



Flood Risk Assessment and Drainage Strategy

Prepared for
Owl Homes

Proposed Residential Development of
Higham on the Hill

Travis Baker Ltd
Trinity Point
New Road
Halesowen
West Midlands
B63 3HY

Tel: 0121 550 8037
Fax: 0121 550 8047

info@travisbaker.co.uk
www.travisbaker.co.uk

Document Control

Project Title: Proposed Development at
Higham on the Hill

Document Type: Flood Risk Assessment and Drainage Strategy

Project Number: 23031

Revision	Date	Comments	Prepared by	Checked by
-	5 May 2023	DRAFT FOR COMMENT	James Cross	Rob Travis
A	8 June 2023	UPDATED SITE APPRAISAL AND CALCULATIONS AMENDED TO SUIT	James Cross	Rob Travis

This document has been prepared by Travis Baker Limited for the exclusive use by the commissioning party in accordance with the terms and conditions of the contract between Travis Baker Limited and the commissioning party. No other party may use, make use or rely on the contents of this report without the prior written consent of Travis Baker Limited. No liability is accepted by Travis Baker Limited for any use of this report other than for the purpose for which it was originally prepared. This document may contain and rely on information provided by Third Parties; no verification of such information has been undertaken and Travis Baker Limited accept no responsibility for any inaccuracies within such information. No part of this report may be copied or reproduced by any means without written permission from Travis Baker Limited.

The consultant's liability to the client arising out of or in connection with this document whether under the law of contract in tort (including negligence), in equity, or under statute or otherwise shall be limited to the fee paid for the preparation of this document. The consultant shall not be liable to the client in respect of any consequential or indirect loss or damage. The consultant shall be deemed to have been discharged from all liability in respect of this document whether under contract, in tort (including negligence), under statute or otherwise, on the expiration of 1 year from the completion of this document.

Contents

1.0 INTRODUCTION

- 1.1 Background**
- 1.2 Site Location and Surroundings**
- 1.3 Development Proposals**

2.0 EXISTING SITE CONDITIONS

- 2.1 Existing Topography and Drainage**
- 2.2 Existing Flood Risk**
- 2.3 Existing Drainage**

3.0 PROPOSED SITE LEVELS, FLOOD MITIGATION AND DRAINAGE SYSTEMS

- 3.1 Proposed Site Levels**
- 3.2 Proposed Flood Mitigation**
- 3.3 Sustainable Surface Water Drainage**
- 3.4 Foul Water Drainage**
- 3.5 Ongoing Maintenance**

4.0 CONCLUSIONS

- 4.1 Flood Risk, Flood Consequences and Sustainable Design**

5.0 APPENDICES



1.0 INTRODUCTION

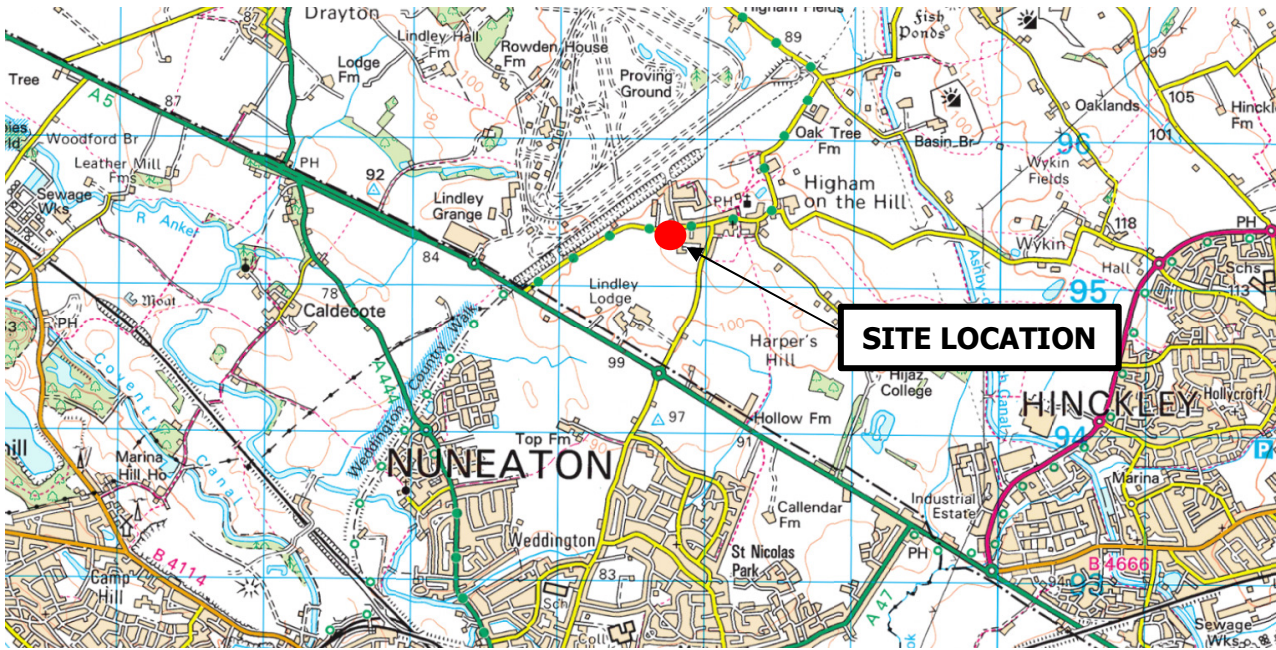
1.1 Background

- 1.1.1 This Flood Risk Assessment and Drainage Strategy report has been prepared by Travis Baker Ltd on behalf of Owl Homes.
- 1.1.2 This Flood Risk Assessment has been prepared under the guidance of the National Planning Policy Framework (NPPF) and associated technical guidance. The site is located within flood zone 1. The report will focus on these flood zone areas and other possible flood risks to or from the development as well as the sustainable disposal of surface water.
- 1.1.3 The potential effects of climate change on future rainfall intensity will also be taken into account.

1.2 Site Location and Surroundings

- 1.2.1 The site is located in Higham on the Hill, Leicestershire, approximately 2.5 miles north of Nuneaton. The centre of the site is at approximate grid reference 437774, 295331, and the post code is CV13 6AG. The site covers an area of approximately 2.6 hectares.
- 1.2.2 The site is greenfield land. To the north and east is residential housing and to the south and west is greenfield land. Wood Lane runs directly across northern boundary to the site.

1.2.3 The site location is shown below:



1.3 Development Proposals

1.3.1 The proposals are for a residential development by Owl Homes for 61 residential dwellings. The site access, along with pedestrian access into the site, will be from Wood Lane.



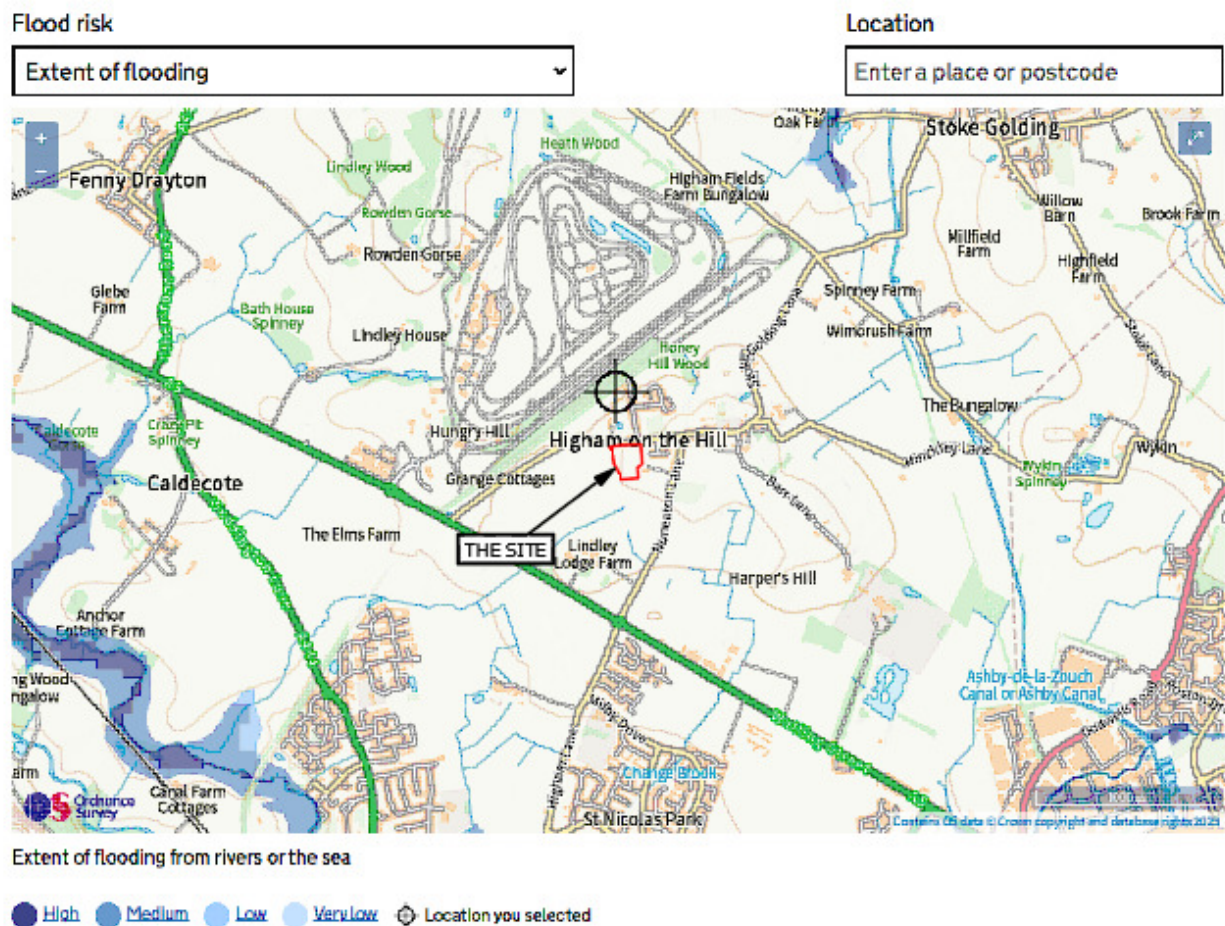
2.0 EXISTING SITE CONDITIONS

2.1 Existing Topography and Drainage

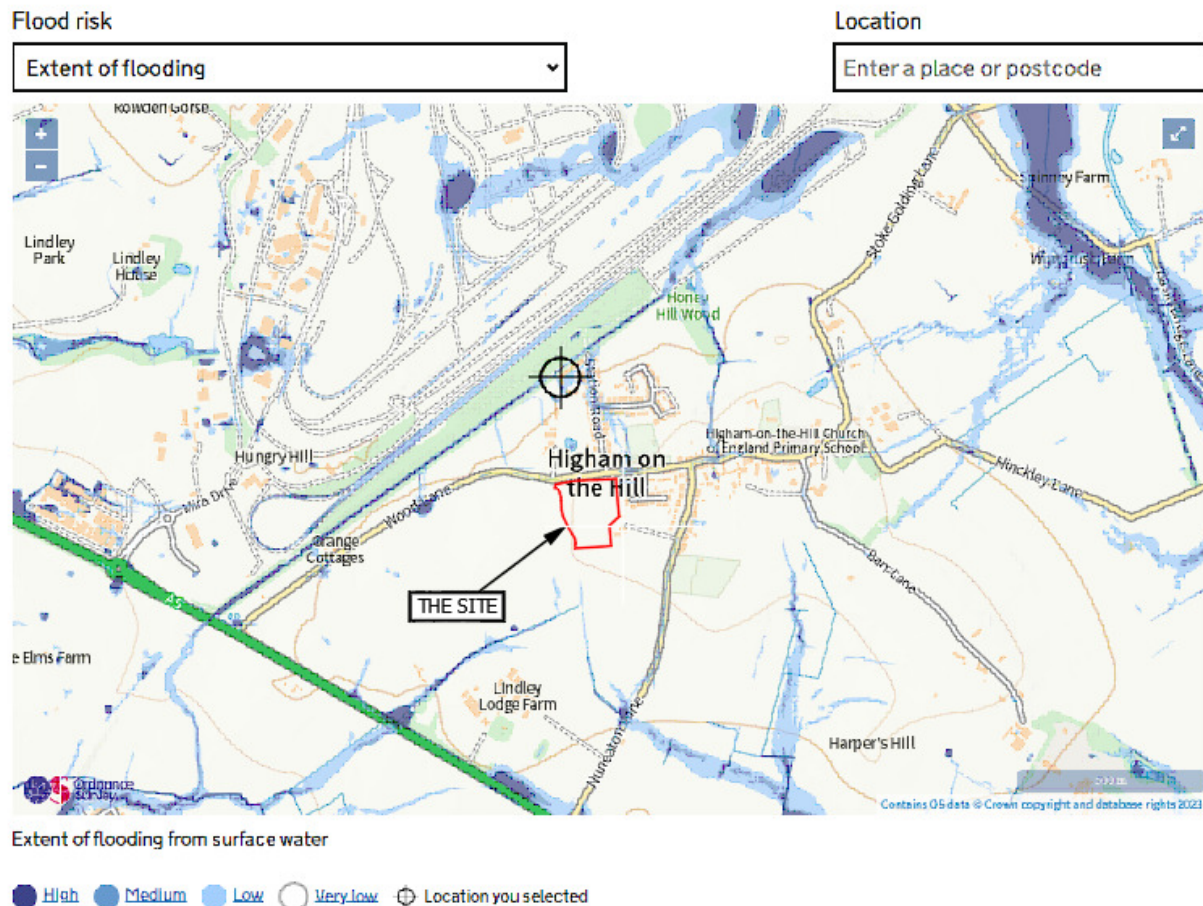
- 2.1.1 The site has a gradual fall from east to north west with the levels ranging from approximately 113.57m AOD down to 107.17m. A copy of the topographical survey can be found in the appendices.
- 2.1.2 There is an existing ditch course approximately 175m south of the south western corner of the site which can be seen on the topographical survey.
- 2.1.3 There is an existing public combined water sewer located to the north east of the site within the junction of Station Road, Wood Lane and Main Street.

2.2 Existing Flood Risk

- 2.2.1 The flood mapping available from the Government website (below) shows that there is no risk of fluvial flooding within the site. The nearest significant flood extent is associated with the river Anker approximately 2.5km to the south west of the proposed development.



- 2.2.2 The risk of flooding from surface water mapping, available from the Government website (below), shows that there is very low risk of flooding within the site.



- 2.2.3 The mapping provided by the Government is based upon aerial LIDAR survey, and places surface water in areas where there are low points in the topography. It is accepted that the mapping is generally coarse in nature.

