Realm areas with low traffic roads.

4.79 CIRIA 763 SuDS Manual Table 26.2 shows Low Traffic Roads have a Pollution Hazard Level of LOW. Runoff from all hardstanding areas shall be treated via a Hydro-International Downstream Defender (Advanced Vortex) proprietary treatment system. Table 26.2 shows Low-Traffic Roads have TSS of 0.5 Metals, 0.4 and Hydrocarbons 0.4. Table 26.3. 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 Q** as well as advice from Hydro-International on sizing Downstream Defenders.

4.80 Relating to run-off from hardstanding areas that is directed to Bioretention Systems. To undertake a water quality assessment, these pedestrian areas have been considered as Commercial Roof. CIRIA 763 SuDS Manual Table 26.2 Other Roofs have a Pollution Hazard Level of LOW. Table 26.2 shows Other Roofs have TSS of 0.3 Metals, 0.2 and Hydrocarbons 0.05. Table 26.3 shows mitigation indices for discharges to surface waters for Bioretention systems as: TSS of 0.8 Metals, 0.8 and Hydrocarbons 0.8.

System 6 – Block E – Outline Planning

4.81 SuDS Feature Selection – This catchment comprises commercial units with residential dwellings above and some public realm/pedestrian walkways. Green roof shall cover some roof area. Bioretention systems shall collect run-off from highway areas to the west, as agreed in principle with the Highway Authority. Details of the split between private and highway catchments and the drainage features which serve these areas shall be confirmed during detailed design stage. For now, and to be conservative, the hydraulic models shall assume all areas within the catchment boundary will be collected within a private drainage network. The catchment shall be considered 100% impermeable with a contributing area of 6420m^2.

4.82 At this Outline stage the surface water drainage strategy shall allow for all waters to be collected within a geocellular attenuation device with a restricted outfall directed to the diverted adopted 675dia surface water sewer crossing the site. Due to spatial constraints, storage volume requirements and the depth of the receiving adopted sewer, it will be necessary to pump surface water flows to a ‘demarcation chamber’ with a connection to the diverted 675dia surface water sewer. Flows shall be cleansed via a Downstream Defender (proprietary treatment unit) prior to outfall.

4.83 The maximum outfall rate for this catchment has been set at 30.0 l/s to manage all storms up to and including the 1 in 100yr + 45% Climate Change Event. The proposed Surface Water Drainage Layouts are contained in **Appendix O** and shows the indicative surface water drainage network serving Block E on drawing DR-003.

4.84 WINDES MicroDrainage modelling software has been used to calculate the required attenuation volume for the geo-cellular storage device whilst restricting flows to 30.0 l/s for the 1:100yr + 45% Climate Change storm event. Any attenuation volume that may be provided in green roofs and bio-retention areas has not been allowed for to ensure a robust estimation of the required attenuation volumes to serve this catchment are made. The hydraulic output data is contained in **Appendix P** and shows an attenuation volume of 277.2m^3 in the geo-cellular storage device with a maximum outfall rate of **30.0 l/s** is required to manage a 1 in 100 year + 45% Climate Change event. This can be contained within a geo-cellular storage device sized 147.2m^2 x 1.98m with 95% voids – this provides a maximum attenuation volume of 276.9m^3.

4.85 Half Drain Times – The hydraulic model demonstrates the Geo-cellular storage device half-drains in 83mins for a 1 in 100yr + 45% Climate Change Storm Event. All well within 24hrs.

4.86 Water Quality – This catchment comprises Other Roofs, Green Roofs as well as Pedestrian Walkways.

4.87 Relating to runoff from ‘standard’ roofs and pedestrian public realm, to undertake a water quality assessment, the pedestrian areas have also been considered as Other Roofs. CIRIA 763 SuDS Manual Table 26.2 shows Other Roofs have a Pollution Hazard Level of LOW. Runoff from ‘standard’ roofs and footpaths shall be treated via a Hydro-International Downstream Defender (Advanced Vortex) proprietary treatment system. Table 26.2 shows Other Roofs have TSS of 0.3 Metals 0.2 and Hydrocarbons 0.05. 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 Q** as well as advice from Hydro-International on sizing Downstream Defenders.

4.88 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.

4.89 Relating to run-off from hardstanding areas that is directed to Bioretention Systems. To undertake a water quality assessment, these pedestrian areas have been considered as Commercial Roof. CIRIA 763 SuDS Manual Table 26.2 Other Roofs have a Pollution Hazard Level of LOW. Table 26.2 shows Other Roofs have TSS of 0.3 Metals, 0.2 and Hydrocarbons 0.05. Table 26.3 shows mitigation indices for discharges to surface waters for Bioretention systems as: TSS of 0.8 Metals, 0.8 and Hydrocarbons 0.8.

System 7 – Block F – Outline Planning

4.90 SuDS Feature Selection – This catchment comprises commercial units with residential dwellings above and some public realm/pedestrian walkways. Green roof shall cover some roof area whilst a section of permeable paving system shall form the external parking area (approx.350 m^2). Bioretention systems shall collect run-off from pedestrian walkways where possible. For now, and to be conservative, the hydraulic models shall assume all areas within the catchment boundary shall be collected within a private drainage network. The catchment shall be considered 100% impermeable with a contributing area of 4460m².

4.91 At this Outline stage the surface water drainage strategy shall allow for all waters to be collected within a Geocellular attenuation device with a restricted outfall directed to the diverted adopted 675dia surface water sewer crossing the site. Due to spatial constraints, storage volume requirements and the depth of the receiving adopted sewer, it will be necessary to pump surface water flows to a 'demarcation chamber' with a connection to the diverted 675dia surface water sewer. Flows shall be cleansed via a Downstream Defender (proprietary treatment unit) prior to outfall.

4.92 The maximum outfall rate for this catchment has been set at 20.0 l/s to manage all storms up to and including the 1 in 100yr + 45% Climate Change Event. The proposed Surface Water Drainage Layouts are contained in **Appendix O** and shows the network serving Block F on drawing DR-003.

4.93 WINDES MicroDrainage modelling software has been used to calculate the required attenuation volume for the geo-cellular storage device whilst restricting flows to 20.0 l/s for the 1:100yr + 45% Climate Change storm event. Any attenuation volume that may be provided in green roofs, permeable paving and bio-retention areas has not been allowed for to ensure a robust estimation of the required attenuation volumes to serve this catchment are made. The hydraulic output data is contained in **Appendix P** and shows an attenuation volume of 187.9m³ in the geo-cellular storage device with a maximum outfall rate of **20.0 l/s** is required to manage a 1 in 100 year + 45% Climate Change event. This can be contained within a geo-cellular storage device sized 112.6m² x 1.98m with 95% voids – this provides a maximum attenuation volume of 211.8m³. Noting that due to spatial constraints and to maintain a distance of 5m from the building line, the geocellular storage device is split in two sections and are connected via a 600dia connector pipe.

4.94 Half Drain Times – The hydraulic model demonstrates the Geo-cellular storage device half-drains in 79mins for a 1 in 100yr + 45% Climate Change Storm Event. All well within 24hrs.

4.95 Water Quality – This catchment comprises Other Roofs, Green Roofs as well as Pedestrian Walkways.

4.96 Relating to runoff from 'standard' roofs and pedestrian public realm: CIRIA 763 SuDS Manual Table 26.2 shows Residential Roofs have a Pollution Hazard Level of LOW. Runoff from 'standard' roofs and footpaths shall be treated via a Hydro-International Downstream Defender (Advanced Vortex) proprietary treatment system. Table 26.2 shows Residential Roofs have TSS of 0.2 Metals 0.2 and Hydrocarbons 0.05. 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 Q as well as advice from Hydro-International on sizing Downstream Defenders.

4.97 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

4.98 Relating to run-off from hardstanding areas that is directed to Bioretention Systems. To undertake a water quality assessment, these pedestrian areas have been considered as Commercial Roof. CIRIA 763 SuDS Manual Table 26.2 Other Roofs have a Pollution Hazard Level of LOW. Table 26.2 shows Other Roofs have TSS of 0.3 Metals, 0.2 and Hydrocarbons 0.05. Table 26.3 shows mitigation indices for discharges to surface waters for Bioretention systems as: TSS of 0.8 Metals, 0.8 and Hydrocarbons 0.8.

4.99 Relating to runoff from other public realm areas that do not drain to bioretention systems, to undertake a water quality assessment, these pedestrian areas have been considered as Other Roofs. CIRIA 763 SuDS Manual Table 26.2 shows Other Roofs have a Pollution Hazard Level of LOW. Runoff from these pedestrian areas shall be treated via a Hydro-International Downstream Defender (Advanced Vortex) proprietary treatment system. Table 26.2 shows Other Roofs have TSS of 0.3 Metals 0.2 and Hydrocarbons 0.05. 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 Q** as well as advice from Hydro-International on sizing Downstream Defenders.

4.100 Relating to runoff from permeable block paved trafficked areas: CIRIA 763 SuDS Manual Table 26.2 shows Residential Car Parks have a Pollution Hazard Level of LOW. Runoff from permeable block paving will be managed by itself. Table 26.2 shows Residential Car Parks have TSS of 0.5 Metals 0.4 and Hydrocarbons 0.4. Table 26.3 shows mitigation indices for Permeable Pavement is TSS at 0.7; Metals at 0.6 and Hydrocarbons at 0.7. Surface water run-off from these areas is therefore more than sufficiently mitigated by use of the Permeable Block Paving itself.

System 8 – Blocks G and J – Outline Planning

4.101 SuDS Feature Selection – This catchment comprises residential units, commercial units with residential dwellings above as well as some public realm/pedestrian walkways and vehicular access to undercroft car parks in Blocks G and J. Green roof shall cover some roof area. Permeable block paving covering an area of approx. 614 m² shall collect surface water run-off from part of the vehicular access areas that will be trafficked. A surface water drainage network will collect surface water runoff from rainwater down pipes, external paved areas via channel drains and gullies and convey to the geocelular storage device. The catchment shall be considered 100% impermeable with a contributing area of 9640m² for robustness with no allowance for green roofs or permeable block paving.

4.102 At this Outline stage the surface water drainage strategy shall allow for all waters to be collected within a Geocellular attenuation device with a restricted outfall directed to the diverted adopted 675dia surface water sewer crossing the site. Due to spatial constraints, storage volume requirements and the depth of the receiving adopted sewer, it will be necessary to pump surface water flows to a 'demarcation chamber' with a connection to the diverted 675dia surface water sewer. Flows shall be cleansed via a Downstream Defender (proprietary treatment unit) prior to outfall. The maximum outfall rate for this catchment has been set at 70.0 l/s to manage all storms up to and including the 1 in 100yr + 45%

Climate Change Event. The proposed Surface Water Drainage Layouts are contained in **Appendix O** and shows the network serving Block F on drawing DR-003 and DR-004.

4.103 WINDES MicroDrainage modelling software has been used to calculate the required attenuation volume for the geo-cellular storage device whilst restricting flows to 70.0 l/s for the 1:100yr + 45% Climate Change storm event. Any attenuation volume that may be provided in green roofs and permeable block paving has not been allowed for to ensure a robust estimation of the required attenuation volumes to serve this catchment are made. The hydraulic output data is contained in **Appendix P** and shows an attenuation volume of 370.4m^3 in the geo-cellular storage device with a maximum outfall rate of **70.0 l/s** is required to manage a 1 in 100 year + 45% Climate Change event. This can be contained within a geo-cellular storage device sized 195.8m^2 x 1.67m with 95% voids – this provides a maximum attenuation volume of 310.63m^3.

4.104 Half Drain Times – The hydraulic model demonstrates the Geo-cellular storage device half-drains in 53mins for a 1:100yr + 45% Climate Change Storm Event. All well within 24hrs.

4.105 Water Quality Assessment – This catchment comprises commercial/residential roofs, pedestrian walkways and low-traffic roads only.

4.106 Relating to runoff from 'standard' roofs and pedestrian public realm, to undertake a water quality assessment, the pedestrian areas have also been considered as Other Roofs. CIRIA 763 SuDS Manual Table 26.2 shows Other Roofs have a Pollution Hazard Level of LOW. Runoff from 'standard' roofs and footpaths shall be treated via a Hydro-International Downstream Defender (Advanced Vortex) proprietary treatment system. Table 26.2 shows Other Roofs have TSS of 0.3 Metals 0.2 and Hydrocarbons 0.05. 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 Q** as well as advice from Hydro-International on sizing Downstream Defenders.

4.107 Relating to runoff from non-permeable block paved trafficked areas: CIRIA 763 SuDS Manual Table 26.2 shows Residential Car Parks have a Pollution Hazard Level of LOW. Runoff from 'standard' roofs and footpaths shall be treated via a Hydro-International Downstream Defender (Advanced Vortex) proprietary treatment system. Table 26.2 shows Residential Car Parks have TSS of 0.5 Metals 0.4 and Hydrocarbons 0.4. 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 Q** as well as advice from Hydro-International on sizing Downstream Defenders.

4.108 Relating to runoff from permeable block paved trafficked areas: CIRIA 763 SuDS Manual Table 26.2 shows Residential Car Parks have a Pollution Hazard Level of LOW. Runoff from permeable block paving will be managed by itself. Table 26.2 shows Residential Car Parks have TSS of 0.5 Metals 0.4 and Hydrocarbons 0.4. Table 26.3 shows mitigation indices for Permeable Pavement is TSS at 0.7; Metals at 0.6 and Hydrocarbons at 0.7. Surface water run-off from these areas is therefore more than sufficiently mitigated by use of the Permeable Block Paving itself.

4.109 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.

System 9 – Block H – Outline Planning

4.110 SuDS Feature Selection – This catchment comprises commercial units with residential dwellings above and some public realm/pedestrian walkways. Green roof shall cover some roof area and a bioretention system is proposed – some runoff from hardstanding area is directed to this system, however most runoff from hardstanding shall be directed to the proposed surface water drainage network via channel drains and gullies. Due to spatial constraints, storage volume requirements and the depth of the receiving adopted sewer, it will be necessary to pump surface water flows to a 'demarcation chamber' with a connection to the diverted 675dia surface water sewer. For now, and to be conservative, the hydraulic models shall assume all areas within the catchment boundary shall be collected within a private drainage network. The catchment shall be considered 100% impermeable with a contributing area of 3460m².

4.111 At this Outline stage the surface water drainage strategy shall allow for all waters to be collected within a geocellular attenuation device with a restricted outfall directed to the diverted adopted 675dia surface water sewer crossing the site. Flows shall be cleansed via a Downstream Defender (proprietary treatment unit) prior to outfall. The maximum outfall rate for this catchment has been set at 24.5 l/s to manage all storms up to and including the 1 in 100yr + 45% Climate Change Event. The proposed Surface Water Drainage Layouts are contained in **Appendix O** and shows the network serving Block H on drawing DR-002.

4.112 WINDES MicroDrainage modelling software has been used to calculate the required attenuation volume for the geo-cellular storage device whilst restricting flows to 24.5 l/s for the 1:100yr + 45% Climate Change storm event. Any attenuation volume that may be provided in green roofs has not been allowed for to ensure a robust estimation of the required attenuation volumes to serve this catchment are made. The hydraulic output data is contained in **Appendix P** and shows an attenuation volume of 141.1m³ in the geo-cellular storage device with a maximum outfall rate of **24.5 l/s** is required to manage a 1 in 100 year + 40% Climate Change event. This can be contained within a geo-cellular storage device sized 112.0m² x 1.32m with 95% voids – this provides a maximum attenuation volume of 140.448m³.

4.113 Half Drain Times – The hydraulic model demonstrates the Geo-cellular storage device half-drains in 61mins. All well within 24hrs.

4.114 Water Quality – This catchment comprises Other Roofs as well as Pedestrian Walkways.

4.115 Relating to runoff from 'standard' roofs and pedestrian public realm, to undertake a water quality assessment, the pedestrian areas have also been considered as Other Roofs. CIRIA 763 SuDS Manual Table 26.2 shows Other Roofs have a Pollution Hazard Level of LOW. Runoff from 'standard' roofs and footpaths shall be treated via a Hydro-International

Downstream Defender (Advanced Vortex) proprietary treatment system. Table 26.2 shows Other Roofs have TSS of 0.3 Metals 0.2 and Hydrocarbons 0.05. 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 Q** as well as advice from Hydro-International on sizing Downstream Defenders.

4.116 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.

Summary of Catchments and Proposed Outfall Rates

4.117 As discussed in para. 4.13, the total allowable outfall rate for the Anglia Square Regeneration site has been set at 242 l/s, which is a reduction of 50.5% against the existing 1:1yr Brownfield Runoff Rate – a significant betterment. Below is a breakdown of outfall rates for each catchment (System) and total:

- System 1 – Maximum surface water outfall rate of 5.0 l/s
- System 2 – Maximum surface water outfall rate of 5.0 l/s
- System 3 – Maximum surface water outfall rate of 12.5 l/s
- System 4 - Maximum surface water outfall rate of 65.0 l/s
- System 5 – Maximum surface water outfall rate of 10.0 l/s
- System 6 – Maximum surface water outfall rate of 30.0 l/s
- System 7 – S Maximum surface water outfall rate of 20.0 l/s
- System 8 – Maximum surface water outfall rate of 70.0 l/s
- System 9 - Maximum surface water outfall rate of 24.5 l/s
- All Systems – Total 242.0 l/s maximum outfall rate to manage all storms up to and including the 1:100yr + 45% Climate Change Event. The equivalent of 49.5% of the existing 1:1yr surface water run-off rate. This is a significant improvement to the existing situation. In addition, the existing drainage system does not benefit from any water treatment stages, whilst the proposed drainage strategy allows for water quality and treatment stages to meet the guidance within CIRIA 753 SuDS Manual.

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk

Attenuation Tank Alarm System

4.118 The proposed development site shall be served by a Flood Evacuation Warning Plan, the proposals of which are discussed in the Flood Risk Assessment Report however will be detailed further at a Discharge of Conditions stage. As the development site is within a Critical Drainage Catchment and there is risk of off-site flows from entering the proposed on-site drainage system, it is identified that monitoring of attenuation capacity would be beneficial for maintenance and management purposes and to reduce the risk of flooding. Full Planning Block A, M, K/L and J3 and Outline Planning Block E, Block F, Block G and J and Block H catchments are served by geocellular attenuation devices whereby the outfalls are controlled using surface water pumps. These pumping stations will be equipped with a secondary back-up pump as well as a telemetry alarm system to alert the Management Company of any pump failures. Block, B, Block C, Block D and Botolph Street proposed drainage systems are controlled using gravity type Flow Control Devices (hydro brakes), which are not alarmed.

4.119 The proposed surface water drainage systems are not be designed to include any flows or volumes from off-site which may enter the system. It is appreciated that off-site flows could enter the proposed surface water drainage systems in certain catchments and as such it is appropriate to install an alarm system which will be triggered to alert the Management Company when tanks fail to drain-down after a storm event. This type of system monitors the hydrostatic pressure within attenuation devices and communicates the available capacity via a radio transmitter to a receiving control panel that shall be located within kiosks as shown on the Proposed Surface Water Drainage Layouts in Appendix O.

4.120 Failure to drain-down after a storm event could occur due to debris/blockages within pipework or attenuation devices, or could be attributed to flow control devices not operating effectively. By identifying a possible issue in the drainage system, maintenance can be undertaken to ensure that the drainage systems operate fully and attenuation volumes, as required, are available at all times. This means that should overland flow routes pass through the site, these paths and depths of surface water are not exacerbated by poorly functioning on-site drainage systems.

4.121 This alarm system could be linked to the Flood Evacuation Plan (to be Conditioned) for information only, however its primary function is to inform the need for any Maintenance to be undertaken.

Surface Water Pump Alarm System

4.122 Wherever possible it is proposed to utilise an outfall to the adopted sewer network via a gravity connection using a hydrobrake or other suitable flow control device, such as orifice plates for permeable paving outlets. Where this is not possible, due to attenuation volume requirements, spatial constraints and/or the receiving adopted sewer being higher than the proposed drainage, surface water has to be pumped to a 'demarcation' chamber to allow waters to flow into the adopted sewer network by gravity connection.

4.123 Where surface water pumps are to be used, 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 kiosks as shown on the Proposed Surface Water Drainage Layouts.

4.124 The risk of pump failure is low, however in the very unlikely event that primary, secondary and temporary pumps all fail, waters would fill the attenuation tanks and overspill into the public realm, following the overland flow paths. There is no risk to property as pumps and tanks are located externally.

Surface Water Pumps – Power Failure

4.125 In case of power failure, it is necessary to consider the impact on surface water drainage systems which rely on a powered surface water pump. It is therefore proposed to connect the surface water pumps serving Block A, M, K/L and J3 (Full) and Blocks, E, F, G, J and H (Outline) to the emergency power generator system serving the site. This emergency power generator system will serve the site's electrical needs during a power failure, this includes emergency lighting, sprinkler systems and surface water drainage pumps. In the event that a power failure occurs during a storm event, the surface water pumps will be unaffected and will continue to function. It is recommended that the emergency power generator system link to the surface water drainage pumps is tested regularly for maintenance and monitoring purposes. This is discussed further in the Maintenance and Management Plan.

4.126 No additional 'emergency' attenuation volume is therefore required, the proposed attenuation devices are sized to manage all storms up to and including a 1:100yr + 45% Climate Change event and measures are put in place to ensure power to the surface water pumps is available during a power cut/power failure to the site. The indicative locations of emergency generators are indicated on the surface water drainage layouts.

Exceedance Routes

4.127 In the event of a greater than 1 in 100 year (+45%CC) rainfall event occurring, the exceedance routes would follow proposed and existing surface water flow paths as identified on SK05 in **Appendix R.** The flow paths shown head towards the south-east of the site and follow routes as identified in the Flood Risk Assessment Report by Royal Haskoning DHV.

4.128 As discussed in the separate FRA by Royal Haskoning DHV, their hydraulic model assumes the public sewer system is almost at capacity and there is no functioning drainage system within the site boundary. This would result in the overland flows collecting in the pedestrian walkways and passing through the site from north west to south east. The flows would leave the site at Magdalen Street.

Sewer Diversions

4.129 As noted in Section 3, there are a number of Anglian Water sewers passing through the existing site. Anglian Water were consulted in 2018 for the previous scheme on the potential diversion of several of their sewers around the proposed development and it is understood that this will need to be considered in detail at a later stage through a diversion application, when information such as the foundation design is available. Anglian Water Drainage Engineer Darren Sewell provided some information on the requirements when diverting sewers within a new development site. This has been included at **Appendix S**. To summarise.

- Any re-development areas falling within 3m of an existing public sewer but remaining only 'built near' an existing sewer, assuming the same clearance and access is available, would in principle be acceptable.

- Any areas falling within 3m of the existing public sewer would need to comply with Part H4 Building Regulations in respect of 'building near' public sewers and Anglian Water criteria on the website.

- Foundation design of the new buildings would need to be carefully considered to ensure that no loading would be transferred on a 45 degree 'angle of repose' onto the sewer.

- The only area which would appear to require consideration of a formal diversion of a sewer would be the existing 675mm diameter surface water sewer and the existing 225mm foul sewer running immediately south of unit A1.01 (675mm surface water sewer close to MH 0453 to 0456 and 225mm foul sewer near to MH 0405 to 0408).

- The above sewer may require a diversion, and the technicalities of this will be considered at a later stage. Anglian Water could consider formally devesting some sections of the existing public sewer which are no longer needed/fall beneath buildings (these need to be sewers serving only the existing site and no third parties). This means the Developer would apply to devest the sewer into their private ownership, and these sections of devested sewer could then be removed if no longer needed.

4.130 It would be necessary to consult Anglian Water further on the diverting and devesting of their public sewers across the site prior to any development taking place, to ensure that the issues raised in the email at **Appendix S** have been addressed.

Foul Sewer Network

4.131 An Anglian Water capacity check was carried out for the previous scheme to determine whether there would be sufficient capacity within their existing foul network to accommodate the foul flows from the proposed development. This is in their pre-development enquiry in **Appendix K** and confirms that there is sufficient capacity in the existing foul network and no improvements would be needed to the network.

Standard Surface Water Drainage Construction Details

4.132 The LLFA Developer Guidance requires that details of proposed surface water drainage features are provided at Full Planning Application stage. Standard Construction Details for the following features has therefore been provided in **Appendix T**.

- Green Roofs – see PlanIt drawings and cross-sections

- Bio-Retention Systems

- Manholes, Gullies and Channel Drains

- Typical Hydro-Brakes

- Surface Water Pumps

- Permeable Block Paving

Carbon Impact Consideration

4.133 In accordance with Policy E8 “Towards Net Zero” the developer has considered how the carbon emissions can be minimised for the drainage systems associated with the proposed development.

4.134 The primary objective of the design is for the systems to operate under gravity, thereby avoiding the need for pumps which generate carbon emissions from their operation. Wherever possible and where cover and invert levels of receiving adopted sewers allow, surface water runoff from the development site is attenuated and restricted using gravity-type flow control devices, such as hydrobrakes or orifice plates.

4.135 Where the proposed drainage and storage devices cannot be shallower than the adopted sewer network, due to cover levels, length of drainage network, attenuation volumes and spatial constraints, it is necessary to pump restricted flows. The use of surface water pumping stations to serve some catchments within the development site is unavoidable though is only proposed where necessary.

4.136 For the Full Planning Application areas (Blocks A, B, C, D, M, K/L and J3), the surface water drainage strategy has been developed to drain catchments by gravity wherever possible. Blocks B, C, D and Botolph Street catchments are drained into the adopted sewer network via a gravity Hydrobrake type device whilst Block A, M, K/L and J3 catchment will rely on a pumped outfall (1no. surface water pump in the full Application). The pump specifications for this catchment are contained in **Appendix T**.

4.137 For the Outline Planning Application areas (Blocks E, F, H, G and J) there may be scope at a later design stage to reduce the areas flowing to pumping stations by splitting catchment areas into smaller areas, whereby some may be able to drain via gravity, however at this stage it is considered conservative to allow for these 4no. pumping stations.

4.138 Where pumps are necessary, their operational carbon emissions will be minimised through the following measures.

- Minimised peak flow rate through attenuation and flow control devices to reduce the size of the pumps and hence their power demand.
- Pumps selected to maximise efficiency at the design duty to lower energy demand
- Pump operation controlled on levels within the chamber to ensure they only operate when required
- Appropriate electrical metering and links to the development control systems to allow monitoring of energy use.
- Regular cleaning and servicing to ensure the pumps are operating as efficiently as possible. This is discussed in the Maintenance and Management Plan.

5 Proposed SuDS Features Information

SuDS Features and the "Four Pillars of SuDS"

5.1 The city center site gives opportunities for "urban types" of SuDS features to be incorporated. These features provide water quantity, water quality, biodiversity and amenity enhancements. The table below summarises the proposed SuDS Features and how they contribute to the Four Pillars of SuDS. Further details of the proposed SuDS Features are discussed from para 5.2 onwards.

Water Quantity	Water Quality	Biodiversity	Amenity
The Bio-Retention Systems proposed allow for reduction of water quantity by providing opportunity for transpiration.	The engineered soils and vegetation within the proposed bio-retention systems provide a filter medium to cleanse waters prior to outfall to the drainage network.	The Bioretention Systems proposed will provide biodiversity enhancement by introducing new habitats in the urban environment.	Amenity space in bioretention systems is formed by shallow depressions in the landscaping with stepping stones and seating areas.
The Tree-Pits proposed allow for reduction of water quantity by providing opportunity for transpiration. The Green Roofs proposed allow for reduction of water quantity by providing opportunity for transpiration. Some transpiration will occur for waters on the permeable block paving surface and will reduce water quantity, though it is appreciated it will not be to the same extent as bioretention systems or green roofs could provide. Rainwater harvesting. Some reduction in water quantity is expected by reuse for private gardens in Block B and for bin-wash-down in Blocks, A, D, E, F, G, H, J, K/L, M and J3.	The engineered soils within the proposed tree-pits provide a filter medium to cleanse waters prior to outfall to the drainage network. The proposed green-roofs provide a water quality treatment stage for runoff from these roof areas. The granular subbase within permeable block paving attenuation systems provide a water quality treatment stage for runoff from trafficked areas.	The Tree-Pits proposed will provide biodiversity enhancement by introducing new habitats in the urban environment. The intensive and extensive green roofs will provide new habitats in the urban environment.	The Tree-Pits proposed will enhance the amenity space of the public realm. Amenity space is provided on green-roof terraces on the podiums.

Green Roofs

5.2 Green Roofs will provide Amenity, Biodiversity, Water Quality and Water Volume benefits in line with the Four Pillars of SuDS. Amenity space is formed by roof-top gardens and terraces for. Biodiversity is formed by use of extensive and intensive green-roofs. Water Quality, the green roof areas will provide a treatment stage for surface water runoff. Water Volume, green roofs provide attenuation volume and slow the rate of waters entering the main sewer system. Transpiration shall also reduce overall water volumes.

5.3 CIRIA SuDS Manual C753 Chapter 12 describes Green Roofs as follows:

"Green roofs area areas of living vegetation, installed on the top of buildings, for a range of reasons including visual benefit, ecological value, enhanced building performance and the reduction of surface water runoff. Types of green roof can be divided into two main categories:

-Extensive roofs, have low substrate depths (and therefore low loadings on the building structure), simple planting and low maintenance requirements; they tend not to be accessible.

-Intensive roofs (or roof gardens) have deeper substrate (and therefore higher loadings on the building structure) that can support a wide variety of planting but which tend to require more intensive maintenance; they are usually accessible."

5.4 The Full Planning proposals include for a number of garden roof terraces which comprise some areas of extensive and intensive type green roof as well as paved areas – these are currently detailed on Blocks A, D, M and K/L. Green roofs are also shown indicatively on Outline Application Blocks E, F, G, J, and H, it is expected that these will also comprise extensive and intensive green roof areas and paved areas. Details of the Proposed Green Roofs can be found on PlanIt Roof Masterplan drawing in Appendix M. As described above, the drainage calculations in Section 4 do not account for any attenuation that may be available on green roof areas. However, as a general rule, it is assumed that green roofs are saturated when calculating a site's attenuation requirements anyhow.

5.5 Green roofs and Garden Roof Terraces will provide water quality and biodiversity benefits to the overall scheme.

Bio-Retention Systems

5.6 Bio-Retention Systems will provide Amenity, Biodiversity, Water Quality and Water Volume benefits in line with the Four Pillars of SuDS. Amenity space is formed by shallow depressions in the landscaping with stepping stones and seating areas. Biodiversity is formed by use of suitable planting. In terms of Water Quality, the bioretention systems shall provide a treatment stage for surface water runoff. Water Volume – bioretention systems shall provide attenuation volume and slow the rate of waters entering the main sewer system. Transpiration shall also reduce overall water volumes.

5.7 CIRIA SuDS Manual C753 Chapter 18 describes Bio-Retention Systems as follows:

"Bioretention systems (including rain gardens) are shallow landscaped depressions that can reduce run-off rates and volumes, and treat pollution through the use of engineered soils and vegetation. They are particularly effective in delivering interception and can also provide: attractive landscape features that are self-irrigating and ; habitat and biodiversity; and cooling of the micro-climate due to evapotranspiration."

5.8 Bio-Retention Systems are proposed within the public realm of the Full Planning Application and Outline Planning Application areas. Where possible, surface water run-off from public realm hardstanding hall be directed to these bioretention systems which shall provide a first stage of attenuation and treatment of run-off. Overflow from these bio-retention systems shall be directed into the wider surface water drainage system.

5.9 Norwich County Council's Highway Team have been consulted as part of the application consultation process and have commented upon the provision of bio-retention systems along the western boundary of the site which would collect surface water run-off from Botolph Street and form part of the highway drainage network. They have raised no objection shall require a commuted sum in order to adopt them. This will be detailed further post-planning in any S278/S38 negotiations.

Tree Pits

5.10 Tree-Pits will provide Biodiversity, Water Quality and Water Volume benefits in line with the Four Pillars of SuDS. Biodiversity is formed by use of suitable planting. In terms of Water Quality, the bioretention tree-pit filter mediums shall provide a treatment stage for surface water runoff. Water Volume – bioretention tree-pits shall provide attenuation volume and slow the rate of waters entering the main sewer system. Transpiration shall also reduce overall water volumes.

5.11 CIRIA SuDS Manual C753 Chapter 19 describes Tree Systems as follows:

"Trees and their planting structures provide benefits to surface water management in the following ways:

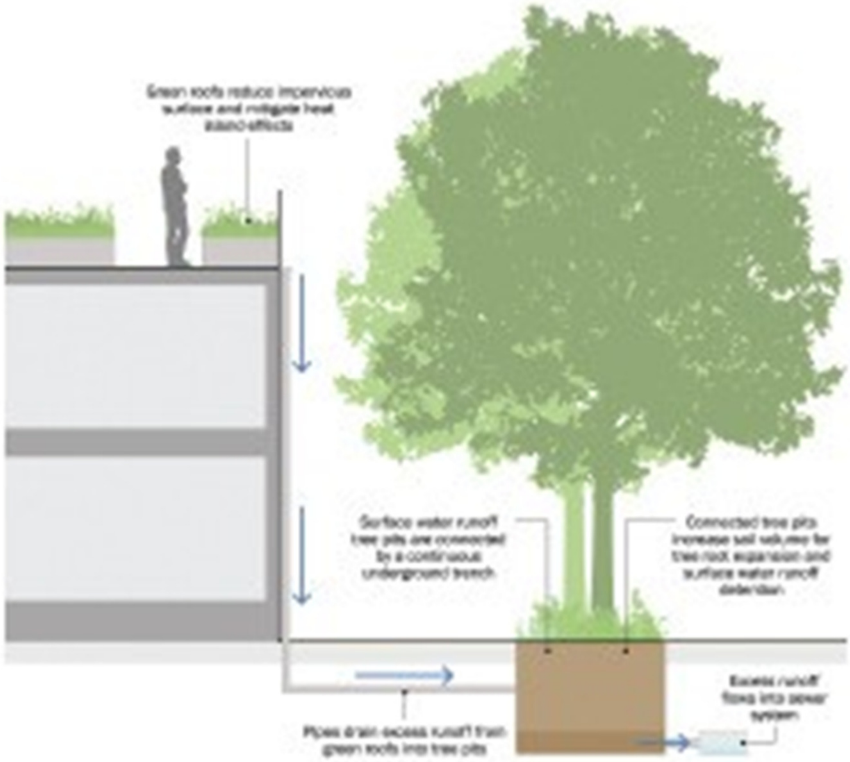
Transpiration – This is the process by which water, taken in from soil by tree roots, is evapourated through the pores or stomata on the surface of leaves. Trees draw large quantities of water from the soil, which can contribute to reducing run-off volumes.

Interception – Leaves, branches and trunk surfaces intercept (store and allow water to evapourate) and absorb rainfall, reducing the amount of water that reached the ground, delaying the onset and reducing the volume of run-off.

Increased infiltration – Root growth and decomposition increase soil infiltration capacity and rate, reducing runoff volumes.

Phytoremediation – In the process of drawing water from the soil, trees also take up trace amounts of harmful chemicals, including metals, organs compunds, fuels and solvents that are present in the soil. Inside the tree, these chemicals can be transformed into less harmful substances, used as nutrients and/or storeg in roots, stems and leaves.

…Tree Planters are essentially bio-retention systems with trees in them, to enhance capacity and performance, and/or to deliver amenity and biodiversity benefits. They have similar functionality and design requiements to standard tree pits, but have open surace and generally a larger surface area, so their overall appearance is different"



5.12 Tree-Pits are proposed within the public realm of the Full Planning Application and Outline Planning Application areas. Where possible, surface water run-off from public realm hardstanding hall be directed to these bioretention systems which shall provide a first stage of attenuation and treatment of run-off. Overflow shall be directed into the wider surface water drainage system.

Permeable Block Paving

5.13 Permeable block paving (pervious pavements) will provide Water Quality and Water Volume benefits in line with the Four Pillars of SuDS. In terms of Water Quality, the subbase gravels shall provide a treatment stage for surface water runoff. Water Volume – subbase gravels shall provide attenuation volume and slow the rate of waters entering the main sewer system. Some transpiration shall also reduce overall water volumes as waters within the subbase and within sand layers between blocks shall have (little) opportunity to evaporate – this is still to be considered overall.

5.14 CIRIA SuDS Manual C753 Chapter 20 describes Pervious Pavements as follows:

"Pervious surfaces, along with their associated substructures, are an efficient means of managing surface water runoff close to its source – intercepting runoff, reducing the volume and frequency of runoff, and providing a treatment medium. Treatment processes that occur within the surface structure, the subsurface matrix and the geotextile layers include:

-Filtration

-Absorption

-Biodegredation

-Sedimentation"

5.15 Lined Permeable Block Paving Attenuation Systems are proposed across the site. The access road and parking areas for Block B and Block F as well as access and hardstanding areas around Block G and J.

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG **Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk**

6 Mainenance of Development Drainage

6.1 The responsibility for ongoing maintenance will be the responsibility of an elected Management Company whom will be appointed by the Site Owner.

6.2 The proposed private surface water drainage features should be regularly inspected and maintained to ensure they are effective throughout the lifetime of the development and do not become blocked or damaged over time.

6.3 Some maintenance details for elements of the drainage system from CIRIA SUDS Manual (C753) are included in the tables below:

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 it may cause risks to performance) and from silt traps prior to cells.	Monthly
	For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae or other matter; remove and replace surface infiltration as necessary	Annually
	Remove sediment from pre-treatment structures and/or internal forebays	Annually or as required
Remedial actions	Reconstruct soakaway if performance deteriorates or in the event of failure.	As required
Monitoring	Inspect silt traps and note rate of sediment accumulation	Monthly in the first year then annually
	Survey inside of tank for sediment build up and remove if necessary.	Every 5 years or as required

Table 6.1: Maintenance tasks for attenuation tanks (Source: CIRIA C753, The SuDS Manual)

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk

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.	As required.
	Removal of weeds.	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.	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance of a hazard to the user.	As required
	Rehabilitation of surface and upper sub-surface.	As required (if infiltration performance is reduced as a result of significant clogging.)
Monitoring	Initial inspection	Monthly for 3 months after installation. 3 monthly, 48 hours after large storms.
	Inspect for evidence of poor operation and/or weed growth. If required, take remedial action	Annually.
	Inspect silt accumulation rates and establish appropriate brushing frequencies.	Annually.
	Monitor inspection chambers.	Annually

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

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS

Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG **Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk**

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)

Maintenance Schedule	Required Action	Frequency
Regular maintenance	Inspect all components including soil substrate, vegetation, drains, irrigation systems (if applicable), membranes and roof structures for proper operation, integrity of waterproofing and structural stability Inspect soil substrate for evidence for erosion channels and identify any sediment sources Inspect drain inlets inlets to ensure unrestricted runoff from the drainage layer to the conveyance or roof drain system Inspect underside of roof for evidence of leakage	Annually and after severe storms Annually and after severe storms Annually and after severe storms Annually and after severe storms
Remedial Actions	Remove debris and litter to prevent clogging of inlet drains and interference with plant growth During establishment (i.e. year one) replace dead plants as required Post establishment, replace dead plants as required (where >5% of coverage) Remove fallen leaves and debris from deciduous plant foliage Remove nuisance and invasive vegetation, including weeds Mow grasses, prune shrubs and manage other planting (if appropriate) as required – clippings should be removed and not allowed to accumulate	Six monthly and annually or as required Monthly (but usually responsibility of manufacturer) Annually (in autumn) Six monthly or as required Six monthly or as required Six monthly or as required
	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed. Survey inside of tank/crate system for sediment build-up and remove if necessary.	Annually Every 5 years or as required.

Table 6.4 Maintenance tasks and frequencies for green roofs (The SUDS Manual C753, CIRIA)

Maintenance Schedule	Required Action	Frequency
Regular Maintenance	Remove litter and debris	Monthly (or as required)
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspect inlets and outlets	Inspect monthly
Occasional maintenance	Check tree health and manage tree appropriately	Annually
	Remove silt build-up from inlets and surface and replace mulch as necessary	Annually or as required
	Water	As required (in periods of drought)
Monitoring	Inspect silt accumulation rates and establish appropriate removal frequencies	Half yearly

Table 6.4 Maintenance tasks and frequencies for tree pits (The SUDS Manual C753, CIRIA)

Maintenance Schedule	Required Action	Frequency
Routine Maintenance	Remove litter and debris and inspect for sediment, oil and grease accumulation	Sixth Monthly
	Change the filter media	As recommended by the manufacturer
	Remove sediment, oil, grease and floatables	As necessary-indicated by a system inspections or immediately following significant spill
Remedial Actions	Replace malfunctioning parts or structures	As required
Monitoring	Inspect for evidence of poor operation	Six Monthly
	Inspect filter media and establish appropriate replacement frequencies	Six Monthly
	Inspect sediment accumulation rates and establish appropriate removal frequencies	Monthly during first half year of operation, then every six months

Table 6.5 Example operation and maintenance requirements for propriety treatment systems (The SUDS Manual C753, CIRIA)

Adopted Sewer Network

6.4 The adopted surface and foul water sewers which cross the propose development site will be diverted and or divested accordingly and as agreed with Anglian Water. Adopted sewers are and will continue to be the responsibility of the Water Authority – Anglian Water.

Geocellular Storage Device – Drain-Down Alarm System

6.5 It is recommended that the drain-down alarm systems are tested every 3 months and to the 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 alarm system is functioning correctly and effectively. Kiosks containing control panels should be checked for damage and replaced as necessary.

Surface Water Pumps – Pump Failure Alarm System

6.6 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.

Surface Water Pumps – Link to Emergency Back-up Power Generator System

6.7 The site shall be served by an emergency power system/back-up generators to ensure essential services such as emergency lighting and sprinkler pumps are able to function in case of power failure/power cut. It is proposed to link the surface water pumps serving the site to this back-up power generator system. This will ensure that, should a power failure occur during a storm event, the surface water pumps will continue to function. It is therefore necessary to ensure the link between the surface water pumps and the emergency–back-up generator system is functional. It is recommended that the power link to the pumps are tested every 3 months and to manufacturers guidelines.

Manholes and Sewers

6.8 Manhole covers should be lifted each year to remove visible debris and check for blockages – it is suggested that this is undertaken every November after the heaviest leaf-fall has occurred.

6.9 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

6.10 t 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.

Orifice Plate with Suitable Filter

6.11 It is advised that maintenance company take time to review the manufactures maintenance recommendations and follow accordingly, with regular inspections anticipated to be required every 3 months and after heavy rainfall events.

7 Water Quality Management During Construction

7.1 It is anticipated that a suitably worded Condition to Planning shall be included which sets out requirement to confirm any schemes for water quality management during the construction of the development. For guidance and to demonstrate that this has been considered during the planning stage, a construction phase plan has been provided in **Appendix U**, showing 4no. construction phases.

7.2 Anglian Water have been contacted to gain an agreement in principle for temporary surface water outfalls for during the construction period. It has been demonstrated that surface water shall be treated prior to outfall via a proprietary treatment unit and that the risk of surface water flooding is not increased compared to the existing situation. Once temporary and permanent drainage features are installed, the risk of flooding is further reduced due to the provision of a modern standard drainage system. Anglian Water's agreement in principle is contained in **Appendix U** also.

7.3 The Construction Phase Plan shows that each discreet drainage system can be constructed within a single phase – with the exception of Block A, M, K/L and J3 which is split between Phase 1 and 2. Blocks A and M will be in Phase 1 whilst Block K/L and J3 are in Phase 2. The proposed geocellular storage device which serves System 4 will therefore be built in two phases. The geocellular storage device within Phase 1 will be built first, then when Phase 2 begins, the geocellular storage cells will be "extended" to complete System 4. A temporary connection to the diverted 675dia sewer for Phase 1 will be agreed with Anglian Water accordingly post-planning.

7.4 As the geocellular storage device will straddle the two phases, it will necessary to ensure that the storage volume constructed or each phase can deal with surace water runoff from that phase. For Block A, M, K/L and J3 catchment, Phase 1 covers 62% of this area and Phase 2 covers 38% of the catchment. As such, it is proposed to ensure that 62% of the proposed geocellular storage device is constructed in Phase 1 and 38% in Phase 2. This is indicated on the proposed surface water drainage layouts in **Appendix O**.

7.5 Further information regarding the construction phase : Activities such as earthworks and construction plant use may result in an increase of silt load in surface water runoff onsite. The presence of heavy plant and other vehicles onsite also introduces the potential for spillages, for example, diesel and hydraulic fluids, wet concrete, construction chemicals and wash-down wastes. Contaminants could enter the sub-soils, surface water, groundwater and nearby watercourse via infiltration and surface water runoff.

7.6 Earthmoving operations should be sequenced and timed to avoid heavy rainfall events. This will reduce the risk of soils and silts being mobilised within surface water run-off. Designated vehicle washdown areas shall be provided. Wash-down and surface water run-off from this area will be directed to the drainage network via a silt trap and oil interceptor and a suitable agreement for a temporary use with Anglian Water will be sought. A watching brief for unforeseen contamination of groundwater and surface water will be prepared. Spillages of fuels and chemicals will be controlled in secure bunded areas and containment at refueling and maintenance facilities in accordance with the EA guidelines.

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG **Tel 01920 871 777** **e: contact@eastp.co.uk** **www.eastp.co.uk**

8 Conclusions

8.1 EAS have been commissioned by Weston Homes Ltd to prepare a Surface Water Drainage Strategy for the redevelopment of Anglia Square, Norwich, Norfolk.

8.2 A separate report, undertaken by others, deals with the flood risk assessment, hydraulic modelling study and impact assessment and should be read in conjunction with this report.

8.3 As described in Section 1, it is proposed to make a Hybrid planning application: Full Planning for Blocks, A, B, C, J3, K/L and M and Outline Planning for Blocks E, F, G, H and J.

8.4 The proposed surface water drainage strategy for the Hybrid Planning Application site has been based on sustainable principles with aim to provide a significant betterment to the existing situation. Currently the site does not benefit from any attenuation features and as such surface water run-off flows freely into the adopted sewer network, unrestricted and untreated.

8.5 The city center site gives opportunities for “urban types” of Sustainable Drainage Systems (SuDS) features to be incorporated. These features provide water quantity, water quality, biodiversity and amenity enhancements in line with the Four Pillars of SuDS. The proposals include green roofs, bioretention systems, tree-pits, lined permeable paving and geo-cellular attenuation devices.

8.6 An assessment was undertaken to determine the existing surface water run-off from the site and what flow rate would likely enter the adopted sewer network. The assessment was discussed with Anglian Water and the LLFA. Anglian Water have agreed in principle to a maximum outfall rate of 242 l/s to be directed to a diverted 675dia surface water sewer which crosses the site and also to the surface water sewer in Edward Street. Anglian Water have also provided an agreement in principle for the proposed 9no. outfalls to the adopted surface water sewer network.

8.7 A maximum surface water outfall rate of 242 l/s has been agreed to to manage all storms up to and including the 1:100yr + 45% Climate Change Event. This will be the equivalent of 49.5% of the existing 1:1yr surface water run-off rate, a significant reduction.

8.8 The development parcels have been split into 9no. drainage catchments. Each catchment has a restricted outfall to the adopted surface water sewer network and attenuation designed to accommodate a 1:100yr + Climate Change Storm Event. Suitable water treatment stages, in line with CIRIA SuDS Manual are proposed and will provide an improvement to the existing situation, where waters enter the adopted sewer network, untreated.

8.9 Maintenance of the attenuation features will remain the responsibility of the site owner or an appointed management company. The Anglian Water sewers that pass through the site will remain the responsibility of Anglian Water.

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk

9 Appendices

Appendix: A – Location Plan and Application Description
Appendix: B – Application Boundary
Appendix: C – LLFA Comments Tracker
Appendix: D – Topographical Survey and Utilities Survey
Appendix: E – Anglian Water Sewer Records
Appendix: F – CCTV Survey
Appendix: G – Existing Impermeable Areas and Drainage Catchments
Appendix: H – FEH Brownfield Runoff Hydraulic Calculations
Appendix: I – Greenfield Run-off Rate Calculations
Appendix J – Greenfield vs. Brownfield Storage Volumes
Appendix K – Anglian Water Pre-Development Enquiry
Appendix L – Anglian Water Agreement in Principle for Outfalls
Appendix M – Roof Level Soft Landscaping Plan (Green Roofs)
Appendix N – Hard and Soft Landscaping Masterplan
Appendix O – Proposed Surface Water Drainage Layouts
Appendix P – WinDes Hydraulic Model Outputs
Appendix Q – Downstream Defender Mitigation Indices and Unit Selection
Appendix R – Exceedance Routes
Appendix S – Anglian Water Sewer Diversion Information
Appendix T – Standard Surface Water Drainage Details
Appendix U – Construction Phasing Plan

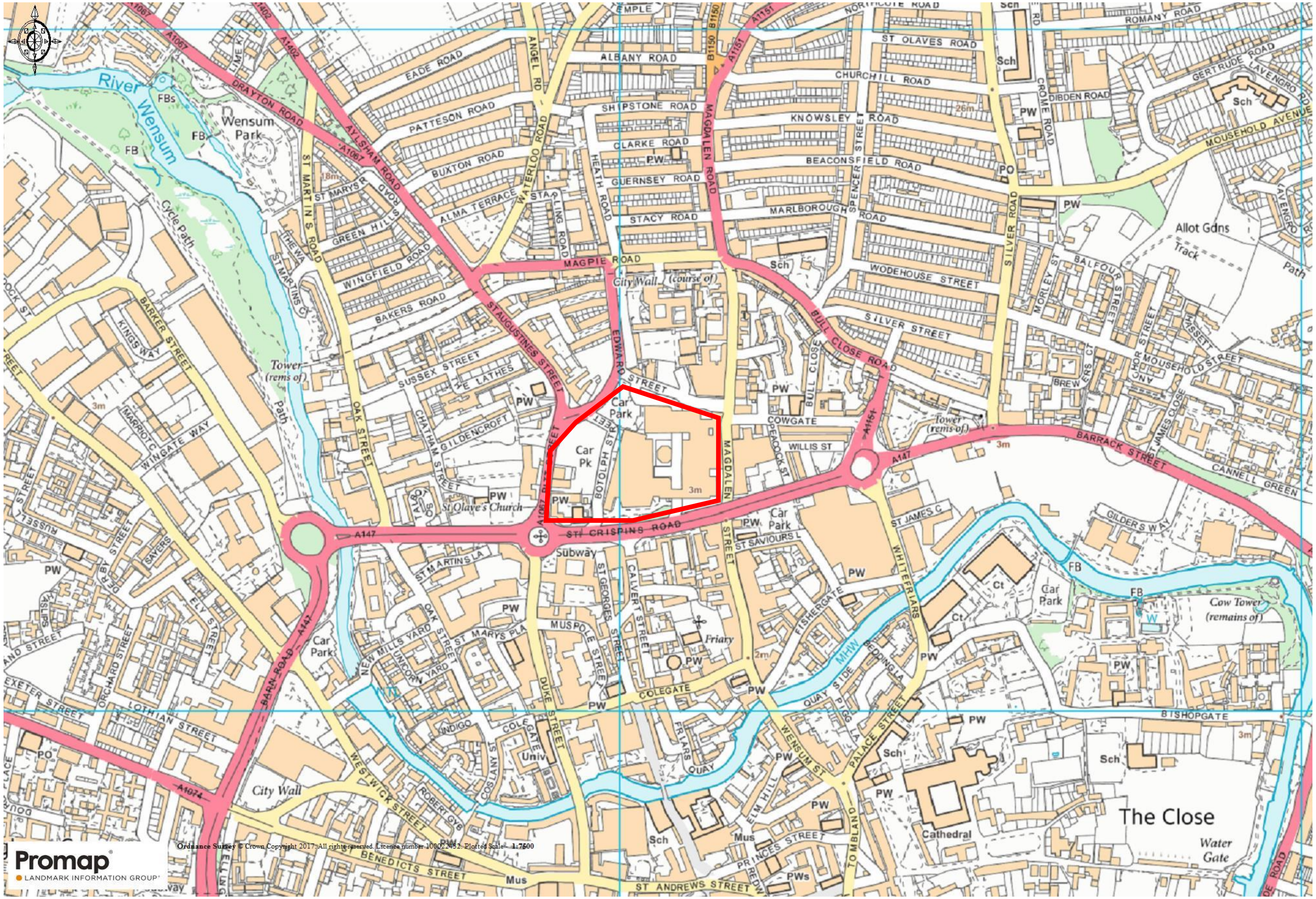
TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG **Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk**

Appendix: A – Location Plan and Application Description

Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG **Tel 01920 871 777** **e: contact@eastp.co.uk** **www.eastp.co.uk**

Anglia Square, Norwich, Norfolk NR3 1DZ

Site



Anglia Square: Hybrid Application Development Description

"Hybrid (part full/part outline) application on site of 4.65ha for demolition and clearance of all buildings and structures and the phased, comprehensive redevelopment of the site with 14 buildings ranging in height from 1 to 8 storeys, for a maximum of 1,100 residential dwellings, (houses, duplexes and flats) (Use Class C3); a maximum of 8,000 sqm flexible retail, commercial and other non-residential floorspace (retail, business, services, food and drink premises, offices, workshops, non-residential institutions, community hub, local community uses, and other floorspace (Use Classes E/F1/F2/Sui Generis (public conveniences, drinking establishments with expanded food provision, bookmakers and/or nail bars (up to 550sqm), and dry cleaner (up to 150sqm))); service yard, cycle and refuse stores, plant rooms, car parking and other ancillary space; with associated new and amended means of access on Edward Street and Pitt Street, closure of existing means of access on Edward Street, New Botolph Street, Pitt Street and St Crispins Road flyover, formation of cycle path between Edward Street and St Crispins Road, formation of wider footways, laybys and other associated highway works on all boundaries, formation of car club parking area off New Botolph Street, up to 450 car parking spaces (at least 95% spaces for class C3 use, and up to 5% for class E/F1/F2/Sui Generis uses), hard and soft landscaping of public open spaces comprising streets and squares/courtyards for pedestrians and cyclists, other landscape works within existing streets surrounding the site, service infrastructure and other associated work; (All floor areas given as maximum Net Internal Area);

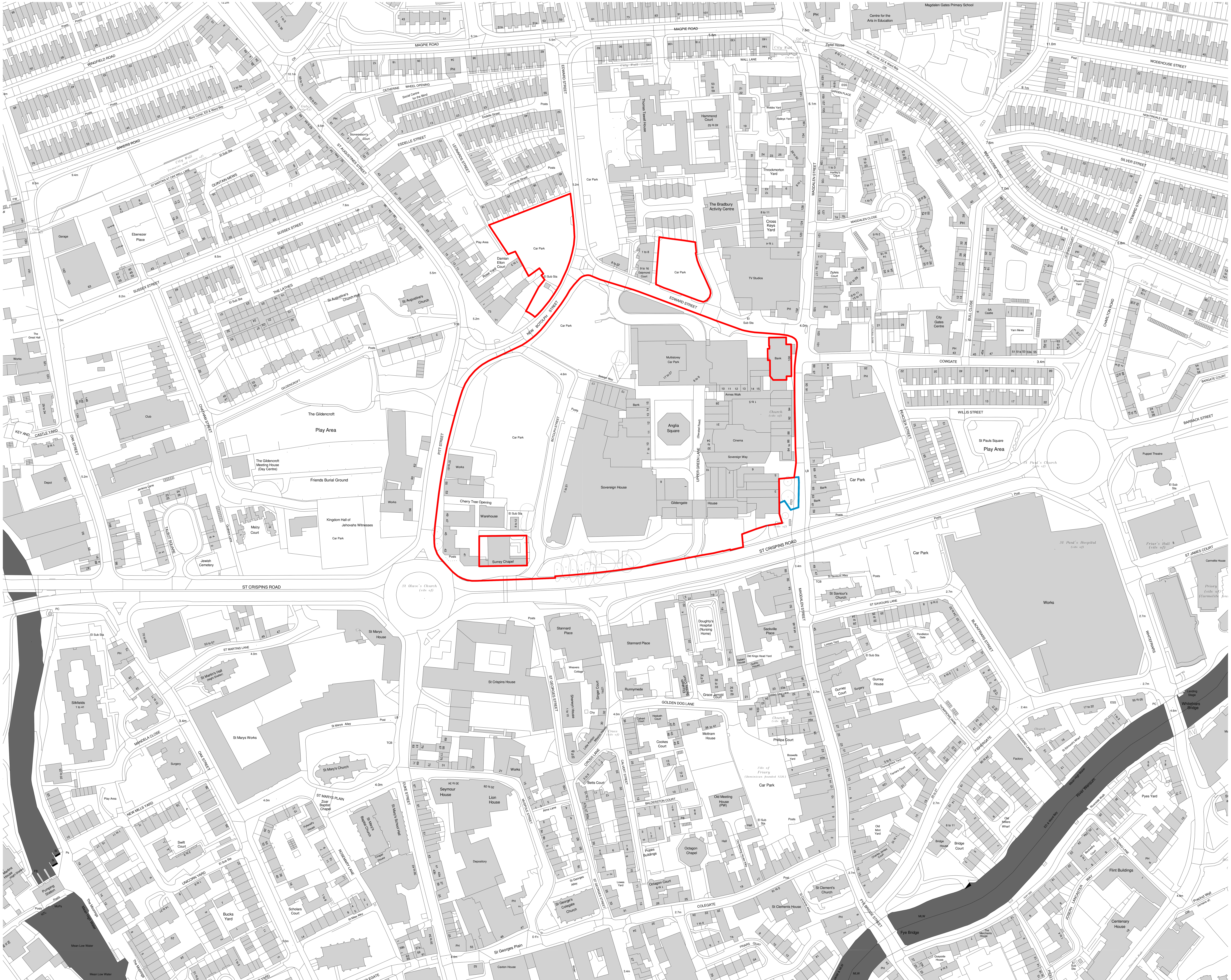
Comprising;

Full planning permission on 2.25ha of the site for demolition and clearance of all buildings and structures, erection of 8 buildings ranging in height from 1 to 7 storeys for 353 residential dwellings (Use Class C3) (142 dwellings in Block A, 25 dwellings in Block B, 21 dwellings in Block C, 28 dwellings in Block D, 8 dwellings in Block J3, 81 dwellings in Block K/L, and 48 dwellings in Block M) with associated cycle and refuse stores), and, for 5,906sqm flexible retail, commercial and other non-residential floorspace (retail, business, services, food and drink premises, offices, workshops, non-residential institutions, community hub, local community uses, and other floorspace (Use Classes E/F1/F2/Sui Generis (public conveniences, drinking establishments with expanded food provision, bookmakers and/or nail bars (up to 550sqm), and dry cleaner (up to 150sqm))), service yard, cycle and refuse stores, plant rooms, car parking and other ancillary space, with associated new and amended means of access on Edward Street, closure of existing means of access on Edward Street and New Botolph Street, formation of cycle path from Edward Street to St Crispins Road, formation of wider footways, laybys and other associated highway works on Edward Street, New Botolph Street, and Magdalen Street, formation of car club parking area off New Botolph Street, 134 car parking spaces (at least 95% spaces for class C3 use, and up to 5% for class E/F1/F2/Sui Generis uses) within Blocks A and B, hard and soft landscape works to public open spaces comprising streets and squares for pedestrians and cyclists, other landscape works, service infrastructure and other associated works; (All floor areas given as maximum Net Internal Areas);

and

Outline planning permission on 2.4ha of the site, with landscaping and appearance as reserved matters, for demolition and clearance of all buildings and structures, erection of 6 buildings (Blocks E – H and J) ranging in height from 2 to 8 stories for up to 747 residential dwellings, (houses, duplexes, and flats) (Use Class C3), a maximum of 2,094 sqm flexible retail, commercial and other non-residential floorspace (retail, business, services, food and drink premises, offices, non-residential institutions, local community uses and other floorspace (Use Classes E/F1/F2/Sui Generis (drinking establishments with expanded food provision, bookmakers and/or nail bars (up to 550sqm), and dry cleaner (up to 150sqm))); cycle and refuse stores, plant rooms, car parking and other ancillary space; with associated new and altered means of access on Pitt Street and St Crispins Road, closure of means of access on Pitt Street and St Crispins Road flyover, formation of wider footways, laybys and other associated highway works on Pitt Street and St Crispins Road, a maximum of 316 car parking spaces (at least 95% spaces for class C3 use, and up to 5% for class E/F1/F2/Sui Generis uses), service infrastructure and other associated works (landscaping and appearance are reserved matters); (All floor areas given as maximum Net Internal Areas)."

Appendix: B – Application Boundary



Contractors and consultants are not to scale dimensions from this drawing

The survey information shown on this drawing is based on a topographical survey prepared by a third party and Broadway Malyan Limited accept no responsibility for the accuracy or completeness of the survey.

Drawings to be read in conjunction with the associated Design & Access Statement, associated consultant desin team documents & reports and landscape information

Landscape shown is for illustrative purposes only. For detailed landscape information, please refer to the landscape information & documents.

0m 62.5m 125m

N

General Notes

All figures and areas are approximate only and subject to statutory constraints, detail design & design development

Structural Design: Subject to structural input & coordination

Services Design: Subject to services input & coordination

Fire Strategy: Subject to fire input & coordination

Application Boundary

Land Owned by CT to be subject to separate application for part of the Mobility Hub

Revision	Date	Drawn By	Description
D0-1	31.03.22		Issued For Planning

BroadwayMalyan[BM]

4 Pear Place
London
SE1 8BT

T: +44 (0)20 7261 4200
F: +44 (0)20 7261 4300
E: Lon@BroadwayMalyan.com

www.BroadwayMalyan.com

Client
Weston Homes

Project
Anglia Square
Norwich

Description
Hybrid Application - Location Plan on Existing OS Base

Status
For Planning

Scale	Drawn By	Date
1:1250@A1	BM	31.03.22
Job Number	**Drawing Number**	**Revision**
35301	ZZ-00-DR-A-01-1000	D0-1

Appendix: C – LLFA Comments Tracker

Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG **Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk**

Red	Further Action Required	**Full** = Full Application Area
Amber	Some Action Needed	**Outline** = Outline Application Area
Green	Complete	**Whole** = Both the Full and Outline Application Areas

Item	Consultee Comment (FW2022_0423)	EAS Drainage Strategy Response (Rev D (dated 15 July 2022))	RHDHV FRA Response (FRA dated 13 July 2022)	LLFA Review Comments (dated 24 August 2022) (FW2022_0703)	EAS Drainage Strategy Response (Rev E (REV B SUMBISSION
1 Whole	An updated Flood Risk Assessment (FRA), Drainage Strategy and Hydraulic Modelling Study that consistently provides information that interlinks each of the documents.	Cross-references have been added throughout this document where appropriate.	-	Some improvement in the cross referencing.	Noted, further cross-references have been provided.
2 Whole	Within the FRA, Drainage Strategy, Hydraulic Modelling Study and yet to be developed detailed drainage design, we request these documents incorporates the evidence to address the issues identified in the Annex.	The issues identified in the Annex are, largely, included within the following itemised comments and are addressed as follows. Other items in the Annex raised include: -The site is within the River Wensum area and is subject to requirements relating to maintenance of nutrient neutrality. This is being addressed by Others and a report shall be submitted in Rev A Submission. - LLFA notes there is reference to Table 3, yet there is no Table 3. There is no reference to Table 3 in this Drainage Report. - Calculate greenfield and brownfield run-off rates using the latest datasets and hydrological methods. The modified rational method was used to calculate brownfield runoff rates to be updated to FEH. It should be noted that Anglian Water have accepted a proposed maximum outfall rate of 242 l/s and the proposed drainage strategy meets this requirement. - LLFA disagree with the accuracy of the sewer catchments defined in Appendix F stating that permeable areas shown are unlikely to be permeable. The assessment undertaken by the LLFA would likely result in the existing brownfield run-off from the site increasing in rate and volume. The calculation undertaken is therefore conservative as it considers gravels and green areas as permeable, whilst the LLFA assessment would consider these as generating runoff. - NPPF in para 4.1 incorrect – this has been updated Evidence to support infiltration is not viable due to contamination and high groundwater. The Royal Haskoning FRA report refers to borehole data which describes a groundwater level of 3m bgl which was taken in May 2022. As this level was taken in drier months, it is considered likely that the water table will be elevated in the winter months Considering that the base of a soakaway is to be 1m above the highest groundwater level (in accordance with CIRIA SuDS Manual, it is not possible to achieve this whilst also achieving suitable cover above the soakaway. -Residual risk of surface water pumps – This has been addressed, see below. - Inconsistencies with Landscaping layout vs SuDS Layout regarding Green Roofs – Proposed green roofs for the Full Planning Application areas are clearly identified.	The issues identified in the Annex have been addressed within this report.	Please see the responses in the sections below that address each of the points discussed and responded to.	See below

2.1 Whole	The assessment of the greenfield and brownfield rates and volumes are required to be calculated accurately using the FEH in accordance with the LLFA Developer Guidance requirements and presented clearly and consistently within the technical reports.	The hydraulic model prepared for the Surface Water Drainage networks serving each catchment area now include FEH rainfall data as requested. See hydraulic model outputs in Appendix J of this report.	Addressed in Drainage Strategy Report prepared by EAS	The LLFA has reviewed both the Drainage Strategy and the Drainage Strategy Addendum Letter. The LLFA notes that applicant has not provided the "original pre-development (greenfield) runoff rate" as required by the LLFA developer guidance (Section 14.3). NPPF clearly states in paragraph 169 "a) take account of advice from the lead local flood authority;". The LLFA's position is based upon S3 of the Non-Adoptable Technical Standards for Sustainable Drainage Systems (2015) which states "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". Therefore, it is a clear and common approach that is commonly applied in the surface water management industry and the LLFA requires the information to be provided. This has been previously requested by the LLFA and has not been provided by the applicant. All "original pre-development (greenfield) runoff rate" calculations should be undertaken using the most appropriate and uptodate Flood Estimation Handbook (FEH) rainfall data and catchment characteristics as per section 14.4 of the LLFA Developer Guidance. The LLFA notes that the greenfield runoff run calculations shown in Appendix H of the Drainage Strategy are for a 1 hectare area and does not reflect either the area of the site or the proposed discreet drainage areas. They also do not use an FEH calculation method. Therefore, these greenfield calculations are also incorrect and not appropriate for use at this time. From a review of the Drainage Strategy Addendum Letter, the LLFA notes the brownfield runoff rates were re-calculated for this site using FEH13 hydrology. In the Drainage Strategy the LLFA notes: • The Modified Rational Method has been used to calculate the existing runoff rate rather than the FEH approach. • The greenfield runoff rate for the whole site and for each of the proposed discreet drainage system areas has not been provided as per the LLFA's previous request in accordance with the LLFA's Developer guidance and the Non-Adoptable SuDS Standards. This means there is no baseline to compare and assess whether there is a likely increase in flood risk from the proposed development. • In the currently provided, but incorrect, approach that has been applied, some of the greenfield areas identified in green to the east of the car park area marked in brown in Appendix F appear to be served by a surface water drain that discharge to the Anglian Water surface water sewer network. • The LLFA would consider these areas would appear to have a surface water discharge connection that indicates they are positively drained. • The brown car park area is indicated as a private drainage system on the plan in Appendix F. However, it is not clear from the plan or the report where these drains discharge to. Are they infiltration or do they connect to the public sewer network? • To the east of the flyover there is an area marked as permeable that is impermeable. • The LLFA notes that section 3.13 states "existing run-off rate calculations are contained in Appendix E", which is not correct. Rather, Appendix E shows the runoff rate for one storm with an intensity of 50mm/hr and does not show the runoff rates for the various return periods that are referred to in section 3.12, and are required by the LLFA Developer Guidance in accordance with the SuDS Non-Statutory Technical Standards. While in section 3.12 three different return periods are shown with three unrelated storm intensities when compared to the intensity shown in Appendix E. Section 3.12 identifies that these were undertaken using WINDES MicroDrainage, however, no calculations were provided to support this statement or indicate the parameters used in the drainage strategy. • The LLFA have reviewed the Surface Water Drainage Network modelling which clearly shows the Synthetic Rainfall Details for proposed Block D networks (on page 9 of the calculation sheets) uses the FSR rainfall model not the FEH rainfall model. While on page 12 of the same series of calculation sheets the FEH Rainfall model is applied. This is not acceptable as it is not in accordance with the LLFA Developer Guidance. This has occurred in other sets of calculation for each of the systems. While in the Drainage Strategy Appended Letter, the LLFA notes: • The brownfield runoff rate is calculated and a comparison using the FSR and FEH13 methods and data. • The MicroDrainage Calculations show that for the storm summary results the FEH13 method is used for the synthetic Rainfall Details, while in the pipeline schedule the FSR method is still used. This means that all the calculations prepared in MicroDrainage have a mixture of FSR and FEH hydrology applied. • The MicroDrainage Calculations have used a MADD Factor of 2 which should be 0, otherwise double counting will be experienced in the network. Again the information provided in the Drainage Strategy addendum Letter did not provide the information previously requested or in accordance with the LLFA Developer Guidance.	Greenfield and Brownfield Runoff Rate calculations are provided in Section 3 of the report, in line with the methodologies required by LLFA.
2.2 Whole	Provide evidence to support the justification of increasing the greenfield discharge rate is required in accordance with the LLFA Developer Guidance.	The site is Brownfield and currently drains unrestricted and untreated into the existing Anglian Water surface water sewers which cross the site. As the site is Brownfield and practically 100% impermeable, it is not considered reasonable or appropriate to apply greenfield run-off rates for this Application. Anglian Water state that where this is not practical they will assess capacity based on the 1:1 year calculated rate. They therefore permit a maximum discharge rate of 242 l/s to manage all storms up to and including the 1:100yr + Climate Change Event. A Pre-Development Enquiry and Capacity Check from Anglian Water confirming this is contained in Appendix I of this report.	Addressed in Drainage Strategy Report prepared by EAS	The LLFA Developer Guidance clearly states in section 14.3 that "Brownfield sites should discharge at the original pre-development (greenfield) runoff rate. If not possible, a significant reduction in the current rate of discharge should be achieved and agreed with the relevant drainage body (LLFA, IDB or Anglian Water) providing evidence as to why an alternative should be considered." At present, EAS has not accurately defined the predevelopment (greenfield) runoff rate of the site. Therefore it is not possible to compare the predevelopment and post development runoff rate. While we appreciate the reminder of the Anglian Water approach, the LLFA guidance differs slightly and at the LLFA we apply the LLFA's Developer Guidance. We shall remind the applicant that NPPF in paragraph 169a states "take account of advice from the lead local flood authority". The LLFA notes the current agreement in principle from Anglia Water is for a single discharge point at manhole 1355 that is near to the southeast corner of the site. The current proposal has four connection points not in this location. In addition, the evidence base to support the proposed design is incomplete to due a lack of correctly calculated information. It would be appropriate to discuss this with Anglian Water as at present the proposed design discharge locations are not in accordance with the agreement in principle. The applicant's response states the site is "Brownfield and practically 100% impermeable" yet your existing runoff calculations do not reflect this. Please see comments above on the existing surface water run off calculation corrections that are required as the wrong method and approach has been applied. This means it is not possible for the applicant to demonstrate the difference between the predevelopment (as defined in section 14.3 of the LLFA Developer Guidance) and the proposed submission. The current approach taken which calculates the existing brownfield runoff rate is not acceptable to the LLFA. **The LLFA considers this requirement incomplete for a second time.**	Justification of proposed runoff rates is provided in Section 4 of the report. Agreement from Anglian Water for the proposed outfall points and rates is shown in Appendix L of the updated report.

2.3 Whole	Apply the latest (May 2022) Climate change guidance, which would require the application of a 45% climate change allowance to the 1% AEP and to apply the appropriate climate change allowance of 40% to the 3.3% AEP calculations.	The hydraulic models prepared for the Surface Water Drainage networks serving each catchment area now include the up-to date Climate Change Allowances as requested. See hydraulic model outputs in Appendix J of this report.	All model runs now include the latest climate change allowance, which were released post completion of the previous FRA. See Figures in Appendix I and J	The LLFA notes the applicant's commitment to using the latest climate change allowance for peak rainfall intensity in the drainage strategy in section 4.15. This was thought to continue through to the drainage calculations in Appendix J. However on review of the drainage calculations the LLFA note that there is no climate change allowance included on page 13 of the calculations for Block A, M, J3 and K/L SW Drainage Network which is where the FSR rainfall model is also noted as being used. However, in the subsequent calculations for the 1% for the Block A, M, J3 and K/L SW Drainage Network the FEH Rainfall model is used and has a 45% climate change allowance applied. The same has occurred on the Block B, the Bolph Street, SW Network Calculations where the FSR method has been used in part of the network assessment and FEH has been reported in the 1% +45% CC storm results. The LLFA notes that drainage design for Block E, F, H, G and J have the FEH rainfall method applied and the 1% +45% for climate change applied. These systems are in the outline planning application area. The LLFA notes there are no 3.3% and 3.3% +CC calculations submitted for any area as per the requirements of the latest climate guidance and the LLFA Developer Guidance. The LLFA notes that on the Block B Porous Car Park Manholes, a Factor of Safety of 2 is applied. The Ciria SuDS Manual (C753) recommends that a factor of safety of 10 is applied to the surface infiltration rate for all types of surface (Chapter 20 section 5.1 (page 400)). This will require updating.	All existng and proposed catchments have been hydraulically modelled using MADD factor of 0, FEH Rainfall Data and to generate a 1:1yr, 1:30yr, 1:30yr + 45% CC, 1:100yr and 1:100yr + 45%CC storm events. See Sections 3 and 4 of the report and the corresponding Appendices. Regarding the hydraulic model out I'm afraid the above is the only way that WinDes Microsoft displays hydraulic model outputs. The return period is listed above, in the results below "Event" shows that the model has been run with 45% climate change allowance. I cannot change this. Please refer to the results "Event" for confirmation of the storm event including the climate change allowance.
2.4 Whole	Evidence that recent liaison with Anglian Water relevant to this new planning application that provides:	Up-to-date sewer records have been obtained and an up-to-date pre-development enquiry has been received. Sewer records are contained in Appendix D and Pre-dev enquiry is contained in Appendix I.	Addressed in Drainage Strategy Report prepared by EAS	As per response 2.2, the LLFA notes the applicant has obtained updated Anglian Water sewer plans in April 2022. In addition, the applicant has received a high level pre-planning assessment report (PPE-0143339 dated: 08/04/2022). The LLFA have reviewed this PPE and note this planning report provides an agreement in principle for one connection to discharge a maximum of 242 l/s to manhole 1355 in the south east corner subject to the provision of connection hierarchy information being provided to AW. The proposed outline drainage design provided for the hybrid application identifies there will be four discharge locations to the AW sewers in locations not specified by the Pre-Application Assessment. In addition, the LLFA observes the PPE has not considered the site is located within the largest critical drainage catchment (CDC) in Norfolk or that the proposed drainage systems to connect to the network are pumped. The PPE states "should your assumptions or evidence change then an alternative solution, connection point or flow rate may be required." At present, the proposed drainage design submitted for the hybrid application is not in accordance with the Pre-Planning Assessment agreement in principle and therefore it is not considered in keeping with the agreement in principle. The LLFA require that these	Anglian Water have provided an update to their Pre-Development Enquiry, see Appendix K and Appendix L of the report.
2.4.1 Whole	Confirmation from Anglian Water that no changes have occurred in the public network since 2017.	Up-to-date sewer records are contained in Appendix D.	Addressed in Drainage Strategy Report prepared by EAS	The LLFA notes the applicant has obtained updated Anglian Water sewer plans in April 2022.	Noted
2.4.2 Whole	Obtain recent drainage assessment from Anglian Water that relates to the current proposed development.	Up-to-date pre-development enquiry is contained in Appendix I.	Addressed in Drainage Strategy Report prepared by EAS	The applicant has received a high level pre-planning assessment report (PPE-0143339 dated: 08/04/2022). The LLFA have reviewed this PPE and note this planning report provides an agreement in principle for one connection to discharge a maximum of 242 l/s to manhole 1355 in the south east corner subject to the provision of connection hierarchy information being provided to AW. The proposed outline drainage design provided for the hybrid application identifies there will be four discharge locations to the AW sewers in locations not specified by the PPE. In addition, the LLFA observes the PPE has not considered the site is located within the largest critical drainage catchment (CDC) in Norfolk or that the proposed drainage systems to connect to the network are pumped. The PPE states "should your assumptions or evidence change then an alternative solution, connection point or flow rate may be required." Therefore, at present the proposed drainage design submitted for the hybrid application is not in accordance with the PPE and should be re-assessed by AW.	Anglian Water have provided an update to their Pre-Development Enquiry, see Appendix K and Appendix L of the report.
2.4.3 Whole	Provide current set of DG5 records from Anglian Water.	Anglian Water were able to confirm that there have been cases of sewer flooding in the vicinity of the site, but for data protection were unable to specify any locations. See email dated 22.06.2022 in Appendix M.	Addressed in Drainage Strategy Report prepared by EAS	The applicant has now obtained confirmation that there have been incidents of sewer flooding in the vicinity of the proposed development as demonstrated in Appendix M. No specifics were given at this time. This is further supported by a letter in Appendix C of the Drainage Strategy Addendum Letter.	Noted
2.4.4 Whole	Provide evidence of an "agreement in principle" with any third parties taking on surface water drainage management and maintenance responsibility.	Surface water drainage serving private catchments will be the responsibility of an elected Management and Management Company, whom shall be appointed by the Site Owner. Any adopted sewer or diverted adopted sewers within the red-line boundary shall be the responsibility of Anglian Water.	Addressed in Drainage Strategy Report prepared by EAS	No evidence of Anglian Water agreement in principle to take on the maintenance and management of the proposed drainage system is provided in the PPE. The LLFA requires this evidence for all structures that it applies to in the full planning application area of the design. For adoptable structures in the outline planning areas, this can be conditioned.	All proposed surface water drainage within the site boundary (Full or Outline) will be privately owned and managed/maintained - with the exception of the diverted adopted 675dia sewer. This sewer is currently adopted and after diversion will continue to be adopted and maintained by Anglian Water. Anglian Water have stated that a S185 Application should be made to agree the diversion formally - this itself confirms that AW intend on retaining their ownership and responsibility of the 675dia sewer. EAS have requested a statement from AW to this effect and await their response.
2.5 Whole	Provide a more in-depth consideration and assessment of rainwater harvesting and re-use opportunities.	See Section 4 para. 4.6 and 4.7.	Addressed in Drainage Strategy Report prepared by EAS	The LLFA have reviewed Paragraph 4.6 which contains a very limited consideration of rainwater harvesting in relation to the proposed development. There is no breakdown of the assessment per block or quantative assessment of the rainwater harvesting potential. The and Paragraph 4.7 is not relevant to this matter. The statements made in the drainage strategy are unevidenced and further assessment remains required to support the statements made.	This section has now been expanded to include a more detailed assessment of suitable rainwater harvesting opportunities
2.6 Whole	Provide a more in-depth consideration and assessment of groundwater flood risk.	Addressed in Royal Haskoning DHV FRA Report.	Included at 7.10 onwards and 8.52	The LLFA has reviewed section 7.9 to 7.16 in the FRA. The LLFA notes that Figure 6 only defines the banding names not the meaning of all the bandings. In section 7.10 a definition of Band B is given but no others. This means it is not possible for the LLFA to reasonably be able to interpret the information provided by the applicant at this time. Furthermore, there appears to potentially be a fourth undefined colour band which the site sits within. Further clarification is required before the LLFA can accept the information being presented in the report. The FRA in section 7.11 confirms that site-specific boreholes have not been drilled yet and nor has groundwater monitoring been undertaken. Historic groundwater borehole information is provided in Table 5 with the two most recent results (showing a winter (January 1993) groundwater level of 2.40m bgl and a spring (May 1993) groundwater level of 4.40m bgl) confirming that in the likely worst case there is not likely to be suitable distance between the base of a below ground infiltration structure and the groundwater level all year round. It is not	RHDHV

2.7 Whole	Provide a more in-depth consideration and assessment of sewer flood risk.	Addressed in Royal Haskoning DHV FRA Report.	Included at 7.3 and 8.59	The LLFA have reviewed the FRA section referred to. The LLFA notes that Anglian Water have been contacted in June 2022 and confirmed that sewer flooding has occurred recently in the local area. Further information is currently being waited for, although the precise locations of the incidents will not be recieved due to confidentiality. The information provided in the email dated 22 June 2022 from Anglian Water states "Anglian Water is able to confirm that there have been instances of flooding within the vicinity of the proposed development." Yet the FRA states in section 7.8 that "Although no sewer flooding has been reported locally to date, there may be potential for sewer flooding in extreme events greater than those modelled" which misrepresents the information provided by Anglian Water that indicates sewer flooding has occurred locally but they are unable to share any more details. While in the Drainage Strategy Addendum Letter (Appendix C) Anglian Water confirm in mid July 2022 that they "have no records of flooding in the vicinity that can be attributed to capacity limitations". The LLFA notes there is further ambiguous information in section 7.6 of the FRA, which states there is capacity in both the foul and surface water sewers. Although on review of the preplanning assessment in Appendix G there is no clear statement from Anglian Water that confirms this. The Anglian Water Pre-Planning Enquiry Report for the site only states there is "available capacity" in the foul water sewer network and recycling centre, however, there is no equivalent statement made by Anglian Water for the surface water sewers. The Pre-Planning Assessment clearly indicates that Anglian Water have not recieved enough information required for conducting an appropriate assessment at that time. It is clear in the Anglian Water assessment that it is possible for Anglian Water to revise their response which may result in the need for an alternative solution, connection point or flow rate. Further comments on the pre-Planning Assessment from Anglian Water are available in response 2.4.2. Furthermore, the applicant has not yet demonstrated that some areas of the site have a historic connection to the Anglian Water Sewer network. Therefore, while a more considered assessment of sewer flood risk has occurred in the FRA, the LLFA is aware there are a number of occasions where there is an over statement of the information that the assessment is based upon. The LLFA is NOT CONFIDENT in the assessment at this time and requires a statement from Anglian Water that they are confident in this assessment of sewer flooding for the site and surrounding area to improve confidence in this assessment.	RHDHV to include email fom AW regarding sewer flooding ocurring downstream of the proposed development to remove any ambiguity.
2.8 Whole	Provide clarification on the retention of surface water runoff on the site and whether this is actually the provision of either blue or green roofs not previously included in the surface water drainage calculations.	No blue-roofs are proposed on site. Greenroofs are to be provided. In terms of drainage calculations. It is considered robust to assume green-roofs are saturated and will not provide any attenuation for large storm events. As such, the 1:100yr + Climate Change hydraulic modelling assumes all roof areas are impermeable. This provides a conservative assessment of required attenuation volumes.	Addressed in Drainage Strategy Report prepared by EAS	The LLFA have reviewed this assessment approach and can accept this approach at this time.	Noted
2.9 Full	Provide clarification on the water depth for the return periods given at Edward Street Service Yard as there are significant discrepancies.	Addressed in Royal Haskoning DHV FRA Report.	Clarified in 5.38-5.40	The proposed development model runs included all ground FFLs of the buildings where known, as Zshapes. The basement car park located in Block A is within the surface water flow path and therefore identified as a vulnerable part of the development. The LLFA requested that the basement car park was set at ground floor level, or the entrance to the car park is raised 300mm above the 1 in 100 year (+45%CC) flood level. Discussion within the applicant's documents confirms that humps could be located at the entrance to the basement car park and the entrance to the low lying service yard, which would be set 300mm higher than the 1 in 100 year (+45%CC) flood level. The humps were represented as Z-lines which were set at the level 300mm higher than the flood level at these locations. For the entrance car park, this was a level of 4.80m AOD and for the service yard it was a level of 4.45m AOD. This prevented surface water from entering these two vulnerable parts of the site. Walls were located around the service yard and basement car park entrance ramp, to prevent water from flowing 'through' walls and into the low lying areas. The walls were represented as Z-lines and set at 999m high within the model, to prevent any water passing through. The proposed model was run for both the 'no mitigation' and 'mitigation' scenarios upon the request of the LLFA, and flood maps have been prepared for both. The 'no mitigation' runs are called 'Proposed' and the 'mitigation' scenarios including the humps at the car park and service yard entrances are called 'Proposed_Barrier'. FRA report section 5.38 and 5.39 outline the 1%+CC depth but does not present the 1 in 30 year depths. Mitigation is discussed in Section 5.4.1. The maps in Appendix I show no flooding of the service yard in the proposed mitigation scenario, depths adjacent to the barrier are Max 0.1m and adjacent to the building wall are 0.2m. Representation of these features in the model are described in section 7.3.2 of the modelling report (extract in modelling column). The levels modelled for the entrance hump match the proposed mitigation levels - this is considered reasonable. The walls are modelled as 999m high, however as depths against them do not exceed 200mm therefore this is considered a reasonable representation provided that any doors/airbricks in the wall between block M and the service yard are above this level, as inputting exact levels in this instance would not change model results. Section 8.12 of the FRA states "No openings such as air bricks, doors or windows should be included in the neighbouring wall with Block M, to prevent water ingress into the surrounding blocks". Note "should" rather than "will" - need to confirm that this recommendation is included in the building design. There is a gully proposed in the service yard that has been represented as an "SX" link, this is considered	RHDHV

2.10 Full	Prepare and provide a full detailed drainage design that includes all the proposed elements of the surface water management system. This includes clarification of the design details (including plans, modelling, calculations and supporting information in accordance with the LLFA's Developer Guidance) of suitable drainage featured, such as green/blue roofs, bio-retention features and tree-pits.	See Appendix K.	Addressed in Drainage Strategy Report prepared by EAS	The detailed design information is missing some calculations, plans and supporting information as well as requiring corrections to the calculations provided. Information missing includes typical design sections and plans, 3.3% and 3.3%+CC calculations for each element. The SW drainage model includes the larger SuDS elements but appears to be missing some features. All SW Drainage calculations have a manhole table that has at least one column that is not visible to read as it is off the page in the results PDF in Appendix K. This needs to be updated so that the information is provided in a readable format. The LLFA notes that section 8.2 and 8.3 indicate which development blocks are at flood risk however there is no summary of which roads and pedestrian access routes which are at surface water flood risk. The LLFA observes this gives an overly optimistic outlook on the flood risk across the site. In section 8.4 the FRA notes that "is impractical to prevent offsite flows entering the onsite drainage system in some areas". However, within the Drainage Strategy there are no allowances given within the drainage design for the any offsite surface water that may enter the system. An allowance for offsite flows needs to be included within those systems likely to be affected by offsite flows.	Noted. All proposed surface water drainage hydraulic calculations shall be presented clearly, ensuring data outputs are visible. Drainage systems shall be tested for 1:1yr, 1:30yr, 1:30yr+CC, 1:100yr and 1:100yr+CC storm events. MADD Factor of 0 shall be applied. As discussed, no attenuation volume is accounted for within green-roofs and bioretention swales/tree pits in order to provide a robust assessment. The proposed surface water drainage systems for the development site will deal with rainfall falling within the redline application boundary only. The attenuation volumes shall be designed to manage all storms up to and including the 1:100yr + 45% Climate Change Event whilst restricting flows to Anglian Water agreed outfall rates. The proposed surface water drainage systems will not be designed to include any flows or volumes from off-site which may enter the system. It is appreciated that off site flows/volumes will affect the proposed surface water drainage systems in certain catchments and as such it is appropriate to instal an alarm system which will be triggered to alert the Managemetn Company when tanks fail to drain-down after a storm event. Failure to drain-down after a storm event could ocurr due to debris/blockages within pipework or attenuation devices, or could be attributed to flow control devices not operating effectively. By identifying a possible issue in the drainage system, maintenance can be undertaken to ensure that the drainage systems operate fully and attenuation volumes, as required, are available at all times. This means that should overland flow routes pass through the site, these paths and depths of surface water are not exacerbated by poorly functioning on site drainage systems. This alarm system could be linked to the Flood Evacuation Plan (to be Conditioned) for informaiton only, however its primary function is to inform the need for any Maintenance to be undertaken.
2.10.1 Full	response to 2.10 for system 1			**System 1 relates to Block B - Full** • It is not clear to the LLFA how a discharge rate of 5 l/s was derived and how this relates to the pre-development greenfield runoff rate for the drainage area. • No patios shown on the drawing information submitted for the residential houses. Urban creep should be applied to the residential houses and the patios need to be included in the design along with their drainage connections. • One of the parking spaces in the residential houses area appears to not be permeable. Is this correct? The LLFA would recommend that this space is also included within the permeable paving area too as there is no justification made by the applicant not to include it.The LLFA requests clarification on this approach. • No design information shown on plan for inflow and outflow pipes for PP2 on the SW drainage plan. This is needs to be included as part of the full application. • In section 4.20 of the drainage Strategy and in the plan (drawing No PJ-3831 DR-002) a flow control device is identified at the outfall of the system, in section 4.25 it states a downstream defender (a hydrodynamic vortex separator) is specified in the design which is supported by the design on the plan. While in the MicroDrainage calculations for Block B a Hydrobrake Optimum device is specified and included in the calculations there is no downstream defender included in the calculations. The calculations will need to be updated to reflect the inclusion of the downstream defender as Block B (System 1) is part of the full application area.	• The proposed rate for this catchment is discussed in para. 4.22 and 4.23 of the Drainage Report. • The proposed hardlandscaping is in accordance with PlanIt's Lanscape Masterplan in Appendix N. An allowance for patios and urban creep has been made for the terraced houses. • The proposed hardlandscaping is in accordance with PlanIt's Lanscape Masterplan in Appendix N. All areas that can be permeable paving are so. • The hydraulic model includes all nodes. • A Hydro-brake is proposed to restrict flows from this catchment. After flows are restricted, a downstream defender treatment unit is provided. The hydrobrake is included in the hydraulic model though it is not necessary to include the downstream defender as it offers no flow control measures and was sized by Hydro-International based on the maximum outfall rate from teh flow control device (hydrobrake). There is no benefit or disbenefit form not inlcuding the downstream defencer in the model. • Hatching updated on the drainage layout drawings and included in the key.
2.10.2 Full	response to 2.10 for system 2			**System 2 relates to Block C - Full** • It is not clear to the LLFA how a discharge rate of 5 l/s was derived and how this relates to the pre-development greenfield runoff rate for the drainage area. • The LLFA has reviewed the proposal to discharge the rising main from the attenuation tank through the medium of small bioretention system is not considered appropriate in combination with a pumped discharge to the medium in a highly urban environment within a critical drainage catchment. The bioretention feature is designed to slow water conveyance while the pumped discharge to the medium could potentially overload the system and cause localised surface water flooding on a very flat site. The LLFA notes the area with the bio-retention features would experience flooding in a 1% +45% climate change to a depth of typically between 100mm to 200mm. Therefore the LLFA consider that the pumped discharge for 1% +45% climate change in the into the medium during a significant storm event, such as the 1% +45% climate change, the medium would likely be saturated and flood risk would likely be increased by the proposed surface water drainage design currently proposed. • The LLFA notes there is a significant area of the site that is understood to be paved, although it is not confirmed what this area is to be paved with, its finished ground levels or how it will be drained. Clarification of the surfacing is required. • The bioretention swale is not included within the MicroDrainage calculations and neither are the last couple of manholes and pipes (C11 and C12). Therefore, the submitted calculations are incomplete for this system. In addition the MircoDrainage calculations indicate that the applicant is to offer pipe 1.007 onwards for adoption. This means the statements regarding the half drain times are not appropriate as the downstream elements of the system have not been included within the model and there is no evidence that this system operation approach would be appropriate. • The LLFA requests clarification on whether the corner of the geo-cellular tank is at least 5m away from the building. • Trees appear to be placed over the geo-cellular attenuation tank. This is not an acceptable design approach as the roots may penetrate the membrane leading to soil ingress and tank capacity reduction. Geo-cellular tanks	• The proposed rate for this catchment is discussed in para. 4.22 and 4.23 of the Drainage Report. • The surface water drianage for this catchment has been redesigned following slight amendments to the site layout (removal of cycle store) and it is now possible for this catchment o drain via gravity. It is no longer proposed to utilise bioretention swales in this catchment, following advice from LLFA and taking into consideration that a green roof is proposed. The hardstandings drain to slot drains and are treated via a down-stream defender. • The proposed levels are shown on the drainage layout drawings and confirm that runoff from hardstanding areas is directed to slot drains, which outfall to the main surface water sewer network. The hardlandscaping is in accordance with PlanIt's Lanscape Masterplan in Appendix N. • Bioretention swale removed as per LLFA advice. • The geocellular storage device is 5m from the building line. • No trees are proposed over the geocellular storage device. • A Hydro-brake is proposed to restrict flows from this catchment. After flows are restricted, a downstream defender treatment unit is provided. The hydrobrake is included in the hydraulic model though it is not necessary to include the downstream defender as it offers no flow control measures and was sized by Hydro-International based on the maximum outfall rate from teh flow control device (hydrobrake). There is no benefit or disbenefit form not inlcuding the downstream defencer in the model. • Hatching updated on the drainage layout drawings and included in the key.