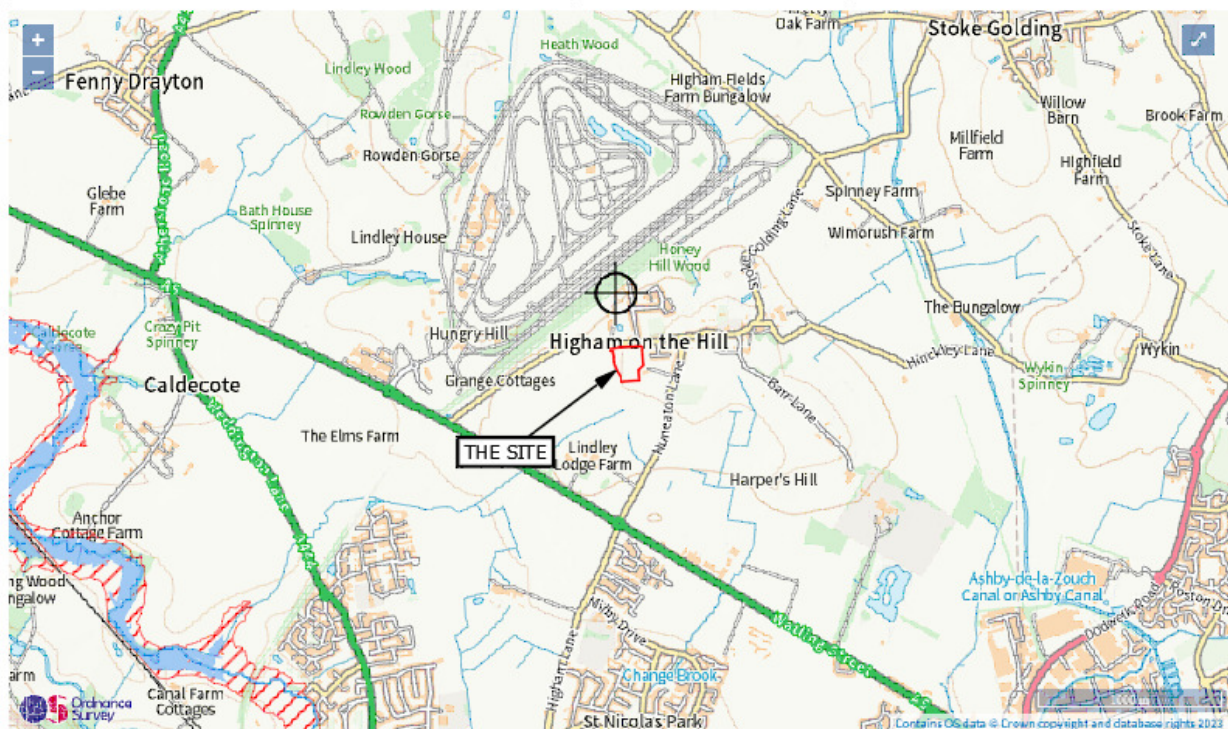
- 2.2.4 The reservoir flood map from the Government website (below), shows that there is no risk of reservoir flooding within the site. The nearest significant reservoir flooding is associated with the river Anker approximately 2.5km to the south west of the proposed development.
- 2.2.5 The Reservoirs Act 1975 ensures that reservoirs are regularly managed, maintained, and inspected which makes reservoir breaches rare.

Flood risk

Extent of flooding

Location

Enter a place or postcode



Maximum extent of flooding from reservoirs:

● when river levels are normal
 ● when there is also flooding from rivers
 ● Location you selected



2.3 Existing Drainage

- 2.3.1 There is an existing ditch course approximately 175m south of the south western corner of the site which can be seen on the topographical survey.
- 2.3.2 There is an existing public combined water sewer located to the north east of the site within the junction of Station Road, Wood Lane and Main Street.
- 2.3.3 Two manhole covers are shown on eastern side of the topographical survey. Further investigation works are required to confirm if there are any existing connections into these manholes which may result in diversion works.

PROPOSED SITE LEVELS, FLOOD MITIGATION AND DRAINAGE SYSTEMS

2.4 Proposed Site Levels

- 2.4.1 It is proposed that upon redevelopment the existing site levels will be followed as far as reasonably practical.

2.5 Proposed Flood Mitigation

- 2.5.1 As noted previously, the Government maps for reservoir flooding do not show any risk of flooding. There is also no risk shown of fluvial flooding within the site and very low risk of surface water flooding.
- 2.5.2 The minimum existing level is at approximately 107.17m AOD.

2.6 Sustainable Surface Water Drainage

- 2.6.1 As with any new development, and in accordance with requirements of the Building Regulations and other national guidance, the first method which should be considered for the disposal of surface water is by infiltration into the ground.
- 2.6.2 A Geo-Environmental Assessment is required to be carried out to confirm the ground conditions and whether the use of soakaways is viable. At this stage, as a Geo-Environmental Assessment hasn't been carried out, we are assuming that soakaways are not viable and an alternative surface water disposal solution is required.
- 2.6.3 The surface water for the site will be proposed to discharge at 9.4l/s into the existing ditch course south west of the site subject to Lead Local Flood Authority approval and third-party land agreement.
- 2.6.4 The site is proposed to be discharging to a proposed attenuation pond which will be sized to cater for the 100 year + 40% Climate Change Storm Event. Flows will then be restricted using a flow control device. The restricted flows will then outfall to the existing ditch course 175m south east of the site.
- 2.6.5 In order to assess the performance of the sustainable drainage features a Simple Index Assessment (CIRIA SuDS Manual) has been undertaken using the HR Wallingford tool. Three separate assessments have been undertaken covering Rooves, Parking and Roads. The results in the appendices show that the proposed SuDS features provide sufficient surface water quality management.
- 2.6.6 A section 104 application will be submitted to Severn Trent Water for the adoption of the on-site surface water drainage.
- 2.6.7 A land drainage consent application will be submitted for the consent to outfall to the existing ditch course.

2.7 Foul Water Drainage

- 2.7.1 The foul drainage for the site is proposed to be drained by gravity to an existing 225dia. public combined water sewer at the north east of the site within the junction of Station Road, Wood Land and Main Street.
- 2.7.2 A section 106 application will be required for the connection into the existing public combined water sewer.
- 2.7.3 A section 104 application will be submitted to Severn Trent Water for the adoption of the on-site foul water drainage.

2.8 Ongoing Maintenance

- 2.8.1 It is proposed that the surface water drainage systems within the development will be adopted by Severn Trent Water who will carry out the maintenance of the surface water drainage system.
- 2.8.2 It is proposed that the foul water drainage systems within the development will be adopted by Severn Trent Water who will carry out the maintenance of the foul water drainage system.
- 2.8.3 This ongoing maintenance will ensure that the drainage systems will operate as originally intended throughout the life of the development.
- 2.8.4 The proposed attenuation pond will be managed by a private management company.

3.0 CONCLUSIONS

3.1 Flood Risk, Flood Consequences and Sustainable Design

- 3.1.1 There is no risk of flooding to the development from nearby fluvial sources.
- 3.1.2 There is a very low risk of flooding from surface water within the site.
- 3.1.3 There is no risk of reservoir breach flooding from any nearby reservoirs.
- 3.1.4 The surface water drainage systems are proposed to be designed in accordance with nationally agreed standards, and will provide protection from surface flooding under the critical 100-year rainfall event, including the recognised allowance for the effects of climate change.
- 3.1.5 The main drainage systems are proposed to be offered for adoption and to be maintained by Severn Trent Water. This will ensure long term maintenance throughout the life of the development.

4.0 APPENDICES

Appendix 1 – Site Appraisal – Drawing Number 1 Rev I

Appendix 2 – Sewer Records supplied by Severn Trent Water

Appendix 3 – Topographical Survey – Drawing number 47368CVLS-01-03-REV-B produced by Survey Solutions

Appendix 4.1 – Water Quality Assessment – Parking

Appendix 4.2 – Water Quality Assessment – Roads

Appendix 4.3 – Water Quality Assessment – Rooves

Appendix 5.1 – FLOW Drainage Calculations – 2yr Storm Event

Appendix 5.2 – FLOW Drainage Calculations – 30yr Storm Event

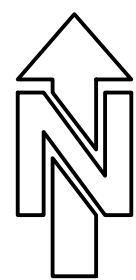
Appendix 5.3 – FLOW Drainage Calculations – 100yr Storm Event

Appendix 5.4 – FLOW Drainage Calculations – 100yr+40% Climate Change Storm Event



Appendix 1

Site Appraisal Drawing Number 1 Rev I



PROPOSED ATTENUATION BASIN
SIZED FOR THE 100YR + 40%CC
STORM EVENT.
TOP OF POND LEVEL = 108.40
POND BED LEVEL = 106.40
PERMANENT WATER LEVEL = 106.90
TOP WATER LEVEL = 108.10
POND VOLUME = 930m³

ADDITIONAL TOPOGRAPHICAL
SURVEY REQUIRED ALONG
WESTERN BOUNDARY TO
CONFIRM TIE IN LEVELS FROM
THE TOP OF POND TO EXISTING
GROUND LEVELS

PROPOSED HYDROBRAKE FLOW
CONTROL MANHOLE. FLOW RATE
RESTRICTED TO 1 IN 1 YEAR
QBAR RATE OF 9.4l/s BASED ON
A SITE AREA OF 2.58 HECTARES.

MANHOLE DEPTH
CIRCA 4-5M DEEP

MANHOLE DEPTH
CIRCA 4.5-5.5M DEEP

4m WIDE GATED
ACCESS

MANHOLE DEPTH
CIRCA 4-5M DEEP

10M WORKING
SPACE STRIP

5M DRAINAGE
EASEMENT

10M WORKING
SPACE STRIP

10M WORKING
SPACE STRIP

STORM DRAINAGE TO
OUTFALL TO EXISTING
DITCH COURSE
SUBJECT TO LLFA
APPROVAL

EXISTING MANHOLE INVERT
LEVEL TAKEN FROM STW SEWER
RECORDS. EXACT LINE AND
LEVEL TO BE CONFIRMED BY
CLIENT.

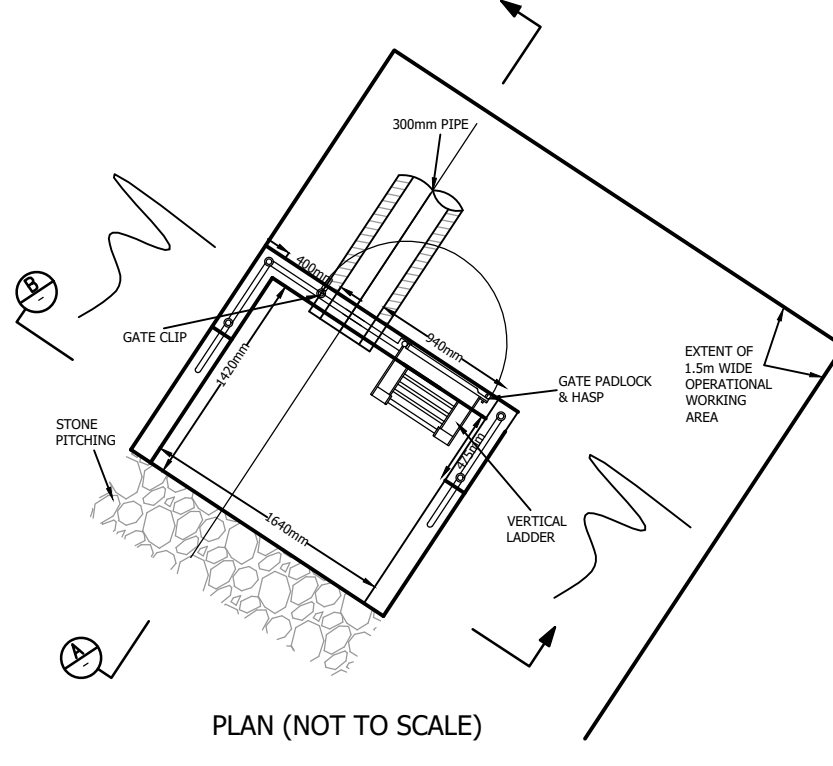
PROPOSED FOUL WATER
SEWER TO OUTFALL TO
EXISTING COMBINED WATER
SEWER SUBJECT TO SECTION
106 APPROVAL

1. DO NOT SCALE FROM THIS DRAWING. IF IN DOUBT CONTACT TRAVIS BAKER LIMITED.
2. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.
3. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS RELATING TO THIS PROJECT.
4. ALL DIMENSIONS SHOWN ON THIS DRAWING ARE FULLY COMPATIBLE WITH ANY AS DISCREPANCIES SHOULD BE IMMEDIATELY NOTIFIED IN WRITING TO TRAVIS BAKER LIMITED.
5. THE CONTRACTOR SHALL PRIOR TO CONSTRUCTION CHECK AND VERIFY THAT THE DETAILS SHOWN ON THIS DRAWING ARE FULLY COMPATIBLE WITH ANY AS CONSTRUCTED DIMENSIONS OR LEVELS. ANY DISCREPANCIES TO BE REPORTED IMMEDIATELY IN WRITING TO TRAVIS BAKER LIMITED.
6. THIS DRAWING HAS BEEN PREPARED FOR THE EXCLUSIVE USE OF THE COMMISSIONING PARTY AND UNLESS AGREED IN WRITING BY TRAVIS BAKER LIMITED NO OTHER PARTY MAY USE OR RELY ON ITS CONTENTS. NO LIABILITY IS ACCEPTED BY TRAVIS BAKER LIMITED FOR ANY USE OF THIS DRAWING OTHER THAN FOR THE PURPOSE FOR WHICH IT WAS ORIGINALLY PREPARED.
7. IT SHOULD BE NOTED THAT THIS DRAWING MAY INCLUDE DATA PROVIDED BY THIRD PARTIES. NO LIABILITY IS ACCEPTED BY TRAVIS BAKER LIMITED AS TO THE ACCURACY OF THIS DATA.
8. THIS DRAWING SHALL NOT BE REPRODUCED IN ANY WAY WITHOUT THE WRITTEN PERMISSION OF TRAVIS BAKER LIMITED.

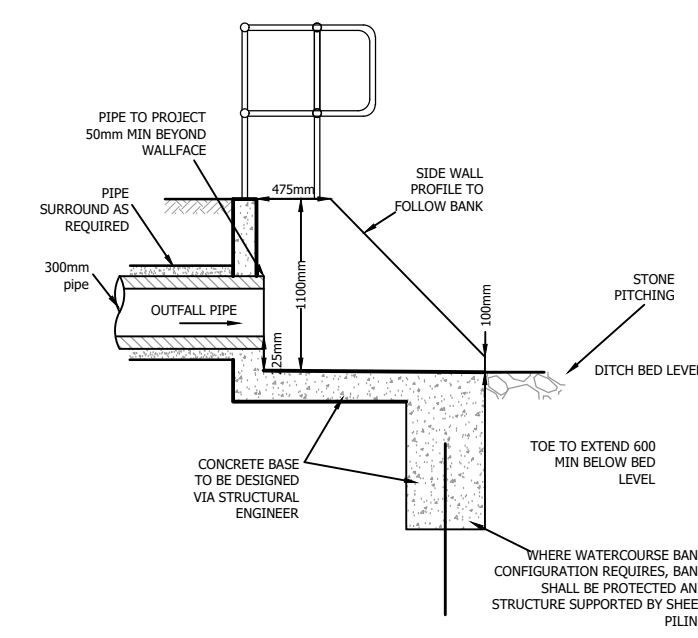
**ALL INFORMATION SHOWN IS
INDICATIVE ONLY SUBJECT
TO DETAILED DESIGN**

KEY

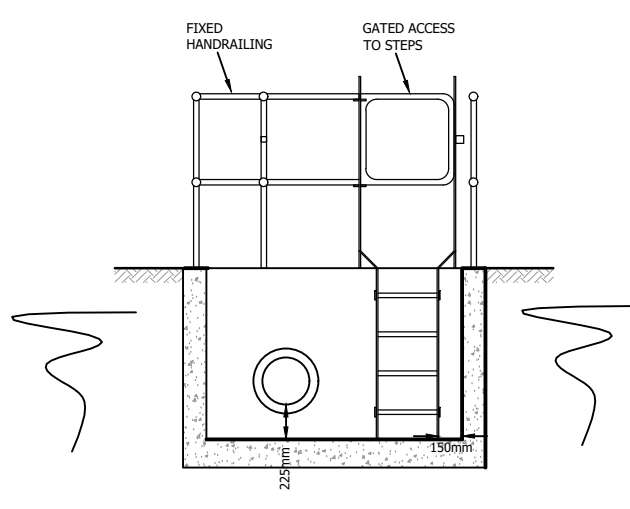
- EX - CWS EXISTING PUBLIC COMBINED WATER SEWER
- EXISTING GROUND LEVEL
- PROPOSED STORM WATER SEWER
- PROPOSED FOUL WATER SEWER
- PROPOSED FINISHED FLOOR LEVEL
- PROPOSED RETAINING FEATURE
- PROPOSED LEVEL
- PROPOSED GRADIENT
- BANKING
- PROPOSED SEWER EASEMENT
- PROPOSED HEADWALL
- EXISTING DITCH COURSE
- SITE BOUNDARY
- 10M WORKING SPACE STRIP



PLAN (NOT TO SCALE)



SECTION - A



SECTION - B

I	S14A MANHOLE RELOCATED AND EASEMENT AMENDED TO SUIT.	05.06.23	JC	RWT
H	S14A MANHOLE RELOCATED AND EASEMENT AMENDED TO SUIT.	01.06.23	JC	RWT
G	S13, S14A AND OUTFALL HEADWALL RE-POSITIONED, 10M WORKING SPACE AND DRAINAGE EASEMENT UPDATED TO SUIT.	25.05.23	JC	RWT
F	STORM OUTFALL ROUTE AND EASEMENT ADDED TO SUIT CLIENT COMMENTS. ADDITIONAL NOTE ADDED.	17.05.23	JC	RWT
E	HEDGE HATCH ADDED.	09.05.23	RP	JC
D	'X' ADDED AT PROPOSED GATE ACCESS	05.05.23	JC	RWT
C	SEWER EASEMENT ADDED TO SUIT ROADS BEING PROPOSED AS PRIVATE.	05.05.23	JC	RWT
B	REVISED SITE LAYOUT REV C INCORPORATED AND SITE APPRAISAL UPDATED TO SUIT. 4M GATE POSITION ADDED AND ADDITIONAL WORKING SPACE STRIP PROVIDED AS REQUESTED BY CLIENT.	04.05.23	JC	RWT
A	STORM OUTFALL ROUTE UPDATED TO SUIT POSITION TAKEN FROM ALLSOP & AVERY AND 10M WORKING SPACE STRIP ADDED AT CLIENT REQUEST.	28.04.23	RP	JC

REV	DESCRIPTION	DATE	BY	AUTH
-----	-------------	------	----	------

Travis Baker
Trinity Point,
New Road
Halesowen
West Midlands
B63 3HT

Tel: **0121 550 8037**
Fax: **0121 550 8047**
info@travisbaker.co.uk
www.travisbaker.co.uk

CLIENT
OWL HOMES

PROJECT
**HIGHAM ON THE HILL,
LEICESTERSHIRE**

TITLE
SITE APPRAISAL

DRAWN	AUTHORISED	SCALE	DATE
RP	JC	1:500@A1	05.04.23

PROJECT NO.	DRAWING NO.	REV
23031	1	I

STATUS.
INDICATIVE

COPYRIGHT TRAVIS BAKER LIMITED. ALL RIGHTS RESERVED.



Appendix 2

Sewer Records supplied by Severn Trent Water



TOPOGRAPHICAL & MEASURED BUILDING SURVEYS

[illegible]

DRAWING NOTES

Trees are drawn to scale showing the average canopy spread. Descriptions and heights should be used as a guide only.

All building names, descriptions, number of storeys, construction type including roof line details are indicative only and taken externally from ground level.

All below ground details including drainage, voids and services have been identified from above ground and therefore all details relating to these features including; sizes, depth, description etc will be approximate only. All critical dimensions and connections should be checked and verified prior to starting work.

Detail, services and features may not have been surveyed if obstructed or not reasonably visible at the time of the survey.

Surveyed physical features may not necessarily represent the legal boundary line.

Measured Building Surveys

Measurements to internal walls are taken to the wall finishes at approx 1m above the floor level and the wall assumed to be vertical.

Cill heights are measured as floor to the cill and head heights are measured from cill to the top of window.

General

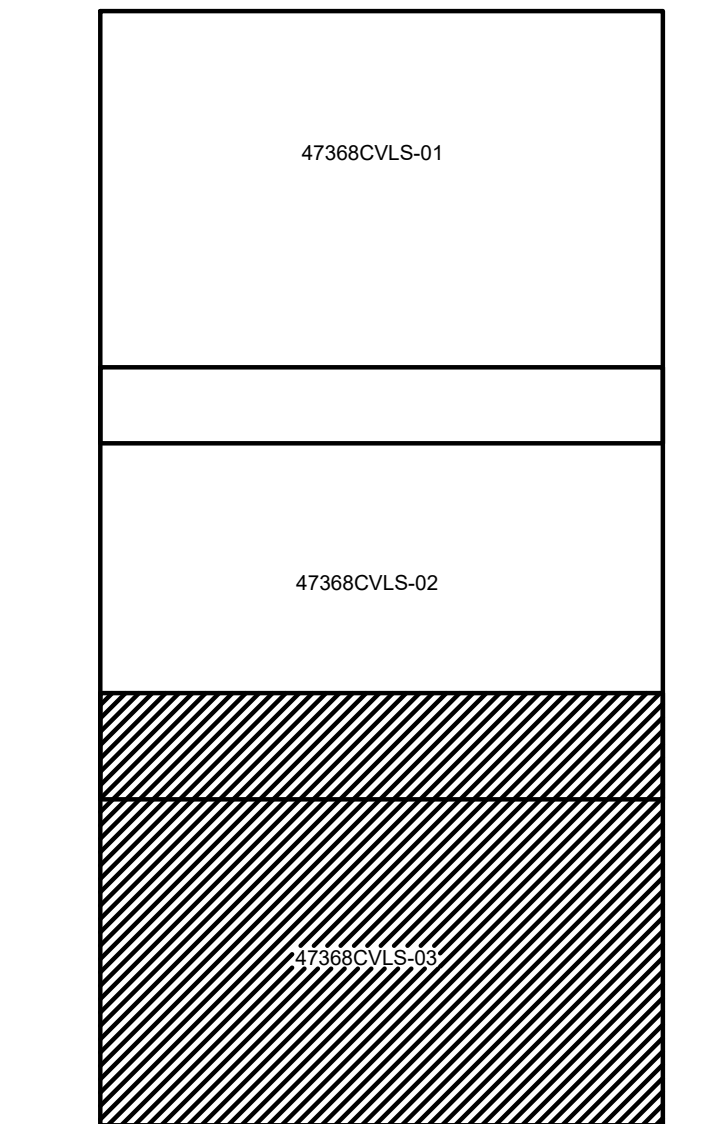
The contractor must check and verify all site and building dimensions, levels, utilities and drainage details and connections prior to commencing work. Any error or discrepancy must be notified to Super Solutions immediately.

The accuracy of the digital data is the same as the plotting scale implies. All dimensions are in metres unless otherwise stated.

The survey control listed is only to be used for topographical surveys at the stated scale. All control must be checked and verified prior to use.

© Land Survey Solutions Limited holds the copyright to all the information contained within this document and their written consent must be obtained before copying or using the data other than for the purpose it was originally supplied.

Do not scale from this drawing.



SURVEY CONTROL CO-ORDINATES				
STATIONS	EASTINGS	NORTHINGS	LEVEL	DESCRIPTION
S101	437833.668	295416.910	110.318	PK Nail
S102	437766.149	295410.028	111.050	PEG & Nail
S201	437752.886	295330.774	111.910	PEG & Nail
S103	437833.592	295364.237	112.748	PEG & Nail
ST02	437805.595	295301.802	113.068	PEG & Nail
S203	437814.252	295210.426	112.231	PEG & Nail
ST04	437807.320	295127.513	110.702	PEG & Nail

SURVEY GRID AND LEVEL DATUM

The coordinate system established for this survey is related to Ordnance Survey (OS) national grid at a single point using Smartnet, then orientated to grid north with a scale factor of 1.000.

The level datum established for this survey is related to Ordnance Survey (OS) using GPS Smartnet

To avoid discrepancies any coordinated data used in conjunction with this survey must be derived directly from this control data.

REV	DESCRIPTION	DRAWN	APPD	DATE
-----	-------------	-------	------	------

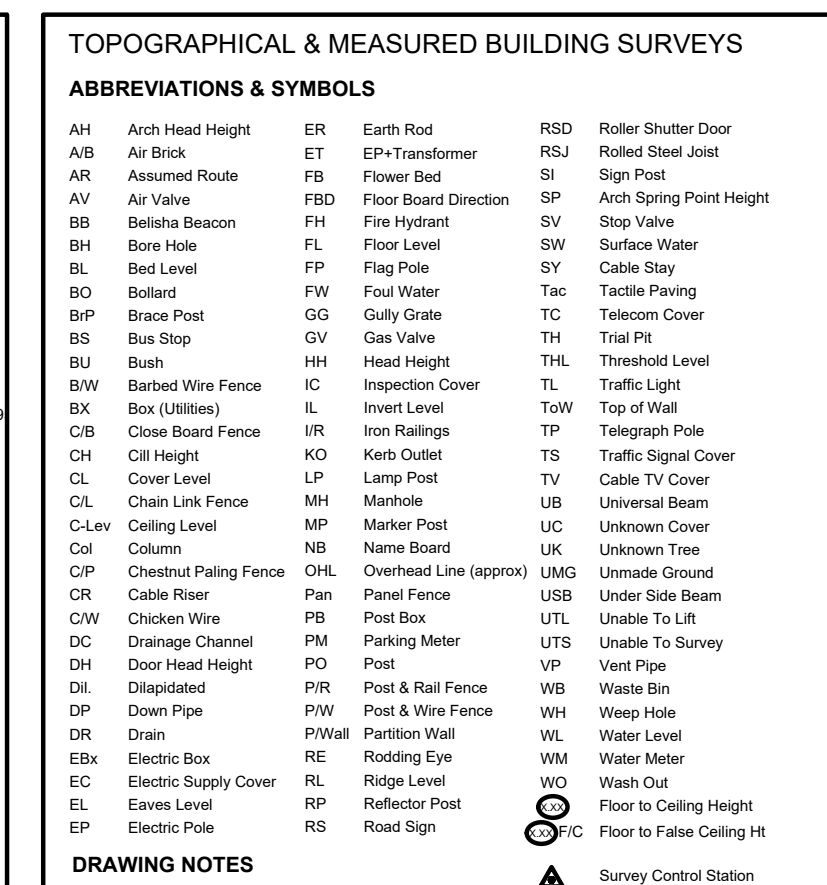


PROJECT TITLE
MAIN STREET,
HIGHAM ON THE HILL, CV10 0TX

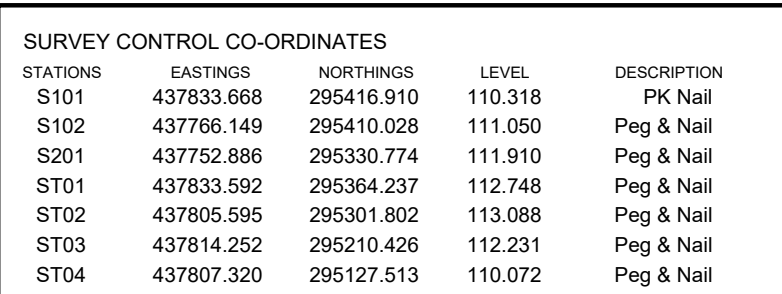
DRAWING DETAIL
TOPOGRAPHICAL SURVEY

Sheet 3 of 3				
CLIENT OWL HOMES				SCALE 1:200
SURVEYOR JK	SURVEY DATE 24/01/23	CHECKED BY BWM	APPROVED BY RAG	DWG STATUS FINAL
DRAWING NUMBER 47368CVLS-03			REVISION	ISSUE DATE 25/01/23





Do not scale from this drawing.



B	Adding additional levels to cleared hedge	AJC	MM	22/02/23
REV	DESCRIPTION	GRAMM	AMOUNT	DATE

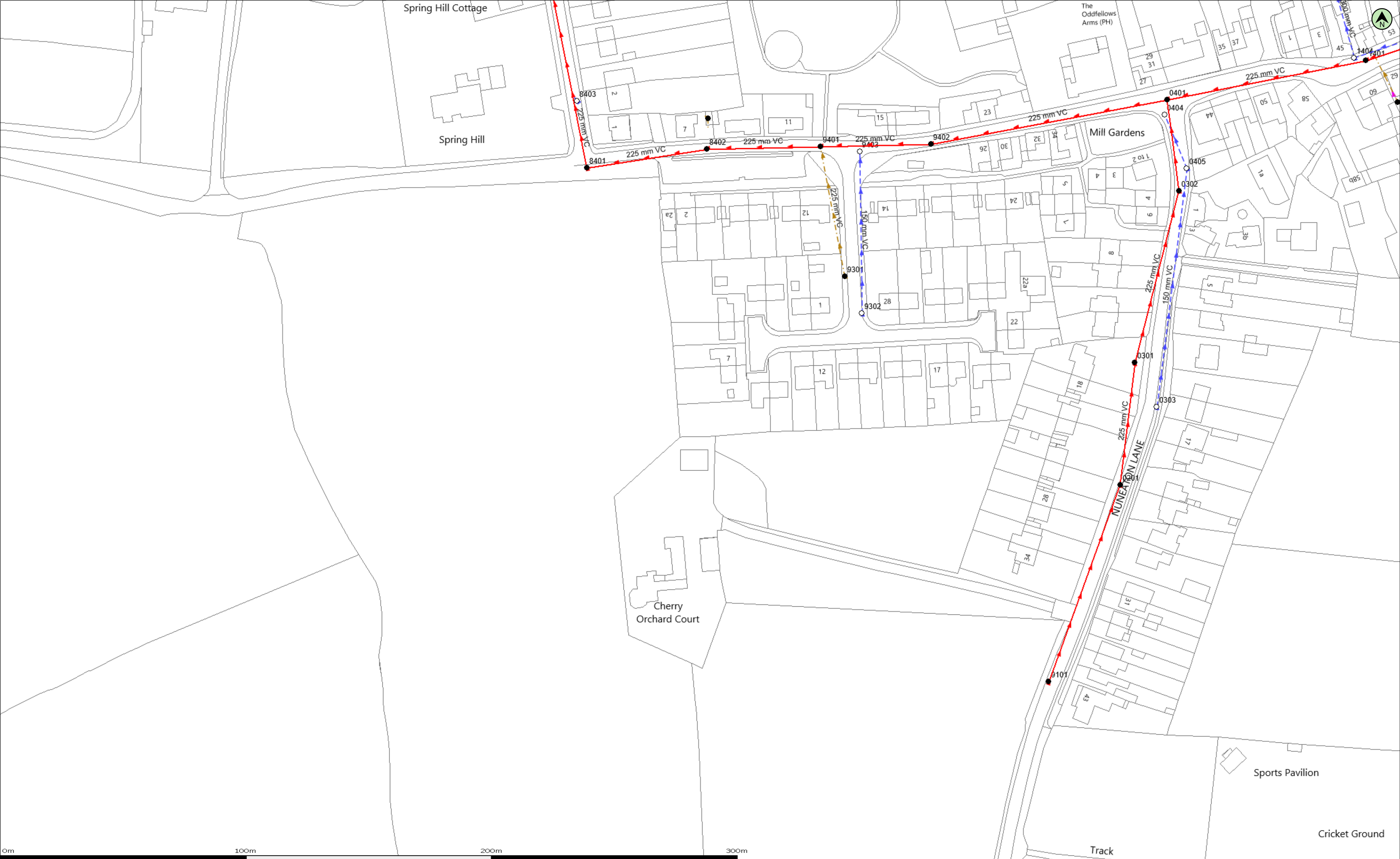
PROJECT TITLE					
MAIN STREET, HIGHAM ON THE HILL, CV10 0TX					
DRAWING DETAIL					
TOPOGRAPHICAL SURVEY					
Sheet 3 of 3					
CLIENT				SCALE	
OWL HOMES				1:200	
SURVEYOR	SURVEY DATE	CHECKED BY	APPROVED BY	DWG STATUS	
JK	24/01/23	BWM	RAG	FINAL	
DRAWING NUMBER			REVISION	ISSUE DATE	
47368CVLS-03			B	25/01/23	



Appendix 3

Topographical Survey produced by Survey Solutions

Drawing Number 47368CVLS-01-03-REV-B



Do not scale off this Map. This plan and any information supplied with it is furnished as a general guide, is only valid at the date of issue and no warranty as to its correctness is given or implied. In particular this plan and any information shown on it must not be relied upon in the event of any development or works (including but not limited to excavations) in the vicinity of SEVERN TRENT WATER assets or for the purposes of determining the suitability of a point of connection to the sewerage or distribution systems. On 1 October 2011 most private sewers and private lateral drains in Severn Trent Water's sewerage area, which were connected to a public sewer as at 1 July 2011, Transferred to the ownership of Severn Trent Water and became public sewers and public lateral drains. A further transfer takes place on 1 October 2012. Private pumping stations, which form part of these sewers or lateral drains, will transfer to ownership of Severn Trent Water on or before 1 October 2016. Severn Trent Water does not assess complete records of these assets. These assets may not be displayed on the map. Reproduction by permission of Ordnance Survey on behalf of HMSO. © Crown Copyright and database right 2004. All rights reserved. Ordnance Survey licence number: 100031673. Document users other than SEVERN TRENT WATER business users are advised that this document is provided for reference purpose only and is subject to copyright, therefore, no further copies should be made from it.