				• The LLFA observe that based on the manhole cover levels of 4.050m and the given finished floor level of 4.650m there is a 600mm freeboard incorporated into the design. On review of the applicant's surface water flood risk hydraulic modelling within the latest FRA, which shows the mapped results indicate the surface water flood depths to the north of the block are typically between 300mm to 500mm, while the southern end of the building is typically between 100mm and 300mm. The FRA indicates the finished floor level is 300mm higher than the level of the design flood event (1% AEP +45% CC). However, the report and the maps indicate that in some areas to the north of Block C the modelled water depth is 420mm. This would indicate that the finished floor levels would need to be at least 4.75m to provide the required 300mm freeboard above the design flood event water level. • It is not clear where some of the patio areas to the east of the building and the pathway areas to the west of the building will be draining to as there is no drainage shown for these areas, only drainage associated with the roof. As the site is very flat (based on the manhole cover levels given as no finished ground levels are provided) there drainage in these areas is important to ensure that dry access and egress to the building is possible. • The LLFA observes that the drainage plans in Appendix K of the drainage strategy are using different block layout arrangements for Block C compared to those shown in Drawing number 35301-ZC_00_DR-A-03-0100-D0-2 (dated 31.03.22). Please confirm which block layout represents the current design? • Based on the information provided in the plans, it is not clear to the LLFA what the feature is that extends from the downstream side of the geocellular crate to the pump chamber. The LLFA requires clarification on what this feature is from the applicant as there is nothing shown either in the drawing or in the legend of the drawing. • The below ground infrastructure for the pumping station is indicated however it is not clear whether there will be any above ground control kiosk for the pumping station. The LLFA reminds the applicant the level of the control kiosk for the pumping station should be above the design flood water level and include appropriate freeboard as defined in the LLFA's Developer Guidance in section 20.3. The LLFA requires confirmation of the proposed outline arrangements for the control kiosk. • The LLFA is not able to determine from the drawings if the geocellular structures are an appropriate distance from the foundations of Block C. The notes that section 3.1 from Ciria C737 on the Structural and geotechnical design of modular geocellular drainage systems determines that the geocellular tanks must be at least 2m plus the depth of the storage structure from the foundations of a building. Due to the space constraints the LLFA will require demonstration from the applicant the proposed Geocellular tank is able to meet this requirement. This is to demonstrate the proposed outlined drainage system is achievable when the drainage design is developed in full at a later stage. The LLFA has reviewed the proposed surface water drainage System 2 which serves Block C. The LLFA notes the applicant is intending to place a residential block of flats with a green roof in an area of surface water flood risk. The extent of the surface water flood risk has been modelled by the applicant and confirms the block located in an area of flood risk, which is not in keeping with the application of the sequential test. The building is proposed to have a green roof that would discharge surface water into the drainage system that would attenuation the flow in a below ground geocellular tank. At least two trees planted are proposed to be planted on top of the geocelluar tank. The water from the tank would be pumped out into the medium of a small bioretention area with a perforated pipe underdrain before the system connects through a series of standard below ground pipes in the site and the road to discharges to the existing Anglian Water sewer in Edward Street. The LLFA is very concerned the trees planted over the tank would damage the tank and reduce the capacity and function of the system as the trees grow. In addition, the pumped discharge to a small bioretention area is unlikely to operate and would lead to exacerbating the existing and residual flood risk in this location, which could increase the difficulties associated with safe access and egress from the block. While it is questionable about whether the location for this residential accommodation being located in this area of the site due to the existing and post development flood risk, the proposed ground level surface water drainage system combined with the pumped discharge of the attenuation tank is considered by the LLFA likely to increase the surface water risk associated with Block C. Therefore, only for Block C in this proposed development the LLFA recommend an alternative design	• The proposed levels have been updated and are in line with the levels proposed by RHDHV in their hydraulic model FRA report. • The drainage layout drawings have been updated and confirm that runoff from hardstanding areas is directed to slot drains, which outfall to the main surface water sewer network. The hardlandscaping is in accordance with PlanIt's Lanscape Masterplan in Appendix N. • The uptodate site layout has been included. • Kiosk shown for tank alarm system described in para. 4.47. No pumps. • The geocellular storage device is 5m away fromt he building line. RHDHV have updated their hydraulic model to answer query relating to sequential test.
2.10.3 Full	response to 2.10 for system 3			**System 3 relates to Block D - Full** • It is not clear to the LLFA how a discharge rate of 12.5 l/s was derived and how this relates to the pre-development greenfield runoff rate for the drainage area. • Paragraph 4.32 states "to be conservative, the hydraulic models shall assume green-roofs are saturated and will bit allow for any impermeable areas, as such will be considered 100% impermeable with a contributing area of 2580m2." The LLFA observes the statement indicates that "no impermeable area will be allowed for" but then the model assumes a "100% impermeable area". This contradiction in the statement needs to be corrected. • A channel /slot drain is positioned around the perimeter of the building. The bio-retention tree pits and swales are positioned further away from the building. These bioretention feature discharge to the drainage network. However, it is not clear what discreet drainage area these bio-retention features serve as there is very limited information about the finished ground levels as only the cover levels of the manholes and tanks are provided. Paragraph 4.37 indicates that "roofs and pedestrian walkways will discharge directly to the adopted sewer via a bioretention swale". However, this is not supported by the proposed drainage plan shown in Appendix K as it is not clear how the water will be directed to these bioretention swale features rather than the slot drains to benefit from the water treatment. In addition, there is no connection shown directly from the roofs to the bio-rention swales, meaning the roof water will not be directed through the swales for water quality treatment. Therefore, the text in the drainage strategy is not consistent with the proposed drainage layout and the proposed drainage layout is not considered appropriate at this time based on the limited information provided. The proposed design requires further work as there is insufficient information for a full drainage design and design improvement to be made. • The LLFA observe that northern section of the building the manhole cover levels of 4.950m and the given finished floor level of building is set at 4.950m meaning there is a no freeboard incorporated into the design. it is the same at the southern end of the building manhole cover levels of 4.500m and the given finished floor level of building is set at 4.500m meaning again is a no freeboard incorporated into the design. This is not in accordance with the LLFA Developer Guidance and means there is a risk of surface water entering the building. The LLFA's concern is supported by the applicant's surface water flood risk hydraulic modelling within the latest FRA, which show the mapped results indicate the southern end of the Block D building would likely flood in a 1%AEP with 45% climate change allowance to a depth of between 50mm to 100mm. • A pumped discharge is identified on the outline drainage plan in Appendix K, yet there is no pumped discharge identified in the drainage description for system 3 (paragraph 4.32 - 4.37). The pumped discharge set at a rate of 12.5 l/s is proposed to discharge through the filter medium of the bio- retention swale before discharging to the diverted Anglian Water Sewer. The LLFA has reviewed the proposal to discharge the rising main from the attenuation tank through the medium of small bioretention system is not considered appropriate in combination with a pumped discharge to the medium in a highly urban environment within a critical drainage catchment. The bioretention feature is designed to slow water conveyance while the pumped discharge to the medium could	• The proposed rate for this catchment is discussed in para. 4.22 and 4.23 of the Drainage Report. • This typo has been corrected. • A slot drain has been provided around the building line as a precaution and due to the level thresholds. Levels are designed to fall away from the building and towards the bioretention swales or other slot drains. The updated drainage layout drawings reflect this and this is described int he report. • Levels are designed to fall away from the building and towards the bioretention swales or other slot drains. The updated drainage layout drawings reflect this and this is described int he report. • Levels have been updated to be in line with those provided by RHDHV in thir lasted hydraulic model report. The south side of Block D level has been raised to 4.6mAOD and this is shown on the drainage layout drawings. The surface water drainage has been redesigned to ensure geocellular storage is 5m away from proposed buildings and allowing for updated levels. This has presented opportunity for a gravity outfall and as such, this catchment drains to the adopted sewer network via a hydrobrake. Outfall flows are no longer directed into the bioretention swale medium meaning there is lower risk of these features becoming overwhelmed. • Bioretention swales and greenroofs are not included in the WinDes drainage models as these are assumed to be saturated, not providing any storage volume. This then assumes that all flows are directed to the geocellular storage device and provides a robust calculation. It is not considered necessary or beneficial to add bioretention swales or green roofs to the hydraulic calculations. • The kiosk to serve the tenk drain-down alarm system is shown on the drainage layout drawings. note that a pump is no longer proposed. • The geocellular storage device has been rearranged to ensure 5m clearance from proposed building lines.

				potentially overload the system and cause localise surface water flooding on a site with a gentle slope. The LLFA expects this aspect of the system will need to be re-designed appropriately. • The LLFA has reviewed the proposal to discharge the rising main from the attenuation tank through the medium of small bioretention system is not considered appropriate in combination with a pumped discharge to the medium of the feature in a highly urban environment within a critical drainage catchment. The bioretention feature is designed to slow water conveyance while the pumped discharge to the medium could potentially overload the system and cause localise surface water flooding on a very flat site. The LLFA notes the area with the bio-retention features would partly be in a surface water flowpath during a 1% +45% climate change storm event. The typical depth of surface water flooding is up to 50mm. Therefore the LLFA consider the pumped discharge for 1% +45% climate change in the into the medium during a significant storm event, such as the 1% +45% climate change, the medium would likely be saturated and flood risk would likely be increased by the proposed surface water drainage design currently proposed. • The tree pits, bioretention areas and the supporting pipework are not shown in the current MicroDrainage	
2.10.4 Full	response to 2.10 for system 4			**System 4 relates to Blocks A, M, J3 and K/L** • It is not clear to the LLFA how a discharge rate of 65 l/s was derived and how this relates to the pre-development greenfield runoff rate for the drainage area. • The level of the suspended drainage on Blocks A, M and K/L are not identified on the plans in Appendix K. The LLFA requires clarification on this design detail. • The LLFA notes the centre of Block A has planted areas shown on the first floor courtyard area (Drawing 35301_ZA_01_DR_A_03_0101_D0_2, Dated 15/07/22). However, it is not clear how this area will be drained. • The information about the connection routes for the rainwater pipes associated with the buildings does not appear to be correct when the varying building roof heights are taken into account. As this is for the full planning application this does need to be resolved to ensure the proposed drainage design is not going to increase flood risk and that appropriate space is available to deliver the design. • The LLFA notes the north facing commercial unit on the western part of Block A has a finished floor level of 4.5m which is lower than the manhole 01 cover level of 4.95m, while the neighbouring residential unit has a finished floor level of 5.4m. This puts the commercial unit at an increased flood risk by design. The LLFA observes the access to the residential lobbies on the east side of Block A open directly on to a significant flood flow route in front of these entrances. There is a similar issue with the finish floor levels for all the residential entrance lobbies and other commercial units match the levels of adjacent manhole covers. The LLFA requires the finished floor level of all buildings to be increased in accordance with the LLFA Developer Guidance Section 20.3 requirements. • The LLFA notes the road in front of the Block A car access to the basement car park is to be raised by 300mm as a flood resistance measure. However, it is not clear on the surface water drainage plans how far this raised section of road will extend. Further information is required to be included on these plans. • On Block M there appears to be at least 4 no. green roof rainwater points that are not located near any identified green roof. Please update the plans to reflect which green roofs these rainwater points relate too. • Here is an existing building in the System 4 discreet drainage area that is excluded from the proposed drainage calculations. However, the area surrounding the building appears to be included within the drainage calculations, yet there is no information regarding the proposed drainage system that would serve this area. The LLFA requires clarification regarding the proposed detailed drainage design for this area of System 4. • The text in sections 4.38 to 4.42 is not consistent with the proposed design in the Appendix K plans. The text does not include the pumping station to discharge the water from the attenuation system into the diverted Anglian Water surface water sewer. • The LLFA observes the FRA identifies the commercial areas of Blocks A and M are to have a water exclusion strategy, however no commitment to water barriers has been included within either FRA or the drainage strategy. Therefore, at present the information provided by the applicant indicates that flooding these premises during a 1% AEP +40% Climate Change is part of the design approach (see section 8.16 of the FRA). The LLFA note the climate change allow given in this section is not in accordance with the current climate change guidance. • Based on the information provided in the plans, it is not clear to the LLFA what the feature is that extends from the downstream side of the geocellular crate to the pump chamber. The LLFA requires clarification on what this	• The proposed rate for this catchment is discussed in para. 4.22 and 4.23 of the Drainage Report. • The internal drainage is shown for information only - it is not intended to present detailed structural drawings which show internal rainwater down-pipe routes through the building. It is considered that the external and below ground surface water drainage design provided will gives the LLFA a suitable amount of information to prove that surface water drainage can be managed effectively and in line with Anglian Water's requirements and the NPPF. • The rainwater pipe locations have been provided by the architect - the structural internal and M&E design for the rainwater down pipe routes are not considered necessary to be provided to the LLFA. • Levels have been updated to be in line with those provided by RHDHV in thir lasted hydraulic model report. • Further details of the ramps leading to car parks serving Block A and Block M are provided in the FRA report. The levels are now shown on the drainage layout drawings. • The green roof rainwater pipe locations have been provided by the architect - the structural internal and M&E design for the green roof rainwater down pipe routes are not available. The external and below ground surface water drainage design provided will gives the LLFA a suitable amount of information to prove that surface water drainage can be managed effectively and in line with Anglian Water's requirements and the NPPF . • The area around former Barclays Bank building is included in the hydraulic network. • The drainage layout drawings have been updated to include a key showing all features or ensuring that features are labelled. • A kiosk for the tank drain-down alarm system control panel as well as control panel serving the pump is now indicated on the drainage layout drawing and is on a plinth above the flood level.
2.10.5 Full	response to 2.10 for system 5			**System 5 relates to Botolph Street Public Realm Area - Full** • It is not clear to the LLFA how a discharge rate of 10 l/s was derived and how this relates to the pre-development greenfield runoff rate for the drainage area. The LLFA requires this information. • A shared bioretention swale is included within both the areas for system 5 and 7. It is not clear with drainage area this feature will serve or how it will possibly serve both areas. The LLFA require further information to clarify which drainage area this bioretention area will serve and how it will connect and relate to the proposed drainage network. • The LLFA notes that a significant amount of this proposed drainage system will be directly influenced by the finished surface levels of the road, pavement and open space areas, yet no information has been provided show the finished ground levels. The LLFA requires further design information demonstrating how water will enter the network particularly in the shared drainage area at the south of system 5. • The LLFA notes that no quantitive assessment of the Water Quality indices was provided in 4.46 for system 5. As this is part of the full application area the LLFA requires further detailed information to be provided including for the proprietary device. The LLFA also notes the inclusion of a number of bioretention areas within the design that are labelled as swales. The LLFA reminds the applicant that a swale is a conveyance structure while these features are designed to look and behave like basins. As the drainage path is shorter due to the connection of each area directly to the network, the amount of biofiltration treatment achieved for the water is potentially lower compared to having them using a longer drainage path. The LLFA expects further investigation and consideration of the assessment of water quality for this system.	• The proposed rate for this catchment is discussed in para. 4.22 and 4.23 of the Drainage Report. • The bioretention swale in question straddles Botolph Street catchment and Block F catchment. It is intended that the section in Botolph Street catchment will be built in Phase 3 and the other section in Phase 4. An outfall for the section in Phase 3 will be directed to the Boolph Street drainage network and a second outfall to the Block F drainage network will be provided in Phase 4. • Further details for levels have been provided. • The bioretention swales have been renames bioretention systems in line wuth CIRIA. A further treatment stage, using a Downstream Defender is proposed to ensure water quality requirement is met for all runoff. • overland flow paths are considered and discussed in para. 4.56 and 4.57. • all pipes are included in the model.

2.10.6 Outline	response to 2.10 for system 6			**System 6 relates to Block E - Outline** • It is not clear to the LLFA how a discharge rate of 30 l/s was derived and how this relates to the pre-development greenfield runoff rate for the drainage area. The LLFA requires this information. • The LLFA notes that this is part of the outline planning application, however, the LLFA require an indication of the approximate size and location of the proposed green roofs within the drainage area. • The LLFA notes the geocellular tank is located in the system 5 drainage area. There is no indication of how or where water from System 6 will enter the geocellular tanks. Outline design calculations have been provided in Appendix J to support the initial tank sizing. There is no modelling of the outline drainage network for the system. Most of Block E appears to be in a downstream location to the attenuation tank. The LLFA requires a preliminary indication of the drainage network to demonstrate that a workable solution to discharge the surface water to the tank. This is to demonstrate the proposed outlined drainage system is achievable when the drainage design is developed in full at a later stage. • The LLFA is not able to determine from the drawings if the geocellular structures are an appropriate distance from the foundations of Block E. The notes that section 3.1 from Ciria C737 on the Structural and geotechnical design of modular geocellular drainage systems determines that the geocellular tanks must be at least 2m plus the depth of the storage structure from the foundations of a building. Due to the space constraints the LLFA will require demonstration from the applicant the proposed Geocellular tank is able to meet this requirement. This is to demonstrate the proposed outlined drainage system is achievable when the drainage design is developed in full at a later stage. • The text in the drainage strategy (paragraph 4.47 to 4.52) does not include a pump in the description, yet it is shown on the plans in Appendix K. The LLFA requires confirmation of whether the pump is to be included or not as it is a significant component of the proposed drainage system. Furthermore the drainage strategy will need to be updated to reflect the design appropriately. • Based on the information provided in the plans, it is not clear to the LLFA what the feature is that extends from the downstream side of the geocellular crate to the pump chamber. The LLFA requires clarification on what this feature is from the applicant as there is nothing shown either in the drawing or in the legend of the drawing. • The below ground infrastructure for the pumping station is indicated however it is not clear whether there will be any above ground control kiosk for the pumping station. The LLFA reminds the applicant the level of the control kiosk for the pumping station should be above the design flood water level and include appropriate freeboard as defined in the LLFA's Developer Guidance in section 20.3. The LLFA requires confirmation of the proposed outline arrangements for the control kiosk. • The LLFA notes there is no additional capacity within the attenuation tank for the residual risk of pump failure	• The proposed rate for this catchment is discussed in para. 4.22 and 4.23 of the Drainage Report. • Greenroofs are indicated on the drainage layout drawings. • Indicative drainage pipe networks added. • Geocellular Storage is located 5m from the buidling line (note there are walled garden entrances which are not to be confused with the building line) Depth of storage from cover to base is no more than 3m.. • The text has been updated to describe the surface water pumped outfall. . • Control kiosk for surface water pump and drain-time alarm system added. • Due to spatial constraints for this particular catchment it is not always possible to follow the guidance within Design Guidance such as CIRIA. As such, it is recommended that the structural engineer allow for the location of geocellular storage within their loadings calculations and adjust the structure accordingly.
2.10.7 Outline	response to 2.10 for system 7			**System 7 relates to Block F - Outline** • It is not clear to the LLFA how a discharge rate of 20 l/s was derived and how this relates to the pre-development greenfield runoff rate for the drainage area. The LLFA requires this information. • The LLFA notes that this is part of the outline planning application, however, the LLFA require an indication of the approximate size and location of the proposed green roofs within the drainage area. • It is not clear whether the geocelluar tank will be lined or not, this is particular relevant in an area where the geocellular tank crosses the permeable paving. It is not clear if water will be able to infiltrate through the tank walls for this feature or whether water will be able to enter solely through the single denoted inlet to the south of the permeable paving. The LLFA request clarifications on this matter. • The text in the drainage strategy (paragraph 4.53 to 4.59) does not include a pump in the description, yet it is shown on the plans in Appendix K. The LLFA requires confirmation of whether the pump is to be included or not as it is a significant component of the proposed drainage system. Furthermore the drainage strategy will need to be updated to reflect the design appropriately. • The below ground infrastructure for the pumping station is indicated however it is not clear whether there will be any above ground control kiosk for the pumping station. The LLFA reminds the applicant the level of the control kiosk for the pumping station should be above the design flood water level and include appropriate freeboard as defined in the LLFA's Developer Guidance in section 20.3. The LLFA requires confirmation of the proposed outline arrangements for the control kiosk. • Minor point the label arrow for the geocellular tank is not pointing at the tank rather its pointing to the permeable paving. Please correct. • The open space areas in the centre of Block F and to the north of Block F shows outlets from the bioretention tree pits from these features. However, it does not show how they are intended to be connected to the drainage system or relate to each other. This is to demonstrate the proposed outlined drainage system is achievable when the drainage design is developed in full at a later stage. • A bioretention swale is included within the area for system 7 and which is also included in the area for system 5. it is not clear with drainage area this feature will serve or how it will possibly serve both areas. The LLFA require further information to clarify which drainage area this bioretention area will serve and how it will connect and relate to the proposed drainage network.	• The proposed rate for this catchment is discussed in para. 4.22 and 4.23 of the Drainage Report. • Greenroofs are indicated on the drainage layout drawings. • Indicative drainage pipe networks added. • Geocellular Storage is located 5m from the buidling line (it has been necessary to split the geocellular storage device into two sections and link with a connector pipe to achieve this). • The text has been updated to describe the surface water pumped outfall. . • Control kiosk for surface water pump and drain-time alarm system added.• arrow moved • Indicative drainage layout shown to demonstrate how features could be linked to geocellular storage device. • Bioretention system straddles two systems and will be constructed in two phases, ensuring outlest are directed to the corresponding phase sw system.

2.10.8 Outline	response to 2.10 for system 8			**System 8 relates to Blocks G and J - Outline** • It is not clear to the LLFA how a discharge rate of 70 l/s was derived and how this relates to the pre-development greenfield runoff rate for the drainage area. • The LLFA notes that this is part of the outline planning application, however, the LLFA require an indication of the approximate size and location of the proposed green roofs within the drainage area. • It is not clear whether the geocelluar tank will be lined or not, this is particular relevant in an area where the geocellular tank crosses the permeable paving. It is not clear if water will be able to infiltrate through the tank walls for this feature or whether it will be solely through the denoted inlets. The LLFA request clarifications on this matter. • The text in the drainage strategy (paragraph 4.60 to 4.66) does not include a pump in the description, yet it is shown on the plans in Appendix K. The LLFA requires confirmation of whether the pump is to be included or not as it is a significant component of the proposed drainage system. Furthermore the drainage strategy will need to be updated to reflect the design appropriately. • Based on the information provided in the plans, it is not clear to the LLFA what the feature is that extends from the downstream side of the geocellular crate to the pump chamber. The LLFA requires clarification on what this feature is from the applicant as there is nothing shown either in the drawing or in the legend of the drawing. • The below ground infrastructure for the pumping station is indicated however it is not clear whether there will be any above ground control kiosk for the pumping station. The LLFA reminds the applicant the level of the control kiosk for the pumping station should be above the design flood water level and include appropriate freeboard as defined in the LLFA's Developer Guidance in section 20.3. The LLFA requires confirmation of the proposed outline arrangements for the control kiosk. • The LLFA observes that the discharge for the system 8 is in part shared with the discharge from System 9. The discharge route of the off-site pipe run is proposed to pass under trees. The LLFA does not find this route acceptable and requests the pipe is not placed under two trees. • The LLFA notes that the drainage area for System 8 on the western side is within the pavement area that adjoins to System 5. It is not clear from the drawing what the structure is along the boundary in the street and whether this will divide the catchment areas or not. The LLFA request clarification on how this drainage catchment will be divided from System 5.	• The proposed rate for this catchment is discussed in para. 4.22 and 4.23 of the Drainage Report. • Greenroofs are indicated on the drainage layout drawings. •Geocellular storage devices are all wrapped in an impermeable geomembrane as poer Standard Construction Details in Appendix T. Indicative drainage pipe networks added to show how systems are linked. . • The text has been updated to describe the surface water pumped outfall. • all drainage features are labelled or in the key on the drainage layout drawings. • Control kiosk for surface water pump and drain-time alarm system added.• drainage located away from trees. • channel drains indicated. • Due to spatial constraints for this particular catchment it is not always possible to follow the guidance within Design Guidance such as CIRIA. As such, it is recommended that the structural engineer allow for the location of geocellular storage within their loadings calculations and adjust the structure accordingly.
2.10.9 Outline	response to 2.10 for system 9			**System 9 relates to Block H - Outline** • It is not clear to the LLFA how a discharge rate of 24.5 l/s was derived and how this relates to the pre-development greenfield runoff rate for the drainage area. • The defined drainage has a small triangle on the south western corner of the system drainage catchment. The LLFA questions whether this is realistic? The LLFA suggests this little slither should be included in the System 5 drainage area. Please adjust the catchment areas accordingly. • The LLFA notes that this is part of the outline planning application, however, the LLFA require an indication of the approximate size and location of the green roof within the drainage area. • The discharge route of the off-site pipe run is proposed to pass under trees. The LLFA does not find this route acceptable and requests the pipe is not placed under two trees. • Minor point the label arrow for the geocellular tank is not pointing at the tank rather it's pointing to a room in Block G. • The geocelluar tank appears to be under features between Block H and Block G. The LLFA seeks clarification from the applicant about what these features are as it is not shown on the drawing. • The text in the drainage strategy (paragraph 4.67 to 4.72) does not include a pump in the description, yet it is shown on the plans in Appendix K. The LLFA requires confirmation of whether the pump is to be included or not as it is a significant component of the proposed drainage system. Furthermore the drainage strategy will need to be updated to reflect the design appropriately. • Based on the information provided in the plans, it is not clear to the LLFA what the feature is that extends from the downstream side of the geocellular crate to the pump chamber. The LLFA requires clarification on what this feature is from the applicant as there is nothing shown either in the drawing or in the legend of the drawing. • The below ground infrastructure for the pumping station is indicated however it is not clear whether there will be any above ground control kiosk for the pumping station. The LLFA reminds the applicant the level of the control kiosk for the pumping station should be above the design flood water level and include appropriate freeboard as defined in the LLFA's Developer Guidance in section 20.3. The LLFA requires confirmation of the proposed outline arrangements for the control kiosk. • Outline design calculations have been provided in Appendix J to support the initial tank sizing. There is no modelling of the outline drainage network for the system. As Block H has multiple roofs that appear in a downstream location to the attenuation tank, at this time the LLFA requires a preliminary indication of the drainage network to demonstrate that a workable solution to discharge the surface water to the tank. This is to demonstrate the proposed outlined drainage system is achievable when the drainage design is developed in full at a later stage. The LLFA notes there again is no additional capacity within the attenuation tank for the residual risk of pump failure. As it normally takes around 24 hours for a pump to be repaired even in an emergency, the LLFA requests that further information is provided regarding the impact of a pump failure and the proposed drainage design will be adjust to mitigate the impact of this failure. • The open space area in the centre of Block H shows a bioretention swale outlet and a bioretention tree pit outlet are positioned within these features. However, it does not show how they are intended to connect to the drainage system or relate to each other. This is to demonstrate the proposed outlined drainage system is achievable when the drainage design is developed in full at a later stage. • The LLFA is not able to determine from the drawings if the geocellular structures are an appropriate distance from the foundations of Block H. The notes that section 3.1 from Ciria C737 on the Structural and geotechnical design of modular geocellular drainage systems determines that the geocellular tanks must be at least 2m plus the depth of the storage structure from the foundations of a building. Due to the space constraints the LLFA will require demonstration from the applicant the proposed geocellular tank is able to meet this requirement. This is to demonstrate the proposed outlined drainage system is achievable when the drainage design is developed in full at a later stage.	• The proposed rate for this catchment is discussed in para. 4.22 and 4.23 of the Drainage Report. • slither rectified. •Greenroofs indicated. •pipework moved away from trees. •arrow moved. •geocellular storage device is located beneath paved area only. •Text updated to describe pump. •all drainage features labelled or in key on drainage layout drawings. • Control kiosk for surface water pump and drain-time alarm system added.• indivative drainage layout provided. pump failure mitigation discussed. • channel drains indicated. • outlet for bioretention system indicated. • Due to spatial constraints for this particular catchment it is not always possible to follow the **guidance** within Design Guidance such as CIRIA. As such, it is recommended that the structural engineer allow for the location of geocellular storage within their loadings calculations and adjust the structure accordingly.

2.11 Whole	Provide the proposed discreet drainage catchment areas and supporting information on a plan for each of the proposed systems in accordance with the LLFA Developer Guidance.	See Appendix K.	Addressed in Drainage Strategy Report prepared by EAS	Provided in plans in Appendix K (Drawing no. 3831-DR-001, 3831-DR-002, 3831-DR-003 and 3831-DR-004, dated 13/07/2022). Shown as dashed coloured line. The System Information Summary box has the same coloured dashed line as the discreet drainage area. This is shown for all 9 drainage systems.	Noted
2.12 Whole	Undertake an assessment that demonstrates how the proposed SuDS systems meets the four pillars of SuDS in accordance with the LLFA Developer guidance and in relation to Policy E9 of the Local Flood Risk Management Plan.	See paragraphs 5.4, 5.9, 5.13 and 5.16.	Addressed in Drainage Strategy Report prepared by EAS	Consideration of the textual information regarding the four pillars of SuDS (water quantity, water quality, biodiversity and amenity) and the benefits provided by the various SuDS elements included in the system. The SuDS features included in this as assessment are Green Roofs, bio-retention swales, tree planters (also known as Tree Pits) and Pervious Pavement (although the description given is for permeable paving rather than pervious paving). The LLFA notes the applicant is intending to include areas of permeable block paving in the design, however they have also referred to pervious paving (such as pervious ashfelt is laid). The LLFA requires clarification on which surfacing system is being proposed by the applicant.	See Section 5 in the drainage report.
2.13 Whole	Undertake a further assessment and consideration of the carbon impact of additional pumps operating on this site is recommended in accordance with Policy E8 of the Local Flood Risk Management Plan.	A further assessment of the carbon impact of pumps has been undertaken by the M&E Engineer and is included within their report.	Addressed in Drainage Strategy Report prepared by EAS	The LLFA have reviewed the Drainage Strategy and the Drainage Strategy Addendum Letter. In the Drainage Strategy Addendum Letter the applicant states that "the primary objective of the design is for the systems to operate under gravity, thereby avoiding the need for pumps which generate carbon emissions from their operation. Wherever possible and where cover and invert levels of receiving adopted sewers allow, surface water runoff from the development site is attenuated and restricted using gravity-type flow control devices, such as hydro brakes or office plates. Where the proposed drainage and storage devices cannot be shallower than the adopted sewer network due to cover levels length of drainage network, attenuation volumes and spatial constraints, it is necessary to pump restricted flows. The use of surface water pumping stations to serve some catchments within the development site is unavoidable though is only proposed where necessary". The LLFA compares this commitment to the proposed surface water drainage design and notes that of the nine proposed systems only two discharge using gravity. Therefore, the applicant's proposed design puts forward that seven of the nine surface water systems on site will have a pumped discharge. This is a significant reliance on a pumped drainage system for a site in the lower end of the largest critical drainage catchment in the county. These pumped drainage systems are proposed to discharge to three out of the four discharge locations. This is not in keeping with the terms of Anglian Water's agreement in principle. The applicant considers the operation approach in order to minimise carbon emissions during the operation phase presented in the Drainage Strategy addendum Letter states the measures the applicant would include are: "• minimising the peak flow rate through attenuation and flow control devices to reduce the size of the pumps and hence their power demand. • pumps selected to maximise efficiency at the design duty to lower energy demand • pump operation controlled on levels within the chamber to ensure they only operate when required. • appropriate electrical metering and links to the development control systems to allow monitoring of energy use. • regular cleaning and servicing to ensure the pumps are operating as efficiently as possible." The applicant has committed to minimise the peak flow rate yet there is no baseline greenfield runoff rate information has been provided in accordance with the LLFA's Developer guidance. In addition, additional attenuation to account for the inclusion of pump failure has not been accounted for in the Drainage Strategy and supporting calculations provided in the application. The attenuation provided could be more extensive as if a pumped system is being provided in a lined geocellular crate system then there is the potential to increase the size The pump operation being controlled on levels needs to ensure the design attenuation volume of the tank is returned within at least a 24 hour period, although preferably sooner. Also where the attenuation tanks are unable to prevent the offsite flows entering the tanks, pumps operating of levels need to better understand how to manage these flows in relation to tank volume management and carbon emissions management effectively. The inclusion of appropriate metering of the development control systems is welcomed. However no information has been provided in either the Drainage Strategy or the Drainage Strategy Addendum Letter about where the pumping station controls will be located or what arrangements for the controls of the pumps are proposed. On review of the maintenance and management plan in Section 6 of the Drainage Strategy, there is no maintenance schedule included for the proposed pumps. However, a review of the residual risks associated with the pumps is provided. While this considers the risk of lack of maintenance of the pumps and commits to including the a secondary (backup) pump in each of the systems, there is no consideration on the site about loss of power to the site. As the majority of the site is proposed to be served by a pumped surface water drainage network located in critical drainage catchment with a significant surface water flow route passing through part of the site, will there be an independent back up power supply to the pumps? Some of these issues overlap with other comments within our response or provide a contradiction to other aspects of the application. Further information will be required in particular the greenfield runoff rates, tank sizing, pump operation, residual risk management and the maintenance and management arrangements all need to be resolved in order to demonstrate the efforts to minimise carbon emissions is demonstrated.	Due to comments received from LLFA and amendments to some external levels, it has been possible to reduce the number of surface water pumps in the Full Planning Application as discussed above. There is commitment to minimise the carbon footprint of the proposed development, and as such some rainwater harvesting systems are not viable. The Carbon Impact Consideration has been updated and added to the drainage report. Tank Drain-Down Alarm System added to proposals. Location of Pumping Station Control Panels is now shown on the drainage layout drawings. Maintenance of surface water pumps and drain-down alarm system added to the Maintenance and Management Plan. Surface water pumps shall be linked to the emergency power meaning that they remain functional during a power cut/power failure. Greenfield runoff rates have been provided.

2.14 Full	Prepare a surface water drainage phasing plan for the development.	Weston Homes have provided a Draft Phasing Strategy document which is included in the Rev A Submission. This shows the following blocks to be delivered in each phase. Phase 1 = Block A, B, C, D and M Phase 2 = Block K/L and J3 Phase 3 = Block H, G and J Phase 4 = Block E and F The proposed drainage strategy allows for Blocks B, C, D, E, F, G, J and H to be managed by stand-alone drainage systems that do not rely on other phases to be built. System 4 managing Blocks A, M, J3 and K/L shall be delivered in Phases 1 and 2 and as such it is anticipated that a temporary drainage network, comprising as much of the designed drainage for Block A and M shall be installed in Phase 1 and shall be linked with Block K/L and J3 in Phase 2. As these phases follow each-other, it is considered suitable to allow for one drainage system to cover two phases.	Addressed in Drainage Strategy Report prepared by EAS	The LLFA reviewed ES Addendum A2 Updated Phasing Strategy which contains a series of plans that identify the activities to be undertaken at and within each phase. The activities relate to the construction of the dominant structures and not the supporting infrastructures such as surface water drainage and sewer diversions. The LLFA notes that in phase one, Blocks B and C will discharge to Edward Street while Blocks A, D and M will discharge in to the diverted sewer which is not mentioned in the phasing plan. As the phase one is under consideration of full planning application and as the diverted surface water sewer currently serves a large number of properties upstream of the proposed development which are all within a critical drainage catchment, the LLFA requires details of the proposed diversion of the sewer and the management of surface water runoff during the construction phase. It is likely that some dewatering activities are likely to be required during the construction of the basement car park. This is scheduled to start at the beginning of Q1 2023 and complete by the end of Q1 2025. The LLFA notes the phasing schedule shows the ground floor of the phase one blocks A, D and M will be undertaken between Q2 and Q3 of 2023. Therefore, on consideration of all these factors the LLFA request that further detail is provided in the Phasing Strategy to show when the surface water drainage will be constructed and sewer diverted in relation to the construction of each of the blocks in Phase One. The LLFA observed the schedule identifies that the ground level for Blocks A, D and M will be undertaken very soon and would expect that discussions with AW to address this matter will be ongoing at present, therefore the LLFA request the applicant provides confirmation that AW support the proposed phasing approach. This (and other) information is requested	See Section 7 in the drainage report.
2.15 Whole	Provide updated water quality assessment information that acknowledge the inclusion of all elements of the SuDS system.	See Section 4 showing water quality treatment features for each catchment.	Addressed in Drainage Strategy Report prepared by EAS	Greenroofs have not been included within the water quality assessment. This appears to have lead to the greater need to incorporate a secondary treatment process. The LLFA notes that in the applicant is likely to be able to better demonstrate water quality benefit if they apply the indices given in Annex 5, Table 26.14 and Table 26.15 of the Ciria SuDS Manual (C753) which includes figures for Green Roofs. The LLFA will expect the Water quality assessment to be updated to include the greenroofs.	All SuDS Features have been included in the Water Quality Assessments for each catchment.
2.16 Full	Provide further information regarding the water quality management approaches required for the construction of the proposed development	See Section 7	Addressed in Drainage Strategy Report prepared by EAS	Insufficient information has been provided for the area under full planning application for the water quality management approaches during the construction phase. At present there is very limited consideration of sediment ingress management to the sewers within the largest critical drainage catchment in Norfolk. Section 7 of the drainage strategy indicates the applicant's intention to manage the sediment movement through management practises and the installation of silt traps and oil interceptors. However no temporary surface water drainage plan has been provided to identify the locations where the temporary sediment traps are to be installed along with a size indication, the maintenance and management arrangement and confirmation of when these temporary sediment traps are to be removed and how the assessment of any remedial works will be undertaken should it be identified as necessary. A commitment from the applicant to undertake an asset condition inspection of the sewer sections immediately downstream of the sediment traps before and after the construction of the development to ensure that there is no deteriation in the condition of the sewers due to the development. This is to ensure the	See Section 7 in the drainage report.
2.17 Full / Whole	Identify and assess the residual risk and provide suitable mitigation associated with the management of pumps and the attenuation tanks.	See paragraphs 4.75 to 4.77.	Addressed in Drainage Strategy Report prepared by EAS	The LLFA has reviewed the Drainage Strategy as referenced in the applicant's response. Paragraph 4.77 states the flowpaths for the exceedance routes greater than the 1% AEP +45% climate change allowance are shown in Figure 1. On review of Figure 1, there is no legend for the information on the figure. The information provided relates to some numbers (possibly levels) inside boxes. It is not clear what these numbers relate to nor are they clear to read due to the resolution quality of the image. The clarity of the arrows in the image is also not clear due to the resolution. The quality of the figure needs to be improved and a legend included. Figure 1 also includes an aerial base image and the what appears to be a hazard map. The hazard map extent outline in Figure 1 for an undefined "event greater than 1% AEP plus 45% for climate change was compared to the hazard maps given in the FRA Appendix J for the 1% AEP plus 45% for climate change. The LLFA observed significant extent differences between the hazard map extents shown in the FRA Appendix J and the drainage strategy Figure 1, with the extents in figure 1 being significantly smaller even though the text in paragraph 4.77 to 4.78 infer event modelled was greater and the hydraulic model representation of the sewers assumed they were nearly at full capacity and no surface water drainage was present. Therefore, the results shown in Figure 1 are contradicting those shown in the FRA. Further	Surface water pumps shall be linked to the emergency power meaning that they remain functional during a power cut/power failure. No additional storage is anticipated to be required.
2.18 Whole	Provide a site layout plan that demonstrates all surface water drainage features sized appropriately and to ensure suitable space is available within the proposed development. The design should be in accordance with both the LLFA Developer Guidance, the Ciria Suds manual, the building regulations and other relevant local and national guidance, practices and policies.	See Appendix K.	Addressed in Drainage Strategy Report prepared by EAS	The LLFA has reviewed the Drainage Strategy Appendix K plans. The LLFA is not able to determine from the drawings if the geocellular structures are an appropriate distance from the foundations of BlocksC, D, E and H. The LLFA notes that section 3.1 from Ciria C737 on the Structural and geotechnical design of modular geocellular drainage systems determines that the geocellular tanks must be at least 2m plus the depth of the storage structure from the foundations of a building. Due to the space constraints the LLFA will require demonstration from the applicant the proposed Geocellular tank is able to meet this requirement. This information must be provided for all blocks within the full and outline planning application areas to demonstrate the proposed drainage design for the affected systems is achievable. In addition the LLFA notes that while there are pumping stations shown in manholes, there are no pumping station kiosks included in the proposed design layout shown on the plans. The LLFA reminds the applicant the level of the control kiosk for the pumping station should be above the design flood water level and include appropriate freeboard as defined in the LLFA's Developer Guidance in section 20.3. The LLFA requires confirmation of the proposed arrangements for the control kiosk for both the full and outline planning applications with obviously more detailed information being required for those in the full planning application area.	See Appendix O and Appendix T.
2.19 Full	Provide detailed information of the design and operation of the flood barrier for inclusion within the hydraulic model as part of the full application.	Addressed in Royal Haskoning DHV FRA Report.	Not required – Alternative mitigation measures discussed in Section 8	The LLFA notes that the basement car park mitigation has changed to include a hump at the entrance 300mm above the 100y + 45% CC. This is modelled at the level described in the FRA (4.8mAOD) and maps in Appendix I show no flooding. A wall has been included around the basement car park at 999m, this is considered acceptable provided the precautions to ensure the carpark is watertight, described in Section 8.16-8.19 of the FRA, are adhered to and airbricks/ window/ doors etc. are above the modelled water levels adjacent to the walls.	Noted

2.20 Full / Whole	Update the hydraulic model and the drainage strategy to ensure they are consistent with other technical disciplines' submissions.	See Appendix J and K.	RHDHV have further liaised with EAS and Weston Homes to ensure consistency with respect to the updates.	The LLFA has reviewed the information provided in Appendix J (microdrainage calculations) and K (drainage strategy plan). The information provided in these appendices has improved as the plans now include information about the location of more of the SuDS features such as swales and tree pits. However, not all the information has been included such as the outline indication of the green roof positions for Blocks in the outline planning area. The information in Appendix J is also not consistent with the information used with the FRA assessment as no downstream boundary data has been applied to represent the typical flow in the AW sewers for the various discharge locations. This information could be provided by AW from their own models or flow sensors. Although it is clear from the review of the FRA and surface water flood risk hydraulic modelling report that the information used in this model is requires further clarification (see response comments to 3.2). In addition, the LLFA note that the MADD factor is currently set to 2 when it should be set to 0, otherwise this increases capacity within the sewer network without the capacity ever being constructed. The LLFA also notes that calculations for only the 1% +45% for climate change were submitted, however no modelled information or calculations were provided for the 3.3% + 40% for climate change as is required by the National Guidance on Flood Risk Assessment: Climate Change Allowances (https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances#using-peak-rainfall-intensity-allowances-to-assess-surface-water- flood-risk) which clearly states in the peak rainfall intensity that "You must do this for both the 1% and 3.3% annual exceedance probability events for the 2070s epoch (2061 to 2125)." This is also required by the LLFA Developer Guidance. This means the application is not in accordance with NPPF.	Drainage Layout Drawings now include outline green roof areas. Hydraulic models have been run with a surcharged outfall to represent adopted sewer surcharge. All catchments have been modelled to 1:1yr, 1:30yr, 1:30+40%CC, 1:100yr and 1:100yr+45%CC storm events. MADD Factor os set to 0 and using FEH rainfall data.
2.21 Whole	An assessment of the surface water treatment required for all elements of the proposed development to determine whether the SuDS system is providing an appropriate amount of water quality treatment.	See updated Section 4.	Addressed in Drainage Strategy Report prepared by EAS	The LLFA have reviewed the appropriate paragraphs within section 4 against the information provided in Appendix K. The LLFA note the approach used for many of the systems is the simple index approach from the Ciria SuDS Manual (C753). However, the benefits that green roofs provide has not been considered in any of the systems where these features has been incorporated. The simple index approach has not been applied to all the systems appropriately and there will be some systems where no indices have been applied for the assessment at all even though it is possible. A summary of the finding for each of the systems can be found in the system specific notes below. System 1 - Water quality assessment approach is acceptable although there is a lack of information regarding the water quality treatment to be provided by the downstream defender. As this element is within the full planning application area this information is required to be provided at this time. System 2 - The only treatment process acknowledged in the water quality assessment relates to the bioretention area. There is no inclusion of the proposed green roof that would cover the whole roof space of the main residential block (see response 2.15). While the technical approach to the simple index method of assessment is in accordance with the Ciria SuDS Manual, the proposed design is not considered appropriate (see previous comments in Response 2.10). The LLFA therefore considers the current water quality assessment is not suitable at this time as it does not assess all the elements and it assesses a system that requires redesigning. System 3 - There is no inclusion of the proposed green roof that would cover the approximately half of the roof space of Block D (see response 2.15). While the technical approach to the simple index method of assessment is in accordance with the Ciria SuDS Manual, the proposed design is not considered appropriate (see previous comments in Response 2.10). The LLFA therefore considers the current water quality assessment is not suitable at this time as it does not assess all the elements and it assesses a system that requires some partial redesigning. System 4 - There is no inclusion of the proposed green roofs (see response 2.15). There is a lack of information regarding the water quality treatment to be provided by the downstream defender. As these elements are within the full planning application area this information is required to be provided at this time. System 5 - There is a lack of information regarding the water quality treatment to be provided by the downstream defender along with no inclusion of the bio-retention areas. As these elements are within the full planning application area this information is required to be provided at this time. System 6, 7, 8 and 9 - There is no inclusion of the proposed green roofs (see response 2.15) and there is a lack of information regarding the water quality treatment to be provided by the downstream defenders on each of these. As these elements are within the outline planning application area this information is required to be provided on the submission of the detailed design.	See Water Quality Assessment for each catchment within Section 4 of the drainage reort.
2.22 Whole	A surface water drainage design that includes a site plan with appropriately sized SuDS Features and conveyance with both the LLFA Developer Guidance and the Ciria SuDS Manual.	See Appendix K.	Addressed in Drainage Strategy Report prepared by EAS	The LLFA has reviewed the proposed drainage strategy plan in Appendix K of the Drainage Strategy. At present the LLFA considers the plan to be incomplete as SuDS features proposed to be incorporated into the design and the support principle infrastructure has not been included on all the nine drainage systems being proposed on site. Furthermore, some of the items shown on the plan are not included in the system description within section 4 (see Response 2.10). This contradiction leaves the LLFA unsure about what is being actually being proposed and committed to within the application. In addition, the LLFA notes that brown roofs are mentioned for inclusion in the design in paragraph 6.2 of the drainage strategy but there is no further information within the drainage strategy of where these brown roofs are to be located. Further clarification of the design along with the inclusion of key elements in the propose drainage plan is required for both the outline and full areas of the planning application.	See Appendix O and Appendix T.
2.23 Full	Identification of the structures to be placed below ground and an assessment of the risk of groundwater flooding and specific mitigation measures to manage the groundwater flood risk to those structures where required.	Addressed in Royal Haskoning DHV FRA Report.	Included at 7.10 onwards and 8.52	No mention of groundwater in the hydraulic modelling report. There is very limited historic groundwater levels from between the 1970s and mid 1990s that gives an indication of shallow groundwater While there is no site specific groundwater monitoring to ascertain whether there would be infiltration into the system. However, the LLFA can accept the conclusions of the FRA in section 7.16 that states "the site is considered to be at moderate risk of flooding from groundwater. This could impact the proposed below ground basement car park and the service yard, which is lower than the existing ground level." A review of section 8.52 to 8.58 in the FRA which states "the basement car park and service yard will be made water- tight ('tanked') to prevent water ingress.", "a sump pump will be included in both of these areas as a failsafe" and that "All subsurface surface water drainage infrastructure must be designed with high groundwater levels in mind at the detailed design stage, so that rising groundwater levels will not compromise the attenuation volume available in the cellular storage tanks. Cellular storage tanks will be lined accordingly.". However the finished floor level of all buildings in the proposed development are not raised above ground level. Therefore should the groundwater reach surface level groundwater ingress is possible. The LLFA	RHDHV

2.24 Whole	A Maintenance and Management Plan detailing the activities required to manage the proposed SuDS including confirmation of ownership, maintenance responsibilities and in principle agreements.	See updated Section 6.	Addressed in Drainage Strategy Report prepared by EAS	The LLFA have reviewed section 6 of the Drainage Strategy where the applicant was able to confirm that a management company would be responsible for the private surface water sewers, attenuation tanks and green/brown roofs. However, there is no indication of who will be specifically responsible for the areas permeable paving, pumps, downstream defenders, bio-retention areas and bioretention swales. Some of the proposed surface drainage network is within the roads to connect to the AW sewers but it is not clear (particularly on the full drainage application area) the extent of each network that will not be under the management of the management company. Further information is required to better define the extent of the responsibility of the management company. A review of the maintenance schedules in section 6 shows that no maintenance schedule for the pumps, downstream defenders, bio-retention areas and bioretention swales has been provided. The maintenance and management plan is required to be updated to identify who will be responsible for the maintenance and management of the features not included in the plan and the maintenance schedule for the features not included at present.	Maintenance and Management Plan updated, see Section 6 in the drainage report.
2.25 Whole	2.25 Provide an updated assessment of the suitability of the different types of SuDS components on the site.	See Table 4.1.	Addressed in Drainage Strategy Report prepared by EAS	The LLFA have reviewed Table 4.1 and acknowledge the table has been updated.	Noted
2.26 Full	2.26 Provide further evidence to support the viability of the Edward Street Service Yard residual risk mitigation and provide clarification on whether an automated flood barrier could be installed.	Addressed in Royal Haskoning DHV FRA Report.	Flood barrier no longer required – see 5.38- 5.43	Mitigation is discussed in Section 5.4.1. The maps in Appendix I show no flooding of the service yard in the proposed mitigation scenario, depths adjacent to the barrier are Max 0.1m and adjacent to the building wall are 0.2m. Representation of these features in the model are described in section 7.3.2 of the modelling report (extract in modelling column). The ground levels modelled for the entrance hump match the proposed mitigation levels, which is considered reasonable. The walls are modelled as 999m high, depths against them do not exceed 200mm, therefore this is considered a reasonable representation provided that any doors/airbricks in the wall between Block M and the service yard are above this level, as inputting exact levels in this instance would not change model results. Section 8.12 of the FRA states "No openings such as air bricks, doors or windows should be included in the neighbouring wall with Block M, to prevent water ingress into the surrounding blocks". The LLFA notes the word "should" is used and requests clarification that these measures will be taken. Additionally, please note LLFA comment responses 3.1 to 3.2.2 relating to remaining concerns with	RHDHV
2.27 Full	The Emergency Flood Plan should be prepared in accordance with the ADEPT guidance (2019), available at https://adeptnet.org.uk/fl oodriskemergency plan and demonstrate ongoing liaison with the relevant Emergency Planning Team	Addressed in Royal Haskoning DHV FRA Report. It is understood that The Emergency Planning Team (Teresa Cannon) has confirmed that this can be Conditioned.	Acknowledged. Norwich City Council Emergency Planning Team were contacted and agreed the Flood Plan could be conditioned (Appendix M and 8.41)	The LLFA are pleased the applicant has agreed to use the Flood Plan Guidance by ADEPT/ Environment Agency to prepare the Flood Plan for each of the blocks. The LLFA advises the LPA that NPPF Paragraph 167 (e) states that "When determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood-risk assessment. Development should only be allowed in areas at risk of flooding where, in the light of this assessment (and the sequential and exception tests, as applicable) it can be demonstrated that: (e) safe access and escape routes are included where appropriate, as part of an agreed emergency plan." The applicant's own surface water flood risk modelling and FRA identifies significant flood risk remains on site once the site has been developed. This indicates that an emergency plan should be provided prior to determination of a planning application. Therefore the LLFA would advise the LPA that the applicant's proposal to discharge this requirement by conditioning is not in accordance with the NPPF requirements.	RHDHV
2.28 Full	An assessment of the potential to install some flow and level monitoring gauges to enable the site manager to monitor and manage the flood risk on site.	Addressed in Royal Haskoning DHV FRA Report.	No longer required – Section 8 discusses amended mitigation measures	The LLFA notes the change in mitigation approach for both the below ground level service yard and the basement car park. However, in a review of section 8 of the FRA, we note there is reference to a flood warning and evacuation plan in relation to Block C (Section 8.22 -8.23), as well as a site wide warning and evacuation plan (Section 8.26-8.40) and a flood warning notice for the south east of block J. The LLFA notes that section 8.2 and 8.3 indicate which development blocks are at flood risk however there is no summary of which roads and pedestrian access routes which are at surface water flood risk. The LLFA observes this gives an overly optimistic outlook on the flood risk across the site. In section 8.4 the FRA notes that "is impractical to prevent offsite flows entering the onsite drainage system in some areas". However, within the Drainage Strategy there are no allowances given within the drainage design for the any offsite surface water that may enter the system. The LLFA notes the proposed use of tank alarms for tanks affected by offsite site flows when they reach 75% capacity. The alarm would trigger a co- ordinated response to warn all the relevant ground floor properties of the potential flood risk so they can close and prepare for potential flooding as appropriate. However, the FRA (section 8.7) also acknowledges that at present they do not know if the 75% capacity is will give a suitable amount of time for properties to evacuate and prepare for potential flooding by stating "The 75% capacity level was considered to be acceptable as it would ensure the alarms would not be triggered in the lower return period, every day events, but further analysis to provide supporting evidence to this approach needs be provided to verify this." In addition, while the idea of this tank alarm system is acceptable if all other forms of mitigation have applied. However, the applicant has not yet avoided flood risk through raising the finished floor level of all building through the application of the provision of appropriate freeboard and therefore have not demonstrated there is a residual risk. Rather this approach is to address an unmitigated design risk. **The LLFA require the finish floor levels for all buildings to be revised to ensure they meet the LLFA's Developer Guidance requirements in section 20.3.** In Section 8.9 of the FRA, provides a link to a website of an example of an alarm system that could be used (RDNET1000 STM Storm Tank Level Monitoring and Alarm System). This is repeated in the Drainage Strategy although there is no further details provided to support the full or outline design application.	RHDHV

2.29 Full / Whole	Update the assessment of the residual flood risks within the FRA for the proposed development and its components.	Addressed in Royal Haskoning DHV FRA Report.	Included at 8.59 onwards	This section does not reference the hydraulic model. FRA (Section 8.59) states that "in the event of a rainfall event greater than that considered in this assessment, the external areas may experience some flooding. The likely exceedance routes in this event have been considered in the Proposed Surface Water Drainage Strategy, prepared by EAS." This contradicts the statement in the drainage strategy that this will be addressed in the Royal Haskoning DHV FRA report. The LLFA requires this contradiction to be addressed and resolved. The residual flood risk assessment in sections 8.59 to 8.61 of the FRA is very limited and has considered a very limited range of residual risks that focus on blockage due to lack of maintenance and exceedance flooding. The information provided is vague and has not considered issues such as additional water capacity of attenuation tanks due to pump failure or loss of power (see Response 2.13 and other part of other responses). The LLFA note in general the FRA makes recommendations for mitigation but does not commit to what will be included within the design. In addition their is no detailed design information available to confirm what will be included in within the proposed design. A review of the design and access statement indicates that there is a difference in the amount of green roofs indicated between the Drainage Strategy and the Design and Access Statement, which means there is further inconsistency between the different documents that are supporting the planning submission and erodes the LLFAs confidence in the delivery of the proposed surface water drainage strategy. The various sub-sections of the FRA section 8 on Mitigation are inconsistent with other areas of the Drainage Strategy and its Addendum Letter. For example, an example Flood Warning sign is included in section 8.22 for Block c which refers to both vehicle movements on the site and to where to put the sign in the car park, However, the LLFA is not able to identify any car parking shown on site in the surface water drainage plans. In addition a Flood Evacuation Plan is seen as vital importance for residents of Block C to facilitate the development, yet the application has not included the application has not Flood Plan for the Full application area contrary to the NPPF requirements. Furthermore the finish flood levels in Block C on the Plans in Appendix K in the Drainage Strategy show a single floor level yet in the FRA the bin store area in Block C is noted to flood by up to 300mm. There are many other contradictions and inconsistencies with the FRA mitigation recommendations, the Drainage Strategy proposals and the Design and Access statement, which leaves the LLFA unclear over what is being proposed for	RHDHV
2.3 Full	Inclusion of an updated Exceedance Flow Routes Plan for the site with proposed finished floor levels marked on.	Figure 1 in Section 4 updated to show levels as requested.	Addressed in Drainage Strategy Report prepared by EAS	The LLFA has reviewed the Drainage Strategy as reference in the applicant's response. Paragraph 4.77 states the flowpaths for the exceedance routes greater than the 1% AEP +45% climate change allowance are shown in Figure 1. On review of Figure 1, there is no legend for the information on the figure. The information provided relates to some numbers (possibly levels) inside boxes. It is not clear what these numbers relate to nor are they clear to read due to the resolution quality of the image. The clarity of the arrows in the image is also not clear due to the resolution. The quality of the figure needs to be improved and a legend included. Figure 1 also includes an aerial base image and the what appears to be a hazard map. The hazard map extent outline in Figure 1 for an undefined "event greater than 1% AEP plus 45% for climate change was compared to the hazard maps given in the FRA Appendix J for the 1% AEP plus 45% for climate change. The LLFA observed significant extent differences between the hazard map extents shown in the FRA Appendix J and the drainage strategy Figure 1, with the extents in figure 1 being significantly smaller even though the text in paragraph 4.77 to 4.78 infer event modelled was greater and the hydraulic model representation of the sewers assumed they were nearly at full capacity and no surface water drainage was present. Therefore, the results shown in Figure 1 are contradicting those shown in the FRA. Further	See Appendix R
2.31 Whole	Both the FRA and the Drainage Strategy require updating to address the large number of statements and conjecture that are not supported by evidence. These statements and assessment need to be evidence based for the statements to validated.	Noted and actioned.	Noted. This FRA is supported by evidence whe	The FRA and Drainage Strategy have been reviewed by the LLFA and it is acknowledge that some minor updates have occurred however, there are other significant updates that are required to ensure the surface water management is in accordance with both NPPF and the LLFA's Developer Guidance.	Actioned
2.32 Full	Provide a proposed drainage design with supporting evidence (plans, calculations, modelling and detailed design) that provide evidence of inclusion and support the proposed offsite drainage of surface water for the car park entrance and the service yard entrance on Edward Street. The evidence should demonstrate that the mitigation is appropriate, operable and "agreed in principle" by Anglian Water along with identifying who will be responsible for the maintenance and management.	Addressed in Royal Haskoning DHV FRA Report.	Drainage from service yard to Anglian Water sewer in Edward Street no longer required as service yard will not flood in any event up to and including the 100 year (+45%CC) event. A drain with a flap valve has been included in this area which now connects into the onsite drainage system in the event that an event greater than the 1 in 100 year (+45%CC) occurs and floodwater reaches this area. (Discussed in 8.11)	The LLFA has reviewed both the Drainage Strategy and the FRA with regard to the Edward Street Service Yard internal drainage solution and flood mitigation approach. The FRA has included a 300mm hump in the service yard entrance to prevent water entering the yard and has confirmed that a drain is located in the service yard to discharge any exceedance flow that may entre the yard (See section 8.11). The Drainage Strategy plan in Appendix K indicates that a gully will be included in the service yard (no cover or invert levels are given and this has not been included in the MicroDrainage Model) and will discharge to the north of Block M in Edward Street. The system 4 text does not discuss the inclusion of this gully nor is their any indication that a flap value will be installed. In the hydraulic Modelling report it is stated that a inlet pit has been included in the surface water flood model with a flap valve. This inlet pit is to drain any exceedance flow from the service yard into the diverted Anglian Water sewer via the onsite drainage system. The modelling report has indicated that as the inlet pit was not used in the 1%AEP +45% CC "proposed scenario" model runs, it has not been included in the surface water drainage design (Section 7.4 (paragraph 6) in the Modelling report). The LLFA notes that no exceedance events were run to confirm this. In addition, there appears to be an inconsistent approach applied to the detailed drainage design of the service yard between the FRA, the Drainage Strategy and the modelling report. The LLFA requires clarification from the applicant and their different design on what the drainage proposals are for this area. The FRA response summary indicates that a flap valve was included in the design proposed but none is shown in section 8.11 of the FRA or the Drainage Strategy. Detailed design information for the drainage design for all areas of the full application area (such as typical cross sections and detailed designs plans for each of the structures proposed) remains unsubmitted and the LLFA requires these to be submitted for the full application area.	The speed humps are shown on Drainage Layout Drawings in Appendix O.

2.33 Whole	Provide clarifications from the applicant on whether the inclusion of flood doors have been considered on the proposed development.	Addressed in Royal Haskoning DHV FRA Report.	Flood doors are not required – all residential uses FFL raised at least 300mm above 100 year (+45%CC) flood level (Section 8 and 5.46)	The LLFA observes that the drainage strategy does not indicate that the finished floor levels adhere to the LLFA Developer guidance. It states "It should be demonstrated that the drainage system must be designed so that unless an area is designated to hold or convey water flooding must not occur in any part of a building or utility plant susceptible to water e.g. pumping station or electricity sub-station (Standard S8 of the SuDS Non-Statutory Technical Standards (2015))." (section 20.3 of the LLFA Developer Guidance). There is inconsistency between the approach taken in the drainage strategy and the approach in the FRA. The FRA indicates the residential buildings are raised approximately 300mm above the design flood event. However, on review of the FRA details in section 5.46 and section 8, the LLFA notes that no finished floor level is set only a freeboard allowance is provided with a maximum modelled water depth of 420mm. The FRA observes that the bin store in Block C is likely o flood but not the residential accommodation implying there are different flood levels within Block C. While in the Drainage Strategy, the finished floor level is set at a single finished floor level of 4.65m rather than 4.75m which would provide the 300mm freeboard allowance required. Regarding the other residential areas of the development there is less information available when compared to Block C. In the drainage strategy, the finished floor levels in the commercial and other building areas are set to match the street level. Therefore, there are inconsistencies between the FRA and the drainage strategy on this matter and the LLFA require design clarification	Proposed Flood Defence measures are detailed in the RHDHV FRA Report. The Drainage Strategy Report states that FFL's are as per FRA recommendations and in line with Developer Guidance.
2.34 Whole	Provide discussion on whether an alternative design approach and location was considered before placing the car park entrance ramp on Edward Street.	Addressed in Royal Haskoning DHV FRA Report.	Included at 3.48-3.58	The LLFA have reviewed the FRA, the Drainage Strategy and the Modelling Report. The surface water model is not used to support the argument for it's location. The FRA reviewed sections 3.48-3.58 of the FRA as referred to in the applicant's response. It is clear from the response that there were many factors considered in the location of where to access the basement car parking but that flood risk was not one of the factors considered until raised by the LLFA as a significant concern. A permanent hump in the access way to the basement car parking has now been included but the location of the basement car parking access has remaining in an area of flood risk due to non flood risk related constraints. The LLFA remains concerns about the location of the access although we acknowledge that the flood mitigation access hump has been installed and the model demonstrates it is located as an appropriate level. It is not clear whether the residents will be prevented from accessing the basement during floods as driving vehicles through the water is likely to wash flood water in to the basement. The LLFA requires the	RHDHV
2.35 Full	Provide an assessment of flow entering the basement car park should mitigation not be installed or the failure of mitigation measures.	Addressed in Royal Haskoning DHV FRA Report.	Model was run for proposed scenario with no mitigation measures – 5.39-5.40 and Table 3	The LLFA observe that the model has been simulated without the barrier to the basement carpark included. Appendix I shows flood depths of 0.1-0.2m in the unmitigated scenario and no flooding in the mitigated scenario. The LLFA notes that proposed mitigation has changed to include a hump at the entrance 300mm above the 1% AEP + 45% Climate Change. This is modelled at the level described in the FRA (4.8mAOD) and maps in FRA Appendix I show no flooding. A wall has been included around the basement carpark at 999m, which is considered acceptable provided the precautions to ensure the carpark is watertight, described in Section 8.16-8.19 of the FRA, are adhered to and airbricks/ window/ doors etc. are above the modelled water levels adjacent to the walls. Additionally please note LLFA comment responses 3.1 to 3.2.2 relating to remaining concerns with the model set up and consequent results. These will need to be acted upon and then reviewed against this issue subsequently.	No longer required, RHDHV hydraulic model shows that flooding does not occur in basement car parks and further mitigation measures are no longer required as agreed with LLFA.
2.36 Whole	Provide evidence the proposed development scheme that in accordance with NPPF where "the development should be made safe for its lifetime without increasing flood risk elsewhere."	Addressed in Royal Haskoning DHV FRA Report.	Discussed in Sections 6 and 8	Section 6 of the FRA report outlines the impact of the development on flood risk Section 6.9 states that "Various limitations mean that the level of flooding shown in Appendices I and K may be overestimated." Section 10.2 of the modelling report outlines some limitations of the modelling, the LLFA acknowledges these limitations. However, these limitations could result in under-estimation of depths or over-estimation. Section 8 outlines mitigation measures. Modelling data is used to define the levels of mitigation features and floor levels. Please note LLFA comment responses 3.1 to 3.2.2 relating to remaining concerns with the model set up and consequently results. These will need to be acted upon and then reviewed against this issue subsequently.	RHDHV
2.37 Whole	Address all LLFA queries given in the attached Annex.	See point 2. above.	Noted and included throughout this FRA	The LLFA has provided comments and responses against other responses above and below.	Noted
3 Whole	The hydraulic modelling report and model requires updating to include.				RHDHV

3.1 Whole	Confirmation that the key parameters (URBEXT, Catchment area, etc.) have been checked and the parameters where appropriate adjusted accordingly.	Addressed in Royal Haskoning DHV FRA Report.	Section 6 of the hydraulic modelling report: 'Anglia Square Norwich Modelling Study (July 2022)'	It is important and considered standard practice in UK hydrology assessments and subsequent fluvial hydraulic modelling to undertake at least a rudimentary check on some of the FEH catchment descriptors obtained from the FEH Web Service before proceeding with in-depth hydrological catchment analysis. With regards to the direct rainfall approach used in surface water or pluvial modelling the checking of FEH catchment descriptors is viewed as not so critical. However, confirmation that the catchment boundary is appropriate for the study site in question should be checked. In this study case the FEH catchment area boundary is considered conservative but appropriate, as it allows for a good understanding of overland flow routes and identification of areas of ponding across the wider urban area. The BFIHOST value assigned to the study catchment is 0.861, suggests a highly permeable underlying geological strata. This correlates with the geology data held on the BGS Geology of Britain Viewer Web Service which indicates the catchment is underlain by a bedrock of the chalk formations covered with a superficial geology of locally derived Alluvium deposits comprising of Clay, Silt, Sand and Gravel. The high BFIHOST value is also confirmed by soil data mapping held on the Soilscapes Web Service which indicates that the majority of the study catchment sits on Soilscape 6 type soil, described as freely draining, slightly acid loamy soils where rainfall drains to local groundwater and rivers. The URBEXT2000 value assigned to the study catchment of 0.39 categorises the catchment area as very heavily urbanised. Confirmation of the extent of urban coverage can be undertaken in a GIS using suitable mapping data. However, this is considered only necessary when there are doubts over the degree of urban and rural coverage across a more heterogenous catchment area, which in this study this is not the case as the study area is obviously heavily urbanised. The LLFA welcomes the details added regarding checks to BFI HOST. However URBEXT should also be checked. The LLFA notes that if pluvial modelling is undertaken using gross rainfall and infiltration and evaporation losses accounted for in the hydraulic model, checking of the catchment descriptors is unimportant. However, in this case REFH2 net rainfall is being used. Whilst this is a valid approach, the REFH2 Urban Loss Model (Which should be used in this case given that the area is clearly very heavily to extremely heavily urbanised) uses URBEXT to calculate the Impervious Factor (IF) value. This is in turn used to calculate net rainfall. Therefore it is a critical parameter for the calculation and should be checked to ensure it is accurate and altered if necessary. Alternatively sensitivity testing in REFH2 could be used to show that net rainfall is not sensitive to this value, for example by increasing it to a minimum of 0.6 and comparing it to the net rainfall as it is currently. This is particularly important when reviewed alongside sensitivity testing in Section 8.6.1 of the hydraulic modelling report which shows that the model is sensitive to rainfall inflows. It is not clear from this section what area has been used in ReFH. In Section 3.1 does contain a review of the catchment. However the catchment area has been checked against WFD catchment rather than DTM, this is likely to result in an areal reduction factor (ARF) that is too high and therefore under- estimation of rainfall. Please review the catchment area for use in REFH 2 based on the DTM or include details of this check if you have already	RHDHV
3.2 Full	Includes sewers in the hydraulic model for the sewer network affecting the parts of the site included in this application to support the full application that demonstrates there is no increase in flood risk elsewhere.	Addressed in Royal Haskoning DHV FRA Report.	Model has been updated to include nearby Anglian Water sewers – please refer to 'Anglia Square Norwich Modelling Study (July 2022)' and 5.25	7.2 1D Network Following a request from the LLFA, the Anglian Water sewer network was included in the model for the surrounding streets. The Anglian Water sewer records (obtained June 2022) were used to determine the dimensions of the sewers and manholes in the surrounding roads. The sewers were included in the model as sections of '1d_nwk' and the manholes were included as rectangular inlet pits with 'SX' boundaries. This meant that any water in the inlet pit cell would be directed into the 1D sewer network. The downstream end of the sewer networks (at the edge of the Anglian Water mapping) were represented as 'HT' boundaries which allowed water to freely exit the sewers. 7.4 Paragraph 4 "Anglian Water sewers were included in the model for the roads surrounding the site. The sizes of these sewers and manholes were taken from the latest sewer records. 'SX' boundaries and inlet pits were included at each manhole to enable water reaching these cells to be taken into the sewer network. At the downstream ends of the sewer networks, which were between 140m and 500m from the site, 'HT' boundaries were included to allow water to discharge freely." The LLFA welcomes inclusion of the network and the downstream boundary location is justified through sensitivity testing which shows the model is not sensitive. However further detail is required to review how this has been included. Please provide a drawing showing the 1D model extent. Where the sewer included has upstream sewers	RHDHV
3.2.2 Whole	Is extended to cover the full catchment to ensure the inflows are calculated correctly, or includes sensitivity testing showing that these inflows do not impact flood risk at the site.	Addressed in Royal Haskoning DHV FRA Report.	Model has been extended to cover wider catchment – please refer to 'Anglia Square Norwich Modelling Study (July 2022)' and 5.23	Section 3.1 of the modelling report details catchment delineation and model extent is shown in figure 3-3. The revised model extent is considered appropriate.	RHDHV
3.3 Whole	Provide clarification on whether Anglian Water has been contacted to supply sewer data. This should be requested and included where interactions with the sewer system are likely to impact flooding.	Addressed in Royal Haskoning DHV FRA Report.	Sections 4.26 and 7.6	See 3.2. See comments on 3.2 Anglian Water data has been requested and included. However the report has insufficient detail to confirm that sewers have been included where "interactions with the sewer system are likely to impact flooding" as the 1D extent isn't shown so its not possible to ascertain if this has been done appropriately.	RHDHV
3.4 Full	The inclusion of information regarding the onset of flooding and its associated duration for vulnerable locations across the site including the basement car park entrance and the service yard and loading facilities.	Addressed in Royal Haskoning DHV FRA Report.	Time to peak flood maps included via link in Appendix I. However, alternative mitigation measures now included (Section 8) to provide safety of vulnerable areas which is not reliant on alerts from elsewhere in the catchment/site.	Nothing specifically shown within the main body of the modelling report relating to the time to peak mapping or results. The LLFA notes that a link was provided in the FRA Appendix I to the Time to Peak Flood Maps. However, the LLFA was unable to download these maps. The LLFA cannot access these unsubmitted time to peak plans at this time and requests the applicant to submit this information via normal planning submission routes so that the LLFA can review this information.	RHDHV

SuDS Standards Review	Summary of alignment to relevant Non-Statutory Technical Standards for Sustainable Drainage Systems
S3 (Brownfield)	***Incomplete*** - due to various updates required on the greenfield and brownfield runoff calculations and further methods ***- further information required.***
S5/S6 (Brownfield)	***Incomplete*** - due to a lack of drainage design information, various updates required on the greenfield and brownfield runoff calculations and further updates on the surface water hydraulic modelling ***- further information required.***
S7	***Incomplete*** - due to a lack of drainage design information ***- further information required.***
S8	***Incomplete*** - due to a lack of drainage design information ***- further information required***
S9	***Unable to complete*** - due to a lack of drainage design information, various updates required on the greenfield and brownfield runoff calculations and further updates on the surface water hydraulic modelling required to enable appropriate evidence to assess and determine whether the mitigation measures are appropriate ***- further information required***

Appendix: D – Topographical Survey and Utilities Survey


Barclays Bank
SERVICE LEGEND
FOUL DRAINAGE
SURFACE WATER DRAINAGE
WATER
GAS
ELECTRICITY
TELEPHONE
CABLE TV
MERCURY
TRAFFIC SIGNAL
OIL
UNKNOWN SERVICE
NEW DETAIL
UNDERGROUND CHAMBER

Appendix: E – Anglian Water Sewer Records

(c) Crown copyright and database rights 2022 Ordnance Survey 100022432 | Date: 21/06/22 | Scale: 1:1250 | Map Centre: 623069,309376 | Data updated: 31/05/22 | Our Ref: 882987 - 1 | Wastewater Plan A1

Foul Sewer
Surface Sewer
Combined Sewer
Final Effluent
Rising Main*
Private Sewer*
Decommissioned Sewer*

Outfall*
Inlet*
Manhole*

Sewage Treatment Works
Public Pumping Station
Decommissioned Pumping Station
*(Colour denotes effluent type)

james.cahuzac@eastp.co.uk
Anglia Square

love every drop
anglianwater

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert
0008	623008	309060	C	3.23	0.28	2.95
0101	623023	309178	C	4	1.85	2.15
0104	623025	309161	C	3.95	1.74	2.21
0105	623036	309101	C	3.43	0.14	3.29
0107	623073	309110	C	3.64	2.28	1.36
0201	623015	309237	C	4.34	2.12	2.22
0202	623010	309274	C	-	-	-
0604	623030	309667	C	-	-	2.4
1015	623192	309077	C	-	-	-
1112	623120	309178	C	3.874	1.179	2.695
1114	623189	309114	C	2.742	1.072	1.67
1201	623196	309247	C	3.13	1.38	1.75
1203	623162	309240	C	3.147	1.647	1.5
1204	623103	309267	C	3.55	1.18	2.37
1205	623147	309279	C	3.38	1.17	2.21
1213	623155	309280	C	3.347	1.747	1.6
1214	623169	309204	C	-	-	-
1215	623159	309280	C	-	-	-
1313	623160	309375	C	-	-	-
1407	623164	309465	C	-	-	-
1504	623169	309561	C	-	-	-
1505	623169	309559	C	5.342	1.407	3.935
1610	623138	309671	C	-	-	2.51
1611	623151	309676	C	-	-	2.68
2003	623246	309077	C	-	-	4.3
2017	623248	309069	C	-	-	-
2101	623281	309151	C	2.47	1	1.47
2103	623255	309184	C	2.99	1.86	1.13
2104	623261	309115	C	-	-	3.95
2201	623212	309251	C	3.28	0.13	3.15
2203	623269	309260	C	-	-	3.275
2205	623294	309270	C	3.02	1.29	1.73
2207	623298	309210	C	-	-	3.1
2208	623207	309272	C	-	-	-
2209	623223	309253	C	-	-	-
2505	623282	309594	C	-	-	-
2506	623229	309537	C	-	-	-
3006	623394	309092	C	3.5	1.97	1.53
3007	623351	309067	C	-	-	-
3101	623307	309165	C	2.449	0.349	2.1
3102	623319	309175	C	2.406	0.456	1.95
3106	623372	309187	C	-	-	3.48
3107	623337	309129	C	1.76	0.28	1.48
3109	623389	309118	C	-	-	-
3506	623383	309536	C	-	-	-
3602	623321	309637	C	-	-	-
3609	623383	309682	C	-	-	-
3610	623383	309673	C	-	-	-
3611	623383	309669	C	-	-	-
4108	623405	309104	C	3.44	1.23	2.21
4109	623422	309107	C	3.73	2.25	1.48
4110	623416	309115	C	3.36	1.78	1.58
4111	623452	309112	C	3.837	-	-
4201	623410	309220	C	-	-	3.275
4509	623455	309579	C	8.19	6.92	1.27
4510	623497	309538	C	-	-	1.7
4511	623471	309527	C	-	-	-
4512	623494	309522	C	-	-	0.62
4513	623490	309568	C	-	-	-
5101	623506	309141	C	-	-	3.125
5503	623523	309538	C	-	-	-
5507	622598	309555	C	-	-	8
5509	622598	309537	C	-	-	-
5510	622584	309590	C	-	-	4.61
5510	623521	309516	C	-	-	1.42
5510	623501	309552	C	-	-	1.05
5511	623504	309565	C	-	-	1.42
5608	622573	309651	C	-	-	2.3
5609	622559	309680	C	-	-	1.41
5612	622583	309620	C	-	-	1.62
6304	622635	309360	C	-	-	2.62
6351	622654	309301	C	-	-	1.82
6401	622616	309454	C	-	-	3.2
6402	622689	309483	C	-	-	3.82
6405	622697	309442	C	-	-	-
6406	622683	309438	C	-	-	-
6407	622685	309432	C	-	-	-
6408	622691	309412	C	-	-	-
6506	622664	309587	C	-	-	1.07
6507	622634	309532	C	-	-	1
6508	622669	309584	C	-	-	2.845
6605	622689	309658	C	-	-	1.9
6608	622634	309659	C	-	-	1.67
6610	622627	309680	C	-	-	0.97
6611	622641	309675	C	-	-	0.66
6612	622651	309618	C	-	-	1.35
6613	622670	309643	C	-	-	1.63
6615	622699	309655	C	-	-	1.42
6622	622655	309668	C	-	-	-
6703	622619	309702	C	-	-	1.47
7107	622799	309154	C	-	-	2.58
7201	622736	309218	C	-	-	2.71
7202	622765	309219	C	-	-	1.74
7203	622791	309228	C	-	-	2.83
7210	622706	309269	C	-	-	1.4
7301	622731	309382	C	-	-	1.37
7302	622732	309351	C	-	-	1.43
7303	622737	309356	C	-	-	1.5
7401	622758	309486	C	-	-	2.69
7402	622760	309472	C	-	-	2.015
7403	622761	309469	C	-	-	1.98
7502	622750	309506	C	-	-	3.56
7503	622792	309515	C	-	-	-

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert
7504	622796	309506	C	-	-	-
7603	622733	309694	C	12.802	10.449	2.353
7606	622783	309629	C	10.756	8.12	2.636
7608	622798	309609	C	9.754	7.196	2.558
7611	622793	309607	C	-	-	0.83
8004	622832	309063	C	-	-	1.92
8103	622872	309129	C	4.18	1.44	2.74
8107	622873	309126	C	4.19	0.94	3.25
8203	622889	309284	C	-	-	2.21
8302	622898	309366	C	-	-	2.565
8303	622892	309327	C	-	-	2.16
8402	622845	309436	C	-	-	2.24
8403	622805	309417	C	-	-	2
8404	622896	309451	C	-	-	2.6
8502	622826	309579	C	7.483	3.292	4.191
8503	622868	309585	C	-	-	2.011
8504	622857	309549	C	7.483	3.292	4.191
8508	622842	309544	C	-	-	1.93
8601	622891	309623	C	-	-	0.84
8606	622899	309648	C	-	-	1.3
8607	622819	309612	C	-	-	0.915
8612	622817	309622	C	-	-	-
8613	622815	309623	C	-	-	-
9101	622981	309175	C	-	-	2.51
9102	622990	309126	C	3.65	1.26	2.39
9103	622995	309110	C	3.6	1.04	2.56
9104	622990	309108	C	3.63	1.43	2.2
9203	622972	309226	C	4.29	1.82	2.47
9207	622939	309245	C	4.76	2.73	2.03
9305	622974	309354	C	-	-	2.77
9306	622985	309400	C	-	-	2.87
9424	622941	309494	C	-	-	2.745
9426	622917	309445	C	-	-	2.92
9427	622906	309403	C	-	-	3.02
9501	622912	309579	C	-	-	1.04
9502	622929	309545	C	-	-	0.915
9503	622993	309573	C	-	-	1.725
9507	622995	309546	C	5.15	3.49	1.66
9508	622997	309522	C	5.09	3.31	1.78
9509	622955	309591	C	-	-	-
9510	622964	309593	C	-	-	0.8
9511	622975	309595	C	-	-	-
9512	622986	309589	C	-	-	-
9515	622949	309535	C	-	-	-
9516	622941	309587	C	-	-	0.5
9601	622900	309629	C	-	-	0.99
9602	622981	309617	C	6.248	4.328	1.92
9605	622925	309601	C	-	-	1.525
9606	622977	309661	C	6.111	4.023	2.088
9610	622904	309648	C	-	-0.61	0.61
9612	622917	309684	C	6.767	5.352	1.415
0301	623059	309354	F	3.99	0.33	3.66
0302	623080	309355	F	4	0.22	3.78
0303	623060	309310	F	3	1.36	1.64
0304	623060	309304	F	3.23	1.45	1.78
0401	623099	309460	F	4.22	1.41	2.81
0402	623066	309471	F	4.41	1.72	2.69
0403	623025	309487	F	4.65	2.04	2.61
0404	623008	309493	F	4.91	2.36	2.55
0405	623005	309415	F	4.5	1.92	2.58
0406	623033	309408	F	3.98	1.36	2.62
0407	623035	309401	F	3.97	1.14	2.83
0408	623056	309401	F	3.96	0.9	3.06
0409	623001	309497	F	-	-	-
0601	623023	309693	F	-	-	1.22
0602	623056	309694	F	-	-	1.02
0603	623029	309669	F	-	-	-
0605	623092	309675	F	-	-	-
0606	623046	309644	F	-	-	-
0607	623086	309645	F	-	-	-
0608	623091	309689	F	-	-	-
0609	623088	309690	F	-	-	-
0610	623097	309690	F	-	-	-
0611	623095	309690	F	-	-	-
0612	623067	309688	F	-	-	-
0613	623079	309688	F	-	-	-
0614	623024	309686	F	-	-	-
0615	623043	309686	F	-	-	-
0616	623039	309687	F	-	-	-
0617	623042	309644	F	-	-	-
0618	623086	309660	F	-	-	-
0619	623099	309645	F	-	-	-
1001	623158	309073	F	2.81	2.04	0.77
1003	623184	309067	F	2.55	-2.02	4.57
1014	623190	309074	F	2.56	0.8	1.76
1107	623171	309190	F	2.826	-0.934	3.76
1119	623129	309187	F	-	-	-
1211	623153	309285	F	3.42	0.59	2.83
1303	623143	309320	F	3.47	0.99	2.48
1306	623107	309356	F	3.91	-0.02	3.93
1307	623119	309355	F	3.61	-	-
1308	623131	309356	F	-	-	3.35
1309	623160	309343	F	3.18	-0.2	3.38
1310	623152	309346	F	-	-	3.5
1312	623158	309390	F	3.42	1.81	1.61
1401	623118	309453	F	4.1	1.25	2.85
1403	623156	309429	F	3.75	0.25	3.5
1406	623159	309451	F	4.07	1.96	2.11
1502	623163	309525	F	4.558	1.203	3.355
1503	623163	309559	F	4.558	1.203	3.355
1607	623114	309698	F	-	-	-
1608	623138	309673	F	-	-	-
1609	623154	309674	F	-	-	-

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert
1612	623177	309693	F	-	-	0.91
1614	623161	309637	F	-	-	-
1617	623116	309645	F	7.333	5.473	1.86
1618	623102	309690	F	-	-	-
1619	623110	309690	F	-	-	-
2303	623249	309333	F	3.22	1.1	2.12
2304	623265	309338	F	3.37	1.57	1.8
2307	623257	309307	F	2.917	0.918	1.999
2504	623287	309589	F	-	-	2.5
2703	623243	309703	F	-	-	0.87
3008	623347	309072	F	-	-	-
3009	623393	309074	F	-	-	-
3010	623380	309064	F	-	-	-
3011	623364	309049	F	-	-	-
3302	623371	309359	F	2.57	-0.08	2.65
3501	623391	309509	F	-	-	2.1
3502	623332	309534	F	-	-	2.2
3503	623306	309556	F	-	-	-
3504	623395	309520	F	-	-	-
3505	623326	309587	F	-	-	-
3601	623306	309624	F	-	-	2.5
3603	623334	309655	F	-	-	2.4
3604	623301	309629	F	-	-	1.2
3605	623360	309651	F	-	-	-
3606	623365	309688	F	-	-	2.13
3607	623356	309615	F	-	-	-
3608	623358	309635	F	-	-	-
3609	623364	309603	F	-	-	-
4003	623433	309080	F	3.95	0.15	3.8
4101	623421	309189	F	-	-	3.455
4401	623479	309476	F	-	-	2.86
4402	623469	309476	F	-	-	2.8
4501	623412	309565	F	-	-	-
4502	623446	309557	F	-	-	-
4503	623457	309594	F	-	-	1.52
4504	623408	309588	F	-	-	-
4505	623413	309587	F	-	-	-
4506	623420	309585	F	-	-	-
4507	623438	309513	F	-	-	-
4508	623445	309538	F	-	-	-
4601	623454	309674	F	-	-	1.37
4602	623482	309633	F	-	-	-
4603	623402	309605	F	-	-	-
4604	623406	309670	F	-	-	-
4605	623406	309667	F	-	-	-
5201	622581	309267	F	-	-	-
5301	622563	309365	F	-	-	-
5302	622564	309357	F	-	-	-
5402	622563	309412	F	-	-	-
5402	623549	309406	F	-	-	-
5403	623545	309411	F	2.87	-0.18	3.05
5406	623536	309433	F	-	-	3.607
5407	623537	309458	F	-	-	3.226
5408	623548	309469	F	-	-	2.77
5409	623516	309464	F	-	-	3.265
5410	623527	309405	F	-	-	-
5501	623552	309525	F	-	-	2.22
5502	623549	309531	F	-	-	-
5504	623556	309529	F	-	-	-
5505	623559	309557	F	-	-	2.25
5506	623562	309581	F	-	-	1.95
5507	623516	309585	F	-	-	-
5511	622586	309593	F	-	-	8.36
5512	622575	309590	F	-	-	3.886
5513	622570	309586	F	-	-	1.855
5514	622580	309555	F	-	-	0.915
5601	623566	309618	F	-	-	2.07
5602	623574	309688	F	-	-	2.28
5603	623572	309691	F	-	-	-
5604	622563	309647	F	-	-	9.13
5604	623537	309624	F	10.459	8.729	1.73
5605	623541	309659	F	-	-	1.905
5607	623543	309694	F	-	-	-
6000	622669	309095	F	4.042	2.39	1.652
6001	622684	309069	F	4.125	2.591	1.534
6002	622658	309054	F	4.3	2.792	1.508
6102	622695	309188	F	-	-	3.4
6103	622699	309193	F	-	-	6.4
6104	622698	309110	F	-	-	1.14
6105	622673	309147	F	-	1.5	-
6106	622660	309127	F	-	1.75	-
6107	622643	309126	F	-	1.95	-
6108	622666	309159	F	-	1.8	-
6109	622667	309183	F	-	2.2	-
6110	622656	309121	F	4	1.966	2.034
6201	622657	309265	F	-	1.411	-
6204	622664	309262	F	-	-	-
6205	622617	309252	F	-	1.643	-
6302	622634	309356	F	-	-	5.82
6404	622614	309454	F	-	-	7
6504	622609	309558	F	-	-	9.45
6616	622676	309698	F	-	-	-
6617	622680	309695	F	-	-	-
6618	622685	309692	F	-	-	-
6619	622689	309689	F	-	-	-
6620	622693	309685	F	-	-	-
6621	622698	309683	F	-	-	-
6623	622671	309696	F	-	-	-
7002	622744	309099	F	-	-	3.66
7005	622751	309098	F	-	-	6.8
7007	622756	309072	F	3.583	0.51	3.073
7008	622752	309070	F	3.603	2.015	1.588
7009	622727	309058	F	4.04	2.202	1.838

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert
7101	622708	309166	F	-	-0.04	-
7104	622720	309122	F	-	-	1.17
7105	622703	309194	F	-	-	2.7
7106	622799	309115	F	-	-	3
7108	622703	309164	F	-	1.1	-
7205	622712	309284	F	-	-	1.845
7206	622782	309285	F	-	-	-
7207	622753	309285	F	-	-	1.635
7404	622758	309477	F	-	-	-
7405	622704	309466	F	-	-	-
7406	622720	309473	F	-	-	-
7501	622718	309599	F	-	-	11.75
7602	622773	309641	F	10.67	8	2.67
8001	622884	309059	F	4.27	0.55	3.72
8102	622874	309170	F	4.32	1.71	2.61
8104	622811	309104	F	-	-	1.3
8204	622881	309211	F	-	-	-
8405	622862	309430	F	-	-	-
8509	622892	309570	F	-	-	-
8604	622816	309660	F	-	-	-
8610	622830	309693	F	9.982	5.902	4.08
8611	622812	309662	F	10.267	7.147	3.12
8615	622824	309616	F	-	-	-
8616	622818	309623	F	-	-	-
9001	622961	309099	F	3.87	1.77	2.1
9002	622979	309048	F	3.46	1.44	2.02
9202	622969	309245	F	-	-	2.6
9206	622966	309292	F	-	-	2.185
9208	622967	309283	F	4.3	2.13	2.17
9209	622986	309290	F	-	-	-
9301	622967	309310	F	4.37	2.25	2.12
9401	622973	309428	F	-	-	2.36
9414	622911	309475	F	-	-	2.845
9423	622945	309444	F	-	-	2.59
9425	622921	309458	F	-	-	2.615
9428	622929	309471	F	-	-	-
9429	622935	309475	F	-	-	-
9504	622992	309546	F	-	-	-
9513	622944	309573	F	-	-	-
9514	622905	309577	F	-	-	-
9607	622998	309664	F	5.447	3.487	1.96
9608	622902	309655	F	-	-	1.6
9609	622922	309660	F	6.1	0.176	5.924
9611	622992	309690	F	5.43	3.205	2.225
9613	622935	309623	F	-	-	-
9614	622948	309627	F	-	-	0.5
9615	622985	309689	F	-	-	0.95
9616	622962	309630	F	-	-	-
0251	623009	309263	S	4.47	3.05	1.42
0252	623039	309294	S	3.64	2.03	1.61
0253	623052	309269	S	-	4.66	-
0351	623078	309356	S	3.97	1.07	2.9
0352	623062	309309	S	3.05	1.74	1.31
0353	623062	309303	S	3.28	1.83	1.45
0354	623061	309356	S	4.01	1.03	2.98
0451	623036	309480	S	4.57	2.02	2.55
0452	623004	309492	S	5.01	2.2	2.81
0453	623005	309417	S	4.49	1.32	3.17
0454	623035	309410	S	3.95	1.21	2.74
0455	623046	309404	S	3.98	1.08	2.9
0456	623057	309404	S	3.96	1.08	2.88
0457	623087	309499	S	3.99	2.46	1.53
0458	623095	309478	S	4.19	2.23	1.96
0459	623097	309459	S	4.23	1.85	2.38
1051	623153	309091	S	2.83	1.69	1.14
1057	623187	309075	S	-	-	-
1153	623168	309191	S	-	-	2.49
1251	623156	309286	S	3.51	-0.55	4.06
1252	623103	309279	S	-	7.21	-
1351	623157	309346	S	3.23	0.79	2.44
1352	623108	309357	S	3.88	1.04	2.84
1353	623133	309357	S	-	-	2.45
1355	623145	309319	S	3.49	-0.26	3.75
1357	623156	309388	S	-	-	-
1451	623118	309451	S	4.09	1.64	2.45
1452	623158	309447	S	-	-	-
1453	623154	309427	S	3.78	1.02	2.76
1459	623168	309427	S	3.8	2.16	1.64
1553	623167	309558	S	-	-	-
1651	623150	309668	S	-	-	5.73
2351	623263	309338	S	-	-	1.93
2352	623207	309309	S	8.37	7.18	1.19
2354	623272	309315	S	3.09	1.29	1.8
2355	623250	309387	S	3.65	2.32	1.33
2361	623258	309307	S	2.918	1.168	1.75
2362	623250	309334	S	-	-	1.93
2363	623265	309326	S	-	4.11	-
2452	623274	309428	S	-	-	-
2552	623282	309589	S	-	-	2.2
3050	623390	309076	S	-	-	-
3051	623378	309064	S	-	-	-
3052	623364	309051	S	-	-	-
3351	623326	309343	S	3.29	1.24	2.05
3352	623321	309343	S	3.38	1.56	1.82
3353	623370	309348	S	2.54	0.65	1.89
3357	623382	309316	S	2.801	0.251	2.55
3358	623368	309351	S	-	-	-
3359	623365	309359	S	-	-	-
3360	623338	309352	S	-	-	-
3361	623346	309384	S	-	-	1.93
3457	623366	309424	S	-	-	3.04
3458	623386	309493	S	-	-	-
3551	623387	309506	S	-	-	2.1

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert
3552	623330	309532	S	-	-	1.8
3553	623305	309554	S	-	-	1.9
3554	623392	309521	S	-	-	-
3555	623324	309590	S	-	-	-
3651	623303	309624	S	-	-	2.1
3652	623332	309659	S	-	-	2.1
3653	623359	309654	S	-	-	-
4051	623435	309080	S	3.97	1.56	2.41
4157	623423	309190	S	-	-	2.77
4453	623468	309472	S	-	-	2.7
4551	623409	309568	S	-	-	-
4552	623449	309558	S	-	-	-
4651	623413	309644	S	-	-	-
4652	623468	309633	S	-	-	-
5350	623570	309310	S	2.1	0.51	1.59
5351	623576	309313	S	-	-	-
5451	623550	309413	S	2.86	0.28	2.58
5454	623549	309447	S	-	-	2.16
5455	623551	309469	S	-	-	2.415
5456	623531	309408	S	-	-	-
5551	623554	309532	S	-	-	1.92
5552	623556	309557	S	-	-	1.95
5553	623559	309581	S	-	-	1.67
5555	622569	309584	S	-	-	-
5556	622558	309579	S	-	-	1.168
5651	623563	309617	S	-	-	1.76
5652	623572	309688	S	-	-	1.98
5653	623575	309691	S	-	-	-
5654	623536	309621	S	10.441	9.016	1.425
5655	623545	309696	S	-	-	-
6054	622694	309051	S	4.022	1.333	2.689
6055	622667	309095	S	4.04	1.834	2.206
6056	622642	309083	S	4.319	2.634	1.685
6151	622671	309148	S	-	1.8	-
6152	622659	309129	S	-	2.05	-
6153	622643	309128	S	-	2.2	-
6154	622664	309160	S	-	2.1	-
6155	622665	309185	S	-	2.5	-
6156	622698	309187	S	-	-	1.2
6251	622666	309241	S	-	-	1.83
6252	622660	309259	S	-	1.548	-
6253	622657	309260	S	-	1.829	-
6254	622611	309258	S	-	2.999	-
6551	622622	309568	S	9.29	2.49	6.8
6552	622688	309590	S	10.73	7.65	3.08
6652	622644	309634	S	-	-	1.27
7052	622725	309056	S	4.102	1.861	2.241
7053	622749	309067	S	3.721	2.26	1.461
7152	622710	309169	S	-	1.3	-
7153	622703	309166	S	-	1.4	-
7154	622737	309117	S	-	-	2.9
7155	622748	309094	S	-	-	-
7156	622771	309107	S	-	-	-
7157	622798	309118	S	-	-	-
7251	622714	309285	S	-	-	1.575
7252	622788	309259	S	-	-	-
7253	622707	309257	S	-	1.734	-
7254	622745	309258	S	-	1.893	-
7351	622780	309326	S	-	-	1.83
7352	622745	309333	S	-	-	1.6
7354	622797	309321	S	-	-	1.3
7451	622760	309476	S	-	-	1.15
7652	622779	309637	S	-	-	3.81
7653	622788	309632	S	-	-	7.77
8151	622873	309169	S	4.32	1.96	2.36
8152	622802	309153	S	-	-	-
8153	622861	309166	S	-	-	-
8253	622833	309254	S	-	2.548	-
8254	622879	309213	S	-	-	-
8255	622882	309233	S	-	-	-
8452	622807	309490	S	-	-	1.38
8557	622860	309511	S	-	-	-
8653	622810	309662	S	10.267	7.447	2.82
8654	622829	309696	S	9.982	6.202	3.78
9252	622971	309247	S	-	-	2.25
9253	622970	309284	S	-	-	3.99
9254	622973	309261	S	-	-	-
9255	622973	309295	S	-	-	-
9256	622982	309292	S	-	-	-
9351	622973	309312	S	-	-	-
9459	622975	309422	S	-	-	3
9460	622930	309452	S	-	-	3.15
9462	622912	309477	S	-	-	3.48
9465	622991	309411	S	-	-	-

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert

Appendix: F – CCTV Survey

Draincare Environmental Services Ltd

1394 - Anglia Square, Norwich, NR3 1DZ

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Harpenden
Tel.: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Table of contents

Project Name:	Project number:	Date:	Contact:	
1394 - Anglia Square, Norwi	1394	13/11/2018	Howard Palmer	

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Harpenden
Tel.: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Table of contents

Project Name:	Project number:	Date:	Contact:	
1394 - Anglia Square, Norwi	1394	13/11/2018	Howard Palmer	

Place :

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

ΣØ / Main sections

Project name :	Project number :	Contact :	Date :
1394 - Anglia Square, Norwich, NR3	**1394**	**Howard Palmer**	**13/11/2018**

Nr.	US MH	DS MH	Date	Road	Tape No.	Material	m	(m)
35	MH1 outlet1	Main	01/11/2018	Edward street		Vitrified clay	6.25	6.25
36	MH1 outlet2	Unknown	30/10/2018	Edward street		Vitrified clay	1.59	1.59
39	MH5 Outl 2	Unknown	01/11/2018	Edward street site1		Vitrified clay	0.00	0.00

Pipe size: CIRCULAR 100/100 = 7.84 m (7.84 m)

Nr.	US MH	DS MH	Date	Road	Tape No.	Material	m	(m)
10	9209	B/Junction	29/10/2018	Anglia Square		Vitrified clay	19.54	19.54
20	8303A	8303C	30/10/2018	Anglia Square		Vitrified clay	18.69	18.69
21	8303A	8303C	30/10/2018	Anglia Square		Vitrified clay	20.88	20.88
37	MH4	MH5	30/10/2018	Edward street		Vitrified clay	22.98	22.98
38	MH5 Outl 1	Unknown	01/11/2018	Edward street site1		Vitrified clay	11.74	11.74
40	0457A	0457	31/10/2018	Edward street site2		Pitch fibre	5.74	5.74

Pipe size: CIRCULAR 150/150 = 99.57 m (99.57 m)

Nr.	US MH	DS MH	Date	Road	Tape No.	Material	m	(m)
1	9401	0405	29/10/2018	Anglia Square		Vitrified clay	31.82	31.82
2	0405	0406	29/10/2018	Anglia Square		Vitrified clay	28.25	28.25
3	0406	0408	29/10/2018	Anglia Square		Vitrified clay	26.74	26.74
4	0408	0301	29/10/2018	Anglia Square		Vitrified clay	42.29	42.29
7	0303	0301	29/10/2018	Anglia Square		Vitrified clay	45.47	45.47
9	0252	0352	29/10/2018	Anglia Square		Vitrified clay	29.63	29.63
11	9351 A	9305	29/10/2018	Anglia Square		Vitrified clay	65.25	65.25
12	9305	9306	29/10/2018	Anglia Square		Vitrified clay	42.93	42.93
13	9306	9305	29/10/2018	Anglia Square		Vitrified clay	43.69	43.69
14	9305	9301	29/10/2018	Anglia Square		Vitrified clay	7.41	7.41
16	9256	9255	30/10/2018	Anglia Square		Vitrified clay	8.84	8.84
17	9255	9305A	30/10/2018	Anglia Square		Vitrified clay	60.82	60.82
18	9305A	9465A	30/10/2018	Anglia Square		Vitrified clay	37.89	37.89
19	9465A	9465	30/10/2018	Anglia Square		Vitrified clay	1.72	1.72
31	9305	9208	01/11/2018	Anglia square		Vitrified clay	0.08	0.08
32	9208	9351A	01/11/2018	Anglia square		Vitrified clay	16.14	16.14

Pipe size: CIRCULAR 225/225 = 488.97 m (488.97 m)

Nr.	US MH	DS MH	Date	Road	Tape No.	Material	m	(m)
5	0301	0305	29/10/2018	Anglia Square		Vitrified clay	19.36	19.36
6	0305	1306	29/10/2018	Anglia Square		Vitrified clay	24.27	24.27
8	0352	0354	29/10/2018	Anglia Square		Vitrified clay	49.35	49.35
15	9306	9465 Br1	29/10/2018	Anglia Square		Vitrified clay	9.95	9.95
29	0308	0310	31/10/2018	Anglia square		Vitrified clay	3.17	3.17
34	9423	9401	01/11/2018	Anglia square		Vitrified clay	0.08	0.08

Pipe size: CIRCULAR 300/300 = 106.18 m (106.18 m)

Nr.	US MH	DS MH	Date	Road	Tape No.	Material	m	(m)
22	9465	9465B	31/10/2018	Anglia square			6.10	**5.20**
23	9465	0453	31/10/2018	Anglia square			23.97	23.97
30	0310	0309	31/10/2018	Anglia square		Vitrified clay	8.77	8.77

Pipe size: CIRCULAR 375/375 = 38.84 m (37.94 m)

Nr.	US MH	DS MH	Date	Road	Tape No.	Material	m	(m)
24	9459	0456	31/10/2018	Anglia square			32.69	32.69
25	9459	0454	31/10/2018	Anglia square			22.40	22.40
26	0454	0456	31/10/2018	Anglia square			27.40	27.40

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

∑∅ / Main sections

Project name :	Project number :	Contact :	Date :
1394 - Anglia Square, Norwich, NR3	**1394**	**Howard Palmer**	**13/11/2018**

Nr.	US MH	DS MH	Date	Road	Tape No.	Material	m	(m)
27	0456	0354	31/10/2018	Anglia square			0.16	0.16
28	0354	1351	31/10/2018	Anglia square			97.16	97.16

Pipe size: CIRCULAR 675/675 = 179.81 m (179.81 m)

Nr.	US MH	DS MH	Date	Road	Tape No.	Material	m	(m)
33	9460	9459	01/11/2018	Anglia square		Brick	35.31	**35.30**

Pipe size: EGG SHAPED 675/675 = 35.31 m (35.3 m)

All sections = 956.52 m (955.61 m)

Project-information

Project name :	Project Number :	Contact :	Date :
1394 - Anglia Square, Norwich, NR3	**1394**	**Howard Palmer**	**29/10/2018**

Client:	**Weston Homes PLC**
Contact Name:	**Howard Palmer**
Department:	**CCTV**
Road:	**Parsonage Road**
Town:	**Takeley**
County:	**CM22 6PU**
Telephone:	**01279 873341**
Fax:	
Mobile:	
E-mail:	**howard.palmer@weston-homes.com**

Site:	**Weston Homes PLC**
Contact Name:	**Howard Palmer**
Department:	**CCTV**
Road:	**Anglia Square**
Town:	**Norwich**
County:	**NR3 1DZ**
Telephone:	**01279 873341**
Fax:	
Mobile:	
E-mail:	**howard.palmer@weston-homes.com**

Contractor	**Draincare Environmental Services Ltd**
Contact Name:	**Nigel Gifkins**
Department:	**CCTV Department**
Road:	**Unit 2, Batford Mill, Lower Luton Road**
Town:	**Harpenden**
County:	**Herts, AL5 5BZ**
Telephone:	**01582 467111**
Fax:	
Mobile:	**07887 536573**
E-mail:	**nigelgifkins@draincare.com**

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Project-information

Project name :	Project Number :	Contact :	Date :
1394 - Anglia Square, Norwich, NR3	**1394**	**Howard Palmer**	**29/10/2018**

Background:

Draincare Environmental Services Ltd has been requested to undertake an investigation of the drainage at the above site.

Executive Summary / Overview:

Defects fully detailed and graded within the report.

CCTV survey conducted to establish pipework condition and defects.

Any operational or structural defects found during CCTV works are noted and graded, and if graded 4 or 5 photographed, within the following report.

All pipework, once past the property's boundary or found to be shared, may be the Water Utility's responsibility, following the 2011 legislation change, as described on the last page of this report.

Note(s):

Unable to CCTV survey the pipework between chambers 9423 d/s to 9401 (Plan 1), 0456 d/s to 0354 (Plan 2), 0351 d/s to 1352 (Plan 2 & 3), 1352 d/s to 1353 (Plan 3), 1353 d/s to main in road (Plan 3), 0306 d/s to 0307 (Plan 3), 0307 d/s to 0308 (Plan 3), 0308 d/s to 0310 (Plan 3), 0303 u/s to 0304 (redundant, Plan 4) and 9208 d/s to 9305 (Plan 5 & 6) due to high levels of debris / water and requiring a combination tanker-jetter lorry to clean and remove debris.

Unable to CCTV survey downstream from chamber 0402A located within Site 2 Edward Street car park due to the main in the road being blocked at the time causing chambers 0402A and chamber 0402 located within Edward Road to be full. AW were made aware and cleared main after site attendance.

Recommendations:

1) All operational defects graded 4 or above should be considered for appropriate remedial works to be undertaken (i.e. High Pressure Jetting, suction, cleaning/clearing works etc), in an attempt to return the pipework to a satisfactory and serviceable condition or facilitate further CCTV works.

2) All structural defects graded 4 or above should be considered for appropriate remedial works to be undertaken (i.e. lining, excavation, repair/replace etc), in an attempt to return the pipework to a satisfactory and serviceable condition.

All operational and structural defects graded 1 or 2 should not be detrimental to the effectiveness of the drainage, and are identified as a general note only.
All operational and structural defects graded 3 are unlikely to be detrimental to the effectiveness of the drainage.
All operational and structural defects graded 4 or 5 may be detrimental to the effectiveness of the drainage and should be considered for remedial work.
Pipe deformation / ovaling is described in % terms - % being an approximation of the amount of vertical dimension compressed.
The pipe materials as described should be recognised as the survey engineer's best judgement only.