Public Foul Gravity/Lateral Drain		Highway Drain		Manhole Foul	
Public Combined Gravity/Lateral Drain		Overflow Pipe		Manhole Surface	
Public Surface Water Gravity/Lateral Drain		Disposal Pipe		Abandoned Pipe	
Pressure Foul		Culverted Water Course		Section 104 sewers are shown in green	
Pressure Combined		Pumping Station		Private sewers are shown in magenta	
Pressure Surface Water		Fitting			

sam@utilityconsult.co.uk

C1200





GENERAL CONDITIONS AND PRECAUTIONS TO BE TAKEN WHEN CARRYING OUT WORK ADJACENT TO SEVERN TRENT WATER'S APPARATUS

Please ensure that a copy of these conditions is passed to your representative and/or your contractor on site. If any damage is caused to Severn Trent Water Limited (STW) apparatus (defined below), the person, contractor or subcontractor responsible must inform STW immediately on:
0800 783 4444 (24 hours)

- a) These general conditions and precautions apply to the public sewerage, water distribution and cables in ducts including (but not limited to) sewers which are the subject of an Agreement under Section 104 of the Water Industry Act 1991(a legal agreement between a developer and STW, where a developer agrees to build sewers to an agreed standard, which STW will then adopt); mains installed in accordance with an agreement for the self-construction of water mains entered into with STW and the assets described at condition b) of these general conditions and precautions. Such apparatus is referred to as "STW Apparatus" in these general conditions and precautions.
- b) Please be aware that due to The Private Sewers Transfer Regulations June 2011, the number of public sewers has increased, but many of these are not shown on the public sewer record. However, some idea of their positions may be obtained from the position of inspection covers and their existence must be anticipated.
- c) On request, STW will issue a copy of the plan showing the approximate locations of STW Apparatus although in certain instances a charge will be made. The position of private drains, private sewers and water service pipes to properties are not normally shown but their presence must be anticipated. This plan and the information supplied with it is furnished as a general guide only and STW does not guarantee its accuracy.
- d) STW does not update these plans on a regular basis. Therefore the position and depth of STW Apparatus may change and this plan is issued subject to any such change. Before any works are carried out, you should confirm whether any changes to the plan have been made since it was issued.
- e) The plan must not be relied upon in the event of excavations or other works in the vicinity of STW Apparatus. It is your responsibility to ascertain the precise location of any STW Apparatus prior to undertaking any development or other works (including but not limited to excavations).
- f) No person or company shall be relieved from liability for loss and/or damage caused to STW Apparatus by reason of the actual position and/or depths of STW Apparatus being different from those shown on the plan.

In order to achieve safe working conditions adjacent to any STW Apparatus the following should be observed:

1. All STW Apparatus should be located by hand digging prior to the use of mechanical excavators.
2. All information set out in any plans received from us, or given by our staff at the site of the works, about the position and depth of the mains, is approximate. Every possible precaution should be taken to avoid damage to STW Apparatus. You or your contractor must ensure the safety of STW Apparatus and will be responsible for the cost of repairing any loss and/or damage caused (including without limitation replacement parts).
3. Water mains are normally laid at a depth of 900mm. No records are kept of customer service pipes which are normally laid at a depth of 750mm; but some idea of their positions may be obtained from the position of stop tap covers and their existence must be anticipated.
4. During construction work, where heavy plant will cross the line of STW Apparatus, specific crossing points must be agreed with STW and suitably reinforced where required. These crossing points should be clearly marked and crossing of the line of STW Apparatus at other locations must be prevented.
5. Where it is proposed to carry out piling or boring within 20 metres of any STW Apparatus, STW should be consulted to enable any affected STW Apparatus to be surveyed prior to the works commencing.
6. Where excavation of trenches adjacent to any STW Apparatus affects its support, the STW Apparatus must be supported to the satisfaction of STW. Water mains and some sewers are pressurised and can fail if excavation removes support to thrust blocks to bends and other fittings.
7. Where a trench is excavated crossing or parallel to the line of any STW Apparatus, the backfill should be adequately compacted to prevent any settlement which could subsequently cause damage to the STW Apparatus. In special cases, it may be necessary to provide permanent support to STW Apparatus which has been exposed over a length of the excavation before backfilling and reinstatement is carried out. There should be no concrete backfill in contact with the STW Apparatus.
8. No other apparatus should be laid along the line of STW Apparatus irrespective of clearance. Above ground apparatus must not be located within a minimum of 3 metres either side of the centre line of STW Apparatus for smaller sized pipes and 6 metres either side for larger sized pipes without prior approval. No manhole or chamber shall be built over or around any STW Apparatus.
9. A minimum radial clearance of 300 millimetres should be allowed between any plant or equipment being installed and existing STW Apparatus. We reserve the right to increase this distance where strategic assets are affected.
10. Where any STW Apparatus coated with a special wrapping is damaged, even to a minor extent, STW must be notified and the trench left open until the damage has been inspected and the necessary repairs have been carried out. In the case of any material damage to any STW Apparatus causing leakage, weakening of the mechanical strength of the pipe or corrosion-protection damage, the necessary remedial work will be recharged to you.
11. It may be necessary to adjust the finished level of any surface boxes which may fall within your proposed construction. Please ensure that these are not damaged, buried or otherwise rendered inaccessible as a result of the works and that all stop taps, valves, hydrants, etc. remain accessible and operable. Minor reduction in existing levels may result in conflict with STW Apparatus such as valve spindles or tops of hydrants housed under the surface boxes. Checks should be made during site investigations to ascertain the level of such STW Apparatus in order to determine any necessary alterations in advance of the works.
12. With regard to any proposed resurfacing works, you are required to contact STW on the number given above to arrange a site inspection to establish the condition of any STW Apparatus in the nature of surface boxes or manhole covers and frames affected by the works. STW will then advise on any measures to be taken, in the event of this a proportionate charge will be made.
13. You are advised that STW will not agree to either the erection of posts, directly over or within 1.0 metre of valves and hydrants,
14. No explosives are to be used in the vicinity of any STW Apparatus without prior consultation with STW.

TREE PLANTING RESTRICTIONS

There are many problems with the location of trees adjacent to sewers, water mains and other STW Apparatus and these can lead to the loss of trees and hence amenity to the area which many people may have become used to. It is best if the problem is not created in the first place. Set out below are the recommendations for tree planting in close proximity to public sewers, water mains and other STW Apparatus.

15. Please ensure that, in relation to STW Apparatus, the mature root systems and canopies of any tree planted do not and will not encroach within the recommended distances specified in the notes below.
16. Both Poplar and Willow trees have extensive root systems and should not be planted within 12 metres of a sewer, water main or other STW Apparatus.
17. The following trees and those of similar size, be they deciduous or evergreen, should not be planted within 6 metres of a sewer, water main or other STW Apparatus. E.g. Ash, Beech, Birch, most Conifers, Elm, Horse Chestnut, Lime, Oak, Sycamore, Apple and Pear. Asset Protection Statements Updated May 2014
18. STW personnel require a clear path to conduct surveys etc. No shrubs or bushes should be planted within 2 metre of the centre line of a sewer, water main or other STW Apparatus.
19. In certain circumstances, both STW and landowners may wish to plant shrubs/bushes in close proximity to a sewer, water main of other STW Apparatus for screening purposes. The following are shallow rooting and are suitable for this purpose: Blackthorn, Broom, Cotoneaster, Elder, Hazel, Laurel, Privet, Quickthorn, Snowberry, and most ornamental flowering shrubs.



Appendix 4.1

Water Quality Assessment – Parking

SUMMARY TABLE		DESIGN CONDITIONS			
		1	2	3	4
Land Use Type	Residential parking				
Pollution Hazard Level	Low				
Pollution Hazard Indices					
TSS	0.5				
Metals	0.4				
Hydrocarbons	0.4				
SuDS components proposed					
Component 1	Pond or wetland	SuDS components can only be assumed to deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters of the SuDS Manual. See also checklists in Appendix B	Ponds/wetlands should be preceded by an upstream component(s) that trap(s) silt, or designed specifically to retain sediment in a separate zone, easily accessible for maintenance, such that the sediment will not be re-suspended in subsequent events		
Component 2	None				
Component 3	None				
SuDS Pollution Mitigation Indices					
TSS		0.7			
Metals		0.7			
Hydrocarbons		0.5			
Groundwater protection type	None				
Groundwater protection					
Pollution Mitigation Indices					
TSS	0				
Metals	0				
Hydrocarbons	0				
Combined Pollution Mitigation Indices					
TSS		0.7			
Metals		0.7			
Hydrocarbons		0.5			
Acceptability of Pollution Mitigation		Reference to local planning documents should also be made to identify any additional protection required for sites due to habitat conservation (see Chapter 7 The SuDS design process). The implications of developments on or within close proximity to an area with an environmental designation, such as a Site of Special Scientific Interest (SSSI), should be considered via consultation with relevant conservation bodies such as Natural England			
TSS	Sufficient				
Metals	Sufficient				
Hydrocarbons	Sufficient				



Appendix 4.2

Water Quality Assessment – Roads

SUMMARY TABLE		DESIGN CONDITIONS			
		1	2	3	4
Land Use Type Pollution Hazard Level Pollution Hazard Indices TSS Metals Hydrocarbons	Low traffic roads (e.g. residential roads and general access roads, < 300 traffic movements/day) Low 0.5 0.4 0.4				
SuDS components proposed					
Component 1	Pond or wetland	SuDS components can only be assumed to deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters of the SuDS Manual. See also checklists in Appendix B	Ponds/wetlands should be preceded by an upstream component(s) that trap(s) silt, or designed specifically to retain sediment in a separate zone, easily accessible for maintenance, such that the sediment will not be re-suspended in subsequent events		
Component 2	None				
Component 3	None				
SuDS Pollution Mitigation Indices TSS Metals Hydrocarbons	 0.7 0.7 0.5				
Groundwater protection type Groundwater protection Pollution Mitigation Indices TSS Metals Hydrocarbons	None 0 0 0				
Combined Pollution Mitigation Indices TSS Metals Hydrocarbons Acceptability of Pollution Mitigation TSS Metals Hydrocarbons	 0.7 0.7 0.5 Sufficient Sufficient Sufficient	Note: In order to meet both Water Quality criteria set out in the SuDS Manual (Chapter 4), Interception should be delivered for all impermeable areas wherever possible. Interception delivery and treatment may be met by the same components, but Interception requires separate evaluation.	Reference to local planning documents should also be made to identify any additional protection required for sites due to habitat conservation (see Chapter 7 The SuDS design process). The implications of developments on or within close proximity to an area with an environmental designation, such as a Site of Special Scientific Interest (SSSI), should be considered via consultation with relevant conservation bodies such as Natural England		



Appendix 4.3

Water Quality Assessment - Rooves

SUMMARY TABLE		DESIGN CONDITIONS			
		1	2	3	4
Land Use Type	Residential roofing				
Pollution Hazard Level	Very low				
Pollution Hazard Indices					
TSS	0.2				
Metals	0.2				
Hydrocarbons	0.05				
SuDS components proposed		SuDS components can only be assumed to deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters of the SuDS Manual. See also checklists in Appendix B	Ponds/wetlands should be preceded by an upstream component(s) that trap(s) silt, or designed specifically to retain sediment in a separate zone, easily accessible for maintenance, such that the sediment will not be re-suspended in subsequent events		
Component 1	Pond or wetland				
Component 2	None				
Component 3	None				
SuDS Pollution Mitigation Indices					
TSS	0.7				
Metals	0.7				
Hydrocarbons	0.5				
Groundwater protection type	None				
Groundwater protection					
Pollution Mitigation Indices					
TSS	0				
Metals	0				
Hydrocarbons	0				
Combined Pollution Mitigation Indices		Note: In order to meet both Water Quality criteria set out in the SuDS Manual (Chapter 4), Interception should be delivered for all impermeable areas wherever possible. Interception delivery and treatment may be met by the same components, but Interception requires separate evaluation.	Reference to local planning documents should also be made to identify any additional protection required for sites due to habitat conservation (see Chapter 7 The SuDS design process). The implications of developments on or within close proximity to an area with an environmental designation, such as a Site of Special Scientific Interest (SSSI), should be considered via consultation with relevant conservation bodies such as Natural England		
TSS	0.7				
Metals	0.7				
Hydrocarbons	0.5				
Acceptability of Pollution Mitigation					
TSS	Sufficient				
Metals	Sufficient				
Hydrocarbons	Sufficient				



Appendix 5.1

FLOW Drainage Calculations – 2yr Storm Event

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	2	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1	0.100	5.00	112.250	1500	437767.220	295250.471	1.750
2	0.094	5.00	112.350	1200	437772.778	295254.695	1.890
3	0.051	5.00	112.350	1200	437765.617	295275.764	1.990
4	0.066	5.00	112.380	1200	437764.399	295305.117	2.150
16	0.182	5.00	113.050	1350	437811.525	295331.368	1.500
17	0.000		112.750	1350	437793.930	295324.617	1.450
18	0.042	5.00	112.540	1350	437782.527	295322.432	1.490
5	0.034	5.00	112.390	1500	437766.033	295324.345	2.330
6	0.110	5.00	111.980	1500	437769.811	295356.587	2.110
19	0.022	5.00	111.060	1200	437766.167	295400.161	1.510
7	0.111	5.00	111.420	1800	437766.785	295390.815	2.230
8	0.063	5.00	110.150	1500	437727.760	295388.348	1.750
9	0.000		108.625	1500	437718.619	295386.148	1.725
20	0.063	5.00	111.740	1350	437741.701	295341.723	1.440
23	0.037	5.00	110.500	1500	437715.040	295348.159	1.450
21	0.000	5.00	110.970	1200	437717.399	295339.574	1.980
22	0.148	5.00	110.600	1350	437705.417	295336.332	1.790
10	0.000		110.100	3000	437698.186	295330.074	3.250
11	0.000		110.950	1200	437699.137	295297.529	4.300
12			111.150	1200	437730.094	295233.655	4.930
13			110.200	1200	437731.968	295196.880	4.200
14	0.000		107.900	1200	437737.861	295134.685	2.280
14a	0.000	5.00	105.820	1200	437740.296	295064.845	1.530
15			105.340	1200	437719.220	295037.657	1.200

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	1	2	6.981	0.600	110.500	110.460	0.040	174.5	300	5.10	50.0
1.001	2	3	22.253	0.600	110.460	110.360	0.100	222.5	300	5.45	50.0
1.002	3	4	29.378	0.600	110.360	110.230	0.130	226.0	300	5.92	50.0
1.003	4	5	19.297	0.600	110.230	110.140	0.090	214.4	300	6.22	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	1.187	83.9	13.6	1.450	1.590	0.100	0.0	81	0.878
1.001	1.050	74.2	26.3	1.590	1.690	0.194	0.0	123	0.963
1.002	1.041	73.6	33.2	1.690	1.850	0.245	0.0	141	1.015
1.003	1.070	75.6	42.1	1.850	1.950	0.311	0.0	160	1.098

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
2.000	16	17	18.846	0.600	111.550	111.300	0.250	75.4	225	5.21	50.0
2.001	17	18	11.610	0.600	111.300	111.050	0.250	46.4	225	5.31	50.0
2.002	18	5	16.605	0.600	111.050	110.210	0.840	19.8	225	5.40	50.0
1.004	5	6	32.463	0.600	110.060	109.945	0.115	282.3	375	6.73	50.0
1.005	6	7	34.361	0.600	109.870	109.270	0.600	57.3	450	6.94	50.0
3.000	19	7	9.366	0.600	109.550	109.490	0.060	156.1	225	5.15	50.0
1.006	7	8	39.103	0.600	109.190	108.400	0.790	49.5	525	7.14	50.0
1.007	8	9	9.402	0.600	108.400	106.900	1.500	6.3	525	7.16	50.0
1.008	9	10	59.681	0.600	106.900	106.850	0.050	1193.6	525	8.72	50.0
4.000	20	21	24.397	0.600	110.300	108.990	1.310	18.6	225	5.13	50.0
5.000	23	21	8.903	0.600	109.050	108.990	0.060	148.4	225	5.14	50.0
4.001	21	22	12.413	0.600	108.990	108.910	0.080	155.2	225	5.34	50.0
4.002	22	10	9.563	0.600	108.810	106.850	1.960	4.9	225	5.36	50.0
1.009	10	11	32.559	0.600	106.850	106.650	0.200	162.8	225	9.25	0.0
1.010	11	12	70.980	0.600	106.650	106.220	0.430	165.1	225	10.41	0.0
1.011	12	13	36.823	0.600	106.220	106.000	0.220	167.4	225	11.02	0.0
1.012	13	14	62.474	0.600	106.000	105.620	0.380	164.4	225	12.05	0.0
1.013	14	14a	69.882	0.600	105.620	104.365	1.255	55.7	225	12.71	0.0
1.014	14a	15	34.400	0.600	104.290	104.140	0.150	229.3	225	13.38	0.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
2.000	1.507	59.9	24.7	1.275	1.225	0.182	0.0	101	1.437
2.001	1.924	76.5	24.7	1.225	1.265	0.182	0.0	87	1.718
2.002	2.956	117.5	30.4	1.265	1.955	0.224	0.0	78	2.491
1.004	1.073	118.5	77.1	1.955	1.660	0.569	0.0	221	1.140
1.005	2.690	427.9	92.0	1.660	1.700	0.679	0.0	141	2.164
3.000	1.044	41.5	3.0	1.285	1.705	0.022	0.0	41	0.611
1.006	3.189	690.3	110.0	1.705	1.225	0.812	0.0	141	2.365
1.007	8.985	1945.0	118.6	1.225	1.200	0.875	0.0	86	5.068
1.008	0.640	138.5	118.6	1.200	2.725	0.875	0.0	376	0.715
4.000	3.046	121.1	8.5	1.215	1.755	0.063	0.0	40	1.769
5.000	1.071	42.6	5.0	1.225	1.755	0.037	0.0	52	0.725
4.001	1.047	41.6	13.6	1.755	1.465	0.100	0.0	88	0.939
4.002	5.963	237.1	33.6	1.565	3.025	0.248	0.0	57	4.245
1.009	1.022	40.6	0.0	3.025	4.075	1.123	0.0	0	0.000
1.010	1.015	40.3	0.0	4.075	4.705	1.123	0.0	0	0.000
1.011	1.008	40.1	0.0	4.705	3.975	1.123	0.0	0	0.000
1.012	1.017	40.4	0.0	3.975	2.055	1.123	0.0	0	0.000
1.013	1.756	69.8	0.0	2.055	1.230	1.123	0.0	0	0.000
1.014	0.859	34.2	0.0	1.305	0.975	1.123	0.0	0	0.000

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	6.981	174.5	300	Circular_Default Sewer Type	112.250	110.500	1.450	112.350	110.460	1.590
1.001	22.253	222.5	300	Circular_Default Sewer Type	112.350	110.460	1.590	112.350	110.360	1.690
1.002	29.378	226.0	300	Circular_Default Sewer Type	112.350	110.360	1.690	112.380	110.230	1.850
1.003	19.297	214.4	300	Circular_Default Sewer Type	112.380	110.230	1.850	112.390	110.140	1.950
2.000	18.846	75.4	225	Circular_Default Sewer Type	113.050	111.550	1.275	112.750	111.300	1.225
2.001	11.610	46.4	225	Circular_Default Sewer Type	112.750	111.300	1.225	112.540	111.050	1.265
2.002	16.605	19.8	225	Circular_Default Sewer Type	112.540	111.050	1.265	112.390	110.210	1.955
1.004	32.463	282.3	375	Circular_Default Sewer Type	112.390	110.060	1.955	111.980	109.945	1.660
1.005	34.361	57.3	450	Circular_Default Sewer Type	111.980	109.870	1.660	111.420	109.270	1.700
3.000	9.366	156.1	225	Circular_Default Sewer Type	111.060	109.550	1.285	111.420	109.490	1.705
1.006	39.103	49.5	525	Circular_Default Sewer Type	111.420	109.190	1.705	110.150	108.400	1.225
1.007	9.402	6.3	525	Circular_Default Sewer Type	110.150	108.400	1.225	108.625	106.900	1.200
1.008	59.681	1193.6	525	Circular_Default Sewer Type	108.625	106.900	1.200	110.100	106.850	2.725
4.000	24.397	18.6	225	Circular_Default Sewer Type	111.740	110.300	1.215	110.970	108.990	1.755
5.000	8.903	148.4	225	Circular_Default Sewer Type	110.500	109.050	1.225	110.970	108.990	1.755
4.001	12.413	155.2	225	Circular_Default Sewer Type	110.970	108.990	1.755	110.600	108.910	1.465
4.002	9.563	4.9	225	Circular_Default Sewer Type	110.600	108.810	1.565	110.100	106.850	3.025
1.009	32.559	162.8	225	Circular_Default Sewer Type	110.100	106.850	3.025	110.950	106.650	4.075
1.010	70.980	165.1	225	Circular_Default Sewer Type	110.950	106.650	4.075	111.150	106.220	4.705
1.011	36.823	167.4	225	Circular_Default Sewer Type	111.150	106.220	4.705	110.200	106.000	3.975
1.012	62.474	164.4	225	Circular_Default Sewer Type	110.200	106.000	3.975	107.900	105.620	2.055
1.013	69.882	55.7	225	Circular_Default Sewer Type	107.900	105.620	2.055	105.820	104.365	1.230
1.014	34.400	229.3	225	Circular_Default Sewer Type	105.820	104.290	1.305	105.340	104.140	0.975

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	1	1500	Manhole	Adoptable	2	1200	Manhole	Adoptable
1.001	2	1200	Manhole	Adoptable	3	1200	Manhole	Adoptable
1.002	3	1200	Manhole	Adoptable	4	1200	Manhole	Adoptable
1.003	4	1200	Manhole	Adoptable	5	1500	Manhole	Adoptable
2.000	16	1350	Manhole	Adoptable	17	1350	Manhole	Adoptable
2.001	17	1350	Manhole	Adoptable	18	1350	Manhole	Adoptable
2.002	18	1350	Manhole	Adoptable	5	1500	Manhole	Adoptable
1.004	5	1500	Manhole	Adoptable	6	1500	Manhole	Adoptable
1.005	6	1500	Manhole	Adoptable	7	1800	Manhole	Adoptable
3.000	19	1200	Manhole	Adoptable	7	1800	Manhole	Adoptable
1.006	7	1800	Manhole	Adoptable	8	1500	Manhole	Adoptable
1.007	8	1500	Manhole	Adoptable	9	1500	Manhole	Adoptable
1.008	9	1500	Manhole	Adoptable	10	3000	Manhole	Adoptable
4.000	20	1350	Manhole	Adoptable	21	1200	Manhole	Adoptable
5.000	23	1500	Manhole	Adoptable	21	1200	Manhole	Adoptable
4.001	21	1200	Manhole	Adoptable	22	1350	Manhole	Adoptable
4.002	22	1350	Manhole	Adoptable	10	3000	Manhole	Adoptable
1.009	10	3000	Manhole	Adoptable	11	1200	Manhole	Adoptable
1.010	11	1200	Manhole	Adoptable	12	1200	Manhole	Adoptable
1.011	12	1200	Manhole	Adoptable	13	1200	Manhole	Adoptable
1.012	13	1200	Manhole	Adoptable	14	1200	Manhole	Adoptable
1.013	14	1200	Manhole	Adoptable	14a	1200	Manhole	Adoptable
1.014	14a	1200	Manhole	Adoptable	15	1200	Manhole	Adoptable

Simulation Settings

Rainfall Methodology	FSR	Skip Steady State	✓
FSR Region	England and Wales	Drain Down Time (mins)	240
M5-60 (mm)	20.000	Additional Storage (m ³ /ha)	0.0
Ratio-R	0.400	Check Discharge Rate(s)	✓
Summer CV	0.750	Check Discharge Volume	✓
Winter CV	0.840	100 year 360 minute (m ³)	
Analysis Speed	Detailed		

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

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	1.95
Greenfield Method	IH124	Growth Factor 100 year	2.48
Positively Drained Area (ha)		Betterment (%)	0
SAAR (mm)		QBar	
Soil Index	1	Q 1 year (l/s)	
SPR	0.10	Q 30 year (l/s)	
Region	1	Q 100 year (l/s)	
Growth Factor 1 year	0.85		

Pre-development Discharge Volume

Site Makeup	Greenfield	Return Period (years)	100
Greenfield Method	FSR/FEH	Climate Change (%)	0
Positively Drained Area (ha)		Storm Duration (mins)	360
Soil Index	1	Betterment (%)	0
SPR	0.10	PR	
CWI		Runoff Volume (m ³)	

Node 10 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	106.850	Product Number	CTL-SHE-0137-9400-1300-9400
Design Depth (m)	1.300	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	9.4	Min Node Diameter (mm)	1200

Node 9 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	106.900
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	0

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	377.0	0.0	1.500	863.0	0.0	1.510	0.0	0.0

Results for 2 year Critical Storm Duration. Lowest mass balance: 98.24%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	10	110.624	0.124	18.2	0.2189	0.0000	OK
15 minute winter	2	10	110.615	0.155	35.0	0.1751	0.0000	OK
15 minute winter	3	11	110.535	0.175	43.8	0.1981	0.0000	OK
15 minute winter	4	11	110.438	0.208	54.8	0.2353	0.0000	OK
15 minute winter	16	10	111.678	0.128	33.2	0.1830	0.0000	OK
15 minute winter	17	10	111.414	0.114	32.9	0.1629	0.0000	OK
15 minute winter	18	10	111.143	0.093	40.2	0.1328	0.0000	OK
15 minute winter	5	11	110.336	0.276	100.1	0.4872	0.0000	OK
15 minute winter	6	11	110.041	0.171	119.0	0.3017	0.0000	OK
15 minute winter	19	10	109.599	0.049	4.0	0.0551	0.0000	OK
15 minute winter	7	11	109.367	0.176	141.3	0.4491	0.0000	OK
15 minute summer	8	10	108.519	0.119	145.0	0.2099	0.0000	OK
180 minute winter	9	156	107.198	0.298	37.5	127.1708	0.0000	OK
15 minute winter	20	10	110.347	0.047	11.5	0.0666	0.0000	OK
15 minute winter	23	10	109.110	0.060	6.7	0.1053	0.0000	OK
15 minute winter	21	11	109.099	0.109	18.0	0.1232	0.0000	OK
15 minute winter	22	10	108.875	0.065	44.4	0.0936	0.0000	OK
180 minute winter	10	148	107.198	0.347	11.1	2.4565	0.0000	SURCHARGED
180 minute winter	11	152	106.724	0.074	9.4	0.0835	0.0000	OK
180 minute winter	12	156	106.295	0.075	9.4	0.0846	0.0000	OK
180 minute winter	13	156	106.077	0.077	9.4	0.0871	0.0000	OK
180 minute winter	14	160	105.676	0.056	9.4	0.0633	0.0000	OK
180 minute winter	14a	160	104.372	0.082	9.4	0.0927	0.0000	OK
180 minute winter	15	160	104.219	0.079	9.4	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	1.000	2	17.9	0.561	0.214	0.2237	
15 minute winter	2	1.001	3	34.5	0.873	0.465	0.8788	
15 minute winter	3	1.002	4	43.5	0.920	0.591	1.3932	
15 minute winter	4	1.003	5	55.0	1.097	0.727	0.9728	
15 minute winter	16	2.000	17	32.9	1.516	0.549	0.4091	
15 minute winter	17	2.001	18	32.5	1.853	0.425	0.2064	
15 minute winter	18	2.002	5	40.2	2.491	0.342	0.3110	
15 minute winter	5	1.004	6	100.1	1.259	0.844	2.5759	
15 minute winter	6	1.005	7	118.5	2.251	0.277	1.8088	
15 minute winter	19	3.000	7	3.9	0.645	0.095	0.0572	
15 minute winter	7	1.006	8	140.6	2.953	0.204	1.9231	
15 minute winter	8	1.007	9	152.6	5.791	0.078	0.3647	
15 minute winter	9	1.008	10	-33.7	-0.566	-0.243	5.0718	
15 minute winter	20	4.000	21	11.4	1.033	0.094	0.3036	
15 minute winter	23	5.000	21	6.6	0.490	0.155	0.1219	
15 minute winter	21	4.001	22	17.7	0.972	0.425	0.2258	
15 minute winter	22	4.002	10	44.3	2.519	0.187	0.2359	
180 minute winter	10	Hydro-Brake®	11	9.4				
180 minute winter	11	1.010	12	9.4	0.821	0.232	0.8108	
180 minute winter	12	1.011	13	9.4	0.797	0.234	0.4331	
180 minute winter	13	1.012	14	9.4	0.957	0.232	0.6150	
180 minute winter	14	1.013	14a	9.4	1.228	0.134	0.5334	
180 minute winter	14a	1.014	15	9.4	0.736	0.274	0.4384	184.7



Appendix 5.2

FLOW Drainage Calculations – 30yr Storm Event

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	2	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1	0.100	5.00	112.250	1500	437767.220	295250.471	1.750
2	0.094	5.00	112.350	1200	437772.778	295254.695	1.890
3	0.051	5.00	112.350	1200	437765.617	295275.764	1.990
4	0.066	5.00	112.380	1200	437764.399	295305.117	2.150
16	0.182	5.00	113.050	1350	437811.525	295331.368	1.500
17	0.000		112.750	1350	437793.930	295324.617	1.450
18	0.042	5.00	112.540	1350	437782.527	295322.432	1.490
5	0.034	5.00	112.390	1500	437766.033	295324.345	2.330
6	0.110	5.00	111.980	1500	437769.811	295356.587	2.110
19	0.022	5.00	111.060	1200	437766.167	295400.161	1.510
7	0.111	5.00	111.420	1800	437766.785	295390.815	2.230
8	0.063	5.00	110.150	1500	437727.760	295388.348	1.750
9	0.000		108.625	1500	437718.619	295386.148	1.725
20	0.063	5.00	111.740	1350	437741.701	295341.723	1.440
23	0.037	5.00	110.500	1500	437715.040	295348.159	1.450
21	0.000	5.00	110.970	1200	437717.399	295339.574	1.980
22	0.148	5.00	110.600	1350	437705.417	295336.332	1.790
10	0.000		110.100	3000	437698.186	295330.074	3.250
11	0.000		110.950	1200	437699.137	295297.529	4.300
12			111.150	1200	437730.094	295233.655	4.930
13			110.200	1200	437731.968	295196.880	4.200
14	0.000		107.900	1200	437737.861	295134.685	2.280
14a	0.000	5.00	105.820	1200	437740.296	295064.845	1.530
15			105.340	1200	437719.220	295037.657	1.200