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection report

Date : **29/10/2018**	Job number : **Weston**	Weather : **no rain or snow**	Operator : **Draincare**	Section number : **1**	PLR SUFFIX: **X**
Weather **no rain or snow**	Vehicle :	Camera :	Preset :	Cleaned : **no**	Operator : **Draincare**

Place :	**Norwich**	Location details:		U/S MH :	**9401**
Road :	**Anglia Square**	Catchment:	**Plan 1**	U/S Depth :	**2.23**
Location	**Road**	Tape number :		D/S MH :	**0405**
Inspection	**9401 (D/S) 0405**	Pipe Length		D/S Depth :	

Use:	**Foul**	Pipe shape :	**Circular**
Year laid :		Pipe size :	**225 mm**
Purpose :	**Other (state in remarks)**	Pipe material :	**Vitrified clay**
Total length :	**31.82 m**	Lining :	

Comment :

1:255 Depth: 2.23	Position	Code	Observation	Photo	Grade
9401	0.00	MH	Start node type, manhole reference number: 9401		(Constr) 0
	0.00	WL	Water level 20 % of the vertical dimension Flow		(Serv) 0
	1.27	CUW	Loss of vision, camera under water		(Misc) 0
	8.27	DEC	Settled deposits, hard or compacted 10 % cross-sectional area loss		(Serv) 3
0405	31.82	MHF	Finish node type, manhole reference number: 0405		(Constr) 0

Structural Defects					Constructional Features				
Service Defects					**Miscellaneous Features**				
STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	0	0	0	1	1	2	0.06	2	3

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

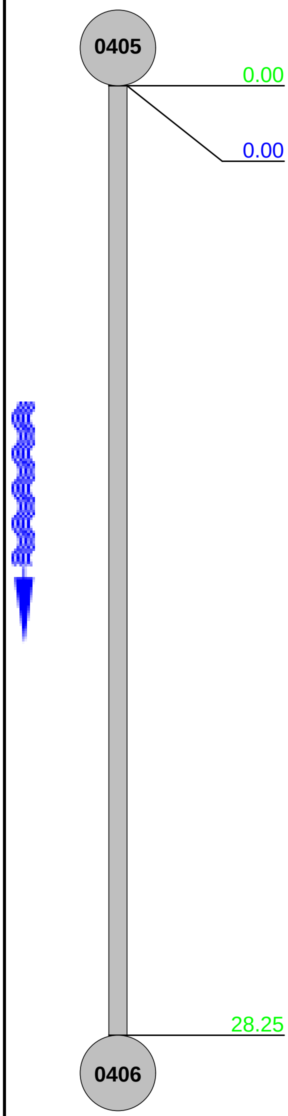
Inspection report

Date :	Job number :	Weather :	Operator :	Section number :	PLR SUFFIX:
29/10/2018	**Weston**	**no rain or snow**	**Draincare**	**2**	**X**
Weather **no rain or snow**	Vehicle :	Camera :	Preset :	Cleaned : **no**	Operator : **Draincare**

Place :	**Norwich**	Location details:		U/S MH :	**0405**
Road :	**Anglia Square**	Catchment:	**Plan 1 & 2**	U/S Depth :	
Location	**Other Pedestrian area**	Tape number :		D/S MH :	**0406**
Inspection	**0405 (D/S) 0406**	Pipe Length		D/S Depth :	**2.6**

Use:	**Foul**	Pipe shape :	**Circular**
Year laid :		Pipe size :	**225 mm**
Purpose :	**Other (state in remarks)**	Pipe material :	**Vitrified clay**
Total length :	**28.25 m**	Lining :	

Comment :



1:225	Position	Code	Observation	Photo	Grade
	0.00	MH	Start node type, manhole reference number: 0405		(Constr) 0
	0.00	WL	Water level 10 % of the vertical dimension Flow		(Serv) 0
	28.25	MHF	Finish node type, manhole reference number: 0406		(Constr) 0

Depth: 2.6

Structural Defects					Constructional Features				
Service Defects					**Miscellaneous Features**				
STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection report

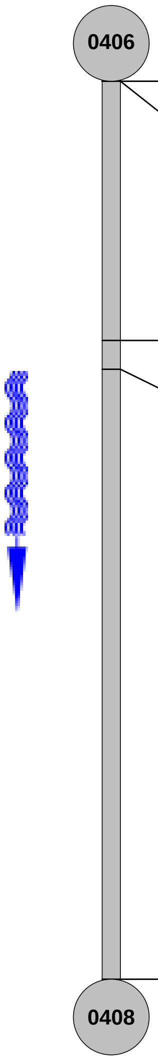
Date :	Job number :	Weather :	Operator :	Section number :	PLR SUFFIX:
29/10/2018	**Weston**	**no rain or snow**	**Draincare**	**3**	**X**
Weather **no rain or snow**	Vehicle :	Camera :	Preset :	Cleaned : **no**	Operator : **Draincare**

Place :	**Norwich**	Location details:		U/S MH :	**0406**
Road :	**Anglia Square**	Catchment:	**Plan 2**	U/S Depth :	**2.6**
Location	**Other Pedestrian area**	Tape number :		D/S MH :	**0408**
Inspection	**0406 (D/S) 0408**	Pipe Length		D/S Depth :	**3.07**

Use:	**Foul**	Pipe shape :	**Circular**
Year laid :		Pipe size :	**225 mm**
Purpose :	**Other (state in remarks)**	Pipe material :	**Vitrified clay**
Total length :	**26.74 m**	Lining :	

Comment :

Depth: 2.6



1:225 Position	Code	Observation	Photo	Grade
0.00	MH	Start node type, manhole reference number: 0406		(Constr) 0
0.00	WL	Water level 10 % of the vertical dimension Flow		(Serv) 0
7.72	REM	General remark 0407		(Misc) 0
8.58	LL	Line deviates left		(Serv) 0
26.74	MHF	Finish node type, manhole reference number: 0408		(Constr) 0

Depth: 3.07

Structural Defects | **Constructional Features**
Service Defects | **Miscellaneous Features**

STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection report

Date :	Job number :	Weather :	Operator :	Section number :	PLR SUFFIX:
29/10/2018	**Weston**	**no rain or snow**	**Draincare**	**4**	**X**
Weather **no rain or snow**	Vehicle :	Camera :	Preset :	Cleaned : **no**	Operator : **Draincare**

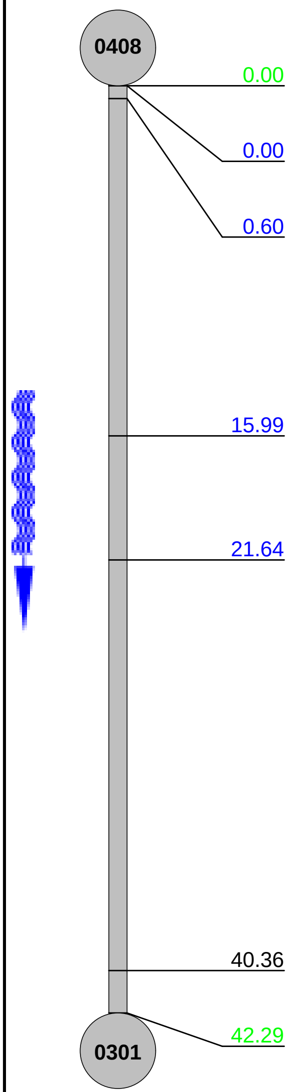
Place :	**Norwich**	Location details:		U/S MH :	**0408**
Road :	**Anglia Square**	Catchment:	**Plan 2**	U/S Depth :	**3.07**
Location	**Other Pedestrian area**	Tape number :		D/S MH :	**0301**
Inspection	**0408 (D/S) 0301**	Pipe Length		D/S Depth :	**3.6**

Use:	**Foul**	Pipe shape :	**Circular**
Year laid :		Pipe size :	**225 mm**
Purpose :	**Other (state in remarks)**	Pipe material :	**Vitrified clay**
Total length :	**42.29 m**	Lining :	

Comment :

1:345

Depth: 3.07



Position	Code	Observation	Photo	Grade
0.00	MH	Start node type, manhole reference number: 0408		(Constr) 0
0.00	WL	Water level 0 % of the vertical dimension		(Serv) 0
0.60	WL	Water level 5 % of the vertical dimension Flow		(Serv) 0
15.99	WL	Water level 20 % of the vertical dimension		(Serv) 0
21.64	DEG	Attached deposits, grease from 5 O'Clock to 7 O'Clock 10 % cross-sectional area loss		(Serv) 3
40.36	CUW	Loss of vision, camera under water		(Misc) 0
42.29	MHF	Finish node type, manhole reference number: 0301		(Constr) 0

Depth: 3.6

Structural Defects					Constructional Features				
Service Defects					**Miscellaneous Features**				
STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	**0**	**0**	**0**	**1**	**1**	**2**	**0.05**	**2**	**3**

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection report

Date :	Job number :	Weather :	Operator :	Section number :	PLR SUFFIX:
29/10/2018	**Weston**	**no rain or snow**	**Draincare**	**5**	**X**
Weather	Vehicle :	Camera :	Preset :	Cleaned :	Operator :
no rain or snow				**no**	**Draincare**

Place :	**Norwich**	Location details:		U/S MH :	**0301**
Road :	**Anglia Square**	Catchment:	**Plan 2**	U/S Depth :	**3.6**
Location	**Other Pedestrian area**	Tape number :		D/S MH :	**0305**
Inspection	**0301 (D/S) 0305**	Pipe Length		D/S Depth :	**3.78**

Use:	**Foul**	Pipe shape :	**Circular**
Year laid :		Pipe size :	**300 mm**
Purpose :	**Other (state in remarks)**	Pipe material :	**Vitrified clay**
Total length :	**19.36 m**	Lining :	

Comment :

1:165

Depth: 3.6

Node	Position	Code	Observation	Photo	Grade
0301	0.00	MH	Start node type, manhole reference number: 0301		(Constr) 0
	0.00	WL	Water level 50 % of the vertical dimension		(Serv) 0
	0.00	CUW	Loss of vision, camera under water		(Misc) 0
	1.71	WL	Water level 30 % of the vertical dimension		(Serv) 0
	10.58	DEX	Settled deposits, other 40 % cross-sectional area loss Debris	6_6_26_A.jpg	(Serv) 4
	15.64	FL	Fracture, longitudinal from 3 O'Clock		(Struct) 3
0305	19.36	MHF	Finish node type, manhole reference number: 0305		(Constr) 0

Depth: 3.78

Structural Defects					Constructional Features				
Service Defects					**Miscellaneous Features**				
STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
1	**40**	**2.07**	**40**	**3**	**1**	**5**	**0.26**	**5**	**4**

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection pictures

Place :	Road :	Date :	Section number :	PLR Suffix :
Norwich	**Anglia Square**	**29/10/2018**	**5**	**X**

Photo: 6_6_26_A.jpg, 00:02:11
10.58m, Settled deposits, other 40 % cross-sectional area loss   Debris

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection report

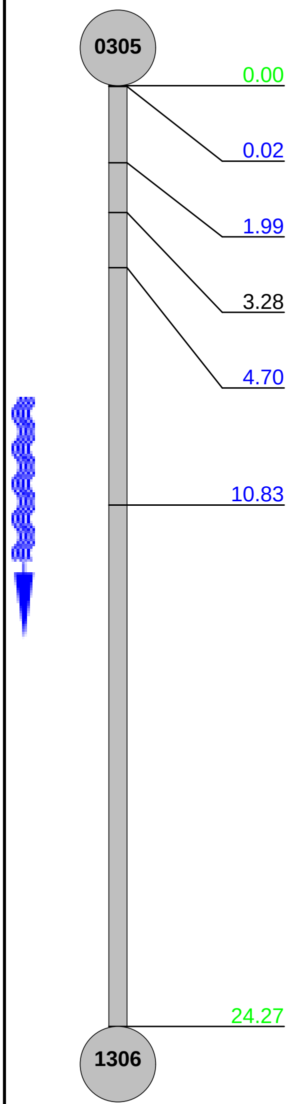
Date :	Job number :	Weather :	Operator :	Section number :	PLR SUFFIX:
29/10/2018	**Weston**	**no rain or snow**	**Draincare**	**6**	**X**
Weather **no rain or snow**	Vehicle :	Camera :	Preset :	Cleaned : **no**	Operator : **Draincare**

Place :	**Norwich**	Location details:		U/S MH :	**0305**
Road :	**Anglia Square**	Catchment:	**Plan 3**	U/S Depth :	**3.78**
Location	**Other Pedestrian area**	Tape number :		D/S MH :	**1306**
Inspection	**0305 (D/S) 1306**	Pipe Length		D/S Depth :	

Use:	**Foul**	Pipe shape :	**Circular**
Year laid :		Pipe size :	**300 mm**
Purpose :	**Other (state in remarks)**	Pipe material :	**Vitrified clay**
Total length :	**24.27 m**	Lining :	

Comment :

1:195 **Depth: 3.78**



Position	Code	Observation	Photo	Grade
0.00	MH	Start node type, manhole reference number: 0305		(Constr) 0
0.02	WL	Water level 5 % of the vertical dimension Flow		(Serv) 0
1.99	WL	Water level 10 % of the vertical dimension		(Serv) 0
3.28	CUW	Loss of vision, camera under water		(Misc) 0
4.70	WL	Water level 20 % of the vertical dimension		(Serv) 0
10.83	WL	Water level 40 % of the vertical dimension		(Serv) 0
24.27	MHF	Finish node type, manhole reference number: 1306		(Constr) 0

Structural Defects					Constructional Features				
Service Defects					**Miscellaneous Features**				
STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection report

Date :	Job number :	Weather :	Operator :	Section number :	PLR SUFFIX:
29/10/2018	**Weston**	**no rain or snow**	**Draincare**	**7**	**X**
Weather **no rain or snow**	Vehicle :	Camera :	Preset :	Cleaned : **no**	Operator : **Draincare**

Place :	**Norwich**	Location details:		U/S MH :	**0303**
Road :	**Anglia Square**	Catchment:	**Plan 4 & 2**	U/S Depth :	**1.6**
Location	**Road**	Tape number :		D/S MH :	**0301**
Inspection	**0303 (D/S) 0301**	Pipe Length		D/S Depth :	**3.6**

Use:	**Foul**	Pipe shape :	**Circular**
Year laid :		Pipe size :	**225 mm**
Purpose :	**Other (state in remarks)**	Pipe material :	**Vitrified clay**
Total length :	**45.47 m**	Lining :	

Comment :

1:360 **Depth: 1.6**

Position	Code	Observation	Photo	Grade
0.00	MH	Start node type, manhole reference number: 0303		(Constr) 0
0.00	WL	Water level 0 % of the vertical dimension		(Serv) 0
13.66	REM	General remark 0303A		(Misc) 0
31.36	WL	Water level 5 % of the vertical dimension		(Serv) 0
45.47	MHF	Finish node type, manhole reference number: 0301 backdrop shaft prior to 0301		(Constr) 0

0303 — 0301

Depth: 3.6

Structural Defects					Constructional Features				
Service Defects					**Miscellaneous Features**				
STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	0	0	0	1	0	0	0	0	1

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection report

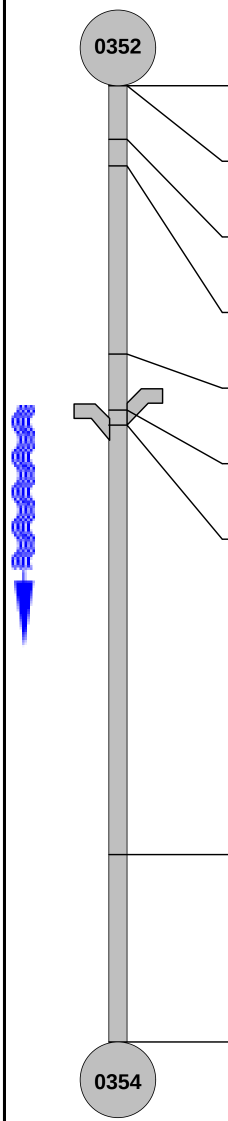
Date :	Job number :	Weather :	Operator :	Section number :	PLR SUFFIX:
29/10/2018	**Weston**	**no rain or snow**	**Draincare**	**8**	**X**
Weather **no rain or snow**	Vehicle :	Camera :	Preset :	Cleaned : **no**	Operator : **Draincare**

Place :	**Norwich**	Location details:		U/S MH :	**0352**
Road :	**Anglia Square**	Catchment:	**Plan 4 & 2**	U/S Depth :	**1.28**
Location	**Road**	Tape number :		D/S MH :	**0354**
Inspection	**0352 (D/S) 0354**	Pipe Length		D/S Depth :	

Use:	**Surface water**	Pipe shape :	**Circular**
Year laid :		Pipe size :	**300 mm**
Purpose :	**Other (state in remarks)**	Pipe material :	**Vitrified clay**
Total length :	**49.35 m**	Lining :	

Comment :

1:390 **Depth: 1.28**



Position	Code	Observation	Photo	Grade
0.00	MH	Start node type, manhole reference number: 0352		(Constr) 0
0.00	WL	Water level 5 % of the vertical dimension		(Serv) 0
2.76	SC	Dimension of drain/sewer changes 300 mm high 300 mm wide		0
4.13	DEX	Settled deposits, other 10 % cross-sectional area loss debris		(Serv) 3
13.83	REM	General remark 0352A		(Misc) 0
16.75	CN	Connection other than junction from 11 O'Clock diameter: 150 mm		(Constr) 0
17.52	CN	Connection other than junction from 1 O'Clock diameter: 150 mm		(Constr) 0
39.67	DEX	Settled deposits, other 5 % cross-sectional area loss debris		(Serv) 2
49.35	MHF	Finish node type, manhole reference number: 0354 Backdrop prior to 0354		(Constr) 0

Structural Defects | **Constructional Features**
Service Defects | **Miscellaneous Features**

STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	0	0	0	1	2	2	0.06	3	3

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection report

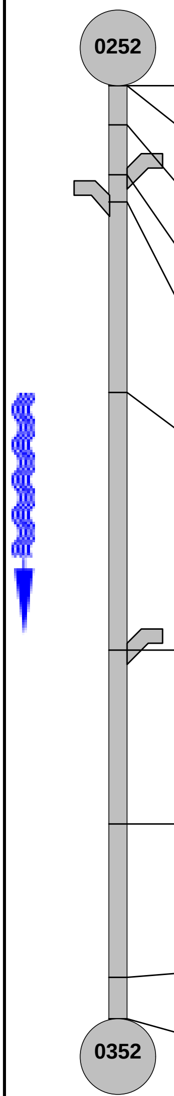
Date :	Job number :	Weather :	Operator :	Section number :	PLR SUFFIX:
29/10/2018	**Weston**	**no rain or snow**	**Draincare**	**9**	**X**
Weather	Vehicle :	Camera :	Preset :	Cleaned :	Operator :
no rain or snow				**no**	**Draincare**

Place :	**Norwich**	Location details:		U/S MH :	**0252**
Road :	**Anglia Square**	Catchment:	**Plan 4**	U/S Depth :	**1.57**
Location	**Road**	Tape number :		D/S MH :	**0352**
Inspection	**0252 (D/S) 0352**	Pipe Length		D/S Depth :	

Use:	**Surface water**	Pipe shape :	**Circular**
Year laid :		Pipe size :	**225 mm**
Purpose :	**Other (state in remarks)**	Pipe material :	**Vitrified clay**
Total length :	**29.63 m**	Lining :	

Comment :

1:240 **Depth: 1.57**



Position	Code	Observation	Photo	Grade
0.00	MH	Start node type, manhole reference number: 0252		(Constr) 0
0.00	WL	Water level 0 % of the vertical dimension		(Serv) 0
1.25	LL	Line deviates left		(Serv) 0
2.82	JN	Junction from 11 O'Clock diameter: 150 mm RG		(Constr) 0
3.69	JN	Junction from 2 O'Clock diameter: 150 mm RG		(Constr) 0
9.75	WL	Water level 5 % of the vertical dimension		(Serv) 0
17.92	JN	Junction from 10 O'Clock diameter: 150 mm		(Constr) 0
23.44	REM	General remark 0353		(Misc) 0
28.32	DEX	Settled deposits, other 5 % cross-sectional area loss Debris		(Serv) 2
29.63	MHF	Finish node type, manhole reference number: Drain run 0352		(Constr) 0

Structural Defects					Constructional Features				
Service Defects					Miscellaneous Features				
STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	0	0	0	1	1	1	0.03	1	2

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection report

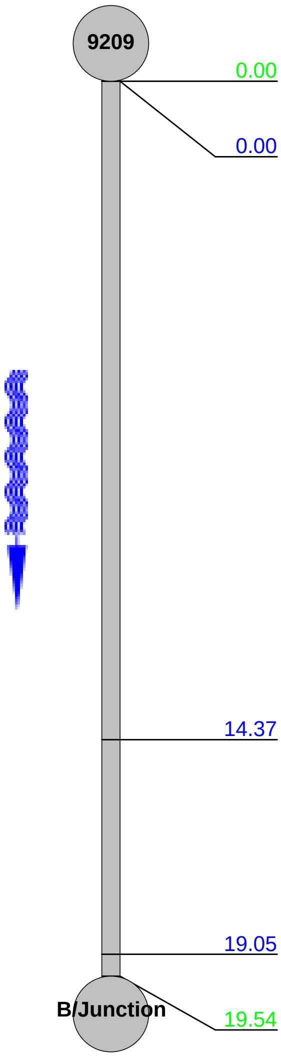
Date :	Job number :	Weather :	Operator :	Section number :	PLR SUFFIX:
29/10/2018	**Weston**	**no rain or snow**	**Draincare**	**10**	**X**
Weather **no rain or snow**	Vehicle :	Camera :	Preset :	Cleaned : **no**	Operator : **Draincare**

Place :	**Norwich**	Location details:		U/S MH :	**9209**
Road :	**Anglia Square**	Catchment:	**Plan 5**	U/S Depth :	**1.13**
Location	**Road**	Tape number :		D/S MH :	**B/Junction**
Inspection	**9209 (D/S) B/Junction**	Pipe Length		D/S Depth :	

Use:	**Foul**	Pipe shape :	**Circular**
Year laid :		Pipe size :	**150 mm**
Purpose :	**Other (state in remarks)**	Pipe material :	**Vitrified clay**
Total length :	**19.54 m**	Lining :	

Comment :

1:165
Depth: 1.13



Position	Code	Observation	Photo	Grade
0.00	MH	Start node type, manhole reference number: 9209		(Constr) 0
0.00	WL	Water level 0 % of the vertical dimension		(Serv) 0
14.37	DES	Settled deposits, fine 5 % cross-sectional area loss		(Serv) 2
19.05	LL	Line deviates left		(Serv) 0
19.54	BRF	Finish node type, major connection without manhole reference number: Blind junction downstream of 9301		(Constr) 0

Structural Defects					Constructional Features				
Service Defects					**Miscellaneous Features**				
STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	**0**	**0**	**0**	**1**	**1**	**1**	**0.05**	**1**	**2**

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection report

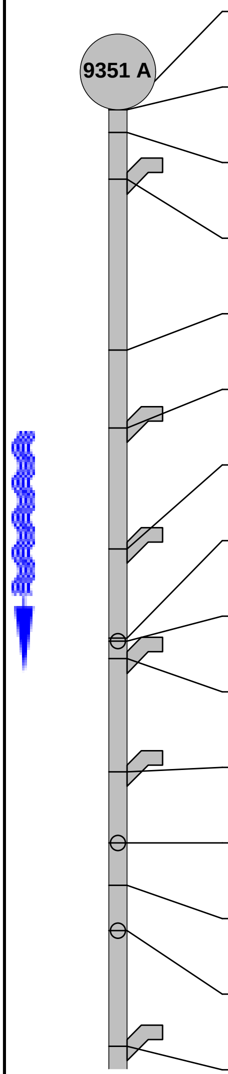
Date :	Job number :	Weather :	Operator :	Section number :	PLR SUFFIX:
29/10/2018	**Weston**	**no rain or snow**	**Draincare**	**11**	**X**
Weather **no rain or snow**	Vehicle :	Camera :	Preset :	Cleaned : **no**	Operator : **Draincare**

Place :	**Norwich**	Location details:		U/S MH :	**9351 A**
Road :	**Anglia Square**	Catchment:	**Plan 5 & 6**	U/S Depth :	**2.13**
Location	**Road**	Tape number :		D/S MH :	**9305**
Inspection	**9351 A (D/S) 9305**	Pipe Length		D/S Depth :	**2.74**

Use:	**Surface water**	Pipe shape :	**Circular**
Year laid :		Pipe size :	**225 mm**
Purpose :	**Other (state in remarks)**	Pipe material :	**Vitrified clay**
Total length :	**65.25 m**	Lining :	

Comment :

1:504 **Depth: 2.13**



Position	Code	Observation	Photo	Grade
0.00	MH	Start node type, manhole reference number: 9351 A		(Constr) 0
0.00	WL	Water level 0 % of the vertical dimension		(Serv) 0
1.52	WL	Water level 10 % of the vertical dimension		(Serv) 0
4.64	JN	Junction from 11 O'Clock diameter: 100 mm		(Constr) 0
16.05	LR	Line deviates right		(Serv) 0
21.20	JN	Junction from 11 O'Clock diameter: 100 mm		(Constr) 0
29.28	JN	Junction from 11 O'Clock diameter: 150 mm		(Constr) 0
35.23	WL	Water level 5 % of the vertical dimension		(Serv) 0
35.43	JN	Junction from 12 O'Clock diameter: 150 mm		(Constr) 0
36.61	JN	Junction from 11 O'Clock diameter: 150 mm		(Constr) 0
44.15	CN	Connection other than junction from 11 O'Clock diameter: 150 mm		(Constr) 0
48.89	JN	Junction from 12 O'Clock diameter: 100 mm		(Constr) 0
51.73	REM	General remark 9305		(Misc) 0
54.72	JN	Junction from 12 O'Clock diameter: 100 mm		(Constr) 0
62.43	JN	Junction from 9 O'Clock diameter: 150 mm		(Constr) 0

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection Report

Date : **29/10/2018**	Job number : **Weston**	Weather : **no rain or snow**	Operator : **Draincare**	Section number : **11**	PLR : **X**
Weather **no rain or snow**	Vehicle :	Camera :	Preset :	Cleaned : **no**	Grade:

1:504	Position	Code	Observation	Photo	Grade
	65.25	SA	Survey abandoned (can't push coiler further)		(Misc) 0

Structural Defects					Constructional Features				
Service Defects					Miscellaneous Features				
STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	0	0	0	1	0	0	0	0	1

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection report

Date :	Job number :	Weather :	Operator :	Section number :	PLR SUFFIX:
29/10/2018	**Weston**	**no rain or snow**	**Draincare**	**12**	**X**
Weather	Vehicle :	Camera :	Preset :	Cleaned :	Operator :
no rain or snow				**no**	**Draincare**

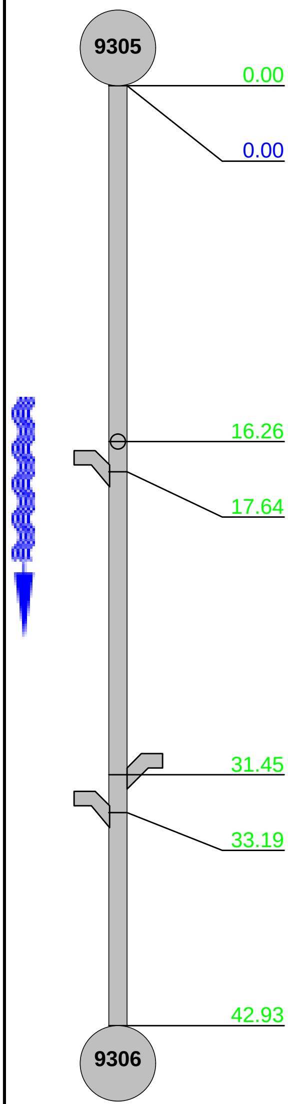
Place :	**Norwich**	Location details:		U/S MH :	**9305**
Road :	**Anglia Square**	Catchment:	**Plan 6 & 1**	U/S Depth :	**2.74**
Location	**Road**	Tape number :		D/S MH :	**9306**
Inspection	**9305 (D/S) 9306**	Pipe Length		D/S Depth :	

Use:	**Surface water**	Pipe shape :	**Circular**
Year laid :		Pipe size :	**225 mm**
Purpose :	**Other (state in remarks)**	Pipe material :	**Vitrified clay**
Total length :	**42.93 m**	Lining :	

Comment :

1:345 **Position** **Code** **Observation** **Photo** **Grade**

Depth: 2.74



Position	Code	Observation	Photo	Grade
0.00	MH	Start node type, manhole reference number: 9305		(Constr) 0
0.00	WL	Water level 0 % of the vertical dimension		(Serv) 0
16.26	JN	Junction from 12 O'Clock diameter: 100 mm		(Constr) 0
17.64	JN	Junction from 2 O'Clock diameter: 100 mm		(Constr) 0
31.45	JN	Junction from 9 O'Clock diameter: 100 mm		(Constr) 0
33.19	JN	Junction from 2 O'Clock diameter: 100 mm		(Constr) 0
42.93	MHF	Finish node type, manhole reference number: 9306		(Constr) 0

Unable to lift

Structural Defects	**Constructional Features**
Service Defects	**Miscellaneous Features**

STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	0	0	0	1	0	0	0	0	1

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

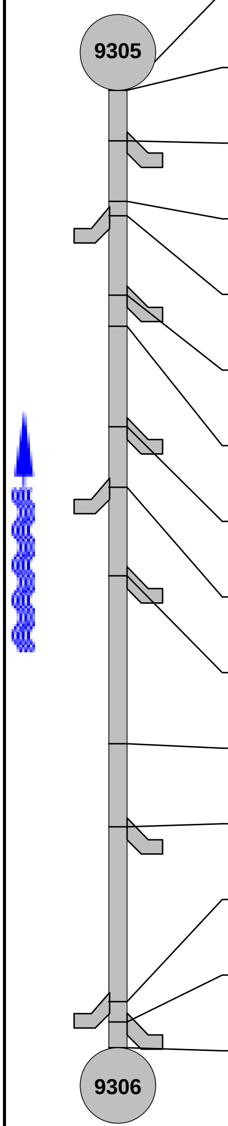
Inspection report

Date :	Job number :	Weather :	Operator :	Section number :	PLR SUFFIX:
29/10/2018	**Weston**	**no rain or snow**	**Draincare**	**13**	**X**
Weather **no rain or snow**	Vehicle :	Camera :	Preset :	Cleaned : **no**	Operator : **Draincare**

Place :	**Norwich**	Location details:		U/S MH :	**9306**
Road :	**Anglia Square**	Catchment:	**Plan 6 & 1**	U/S Depth :	
Location	**Road**	Tape number :		D/S MH :	**9305**
Inspection	**9305 (U/S) 9306**	Pipe Length		D/S Depth :	**2.12**

Use:	**Foul**	Pipe shape :	**Circular**
Year laid :		Pipe size :	**225 mm**
Purpose :	**Other (state in remarks)**	Pipe material :	**Vitrified clay**
Total length :	**43.69 m**	Lining :	

Comment :



1:345 **Depth: 2.12**

Position	Code	Observation	Photo	Grade
0.00	MH	Start node type, manhole reference number: 9305		(Constr) 0
0.00	WL	Water level 0 % of the vertical dimension		(Serv) 0
2.31	JN	Junction from 9 O'Clock diameter: 225 mm		(Constr) 0
5.08	DEX	Settled deposits, other 10 % cross-sectional area loss Debris		(Serv) 3
5.74	JN	Junction from 2 O'Clock diameter: 225 mm		(Constr) 0
9.34	JN	Junction from 11 O'Clock diameter: 225 mm		(Constr) 0
10.77	WL	Water level 20 % of the vertical dimension		(Serv) 0
15.36	JN	Junction from 11 O'Clock diameter: 225 mm		(Constr) 0
18.10	JN	Junction from 2 O'Clock diameter: 225 mm		(Constr) 0
22.15	JN	Junction from 11 O'Clock diameter: 225 mm		(Constr) 0
29.81	WL	Water level 5 % of the vertical dimension		(Serv) 0
33.62	JN	Junction from 11 O'Clock diameter: 225 mm		(Constr) 0
41.56	CN	Connection other than junction from 2 O'Clock diameter: 225 mm		(Constr) 0
42.51	JN	Junction from 11 O'Clock diameter: 150 mm		(Constr) 0
43.69	MHF	Finish node type, manhole reference number: 9306		(Constr) 0

Structural Defects — Constructional Features
Service Defects — Miscellaneous Features

STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	0	0	0	1	1	2	0.05	2	3

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection report

Date :	Job number :	Weather :	Operator :	Section number :	PLR SUFFIX:
29/10/2018	**Weston**	**no rain or snow**	**Draincare**	**14**	**X**
Weather **no rain or snow**	Vehicle :	Camera :	Preset :	Cleaned : **no**	Operator : **Draincare**

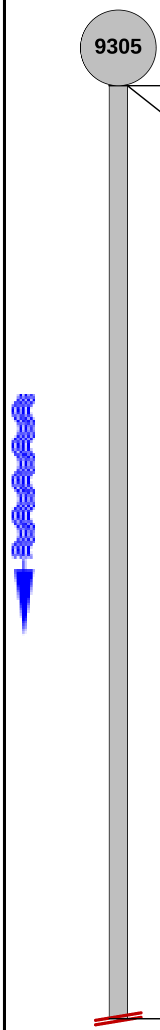
Place :	**Norwich**	Location details:		U/S MH :	**9305**
Road :	**Anglia Square**	Catchment:	**Plan 6**	U/S Depth :	**2.12**
Location	**Road**	Tape number :		D/S MH :	**9301**
Inspection	**9305 (D/S) 9301**	Pipe Length		D/S Depth :	

Use:	**Foul**	Pipe shape :	**Circular**
Year laid :		Pipe size :	**225 mm**
Purpose :	**Other (state in remarks)**	Pipe material :	**Vitrified clay**
Total length :	**7.41 m**	Lining :	

Comment :

1:60 **Position** **Code** **Observation** **Photo** **Grade**

Depth: 2.12



Position	Code	Observation	Photo	Grade
0.00	MH	Start node type, manhole reference number: 9305		(Constr) 0
0.00	WL	Water level 0 % of the vertical dimension		(Serv) 0
7.41	SA	Survey abandoned (can't push coiler further)		(Misc) 0

Structural Defects					Constructional Features				
Service Defects					**Miscellaneous Features**				
STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection report

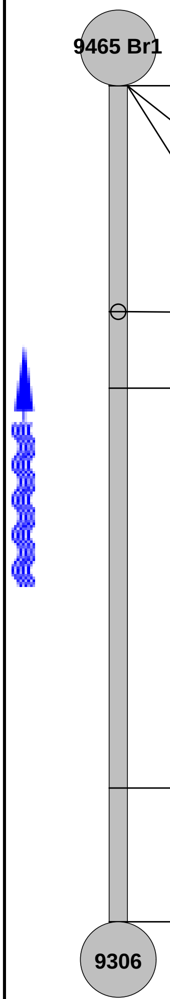
Date :	Job number :	Weather :	Operator :	Section number :	PLR SUFFIX:
29/10/2018	**Weston**	**no rain or snow**	**Draincare**	**15**	**X**
Weather **no rain or snow**	Vehicle :	Camera :	Preset :	Cleaned : **no**	Operator : **Draincare**

Place :	**Norwich**	Location details:		U/S MH :	**9306**
Road :	**Anglia Square**	Catchment:	**Plan 1**	U/S Depth :	
Location	**Road**	Tape number :		D/S MH :	**9465 Br1**
Inspection	**9465 Br1 (U/S) 9306**	Pipe Length		D/S Depth :	**2.7**

Use:	**Surface water**	Pipe shape :	**Circular**
Year laid :		Pipe size :	**300 mm**
Purpose :	**Other (state in remarks)**	Pipe material :	**Vitrified clay**
Total length :	**9.95 m**	Lining :	

Comment :

1:90 **Depth: 2.7**



Position	Code	Observation	Photo	Grade
0.00	MH	Start node type, manhole reference number: 9465 Br1		(Constr) 0
0.00	WL	Water level 5 % of the vertical dimension		(Serv) 0
0.00	DEX	Settled deposits, other 5 % cross-sectional area loss debris		(Serv) 2
2.69	JN	Junction from 12 O'Clock diameter: 100 mm		(Constr) 0
3.60	DEX	Settled deposits, other 5 % cross-sectional area loss debris		(Serv) 2
8.36	WL	Water level 10 % of the vertical dimension		(Serv) 0
9.95	MHF	Finish node type, manhole reference number: Drain run 9306		(Constr) 0

Unable to lift

Structural Defects					Constructional Features				
Service Defects					Miscellaneous Features				
STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	0	0	0	1	2	1	0.2	2	2

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection report

Date : 30/10/2018	Job number : Weston	Weather : rain	Operator : Draincare	Section number : 16	PLR SUFFIX: X
Weather rain	Vehicle :	Camera :	Preset :	Cleaned : no	Operator : Draincare

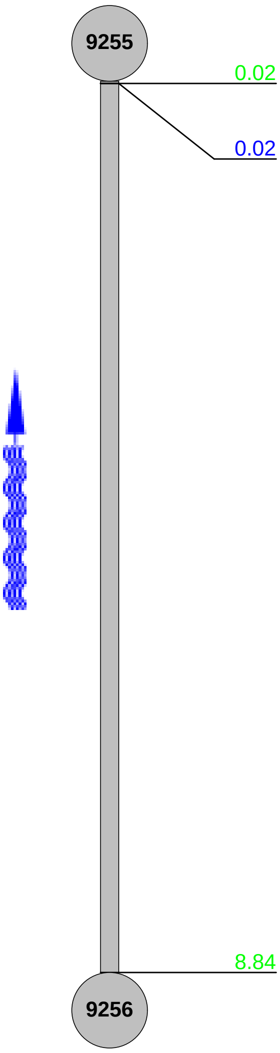
Place :	**Norwich**	Location details:		U/S MH :	**9256**
Road :	**Anglia Square**	Catchment:	**Plan 5**	U/S Depth :	**1.34**
Location	**Road**	Tape number :		D/S MH :	**9255**
Inspection	**9255 (U/S) 9256**	Pipe Length		D/S Depth :	**1.4**

Use:	**Surface water**	Pipe shape :	**Circular**
Year laid :		Pipe size :	**225 mm**
Purpose :	**Other (state in remarks)**	Pipe material :	**Vitrified clay**
Total length :	**8.84 m**	Lining :	

Comment :

1:75	Position	Code	Observation	Photo	Grade
	0.02	MH	Start node type, manhole reference number: 9255		(Constr) 0
	0.02	WL	Water level 5 % of the vertical dimension		(Serv) 0
	8.84	MHF	Finish node type, manhole reference number: 9256		(Constr) 0

Depth: 1.4



Depth: 1.34

Structural Defects					Constructional Features				
Service Defects					**Miscellaneous Features**				
STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	0	0	0	1	0	0	0	0	1

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Draincare

Inspection report

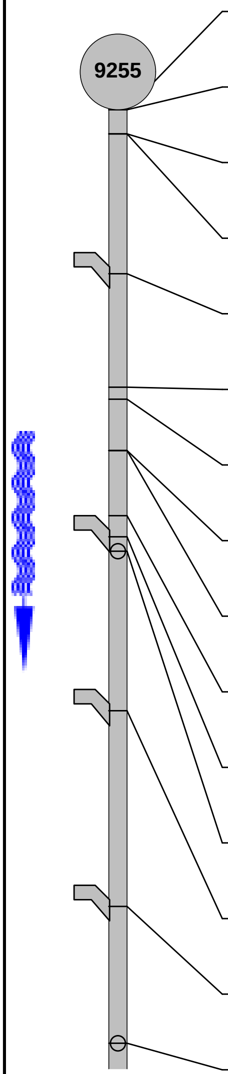
Date :	Job number :	Weather :	Operator :	Section number :	PLR SUFFIX:
30/10/2018	**Weston**	**rain**	**Draincare**	**17**	**X**
Weather **rain**	Vehicle :	Camera :	Preset :	Cleaned : **no**	Operator : **Draincare**

Place :	**Norwich**	Location details:		U/S MH :	**9255**
Road :	**Anglia Square**	Catchment:	**Plan 5 & 6**	U/S Depth :	**1.4**
Location	**Road**	Tape number :		D/S MH :	**9305A**
Inspection	**9255 (D/S) 9305A**	Pipe Length		D/S Depth :	

Use:	**Surface water**	Pipe shape :	**Circular**
Year laid :		Pipe size :	**225 mm**
Purpose :	**Other (state in remarks)**	Pipe material :	**Vitrified clay**
Total length :	**60.82 m**	Lining :	

Comment :

1:432 **Depth: 1.4**



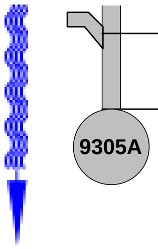
Position	Code	Observation	Photo	Grade
0.00	MH	Start node type, manhole reference number: 9255		(Constr) 0
0.00	WL	Water level 0 % of the vertical dimension		(Serv) 0
1.40	WL	Water level 5 % of the vertical dimension		(Serv) 0
1.40	CCJ	Crack, circumferential at joint from 12 O'Clock to 6 O'Clock		(Struct) 2
9.36	JN	Junction from 2 O'Clock diameter: 100 mm		(Constr) 0
15.86	REM	General remark 9351		(Misc) 0
16.54	LR	Line deviates right		(Serv) 0
19.50	LR	Line deviates right		(Serv) 0
19.50	WL	Water level 10 % of the vertical dimension		(Serv) 0
23.20	DEX	Settled deposits, other 20 % cross-sectional area loss Debris		(Serv) 3
24.41	JN	Junction from 3 O'Clock diameter: 150 mm		(Constr) 0
25.24	CN	Connection other than junction from 12 O'Clock diameter: 100 mm		(Constr) 0
34.36	JN	Junction from 3 O'Clock diameter: 150 mm		(Constr) 0
45.52	JN	Junction from 2 O'Clock diameter: 100 mm		(Constr) 0
53.37	CN	Connection other than junction from 12 O'Clock diameter: 100 mm		(Constr) 0

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection Report

Date :	Job number :	Weather :	Operator :	Section number :	PLR :
30/10/2018	**Weston**	**rain**	**Draincare**	**17**	**X**
Weather **rain**	Vehicle :	Camera :	Preset :	Cleaned : **no**	Grade:



1:432	Position	Code	Observation	Photo	Grade
	56.51	JN	Junction from 2 O'Clock diameter: 100 mm		(Constr) 0
	60.82	MHF	Finish node type, manhole reference number: 9305A		(Constr) 0

Structural Defects					Constructional Features				
Service Defects					Miscellaneous Features				
STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
1	10	0.16	10	2	1	2	0.03	2	3

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection report

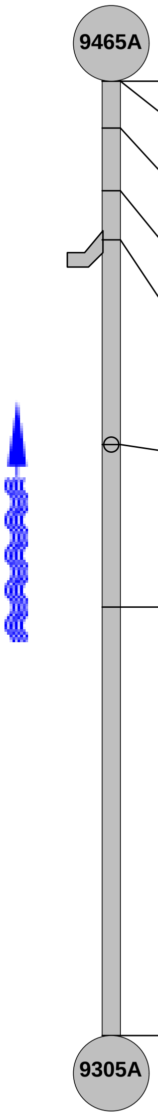
Date :	Job number :	Weather :	Operator :	Section number :	PLR SUFFIX:
30/10/2018	**Weston**	**rain**	**Draincare**	**18**	**X**
Weather	Vehicle :	Camera :	Preset :	Cleaned :	Operator :
rain				**no**	**Draincare**

Place :	**Norwich**	Location details:		U/S MH :	**9305A**
Road :	**Anglia Square**	Catchment:	**Plan 1 & 6**	U/S Depth :	
Location	**Road**	Tape number :		D/S MH :	**9465A**
Inspection	**9465A (U/S) 9305A**	Pipe Length		D/S Depth :	**2.1**

Use:	**Surface water**	Pipe shape :	**Circular**
Year laid :		Pipe size :	**225 mm**
Purpose :	**Other (state in remarks)**	Pipe material :	**Vitrified clay**
Total length :	**37.89 m**	Lining :	

Comment :

1:300 **Depth: 2.1**



Position	Code	Observation	Photo	Grade
0.00	MH	Start node type, manhole reference number: 9465A		(Constr) 0
0.00	WL	Water level 0 % of the vertical dimension		(Serv) 0
1.86	WL	Water level 5 % of the vertical dimension Flow		(Serv) 0
4.34	WL	Water level 10 % of the vertical dimension Flow		(Serv) 0
6.31	CN	Connection other than junction from 2 O'Clock diameter: 100 mm		(Constr) 0
14.42	JN	Junction from 12 O'Clock diameter: 100 mm		(Constr) 0
20.88	WL	Water level 20 % of the vertical dimension		(Serv) 0
37.89	MHF	Finish node type, manhole reference number: 9305A		(Constr) 0

Structural Defects					Constructional Features				
Service Defects					Miscellaneous Features				
STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	0	0	0	1	0	0	0	0	1

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection report

Date :	Job number :	Weather :	Operator :	Section number :	PLR SUFFIX:
30/10/2018	**Weston**	**rain**	**Draincare**	**19**	**X**
Weather **rain**	Vehicle :	Camera :	Preset :	Cleaned : **no**	Operator : **Draincare**

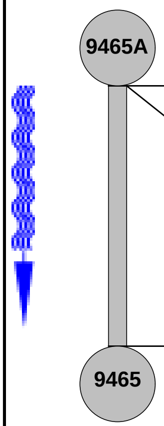
Place :	**Norwich**	Location details:		U/S MH :	**9465A**
Road :	**Anglia Square**	Catchment:	**Plan 1**	U/S Depth :	**2.1**
Location	**Road**	Tape number :		D/S MH :	**9465**
Inspection	**9465A (D/S) 9465**	Pipe Length		D/S Depth :	**2.75**

Use:	**Surface water**	Pipe shape :	**Circular**
Year laid :		Pipe size :	**225 mm**
Purpose :	**Other (state in remarks)**	Pipe material :	**Vitrified clay**
Total length :	**1.72 m**	Lining :	

Comment :

1:50 **Position** **Code** **Observation** **Photo** **Grade**

Depth: 2.1



Position	Code	Observation	Photo	Grade
0.00	MH	Start node type, manhole reference number: 9465A		(Constr) 0
0.00	WL	Water level 10 % of the vertical dimension Flow		(Serv) 0
1.72	MHF	Finish node type, manhole reference number: 9465		(Constr) 0

Depth: 2.75

Structural Defects					**Constructional Features**				
Service Defects					**Miscellaneous Features**				
STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection report

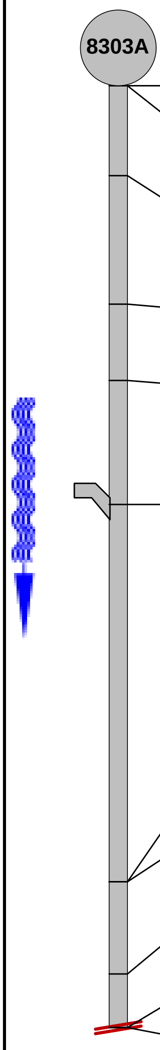
Date :	Job number :	Weather :	Operator :	Section number :	PLR SUFFIX:
30/10/2018	**Weston**	**rain**	**Draincare**	**20**	**X**
Weather **rain**	Vehicle :	Camera :	Preset :	Cleaned : **no**	Operator : **Draincare**

Place :	**Norwich**	Location details:		U/S MH :	**8303A**
Road :	**Anglia Square**	Catchment:	**Plan 7**	U/S Depth :	**1.08**
Location	**Road**	Tape number :		D/S MH :	**8303C**
Inspection	**8303A (D/S) 8303C**	Pipe Length		D/S Depth :	

Use:	**Foul**	Pipe shape :	**Circular**
Year laid :		Pipe size :	**150 mm**
Purpose :	**Other (state in remarks)**	Pipe material :	**Vitrified clay**
Total length :	**18.69 m**	Lining :	

Comment :

1:150 **Depth: 1.08**



Position	Code	Observation	Photo	Grade
0.00	MH	Start node type, manhole reference number: 8303A		(Constr) 0
0.00	WL	Water level 5 % of the vertical dimension		(Serv) 0
1.78	WL	Water level 10 % of the vertical dimension		(Serv) 0
4.34	DEX	Settled deposits, other 10 % cross-sectional area loss Waste		(Serv) 3
5.85	REM	General remark 8303B		(Misc) 0
8.31	CN	Connection other than junction from 2 O'Clock diameter: 100 mm		(Constr) 0
15.79	WL	Water level 20 % of the vertical dimension		(Serv) 0
15.79	DEX	Settled deposits, other 20 % cross-sectional area loss waste		(Serv) 3
17.62	CUW	Loss of vision, camera under water		(Misc) 0
18.69	OBZ	Other obstacles, other from 3 O'Clock to 9 O'Clock 60 % cross-sectional area loss Debris	21_21_153_A.jpg	(Serv) 5
18.69	SA	Survey abandoned		(Misc) 0

Structural Defects					Constructional Features				
Service Defects					Miscellaneous Features				
STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	0	0	0	1	3	10	0.75	14	5

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection pictures

Place :	Road :	Date :	Section number :	PLR Suffix :
Norwich	**Anglia Square**	**30/10/2018**	**20**	**X**

Photo: 21_21_153_A.jpg, 00:02:04
18.69m, Other obstacles, other from 3 O'Clock to 9 O'Clock
60 % cross-sectional area loss   Debris

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection report

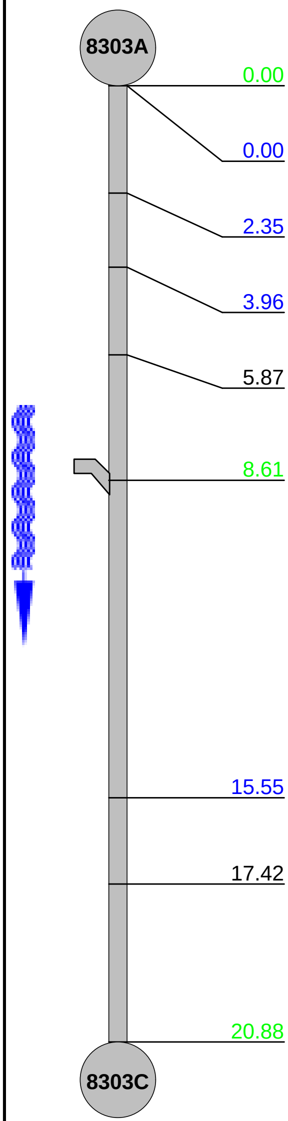
Date :	Job number :	Weather :	Operator :	Section number :	PLR SUFFIX:
30/10/2018	**Weston**	**rain**	**Draincare**	**21**	**X**
Weather **rain**	Vehicle :	Camera :	Preset :	Cleaned : **no**	Operator : **Draincare**

Place :	**Norwich**	Location details:		U/S MH :	**8303A**
Road :	**Anglia Square**	Catchment:	**Plan 7**	U/S Depth :	**1.08**
Location	**Road**	Tape number :		D/S MH :	**8303C**
Inspection	**8303A (D/S) 8303C**	Pipe Length		D/S Depth :	

Use:	**Foul**	Pipe shape :	**Circular**
Year laid :		Pipe size :	**150 mm**
Purpose :	**Other (state in remarks)**	Pipe material :	**Vitrified clay**
Total length :	**20.88 m**	Lining :	

Comment :

1:165 **Depth: 1.08**



Position	Code	Observation	Photo	Grade
0.00	MH	Start node type, manhole reference number: 8303A		(Constr) 0
0.00	WL	Water level 0 % of the vertical dimension		(Serv) 0
2.35	WL	Water level 10 % of the vertical dimension		(Serv) 0
3.96	DEX	Settled deposits, other 30 % cross-sectional area loss debris	22_22_157_A.jpg	(Serv) 4
5.87	REM	General remark 8303B		(Misc) 0
8.61	CN	Connection other than junction from 2 O'Clock diameter: 100 mm		(Constr) 0
15.55	DEX	Settled deposits, other 20 % cross-sectional area loss debris		(Serv) 3
17.42	CUW	Loss of vision, camera under water		(Misc) 0
20.88	MHF	Finish node type, manhole reference number: 8303C		(Constr) 0

Structural Defects					Constructional Features				
Service Defects					Miscellaneous Features				
STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	0	0	0	1	2	5	0.34	7	4

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection pictures

Place :	Road :	Date :	Section number :	PLR Suffix :
Norwich	**Anglia Square**	**30/10/2018**	**21**	**X**

Photo: 22_22_157_A.jpg, 00:00:29
3.96m, Settled deposits, other 30 % cross-sectional area loss
debris

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

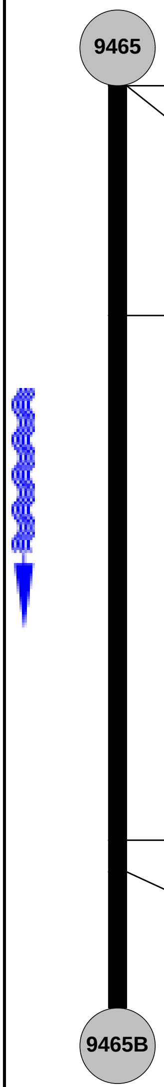
Inspection report

Date : **31/10/2018**	Job number : **Weston**	Weather : **no rain or snow**	Operator :	Section number : **22**	PLR SUFFIX:
Weather **no rain or snow**	Vehicle :	Camera :	Preset :	Cleaned : **no**	Operator :

Place :		Location details:		U/S MH :	**9465**
Road :	**Anglia square**	Catchment:	**Plan 1**	U/S Depth :	
Location	**Road**	Tape number :		D/S MH :	**9465B**
Inspection	**9465 (D/S) 9465B**	Pipe Length	0.00 m	D/S Depth :	

Use:	**Surface water**	Pipe shape :	**Circular**
Year laid :		Pipe size :	**375 mm**
Purpose :	**Routine inspection of condition**	Pipe material :	
Total length :	**6.10 m**	Lining :	

Comment :



1:50 Position	Code	Observation	Photo	Grade
0.00	MH	Start node type, manhole, reference number: 9465		(Constr) 0
0.00	WL	Water level, 0 % of the vertical dimension		(Serv) 0
1.52	WL	Water level, 10 % of the vertical dimension		(Serv) 0
4.99	LL	Line deviates left		(Serv) 0
5.20	MHF	Finish node type, manhole reference number: 9465B		(Constr) 0

Structural Defects | **Constructional Features**
Service Defects | **Miscellaneous Features**

STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	0	0	0	1	0	0	0	0	1

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection report

Date :	Job number :	Weather :	Operator :	Section number :	PLR SUFFIX:
31/10/2018	**Weston**	**no rain or snow**	**Draincare**	**23**	
Weather **no rain or snow**	Vehicle :	Camera :	Preset :	Cleaned : **no**	Operator : **Draincare**

Place :		Location details:		U/S MH :	**9465**
Road :	**Anglia square**	Catchment:	**Plan 1**	U/S Depth :	**2.75**
Location	**Road**	Tape number :		D/S MH :	**0453**
Inspection	**9465 (D/S) 0453**	Pipe Length	0.00 m	D/S Depth :	

Use:	**Surface water**	Pipe shape :	**Circular**
Year laid :		Pipe size :	**375 mm**
Purpose :	**Routine inspection of condition**	Pipe material :	
Total length :	**23.97 m**	Lining :	

Comment :

Depth: 2.75

1:195	Position	Code	Observation	Photo	Grade
9465	0.00	MH	Start node type, manhole, reference number: 9465		(Constr) 0
	0.00	WL	Water level, 0 % of the vertical dimension		(Serv) 0
	1.79	WL	Water level, 10 % of the vertical dimension		(Serv) 0
	4.93	REM	General remark, 9465B		(Misc) 0
	4.93	LL	Line deviates left		(Serv) 0
	10.10	DES	Settled deposits, fine, 5 % cross-sectional area loss		(Serv) 2
0453	23.97	MHF	Finish node type, manhole, reference number: 0453		(Constr) 0

Structural Defects					Constructional Features				
Service Defects					Miscellaneous Features				
STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	**0**	**0**	**0**	**1**	**1**	**1**	**0.04**	**1**	**2**

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection report

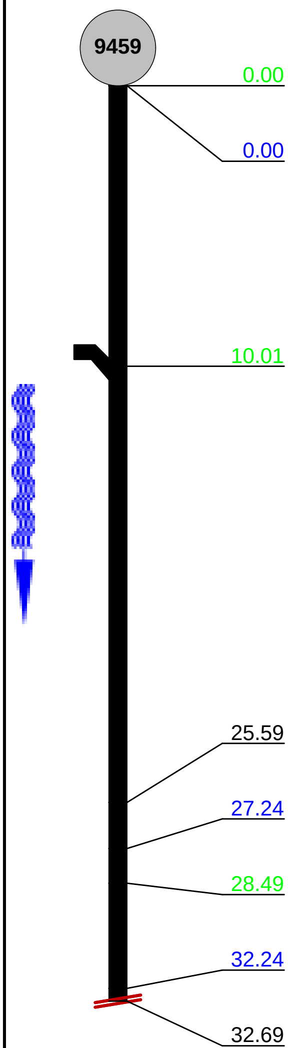
Date : **31/10/2018**	Job number : **Weston**	Weather : **no rain or snow**	Operator : **Draincare**	Section number : **24**	PLR SUFFIX:
Weather **no rain or snow**	Vehicle :	Camera :	Preset :	Cleaned : **no**	Operator : **Draincare**

Place :		Location details:		U/S MH :	**9459**
Road :	**Anglia square**	Catchment:	**Plan 1**	U/S Depth :	**2.99**
Location	**Road**	Tape number :		D/S MH :	**0456**
Inspection	**9459 (D/S) 0456**	Pipe Length	0.00 m	D/S Depth :	**2.91**

Use:	**Surface water**	Pipe shape :	**Circular**
Year laid :		Pipe size :	**675 mm**
Purpose :	**Routine inspection of condition**	Pipe material :	
Total length :	**32.69 m**	Lining :	

Comment :

1:270 **Depth: 2.99**



Position	Code	Observation	Photo	Grade
0.00	MH	Start node type, manhole, reference number: 9459		(Constr) 0
0.00	WL	Water level, 5 % of the vertical dimension		(Serv) 0
10.01	CN	Connection other than junction, at 2 o'clock, diameter: 150 mm		(Constr) 0
25.59	REM	General remark, buried 0453		(Misc) 0
27.24	WL	Water level, 20 % of the vertical dimension		(Serv) 0
28.49	CN	Connection other than junction, at 12 o'clock, diameter: 150 mm		(Constr) 0
32.24	OBZ	Other obstacles, other, from 6 o'clock, to 7 o'clock, 10 % cross-sectional area loss, hard material		(Serv) 3
32.69	SA	Survey abandoned, obstruction in line (to be surveyed up from 0456)		(Misc) 0

Structural Defects | **Constructional Features**
Service Defects | **Miscellaneous Features**

STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	0	0	0	1	1	10	0.31	10	5

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection report

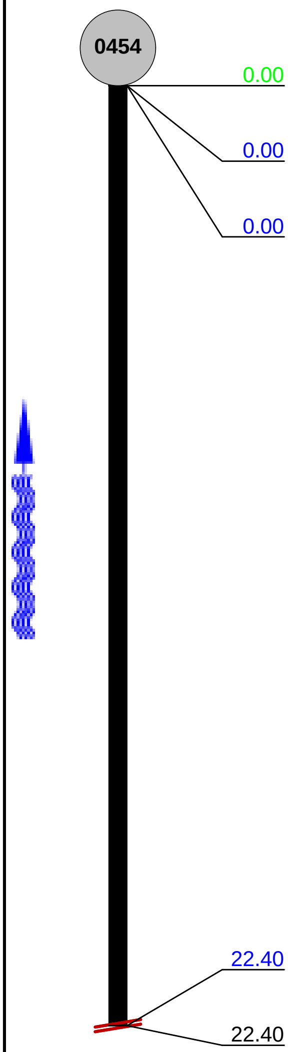
Date :	Job number :	Weather :	Operator :	Section number :	PLR SUFFIX:
31/10/2018	**Weston**	**no rain or snow**	**Draincare**	**25**	
Weather	Vehicle :	Camera :	Preset :	Cleaned :	Operator :
no rain or snow				**no**	**Draincare**

Place :		Location details:		U/S MH :	**9459**
Road :	**Anglia square**	Catchment:	**Plan 2 & 1**	U/S Depth :	**2.99**
Location	**Road**	Tape number :		D/S MH :	**0454**
Inspection	**0454 (U/S) 9459**	Pipe Length	0.00 m	D/S Depth :	**2.91**

Use:	**Surface water**	Pipe shape :	**Circular**
Year laid :		Pipe size :	**675 mm**
Purpose :	**Routine inspection of condition**	Pipe material :	
Total length :	**22.40 m**	Lining :	

Comment :

1:180 **Depth: 2.91**



Position	Code	Observation	Photo	Grade
0.00	MH	Start node type, manhole, reference number: 0454		(Constr) 0
0.00	WL	Water level, 10 % of the vertical dimension		(Serv) 0
0.00	DES	Settled deposits, fine, 20 % cross-sectional area loss		(Serv) 3
22.40	OBZ	Other obstacles, other, from 6 o'clock, to 7 o'clock, 10 % cross-sectional area loss, hard material		(Serv) 3
22.40	SA	Survey abandoned, obstruction (cross over point from Section 24)		(Misc) 0

Structural Defects					Constructional Features				
Service Defects					**Miscellaneous Features**				
STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	**0**	**0**	**0**	**1**	**2**	**10**	**0.54**	**12**	**5**

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection report

Date :	Job number :	Weather :	Operator :	Section number :	PLR SUFFIX:
31/10/2018	**Weston**	**no rain or snow**	**Draincare**	**26**	
Weather **no rain or snow**	Vehicle :	Camera :	Preset :	Cleaned : **no**	Operator : **Draincare**

Place :		Location details:		U/S MH :	**0454**
Road :	**Anglia square**	Catchment:	**Plan 2**	U/S Depth :	**2.91**
Location	**Road**	Tape number :		D/S MH :	**0456**
Inspection	**0454 (D/S) 0456**	Pipe Length	0.00 m	D/S Depth :	

Use:	**Surface water**	Pipe shape :	**Circular**
Year laid :		Pipe size :	**675 mm**
Purpose :	**Routine inspection of condition**	Pipe material :	
Total length :	**27.40 m**	Lining :	

Comment :

1:225 **Depth: 2.91**

0454

Position	Code	Observation	Photo	Grade
0.00	MH	Start node type, manhole, reference number: 0456		(Constr) 0
0.00	WL	Water level, 20 % of the vertical dimension		(Serv) 0
1.57	DES	Settled deposits, fine, 20 % cross-sectional area loss		(Serv) 3
13.70	LL	Line deviates left		(Serv) 0
15.00	REM	General remark, 0455		(Misc) 0
16.10	WL	Water level, 40 % of the vertical dimension		(Serv) 0
22.15	DES	Settled deposits, fine, 30 % cross-sectional area loss	28_28_197_A.jpg	(Serv) 4
23.22	LR	Line deviates right		(Serv) 0
23.73	REM	General remark, 0456		(Misc) 0
25.67	DES	Settled deposits, fine, 30 % cross-sectional area loss	28_28_200_A.jpg	(Serv) 4
25.67	WL	Water level, 40 % of the vertical dimension		(Serv) 0
27.40	SA	Survey abandoned, debris/silt		(Misc) 0

Structural Defects					Constructional Features				
Service Defects					Miscellaneous Features				
STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	0	0	0	1	3	5	0.44	12	4

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection pictures

Place :	Road :	Date :	Section number :	PLR Suffix :
	Anglia square	**31/10/2018**	**26**	

Photo: 28_28_197_A.jpg, 00:06:20
22.15m, Settled deposits, fine, 30 % cross-sectional area loss

Photo: 28_28_200_A.jpg, 00:07:28
25.67m, Settled deposits, fine, 30 % cross-sectional area loss

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection report

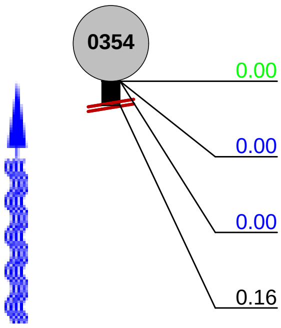
Date :	Job number :	Weather :	Operator :	Section number :	PLR SUFFIX:
31/10/2018	**Weston**	**no rain or snow**	**Draincare**	**27**	
Weather	Vehicle :	Camera :	Preset :	Cleaned :	Operator :
no rain or snow				**no**	**Draincare**

Place :		Location details:		U/S MH :	**0456**
Road :	**Anglia square**	Catchment:	**Plan 2**	U/S Depth :	**2.91**
Location	**Road**	Tape number :		D/S MH :	**0354**
Inspection	**0354 (U/S) 0456**	Pipe Length	0.00 m	D/S Depth :	**3**

Use:	**Surface water**	Pipe shape :	**Circular**
Year laid :		Pipe size :	**675 mm**
Purpose :	**Routine inspection of condition**	Pipe material :	
Total length :	**0.16 m**	Lining :	

Comment :

1:50
Depth: 3



Position	Code	Observation	Photo	Grade
0.00	MH	Start node type, manhole, reference number: 0354		(Constr) 0
0.00	WL	Water level, 10 % of the vertical dimension		(Serv) 0
0.00	DES	Settled deposits, fine, 40 % cross-sectional area loss	29_29_204_A.jpg	(Serv) 4
0.16	SA	Survey abandoned, silt		(Misc) 0

Structural Defects					Constructional Features				
Service Defects					**Miscellaneous Features**				
STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	**0**	**0**	**0**	**1**	**1**	**5**	**31.25**	**5**	**5**

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection pictures

Place :	Road :	Date :	Section number :	PLR Suffix :
	Anglia square	**31/10/2018**	**27**	

Photo: 29_29_204_A.jpg, 00:00:05
0m, Settled deposits, fine, 40 % cross-sectional area loss

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection report

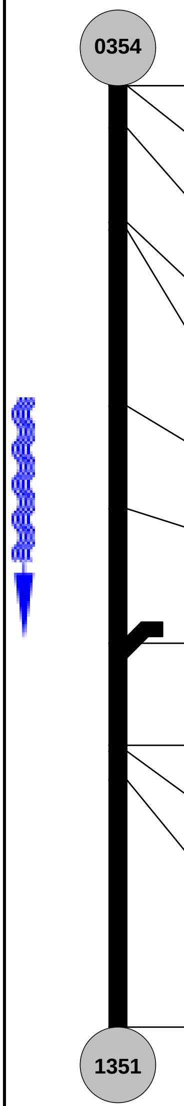
Date :	Job number :	Weather :	Operator :	Section number :	PLR SUFFIX:
31/10/2018	**Weston**	**no rain or snow**	**Draincare**	**28**	
Weather **no rain or snow**	Vehicle :	Camera :	Preset :	Cleaned : **no**	Operator : **Draincare**

Place :		Location details:		U/S MH :	**0354**
Road :	**Anglia square**	Catchment:	**Plan 2**	U/S Depth :	**3**
Location	**Road**	Tape number :		D/S MH :	**1351**
Inspection	**0354 (D/S) 1351**	Pipe Length	0.00 m	D/S Depth :	

Use:	**Surface water**	Pipe shape :	**Circular**
Year laid :		Pipe size :	**675 mm**
Purpose :	**Routine inspection of condition**	Pipe material :	
Total length :	**97.16 m**	Lining :	

Comment :

1:780 **Depth: 3**



Position	Code	Observation	Photo	Grade
0.00	MH	Start node type, manhole, reference number: 0354		(Constr) 0
0.00	WL	Water level, 20 % of the vertical dimension		(Serv) 0
4.36	DES	Settled deposits, fine, 20 % cross-sectional area loss		(Serv) 3
14.15	DEE	Attached deposits, encrustation, from 3 o'clock, to 5 o'clock, 20 % cross-sectional area loss		(Serv) 3
14.91	REM	General remark, 0351		(Misc) 0
33.04	REM	General remark, 1352		(Misc) 0
43.65	REM	General remark, 0352A		(Misc) 0
57.56	JN	Junction, at 9 o'clock, diameter: 675 mm		(Constr) 0
68.12	LR	Line deviates right		(Serv) 0
68.70	REM	General remark, 1353		(Misc) 0
71.67	DES	Settled deposits, fine, 30 % cross-sectional area loss	30_30_217_A.jpg	(Serv) 4
97.16	MHF	Finish node type, manhole reference number: 1351		(Constr) 0

AW Main in road

Structural Defects					Constructional Features				
Service Defects					**Miscellaneous Features**				
STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	0	0	0	1	3	5	0.09	9	4

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection pictures

Place :	Road :	Date :	Section number :	PLR Suffix :
	Anglia square	**31/10/2018**	**28**	

Photo: 30_30_217_A.jpg, 00:16:24
71.67m, Settled deposits, fine, 30 % cross-sectional area loss

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection report

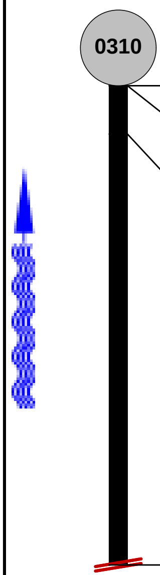
Date :	Job number :	Weather :	Operator :	Section number :	PLR SUFFIX:
31/10/2018	**Weston**	**no rain or snow**	**Draincare**	**29**	
Weather **no rain or snow**	Vehicle :	Camera :	Preset :	Cleaned : **no**	Operator : **Draincare**

Place :		Location details:		U/S MH :	**0308**
Road :	**Anglia square**	Catchment:	**Plan 3**	U/S Depth :	
Location	**Other Pedestrian area**	Tape number :		D/S MH :	**0310**
Inspection	**0310 (U/S) 0308**	Pipe Length	0.00 m	D/S Depth :	**3.51**

Use:	**Foul**	Pipe shape :	**Circular**
Year laid :		Pipe size :	**300 mm**
Purpose :	**Routine inspection of condition**	Pipe material :	**Vitrified clay**
Total length :	**3.17 m**	Lining :	

Comment :

Depth: 3.51



1:50 Position	Code	Observation	Photo	Grade
0.00	MH	Start node type, manhole, reference number: 0310		(Constr) 0
0.00	WL	Water level, 30 % of the vertical dimension		(Serv) 0
0.32	CUW	Loss of vision, camera under water		(Misc) 0
3.17	SA	Survey abandoned, to much flow & debris underwater		(Misc) 0

Structural Defects					Constructional Features				
Service Defects					**Miscellaneous Features**				
STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

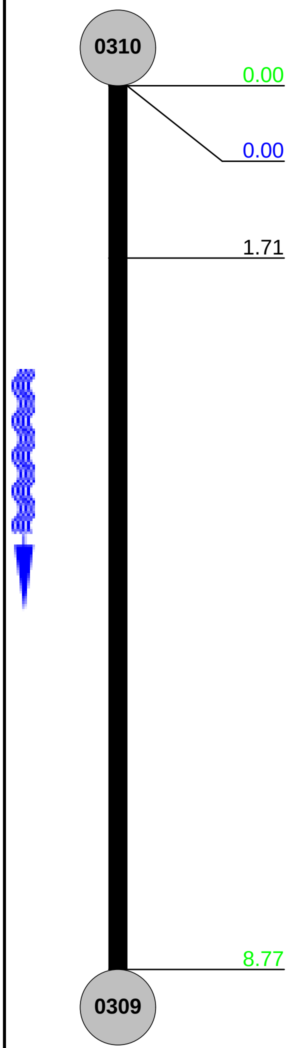
Inspection report

Date :	Job number :	Weather :	Operator :	Section number :	PLR SUFFIX:
31/10/2018	**Weston**	**no rain or snow**	**Draincare**	**30**	
Weather **no rain or snow**	Vehicle :	Camera :	Preset :	Cleaned : **no**	Operator : **Draincare**

Place :		Location details:		U/S MH :	**0310**
Road :	**Anglia square**	Catchment:	**Plan 3**	U/S Depth :	
Location	**Other Pedestrian area**	Tape number :		D/S MH :	**0309**
Inspection	**0310 (D/S) 0309**	Pipe Length	0.00 m	D/S Depth :	

Use:	**Foul**	Pipe shape :	**Circular**
Year laid :		Pipe size :	**375 mm**
Purpose :	**Routine inspection of condition**	Pipe material :	**Vitrified clay**
Total length :	**8.77 m**	Lining :	

Comment :



1:75 Position	Code	Observation	Photo	Grade
0.00	MH	Start node type, manhole, reference number: 0310		(Constr) 0
0.00	WL	Water level, 40 % of the vertical dimension		(Serv) 0
1.71	REM	General remark, suspect burst water main due to flow from joint		(Misc) 0
8.77	MHF	Finish node type, manhole reference number: 0309 (AW Main in road)		(Constr) 0

AW Main in road

Structural Defects					Constructional Features				
Service Defects					Miscellaneous Features				
STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	0	0	0	1	0	0	0	0	1

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

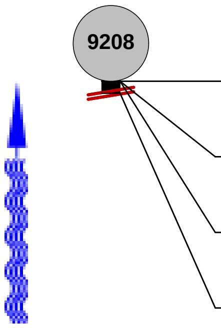
Inspection report

Date : 01/11/2018	Job number : Weston	Weather : no rain or snow	Operator : Draincare	Section number : 31	PLR SUFFIX:
Weather no rain or snow	Vehicle :	Camera :	Preset :	Cleaned : no	Operator : Draincare

Place :		Location details:		U/S MH :	**9305**
Road :	**Anglia square**	Catchment:	**Plan 5**	U/S Depth :	**2.12**
Location	**Other Pedestrian area**	Tape number :		D/S MH :	**9208**
Inspection	**9208 (U/S) 9305**	Pipe Length	0.00 m	D/S Depth :	**2.29**

Use:	**Foul**	Pipe shape :	**Circular**
Year laid :		Pipe size :	**225 mm**
Purpose :	**Routine inspection of condition**	Pipe material :	**Vitrified clay**
Total length :	**0.08 m**	Lining :	

Comment :



1:50 Depth: 2.29	Position	Code	Observation	Photo	Grade
	0.00	MH	Start node type, manhole, reference number: 9208		(Constr) 0
	0.00	WL	Water level, 80 % of the vertical dimension		(Serv) 0
	0.00	CUW	Loss of vision, camera under water		(Misc) 0
	0.08	SA	Survey abandoned, to much flow		(Misc) 0

Structural Defects					Constructional Features				
Service Defects					Miscellaneous Features				
STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	0	0	0	1	0	0	0	0	1

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection report

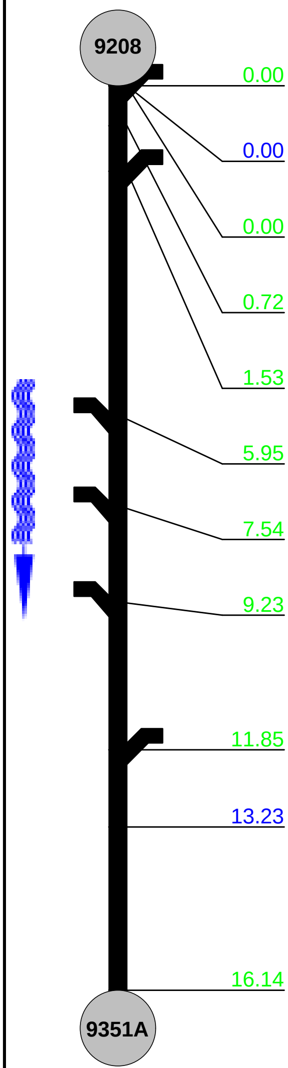
Date :	Job number :	Weather :	Operator :	Section number :	PLR SUFFIX:
01/11/2018	**Weston**	**no rain or snow**	**Draincare**	**32**	
Weather **no rain or snow**	Vehicle :	Camera :	Preset :	Cleaned : **no**	Operator : **Draincare**

Place :		Location details:		U/S MH :	**9208**
Road :	**Anglia square**	Catchment:	**Plan 5**	U/S Depth :	**2.08**
Location	**Other Pedestrian area**	Tape number :		D/S MH :	**9351A**
Inspection	**9208 (D/S) 9351A**	Pipe Length	0.00 m	D/S Depth :	**2.13**

Use:	**Surface water**	Pipe shape :	**Circular**
Year laid :		Pipe size :	**225 mm**
Purpose :	**Routine inspection of condition**	Pipe material :	**Vitrified clay**
Total length :	**16.14 m**	Lining :	

Comment :

Depth: 2.08



1:135 Position	Code	Observation	Photo	Grade
0.00	MH	Start node type, manhole, reference number: 9208		(Constr) 0
0.00	WL	Water level, 0 % of the vertical dimension		(Serv) 0
0.00	CN	Connection other than junction, at 11 o'clock, diameter: 150 mm		(Constr) 0
0.72	JN	Junction, at 12 o'clock, diameter: 100 mm		(Constr) 0
1.53	JN	Junction, at 11 o'clock, diameter: 100 mm		(Constr) 0
5.95	JN	Junction, at 1 o'clock, diameter: 100 mm		(Constr) 0
7.54	CN	Connection other than junction, at 3 o'clock, diameter: 150 mm		(Constr) 0
9.23	CN	Connection other than junction, at 2 o'clock, diameter: 100 mm		(Constr) 0
11.85	CN	Connection other than junction, at 11 o'clock, diameter: 150 mm, vast amounts of water flow		(Constr) 0
13.23	WL	Water level, 30 % of the vertical dimension		(Serv) 0
16.14	MHF	Finish node type, manhole, reference number: 9351A		(Constr) 0

Depth: 2.13

Structural Defects					Constructional Features				
Service Defects					Miscellaneous Features				
STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	0	0	0	1	0	0	0	0	1

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection report

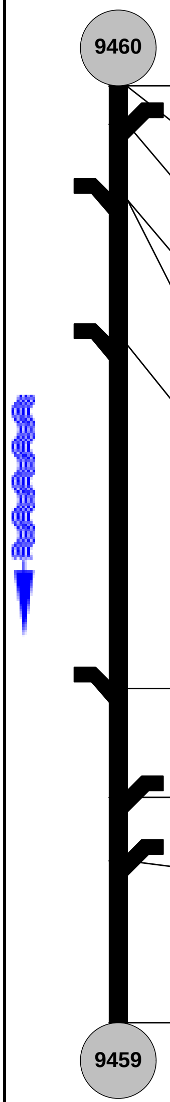
Date : **01/11/2018**	Job number : **Weston**	Weather : **no rain or snow**	Operator : **Draincare**	Section number : **33**	PLR SUFFIX:
Weather **no rain or snow**	Vehicle :	Camera :	Preset :	Cleaned : **no**	Operator : **Draincare**

Place :		Location details:		U/S MH :	**9460**
Road :	**Anglia square**	Catchment:	**Plan 1**	U/S Depth :	**3.17**
Location	**Other Pedestrian area**	Tape number :		D/S MH :	**9459**
Inspection	**9460 (D/S) 9459**	Pipe Length	0.00 m	D/S Depth :	**2.99**

Use:	**Surface water**	Pipe shape :	**Egg shaped**
Year laid :		Pipe size :	**675 mm**
Purpose :	**Routine inspection of condition**	Pipe material :	**Brick**
Total length :	**35.31 m**	Lining :	

Comment :

Depth: 3.17



1:285 Position	Code	Observation	Photo	Grade
0.01	MH	Start node type, manhole, reference number: 9460		(Constr) 0
0.02	WL	Water level, 30 % of the vertical dimension		(Serv) 0
1.45	CN	Connection other than junction, at 11 o'clock, diameter: 150 mm		(Constr) 0
4.29	CN	Connection other than junction, at 3 o'clock, diameter: 150 mm		(Constr) 0
4.29	REM	General remark, possible mh		(Misc) 0
9.78	CN	Connection other than junction, at 3 o'clock, diameter: 150 mm		(Constr) 0
22.71	CN	Connection other than junction, at 3 o'clock, diameter: 150 mm		(Constr) 0
26.81	CN	Connection other than junction, at 11 o'clock, diameter: 150 mm		(Constr) 0
29.20	CN	Connection other than junction, at 11 o'clock, diameter: 150 mm		(Constr) 0
35.31	MHF	Finish node type, manhole, reference number: 9459		(Constr) 0

Depth: 2.99

Structural Defects	Constructional Features
Service Defects	Miscellaneous Features

STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	0	0	0	1	0	0	0	0	1

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection report

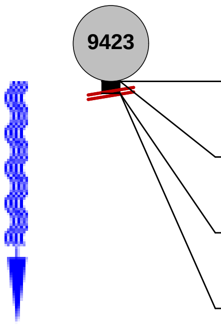
Date :	Job number :	Weather :	Operator :	Section number :	PLR SUFFIX:
01/11/2018	**Weston**	**no rain or snow**	**Draincare**	**34**	
Weather **no rain or snow**	Vehicle :	Camera :	Preset :	Cleaned : **no**	Operator : **Draincare**

Place :		Location details:		U/S MH :	**9423**
Road :	**Anglia square**	Catchment:	**Plan 1**	U/S Depth :	**2.4**
Location	**Other Pedestrian area**	Tape number :		D/S MH :	**9401**
Inspection	**9423 (D/S) 9401**	Pipe Length	0.00 m	D/S Depth :	**2.23**

Use:	**Foul**	Pipe shape :	**Circular**
Year laid :		Pipe size :	**300 mm**
Purpose :	**Routine inspection of condition**	Pipe material :	**Vitrified clay**
Total length :	**0.08 m**	Lining :	

Comment :

1:50 **Depth: 2.4**



Position	Code	Observation	Photo	Grade
0.00	MH	Start node type, manhole, reference number: 9423		(Constr) 0
0.00	WL	Water level, 50 % of the vertical dimension		(Serv) 0
0.08	OBZ	Other obstacles, other, from 3 o'clock, to 9 o'clock, 20 % cross-sectional area loss, assumed scale under flow	36_36_254_A.jpg	(Serv) 5
0.08	SA	Survey abandoned, to much flow		(Misc) 0

Structural Defects | **Constructional Features**
Service Defects | **Miscellaneous Features**

STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	**0**	**0**	**0**	**1**	**1**	**10**	**125**	**10**	**5**

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection pictures

Place :	Road :	Date :	Section number :	PLR Suffix :
	Anglia square	**01/11/2018**	**34**	

Photo: 36_36_254_A.jpg, 00:00:46
0.08m, Other obstacles, other, from 3 o'clock, to 9 o'clock, 20 % cross-sectional area loss, assumed scale under flow

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection report

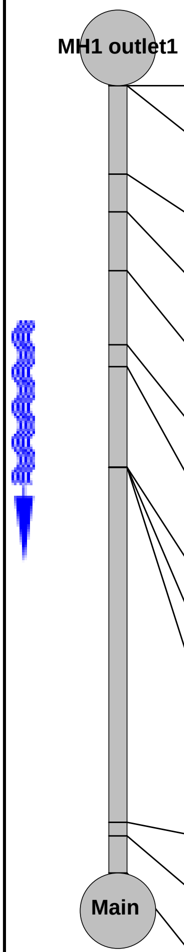
Date :	Job number :	Weather :	Operator :	Section number :	PLR SUFFIX:
01/11/2018	**Weston**	**rain**	**Draincare**	**35**	**X**
Weather **rain**	Vehicle :	Camera :	Preset :	Cleaned : **no**	Operator : **Draincare**

Place :	**Norwich**	Location details:		U/S MH :	**MH1 outlet1**
Road :	**Edward street**	Catchment:	**Site1 Plan**	U/S Depth :	**0.98**
Location	**Road**	Tape number :		D/S MH :	**Main**
Inspection	**MH1 outlet1 (D/S) Main**	Pipe Length		D/S Depth :	

Use:	**Other (state in comments)**	Pipe shape :	**Circular**
Year laid :		Pipe size :	**100 mm**
Purpose :	**Other (state in remarks)**	Pipe material :	**Vitrified clay**
Total length :	**6.25 m**	Lining :	

Comment : **Edward Street Site1 Plan. Assumed SW**

1:60 **Depth: 0.98**



Position	Code	Observation	Photo	Grade
0.00	MH	Start node type, manhole reference number: MH1 outlet1		(Constr) 0
0.00	WL	Water level 0 % of the vertical dimension		(Serv) 0
0.70	DEX	Settled deposits, other 20 % cross-sectional area loss Debris		(Serv) 3
1.00	CC	Crack, circumferential from 9 O'Clock to 3 O'Clock		(Struct) 2
1.47	LR	Line deviates right		(Serv) 0
2.06	OJL	Open joint, large		(Struct) 1
2.23	FM	Fracture, multiple from 9 O'Clock to 3 O'Clock	38_38_263_A.jpg	(Struct) 4
3.03	FL	Fracture, longitudinal from 2 O'Clock		(Struct) 3
3.03	LL	Line deviates left		(Serv) 0
3.03	LD	Line deviates down		(Serv) 0
5.85	LD	Line deviates down		(Serv) 0
5.96	LR	Line deviates right		(Serv) 0
6.25	BRF	Finish node type, major connection without manhole reference number: Main		(Constr) 0

Structural Defects | **Constructional Features**
Service Defects | **Miscellaneous Features**

STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
4	80	21.12	132	4	1	2	0.32	2	3

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection pictures

Place :	Road :	Date :	Section number :	PLR Suffix :
Norwich	**Edward street**	**01/11/2018**	**35**	**X**

Photo: 38_38_263_A.jpg, 00:00:49
2.23m, Fracture, multiple from 9 O'Clock to 3 O'Clock

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection report

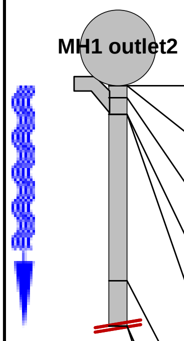
Date :	Job number :	Weather :	Operator :	Section number :	PLR SUFFIX:
30/10/2018	**Weston**	**rain**	**Draincare**	**36**	**X**
Weather **rain**	Vehicle :	Camera :	Preset :	Cleaned : **no**	Operator : **Draincare**

Place :	**Norwich**	Location details:		U/S MH :	**MH1 outlet2**
Road :	**Edward street**	Catchment:	**Site1 Plan**	U/S Depth :	**0.97**
Location	**Road**	Tape number :		D/S MH :	**Unknown**
Inspection	**MH1 outlet2 (D/S) Unknown**	Pipe Length		D/S Depth :	

Use:	**Other (state in comments)**	Pipe shape :	**Circular**
Year laid :		Pipe size :	**100 mm**
Purpose :	**Other (state in remarks)**	Pipe material :	**Vitrified clay**
Total length :	**1.59 m**	Lining :	

Comment : **Edward Street Site1 Plan. Assumed FW**

1:50 **Depth: 0.97**



Position	Code	Observation	Photo	Grade
0.00	MH	Start node type, manhole reference number: MH1 outlet2		(Constr) 0
0.00	WL	Water level 0 % of the vertical dimension		(Serv) 0
0.08	JN	Junction from 3 O'Clock diameter: 100 mm		(Constr) 0
0.19	DEX	Settled deposits, other 5 % cross-sectional area loss debris		(Serv) 2
0.19	LR	Line deviates right		(Serv) 0
1.29	FM	Fracture, multiple at 12 O'Clock	39_39_275_A.jpg	(Struct) 4
1.59	OBZ	Other obstacles, other at 12 O'Clock 70 % cross-sectional area loss debris / rubble	39_39_276_A.jpg	(Serv) 5
1.59	SA	Survey abandoned Debris / rubble		(Misc) 0

Structural Defects					Constructional Features				
Service Defects					Miscellaneous Features				
STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
1	80	50.31	80	4	2	10	6.92	11	5

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection pictures

Place :	Road :	Date :	Section number :	PLR Suffix :
Norwich	**Edward street**	**30/10/2018**	**36**	**X**

Photo: 39_39_275_A.jpg, 00:00:20
1.29m, Fracture, multiple at 12 O'Clock

Photo: 39_39_276_A.jpg, 00:00:32
1.59m, Other obstacles, other at 12 O'Clock 70 % cross-sectional area loss   debris / rubble

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection report

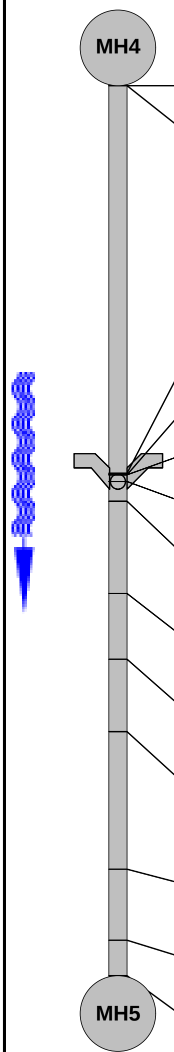
Date :	Job number :	Weather :	Operator :	Section number :	PLR SUFFIX:
30/10/2018	**Weston**	**rain**	**Draincare**	**37**	**X**
Weather **rain**	Vehicle :	Camera :	Preset :	Cleaned : **no**	Operator : **Draincare**

Place :	**Norwich**	Location details:		U/S MH :	**MH4**
Road :	**Edward street**	Catchment:	**Site1 Plan**	U/S Depth :	**1.06**
Location	**Other (state in comments)**	Tape number :		D/S MH :	**MH5**
Inspection	**MH4 (D/S) MH5**	Pipe Length		D/S Depth :	

Use:	**Other (state in comments)**	Pipe shape :	**Circular**
Year laid :		Pipe size :	**150 mm**
Purpose :	**Other (state in remarks)**	Pipe material :	**Vitrified clay**
Total length :	**22.98 m**	Lining :	

Comment : **Edward Street Site1 Plan. Unknown FW or SW.**

1:195 **Depth: 1.06**



Position	Code	Observation	Photo	Grade
0.00	MH	Start node type, manhole reference number: MH4		(Constr) 0
0.00	WL	Water level 0 % of the vertical dimension		(Serv) 0
10.00	LR	Line deviates right		(Serv) 0
10.04	JN	Junction from 3 O'Clock diameter: 150 mm		(Constr) 0
10.04	JN	Junction from 9 O'Clock diameter: 150 mm		(Constr) 0
10.21	JN	Junction from 12 O'Clock diameter: 150 mm		(Constr) 0
10.73	LR	Line deviates right		(Serv) 0
13.11	CC	Crack, circumferential from 9 O'Clock to 3 O'Clock		(Struct) 2
14.80	RF	Roots, fine		(Serv) 2
16.67	LD	Line deviates down		(Serv) 0
20.22	LD	Line deviates down		(Serv) 0
22.06	LD	Line deviates down		(Serv) 0
22.98	BRF	Finish node type, major connection without manhole reference number: MH5		(Constr) 0

Structural Defects | **Constructional Features**
Service Defects | **Miscellaneous Features**

STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
2	10	0.48	11	2	0	0	0	0	1

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection report

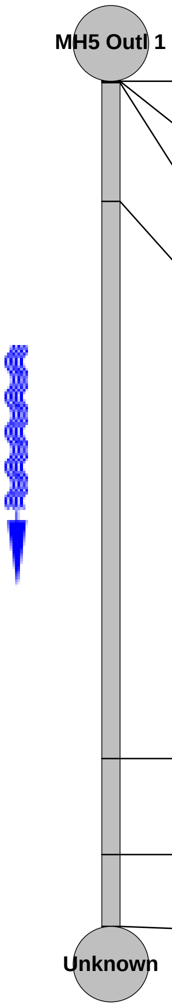
Date :	Job number :	Weather :	Operator :	Section number :	PLR SUFFIX:
01/11/2018	**Weston**	**rain**	**Draincare**	**38**	**X**
Weather **rain**	Vehicle :	Camera :	Preset :	Cleaned : **no**	Operator : **Draincare**

Place :	**Norwich**	Location details:		U/S MH :	**MH5 Outl 1**
Road :	**Edward street site1**	Catchment:	**Site1 Plan**	U/S Depth :	**1.08**
Location	**Other (state in comments)**	Tape number :		D/S MH :	**Unknown**
Inspection	**MH5 Outl 1 (D/S) Unknown**	Pipe Length		D/S Depth :	

Use:	**Other (state in comments)**	Pipe shape :	**Circular**
Year laid :		Pipe size :	**150 mm**
Purpose :	**Other (state in remarks)**	Pipe material :	**Vitrified clay**
Total length :	**11.74 m**	Lining :	

Comment : **Edward Street Site1 Plan. Assumed FW**

Depth: 1.08



1:105 Position	Code	Observation	Photo	Grade
0.00	MH	Start node type, manhole reference number: Mh5/1		(Constr) 0
0.00	WL	Water level 0 % of the vertical dimension		(Serv) 0
0.02	LR	Line deviates right		(Serv) 0
1.67	CC	Crack, circumferential from 9 O'Clock to 3 O'Clock		(Struct) 2
9.41	LD	Line deviates down		(Serv) 0
10.74	LD	Line deviates down		(Serv) 0
11.74	BRF	Finish node type, major connection without manhole reference number: Unknown		(Constr) 0

Structural Defects | **Constructional Features**

Service Defects | **Miscellaneous Features**

STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
1	10	0.85	10	2	0	0	0	0	1

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection report

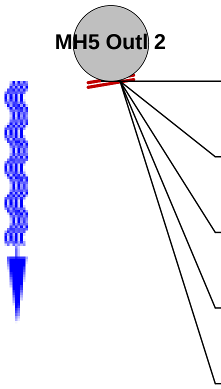
Date : **01/11/2018**	Job number : **Weston**	Weather : **rain**	Operator : **Draincare**	Section number : **39**	PLR SUFFIX: **X**
Weather **rain**	Vehicle :	Camera :	Preset :	Cleaned : **no**	Operator : **Draincare**

Place :	**Norwich**	Location details:		U/S MH :	**MH5 Outl 2**
Road :	**Edward street site1**	Catchment:	**Site1 Plan**	U/S Depth :	**1.3**
Location	**Other (state in comments)**	Tape number :		D/S MH :	**Unknown**
Inspection	**MH5 Outl 2 (D/S) Unknown**	Pipe Length		D/S Depth :	

Use:	**Other (state in comments)**	Pipe shape :	**Circular**
Year laid :		Pipe size :	**100 mm**
Purpose :	**Other (state in remarks)**	Pipe material :	**Vitrified clay**
Total length :	**0.00 m**	Lining :	

Comment : **Edward Street Site1 Plan. Assumed SW**

1:50 **Depth: 1.3**



Position	Code	Observation	Photo	Grade
0.00	MH	Start node type, manhole reference number: Mh5/2		(Constr) 0
0.00	WL	Water level 5 % of the vertical dimension		(Serv) 0
0.00	RM	Roots, mass 10 % cross-sectional area loss		(Serv) 3
0.00	DES	Settled deposits, fine 50 % cross-sectional area loss	42_42_301_A.jpg	(Serv) 4
0.00	SA	Survey abandoned IC trap full of silt/roots		(Misc) 0

Structural Defects					Constructional Features				
Service Defects					Miscellaneous Features				
STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	0	0	0	1	2	9	0	9	4

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection pictures

Place :	Road :	Date :	Section number :	PLR Suffix :
Norwich	**Edward street site1**	**01/11/2018**	**39**	**X**

Photo: 42_42_301_A.jpg, 00:00:05
0m, Settled deposits, fine 50 % cross-sectional area loss

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Inspection report

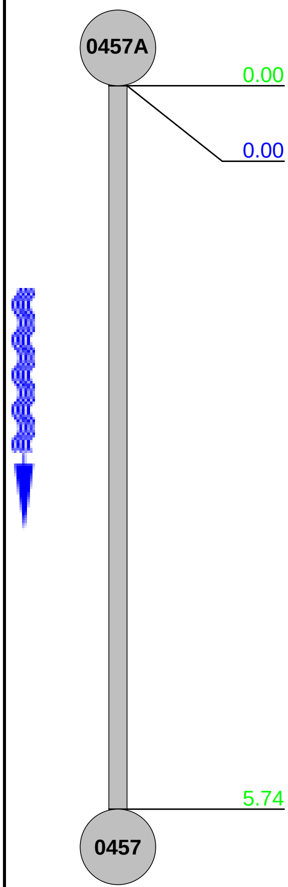
Date :	Job number :	Weather :	Operator :	Section number :	PLR SUFFIX:
31/10/2018	**Weston**	**rain**	**Draincare**	**40**	**X**
Weather **rain**	Vehicle :	Camera :	Preset :	Cleaned : **no**	Operator : **Draincare**

Place :	**Norwich**	Location details:		U/S MH :	**0457A**
Road :	**Edward street site2**	Catchment:	**Site2 Plan**	U/S Depth :	**1.2**
Location	**Other (state in comments)**	Tape number :		D/S MH :	**0457**
Inspection	**0457A (D/S) 0457**	Pipe Length		D/S Depth :	**1.47**

Use:	**Surface water**	Pipe shape :	**Circular**
Year laid :		Pipe size :	**150 mm**
Purpose :	**Other (state in remarks)**	Pipe material :	**Pitch fibre**
Total length :	**5.74 m**	Lining :	

Comment :

Depth: 1.2



1:60	Position	Code	Observation	Photo	Grade
	0.00	MH	Start node type, manhole reference number: 0457A		(Constr) 0
	0.00	WL	Water level 0 % of the vertical dimension		(Serv) 0
	5.74	MHF	Finish node type, manhole reference number: 0457		(Constr) 0

Depth: 1.47

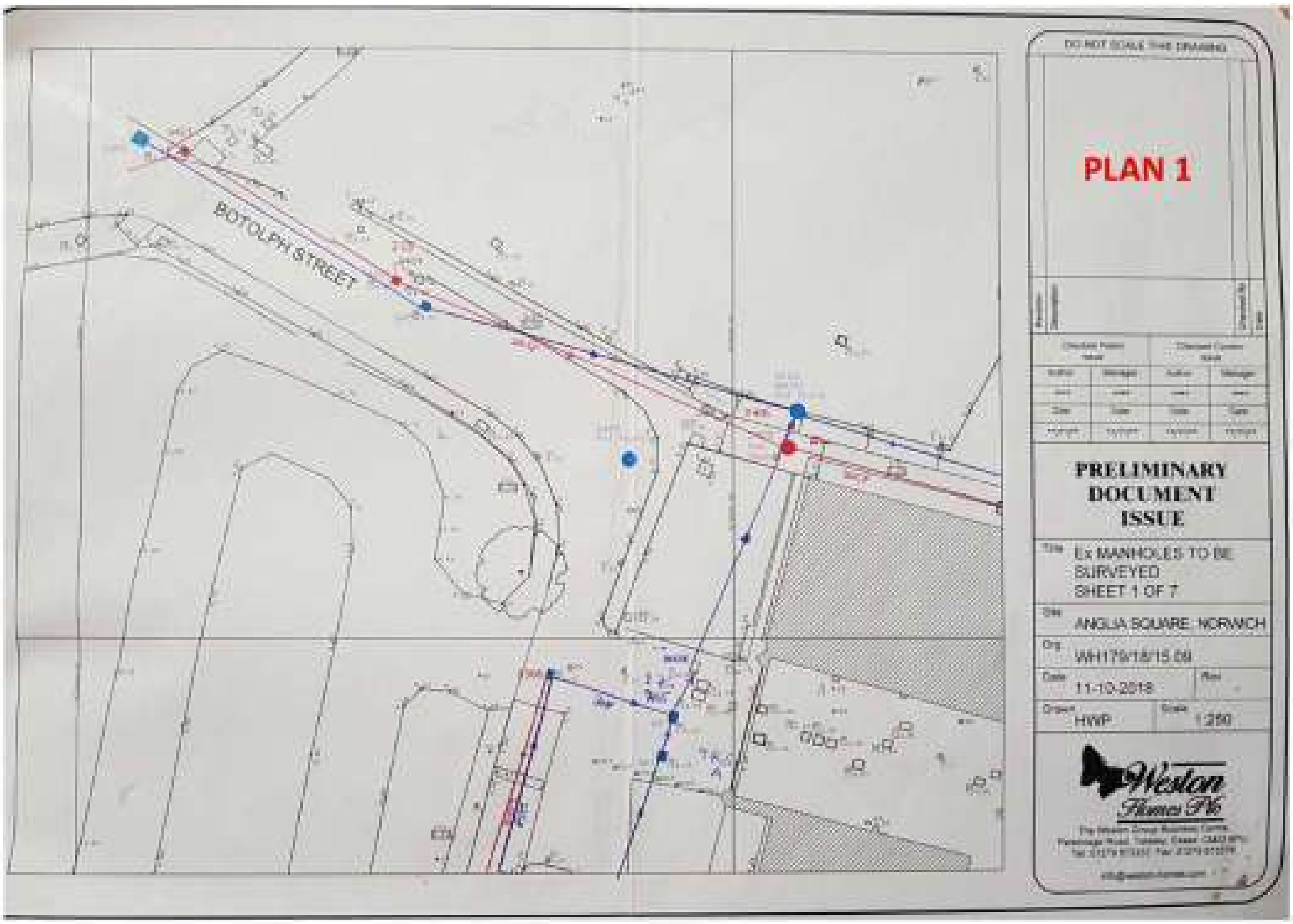
Structural Defects					Constructional Features				
Service Defects					Miscellaneous Features				
STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Date:	Job # : **Weston**	Weather : **rain**	Operator : **Draincare**	Section # : **40**	Section name :
Present :	Vehicle :	Camera :	Preset :	Cleaned : **no**	Rate :