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	1	2	6.981	0.600	110.500	110.460	0.040	174.5	300	5.10	50.0
1.001	2	3	22.253	0.600	110.460	110.360	0.100	222.5	300	5.45	50.0
1.002	3	4	29.378	0.600	110.360	110.230	0.130	226.0	300	5.92	50.0
1.003	4	5	19.297	0.600	110.230	110.140	0.090	214.4	300	6.22	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	1.187	83.9	13.6	1.450	1.590	0.100	0.0	81	0.878
1.001	1.050	74.2	26.3	1.590	1.690	0.194	0.0	123	0.963
1.002	1.041	73.6	33.2	1.690	1.850	0.245	0.0	141	1.015
1.003	1.070	75.6	42.1	1.850	1.950	0.311	0.0	160	1.098

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
2.000	16	17	18.846	0.600	111.550	111.300	0.250	75.4	225	5.21	50.0
2.001	17	18	11.610	0.600	111.300	111.050	0.250	46.4	225	5.31	50.0
2.002	18	5	16.605	0.600	111.050	110.210	0.840	19.8	225	5.40	50.0
1.004	5	6	32.463	0.600	110.060	109.945	0.115	282.3	375	6.73	50.0
1.005	6	7	34.361	0.600	109.870	109.270	0.600	57.3	450	6.94	50.0
3.000	19	7	9.366	0.600	109.550	109.490	0.060	156.1	225	5.15	50.0
1.006	7	8	39.103	0.600	109.190	108.400	0.790	49.5	525	7.14	50.0
1.007	8	9	9.402	0.600	108.400	106.900	1.500	6.3	525	7.16	50.0
1.008	9	10	59.681	0.600	106.900	106.850	0.050	1193.6	525	8.72	50.0
4.000	20	21	24.397	0.600	110.300	108.990	1.310	18.6	225	5.13	50.0
5.000	23	21	8.903	0.600	109.050	108.990	0.060	148.4	225	5.14	50.0
4.001	21	22	12.413	0.600	108.990	108.910	0.080	155.2	225	5.34	50.0
4.002	22	10	9.563	0.600	108.810	106.850	1.960	4.9	225	5.36	50.0
1.009	10	11	32.559	0.600	106.850	106.650	0.200	162.8	225	9.25	0.0
1.010	11	12	70.980	0.600	106.650	106.220	0.430	165.1	225	10.41	0.0
1.011	12	13	36.823	0.600	106.220	106.000	0.220	167.4	225	11.02	0.0
1.012	13	14	62.474	0.600	106.000	105.620	0.380	164.4	225	12.05	0.0
1.013	14	14a	69.882	0.600	105.620	104.365	1.255	55.7	225	12.71	0.0
1.014	14a	15	34.400	0.600	104.290	104.140	0.150	229.3	225	13.38	0.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
2.000	1.507	59.9	24.7	1.275	1.225	0.182	0.0	101	1.437
2.001	1.924	76.5	24.7	1.225	1.265	0.182	0.0	87	1.718
2.002	2.956	117.5	30.4	1.265	1.955	0.224	0.0	78	2.491
1.004	1.073	118.5	77.1	1.955	1.660	0.569	0.0	221	1.140
1.005	2.690	427.9	92.0	1.660	1.700	0.679	0.0	141	2.164
3.000	1.044	41.5	3.0	1.285	1.705	0.022	0.0	41	0.611
1.006	3.189	690.3	110.0	1.705	1.225	0.812	0.0	141	2.365
1.007	8.985	1945.0	118.6	1.225	1.200	0.875	0.0	86	5.068
1.008	0.640	138.5	118.6	1.200	2.725	0.875	0.0	376	0.715
4.000	3.046	121.1	8.5	1.215	1.755	0.063	0.0	40	1.769
5.000	1.071	42.6	5.0	1.225	1.755	0.037	0.0	52	0.725
4.001	1.047	41.6	13.6	1.755	1.465	0.100	0.0	88	0.939
4.002	5.963	237.1	33.6	1.565	3.025	0.248	0.0	57	4.245
1.009	1.022	40.6	0.0	3.025	4.075	1.123	0.0	0	0.000
1.010	1.015	40.3	0.0	4.075	4.705	1.123	0.0	0	0.000
1.011	1.008	40.1	0.0	4.705	3.975	1.123	0.0	0	0.000
1.012	1.017	40.4	0.0	3.975	2.055	1.123	0.0	0	0.000
1.013	1.756	69.8	0.0	2.055	1.230	1.123	0.0	0	0.000
1.014	0.859	34.2	0.0	1.305	0.975	1.123	0.0	0	0.000

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	6.981	174.5	300	Circular_Default Sewer Type	112.250	110.500	1.450	112.350	110.460	1.590
1.001	22.253	222.5	300	Circular_Default Sewer Type	112.350	110.460	1.590	112.350	110.360	1.690
1.002	29.378	226.0	300	Circular_Default Sewer Type	112.350	110.360	1.690	112.380	110.230	1.850
1.003	19.297	214.4	300	Circular_Default Sewer Type	112.380	110.230	1.850	112.390	110.140	1.950
2.000	18.846	75.4	225	Circular_Default Sewer Type	113.050	111.550	1.275	112.750	111.300	1.225
2.001	11.610	46.4	225	Circular_Default Sewer Type	112.750	111.300	1.225	112.540	111.050	1.265
2.002	16.605	19.8	225	Circular_Default Sewer Type	112.540	111.050	1.265	112.390	110.210	1.955
1.004	32.463	282.3	375	Circular_Default Sewer Type	112.390	110.060	1.955	111.980	109.945	1.660
1.005	34.361	57.3	450	Circular_Default Sewer Type	111.980	109.870	1.660	111.420	109.270	1.700
3.000	9.366	156.1	225	Circular_Default Sewer Type	111.060	109.550	1.285	111.420	109.490	1.705
1.006	39.103	49.5	525	Circular_Default Sewer Type	111.420	109.190	1.705	110.150	108.400	1.225
1.007	9.402	6.3	525	Circular_Default Sewer Type	110.150	108.400	1.225	108.625	106.900	1.200
1.008	59.681	1193.6	525	Circular_Default Sewer Type	108.625	106.900	1.200	110.100	106.850	2.725
4.000	24.397	18.6	225	Circular_Default Sewer Type	111.740	110.300	1.215	110.970	108.990	1.755
5.000	8.903	148.4	225	Circular_Default Sewer Type	110.500	109.050	1.225	110.970	108.990	1.755
4.001	12.413	155.2	225	Circular_Default Sewer Type	110.970	108.990	1.755	110.600	108.910	1.465
4.002	9.563	4.9	225	Circular_Default Sewer Type	110.600	108.810	1.565	110.100	106.850	3.025
1.009	32.559	162.8	225	Circular_Default Sewer Type	110.100	106.850	3.025	110.950	106.650	4.075
1.010	70.980	165.1	225	Circular_Default Sewer Type	110.950	106.650	4.075	111.150	106.220	4.705
1.011	36.823	167.4	225	Circular_Default Sewer Type	111.150	106.220	4.705	110.200	106.000	3.975
1.012	62.474	164.4	225	Circular_Default Sewer Type	110.200	106.000	3.975	107.900	105.620	2.055
1.013	69.882	55.7	225	Circular_Default Sewer Type	107.900	105.620	2.055	105.820	104.365	1.230
1.014	34.400	229.3	225	Circular_Default Sewer Type	105.820	104.290	1.305	105.340	104.140	0.975

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	1	1500	Manhole	Adoptable	2	1200	Manhole	Adoptable
1.001	2	1200	Manhole	Adoptable	3	1200	Manhole	Adoptable
1.002	3	1200	Manhole	Adoptable	4	1200	Manhole	Adoptable
1.003	4	1200	Manhole	Adoptable	5	1500	Manhole	Adoptable
2.000	16	1350	Manhole	Adoptable	17	1350	Manhole	Adoptable
2.001	17	1350	Manhole	Adoptable	18	1350	Manhole	Adoptable
2.002	18	1350	Manhole	Adoptable	5	1500	Manhole	Adoptable
1.004	5	1500	Manhole	Adoptable	6	1500	Manhole	Adoptable
1.005	6	1500	Manhole	Adoptable	7	1800	Manhole	Adoptable
3.000	19	1200	Manhole	Adoptable	7	1800	Manhole	Adoptable
1.006	7	1800	Manhole	Adoptable	8	1500	Manhole	Adoptable
1.007	8	1500	Manhole	Adoptable	9	1500	Manhole	Adoptable
1.008	9	1500	Manhole	Adoptable	10	3000	Manhole	Adoptable
4.000	20	1350	Manhole	Adoptable	21	1200	Manhole	Adoptable
5.000	23	1500	Manhole	Adoptable	21	1200	Manhole	Adoptable
4.001	21	1200	Manhole	Adoptable	22	1350	Manhole	Adoptable
4.002	22	1350	Manhole	Adoptable	10	3000	Manhole	Adoptable
1.009	10	3000	Manhole	Adoptable	11	1200	Manhole	Adoptable
1.010	11	1200	Manhole	Adoptable	12	1200	Manhole	Adoptable
1.011	12	1200	Manhole	Adoptable	13	1200	Manhole	Adoptable
1.012	13	1200	Manhole	Adoptable	14	1200	Manhole	Adoptable
1.013	14	1200	Manhole	Adoptable	14a	1200	Manhole	Adoptable
1.014	14a	1200	Manhole	Adoptable	15	1200	Manhole	Adoptable

Simulation Settings

Rainfall Methodology	FSR	Skip Steady State	✓
FSR Region	England and Wales	Drain Down Time (mins)	240
M5-60 (mm)	20.000	Additional Storage (m³/ha)	0.0
Ratio-R	0.400	Check Discharge Rate(s)	✓
Summer CV	0.750	Check Discharge Volume	✓
Winter CV	0.840	100 year 360 minute (m³)	
Analysis Speed	Detailed		

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

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

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	1.95
Greenfield Method	IH124	Growth Factor 100 year	2.48
Positively Drained Area (ha)		Betterment (%)	0
SAAR (mm)		QBar	
Soil Index	1	Q 1 year (l/s)	
SPR	0.10	Q 30 year (l/s)	
Region	1	Q 100 year (l/s)	
Growth Factor 1 year	0.85		

Pre-development Discharge Volume

Site Makeup	Greenfield	Return Period (years)	100
Greenfield Method	FSR/FEH	Climate Change (%)	0
Positively Drained Area (ha)		Storm Duration (mins)	360
Soil Index	1	Betterment (%)	0
SPR	0.10	PR	
CWI		Runoff Volume (m³)	

Node 10 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	106.850	Product Number	CTL-SHE-0137-9400-1300-9400
Design Depth (m)	1.300	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	9.4	Min Node Diameter (mm)	1200

Node 9 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	106.900
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	377.0	0.0	1.500	863.0	0.0	1.510	0.0	0.0

Results for 30 year Critical Storm Duration. Lowest mass balance: 98.90%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	11	111.090	0.590	34.6	1.0421	0.0000	SURCHARGED
15 minute winter	2	11	111.078	0.618	61.9	0.6987	0.0000	SURCHARGED
15 minute winter	3	11	110.988	0.628	78.0	0.7098	0.0000	SURCHARGED
15 minute winter	4	11	110.806	0.576	98.9	0.6516	0.0000	SURCHARGED
15 minute winter	16	11	111.802	0.252	63.0	0.3603	0.0000	SURCHARGED
15 minute winter	17	11	111.476	0.176	60.5	0.2516	0.0000	OK
15 minute winter	18	11	111.196	0.146	74.7	0.2083	0.0000	OK
15 minute winter	5	11	110.597	0.537	184.5	0.9481	0.0000	SURCHARGED
15 minute winter	6	11	110.117	0.247	219.4	0.4370	0.0000	OK
15 minute winter	19	10	109.618	0.068	7.6	0.0774	0.0000	OK
15 minute winter	7	11	109.442	0.252	261.6	0.6424	0.0000	OK
15 minute summer	8	10	108.556	0.156	268.0	0.2755	0.0000	OK
240 minute winter	9	236	107.509	0.609	60.3	290.5757	0.0000	SURCHARGED
15 minute winter	20	10	110.364	0.064	21.8	0.0919	0.0000	OK
15 minute winter	23	11	109.163	0.113	12.8	0.1989	0.0000	OK
15 minute winter	21	11	109.157	0.167	34.0	0.1891	0.0000	OK
15 minute winter	22	10	108.902	0.091	83.8	0.1309	0.0000	OK
240 minute winter	10	236	107.508	0.658	16.0	4.6537	0.0000	SURCHARGED
15 minute winter	11	17	106.724	0.074	9.4	0.0836	0.0000	OK
30 minute winter	12	140	106.295	0.075	9.4	0.0847	0.0000	OK
15 minute winter	13	11	106.078	0.078	9.4	0.0882	0.0000	OK
30 minute summer	14	101	105.676	0.056	9.4	0.0633	0.0000	OK
30 minute summer	14a	101	104.372	0.082	9.4	0.0928	0.0000	OK
30 minute summer	15	101	104.219	0.079	9.4	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	1.000	2	31.4	0.572	0.374	0.4916	
15 minute winter	2	1.001	3	61.4	0.927	0.828	1.5670	
15 minute winter	3	1.002	4	77.4	1.099	1.051	2.0688	
15 minute winter	4	1.003	5	98.4	1.398	1.302	1.3589	
15 minute winter	16	2.000	17	60.5	1.654	1.009	0.6885	
15 minute winter	17	2.001	18	61.0	2.065	0.798	0.3509	
15 minute winter	18	2.002	5	75.0	2.536	0.638	0.5557	
15 minute winter	5	1.004	6	183.6	1.681	1.549	3.3879	
15 minute winter	6	1.005	7	218.2	2.602	0.510	2.8822	
15 minute winter	19	3.000	7	7.5	0.768	0.181	0.0914	
15 minute winter	7	1.006	8	260.5	3.468	0.377	3.0144	
15 minute winter	8	1.007	9	282.1	6.115	0.145	0.7731	
15 minute winter	9	1.008	10	-74.7	-0.759	-0.540	9.9994	
15 minute winter	20	4.000	21	21.7	1.193	0.179	0.4957	
15 minute winter	23	5.000	21	12.3	0.514	0.290	0.2292	
15 minute winter	21	4.001	22	33.4	1.114	0.802	0.3716	
15 minute winter	22	4.002	10	83.7	2.722	0.353	0.2626	
15 minute summer	10	Hydro-Brake®	11	9.4				
15 minute winter	11	1.010	12	9.4	0.873	0.233	0.8118	
30 minute summer	12	1.011	13	9.4	0.797	0.234	0.4337	
15 minute winter	13	1.012	14	9.4	1.038	0.233	0.6157	
30 minute summer	14	1.013	14a	9.4	1.229	0.134	0.5341	
30 minute summer	14a	1.014	15	9.4	0.736	0.275	0.4390	142.4



Appendix 5.3

FLOW Drainage Calculations – 100yr Storm Event

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	2	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1	0.100	5.00	112.250	1500	437767.220	295250.471	1.750
2	0.094	5.00	112.350	1200	437772.778	295254.695	1.890
3	0.051	5.00	112.350	1200	437765.617	295275.764	1.990
4	0.066	5.00	112.380	1200	437764.399	295305.117	2.150
16	0.182	5.00	113.050	1350	437811.525	295331.368	1.500
17	0.000		112.750	1350	437793.930	295324.617	1.450
18	0.042	5.00	112.540	1350	437782.527	295322.432	1.490
5	0.034	5.00	112.390	1500	437766.033	295324.345	2.330
6	0.110	5.00	111.980	1500	437769.811	295356.587	2.110
19	0.022	5.00	111.060	1200	437766.167	295400.161	1.510
7	0.111	5.00	111.420	1800	437766.785	295390.815	2.230
8	0.063	5.00	110.150	1500	437727.760	295388.348	1.750
9	0.000		108.625	1500	437718.619	295386.148	1.725
20	0.063	5.00	111.740	1350	437741.701	295341.723	1.440
23	0.037	5.00	110.500	1500	437715.040	295348.159	1.450
21	0.000	5.00	110.970	1200	437717.399	295339.574	1.980
22	0.148	5.00	110.600	1350	437705.417	295336.332	1.790
10	0.000		110.100	3000	437698.186	295330.074	3.250
11	0.000		110.950	1200	437699.137	295297.529	4.300
12			111.150	1200	437730.094	295233.655	4.930
13			110.200	1200	437731.968	295196.880	4.200
14	0.000		107.900	1200	437737.861	295134.685	2.280
14a	0.000	5.00	105.820	1200	437740.296	295064.845	1.530
15			105.340	1200	437719.220	295037.657	1.200