Street 1 : **Edward street site2**	City : **Norwich**	Section type : **unknown**
Street 2 :	Map # 1 :	Map # 2 :
VCR # :	Media # :	US MH : **0457A**
DS MH : **0457**	Section length : **5.74 m**	Joint length :
Remark :		

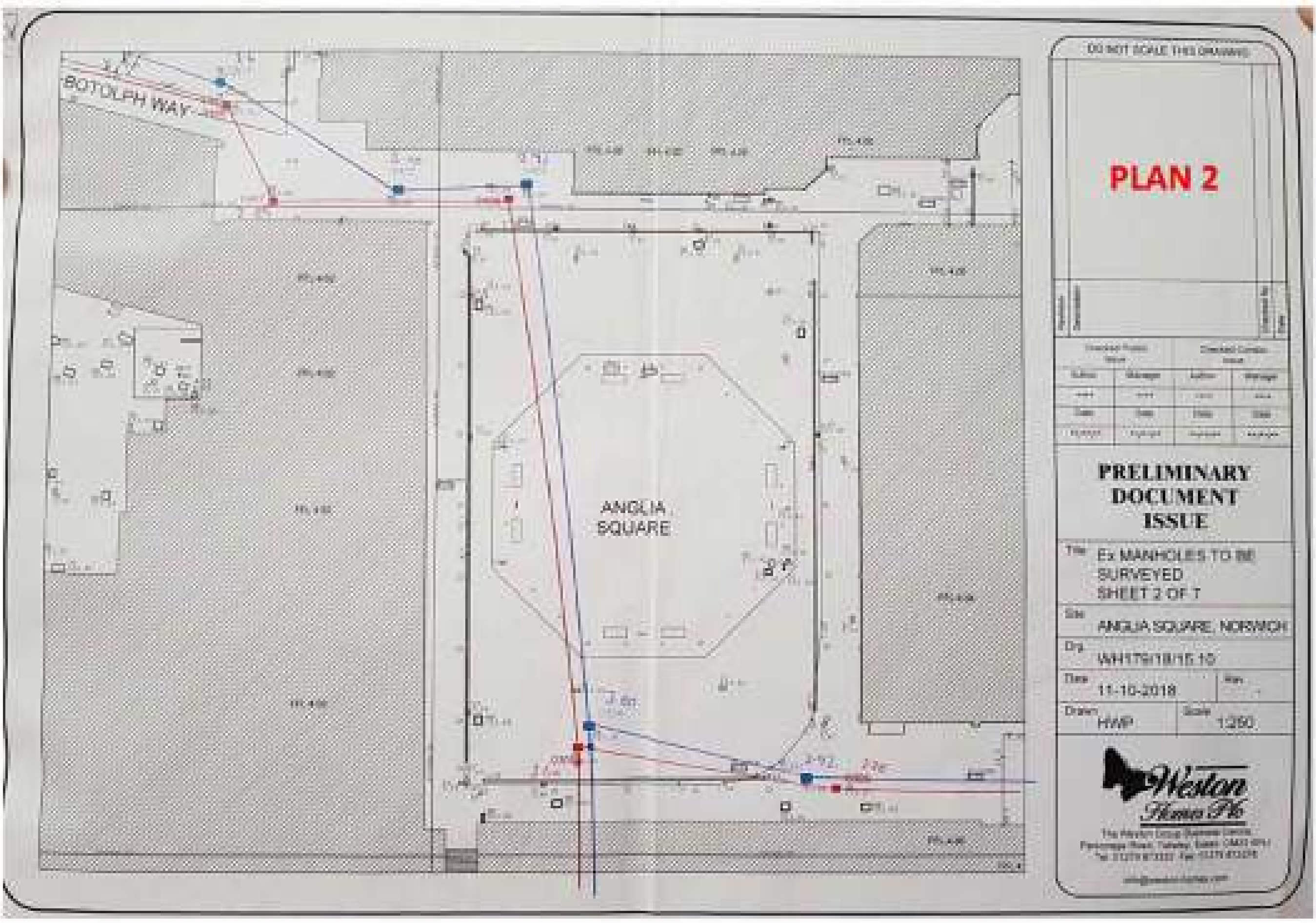


Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Date:	Job # : **Weston**	Weather : **rain**	Operator : **Draincare**	Section # : **40**	Section name :
Present :	Vehicle :	Camera :	Preset :	Cleaned : **no**	Rate :

Street 1 : **Edward street site2**	City : **Norwich**	Section type : **unknown**
Street 2 :	Map # 1 :	Map # 2 :
VCR # :	Media # :	US MH : **0457A**
DS MH : **0457**	Section length : **5.74 m**	Joint length :
Remark :		

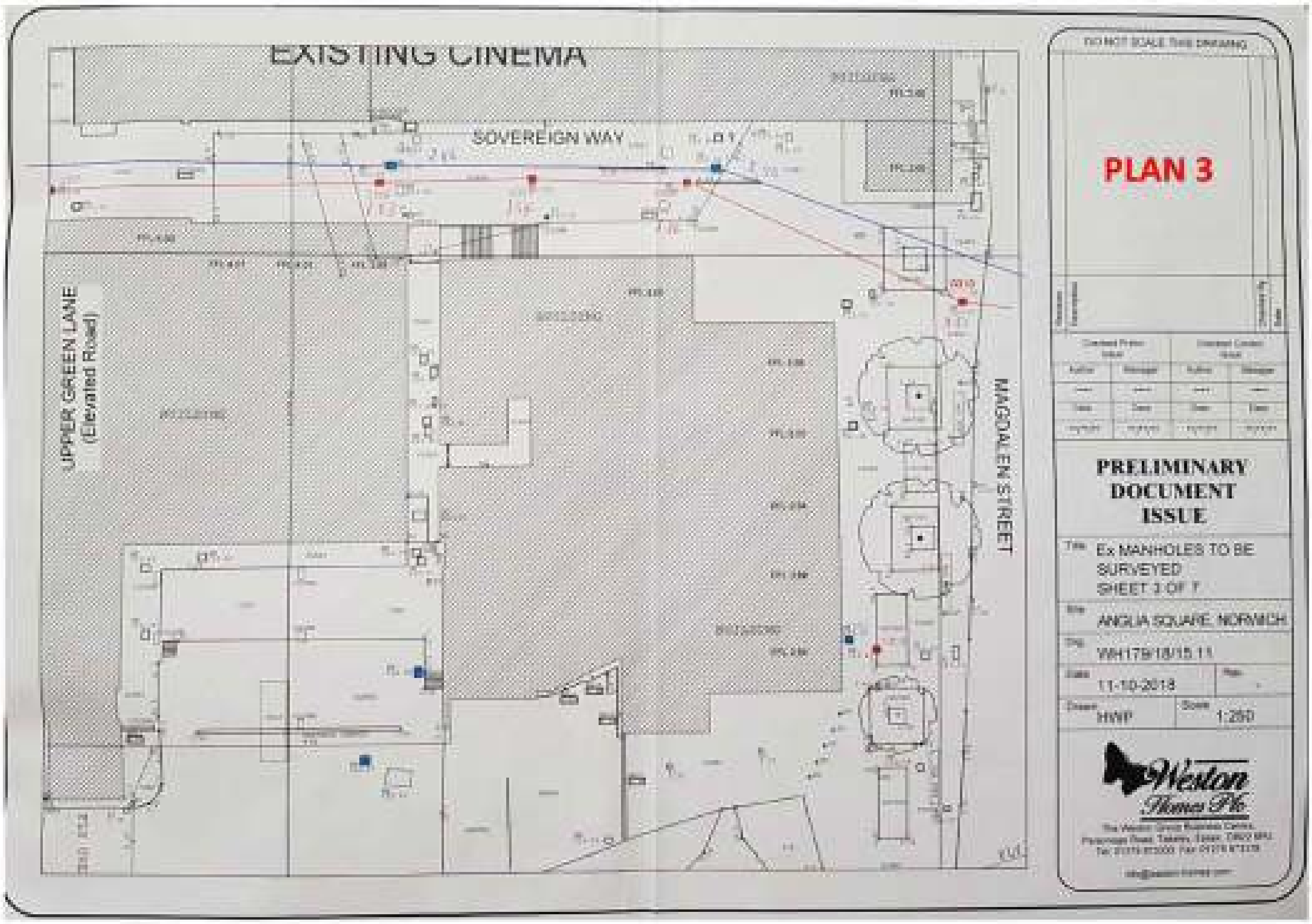


Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Date:	Job # : **Weston**	Weather : **rain**	Operator : **Draincare**	Section # : **40**	Section name :
Present :	Vehicle :	Camera :	Preset :	Cleaned : **no**	Rate :

Street 1 : **Edward street site2**	City : **Norwich**	Section type : **unknown**
Street 2 :	Map # 1 :	Map # 2 :
VCR # :	Media # :	US MH : **0457A**
DS MH : **0457**	Section length : **5.74 m**	Joint length :
Remark :		

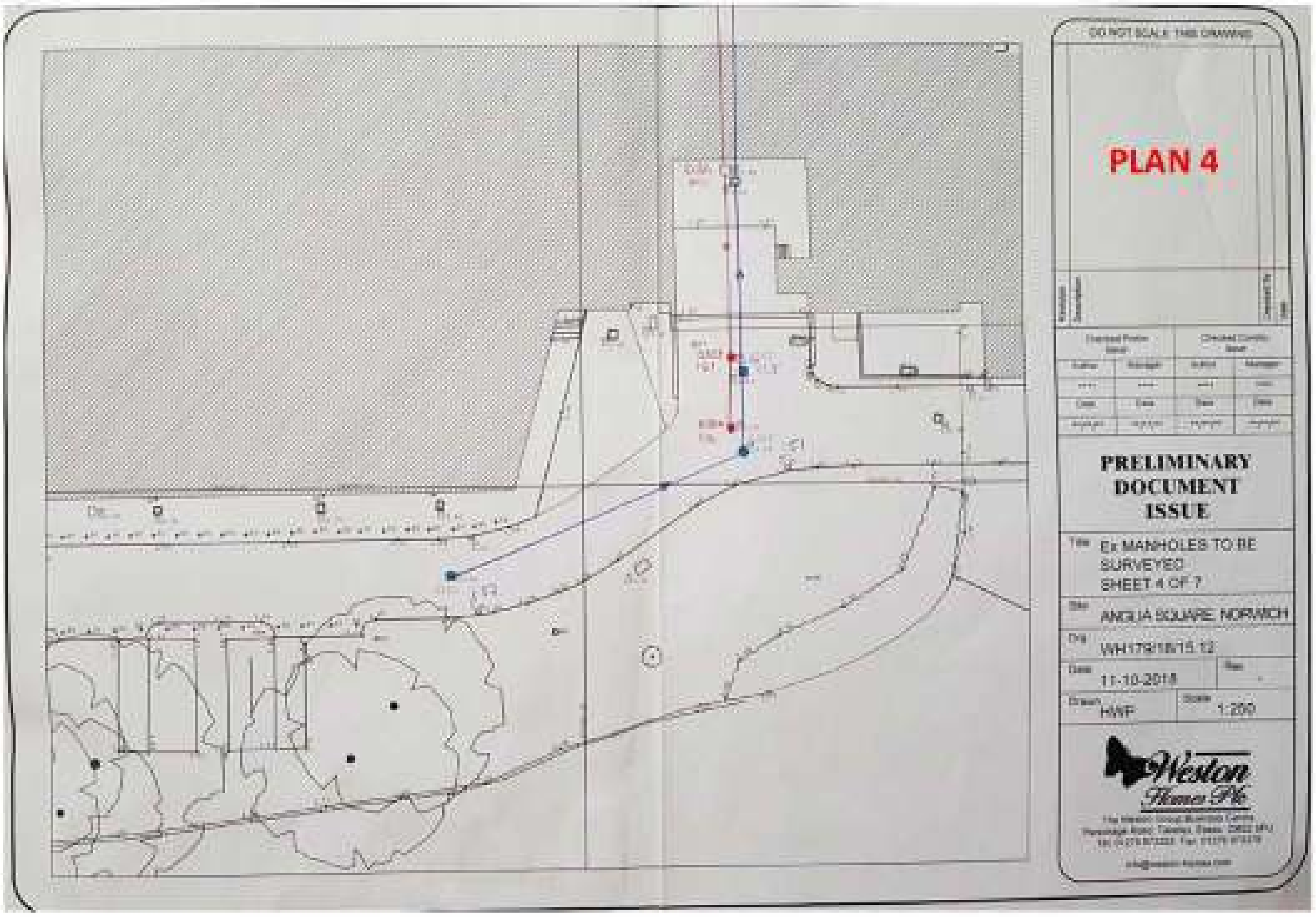


Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Date:	Job # : **Weston**	Weather : **rain**	Operator : **Draincare**	Section # : **40**	Section name :
Present :	Vehicle :	Camera :	Preset :	Cleaned : **no**	Rate :

Street 1 : **Edward street site2**	City : **Norwich**	Section type : **unknown**
Street 2 :	Map # 1 :	Map # 2 :
VCR # :	Media # :	US MH : **0457A**
DS MH : **0457**	Section length : **5.74 m**	Joint length :
Remark :		

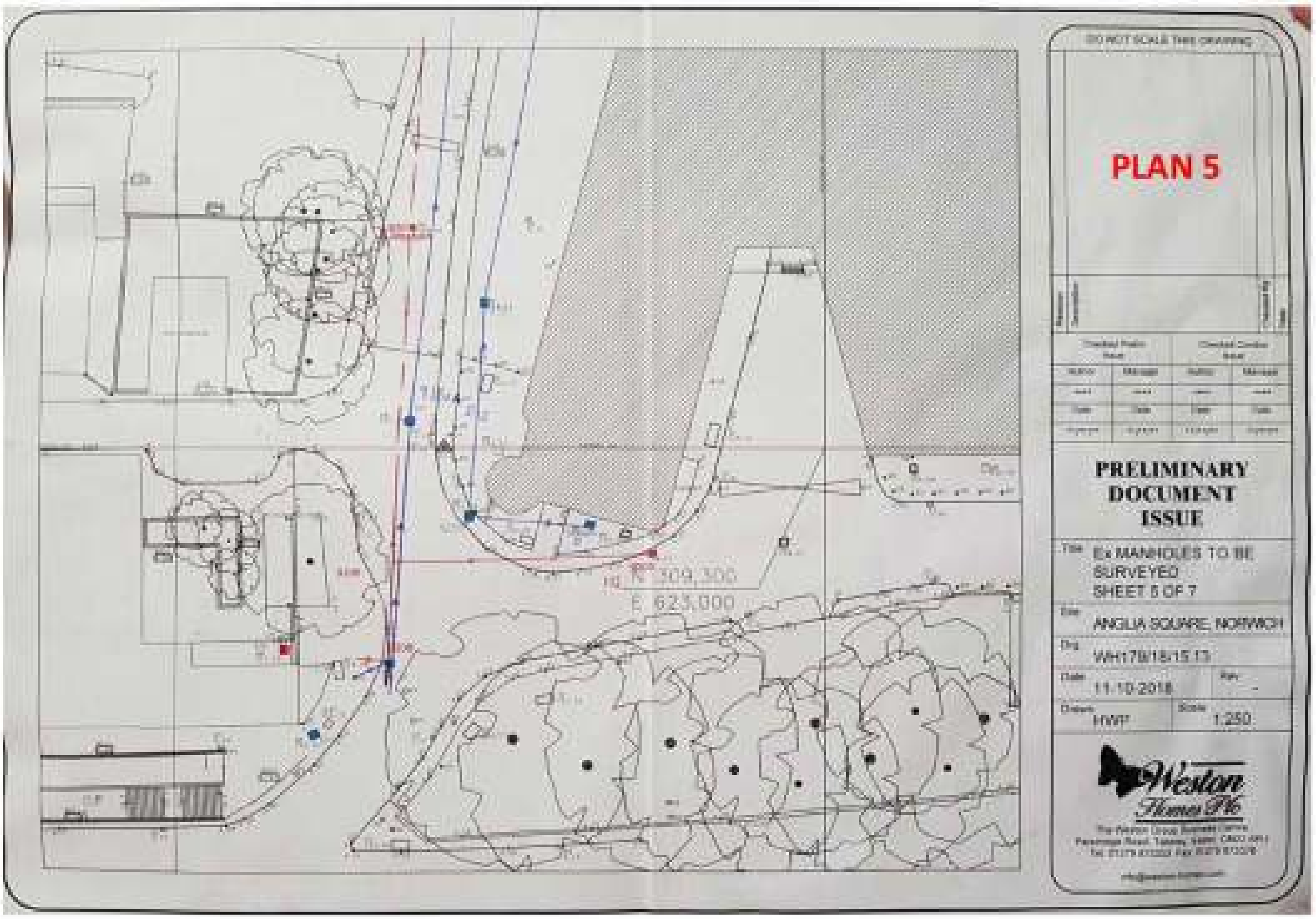


Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Date:	Job # : **Weston**	Weather : **rain**	Operator : **Draincare**	Section # : **40**	Section name :
Present :	Vehicle :	Camera :	Preset :	Cleaned : **no**	Rate :

Street 1 : **Edward street site2**	City : **Norwich**	Section type : **unknown**
Street 2 :	Map # 1 :	Map # 2 :
VCR # :	Media # :	US MH : **0457A**
DS MH : **0457**	Section length : **5.74 m**	Joint length :
Remark :		

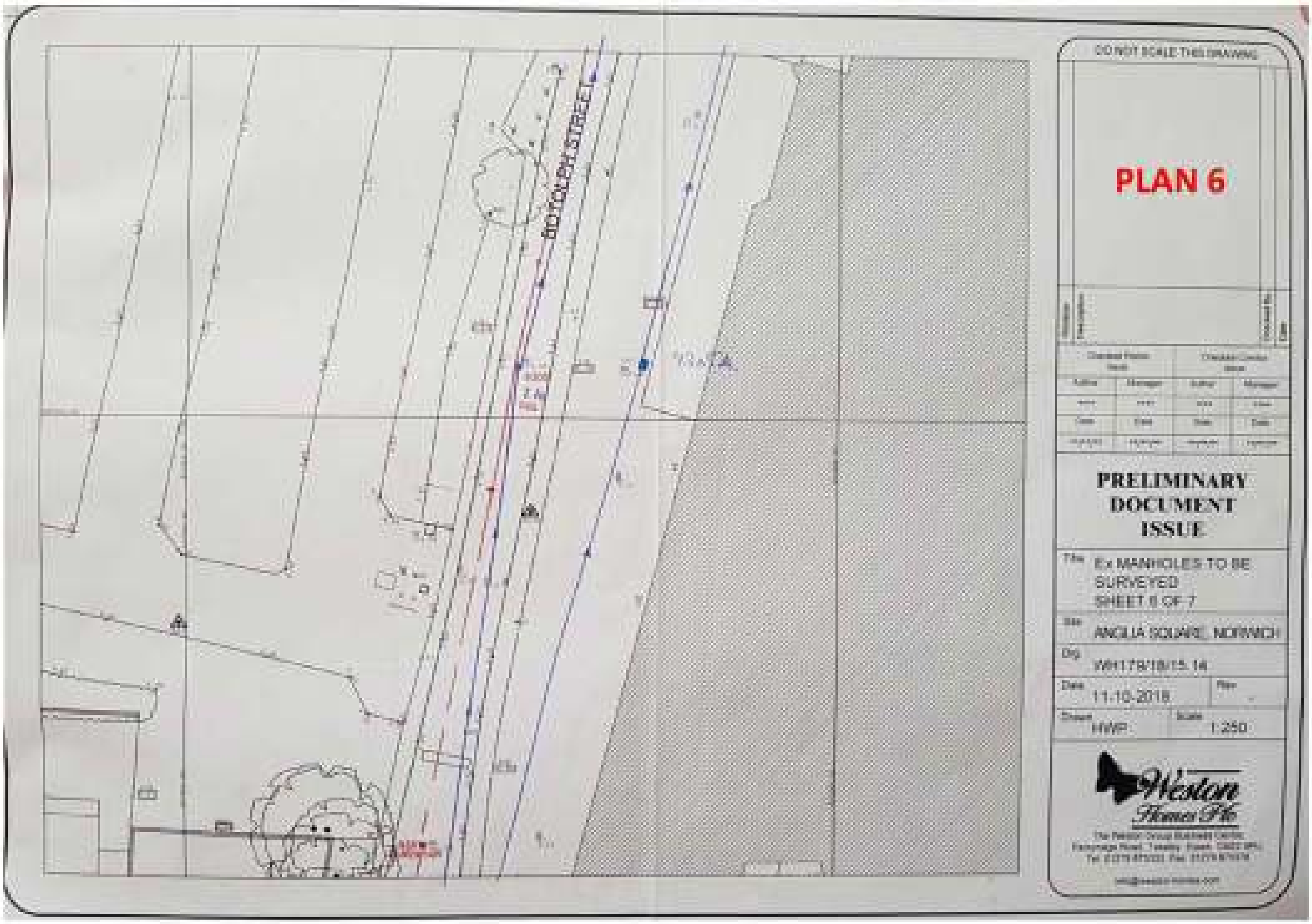


Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Date:	Job # : **Weston**	Weather : **rain**	Operator : **Draincare**	Section # : **40**	Section name :
Present :	Vehicle :	Camera :	Preset :	Cleaned : **no**	Rate :

Street 1 : **Edward street site2**	City : **Norwich**	Section type : **unknown**
Street 2 :	Map # 1 :	Map # 2 :
VCR # :	Media # :	US MH : **0457A**
DS MH : **0457**	Section length : **5.74 m**	Joint length :
Remark :		

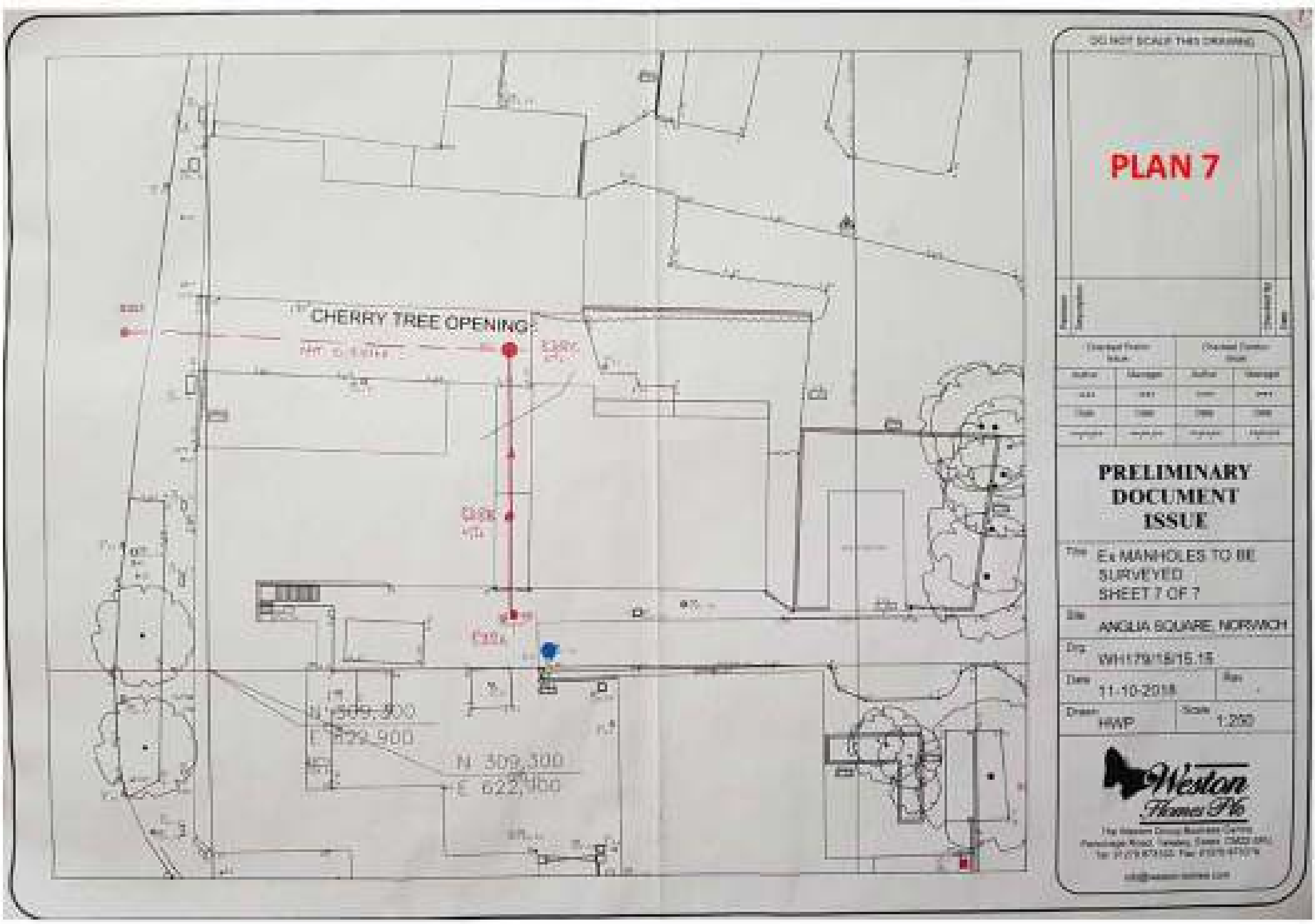


Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Date:	Job # : **Weston**	Weather : **rain**	Operator : **Draincare**	Section # : **40**	Section name :
Present :	Vehicle :	Camera :	Preset :	Cleaned : **no**	Rate :

Street 1 : **Edward street site2**	City : **Norwich**	Section type : **unknown**
Street 2 :	Map # 1 :	Map # 2 :
VCR # :	Media # :	US MH : **0457A**
DS MH : **0457**	Section length : **5.74 m**	Joint length :
Remark :		

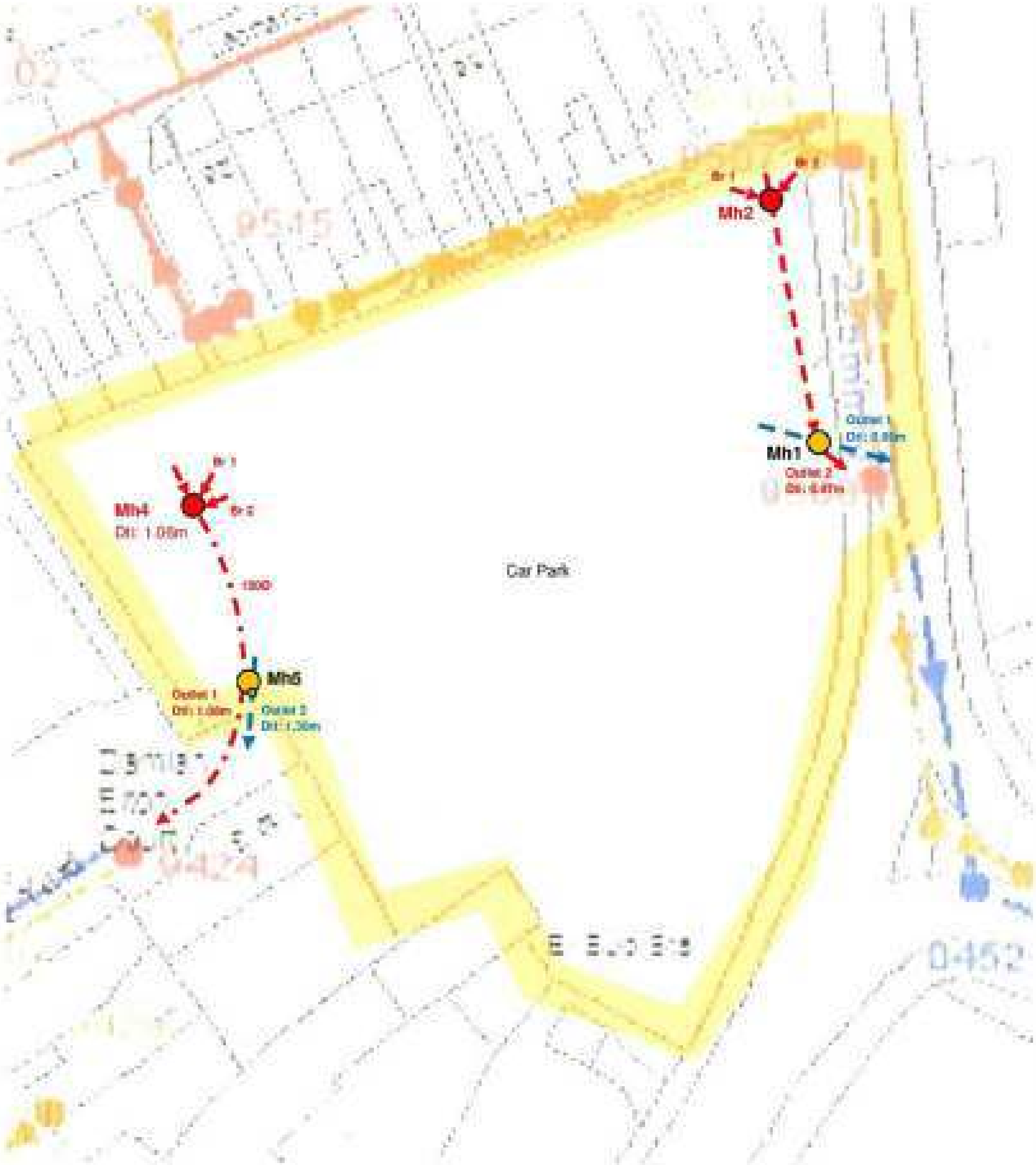


Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Date:	Job # : **Weston**	Weather : **rain**	Operator : **Draincare**	Section # : **40**	Section name :
Present :	Vehicle :	Camera :	Preset :	Cleaned : **no**	Rate :

Street 1 : **Edward street site2**	City : **Norwich**	Section type : **unknown**
Street 2 :	Map # 1 :	Map # 2 :
VCR # :	Media # :	US MH : **0457A**
DS MH : **0457**	Section length : **5.74 m**	Joint length :
Remark :		



Pipe diameters are stated in millimetres (mm). Depths and lengths are in metres (m)
All pipework surveyed on site-plan will be 100Ø unless otherwise indicated.

OUTLINE DRAINAGE PLAN – EDWARD STREET SITE 1

Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Date:	Job # : **Weston**	Weather : **rain**	Operator : **Draincare**	Section # : **40**	Section name :
Present :	Vehicle :	Camera :	Preset :	Cleaned : **no**	Rate :

Street 1 : **Edward street site2**	City : **Norwich**	Section type : **unknown**
Street 2 :	Map # 1 :	Map # 2 :
VCR # :	Media # :	US MH : **0457A**
DS MH : **0457**	Section length : **5.74 m**	Joint length :
Remark :		

Pipe diameters are stated in millimetres (mm). Depths and lengths are in metres (m)
All pipework surveyed on site-plan will be 150Ø unless otherwise indicated.

OUTLINE DRAINAGE PLAN – EDWARD STREET SITE 2

Draincare

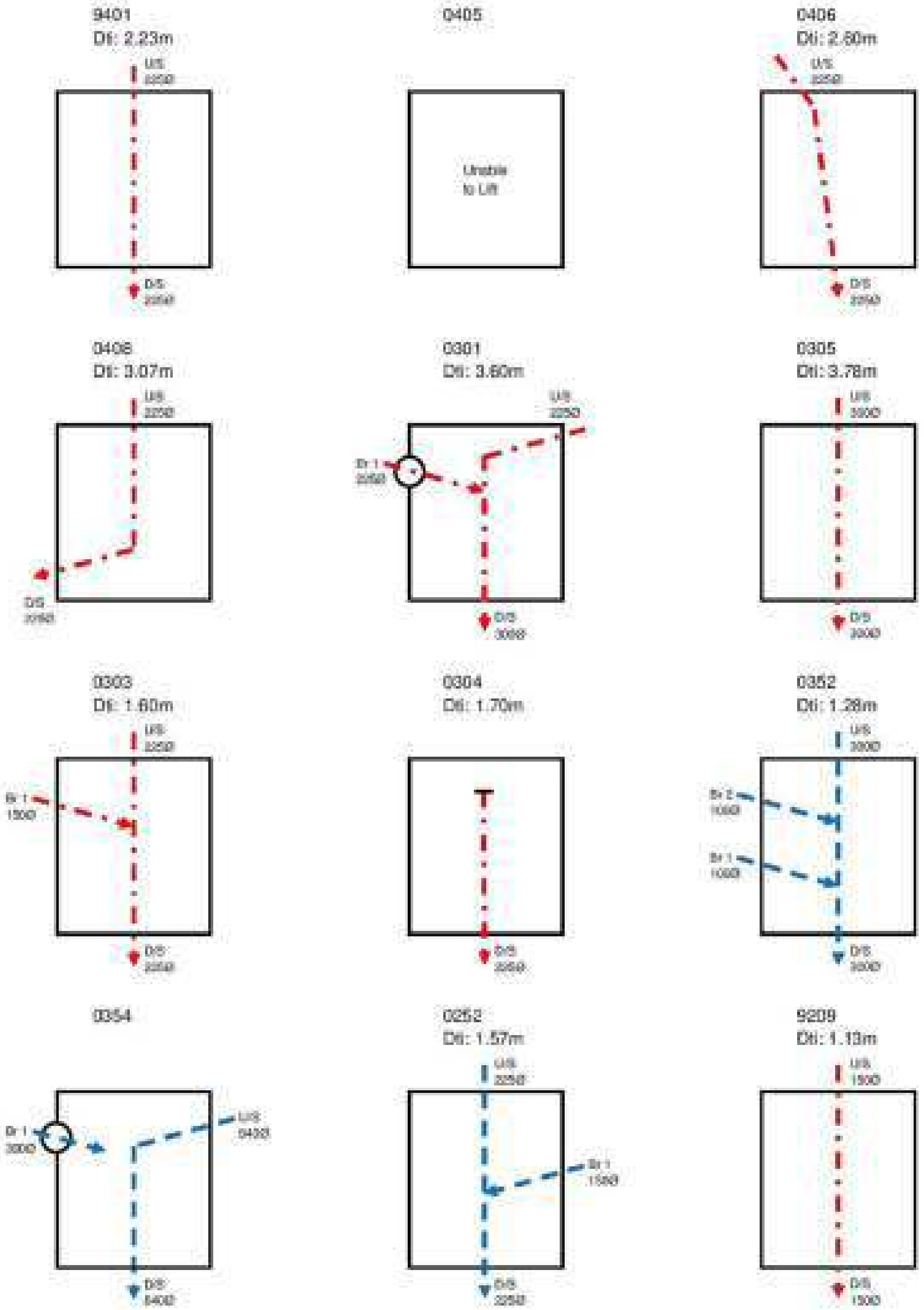
Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Date:	Job # : **Weston**	Weather : **rain**	Operator : **Draincare**	Section # : **40**	Section name :
Present :	Vehicle :	Camera :	Preset :	Cleaned : **no**	Rate :

Street 1 : **Edward street site2**	City : **Norwich**	Section type : **unknown**
Street 2 :	Map # 1 :	Map # 2 :
VCR # :	Media # :	US MH : **0457A**
DS MH : **0457**	Section length : **5.74 m**	Joint length :
Remark :		

Manhole Data:

Pipe diameters are stated in millimetres (mm). Depths and lengths are in metres (m)

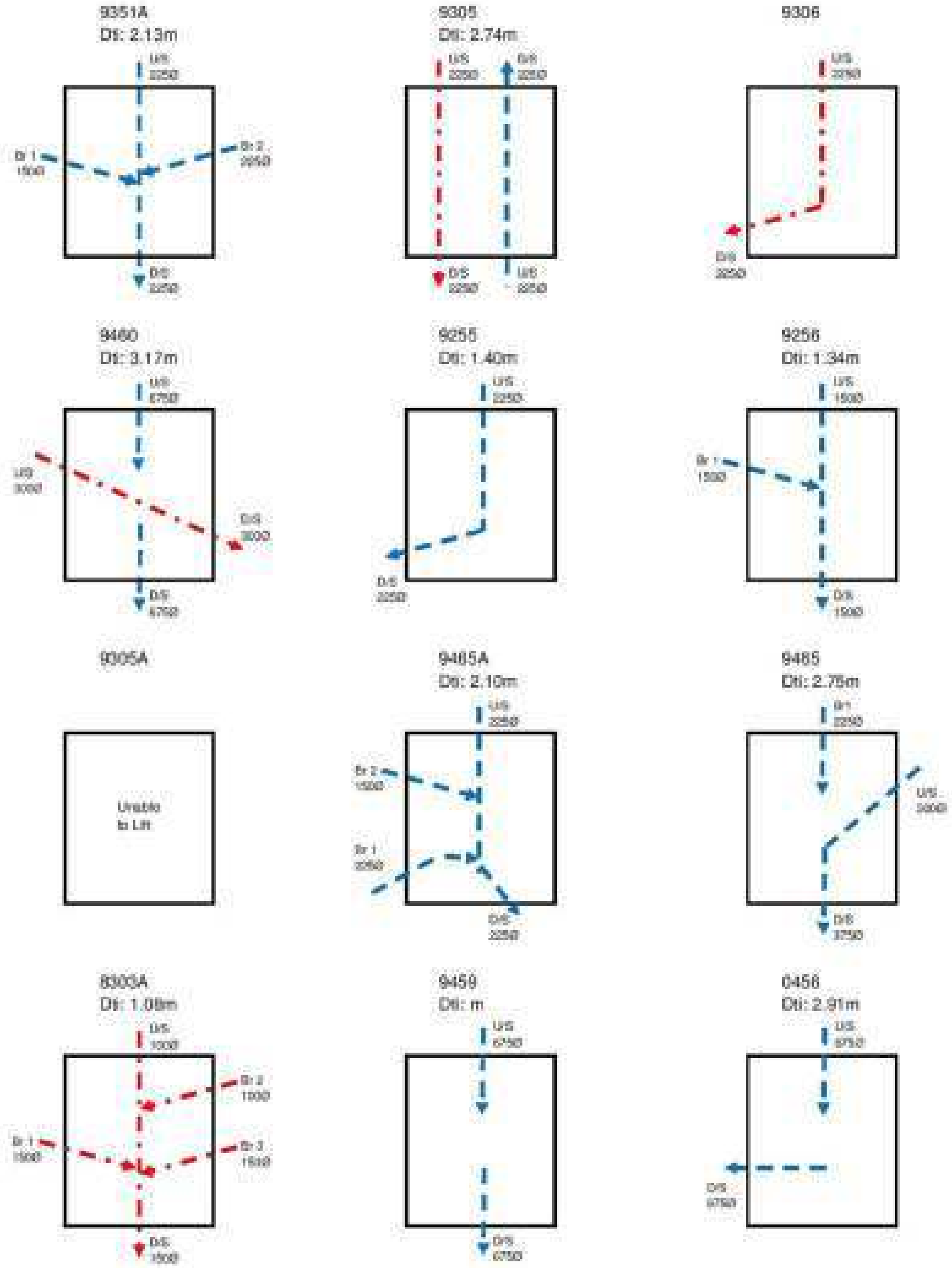


Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Date:	Job # : **Weston**	Weather : **rain**	Operator : **Draincare**	Section # : **40**	Section name :
Present :	Vehicle :	Camera :	Preset :	Cleaned : **no**	Rate :

Street 1 : **Edward street site2**	City : **Norwich**	Section type : **unknown**
Street 2 :	Map # 1 :	Map # 2 :
VCR # :	Media # :	US MH : **0457A**
DS MH : **0457**	Section length : **5.74 m**	Joint length :
Remark :		

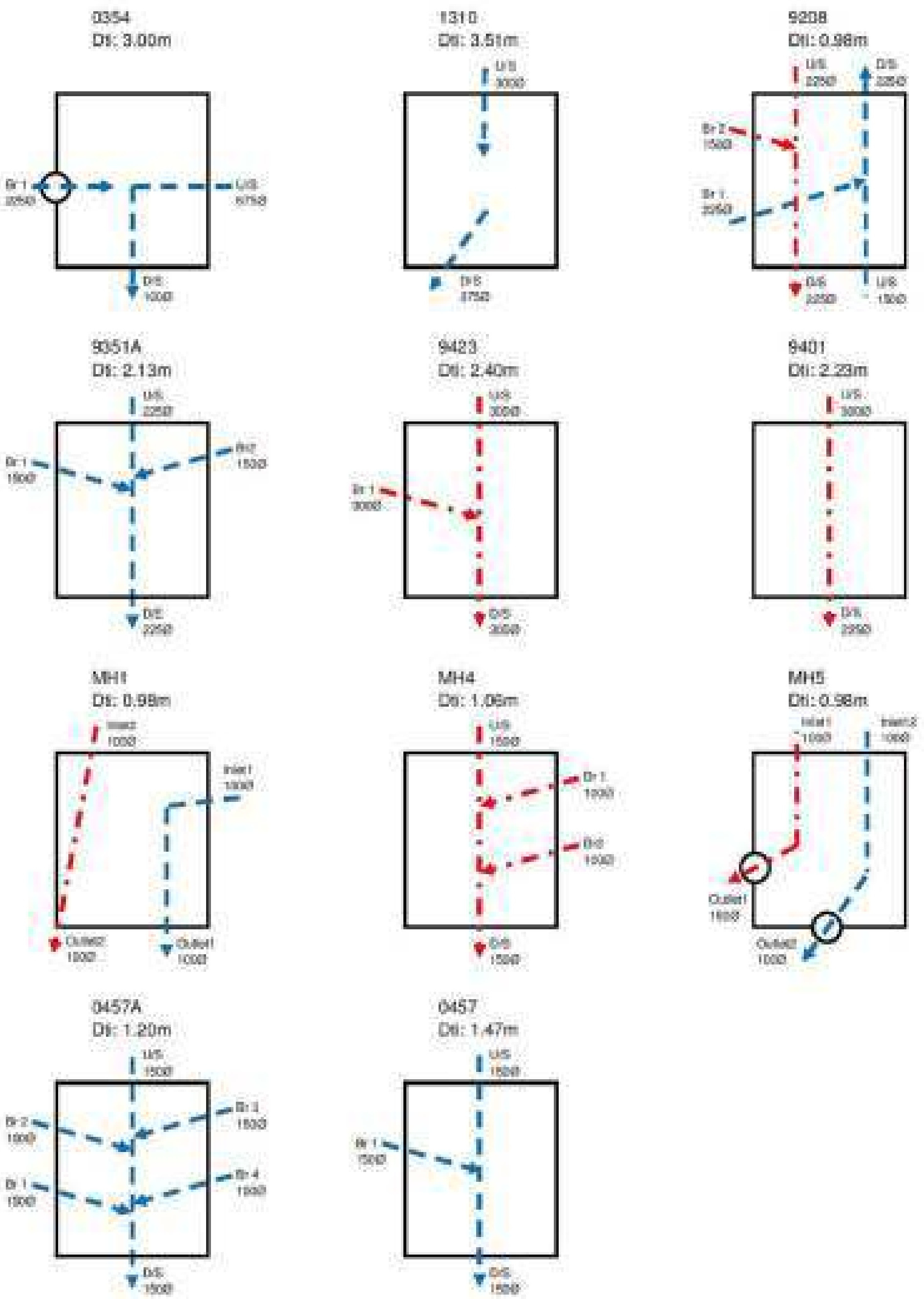


Draincare

Draincare Environmental Services Ltd
Unit 2, Batford Mill, Lower Luton Road
Street : Harpenden
Tel: 01582 467111
Fax:
Email: nigelgifkins@draincare.com

Date:	Job # : **Weston**	Weather : **rain**	Operator : **Draincare**	Section # : **40**	Section name :
Present :	Vehicle :	Camera :	Preset :	Cleaned : **no**	Rate :

Street 1 : **Edward street site2**	City : **Norwich**	Section type : **unknown**
Street 2 :	Map # 1 :	Map # 2 :
VCR # :	Media # :	US MH : **0457A**
DS MH : **0457**	Section length : **5.74 m**	Joint length :
Remark :		



Grade 1 & 2 structural and service/operational defects should not be detrimental to the effectiveness of the drainage.

Grade 3, 4 & 5 structural and service/operational defects may be detrimental to the effectiveness of the drainage, and may require remedial treatment.
Pipework grading is based on the Sewerage Rehabilitating Manual (SRM) grading from the Water Research Centre (WRC).

The pipe materials as described should be recognized as the survey engineer's best judgment only.

The information provided in this report is given without obligation and the accuracy cannot be guaranteed without verification. No liability of any kind whatsoever is accepted by Draincare Ltd, their agents, or servants for any error or omission. The actual position of pipelines/services faults must be verified and established on the site before any mechanical plant is used or excavations/repairs attempted.

The survey is recorded on DVD or Hard Drive, which is enclosed with the report.
Please note that DVD or Hard Drive references and survey run titles are correct in the written report. Survey run titles on DVD or Hard Drive should be referred to the written report.

If the pipework material within your survey is noted as **Pitch Fibre or Asbestos Cement** please note that any works which may disturb the pipe structure must be undertaken in accordance with the Approved Code of Practice "Managing and Working With Asbestos – Control of Asbestos Regulations 2012"

Any quotation provided in this report for remedial measures affecting **Pitch Fibre Pipes** may exclude any additional costs associated with the presence of Asbestos and specialist support services.

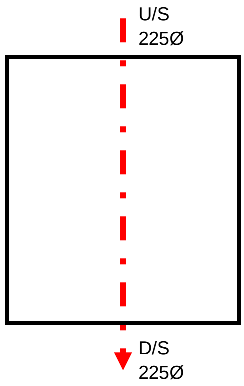
The Water Industry (Schemes for Adoption of Private Sewers) Regulations 2011 became effective from 1st October 2011. As a result your responsibility for drainage may cease at your property boundary or you may only be responsible for the pipework before it connects to a communal drain serving your property.

We recommend that the responsibility is determined before work to the drainage system is undertaken.

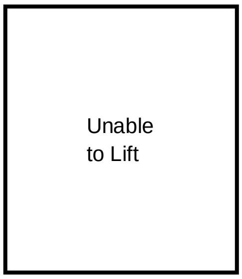
Manhole Data:

Pipe diameters are stated in millimetres (mm). Depths and lengths are in metres (m)

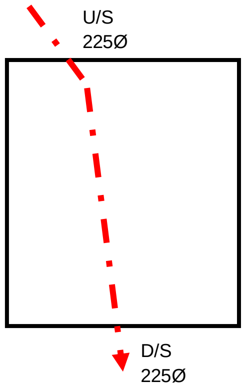
9401
Dti: 2.23m



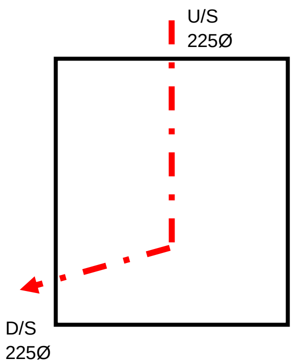
0405



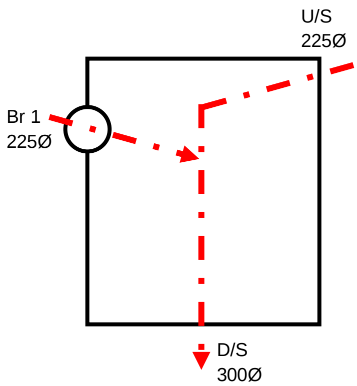
0406
Dti: 2.60m



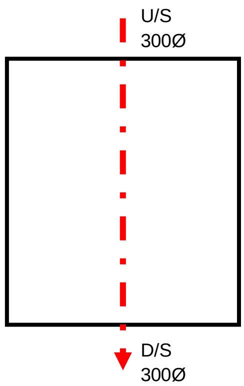
0408
Dti: 3.07m



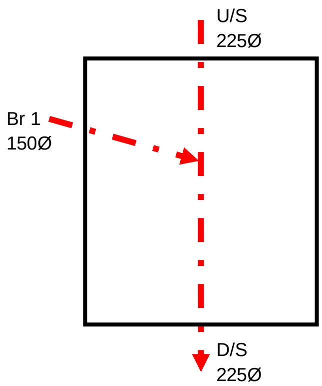
0301
Dti: 3.60m



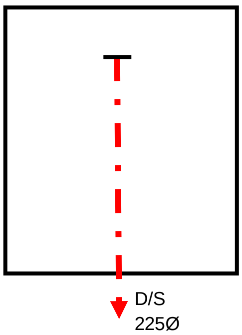
0305
Dti: 3.78m



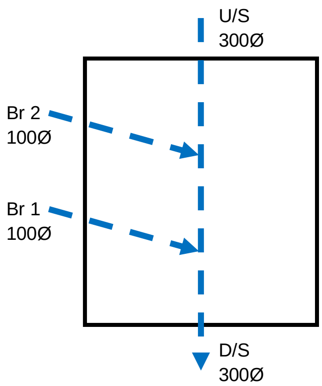
0303
Dti: 1.60m



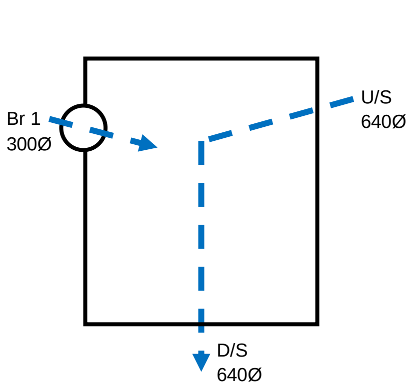
0304
Dti: 1.70m



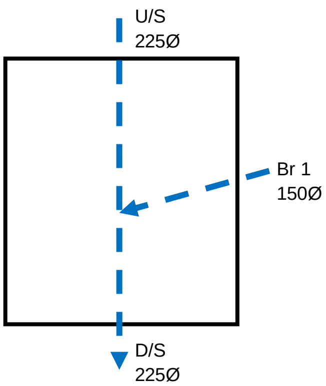
0352
Dti: 1.28m



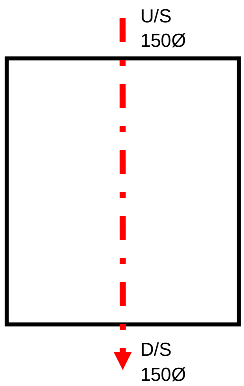
0354



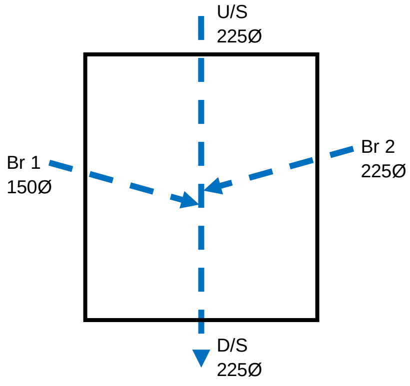
0252
Dti: 1.57m



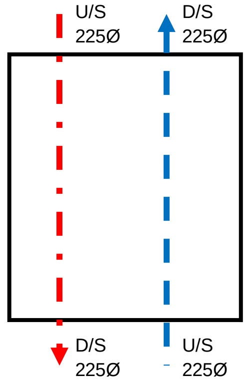
9209
Dti: 1.13m



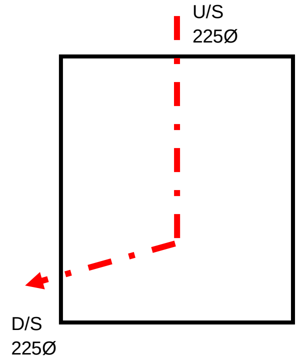
9351A
Dti: 2.13m



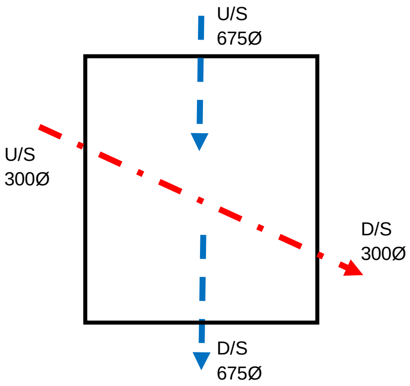
9305
Dti: 2.74m



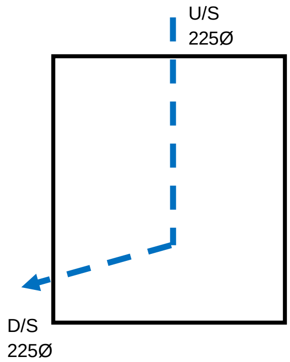
9306



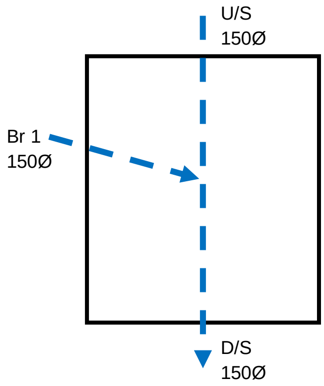
9460
Dti: 3.17m



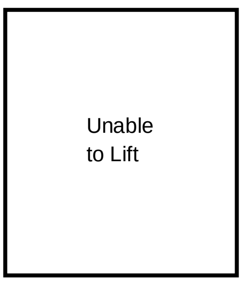
9255
Dti: 1.40m



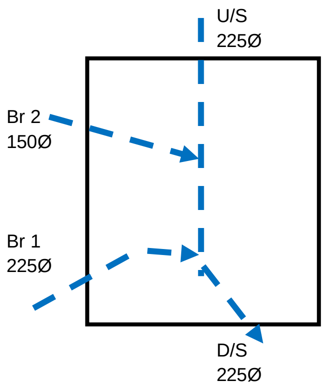
9256
Dti: 1.34m



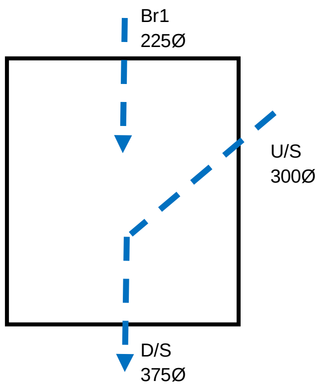
9305A



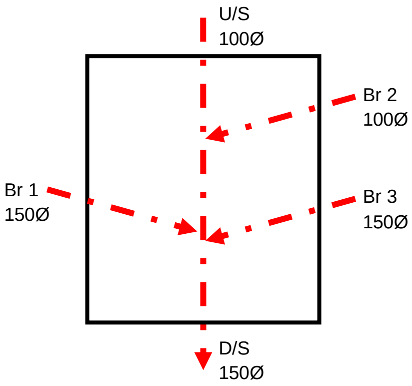
9465A
Dti: 2.10m



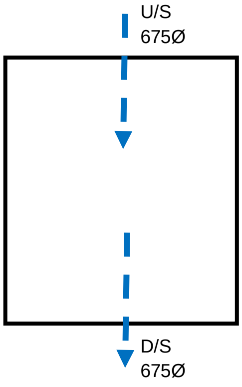
9465
Dti: 2.75m



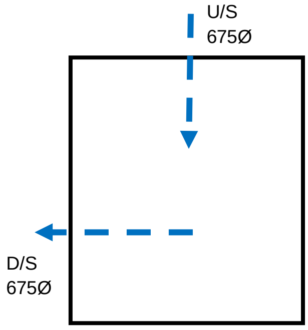
8303A
Dti: 1.08m



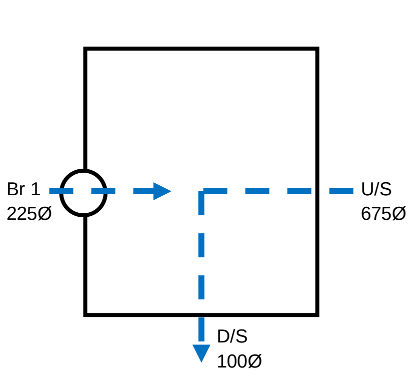
9459
Dti: m



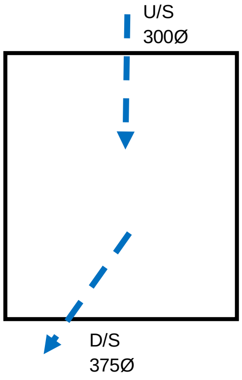
0456
Dti: 2.91m



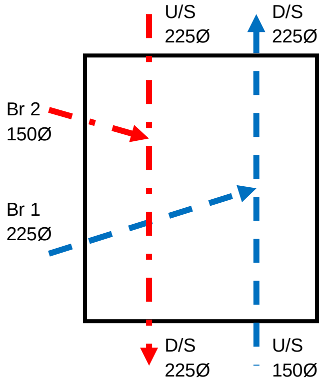
0354
Dti: 3.00m



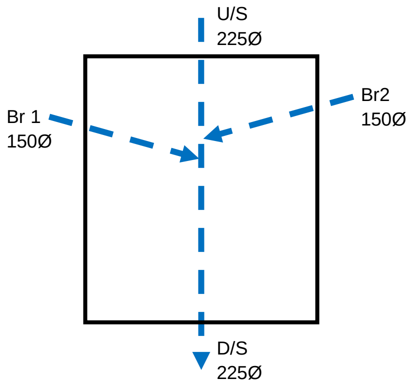
1310
Dti: 3.51m



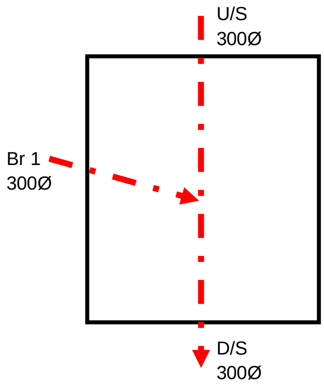
9208
Dti: 0.98m



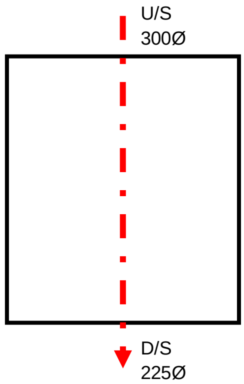
9351A
Dti: 2.13m



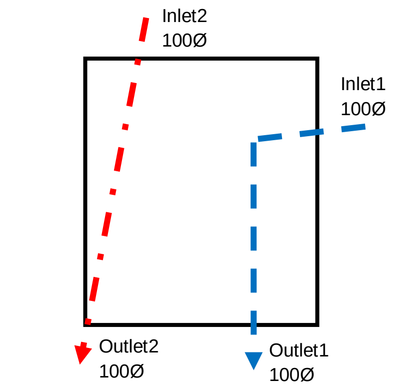
9423
Dti: 2.40m



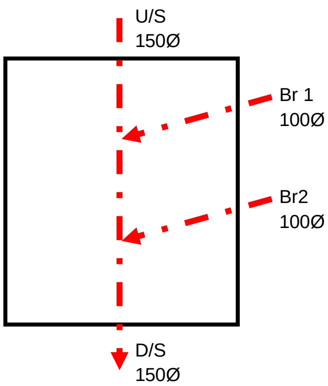
9401
Dti: 2.23m



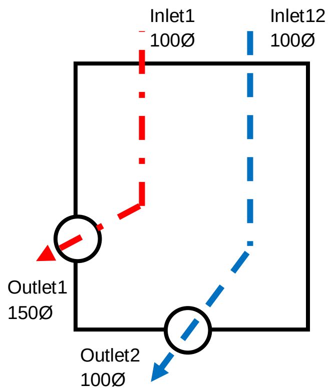
MH1
Dti: 0.98m



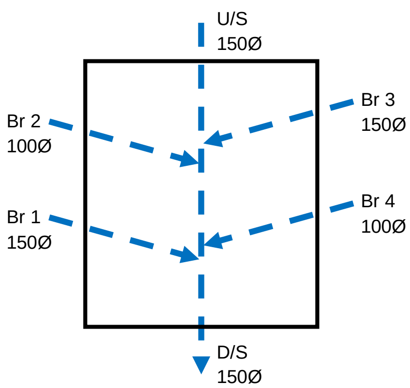
MH4
Dti: 1.06m



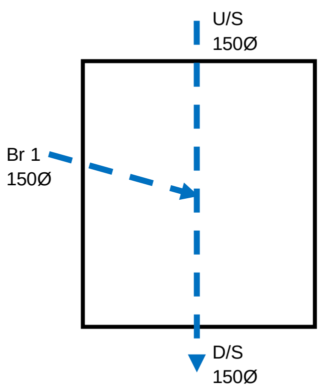
MH5
Dti: 0.98m

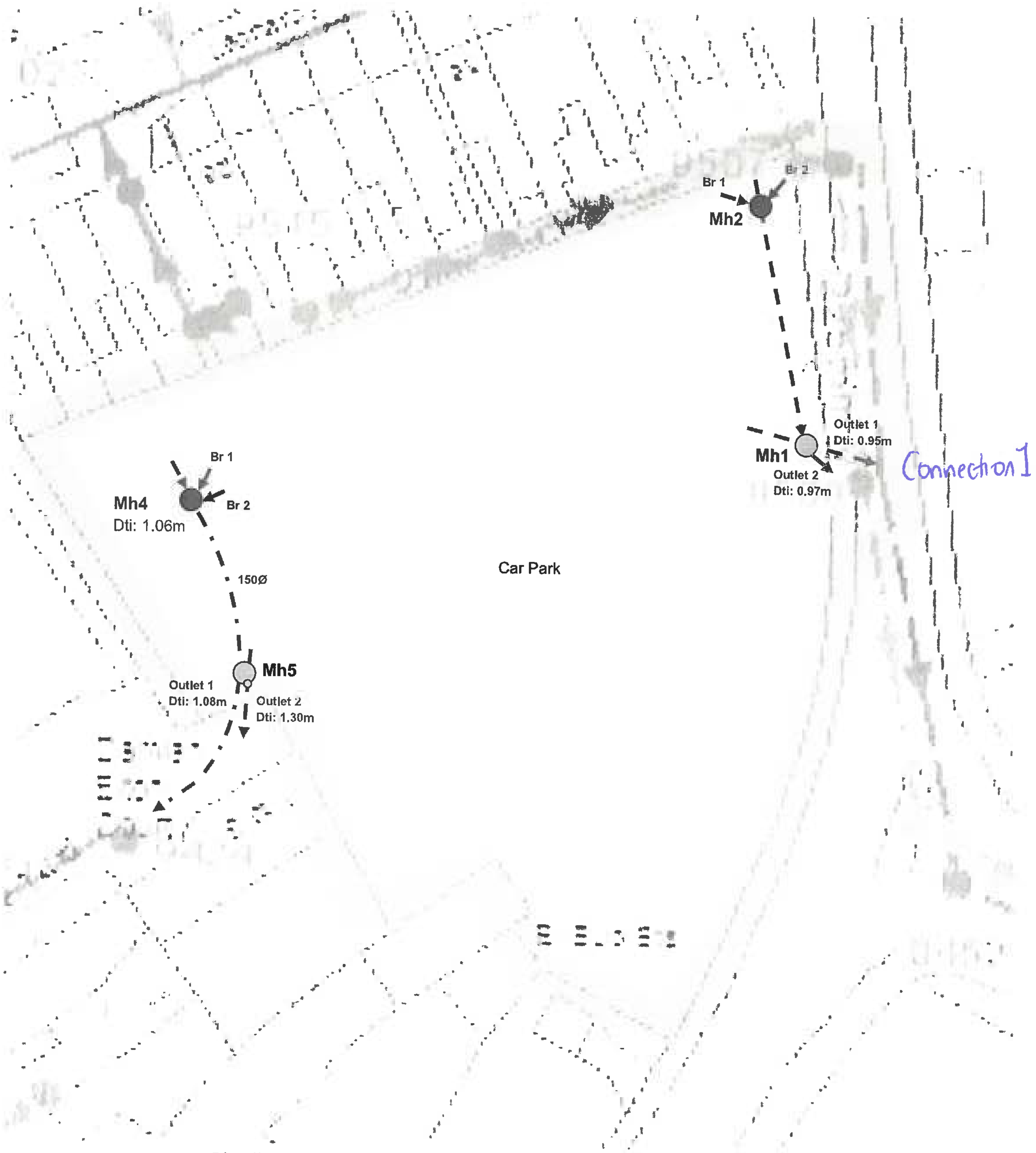


0457A
Dti: 1.20m



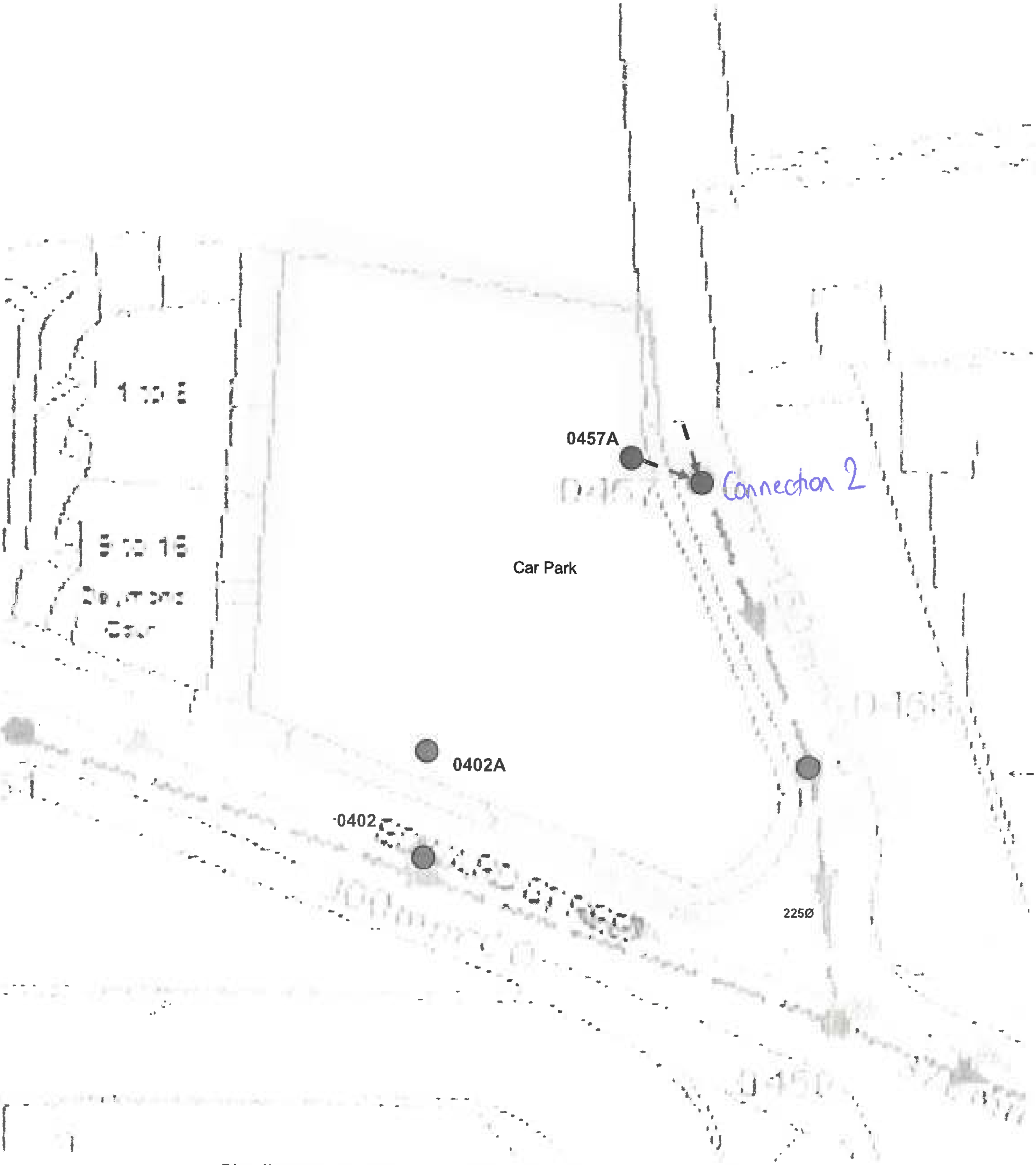
0457
Dti: 1.47m





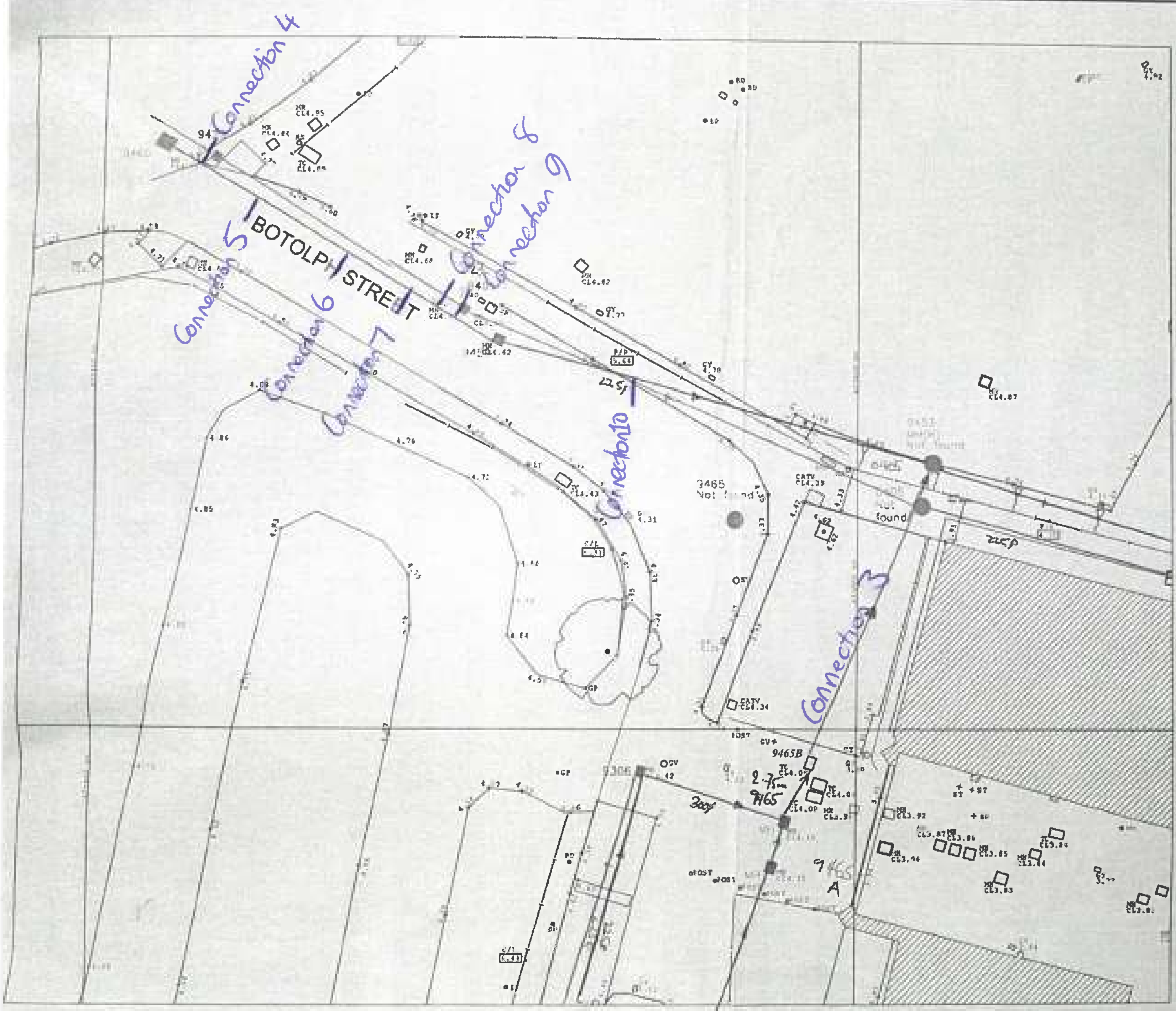
Pipe diameters are stated in millimetres (mm). Depths and lengths are in metres (m)
All pipework surveyed on site-plan will be 100Ø unless otherwise indicated.

OUTLINE DRAINAGE PLAN – EDWARD STREET SITE 1



Pipe diameters are stated in millimetres (mm). Depths and lengths are in metres (m)
All pipework surveyed on site-plan will be 150Ø unless otherwise indicated.

OUTLINE DRAINAGE PLAN – EDWARD STREET SITE 2



DO NOT SCALE THIS DRAWING

PLAN 1

Revision	Description	Checked By	Date

Checked Prelim issue		Checked Condoc issue	
Author	Manager	Author	Manager
****	****	****	****
Date	Date	Date	Date
//**	**/**/**	**/**/**	**/**/**

PRELIMINARY DOCUMENT ISSUE

Title: Ex MANHOLES TO BE SURVEYED SHEET 1 OF 7

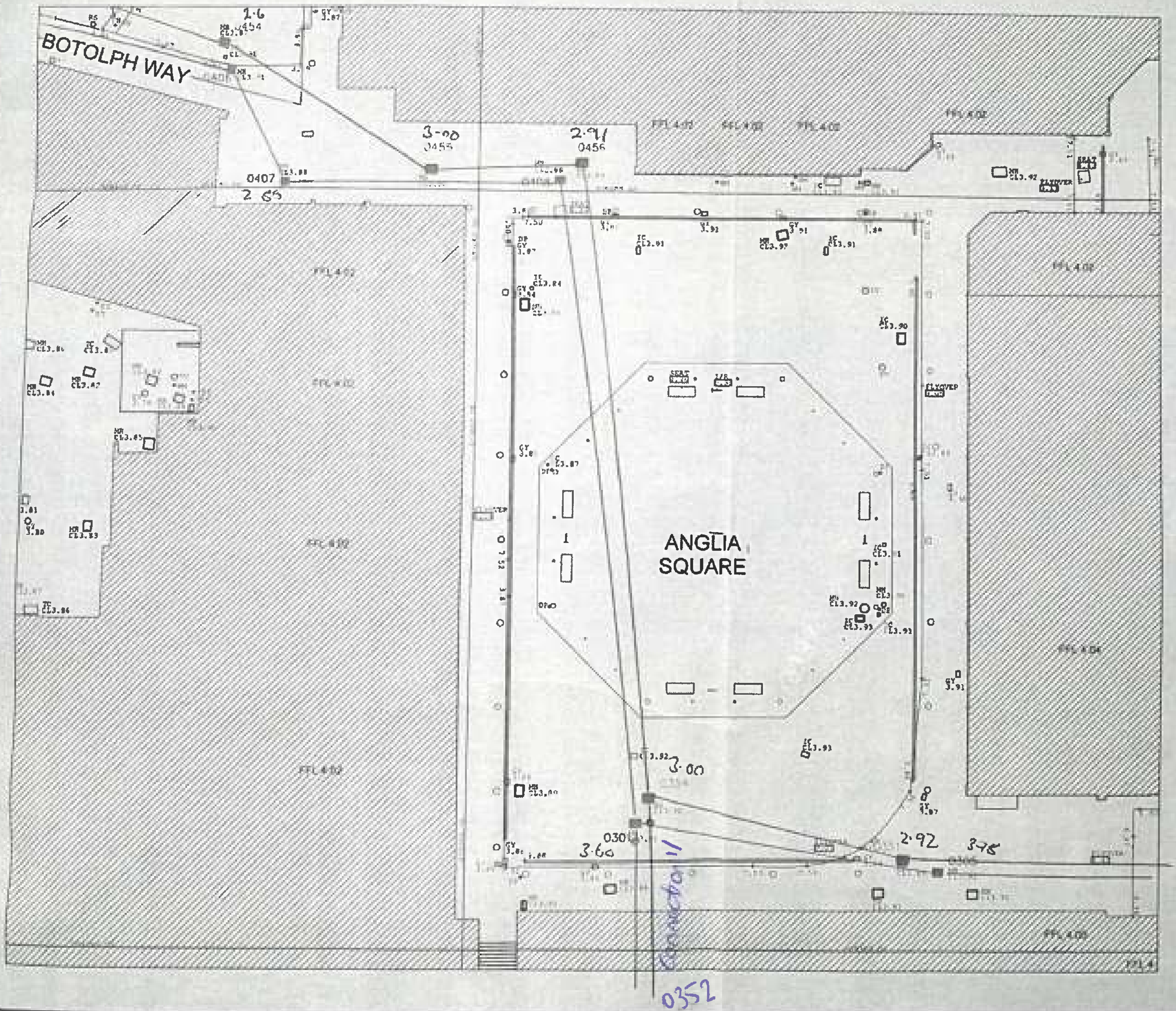
Site: ANGLIA SQUARE, NORWICH

Drg.: WH179/18/15.09

Date: 11-10-2018 | Rev: -

Drawn: HWP | Scale: 1:250

Weston Homes Plc
The Weston Group Business Centre, Parsonage Road, Takeley, Essex. CM22 6PU.
Tel: 01279 873333 Fax: 01279 873378
info@weston-homes.com



DO NOT SCALE THIS DRAWING

PLAN 2

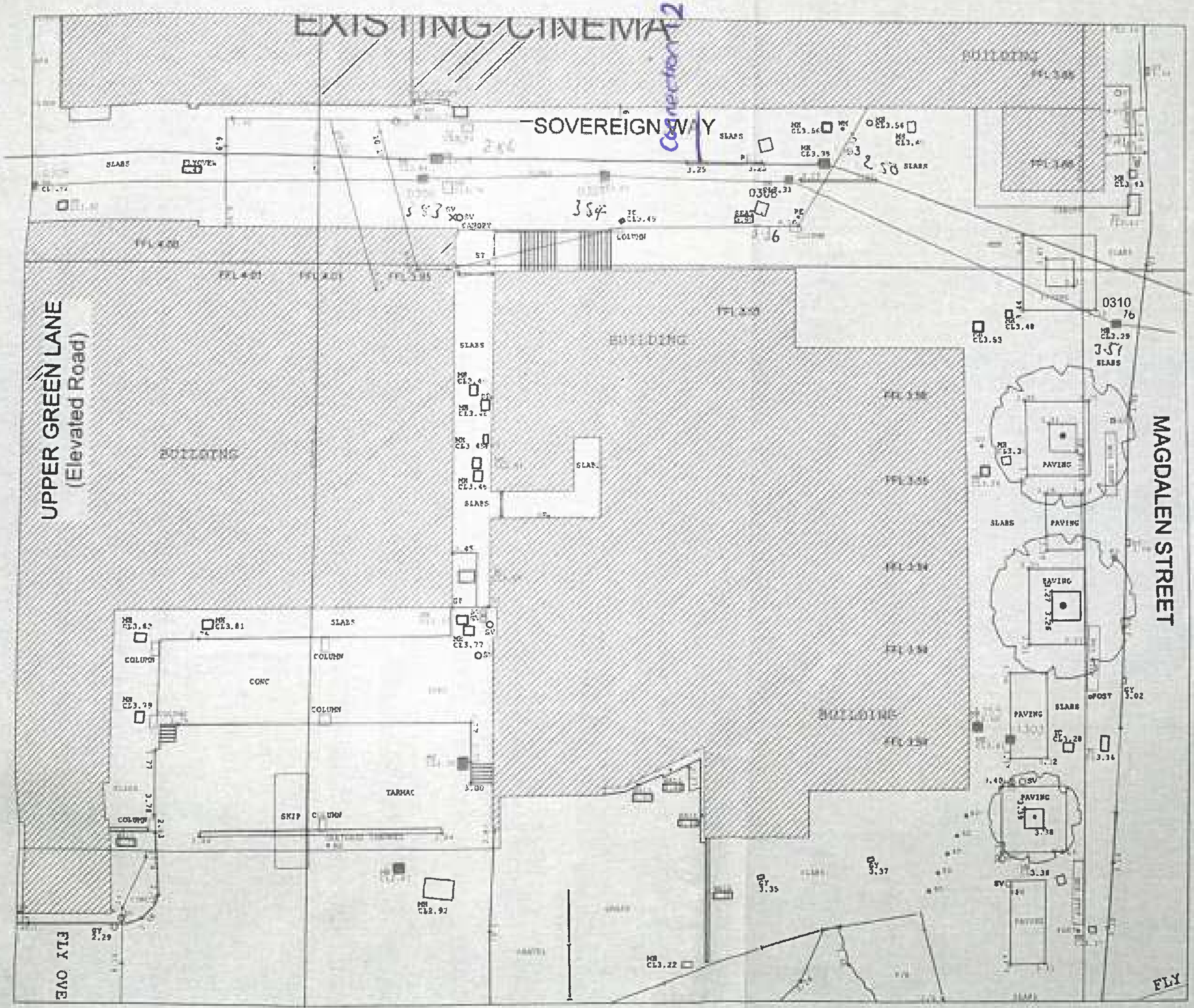
Revision	Description	Checked By	Date

Checked Prelim Issue		Checked Condoc Issue	
Author	Manager	Author	Manager
****	****	****	****
Date	Date	Date	Date
//**	**/**/**	**/**/**	**/**/**

PRELIMINARY DOCUMENT ISSUE

Title	Ex MANHOLES TO BE SURVEYED SHEET 2 OF 7
Site	ANGLIA SQUARE, NORWICH
Dwg	WH179/18/15.10
Date	11-10-2018
Rev	-
Drawn	HWP
Scale	1:250

Weston Homes Plc
The Weston Group Business Centre
Parsonage Road, Takeley, Essex CM22 6PU
Tel: 01279 873333 Fax: 01279 873378
info@weston-homes.com



DO NOT SCALE THIS DRAWING

PLAN 3

Revision	Description	Checked By	Date

Checked Prelim Issue		Checked Condoc Issue	
Author	Manager	Author	Manager
****	****	****	****
Date	Date	Date	Date
//**	**/**/**	**/**/**	**/**/**

PRELIMINARY DOCUMENT ISSUE

Title: Ex MANHOLES TO BE SURVEYED SHEET 3 OF 7

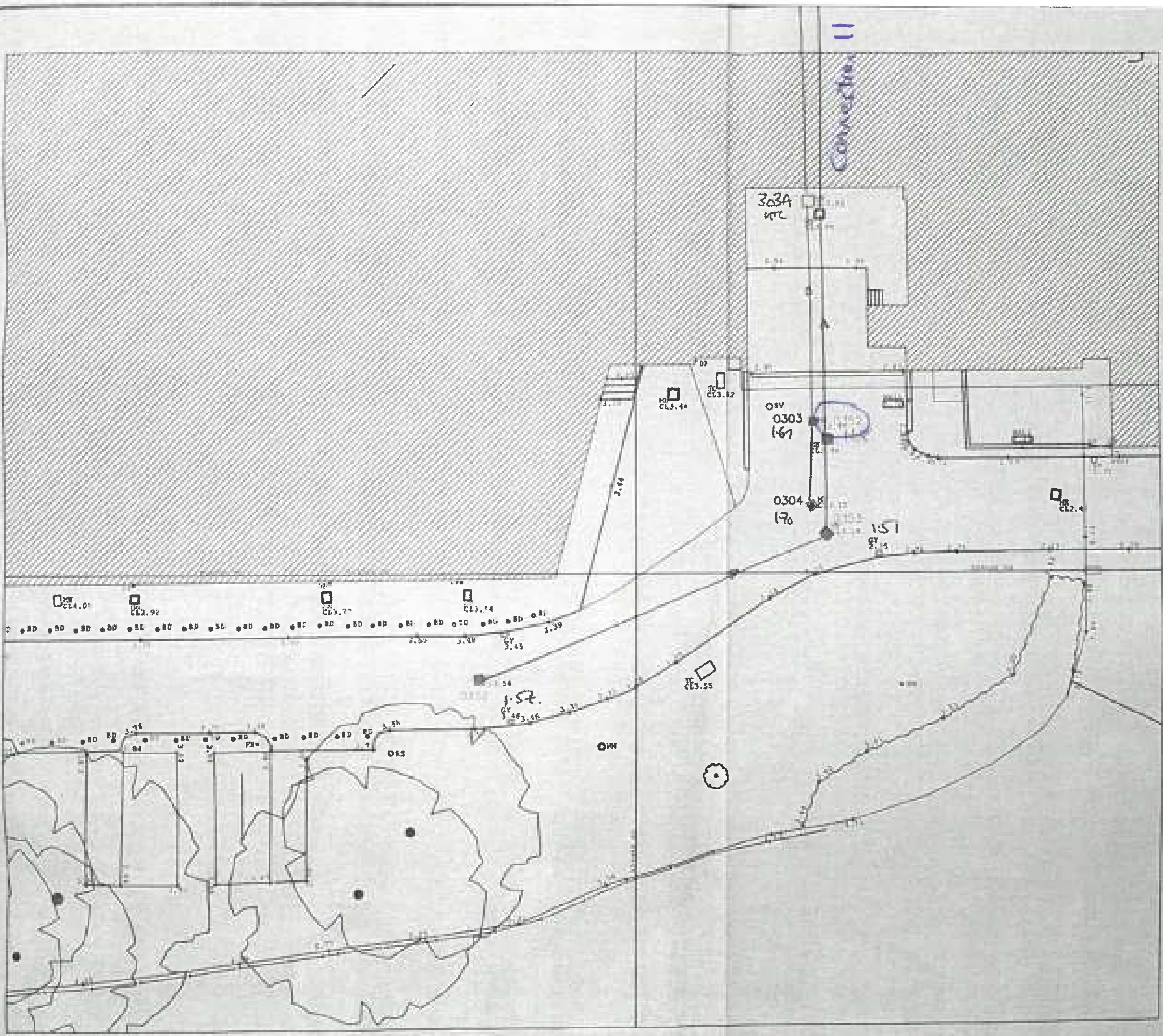
Site: ANGLIA SQUARE, NORWICH

Drg: WH179/18/15.11

Date: 11-10-2018 Rev: -

Drawn: HWP Scale: 1:250

Weston Homes Plc
The Weston Group Business Centre,
Parsonage Road, Takeley, Essex, CM22 6PU
Tel: 01279 873333 Fax: 01279 873376
info@weston-homes.com



DO NOT SCALE THIS DRAWING

PLAN 4

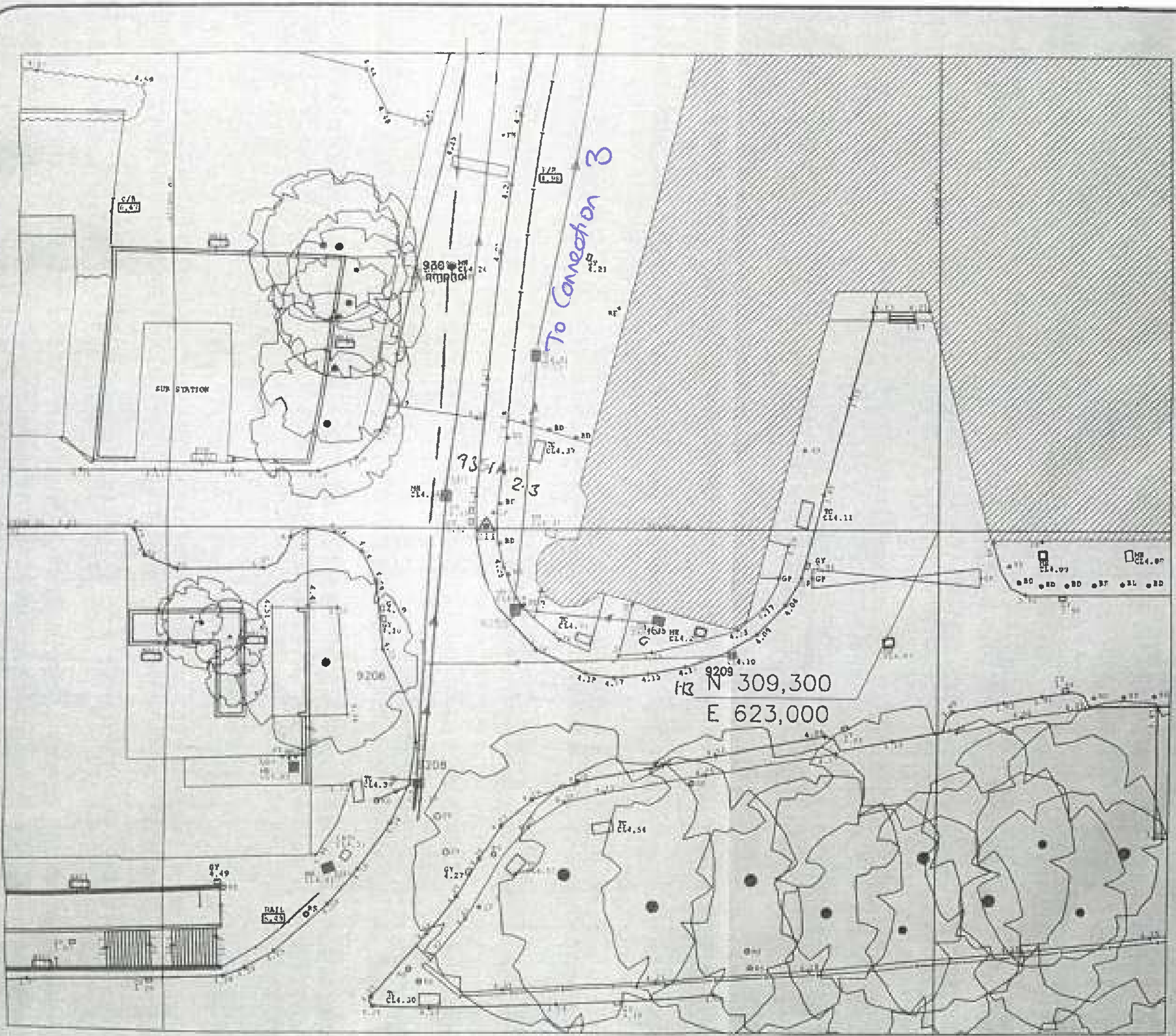
Revision	Description	Checked By	Date

Checked Prelim Issue		Checked Condoc Issue	
Author	Manager	Author	Manager
****	****	****	****
Date	Date	Date	Date
//**	**/**/**	**/**/**	**/**/**

PRELIMINARY DOCUMENT ISSUE

Title	Ex MANHOLES TO BE SURVEYED SHEET 4 OF 7
Site	ANGLIA SQUARE, NORWICH
Dwg	WH179/18/15.12
Date	11-10-2018
Rev	-
Drawn	HWP
Scale	1:250

Weston Homes Plc
The Weston Group Business Centre, Parsonage Road, Takeley, Essex, CM22 6PU.
Tel: 01279 873333 Fax: 01279 873378
info@weston-homes.com



DO NOT SCALE THIS DRAWING

PLAN 5

Revision	Description	Checked By	Date

Checked Prelim Issue		Checked Condoc Issue	
Author	Manager	Author	Manager
****	****	****	****
Date	Date	Date	Date
--/--/--	--/--/--	--/--/--	--/--/--

PRELIMINARY DOCUMENT ISSUE

Title: Ex MANHOLES TO BE SURVEYED SHEET 5 OF 7

Site: ANGLIA SQUARE, NORWICH

Drg: WH179/18/15 13

Date: 11-10-2018 Rev: -

Drawn: HWP Scale: 1:250

Weston Homes Plc
The Weston Group Business Centre, Parsonage Road, Takeley, Essex CM22 6PU
Tel: 01279 873333 Fax: 01279 873378
info@westonhomes.com

DO NOT SCALE THIS DRAWING

PLAN 6

Revision	Description	Checked By	Date

Checked Prelim Issue		Checked Condoc Issue	
Author	Manager	Author	Manager
****	****	****	****
Date	Date	Date	Date
//**	**/**/**	**/**/**	**/**/**

PRELIMINARY DOCUMENT ISSUE

Title: Ex MANHOLES TO BE SURVEYED SHEET 6 OF 7

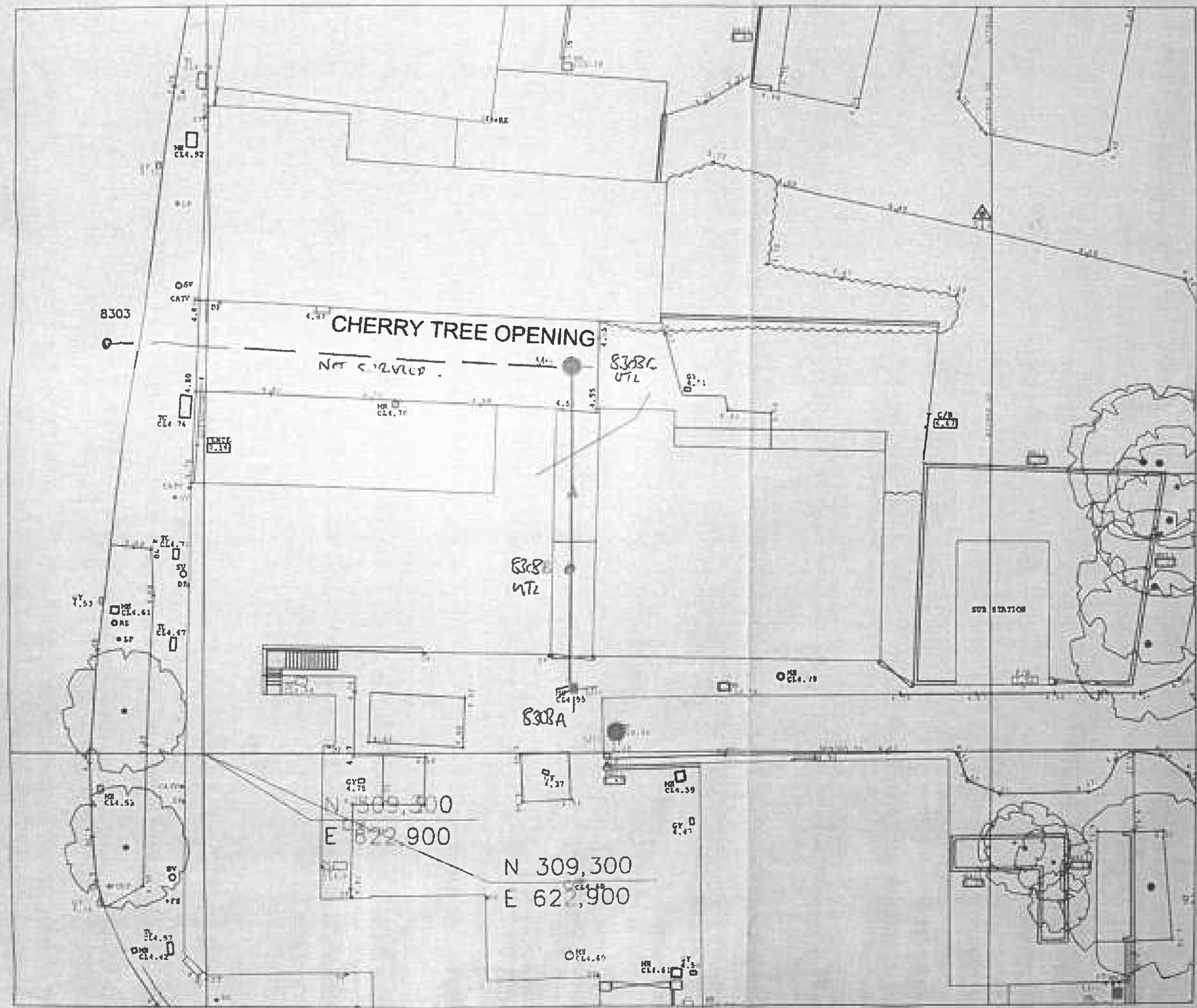
Site: ANGLIA SQUARE, NORWICH

Drg: WH179/18/15.14

Date: 11-10-2018 Rev: -

Drawn: HWP Scale: 1:250

Weston Homes Plc
The Weston Group Business Centre,
Parsonage Road, Takeley, Essex CM22 6PU
Tel 01279 873333 Fax 01279 873378
info@weston-homes.com



DO NOT SCALE THIS DRAWING

PLAN 7

Revision	Description	Checked By	Date

Checked Prelim Issue		Checked Condoc Issue	
Author	Manager	Author	Manager
****	****	****	****
Date	Date	Date	Date
--/--/--	--/--/--	--/--/--	--/--/--

PRELIMINARY DOCUMENT ISSUE

Title: Ex MANHOLES TO BE SURVEYED SHEET 7 OF 7

Site: ANGLIA SQUARE, NORWICH

Drg.: WH179/18/15.15

Date: 11-10-2018 Rev: -

Drawn: HWP Scale: 1:250

Weston Homes Plc
The Weston Group Business Centre
Parsonage Road, Takeley, Essex CM22 6PU
Tel 01279 873333 Fax 01279 873376
info@weston-homes.com

Summary of CCTV Drainage Survey Connections:

Ex. Connection 1 – outfall to 225dia sewer in Edward Street – see attached Edward Street Area 1 and page 48 of the cctv survey report.

Ex. Connection 2 – outfall to 300dia sewer in Edward Street via 0458 – see attached Edward Street Area 2 and page 56 of the cctv survey report.

Ex. Connection 3 – outfall to 675dia sewer at mh 0453 – see attached Plan 1 and page 32 of the cctv survey report.

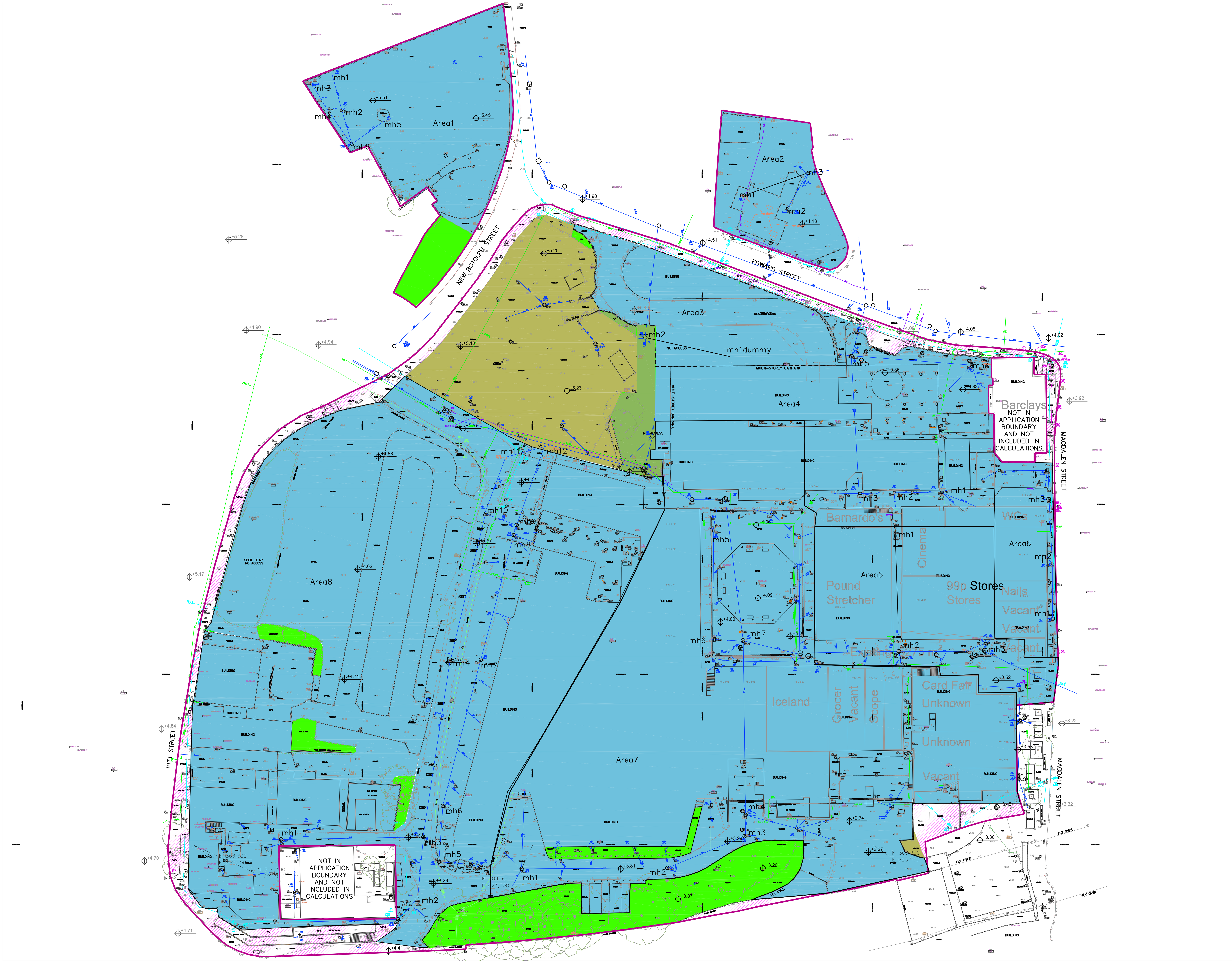
Ex. Connections 4 to 9 – outfalls to 675dia sewer between mhs 9460 and 9459 – shown as junctions on page 45 of the cctv survey report.

Ex. Connection 10 – outfall to 675dia sewer – shown as junction on page 33 of the cctv survey report.

Ex. Connection 11 – outfall to 675dia sewer - see attached Plan 2, Plan 4 and page 13 of the cctv survey report.

Ex. Connection 12 – outfall to 675dia sewer - see attached Plan 3 and shown as junction on page 39 of the cctv survey report.

Appendix: G – Existing Impermeable Areas and Drainage Catchments



TOTAL SITE AREA: 46502.3m²

AREAS OF ADOPTED PUBLIC HIGHWAY OR BUILDINGS OUTSIDE APPLICATION BOUNDARY: NOT INCLUDED IN BROWNFIELD RUNOFF CALCULATIONS: 2239.3m²

AREA OF PERMEABLE SURFACE OR LANDSCAPING. IT IS EXPECTED THAT SOME GREEN-FIELD RUNOFF WOULD OCCUR HOWEVER THESE RATES SHALL NOT BE INCLUDED IN BROWNFIELD RUNOFF CALCULATIONS: 1845m²

AREA OF CAR PARK WHICH DRAINS TO PRIVATE DRAINAGE SYSTEM AND NOT INTO ANGLIAN WATER SEWERS. NOT INCLUDED IN BROWNFIELD RUNOFF CALCULATIONS: 2814m².

AREA OF IMPERMEABLE SURFACE THAT DRAINS SURFACE WATER RUN-OFF TO EXISTING ANGLIAN WATER SURFACE WATER SEWERS: INCLUDED IN BROWNFIELD RUNOFF CALCULATIONS: 39,182m²

SURFACE WATER RUNOFF FROM EXISTING LANDSCAPED AREA IS IDENTIFIED AS CONTRIBUTING TO THE ADOPTED SURFACE WATER SEWER NETWORK. GREENFIELD RUNOFF RATES APPLIED. INCLUDED IN BROWNFIELD RUNOFF CALCULATIONS: 395m²

REV	DATE	BY	DESCRIPTION	CHK	APD

DRAWING STATUS: FOR INFORMATION

EAS

Unit 23, The Maltings, Stanstead Abbotts, Hertfordshire, SG12 8HG
Tel: 01920 871777
www.eastp.co.uk

CLIENT: WESTON HOMES

ARCHITECT:

PROJECT: ANGLIA SQUARE, NORWICH

TITLE: EXISTING IMPERMEABLE AREAS WHICH DRAIN SURFACE WATER TO ANGLIAN WATER SURFACE WATER SEWERS

SCALE @ A1:	DESIGN-DRAWN:	DATE:
1:500	MD	06.04.2017

PROJECT No:	DRAWING No:
3831	SK01-D

Appendix: H – FEH Brownfield Runoff Hydraulic Calculations

Existing Network Details for Storm

* - Indicates pipe has been modified outside of System 1

	PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	k (mm)	HYD SECT	DIA (mm)	Section Type
*	1.000	23.300	0.291	80.1	0.040	3.00	0.600	o	150	Pipe/Conduit
*	1.001	21.000	0.292	71.9	0.040	0.00	0.600	o	150	Pipe/Conduit
*	2.000	18.000	0.225	80.0	0.040	3.00	0.600	o	150	Pipe/Conduit
*	2.001	22.000	0.275	80.0	0.040	0.00	0.600	o	150	Pipe/Conduit
*	3.000	23.000	0.287	80.1	0.040	3.00	0.600	o	150	Pipe/Conduit
*	1.002	10.000	0.125	80.0	0.039	0.00	0.600	o	150	Pipe/Conduit

	PN	US/MH Name	US/CL (m)	US/IL (m)	US C.Depth (m)	DS/CL (m)	DS/IL (m)	DS C.Depth (m)	Ctrl	US/MH (mm)
*	1.000	mh1	5.510	4.545	0.815	5.510	4.254	1.106		1200
*	1.001	mh2	5.510	4.254	1.106	5.500	3.962	1.388		1200
*	2.000	mh3	5.510	4.492	0.868	5.510	4.267	1.093		1200
*	2.001	mh4	5.510	4.267	1.093	5.500	3.992	1.358		1200
*	3.000	mh5	5.510	4.249	1.111	5.500	3.962	1.388		1200
*	1.002	mh6	5.500	3.887	1.463	5.500	3.762	1.588		1200

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
mh1	5.510	0.965	Open Manhole	1200	1.000	4.545	150				
mh2	5.510	1.256	Open Manhole	1200	1.001	4.254	150	1.000	4.254	150	
mh3	5.510	1.018	Open Manhole	1200	2.000	4.492	150				
mh4	5.510	1.243	Open Manhole	1200	2.001	4.267	150	2.000	4.267	150	
mh5	5.510	1.261	Open Manhole	1200	3.000	4.249	150				
mh6	5.500	1.613	Open Manhole	1200	1.002	3.887	150	1.001	3.962	150	75
								2.001	3.992	150	105
								3.000	3.962	150	75
	5.500	1.738	Open Manhole	0		OUTFALL		1.002	3.762	150	

No coordinates have been specified, layout information cannot be produced.

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	150	mh1	5.510	4.545	0.815	Open Manhole	1200
1.001	o	150	mh2	5.510	4.254	1.106	Open Manhole	1200
2.000	o	150	mh3	5.510	4.492	0.868	Open Manhole	1200
2.001	o	150	mh4	5.510	4.267	1.093	Open Manhole	1200
3.000	o	150	mh5	5.510	4.249	1.111	Open Manhole	1200
1.002	o	150	mh6	5.500	3.887	1.463	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	23.300	80.1	mh2	5.510	4.254	1.106	Open Manhole	1200
1.001	21.000	71.9	mh6	5.500	3.962	1.388	Open Manhole	1200
2.000	18.000	80.0	mh4	5.510	4.267	1.093	Open Manhole	1200
2.001	22.000	80.0	mh6	5.500	3.992	1.358	Open Manhole	1200
3.000	23.000	80.1	mh6	5.500	3.962	1.388	Open Manhole	1200
1.002	10.000	80.0		5.500	3.762	1.588	Open Manhole	0

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.002		5.500	3.762	0.000	0	0

Simulation Criteria for Storm

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.255
Return Period (years)	1	E (1km)	0.310
FEH Rainfall Version	1999	F (1km)	2.498
Site Location	GB 622800 309650 TG 22800 09650	Summer Storms	Yes
C (1km)	-0.024	Winter Storms	No
D1 (1km)	0.275	Cv (Summer)	0.750
D2 (1km)	0.370	Cv (Winter)	0.840

Synthetic Rainfall Details

Storm Duration (mins) 30

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 20.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.405 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 2
Climate Change (%) 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	mh1	15 Summer	1	+0%					4.608	-0.087	0.000
1.001	mh2	15 Summer	1	+0%	2/15 Summer				4.335	-0.069	0.000
2.000	mh3	15 Summer	1	+0%					4.556	-0.086	0.000
2.001	mh4	15 Summer	1	+0%	2/15 Summer				4.351	-0.066	0.000
3.000	mh5	15 Summer	1	+0%	2/15 Winter				4.312	-0.087	0.000
1.002	mh6	15 Winter	1	+0%	1/15 Summer				4.256	0.219	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	0.34			6.5	OK	
1.001	mh2	0.56			11.1	OK	
2.000	mh3	0.36			6.6	OK	
2.001	mh4	0.59			11.1	OK	
3.000	mh5	0.35			6.5	OK	
1.002	mh6	1.67			29.5	SURCHARGED	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model		FSR M5-60 (mm)	20.000	Cv (Summer)	0.750
Region	England and Wales	Ratio R	0.405	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 2
Climate Change (%)	0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	mh1	15 Summer	2	+0%					4.618	-0.077	0.000
1.001	mh2	15 Summer	2	+0%	2/15 Summer				4.455	0.051	0.000
2.000	mh3	15 Summer	2	+0%					4.566	-0.076	0.000
2.001	mh4	15 Summer	2	+0%	2/15 Summer				4.459	0.042	0.000
3.000	mh5	15 Summer	2	+0%	2/15 Winter				4.391	-0.008	0.000
1.002	mh6	15 Winter	2	+0%	1/15 Summer				4.380	0.343	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	0.45			8.4	OK	
1.001	mh2	0.63			12.4	SURCHARGED	
2.000	mh3	0.46			8.5	OK	
2.001	mh4	0.67			12.6	SURCHARGED	
3.000	mh5	0.44			8.4	OK	
1.002	mh6	1.94			34.3	SURCHARGED	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH Data Type Point
FEH Rainfall Version 2013 Cv (Summer) 0.750
Site Location GB 623065 309383 TG 23065 09383 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 2
Climate Change (%) 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	mh1	15 Summer	2	+0%					4.615	-0.080	0.000
1.001	mh2	15 Summer	2	+0%	2/15 Summer				4.415	0.011	0.000
2.000	mh3	15 Summer	2	+0%					4.563	-0.079	0.000
2.001	mh4	15 Summer	2	+0%	2/15 Summer				4.420	0.003	0.000
3.000	mh5	15 Summer	2	+0%					4.359	-0.040	0.000
1.002	mh6	15 Winter	2	+0%	2/15 Summer				4.341	0.304	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	0.42			7.8	OK	
1.001	mh2	0.61			12.0	SURCHARGED	
2.000	mh3	0.43			8.0	OK	
2.001	mh4	0.64			12.1	SURCHARGED	
3.000	mh5	0.42			7.9	OK	
1.002	mh6	1.86			32.9	SURCHARGED	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	Data Type	Point
FEH Rainfall Version	2013	Cv (Summer)	0.750
Site Location	GB 623065 309383 TG 23065 09383	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	30
Climate Change (%)	0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	mh1	15 Winter	30	+0%	30/15 Summer				5.508	0.813
1.001	mh2	15 Winter	30	+0%	30/15 Summer	30/15 Summer			5.510	1.106
2.000	mh3	15 Winter	30	+0%	30/15 Summer	30/15 Summer			5.511	0.869
2.001	mh4	15 Winter	30	+0%	30/15 Summer	30/15 Summer			5.510	1.093
3.000	mh5	15 Winter	30	+0%	30/15 Summer				5.458	1.059
1.002	mh6	15 Winter	30	+0%	30/15 Summer				5.332	1.295

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	0.000	0.80			15.0	FLOOD RISK	
1.001	mh2	0.108	1.03			20.4	FLOOD	2
2.000	mh3	1.400	0.78			14.6	FLOOD	3
2.001	mh4	0.109	1.12			21.0	FLOOD	2
3.000	mh5	0.000	0.66			12.4	FLOOD RISK	
1.002	mh6	0.000	3.35			59.3	FLOOD RISK	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	Data Type	Point
FEH Rainfall Version	2013	Cv (Summer)	0.750
Site Location	GB 623065 309383 TG 23065 09383	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	30
Climate Change (%)	45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	mh1	15 Winter	30	+45%	30/15 Summer	30/15 Summer			5.516	0.821
1.001	mh2	15 Winter	30	+45%	30/15 Summer	30/15 Summer			5.512	1.108
2.000	mh3	15 Winter	30	+45%	30/15 Summer	30/15 Summer			5.516	0.874
2.001	mh4	15 Winter	30	+45%	30/15 Summer	30/15 Summer			5.512	1.095
3.000	mh5	15 Winter	30	+45%	30/15 Summer	30/15 Summer			5.512	1.113
1.002	mh6	15 Summer	30	+45%	30/15 Summer				5.413	1.376

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	5.923	1.16			21.9	FLOOD	4
1.001	mh2	1.917	1.11			22.1	FLOOD	5
2.000	mh3	5.847	1.24			23.0	FLOOD	6
2.001	mh4	2.007	1.23			23.1	FLOOD	5
3.000	mh5	1.693	0.89			16.7	FLOOD	4
1.002	mh6	0.000	3.44			60.9	FLOOD RISK	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH Data Type Point
FEH Rainfall Version 2013 Cv (Summer) 0.750
Site Location GB 623065 309383 TG 23065 09383 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 100
Climate Change (%) 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	mh1	15 Winter	100	+0%	100/15 Summer	100/15 Summer			5.514	0.819
1.001	mh2	15 Winter	100	+0%	100/15 Summer	100/15 Summer			5.511	1.107
2.000	mh3	15 Winter	100	+0%	100/15 Summer	100/15 Summer			5.515	0.873
2.001	mh4	15 Winter	100	+0%	100/15 Summer	100/15 Summer			5.511	1.094
3.000	mh5	15 Winter	100	+0%	100/15 Summer	100/15 Summer			5.511	1.112
1.002	mh6	15 Winter	100	+0%	100/15 Summer				5.394	1.357

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	4.270	1.09			20.6	FLOOD	4
1.001	mh2	1.196	1.11			21.9	FLOOD	4
2.000	mh3	4.577	1.14			21.1	FLOOD	5
2.001	mh4	1.272	1.21			22.8	FLOOD	4
3.000	mh5	0.930	0.86			16.1	FLOOD	4
1.002	mh6	0.000	3.43			60.6	FLOOD RISK	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH Data Type Point
FEH Rainfall Version 2013 Cv (Summer) 0.750
Site Location GB 623065 309383 TG 23065 09383 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 100
Climate Change (%) 45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	mh1	15 Winter	100	+45%	100/15 Summer	100/15 Summer			5.519	0.824
1.001	mh2	15 Winter	100	+45%	100/15 Summer	100/15 Summer			5.515	1.111
2.000	mh3	15 Winter	100	+45%	100/15 Summer	100/15 Summer			5.519	0.877
2.001	mh4	15 Winter	100	+45%	100/15 Summer	100/15 Summer			5.515	1.098
3.000	mh5	15 Winter	100	+45%	100/15 Summer	100/15 Summer			5.514	1.115
1.002	mh6	15 Summer	100	+45%	100/15 Summer				5.458	1.421

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	9.165	1.18			22.2	FLOOD	6
1.001	mh2	4.581	1.13			22.3	FLOOD	6
2.000	mh3	9.085	1.25			23.3	FLOOD	7
2.001	mh4	4.680	1.24			23.3	FLOOD	6
3.000	mh5	4.242	0.97			18.2	FLOOD	6
1.002	mh6	0.000	3.49			61.8	FLOOD RISK	

Existing Network Details for Storm

* - Indicates pipe has been modified outside of System 1

	PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	k (mm)	HYD SECT	DIA (mm)	Section Type
*	1.000	19.000	0.320	59.4	0.042	3.00	0.600	o	150	Pipe/Conduit
*	2.000	12.000	0.380	31.6	0.042	3.00	0.600	o	150	Pipe/Conduit
*	1.001	10.000	0.250	40.0	0.041	0.00	0.600	o	150	Pipe/Conduit

	PN	US/MH Name	US/CL (m)	US/IL (m)	US C.Depth (m)	DS/CL (m)	DS/IL (m)	DS C.Depth (m)	Ctrl	US/MH (mm)
*	1.000	mh1	4.060	3.220	0.690	4.000	2.900	0.950		1200
*	2.000	mh2	3.980	3.280	0.550	4.000	2.900	0.950		1200
*	1.001	mh3	4.000	2.900	0.950	5.500	2.650	2.700		1200

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
mh1	4.060	0.840	Open Manhole	1200	1.000	3.220	150				
mh2	3.980	0.700	Open Manhole	1200	2.000	3.280	150				
mh3	4.000	1.100	Open Manhole	1200	1.001	2.900	150	1.000	2.900	150	
								2.000	2.900	150	
	5.500	2.850	Open Manhole	0		OUTFALL		1.001	2.650	150	

No coordinates have been specified, layout information cannot be produced.

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	150	mh1	4.060	3.220	0.690	Open Manhole	1200
2.000	o	150	mh2	3.980	3.280	0.550	Open Manhole	1200
1.001	o	150	mh3	4.000	2.900	0.950	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	19.000	59.4	mh3	4.000	2.900	0.950	Open Manhole	1200
2.000	12.000	31.6	mh3	4.000	2.900	0.950	Open Manhole	1200
1.001	10.000	40.0		5.500	2.650	2.700	Open Manhole	0

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.001		5.500	2.650	0.000	0	0

Simulation Criteria for Storm

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	E (1km)	0.310
Return Period (years)	1	F (1km)	2.498
FEH Rainfall Version	1999	Summer Storms	Yes
Site Location	GB 622800 309650 TG 22800 09650	Winter Storms	No
C (1km)	-0.024	Cv (Summer)	0.750
D1 (1km)	0.275	Cv (Winter)	0.840
D2 (1km)	0.370	Storm Duration (mins)	30
D3 (1km)	0.255		

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 20.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.405 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 2
Climate Change (%) 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	mh1	15 Summer	1	+0%					3.280	-0.090	0.000
2.000	mh2	15 Summer	1	+0%					3.331	-0.099	0.000
1.001	mh3	15 Summer	1	+0%					2.999	-0.051	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	0.32			7.0	OK	
2.000	mh2	0.24			7.0	OK	
1.001	mh3	0.74			18.5	OK	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	20.000	Cv (Summer)	0.750
Region	England and Wales	Ratio R	0.405	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 2
Climate Change (%)	0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	mh1	15 Summer	2	+0%					3.289	-0.081	0.000
2.000	mh2	15 Summer	2	+0%					3.339	-0.091	0.000
1.001	mh3	15 Summer	2	+0%					3.019	-0.031	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	0.42			9.1	OK	
2.000	mh2	0.32			9.1	OK	
1.001	mh3	0.96			24.1	OK	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.255
FEH Rainfall Version	1999	E (1km)	0.310
Site Location	GB 622800 309650 TG 22800 09650	F (1km)	2.498
C (1km)	-0.024	Cv (Summer)	0.750
D1 (1km)	0.275	Cv (Winter)	0.840
D2 (1km)	0.370		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	2
Climate Change (%)	0

PN	**US/MH Name**	**Storm**	**Return Period**	**Climate Change**	**First (X) Surcharge**	**First (Y) Flood**	**First (Z) Overflow**	**Overflow Act.**	**Water Level (m)**	**Surcharged Depth (m)**	**Flooded Volume (m³)**
1.000	mh1	15 Summer	2	+0%					3.291	-0.079	0.000
2.000	mh2	15 Summer	2	+0%					3.341	-0.089	0.000
1.001	mh3	15 Summer	2	+0%					3.030	-0.020	0.000

PN	**US/MH Name**	**Flow / Cap.**	**Overflow (l/s)**	**Half Drain Time (mins)**	**Pipe Flow (l/s)**	**Status**	**Level Exceeded**
1.000	mh1	0.44			9.5	OK	
2.000	mh2	0.33			9.5	OK	
1.001	mh3	1.00			25.1	OK	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH D3 (1km) 0.255
FEH Rainfall Version 1999 E (1km) 0.310
Site Location GB 622800 309650 TG 22800 09650 F (1km) 2.498
C (1km) -0.024 Cv (Summer) 0.750
D1 (1km) 0.275 Cv (Winter) 0.840
D2 (1km) 0.370

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 30
Climate Change (%) 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	mh1	15 Summer	30	+0%	30/15 Summer	30/15 Summer			4.060	0.690
2.000	mh2	15 Winter	30	+0%	30/15 Summer	30/15 Summer			3.980	0.550
1.001	mh3	15 Winter	30	+0%	30/15 Summer				3.877	0.827

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	0.266	0.80			17.3	FLOOD	2
2.000	mh2	0.332	0.63			18.0	FLOOD	2
1.001	mh3	0.000	2.06			51.8	FLOOD RISK	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH D3 (1km) 0.255
FEH Rainfall Version 1999 E (1km) 0.310
Site Location GB 622800 309650 TG 22800 09650 F (1km) 2.498
C (1km) -0.024 Cv (Summer) 0.750
D1 (1km) 0.275 Cv (Winter) 0.840
D2 (1km) 0.370

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 30
Climate Change (%) 45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	mh1	15 Winter	30	+45%	30/15 Summer	30/15 Summer			4.063	0.693
2.000	mh2	15 Winter	30	+45%	30/15 Summer	30/15 Summer			3.984	0.554
1.001	mh3	15 Winter	30	+45%	30/15 Summer				3.941	0.891

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	3.157	0.98			21.3	FLOOD	4
2.000	mh2	3.829	0.79			22.8	FLOOD	4
1.001	mh3	0.000	2.14			53.7	FLOOD RISK	

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

Simulation Criteria

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

Number of Input Hydrographs 0 | Number of Offline Controls 0 | Number of Time/Area Diagrams 0
Number of Online Controls 0 | Number of Storage Structures 0 | Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH | D3 (1km) 0.255
FEH Rainfall Version 1999 | E (1km) 0.310
Site Location GB 622800 309650 TG 22800 09650 | F (1km) 2.498
C (1km) -0.024 | Cv (Summer) 0.750
D1 (1km) 0.275 | Cv (Winter) 0.840
D2 (1km) 0.370

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 100
Climate Change (%) 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	mh1	15 Winter	100	+0%	100/15 Summer	100/15 Summer			4.064	0.694
2.000	mh2	15 Winter	100	+0%	100/15 Summer	100/15 Summer			3.984	0.554
1.001	mh3	15 Winter	100	+0%	100/15 Summer				3.946	0.896

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	3.581	0.99			21.5	FLOOD	4
2.000	mh2	4.359	0.82			23.6	FLOOD	4
1.001	mh3	0.000	2.15			53.9	FLOOD RISK	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH D3 (1km) 0.255
FEH Rainfall Version 1999 E (1km) 0.310
Site Location GB 622800 309650 TG 22800 09650 F (1km) 2.498
C (1km) -0.024 Cv (Summer) 0.750
D1 (1km) 0.275 Cv (Winter) 0.840
D2 (1km) 0.370

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 100
Climate Change (%) 45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	mh1	15 Winter	100	+45%	100/15 Summer	100/15 Summer			4.069	0.699
2.000	mh2	15 Winter	100	+45%	100/15 Summer	100/15 Summer			3.992	0.562
1.001	mh3	15 Summer	100	+45%	100/15 Summer	100/15 Summer			4.000	0.950

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	9.421	1.06			23.0	FLOOD	5
2.000	mh2	12.052	1.02			29.3	FLOOD	5
1.001	mh3	0.071	2.20			55.2	FLOOD	2

Existing Network Details for Storm

* - Indicates pipe has been modified outside of System 1

	PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	k (mm)	HYD SECT	DIA (mm)	Section Type
*	1.000	25.600	0.256	100.0	0.085	3.00	0.600	o	225	Pipe/Conduit
*	1.001	32.700	0.000	0.0	0.085	0.00	0.600	o	225	Pipe/Conduit

	PN	US/MH Name	US/CL (m)	US/IL (m)	US C.Depth (m)	DS/CL (m)	DS/IL (m)	DS C.Depth (m)	Ctrl	US/MH (mm)
*	1.000	mh1	5.000	3.156	1.619	5.000	2.900	1.875		1200
*	1.001	mh2	5.000	2.900	1.875	5.500	2.900	2.375		1200

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
mh1	5.000	1.844	Open Manhole	1200	1.000	3.156	225				
mh2	5.000	2.100	Open Manhole	1200	1.001	2.900	225	1.000	2.900	225	
	5.500	2.600	Open Manhole	0		OUTFALL		1.001	2.900	225	

No coordinates have been specified, layout information cannot be produced.

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	225	mh1	5.000	3.156	1.619	Open Manhole	1200
1.001	o	225	mh2	5.000	2.900	1.875	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	25.600	100.0	mh2	5.000	2.900	1.875	Open Manhole	1200
1.001	32.700	0.0		5.500	2.900	2.375	Open Manhole	0

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.001		5.500	2.900	0.000	0	0

Simulation Criteria for Storm

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

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

Synthetic Rainfall Details

Rainfall Model	FEH
Return Period (years)	1
FEH Rainfall Version	1999
Site Location	GB 622800 309650 TG 22800 09650
C (1km)	-0.024
D1 (1km)	0.275
D2 (1km)	0.370
D3 (1km)	0.255
E (1km)	0.310
F (1km)	2.498
Summer Storms	Yes
Winter Storms	No

Synthetic Rainfall Details

Cv (Summer)	0.750
Cv (Winter)	0.840
Storm Duration (mins)	30

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.407
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 2
Climate Change (%)	0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	mh1	15 Summer	1	+0%					3.242
1.001	mh2	15 Winter	1	+0%	1/15 Summer				3.189

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	-0.139	0.000	0.29			14.0	OK	
1.001	mh2	0.064	0.000	1.82			22.3	SURCHARGED	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.407
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 20.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 2
Climate Change (%) 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	mh1	15 Summer	2	+0%					3.279
1.001	mh2	15 Winter	2	+0%	1/15 Summer				3.238

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	-0.102	0.000	0.37			17.8	OK	
1.001	mh2	0.113	0.000	2.35			28.7	SURCHARGED	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	1999
Site Location	GB 622800 309650 TG 22800 09650
C (1km)	-0.024
D1 (1km)	0.275
D2 (1km)	0.370
D3 (1km)	0.255
E (1km)	0.310
F (1km)	2.498
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	2
Climate Change (%)	0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	mh1	15 Summer	2	+0%					3.291
1.001	mh2	15 Winter	2	+0%	2/15 Summer				3.250

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	-0.090	0.000	0.38			18.5	OK	
1.001	mh2	0.125	0.000	2.45			30.0	SURCHARGED	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	1999
Site Location	GB 622800 309650 TG 22800 09650
C (1km)	-0.024
D1 (1km)	0.275
D2 (1km)	0.370
D3 (1km)	0.255
E (1km)	0.310
F (1km)	2.498
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	30
Climate Change (%)	0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	mh1	15 Summer	30	+0%	30/15 Summer				4.349
1.001	mh2	15 Winter	30	+0%	30/15 Summer				4.128

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	0.968	0.000	0.88			42.5	SURCHARGED	
1.001	mh2	1.003	0.000	6.64			81.3	SURCHARGED	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	1999
Site Location	GB 622800 309650 TG 22800 09650
C (1km)	-0.024
D1 (1km)	0.275
D2 (1km)	0.370
D3 (1km)	0.255
E (1km)	0.310
F (1km)	2.498
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	30
Climate Change (%)	45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	mh1	15 Winter	30	+45%	30/15 Summer	30/15 Summer			5.002
1.001	mh2	15 Winter	30	+45%	30/15 Summer				4.812

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	1.621	1.831	1.22			58.6	FLOOD	2
1.001	mh2	1.687	0.000	8.64			105.9	FLOOD RISK	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.255
FEH Rainfall Version	1999	E (1km)	0.310
Site Location	GB 622800 309650 TG 22800 09650	F (1km)	2.498
C (1km)	-0.024	Cv (Summer)	0.750
D1 (1km)	0.275	Cv (Winter)	0.840
D2 (1km)	0.370		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	100
Climate Change (%)	0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	mh1	15 Summer	100	+0%	100/15 Summer	100/15 Summer			5.003	1.622
1.001	mh2	15 Winter	100	+0%	100/15 Summer				4.824	1.699

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	2.712	1.27			60.9	FLOOD	2
1.001	mh2	0.000	8.72			106.8	FLOOD RISK	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.255
FEH Rainfall Version	1999	E (1km)	0.310
Site Location	GB 622800 309650 TG 22800 09650	F (1km)	2.498
C (1km)	-0.024	Cv (Summer)	0.750
D1 (1km)	0.275	Cv (Winter)	0.840
D2 (1km)	0.370		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	100
Climate Change (%)	45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	mh1	15 Winter	100	+45%	100/15 Summer	100/15 Summer			5.016	1.635
1.001	mh2	15 Winter	100	+45%	100/15 Summer	100/15 Winter			4.960	1.835

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	15.999	1.66			79.8	FLOOD	4
1.001	mh2	0.041	9.20			112.7	FLOOD	

Existing Network Details for Storm

* - Indicates pipe has been modified outside of System 1

	PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	k (mm)	HYD SECT	DIA (mm)	Section Type
*	1.000	8.700	0.200	43.5	0.058	3.00	0.600	o	150	Pipe/Conduit
*	1.001	10.300	0.140	73.6	0.059	0.00	0.600	o	150	Pipe/Conduit
*	1.002	40.500	0.690	58.7	0.088	0.00	0.600	o	225	Pipe/Conduit
*	2.000	35.000	0.380	92.1	0.059	3.00	0.600	o	150	Pipe/Conduit
*	1.003	15.500	0.155	100.0	0.088	0.00	0.600	o	300	Pipe/Conduit

	PN	US/MH Name	US/CL (m)	US/IL (m)	US C.Depth (m)	DS/CL (m)	DS/IL (m)	DS C.Depth (m)	Ctrl	US/MH (mm)
*	1.000	mh1	3.800	3.120	0.530	3.920	2.920	0.850		1200
*	1.001	mh2	3.920	2.920	0.850	3.300	2.780	0.370		1200
*	1.002	mh3	3.300	2.780	0.295	3.300	2.090	0.985		1200
*	2.000	mh4	3.640	2.470	1.020	3.300	2.090	1.060		1200
*	1.003	mh5	3.300	2.090	0.910	5.500	1.935	3.265		1200

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
mh1	3.800	0.680	Open Manhole	1200	1.000	3.120	150				
mh2	3.920	1.000	Open Manhole	1200	1.001	2.920	150	1.000	2.920	150	
mh3	3.300	0.520	Open Manhole	1200	1.002	2.780	225	1.001	2.780	150	
mh4	3.640	1.170	Open Manhole	1200	2.000	2.470	150				
mh5	3.300	1.210	Open Manhole	1200	1.003	2.090	300	1.002	2.090	225	
								2.000	2.090	150	
	5.500	3.565	Open Manhole	0		OUTFALL		1.003	1.935	300	

No coordinates have been specified, layout information cannot be produced.

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	150	mh1	3.800	3.120	0.530	Open Manhole	1200
1.001	o	150	mh2	3.920	2.920	0.850	Open Manhole	1200
1.002	o	225	mh3	3.300	2.780	0.295	Open Manhole	1200
2.000	o	150	mh4	3.640	2.470	1.020	Open Manhole	1200
1.003	o	300	mh5	3.300	2.090	0.910	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	8.700	43.5	mh2	3.920	2.920	0.850	Open Manhole	1200
1.001	10.300	73.6	mh3	3.300	2.780	0.370	Open Manhole	1200
1.002	40.500	58.7	mh5	3.300	2.090	0.985	Open Manhole	1200
2.000	35.000	92.1	mh5	3.300	2.090	1.060	Open Manhole	1200
1.003	15.500	100.0		5.500	1.935	3.265	Open Manhole	0

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.003		5.500	1.935	0.000	0	0

Simulation Criteria for Storm

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	E (1km)	0.310
Return Period (years)	1	F (1km)	2.498
FEH Rainfall Version	1999	Summer Storms	Yes
Site Location	GB 622800 309650 TG 22800 09650	Winter Storms	No
C (1km)	-0.024	Cv (Summer)	0.750
D1 (1km)	0.275	Cv (Winter)	0.840
D2 (1km)	0.370	Storm Duration (mins)	30
D3 (1km)	0.255		

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model		FSR M5-60 (mm)	20.000	Cv (Summer)	0.750
Region	England and Wales	Ratio R	0.405	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 2
Climate Change (%)	0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	mh1	15 Summer	1	+0%					3.188	-0.082	0.000
1.001	mh2	15 Summer	1	+0%	2/15 Summer				3.032	-0.038	0.000
1.002	mh3	15 Winter	1	+0%					2.880	-0.125	0.000
2.000	mh4	15 Summer	1	+0%					2.552	-0.068	0.000
1.003	mh5	15 Winter	1	+0%					2.239	-0.151	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	0.41			9.8	OK	
1.001	mh2	0.88			16.2	OK	
1.002	mh3	0.41			26.3	OK	
2.000	mh4	0.53			9.5	OK	
1.003	mh5	0.49			45.4	OK	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 20.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.405 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 2
Climate Change (%) 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	mh1	15 Summer	2	+0%					3.200	-0.070	0.000
1.001	mh2	15 Summer	2	+0%	2/15 Summer				3.098	0.028	0.000
1.002	mh3	15 Winter	2	+0%					2.896	-0.109	0.000
2.000	mh4	15 Summer	2	+0%					2.567	-0.053	0.000
1.003	mh5	15 Winter	2	+0%					2.263	-0.127	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	0.53			12.7	OK	
1.001	mh2	1.12			20.7	SURCHARGED	
1.002	mh3	0.52			33.7	OK	
2.000	mh4	0.69			12.3	OK	
1.003	mh5	0.62			58.1	OK	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.255
FEH Rainfall Version	1999	E (1km)	0.310
Site Location	GB 622800 309650 TG 22800 09650	F (1km)	2.498
C (1km)	-0.024	Cv (Summer)	0.750
D1 (1km)	0.275	Cv (Winter)	0.840
D2 (1km)	0.370		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	2, 30
Climate Change (%)	0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	mh1	15 Summer	2	+0%	30/15 Summer	30/15 Summer			3.202	-0.068
1.001	mh2	15 Summer	2	+0%	2/15 Summer				3.117	0.047
1.002	mh3	15 Winter	2	+0%	30/15 Summer	30/15 Summer			2.900	-0.105
2.000	mh4	15 Summer	2	+0%	30/15 Summer				2.570	-0.050
1.003	mh5	15 Winter	2	+0%	30/15 Summer				2.269	-0.121

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	0.000	0.56			13.3	OK	3
1.001	mh2	0.000	1.17			21.7	SURCHARGED	
1.002	mh3	0.000	0.55			35.3	OK	2
2.000	mh4	0.000	0.72			12.9	OK	
1.003	mh5	0.000	0.65			61.0	OK	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH D3 (1km) 0.255
FEH Rainfall Version 1999 E (1km) 0.310
Site Location GB 622800 309650 TG 22800 09650 F (1km) 2.498
C (1km) -0.024 Cv (Summer) 0.750
D1 (1km) 0.275 Cv (Winter) 0.840
D2 (1km) 0.370

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 2, 30
Climate Change (%) 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	mh1	15 Winter	30	+0%	30/15 Summer	30/15 Summer			3.804	0.534
1.001	mh2	30 Summer	30	+0%	2/15 Summer				3.749	0.679
1.002	mh3	15 Winter	30	+0%	30/15 Summer	30/15 Summer			3.302	0.297
2.000	mh4	15 Winter	30	+0%	30/15 Summer				3.531	0.911
1.003	mh5	15 Winter	30	+0%	30/15 Summer				2.564	0.174

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	4.222	1.29			30.5	FLOOD	3
1.001	mh2	0.000	2.00			37.0	FLOOD RISK	
1.002	mh3	1.593	1.10			71.0	FLOOD	2
2.000	mh4	0.000	1.55			27.6	FLOOD RISK	
1.003	mh5	0.000	1.47			137.5	SURCHARGED	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.255
FEH Rainfall Version	1999	E (1km)	0.310
Site Location	GB 622800 309650 TG 22800 09650	F (1km)	2.498
C (1km)	-0.024	Cv (Summer)	0.750
D1 (1km)	0.275	Cv (Winter)	0.840
D2 (1km)	0.370		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	30
Climate Change (%)	45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	mh1	15 Winter	30	+45%	30/15 Summer	30/15 Summer			3.812	0.542
1.001	mh2	30 Winter	30	+45%	30/15 Summer				3.786	0.716
1.002	mh3	15 Winter	30	+45%	30/15 Summer	30/15 Summer			3.308	0.303
2.000	mh4	15 Winter	30	+45%	30/15 Summer	30/15 Summer			3.642	1.022
1.003	mh5	15 Winter	30	+45%	30/15 Summer				2.657	0.267

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	11.941	1.43			34.0	FLOOD	5
1.001	mh2	0.000	2.04			37.7	FLOOD RISK	
1.002	mh3	8.059	1.16			75.0	FLOOD	4
2.000	mh4	2.417	1.73			30.9	FLOOD	3
1.003	mh5	0.000	1.68			156.8	SURCHARGED	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.255
FEH Rainfall Version	1999	E (1km)	0.310
Site Location	GB 622800 309650 TG 22800 09650	F (1km)	2.498
C (1km)	-0.024	Cv (Summer)	0.750
D1 (1km)	0.275	Cv (Winter)	0.840
D2 (1km)	0.370		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	100
Climate Change (%)	0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	mh1	15 Winter	100	+0%	100/15 Summer	100/15 Summer			3.813	0.543
1.001	mh2	60 Summer	100	+0%	100/15 Summer				3.738	0.668
1.002	mh3	15 Winter	100	+0%	100/15 Summer	100/15 Summer			3.309	0.304
2.000	mh4	15 Winter	100	+0%	100/15 Summer	100/15 Summer			3.643	1.023
1.003	mh5	15 Winter	100	+0%	100/15 Summer				2.670	0.280

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	13.258	1.44			34.1	FLOOD	5
1.001	mh2	0.000	2.02			37.5	FLOOD RISK	
1.002	mh3	9.278	1.16			74.7	FLOOD	4
2.000	mh4	2.995	1.73			30.9	FLOOD	3
1.003	mh5	0.000	1.70			159.1	SURCHARGED	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.255
FEH Rainfall Version	1999	E (1km)	0.310
Site Location	GB 622800 309650 TG 22800 09650	F (1km)	2.498
C (1km)	-0.024	Cv (Summer)	0.750
D1 (1km)	0.275	Cv (Winter)	0.840
D2 (1km)	0.370		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	100
Climate Change (%)	45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	mh1	15 Winter	100	+45%	100/15 Summer	100/15 Summer			3.827	0.557
1.001	mh2	15 Summer	100	+45%	100/15 Summer	100/15 Summer			3.922	0.852
1.002	mh3	15 Winter	100	+45%	100/15 Summer	100/15 Summer			3.322	0.317
2.000	mh4	15 Winter	100	+45%	100/15 Summer	100/15 Summer			3.649	1.029
1.003	mh5	15 Winter	100	+45%	100/15 Summer				2.807	0.417

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	26.702	1.45			34.3	FLOOD	6
1.001	mh2	1.641	2.10			38.8	FLOOD	2
1.002	mh3	22.164	1.20			77.4	FLOOD	6
2.000	mh4	9.331	1.79			32.0	FLOOD	5
1.003	mh5	0.000	1.94			181.5	SURCHARGED	

Existing Network Details for Storm

* - Indicates pipe has been modified outside of System 1

	PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	k (mm)	HYD SECT	DIA (mm)	Section Type
*	1.000	34.000	0.340	100.0	0.083	3.00	0.600	o	225	Pipe/Conduit
*	1.001	25.600	1.100	23.3	0.084	0.00	0.600	o	675	Pipe/Conduit
*	1.002	20.000	0.200	100.0	0.084	0.00	0.600	o	675	Pipe/Conduit

	PN	US/MH Name	US/CL (m)	US/IL (m)	US C.Depth (m)	DS/CL (m)	DS/IL (m)	DS C.Depth (m)	Ctrl	US/MH (mm)
*	1.000	mh1	3.910	1.930	1.755	3.740	1.590	1.925		1200
*	1.001	mh2	3.740	1.140	1.925	3.350	0.040	2.635		1800
*	1.002	mh3	3.350	0.040	2.635	5.500	-0.160	4.985		1800

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
mh1	3.910	1.980	Open Manhole	1200	1.000	1.930	225				
mh2	3.740	2.600	Open Manhole	1800	1.001	1.140	675	1.000	1.590	225	
mh3	3.350	3.310	Open Manhole	1800	1.002	0.040	675	1.001	0.040	675	
	5.500	5.660	Open Manhole	0		OUTFALL		1.002	-0.160	675	

No coordinates have been specified, layout information cannot be produced.

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	225	mh1	3.910	1.930	1.755	Open Manhole	1200
1.001	o	675	mh2	3.740	1.140	1.925	Open Manhole	1800
1.002	o	675	mh3	3.350	0.040	2.635	Open Manhole	1800

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	34.000	100.0	mh2	3.740	1.590	1.925	Open Manhole	1800
1.001	25.600	23.3	mh3	3.350	0.040	2.635	Open Manhole	1800
1.002	20.000	100.0		5.500	-0.160	4.985	Open Manhole	0

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.002		5.500	-0.160	0.000	0	0

Simulation Criteria for Storm

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	E (1km)	0.310
Return Period (years)	1	F (1km)	2.498
FEH Rainfall Version	1999	Summer Storms	Yes
Site Location	GB 622800 309650 TG 22800 09650	Winter Storms	No
C (1km)	-0.024	Cv (Summer)	0.750
D1 (1km)	0.275	Cv (Winter)	0.840
D2 (1km)	0.370	Storm Duration (mins)	30
D3 (1km)	0.255		

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 20.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.406 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 2
Climate Change (%) 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	mh1	15 Summer	1	+0%					2.013	-0.142	0.000
1.001	mh2	15 Summer	1	+0%					1.198	-0.617	0.000
1.002	mh3	15 Summer	1	+0%					0.144	-0.571	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	0.28			13.5	OK	
1.001	mh2	0.02			23.6	OK	
1.002	mh3	0.06			33.2	OK	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 20.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.406 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 2
Climate Change (%)	0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	mh1	15 Summer	2	+0%					2.026	-0.129	0.000
1.001	mh2	15 Summer	2	+0%					1.210	-0.605	0.000
1.002	mh3	15 Summer	2	+0%					0.162	-0.553	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	0.36			17.5	OK	
1.001	mh2	0.02			30.3	OK	
1.002	mh3	0.08			42.9	OK	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH D3 (1km) 0.255
FEH Rainfall Version 1999 E (1km) 0.310
Site Location GB 622800 309650 TG 22800 09650 F (1km) 2.498
C (1km) -0.024 Cv (Summer) 0.750
D1 (1km) 0.275 Cv (Winter) 0.840
D2 (1km) 0.370

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 2, 30
Climate Change (%) 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	mh1	15 Summer	2	+0%					2.029	-0.126	0.000
1.001	mh2	15 Summer	2	+0%					1.211	-0.604	0.000
1.002	mh3	15 Summer	2	+0%					0.166	-0.549	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	0.37			18.3	OK	
1.001	mh2	0.02			31.7	OK	
1.002	mh3	0.08			44.9	OK	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.255
FEH Rainfall Version	1999	E (1km)	0.310
Site Location	GB 622800 309650 TG 22800 09650	F (1km)	2.498
C (1km)	-0.024	Cv (Summer)	0.750
D1 (1km)	0.275	Cv (Winter)	0.840
D2 (1km)	0.370		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	2, 30
Climate Change (%)	0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	mh1	15 Summer	30	+0%					2.135	-0.020	0.000
1.001	mh2	15 Summer	30	+0%					1.256	-0.559	0.000
1.002	mh3	15 Summer	30	+0%					0.263	-0.452	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	0.95			46.3	OK	
1.001	mh2	0.07			90.4	OK	
1.002	mh3	0.24			134.3	OK	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.255
FEH Rainfall Version	1999	E (1km)	0.310
Site Location	GB 622800 309650 TG 22800 09650	F (1km)	2.498
C (1km)	-0.024	Cv (Summer)	0.750
D1 (1km)	0.275	Cv (Winter)	0.840
D2 (1km)	0.370		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	30
Climate Change (%)	45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	mh1	15 Summer	30	+45%	30/15 Summer				2.515	0.360	0.000
1.001	mh2	15 Summer	30	+45%					1.282	-0.533	0.000
1.002	mh3	15 Summer	30	+45%					0.310	-0.405	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	1.40			68.3	SURCHARGED	
1.001	mh2	0.10			131.0	OK	
1.002	mh3	0.34			193.0	OK	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.255
FEH Rainfall Version	1999	E (1km)	0.310
Site Location	GB 622800 309650 TG 22800 09650	F (1km)	2.498
C (1km)	-0.024	Cv (Summer)	0.750
D1 (1km)	0.275	Cv (Winter)	0.840
D2 (1km)	0.370		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	100
Climate Change (%)	0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	mh1	15 Summer	100	+0%	100/15 Summer				2.581	0.426	0.000
1.001	mh2	15 Summer	100	+0%					1.285	-0.530	0.000
1.002	mh3	15 Summer	100	+0%					0.317	-0.398	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	1.46			71.4	SURCHARGED	
1.001	mh2	0.10			137.0	OK	
1.002	mh3	0.36			201.9	OK	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.255
FEH Rainfall Version	1999	E (1km)	0.310
Site Location	GB 622800 309650 TG 22800 09650	F (1km)	2.498
C (1km)	-0.024	Cv (Summer)	0.750
D1 (1km)	0.275	Cv (Winter)	0.840
D2 (1km)	0.370		

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 100
Climate Change (%) 45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	mh1	15 Summer	100	+45%	100/15 Summer				3.369	1.214	0.000
1.001	mh2	15 Summer	100	+45%					1.312	-0.503	0.000
1.002	mh3	15 Summer	100	+45%					0.382	-0.333	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	2.09			102.2	SURCHARGED	
1.001	mh2	0.15			196.6	OK	
1.002	mh3	0.51			289.8	OK	

Existing Network Details for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	k (mm)	HYD SECT	DIA (mm)	Section Type
1.000	16.200	0.250	64.8	0.035	3.00	0.600	o	150	Pipe/Conduit
1.001	27.300	0.170	160.6	0.035	0.00	0.600	o	150	Pipe/Conduit
1.002	20.000	0.100	200.0	0.035	0.00	0.600	o	150	Pipe/Conduit

PN	US/MH Name	US/CL (m)	US/IL (m)	US C.Depth (m)	DS/CL (m)	DS/IL (m)	DS C.Depth (m)	Ctrl	US/MH (mm)
1.000	mh1	3.500	2.810	0.540	3.560	2.560	0.850		1200
1.001	mh2	3.560	2.560	0.850	3.730	2.390	1.190		1200
1.002	mh3	3.730	2.390	1.190	5.500	2.290	3.060		1200

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
mh1	3.500	0.690	Open Manhole	1200	1.000	2.810	150				
mh2	3.560	1.000	Open Manhole	1200	1.001	2.560	150	1.000	2.560	150	
mh3	3.730	1.340	Open Manhole	1200	1.002	2.390	150	1.001	2.390	150	
	5.500	3.210	Open Manhole	0		OUTFALL		1.002	2.290	150	

No coordinates have been specified, layout information cannot be produced.

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	150	mh1	3.500	2.810	0.540	Open Manhole	1200
1.001	o	150	mh2	3.560	2.560	0.850	Open Manhole	1200
1.002	o	150	mh3	3.730	2.390	1.190	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	16.200	64.8	mh2	3.560	2.560	0.850	Open Manhole	1200
1.001	27.300	160.6	mh3	3.730	2.390	1.190	Open Manhole	1200
1.002	20.000	200.0		5.500	2.290	3.060	Open Manhole	0

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.002		5.500	2.290	0.000	0	0

Simulation Criteria for Storm

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	E (1km)	0.310
Return Period (years)	1	F (1km)	2.498
FEH Rainfall Version	1999	Summer Storms	Yes
Site Location	GB 622800 309650 TG 22800 09650	Winter Storms	No
C (1km)	-0.024	Cv (Summer)	0.750
D1 (1km)	0.275	Cv (Winter)	0.840
D2 (1km)	0.370	Storm Duration (mins)	30
D3 (1km)	0.255		

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 20.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.405 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 2
Climate Change (%) 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	mh1	15 Summer	1	+0%					2.866	-0.094	0.000
1.001	mh2	15 Summer	1	+0%	2/15 Summer				2.657	-0.053	0.000
1.002	mh3	15 Winter	1	+0%	1/15 Summer				2.552	0.012	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	0.29			5.9	OK	
1.001	mh2	0.71			9.5	OK	
1.002	mh3	1.08			12.7	SURCHARGED	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	20.000	Cv (Summer)	0.750
Region	England and Wales	Ratio R	0.405	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 2
Climate Change (%)	0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	mh1	15 Summer	2	+0%					2.874	-0.086	0.000
1.001	mh2	15 Summer	2	+0%	2/15 Summer				2.714	0.004	0.000
1.002	mh3	15 Winter	2	+0%	1/15 Summer				2.616	0.076	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	0.37			7.6	OK	
1.001	mh2	0.85			11.3	SURCHARGED	
1.002	mh3	1.34			15.8	SURCHARGED	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.255
FEH Rainfall Version	1999	E (1km)	0.310
Site Location	GB 622800 309650 TG 22800 09650	F (1km)	2.498
C (1km)	-0.024	Cv (Summer)	0.750
D1 (1km)	0.275	Cv (Winter)	0.840
D2 (1km)	0.370		

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 2, 30
Climate Change (%) 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	mh1	15 Summer	2	+0%	30/15 Summer	30/15 Summer			2.876	-0.084
1.001	mh2	15 Summer	2	+0%	2/15 Summer				2.734	0.024
1.002	mh3	15 Winter	2	+0%	2/15 Summer				2.631	0.091

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	0.000	0.39			8.0	OK	3
1.001	mh2	0.000	0.87			11.6	SURCHARGED	
1.002	mh3	0.000	1.39			16.4	SURCHARGED	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH D3 (1km) 0.255
FEH Rainfall Version 1999 E (1km) 0.310
Site Location GB 622800 309650 TG 22800 09650 F (1km) 2.498
C (1km) -0.024 Cv (Summer) 0.750
D1 (1km) 0.275 Cv (Winter) 0.840
D2 (1km) 0.370

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 2, 30
Climate Change (%) 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	mh1	15 Winter	30	+0%	30/15 Summer	30/15 Summer			3.503	0.543
1.001	mh2	15 Winter	30	+0%	2/15 Summer				3.524	0.814
1.002	mh3	15 Winter	30	+0%	2/15 Summer				3.287	0.747

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	2.756	0.89			18.2	FLOOD	3
1.001	mh2	0.000	1.59			21.2	FLOOD RISK	
1.002	mh3	0.000	2.87			33.7	SURCHARGED	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.255
FEH Rainfall Version	1999	E (1km)	0.310
Site Location	GB 622800 309650 TG 22800 09650	F (1km)	2.498
C (1km)	-0.024	Cv (Summer)	0.750
D1 (1km)	0.275	Cv (Winter)	0.840
D2 (1km)	0.370		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	30
Climate Change (%)	45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	mh1	15 Winter	30	+45%	30/15 Summer	30/15 Summer			3.509	0.549
1.001	mh2	15 Winter	30	+45%	30/15 Summer	30/15 Summer			3.561	0.851
1.002	mh3	15 Winter	30	+45%	30/15 Summer				3.477	0.937

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	8.863	1.06			21.7	FLOOD	5
1.001	mh2	1.320	1.63			21.7	FLOOD	2
1.002	mh3	0.000	3.20			37.6	FLOOD RISK	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.255
FEH Rainfall Version	1999	E (1km)	0.310
Site Location	GB 622800 309650 TG 22800 09650	F (1km)	2.498
C (1km)	-0.024	Cv (Summer)	0.750
D1 (1km)	0.275	Cv (Winter)	0.840
D2 (1km)	0.370		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	100
Climate Change (%)	0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	mh1	15 Winter	100	+0%	100/15 Summer	100/15 Summer			3.510	0.550
1.001	mh2	15 Winter	100	+0%	100/15 Summer	100/15 Summer			3.562	0.852
1.002	mh3	15 Winter	100	+0%	100/15 Summer				3.492	0.952

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	9.653	1.06			21.7	FLOOD	5
1.001	mh2	1.731	1.63			21.7	FLOOD	2
1.002	mh3	0.000	3.22			37.9	FLOOD RISK	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.255
FEH Rainfall Version	1999	E (1km)	0.310
Site Location	GB 622800 309650 TG 22800 09650	F (1km)	2.498
C (1km)	-0.024	Cv (Summer)	0.750
D1 (1km)	0.275	Cv (Winter)	0.840
D2 (1km)	0.370		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	100
Climate Change (%)	45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	mh1	15 Winter	100	+45%	100/15 Summer	100/15 Summer			3.518	0.558
1.001	mh2	15 Winter	100	+45%	100/15 Summer	100/15 Summer			3.567	0.857
1.002	mh3	15 Winter	100	+45%	100/15 Summer				3.568	1.028

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	17.703	1.06			21.8	FLOOD	7
1.001	mh2	7.432	1.85			24.7	FLOOD	4
1.002	mh3	0.000	3.37			39.6	FLOOD RISK	

Existing Network Details for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	k (mm)	HYD SECT	DIA (mm)	Section Type
1.000	43.200	0.750	57.6	0.133	3.00	0.600	o	225	Pipe/Conduit
1.001	24.300	0.115	211.3	0.133	0.00	0.600	o	225	Pipe/Conduit
1.002	6.400	0.070	91.4	0.133	0.00	0.600	o	300	Pipe/Conduit
1.003	51.700	0.355	145.6	0.133	0.00	0.600	o	300	Pipe/Conduit
2.000	32.400	0.430	75.3	0.133	5.00	0.600	o	225	Pipe/Conduit
2.001	8.500	1.070	7.9	0.133	0.00	0.600	o	225	Pipe/Conduit
1.004	20.000	0.067	298.5	0.399	0.00	0.600	o	675	Pipe/Conduit

PN	US/MH Name	US/CL (m)	US/IL (m)	US C.Depth (m)	DS/CL (m)	DS/IL (m)	DS C.Depth (m)	Ctrl	US/MH (mm)
1.000	mh1	4.070	2.810	1.035	3.540	2.060	1.255		1200
1.001	mh2	3.540	2.060	1.255	3.190	1.945	1.020		1200
1.002	mh3	3.190	1.870	1.020	2.900	1.800	0.800		1200
1.003	mh4	2.900	1.800	0.800	3.930	1.445	2.185		1200
2.000	mh5	3.840	3.020	0.595	3.890	2.590	1.075		1200
2.001	mh6	3.890	2.590	1.075	3.930	1.520	2.185		1200
1.004	mh7	3.930	1.070	2.185	5.500	1.003	3.822		1800

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
mh1	4.070	1.260	Open Manhole	1200	1.000	2.810	225				
mh2	3.540	1.480	Open Manhole	1200	1.001	2.060	225	1.000	2.060	225	
mh3	3.190	1.320	Open Manhole	1200	1.002	1.870	300	1.001	1.945	225	
mh4	2.900	1.100	Open Manhole	1200	1.003	1.800	300	1.002	1.800	300	
mh5	3.840	0.820	Open Manhole	1200	2.000	3.020	225				
mh6	3.890	1.300	Open Manhole	1200	2.001	2.590	225	2.000	2.590	225	
mh7	3.930	2.860	Open Manhole	1800	1.004	1.070	675	1.003	1.445	300	
								2.001	1.520	225	
	5.500	4.497	Open Manhole	0		OUTFALL		1.004	1.003	675	

No coordinates have been specified, layout information cannot be produced.

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	225	mh1	4.070	2.810	1.035	Open Manhole	1200
1.001	o	225	mh2	3.540	2.060	1.255	Open Manhole	1200
1.002	o	300	mh3	3.190	1.870	1.020	Open Manhole	1200
1.003	o	300	mh4	2.900	1.800	0.800	Open Manhole	1200
2.000	o	225	mh5	3.840	3.020	0.595	Open Manhole	1200
2.001	o	225	mh6	3.890	2.590	1.075	Open Manhole	1200
1.004	o	675	mh7	3.930	1.070	2.185	Open Manhole	1800

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	43.200	57.6	mh2	3.540	2.060	1.255	Open Manhole	1200
1.001	24.300	211.3	mh3	3.190	1.945	1.020	Open Manhole	1200
1.002	6.400	91.4	mh4	2.900	1.800	0.800	Open Manhole	1200
1.003	51.700	145.6	mh7	3.930	1.445	2.185	Open Manhole	1800
2.000	32.400	75.3	mh6	3.890	2.590	1.075	Open Manhole	1200
2.001	8.500	7.9	mh7	3.930	1.520	2.185	Open Manhole	1800
1.004	20.000	298.5		5.500	1.003	3.822	Open Manhole	0

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.004		5.500	1.003	0.000	0	0

Simulation Criteria for Storm

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.255
Return Period (years)	1	E (1km)	0.310
FEH Rainfall Version	1999	F (1km)	2.498
Site Location	GB 622800 309650 TG 22800 09650	Summer Storms	Yes
C (1km)	-0.024	Winter Storms	No
D1 (1km)	0.275	Cv (Summer)	0.750
D2 (1km)	0.370	Cv (Winter)	0.840

Synthetic Rainfall Details

Storm Duration (mins) 30

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 20.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.404 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 2
Climate Change (%) 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	mh1	15 Summer	1	+0%					2.902	-0.133	0.000
1.001	mh2	15 Winter	1	+0%	1/15 Summer				2.298	0.013	0.000
1.002	mh3	15 Winter	1	+0%					2.070	-0.100	0.000
1.003	mh4	15 Winter	1	+0%					1.998	-0.102	0.000
2.000	mh5	15 Winter	1	+0%					3.109	-0.136	0.000
2.001	mh6	15 Winter	1	+0%					2.664	-0.151	0.000
1.004	mh7	15 Winter	1	+0%					1.354	-0.391	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	0.33			21.4	OK	
1.001	mh2	1.07			35.1	SURCHARGED	
1.002	mh3	0.77			51.1	OK	
1.003	mh4	0.76			65.8	OK	
2.000	mh5	0.32			18.3	OK	
2.001	mh6	0.23			33.9	OK	
1.004	mh7	0.37			145.1	OK	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 20.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.404 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 2
Climate Change (%) 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	mh1	15 Summer	2	+0%					2.917	-0.118	0.000
1.001	mh2	15 Winter	2	+0%	1/15 Summer				2.391	0.106	0.000
1.002	mh3	15 Winter	2	+0%					2.111	-0.059	0.000
1.003	mh4	15 Winter	2	+0%					2.038	-0.062	0.000
2.000	mh5	15 Winter	2	+0%					3.123	-0.122	0.000
2.001	mh6	15 Winter	2	+0%					2.675	-0.140	0.000
1.004	mh7	15 Winter	2	+0%					1.399	-0.346	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	0.42			27.7	OK	
1.001	mh2	1.39			45.6	SURCHARGED	
1.002	mh3	1.00			66.1	OK	
1.003	mh4	0.98			85.3	OK	
2.000	mh5	0.42			23.6	OK	
2.001	mh6	0.30			43.8	OK	
1.004	mh7	0.47			186.5	OK	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.255
FEH Rainfall Version	1999	E (1km)	0.310
Site Location	GB 622800 309650 TG 22800 09650	F (1km)	2.498
C (1km)	-0.024	Cv (Summer)	0.750
D1 (1km)	0.275	Cv (Winter)	0.840
D2 (1km)	0.370		

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 2, 30
Climate Change (%) 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	mh1	15 Summer	2	+0%	30/15 Summer	30/15 Summer			2.920	-0.115
1.001	mh2	15 Winter	2	+0%	2/15 Summer	30/15 Summer			2.413	0.128
1.002	mh3	15 Winter	2	+0%	30/15 Summer	30/15 Summer			2.153	-0.017
1.003	mh4	15 Winter	2	+0%	30/15 Summer	30/15 Summer			2.055	-0.045
2.000	mh5	15 Winter	2	+0%	30/15 Summer				3.126	-0.119
2.001	mh6	15 Winter	2	+0%					2.678	-0.137
1.004	mh7	15 Winter	2	+0%	30/15 Summer				1.407	-0.338

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	0.000	0.44			29.0	OK	2
1.001	mh2	0.000	1.46			47.8	SURCHARGED	4
1.002	mh3	0.000	1.00			66.3	OK	
1.003	mh4	0.000	1.00			86.8	OK	3
2.000	mh5	0.000	0.44			24.8	OK	
2.001	mh6	0.000	0.31			45.9	OK	
1.004	mh7	0.000	0.49			194.5	OK	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH D3 (1km) 0.255
FEH Rainfall Version 1999 E (1km) 0.310
Site Location GB 622800 309650 TG 22800 09650 F (1km) 2.498
C (1km) -0.024 Cv (Summer) 0.750
D1 (1km) 0.275 Cv (Winter) 0.840
D2 (1km) 0.370

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 2, 30
Climate Change (%) 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	mh1	15 Summer	30	+0%	30/15 Summer	30/15 Summer			4.072	1.037
1.001	mh2	15 Winter	30	+0%	2/15 Summer	30/15 Summer			3.554	1.269
1.002	mh3	15 Summer	30	+0%	30/15 Summer	30/15 Summer			3.164	0.994
1.003	mh4	15 Winter	30	+0%	30/15 Summer	30/15 Summer			2.906	0.806
2.000	mh5	15 Winter	30	+0%	30/15 Summer				3.351	0.106
2.001	mh6	15 Winter	30	+0%					2.756	-0.059
1.004	mh7	15 Winter	30	+0%	30/15 Summer				1.791	0.046

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	1.953	0.84			54.6	FLOOD	2
1.001	mh2	13.521	2.99			98.0	FLOOD	4
1.002	mh3	0.026	1.93			128.0	FLOOD	
1.003	mh4	6.371	1.82			157.7	FLOOD	3
2.000	mh5	0.000	1.11			62.3	SURCHARGED	
2.001	mh6	0.000	0.87			127.3	OK	
1.004	mh7	0.000	1.21			475.4	SURCHARGED	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH D3 (1km) 0.255
FEH Rainfall Version 1999 E (1km) 0.310
Site Location GB 622800 309650 TG 22800 09650 F (1km) 2.498
C (1km) -0.024 Cv (Summer) 0.750
D1 (1km) 0.275 Cv (Winter) 0.840
D2 (1km) 0.370

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 30
Climate Change (%) 45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	mh1	15 Summer	30	+45%	30/15 Summer	30/15 Summer			4.078	1.043
1.001	mh2	15 Winter	30	+45%	30/15 Summer	30/15 Summer			3.569	1.284
1.002	mh3	15 Summer	30	+45%	30/15 Summer	30/15 Summer			3.194	1.024
1.003	mh4	15 Winter	30	+45%	30/15 Summer	30/15 Summer			2.921	0.821
2.000	mh5	15 Winter	30	+45%	30/15 Summer	30/15 Summer			3.843	0.598
2.001	mh6	15 Winter	30	+45%	30/15 Summer				3.264	0.449
1.004	mh7	15 Winter	30	+45%	30/15 Summer				1.875	0.130

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	8.327	0.84			54.7	FLOOD	4
1.001	mh2	28.930	3.16			103.7	FLOOD	5
1.002	mh3	3.566	2.02			133.9	FLOOD	2
1.003	mh4	21.015	1.83			158.7	FLOOD	5
2.000	mh5	2.682	1.51			84.9	FLOOD	2
2.001	mh6	0.000	1.11			161.9	SURCHARGED	
1.004	mh7	0.000	1.52			598.6	SURCHARGED	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH D3 (1km) 0.255
FEH Rainfall Version 1999 E (1km) 0.310
Site Location GB 622800 309650 TG 22800 09650 F (1km) 2.498
C (1km) -0.024 Cv (Summer) 0.750
D1 (1km) 0.275 Cv (Winter) 0.840
D2 (1km) 0.370

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 100
Climate Change (%) 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	mh1	15 Summer	100	+0%	100/15 Summer	100/15 Summer			4.080	1.045
1.001	mh2	15 Winter	100	+0%	100/15 Summer	100/15 Summer			3.571	1.286
1.002	mh3	15 Summer	100	+0%	100/15 Summer	100/15 Summer			3.195	1.025
1.003	mh4	15 Winter	100	+0%	100/15 Summer	100/15 Summer			2.923	0.823
2.000	mh5	15 Winter	100	+0%	100/15 Summer	100/15 Summer			3.844	0.599
2.001	mh6	15 Winter	100	+0%	100/15 Summer				3.295	0.480
1.004	mh7	15 Winter	100	+0%	100/15 Summer				1.887	0.142

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	9.518	0.84			54.7	FLOOD	4
1.001	mh2	31.113	3.17			103.9	FLOOD	6
1.002	mh3	4.576	2.02			133.9	FLOOD	3
1.003	mh4	22.879	1.83			158.9	FLOOD	5
2.000	mh5	3.961	1.54			86.5	FLOOD	2
2.001	mh6	0.000	1.14			166.3	SURCHARGED	
1.004	mh7	0.000	1.56			617.1	SURCHARGED	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH D3 (1km) 0.255
FEH Rainfall Version 1999 E (1km) 0.310
Site Location GB 622800 309650 TG 22800 09650 F (1km) 2.498
C (1km) -0.024 Cv (Summer) 0.750
D1 (1km) 0.275 Cv (Winter) 0.840
D2 (1km) 0.370

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 100
Climate Change (%) 45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	mh1	15 Summer	100	+45%	100/15 Summer	100/15 Summer			4.092	1.057
1.001	mh2	15 Winter	100	+45%	100/15 Summer	100/15 Summer			3.592	1.307
1.002	mh3	15 Summer	100	+45%	100/15 Summer	100/15 Summer			3.205	1.035
1.003	mh4	15 Winter	100	+45%	100/15 Summer	100/15 Summer			2.943	0.843
2.000	mh5	15 Winter	100	+45%	100/15 Summer	100/15 Summer			3.863	0.618
2.001	mh6	15 Winter	100	+45%	100/15 Summer				3.705	0.890
1.004	mh7	15 Winter	100	+45%	100/15 Summer				2.015	0.270

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	21.872	0.84			54.7	FLOOD	6
1.001	mh2	52.445	3.18			104.3	FLOOD	7
1.002	mh3	15.174	2.02			133.8	FLOOD	4
1.003	mh4	43.311	1.85			160.3	FLOOD	6
2.000	mh5	23.098	1.57			88.1	FLOOD	4
2.001	mh6	0.000	1.26			183.2	FLOOD RISK	
1.004	mh7	0.000	1.95			770.8	SURCHARGED	

Existing Network Details for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	k (mm)	HYD SECT	DIA (mm)	Section Type
1.000	41.600	0.735	56.6	0.123	3.00	0.600	o	225	Pipe/Conduit
2.000	17.900	0.015	1193.3	0.123	5.00	0.600	o	225	Pipe/Conduit
1.001	52.600	0.400	131.5	0.123	0.00	0.600	o	300	Pipe/Conduit
1.002	44.400	0.380	116.8	0.123	0.00	0.600	o	300	Pipe/Conduit
3.000	16.400	0.230	71.3	0.123	5.00	0.600	o	225	Pipe/Conduit
3.001	44.400	0.400	111.0	0.123	0.00	0.600	o	225	Pipe/Conduit
3.002	38.000	0.065	584.6	0.123	0.00	0.600	o	225	Pipe/Conduit
3.003	3.400	0.750	4.5	0.123	0.00	0.600	o	300	Pipe/Conduit
3.004	10.000	0.050	200.0	0.124	0.00	0.600	o	300	Pipe/Conduit
1.003	18.000	0.090	200.0	0.124	0.00	0.600	o	375	Pipe/Conduit
1.004	14.100	0.071	198.6	0.123	0.00	0.600	o	375	Pipe/Conduit
1.005	10.000	0.023	434.8	0.124	0.00	0.600	o	675	Pipe/Conduit

PN	US/MH Name	US/CL (m)	US/IL (m)	US C.Depth (m)	DS/CL (m)	DS/IL (m)	DS C.Depth (m)	Ctrl	US/MH (mm)
1.000	mh1	4.480	2.990	1.265	4.180	2.255	1.700		1200
2.000	mh2	4.190	2.270	1.695	4.180	2.255	1.700		1200
1.001	mh3	4.180	2.180	1.700	4.520	1.780	2.440		1200
1.002	mh4	4.520	1.780	2.440	4.100	1.400	2.400		1200
3.000	mh5	4.290	2.970	1.095	4.310	2.740	1.345		1200
3.001	mh6	4.310	2.740	1.345	4.260	2.340	1.695		1200
3.002	mh7	4.260	2.340	1.695	4.160	2.275	1.660		1200
3.003	mh8	4.160	2.200	1.660	4.100	1.450	2.350		1200
3.004	mh9	4.100	1.450	2.350	4.100	1.400	2.400		1200
1.003	mh10	4.100	1.325	2.400	4.100	1.235	2.490		1500
1.004	mh11	4.100	1.235	2.490	4.840	1.164	3.301		1500
1.005	mh12	4.840	0.864	3.301	5.500	0.841	3.984		1800

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
mh1	4.480	1.490	Open Manhole	1200	1.000	2.990	225				
mh2	4.190	1.920	Open Manhole	1200	2.000	2.270	225				
mh3	4.180	2.000	Open Manhole	1200	1.001	2.180	300	1.000	2.255	225	
								2.000	2.255	225	
mh4	4.520	2.740	Open Manhole	1200	1.002	1.780	300	1.001	1.780	300	
mh5	4.290	1.320	Open Manhole	1200	3.000	2.970	225				
mh6	4.310	1.570	Open Manhole	1200	3.001	2.740	225	3.000	2.740	225	
mh7	4.260	1.920	Open Manhole	1200	3.002	2.340	225	3.001	2.340	225	
mh8	4.160	1.960	Open Manhole	1200	3.003	2.200	300	3.002	2.275	225	
mh9	4.100	2.650	Open Manhole	1200	3.004	1.450	300	3.003	1.450	300	
mh10	4.100	2.775	Open Manhole	1500	1.003	1.325	375	1.002	1.400	300	
								3.004	1.400	300	
mh11	4.100	2.865	Open Manhole	1500	1.004	1.235	375	1.003	1.235	375	
mh12	4.840	3.976	Open Manhole	1800	1.005	0.864	675	1.004	1.164	375	
	5.500	4.659	Open Manhole	0		OUTFALL		1.005	0.841	675	

No coordinates have been specified, layout information cannot be produced.

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	225	mh1	4.480	2.990	1.265	Open Manhole	1200
2.000	o	225	mh2	4.190	2.270	1.695	Open Manhole	1200
1.001	o	300	mh3	4.180	2.180	1.700	Open Manhole	1200
1.002	o	300	mh4	4.520	1.780	2.440	Open Manhole	1200
3.000	o	225	mh5	4.290	2.970	1.095	Open Manhole	1200
3.001	o	225	mh6	4.310	2.740	1.345	Open Manhole	1200
3.002	o	225	mh7	4.260	2.340	1.695	Open Manhole	1200
3.003	o	300	mh8	4.160	2.200	1.660	Open Manhole	1200
3.004	o	300	mh9	4.100	1.450	2.350	Open Manhole	1200
1.003	o	375	mh10	4.100	1.325	2.400	Open Manhole	1500
1.004	o	375	mh11	4.100	1.235	2.490	Open Manhole	1500
1.005	o	675	mh12	4.840	0.864	3.301	Open Manhole	1800

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	41.600	56.6	mh3	4.180	2.255	1.700	Open Manhole	1200
2.000	17.900	1193.3	mh3	4.180	2.255	1.700	Open Manhole	1200
1.001	52.600	131.5	mh4	4.520	1.780	2.440	Open Manhole	1200
1.002	44.400	116.8	mh10	4.100	1.400	2.400	Open Manhole	1500
3.000	16.400	71.3	mh6	4.310	2.740	1.345	Open Manhole	1200
3.001	44.400	111.0	mh7	4.260	2.340	1.695	Open Manhole	1200
3.002	38.000	584.6	mh8	4.160	2.275	1.660	Open Manhole	1200
3.003	3.400	4.5	mh9	4.100	1.450	2.350	Open Manhole	1200
3.004	10.000	200.0	mh10	4.100	1.400	2.400	Open Manhole	1500
1.003	18.000	200.0	mh11	4.100	1.235	2.490	Open Manhole	1500
1.004	14.100	198.6	mh12	4.840	1.164	3.301	Open Manhole	1800
1.005	10.000	434.8		5.500	0.841	3.984	Open Manhole	0

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.005		5.500	0.841	0.000	0	0

Simulation Criteria for Storm

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	E (1km)	0.310
Return Period (years)	1	F (1km)	2.498
FEH Rainfall Version	1999	Summer Storms	Yes
Site Location	GB 622800 309650 TG 22800 09650	Winter Storms	No
C (1km)	-0.024	Cv (Summer)	0.750
D1 (1km)	0.275	Cv (Winter)	0.840
D2 (1km)	0.370	Storm Duration (mins)	30
D3 (1km)	0.255		

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 20.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.405 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 2
Climate Change (%) 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	mh1	15 Summer	1	+0%					3.078	-0.137	0.000
2.000	mh2	15 Winter	1	+0%	1/15 Summer				2.503	0.008	0.000
1.001	mh3	15 Winter	1	+0%					2.339	-0.141	0.000
1.002	mh4	15 Winter	1	+0%	2/15 Summer				1.959	-0.121	0.000
3.000	mh5	15 Winter	1	+0%	2/15 Winter				3.057	-0.138	0.000
3.001	mh6	15 Winter	1	+0%	2/15 Summer				2.936	-0.029	0.000
3.002	mh7	15 Winter	1	+0%	1/15 Summer				2.779	0.214	0.000
3.003	mh8	15 Winter	1	+0%					2.302	-0.198	0.000
3.004	mh9	15 Winter	1	+0%	1/15 Summer				1.877	0.127	0.000
1.003	mh10	15 Winter	1	+0%	1/15 Summer				1.803	0.103	0.000
1.004	mh11	15 Winter	1	+0%	1/15 Summer				1.673	0.063	0.000
1.005	mh12	15 Winter	1	+0%					1.299	-0.240	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	0.30			20.0	OK	
2.000	mh2	1.68			16.9	SURCHARGED	
1.001	mh3	0.54			49.1	OK	
1.002	mh4	0.65			62.6	OK	
3.000	mh5	0.31			17.2	OK	
3.001	mh6	0.63			29.4	OK	
3.002	mh7	2.08			41.8	SURCHARGED	
3.003	mh8	0.25			54.4	OK	
3.004	mh9	1.10			67.2	SURCHARGED	
1.003	mh10	1.19			138.8	SURCHARGED	
1.004	mh11	1.41			151.1	SURCHARGED	
1.005	mh12	0.73			164.1	OK	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 20.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.405 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 2
Climate Change (%) 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	mh1	15 Summer	2	+0%					3.092	-0.123	0.000
2.000	mh2	15 Winter	2	+0%	1/15 Summer				2.514	0.019	0.000
1.001	mh3	15 Winter	2	+0%					2.368	-0.112	0.000
1.002	mh4	15 Winter	2	+0%	2/15 Summer				2.148	0.068	0.000
3.000	mh5	15 Summer	2	+0%	2/15 Winter				3.131	-0.064	0.000
3.001	mh6	15 Winter	2	+0%	2/15 Summer				3.160	0.195	0.000
3.002	mh7	15 Winter	2	+0%	1/15 Summer				2.925	0.360	0.000
3.003	mh8	15 Winter	2	+0%					2.315	-0.185	0.000
3.004	mh9	15 Winter	2	+0%	1/15 Summer				2.054	0.304	0.000
1.003	mh10	15 Winter	2	+0%	1/15 Summer				1.941	0.241	0.000
1.004	mh11	15 Winter	2	+0%	1/15 Summer				1.747	0.137	0.000
1.005	mh12	15 Winter	2	+0%					1.354	-0.185	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	0.39			25.9	OK	
2.000	mh2	2.18			21.8	SURCHARGED	
1.001	mh3	0.69			63.4	OK	
1.002	mh4	0.74			71.1	SURCHARGED	
3.000	mh5	0.38			21.0	OK	
3.001	mh6	0.75			35.4	SURCHARGED	
3.002	mh7	2.55			51.3	SURCHARGED	
3.003	mh8	0.31			66.9	OK	
3.004	mh9	1.36			83.2	SURCHARGED	
1.003	mh10	1.46			169.9	SURCHARGED	
1.004	mh11	1.73			185.2	SURCHARGED	
1.005	mh12	0.90			200.8	OK	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.255
FEH Rainfall Version	1999	E (1km)	0.310
Site Location	GB 622800 309650 TG 22800 09650	F (1km)	2.498
C (1km)	-0.024	Cv (Summer)	0.750
D1 (1km)	0.275	Cv (Winter)	0.840
D2 (1km)	0.370		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	2, 30
Climate Change (%)	0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	mh1	15 Summer	2	+0%	30/15 Summer	30/15 Summer			3.094	-0.121
2.000	mh2	15 Winter	2	+0%	2/15 Summer	30/15 Summer			2.516	0.021
1.001	mh3	15 Winter	2	+0%	30/15 Summer	30/15 Summer			2.374	-0.106
1.002	mh4	15 Winter	2	+0%	2/15 Summer				2.199	0.119
3.000	mh5	15 Winter	2	+0%	2/15 Winter	30/15 Summer			3.261	0.066
3.001	mh6	15 Winter	2	+0%	2/15 Summer	30/15 Summer			3.223	0.258
3.002	mh7	15 Winter	2	+0%	2/15 Summer	30/15 Summer			2.968	0.403
3.003	mh8	15 Winter	2	+0%	30/15 Summer				2.318	-0.182
3.004	mh9	15 Winter	2	+0%	2/15 Summer				2.099	0.349
1.003	mh10	15 Winter	2	+0%	2/15 Summer				1.976	0.276
1.004	mh11	15 Winter	2	+0%	2/15 Summer				1.766	0.156
1.005	mh12	15 Winter	2	+0%	30/15 Summer				1.365	-0.174

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	0.000	0.41			27.1	OK	2
2.000	mh2	0.000	2.28			22.9	SURCHARGED	4
1.001	mh3	0.000	0.73			66.5	OK	3
1.002	mh4	0.000	0.76			73.3	SURCHARGED	
3.000	mh5	0.000	0.39			21.4	SURCHARGED	5
3.001	mh6	0.000	0.79			37.0	SURCHARGED	4
3.002	mh7	0.000	2.66			53.6	SURCHARGED	3
3.003	mh8	0.000	0.32			69.8	OK	
3.004	mh9	0.000	1.42			86.7	SURCHARGED	

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

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.003	mh10	0.000	1.52			176.7	SURCHARGED	
1.004	mh11	0.000	1.80			192.7	SURCHARGED	
1.005	mh12	0.000	0.94			209.1	OK	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH D3 (1km) 0.255
FEH Rainfall Version 1999 E (1km) 0.310
Site Location GB 622800 309650 TG 22800 09650 F (1km) 2.498
C (1km) -0.024 Cv (Summer) 0.750
D1 (1km) 0.275 Cv (Winter) 0.840
D2 (1km) 0.370

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 2, 30
Climate Change (%) 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	mh1	15 Summer	30	+0%	30/15 Summer	30/15 Summer			4.482	1.267
2.000	mh2	15 Winter	30	+0%	2/15 Summer	30/15 Summer			4.203	1.708
1.001	mh3	15 Winter	30	+0%	30/15 Summer	30/15 Summer			4.188	1.708
1.002	mh4	15 Winter	30	+0%	2/15 Summer				4.083	2.003
3.000	mh5	15 Winter	30	+0%	2/15 Winter	30/15 Summer			4.311	1.116
3.001	mh6	15 Winter	30	+0%	2/15 Summer	30/15 Summer			4.319	1.354
3.002	mh7	15 Winter	30	+0%	2/15 Summer	30/15 Summer			4.267	1.702
3.003	mh8	15 Summer	30	+0%	30/15 Summer				4.149	1.649
3.004	mh9	15 Winter	30	+0%	2/15 Summer				3.989	2.239
1.003	mh10	15 Summer	30	+0%	2/15 Summer				3.516	1.816
1.004	mh11	15 Winter	30	+0%	2/15 Summer				2.722	1.112
1.005	mh12	15 Winter	30	+0%	30/15 Summer				1.611	0.072

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	1.797	0.72			47.6	FLOOD	2
2.000	mh2	13.158	9.28			93.1	FLOOD	4
1.001	mh3	7.788	1.28			117.1	FLOOD	3
1.002	mh4	0.000	1.43			137.3	SURCHARGED	
3.000	mh5	21.361	1.20			65.9	FLOOD	5
3.001	mh6	8.840	1.45			68.1	FLOOD	4
3.002	mh7	6.747	4.12			82.8	FLOOD	3
3.003	mh8	0.000	0.52			112.9	FLOOD RISK	
3.004	mh9	0.000	2.75			168.4	FLOOD RISK	

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

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.003	mh10	0.000	2.99			348.0	SURCHARGED	
1.004	mh11	0.000	3.79			406.5	SURCHARGED	
1.005	mh12	0.000	2.08			465.7	SURCHARGED	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH D3 (1km) 0.255
FEH Rainfall Version 1999 E (1km) 0.310
Site Location GB 622800 309650 TG 22800 09650 F (1km) 2.498
C (1km) -0.024 Cv (Summer) 0.750
D1 (1km) 0.275 Cv (Winter) 0.840
D2 (1km) 0.370

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 30
Climate Change (%) 45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	mh1	15 Winter	30	+45%	30/15 Summer	30/15 Summer			4.490	1.275
2.000	mh2	15 Winter	30	+45%	30/15 Summer	30/15 Summer			4.217	1.722
1.001	mh3	15 Winter	30	+45%	30/15 Summer	30/15 Summer			4.207	1.727
1.002	mh4	15 Winter	30	+45%	30/15 Summer				4.228	2.148
3.000	mh5	15 Summer	30	+45%	30/15 Summer	30/15 Summer			4.320	1.125
3.001	mh6	15 Winter	30	+45%	30/15 Summer	30/15 Summer			4.330	1.365
3.002	mh7	15 Winter	30	+45%	30/15 Summer	30/15 Summer			4.282	1.717
3.003	mh8	15 Summer	30	+45%	30/15 Summer	30/15 Summer			4.169	1.669
3.004	mh9	15 Summer	30	+45%	30/15 Summer	30/15 Summer			4.101	2.351
1.003	mh10	15 Winter	30	+45%	30/15 Summer				3.734	2.034
1.004	mh11	15 Summer	30	+45%	30/15 Summer				3.014	1.404
1.005	mh12	15 Summer	30	+45%	30/15 Summer				1.667	0.128

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	10.403	0.66			43.4	FLOOD	5
2.000	mh2	27.419	10.97			110.1	FLOOD	5
1.001	mh3	27.164	1.56			142.7	FLOOD	5
1.002	mh4	0.000	1.49			143.2	FLOOD RISK	
3.000	mh5	30.269	1.21			66.5	FLOOD	6
3.001	mh6	19.760	1.58			74.5	FLOOD	5
3.002	mh7	22.656	4.88			98.1	FLOOD	5
3.003	mh8	8.972	0.72			156.8	FLOOD	3
3.004	mh9	1.296	3.08			188.8	FLOOD	2

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

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.003	mh10	0.000	3.06			356.1	SURCHARGED	
1.004	mh11	0.000	4.14			444.0	SURCHARGED	
1.005	mh12	0.000	2.40			536.9	SURCHARGED	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.255
FEH Rainfall Version	1999	E (1km)	0.310
Site Location	GB 622800 309650 TG 22800 09650	F (1km)	2.498
C (1km)	-0.024	Cv (Summer)	0.750
D1 (1km)	0.275	Cv (Winter)	0.840
D2 (1km)	0.370		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	100
Climate Change (%)	0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	mh1	15 Summer	100	+0%	100/15 Summer	100/15 Summer			4.490	1.275
2.000	mh2	15 Winter	100	+0%	100/15 Summer	100/15 Summer			4.220	1.725
1.001	mh3	15 Winter	100	+0%	100/15 Summer	100/15 Summer			4.210	1.730
1.002	mh4	15 Winter	100	+0%	100/15 Summer				4.224	2.144
3.000	mh5	15 Winter	100	+0%	100/15 Summer	100/15 Summer			4.327	1.132
3.001	mh6	15 Summer	100	+0%	100/15 Summer	100/15 Summer			4.328	1.363
3.002	mh7	15 Winter	100	+0%	100/15 Summer	100/15 Summer			4.285	1.720
3.003	mh8	15 Winter	100	+0%	100/15 Summer	100/15 Summer			4.172	1.672
3.004	mh9	15 Summer	100	+0%	100/15 Summer	100/15 Summer			4.102	2.352
1.003	mh10	15 Winter	100	+0%	100/15 Summer				3.754	2.054
1.004	mh11	15 Summer	100	+0%	100/15 Summer				3.026	1.416
1.005	mh12	15 Summer	100	+0%	100/15 Summer				1.674	0.135

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	9.879	0.67			44.1	FLOOD	5
2.000	mh2	29.582	11.04			110.8	FLOOD	6
1.001	mh3	30.365	1.59			145.0	FLOOD	5
1.002	mh4	0.000	1.50			144.4	FLOOD RISK	
3.000	mh5	36.923	1.21			66.4	FLOOD	6
3.001	mh6	17.722	1.59			74.7	FLOOD	6
3.002	mh7	24.793	4.98			100.0	FLOOD	5
3.003	mh8	12.086	0.73			159.2	FLOOD	3
3.004	mh9	2.308	3.09			189.0	FLOOD	2

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

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.003	mh10	0.000	3.04			354.5	SURCHARGED	
1.004	mh11	0.000	4.16			446.3	SURCHARGED	
1.005	mh12	0.000	2.44			544.4	SURCHARGED	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.255
FEH Rainfall Version	1999	E (1km)	0.310
Site Location	GB 622800 309650 TG 22800 09650	F (1km)	2.498
C (1km)	-0.024	Cv (Summer)	0.750
D1 (1km)	0.275	Cv (Winter)	0.840
D2 (1km)	0.370		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	100
Climate Change (%)	45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	mh1	60 Winter	100	+45%	100/15 Summer	100/15 Summer			4.484	1.269
2.000	mh2	15 Winter	100	+45%	100/15 Summer	100/15 Summer			4.241	1.746
1.001	mh3	15 Summer	100	+45%	100/15 Summer	100/15 Summer			4.232	1.752
1.002	mh4	15 Summer	100	+45%	100/15 Summer	100/15 Summer			4.520	2.440
3.000	mh5	15 Summer	100	+45%	100/15 Summer	100/15 Summer			4.339	1.144
3.001	mh6	15 Winter	100	+45%	100/15 Summer	100/15 Summer			4.349	1.384
3.002	mh7	15 Winter	100	+45%	100/15 Summer	100/15 Summer			4.304	1.739
3.003	mh8	15 Winter	100	+45%	100/15 Summer	100/15 Summer			4.194	1.694
3.004	mh9	15 Summer	100	+45%	100/15 Summer	100/15 Summer			4.119	2.369
1.003	mh10	15 Summer	100	+45%	100/15 Summer				3.964	2.264
1.004	mh11	15 Summer	100	+45%	100/15 Summer				3.217	1.607
1.005	mh12	15 Winter	100	+45%	100/15 Summer				1.722	0.183

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	mh1	3.779	0.64			42.0	FLOOD	6
2.000	mh2	51.394	11.22			112.5	FLOOD	7
1.001	mh3	52.378	1.64			149.8	FLOOD	6
1.002	mh4	0.548	1.54			147.7	FLOOD	1
3.000	mh5	48.940	1.20			65.7	FLOOD	8
3.001	mh6	39.171	1.60			75.1	FLOOD	7
3.002	mh7	44.090	4.88			98.2	FLOOD	6
3.003	mh8	33.935	0.72			157.1	FLOOD	5
3.004	mh9	18.661	3.49			213.6	FLOOD	3

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

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.003	mh10	0.000	3.06			356.4	FLOOD RISK	
1.004	mh11	0.000	4.46			478.1	SURCHARGED	
1.005	mh12	0.000	2.76			616.8	SURCHARGED	

Appendix: I – Greenfield Run-off Rate Calculations

Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk

Simulation Settings

Rainfall Methodology	FEH-13	Skip Steady State	x	1 year (l/s)	0.5
Summer CV	0.750	Drain Down Time (mins)	240	30 year (l/s)	1.4
Winter CV	0.840	Additional Storage (m³/ha)	20.0	100 year (l/s)	2.0
Analysis Speed	Normal	Check Discharge Rate(s)	✓	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

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	2.55
Greenfield Method	FEH	Growth Factor 100 year	3.56
Positively Drained Area (ha)	1.000	Betterment (%)	0
SAAR (mm)	634	QMed	0.5
Host	1	QBar	0.6
BFIHost	0.859	Q 1 year (l/s)	0.5
Region	5	Q 30 year (l/s)	1.4
QBar/QMed conversion factor	1.124	Q 100 year (l/s)	2.0
Growth Factor 1 year	0.87		

Simulation Settings

Rainfall Methodology	FEH-13	Skip Steady State	x	1 year (l/s)	0.5
Summer CV	0.750	Drain Down Time (mins)	240	30 year (l/s)	1.4
Winter CV	0.840	Additional Storage (m^3/ha)	20.0	100 year (l/s)	2.0
Analysis Speed	Normal	Check Discharge Rate(s)	✓	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

Pre-development Discharge Rate

Site Makeup	Greenfield	Betterment (%)	0
Greenfield Method	ReFH2	Q 1 year (l/s)	0.9
Region	England, Wales, NI	Q 30 year (l/s)	3.0
Include Baseflow	x	Q 100 year (l/s)	4.1
Positively Drained Area (ha)	1.000		

Anglia Square
Greenfield Run-off Rates using FEH Methods

			FEH GRR					RFEH2 GRR				
			1 in 1 year Greenfield Runoff Rate (based on 0.5 l/s/ha)	1 in 30 year Greenfield Runoff Rate (based on 1.4 l/s/ha)	1 in 30 year + 45% Climate Change Greenfield Runoff Rate (based on 2.9 l/s/ha)	1 in 100 year Greenfield Runoff Rate (based on 2.0 l/s/ha)	1 in 100 year + 45% Climate Change Greenfield Runoff Rate (based on 1.4 l/s/ha)	1 in 1 year Greenfield Runoff Rate (based on 0.9 l/s/ha)	1 in 30 year Greenfield Runoff Rate (based on 3.0 l/s/ha)	1 in 30 year + 45% Climate Change Greenfield Runoff Rate (based on 4.35 l/s/ha)	1 in 100 year Greenfield Runoff Rate (based on 4.1 l/s/ha)	1 in 100 year + 45% Climate Change Greenfield Runoff Rate (based on 5.9 l/s/ha)
			0.5	1.4	2.03	2	2.9	0.9	3	4.35	4.1	5.9
	(ha)											
Total Site Area	4.65		**2.325**	**6.51**	**9.4395**	**9.3**	**13.485**	**4.185**	**13.95**	**20.2275**	**19.065**	**27.435**
Block B Total Area	0.2692		0.1346	0.37688	0.546476	0.5384	0.78068	0.24228	0.8076	1.17102	1.10372	1.58828
Block B Impermeable Area	0.1651		0.08255	0.23114	0.335153	0.3302	0.47879	0.14859	0.4953	0.718185	0.67691	0.97409
Block C Total Area	0.1263		0.06315	0.17682	0.256389	0.2526	0.36627	0.11367	0.3789	0.549405	0.51783	0.74517
Block C Impermeable Area	0.075		0.0375	0.105	0.15225	0.15	0.2175	0.0675	0.225	0.32625	0.3075	0.4425
Block D Total Area	0.258		0.129	0.3612	0.52374	0.516	0.7482	0.2322	0.774	1.1223	1.0578	1.5222
(NB: total catchment considered impermeable)												
Block A, M, K/L and J3 Total Area	1.485		0.7425	2.079	3.01455	2.97	4.3065	1.3365	4.455	6.45975	6.0885	8.7615
(NB: total catchment considered impermeable)												
Botolph Street Total Area	0.163		0.0815	0.2282	0.33089	0.326	0.4727	0.1467	0.489	0.70905	0.6683	0.9617
(NB: total catchment considered impermeable)												
Block E Total Area	0.642		0.321	0.8988	1.30326	1.284	1.8618	0.5778	1.926	2.7927	2.6322	3.7878
(NB: total catchment considered impermeable)												
Block F Total Area	0.446		0.223	0.6244	0.90538	0.892	1.2934	0.4014	1.338	1.9401	1.8286	2.6314
(NB: total catchment considered impermeable)												
Block G&J Total Area	0.964		0.482	1.3496	1.95692	1.928	2.7956	0.8676	2.892	4.1934	3.9524	5.6876
(NB: total catchment considered impermeable)												
Block H Total Area	0.346		0.173	0.4844	0.70238	0.692	1.0034	0.3114	1.038	1.5051	1.4186	2.0414
(NB: total catchment considered impermeable)												
Total Proposed Contributing Area	**4.7**		**2.35**	**6.58**	**9.541**	**9.4**	**13.63**	**4.23**	**14.1**	**20.445**	**19.27**	**27.73**
NB: Causeway Flow (and also MicroDrainage) hydraulic modeling software does not generate greenfield runoff rates including Climate Change Allowance. Causeway Flow were contacted to ascertain how a Climate Change Allowance could be applied to the generated greenfield flow rate, but they were unable to confirm how this could be done. For the purpose of discussion, it is proposed to apply a growth-factor to the greenfield run-off rates. As such, for 45% Climate Change Allowance, for that storm event, the greenfield runoff rate shall be multiplied by 1.45.					**As such 1:30yr +45% CC is calculated at 1.4 x 1.45 = 2.03**		**As such 1:100yr +45% CC is calculated at 2.0 x 1.45 = 2.9**			**As such 1:30yr +45% CC is calculated at 3.0 x 1.45 = 4.35**		**As such 1:100yr +45% CC is calculated at 4.1 x 1.45 = 5.9**

Appendix J – Greenfield vs. Brownfield Storage Volumes

Summary of Results for 100 year Return Period (+45%)

Half Drain Time : 261 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	1.703	1.203	0.0	28.1	28.1	599.9	O K
30 min Summer	1.823	1.323	0.0	28.1	28.1	660.0	O K
60 min Summer	1.918	1.418	0.0	28.1	28.1	707.2	O K
120 min Summer	1.945	1.445	0.0	28.1	28.1	720.7	O K
180 min Summer	1.902	1.402	0.0	28.1	28.1	699.3	O K
240 min Summer	1.838	1.338	0.0	28.1	28.1	667.1	O K
360 min Summer	1.728	1.228	0.0	28.1	28.1	612.7	O K
480 min Summer	1.638	1.138	0.0	28.1	28.1	567.4	O K
600 min Summer	1.556	1.056	0.0	28.1	28.1	526.7	O K
720 min Summer	1.480	0.980	0.0	28.1	28.1	488.7	O K
960 min Summer	1.383	0.883	0.0	28.1	28.1	440.5	O K
1440 min Summer	1.197	0.697	0.0	28.1	28.1	347.6	O K
2160 min Summer	0.959	0.459	0.0	28.1	28.1	228.8	O K
2880 min Summer	0.784	0.284	0.0	28.1	28.1	141.5	O K
4320 min Summer	0.599	0.099	0.0	27.9	27.9	49.4	O K
5760 min Summer	0.578	0.078	0.0	21.8	21.8	38.9	O K
7200 min Summer	0.565	0.065	0.0	18.2	18.2	32.2	O K
8640 min Summer	0.555	0.055	0.0	15.5	15.5	27.5	O K
10080 min Summer	0.549	0.049	0.0	13.7	13.7	24.2	O K
15 min Winter	1.857	1.357	0.0	28.1	28.1	676.9	O K
30 min Winter	1.997	1.497	0.0	28.1	28.1	746.4	O K
60 min Winter	2.113	1.613	0.0	28.1	28.1	804.6	O K
120 min Winter	2.167	1.667	0.0	28.1	28.1	831.3	O K
180 min Winter	2.139	1.639	0.0	28.1	28.1	817.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	233.627	0.0	646.1	33
30 min Summer	130.931	0.0	724.2	46
60 min Summer	73.377	0.0	811.7	72
120 min Summer	41.122	0.0	909.8	128
180 min Summer	29.307	0.0	972.6	182
240 min Summer	23.046	0.0	1019.8	216
360 min Summer	16.424	0.0	1090.2	276
480 min Summer	12.916	0.0	1143.0	342
600 min Summer	10.719	0.0	1185.8	408
720 min Summer	9.205	0.0	1221.7	474
960 min Summer	7.439	0.0	1316.4	610
1440 min Summer	5.510	0.0	1462.6	870
2160 min Summer	4.081	0.0	1624.9	1236
2880 min Summer	3.298	0.0	1750.9	1572
4320 min Summer	2.331	0.0	1856.7	2204
5760 min Summer	1.823	0.0	1935.5	2936
7200 min Summer	1.506	0.0	1999.0	3672
8640 min Summer	1.289	0.0	2052.4	4344
10080 min Summer	1.129	0.0	2098.8	5104
15 min Winter	233.627	0.0	723.7	33
30 min Winter	130.931	0.0	811.1	46
60 min Winter	73.377	0.0	909.1	74
120 min Winter	41.122	0.0	1019.0	128
180 min Winter	29.307	0.0	1089.3	182

Summary of Results for 100 year Return Period (+45%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Σ Max Outflow (l/s)	Max Volume (m³)	Status
240 min Winter	2.079	1.579	0.0	28.1	28.1	787.3	O K
360 min Winter	1.938	1.438	0.0	28.1	28.1	717.0	O K
480 min Winter	1.817	1.317	0.0	28.1	28.1	656.8	O K
600 min Winter	1.700	1.200	0.0	28.1	28.1	598.7	O K
720 min Winter	1.588	1.088	0.0	28.1	28.1	542.8	O K
960 min Winter	1.432	0.932	0.0	28.1	28.1	464.8	O K
1440 min Winter	1.137	0.637	0.0	28.1	28.1	317.7	O K
2160 min Winter	0.789	0.289	0.0	28.1	28.1	144.1	O K
2880 min Winter	0.604	0.104	0.0	28.1	28.1	52.0	O K
4320 min Winter	0.572	0.072	0.0	20.3	20.3	35.9	O K
5760 min Winter	0.557	0.057	0.0	15.9	15.9	28.2	O K
7200 min Winter	0.547	0.047	0.0	13.1	13.1	23.2	O K
8640 min Winter	0.540	0.040	0.0	11.3	11.3	20.0	O K
10080 min Winter	0.535	0.035	0.0	9.9	9.9	17.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	23.046	0.0	1142.2	236
360 min Winter	16.424	0.0	1221.0	296
480 min Winter	12.916	0.0	1280.2	370
600 min Winter	10.719	0.0	1328.1	444
720 min Winter	9.205	0.0	1368.6	518
960 min Winter	7.439	0.0	1474.4	660
1440 min Winter	5.510	0.0	1638.1	924
2160 min Winter	4.081	0.0	1820.2	1268
2880 min Winter	3.298	0.0	1961.1	1504
4320 min Winter	2.331	0.0	2079.5	2192
5760 min Winter	1.823	0.0	2167.8	2944
7200 min Winter	1.506	0.0	2238.9	3664
8640 min Winter	1.289	0.0	2298.8	4344
10080 min Winter	1.129	0.0	2350.6	5144

Rainfall Details

Rainfall Model	FEH	F (1km)	2.498
Return Period (years)	100	Summer Storms	Yes
FEH Rainfall Version	1999	Winter Storms	Yes
Site Location	GB 622800 309650 TG 22800 09650	Cv (Summer)	0.750
C (1km)	-0.024	Cv (Winter)	0.840
D1 (1km)	0.275	Shortest Storm (mins)	15
D2 (1km)	0.370	Longest Storm (mins)	10080
D3 (1km)	0.255	Climate Change %	+45
E (1km)	0.310		

Time Area Diagram

Total Area (ha) 1.475

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.295	4	8	0.295	8	12	0.295	12	16	0.295	16	20	0.295

Model Details

Storage is Online Cover Level (m) 4.050

Cellular Storage Structure

Invert Level (m) 0.500 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	525.0	0.0	1.320	525.0	0.0	1.671	0.0	0.0
0.660	525.0	0.0	1.670	525.0	0.0			

Pump Outflow Control

Invert Level (m) 0.500

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	28.1000	0.700	28.1000	1.300	28.1000	1.900	28.1000	2.500	28.1000
0.200	28.1000	0.800	28.1000	1.400	28.1000	2.000	28.1000	2.600	28.1000
0.300	28.1000	0.900	28.1000	1.500	28.1000	2.100	28.1000	2.700	28.1000
0.400	28.1000	1.000	28.1000	1.600	28.1000	2.200	28.1000	2.800	28.1000
0.500	28.1000	1.100	28.1000	1.700	28.1000	2.300	28.1000	2.900	28.1000
0.600	28.1000	1.200	28.1000	1.800	28.1000	2.400	28.1000	3.000	28.1000

Summary of Results for 100 year Return Period (+45%)

Half Drain Time : 97 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control Σ (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	1.830	1.330	0.0	65.0	65.0	543.1	O K
30 min Summer	1.930	1.430	0.0	65.0	65.0	584.1	O K
60 min Summer	1.940	1.440	0.0	65.0	65.0	588.2	O K
120 min Summer	1.788	1.288	0.0	65.0	65.0	526.3	O K
180 min Summer	1.656	1.156	0.0	65.0	65.0	472.3	O K
240 min Summer	1.543	1.043	0.0	65.0	65.0	426.3	O K
360 min Summer	1.346	0.846	0.0	65.0	65.0	345.5	O K
480 min Summer	1.174	0.674	0.0	65.0	65.0	275.4	O K
600 min Summer	1.027	0.527	0.0	65.0	65.0	215.1	O K
720 min Summer	0.903	0.403	0.0	65.0	65.0	164.4	O K
960 min Summer	0.746	0.246	0.0	65.0	65.0	100.5	O K
1440 min Summer	0.600	0.100	0.0	65.0	65.0	41.0	O K
2160 min Summer	0.575	0.075	0.0	48.9	48.9	30.7	O K
2880 min Summer	0.561	0.061	0.0	39.8	39.8	24.9	O K
4320 min Summer	0.543	0.043	0.0	28.1	28.1	17.6	O K
5760 min Summer	0.534	0.034	0.0	21.9	21.9	13.9	O K
7200 min Summer	0.528	0.028	0.0	18.4	18.4	11.5	O K
8640 min Summer	0.524	0.024	0.0	15.8	15.8	9.8	O K
10080 min Summer	0.521	0.021	0.0	13.8	13.8	8.6	O K
15 min Winter	2.014	1.514	0.0	65.0	65.0	618.7	O K
30 min Winter	2.136	1.636	0.0	65.0	65.0	668.1	O K
60 min Winter	2.170	1.670	0.0	65.0	65.0	682.1	O K
120 min Winter	2.014	1.514	0.0	65.0	65.0	618.6	O K
180 min Winter	1.838	1.338	0.0	65.0	65.0	546.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	233.627	0.0	646.1	31
30 min Summer	130.931	0.0	724.2	42
60 min Summer	73.377	0.0	811.7	66
120 min Summer	41.122	0.0	909.8	102
180 min Summer	29.307	0.0	972.6	134
240 min Summer	23.046	0.0	1019.8	168
360 min Summer	16.424	0.0	1090.0	234
480 min Summer	12.916	0.0	1142.9	298
600 min Summer	10.719	0.0	1185.6	358
720 min Summer	9.205	0.0	1221.7	416
960 min Summer	7.439	0.0	1316.4	530
1440 min Summer	5.510	0.0	1462.6	740
2160 min Summer	4.081	0.0	1625.1	1100
2880 min Summer	3.298	0.0	1751.0	1464
4320 min Summer	2.331	0.0	1856.8	2196
5760 min Summer	1.823	0.0	1935.6	2936
7200 min Summer	1.506	0.0	1999.1	3584
8640 min Summer	1.289	0.0	2052.6	4328
10080 min Summer	1.129	0.0	2098.9	5072
15 min Winter	233.627	0.0	723.7	31
30 min Winter	130.931	0.0	811.1	43
60 min Winter	73.377	0.0	909.1	66
120 min Winter	41.122	0.0	1019.0	112
180 min Winter	29.307	0.0	1089.3	146

Summary of Results for 100 year Return Period (+45%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
240 min Winter	1.677	1.177	0.0	65.0	65.0	481.0	O K
360 min Winter	1.382	0.882	0.0	65.0	65.0	360.1	O K
480 min Winter	1.124	0.624	0.0	65.0	65.0	255.1	O K
600 min Winter	0.910	0.410	0.0	65.0	65.0	167.7	O K
720 min Winter	0.744	0.244	0.0	65.0	65.0	99.6	O K
960 min Winter	0.599	0.099	0.0	64.2	64.2	40.4	O K
1440 min Winter	0.574	0.074	0.0	47.9	47.9	30.0	O K
2160 min Winter	0.555	0.055	0.0	35.6	35.6	22.3	O K
2880 min Winter	0.544	0.044	0.0	28.8	28.8	18.0	O K
4320 min Winter	0.531	0.031	0.0	20.3	20.3	12.7	O K
5760 min Winter	0.525	0.025	0.0	16.1	16.1	10.0	O K
7200 min Winter	0.520	0.020	0.0	13.2	13.2	8.3	O K
8640 min Winter	0.517	0.017	0.0	11.2	11.2	7.0	O K
10080 min Winter	0.515	0.015	0.0	9.9	9.9	6.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	23.046	0.0	1142.2	182
360 min Winter	16.424	0.0	1220.8	252
480 min Winter	12.916	0.0	1280.0	316
600 min Winter	10.719	0.0	1328.1	374
720 min Winter	9.205	0.0	1368.3	426
960 min Winter	7.439	0.0	1474.5	500
1440 min Winter	5.510	0.0	1638.1	736
2160 min Winter	4.081	0.0	1820.0	1096
2880 min Winter	3.298	0.0	1961.2	1452
4320 min Winter	2.331	0.0	2079.5	2196
5760 min Winter	1.823	0.0	2167.9	2912
7200 min Winter	1.506	0.0	2239.1	3608
8640 min Winter	1.289	0.0	2298.8	4400
10080 min Winter	1.129	0.0	2350.7	5024

Rainfall Details

Rainfall Model	FEH	F (1km)	2.498
Return Period (years)	100	Summer Storms	Yes
FEH Rainfall Version	1999	Winter Storms	Yes
Site Location	GB 622800 309650 TG 22800 09650	Cv (Summer)	0.750
C (1km)	-0.024	Cv (Winter)	0.840
D1 (1km)	0.275	Shortest Storm (mins)	15
D2 (1km)	0.370	Longest Storm (mins)	10080
D3 (1km)	0.255	Climate Change %	+45
E (1km)	0.310		

Time Area Diagram

Total Area (ha) 1.475

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.295	4	8	0.295	8	12	0.295	12	16	0.295	16	20	0.295

Model Details

Storage is Online Cover Level (m) 4.050

Cellular Storage Structure

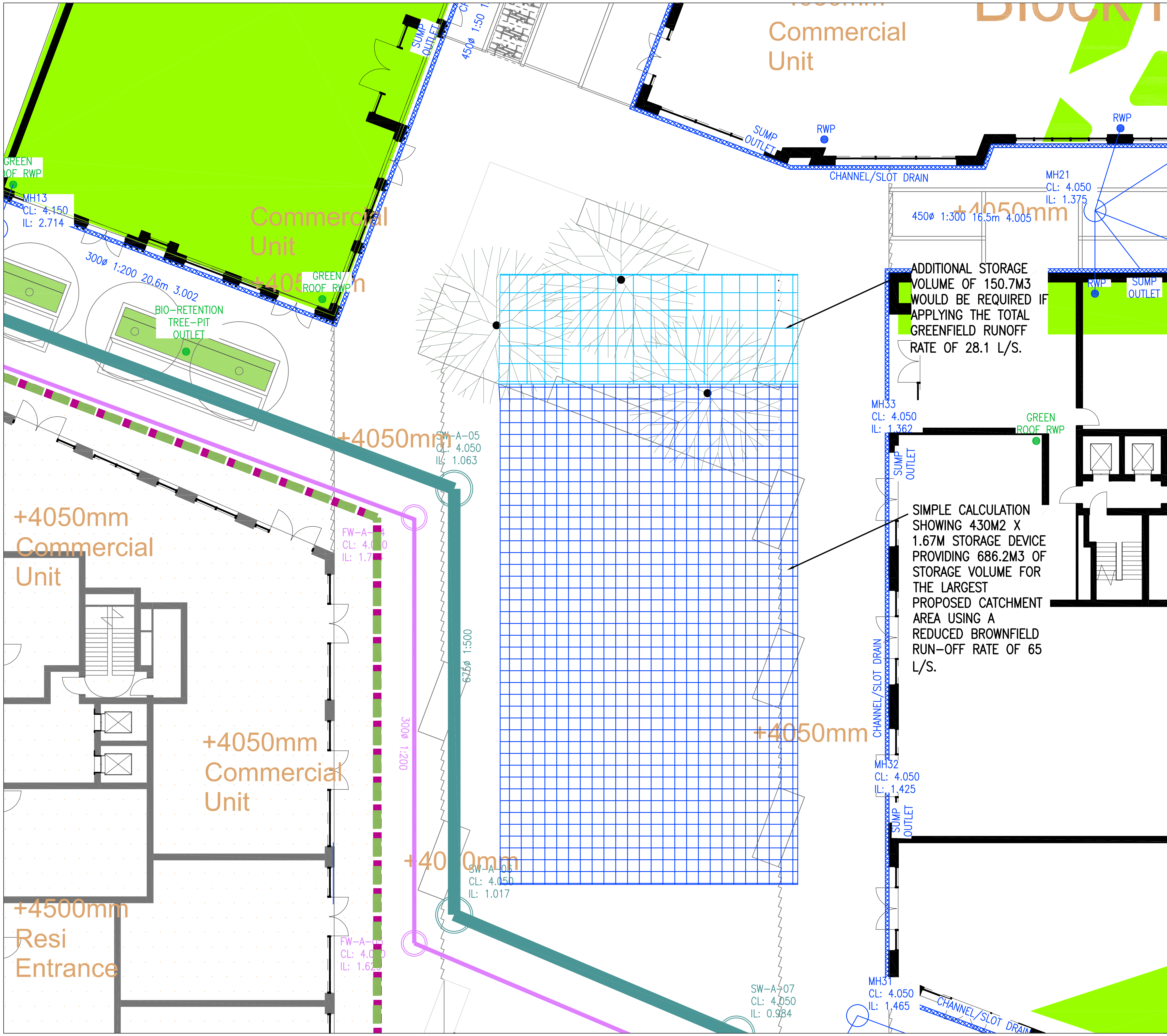
Invert Level (m) 0.500 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	430.0	0.0	1.320	430.0	0.0	1.671	0.0	0.0
0.660	430.0	0.0	1.670	430.0	0.0			

Pump Outflow Control

Invert Level (m) 0.500

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	65.0000	0.700	65.0000	1.300	65.0000	1.900	65.0000	2.500	65.0000
0.200	65.0000	0.800	65.0000	1.400	65.0000	2.000	65.0000	2.600	65.0000
0.300	65.0000	0.900	65.0000	1.500	65.0000	2.100	65.0000	2.700	65.0000
0.400	65.0000	1.000	65.0000	1.600	65.0000	2.200	65.0000	2.800	65.0000
0.500	65.0000	1.100	65.0000	1.700	65.0000	2.300	65.0000	2.900	65.0000
0.600	65.0000	1.200	65.0000	1.800	65.0000	2.400	65.0000	3.000	65.0000



REV	DATE	BY	DESCRIPTION	CHK	APD

DRAWING STATUS: FOR INORMATION

EAS

Unit 23, The Maltings, Stanstead Abbotts, Hertfordshire, SG12 8HG
Tel: 01920 871777

www.eastp.co.uk

CLIENT: WESTON HOMES

ARCHITECT:

PROJECT: ANGLIA SQUARE, NORWICH

TITLE: ATTENUATION VOLUME COMPARISON GREENFIELD VS BROWNFIELD RUNOFF

SCALE @ A3:	DESIGN-DRAWN:	DATE:
1:200	MD	14.09.2022

PROJECT No:	DRAWING No:
	SK04

Appendix K – Anglian Water Pre-Development Enquiry

love every drop
anglianwater

Pre-Planning Assessment Report

Anglia Square

InFlow Reference: PPE-0143339

Assessment Type: Used Water

Report published: 08/04/2022

Thank you for submitting a pre-planning enquiry.