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	1	2	6.981	0.600	110.500	110.460	0.040	174.5	300	5.10	50.0
1.001	2	3	22.253	0.600	110.460	110.360	0.100	222.5	300	5.45	50.0
1.002	3	4	29.378	0.600	110.360	110.230	0.130	226.0	300	5.92	50.0
1.003	4	5	19.297	0.600	110.230	110.140	0.090	214.4	300	6.22	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	1.187	83.9	13.6	1.450	1.590	0.100	0.0	81	0.878
1.001	1.050	74.2	26.3	1.590	1.690	0.194	0.0	123	0.963
1.002	1.041	73.6	33.2	1.690	1.850	0.245	0.0	141	1.015
1.003	1.070	75.6	42.1	1.850	1.950	0.311	0.0	160	1.098

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
2.000	16	17	18.846	0.600	111.550	111.300	0.250	75.4	225	5.21	50.0
2.001	17	18	11.610	0.600	111.300	111.050	0.250	46.4	225	5.31	50.0
2.002	18	5	16.605	0.600	111.050	110.210	0.840	19.8	225	5.40	50.0
1.004	5	6	32.463	0.600	110.060	109.945	0.115	282.3	375	6.73	50.0
1.005	6	7	34.361	0.600	109.870	109.270	0.600	57.3	450	6.94	50.0
3.000	19	7	9.366	0.600	109.550	109.490	0.060	156.1	225	5.15	50.0
1.006	7	8	39.103	0.600	109.190	108.400	0.790	49.5	525	7.14	50.0
1.007	8	9	9.402	0.600	108.400	106.900	1.500	6.3	525	7.16	50.0
1.008	9	10	59.681	0.600	106.900	106.850	0.050	1193.6	525	8.72	50.0
4.000	20	21	24.397	0.600	110.300	108.990	1.310	18.6	225	5.13	50.0
5.000	23	21	8.903	0.600	109.050	108.990	0.060	148.4	225	5.14	50.0
4.001	21	22	12.413	0.600	108.990	108.910	0.080	155.2	225	5.34	50.0
4.002	22	10	9.563	0.600	108.810	106.850	1.960	4.9	225	5.36	50.0
1.009	10	11	32.559	0.600	106.850	106.650	0.200	162.8	225	9.25	0.0
1.010	11	12	70.980	0.600	106.650	106.220	0.430	165.1	225	10.41	0.0
1.011	12	13	36.823	0.600	106.220	106.000	0.220	167.4	225	11.02	0.0
1.012	13	14	62.474	0.600	106.000	105.620	0.380	164.4	225	12.05	0.0
1.013	14	14a	69.882	0.600	105.620	104.365	1.255	55.7	225	12.71	0.0
1.014	14a	15	34.400	0.600	104.290	104.140	0.150	229.3	225	13.38	0.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
2.000	1.507	59.9	24.7	1.275	1.225	0.182	0.0	101	1.437
2.001	1.924	76.5	24.7	1.225	1.265	0.182	0.0	87	1.718
2.002	2.956	117.5	30.4	1.265	1.955	0.224	0.0	78	2.491
1.004	1.073	118.5	77.1	1.955	1.660	0.569	0.0	221	1.140
1.005	2.690	427.9	92.0	1.660	1.700	0.679	0.0	141	2.164
3.000	1.044	41.5	3.0	1.285	1.705	0.022	0.0	41	0.611
1.006	3.189	690.3	110.0	1.705	1.225	0.812	0.0	141	2.365
1.007	8.985	1945.0	118.6	1.225	1.200	0.875	0.0	86	5.068
1.008	0.640	138.5	118.6	1.200	2.725	0.875	0.0	376	0.715
4.000	3.046	121.1	8.5	1.215	1.755	0.063	0.0	40	1.769
5.000	1.071	42.6	5.0	1.225	1.755	0.037	0.0	52	0.725
4.001	1.047	41.6	13.6	1.755	1.465	0.100	0.0	88	0.939
4.002	5.963	237.1	33.6	1.565	3.025	0.248	0.0	57	4.245
1.009	1.022	40.6	0.0	3.025	4.075	1.123	0.0	0	0.000
1.010	1.015	40.3	0.0	4.075	4.705	1.123	0.0	0	0.000
1.011	1.008	40.1	0.0	4.705	3.975	1.123	0.0	0	0.000
1.012	1.017	40.4	0.0	3.975	2.055	1.123	0.0	0	0.000
1.013	1.756	69.8	0.0	2.055	1.230	1.123	0.0	0	0.000
1.014	0.859	34.2	0.0	1.305	0.975	1.123	0.0	0	0.000

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	6.981	174.5	300	Circular_Default Sewer Type	112.250	110.500	1.450	112.350	110.460	1.590
1.001	22.253	222.5	300	Circular_Default Sewer Type	112.350	110.460	1.590	112.350	110.360	1.690
1.002	29.378	226.0	300	Circular_Default Sewer Type	112.350	110.360	1.690	112.380	110.230	1.850
1.003	19.297	214.4	300	Circular_Default Sewer Type	112.380	110.230	1.850	112.390	110.140	1.950
2.000	18.846	75.4	225	Circular_Default Sewer Type	113.050	111.550	1.275	112.750	111.300	1.225
2.001	11.610	46.4	225	Circular_Default Sewer Type	112.750	111.300	1.225	112.540	111.050	1.265
2.002	16.605	19.8	225	Circular_Default Sewer Type	112.540	111.050	1.265	112.390	110.210	1.955
1.004	32.463	282.3	375	Circular_Default Sewer Type	112.390	110.060	1.955	111.980	109.945	1.660
1.005	34.361	57.3	450	Circular_Default Sewer Type	111.980	109.870	1.660	111.420	109.270	1.700
3.000	9.366	156.1	225	Circular_Default Sewer Type	111.060	109.550	1.285	111.420	109.490	1.705
1.006	39.103	49.5	525	Circular_Default Sewer Type	111.420	109.190	1.705	110.150	108.400	1.225
1.007	9.402	6.3	525	Circular_Default Sewer Type	110.150	108.400	1.225	108.625	106.900	1.200
1.008	59.681	1193.6	525	Circular_Default Sewer Type	108.625	106.900	1.200	110.100	106.850	2.725
4.000	24.397	18.6	225	Circular_Default Sewer Type	111.740	110.300	1.215	110.970	108.990	1.755
5.000	8.903	148.4	225	Circular_Default Sewer Type	110.500	109.050	1.225	110.970	108.990	1.755
4.001	12.413	155.2	225	Circular_Default Sewer Type	110.970	108.990	1.755	110.600	108.910	1.465
4.002	9.563	4.9	225	Circular_Default Sewer Type	110.600	108.810	1.565	110.100	106.850	3.025
1.009	32.559	162.8	225	Circular_Default Sewer Type	110.100	106.850	3.025	110.950	106.650	4.075
1.010	70.980	165.1	225	Circular_Default Sewer Type	110.950	106.650	4.075	111.150	106.220	4.705
1.011	36.823	167.4	225	Circular_Default Sewer Type	111.150	106.220	4.705	110.200	106.000	3.975
1.012	62.474	164.4	225	Circular_Default Sewer Type	110.200	106.000	3.975	107.900	105.620	2.055
1.013	69.882	55.7	225	Circular_Default Sewer Type	107.900	105.620	2.055	105.820	104.365	1.230
1.014	34.400	229.3	225	Circular_Default Sewer Type	105.820	104.290	1.305	105.340	104.140	0.975

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	1	1500	Manhole	Adoptable	2	1200	Manhole	Adoptable
1.001	2	1200	Manhole	Adoptable	3	1200	Manhole	Adoptable
1.002	3	1200	Manhole	Adoptable	4	1200	Manhole	Adoptable
1.003	4	1200	Manhole	Adoptable	5	1500	Manhole	Adoptable
2.000	16	1350	Manhole	Adoptable	17	1350	Manhole	Adoptable
2.001	17	1350	Manhole	Adoptable	18	1350	Manhole	Adoptable
2.002	18	1350	Manhole	Adoptable	5	1500	Manhole	Adoptable
1.004	5	1500	Manhole	Adoptable	6	1500	Manhole	Adoptable
1.005	6	1500	Manhole	Adoptable	7	1800	Manhole	Adoptable
3.000	19	1200	Manhole	Adoptable	7	1800	Manhole	Adoptable
1.006	7	1800	Manhole	Adoptable	8	1500	Manhole	Adoptable
1.007	8	1500	Manhole	Adoptable	9	1500	Manhole	Adoptable
1.008	9	1500	Manhole	Adoptable	10	3000	Manhole	Adoptable
4.000	20	1350	Manhole	Adoptable	21	1200	Manhole	Adoptable
5.000	23	1500	Manhole	Adoptable	21	1200	Manhole	Adoptable
4.001	21	1200	Manhole	Adoptable	22	1350	Manhole	Adoptable
4.002	22	1350	Manhole	Adoptable	10	3000	Manhole	Adoptable
1.009	10	3000	Manhole	Adoptable	11	1200	Manhole	Adoptable
1.010	11	1200	Manhole	Adoptable	12	1200	Manhole	Adoptable
1.011	12	1200	Manhole	Adoptable	13	1200	Manhole	Adoptable
1.012	13	1200	Manhole	Adoptable	14	1200	Manhole	Adoptable
1.013	14	1200	Manhole	Adoptable	14a	1200	Manhole	Adoptable
1.014	14a	1200	Manhole	Adoptable	15	1200	Manhole	Adoptable

Simulation Settings

Rainfall Methodology	FSR	Skip Steady State	✓
FSR Region	England and Wales	Drain Down Time (mins)	240
M5-60 (mm)	20.000	Additional Storage (m³/ha)	0.0
Ratio-R	0.400	Check Discharge Rate(s)	✓
Summer CV	0.750	Check Discharge Volume	✓
Winter CV	0.840	100 year 360 minute (m³)	
Analysis Speed	Detailed		

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

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

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	1.95
Greenfield Method	IH124	Growth Factor 100 year	2.48
Positively Drained Area (ha)		Betterment (%)	0
SAAR (mm)		QBar	
Soil Index	1	Q 1 year (l/s)	
SPR	0.10	Q 30 year (l/s)	
Region	1	Q 100 year (l/s)	
Growth Factor 1 year	0.85		

Pre-development Discharge Volume

Site Makeup	Greenfield	Return Period (years)	100
Greenfield Method	FSR/FEH	Climate Change (%)	0
Positively Drained Area (ha)		Storm Duration (mins)	360
Soil Index	1	Betterment (%)	0
SPR	0.10	PR	
CWI		Runoff Volume (m³)	

Node 10 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	106.850	Product Number	CTL-SHE-0137-9400-1300-9400
Design Depth (m)	1.300	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	9.4	Min Node Diameter (mm)	1200

Node 9 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	106.900
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	377.0	0.0	1.500	863.0	0.0	1.510	0.0	0.0

Results for 100 year Critical Storm Duration. Lowest mass balance: 99.17%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	11	111.623	1.123	44.9	1.9842	0.0000	SURCHARGED
15 minute winter	2	11	111.605	1.145	80.2	1.2945	0.0000	SURCHARGED
15 minute winter	3	11	111.454	1.094	100.6	1.2374	0.0000	SURCHARGED
15 minute winter	4	11	111.155	0.925	127.5	1.0462	0.0000	SURCHARGED
15 minute winter	16	11	112.283	0.733	81.7	1.0485	0.0000	SURCHARGED
15 minute winter	17	11	111.779	0.479	77.1	0.6854	0.0000	SURCHARGED
15 minute winter	18	11	111.451	0.401	90.9	0.5744	0.0000	SURCHARGED
15 minute winter	5	11	110.810	0.750	230.1	1.3252	0.0000	SURCHARGED
15 minute winter	6	11	110.159	0.289	275.3	0.5099	0.0000	OK
15 minute winter	19	10	109.629	0.079	9.9	0.0894	0.0000	OK
15 minute winter	7	11	109.482	0.292	330.4	0.7424	0.0000	OK
15 minute winter	8	10	108.577	0.176	355.9	0.3118	0.0000	OK
240 minute winter	9	240	107.713	0.813	82.5	415.2908	0.0000	SURCHARGED
15 minute winter	20	10	110.374	0.074	28.3	0.1052	0.0000	OK
15 minute winter	23	11	109.213	0.163	16.6	0.2887	0.0000	OK
15 minute winter	21	11	109.205	0.215	43.8	0.2434	0.0000	OK
15 minute winter	22	10	108.917	0.107	108.5	0.1533	0.0000	OK
240 minute winter	10	240	107.713	0.863	20.9	6.1009	0.0000	SURCHARGED
15 minute summer	11	10	106.724	0.074	9.4	0.0837	0.0000	OK
15 minute summer	12	91	106.295	0.075	9.4	0.0847	0.0000	OK
15 minute winter	13	10	106.078	0.078	9.4	0.0886	0.0000	OK
15 minute summer	14	96	105.676	0.056	9.5	0.0633	0.0000	OK
15 minute summer	14a	95	104.372	0.082	9.4	0.0928	0.0000	OK
15 minute summer	15	96	104.219	0.079	9.4	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	1.000	2	40.5	0.575	0.483	0.4916	
15 minute winter	2	1.001	3	79.0	1.123	1.065	1.5670	
15 minute winter	3	1.002	4	99.6	1.414	1.352	2.0688	
15 minute winter	4	1.003	5	126.6	1.798	1.675	1.3589	
15 minute winter	16	2.000	17	77.1	1.938	1.286	0.7495	
15 minute winter	17	2.001	18	73.1	2.057	0.956	0.4617	
15 minute winter	18	2.002	5	89.7	2.464	0.763	0.6604	
15 minute winter	5	1.004	6	228.8	2.076	1.931	3.4946	
15 minute winter	6	1.005	7	274.1	2.734	0.641	3.4484	
15 minute winter	19	3.000	7	9.8	0.823	0.235	0.1111	
15 minute winter	7	1.006	8	329.3	3.649	0.477	3.6002	
15 minute winter	8	1.007	9	357.2	6.232	0.184	0.9942	
15 minute winter	9	1.008	10	-97.4	-0.830	-0.703	12.2734	
15 minute winter	20	4.000	21	28.1	1.249	0.232	0.6096	
15 minute winter	23	5.000	21	15.8	0.517	0.372	0.3117	
15 minute winter	21	4.001	22	43.1	1.181	1.035	0.4472	
15 minute winter	22	4.002	10	108.2	3.219	0.456	0.2792	
15 minute summer	10	Hydro-Brake®	11	9.4				
15 minute summer	11	1.010	12	9.4	0.870	0.233	0.8118	
15 minute summer	12	1.011	13	9.4	0.847	0.234	0.4364	
15 minute winter	13	1.012	14	9.5	1.041	0.235	0.6158	
15 minute summer	14	1.013	14a	9.4	1.229	0.134	0.5341	
15 minute summer	14a	1.014	15	9.4	0.736	0.275	0.4390	136.3



Appendix 5.4

FLOW Drainage Calculations – 100yr+40% Climate Change Storm Event

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	2	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1	0.100	5.00	112.250	1500	437767.220	295250.471	1.750
2	0.094	5.00	112.350	1200	437772.778	295254.695	1.890
3	0.051	5.00	112.350	1200	437765.617	295275.764	1.990
4	0.066	5.00	112.380	1200	437764.399	295305.117	2.150
16	0.182	5.00	113.050	1350	437811.525	295331.368	1.500
17	0.000		112.750	1350	437793.930	295324.617	1.450
18	0.042	5.00	112.540	1350	437782.527	295322.432	1.490
5	0.034	5.00	112.390	1500	437766.033	295324.345	2.330
6	0.110	5.00	111.980	1500	437769.811	295356.587	2.110
19	0.022	5.00	111.060	1200	437766.167	295400.161	1.510
7	0.111	5.00	111.420	1800	437766.785	295390.815	2.230
8	0.063	5.00	110.150	1500	437727.760	295388.348	1.750
9	0.000		108.625	1500	437718.619	295386.148	1.725
20	0.063	5.00	111.740	1350	437741.701	295341.723	1.440
23	0.037	5.00	110.500	1500	437715.040	295348.159	1.450
21	0.000	5.00	110.970	1200	437717.399	295339.574	1.980
22	0.148	5.00	110.600	1350	437705.417	295336.332	1.790
10	0.000		110.100	3000	437698.186	295330.074	3.250
11	0.000		110.950	1200	437699.137	295297.529	4.300
12			111.150	1200	437730.094	295233.655	4.930
13			110.200	1200	437731.968	295196.880	4.200
14	0.000		107.900	1200	437737.861	295134.685	2.280
14a	0.000	5.00	105.820	1200	437740.296	295064.845	1.530
15			105.340	1200	437719.220	295037.657	1.200

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	1	2	6.981	0.600	110.500	110.460	0.040	174.5	300	5.10	50.0
1.001	2	3	22.253	0.600	110.460	110.360	0.100	222.5	300	5.45	50.0
1.002	3	4	29.378	0.600	110.360	110.230	0.130	226.0	300	5.92	50.0
1.003	4	5	19.297	0.600	110.230	110.140	0.090	214.4	300	6.22	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	1.187	83.9	13.6	1.450	1.590	0.100	0.0	81	0.878
1.001	1.050	74.2	26.3	1.590	1.690	0.194	0.0	123	0.963
1.002	1.041	73.6	33.2	1.690	1.850	0.245	0.0	141	1.015
1.003	1.070	75.6	42.1	1.850	1.950	0.311	0.0	160	1.098

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
2.000	16	17	18.846	0.600	111.550	111.300	0.250	75.4	225	5.21	50.0
2.001	17	18	11.610	0.600	111.300	111.050	0.250	46.4	225	5.31	50.0
2.002	18	5	16.605	0.600	111.050	110.210	0.840	19.8	225	5.40	50.0
1.004	5	6	32.463	0.600	110.060	109.945	0.115	282.3	375	6.73	50.0
1.005	6	7	34.361	0.600	109.870	109.270	0.600	57.3	450	6.94	50.0
3.000	19	7	9.366	0.600	109.550	109.490	0.060	156.1	225	5.15	50.0
1.006	7	8	39.103	0.600	109.190	108.400	0.790	49.5	525	7.14	50.0
1.007	8	9	9.402	0.600	108.400	106.900	1.500	6.3	525	7.16	50.0
1.008	9	10	59.681	0.600	106.900	106.850	0.050	1193.6	525	8.72	50.0
4.000	20	21	24.397	0.600	110.300	108.990	1.310	18.6	225	5.13	50.0
5.000	23	21	8.903	0.600	109.050	108.990	0.060	148.4	225	5.14	50.0
4.001	21	22	12.413	0.600	108.990	108.910	0.080	155.2	225	5.34	50.0
4.002	22	10	9.563	0.600	108.810	106.850	1.960	4.9	225	5.36	50.0
1.009	10	11	32.559	0.600	106.850	106.650	0.200	162.8	225	9.25	0.0
1.010	11	12	70.980	0.600	106.650	106.220	0.430	165.1	225	10.41	0.0
1.011	12	13	36.823	0.600	106.220	106.000	0.220	167.4	225	11.02	0.0
1.012	13	14	62.474	0.600	106.000	105.620	0.380	164.4	225	12.05	0.0
1.013	14	14a	69.882	0.600	105.620	104.365	1.255	55.7	225	12.71	0.0
1.014	14a	15	34.400	0.600	104.290	104.140	0.150	229.3	225	13.38	0.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
2.000	1.507	59.9	24.7	1.275	1.225	0.182	0.0	101	1.437
2.001	1.924	76.5	24.7	1.225	1.265	0.182	0.0	87	1.718
2.002	2.956	117.5	30.4	1.265	1.955	0.224	0.0	78	2.491
1.004	1.073	118.5	77.1	1.955	1.660	0.569	0.0	221	1.140
1.005	2.690	427.9	92.0	1.660	1.700	0.679	0.0	141	2.164
3.000	1.044	41.5	3.0	1.285	1.705	0.022	0.0	41	0.611
1.006	3.189	690.3	110.0	1.705	1.225	0.812	0.0	141	2.365
1.007	8.985	1945.0	118.6	1.225	1.200	0.875	0.0	86	5.068
1.008	0.640	138.5	118.6	1.200	2.725	0.875	0.0	376	0.715
4.000	3.046	121.1	8.5	1.215	1.755	0.063	0.0	40	1.769
5.000	1.071	42.6	5.0	1.225	1.755	0.037	0.0	52	0.725
4.001	1.047	41.6	13.6	1.755	1.465	0.100	0.0	88	0.939
4.002	5.963	237.1	33.6	1.565	3.025	0.248	0.0	57	4.245
1.009	1.022	40.6	0.0	3.025	4.075	1.123	0.0	0	0.000
1.010	1.015	40.3	0.0	4.075	4.705	1.123	0.0	0	0.000
1.011	1.008	40.1	0.0	4.705	3.975	1.123	0.0	0	0.000
1.012	1.017	40.4	0.0	3.975	2.055	1.123	0.0	0	0.000
1.013	1.756	69.8	0.0	2.055	1.230	1.123	0.0	0	0.000
1.014	0.859	34.2	0.0	1.305	0.975	1.123	0.0	0	0.000

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	6.981	174.5	300	Circular_Default Sewer Type	112.250	110.500	1.450	112.350	110.460	1.590
1.001	22.253	222.5	300	Circular_Default Sewer Type	112.350	110.460	1.590	112.350	110.360	1.690
1.002	29.378	226.0	300	Circular_Default Sewer Type	112.350	110.360	1.690	112.380	110.230	1.850
1.003	19.297	214.4	300	Circular_Default Sewer Type	112.380	110.230	1.850	112.390	110.140	1.950
2.000	18.846	75.4	225	Circular_Default Sewer Type	113.050	111.550	1.275	112.750	111.300	1.225
2.001	11.610	46.4	225	Circular_Default Sewer Type	112.750	111.300	1.225	112.540	111.050	1.265
2.002	16.605	19.8	225	Circular_Default Sewer Type	112.540	111.050	1.265	112.390	110.210	1.955
1.004	32.463	282.3	375	Circular_Default Sewer Type	112.390	110.060	1.955	111.980	109.945	1.660
1.005	34.361	57.3	450	Circular_Default Sewer Type	111.980	109.870	1.660	111.420	109.270	1.700
3.000	9.366	156.1	225	Circular_Default Sewer Type	111.060	109.550	1.285	111.420	109.490	1.705
1.006	39.103	49.5	525	Circular_Default Sewer Type	111.420	109.190	1.705	110.150	108.400	1.225
1.007	9.402	6.3	525	Circular_Default Sewer Type	110.150	108.400	1.225	108.625	106.900	1.200
1.008	59.681	1193.6	525	Circular_Default Sewer Type	108.625	106.900	1.200	110.100	106.850	2.725
4.000	24.397	18.6	225	Circular_Default Sewer Type	111.740	110.300	1.215	110.970	108.990	1.755
5.000	8.903	148.4	225	Circular_Default Sewer Type	110.500	109.050	1.225	110.970	108.990	1.755
4.001	12.413	155.2	225	Circular_Default Sewer Type	110.970	108.990	1.755	110.600	108.910	1.465
4.002	9.563	4.9	225	Circular_Default Sewer Type	110.600	108.810	1.565	110.100	106.850	3.025
1.009	32.559	162.8	225	Circular_Default Sewer Type	110.100	106.850	3.025	110.950	106.650	4.075
1.010	70.980	165.1	225	Circular_Default Sewer Type	110.950	106.650	4.075	111.150	106.220	4.705
1.011	36.823	167.4	225	Circular_Default Sewer Type	111.150	106.220	4.705	110.200	106.000	3.975
1.012	62.474	164.4	225	Circular_Default Sewer Type	110.200	106.000	3.975	107.900	105.620	2.055
1.013	69.882	55.7	225	Circular_Default Sewer Type	107.900	105.620	2.055	105.820	104.365	1.230
1.014	34.400	229.3	225	Circular_Default Sewer Type	105.820	104.290	1.305	105.340	104.140	0.975

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	1	1500	Manhole	Adoptable	2	1200	Manhole	Adoptable
1.001	2	1200	Manhole	Adoptable	3	1200	Manhole	Adoptable
1.002	3	1200	Manhole	Adoptable	4	1200	Manhole	Adoptable
1.003	4	1200	Manhole	Adoptable	5	1500	Manhole	Adoptable
2.000	16	1350	Manhole	Adoptable	17	1350	Manhole	Adoptable
2.001	17	1350	Manhole	Adoptable	18	1350	Manhole	Adoptable
2.002	18	1350	Manhole	Adoptable	5	1500	Manhole	Adoptable
1.004	5	1500	Manhole	Adoptable	6	1500	Manhole	Adoptable
1.005	6	1500	Manhole	Adoptable	7	1800	Manhole	Adoptable
3.000	19	1200	Manhole	Adoptable	7	1800	Manhole	Adoptable
1.006	7	1800	Manhole	Adoptable	8	1500	Manhole	Adoptable
1.007	8	1500	Manhole	Adoptable	9	1500	Manhole	Adoptable
1.008	9	1500	Manhole	Adoptable	10	3000	Manhole	Adoptable
4.000	20	1350	Manhole	Adoptable	21	1200	Manhole	Adoptable
5.000	23	1500	Manhole	Adoptable	21	1200	Manhole	Adoptable
4.001	21	1200	Manhole	Adoptable	22	1350	Manhole	Adoptable
4.002	22	1350	Manhole	Adoptable	10	3000	Manhole	Adoptable
1.009	10	3000	Manhole	Adoptable	11	1200	Manhole	Adoptable
1.010	11	1200	Manhole	Adoptable	12	1200	Manhole	Adoptable
1.011	12	1200	Manhole	Adoptable	13	1200	Manhole	Adoptable
1.012	13	1200	Manhole	Adoptable	14	1200	Manhole	Adoptable
1.013	14	1200	Manhole	Adoptable	14a	1200	Manhole	Adoptable
1.014	14a	1200	Manhole	Adoptable	15	1200	Manhole	Adoptable

Simulation Settings

Rainfall Methodology	FSR	Skip Steady State	✓
FSR Region	England and Wales	Drain Down Time (mins)	240
M5-60 (mm)	20.000	Additional Storage (m³/ha)	0.0
Ratio-R	0.400	Check Discharge Rate(s)	✓
Summer CV	0.750	Check Discharge Volume	✓
Winter CV	0.840	100 year 360 minute (m³)	
Analysis Speed	Detailed		

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

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

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	1.95
Greenfield Method	IH124	Growth Factor 100 year	2.48
Positively Drained Area (ha)		Betterment (%)	0
SAAR (mm)		QBar	
Soil Index	1	Q 1 year (l/s)	
SPR	0.10	Q 30 year (l/s)	
Region	1	Q 100 year (l/s)	
Growth Factor 1 year	0.85		

Pre-development Discharge Volume

Site Makeup	Greenfield	Return Period (years)	100
Greenfield Method	FSR/FEH	Climate Change (%)	0
Positively Drained Area (ha)		Storm Duration (mins)	360
Soil Index	1	Betterment (%)	0
SPR	0.10	PR	
CWI		Runoff Volume (m³)	

Node 10 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	106.850	Product Number	CTL-SHE-0137-9400-1300-9400
Design Depth (m)	1.300	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	9.4	Min Node Diameter (mm)	1200

Node 9 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	106.900
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	377.0	0.0	1.500	863.0	0.0	1.510	0.0	0.0

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.15%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	10	112.250	1.750	62.9	3.0923	3.7420	FLOOD
15 minute winter	2	10	112.242	1.782	96.6	2.0150	0.0000	FLOOD RISK
15 minute winter	3	10	112.073	1.713	119.8	1.9376	0.0000	FLOOD RISK
15 minute winter	4	10	111.649	1.419	162.1	1.6051	0.0000	SURCHARGED
15 minute winter	16	10	113.050	1.500	114.4	2.1465	3.5411	FLOOD
15 minute winter	17	11	112.450	1.150	90.1	1.6457	0.0000	FLOOD RISK
15 minute winter	18	11	112.038	0.988	109.1	1.4143	0.0000	SURCHARGED
15 minute winter	5	11	111.114	1.054	284.1	1.8632	0.0000	SURCHARGED
15 minute winter	6	11	110.219	0.349	349.6	0.6166	0.0000	OK
15 minute winter	19	10	109.645	0.095	13.8	0.1079	0.0000	OK
15 minute winter	7	11	109.537	0.347	430.0	0.8835	0.0000	OK
15 minute winter	8	10	108.604	0.204	468.5	0.3610	0.0000	OK
360 minute winter	9	352	108.029	1.129	86.3	634.1732	0.0000	SURCHARGED
15 minute winter	20	10	110.388	0.088	39.6	0.1258	0.0000	OK
15 minute winter	23	11	109.365	0.315	23.3	0.5557	0.0000	SURCHARGED
15 minute winter	21	11	109.339	0.349	61.4	0.3949	0.0000	SURCHARGED
15 minute winter	22	10	108.958	0.148	152.5	0.2114	0.0000	OK
360 minute winter	10	352	108.029	1.179	21.3	8.3335	0.0000	SURCHARGED
15 minute winter	11	7	106.724	0.074	9.4	0.0839	0.0000	OK
15 minute winter	12	9	106.295	0.075	9.4	0.0847	0.0000	OK
15 minute winter	13	10	106.079	0.079	9.4	0.0889	0.0000	OK
15 minute summer	14	238	105.676	0.056	9.5	0.0633	0.0000	OK
15 minute summer	14a	238	104.372	0.082	9.4	0.0928	0.0000	OK
15 minute summer	15	238	104.219	0.079	9.4	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	1	1.000	2	49.5	0.703	0.590	0.4916	
30 minute summer	2	1.001	3	95.5	1.356	1.287	1.5670	
30 minute summer	3	1.002	4	120.8	1.715	1.641	2.0688	
15 minute winter	4	1.003	5	158.8	2.255	2.100	1.3589	
15 minute summer	16	2.000	17	92.8	2.333	1.548	0.7495	
15 minute summer	17	2.001	18	85.0	2.138	1.111	0.4617	
15 minute winter	18	2.002	5	107.1	2.693	0.911	0.6604	
15 minute winter	5	1.004	6	284.5	2.580	2.400	3.5444	
15 minute winter	6	1.005	7	351.2	2.855	0.821	4.2166	
15 minute winter	19	3.000	7	13.6	0.898	0.328	0.1422	
15 minute winter	7	1.006	8	431.2	3.815	0.625	4.4354	
15 minute winter	8	1.007	9	471.2	6.344	0.242	1.2287	
15 minute winter	9	1.008	10	-136.5	-0.924	-0.986	12.8931	
15 minute winter	20	4.000	21	39.4	1.306	0.326	0.6602	
15 minute winter	23	5.000	21	22.5	0.565	0.528	0.3541	
15 minute winter	21	4.001	22	60.7	1.528	1.458	0.4790	
15 minute winter	22	4.002	10	152.1	4.111	0.642	0.3223	
15 minute summer	10	Hydro-Brake®	11	9.4				
15 minute winter	11	1.010	12	9.4	0.915	0.233	0.8120	
15 minute winter	12	1.011	13	9.4	0.870	0.235	0.4391	
15 minute winter	13	1.012	14	9.5	1.051	0.236	0.6151	
15 minute summer	14	1.013	14a	9.4	1.229	0.134	0.5341	
15 minute summer	14a	1.014	15	9.4	0.736	0.275	0.4390	136.7