This has been produced for EAS Transport Planning Ltd.

Your reference number is **PPE-0143339**.

This report can be submitted as a drainage strategy for the development should it seek planning permission.

If you have any questions upon receipt of this report, you can submit a further question via InFlow. Alternatively, please contact the Planning & Capacity team on **07929 786 955** or email planningliaison@anglianwater.co.uk

---

Section 1 - Proposed development

The response within this report has been based on the following information which was submitted as part of your application:

List of planned developments	
Type of development	**No. Of units**
Shops	50
Restaurants and cafes	25
Dwellings	1500

The anticipated residential build rate is:

Year	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12
Build rate	50	50	50	50	50	50	50	50	50	50	50	1025

Development type: Brownfield

Planning application status: Unknown

Site grid reference number: TG2302009411

The comments contained within this report relate to the public water mains and sewers indicated on our records.

Your attention is drawn to the disclaimer in the useful information section of this report.

Section 2 - Assets affected

Our records indicate that we have the following types of assets within or overlapping the boundary of your development site as listed in the table below.

Additionally, it is highly recommended that you carry out a thorough investigation of your proposed working area to establish whether any unmapped public or private sewers and lateral drains are in existence. We are unable to permit development either over or within the easement strip without our prior consent. The extent of the easement is provided in the table below. Please be aware that the existing water mains/public sewers should be located in highway or open space and not in private gardens. This is to ensure available access for any future maintenance and repair and this should be taken into consideration when planning your site layout.

Water and Used water easement information		
Asset type	Pipe size (mm)	Total easement required (m)
Water mains	152	6.00 m overall easement
Water mains	76	6.00 m overall easement
Water mains	102	4.50 m overall easement
Water mains	127	6.00 m overall easement
Water mains	102	4.50 m overall easement
Sewer mains	675	6.00 m either side of the centre line
Sewer mains	300	3.00 m either side of the centre line
Sewer mains	225	3.00 m either side of the centre line
Sewer mains	150	3.00 m either side of the centre line
Sewer mains	9	3.00 m either side of the centre line
Sewer mains	Unknown	3.00 m either side of the centre line
Sewer mains	27	3.00 m either side of the centre line
Sewer mains	7	4.50 m either side of the centre line
Sewer mains	850	4.00 m either side of the centre line
Sewer mains	36	3.00 m either side of the centre line
Sewer mains	24	6.00 m either side of the centre line
Sewer mains	375	3.00 m either side of the centre line
Sewer mains	225	3.00 m either side of the centre line

If it is not possible to avoid our assets then these may need to be diverted in accordance with Section 185 of the Water Industry Act (1991). You will need to make a formal application if you would like a diversion to be considered.

Due to the private sewer transfer in October 2011 many newly adopted public used water assets and their history are not indicated on our records. You also need to be aware that your development site may contain private water mains, drains or other assets not shown on our records. These are private assets and not the responsibility of Anglian Water but that of the landowner.

Section 3 - Water recycling services

In examining the used water system we assess the ability for your site to connect to the public sewerage network without causing a detriment to the operation of the system. We also assess the receiving water recycling centre and determine whether the water recycling centre can cope with the increased flow and effluent quality arising from your development.

Water recycling centre

The foul drainage from the proposed development is in the catchment of Whitlingham Trowse Water Recycling Centre, which currently has capacity to treat the flows from your development site. Anglian Water cannot reserve capacity and the available capacity at the water recycling centre can be reduced at any time due to growth, environmental and regulation driven changes.

Used water network

Our assessment has been based on development flows connecting to the nearest foul water sewer of the same size or greater pipe diameter to that required to drain the site. The infrastructure to convey foul water flows to the receiving sewerage network is assumed to be the responsibility of the developer. Conveyance to the connection point is considered as Onsite Work and includes all work carried out upstream from of the point of connection, including making the connection to our existing network. This connection point has been determined in reference to the calculated discharge flow and on this basis, a 375mm internal diameter pipe is required to drain the development site. The preferred connection point at manhole 1310 is to a 300mm sewer, that does not have capacity to accommodate the flows from the full development. The foul sewerage system will have capacity for the development if the connection is made over several points across the network surrounding the development site.

In order to assess a suitable drainage strategy and provide connection points, please provide us with a site layout and phasing plan. Anglian water has assessed the impact of gravity flows from the planned development to the public foul sewerage network. We can confirm that this is acceptable as the foul sewerage system, at present, has available capacity for your site.

Please note that Anglian Water will request a suitably worded condition at planning application stage to ensure this strategy is implemented to mitigate the risk of flooding.

It is assumed that the developer will provide the necessary infrastructure to convey flows from the site to the network. Consequently, this report does not include any costs for the conveyance of flows.

Surface water disposal

In principle, your proposed method of surface water disposal is acceptable to Anglian Water. It is our understanding that the evidence to confirm compliance with the surface water hierarchy is not available. Once the evidence has been confirmed, then a connection point may be made to manhole 1355 at NGR TG 23145 09319 at a rate of 242l/s. Our assessment has been based on development flows connecting to the nearest surface water sewer of the same size or greater pipe diameter. It is your responsibility to provide the evidence to confirm that all alternative methods of surface water disposal have been explored and these will be required before your connection can be agreed. This is subject to satisfactory evidence which shows the surface water management hierarchy as outlined in Building Regulations Part H has been explored. This would encompass the results from the site specific infiltration testing and/or confirmation that the flows cannot be discharged to a watercourse. Anglian Water's surface water policy follows the Surface Water hierarchy, outlined in Part H of the Building Regulations. Should your assumptions or evidence change then an alternative solution, connection point or flow rate may be required.

You are thereforeadvised to update Anglian Water with the key supporting evidence at your earliest convenience.

As you may be aware, Anglian Water will consider the adoption of SuDs provided that they meet the criteria outline in our SuDs adoption manual. This can be found on our website. We will adopt features located in public open space that are designed and constructed, in conjunction with the Local Authority and Lead Local Flood Authority (LLFA), to the criteria within our SuDs adoption manual. Specifically, developers must be able to demonstrate:

1. Effective upstream source control,
2. Effective exceedance design, and
3. Effective maintenance schedule demonstrating than the assets can be maintained both now and in the future with adequate access.

If you wish to look at the adoption of any SuDs then an expression of interest form can be found on our website

Trade Effluent

We note that you do not have any trade effluent requirements. Should this be required in the future you will need our written formal consent. This is in accordance with Section 118 of the Water Industry Act (1991).

Used Water Budget Costs

Your development site will be required to pay an Infrastructure charge for each new property connecting to the public water and sewerage network that benefits from Full planning permission. The infrastructure charge replaces the zonal charge as previously identified.

You will be required to pay an infrastructure charge upon connection for each new plot on your development site. The infrastructure charge are types of charges set out in Section 146(2) of the Water Industry Act 1991.

The charge should be paid by anyone who wishes to build or develop a property and is payable upon request of connection.

• The Infrastructure Charge is based on the cost of any reinforcement and upgrades to our existing network ("Network Reinforcements"), whether designed to address strategic or local capacity issues. For more information on our Infrastructure Charge, please see the 'Useful Information' section of this report.

Infrastructure charges are raised on a standard basis of one charge per new connection (one for water and one for sewerage).

The Water Recycling Infrastructure charge for your dwellings is:

Infrastructure charge	Number of units	Total
£ 490	1500	£735,000.00

Please note that you should also budget for infrastructure charges on non-household premises where applicable and these will be calculated according to the number and type of water fittings in the premises. This is called the "relevant multiplier" method of calculating the charge and the relevant multiplier will be applied to the figures set out in our 2022-23 Developer Charging Arrangements to arrive at the amount payable. Details of the relevant multiplier for each fitting can be found on our website.

Section 4 - Map of Proposed Point of Connection(s)

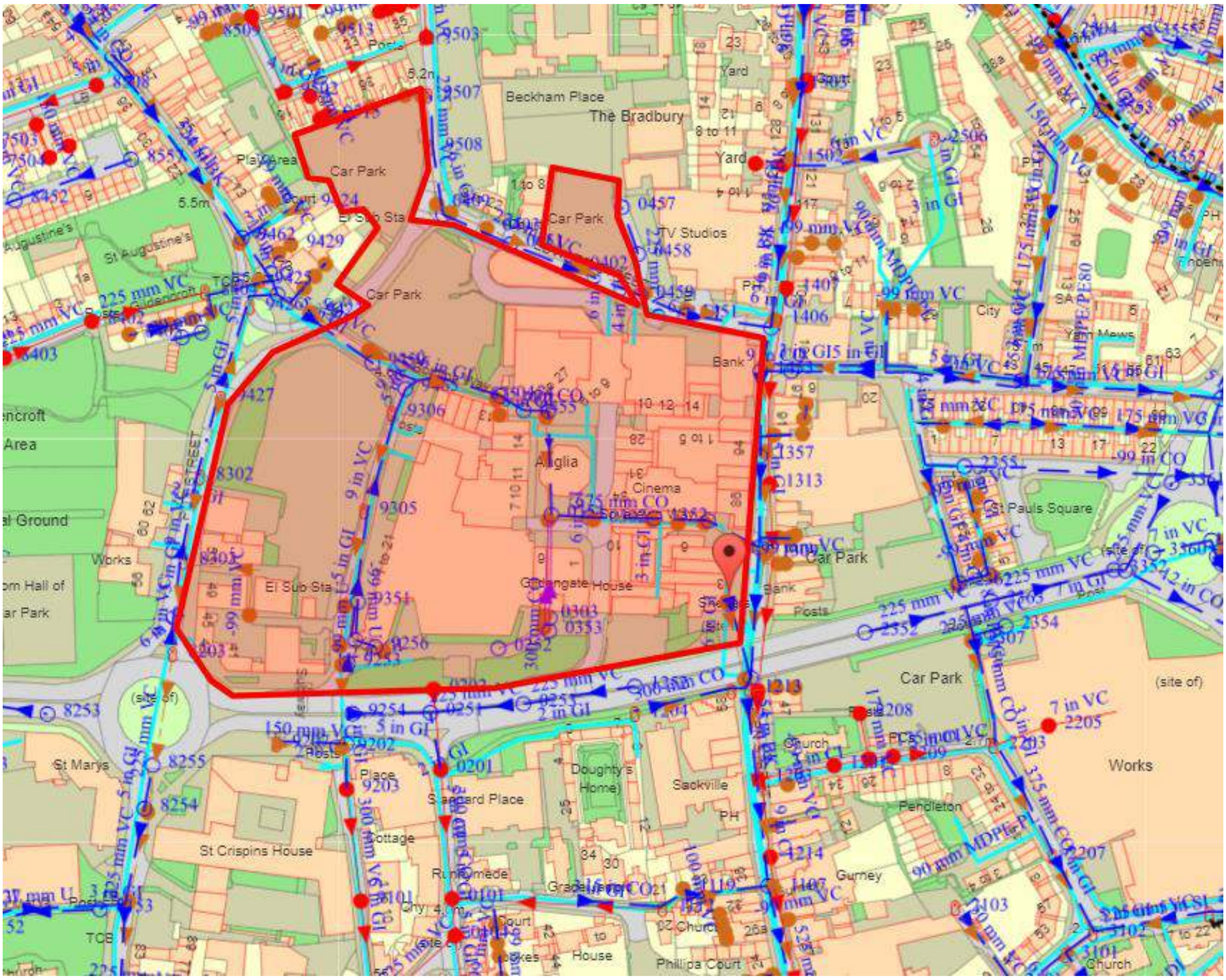


Figure 2: Showing your water recycling surface water point of connection

Section 5 - Useful information

Water Industry Act – Key used water sections

Section 98:

This provides you with the right to requisition a new public sewer. The new public sewer can be constructed by Anglian Water on your behalf. Alternatively, you can construct the sewer yourself under section 30 of the Anglian Water Authority Act 1977.

Section 102:

This provides you with the right to have an existing sewerage asset vested by us. It is your responsibility to bring the infrastructure to an adoptable condition ahead of the asset being vested.

Section 104:

This provides you with the right to have a design technically vetted and an agreement reached that will see us adopt your assets following their satisfactory construction and connection to the public sewer.

Section 106:

This provides you with the right to have your constructed sewer connected to the public sewer.

Section 185

This provides you with the right to have a public sewerage asset diverted.

Details on how to make a formal application for a new sewer, new connection or diversion are available on our website or via our Development Services team on **0345 60 66 087**.

Sustainable drainage systems

Many existing urban drainage systems can cause problems of flooding, pollution or damage to the environment and are not resilient to climate change in the long term. .

Our preferred method of surface water disposal is through the use of Sustainable Drainage Systems or SuDS.

SuDS are a range of techniques that aim to mimic the way surface water drains in natural systems within urban areas. For more information on SuDS, please visit our website

We recommend that you contact the Local Authority and Lead Local Flood Authority (LLFA) for your site to discuss your application.

Private sewer transfers

Sewers and lateral drains connected to the public sewer on the 1 July 2011 transferred into Water Company ownership on the 1 October 2011. This follows the implementation of the Floods and Water Management Act (FWMA). This included sewers and lateral drains that were subject to an existing Section 104 Adoption Agreement and those that were not. There were exemptions and the main non-transferable assets were as follows:

Surface water sewers and lateral drains that do not discharge to the public sewer, e.g. those that discharged to a watercourse.

Foul sewers and lateral drains that discharged to a privately owned sewage treatment/collection facility.

Pumping stations and rising mains will transfer between 1 October 2011 and 1 October 2016.

The implementation of Section 42 of the FWMA will ensure that future private sewers will not be created. It is anticipated that all new sewer applications will need to have an approved section 104 application ahead of a section 106 connection.

It is anticipated that all new sewer applications will need to have an approved Section104 application ahead of a Section 106 connection

Proposed Surface Water Drainage Strategy

January 2023

Anglia Square Regeneration

Norwich

Weston Homes

Document History

JOB NUMBER: 3831/2023
DOCUMENT REF: SUDS/3831/2023

REVISIONS: H – REV C SUBMISSION

Revision	Comments	By	Checked	Authorised	Date
A	Client Draft	MD/JP	SA	SA	07.03.2022
B	Final	MD	MD	SA	01.04.2022
C	REV A SUBMISSION	MD	MD	SA	14.07.2022
D	REV A SUBMISSION	MD	MD	SA	15.07.2022
E	REV B SUBMISSION	MD	MD	SA	22.09.2022
F	REV B SUBMISSION	MD	MD	SA	26.09.2022
G	REV C SUBMISSION	MD	MD	SA	27.01.2023
H	REV C SUBMISSION	MD	MD	SA	01.02.2023

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

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk

EAS

Contents

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk

1 Introduction

1.1 A hybrid planning application (Ref. 22/00434/F) (the Application) was submitted by Weston Homes (the Applicant) to Norwich City Council (NCC) on 1st April 2022 for the comprehensive redevelopment of Anglia Square and various parcels of mostly open surrounding land, (the Site), as shown within a red line on drawing 'ZZ-00-DR-A-01-0200'. The Application comprised a full set of technical documents to assess the potential impacts of the proposals, including an EIA which covered a number of topics. In respect of SuDS Drainage Strategy, this was described and explained in the Surface Water Drainage Strategy Report (Rev B dated 01.04.2022). Please refer to the original documents for further details. NB: this Revision-G Submission version of the Surface Water Drainage Strategy Report supersedes previous issues and any Addendum letters and should be read in conjunction with the Flood Risk Assessment by Royal Haskoning DHV.

1.2 Application Ref. 22/00434/F follows a previous application on a somewhat smaller development parcel, (NCC Ref. 18/00330/F) made jointly by Weston Homes Plc as development partner and Columbia Threadneedle Investments, (CTI), the Site's owner, for a residential-led mixed use scheme consisting of up to 1,250 dwellings with decked parking, and 11,000 sqm GEA flexible ground floor retail/commercial/non-residential institution floorspace, hotel, cinema, multi-storey public car park, place of worship, and associated public realm and highway works. This was subject to a Call-in by the Secretary of State (PINS Ref. APP/G2625/V/19/3225505) who refused planning permission on 12th November 2020, (the 'Call in Scheme').

1.3 Following submission of the Application Ref. 22/00434/F, and completion of the statutory consultation exercise, amended application material (RevA) was submitted in July 2022 in response to consultation comments. Following completion of the second statutory consultation on the RevA material, the Applicant has worked with NCC to review the consultation responses received to identify an appropriate response where considered relevant. As a result of consideration of these comments, as well as ongoing discussions with NCC, some further minor amendments are now proposed which are summarised in the Planning Statement Addendum. The Amended Application material (RevC) submitted in January 2023 continues to seek consent for up to 1,100 dwellings and up to 8,000 Sqm (NIA) non-residential floorspace and associated development. However, since the amendments result in minor changes to the full development description, an updated version of the full Amended Application description is contained in **Appendix A** along with the Site Location Plan.

1.4 In September 2022 an updated Proposed Surface Water Drainage Strategy was submitted to the Lead Local Flood Authority (LLFA) for comment which sets out where necessary a response to the drainage related comments received on the Rev-A application material, then describes how the design has been developed and adapted as a result of these and other comments, In November 2022, the LLFA provided comments (see **Appendix C**) in the Proposed Surface Water Drainage Strategy (September 2022) confirming they no longer object to the Application subject to planning conditions being imposed.

1.5 Following the November 2022 LLFA comments, the landscaping plans for the proposed development have been amended further, introducing additional soft landscaping, to address other consultation feedback received. As part of the RevC update to the Application, the Proposed Surface Water Drainage Strategy has been updated to reflect the amended landscaping changes. The overall drainage strategy retains the principles and surface water run off rates as that accepted by the LLFA in November 2022.

1.6 The proposed Outline/Full Planning Application Boundaries and Development Proposals are contained in **Appendix B.**

1.7 A summary of the drainage related comments on the Application are contained in **Appendix C**.

1.8 A separate report, undertaken by Royal Haskoning DHV, deals with the flood risk assessment, hydraulic modelling study and impact assessment and should be read in conjunction with this report.

1.9 The Application Description and Location Plan are contained in **Appendix A**.

2 Policy Framework and Pre-Application Comments

Local Policy

Greater Norwich Local Plan

2.1 The GNLP was submitted to the Secretary of Stage for independent examination on 30th July 2021. The emerging plan allocates the Anglia Square site (GNLP0506) for Mixed Use Allocation.

2.2 Emerging Policy: GNLP Policy 2 would be anticipated to reduce the risk of fluvial flooding that may arise as a result of development, through the requirement to carry out flood risk assessments, and incorporate sustainable drainage measures.

2.3 Emerging Policy : GNLP Policy 2 would be anticipated to mitigate the risk of surface water flooding that may arise as a result of development, through the requirement for development to incorporate sustainable drainage measures and contribute to the green infrastructure cover.

2.4 A SuDS drainage plan incorporating sustainable drainage (SuDS) is included in Section 7, detailing how surface water will be managed on the site and the rationale for the approaches used. Surface water runoff from the site will be restricted as far as possible to ensure that the risk of flooding both to the site and elsewhere is minimised, taking into account the effects of climate change.

2.5 This section sets out the policy context. This FRA is based on the advice set out in the National Planning Policy Framework (NPPF) published in July 2021, the Planning Practice Guidance (PPG) published March 2014, which is updated on an ad hoc basis and Annex 3: Flood risk vulnerability classification.

Development Management Policies Local Plan

2.6 The Development Management Policies Plan (DM policies) sets out policies which will apply across the whole city, as well as policies which apply in designated areas.

Policy DM5 – Planning effectively for flood resilience' details the policy for flooding, sustainable drainage and surface water flooding and surface treatment. The policy states:

"*Developers will be required to show that the proposed development:*

> *-would not increase the vulnerability of the site, or the wider catchment, to flooding from surface water run-off from existing or predicted water flows; and*
>
> *-would, wherever practicable, have a positive impact on the risk of surface water flooding in the wider area.*

Development must, as appropriate, incorporate mitigation measures to reduce surface water runoff, manage surface water flood risk to the development itself and to others, maximise the use of permeable materials to increase infiltration capacity, incorporate on-site water storage and make use of green roofs and walls wherever reasonably practicable.

The use of permeable materials, on-site rainwater storage, green roofs and walls will be required unless the developer can provide justification to demonstrate that this would not be practicable or feasible within the constraints or configuration of the site, or would compromise wider regeneration objectives."

2.7 The landscaping of the development in terms of surface water management is also considered in Policy DM5. This states:

"Development proposals will be required to maximise the use of soft landscaping and permeable surfacing materials unless the developer can provide justification to demonstrate that this is not feasible.

Where permission is required, proposals involving the provision of new or replacement paved and other impermeable surfaced areas will only be permitted:

-in areas of impermeable soils as identified in Appendix 1;

-in other areas where it can be demonstrated that permeable surfaces are not practicable due to poor soil infiltration capacity, high groundwater levels or risk of subsidence; and

-in areas with soils with average or good infiltration capacity, where it can be demonstrated that there is an exceptional and overriding justification for such surfaces.

In cases where poor soil infiltration capacity or other factors preclude the use of permeable surfacing materials, development proposals should seek to manage and minimise the impact of surface water run-off by suitable measures for water storage on-site."

2.8 A SuDS drainage plan incorporating sustainable drainage (SuDS) is included in Section 7, detailing how surface water will be managed on the site and the rationale for the approaches used. Surface water runoff from the site will be restricted as far as possible to ensure that the risk of flooding both to the site and elsewhere is minimised, taking into account the effects of climate change.

Natural England and Nutrient Neutrality Assessments

2.9 In In March 2022, Natural England issued a letter to Local Planning Authorities, Environment Agency and all Heads of Planning and Chief Executives to give advice for development proposals with the potential to affect water quality resulting in adverse nutrient impacts on habitats and sites. The letter provides advice on the assessment of new plans and projects under Regulation 63 of the Habitats Regulations. The purpose of that assessment is to avoid adverse effects occurring on habitats sites as a result of the nutrients released by those plans and projects. This advice does not address the positive measures that will need to be implemented to reduce nutrient impacts from existing sources, such as existing developments, agriculture, and the treatment and disposal of wastewater. It proposes that nutrient neutrality might be an approach that planning authorities wish to explore.

2.10 The following background is given:

"In freshwater habitats and estuaries, poor water quality due to nutrient enrichment from elevated nitrogen and phosphorus levels is one of the primary reasons for habitats sites being in unfavourable condition. Excessive levels of nutrients can cause the rapid growth of certain plants through the process of eutrophication. The effects of this look different depending on the habitat, however in each case, there is a loss of biodiversity, leading to sites

being in 'unfavourable condition'. To achieve the necessary improvements in water quality, it is becoming increasingly evident that in many cases substantial reductions in nutrients are needed. In addition, for habitats sites that are unfavourable due to nutrients, and where there is considerable development pressure, mitigation solutions are likely to be needed to enable new development to proceed without causing further harm.

In light of this serious nutrient issue, Natural England has recently reviewed its advice on the impact of nutrients on habitats sites which are already in unfavourable condition. Natural England is now advising that there is a risk of significant effects in more cases where habitats sites are in unfavourable condition due to exceeded nutrient thresholds. More plans and projects are therefore likely to proceed to appropriate assessment.

The principles underpinning HRAs are well established. At the screening stage, plans and projects should only be granted consent where it is possible to exclude, on the basis of objective information, that the plan or project will have significant effects on the sites concerned. Where it is not possible to rule out likely significant effects, plans and projects should be subject to an appropriate assessment. That appropriate assessment must contain complete, precise and definitive findings which are capable of removing all reasonable scientific doubt as to the absence of adverse effects on the integrity of the site.

Appropriate assessments should be made in light of the characteristics and specific environmental conditions of the habitats site. Where sites are already in unfavourable condition due to elevated nutrient levels, Natural England considers that competent authorities will need to carefully justify how further inputs from new plans or projects, either alone or in combination, will not adversely affect the integrity of the site in view of the conservation objectives. This should be assessed on a case-by-case basis through appropriate assessment of the effects of the plan or project. In Natural England's view, the circumstances in which a Competent Authority can allow such plans or projects may be limited. Developments that contribute water quality effects at habitats sites may not meet the no adverse effect on site integrity test without mitigation.

Mitigation through nutrient neutrality offers a potential solution. Nutrient neutrality is an approach which enables decision makers to assess and quantify mitigation requirements of new developments. It allows new developments to be approved with no net increase in nutrient loading within the catchments of the affected habitats site.

Where properly applied, Natural England considers that nutrient neutrality is an acceptable means of counterbalancing nutrient impacts from development to demonstrate no adverse effect on the integrity of habitats sites and we have provided guidance and tools to enable you to do this."

2.11 A Nutrient Neutrality Assessment is to be undertaken by others and will be submitted as part of this planning application.

3 Existing Site Assessment

Existing Site Description

3.1 The site is located at Anglia Square, Norwich and consists of a shopping precinct including stores such as Iceland and Boots and a former cinema. Large office blocks are also present at the site; the disused seven-storey Sovereign House which runs north-south along Botolph Street previously housed Her Majesty's Stationary Office (HMSO) and the under-utilised six-storey Gildengate House, built over shops underneath. The Full and Outline Application boundaries cover a combined area of 4.65ha – which also includes some areas of adopted highway.

3.2 The existing site is almost entirely impermeable and is served by both private and adopted foul and surface water sewers. Surface water run-off is unrestricted and untreated and ultimately outfalls to the adopted sewer network to the south-east of the site. This is further evidenced and discussed below.

Site Levels

3.3 A site-specific topographical survey (including a utilities/drainage survey) is included in Appendix D. For the main Anglia Square site, levels vary between 5.09m AOD in the north west corner to 2.40m AOD at the existing access road from St Crispin's Road to the south of the site. Away from this low spot, levels in the south east corner of the site are in the region of 3.08m AOD. For the existing Anglia Square shopping centre, levels are around 3.51m AOD. The site slopes in a generally south easterly direction at a gradient of approximately 1:125.

3.4 The parcel north west of New Botolph Street slopes in a southerly direction, at a gradient of approximately 1:185 with the highest level to the north west of the site at 5.40m AOD and the lowest level at 5.11m AOD at the southern extent of the parcel. The site is approximately 0.35-0.4m higher than the carriageway of New Botolph Street/ Edward Street.

3.5 North of Edward Street the site slopes towards the north, at a gradient of approximately 1:100, with the highest point in the south west corner at a level of 4.27m AOD and the lowest point in the north at 3.87m AOD.

Sewer Network

3.6 Sewer records, obtained from Anglian Water and included in Appendix E, show there to be a 850mm/24" surface water sewer and 300mm foul sewer flowing in a south westerly direction through the site. It should be noted that a drainage survey of the surface water sewer crossing Anglia Square shows this to be a 675dia sewer and not 850dia/24" as indicated on the sewer records. For ease and in line with the gathered survey data, this sewer shall be referred to as 675dia throughout the remainder of this report.

3.7 A 300mm surface water sewer and 225mm foul sewer also run west to east with Edward Street, to the north of the main portion of the site. Both sewers connect to the respective foul and surface water sewers in Magdalen Street before flowing southwards with surface water sewers discharging into the River between Fye Bridge Street and Whitefriars Bridge.

3.8 A further 525mm combined sewer flows southwards along Magdalen Street. It is highly likely that surface water flows from the Dalymond Dyke flow within this sewer, given the location of the sewer and the available information on the Dalymond Dyke.

3.9 The sewer locations and sizes within the site boundary are shown in more detail on the topographical survey contained in Appendix D.

Pre-Development Run-off Rate

3.10 The total site area covers 4.65ha and is entirely brownfield comprising a shopping centre, office block, paved open spaces and car parks with some areas of landscaping and planting. The existing impermeable area (not including adopted highway) has been measured at 4.1768ha.

3.11 In order to calculate the brownfield (existing) surface water runoff rates from the proposed development site, a review of the Anglian Water sewer mapping, the topographical survey (including utility and drainage survey data) and CCTV drainage surveys was undertaken to determine the existing catchment areas and existing drainage features that serve the site.

3.12 The topographical survey is contained in Appendix D and Anglian Water Sewer Mapping is contained in Appendix E. A CCTV drainage survey, undertaken by Draincare Environmental Ltd is contained in Appendix F.

3.13 The CCTV drainage survey of the 675dia sewer crossing Anglia Square shows a number of incoming connections from the north and south of the sewer. These are summarised below and for ease, are clearly indicated on the last page of Appendix F.

- Ex. Connection 1 – outfall to 225dia sewer in Edward Street – Edward Street Area 1 and page 48 of the cctv survey report in Appendix F.
- Ex. Connection 2 – outfall to 300dia sewer in Edward Street via 0458 – Edward Street Area 2 and page 56 of the cctv survey report.
- Ex. Connection 3 – outfall to 675dia sewer at mh 0453 – Plan 1 and page 32 of the cctv survey report in Appendix F.
- Ex. Connections 4 to 9 – outfalls to 675dia sewer between mhs 9460 and 9459 – shown as junctions on page 45 of the cctv survey report.
- Ex. Connection 10 – outfall to 675dia sewer – shown as junction on page 33 of the cctv survey report in Appendix F.
- Ex. Connection 11 – outfall to 675dia sewer - see Plan 2, Plan 4 and page 13 of the cctv survey report in Appendix F.
- Ex. Connection 12 – outfall to 675dia sewer - see Plan 3 and shown as junction on page 39 of the cctv survey report in Appendix F.

3.14 The CCTV drainage survey connections, when compared against the topographical/drainage survey verifies these connections and proves that the site is served by a private surface water drainage system that freely outfalls to the adopted sewer network, aside from the brown-coloured car park area shown on SK01-D in Appendix G.

3.15 In order to calculate the existing outfall rates, the LLFA in their consultation comments (ref FW2022_0423), requested that FEH Methods in line with CIRIA SuDS Manual C753 should be applied. Section 24.5 in the CIRIA SuDS Manual C753 discusses Peak Run-of Rates for Previously Developed Sites as below:

Runoff characteristics for a previously developed site can be estimated in a number of ways:

1 Any land that has been previously developed is likely to have had a system in place to drain surface water runoff from the site. This drainage system may or may not have included storage and flow control systems. Where any drainage system is still operational, peak flow rates at the outfall for the relevant return periods (usually 1:1 year, 1:30 year and 1:100 year) can be demonstrated by producing a simulation model that includes an accurate representation of the drainage system and site area contributions – thus allowing derivation of an appropriate head–discharge relationship at the outfall.

It is recognised that existing drainage systems will probably be overwhelmed for the 1:30 and 1:100 year events and therefore the actual rate of discharge from the site in such scenarios is likely to be increased by overland flow contributions or surcharging. However, these effects should not be accounted for, and the discharge limit should be based solely on the flow rate from the piped system (thus providing a conservative estimate).

3.16 As the topographical survey contains details of the existing drainage system, it is possible to produce a simulation model that includes an accurate representation of the drainage system and site area contributions – thus allowing derivation of an appropriate head-discharge relationship at the outfall.

3.17 SK01-D in Appendix G shows the existing impermeable and permeable areas as well as the existing drainage systems serving the site and their catchment areas. The site is split into 8no. catchments areas. In their consultation comments (ref FW2022_0703) the LLFA requested that a section of landscaped area to the west of Area 4 (395m²) should be included in the brownfield runoff rates, as such, the greenfield runoff rate for this area shall be added to the calculations.

3.18 Greenfield Run-off Rates are discussed below. In order to avoid overestimation of brownfield runoff rates and provide a robust calculation, a brown-coloured car park area to the west of Area 3 (2814m²) is not included in the impermeable area as the drainage survey is incomplete and does not confirm where this area drains to. It would therefore be inappropriate to include this within the following calculations. The total contributing area for brownfield runoff is therefore 3.9577ha (including 395m² of landscaped area).

3.19 The CCTV Drainage survey and topographical drainage survey show that surface water runoff from the existing site (with the exception of the brown-coloured car park area of 2814m and landscaped areas of 1845m²) is directed adopted surface water sewers in Edward Street, the 675dia sewer crossing Anglia Square and the 36" sewer in Magdalen Street. Looking at SK01-D in Appendix G it can be determined:

- Outfalls to Edward Street Sewer:
  Area 1 (around 50% of this catchment) to AWMH 0452
  Area 2 (via a sewer in Beckham Place) to AWMH 0459
  Area 3 to AWMH 0451
  Area 4 to AWMH 0452

- Outfalls to 675dia Sewer:
  Area 1 (around 50% of this catchment) via AWMH 9462 in St Augustin Street
  Area 5 to AWMH 1352
  Area 7 to AWMH 0354
  Area 8 to AWMH 9459

- Outfalls to Magdalen Street sewer:

Area 6 to AWMH 1357

3.20 It is not possible to model a 1:1yr storm event with FEH data therefore, to ascertain what the equivalent 1:1yr outfall rate would be for an FEH storm, it is deemed appropriate to apply a percentage to the FEH calculated runoff. This percentage shall be based on runoff rates for a 1:1yr and 1:2yr storm event generated using FSR rainfall data using the formula below:

A FSR 1:1yr storm runoff is 20 l/s

A FSR 1:2yr storm runoff is 25 l/s

20 ÷ 25 = 0.8

As such, the 1:1yr runoff rate is 80% of the 1:2yr runoff rate

- If the FEH 1:2yr storm runoff is 23 l/s – the 1:1yr equivalent is 18.4 l/s

3.21 Causeway Flow (hydraulic modelling software) was used to model each existing catchment using FEH data for a range of storm events (whilst applying a MADD Factor of 0 as requested by the LLFA). As described above, FSR data was used to generate runoff rates for 1:1yr and 1:2yr storm events as a means to calculate a 1:1yr FEH equivalent. The hydraulic model results are contained in Appendix H and show brownfield runoff rate calculations for 1:1yr, 1:2yr, 1:30yr, 1:30yr+45%CC, 1:100yr and 1:100yr+45%CC rates.

3.22 1:1yr Brownfield Runoff Rates are summarised below and includes the greenfield runoff rate for the 395m² of landscaped area:

	Contributing Area (ha)	1:2 FEH l/s	1:1 FSR l/s	1:2 FSR l/s	% 1:1 to 1:2 FSR	1:1 FEH Equivalent l/s
Area 1	0.239	32.9	29.5	34.3	86.0	28.29
Area 2	0.125	25.1	18.5	24.1	76.8	19.27
Area 3	0.170	30.0	22.3	28.7	77.8	23.31
Area 4	0.352	61.0	45.4	58.1	78.1	47.67
Area 5	0.251	44.9	33.2	42.9	77.4	34.75
Area 6	0.105	16.4	12.7	15.8	80.4	13.18
Area 7	1.197	194.5	145.1	186.5	77.8	151.32
Area 8	1.479	209.1	164.1	200.8	81.7	170.88
395m2 landscape area	0.0395					(REFH2 0.9 l/s/ha) 0.036
Total	3.957	**613.9**	**470.8**	**591.2**		**488.706**

3.23 The 1:1yr brownfield runoff rate for the site is therefore **488.706 l/s.**

3.24 The 1:1yr brownfield runoff rate directed to the Edward Street Sewer is: 104.395 l/s.

3.25 The 1:1yr brownfield runoff rate directed to the 675dia sewer is: 371.131 l/s (including the green landscaped area).

3.26 The 1:1yr brownfield runoff rate directed to the Magdalen Street sewer is:13.18 l/s.

Pre-Development Storage Volumes

3.27 A simple analysis was carried out based on the topographical survey. The various sewers serving the existing site along with the diameters are shown on the topographic survey. These were measured and the available capacity in each sewer has been calculated. This analysis identified only the private sewers which outfall from the existing development to the adopted sewers but does not include the adopted sewers themselves or any outfall pipes from gullies or rainwater pipes. It is noted that there could be additional private sewers which haven't been picked up on the topographical survey so were not included in this analysis.

3.28 The storage volume available in the pipe network serving the existing brownfield site is as follows:

150dia @ 335.4m = 6.04m3
225dia @ 296.4m = 11.86m3
300dia @ 71.5m = 5.08m3
375dia @ 34.9m = 3.84m3

Assume 1m3 volume for each manhole. 37 x manholes = 37m^3

3.29 The total 'storage' volume available in the surface water sewers on the existing site is therefore approximately 63.82m3.

Existing Sewers, Diversions and Build-Overs

3.30 The proposals will require the adopted surface and foul water sewers which cross the site to be diverted. It is anticipated that a S185 Sewer diversion Application shall be made to Anglian Water which will preclude the need for any Build-Over Agreements. Further information on sewer diversions are contained in Section 4.

3.31 A number of private surface and foul water sewers serve the existing site. These sewers are not anticipated to be retained as part of the proposed surface water drainage strategy and will therefore be removed and new surface and foul water sewers provided. Removal/divestment of any sewers shall be agreed with Anglian Water as part of a S185 Application.

Greenfield Run-off Rates

3.32 The LLFA in their consultation comments (ref FW2022_0423 and FW2022_0703) request that greenfield runoff rates are provided and calculation using FEH rainfall data methods. Using hydraulic modelling software Causeway Flow, greenfield runoff rates for 1:1yr, 1:2yr, 1:30yr and 1:100yr storm events were calculated using FEH rainfall data and also using ReFH2 rainfall data. The results of which are contained in Appendix I, and show runoff rates for each proposed discrete drainage system – as outlined in Section 4 of this report.

3.33 Causeway Flow hydraulic modeling software does not generate greenfield runoff rates including Climate Change Allowance. Causeway Flow were contacted to ascertain how a Climate Change Allowance could be applied to the generated greenfield flow rate, but they were unable to confirm how this could be done. For the purpose of discussion, it is proposed to apply a growth-factor to the greenfield run-off rates. As such, for 45% Climate Change Allowance, for that storm event, the greenfield runoff rate shall be multiplied by 1.45. So for a 1:100yr greenfield runoff rate of 1.0 l/s – to calculate a 1:100yr + 45% Climate Change event, 1.0 l/s shall be multiplied by 1.45 – giving a rate of 1.45 l/s.

3.34 Applying the 1:100yr + 45% Climate Change Event greenfield runoff rate, ReFH2 methods (5.9 litres per second per hectare), to the total application boundary (4.65ha) results in a rate of 27.435 l/s.

3.35 Applying the 1:100yr + 45% Climate Change Event greenfield runoff rate, ReFH2 methods (5.9 litres per second per hectare), to the total proposed contributing area (4.7ha) results in a rate of 27.73 l/s (NB Total contributiong area includes some off-site adopteable highway for robustness).

3.36 Applying the 1:100yr + 45% Climate Change Event greenfield runoff rate, FEH methods (2.9 litres per second per hectare), to the total application boundary (4.65ha) results in a rate of 13.485 l/s.

3.37 Applying the 1:100yr + 45% Climate Change Event greenfield runoff rate, FEH methods (2.9 litres per second per hectare), to the total proposed contributing area (4.7ha) results in a rate of 13.63 l/s (NB Total contributiong area includes some off-site adopteable highway for robustness).

3.38 Outfall rates to be applied to the proposed surface water drainage strategy are discussed below.

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS

Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk

4 Proposed Drainage Strategy

Relevant SuDS Policy

4.1 The NPPF states that, “using opportunities provided by new development and improvements in green and other infrastructure to reduce the causes and impacts of flooding, (making as much use as possible of natural flood management techniques as part of an integrated approach to flood risk management)”.

4.2 SuDS mimic the natural drainage system and provide a method of surface water drainage which can decrease the quantity of water discharged, and hence reduce the risk of flooding. In addition to reducing flood.

4.3 The SuDS management train incorporates a hierarchy of techniques and considers all three SuDS criteria of flood reduction, pollution reduction, and landscape and wildlife benefit. 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.

4.4 The philosophy of SuDS is to replicate as closely as possible the natural drainage from a site pre-development and to treat runoff to remove pollutants, resulting in a reduced impact on the receiving watercourses. The benefits of this approach are as follows:

- Reducing runoff rates, thus reducing the flood risk downstream.
- Reducing pollutant concentrations, thus protecting the quality of the receiving water body
- Groundwater recharge
- Contributing to the enhanced amenity and aesthetic value of development areas.
- Providing habitats for wildlife in developed areas, and opportunity for biodiversity enhancement.

Site Specific SuDS

4.5 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 4.1 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.	Roof Terraces and Roof Gardens are proposed as part of this development.	Yes
Infiltration devices & Soakaways (source control)	Store runoff and allow water to percolate into the ground via natural infiltration.	Potential for high groundwater and contamination indicated due to brownfield site.	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.	Potential for high groundwater and contamination indicated due to brownfield site. Lined permeable paving is proposed in some pedestrian areas which are outside the main thoroughfares.	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.	Water butts are proposed for Block C and rainwater recycling for landlord use to wash-down bin stores is also proposed.	Yes
Swales (permeable conveyance)	Broad shallow channels that convey / store runoff, and allow infiltration (ground conditions permitting).	Due to spatial constraints, swales are not proposed for conveyance and due to potential for high groundwater not proposed for infiltration.	No
Bioretention System	Shallow landscaped depression that can reduce runoff rates and volumes and treat pollution through engineered soils and vegetation.	Bioretention systems and tree-pits are proposed throughout the public realm and alongside highways where possible and where spatial constraints allow.	Yes
Filter drains & perforated pipes (permeable conveyance)	Trenches filled with granular materials (to take flows from adjacent impermeable areas) that convey runoff while allowing infiltration.	Some areas of the site may be suitable for use of filter drains, however no infiltration is expected to be viable due to contamination. Filter drains would therefore be lined and used for Water Quality purposes to filter waters prior to outfall.	Yes
Filter Strips (permeable conveyance)	Wide gently sloping areas of grass or dense vegetation that remove pollutants from run-off from adjacent areas.	Potential for high groundwater and contamination indicated due to brownfield site.	No
Infiltration basins (end of pipe treatment)	Depressions in the surface designed to store runoff and allow infiltration.	High density city centre site Potential for high groundwater and contamination indicated due to brownfield site.	No
Wet ponds & constructed wetlands (end of pipe treatment)	Provide water quality treatment & temporary storage above the permanent water level.	High density city centre site so no landscaped areas for ponds and wetlands.	No
Attenuation Underground (end of pipe treatment)	Oversized pipes or geo-cellular tanks designed to store water below ground level.	These are proposed as the SuDS listed above will not achieve sufficient volumes to restrict to the required rate. This is likely to be used alongside other means of attenuation at the site to provide the required storage volume.	Yes

Table 4.1: Site Specific Sustainable Drainage

EAS

Site Specific SuDS

4.6 Where possible, rainwater harvesting features shall be incorporated in the proposals where it is suitable to do so. The suitability of rainwater harvesting features has been considered against the Environment Agency's Energy and carbon implications of rainwater harvesting and greywater recycling (Report: SC090018), available here: scho0610bsmq-e-e.pdf (publishing.service.gov.uk), which summarises its key findings as follows:

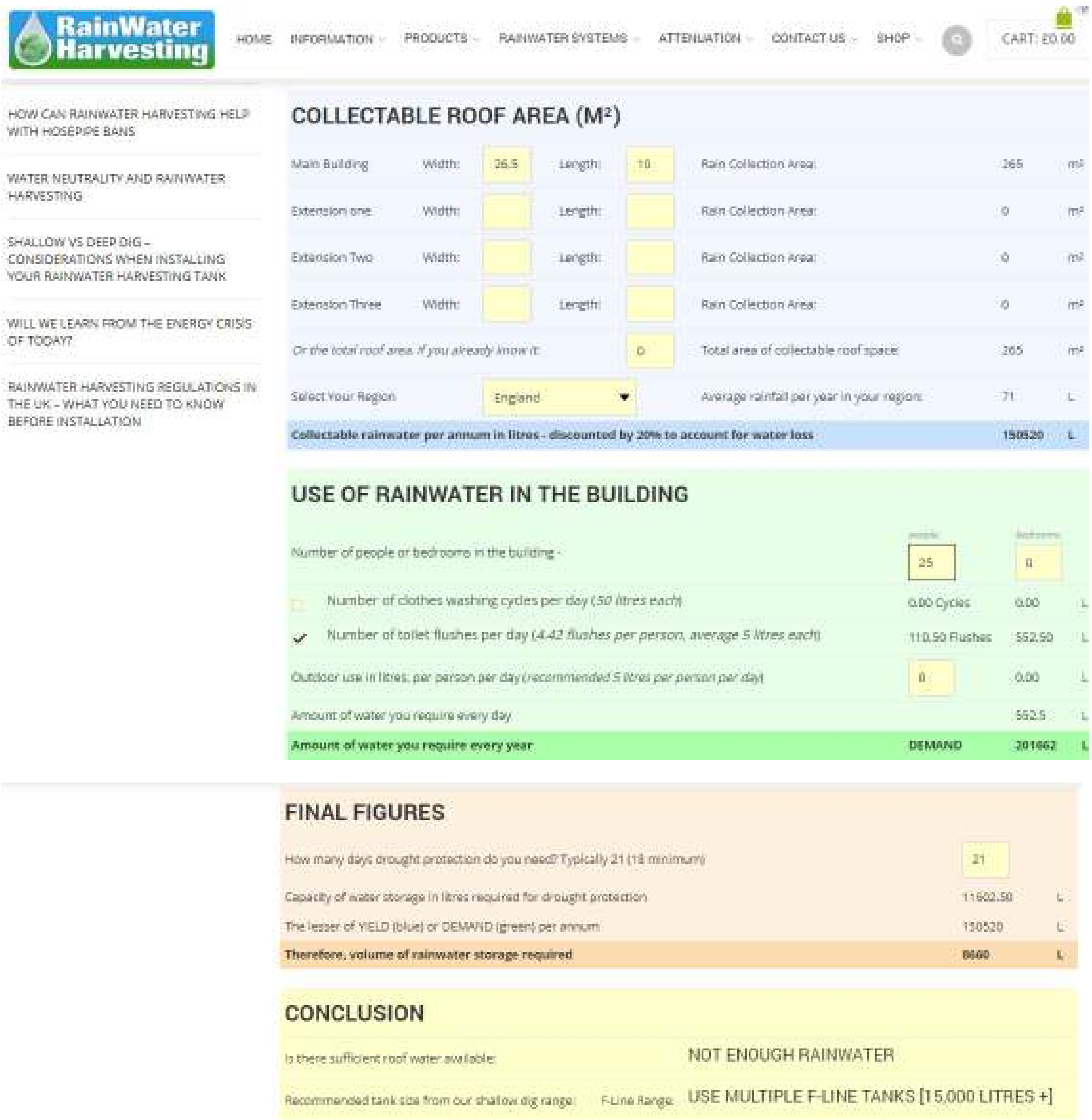
1. Buildings using harvested rainwater or treated greywater typically increase greenhouse gas emissions compared to using mains water, where total cradle to gate embodied and operational carbon are considered. For example over 30 years, where an 'average' 90m2 house has a RWH system with a polyethylene tank, the total carbon footprint is approximately 1.25 – 2 tonnes of carbon dioxide equivalent (CO2e). This is similar to one year of energy-related emissions from a house built to Code for Sustainable Homes Level 3 energy efficiency standards. The footprints of systems applied to commercial buildings vary widely, but over a 30 year lifespan were found to represent around one month's operational energy-related emissions in the hotel, office and schools studied.

2. With one exception, the operational energy and carbon intensities of the systems studied were higher than for mains water by around 40 per cent for a typical rainwater application, and over 100 per cent for most greywater applications. The exception is short retention greywater systems which are around 40 per cent less carbon intensive than mains water supply. The assumed operational intensities of rainwater and greywater systems are based on the limited measured data and information available to this study.

3. There is scope to improve the efficiency and design of systems to reduce their carbon footprints. Storage tanks account for a large proportion of the embodied carbon footprint of rainwater systems; slightly less so for greywater. Pumps also make up a large proportion of rainwater and greywater embodied carbon and pumping determines net operational carbon. Direct feed rainwater systems have a large operational footprint because both rainwater and mains backup are pumped to end uses via the storage tank. Innovation in these and other areas could reduce carbon footprints. Manufacturers and suppliers should work quickly to reduce the footprints of their systems, and particularly to reduce the energy intensity of pumps and treatment systems."

4.7 Taking the above into consideration, the proposals do not allow for rainwater harvesting for mixed-use areas as rainwater harvesting would need to be pumped for re-use. There is scope to provide suitable rainwater harvesting where the use of pumps is not required, this will be in the form of water-butts for individual properties and for above ground tanks to serve bin-wash down areas for mixed-use buildings.

4.8 The developer was asked to consider rainwater re-use for toilets in the Community Centre in Block D. An assessment on required tank size was undertaken using the calculator on www.rainwaterharvesting.co.uk/tank-size-calcuator/. Based on an average 25 flushes per day (considered to be a conservative estimate of use) and a contributing roof area of 265m2 (the non-green-roof-area of Block D), it is concluded that not enough rainwater is generated to make this viable, see screen-shot below. This also concludes that a rainwater harvesting tank of volume 15,000 litres would be required (or 15m3) for which there is not space to provide within the community centre.



4.9 The following assessment therefore forms the basis of Rainwater Harvesting features that could be viable at the proposed development site for each Block:

Block	Description	Constraints / Comments	Appropriate
Block A – Commercial and Residential. (Full Planning)	The use of filtered rainwater for reuse in toilets and washing machines.	Given the complex split of usages for the Blocks (residential vs commercial) the infrastructure needed to manage this and the possible risk/concern of maintenance and management of a system to serve private, communal and public use toilet water would be difficult to deliver effectively. The use of pumps would be unavoidable and would therefore contribute to the carbon footprint of the development.	No
	The use of filtered rainwater for reuse at outside taps.	Rainwater harvesting tanks to be incorporated for land- lord bin wash-down, which shall be fed by rainwater downpipes and managed and maintained solely by the landlord or elected Management and Maintenance Company. These rainwater harvesting tanks shall be located within the ground-floor bin stores and shall be fed by a nearby rainwater downpipe. Overflow from rainwater harvesting tank shall be directed back into the private surface water drainage network. NB: Gully from bin-wash-down area shall be directed to private foul water drainage network.	Yes
Block B – Residential. (Full Planning)	The use of filtered rainwater for reuse in toilets and washing machines.	There is potential for individual owners of the terraced houses within this Block to install a system in the future, however for commercial reasons it is not proposed for these residential units at this planning stage. It is not expected there will be opportunity for the leaseholder of the apartment block in Block B to retrofit rainwater harvesting however.	No
	The use of filtered rainwater for reuse at outside taps.	Rainwater Water-Butts are to be incorporated for the terraced houses along the northern boundary of Block B.	Yes
Block C – Residential. (Full Planning)	The use of filtered rainwater for reuse in toilets and washing machines.	For commercial and maintenance/management reasons it is not proposed to provide rainwater reuse for toilets for the apartment units at this planning stage.	No
	The use of filtered rainwater for reuse at outside taps.	Not possible for this Block due to possible leaseholder issues.	No
Block D – Commercial and Residential. (Full Planning)	The use of filtered rainwater for reuse in toilets and washing machines.	Given the complex split of usages for the Blocks (residential vs commercial) the infrastructure needed to manage this and the possible risk/concern of maintenance and management of a system to serve private, communal and public use toilet water would be difficult to deliver effectively. The use of pumps would be unavoidable and would therefore contribute to the carbon footprint of the development.	No
	The use of filtered rainwater for reuse at outside taps.	Rainwater harvesting tanks to be incorporated for land- lord bin wash-down, which shall be fed by rainwater downpipes and managed and maintained solely by the landlord or elected Management and Maintenance Company. These rainwater harvesting tanks shall be located within the ground-floor bin stores and shall be fed by a nearby rainwater downpipe. Overflow from rainwater harvesting tank shall be directed back into the private surface water drainage network. NB: Gully from bin-wash-down area shall be directed to private foul water drainage network.	Yes
	The use of filtered rainwater for reuse in toilets and washing machines.	Given the complex split of usages for the Blocks (residential vs commercial) the infrastructure needed to manage this and the possible risk/concern of maintenance and management of a system to serve private, communal and public use toilet water would be difficult to deliver effectively. The use of pumps would be unavoidable and would therefore contribute to the carbon footprint of the development.	No

Block E – Commercial and Residential. (Outline Planning)	The use of filtered rainwater for reuse at outside taps.	Rainwater harvesting tanks to be incorporated for land- lord bin wash-down, which shall be fed by rainwater downpipes and managed and maintained solely by the landlord or elected Management and Maintenance Company. These rainwater harvesting tanks shall be located within the ground-floor bin stores and shall be fed by a nearby rainwater downpipe. Overflow from rainwater harvesting tank shall be directed back into the private surface water drainage network. NB: Gully from bin-wash-down area shall be directed to private foul water drainage network.	Yes
Block F – Commercial and Residential. (Outline Planning)	The use of filtered rainwater for reuse in toilets and washing machines.	Given the complex split of usages for the Blocks (residential vs commercial) the infrastructure needed to manage this and the possible risk/concern of maintenance and management of a system to serve private, communal and public use toilet water would be difficult to deliver effectively. The use of pumps would be unavoidable and would therefore contribute to the carbon footprint of the development.	No
	The use of filtered rainwater for reuse at outside taps.	Rainwater harvesting tanks to be incorporated for land- lord bin wash-down, which shall be fed by rainwater downpipes and managed and maintained solely by the landlord or elected Management and Maintenance Company. These rainwater harvesting tanks shall be located within the ground-floor bin stores and shall be fed by a nearby rainwater downpipe. Overflow from rainwater harvesting tank shall be directed back into the private surface water drainage network. NB: Gully from bin-wash-down area shall be directed to private foul water drainage network.	Yes
Block G – Commercial and Residential. (Outline Planning)	The use of filtered rainwater for reuse in toilets and washing machines.	Given the complex split of usages for the Blocks (residential vs commercial) the infrastructure needed to manage this and the possible risk/concern of maintenance and management of a system to serve private, communal and public use toilet water would be difficult to deliver effectively. The use of pumps would be unavoidable and would therefore contribute to the carbon footprint of the development.	No
	The use of filtered rainwater for reuse at outside taps.	Rainwater harvesting tanks to be incorporated for land- lord bin wash-down, which shall be fed by rainwater downpipes and managed and maintained solely by the landlord or elected Management and Maintenance Company. These rainwater harvesting tanks shall be located within the ground-floor bin stores and shall be fed by a nearby rainwater downpipe. Overflow from rainwater harvesting tank shall be directed back into the private surface water drainage network. NB: Gully from bin-wash-down area shall be directed to private foul water drainage network.	Yes
Block H – Commercial and Residential. (Outline Planning)	The use of filtered rainwater for reuse in toilets and washing machines.	Given the complex split of usages for the Blocks (residential vs commercial) the infrastructure needed to manage this and the possible risk/concern of maintenance and management of a system to serve private, communal and public use toilet water would be difficult to deliver effectively. The use of pumps would be unavoidable and would therefore contribute to the carbon footprint of the development.	No
	The use of filtered rainwater for reuse at outside taps.	Rainwater harvesting tanks to be incorporated for land- lord bin wash-down, which shall be fed by rainwater downpipes and managed and maintained solely by the landlord or elected Management and Maintenance Company. These rainwater harvesting tanks shall be located within the ground-floor bin stores and shall be fed by a nearby rainwater downpipe. Overflow from rainwater harvesting tank shall be directed back into the private surface water drainage network. NB: Gully from bin-wash-down area shall be directed to private foul water drainage network.	Yes
	The use of filtered rainwater for reuse in toilets and washing machines.	Given the complex split of usages for the Blocks (residential vs commercial) the infrastructure needed to manage this and the possible risk/concern of maintenance and management of a system to serve private, communal and public use toilet water would be difficult to	No

Block J – Commercial and Residential. (Outline Planning)		deliver effectively. The use of pumps would be unavoidable and would therefore contribute to the carbon footprint of the development.	
	The use of filtered rainwater for reuse at outside taps.	Rainwater harvesting tanks to be incorporated for land- lord bin wash-down, which shall be fed by rainwater downpipes and managed and maintained solely by the landlord or elected Management and Maintenance Company. These rainwater harvesting tanks shall be located within the ground-floor bin stores and shall be fed by a nearby rainwater downpipe. Overflow from rainwater harvesting tank shall be directed back into the private surface water drainage network. NB: Gully from bin-wash-down area shall be directed to private foul water drainage network.	Yes
Block J3 – Commercial and Residential. (Full Planning)	The use of filtered rainwater for reuse in toilets and washing machines.	Given the complex split of usages for the Blocks (residential vs commercial) the infrastructure needed to manage this and the possible risk/concern of maintenance and management of a system to serve private, communal and public use toilet water would be difficult to deliver effectively. The use of pumps would be unavoidable and would therefore contribute to the carbon footprint of the development.	No
	The use of filtered rainwater for reuse at outside taps.	Rainwater harvesting tanks to be incorporated for land- lord bin wash-down, which shall be fed by rainwater downpipes and managed and maintained solely by the landlord or elected Management and Maintenance Company. These rainwater harvesting tanks shall be located within the ground-floor bin stores and shall be fed by a nearby rainwater downpipe. Overflow from rainwater harvesting tank shall be directed back into the private surface water drainage network. NB: Gully from bin-wash-down area shall be directed to private foul water drainage network.	Yes
Block K/L – Commercial and Residential. (Full Planning)	The use of filtered rainwater for reuse in toilets and washing machines.	Given the complex split of usages for the Blocks (residential vs commercial) the infrastructure needed to manage this and the possible risk/concern of maintenance and management of a system to serve private, communal and public use toilet water would be difficult to deliver effectively. The use of pumps would be unavoidable and would therefore contribute to the carbon footprint of the development.	No
	The use of filtered rainwater for reuse at outside taps.	Rainwater harvesting tanks to be incorporated for land- lord bin wash-down, which shall be fed by rainwater downpipes and managed and maintained solely by the landlord or elected Management and Maintenance Company. These rainwater harvesting tanks shall be located within the ground-floor bin stores and shall be fed by a nearby rainwater downpipe. Overflow from rainwater harvesting tank shall be directed back into the private surface water drainage network. NB: Gully from bin-wash-down area shall be directed to private foul water drainage network.	Yes
Block M – Commercial and Residential. (Full Planning)	The use of filtered rainwater for reuse in toilets and washing machines.	Given the complex split of usages for the Blocks (residential vs commercial) the infrastructure needed to manage this and the possible risk/concern of maintenance and management of a system to serve private, communal and public use toilet water would be difficult to deliver effectively. The use of pumps would be unavoidable and would therefore contribute to the carbon footprint of the development.	No
	The use of filtered rainwater for reuse at outside taps.	Rainwater harvesting tanks to be incorporated for land- lord bin wash-down, which shall be fed by rainwater downpipes and managed and maintained solely by the landlord or elected Management and Maintenance Company. These rainwater harvesting tanks shall be located within the ground-floor bin stores and shall be fed by a nearby rainwater downpipe. Overflow from rainwater harvesting tank shall be directed back into the private surface water drainage network. NB: Gully from bin-wash-down area shall be directed to private foul water drainage network.	Yes

Table 4.2: Site Specific Rainwater Harvesting

Post- Development Run-off Rate

4.10 Given the potentially high groundwater and contamination of the site, infiltration is not recommended. The Royal Haskoning DHV FRA Report (Section 7.11, Table 5) discusses borehole data and shows historic groundwater borehole information showing a winter (January 1993) groundwater level of 2.40m bgl and a spring (May 1993) groundwater level of 4.40m bgl. The relatively high groundwater levels precludes the use of infiltration devices. There are no nearby watercourses to which a connection could be made, and therefore it is proposed that the development will drain to the existing Anglian Water surface water network in the vicinity of the site (matching the existing situation), however at a restricted discharge rate in order to provide a betterment.

4.11 The greenfield runoff rates provided in Section 3 above are very low due to the local geology of chalk. However, in reality the site is almost entirely impermeable, historical mapping shows the site has been developed since at least 1885 and has been a shopping/town centre for many years. The site is Brownfield and it is therefore considered appropriate to review the existing run-off rates with a view to provide a betterment. Using greenfield run-off rates for a site which has been brownfield for over 137 years is inappropriate and would result in excessive attenuation volumes and therefore tank sizes, which could have impacts on other features such as the local archaeology, groundwater and geology.

4.12 S3 of the Non-Adoptable Technical Standards for Sustainable Drainage Systems (2015) 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."

4.13 As discussed in para. 3.32 above, the 1:100yr + 45% Climate Change greenfield runoff rate for the entire application site (4.65ha) is 27.435 l/s. An assessment of whether it is practicable to restrict flows from the development site to match greenfield runoff rates was undertaken by applying the greenfield runoff rate for the entire application boundary of 27.435 l/s to the largest proposed catchment Block A, M, K/L and J3. Using Causeway Flow (hydraulic modelling software), the storage volume, using greenfield runoff rate was calculated at: 832.9m3 requiring a geocellular storage device size of 525m2 x 1.67m x 95% voids. When allowing for a proposed outfall rate of 65 l/s (based on a reduced brownfield/existing run-off rate), the storage volume requirement is calculated as 682.2m3 requiring a geocellular storage device size of 430m2 x 1.67m x 95% voids. This is an increase of 150.7m3 of volume that would be required if using the total 1:100yr + 45% CC greenfield run-off rate for a 1:100yr + 45% CC Storm Event. Refer to **Appendix J** for hydraulic calculations and a sketch showing the sizes of attenuation. Taking into consideration that additional storage volume will be required for some proposed catchments which may rely on a pumped outfall, it is clear that spatial constraints prevent the use of greenfield run-off rates being applied. This assessment shows that it is not possible or practicable to apply greenfield runoff rates.

4.14 S3 above concludes that where it is not reasonably practicable to match peak runoff rates that are directed to a drain or sewer to greenfield rates – proposed rates "should never exceed the rate of discharge from the development prior to redevelopment for that event"

4.15 As it is not practicable to restrict flows from the proposed development site to greenfield runoff rates and the proposals are to direct flows to the adopted sewer network (as per existing), in order to determine an appropriate proposed outfall rate, Anglian Water were consulted. A Pre-Development Assessment Report confirmed that a total discharge rate of 242 l/s would be acceptable, see **Appendix K**. Subsequent discussions with Anglian Water during the consultation period addressed the proposed outfall points and outfall rates. Anglian Water provided a further email statement to confirm that the proposed outfall rates (pumped and gravity) and proposed outfall points were acceptable, this email is contained in **Appendix L**.

4.16 In order to confirm the determined maximum outfall rate of 242 l/s shall never exceed the rate of discharge from the development prior to redevelopment for each storm event, the assessment below looks at the brownfield runoff rates for 1:1yr, 1:30yr and 1:100yr events and compares these with the proposed maximum 242 l/s outfall rate:

	Existing Run-off Rate	Proposed Run-off Rate	Reduction
1:1 Yr Storm	488.706 l/s	242 l/s	-246.706 l/s
1:30 Yr Storm	1439.119 l/s	242 l/s	-1197.119 l/s
1:100yr Storm	1781.933 l/s	242 l/s	-1539.933 l/s

4.17 It is clear from the above assessment that the proposed maximum outfall rate of 242 l/s to manage all storms up to and including the 1:100yr + 45% Climate Change Event shall significantly reduce flows from the development site for all storm events. The proposed 242 l/s is the equivalent of 49.5% of the existing 1:1yr brownfield run-off rate and therefore satisfies S3 of the Non-Adoptable Technical Standards for Sustainable Drainage Systems (2015). This rate and the proposed outfall points are acceptable to Anglian Water as discussed in **Appendix L** and shall therefore inform the proposed surface water drainage strategy as follows.

Proposed Drainage Strategy

4.18 In accordance with the Environment Agency's May 2022 published Climate Change Allowances, all surface water drainage is to be designed to manage a 1:100yr + 45% Climate Change Event. As per LLFA's Developer Guidance, FEH Rainfall Data shall be used within the hydraulic models whilst also applying a MADD Factor of 0. As requested by the LLFA, the hydraulic model assumes that adopted sewers are running at full bore and will be surcharged to the top of pipe.

4.19 The proposed drainage systems shall be hydraulically modelled to test a 1:2yr Storm, 1:30yr Storm, 1:30yr + 40% Climate Change Storm, a 1:100yr Storm and finally a 1:100yr + 45% Climate Change Event.

4.20 As discussed above, the total maximum outfall rate of 242 l/s, to manage all storms up to and including the 1:100yr + 45% Climate Change Event will match 49.5% of the existing 1:1yr brownfield runoff rate – providing a significant betterment to the existing situation for all storm events.

4.21 The former Barclays Bank building in the north east corner of the site and Surrey Chapel in the south-west corner of the site are existing buildings which are outside the Application Boundary. These are to be retained along with the drainage networks which serve them. Run-off from these areas shall not be included within the proposed surface water drainage networks. It is intended to ensure that any drainage pipework serving these buildings that may cross into the Application Boundary will be diverted accordingly if required.

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk

4.22 This maximum outfall rate of 242 l/s shall be proportioned to each proposed catchment area, taking into account the contributing area and spatial constraints whilst ensuring that flow rates to each adopted sewer do not exceed existing 1:1yr Brownfield runoff rates. As discussed in para 3.19 to 3.22 above, 50% of existing Area 1 and the whole of Area 2. Area 3 and Area 4 drain to the Edward Street surface water sewer at a 1:1yr Brownfield rate of 104.395 l/s. In the proposed situation, Blocks B and C (discussed in more detail below) will drain to the Edward Street Sewer at a combined maximum outfall rate of 10 l/s. A significant reduction.

4.23 For the 675dia surface water sewer, in the existing situation 50% of Area 1, and the whole of Area 5, Area 7 and Area 8 drain to this sewer at a 1:1yr Brownfield rate of 371.095 l/s. In the proposed situation, Blocks D, A, M, K/L, J3, E, F, G, J and H (discussed in more detail below), will drain to the diverted 675dia surface water sewer at a combined maximum outfall rate of 232 l/s, again a significant reduction.

4.24 The finished floor levels (FFL's) for each Block have been set following the hydraulic modelling undertaken by Royal Haskoning DHV and are discussed further within their FRA report.

4.25 As described in Section 1, it is proposed to make a Hybrid planning application: Full Planning for Blocks, A, B, C, D, J3, K/L and M and Outline Planning for Blocks E, F, G, H and J.

4.26 The Hybrid site layout precludes the option for completely separating drainage for Outline areas from Full-Planning areas however, largely, the drainage systems serve only Outline or only Full-Planning areas

4.27 development parcels have been split into 9no. drainage catchments:

- System 1 – Serves Block B (Full-Planning)
- System 2 – Serves Block C (Full-Planning)
- System 3 – Serves Block D (Full-Planning)
- System 4 - Serves Block A, M J3 and K/L (Full Planning)
- System 5 – Serves Botolph Street/Public Realm Area (Full Planning)
- System 6 – Serves Block E (Outline Planning)
- System 7 – Serves Block F (Outline Planning)
- System 8 – Serves Blocks G and J (Outline Planning)
- System 9 – Serves Block H (Outline Planning)

System 1 – Block B – Full Planning

4.28 SuDS Feature Selection – This catchment comprises residential dwellings, footpaths, patios and parking areas. The residential apartment block facing New Botolph St has a green roof – the details of which can be seen on the Landscape Masterplan – Roof Level PlanIt drawing in **Appendix M**. It is proposed to utilise lined permeable paving to manage run-off from the trafficked areas. The proposed hard and soft landscaping plans are shown on PlanIt Landscape Masterplan contained in **Appendix N**. Residential rainwater harvesting (water-butts) are to be provided for the terraced houses. A surface water drainage network shall collect run-off from roof, patios and other hardstanding areas with all flows directed to a geo-cellular storage device with outfall to the adopted 225dia surface water sewer in Edward Street (MH AW 0452) via a Downstream Defender (proprietary treatment unit) and Hydrobrake gravity flow control device.

4.29 The contributing area for this catchment has been calculated as: 1790.5m², comprising:

- Roof Area (515m² x 110% allowing for 10% Urban Creep) – 566.5m²
- Green Roof Area – 290m² (assuming the green roof is saturated and do not provide any storage volume)
- Permeable Paving (trafficked) Area – 580m²
- Patios and Footpaths – 354m²

4.30 The maximum outfall rate for this catchment has been set at 5.0 l/s to manage all storms up to and including the 1 in 100yr + 45% Climate Change Event. The proposed Surface Water Drainage Layouts are contained in **Appendix O** and shows the network serving Block B on drawing DR-001.

4.31 There are two sections of permeable paving attenuation system, PP1 covers an area of 432m² and PP2 covers an area of 150m². Surface water runoff from 240m² of surrounding hardstanding areas will be directed to the permeable paving attenuation system PP1. Surface water attenuation volume in the permeable paving attenuation system is provided within the sub- base voids (usually 30% voids and no-fines). Flows from these permeable paving systems are restricted using orifice-plate flow control chambers – flows are then directed to/cascade to the geo-cellular attenuation device which also collects surface water run-off from the remainder of the contributing area.

4.32 Causeway Flow (hydraulic modelling software) has been used to calculate the required attenuation volume for the permeable paving areas and the geo-cellular storage device whilst restricting flows to a maximum of 5.0 l/s to manage all storms up to and including a 1 in 100 year + 45% Climate Change event. As discussed in para. 4.17 above, the hydraulic model allows for the adopted surface water sewers to be surcharged and as such, the pipe flow in that node will include for this. (NB: As the network is modelled with a surcharged outfall on the last pipe, the maximum outfall rate should be read from node: ADOPT1).

4.33 The hydraulic output data shows results for a 2:1yr, 1:30yr, 1:30yr + 40% Climate Change, 1:100yr and 1:100yr + 45% Climate Change events and are contained in **Appendix P**, along with pipe long-sections. For the 1:100yr + 45% Climate Change event an attenuation volume of 52.53m3 in PP1, a volume of 8.99m² in PP2 and a volume of 40.2534m3 in the geo-cellular storage device is calculated. This volume can be contained within the sub-base of the permeable paving areas and within a geo-cellular storage device sized 35.2m² x 1.32m deep with 95% voids.

4.34 Half Drain Times – For the 1:100yr + 45% Climate Change event, the hydraulic model demonstrates that Permeable Paving Area 1 has a half-drain time of 616mins, Permeable Paving Area 2 is 256mins and the Geo-cellular storage device half-drains in 138mins. All well within 24hrs. (See page 7 of the hydraulic output for Block B).

EAS

4.35 Water Quality Assessment – This catchment comprises residential roofs and low-traffic roads only.

4.36 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.

4.37 Relating to runoff from 'standard' roofs and footpaths: CIRIA 763 SuDS Manual Table 26.2 shows Residential Roofs have a Pollution Hazard Level of LOW. Runoff from 'standard' roofs and footpaths shall be treated via a Hydro-International Downstream Defender (Advanced Vortex) proprietary treatment system. Table 26.2 shows Residential Roofs have TSS of 0.2 Metals 0.2 and Hydrocarbons 0.05. 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 Q** as well as advice from Hydro-International on sizing Downstream Defenders

4.38 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.

4.39 Rainwater Harvesting – Slim-line water-butts shall be provided on rainwater downpipes to the rear of the individual properties to serve/support watering of private gardens.

System 2 – Block C – Full Planning

4.40 SuDS Feature Selection – This catchment comprises a residential apartment block, footpaths and landscaped areas. The residential apartment block utilises a green roof - the details of which can be seen on the Landscape Masterplan - Roof Level PlanIt drawing in **Appendix M**. The proposed hard and soft landscaping plans are shown on PlanIt Landscape Masterplan contained in **Appendix N**. A surface water drainage network shall collect run-off from the green roof and footpaths with all flows directed to a geo-cellular storage device with outfall to the adopted 300dia surface water sewer in Edward Street (new MH AW 0451A) via a Downstream Defender (proprietary treatment unit) and a Hydrobrake gravity flow control device.

4.41 The contributing area for this catchment has been calculated as: 728m², comprising:

- Green Roof Area – 433m² (assuming the green roof is saturated and do not provide any storage volume)
- Footpaths – 295m²

4.42 The maximum outfall rate for this catchment has been set at 5.0 l/s to manage all storms up to and including the 1 in 100yr + 45% Climate Change Event. The proposed Surface Water Drainage Layouts are contained in Appendix M and shows the network serving Block C on drawing DR-001.

4.43 Surface water run-off from the Green Roof and pedestrian hardstanding areas is collected in a surface water drainage network which outfalls to a geo-cellular attenuation device. Flows from the geo-cellular attenuation device are restricted using a Hydrobrake gravity flow control device prior to outfall to the adopted surface water sewer via a proprietary treatment unit.

4.44 Causeway Flow (hydraulic modelling software) has been used to calculate the required attenuation volume for the geo-cellular storage device whilst restricting flows to a maximum of 5.0 l/s to manage all storms up to and including a 1 in 100 year + 45% Climate Change event. As discussed in para. 4.17 above, the hydraulic model allows for the adopted surface water sewers to be surcharged and as such, the pipe flow in that node will include for this. (NB: As the network is modelled with a surcharged outfall on the last pipe, the maximum outfall rate should be read from node: C9).

4.45 The hydraulic output data shows results for a 1:2yr, 1:30yr, 1:30yr + 40% Climate Change, 1:100yr and 1:100yr + 45% Climate Change events and are contained in **Appendix P**, along with pipe long-sections. For the 1:100yr + 45% Climate Change event an attenuation volume of 29.068m3 in in the geo-cellular storage device is calculated and can be contained within a geo-cellular storage device sized 62.72m² x 0.66m deep with 95% voids – this provides a maximum attenuation volume of 59.584m3.

4.46 Half Drain Times – The hydraulic model demonstrates the Geo-cellular storage device half-drains in 55mins. Well within 24hrs. (See page 4 of the hydraulic output for Block C).

4.47 Water Quality Assessment – This catchment comprises footpaths and residential roofs only.

4.48 Relating to runoff from pedestrian footpaths, as there is no specific reference for hardscaped areas, it is considered prudent to apply a residential roof as comparison: CIRIA 763 SuDS Manual Table 26.2 shows Residential Roofs have a Pollution Hazard Level of LOW. Runoff from the hard landscaping shall be treated via a Hydro-International Downstream Defender (Advanced Vortex) proprietary treatment system. Table 26.2 shows “Residential Roofs” have TSS of 0.2 Metals 0.2 and Hydrocarbons 0.05. 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 the hard landscaping areas is therefore more than sufficiently mitigated by use of the Downstream Defender (Advanced Vortex). Details of the Downstream Defender is contained in **Appendix Q** as well as advice from Hydro-International on sizing Downstream Defenders.

4.49 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.

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk

System 3 – Block D – Full Planning

4.50 SuDS Feature Selection – This catchment comprises public realm area, a commercial unit block with community centre and residential apartments above. A portion of Block D roof area is green-roof – the details of which can be seen on the Landscape Masterplan - Roof Level PlanIt drawing in **Appendix M**. The proposed hard and soft landscaping plans are shown on PlanIt Landscape Masterplan contained in **Appendix N**. A surface water drainage network shall collect run-off from the green roof, other roof areas and public realm areas (via bio-retention systems, channel/slot drains and gullies) with all flows directed to a geo-cellular storage device. As Block D has level-thresholds, levels are designed to fall away from doorways, however as a precaution a slot-drain is also provided around the building line. Outfall is directed to the diverted adopted 675dia surface water sewer which crosses Anglia Square (new MH SW-A-04) via a Downstream Defender (proprietary treatment unit) and a Hydrobrake gravity flow control device.

4.51 The contributing area for this catchment has been calculated as: 2580m², comprising:

- Green Roof Area – 610m² (assuming the green roof is saturated and do not provide any storage volume)
- Roof Area – 265m²
- Public Realm (including bioretention systems which are assumed to be saturated and do not provide any storage volume) – 1705m²

4.52 The maximum outfall rate for this catchment has been set at 12.5 l/s to manage all storms up to and including the 1 in 100yr + 45% Climate Change Event. The proposed Surface Water Drainage Layouts are contained in **Appendix M** and shows the network serving Block D on drawing DR-001.

4.53 Surface water run-off from the Green Roof, Roof and Public Realm areas is collected in a surface water drainage network which outfalls to a geo-cellular attenuation device. Due to spatial constraints, and to ensure a minimum 5m offset from the building line, the geocellular storage device is split into two sections and is linked by a 600dia connector pipe. Flows from the geo-cellular attenuation device are restricted using a Hydrobrake gravity flow control device prior to outfall to the adopted diverted 675dia surface water sewer via a proprietary treatment unit.

4.54 Causeway Flow (hydraulic modelling software) has been used to calculate the required attenuation volume for the geo-cellular storage device whilst restricting flows to a maximum of 12.5 l/s to manage all storms up to and including a 1 in 100 year + 45% Climate Change event. As discussed in para. 4.17 above, the hydraulic model allows for the adopted surface water sewers to be surcharged and as such, the pipe flow in that node will include for this. (NB: As the network is modelled with a surcharged outfall on the last pipe, the maximum outfall rate should be read from node: D09).

4.55 The hydraulic output data shows results for a 1:2yr, 1:30yr, 1:30yr + 40% Climate Change, 1:100yr and 1:100yr + 45% Climate Change events and are contained in **Appendix P**, along with pipe long-sections. For the 1:100yr + 45% Climate Change event an attenuation volume of 99.1863m3 in in the geo-cellular storage device and 2.844m3 in the 600dia connector pipe is calculated and can be contained within a geo-cellular storage device sized 80m² x 1.32m deep with 95% voids – this provides a maximum attenuation volume of 59.584m3.

4.56 Half Drain Times – The hydraulic model demonstrates the Geo-cellular storage device half-drains in 86mins. All well within 24hrs. (See page 4 of the hydraulic output for Block D).

4.57 Water Quality Assessment – This catchment comprises commercial/residential roofs and green roofs as well as pedestrian Public Realm areas.

4.58 Relating to runoff from 'standard' roofs and pedestrian public realm: CIRIA 763 SuDS Manual Table 26.2 shows Residential Roofs have a Pollution Hazard Level of LOW. Runoff from 'standard' roofs and footpaths shall be treated via a Hydro-International Downstream Defender (Advanced Vortex) proprietary treatment system. Table 26.2 shows Residential Roofs have TSS of 0.2 Metals 0.2 and Hydrocarbons 0.05. 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 Q** as well as advice from Hydro-International on sizing Downstream Defenders.

4.59 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.

4.60 Rainwater Harvesting – a rainwater harvesting tank shall be provided to serve/support a bin-wash-down tap in the landlord/communal bin-store.

System 4 – Blocks A, M, J3 and K/L – Full Planning

4.61 SuDS Feature Selection – This catchment comprises public realm area and commercial unit blocks with residential apartments above. Some roof area is green-roof – the details of which can be seen on the Landscape Masterplan - Roof Level PlanIt drawing in **Appendix M**. The proposed hard and soft landscaping plans are shown on PlanIt Landscape Masterplan contained in **Appendix N**. A surface water drainage network shall collect run-off from the green roof, other roof areas and public realm areas (via bio-retention systems, channel/slot drains and gullies) with all flows directed to a geo-cellular storage device. As Blocks in this catchment have level-thresholds, levels are designed to fall away from doorways, however as a precaution a slot-drain is also provided around the building lines. Outfall is directed to the diverted adopted 675dia surface water sewer which crosses Anglia Square (new MH SW-A-07) via a surface water pump flow control device and Downstream Defender (proprietary treatment unit.

4.62 The contributing area for this catchment has been calculated as: 14,850m², comprising:

- Green Roof Area – 2535m² (assuming the green roof is saturated and do not provide any storage volume)
- Roof Area – 6313m²
- Public Realm (including bioretention systems which are assumed to be saturated and do not provide any storage volume) – 6002 m²

4.63 The maximum outfall rate for this catchment has been set at 65.0 l/s to manage all storms up to and including the 1 in 100yr + 45% Climate Change Event. The proposed Surface Water Drainage Layouts are contained in **Appendix O** and shows the network serving Block A, M, K/L and J3 on drawings DR-002 and DR-004.

4.64 Surface water run-off from the Green Roof, Roof and Public Realm areas is collected in a surface water drainage network which outfalls to a geo-cellular attenuation device. Due to spatial constraints, contributing area and the depth of the adopted sewer, it is necessary to pump surface water flows/outfall from this catchment. Flows from the geo-cellular attenuation device are restricted using a surface water flow control device prior to outfall to the adopted diverted 675dia surface water sewer via a proprietary treatment unit.

4.65 Causeway Flow (hydraulic modelling software) has been used to calculate the required attenuation volume for the geo-cellular storage device whilst restricting flows to a maximum of 65.0 l/s to manage all storms up to and including a 1 in 100 year + 45% Climate Change event. As discussed in para. 4.17 above, the hydraulic model allows for the adopted surface water sewers to be surcharged and as such, the pipe flow in that node will include for this. (NB: As the network is modelled with a surcharged outfall on the last pipe, as such the maximum outfall rate should be read from node: MH38).

4.66 The hydraulic output data shows results for a 1:2yr, 1:30yr, 1:30yr + 40% Climate Change, 1:100yr and 1:100yr + 45% Climate Change events and are contained in **Appendix P**, along with pipe long-sections. For the 1:100yr + 45% Climate Change event an attenuation volume of 535.7961m3 in the geo-cellular storage device and can be contained within a geo-cellular storage device sized 322.6m^2 x 1.98m deep with 95% voids.

4.67 Half Drain Times – The hydraulic model demonstrates the Geo-cellular storage device half-drains in 68mins. All well within 24hrs. (See page 9 of the hydraulic output for Block A, M, J3 , K/L).

4.68 Water Quality Assessment – This catchment comprises commercial/residential roofs and green roofs as well as pedestrian Public Realm areas.

4.69 Relating to runoff from 'standard' roofs and pedestrian public realm: CIRIA 763 SuDS Manual Table 26.2 shows Residential Roofs have a Pollution Hazard Level of LOW. Runoff from 'standard' roofs and footpaths shall be treated via a Hydro-International Downstream Defender (Advanced Vortex) proprietary treatment system. Table 26.2 shows Residential Roofs have TSS of 0.2 Metals 0.2 and Hydrocarbons 0.05. 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 Q** as well as advice from Hydro-International on sizing Downstream Defenders.

4.70 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.

4.71 Relating to run-ff from hardstanding areas that is directed to Bioretention Systems. To undertake a water quality assessment, these pedestrian areas have been considered as Commercial Roof. CIRIA 763 SuDS Manual Table 26.2 Other Roofs have a Pollution Hazard Level of LOW. Table 26.2 shows Other Roofs have TSS of 0.3 Metals, 0.2 and Hydrocarbons 0.05. Table 26.3 shows mitigation indices for discharges to surface waters for Bioretention systems as: TSS of 0.8 Metals, 0.8 and Hydrocarbons 0.8.

4.72 Rainwater Harvesting – rainwater harvesting tanks shall be provided to serve/support a bin-wash-down tap in the landlord/communal bin-stores for each Block.

System 5 – Botolph Street/Public Realm Area – Full Planning

4.73 SuDS Feature Selection – This catchment comprises public realm area and a small area of trafficked access road. The proposed hard and soft landscaping plans are shown on PlanIt Landscape Masterplan contained in **Appendix N**. A surface water drainage network shall collect run-off from the paved areas via bioretention systems, channel drains and gullies with all flows directed to an over-sized pipe storage device. Outfall is directed to the diverted adopted 675dia surface water sewer which crosses Anglia Square (new MH SW-A-04) via a Downstream Defender (proprietary treatment unit) and a Hydrobrake gravity flow control device.

4.74 The proposed over-size pipe system will run underneath the bio-retention systems, PlanIt, the landscape architect for this scheme, were consulted to gain confirmation of planting within the bioretention systems and their root depths. It was confirmed that the proposed planting root depth is not expected to exceed 1.0m in depth and in the main will be contained within 0.6m of depth from the cover level of the bio-retention system. As such, the design ensures that the pipe soffit/top-of-pipe is always at least 1.2m in depth from the lowest bio-retention system cover level to allow for a 200mm drainage layer. This ensures that there will be no root ingress to the proposed over-size pipe system and that outlets from the bioretention systems can be directed to the surface water drainage system.

4.75 The contributing area for this catchment has been calculated as: 1630m², comprising:

- Public Realm (including bioretention systems which are assumed to be saturated and do not provide any storage volume) – 1630m²

4.76 The maximum outfall rate for this catchment has been set at 10.0 l/s to manage all storms up to and including the 1 in 100yr + 45% Climate Change Event. The proposed Surface Water Drainage Layouts are contained in **Appendix O** and shows the network serving Block D on drawing DR-003.

4.77 Surface water run-off from the Public Realm area is collected in an oversized pipe surface water drainage network with flows restricted using a Hydrobrake gravity flow control device prior to outfall to the adopted diverted 675dia surface water sewer via a proprietary treatment unit.

4.78 Causeway Flow (hydraulic modelling software) has been used to calculate the required attenuation volume for the oversized-pipe storage/drainage system whilst restricting flows to a maximum of 10.0 l/s to manage all storms up to and including a 1 in 100 year + 45% Climate Change event. As discussed in para. 4.17 above, the hydraulic model allows for the adopted surface water sewers to be surcharged and as such, the pipe flow in that node will include for this.

(NB: As the network is modelled with a surcharged outfall on the last pipe, as such the maximum outfall rate should be read from node: B.ST 07).

4.79 The hydraulic output data shows results for a 1:2yr, 1:30yr, 1:30yr + 40% Climate Change, 1:100yr and 1:100yr + 45% Climate Change events and are contained in **Appendix P**, along with pipe long-sections. For the 1:100yr + 45% Climate Change event an attenuation volume of 53.1257m3 in “links” 1.000 to 1.005 and their upstream ‘”nodes”.

4.80 Half Drain Times – based on a rate of 10l/s, a volume of 53.1257m^3 can be drained in 88.5mins, well within 24hrs.

4.81 Water Quality Assessment – This catchment comprises Public Realm areas with low traffic roads.

4.82 CIRIA 763 SuDS Manual Table 26.2 shows Low Traffic Roads have a Pollution Hazard Level of LOW. Runoff from all hardstanding areas shall be treated via a Hydro-International Downstream Defender (Advanced Vortex) proprietary treatment system. Table 26.2 shows Low-Traffic Roads have TSS of 0.5 Metals, 0.4 and Hydrocarbons 0.4. Table 26.3. 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 Q** as well as advice from Hydro-International on sizing Downstream Defenders.

4.83 Relating to run-off from hardstanding areas that is directed to Bioretention Systems. To undertake a water quality assessment, these pedestrian areas have been considered as Commercial Roof. CIRIA 763 SuDS Manual Table 26.2 Other Roofs have a Pollution Hazard Level of LOW. Table 26.2 shows Other Roofs have TSS of 0.3 Metals, 0.2 and Hydrocarbons 0.05. Table 26.3 shows mitigation indices for discharges to surface waters for Bioretention systems as: TSS of 0.8 Metals, 0.8 and Hydrocarbons 0.8.

4.84 The proposed landscaping layout shows bioretention swales to the south of this catchment, close to Block F, which straddle the Outline and Full Application boundaries. It is intended that the sections of Bioretention Systems shall be constructed as separate systems. This will be achieved by separating the drainage mediums with a suitable liner and ensuring outlets for each section are directed to the relevant drainage systems. Thus ensuring that flows in the Full application boundary are separated from flows in the Outline application boundary.

System 6 – Block E – Outline Planning

4.85 SuDS Feature Selection – This catchment comprises commercial units with residential dwellings above and some public realm/pedestrian walkways. Green roof shall cover some roof area. Bioretention systems shall collect run-off from highway areas to the west, as agreed in principle with the Highway Authority. Details of the split between private and highway catchments and the drainage features which serve these areas shall be confirmed during detailed design stage. For now, and to be conservative, the hydraulic models shall assume all areas within the catchment boundary will be collected within a private drainage network. The catchment shall be considered 100% impermeable with a contributing area of 6420m^2.

4.86 At this Outline stage the surface water drainage strategy shall allow for all waters to be collected within a geocellular attenuation device with a restricted outfall directed to the diverted adopted 675dia surface water sewer crossing the site. Due to spatial constraints, storage volume requirements and the depth of the receiving adopted sewer, it will be necessary to pump surface water flows to a 'demarcation chamber' with a connection to the diverted 675dia surface water sewer. Flows shall be cleansed via a Downstream Defender (proprietary treatment unit) prior to outfall.

4.87 The maximum outfall rate for this catchment has been set at 30.0 l/s to manage all storms up to and including the 1 in 100yr + 45% Climate Change Event. The proposed Surface Water Drainage Layouts are contained in **Appendix O** and shows the indicative surface water drainage network serving Block E on drawing DR-003.

4.88 WINDES Microdrainage (hydraulic modelling software) has been used to calculate the required attenuation volume for the geo-cellular storage device whilst restricting flows to 30.0 l/s for the 1:100yr + 45% Climate Change storm event. Any attenuation volume that may be provided in green roofs and bio-retention areas has not been allowed for to ensure a robust estimation of the required attenuation volumes to serve this catchment are made. The hydraulic output data is contained in **Appendix P** and shows an attenuation volume of 277.2m^3 in the geo-cellular storage device with a maximum outfall rate of **30.0 l/s** is required to manage a 1 in 100 year + 45% Climate Change event. This can be contained within a geo-cellular storage device sized 147.2m^2 x 1.98m with 95% voids – this provides a maximum attenuation volume of 276.9m^3.

4.89 Half Drain Times – The hydraulic model demonstrates the Geo-cellular storage device half-drains in 83mins for a 1 in 100yr + 45% Climate Change Storm Event. All well within 24hrs.

4.90 Water Quality – This catchment comprises Other Roofs, Green Roofs as well as Pedestrian Walkways.

4.91 Relating to runoff from 'standard' roofs and pedestrian public realm, to undertake a water quality assessment, the pedestrian areas have also been considered as Other Roofs. CIRIA 763 SuDS Manual Table 26.2 shows Other Roofs have a Pollution Hazard Level of LOW. Runoff from 'standard' roofs and footpaths shall be treated via a Hydro-International Downstream Defender (Advanced Vortex) proprietary treatment system. Table 26.2 shows Other Roofs have TSS of 0.3 Metals 0.2 and Hydrocarbons 0.05. 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 Q** as well as advice from Hydro-International on sizing Downstream Defenders.

4.92 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.

4.93 Relating to run-off from hardstanding areas that is directed to Bioretention Systems. To undertake a water quality assessment, these pedestrian areas have been considered as Commercial Roof. CIRIA 763 SuDS Manual Table 26.2 Other Roofs have a Pollution Hazard Level of LOW. Table 26.2 shows Other Roofs have TSS of 0.3 Metals, 0.2 and Hydrocarbons

0.05. Table 26.3 shows mitigation indices for discharges to surface waters for Bioretention systems as: TSS of 0.8 Metals, 0.8 and Hydrocarbons 0.8.

4.94 Rainwater Harvesting – a rainwater harvesting tank shall be provided to serve/support a bin-wash-down tap in the landlord/communal bin-store.

System 7 – Block F – Outline Planning

4.95 SuDS Feature Selection – This catchment comprises commercial units with residential dwellings above and some public realm/pedestrian walkways. Green roof shall cover some roof area whilst a section of permeable paving system shall form the external parking area (approx.350 m²). Bioretention systems shall collect run-off from pedestrian walkways where possible. For now, and to be conservative, the hydraulic models shall assume all areas within the catchment boundary shall be collected within a private drainage network. The catchment shall be considered 100% impermeable with a contributing area of 4460m².

4.96 At this Outline stage the surface water drainage strategy shall allow for all waters to be collected within a Geocellular attenuation device with a restricted outfall directed to the diverted adopted 675dia surface water sewer crossing the site. Due to spatial constraints, storage volume requirements and the depth of the receiving adopted sewer, it will be necessary to pump surface water flows to a 'demarcation chamber' with a connection to the diverted 675dia surface water sewer. Flows shall be cleansed via a Downstream Defender (proprietary treatment unit) prior to outfall.

4.97 The maximum outfall rate for this catchment has been set at 20.0 l/s to manage all storms up to and including the 1 in 100yr + 45% Climate Change Event. The proposed Surface Water Drainage Layouts are contained in **Appendix O** and shows the network serving Block F on drawing DR-003.

4.98 WINDES Microdrainage (hydraulic modelling software) has been used to calculate the required attenuation volume for the geo-cellular storage device whilst restricting flows to 20.0 l/s for the 1:100yr + 45% Climate Change storm event. Any attenuation volume that may be provided in green roofs, permeable paving and bio-retention areas has not been allowed for to ensure a robust estimation of the required attenuation volumes to serve this catchment are made. The hydraulic output data is contained in **Appendix P** and shows an attenuation volume of 187.9m³ in the geo-cellular storage device with a maximum outfall rate of **20.0 l/s** is required to manage a 1 in 100 year + 45% Climate Change event. This can be contained within a geo-cellular storage device sized 112.6m² x 1.98m with 95% voids – this provides a maximum attenuation volume of 211.8m³. Noting that due to spatial constraints and to maintain a distance of 5m from the building line, the geocellular storage device is split in two sections and are connected via a 600dia connector pipe.

4.99 Half Drain Times – The hydraulic model demonstrates the Geo-cellular storage device half-drains in 79mins for a 1 in 100yr + 45% Climate Change Storm Event. All well within 24hrs.

4.100 Water Quality – This catchment comprises Other Roofs, Green Roofs as well as Pedestrian Walkways.

4.101 Relating to runoff from 'standard' roofs and pedestrian public realm: CIRIA 763 SuDS Manual Table 26.2 shows Residential Roofs have a Pollution Hazard Level of LOW. Runoff from 'standard' roofs and footpaths shall be treated via a Hydro-International Downstream

Defender (Advanced Vortex) proprietary treatment system. Table 26.2 shows Residential Roofs have TSS of 0.2 Metals 0.2 and Hydrocarbons 0.05. 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 Q as well as advice from Hydro-International on sizing Downstream Defenders.

4.102 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

4.103 Relating to run-off from hardstanding areas that is directed to Bioretention Systems. To undertake a water quality assessment, these pedestrian areas have been considered as Commercial Roof. CIRIA 763 SuDS Manual Table 26.2 Other Roofs have a Pollution Hazard Level of LOW. Table 26.2 shows Other Roofs have TSS of 0.3 Metals, 0.2 and Hydrocarbons 0.05. Table 26.3 shows mitigation indices for discharges to surface waters for Bioretention systems as: TSS of 0.8 Metals, 0.8 and Hydrocarbons 0.8.

4.104 Relating to runoff from other public realm areas that do not drain to bioretention systems, to undertake a water quality assessment, these pedestrian areas have been considered as Other Roofs. CIRIA 763 SuDS Manual Table 26.2 shows Other Roofs have a Pollution Hazard Level of LOW. Runoff from these pedestrian areas shall be treated via a Hydro-International Downstream Defender (Advanced Vortex) proprietary treatment system. Table 26.2 shows Other Roofs have TSS of 0.3 Metals 0.2 and Hydrocarbons 0.05. 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 Q** as well as advice from Hydro-International on sizing Downstream Defenders.

4.105 Relating to runoff from permeable block paved trafficked areas: CIRIA 763 SuDS Manual Table 26.2 shows Residential Car Parks have a Pollution Hazard Level of LOW. Runoff from permeable block paving will be managed by itself. Table 26.2 shows Residential Car Parks have TSS of 0.5 Metals 0.4 and Hydrocarbons 0.4. Table 26.3 shows mitigation indices for Permeable Pavement is TSS at 0.7; Metals at 0.6 and Hydrocarbons at 0.7. Surface water run-off from these areas is therefore more than sufficiently mitigated by use of the Permeable Block Paving itself.

4.106 Rainwater Harvesting – a rainwater harvesting tank shall be provided to serve/support a bin-wash-down tap in the landlord/communal bin-store.

4.107 The proposed landscaping layout shows bioretention swales to the east of this catchment, close to Botolph Street, which straddle the Outline and Full Application boundaries. It is intended that the sections of Bioretention Systems shall be constructed as separate systems. This will be achieved by separating the drainage mediums with a suitable liner and ensuring outlets for each secion are directed to the relevant drainage systems. Thus ensuring that flows in the Full application boundary are separated from flows in the Outline application boundary.

System 8 – Blocks G and J – Outline Planning

4.108 SuDS Feature Selection – This catchment comprises residential units, commercial units with residential dwellings above as well as some public realm/pedestrian walkways and vehicular access to undercroft car parks in Blocks G and J. Green roof shall cover some roof area. Permeable block paving covering an area of approx. 614 m² shall collect surface water run-off from part of the vehicular access areas that will be trafficked. A surface water drainage network will collect surface water runoff from rainwater down pipes, external paved areas via channel drains and gullies and convey to the geocelular storage device. The catchment shall be considered 100% impermeable with a contributing area of 9640m² for robustness with no allowance for green roofs or permeable block paving.

4.109 At this Outline stage the surface water drainage strategy shall allow for all waters to be collected within a Geocellular attenuation device with a restricted outfall directed to the diverted adopted 675dia surface water sewer crossing the site. Due to spatial constraints, storage volume requirements and the depth of the receiving adopted sewer, it will be necessary to pump surface water flows to a 'demarcation chamber' with a connection to the diverted 675dia surface water sewer. Flows shall be cleansed via a Downstream Defender (proprietary treatment unit) prior to outfall. The maximum outfall rate for this catchment has been set at 70.0 l/s to manage all storms up to and including the 1 in 100yr + 45% Climate Change Event. The proposed Surface Water Drainage Layouts are contained in **Appendix O** and shows the network serving Block F on drawing DR-003 and DR-004.

4.110 WINDES Microdrainage (hydraulic modelling software) has been used to calculate the required attenuation volume for the geo-cellular storage device whilst restricting flows to 70.0 l/s for the 1:100yr + 45% Climate Change storm event. Any attenuation volume that may be provided in green roofs and permeable block paving has not been allowed for to ensure a robust estimation of the required attenuation volumes to serve this catchment are made. The hydraulic output data is contained in **Appendix P** and shows an attenuation volume of 370.4m³ in the geo-cellular storage device with a maximum outfall rate of **70.0 l/s** is required to manage a 1 in 100 year + 45% Climate Change event. This can be contained within a geo-cellular storage device sized 195.8m² x 1.67m with 95% voids – this provides a maximum attenuation volume of 310.63m³.

4.111 Half Drain Times – The hydraulic model demonstrates the Geo-cellular storage device half-drains in 53mins for a 1:100yr + 45% Climate Change Storm Event. All well within 24hrs.

4.112 Water Quality Assessment – This catchment comprises commercial/residential roofs, pedestrian walkways and low-traffic roads only.

4.113 Relating to runoff from 'standard' roofs and pedestrian public realm, to undertake a water quality assessment, the pedestrian areas have also been considered as Other Roofs. CIRIA 763 SuDS Manual Table 26.2 shows Other Roofs have a Pollution Hazard Level of LOW. Runoff from 'standard' roofs and footpaths shall be treated via a Hydro-International Downstream Defender (Advanced Vortex) proprietary treatment system. Table 26.2 shows Other Roofs have TSS of 0.3 Metals 0.2 and Hydrocarbons 0.05. 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 Q** as well as advice from Hydro-International on sizing Downstream Defenders.

4.114 Relating to runoff from non-permeable block paved trafficked areas: CIRIA 763 SuDS Manual Table 26.2 shows Residential Car Parks have a Pollution Hazard Level of LOW. Runoff from 'standard' roofs and footpaths shall be treated via a Hydro-International Downstream Defender (Advanced Vortex) proprietary treatment system. Table 26.2 shows Residential Car Parks have TSS of 0.5 Metals 0.4 and Hydrocarbons 0.4. 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 Q** as well as advice from Hydro-International on sizing Downstream Defenders.

4.115 Relating to runoff from permeable block paved trafficked areas: CIRIA 763 SuDS Manual Table 26.2 shows Residential Car Parks have a Pollution Hazard Level of LOW. Runoff from permeable block paving will be managed by itself. Table 26.2 shows Residential Car Parks have TSS of 0.5 Metals 0.4 and Hydrocarbons 0.4. Table 26.3 shows mitigation indices for Permeable Pavement is TSS at 0.7; Metals at 0.6 and Hydrocarbons at 0.7. Surface water run-off from these areas is therefore more than sufficiently mitigated by use of the Permeable Block Paving itself.

4.116 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.

4.117 Rainwater Harvesting – rainwater harvesting tanks shall be provided to serve/support a bin-wash-down tap in the landlord/communal bin-stores for each Block.

System 9 – Block H – Outline Planning

4.118 SuDS Feature Selection – This catchment comprises commercial units with residential dwellings above and some public realm/pedestrian walkways. Green roof shall cover some roof area and a bioretention system is proposed – some runoff from hardstanding area is directed to this system, however most runoff from hardstanding shall be directed to the proposed surface water drainage network via channel drains and gullies. Due to spatial constraints, storage volume requirements and the depth of the receiving adopted sewer, it will be necessary to pump surface water flows to a 'demarcation chamber' with a connection to the diverted 675dia surface water sewer. For now, and to be conservative, the hydraulic models shall assume all areas within the catchment boundary shall be collected within a private drainage network. The catchment shall be considered 100% impermeable with a contributing area of 3460m^2.

4.119 At this Outline stage the surface water drainage strategy shall allow for all waters to be collected within a geocellular attenuation device with a restricted outfall directed to the diverted adopted 675dia surface water sewer crossing the site. Flows shall be cleansed via a Downstream Defender (proprietary treatment unit) prior to outfall. The maximum outfall rate for this catchment has been set at 24.5 l/s to manage all storms up to and including the 1 in 100yr + 45% Climate Change Event. The proposed Surface Water Drainage Layouts are contained in **Appendix O** and shows the network serving Block H on drawing DR-002.

4.120 WINDES Microdrainage (hydraulic modelling software) has been used to calculate the required attenuation volume for the geo-cellular storage device whilst restricting flows to 24.5 l/s for the 1:100yr + 45% Climate Change storm event. Any attenuation volume that may be provided in green roofs has not been allowed for to ensure a robust estimation of the required attenuation volumes to serve this catchment are made. The hydraulic output data is contained in **Appendix P** and shows an attenuation volume of 141.1m^3 in the geo-cellular storage device with a maximum outfall rate of **24.5 l/s** is required to manage a 1 in 100 year + 40% Climate Change event. This can be contained within a geo-cellular storage device sized 112.0m^2 x 1.32m with 95% voids – this provides a maximum attenuation volume of 140.448m^3.

4.121 Half Drain Times – The hydraulic model demonstrates the Geo-cellular storage device half-drains in 61mins. All well within 24hrs.

4.122 Water Quality – This catchment comprises Other Roofs as well as Pedestrian Walkways.

4.123 Relating to runoff from ‘standard’ roofs and pedestrian public realm, to undertake a water quality assessment, the pedestrian areas have also been considered as Other Roofs. CIRIA 763 SuDS Manual Table 26.2 shows Other Roofs have a Pollution Hazard Level of LOW. Runoff from ‘standard’ roofs and footpaths shall be treated via a Hydro-International Downstream Defender (Advanced Vortex) proprietary treatment system. Table 26.2 shows Other Roofs have TSS of 0.3 Metals 0.2 and Hydrocarbons 0.05. 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 Q** as well as advice from Hydro-International on sizing Downstream Defenders.

4.124 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.

4.125 Rainwater Harvesting – a rainwater harvesting tank shall be provided to serve/support a bin-wash-down tap in the landlord/communal bin-store.

Summary of Catchments and Proposed Outfall Rates

4.126 As discussed in para. 4.13, the total allowable outfall rate for the Anglia Square Regeneration site has been set at 242 l/s, which is a reduction of 50.5% against the existing 1:1yr Brownfield Runoff Rate – a significant betterment. Below is a breakdown of outfall rates for each catchment (System) and total:

- System 1 – Maximum surface water outfall rate of 5.0 l/s
- System 2 – Maximum surface water outfall rate of 5.0 l/s
- System 3 – Maximum surface water outfall rate of 12.5 l/s
- System 4 - Maximum surface water outfall rate of 65.0 l/s
- System 5 – Maximum surface water outfall rate of 10.0 l/s
- System 6 – Maximum surface water outfall rate of 30.0 l/s
- System 7 – S Maximum surface water outfall rate of 20.0 l/s
- System 8 – Maximum surface water outfall rate of 70.0 l/s
- System 9 - Maximum surface water outfall rate of 24.5 l/s
- All Systems – Total 242.0 l/s maximum outfall rate to manage all storms up to and including the 1:100yr + 45% Climate Change Event. The equivalent of 49.5% of the existing 1:1yr surface water run-off rate. This is a significant improvement to the existing situation. In addition, the existing drainage system does not benefit from any water treatment stages, whilst the proposed drainage strategy allows for water quality and treatment stages to meet the guidance within CIRIA 753 SuDS Manual.

Attenuation Tank Alarm System

4.127 The proposed development site shall be served by a Flood Evacuation Warning Plan, the proposals of which are discussed in the Flood Risk Assessment Report however will be detailed further at a Discharge of Conditions stage. As the development site is within a Critical Drainage Catchment and there is risk of off-site flows from entering the proposed on-site drainage system, it is identified that monitoring of attenuation capacity would be beneficial for maintenance and management purposes and to reduce the risk of flooding. Full Planning Block A, M, K/L and J3 and Outline Planning Block E, Block F, Block G and J and Block H catchments are served by geocellular attenuation devices whereby the outfalls are controlled using surface water pumps. These pumping stations will be equipped with a secondary back-up pump as well as a telemetry alarm system to alert the Management Company of any pump failures. Block, B, Block C, Block D and Botolph Street proposed drainage systems are controlled using gravity type Flow Control Devices (hydro brakes), which are not alarmed.

4.128 The proposed surface water drainage systems are not be designed to include any flows or volumes from off-site which may enter the system. It is appreciated that off-site flows could enter the proposed surface water drainage systems in certain catchments and as such it is appropriate to install an alarm system which will be triggered to alert the Management Company when tanks fail to drain-down after a storm event. This type of system monitors the hydrostatic pressure within attenuation devices and communicates the available capacity via a radio transmitter to a receiving control panel that shall be located within kiosks as shown on the Proposed Surface Water Drainage Layouts in Appendix O.

4.129 Failure to drain-down after a storm event could occur due to debris/blockages within pipework or attenuation devices, or could be attributed to flow control devices not operating effectively. By identifying a possible issue in the drainage system, maintenance can be undertaken to ensure that the drainage systems operate fully and attenuation volumes, as required, are available at all times. This means that should overland flow routes pass through the site, these paths and depths of surface water are not exacerbated by poorly functioning on-site drainage systems.

4.130 This alarm system could be linked to the Flood Evacuation Plan (to be Conditioned) for information only, however its primary function is to inform the need for any Maintenance to be undertaken.

Surface Water Pump Alarm System

4.131 Wherever possible it is proposed to utilise an outfall to the adopted sewer network via a gravity connection using a hydrobrake or other suitable flow control device, such as orifice plates for permeable paving outlets. Where this is not possible, due to attenuation volume requirements, spatial constraints and/or the receiving adopted sewer being higher than the proposed drainage, surface water has to be pumped to a 'demarcation' chamber to allow waters to flow into the adopted sewer network by gravity connection.

4.132 Where surface water pumps are to be used, 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 kiosks as shown on the Proposed Surface Water Drainage Layouts.

4.133 The risk of pump failure is low, however in the very unlikely event that primary, secondary and temporary pumps all fail, waters would fill the attenuation tanks and overspill into the public realm, following the overland flow paths. There is no risk to property as pumps and tanks are located externally.

Surface Water Pumps – Power Failure

4.134 In case of power failure, it is necessary to consider the impact on surface water drainage systems which rely on a powered surface water pump. It is therefore proposed to connect the surface water pumps serving Block A, M, K/L and J3 (Full) and Blocks, E, F, G, J and H (Outline) to the emergency power generator system serving the site. This emergency power generator system will serve the site's electrical needs during a power failure, this includes emergency lighting, sprinkler systems and surface water drainage pumps. In the event that a power failure occurs during a storm event, the surface water pumps will be unaffected and will continue to function. It is recommended that the emergency power generator system link to the surface water drainage pumps is tested regularly for maintenance and monitoring purposes. This is discussed further in the Maintenance and Management Plan.

4.135 No additional 'emergency' attenuation volume is therefore required, the proposed attenuation devices are sized to manage all storms up to and including a 1:100yr + 45% Climate Change event and measures are put in place to ensure power to the surface water pumps is available during a power cut/power failure to the site. The indicative locations of emergency generators are indicated on the surface water drainage layouts.

Exceedance Routes

4.136 In the event of a greater than 1 in 100 year (+45%CC) rainfall event occurring, the exceedance routes would follow proposed and existing surface water flow paths as identified on SK05-A in **Appendix R.** The flow paths shown head towards the south-east of the site and follow routes as identified in the Flood Risk Assessment Report by Royal Haskoning DHV.

4.137 As discussed in the separate FRA by Royal Haskoning DHV, their hydraulic model assumes the public sewer system is almost at capacity and there is no functioning drainage system within the site boundary. This would result in the overland flows collecting in the pedestrian walkways and passing through the site from north west to south east. The flows would leave the site at Magdalen Street.

Sewer Diversions

4.138 As noted in Section 3, there are a number of Anglian Water sewers passing through the existing site. Anglian Water were consulted in 2018 for the previous scheme on the potential diversion of several of their sewers around the proposed development and it is understood that this will need to be considered in detail at a later stage through a diversion application, when information such as the foundation design is available. Anglian Water Drainage Engineer Darren Sewell provided some information on the requirements when diverting sewers within a new development site. This has been included at **Appendix S**. To summarise.

- Any re-development areas falling within 3m of an existing public sewer but remaining only 'built near' an existing sewer, assuming the same clearance and access is available, would in principle be acceptable.

- Any areas falling within 3m of the existing public sewer would need to comply with Part H4 Building Regulations in respect of 'building near' public sewers and Anglian Water criteria on the website.

- Foundation design of the new buildings would need to be carefully considered to ensure that no loading would be transferred on a 45 degree 'angle of repose' onto the sewer.

- The only area which would appear to require consideration of a formal diversion of a sewer would be the existing 675mm diameter surface water sewer and the existing 225mm foul sewer running immediately south of unit A1.01 (675mm surface water sewer close to MH 0453 to 0456 and 225mm foul sewer near to MH 0405 to 0408).

- The above sewer may require a diversion, and the technicalities of this will be considered at a later stage. Anglian Water could consider formally devesting some sections of the existing public sewer which are no longer needed/fall beneath buildings (these need to be sewers serving only the existing site and no third parties). This means the Developer would apply to devest the sewer into their private ownership, and these sections of devested sewer could then be removed if no longer needed.

4.139 It would be necessary to consult Anglian Water further on the diverting and devesting of their public sewers across the site prior to any development taking place, to ensure that the issues raised in the email at **Appendix S** have been addressed.

Foul Sewer Network

4.140 An Anglian Water capacity check was carried out for the previous scheme to determine whether there would be sufficient capacity within their existing foul network to accommodate the foul flows from the proposed development. This is in their pre-development enquiry in **Appendix K** and confirms that there is sufficient capacity in the existing foul network and no improvements would be needed to the network.

Standard Surface Water Drainage Construction Details

4.141 The LLFA Developer Guidance requires that details of proposed surface water drainage features are provided at Full Planning Application stage. Standard Construction Details for the following features has therefore been provided in **Appendix T**.

- Green Roofs – see PlanIt drawings and cross-sections
- Bio-Retention Systems
- Manholes, Gullies and Channel Drains
- Typical Hydro-Brakes
- Surface Water Pumps
- Permeable Block Paving

Carbon Impact Consideration

4.142 In accordance with Policy E8 "Towards Net Zero" the developer has considered how the carbon emissions can be minimised for the drainage systems associated with the proposed development.

4.143 The primary objective of the design is for the systems to operate under gravity, thereby avoiding the need for pumps which generate carbon emissions from their operation. Wherever possible and where cover and invert levels of receiving adopted sewers allow, surface water runoff from the development site is attenuated and restricted using gravity-type flow control devices, such as hydrobrakes or orifice plates.

4.144 Where the proposed drainage and storage devices cannot be shallower than the adopted sewer network, due to cover levels, length of drainage network, attenuation volumes and spatial constraints, it is necessary to pump restricted flows. The use of surface water pumping stations to serve some catchments within the development site is unavoidable though is only proposed where necessary.

4.145 For the Full Planning Application areas (Blocks A, B, C, D, M, K/L and J3), the surface water drainage strategy has been developed to drain catchments by gravity wherever possible. Blocks B, C, D and Botolph Street catchments are drained into the adopted sewer network via a gravity Hydrobrake type device whilst Block A, M, K/L and J3 catchment will rely on a pumped outfall (1no. surface water pump in the full Application). The pump specifications for this catchment are contained in **Appendix T**.

4.146 For the Outline Planning Application areas (Blocks E, F, H, G and J) there may be scope at a later design stage to reduce the areas flowing to pumping stations by splitting catchment areas into smaller areas, whereby some may be able to drain via gravity, however at this stage it is considered conservative to allow for these 4no. pumping stations.

4.147 Where pumps are necessary, their operational carbon emissions will be minimised through the following measures.

- Minimised peak flow rate through attenuation and flow control devices to reduce the size of the pumps and hence their power demand.
- Pumps selected to maximise efficiency at the design duty to lower energy demand
- Pump operation controlled on levels within the chamber to ensure they only operate when required
- Appropriate electrical metering and links to the development control systems to allow monitoring of energy use.
- Regular cleaning and servicing to ensure the pumps are operating as efficiently as possible. This is discussed in the Maintenance and Management Plan.

5 Proposed SuDS Features Information

SuDS Features and the "Four Pillars of SuDS"

5.1 The city center site gives opportunities for "urban types" of SuDS features to be incorporated. These features provide water quantity, water quality, biodiversity and amenity enhancements. The table below summarises the proposed SuDS Features and how they contribute to the Four Pillars of SuDS. Further details of the proposed SuDS Features are discussed from para 5.2 onwards.

Water Quantity	Water Quality	Biodiversity	Amenity
The Bio-Retention Systems proposed allow for reduction of water quantity by providing opportunity for transpiration.	The engineered soils and vegetation within the proposed bio-retention systems provide a filter medium to cleanse waters prior to outfall to the drainage network.	The Bioretention Systems proposed will provide biodiversity enhancement by introducing new habitats in the urban environment.	Amenity space in bioretention systems is formed by shallow depressions in the landscaping with stepping stones and seating areas.
The Tree-Pits proposed allow for reduction of water quantity by providing opportunity for transpiration. The Green Roofs proposed allow for reduction of water quantity by providing opportunity for transpiration. Some transpiration will occur for waters on the permeable block paving surface and will reduce water quantity, though it is appreciated it will not be to the same extent as bioretention systems or green roofs could provide. Rainwater harvesting. Some reduction in water quantity is expected by reuse for private gardens in Block B and for bin-wash-down in Blocks, A, D, E, F, G, H, J, K/L, M and J3.	The engineered soils within the proposed tree-pits provide a filter medium to cleanse waters prior to outfall to the drainage network. The proposed green-roofs provide a water quality treatment stage for runoff from these roof areas. The granular subbase within permeable block paving attenuation systems provide a water quality treatment stage for runoff from trafficked areas.	The Tree-Pits proposed will provide biodiversity enhancement by introducing new habitats in the urban environment. The intensive and extensive green roofs will provide new habitats in the urban environment.	The Tree-Pits proposed will enhance the amenity space of the public realm. Amenity space is provided on green-roof terraces on the podiums.

Green Roofs

5.2 Green Roofs will provide Amenity, Biodiversity, Water Quality and Water Volume benefits in line with the Four Pillars of SuDS. Amenity space is formed by roof-top gardens and terraces for. Biodiversity is formed by use of extensive and intensive green-roofs. Water Quality, the green roof areas will provide a treatment stage for surface water runoff. Water Volume, green roofs provide attenuation volume and slow the rate of waters entering the main sewer system. Transpiration shall also reduce overall water volumes.

5.3 CIRIA SuDS Manual C753 Chapter 12 describes Green Roofs as follows:

"Green roofs area areas of living vegetation, installed on the top of buildings, for a range of reasons including visual benefit, ecological value, enhanced building performance and the reduction of surface water runoff. Types of green roof can be divided into two main categories:

-Extensive roofs, have low substrate depths (and therefore low loadings on the building structure), simple planting and low maintenance requirements; they tend not to be accessible.

-Intensive roofs (or roof gardens) have deeper substrate (and therefore higher loadings on the building structure) that can support a wide variety of planting but which tend to require more intensive maintenance; they are usually accessible."

5.4 The Full Planning proposals include for a number of garden roof terraces which comprise some areas of extensive and intensive type green roof as well as paved areas – these are currently detailed on Blocks A, D, M and K/L. Green roofs are also shown indicatively on Outline Application Blocks E, F, G, J, and H, it is expected that these will also comprise extensive and intensive green roof areas and paved areas. Details of the Proposed Green Roofs can be found on PlanIt Roof Masterplan drawing in Appendix M. As described above, the drainage calculations in Section 4 do not account for any attenuation that may be available on green roof areas. However, as a general rule, it is assumed that green roofs are saturated when calculating a site's attenuation requirements anyhow.

5.5 Green roofs and Garden Roof Terraces will provide water quality and biodiversity benefits to the overall scheme.

Bio-Retention Systems

5.6 Bio-Retention Systems will provide Amenity, Biodiversity, Water Quality and Water Volume benefits in line with the Four Pillars of SuDS. Amenity space is formed by shallow depressions in the landscaping with stepping stones and seating areas. Biodiversity is formed by use of suitable planting. In terms of Water Quality, the bioretention systems shall provide a treatment stage for surface water runoff. Water Volume – bioretention systems shall provide attenuation volume and slow the rate of waters entering the main sewer system. Transpiration shall also reduce overall water volumes.

5.7 CIRIA SuDS Manual C753 Chapter 18 describes Bio-Retention Systems as follows:

"Bioretention systems (including rain gardens) are shallow landscaped depressions that can reduce run-off rates and volumes, and treat pollution through the use of engineered soils and vegetation. They are particularly effective in delivering interception and can also provide: attractive landscape features that are self-irrigating and ; habitat and biodiversity; and cooling of the micro-climate due to evapotranspiration."

5.8 Bio-Retention Systems are proposed within the public realm of the Full Planning Application and Outline Planning Application areas. Where possible, surface water run-off from public realm hardstanding hall be directed to these bioretention systems which shall provide a first stage of attenuation and treatment of run-off. Overflow from these bio-retention systems shall be directed into the wider surface water drainage system.

5.9 Norwich County Council's Highway Team have been consulted as part of the application consultation process and have commented upon the provision of bio-retention systems along the western boundary of the site which would collect surface water run-off from Botolph Street and form part of the highway drainage network. They have raised no objection shall require a commuted sum in order to adopt them. This will be detailed further post-planning in any S278/S38 negotiations.

Tree Pits

5.10 Tree-Pits will provide Biodiversity, Water Quality and Water Volume benefits in line with the Four Pillars of SuDS. Biodiversity is formed by use of suitable planting. In terms of Water Quality, the bioretention tree-pit filter mediums shall provide a treatment stage for surface water runoff. Water Volume – bioretention tree-pits shall provide attenuation volume and slow the rate of waters entering the main sewer system. Transpiration shall also reduce overall water volumes.

5.11 CIRIA SuDS Manual C753 Chapter 19 describes Tree Systems as follows:

“Trees and their planting structures provide benefits to surface water management in the following ways:

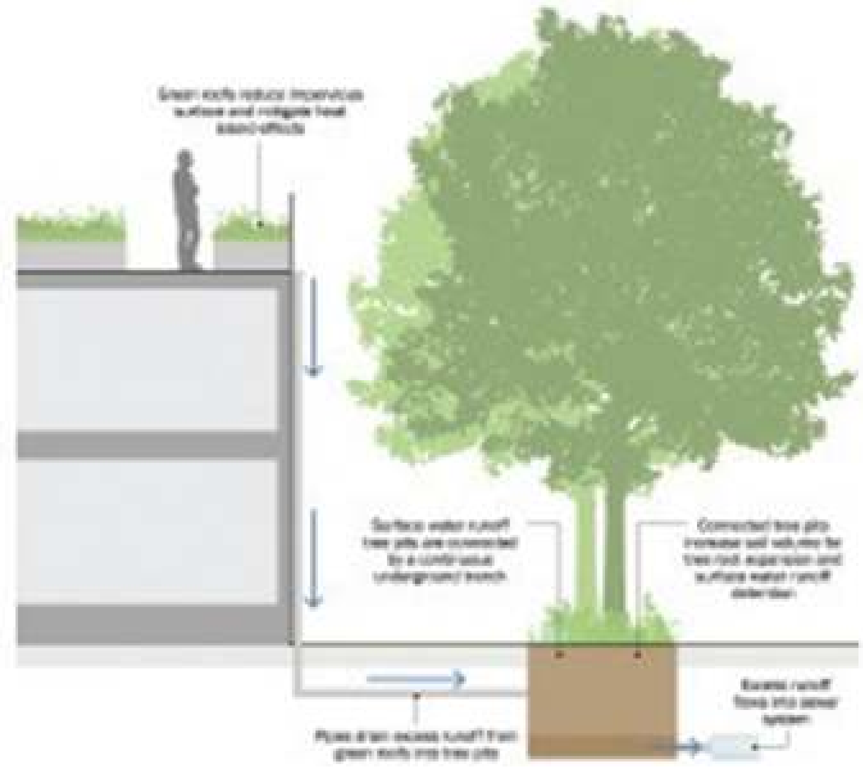
Transpiration – This is the process by which water, taken in from soil by tree roots, is evapourated through the pores or stomata on the surface of leaves. Trees draw large quantities of water from the soil, which can contribute to reducing run-off volumes.

Interception – Leaves, branches and trunk surfaces intercept (store and allow water to evapourate) and absorb rainfall, reducing the amount of water that reached the ground, delaying the onset and reducing the volume of run-off.

Increased infiltration – Root growth and decomposition increase soil infiltration capacity and rate, reducing runoff volumes.

Phytoremediation – In the process of drawing water from the soil, trees also take up trace amounts of harmful chemicals, including metals, organs compunds, fuels and solvents that are present in the soil. Inside the tree, these chemicals can be transformed into less harmful substances, used as nutrients and/or storeg in roots, stems and leaves.

…Tree Planters are essentially bio-retention systems with trees in them, to enhance capacity and performance, and/or to deliver amenity and biodiversity benefits. They have similar functionality and design requiements to standard tree pits, but have open surace and generally a larger surface area, so their overall appearance is different”



5.12 Tree-Pits are proposed within the public realm of the Full Planning Application and Outline Planning Application areas. Where possible, surface water run-off from public realm hardstanding hall be directed to these bioretention systems which shall provide a first stage of attenuation and treatment of run-off. Overflow shall be directed into the wider surface water drainage system.

Permeable Block Paving

5.13 Permeable block paving (pervious pavements) will provide Water Quality and Water Volume benefits in line with the Four Pillars of SuDS. In terms of Water Quality, the subbase gravels shall provide a treatment stage for surface water runoff. Water Volume – subbase gravels shall provide attenuation volume and slow the rate of waters entering the main sewer system. Some transpiration shall also reduce overall water volumes as waters within the subbase and within sand layers between blocks shall have (little) opportunity to evaporate – this is still to be considered overall.

5.14 CIRIA SuDS Manual C753 Chapter 20 describes Pervious Pavements as follows:

"Pervious surfaces, along with their associated substructures, are an efficient means of managing surface water runoff close to its source – intercepting runoff, reducing the volume and frequency of runoff, and providing a treatment medium. Treatment processes that occur within the surface structure, the subsurface matrix and the geotextile layers include:

-Filtration

-Absorption

-Biodegredation

-Sedimentation"

5.15 Lined Permeable Block Paving Attenuation Systems are proposed across the site. The access road and parking areas for Block B and Block F as well as access and hardstanding areas around Block G and J.

6 Mainenance of Development Drainage

6.1 The responsibility for ongoing maintenance will be the responsibility of an elected Management Company whom will be appointed by the Site Owner.

6.2 The proposed private surface water drainage features should be regularly inspected and maintained to ensure they are effective throughout the lifetime of the development and do not become blocked or damaged over time.

6.3 Some maintenance details for elements of the drainage system from CIRIA SUDS Manual (C753) are included in the tables below:

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 it may cause risks to performance) and from silt traps prior to cells.	Monthly
	For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae or other matter; remove and replace surface infiltration as necessary	Annually
	Remove sediment from pre-treatment structures and/or internal forebays	Annually or as required
Remedial actions	Reconstruct soakaway if performance deteriorates or in the event of failure.	As required
Monitoring	Inspect silt traps and note rate of sediment accumulation	Monthly in the first year then annually
	Survey inside of tank for sediment build up and remove if necessary.	Every 5 years or as required

Table 6.1: Maintenance tasks for attenuation tanks (Source: CIRIA C753, The SuDS Manual)

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS

Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk

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.	As required.
	Removal of weeds.	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.	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance of a hazard to the user.	As required
	Rehabilitation of surface and upper sub-surface.	As required (if infiltration performance is reduced as a result of significant clogging.)
Monitoring	Initial inspection	Monthly for 3 months after installation. 3 monthly, 48 hours after large storms.
	Inspect for evidence of poor operation and/or weed growth. If required, take remedial action	Annually.
	Inspect silt accumulation rates and establish appropriate brushing frequencies.	Annually.
	Monitor inspection chambers.	Annually

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

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk

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)

Maintenance Schedule	Required Action	Frequency
Regular maintenance	Inspect all components including soil substrate, vegetation, drains, irrigation systems (if applicable), membranes and roof structures for proper operation, integrity of waterproofing and structural stability Inspect soil substrate for evidence for erosion channels and identify any sediment sources Inspect drain inlets inlets to ensure unrestricted runoff from the drainage layer to the conveyance or roof drain system Inspect underside of roof for evidence of leakage	Annually and after severe storms Annually and after severe storms Annually and after severe storms Annually and after severe storms
Remedial Actions	Remove debris and litter to prevent clogging of inlet drains and interference with plant growth During establishment (i.e. year one) replace dead plants as required Post establishment, replace dead plants as required (where >5% of coverage) Remove fallen leaves and debris from deciduous plant foliage Remove nuisance and invasive vegetation, including weeds Mow grasses, prune shrubs and manage other planting (if appropriate) as required – clippings should be removed and not allowed to accumulate	Six monthly and annually or as required Monthly (but usually responsibility of manufacturer) Annually (in autumn) Six monthly or as required Six monthly or as required Six monthly or as required
	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed. Survey inside of tank/crate system for sediment build-up and remove if necessary.	Annually Every 5 years or as required.

Table 6.4 Maintenance tasks and frequencies for green roofs (The SUDS Manual C753, CIRIA)

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS
Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk

Maintenance Schedule	Required Action	Frequency
Regular Maintenance	Remove litter and debris	Monthly (or as required)
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspect inlets and outlets	Inspect monthly
Occasional maintenance	Check tree health and manage tree appropriately	Annually
	Remove silt build-up from inlets and surface and replace mulch as necessary	Annually or as required
	Water	As required (in periods of drought)
Monitoring	Inspect silt accumulation rates and establish appropriate removal frequencies	Half yearly

Table 6.4 Maintenance tasks and frequencies for tree pits (The SUDS Manual C753, CIRIA)

Maintenance Schedule	Required Action	Frequency
Routine Maintenance	Remove litter and debris and inspect for sediment, oil and grease accumulation	Sixth Monthly
	Change the filter media	As recommended by the manufacturer
	Remove sediment, oil, grease and floatables	As necessary-indicated by a system inspections or immediately following significant spill
Remedial Actions	Replace malfunctioning parts or structures	As required
Monitoring	Inspect for evidence of poor operation	Six Monthly
	Inspect filter media and establish appropriate replacement frequencies	Six Monthly
	Inspect sediment accumulation rates and establish appropriate removal frequencies	Monthly during first half year of operation, then every six months

Table 6.5 Example operation and maintenance requirements for propriety treatment systems (The SUDS Manual C753, CIRIA)

Adopted Sewer Network

6.4 The adopted surface and foul water sewers which cross the propose development site will be diverted and or divested accordingly and as agreed with Anglian Water. Adopted sewers are and will continue to be the responsibility of the Water Authority – Anglian Water.

Geocellular Storage Device – Drain-Down Alarm System

6.5 It is recommended that the drain-down alarm systems are tested every 3 months and to the 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 alarm system is functioning correctly and effectively. Kiosks containing control panels should be checked for damage and replaced as necessary.

Surface Water Pumps – Pump Failure Alarm System

6.6 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.

Surface Water Pumps – Link to Emergency Back-up Power Generator System

6.7 The site shall be served by an emergency power system/back-up generators to ensure essential services such as emergency lighting and sprinkler pumps are able to function in case of power failure/power cut. It is proposed to link the surface water pumps serving the site to this back-up power generator system. This will ensure that, should a power failure occur during a storm event, the surface water pumps will continue to function. It is therefore necessary to ensure the link between the surface water pumps and the emergency–back-up generator system is functional. It is recommended that the power link to the pumps are tested every 3 months and to manufacturers guidelines.

Manholes and Sewers

6.8 Manhole covers should be lifted each year to remove visible debris and check for blockages – it is suggested that this is undertaken every November after the heaviest leaf-fall has occurred.

6.9 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

6.10 t 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.

Orifice Plate with Suitable Filter

6.11 It is advised that maintenance company take time to review the manufactures maintenance recommendations and follow accordingly, with regular inspections anticipated to be required every 3 months and after heavy rainfall events.

7 Water Quality Management During Construction

7.1 It is anticipated that a suitably worded Condition to Planning shall be included which sets out requirement to confirm any schemes for water quality management during the construction of the development. For guidance and to demonstrate that this has been considered during the planning stage, a construction phase plan has been provided in **Appendix U**, showing 4no. construction phases.

7.2 Anglian Water have been contacted to gain an agreement in principle for temporary surface water outfalls for during the construction period. It has been demonstrated that surface water shall be treated prior to outfall via a proprietary treatment unit and that the risk of surface water flooding is not increased compared to the existing situation. Once temporary and permanent drainage features are installed, the risk of flooding is further reduced due to the provision of a modern standard drainage system. Anglian Water's agreement in principle is contained in **Appendix U** also.

7.3 The Construction Phase Plan shows that each discreet drainage system can be constructed within a single phase – with the exception of Block A, M, K/L and J3 which is split between Phase 1 and 2. Blocks A and M will be in Phase 1 whilst Block K/L and J3 are in Phase 2. The proposed geocellular storage device which serves System 4 will therefore be built in two phases. The geocellular storage device within Phase 1 will be built first, then when Phase 2 begins, the geocellular storage cells will be "extended" to complete System 4. A temporary connection to the diverted 675dia sewer for Phase 1 will be agreed with Anglian Water accordingly post-planning.

7.4 As the geocellular storage device will straddle the two phases, it will necessary to ensure that the storage volume constructed or each phase can deal with surace water runoff from that phase. For Block A, M, K/L and J3 catchment, Phase 1 covers 62% of this area and Phase 2 covers 38% of the catchment. As such, it is proposed to ensure that 62% of the proposed geocellular storage device is constructed in Phase 1 and 38% in Phase 2. This is indicated on the proposed surface water drainage layouts in **Appendix O**.

7.5 Further information regarding the construction phase : Activities such as earthworks and construction plant use may result in an increase of silt load in surface water runoff onsite. The presence of heavy plant and other vehicles onsite also introduces the potential for spillages, for example, diesel and hydraulic fluids, wet concrete, construction chemicals and wash-down wastes. Contaminants could enter the sub-soils, surface water, groundwater and nearby watercourse via infiltration and surface water runoff.

7.6 Earthmoving operations should be sequenced and timed to avoid heavy rainfall events. This will reduce the risk of soils and silts being mobilised within surface water run-off. Designated vehicle washdown areas shall be provided. Wash-down and surface water run-off from this area will be directed to the drainage network via a silt trap and oil interceptor and a suitable agreement for a temporary use with Anglian Water will be sought. A watching brief for unforeseen contamination of groundwater and surface water will be prepared. Spillages of fuels and chemicals will be controlled in secure bunded areas and containment at refueling and maintenance facilities in accordance with the EA guidelines.

8 Conclusions

8.1 EAS have been commissioned by Weston Homes Ltd to prepare a Surface Water Drainage Strategy for the redevelopment of Anglia Square, Norwich, Norfolk.

8.2 A separate report, undertaken by others, deals with the flood risk assessment, hydraulic modelling study and impact assessment and should be read in conjunction with this report.

8.3 As described in Section 1, it is proposed to make a Hybrid planning application: Full Planning for Blocks, A, B, C, J3, K/L and M and Outline Planning for Blocks E, F, G, H and J.

8.4 The proposed surface water drainage strategy for the Hybrid Planning Application site has been based on sustainable principles with aim to provide a significant betterment to the existing situation. Currently the site does not benefit from any attenuation features and as such surface water run-off flows freely into the adopted sewer network, unrestricted and untreated.

8.5 The city center site gives opportunities for “urban types” of Sustainable Drainage Systems (SuDS) features to be incorporated. These features provide water quantity, water quality, biodiversity and amenity enhancements in line with the Four Pillars of SuDS. The proposals include green roofs, bioretention systems, tree-pits, lined permeable paving and geo-cellular attenuation devices.

8.6 An assessment was undertaken to determine the existing surface water run-off from the site and what flow rate would likely enter the adopted sewer network. The assessment was discussed with Anglian Water and the LLFA. Anglian Water have agreed in principle to a maximum outfall rate of 242 l/s to be directed to a diverted 675dia surface water sewer which crosses the site and also to the surface water sewer in Edward Street. Anglian Water have also provided an agreement in principle for the proposed 9no. outfalls to the adopted surface water sewer network.

8.7 A maximum surface water outfall rate of 242 l/s has been agreed to to manage all storms up to and including the 1:100yr + 45% Climate Change Event. This will be the equivalent of 49.5% of the existing 1:1yr surface water run-off rate, a significant reduction.

8.8 The development parcels have been split into 9no. drainage catchments. Each catchment has a restricted outfall to the adopted surface water sewer network and attenuation designed to accommodate a 1:100yr + Climate Change Storm Event. Suitable water treatment stages, in line with CIRIA SuDS Manual are proposed and will provide an improvement to the existing situation, where waters enter the adopted sewer network, untreated.

8.9 Maintenance of the attenuation features will remain the responsibility of the site owner or an appointed management company. The Anglian Water sewers that pass through the site will remain the responsibility of Anglian Water.

TRANSPORT PLANNING ■ HIGHWAYS AND DRAINAGE ■ FLOOD RISK ■ TOPOGRAPHICAL SURVEYS

Unit 23 The Maltings Stanstead Abbotts Hertfordshire SG12 8HG Tel 01920 871 777 e: contact@eastp.co.uk www.eastp.co.uk

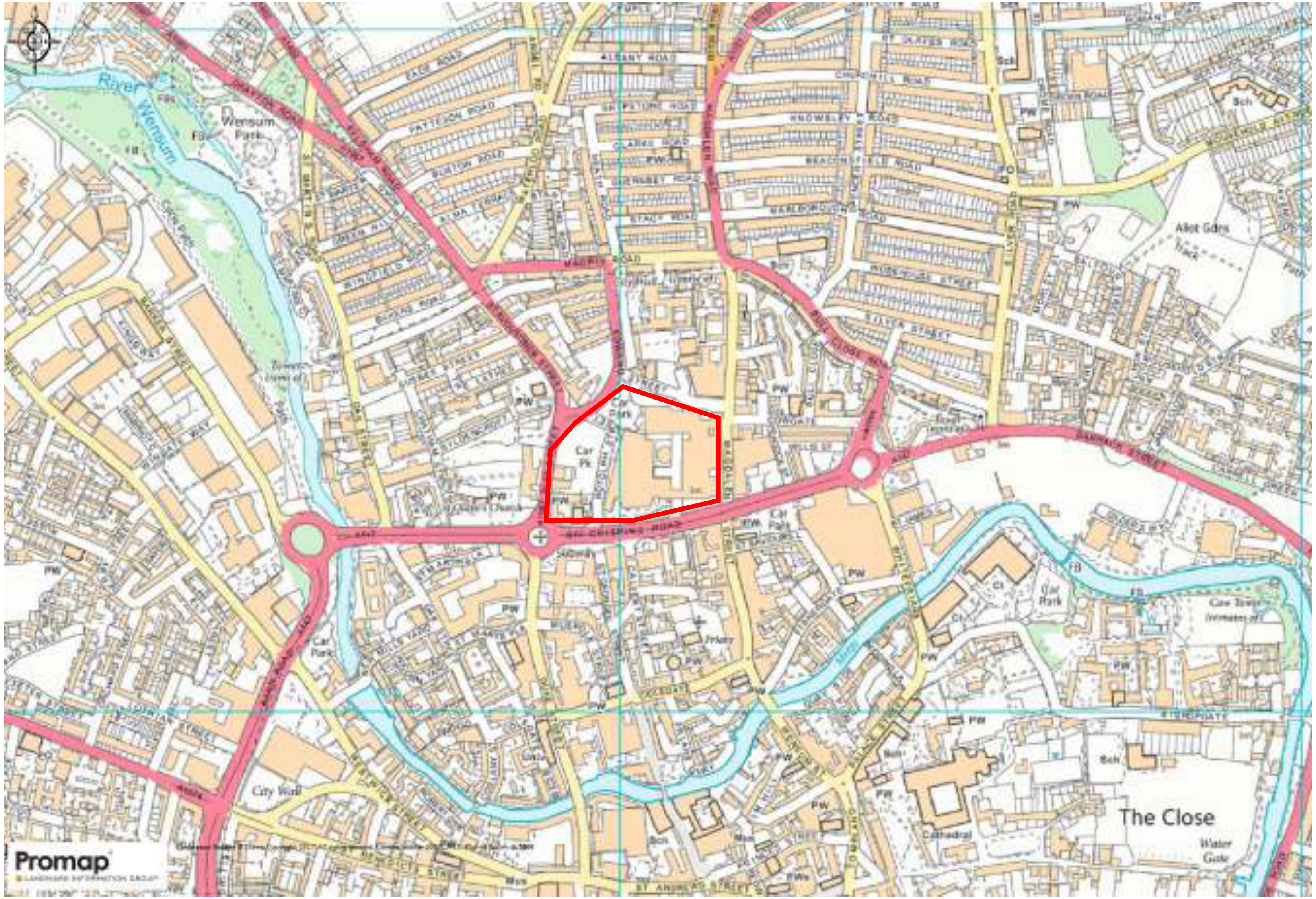
EAS

9 Appendices

Appendix: A – Location Plan and Application Description

Anglia Square, Norwich, Norfolk NR3 1DZ

Site



Anglia Square: Hybrid Application Development Description

"Hybrid (part full/part outline) application on site of 4.65ha for demolition and clearance of all buildings and structures and the phased, comprehensive redevelopment of the site with 14 buildings ranging in height from 1 to 8 storeys, for a maximum of 1,100 residential dwellings, (houses, duplexes and flats) (Use Class C3); a maximum of 8,000 sqm flexible retail, commercial and other non-residential floorspace (retail, business, services, food and drink premises, offices, workshops, non-residential institutions, community hub, local community uses, and other floorspace (Use Classes E/F1/F2/Sui Generis (public conveniences, drinking establishments with expanded food provision, bookmakers and/or nail bars (up to 550sqm), and dry cleaner (up to 150sqm))); service yard, cycle and refuse stores, plant rooms, car parking and other ancillary space; with associated new and amended means of access on Edward Street and Pitt Street, closure of existing means of access on Edward Street, New Botolph Street, Pitt Street and St Crispins Road flyover, formation of cycle path between Edward Street and St Crispins Road, formation of wider footways, laybys and other associated highway works on all boundaries, formation of car club parking area off New Botolph Street, up to 450 car parking spaces (at least 95% spaces for class C3 use, and up to 5% for class E/F1/F2/Sui Generis uses), hard and soft landscaping of public open spaces comprising streets and squares/courtyards for pedestrians and cyclists, other landscape works within existing streets surrounding the site, service infrastructure and other associated work; (All floor areas given as maximum Net Internal Area);

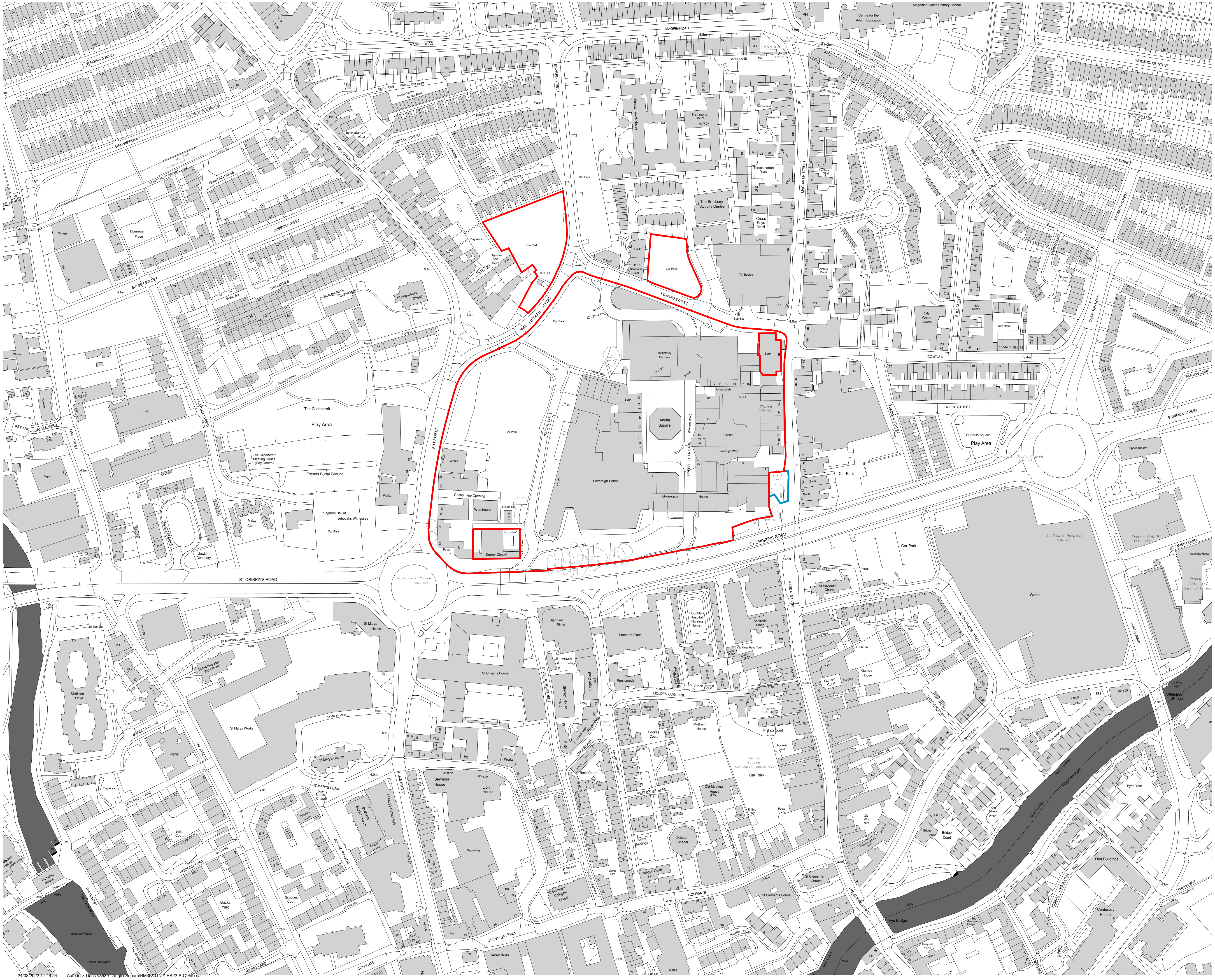
Comprising;

Full planning permission on 2.25ha of the site for demolition and clearance of all buildings and structures, erection of 8 buildings ranging in height from 1 to 7 storeys for 353 residential dwellings (Use Class C3) (142 dwellings in Block A, 25 dwellings in Block B, 21 dwellings in Block C, 28 dwellings in Block D, 8 dwellings in Block J3, 81 dwellings in Block K/L, and 48 dwellings in Block M) with associated cycle and refuse stores), and, for 5,906sqm flexible retail, commercial and other non-residential floorspace (retail, business, services, food and drink premises, offices, workshops, non-residential institutions, community hub, local community uses, and other floorspace (Use Classes E/F1/F2/Sui Generis (public conveniences, drinking establishments with expanded food provision, bookmakers and/or nail bars (up to 550sqm), and dry cleaner (up to 150sqm))), service yard, cycle and refuse stores, plant rooms, car parking and other ancillary space, with associated new and amended means of access on Edward Street, closure of existing means of access on Edward Street and New Botolph Street, formation of cycle path from Edward Street to St Crispins Road, formation of wider footways, laybys and other associated highway works on Edward Street, New Botolph Street, and Magdalen Street, formation of car club parking area off New Botolph Street, 134 car parking spaces (at least 95% spaces for class C3 use, and up to 5% for class E/F1/F2/Sui Generis uses) within Blocks A and B, hard and soft landscape works to public open spaces comprising streets and squares for pedestrians and cyclists, other landscape works, service infrastructure and other associated works; (All floor areas given as maximum Net Internal Areas);

and

Outline planning permission on 2.4ha of the site, with landscaping and appearance as reserved matters, for demolition and clearance of all buildings and structures, erection of 6 buildings (Blocks E – H and J) ranging in height from 2 to 8 stories for up to 747 residential dwellings, (houses, duplexes, and flats) (Use Class C3), a maximum of 2,094 sqm flexible retail, commercial and other non-residential floorspace (retail, business, services, food and drink premises, offices, non-residential institutions, local community uses and other floorspace (Use Classes E/F1/F2/Sui Generis (drinking establishments with expanded food provision, bookmakers and/or nail bars (up to 550sqm), and dry cleaner (up to 150sqm))); cycle and refuse stores, plant rooms, car parking and other ancillary space; with associated new and altered means of access on Pitt Street and St Crispins Road, closure of means of access on Pitt Street and St Crispins Road flyover, formation of wider footways, laybys and other associated highway works on Pitt Street and St Crispins Road, a maximum of 316 car parking spaces (at least 95% spaces for class C3 use, and up to 5% for class E/F1/F2/Sui Generis uses), service infrastructure and other associated works (landscaping and appearance are reserved matters); (All floor areas given as maximum Net Internal Areas)."

Appendix: B – Application Boundary



Contractors and consultants are not to scale dimensions from this drawing

The survey information shown on this drawing is based on a topographical survey prepared by a third party and Broadway Malyan Limited accept no responsibility for the accuracy or completeness of the survey.

Drawings to be read in conjunction with the associated Design & Access Statement, associated consultant desin team documents & reports and landscape information

Landscape shown is for illustrative purposes only. For detailed landscape information, please refer to the landscape information & documents.

0m 62.5m 125m

N

General Notes

All figures and areas are approximate only and subject to statutory constraints, detail design & design development

Structural Design: Subject to structural input & coordination

Services Design: Subject to services input & coordination

Fire Strategy: Subject to fire input & coordination

Application Boundary

Land Owned by CT to be subject to separate application for part of the Mobility Hub

Revision	Date	Drawn By	Description
D0-1	31.03.22		Issued For Planning

BroadwayMalyan[BM]

4 Pear Place
London
SE1 8BT

T: +44 (0)20 7261 4200
F: +44 (0)20 7261 4300
E: Lon@BroadwayMalyan.com

www.BroadwayMalyan.com

Client
Weston Homes

Project
Anglia Square
Norwich

Description
Hybrid Application - Location Plan on Existing OS Base

Status
For Planning

Scale	Drawn By	Date
1:1250@A1	BM	31.03.22
Job Number	**Drawing Number**	**Revision**
35301	ZZ-00-DR-A-01-1000	D0-1

Appendix: C – LLFA Comments Tracker

LLFA Response Tracker: Anglia Square, Norwich

Colour Code		Application
Red	Further Action Required	**Full** = Full Application Area
Amber	Some Action Needed	**Outline** = Outline Application Area
Green	Complete	**Whole** = Both the Full and Outline Application Areas

Item	Consultee Comment (FW2022_0423)	EAS Drainage Strategy Response (Rev D (dated 15 July 2022))	RHDHV FRA Response (FRA dated 13 July 2022)	LLFA Review Comments (dated 24 August 2022) (FW2022_0703)	LLFA Comments (FW2022_0942 - October 2022)
1 Whole	An updated Flood Risk Assessment (FRA), Drainage Strategy and Hydraulic Modelling Study that consistently provides information that interlinks each of the documents.	Cross-references have been added throughout this document where appropriate.	-	Some improvement in the cross referencing.	further improvements due to updates.
2 Whole	Within the FRA, Drainage Strategy, Hydraulic Modelling Study and yet to be developed detailed drainage design, we request these documents incorporates the evidence to address the issues identified in the Annex.	The issues identified in the Annex are, largely, included within the following itemised comments and are addressed as follows. Other items in the Annex raised include: -The site is within the River Wensum area and is subject to requirements relating to maintenance of nutrient neutrality. This is being addressed by Others and a report shall be submitted in Rev A Submission. - LLFA notes there is reference to Table 3, yet there is no Table 3.	The issues identified in the Annex have been addressed within this report.	Please see the responses in the sections below that address each of the points discussed and responded to.	Please see the responses in the sections below that address each of the points discussed and responded to.
2.1 Whole	The assessment of the greenfield and brownfield rates and volumes are required to be calculated accurately using the FEH in accordance with the LLFA Developer Guidance requirements and presented clearly and consistently within the technical reports.	The hydraulic model prepared for the Surface Water Drainage networks serving each catchment area now include FEH rainfall data as requested. See hydraulic model outputs in Appendix J of this report.	Addressed in Drainage Strategy Report prepared by EAS	The LLFA has reviewed both the Drainage Strategy and the Drainage Strategy Addendum Letter. The LLFA notes that applicant has not provided the "original pre-development (greenfield) runoff rate" as required by the LLFA developer guidance (Section 14.3). NPPF clearly states in paragraph 169 "a) take account of advice from the lead local flood authority;". The LLFA's position is based upon S3 of the Non-Adoptable Technical Standards for Sustainable Drainage Systems (2015) which states "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". Therefore, it is a clear and common approach that is commonly applied in the surface water management industry and the LLFA requires the information to be provided. This has been previously requested by the LLFA and has not been provided by the applicant. All "original pre-development (greenfield) runoff rate" calculations should be undertaken using the most appropriate and uptodate Flood Estimation Handbook (FEH) rainfall data and catchment characteristics as per section 14.4 of the LLFA Developer Guidance. The LLFA notes that the greenfield runoff run calculations shown in Appendix H of the Drainage Strategy are for a 1 hectare area and does not reflect either the area of the site or the proposed discreet drainage areas. They also do not use an FEH calculation method. Therefore, these greenfield calculations are also incorrect and not appropriate for use at this time. From a review of the Drainage Strategy Addendum Letter, the LLFA notes the brownfield runoff rates were re-calculated for this site using FEH13 hydrology. In the Drainage Strategy the LLFA notes: • The Modified Rational Method has been used to calculate the existing runoff rate rather than the FEH approach. • The greenfield runoff rate for the whole site and for each of the proposed discreet drainage system areas has not been provided as per the LLFA's previous request in accordance with the LLFA's Developer guidance and the Non-Adoptable SuDS Standards. This means there is no baseline to compare and assess whether there is a likely increase in flood risk from the proposed development. • In the currently provided, but incorrect, approach that has been applied, some of the greenfield areas identified in green to the east of the car park area marked in brown in Appendix F appear to be served by a surface water drain that discharge to the Anglian Water surface water sewer network. • The LLFA would consider these areas would appear to have a surface water discharge connection that indicates they are positively drained. • The brown car park area is indicated as a private drainage system on the plan in Appendix F. However, it is not clear from the plan or the report where these drains discharge to. Are they infiltration or do they connect to the public sewer network? • To the east of the flyover there is an area marked as permeable that is impermeable. • The LLFA notes that section 3.13 states "existing run-off rate calculations are contained in Appendix E", which is not correct. Rather, Appendix E shows the runoff rate for one storm with an intensity of 50mm/hr and does not show the runoff rates for the various return periods that are referred to in section 3.12, and are required by the LLFA Developer Guidance in accordance with the SuDS Non-Statutory Technical Standards. While in section 3.12 three different return periods are shown with three unrelated storm intensities when compared to the intensity shown in Appendix E. Section 3.12 identifies that these were undertaken using WINDES MicroDrainage, however, no calculations were provided to support this statement or indicate the parameters used in the drainage strategy. • The LLFA have reviewed the Surface Water Drainage Network modelling which clearly shows the Synthetic Rainfall Details for proposed Block D networks (on page 9 of the calculation sheets) uses the FSR rainfall model not the FEH rainfall model. While on page 12 of the same series of calculation sheets the FEH Rainfall model is applied. This is not acceptable as it is not in accordance with the LLFA Developer Guidance. This has occurred in other sets of calculation for each of the systems. While in the Drainage Strategy Appended Letter, the LLFA notes: • The brownfield runoff rate is calculated and a comparison using the FSR and FEH13 methods and data. • The MicroDrainage Calculations show that for the storm summary results the FEH13 method is used for the synthetic Rainfall Details, while in the pipeline schedule the FSR method is still used. This means that all the calculations prepared in MicroDrainage have a mixture of FSR and FEH hydrology applied. • The MicroDrainage Calculations have used a MADD Factor of 2 which should be 0, otherwise double counting will be experienced in the network. Again the information provided in the Drainage Strategy addendum Letter did not provide the information previously requested or in accordance with the LLFA Developer Guidance. This information is fundamental to the basic principles to the proposed surface water drainage design. The applicant must correct the predevelopment runoff rate calculations to provide the greenfield runoff rate using FEH method. This must be presented for both the whole site, each of the predevelopment and for the post development catchment areas so that it is possible to make appropriate comparison to the proposed drainage design. Furthermore, the applicant has not yet demonstrated that some areas of the site have a historic connection to the Anglian Water Sewer network.	The LLFA have reviewed the greenfield and brownfield rates given in the Drainage Strategy. These are only partally in accordance with the LLFA developer guidance. The LLFA acknowledges the greenfield runoff rate was calculated for the landscaped areas (totaling 395m2). The rest of the site is still calculated as a brownfield site in the table presented in paragraph 3.3 of the drainage strategy. Using the information provided in the Drainage strategy for the greenfield runoff rates for the landscaped area of 0.9 l/s/ha. However further work was prsented later in paragraph 3.xx, the applicant states that further calculations for the greenfield runoff rate for the discreet drainage areas were undertaken. These calculations were produced using the FEH-13 methodology in Causeway Flow and estimate a Qbar of 0.6 with a Q1 year of 0.5 l/s/ha. The results for the greenfield runoff area was then provided in a table in Appendix I for each of the proposed discreet areas of the site in order to enable a direct comparison of the predevelopment and post development sceanrio for each of the discreet drainage areas.
2.2 Whole	Provide evidence to support the justification of increasing the greenfield discharge rate is required in accordance with the LLFA Developer Guidance.	The site is Brownfield and currently drains unrestricted and untreated into the existing Anglian Water surface water sewers which cross the site. As the site is Brownfield and practically 100% impermeable, it is not considered reasonable or appropriate to apply greenfield run-off rates for this Application. Anglian Water state that where this is not practical they will assess capacity based on the 1:1 year calculated rate. They therefore permit a maximum discharge rate of 242 l/s to manage all storms up to and including the 1:100yr + Climate Change Event. A Pre-Development Enquiry and Capacity Check from Anglian Water confirming this is contained in Appendix I of this report.	Addressed in Drainage Strategy Report prepared by EAS	The LLFA Developer Guidance clearly states in section 14.3 that "Brownfield sites should discharge at the original pre-development (greenfield) runoff rate. If not possible, a significant reduction in the current rate of discharge should be achieved and agreed with the relevant drainage body (LLFA, IDB or Anglian Water) providing evidence as to why an alternative should be considered." At present, EAS has not accurately defined the predevelopment (greenfield) runoff rate of the site. Therefore it is not possible to compare the predevelopment and post development runoff rate. While we appreciate the reminder of the Anglian Water approach, the LLFA guidance differs slightly and at the LLFA we apply the LLFA's Developer Guidance. We shall remind the applicant that NPPF in paragraph 169a states "take account of advice from the lead local flood authority". The LLFA notes the current agreement in principle from Anglia Water is for a single discharge point at manhole 1355 that is near to the southeast corner of the site. The current proposal has four connection points not in this location. In addition, the evidence base to support the proposed design is incomplete to due a lack of correctly calculated information. It would be appropriate to discuss this with Anglian Water as at present the proposed design discharge locations are not in accordance with the agreement in principle. The applicant's response states the site is "Brownfield and practically 100% impermeable" yet your existing runoff calculations do not reflect this. Please see comments above on the existing surface water run off calculation corrections that are required as the wrong method and approach has been applied. This means it is not possible for the applicant to demonstrate the difference between the predevelopment (as defined in section 14.3 of the LLFA Developer Guidance) and the proposed submission. The current approach taken which calculates the existing brownfield runoff rate is not acceptable to the LLFA. **The LLFA considers this requirement incomplete for a second time.**	The LLFA have reviewed the updated drainage strategy and FRA that now provide further information relating to the calculation of both the greenfield and brownfield runoff rates and a discussion around the approach. Anglian Water have confirmed there is capacity within the surface water sewer network for the proposed flows.

2.3 Whole	Apply the latest (May 2022) Climate change guidance, which would require the application of a 45% climate change allowance to the 1% AEP and to apply the appropriate climate change allowance of 40% to the 3.3% AEP calculations.	The hydraulic models prepared for the Surface Water Drainage networks serving each catchment area now include the up-to date Climate Change Allowances as requested. See hydraulic model outputs in Appendix J of this report.	All model runs now include the latest climate change allowance, which were released post completion of the previous FRA. See Figures in Appendix I and J	The LLFA notes the applicant's commitment to using the latest climate change allowance for peak rainfall intensity in the drainage strategy in section 4.15. This was thought to continue through to the drainage calculations in Appendix J. However on review of the drainage calculations the LLFA note that there is no climate change allowance included on page 13 of the calculations for Block A, M, J3 and K/L SW Drainage Network which is where the FSR rainfall model is also noted as being used. However, in the subsequent calculations for the 1% for the Block A, M, J3 and K/L SW Drainage Network the FEH Rainfall model is used and has a 45% climate change allowance applied. The same has occurred on the Block B, the Bolph Street, SW Network Calculations where the FSR method has been used in part of the network assessment and FEH has been reported in the 1% +45% CC storm results. The LLFA notes that drainage design for Block E, F, H, G and J have the FEH rainfall method applied and the 1% +45% for climate change applied. These systems are in the outline planning application area. The LLFA notes there are no 3.3% and 3.3% +CC calculations submitted for any area as per the requirements of the latest climate guidance and the LLFA Developer Guidance. The LLFA notes that on the Block B Porous Car Park Manholes, a Factor of Safety of 2 is applied. The Ciria SuDS Manual (C753) recommends that a factor of safety of 10 is applied to the surface infiltration rate for all types of surface (Chapter 20 section 5.1 (page 400)). This will require updating.	P15 of hydraulic modelling report states 45% used for 1%AEP and 40% for 3.3%AEP for surface water model. The MicroDrainage (WinDES) modelling shows the use of 45% used for 1%AEP and and 40% for 3.3%AEP.
2.4 Whole	Evidence that recent liaison with Anglian Water relevant to this new planning application that provides:	Up-to-date sewer records have been obtained and an up-to-date pre-development enquiry has been received. Sewer records are contained in Appendix D and Pre-dev enquiry is contained in Appendix I.	Addressed in Drainage Strategy Report prepared by EAS	As per response 2.2, the LLFA notes the applicant has obtained updated Anglian Water sewer plans in April 2022. In addition, the applicant has received a high level pre-planning assessment report (PPE-0143339 dated: 08/04/2022). The LLFA have reviewed this PPE and note this planning report provides an agreement in principle for one connection to discharge a maximum of 242 l/s to manhole 1355 in the south east corner subject to the provision of connection hierarchy information being provided to AW. The proposed outline drainage design provided for the hybrid application identifies there will be four discharge locations to the AW sewers in locations not specified by the Pre-Application Assessment. In addition, the LLFA observes the PPE has not considered the site is located within the largest critical drainage catchment (CDC) in Norfolk or that the proposed drainage systems to connect to the network are pumped. The PPE states "should your assumptions or evidence change then an alternative solution, connection point or flow rate may be required." At present, the proposed drainage design submitted for the hybrid application is not in accordance with the Pre-Planning Assessment agreement in principle and therefore it is not considered in keeping with the agreement in principle. The LLFA require that these differences between the proposed design and the AW agreement in principle should be resolved to obtain a valid agreement in principle.	Sewer records have been obtained at the site but not for the full catchment. Further checks have now been undertaken by the applicant to ensure the extent included is adequate, see comment 3.2. Further review of the drainage strategy has been undertaken and the LLFA observes that discussions have occured been the applicant and Anglian Water to reach an agreement in principle.
2.4.1 Whole	Confirmation from Anglian Water that no changes have occurred in the public network since 2017.	Up-to-date sewer records are contained in Appendix D.	Addressed in Drainage Strategy Report prepared by EAS	The LLFA notes the applicant has obtained updated Anglian Water sewer plans in April 2022.	Previously provided
2.4.2 Whole	Obtain recent drainage assessment from Anglian Water that relates to the current proposed development.	Up-to-date pre-development enquiry is contained in Appendix I.	Addressed in Drainage Strategy Report prepared by EAS	The applicant has received a high level pre-planning assessment report (PPE-0143339 dated: 08/04/2022). The LLFA have reviewed this PPE and note this planning report provides an agreement in principle for one connection to discharge a maximum of 242 l/s to manhole 1355 in the south east corner subject to the provision of connection hierarchy information being provided to AW. The proposed outline drainage design provided for the hybrid application identifies there will be four discharge locations to the AW sewers in locations not specified by the PPE. In addition, the LLFA observes the PPE has not considered the site is located within the largest critical drainage catchment (CDC) in Norfolk or that the proposed drainage systems to connect to the network are pumped. The PPE states "should your assumptions or evidence change then an alternative solution, connection point or flow rate may be required." Therefore, at present the proposed drainage design submitted for the hybrid application is not in accordance with the PPE and should be re-assessed by AW.	The Drainage Strategy provides evidence of an agreement in principle with Anglian Water dated 15 September 2022 in appendix L of the Drainage Strategy
2.4.3 Whole	Provide current set of DG5 records from Anglian Water.	Anglian Water were able to confirm that there have been cases of sewer flooding in the vicinity of the site, but for data protection were unable to specify any locations. See email dated 22.06.2022 in Appendix M.	Addressed in Drainage Strategy Report prepared by EAS	The applicant has now obtained confirmation that there have been incidents of sewer flooding in the vicinity of the proposed development as demonstrated in Appendix M. No specifics were given at this time. This is further supported by a letter in Appendix C of the Drainage Strategy Addendum Letter.	Previously provided
2.4.4 Whole	Provide evidence of an "agreement in principle" with any third parties taking on surface water drainage management and maintenance responsibility.	Surface water drainage serving private catchments will be the responsibility of an elected Management and Management Company, whom shall be appointed by the Site Owner. Any adopted sewer or diverted adopted sewers within the red-line boundary shall be the responsibility of Anglian Water.	Addressed in Drainage Strategy Report prepared by EAS	No evidence of Anglian Water agreement in principle to take on the maintenance and management of the proposed drainage system is provided in the PPE. The LLFA requires this evidence for all structures that it applies to in the full planning application area of the design. For adoptable structures in the outline planning areas, this can be conditioned.	The Drainage Strategy provides evidence of an agreement in principle with Anglian Water dated 15 September 2022 in appendix L of the Drainage Strategy
2.5 Whole	Provide a more in-depth consideration and assessment of rainwater harvesting and re-use opportunities.	See Section 4 para. 4.6 and 4.7.	Addressed in Drainage Strategy Report prepared by EAS	The LLFA have reviewed Paragraph 4.6 which contains a very limited consideration of rainwater harvesting in relation to the proposed development. There is no breakdown of the assessment per block or quantative assessment of the rainwater harvesting potential. The and Paragraph 4.7 is not relevant to this matter. The statements made in the drainage strategy are unevidenced and further assessment remains required to support the statements made.	An assessment in the drainage strategy between paragraph 4.6 to 4.9 is provided which confirms that there is not enough storage capacity for a 21 day supply and not enough rainwater available for the supply needed for the toliets in the community centre. However, there is scope for waterbutts to be provided at ground level for individual properties and the reuse of water at outdoor taps as per Table 4.2 in the Drainage Strategy. The LLFA recommends that a condition requiring the installation waterbutts and water reuse facilities prior to first occupation of the properties. ***LLFA recommend condition*** **NOTED**
2.6 Whole	Provide a more in-depth consideration and assessment of groundwater flood risk.	Addressed in Royal Haskoning DHV FRA Report.	Included at 7.10 onwards and 8.52	The LLFA has reviewed section 7.9 to 7.16 in the FRA. The LLFA notes that Figure 6 only defines the banding names not the meaning of all the bandings. In section 7.10 a definition of Band B is given but no others. This means it is not possible for the LLFA to reasonably be able to interpret the information provided by the applicant at this time. Furthermore, there appears to potentially be a fourth undefined colour band which the site sits within. Further clarification is required before the LLFA can accept the information being presented in the report. The FRA in section 7.11 confirms that site-specific boreholes have not been drilled yet and nor has groundwater monitoring been undertaken. Historic groundwater borehole information is provided in Table 5 with the two most recent results (showing a winter (January 1993) groundwater level of 2.40m bgl and a spring (May 1993) groundwater level of 4.40m bgl) confirming that in the likely worst case there is not likely to be suitable distance between the base of a below ground infiltration structure and the groundwater level all year round. It is not possible to identify where these boreholes are in relation to the site. The LLFA will require further information to be submitted to address these issues appropriately.	The LLFA have reviewed the updated FRA section 7.10-7.18 and is acceptant of the clarifications and further information provided. The LLFA acknowledges the moderate groundwater flood risk associated with the site and will consider this when reviewing the flood risk mitigation and residual risk management.

2.7 Whole	Provide a more in-depth consideration and assessment of sewer flood risk.	Addressed in Royal Haskoning DHV FRA Report.	Included at 7.3 and 8.59	The LLFA have reviewed the FRA section referred to. The LLFA notes that Anglian Water have been contacted in June 2022 and confirmed that sewer flooding has occurred recently in the local area. Further information is currently being waited for, although the precise locations of the incidents will not be recieved due to confidentiality. The information provided in the email dated 22 June 2022 from Anglian Water states "Anglian Water is able to confirm that there have been instances of flooding within the vicinity of the proposed development." Yet the FRA states in section 7.8 that "Although no sewer flooding has been reported locally to date, there may be potential for sewer flooding in extreme events greater than those modelled" which misrepresents the information provided by Anglian Water that indicates sewer flooding has occurred locally but they are unable to share any more details. While in the Drainage Strategy Addendum Letter (Appendix C) Anglian Water confirm in mid July 2022 that they "have no records of flooding in the vicinity that can be attributed to capacity limitations". The LLFA notes there is further ambiguous information in section 7.6 of the FRA, which states there is capacity in both the foul and surface water sewers. Although on review of the preplanning assessment in Appendix G there is no clear statement from Anglian Water that confirms this. The Anglian Water Pre-Planning Enquiry Report for the site only states there is "available capacity" in the foul water sewer network and recycling centre, however, there is no equivalent statement made by Anglian Water for the surface water sewers. The Pre-Planning Assessment clearly indicates that Anglian Water have not recieved enough information required for conducting an appropriate assessment at that time. It is clear in the Anglian Water assessment that it is possible for Anglian Water to revise their response which may result in the need for an alternative solution, connection point or flow rate. Further comments on the pre-Planning Assessment from Anglian Water are available in response 2.4.2. Furthermore, the applicant has not yet demonstrated that some areas of the site have a historic connection to the Anglian Water Sewer network. Therefore, while a more considered assessment of sewer flood risk has occurred in the FRA, the LLFA is aware there are a number of occasions where there is an over statement of the information that the assessment is based upon. The LLFA is NOT CONFIDENT in the assessment at this time and requires a statement from Anglian Water that they are confident in this assessment of sewer flooding for the site and surrounding area to improve confidence in this assessment.	The LLFA have reviewed the updated FRA section 7.7 and 8.59. The LLFA welcomed the additional information provided in 7.7 and the supporting Appendix G. The LLFA reviewed 8.59, which relates to identification of the locations of electrical substations on the site. The LLFA is no sure how this relates to their comments on the assessment of sewer flooding.
2.8 Whole	Provide clarification on the retention of surface water runoff on the site and whether this is actually the provision of either blue or green roofs not previously included in the surface water drainage calculations.	No blue-roofs are proposed on site. Greenroofs are to be provided. In terms of drainage calculations. It is considered robust to assume green-roofs are saturated and will not provide any attenuation for large storm events. As such, the 1:100yr + Climate Change hydraulic modelling assumes all roof areas are impermeable. This provides a conservative assessment of required attenuation volumes.	Addressed in Drainage Strategy Report prepared by EAS	The LLFA have reviewed this assessment approach and can accept this approach at this time.	Previously provided
2.9 Full	Provide clarification on the water depth for the return periods given at Edward Street Service Yard as there are significant discrepancies.	Addressed in Royal Haskoning DHV FRA Report.	Clarified in 5.38-5.40	The proposed development model runs included all ground FFLs of the buildings where known, as Zshapes. The basement car park located in Block A is within the surface water flow path and therefore identified as a vulnerable part of the development. The LLFA requested that the basement car park was set at ground floor level, or the entrance to the car park is raised 300mm above the 1 in 100 year (+45%CC) flood level. Discussion within the applicant's documents confirms that humps could be located at the entrance to the basement car park and the entrance to the low lying service yard, which would be set 300mm higher than the 1 in 100 year (+45%CC) flood level. The humps were represented as Z-lines which were set at the level 300mm higher than the flood level at these locations. For the entrance car park, this was a level of 4.80m AOD and for the service yard it was a level of 4.45m AOD. This prevented surface water from entering these two vulnerable parts of the site. Walls were located around the service yard and basement car park entrance ramp, to prevent water from flowing 'through' walls and into the low lying areas. The walls were represented as Z-lines and set at 999m high within the model, to prevent any water passing through. The proposed model was run for both the 'no mitigation' and 'mitigation' scenarios upon the request of the LLFA, and flood maps have been prepared for both. The 'no mitigation' runs are called 'Proposed' and the 'mitigation' scenarios including the humps at the car park and service yard entrances are called 'Proposed_Barrier'. FRA report section 5.38 and 5.39 outline the 1%+CC depth but does not present the 1 in 30 year depths. Mitigation is discussed in Section 5.4.1. The maps in Appendix I show no flooding of the service yard in the proposed mitigation scenario, depths adjacent to the barrier are Max 0.1m and adjacent to the building wall are 0.2m. Representation of these features in the model are described in section 7.3.2 of the modelling report (extract in modelling column). The levels modelled for the entrance hump match the proposed mitigation levels - this is considered reasonable. The walls are modelled as 999m high, however as depths against them do not exceed 200mm therefore this is considered a reasonable representation provided that any doors/airbricks in the wall between block M and the service yard are above this level, as inputting exact levels in this instance would not change model results. Section 8.12 of the FRA states "No openings such as air bricks, doors or windows should be included in the neighbouring wall with Block M, to prevent water ingress into the surrounding blocks". Note "should" rather than "will" - need to confirm that this recommendation is included in the building design. There is a gully proposed in the service yard that has been represented as an "SX" link, this is considered acceptable. However, It has been modelled with a flap valve to prevent water backing up into the service yard - this flap valve is not mentioned in Section 8 of the FRA - need to confirm whether this will be included in the design. Note for non modellers - an SX link connects the pipe network to the surface and allows flow between them based on the flow in the pipe and the level above the gully it is representing.	Modelling of the service yard as per previous comments appears sensible. Section 8.16 of the FRA now states "The service yard must be completely water-tight to prevent water from getting into this area from Edward Street (e.g. through service cable conduits or air vents) and from potentially high groundwater. By making it water-tight, this will also prevent water entering the adjacent buildings (such as Block M). No openings such as air bricks, doors or windows will be included in the neighbouring wall with Block M, to prevent water ingress into the surrounding blocks." FRA now states that a gully and flap valve will be included in the service yard outfalling to the foul sewer network. The flap valve is still included in surface water network within the hydraulic model. The hydraulic modelling report states that the pipe has no flow and thereore this pipe is not included in the surface water drainage design (Section 7.4). Therefore this is considered acceptable. The LLFA have reviewed the FRA section 5.39-5.40 and note the no water enters the Edward Street Service Yard for thte 3.3% AEP and the 3.3% AEP plus climate change is now reported. A modelled water depth of 1.02m is provided although it is not clear for what scenario this relates to.
2.10 Full	Prepare and provide a full detailed drainage design that includes all the proposed elements of the surface water management system. This includes clarification of the design details (including plans, modelling, calculations and supporting information in accordance with the LLFA's Developer Guidance) of suitable drainage featured, such as green/blue roofs, bio-retention features and tree-pits.	See Appendix K.	Addressed in Drainage Strategy Report prepared by EAS	The detailed design information is missing some calculations, plans and supporting information as well as requiring corrections to the calculations provided. Information missing includes typical design sections and plans, 3.3% and 3.3%+CC calculations for each element. The SW drainage model includes the larger SuDS elements but appears to be missing some features. All SW Drainage calculations have a manhole table that has at least one column that is not visible to read as it is off the page in the results PDF in Appendix K. This needs to be updated so that the information is provided in a readable format. The LLFA notes that section 8.2 and 8.3 indicate which development blocks are at flood risk however there is no summary of which roads and pedestrian access routes which are at surface water flood risk. The LLFA observes this gives an overly optimistic outlook on the flood risk across the site. In section 8.4 the FRA notes that "is impractical to prevent offsite flows entering the onsite drainage system in some areas". However, within the Drainage Strategy there are no allowances given within the drainage design for the any offsite surface water that may enter the system. An allowance for offsite flows needs to be included within those systems likely to be affected by offsite flows.	FRA - The LLFA have reviewed the updated FRA that refered to Comment 2.10 as a query on freeboard provided at Block C in paragraph 8.25 of the FRA. This was not the case and was eventually found in paragraph 8.29. The LLFA have reviewed 8.29 - 8.30 where a discussion on the freeboard is provided for Block C. This indicates the finished floor levels of the habitable areas of Block C will be 300mm above the design flood level. The majority of the issues have the addressed. Only a couple of issues were not addressed in relation to the provision of the surface water drainage calculations for the 3.3% AEP and 3.3% AEP plus 40%CC for the outline application areas of the site. **EAS Response - Rev C Submission includes modelling for all Storm Events required by LLFA - 1:2yr, 1:30yr, 1:30yr + 40% Climate Change, 1:100yr and 1:100yr + 45% Climate Change undertaken for Full Application Drainage Systems. Outline Drainage Systems have been modelled for the 1:100yr +45% Climate Change Event only.**
2.10.1 Full	response to 2.10 for system 1			**System 1 relates to Block B - Full** • It is not clear to the LLFA how a discharge rate of 5 l/s was derived and how this relates to the pre-development greenfield runoff rate for the drainage area. • No patios shown on the drawing information submitted for the residential houses. Urban creep should be applied to the residential houses and the patios need to be included in the design along with their drainage connections. • One of the parking spaces in the residential houses area appears to not be permeable. Is this correct? The LLFA would recommend that this space is also included within the permeable paving area too as there is no justification made by the applicant not to include it.The LLFA requests clarification on this approach. • No design information shown on plan for inflow and outflow pipes for PP2 on the SW drainage plan. This is needs to be included as part of the full application. • In section 4.20 of the drainage Strategy and in the plan (drawing No PJ-3831 DR-002) a flow control device is identified at the outfall of the system, in section 4.25 it states a downstream defender (a hydrodynamic vortex separator) is specified in the design which is supported by the design on the plan. While in the MicroDrainage calculations for Block B a Hydrobrake Optimum device is specified and included in the calculations there is no downstream defender included in the calculations. The calculations will need to be updated to reflect the inclusion of the downstream defender as Block B (System 1) is part of the full application area. • The residential houses area has been hatched in on the drawing however, there is no indication of what this hatching represents.	The LLFA notes that not all properties have a downpipe so not every property will recieve a waterbutt. Four properties will be without waterbutts. All other issues now addressed.

2.10.2 Full	response to 2.10 for system 2			**System 2 relates to Block C - Full** • It is not clear to the LLFA how a discharge rate of 5 l/s was derived and how this relates to the pre-development greenfield runoff rate for the drainage area. • The LLFA has reviewed the proposal to discharge the rising main from the attenuation tank through the medium of small bioretention system is not considered appropriate in combination with a pumped discharge to the medium in a highly urban environment within a critical drainage catchment. The bioretention feature is designed to slow water conveyance while the pumped discharge to the medium could potentially overload the system and cause localised surface water flooding on a very flat site. The LLFA notes the area with the bio-retention features would experience flooding in a 1% +45% climate change to a depth of typically between 100mm to 200mm. Therefore the LLFA consider that the pumped discharge for 1% +45% climate change in the into the medium during a significant storm event, such as the 1% +45% climate change, the medium would likely be saturated and flood risk would likely be increased by the proposed surface water drainage design currently proposed. • The LLFA notes there is a significant area of the site that is understood to be paved, although it is not confirmed what this area is to be paved with, its finished ground levels or how it will be drained. Clarification of the surfacing is required. • The bioretention swale is not included within the MicroDrainage calculations and neither are the last couple of manholes and pipes (C11 and C12). Therefore, the submitted calculations are incomplete for this system. In addition the MircoDrainage calculations indicate that the applicant is to offer pipe 1.007 onwards for adoption. This means the statements regarding the half drain times are not appropriate as the downstream elements of the system have not been included within the model and there is no evidence that this system operation approach would be appropriate. • The LLFA requests clarification on whether the corner of the geo-cellular tank is at least 5m away from the building. • Trees appear to be placed over the geo-cellular attenuation tank. This is not an acceptable design approach as the roots may penetrate the membrane leading to soil ingress and tank capacity reduction. Geo-cellular tanks operate differently to tree pits and this means that the inclusion of a geocelluar attenuation feature prevents the inclusion of other feature over the top of the tank other than permeable paving. This element of the system requires redesigning as it does not apply acceptable industry design practises. As the applicant is interested in including trees and a bio-retention feature, the LLFA would recommend considering an alternative surface level lined bio-retention or attenuation feature fed by a swale or rill. Further work and information is required to develop a suitable approach for this system. • The LLFA observe that based on the manhole cover levels of 4.050m and the given finished floor level of 4.650m there is a 600mm freeboard incorporated into the design. On review of the applicant's surface water flood risk hydraulic modelling within the latest FRA, which shows the mapped results indicate the surface water flood depths to the north of the block are typically between 300mm to 500mm, while the southern end of the building is typically between 100mm and 300mm. The FRA indicates the finished floor level is 300mm higher than the level of the design flood event (1% AEP +45% CC). However, the report and the maps indicate that in some areas to the north of Block C the modelled water depth is 420mm. This would indicate that the finished floor levels would need to be at least 4.75m to provide the required 300mm freeboard above the design flood event water level. • It is not clear where some of the patio areas to the east of the building and the pathway areas to the west of the building will be draining to as there is no drainage shown for these areas, only drainage associated with the roof. As the site is very flat (based on the manhole cover levels given as no finished ground levels are provided) there drainage in these areas is important to ensure that dry access and egress to the building is possible. • The LLFA observes that the drainage plans in Appendix K of the drainage strategy are using different block layout arrangements for Block C compared to those shown in Drawing number 35301-ZC_00_DR-A-03-0100-D0-2 (dated 31.03.22). Please confirm which block layout represents the current design? • Based on the information provided in the plans, it is not clear to the LLFA what the feature is that extends from the downstream side of the geocellular crate to the pump chamber. The LLFA requires clarification on what this feature is from the applicant as there is nothing shown either in the drawing or in the legend of the drawing. • The below ground infrastructure for the pumping station is indicated however it is not clear whether there will be any above ground control kiosk for the pumping station. The LLFA reminds the applicant the level of the control kiosk for the pumping station should be above the design flood water level and include appropriate freeboard as defined in the LLFA's Developer Guidance in section 20.3. The LLFA requires confirmation of the proposed outline arrangements for the control kiosk. • The LLFA is not able to determine from the drawings if the geocellular structures are an appropriate distance from the foundations of Block C. The notes that section 3.1 from Ciria C737 on the Structural and geotechnical design of modular geocellular drainage systems determines that the geocellular tanks must be at least 2m plus the depth of the storage structure from the foundations of a building. Due to the space constraints the LLFA will require demonstration from the applicant the proposed Geocellular tank is able to meet this requirement. This is to demonstrate the proposed outlined drainage system is achievable when the drainage design is developed in full at a later stage. The LLFA has reviewed the proposed surface water drainage System 2 which serves Block C. The LLFA notes the applicant is intending to place a residential block of flats with a green roof in an area of surface water flood risk. The extent of the surface water flood risk has been modelled by the applicant and confirms the block located in an area of flood risk, which is not in keeping with the application of the sequential test. The building is proposed to have a green roof that would discharge surface water into the drainage system that would attenuation the flow in a below ground geocellular tank. At least two trees planted are proposed to be planted on top of the geocelluar tank. The water from the tank would be pumped out into the medium of a small bioretention area with a perforated pipe underdrain before the system connects through a series of standard below ground pipes in the site and the road to discharges to the existing Anglian Water sewer in Edward Street. The LLFA is very concerned the trees planted over the tank would damage the tank and reduce the capacity and function of the system as the trees grow. In addition, the pumped discharge to a small bioretention area is unlikely to operate and would lead to exacerbating the existing and residual flood risk in this location, which could increase the difficulties associated with safe access and egress from the block. While it is questionable about whether the location for this residential accommodation being located in this area of the site due to the existing and post development flood risk, the proposed ground level surface water drainage system combined with the pumped discharge of the attenuation tank is considered by the LLFA likely to increase the surface water risk associated with Block C. Therefore, only for Block C in this proposed development the LLFA recommend an alternative design where the bioretention feature is removed, only if the geocellular attenuation capacity is increased significantly and discharge is achieved through a gravity connection to the Anglian Water sewer in Edward Street. This is to reduce the residual risk associated with the pumped discharge and to increase the below ground attenuation to improve the management of surface water while improving safe access and egress to residents of the block. While there are other Blocks within this development that have used the approach of pumping in to the medium of the bioretention area, only on Block C (due to the substantial flood risk and the inclusion of a green roof across the whole of the residential roof) will the LLFA accept a reduction in the amount of water quality treatment. This approach specific to this situation faced by Block C and can not be applied to other blocks within the site or other development applications including any fresh applications on the same site.	The LLFA have reviewed the proposed design information against the previous comments and these issues are now addressed.
2.10.3 Full	response to 2.10 for system 3			**System 3 relates to Block D - Full** • It is not clear to the LLFA how a discharge rate of 12.5 l/s was derived and how this relates to the pre-development greenfield runoff rate for the drainage area. • Paragraph 4.32 states "to be conservative, the hydraulic models shall assume green-roofs are saturated and will bit allow for any impermeable areas, as such will be considered 100% impermeable with a contributing area of 2580m2." The LLFA observes the statement indicates that "no impermeable area will be allowed for" but then the model assumes a "100% impermeable area". This contradiction in the statement needs to be corrected. • A channel /slot drain is positioned around the perimeter of the building. The bio-retention tree pits and swales are positioned further away from the building. These bioretention feature discharge to the drainage network. However, it is not clear what discreet drainage area these bio-retention features serve as there is very limited information about the finished ground levels as only the cover levels of the manholes and tanks are provided. Paragraph 4.37 indicates that "roofs and pedestrian walkways will discharge directly to the adopted sewer via a bioretention swale". However, this is not supported by the proposed drainage plan shown in Appendix K as it is not clear how the water will be directed to these bioretention swale features rather than the slot drains to benefit from the water treatment. In addition, there is no connection shown directly from the roofs to the bio-rention swales, meaning the roof water will not be directed through the swales for water quality treatment. Therefore, the text in the drainage strategy is not consistent with the proposed drainage layout and the proposed drainage layout is not considered appropriate at this time based on the limited information provided. The proposed design requires further work as there is insufficient information for a full drainage design and design improvement to be made. • The LLFA observe that northern section of the building the manhole cover levels of 4.950m and the given finished floor level of building is set at 4.950m meaning there is a no freeboard incorporated into the design. it is the same at the southern end of the building manhole cover levels of 4.500m and the given finished floor level of building is set at 4.500m meaning again is a no freeboard incorporated into the design. This is not in accordance with the LLFA Developer Guidance and means there is a risk of surface water entering the building. The LLFA's concern is supported by the applicant's surface water flood risk hydraulic modelling within the latest FRA, which show the mapped results indicate the southern end of the Block D building would likely flood in a 1%AEP with 45% climate change allowance to a depth of between 50mm to 100mm.	The LLFA have reviewed the proposed design information against the previous coments and these issues are now addressed. The LLFA notes the rainwater harvesting for the landlord wash down is not commented on in the section 4 of the report text relating to the drainage system 3, however it is on the drainage plans. The LLFA notes the additional details provided regarding the pumps and the chamber. The pumping station kiosk / control panel is proposed to be located on the eastern boundary of block A.

				• A pumped discharge is identified on the outline drainage plan in Appendix K, yet there is no pumped discharge identified in the drainage description for system 3 (paragraph 4.32 - 4.37). The pumped discharge set at a rate of 12.5 l/s is proposed to discharge through the filter medium of the bio-retention swale before discharging to the diverted Anglian Water Sewer. The LLFA has reviewed the proposal to discharge the rising main from the attenuation tank through the medium of small bioretention system is not considered appropriate in combination with a pumped discharge to the medium in a highly urban environment within a critical drainage catchment. The bioretention feature is designed to slow water conveyance while the pumped discharge to the medium could potentially overload the system and cause localise surface water flooding on a site with a gentle slope. The LLFA expects this aspect of the system will need to be re-designed appropriately. • The LLFA has reviewed the proposal to discharge the rising main from the attenuation tank through the medium of small bioretention system is not considered appropriate in combination with a pumped discharge to the medium of the feature in a highly urban environment within a critical drainage catchment. The bioretention feature is designed to slow water conveyance while the pumped discharge to the medium could potentially overload the system and cause localise surface water flooding on a very flat site. The LLFA notes the area with the bio-retention features would partly be in a surface water flowpath during a 1% +45% climate change storm event. The typical depth of surface water flooding is up to 50mm. Therefore the LLFA consider the pumped discharge for 1% +45% climate change in the into the medium during a significant storm event, such as the 1% +45% climate change, the medium would likely be saturated and flood risk would likely be increased by the proposed surface water drainage design currently proposed. • The tree pits, bioretention areas and the supporting pipework are not shown in the current MicroDrainage modelling. • The below ground infrastructure for the pumping station is indicated however it is not clear whether there will be any above ground control kiosk for the pumping station. The LLFA reminds the applicant the level of the control kiosk for the pumping station should be above the design flood water level and include appropriate freeboard as defined in the LLFA's Developer Guidance in section 20.3. The LLFA requires confirmation of the proposed outline arrangements for the control kiosk. • The LLFA is not able to determine from the drawings if the geocellular structures are an appropriate distance from the foundations of Block D. The notes that section 3.1 from Ciria C737 on the Structural and geotechnical design of modular geocellular drainage systems determines that the geocellular tanks must be at least 2m plus the depth of the storage structure from the foundations of a building. Due to the space constraints the LLFA will require demonstration from the applicant the proposed Geocellular tank is able to meet this requirement. This is to demonstrate the proposed outlined drainage system is achievable when the drainage design is developed in full at a later stage.	
2.10.4 Full	response to 2.10 for system 4			**System 4 relates to Blocks A, M, J3 and K/L** • It is not clear to the LLFA how a discharge rate of 65 l/s was derived and how this relates to the pre-development greenfield runoff rate for the drainage area. • The level of the suspended drainage on Blocks A, M and K/L are not identified on the plans in Appendix K. The LLFA requires clarification on this design detail. • The LLFA notes the centre of Block A has planted areas shown on the first floor courtyard area (Drawing 35301_ZA_01_DR_A_03_0101_D0_2, Dated 15/07/22). However, it is not clear how this area will be drained. • The information about the connection routes for the rainwater pipes associated with the buildings does not appear to be correct when the varying building roof heights are taken into account. As this is for the full planning application this does need to be resolved to ensure the proposed drainage design is not going to increase flood risk and that appropriate space is available to deliver the design. • The LLFA notes the north facing commercial unit on the western part of Block A has a finished floor level of 4.5m which is lower than the manhole 01 cover level of 4.95m, while the neighbouring residential unit has a finished floor level of 5.4m. This puts the commercial unit at an increased flood risk by design. The LLFA observes the access to the residential lobbies on the east side of Block A open directly on to a significant flood flow route in front of these entrances. There is a similar issue with the finish floor levels for all the residential entrance lobbies and other commercial units match the levels of adjacent manhole covers. The LLFA requires the finished floor level of all buildings to be increased in accordance with the LLFA Developer Guidance Section 20.3 requirements. • The LLFA notes the road in front of the Block A car access to the basement car park is to be raised by 300mm as a flood resistance measure. However, it is not clear on the surface water drainage plans how far this raised section of road will extend. Further information is required to be included on these plans. • On Block M there appears to be at least 4 no. green roof rainwater points that are not located near any identified green roof. Please update the plans to reflect which green roofs these rainwater points relate too. • Here is an existing building in the System 4 discreet drainage area that is excluded from the proposed drainage calculations. However, the area surrounding the building appears to be included within the drainage calculations, yet there is no information regarding the proposed drainage system that would serve this area. The LLFA requires clarification regarding the proposed detailed drainage design for this area of System 4. • The text in sections 4.38 to 4.42 is not consistent with the proposed design in the Appendix K plans. The text does not include the pumping station to discharge the water from the attenuation system into the diverted Anglian Water surface water sewer. • The LLFA observes the FRA identifies the commercial areas of Blocks A and M are to have a water exclusion strategy, however no commitment to water barriers has been included within either FRA or the drainage strategy. Therefore, at present the information provided by the applicant indicates that flooding these premises during a 1% AEP +40% Climate Change is part of the design approach (see section 8.16 of the FRA). The LLFA note the climate change allow given in this section is not in accordance with the current climate change guidance. • Based on the information provided in the plans, it is not clear to the LLFA what the feature is that extends from the downstream side of the geocellular crate to the pump chamber. The LLFA requires clarification on what this feature is from the applicant as there is nothing shown either in the drawing or in the legend of the drawing. • The below ground infrastructure for the pumping station is indicated however it is not clear whether there will be any above ground control kiosk for the pumping station. The LLFA reminds the applicant the level of the control kiosk for the pumping station should be above the design flood water level and include appropriate freeboard as defined in the LLFA's Developer Guidance in section 20.3. The LLFA requires confirmation of the proposed outline arrangements for the control kiosk.	The LLFA have reviewed the proposed design information against the previous coments and these issues are now addressed. The LLFA notes the additional details provided regarding the pumps and the chamber. The pumping station kiosk is proposed to be located on the eastern boundary of Block J.
2.10.5 Full	response to 2.10 for system 5			**System 5 relates to Botolph Street Public Realm Area - Full** • It is not clear to the LLFA how a discharge rate of 10 l/s was derived and how this relates to the pre-development greenfield runoff rate for the drainage area. The LLFA requires this information. • A shared bioretention swale is included within both the areas for system 5 and 7. It is not clear with drainage area this feature will serve or how it will possibly serve both areas. The LLFA require further information to clarify which drainage area this bioretention area will serve and how it will connect and relate to the proposed drainage network. • The LLFA notes that a significant amount of this proposed drainage system will be directly influenced by the finished surface levels of the road, pavement and open space areas, yet no information has been provided show the finished ground levels. The LLFA requires further design information demonstrating how water will enter the network particularly in the shared drainage area at the south of system 5. • The LLFA notes that no quantitive assessment of the Water Quality indices was provided in 4.46 for system 5. As this is part of the full application area the LLFA requires further detailed information to be provided including for the proprietary device. The LLFA also notes the inclusion of a number of bioretention areas within the design that are labelled as swales. The LLFA reminds the applicant that a swale is a conveyance structure while these features are designed to look and behave like basins. As the drainage path is shorter due to the connection of each area directly to the network, the amount of biofiltration treatment achieved for the water is potentially lower compared to having them using a longer drainage path. The LLFA expects further investigation and consideration of the assessment of water quality for this system. • The LLFA notes the FRA shows there is a flood flowpath through the northern half of the system 5 area adjacent to Block H. • The MicroDrainage calculations do not include the final discharge pipe that connects to the diverted AW sewer.	The LLFA notes in the Drainage Strategy there is a potential typo in the sub-section title between paragraph 4.69 and 4.70. As the previous sub-section related to system 4 and the subsequent section relates to system 6. It is likely to be System 5 for Botolph Street and this is supported by the text in paragraph 4.70. **EAS Response -Typo corrected.** Most comments have been addressed although there is one area that is not clear yet. It appears the bioretention area previous queried about where it serves or drains to, continues to have limited information around its design parameters. However there does appear to be two outlets and the bioretention area does have the discreet drainage boundary drawn through the area. This could mean that some of the flows entering either of the outfalls could be more than expected. System 5 is at full application stage (in Phase 3), while System 7 is at outline planning stage (in Phase 4). There is no further information in the Phasing plan. The LLFA seeks clarification around how the area discharging to this feature has been calculated for what appears to be a phased approach. **EAS Response - Paragraphs to decribe the bioretention system which straddles Outline and Full Application areas are within Rev C Submission report, see paragraphs 4.84, 4.107 and 7.4.** The LLFA notes the additional details provided regarding the pumps and the chamber. The pumping station kiosk is proposed to be located on the western boundary of Block H.

2.10.6 Outline	response to 2.10 for system 6			**System 6 relates to Block E - Outline** • It is not clear to the LLFA how a discharge rate of 30 l/s was derived and how this relates to the pre-development greenfield runoff rate for the drainage area. The LLFA requires this information. • The LLFA notes that this is part of the outline planning application, however, the LLFA require an indication of the approximate size and location of the proposed green roofs within the drainage area. • The LLFA notes the geocellular tank is located in the system 5 drainage area. There is no indication of how or where water from System 6 will enter the geocellular tanks. Outline design calculations have been provided in Appendix J to support the initial tank sizing. There is no modelling of the outline drainage network for the system. Most of Block E appears to be in a downstream location to the attenuation tank. The LLFA requires a preliminary indication of the drainage network to demonstrate that a workable solution to discharge the surface water to the tank. This is to demonstrate the proposed outlined drainage system is achievable when the drainage design is developed in full at a later stage. • The LLFA is not able to determine from the drawings if the geocellular structures are an appropriate distance from the foundations of Block E. The notes that section 3.1 from Ciria C737 on the Structural and geotechnical design of modular geocellular drainage systems determines that the geocellular tanks must be at least 2m plus the depth of the storage structure from the foundations of a building. Due to the space constraints the LLFA will require demonstration from the applicant the proposed Geocellular tank is able to meet this requirement. This is to demonstrate the proposed outlined drainage system is achievable when the drainage design is developed in full at a later stage. • The text in the drainage strategy (paragraph 4.47 to 4.52) does not include a pump in the description, yet it is shown on the plans in Appendix K. The LLFA requires confirmation of whether the pump is to be included or not as it is a significant component of the proposed drainage system. Furthermore the drainage strategy will need to be updated to reflect the design appropriately. • Based on the information provided in the plans, it is not clear to the LLFA what the feature is that extends from the downstream side of the geocellular crate to the pump chamber. The LLFA requires clarification on what this feature is from the applicant as there is nothing shown either in the drawing or in the legend of the drawing. • The below ground infrastructure for the pumping station is indicated however it is not clear whether there will be any above ground control kiosk for the pumping station. The LLFA reminds the applicant the level of the control kiosk for the pumping station should be above the design flood water level and include appropriate freeboard as defined in the LLFA's Developer Guidance in section 20.3. The LLFA requires confirmation of the proposed outline arrangements for the control kiosk. • The LLFA notes there is no additional capacity within the attenuation tank for the residual risk of pump failure. As it normally takes around 24 hours for a pump to be repaired even in an emergency, the LLFA requests that further information is provided regarding the impact of a pump failure and the proposed drainage design will be adjust to mitigate the impact of this failure. • The landscaped areas along Pit Street to the west of Block E shows outlets from the bioretention swales from these features. However, it does not show how they are intended to be connected to the drainage system or relate to each other. The LLFA requires this information to demonstrate the proposed outlined drainage system is achievable when the drainage design is developed in full at a later stage.	The LLFA notes the additional details provided regarding the pumps and the chamber. The pumping station kiosk is proposed to be located on the eastern boundary of Block E. The LLFA notes additional capacity in the attenuation tank was not included due to limted space. A more robust pump and tank monitoring system was provided and the residual risk remains should an operational failure of the system occur. The LLFA notes the 3.3% AEP +40%CC calculations have not been provided. ***LLFA condition recommended*** **EAS Response - Rev C Submission includes modelling for all Storm Events required by LLFA - 1:2yr, 1:30yr, 1:30yr + 40% Climate Change, 1:100yr and 1:100yr + 45% Climate Change undertaken for Full Application Drainage Systems. Outline Drainage Systems have been modelled for the 1:100yr +45% Climate Change Event only.**
2.10.7 Outline	response to 2.10 for system 7			**System 7 relates to Block F - Outline** • It is not clear to the LLFA how a discharge rate of 20 l/s was derived and how this relates to the pre-development greenfield runoff rate for the drainage area. The LLFA requires this information. • The LLFA notes that this is part of the outline planning application, however, the LLFA require an indication of the approximate size and location of the proposed green roofs within the drainage area. • It is not clear whether the geocelluar tank will be lined or not, this is particular relevant in an area where the geocellular tank crosses the permeable paving. It is not clear if water will be able to infiltrate through the tank walls for this feature or whether water will be able to enter solely through the single denoted inlet to the south of the permeable paving. The LLFA request clarifications on this matter. • The text in the drainage strategy (paragraph 4.53 to 4.59) does not include a pump in the description, yet it is shown on the plans in Appendix K. The LLFA requires confirmation of whether the pump is to be included or not as it is a significant component of the proposed drainage system. Furthermore the drainage strategy will need to be updated to reflect the design appropriately. • The below ground infrastructure for the pumping station is indicated however it is not clear whether there will be any above ground control kiosk for the pumping station. The LLFA reminds the applicant the level of the control kiosk for the pumping station should be above the design flood water level and include appropriate freeboard as defined in the LLFA's Developer Guidance in section 20.3. The LLFA requires confirmation of the proposed outline arrangements for the control kiosk. • Minor point the label arrow for the geocellular tank is not pointing at the tank rather its pointing to the permeable paving. Please correct. • The open space areas in the centre of Block F and to the north of Block F shows outlets from the bioretention tree pits from these features. However, it does not show how they are intended to be connected to the drainage system or relate to each other. This is to demonstrate the proposed outlined drainage system is achievable when the drainage design is developed in full at a later stage. • A bioretention swale is included within the area for system 7 and which is also included in the area for system 5. it is not clear with drainage area this feature will serve or how it will possibly serve both areas. The LLFA require further information to clarify which drainage area this bioretention area will serve and how it will connect and relate to the proposed drainage network.	The LLFA have reviewed the proposed design information against the previous coments and these issues are now addressed. The LLFA notes the 3.3% AEP +40%CC calculations have not been provided. ***LLFA condition recommended*** **EAS Response - Rev C Submission includes modelling for all Storm Events required by LLFA - 1:2yr, 1:30yr, 1:30yr + 40% Climate Change, 1:100yr and 1:100yr + 45% Climate Change undertaken for Full Application Drainage Systems. Outline Drainage Systems have been modelled for the 1:100yr +45% Climate Change Event only.**
2.10.8 Outline	response to 2.10 for system 8			**System 8 relates to Blocks G and J - Outline** • It is not clear to the LLFA how a discharge rate of 70 l/s was derived and how this relates to the pre-development greenfield runoff rate for the drainage area. • The LLFA notes that this is part of the outline planning application, however, the LLFA require an indication of the approximate size and location of the proposed green roofs within the drainage area. • It is not clear whether the geocelluar tank will be lined or not, this is particular relevant in an area where the geocellular tank crosses the permeable paving. It is not clear if water will be able to infiltrate through the tank walls for this feature or whether it will be solely through the denoted inlets. The LLFA request clarifications on this matter. • The text in the drainage strategy (paragraph 4.60 to 4.66) does not include a pump in the description, yet it is shown on the plans in Appendix K. The LLFA requires confirmation of whether the pump is to be included or not as it is a significant component of the proposed drainage system. Furthermore the drainage strategy will need to be updated to reflect the design appropriately. • Based on the information provided in the plans, it is not clear to the LLFA what the feature is that extends from the downstream side of the geocellular crate to the pump chamber. The LLFA requires clarification on what this feature is from the applicant as there is nothing shown either in the drawing or in the legend of the drawing. • The below ground infrastructure for the pumping station is indicated however it is not clear whether there will be any above ground control kiosk for the pumping station. The LLFA reminds the applicant the level of the control kiosk for the pumping station should be above the design flood water level and include appropriate freeboard as defined in the LLFA's Developer Guidance in section 20.3. The LLFA requires confirmation of the proposed outline arrangements for the control kiosk. • The LLFA observes that the discharge for the system 8 is in part shared with the discharge from System 9. The discharge route of the off-site pipe run is proposed to pass under trees. The LLFA does not find this route acceptable and requests the pipe is not placed under two trees. • The LLFA notes that the drainage area for System 8 on the western side is within the pavement area that adjoins to System 5. It is not clear from the drawing what the structure is along the boundary in the street and whether this will divide the catchment areas or not. The LLFA request clarification on how this drainage catchment will be divided from System 5.	The LLFA have reviewed the proposed design information against the previous coments and these issues are now addressed. The LLFA notes the 3.3% AEP +40%CC calculations have not been provided. **EAS Response - Rev C Submission now includes all Storm Events required by LLFA modelled for all Drainage Systems (Full and Outline) - 1:2, 1:30, 1:30 + 40% Climate Change, 1:100 and 1:100 + 45% Climate Change.**
2.10.9 Outline	response to 2.10 for system 9			**System 9 relates to Block H - Outline** • It is not clear to the LLFA how a discharge rate of 24.5 l/s was derived and how this relates to the pre-development greenfield runoff rate for the drainage area. • The defined drainage has a small triangle on the south western corner of the system drainage catchment. The LLFA questions whether this is realistic? The LLFA suggests this little slither should be included in the System 5 drainage area. Please adjust the catchment areas accordingly. • The LLFA notes that this is part of the outline planning application, however, the LLFA require an indication of the approximate size and location of the green roof within the drainage area. • The discharge route of the off-site pipe run is proposed to pass under trees. The LLFA does not find this route acceptable and requests the pipe is not placed under two trees. • Minor point the label arrow for the geocellular tank is not pointing at the tank rather it's pointing to a room in Block G. • The geocelluar tank appears to be under features between Block H and Block G. The LLFA seeks clarification from the applicant about what these features are as it is not shown on the drawing. • The text in the drainage strategy (paragraph 4.67 to 4.72) does not include a pump in the description, yet it is shown on the plans in Appendix K. The LLFA requires confirmation of whether the pump is to be included or not as it is a significant component of the proposed drainage system. Furthermore the drainage strategy will need to be updated to reflect the design appropriately. • Based on the information provided in the plans, it is not clear to the LLFA what the feature is that extends from the downstream side of the geocellular crate to the pump chamber. The LLFA requires clarification on what this feature is from the applicant as there is nothing shown either in the drawing or in the legend of the drawing. • The below ground infrastructure for the pumping station is indicated however it is not clear whether there will be any above ground control kiosk for the pumping station. The LLFA reminds the applicant the level of the control kiosk for the pumping station should be above the design flood water level and include appropriate freeboard as defined in the LLFA's Developer Guidance in section 20.3. The LLFA requires confirmation of the proposed outline arrangements for the control kiosk.	The LLFA have reviewed the proposed design information against the previous coments and these issues are now addressed. The LLFA notes the 3.3% AEP +40%CC calculations have not been provided. ***LLFA condition recommended*** **EAS Response - Rev C Submission now includes all Storm Events required by LLFA modelled for all Drainage Systems (Full and Outline) - 1:2, 1:30, 1:30 + 40% Climate Change, 1:100 and 1:100 + 45% Climate Change.**

				• Outline design calculations have been provided in Appendix J to support the initial tank sizing. There is no modelling of the outline drainage network for the system. As Block H has multiple roofs that appear in a downstream location to the attenuation tank, at this time the LLFA requires a preliminary indication of the drainage network to demonstrate that a workable solution to discharge the surface water to the tank. This is to demonstrate the proposed outlined drainage system is achievable when the drainage design is developed in full at a later stage. The LLFA notes there again is no additional capacity within the attenuation tank for the residual risk of pump failure. As it normally takes around 24 hours for a pump to be repaired even in an emergency, the LLFA requests that further information is provided regarding the impact of a pump failure and the proposed drainage design will be adjust to mitigate the impact of this failure. • The open space area in the centre of Block H shows a bioretention swale outlet and a bioretention tree pit outlet are positioned within these features. However, it does not show how they are intended to connect to the drainage system or relate to each other. This is to demonstrate the proposed outlined drainage system is achievable when the drainage design is developed in full at a later stage. • The LLFA is not able to determine from the drawings if the geocellular structures are an appropriate distance from the foundations of Block H. The notes that section 3.1 from Ciria C737 on the Structural and geotechnical design of modular geocellular drainage systems determines that the geocellular tanks must be at least 2m plus the depth of the storage structure from the foundations of a building. Due to the space constraints the LLFA will require demonstration from the applicant the proposed geocellular tank is able to meet this requirement. This is to demonstrate the proposed outlined drainage system is achievable when the drainage design is developed in full at a later stage.	
2.11 Whole	Provide the proposed discreet drainage catchment areas and supporting information on a plan for each of the proposed systems in accordance with the LLFA Developer Guidance.	See Appendix K.	Addressed in Drainage Strategy Report prepared by EAS	Provided in plans in Appendix K (Drawing no. 3831-DR-001, 3831-DR-002, 3831-DR-003 and 3831-DR-004, dated 13/07/2022). Shown as dashed coloured line. The System Information Summary box has the same coloured dashed line as the discreet drainage area. This is shown for all 9 drainage systems.	Previously provided
2.12 Whole	Undertake an assessment that demonstrates how the proposed SuDS systems meets the four pillars of SuDS in accordance with the LLFA Developer guidance and in relation to Policy E9 of the Local Flood Risk Management Plan.	See paragraphs 5.4, 5.9, 5.13 and 5.16.	Addressed in Drainage Strategy Report prepared by EAS	Consideration of the textual information regarding the four pillars of SuDS (water quantity, water quality, biodiversity and amenity) and the benefits provided by the various SuDS elements included in the system. The SuDS features included in this as assessment are Green Roofs, bio-retention swales, tree planters (also known as Tree Pits) and Pervious Pavement (although the description given is for permeable paving rather than pervious paving). The LLFA notes the applicant is intending to include areas of permeable block paving in the design, however they have also referred to pervious paving (such as pervious ashfelt is laid). The LLFA requires clarification on which surfacing system is being proposed by the applicant.	This information is now included within section 5 of the drainage strategy report.
2.13 Whole	Undertake a further assessment and consideration of the carbon impact of additional pumps operating on this site is recommended in accordance with Policy E8 of the Local Flood Risk Management Plan.	A further assessment of the carbon impact of pumps has been undertaken by the M&E Engineer and is included within their report.	Addressed in Drainage Strategy Report prepared by EAS	The LLFA have reviewed the Drainage Strategy and the Drainage Strategy Addendum Letter. In the Drainage Strategy Addendum Letter the applicant states that "the primary objective of the design is for the systems to operate under gravity, thereby avoiding the need for pumps which generate carbon emissions from their operation. Wherever possible and where cover and invert levels of receiving adopted sewers allow, surface water runoff from the development site is attenuated and restricted using gravity-type flow control devices, such as hydro brakes or office plates. Where the proposed drainage and storage devices cannot be shallower than the adopted sewer network due to cover levels length of drainage network, attenuation volumes and spatial constraints, it is necessary to pump restricted flows. The use of surface water pumping stations to serve some catchments within the development site is unavoidable though is only proposed where necessary". The LLFA compares this commitment to the proposed surface water drainage design and notes that of the nine proposed systems only two discharge using gravity. Therefore, the applicant's proposed design puts forward that seven of the nine surface water systems on site will have a pumped discharge. This is a significant reliance on a pumped drainage system for a site in the lower end of the largest critical drainage catchment in the county. These pumped drainage systems are proposed to discharge to three out of the four discharge locations. This is not in keeping with the terms of Anglian Water's agreement in principle. The applicant considers the operation approach in order to minimise carbon emissions during the operation phase presented in the Drainage Strategy addendum Letter states the measures the applicant would include are: "• minimising the peak flow rate through attenuation and flow control devices to reduce the size of the pumps and hence their power demand. • pumps selected to maximise efficiency at the design duty to lower energy demand • pump operation controlled on levels within the chamber to ensure they only operate when required. • appropriate electrical metering and links to the development control systems to allow monitoring of energy use. • regular cleaning and servicing to ensure the pumps are operating as efficiently as possible." The applicant has committed to minimise the peak flow rate yet there is no baseline greenfield runoff rate information has been provided in accordance with the LLFA's Developer guidance. In addition, additional attenuation to account for the inclusion of pump failure has not been accounted for in the Drainage Strategy and supporting calculations provided in the application. The attenuation provided could be more extensive as if a pumped system is being provided in a lined geocellular crate system then there is the potential to increase the size and depth of the attenuation available on site. The pump operation being controlled on levels needs to ensure the design attenuation volume of the tank is returned within at least a 24 hour period, although preferably sooner. Also where the attenuation tanks are unable to prevent the offsite flows entering the tanks, pumps operating of levels need to better understand how to manage these flows in relation to tank volume management and carbon emissions management effectively. The inclusion of appropriate metering of the development control systems is welcomed. However no information has been provided in either the Drainage Strategy or the Drainage Strategy Addendum Letter about where the pumping station controls will be located or what arrangements for the controls of the pumps are proposed. On review of the maintenance and management plan in Section 6 of the Drainage Strategy, there is no maintenance schedule included for the proposed pumps. However, a review of the residual risks associated with the pumps is provided. While this considers the risk of lack of maintenance of the pumps and commits to including the a secondary (backup) pump in each of the systems, there is no consideration on the site about loss of power to the site. As the majority of the site is proposed to be served by a pumped surface water drainage network located in critical drainage catchment with a significant surface water flow route passing through part of the site, will there be an independent back up power supply to the pumps? Some of these issues overlap with other comments within our response or provide a contradiction to other aspects of the application. Further information will be required in particular the greenfield runoff rates, tank sizing, pump operation, residual risk management and the maintenance and management arrangements all need to be resolved in order to demonstrate the efforts to minimise carbon emissions is demonstrated.	The LLFA has reviewed the additional information for the hybrid application. Further information for the outline application area will be provided as the design is developed for this area. The applicant has committed to reviewing and where appropriate revising the discreet drainage areas in the outline planning application areas to reduce the need for pumps further at a later stage of design. The LLFA will expect this to be undertake on all future applications for areas included in the outline area that serve blocks E, F, H, G and J. *LLFA condition recommended* **Noted**
2.14 Full	Prepare a surface water drainage phasing plan for the development.	Weston Homes have provided a Draft Phasing Strategy document which is included in the Rev A Submission. This shows the following blocks to be delivered in each phase. Phase 1 = Block A, B, C, D and M Phase 2 = Block K/L and J3 Phase 3 = Block H, G and J Phase 4 = Block E and F The proposed drainage strategy allows for Blocks B, C, D, E, F, G, J and H to be managed by stand-alone drainage systems that do not rely on other phases to be built. System 4 managing Blocks A, M, J3 and K/L shall be delivered in Phases 1 and 2 and as such it is anticipated that a temporary drainage network, comprising as much of the designed drainage for Block A and M shall be installed in Phase 1 and shall be linked with Block K/L and J3 in Phase 2. As these phases follow each-other, it is considered suitable to allow for one drainage system to cover two phases.	Addressed in Drainage Strategy Report prepared by EAS	The LLFA reviewed ES Addendum A2 Updated Phasing Strategy which contains a series of plans that identify the activities to be undertaken at and within each phase. The activities relate to the construction of the dominant structures and not the supporting infrastructures such as surface water drainage and sewer diversions. The LLFA notes that in phase one, Blocks B and C will discharge to Edward Street while Blocks A, D and M will discharge in to the diverted sewer which is not mentioned in the phasing plan. As the phase one is under consideration of full planning application and as the diverted surface water sewer currently serves a large number of properties upstream of the proposed development which are all within a critical drainage catchment, the LLFA requires details of the proposed diversion of the sewer and the management of surface water runoff during the construction phase. It is likely that some dewatering activities are likely to be required during the construction of the basement car park. This is scheduled to start at the beginning of Q1 2023 and complete by the end of Q1 2025. The LLFA notes the phasing schedule shows the ground floor of the phase one blocks A, D and M will be undertaken between Q2 and Q3 of 2023. Therefore, on consideration of all these factors the LLFA request that further detail is provided in the Phasing Strategy to show when the surface water drainage will be constructed and sewer diverted in relation to the construction of each of the blocks in Phase One. The LLFA observed the schedule identifies that the ground level for Blocks A, D and M will be undertaken very soon and would expect that discussions with AW to address this matter will be ongoing at present, therefore the LLFA request the applicant provides confirmation that AW support the proposed phasing approach. This (and other) information is requested by the LLFA to ensure that there will be no increase in flood risk either on site or elsewhere in the catchment during the construction of the site and in particular Phase one of the site.	The LLFA has reviewed Appendix U of the Drainage Strategy which contains a construction phasing plan relevant to the surface water drainage and an email discussion between the applicant and Anglian Water who have agreed to the proposed approach. The LLFA notes complex phasing surface water discharge arrangements that will be greater than the proposed final runoff rate. The LLFA recommends a condition that prevents first occupation of the development until the permanent surface water discharge rate is achieved. This is to ensure there is no increase in surface water flood risk from the site *LLFA Condition recommended* **Noted**

2.15 Whole	Provide updated water quality assessment information that acknowledge the inclusion of all elements of the SuDS system.	See Section 4 showing water quality treatment features for each catchment.	Addressed in Drainage Strategy Report prepared by EAS	Greenroofs have not been included within the water quality assessment. This appears to have lead to the greater need to incorporate a secondary treatment process. The LLFA notes that in the applicant is likely to be able to better demonstrate water quality benefit if they apply the indices given in Annex 5, Table 26.14 and Table 26.15 of the Ciria SuDS Manual (C753) which includes figures for Green Roofs. The LLFA will expect the Water quality assessment to be updated to include the greenroofs.	The LLFA have reviewed the proposed design information in section 4 of the Drainage Strategy, supported by other areas of the drainage strategy, against the previous comments and these issues are now addressed.
2.16 Full	Provide further information regarding the water quality management approaches required for the construction of the proposed development	See Section 7	Addressed in Drainage Strategy Report prepared by EAS	Insufficient information has been provided for the area under full planning application for the water quality management approaches during the construction phase. At present there is very limited consideration of sediment ingress management to the sewers within the largest critical drainage catchment in Norfolk. Section 7 of the drainage strategy indicates the applicant's intention to manage the sediment movement through management practises and the installation of silt traps and oil interceptors. However no temporary surface water drainage plan has been provided to identify the locations where the temporary sediment traps are to be installed along with a size indication, the maintenance and management arrangement and confirmation of when these temporary sediment traps are to be removed and how the assessment of any remedial works will be undertaken should it be identified as necessary. A commitment from the applicant to undertake an asset condition inspection of the sewer sections immediately downstream of the sediment traps before and after the construction of the development to ensure that there is no deteriation in the condition of the sewers due to the development. This is to ensure the development does not increase flood risk elsewhere due to the construction activities undertaken in this sensitive catchment.	The LLFA have reviewed the proposed design information in section 7 of the Drainage Strategy against the previous comments and these issues are now addressed. The LLFA notes that a treatment unit is proposed but there is no further information about the treatment unit. The LLFA recommends a condition that requires further information about the temporary treatment unit and its installation as a priorty activity in the enabling works activities for each phase. No construction work can progress until confirmation of the treatment unit installation has been provided. This is to ensure there is no reduction in surface water from the site during the construction phase ***LLFA Condition recommended*** **Noted**
2.17 Full / Whole	Identify and assess the residual risk and provide suitable mitigation associated with the management of pumps and the attenuation tanks.	See paragraphs 4.75 to 4.77.	Addressed in Drainage Strategy Report prepared by EAS	The LLFA has reviewed the Drainage Strategy as referenced in the applicant's response. Paragraph 4.77 states the flowpaths for the exceedance routes greater than the 1% AEP +45% climate change allowance are shown in Figure 1. On review of Figure 1, there is no legend for the information on the figure. The information provided relates to some numbers (possibly levels) inside boxes. It is not clear what these numbers relate to nor are they clear to read due to the resolution quality of the image. The clarity of the arrows in the image is also not clear due to the resolution. The quality of the figure needs to be improved and a legend included. Figure 1 also includes an aerial base image and the what appears to be a hazard map. The hazard map extent outline in Figure 1 for an undefined "event greater than 1% AEP plus 45% for climate change was compared to the hazard maps given in the FRA Appendix J for the 1% AEP plus 45% for climate change. The LLFA observed significant extent differences between the hazard map extents shown in the FRA Appendix J and the drainage strategy Figure 1, with the extents in figure 1 being significantly smaller even though the text in paragraph 4.77 to 4.78 infer event modelled was greater and the hydraulic model representation of the sewers assumed they were nearly at full capacity and no surface water drainage was present. Therefore, the results shown in Figure 1 are contradicting those shown in the FRA. Further information regarding the hazard extents, how they were derived and what event they are for in the report and the supporting figure.	Uncertaintly in modelling is reduced to expected levels (See comments in Section 3) . Therefore usual freeboard allowances can be applied. The Hazard maps are not included in the model report so have reviewed FRA 1% AEP + 45% maps vs depth maps in the hydraulic modelling report as a sense check. Extents appear to match between the modelling report and FRA, areas of greatest hazard coincide with greatest depths as expected. The exceedance flow route plan has been provided in Appendix R of the Drainage Strategy. This shows the exceedance flow routes but not the finished floor / ground levels. Some of the finished floor / ground levels are provided in the surface water drainage plans in Appendix O of the Drainage Strategies. **EAS Response - Appendix R does show proposed ground levels, however it is appreciated that the text may have been difficult to see. This has been remedied for the Rev C Submission.**
2.18 Whole	Provide a site layout plan that demonstrates all surface water drainage features sized appropriately and to ensure suitable space is available within the proposed development. The design should be in accordance with both the LLFA Developer Guidance, the Ciria Suds manual, the building regulations and other relevant local and national guidance, practices and policies.	See Appendix K.	Addressed in Drainage Strategy Report prepared by EAS	The LLFA has reviewed the Drainage Strategy Appendix K plans. The LLFA is not able to determine from the drawings if the geocellular structures are an appropriate distance from the foundations of BlocksC, D, E and H. The LLFA notes that section 3.1 from Ciria C737 on the Structural and geotechnical design of modular geocellular drainage systems determines that the geocellular tanks must be at least 2m plus the depth of the storage structure from the foundations of a building. Due to the space constraints the LLFA will require demonstration from the applicant the proposed Geocellular tank is able to meet this requirement. This information must be provided for all blocks within the full and outline planning application areas to demonstrate the proposed drainage design for the affected systems is achievable. In addition the LLFA notes that while there are pumping stations shown in manholes, there are no pumping station kiosks included in the proposed design layout shown on the plans. The LLFA reminds the applicant the level of the control kiosk for the pumping station should be above the design flood water level and include appropriate freeboard as defined in the LLFA's Developer Guidance in section 20.3. The LLFA requires confirmation of the proposed arrangements for the control kiosk for both the full and outline planning applications with obviously more detailed information being required for those in the full planning application area.	The LLFA have reviewed the various plans provided in Appendices M, N and O of the Drainage Strategy against the previous comments and these issues are now addressed.
2.19 Full	Provide detailed information of the design and operation of the flood barrier for inclusion within the hydraulic model as part of the full application.	Addressed in Royal Haskoning DHV FRA Report.	Not required – Alternative mitigation measures discussed in Section 8	The LLFA notes that the basement car park mitigation has changed to include a hump at the entrance 300mm above the 100y + 45% CC. This is modelled at the level described in the FRA (4.8mAOD) and maps in Appendix I show no flooding. A wall has been included around the basement car park at 999m, this is considered acceptable provided the precautions to ensure the carpark is watertight, described in Section 8.16-8.19 of the FRA, are adhered to and airbricks/ window/ doors etc. are above the modelled water levels adjacent to the walls.	Previously provided
2.20 Full / Whole	Update the hydraulic model and the drainage strategy to ensure they are consistent with other technical disciplines' submissions.	See Appendix J and K.	RHDHV have further liaised with EAS and Weston Homes to ensure consistency with respect to the updates.	The LLFA has reviewed the information provided in Appendix J (microdrainage calculations) and K (drainage strategy plan). The information provided in these appendices has improved as the plans now include information about the location of more of the SuDS features such as swales and tree pits. However, not all the information has been included such as the outline indication of the green roof positions for Blocks in the outline planning area. The information in Appendix J is also not consistent with the information used with the FRA assessment as no downstream boundary data has been applied to represent the typical flow in the AW sewers for the various discharge locations. This information could be provided by AW from their own models or flow sensors. Although it is clear from the review of the FRA and surface water flood risk hydraulic modelling report that the information used in this model is requires further clarification (see response comments to 3.2). In addition, the LLFA note that the MADD factor is currently set to 2 when it should be set to 0, otherwise this increases capacity within the sewer network without the capacity ever being constructed. The LLFA also notes that calculations for only the 1% +45% for climate change were submitted, however no modelled information or calculations were provided for the 3.3% + 40% for climate change as is required by the National Guidance on Flood Risk Assessment: Climate Change Allowances (https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances#using-peak-rainfall-intensity-allowances-to-assess-surface-water-flood-risk) which clearly states in the peak rainfall intensity that "You must do this for both the 1% and 3.3% annual exceedance probability events for the 2070s epoch (2061 to 2125)." This is also required by the LLFA Developer Guidance. This means the application is not in accordance with NPPF.	Both Clarification has now been received relating to information used within the hydraulic model as per comments in section 3.2. Additionally, the 3.3% AEP + 40% climate change results are now included in the surface water modelling mapping outputs. The Drainage Strategy has also applied these climate change allowances, although the LLFA note the 3.3% and 3.3%+CC scenarios for the surface water d rainage networks ahve not been modelled for the Outline application areas. **EAS Response - Rev C Submission includes modelling for all Storm Events required by LLFA - 1:2yr, 1:30yr, 1:30yr + 40% Climate Change, 1:100yr and 1:100yr + 45% Climate Change undertaken for Full Application Drainage Systems. Outline Drainage Systems have been modelled for the 1:100yr +45% Climate Change Event only..**
2.21 Whole	An assessment of the surface water treatment required for all elements of the proposed development to determine whether the SuDS system is providing an appropriate amount of water quality treatment.	See updated Section 4.	Addressed in Drainage Strategy Report prepared by EAS	The LLFA have reviewed the appropriate paragraphs within section 4 against the information provided in Appendix K. The LLFA note the approach used for many of the systems is the simple index approach from the Ciria SuDS Manual (C753). However, the benefits that green roofs provide has not been considered in any of the systems where these features has been incorporated. The simple index approach has not been applied to all the systems appropriately and there will be some systems where no indices have been applied for the assessment at all even though it is possible. A summary of the finding for each of the systems can be found in the system specific notes below. System 1 - Water quality assessment approach is acceptable although there is a lack of information regarding the water quality treatment to be provided by the downstream defender. As this element is within the full planning application area this information is required to be provided at this time. System 2 - The only treatment process acknowledged in the water quality assessment relates to the bioretention area. There is no inclusion of the proposed green roof that would cover the whole roof space of the main residential block (see response 2.15). While the technical approach to the simple index method of assessment is in accordance with the Ciria SuDS Manual, the proposed design is not considered appropriate (see previous comments in Response 2.10). The LLFA therefore considers the current water quality assessment is not suitable at this time as it does not assess all the elements and it assesses a system that requires redesigning. System 3 - There is no inclusion of the proposed green roof that would cover the approximately half of the roof space of Block D (see response 2.15). While the technical approach to the simple index method of assessment is in accordance with the Ciria SuDS Manual, the proposed design is not considered appropriate (see previous comments in Response 2.10). The LLFA therefore considers the current water quality assessment is not suitable at this time as it does not assess all the elements and it assesses a system that requires some partial redesigning. System 4 - There is no inclusion of the proposed green roofs (see response 2.15). There is a lack of information regarding the water quality treatment to be provided by the downstream defender. As these elements are within the full planning application area this information is required to be provided at this time.	The LLFA have reviewed relevant paragraphs of section 4 of the Drainage Strategy against the previous comments and these issues are now addressed.

				System 5 - There is a lack of information regarding the water quality treatment to be provided by the downstream defender along with no inclusion of the bio-retention areas. As these elements are within the full planning application area this information is required to be provided at this time. System 6, 7, 8 and 9 - There is no inclusion of the proposed green roofs (see response 2.15) and there is a lack of information regarding the water quality treatment to be provided by the downstream defenders on each of these. As these elements are within the outline planning application area this information is required to be provided on the submission of the detailed design.	
2.22 Whole	A surface water drainage design that includes a site plan with appropriately sized SuDS Features and conveyance with both the LLFA Developer Guidance and the Ciria SuDS Manual.	See Appendix K.	Addressed in Drainage Strategy Report prepared by EAS	The LLFA has reviewed the proposed drainage strategy plan in Appendix K of the Drainage Strategy. At present the LLFA considers the plan to be incomplete as SuDS features proposed to be incorporated into the design and the support principle infrastructure has not been included on all the nine drainage systems being proposed on site. Furthermore, some of the items shown on the plan are not included in the system description within section 4 (see Response 2.10). This contradiction leaves the LLFA unsure about what is being actually being proposed and committed to within the application. In addition, the LLFA notes that brown roofs are mentioned for inclusion in the design in paragraph 6.2 of the drainage strategy but there is no further information within the drainage strategy of where these brown roofs are to be located. Further clarification of the design along with the inclusion of key elements in the propose drainage plan is required for both the outline and full areas of the planning application.	The LLFA have reviewed the Drainage Strategy against the previous comments and these issues are now addressed.
2.23 Full	Identification of the structures to be placed below ground and an assessment of the risk of groundwater flooding and specific mitigation measures to manage the groundwater flood risk to those structures where required.	Addressed in Royal Haskoning DHV FRA Report.	Included at 7.10 onwards and 8.52	No mention of groundwater in the hydraulic modelling report. There is very limited historic groundwater levels from between the 1970s and mid 1990s that gives an indication of shallow groundwater While there is no site specific groundwater monitoring to ascertain whether there would be infiltration into the system. However, the LLFA can accept the conclusions of the FRA in section 7.16 that states "the site is considered to be at moderate risk of flooding from groundwater. This could impact the proposed below ground basement car park and the service yard, which is lower than the existing ground level." A review of section 8.52 to 8.58 in the FRA which states "the basement car park and service yard will be made water-tight ('tanked') to prevent water ingress.", "a sump pump will be included in both of these areas as a failsafe" and that "All subsurface surface water drainage infrastructure must be designed with high groundwater levels in mind at the detailed design stage, so that rising groundwater levels will not compromise the attenuation volume available in the cellular storage tanks. Cellular storage tanks will be lined accordingly.". However the finished floor level of all buildings in the proposed development are not raised above ground level. Therefore should the groundwater reach surface level groundwater ingress is possible. The LLFA requires that the appropriate freeboard allowances are applied to all buildings within the proposed development in accordance with the LLFA Developer Guidance (section 20.3).	The LLFA have reviewed the FRA paragraph 7.10 on wards and 8.63 to 8.68 in relation to this comment and the associated response given by the applicant. In paragraph 8.68, the applicant confirms the finish floor level for the commercial units will be "raised at least 100mm above the ground level". The LLFA notes that this is lower that the LLFA requirements and will require flood resistance measures to be installed at relevant commercial properties where the applicant was able to only uplift the finished floor level by 100mm. ***LLFA condition recommended*** **Informative** - The FRA states "Groundwater flooding occurs slowly so there would be ample time for ground level commercial uses to prepare for flooding and implement measures to prevent significant damage." However the FRA has not accounted for the fact that groundwater flooding is sustained over a much longer timeframe that could last for months.
2.24 Whole	A Maintenance and Management Plan detailing the activities required to manage the proposed SuDS including confirmation of ownership, maintenance responsibilities and in principle agreements.	See updated Section 6.	Addressed in Drainage Strategy Report prepared by EAS	The LLFA have reviewed section 6 of the Drainage Strategy where the applicant was able to confirm that a management company would be responsible for the private surface water sewers, attenuation tanks and green/brown roofs. However, there is no indication of who will be specifically responsible for the areas permeable paving, pumps, downstream defenders, bio-retention areas and bioretention swales. Some of the proposed surface drainage network is within the roads to connect to the AW sewers but it is not clear (particularly on the full drainage application area) the extent of each network that will not be under the management of the management company. Further information is required to better define the extent of the responsibility of the management company. A review of the maintenance schedules in section 6 shows that no maintenance schedule for the pumps, downstream defenders, bio-retention areas and bioretention swales has been provided. The maintenance and management plan is required to be updated to identify who will be responsible for the maintenance and management of the features not included in the plan and the maintenance schedule for the features not included at present.	The LLFA have reviewed section 6 of the Drainage Strategy against the previous comments and these issues are now addressed.
2.25 Whole	2.25 Provide an updated assessment of the suitability of the different types of SuDS components on the site.	See Table 4.1.	Addressed in Drainage Strategy Report prepared by EAS	The LLFA have reviewed Table 4.1 and acknowledge the table has been updated.	Previously provided
2.26 Full	2.26 Provide further evidence to support the viability of the Edward Street Service Yard residual risk mitigation and provide clarification on whether an automated flood barrier could be installed.	Addressed in Royal Haskoning DHV FRA Report.	Flood barrier no longer required – see 5.38-5.43	Mitigation is discussed in Section 5.4.1. The maps in Appendix I show no flooding of the service yard in the proposed mitigation scenario, depths adjacent to the barrier are Max 0.1m and adjacent to the building wall are 0.2m. Representation of these features in the model are described in section 7.3.2 of the modelling report (extract in modelling column). The ground levels modelled for the entrance hump match the proposed mitigation levels, which is considered reasonable. The walls are modelled as 999m high, depths against them do not exceed 200mm, therefore this is considered a reasonable representation provided that any doors/airbricks in the wall between Block M and the service yard are above this level, as inputting exact levels in this instance would not change model results. Section 8.12 of the FRA states "No openings such as air bricks, doors or windows should be included in the neighbouring wall with Block M, to prevent water ingress into the surrounding blocks". The LLFA notes the word "should" is used and requests clarification that these measures will be taken. Additionally, please note LLFA comment responses 3.1 to 3.2.2 relating to remaining concerns with the model set up and consequently results.	FRA - The LLFA notes the FRA confirms the modelling before any mitigation at the entrance of the Edward Street Service Yard shows that 1.02m of modelled water depth in the yard would be anticipated during a design flood with climate change. To mitigate this, the applicant proposes to constuct a hump in the access area to prevent water ingress from Edward Street. This was then modelled again and prevents surface water from the road would flow into the service yard.
2.27 Full	The Emergency Flood Plan should be prepared in accordance with the ADEPT guidance (2019), available at https://adeptnet.org.uk/floodriskemergency plan and demonstrate ongoing liaison with the relevant Emergency Planning Team	Addressed in Royal Haskoning DHV FRA Report. It is understood that The Emergency Planning Team (Teresa Cannon) has confirmed that this can be Conditioned.	Acknowledged. Norwich City Council Emergency Planning Team were contacted and agreed the Flood Plan could be conditioned (Appendix M and 8.41)	The LLFA are pleased the applicant has agreed to use the Flood Plan Guidance by ADEPT/ Environment Agency to prepare the Flood Plan for each of the blocks. The LLFA advises the LPA that NPPF Paragraph 167 (e) states that "When determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood-risk assessment. Development should only be allowed in areas at risk of flooding where, in the light of this assessment (and the sequential and exception tests, as applicable) it can be demonstrated that: (e) safe access and escape routes are included where appropriate, as part of an agreed emergency plan." The applicant's own surface water flood risk modelling and FRA identifies significant flood risk remains on site once the site has been developed. This indicates that an emergency plan should be provided prior to determination of a planning application. Therefore the LLFA would advise the LPA that the applicant's proposal to discharge this requirement by conditioning is not in accordance with the NPPF requirements.	FRA - The LLFA confirms the FRA has a strategic Flood Emergency Warning and Evaccuation plan and block specific plans in place too. The inclusion of rain gauges on the blocks is required to support the warning system and from escalating the emergency plan based on local site specific conditions.
2.28 Full	An assessment of the potential to install some flow and level monitoring gauges to enable the site manager to monitor and manage the flood risk on site.	Addressed in Royal Haskoning DHV FRA Report.	No longer required – Section 8 discusses amended mitigation measures	The LLFA notes the change in mitigation approach for both the below ground level service yard and the basement car park. However, in a review of section 8 of the FRA, we note there is reference to a flood warning and evacuation plan in relation to Block C (Section 8.22 -8.23), as well as a site wide warning and evacuation plan (Section 8.26-8.40) and a flood warning notice for the south east of block J. The LLFA notes that section 8.2 and 8.3 indicate which development blocks are at flood risk however there is no summary of which roads and pedestrian access routes which are at surface water flood risk. The LLFA observes this gives an overly optimistic outlook on the flood risk across the site. In section 8.4 the FRA notes that "is impractical to prevent offsite flows entering the onsite drainage system in some areas". However, within the Drainage Strategy there are no allowances given within the drainage design for the any offsite surface water that may enter the system. The LLFA notes the proposed use of tank alarms for tanks affected by offsite site flows when they reach 75% capacity. The alarm would trigger a co-ordinated response to warn all the relevant ground floor properties of the potential flood risk so they can close and prepare for potential flooding as appropriate. However, the FRA (section 8.7) also acknowledges that at present they do not know if the 75% capacity is will give a suitable amount of time for properties to evacuate and prepare for potential flooding by stating "The 75% capacity level was considered to be acceptable as it would ensure the alarms would not be triggered in the lower return period, every day events, but further analysis to provide supporting evidence to this approach needs be provided to verify this." In addition, while the idea of this tank alarm system is acceptable if all other forms of mitigation have applied. However, the applicant has not yet avoided flood risk through raising the finished floor level of all building through the application of the provision of appropriate freeboard and therefore have not demonstrated there is a residual risk. Rather this approach is to address an unmitigated design risk. **The LLFA require the finish floor levels for all buildings to be revised to ensure they meet the LLFA's Developer Guidance requirements in section 20.3.** In Section 8.9 of the FRA, provides a link to a website of an example of an alarm system that could be used (RDNET1000 STM Storm Tank Level Monitoring and Alarm System). This is repeated in the Drainage Strategy although there is no further details provided to support the full or outline design application. There is no Flood Plan available for review as part of this application.	FRA - The evacuation plan is no longer referencing specific levels for the storm tank alarm. This is now suggested as an extra with the main evacuation plan not reliant on it. Alarms are included to indicate any pump failure. The FRA in paragraph 8.7 to 8.9, describes the use of tank alarms to monitor the water level within the surface water attenuation tanks combined with the pump telemetry for the monitoring the performance and available storage capacity within the tanks. The LLFA notes that while the residential buildings are proposing to raise their finished floor level to meet the LLFA freeboard design requirements, while the finished floor levels for the commercial units have been raised by at least 100mm, this is lower that the LLFA's requirements. Therefore, the LLFA will expect flood resistance measures to be installed at relevant commercial properties where the applicant was able to only uplift the finished floor level by 100mm. ***LLFA condition recommended* F62** The hydraulic modelling is used to identify vulnerable areas. The drainage system is included in the surface water model as inflows. The tanks are not represented in the surface water hydraulic model. The LLFA did not observe any mention of the impact of offsite flows on the drainage system being assessed as part of the microdrainage modelling. Therefore the only modelling of the offsite impact of flooding was undertaken in the RHDHV Hydraulic Modelling Report and modelled results.

2.29 Full / Whole	Update the assessment of the residual flood risks within the FRA for the proposed development and its components.	Addressed in Royal Haskoning DHV FRA Report.	Included at 8.59 onwards	This section does not reference the hydraulic model. FRA (Section 8.59) states that "in the event of a rainfall event greater than that considered in this assessment, the external areas may experience some flooding. The likely exceedance routes in this event have been considered in the Proposed Surface Water Drainage Strategy, prepared by EAS." This contradicts the statement in the drainage strategy that this will be addressed in the Royal Haskoning DHV FRA report. The LLFA requires this contradiction to be addressed and resolved. The residual flood risk assessment in sections 8.59 to 8.61 of the FRA is very limited and has considered a very limited range of residual risks that focus on blockage due to lack of maintenance and exceedance flooding. The information provided is vague and has not considered issues such as additional water capacity of attenuation tanks due to pump failure or loss of power (see Response 2.13 and other part of other responses). The LLFA note in general the FRA makes recommendations for mitigation but does not commit to what will be included within the design. In addition there is no detailed design information available to confirm what will be included in within the proposed design. A review of the design and access statement indicates that there is a difference in the amount of green roofs indicated between the Drainage Strategy and the Design and Access Statement, which means there is further inconsistency between the different documents that are supporting the planning submission and erodes the LLFAs confidence in the delivery of the proposed surface water drainage strategy. The various sub-sections of the FRA section 8 on Mitigation are inconsistent with other areas of the Drainage Strategy and its Addendum Letter. For example, an example Flood Warning sign is included in section 8.22 for Block c which refers to both vehicle movements on the site and to where to put the sign in the car park, However, the LLFA is not able to identify any car parking shown on site in the surface water drainage plans. In addition a Flood Evacuation Plan is seen as vital importance for residents of Block C to facilitate the development, yet the application has not included the application has not Flood Plan for the Full application area contrary to the NPPF requirements. Furthermore the finish flood levels in Block C on the Plans in Appendix K in the Drainage Strategy show a single floor level yet in the FRA the bin store area in Block C is noted to flood by up to 300mm. There are many other contradictions and inconsistencies with the FRA mitigation recommendations, the Drainage Strategy proposals and the Design and Access statement, which leaves the LLFA unclear over what is being proposed for construction particularly in the Full Planning Application area.	FRA - The LLFA reviewed the updated FRA paragraph 8.69 to 8.74, which discusses a wider variety of residual risks assocated including pump failure, loss of tank capacity and the monitoring sytsems to be put in place.
2.3 Full	Inclusion of an updated Exceedance Flow Routes Plan for the site with proposed finished floor levels marked on.	Figure 1 in Section 4 updated to show levels as requested.	Addressed in Drainage Strategy Report prepared by EAS	The LLFA has reviewed the Drainage Strategy as reference in the applicant's response. Paragraph 4.77 states the flowpaths for the exceedance routes greater than the 1% AEP +45% climate change allowance are shown in Figure 1. On review of Figure 1, there is no legend for the information on the figure. The information provided relates to some numbers (possibly levels) inside boxes. It is not clear what these numbers relate to nor are they clear to read due to the resolution quality of the image. The clarity of the arrows in the image is also not clear due to the resolution. The quality of the figure needs to be improved and a legend included. Figure 1 also includes an aerial base image and the what appears to be a hazard map. The hazard map extent outline in Figure 1 for an undefined "event greater than 1% AEP plus 45% for climate change was compared to the hazard maps given in the FRA Appendix J for the 1% AEP plus 45% for climate change. The LLFA observed significant extent differences between the hazard map extents shown in the FRA Appendix J and the drainage strategy Figure 1, with the extents in figure 1 being significantly smaller even though the text in paragraph 4.77 to 4.78 infer event modelled was greater and the hydraulic model representation of the sewers assumed they were nearly at full capacity and no surface water drainage was present. Therefore, the results shown in Figure 1 are contradicting those shown in the FRA. Further information regarding the hazard extents, how they were derived and what event they are for in the report and the supporting figure.	The LLFA have reviewed the Drainage Strategy against the previous comments. The exceedance flow route plan showed the flow routes although the finished floor levels were not shown on this plan. These finshed floor levels were on the drainage layout plans.
2.31 Whole	Both the FRA and the Drainage Strategy require updating to address the large number of statements and conjecture that are not supported by evidence. These statements and assessment need to be evidence based for the statements to validated.	Noted and actioned.	Noted. This FRA is supported by evidence whe	The FRA and Drainage Strategy have been reviewed by the LLFA and it is acknowledge that some minor updates have occurred however, there are other significant updates that are required to ensure the surface water management is in accordance with both NPPF and the LLFA's Developer Guidance.	LLFA have more confidence that this has been improved upon.
2.32 Full	Provide a proposed drainage design with supporting evidence (plans, calculations, modelling and detailed design) that provide evidence of inclusion and support the proposed offsite drainage of surface water for the car park entrance and the service yard entrance on Edward Street. The evidence should demonstrate that the mitigation is appropriate, operable and "agreed in principle" by Anglian Water along with identifying who will be responsible for the maintenance and management.	Addressed in Royal Haskoning DHV FRA Report.	Drainage from service yard to Anglian Water sewer in Edward Street no longer required as service yard will not flood in any event up to and including the 100 year (+45%CC) event. A drain with a flap valve has been included in this area which now connects into the onsite drainage system in the event that an event greater than the 1 in 100 year (+45%CC) occurs and floodwater reaches this area. (Discussed in 8.11)	The LLFA has reviewed both the Drainage Strategy and the FRA with regard to the Edward Street Service Yard internal drainage solution and flood mitigation approach. The FRA has included a 300mm hump in the service yard entrance to prevent water entering the yard and has confirmed that a drain is located in the service yard to discharge any exceedance flow that may entre the yard (See section 8.11). The Drainage Strategy plan in Appendix K indicates that a gully will be included in the service yard (no cover or invert levels are given and this has not been included in the MicroDrainage Model) and will discharge to the north of Block M in Edward Street. The system 4 text does not discuss the inclusion of this gully nor is their any indication that a flap value will be installed. In the hydraulic Modelling report it is stated that a inlet pit has been included in the surface water flood model with a flap valve. This inlet pit is to drain any exceedance flow from the service yard into the diverted Anglian Water sewer via the onsite drainage system. The modelling report has indicated that as the inlet pit was not used in the 1%AEP +45% CC "proposed scenario" model runs, it has not been included in the surface water drainage design (Section 7.4 (paragraph 6) in the Modelling report). The LLFA notes that no exceedance events were run to confirm this. In addition, there appears to be an inconsistent approach applied to the detailed drainage design of the service yard between the FRA, the Drainage Strategy and the modelling report. The LLFA requires clarification from the applicant and their different design on what the drainage proposals are for this area. The FRA response summary indicates that a flap valve was included in the design proposed but none is shown in section 8.11 of the FRA or the Drainage Strategy. Detailed design information for the drainage design for all areas of the full application area (such as typical cross sections and detailed designs plans for each of the structures proposed) remains unsubmitted and the LLFA requires these to be submitted for the full application area.	FRA was reviewed and indicates the flap is included along with the petrol interceptor to drain and treat water within the Edward Street Service area. The volume of water to be drained through this system will be significantly lower than previously indicated due to the inclusion of the humps in the access entrance way. The updated drainage design and surface water modelling shows there is a displacement of surface water offsite in the highways to the east of the proposed development. The LLFA have reviewed the Drainage Strategy against the previous comments and the remaining issues are now addressed.
2.33 Whole	Provide clarifications from the applicant on whether the inclusion of flood doors have been considered on the proposed development.	Addressed in Royal Haskoning DHV FRA Report.	Flood doors are not required – all residential uses FFL raised at least 300mm above 100 year (+45%CC) flood level (Section 8 and 5.46)	The LLFA observes that the drainage strategy does not indicate that the finished floor levels adhere to the LLFA Developer guidance. It states "It should be demonstrated that the drainage system must be designed so that unless an area is designated to hold or convey water flooding must not occur in any part of a building or utility plant susceptible to water e.g. pumping station or electricity sub-station (Standard S8 of the SuDS Non-Statutory Technical Standards (2015))." (section 20.3 of the LLFA Developer Guidance). There is inconsistency between the approach taken in the drainage strategy and the approach in the FRA. The FRA indicates the residential buildings are raised approximately 300mm above the design flood event. However, on review of the FRA details in section 5.46 and section 8, the LLFA notes that no finished floor level is set only a freeboard allowance is provided with a maximum modelled water depth of 420mm. The FRA observes that the bin store in Block C is likely o flood but not the residential accommodation implying there are different flood levels within Block C. While in the Drainage Strategy, the finished floor level is set at a single finished floor level of 4.65m rather than 4.75m which would provide the 300mm freeboard allowance required. Regarding the other residential areas of the development there is less information available when compared to Block C. In the drainage strategy, the finished floor levels in the commercial and other building areas are set to match the street level. Therefore, there are inconsistencies between the FRA and the drainage strategy on this matter and the LLFA require design clarification from the applicant and their designers. The LLFA further requests the applicant to provide the modelled flood level outputs for the site to evidence the setting of the finished floor levels. These should be provide for at least the proposed modelled scenarios.	The LLFA has reviewed the FRA and notes that in paragraph 8.26 recommends a water exclusion strategy with the finished ground floor levels of Block A and M being raised 500mm, while in Block C a more modest 300mm above the design flood is proposed (paragraph 8.29). The LLFA has reviewed the information on the drainage plans in Appendix O of the Drainage Strategy and can confirm that an improvement in the freeboard allowances has been made. However, there are a number of blocks with areas where the finished floor level is not in accordance with the LLFA's Developer Guidance, such as some areas of Block D and A. Therefore, the LLFA will expect flood resistance measures to be installed at relevant properties where the applicant was unable to uplift the finished floor level in accordance with the LLFA's Developer Guidance. The LLFA recommends that a condition is set that prior to construction of the proposed development where the finished floor level are not in accordance with the LLFA's Developer Guidance, such as some areas of Block D and A, the LLFA will expect flood resistance measures to be installed at relevant properties by the applicant. ***LLFA condition recommended***

2.34 Whole	Provide discussion on whether an alternative design approach and location was considered before placing the car park entrance ramp on Edward Street.	Addressed in Royal Haskoning DHV FRA Report.	Included at 3.48-3.58	The LLFA have reviewed the FRA, the Drainage Strategy and the Modelling Report. The surface water model is not used to support the argument for it's location. The FRA reviewed sections 3.48-3.58 of the FRA as referred to in the applicant's response. It is clear from the response that there were many factors considered in the location of where to access the basement car parking but that flood risk was not one of the factors considered until raised by the LLFA as a significant concern. A permanent hump in the access way to the basement car parking has now been included but the location of the basement car parking access has remaining in an area of flood risk due to non flood risk related constraints. The LLFA remains concerns about the location of the access although we acknowledge that the flood mitigation access hump has been installed and the model demonstrates it is located as an appropriate level. It is not clear whether the residents will be prevented from accessing the basement during floods as driving vehicles through the water is likely to wash flood water in to the basement. The LLFA requires the applicant to commit to restricting vehicle access moves to the basement significantly during more extreme events. For example vehicles can leave the parking facilities but not return until flood water has drained away from the road and access way area.	The LLFA reviewed the FRA paragraph 3.57 and was supports the majority of the context of the majority paragraph. Hcwever, the LLFA seeks to correct the statement that indicates that LLFA "agreed that in order to not compromise the pedestrianised environment and cycle routes that are fundamental to the masterplan, the access needed to be on the north side of the building". In the meeting on 16th June 2022, the LLFA sought for the developer to move the access point to the western side of the building. However, the developer sought to retain the position of the ramp off Edward street as they prioritised the cycle route alignment over the flood risk to the basement from the existing surface water flood risk. The LLFA does not feel this is accurately reported in the applicant's documentation and therefore seeks for this to be corrected. ***Informative comment in reponse letter***
2.35 Full	Provide an assessment of flow entering the basement car park should mitigation not be installed or the failure of mitigation measures.	Addressed in Royal Haskoning DHV FRA Report.	Model was run for proposed scenario with no mitigation measures – 5.39-5.40 and Table 3	The LLFA observe that the model has been simulated without the barrier to the basement carpark included. Appendix I shows flood depths of 0.1-0.2m in the unmitigated scenario and no flooding in the mitigated scenario. The LLFA notes that proposed mitigation has changed to include a hump at the entrance 300mm above the 1% AEP + 45% Climate Change. This is modelled at the level described in the FRA (4.8mAOD) and maps in FRA Appendix I show no flooding. A wall has been included around the basement carpark at 999m, which is considered acceptable provided the precautions to ensure the carpark is watertight, described in Section 8.16-8.19 of the FRA, are adhered to and airbricks/ window/ doors etc. are above the modelled water levels adjacent to the walls. Additionally please note LLFA comment responses 3.1 to 3.2.2 relating to remaining concerns with the model set up and consequent results. These will need to be acted upon and then reviewed against this issue subsequently.	The LLFA has reviewed the FRA and modelling report. Representation of basement carpark mitigation still appears ok as previously stated. However, some outstanding issues with the model see 3.2.
2.36 Whole	Provide evidence the proposed development scheme that in accordance with NPPF where "the development should be made safe for its lifetime without increasing flood risk elsewhere."	Addressed in Royal Haskoning DHV FRA Report.	Discussed in Sections 6 and 8	Section 6 of the FRA report outlines the impact of the development on flood risk Section 6.9 states that "Various limitations mean that the level of flooding shown in Appendices I and K may be overestimated." Section 10.2 of the modelling report outlines some limitations of the modelling, the LLFA acknowledges these limitations. However, these limitations could result in under-estimation of depths or over-estimation. Section 8 outlines mitigation measures. Modelling data is used to define the levels of mitigation features and floor levels. Please note LLFA comment responses 3.1 to 3.2.2 relating to remaining concerns with the model set up and consequently results. These will need to be acted upon and then reviewed against this issue subsequently.	Reference to under-estimation in section 10.2 of the modelling report has been removed as requested. Comments made in sections 3.1 and 3.2 have now been responded to adequately, see comments on these sections The LLFA has reviewed section 6 and 8 of the FRA including the supporting Afflux mapping in Appendix K. It is clear there are alterations to the distribution of flood risk onsite and offsite. The alterations of flood risk within the site redline boundary are managed within the proposed flood risk and residual flood risk mitigation approaches. However, the increase flood risk in the offsite would have a negative impact on the highways drainage network in an area where there is existing surface water flood risk. In addition, the information within the FRA topographic survey provides data only for the Magdalen Street area and a short distance down Cow Gate. No topographic survey or threshold levels survey has been undertaken for the areas where flood risk has been increased. Therefore it is not possible to accurately determine whether the extent of the potential impact of this increase of surface water flood risk. The FRA identifies that at least two commercial buildings on the corner of Magdelan Street and Cowgate are likely to experience an increase in flooding. Further down Cowgate, Charlton Road and the roundabout there is also an increase in flood risk which would increase pressure on the existing highways drainage network and increase flood risk to the adjacent properties. In regard to the increase in flood risk in the highway, the LLFA requires the developer to work with the Highway Authority to agree and install appropriate highway drainage improvements to ensure there is no increase in surface water flood risk within the highway prior to construction of the proposed development. This is to ensure the properties identified as being at increased flood risk from the proposed development are not negetively affected prior to the construction activities. The LLFA recommends that further work is undertaken by the applicant to determine the number of properties impacted upon by the increase in flood risk in these areas. This will involve undertaking an theshold level survey of properties along these roads along with a suitable topographic survey. This will better inform the applicant of the impact their development would have on offsite properties in addressing any residual risk due to the development. Should this information identify any properties where there is an increase in flood risk, the developer should offer and install suitable flood resistance measures to the affected properties. ***LLFA Condition recommended***
2.37 Whole	Address all LLFA queries given in the attached Annex.	See point 2. above.	Noted and included throughout this FRA	The LLFA has provided comments and responses against other responses above and below.	Previously provided
3 Whole	The hydraulic modelling report and model requires updating to include.				Model has been updated as per comments and detailed in the hydraulic modelling report and clarifications provided on 21/10/2022
3.1 Whole	Confirmation that the key parameters (URBEXT, Catchment area, etc.) have been checked and the parameters where appropriate adjusted accordingly.	Addressed in Royal Haskoning DHV FRA Report.	Section 6 of the hydraulic modelling report: 'Anglia Square Norwich Modelling Study (July 2022)'	It is important and considered standard practice in UK hydrology assessments and subsequent fluvial hydraulic modelling to undertake at least a rudimentary check on some of the FEH catchment descriptors obtained from the FEH Web Service before proceeding with in-depth hydrological catchment analysis. With regards to the direct rainfall approach used in surface water or pluvial modelling the checking of FEH catchment descriptors is viewed as not so critical. However, confirmation that the catchment boundary is appropriate for the study site in question should be checked. In this study case the FEH catchment area boundary is considered conservative but appropriate, as it allows for a good understanding of overland flow routes and identification of areas of ponding across the wider urban area. The BFIHOST value assigned to the study catchment is 0.861, suggests a highly permeable underlying geological strata. This correlates with the geology data held on the BGS Geology of Britain Viewer Web Service which indicates the catchment is underlain by a bedrock of the chalk formations covered with a superficial geology of locally derived Alluvium deposits comprising of Clay, Silt, Sand and Gravel. The high BFIHOST value is also confirmed by soil data mapping held on the Soilscapes Web Service which indicates that the majority of the study catchment sits on Soilscape 6 type soil, described as freely draining, slightly acid loamy soils where rainfall drains to local groundwater and rivers. The URBEXT2000 value assigned to the study catchment of 0.39 categorises the catchment area as very heavily urbanised. Confirmation of the extent of urban coverage can be undertaken in a GIS using suitable mapping data. However, this is considered only necessary when there are doubts over the degree of urban and rural coverage across a more heterogenous catchment area, which in this study this is not the case as the study area is obviously heavily urbanised. The LLFA welcomes the details added regarding checks to BFI HOST. However URBEXT should also be checked. The LLFA notes that if pluvial modelling is undertaken using gross rainfall and infiltration and evaporation losses accounted for in the hydraulic model, checking of the catchment descriptors is unimportant. However, in this case REFH2 net rainfall is being used. Whilst this is a valid approach, the REFH2 Urban Loss Model (Which should be used in this case given that the area is clearly very heavily to extremely heavily urbanised) uses URBEXT to calculate the Impervious Factor (IF) value. This is in turn used to calculate net rainfall. Therefore it is a critical parameter for the calculation and should be checked to ensure it is accurate and altered if necessary. Alternatively sensitivity testing in REFH2 could be used to show that net rainfall is not sensitive to this value, for example by increasing it to a minimum of 0.6 and comparing it to the net rainfall as it is currently.	URBEXT has now been checked and is outlined. ARFs presented for both catchments, ideally it would say which is used. However, it is not likely that this variation will impact the results. Therefore this is considered acceptable.
				This is particularly important when reviewed alongside sensitivity testing in Section 8.6.1 of the hydraulic modelling report which shows that the model is sensitive to rainfall inflows. It is not clear from this section what area has been used in ReFH. In Section 3.1 does contain a review of the catchment. However the catchment area has been checked against WFD catchment rather than DTM, this is likely to result in an areal reduction factor (ARF) that is too high and therefore under-estimation of rainfall. Please review the catchment area for use in REFH 2 based on the DTM or include details of this check if you have already done so. The URBEXT check requested should also be done on the DTM catchment. The model extent is considered appropriate.	Previously provided

3.2 Full	Includes sewers in the hydraulic model for the sewer network affecting the parts of the site included in this application to support the full application that demonstrates there is no increase in flood risk elsewhere.	Addressed in Royal Haskoning DHV FRA Report.	Model has been updated to include nearby Anglian Water sewers – please refer to 'Anglia Square Norwich Modelling Study (July 2022)' and 5.25	7.2 1D Network Following a request from the LLFA, the Anglian Water sewer network was included in the model for the surrounding streets. The Anglian Water sewer records (obtained June 2022) were used to determine the dimensions of the sewers and manholes in the surrounding roads. The sewers were included in the model as sections of '1d_nwk' and the manholes were included as rectangular inlet pits with 'SX' boundaries. This meant that any water in the inlet pit cell would be directed into the 1D sewer network. The downstream end of the sewer networks (at the edge of the Anglian Water mapping) were represented as 'HT' boundaries which allowed water to freely exit the sewers. 7.4 Paragraph 4 "Anglian Water sewers were included in the model for the roads surrounding the site. The sizes of these sewers and manholes were taken from the latest sewer records. 'SX' boundaries and inlet pits were included at each manhole to enable water reaching these cells to be taken into the sewer network. At the downstream ends of the sewer networks, which were between 140m and 500m from the site, 'HT' boundaries were included to allow water to discharge freely." The LLFA welcomes inclusion of the network and the downstream boundary location is justified through sensitivity testing which shows the model is not sensitive. However further detail is required to review how this has been included. Please provide a drawing showing the 1D model extent. Where the sewer included has upstream sewers draining to it how has flow from these sewers been accounted for within the network?	The upstream extent of the Anglian Water system has been checked and is included in Appendix B of the report. There are 2 manholes noted that drain toward the site serving the network but are outside of the catchment. The location is given for the Cowgate Street Manhole. Clarification was sent by the applicant on 20/10/2022 that this is included in the surface water model. This clarification also confirmed the position of the sewer on Aylsham Road, justification is provided for excluding this manhole as it is located on a overland flow path where it enters the system draining to the site downstream, therefore its inclusion is considered unlikely to significantly change the modelling results
3.2.2 Whole	Is extended to cover the full catchment to ensure the inflows are calculated correctly, or includes sensitivity testing showing that these inflows do not impact flood risk at the site.	Addressed in Royal Haskoning DHV FRA Report.	Model has been extended to cover wider catchment – please refer to 'Anglia Square Norwich Modelling Study (July 2022)' and 5.23	Section 3.1 of the modelling report details catchment delineation and model extent is shown in figure 3-3. The revised model extent is considered appropriate.	Previously provided
3.3 Whole	Provide clarification on whether Anglian Water has been contacted to supply sewer data. This should be requested and included where interactions with the sewer system are likely to impact flooding.	Addressed in Royal Haskoning DHV FRA Report.	Sections 4.26 and 7.6	See 3.2. See comments on 3.2 Anglian Water data has been requested and included. However the report has insufficient detail to confirm that sewers have been included where "interactions with the sewer system are likely to impact flooding" as the 1D extent isn't shown so its not possible to ascertain if this has been done appropriately.	Anglian Water Sewers are now included as requested, see 3.2 for further details.
3.4 Full	The inclusion of information regarding the onset of flooding and its associated duration for vulnerable locations across the site including the basement car park entrance and the service yard and loading facilities.	Addressed in Royal Haskoning DHV FRA Report.	Time to peak flood maps included via link in Appendix I. However, alternative mitigation measures now included (Section 8) to provide safety of vulnerable areas which is not reliant on alerts from elsewhere in the catchment/site.	Nothing specifically shown within the main body of the modelling report relating to the time to peak mapping or results. The LLFA notes that a link was provided in the FRA Appendix I to the Time to Peak Flood Maps. However, the LLFA was unable to download these maps. The LLFA cannot access these unsubmitted time to peak plans at this time and requests the applicant to submit this information via normal planning submission routes so that the LLFA can review this information.	Time to peak maps are now included for 1 in 30, 1 in 75, 1in 100, 1 in 1000 and 1 in 30 + CC. These show peak levels occur between 1.5 and 3 hours after the start of the model run for up to the 1 in 100 year event and between 3 and 4 hours for the 1000 year event. As the storm duration used is 3 hours peak rainfall is applied to the model approximately 1.5 hours after the start of the model run, this implies that the peak flow will occur between 0 and 1.5 hours after the peak of the rainfall. However the basement carpark and surface yard no longer flood in any of the events due to the humps installed.

SuDS Standards Review	Summary of alignment to relevant Non-Statutory Technical Standards for Sustainable Drainage Systems (August 22)	Summary of alignment to relevant Non-Statutory Technical Standards for Sustainable Drainage Systems (October 22)
S3 (Brownfield)	***Incomplete*** - due to various updates required on the greenfield and brownfield runoff calculations and further methods ***- further information required.***	***Complete*** - due to various updates provided on the greenfield and brownfield runoff calculations
S5/S6 (Brownfield)	***Incomplete*** - due to a lack of drainage design information, various updates required on the greenfield and brownfield runoff calculations and further updates on the surface water hydraulic modelling ***- further information required.***	***Complete*** - due to updated information for the drainage design information, including the greenfield and brownfield runoff calculations and further updates on the surface water hydraulic modelling
S7	***Incomplete*** - due to a lack of drainage design information ***- further information required.***	***Incomplete*** - The 3.3%AEP and 3.3%AEP +40%CC was only provided fo the drainage systems in the full application ***- further information required for the systems in the outline application area *To be conditioned****
S8	***Incomplete*** - due to a lack of drainage design information ***- further information required***	***Complete*** - due to the updated drainage design information provided
S9	***Unable to complete*** - due to a lack of drainage design information, various updates required on the greenfield and brownfield runoff calculations and further updates on the surface water hydraulic modelling required to enable appropriate evidence to assess and determine whether the mitigation measures are appropriate ***- further information required***	***Complete*** - due to the updated drainage design information provided

Appendix: D – Topographical Survey and Utilities Survey


Barclays Bank
SERVICE LEGEND
FOUL DRAINAGE
SURFACE WATER DRAINAGE
WATER
GAS
ELECTRICITY
TELEPHONE
CABLE TV
MERCURY
TRAFFIC SIGNAL
OIL
UNKNOWN SERVICE
NEW DETAIL
UNDERGROUND CHAMBER

Appendix: E – Anglian Water Sewer Records

 | Date: 21/06/22 | Scale: 1:1250 | Map Centre: 623069,309376 | Data updated: 31/05/22 | Our Ref: 882987 - 1 | Wastewater Plan A1

Foul Sewer
Surface Sewer
Combined Sewer
Final Effluent
Rising Main*
Private Sewer*
Decommissioned Sewer*

Outfall*
Inlet*
Manhole*

Sewage Treatment Works
Public Pumping Station
Decommissioned Pumping Station

*(Colour denotes effluent type)

james.cahuzac@eastp.co.uk
Anglia Square

love every drop
anglianwater

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert
0008	623008	309060	C	3.23	0.28	2.95
0101	623023	309178	C	4	1.85	2.15
0104	623025	309161	C	3.95	1.74	2.21
0105	623036	309101	C	3.43	0.14	3.29
0107	623073	309110	C	3.64	2.28	1.36
0201	623015	309237	C	4.34	2.12	2.22
0202	623010	309274	C	-	-	-
0604	623030	309667	C	-	-	2.4
1015	623192	309077	C	-	-	-
1112	623120	309178	C	3.874	1.179	2.695
1114	623189	309114	C	2.742	1.072	1.67
1201	623196	309247	C	3.13	1.38	1.75
1203	623162	309240	C	3.147	1.647	1.5
1204	623103	309267	C	3.55	1.18	2.37
1205	623147	309279	C	3.38	1.17	2.21
1213	623155	309280	C	3.347	1.747	1.6
1214	623169	309204	C	-	-	-
1215	623159	309280	C	-	-	-
1313	623160	309375	C	-	-	-
1407	623164	309465	C	-	-	-
1504	623169	309561	C	-	-	-
1505	623169	309559	C	5.342	1.407	3.935
1610	623138	309671	C	-	-	2.51
1611	623151	309676	C	-	-	2.68
2003	623246	309077	C	-	-	4.3
2017	623248	309069	C	-	-	-
2101	623281	309151	C	2.47	1	1.47
2103	623255	309184	C	2.99	1.86	1.13
2104	623261	309115	C	-	-	3.95
2201	623212	309251	C	3.28	0.13	3.15
2203	623269	309260	C	-	-	3.275
2205	623294	309270	C	3.02	1.29	1.73
2207	623298	309210	C	-	-	3.1
2208	623207	309272	C	-	-	-
2209	623223	309253	C	-	-	-
2505	623282	309594	C	-	-	-
2506	623229	309537	C	-	-	-
3006	623394	309092	C	3.5	1.97	1.53
3007	623351	309067	C	-	-	-
3101	623307	309165	C	2.449	0.349	2.1
3102	623319	309175	C	2.406	0.456	1.95
3106	623372	309187	C	-	-	3.48
3107	623337	309129	C	1.76	0.28	1.48
3109	623389	309118	C	-	-	-
3506	623383	309536	C	-	-	-
3602	623321	309637	C	-	-	-
3609	623383	309682	C	-	-	-
3610	623383	309673	C	-	-	-
3611	623383	309669	C	-	-	-
4108	623405	309104	C	3.44	1.23	2.21
4109	623422	309107	C	3.73	2.25	1.48
4110	623416	309115	C	3.36	1.78	1.58
4111	623452	309112	C	3.837	-	-
4201	623410	309220	C	-	-	3.275
4509	623455	309579	C	8.19	6.92	1.27
4510	623497	309538	C	-	-	1.7
4511	623471	309527	C	-	-	-
4512	623494	309522	C	-	-	0.62
4513	623490	309568	C	-	-	-
5101	623506	309141	C	-	-	3.125
5503	623523	309538	C	-	-	-
5507	622598	309555	C	-	-	8
5509	622598	309537	C	-	-	-
5510	622584	309590	C	-	-	4.61
5510	623521	309516	C	-	-	1.42
5510	623501	309552	C	-	-	1.05
5511	623504	309565	C	-	-	1.42
5608	622573	309651	C	-	-	2.3
5609	622559	309680	C	-	-	1.41
5612	622583	309620	C	-	-	1.62
6304	622635	309360	C	-	-	2.62
6351	622654	309301	C	-	-	1.82
6401	622616	309454	C	-	-	3.2
6402	622689	309483	C	-	-	3.82
6405	622697	309442	C	-	-	-
6406	622683	309438	C	-	-	-
6407	622685	309432	C	-	-	-
6408	622691	309412	C	-	-	-
6506	622664	309587	C	-	-	1.07
6507	622634	309532	C	-	-	1
6508	622669	309584	C	-	-	2.845
6605	622689	309658	C	-	-	1.9
6608	622634	309659	C	-	-	1.67
6610	622627	309680	C	-	-	0.97
6611	622641	309675	C	-	-	0.66
6612	622651	309618	C	-	-	1.35
6613	622670	309643	C	-	-	1.63
6615	622699	309655	C	-	-	1.42
6622	622655	309668	C	-	-	-
6703	622619	309702	C	-	-	1.47
7107	622799	309154	C	-	-	2.58
7201	622736	309218	C	-	-	2.71
7202	622765	309219	C	-	-	1.74
7203	622791	309228	C	-	-	2.83
7210	622706	309269	C	-	-	1.4
7301	622731	309382	C	-	-	1.37
7302	622732	309351	C	-	-	1.43
7303	622737	309356	C	-	-	1.5
7401	622758	309486	C	-	-	2.69
7402	622760	309472	C	-	-	2.015
7403	622761	309469	C	-	-	1.98
7502	622750	309506	C	-	-	3.56
7503	622792	309515	C	-	-	-
7504	622796	309506	C	-	-	-
7603	622733	309694	C	12.802	10.449	2.353
7606	622783	309629	C	10.756	8.12	2.636
7608	622798	309609	C	9.754	7.196	2.558
7611	622793	309607	C	-	-	0.83
8004	622832	309063	C	-	-	1.92
8103	622872	309129	C	4.18	1.44	2.74
8107	622873	309126	C	4.19	0.94	3.25
8203	622889	309284	C	-	-	2.21
8302	622898	309366	C	-	-	2.565
8303	622892	309327	C	-	-	2.16
8402	622845	309436	C	-	-	2.24
8403	622805	309417	C	-	-	2
8404	622896	309451	C	-	-	2.6
8502	622826	309579	C	7.483	3.292	4.191
8503	622868	309585	C	-	-	2.011
8504	622857	309549	C	7.483	3.292	4.191
8508	622842	309544	C	-	-	1.93
8601	622891	309623	C	-	-	0.84
8606	622899	309648	C	-	-	1.3
8607	622819	309612	C	-	-	0.915
8612	622817	309622	C	-	-	-
8613	622815	309623	C	-	-	-
9101	622981	309175	C	-	-	2.51
9102	622990	309126	C	3.65	1.26	2.39
9103	622995	309110	C	3.6	1.04	2.56
9104	622990	309108	C	3.63	1.43	2.2
9203	622972	309226	C	4.29	1.82	2.47
9207	622939	309245	C	4.76	2.73	2.03
9305	622974	309354	C	-	-	2.77
9306	622985	309400	C	-	-	2.87
9424	622941	309494	C	-	-	2.745
9426	622917	309445	C	-	-	2.92
9427	622906	309403	C	-	-	3.02
9501	622912	309579	C	-	-	1.04
9502	622929	309545	C	-	-	0.915
9503	622993	309573	C	-	-	1.725
9507	622995	309546	C	5.15	3.49	1.66
9508	622997	309522	C	5.09	3.31	1.78
9509	622955	309591	C	-	-	-
9510	622964	309593	C	-	-	0.8
9511	622975	309595	C	-	-	-
9512	622986	309589	C	-	-	-
9515	622949	309535	C	-	-	-
9516	622941	309587	C	-	-	0.5
9601	622900	309629	C	-	-	0.99
9602	622981	309617	C	6.248	4.328	1.92
9605	622925	309601	C	-	-	1.525
9606	622977	309661	C	6.111	4.023	2.088
9610	622904	309648	C	-	-0.61	0.61
9612	622917	309684	C	6.767	5.352	1.415
0301	623059	309354	F	3.99	0.33	3.66
0302	623080	309355	F	4	0.22	3.78
0303	623060	309310	F	3	1.36	1.64
0304	623060	309304	F	3.23	1.45	1.78
0401	623099	309460	F	4.22	1.41	2.81
0402	623066	309471	F	4.41	1.72	2.69
0403	623025	309487	F	4.65	2.04	2.61
0404	623008	309493	F	4.91	2.36	2.55
0405	623005	309415	F	4.5	1.92	2.58
0406	623033	309408	F	3.98	1.36	2.62
0407	623035	309401	F	3.97	1.14	2.83
0408	623056	309401	F	3.96	0.9	3.06
0409	623001	309497	F	-	-	-
0601	623023	309693	F	-	-	1.22
0602	623056	309694	F	-	-	1.02
0603	623029	309669	F	-	-	-
0605	623092	309675	F	-	-	-
0606	623046	309644	F	-	-	-
0607	623086	309645	F	-	-	-
0608	623091	309689	F	-	-	-
0609	623088	309690	F	-	-	-
0610	623097	309690	F	-	-	-
0611	623095	309690	F	-	-	-
0612	623067	309688	F	-	-	-
0613	623079	309688	F	-	-	-
0614	623024	309686	F	-	-	-
0615	623043	309686	F	-	-	-
0616	623039	309687	F	-	-	-
0617	623042	309644	F	-	-	-
0618	623086	309660	F	-	-	-
0619	623099	309645	F	-	-	-
1001	623158	309073	F	2.81	2.04	0.77
1003	623184	309067	F	2.55	-2.02	4.57
1014	623190	309074	F	2.56	0.8	1.76
1107	623171	309190	F	2.826	-0.934	3.76
1119	623129	309187	F	-	-	-
1211	623153	309285	F	3.42	0.59	2.83
1303	623143	309320	F	3.47	0.99	2.48
1306	623107	309356	F	3.91	-0.02	3.93
1307	623119	309355	F	3.61	-	-
1308	623131	309356	F	-	-	3.35
1309	623160	309343	F	3.18	-0.2	3.38
1310	623152	309346	F	-	-	3.5
1312	623158	309390	F	3.42	1.81	1.61
1401	623118	309453	F	4.1	1.25	2.85
1403	623156	309429	F	3.75	0.25	3.5
1406	623159	309451	F	4.07	1.96	2.11
1502	623163	309525	F	4.558	1.203	3.355
1503	623163	309559	F	4.558	1.203	3.355
1607	623114	309698	F	-	-	-
1608	623138	309673	F	-	-	-
1609	623154	309674	F	-	-	-
1612	623177	309693	F	-	-	0.91
1614	623161	309637	F	-	-	-
1617	623116	309645	F	7.333	5.473	1.86
1618	623102	309690	F	-	-	-
1619	623110	309690	F	-	-	-
2303	623249	309333	F	3.22	1.1	2.12
2304	623265	309338	F	3.37	1.57	1.8
2307	623257	309307	F	2.917	0.918	1.999
2504	623287	309589	F	-	-	2.5
2703	623243	309703	F	-	-	0.87
3008	623347	309072	F	-	-	-
3009	623393	309074	F	-	-	-
3010	623380	309064	F	-	-	-
3011	623364	309049	F	-	-	-
3302	623371	309359	F	2.57	-0.08	2.65
3501	623391	309509	F	-	-	2.1
3502	623332	309534	F	-	-	2.2
3503	623306	309556	F	-	-	-
3504	623395	309520	F	-	-	-
3505	623326	309587	F	-	-	-
3601	623306	309624	F	-	-	2.5
3603	623334	309655	F	-	-	2.4
3604	623301	309629	F	-	-	1.2
3605	623360	309651	F	-	-	-
3606	623365	309688	F	-	-	2.13
3607	623356	309615	F	-	-	-
3608	623358	309635	F	-	-	-
3609	623364	309603	F	-	-	-
4003	623433	309080	F	3.95	0.15	3.8
4101	623421	309189	F	-	-	3.455
4401	623479	309476	F	-	-	2.86
4402	623469	309476	F	-	-	2.8
4501	623412	309565	F	-	-	-
4502	623446	309557	F	-	-	-
4503	623457	309594	F	-	-	1.52
4504	623408	309588	F	-	-	-
4505	623413	309587	F	-	-	-
4506	623420	309585	F	-	-	-
4507	623438	309513	F	-	-	-
4508	623445	309538	F	-	-	-
4601	623454	309674	F	-	-	1.37
4602	623482	309633	F	-	-	-
4603	623402	309605	F	-	-	-
4604	623406	309670	F	-	-	-
4605	623406	309667	F	-	-	-
5201	622581	309267	F	-	-	-
5301	622563	309365	F	-	-	-
5302	622564	309357	F	-	-	-
5402	622563	309412	F	-	-	-
5402	623549	309406	F	-	-	-
5403	623545	309411	F	2.87	-0.18	3.05
5406	623536	309433	F	-	-	3.607
5407	623537	309458	F	-	-	3.226
5408	623548	309469	F	-	-	2.77
5409	623516	309464	F	-	-	3.265
5410	623527	309405	F	-	-	-
5501	623552	309525	F	-	-	2.22
5502	623549	309531	F	-	-	-
5504	623556	309529	F	-	-	-
5505	623559	309557	F	-	-	2.25
5506	623562	309581	F	-	-	1.95
5507	623516	309585	F	-	-	-
5511	622586	309593	F	-	-	8.36
5512	622575	309590	F	-	-	3.886
5513	622570	309586	F	-	-	1.855
5514	622580	309555	F	-	-	0.915
5601	623566	309618	F	-	-	2.07
5602	623574	309688	F	-	-	2.28
5603	623572	309691	F	-	-	-
5604	622563	309647	F	-	-	9.13
5604	623537	309624	F	10.459	8.729	1.73
5605	623541	309659	F	-	-	1.905
5607	623543	309694	F	-	-	-
6000	622669	309095	F	4.042	2.39	1.652
6001	622684	309069	F	4.125	2.591	1.534
6002	622658	309054	F	4.3	2.792	1.508
6102	622695	309188	F	-	-	3.4
6103	622699	309193	F	-	-	6.4
6104	622698	309110	F	-	-	1.14
6105	622673	309147	F	-	1.5	-
6106	622660	309127	F	-	1.75	-
6107	622643	309126	F	-	1.95	-
6108	622666	309159	F	-	1.8	-
6109	622667	309183	F	-	2.2	-
6110	622656	309121	F	4	1.966	2.034
6201	622657	309265	F	-	1.411	-
6204	622664	309262	F	-	-	-
6205	622617	309252	F	-	1.643	-
6302	622634	309356	F	-	-	5.82
6404	622614	309454	F	-	-	7
6504	622609	309558	F	-	-	9.45
6616	622676	309698	F	-	-	-
6617	622680	309695	F	-	-	-
6618	622685	309692	F	-	-	-
6619	622689	309689	F	-	-	-
6620	622693	309685	F	-	-	-
6621	622698	309683	F	-	-	-
6623	622671	309696	F	-	-	-
7002	622744	309099	F	-	-	3.66
7005	622751	309098	F	-	-	6.8
7007	622756	309072	F	3.583	0.51	3.073
7008	622752	309070	F	3.603	2.015	1.588
7009	622727	309058	F	4.04	2.202	1.838
7101	622708	309166	F	-	-0.04	-
7104	622720	309122	F	-	-	1.17
7105	622703	309194	F	-	-	2.7
7106	622799	309115	F	-	-	3
7108	622703	309164	F	-	1.1	-
7205	622712	309284	F	-	-	1.845
7206	622782	309285	F	-	-	-
7207	622753	309285	F	-	-	1.635
7404	622758	309477	F	-	-	-
7405	622704	309466	F	-	-	-
7406	622720	309473	F	-	-	-
7501	622718	309599	F	-	-	11.75
7602	622773	309641	F	10.67	8	2.67
8001	622884	309059	F	4.27	0.55	3.72
8102	622874	309170	F	4.32	1.71	2.61
8104	622811	309104	F	-	-	1.3
8204	622881	309211	F	-	-	-
8405	622862	309430	F	-	-	-
8509	622892	309570	F	-	-	-
8604	622816	309660	F	-	-	-
8610	622830	309693	F	9.982	5.902	4.08
8611	622812	309662	F	10.267	7.147	3.12
8615	622824	309616	F	-	-	-
8616	622818	309623	F	-	-	-
9001	622961	309099	F	3.87	1.77	2.1
9002	622979	309048	F	3.46	1.44	2.02
9202	622969	309245	F	-	-	2.6
9206	622966	309292	F	-	-	2.185
9208	622967	309283	F	4.3	2.13	2.17
9209	622986	309290	F	-	-	-
9301	622967	309310	F	4.37	2.25	2.12
9401	622973	309428	F	-	-	2.36
9414	622911	309475	F	-	-	2.845
9423	622945	309444	F	-	-	2.59
9425	622921	309458	F	-	-	2.615
9428	622929	309471	F	-	-	-
9429	622935	309475	F	-	-	-
9504	622992	309546	F	-	-	-
9513	622944	309573	F	-	-	-
9514	622905	309577	F	-	-	-
9607	622998	309664	F	5.447	3.487	1.96
9608	622902	309655	F	-	-	1.6
9609	622922	309660	F	6.1	0.176	5.924
9611	622992	309690	F	5.43	3.205	2.225
9613	622935	309623	F	-	-	-
9614	622948	309627	F	-	-	0.5
9615	622985	309689	F	-	-	0.95
9616	622962	309630	F	-	-	-
0251	623009	309263	S	4.47	3.05	1.42
0252	623039	309294	S	3.64	2.03	1.61
0253	623052	309269	S	-	4.66	-
0351	623078	309356	S	3.97	1.07	2.9
0352	623062	309309	S	3.05	1.74	1.31
0353	623062	309303	S	3.28	1.83	1.45
0354	623061	309356	S	4.01	1.03	2.98
0451	623036	309480	S	4.57	2.02	2.55
0452	623004	309492	S	5.01	2.2	2.81
0453	623005	309417	S	4.49	1.32	3.17
0454	623035	309410	S	3.95	1.21	2.74
0455	623046	309404	S	3.98	1.08	2.9
0456	623057	309404	S	3.96	1.08	2.88
0457	623087	309499	S	3.99	2.46	1.53
0458	623095	309478	S	4.19	2.23	1.96
0459	623097	309459	S	4.23	1.85	2.38
1051	623153	309091	S	2.83	1.69	1.14
1057	623187	309075	S	-	-	-
1153	623168	309191	S	-	-	2.49
1251	623156	309286	S	3.51	-0.55	4.06
1252	623103	309279	S	-	7.21	-
1351	623157	309346	S	3.23	0.79	2.44
1352	623108	309357	S	3.88	1.04	2.84
1353	623133	309357	S	-	-	2.45
1355	623145	309319	S	3.49	-0.26	3.75
1357	623156	309388	S	-	-	-
1451	623118	309451	S	4.09	1.64	2.45
1452	623158	309447	S	-	-	-
1453	623154	309427	S	3.78	1.02	2.76
1459	623168	309427	S	3.8	2.16	1.64
1553	623167	309558	S	-	-	-
1651	623150	309668	S	-	-	5.73
2351	623263	309338	S	-	-	1.93
2352	623207	309309	S	8.37	7.18	1.19
2354	623272	309315	S	3.09	1.29	1.8
2355	623250	309387	S	3.65	2.32	1.33
2361	623258	309307	S	2.918	1.168	1.75
2362	623250	309334	S	-	-	1.93
2363	623265	309326	S	-	4.11	-
2452	623274	309428	S	-	-	-
2552	623282	309589	S	-	-	2.2
3050	623390	309076	S	-	-	-
3051	623378	309064	S	-	-	-
3052	623364	309051	S	-	-	-
3351	623326	309343	S	3.29	1.24	2.05
3352	623321	309343	S	3.38	1.56	1.82
3353	623370	309348	S	2.54	0.65	1.89
3357	623382	309316	S	2.801	0.251	2.55
3358	623368	309351	S	-	-	-
3359	623365	309359	S	-	-	-
3360	623338	309352	S	-	-	-
3361	623346	309384	S	-	-	1.93
3457	623366	309424	S	-	-	3.04
3458	623386	309493	S	-	-	-
3551	623387	309506	S	-	-	2.1

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert
3552	623330	309532	S	-	-	1.8
3553	623305	309554	S	-	-	1.9
3554	623392	309521	S	-	-	-
3555	623324	309590	S	-	-	-
3651	623303	309624	S	-	-	2.1
3652	623332	309659	S	-	-	2.1
3653	623359	309654	S	-	-	-
4051	623435	309080	S	3.97	1.56	2.41
4157	623423	309190	S	-	-	2.77
4453	623468	309472	S	-	-	2.7
4551	623409	309568	S	-	-	-
4552	623449	309558	S	-	-	-
4651	623413	309644	S	-	-	-
4652	623468	309633	S	-	-	-
5350	623570	309310	S	2.1	0.51	1.59
5351	623576	309313	S	-	-	-
5451	623550	309413	S	2.86	0.28	2.58
5454	623549	309447	S	-	-	2.16
5455	623551	309469	S	-	-	2.415
5456	623531	309408	S	-	-	-
5551	623554	309532	S	-	-	1.92
5552	623556	309557	S	-	-	1.95
5553	623559	309581	S	-	-	1.67
5555	622569	309584	S	-	-	-
5556	622558	309579	S	-	-	1.168
5651	623563	309617	S	-	-	1.76
5652	623572	309688	S	-	-	1.98
5653	623575	309691	S	-	-	-
5654	623536	309621	S	10.441	9.016	1.425
5655	623545	309696	S	-	-	-
6054	622694	309051	S	4.022	1.333	2.689
6055	622667	309095	S	4.04	1.834	2.206
6056	622642	309083	S	4.319	2.634	1.685
6151	622671	309148	S	-	1.8	-
6152	622659	309129	S	-	2.05	-
6153	622643	309128	S	-	2.2	-
6154	622664	309160	S	-	2.1	-
6155	622665	309185	S	-	2.5	-
6156	622698	309187	S	-	-	1.2
6251	622666	309241	S	-	-	1.83
6252	622660	309259	S	-	1.548	-
6253	622657	309260	S	-	1.829	-
6254	622611	309258	S	-	2.999	-
6551	622622	309568	S	9.29	2.49	6.8
6552	622688	309590	S	10.73	7.65	3.08
6652	622644	309634	S	-	-	1.27
7052	622725	309056	S	4.102	1.861	2.241
7053	622749	309067	S	3.721	2.26	1.461
7152	622710	309169	S	-	1.3	-
7153	622703	309166	S	-	1.4	-
7154	622737	309117	S	-	-	2.9
7155	622748	309094	S	-	-	-
7156	622771	309107	S	-	-	-
7157	622798	309118	S	-	-	-
7251	622714	309285	S	-	-	1.575
7252	622788	309259	S	-	-	-
7253	622707	309257	S	-	1.734	-
7254	622745	309258	S	-	1.893	-
7351	622780	309326	S	-	-	1.83
7352	622745	309333	S	-	-	1.6
7354	622797	309321	S	-	-	1.3
7451	622760	309476	S	-	-	1.15
7652	622779	309637	S	-	-	3.81
7653	622788	309632	S	-	-	7.77
8151	622873	309169	S	4.32	1.96	2.36
8152	622802	309153	S	-	-	-
8153	622861	309166	S	-	-	-
8253	622833	309254	S	-	2.548	-
8254	622879	309213	S	-	-	-
8255	622882	309233	S	-	-	-
8452	622807	309490	S	-	-	1.38
8557	622860	309511	S	-	-	-
8653	622810	309662	S	10.267	7.447	2.82
8654	622829	309696	S	9.982	6.202	3.78
9252	622971	309247	S	-	-	2.25
9253	622970	309284	S	-	-	3.99
9254	622973	309261	S	-	-	-
9255	622973	309295	S	-	-	-
9256	622982	309292	S	-	-	-
9351	622973	309312	S	-	-	-
9459	622975	309422	S	-	-	3
9460	622930	309452	S	-	-	3.15
9462	622912	309477	S	-	-	3.48
9465	622991	309411	S	-	-	-

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert