



**Building 9, Broadway Farm,
Broad Oak,
SO30 2EU**

Surface Water Drainage Strategy

October 2022



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Client	CCW Services Ltd

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APPENDIX A – DRAWINGS

APPENDIX B – CALCULATIONS

1. INTRODUCTION

- [B] 1.1 This document has been prepared in support of a planning application for the construction of a new warehouse **and vehicle storage** area at Broadway Farm, Broad Oak, SO30 2EU. The location of the site is shown in Figure 1 below.

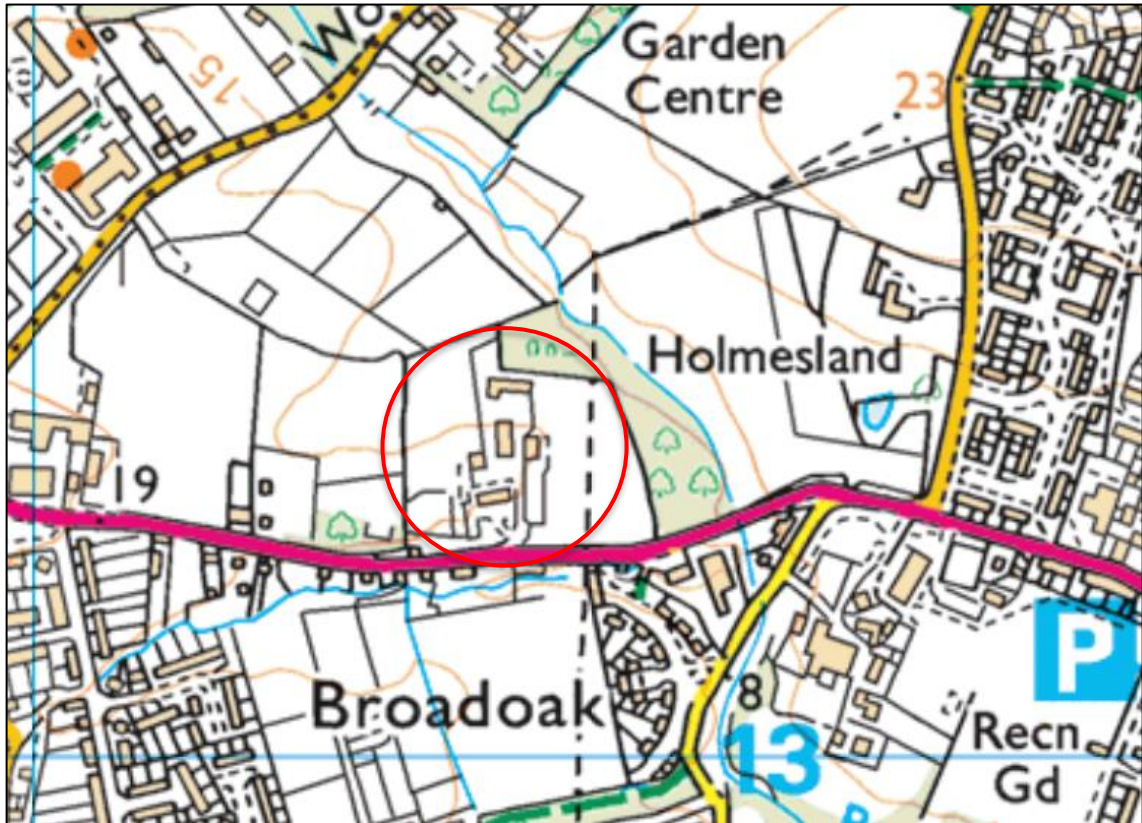


Figure 1. Location Plan

- 1.2 The existing site comprises a tarmac access road, greenfield land, and an area of tarmac parking. For the purpose of this report all areas apart from the access road are considered to be greenfield land.
- 1.3 A topographic survey of the existing site and drawings of the development relevant to this report are included in Appendix A.

2. SUSTAINABLE DRAINAGE PRINCIPLES FOR THE DEVELOPMENT

2.1 The surface water management strategy will adhere to the principles set out in DEFRA's Non-Statutory Technical Standards for Sustainable Drainage Systems. A summary of how the strategy complies with each section of the standards is included in Section 11 of this report.

[B] 2.2 Options for disposal of surface water have been considered in accordance with the drainage hierarchy. A summary of proposed features is shown in Table 2.1.

Disposal Method	Comment
1. Store rainwater for later use.	Not practicable, there is no significant, consistent demand for greywater.
2. Use infiltration techniques.	Not practicable due to ground conditions – refer to Section 5 below.
4. Attenuate rainwater in ponds or open surface water features.	Proposed.
5. Attenuate rainwater by storing in tanks for gradual release.	Not required.
6. Discharge rainwater direct to a watercourse.	Not required.
7. Discharge rainwater to a surface water sewer.	Not required.
8. Discharge rainwater to a combined sewer.	Not required.

Table 2.1 – Summary of Drainage Hierarchy

3. EXISTING FLOWPATHS

3.1 Flowpaths across the existing site are shown below.

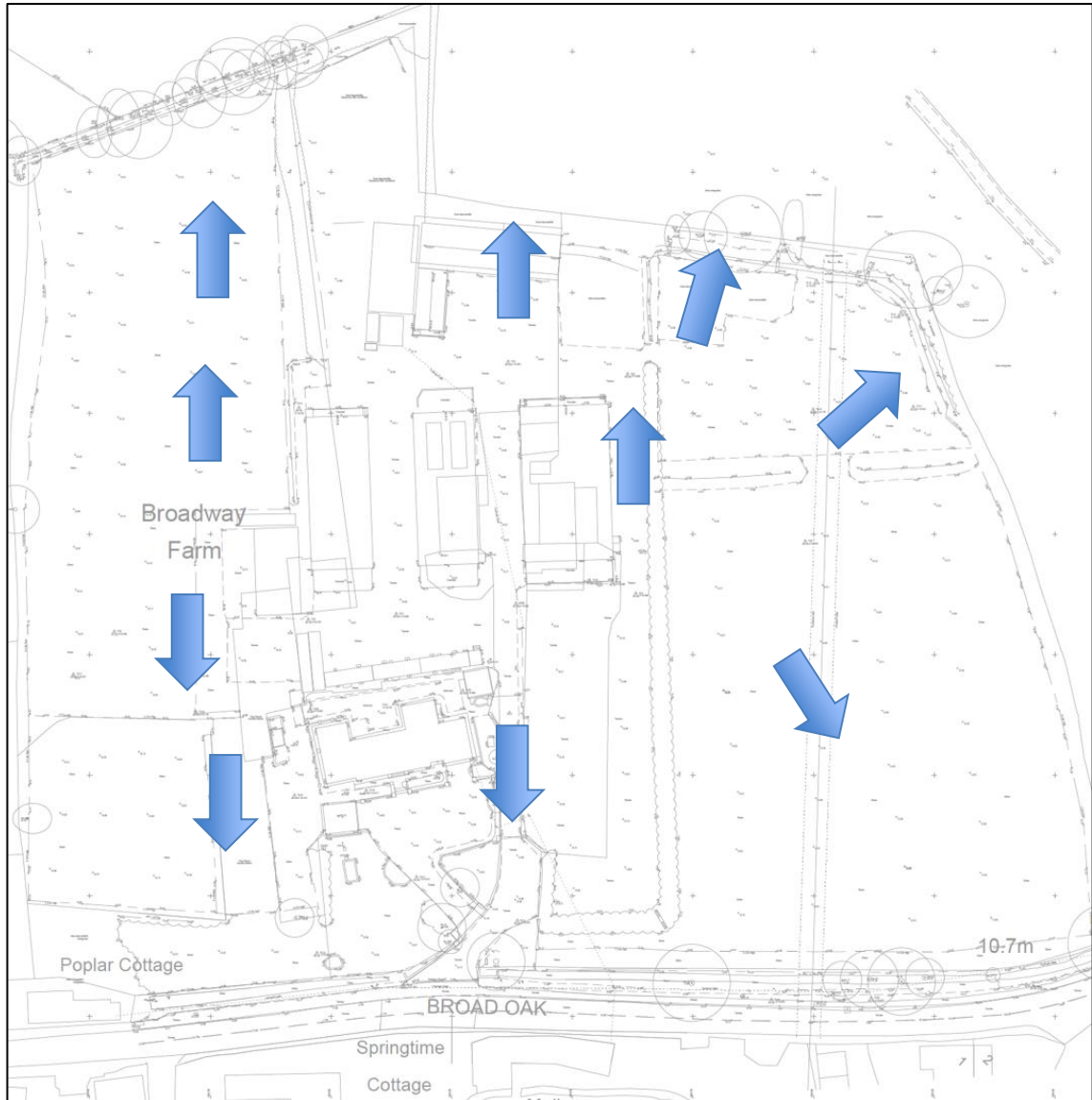


Figure 2. Existing Flowpaths

4. PROPOSED DESTINATION FOR SURFACE WATER POST-DEVELOPMENT

4.1 Post-development it is proposed to discharge runoff from the new warehouse to the ditch immediately to the north of the site as shown on DR-001 in Appendix A. The ditch flows in to a stream which is a tributary of the river Hamble.

[B] 4.2 The new vehicle storage area will be constructed of GrassCrete, thereby mimicking greenfield runoff conditions.

5. GROUND INVESTIGATION RESULTS

5.1 The British Geological Society's 1:50,000 maps show the area in the vicinity of the site to be underlain by the Earnley Sand Formation with no superficial deposits.

5.2 Boreholes in the vicinity of the site describe a silty clayey soil within 2m of ground level and groundwater within 1-2m of ground level.

5.3 The Soilscales database indicates seasonally wet soils with impeded drainage.

5.4 RJ Watkinson's Drainage Philosophy report of October 2021 (previously submitted in support of the planning application) reports that percolation tests were carried out at the site and states that *"Two tests were undertaken using 2m deep trial holes, with groundwater entering the excavation of one trial hole and the water (which was filled 1m deep) only dropping 90mm over a period of 17 hours."*

[B] 5.5 On the basis of the above it is concluded that infiltration will not be feasible for the disposal of runoff for anything other than permeable surfaces, which will mimic greenfield runoff rates and volumes.

6. EXISTING WATERCOURSES

6.1 The ditch on the northern boundary of the site flows in to a tributary of the River Hamble.

6.2 The southern half of the ditch is within the applicant's ownership.

7. EXISTING AND PROPOSED SURFACE WATER SEWERS AND PUMPING STATIONS

7.1 There are no pumping stations within the existing site.

7.2 There are no public surface water sewers into which runoff from the northern part of the site can gravitate.

7.3 All runoff can be discharged from the site without the need for pumping or discharge to a public surface water sewer.

8. SURFACE WATER FLOWS ONTO THE SITE AND FLOWPATHS THROUGH THE DEVELOPMENT

- 8.1 The extract from the Gov.UK flood maps shown in Figure 3 indicates the site is unlikely to experience significant runoff from the surrounding area for rainfall events up to the 1000year return period.



[B] Figure 3. Extract from Gov.UK Map Showing Risk of Surface Water Flooding

- 8.2 Surface water flows around the site will be unaltered by the proposed development and are described in Section 18 below.

9. OFFSITE WORKS REQUIRED TO MITIGATE FLOOD RISK

- 9.1 No off-site works are required for the management of surface water.

10. SENSITIVE RECEPTORS

- 10.1 The EA's groundwater vulnerability maps show the nearest groundwater source protection zones to be approximately 10km from the site.
- 10.2 The watercourse into which it is proposed to discharge ultimately drains to the Upper Hamble Estuary and Woods SSSI.

11. COMPLIANCE WITH THE DEFRA NON-STATUTORY TECHNICAL STANDARDS

- 11.1 Table 11.1 indicates which section of this report provides evidence of compliance with DEFRA's non-statutory technical standards for sustainable drainage systems.

Section	Report Reference
S1	Not Applicable – no surface water bodies in vicinity of site
S2	Section 16
S3	Not Applicable – greenfield development
S4	Section 16
S5	Not Applicable – greenfield development
S6	Not Applicable – greenfield development
S7	Section 16
S8	Section 16
S9	Section 18
S10	Section 23
S11	Section 22-23
S12	Section 7
S13	Section 23
S14	Section 23

Table 11.1 – Summary of Compliance with Technical Standards

12. CONSENTS REQUIRED

- 12.1 No consents are required for the disposal of surface water from the site.

13. SURFACE WATER STORAGE VOLUMES AND LOCATIONS

- [B]** 13.1 An initial estimate of required storage has been made using the HR Wallingford online estimation tool (see Appendix B), which shows that approximately **159m³** of storage is required to attenuate runoff from the site to greenfield rates.
- 13.2 Further details of the drainage arrangements are described below and shown on the drawings in Appendix A.

[B] 14. TREATMENT TRAIN COMPONENTS

14.1 Table 26.2 of the CIRIA SuDS Manual indicates that the pollution indices for a commercial yard are as follows:

- Total suspended solids = 0.7
- Metals = 0.6
- Hydro-carbons = 0.7

14.2 It is proposed to capture runoff from the tarmac area around the warehouse in a filter drain, the treatment parameters for which are given in Table 26.3 of the SuDS Manual and area as follows:

- Total suspended solids = 0.4
- Metals = 0.4
- Hydro-carbons = 0.4

14.3 The filter drain will discharge to a pond, the treatment parameters for which are as follows:

- Total suspended solids = 0.7
- Metals = 0.7
- Hydro-carbons = 0.5

14.4 Following the approach set out in Section 26.7 of the SuDS Manual, the combined mitigation indices are as follows:

- Total suspended solids = $0.4 + (0.7/2)$ = 0.75
- Metals = $0.4 + (0.7/2)$ = 0.75
- Hydro-carbons = $0.4 + (0.5/2)$ = 0.65

14.5 When rounded, the mitigation indices for the tarmac area around the warehouse are equal to the pollution indices, and the treatment measures are deemed to be appropriate.

14.6 It is proposed to construct the vehicle storage area as a permeable surface, the treatment parameters for which are given in Table 26.3 of the SuDS Manual and area as follows:

- Total suspended solids = 0.7
- Metals = 0.6
- Hydro-carbons = 0.7

These parameters are equal to the pollution indices for the site.

15. PROPOSED LANDSCAPING AND VEGETATIVE SYSTEMS

15.1 The new pond will provide biodiversity and amenity benefits.

[B]

16. DESIGN CALCULATIONS

16.1 Greenfield Runoff

16.1.1 The greenfield runoff rates for the area of the site contributing to the proposed drainage system have been estimated using the HR Wallingford Greenfield Runoff Estimation Tool and are summarised below. A copy of the calculation is included in Appendix B.

Return Period (years)	Runoff (l/s)
Qbar	1.5
1	1.3
30	3.5
100	4.8

Table 16.1 – Summary of Greenfield Runoff Rates

16.2 Brownfield Runoff

16.2.1 Not applicable.

16.3 Proposed Peak Flow Rates

16.3.1 It is proposed to limit the peak rate of discharge from the site to the 100year greenfield rate of 7.6l/s for all rainfall events up to the 100year return period plus a 45% increase for the potential impact of climate change.

16.3.2 Calculation 3 in Appendix B indicates that there will be no flooding for the 100year + 45% rainfall event.

16.4 Surface Water Volumes

16.4.1 The proposed drainage strategy will result in an increase in the volume of runoff from the site for the 100yr-6hr rainfall event of approximately 60m³. This is less than the volume of the proposed attenuation pond – see 16.5.1 below.

16.5 Storage Requirements

16.5.1 221m³ of attenuation storage will be provided in an attenuation pond.

16.6 Half Drain Time

16.6.1 From the MicroDrainage printout for the proposed drainage system in Appendix B it can be seen that the half drain down time of the tank for the critical duration 100yr rainfall event is less than 24hours.

17. MULTI-USE AREAS

- [B]** 17.1 The proposed pond and surrounding area can be used to improve biodiversity and as an amenity area for site workers.

18. EXCEEDANCE FLOWS

- 18.1 From Calculation 3 in Appendix B it can be seen that no flooding is predicted for the 1000year return period rainfall event.
- 18.2 The storage areas and flow paths associated with the exceedance flows arising from a blockage or failure of the system are shown on DR-004 in Appendix A.
- 18.3 From DR-004 it can be seen that exceedance flows will not present a danger to people or property.

19. TEMPORARY DRAINAGE DURING CONSTRUCTION

- 19.1 Temporary drainage arrangements will be set up in accordance with CIRIA C768 Guidance on the Construction of SuDS. The location of features to manage runoff from the site during the construction period is shown on DR-003 in Appendix A.

[B] 20. CLIMATE CHANGE ALLOWANCES

- 20.1 EA guidance on climate change allowances requires that both the 20% and **45%** increase in rainfall intensity scenarios be investigated.
- 20.2 The peak flow rates and storage requirements for the proposed development reported in Section 16 above include a **45%** increase in the intensity of rainfall events to allow for the potential impact of climate change.

21. FUTURE DEVELOPMENT ALLOWANCES

- 21.1 Given the nature of the proposed development no allowance has been made for the potential impact of urban creep.

22. SUDS MAINTENANCE

- 22.1 The site owner will be responsible for ensuring that the drainage system is maintained in accordance with the schedules shown in the following tables. Appropriately experienced contractors will be engaged to carry out the works

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter (including leaf litter) and debris from filter drain surface, access chambers and pre-treatment devices	Monthly (or as required)
	Inspect filter drain surface, inlet/outlet pipework and control systems for blockages, clogging, standing water and structural damage	Monthly
	Inspect pre-treatment systems, inlets and perforated pipework for silt accumulation, and establish appropriate silt removal frequencies	Six monthly
	Remove sediment from pre-treatment devices	Six monthly, or as required
Occasional maintenance	Remove or control tree roots where they are encroaching the sides of the filter drain, using recommended methods (eg NJUG, 2007 or BS 3998:2010)	As required
	At locations with high pollution loads, remove surface geotextile and replace, and wash or replace overlying filter medium	Five yearly, or as required
	Clear perforated pipework of blockages	As required

Table 22.1 - Maintenance Schedule for Filter Drains© CIRIA

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly (or as required)
	Cut the grass – public areas	Monthly (during growing season)
	Cut the meadow grass	Half yearly (spring, before nesting season, and autumn)
	Inspect marginal and bankside vegetation and remove nuisance plants (for first 3 years)	Monthly (at start, then as required)
	Inspect inlets, outlets, banksides, structures, pipework etc for evidence of blockage and/or physical damage	Monthly
	Inspect water body for signs of poor water quality	Monthly (May – October)
	Inspect silt accumulation rates in any forebay and in main body of the pond and establish appropriate removal frequencies; undertake contamination testing once some build-up has occurred, to inform management and disposal options	Half yearly
	Check any mechanical devices eg penstocks	Half yearly
	Hand cut submerged and emergent aquatic plants (at minimum of 0.1 m above pond base; include max 25% of pond surface)	Annually
	Remove 25% of bank vegetation from water's edge to a minimum of 1 m above water level	Annually
	Tidy all dead growth (scrub clearance) before start of growing season (Note: tree maintenance is usually part of overall landscape management contract)	Annually
	Remove sediment from any forebay.	Every 1–5 years, or as required
	Remove sediment and planting from one quadrant of the main body of ponds without sediment forebays.	Every 5 years, or as required
Occasional maintenance	Remove sediment from the main body of big ponds when pool volume is reduced by 20%	With effective pre-treatment, this will only be required rarely, eg every 25–50 years
Remedial actions	Repair erosion or other damage	As required
	Replant, where necessary	As required
	Aerate pond when signs of eutrophication are detected	As required
	Realign rip-rap or repair other damage	As required
	Repair / rehabilitate inlets, outlets and overflows.	As required

[B] Table 22.2 - Maintenance Schedule for Attenuation Pond © CIRIA

22.3 The indicative design life/replacement frequency of the various components of the drainage system is shown in Table 22.3

Component Type	Indicative Design Life
Filter drains	20-30years

Table 22.3 – Design Life/Replacement Frequency of Components

23. STRUCTURAL INTEGRITY OF SUDS

- 23.1 All drainage infrastructure will be located to ensure there is no requirement for special support for adjacent foundations, either during the construction or future excavation of the infrastructure.
- 23.2 All SuDS components will be designed in accordance with the guidance and specifications in the SuDS Manual.
- 23.4 Prior to completion of the construction all above ground works will be visually inspected for compliance with the specification and all pipes will be surveyed using CCTV.

Surface Water Drainage Strategy

Building 9, Broadway Farm, Broad Oak, SO30 2EU



APPENDIX A DRAWINGS

Topographic Survey

DR-001 Surface Water Drainage Strategy

DR-002 Surface Water Drainage – Area Take-Off

DR-003 Temporary Surface Water Drainage Arrangements

DR-004 Surface Water Exceedance Flows



Tree List

Tree	Tree	Tree	Tree	Tree	Tree	Tree	Tree
1	2	3	4	5	6	7	8
9	10	11	12	13	14	15	16
17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	32
33	34	35	36	37	38	39	40
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Abbreviations

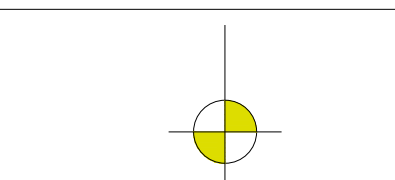
Wt	brick wall	no	roosting owl
Wd	board	mp	road name plate
Wt	bus stop	mp	manometer pipe
Wt	Wt inspection chamber	Wt	road sign
Wt	Wt cable to cover	Wt	survey station
Wt	Wt drainage channel	Wt	stop cock
Wt	Wt dropped kerb	Wt	stop
Wt	Wt diameter	Wt	stop valve
Wt	Wt electricity pole	Wt	traffic light
Wt	Wt earth rod	Wt	telegraph pole
Wt	Wt flower bed	Wt	vent pipe
Wt	Wt fire hydrant	Wt	water meter
Wt	Wt footpath	Wt	water stop cock
Wt	Wt gully	Wt	water stop valve
Wt	Wt gas stop cock	Wt	Wt
Wt	Wt gas stop valve	Wt	Wt
Wt	Wt hydrant	Wt	Wt
Wt	Wt inspection chamber	Wt	Wt
Wt	Wt junction box	Wt	Wt
Wt	Wt kerb	Wt	Wt
Wt	Wt ladder box	Wt	Wt
Wt	Wt lamp post	Wt	Wt
Wt	Wt manhole	Wt	Wt
Wt	Wt manhole	Wt	Wt
Wt	Wt height	Wt	Wt
Wt	Wt post	Wt	Wt
Wt	Wt post box	Wt	Wt
Wt	Wt lamp post	Wt	Wt

Line types

—	Fences
—	Kerb
—	Walls
—	Stairs
—	Change of Surface
—	Footpath
—	Bank Top
—	Bank Bottom
—	Building
—	Building Overhead
—	Roof heights
—	Flower Bed
—	Overhead Cable
—	Road Edge
—	Hedge Row
—	Canopy
—	Edge of vegetation
—	Multi directional tree canopy
—	Trunk position at ground level
—	Edge of canopy
—	No 38
—	Multi bole
—	Tree number

Notes

Tree species should be confirmed by a arboricultural consultant if critical
Trunk sizes are measured at 1.5m above ground level
Eaves heights (where shown) are taken at the end of the tile / top of guttering
Ridge heights are taken at the top of the ridge tile.
Service covers indicated where visible at time of survey



J. Brotherton & Partners
Land Surveyors & Engineers

Frederick 115 Frogmore Lane
Windsor, Berkshire SL4 1JG
Tel: 01753 6059 1979
Email: enquiries@jbrotherton.co.uk
Web: www.jbrotherton.co.uk

Client: Louisa Jane Doe

Drawing Title: Topographic Land Survey

Location: Broadway Farm Broad Oak SO30 2EU

Revisions / Status / Notes

The grid and datum for this survey is based on the Ordnance Survey grid OSGB36, site centered on control station GPS1 with a scale factor of 1.00

LEVELS BASED ON:	OSGB36	Surveyor:	SB	Assistant:	TC
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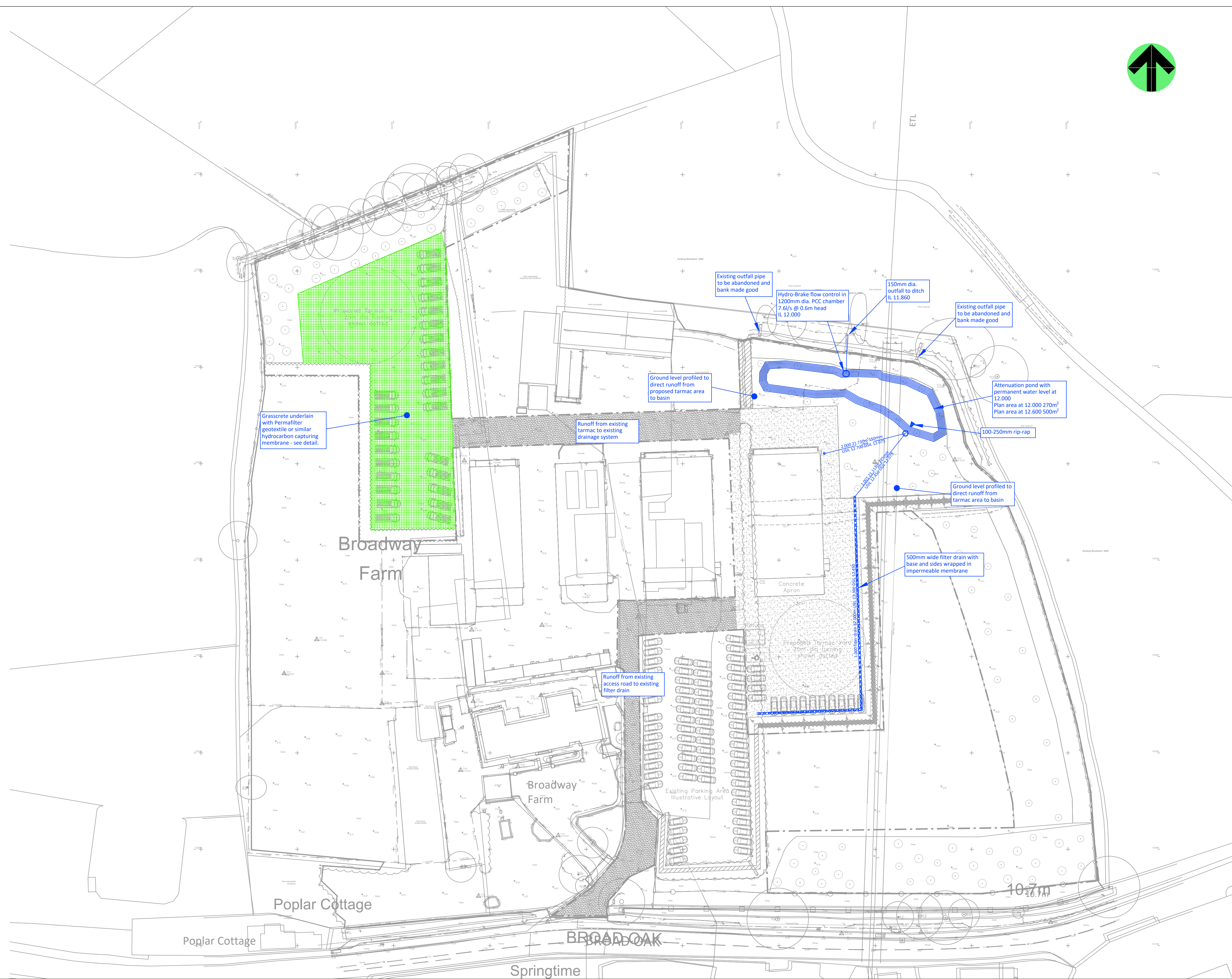
Drawing & CAD File: JOB - 22384

SCALE (where printed): 1:500 @ A1

Date: 22nd August 2022

REVISIONS

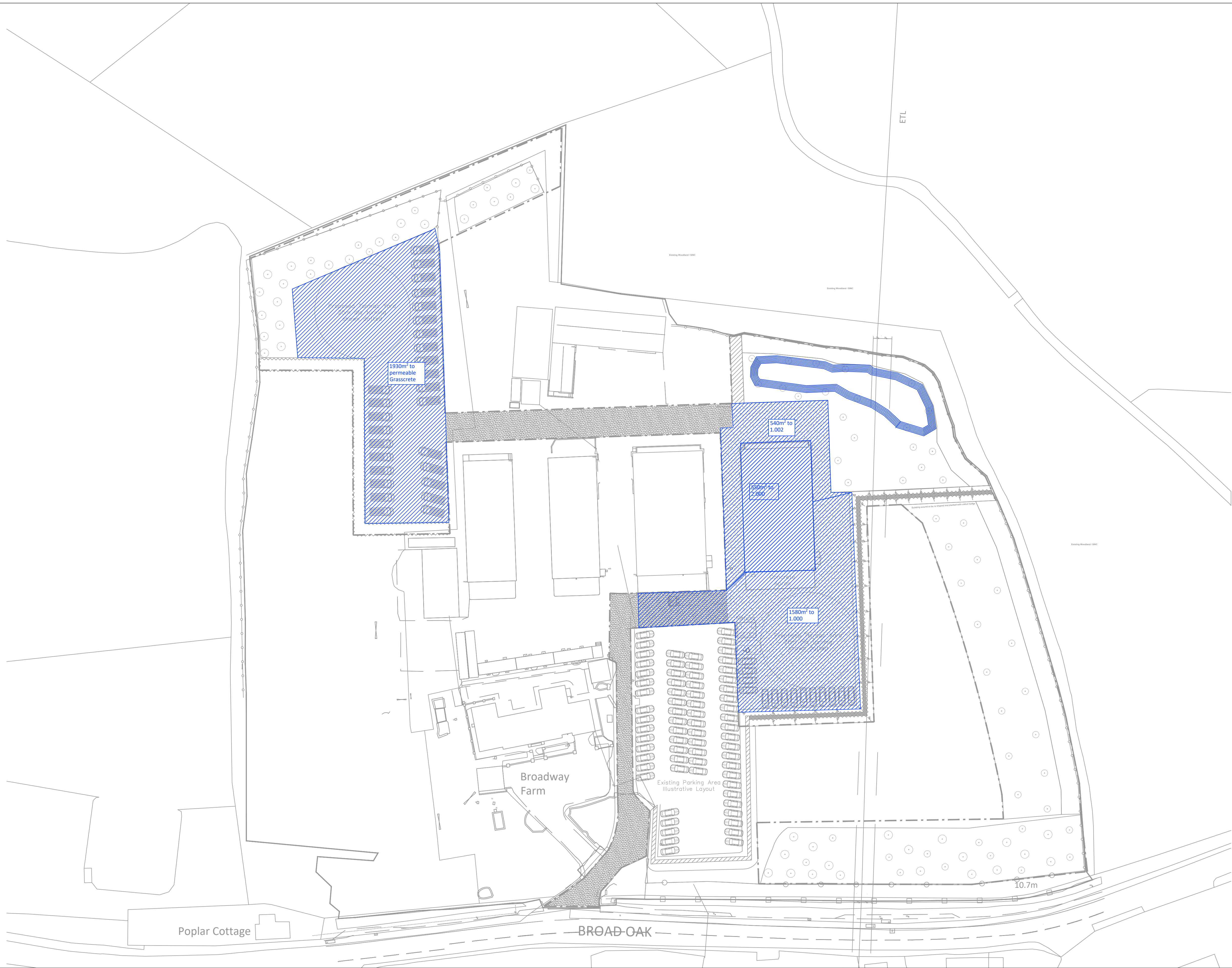
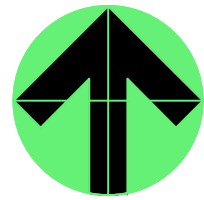
REMOVED BY: THE SURVEY



NOTES

1. Building drainage to be designed and constructed in accordance with Part H of the Building Regulations.
2. Refer to DR-002 for details of contributing areas.



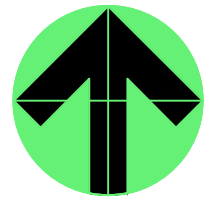


NOTES
1. To be read in conjunction with DR-001.

A	03.05.2022	Initial issue
B	20.10.2022	Amended to suit revised layout
REV	DATE	DESCRIPTION
CLIENT:		

PROJECT: BUILDING 9 BROADWAY FARM		
TITLE: SURFACE WATER DRAINAGE STRATEGY		
REV: B	PROJECT No: 0591	DRAWING No: DR-002
SCALE @ A1: 1:500		





TPOC LIST			
NO	DATE	BY	REVISION
1	03.05.2022	Initial issue	
2	20.10.2022	Amended to suit revised layout	

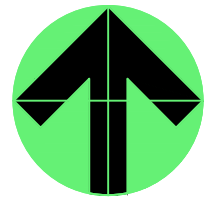
NOTES
1. This drawing to be read in conjunction with the Construction Environmental Management Plan.

REV	DATE	DESCRIPTION
A	03.05.2022	Initial issue
B	20.10.2022	Amended to suit revised layout

CLIENT:	
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PROJECT:	BUILDING 9 BROADWAY FARM	
TITLE:	CONSTRUCTION STAGE SURFACE WATER DRAINAGE ARRANGEMENTS	
REV:	PROJECT No:	DRAWING No:
B	0591	DR-003
SCALE @ A1: 1:500		





TPOC LIST									
NO.	DATE	BY	CHKD	REV	DESCRIPTION	NO.	DATE	BY	CHKD
1	03.05.2022	...	...	...	...	1	03.05.2022	...	...
2	20.10.2022	...	...	...	...	2	20.10.2022	...	...
3	...	...	...	...	...	3	...	...	...
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NOTES
1. No flooding is predicted for the 1 in 100year return period rainfall event. The arrows shown on the plan indicate the route of flood water in the event of a blockage or failure of the system.

PROJECT: BUILDING 9 BROADWAY FARM		DESIGN BY: 	
TITLE: EXCEEDANCE FLOWPATHS			
REV: B	PROJECT No: 0591	DRAWING No: DR-004	
SCALE @ A1: 1:500			

A	03.05.2022	Initial issue
B	20.10.2022	Amended to suit revised layout
REV	DATE	DESCRIPTION
CLIENT:		

Surface Water Drainage Strategy

Building 9, Broadway Farm, Broad Oak, SO30 2EU



APPENDIX B CALCULATIONS

- 1. Greenfield Runoff Rates**
- 2. Initial Estimate of Storage Volumes**
- 3. Simplified MicroDrainage Model of Proposed System (100yr+45%)**

1. Greenfield Runoff Rates



Greenfield runoff rate
estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by: Karl Pitman

Site name: Broadway Farm

Site location: SO30 2EU

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

Site Details

Latitude: 50.91680° N

Longitude: 1.2839° W

Reference: 1589191408

Date: Oct 20 2022 15:14

Runoff estimation approach IH124

Site characteristics

Total site area (ha): 0.267

Methodology

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

SPR estimation method: Calculate from SOIL type

Soil characteristics Default Edited

SOIL type: 4 4

HOST class: N/A N/A

SPR/SPRHOST: 0.47 0.47

Hydrological characteristics Default Edited

SAAR (mm): 797 797

Hydrological region: 7 7

Growth curve factor 1 year: 0.85 0.85

Growth curve factor 30 years: 2.3 2.3

Growth curve factor 100 years: 3.19 3.19

Growth curve factor 200 years: 3.74 3.74

Notes

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

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

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

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

(3) Is SPR/SPRHOST ≤ 0.3?

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

Greenfield runoff rates Default Edited

Q_{BAR} (l/s): 1.5 1.5

1 in 1 year (l/s): 1.28 1.28

1 in 30 years (l/s): 3.45 3.45

1 in 100 year (l/s): 4.79 4.79

1 in 200 years (l/s): 5.61 5.61

2. Initial Estimate of Storage Volumes



Surface water storage
requirements for sites

www.uksuds.com | Storage estimation tool

Calculated by: Karl Pitman

Site name: Broadway Farm

Site location: SO30 2EU

This is an estimation of the storage volume requirements that are needed to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SO30219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). It is not to be used for detailed design of drainage systems. It is recommended that hydraulic modelling software is used to calculate volume requirements and design details before finalising the design of the drainage scheme.

Site Details

Latitude: 50.91631° N

Longitude: 1.28394° W

Reference: 2538171983

Date: Oct 20 2022 15:19

Site characteristics

Total site area (ha): 0.267

Significant public open space (ha): 0

Area positively drained (ha): 0.267

Impermeable area (ha): 0.267

Percentage of drained area that is impermeable (%): 100

Impervious area drained via infiltration (ha): 0

Return period for infiltration system design (year): 10

Impervious area drained to rainwater harvesting (ha): 0

Return period for rainwater harvesting system (year): 10

Compliance factor for rainwater harvesting system (%): 66

Net site area for storage volume design (ha): 0.27

Net impermeable area for storage volume design (ha): 0.27

Pervious area contribution to runoff (%): 30

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

Design criteria

Climate change allowance factor: 1.45

Urban creep allowance factor: 1.0

Volume control approach: Use long term storage

Interception rainfall depth (mm): 5

Minimum flow rate (l/s): 2

Methodology

esti: IH124

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

SPR estimation method: Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	4	4
SPR:	0.47	0.47

Hydrological characteristics

	Default	Edited
Rainfall 100 yrs 6 hrs:	--	63
Rainfall 100 yrs 12 hrs:	--	85.47
FEH / FSR conversion factor:	1.11	1.11
SAAR (mm):	797	797
M5-60 Rainfall Depth (mm):	20	20
'r' Ratio M5-60/M5-2 day:	0.4	0.4
Hydrological region:	7	7
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 10 year:	1.62	1.62
Growth curve factor 30 year:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Q_{BAR} for total site area (l/s):	1.5	1.5
Q_{BAR} for net site area (l/s):	1.5	1.5

Site discharge rates

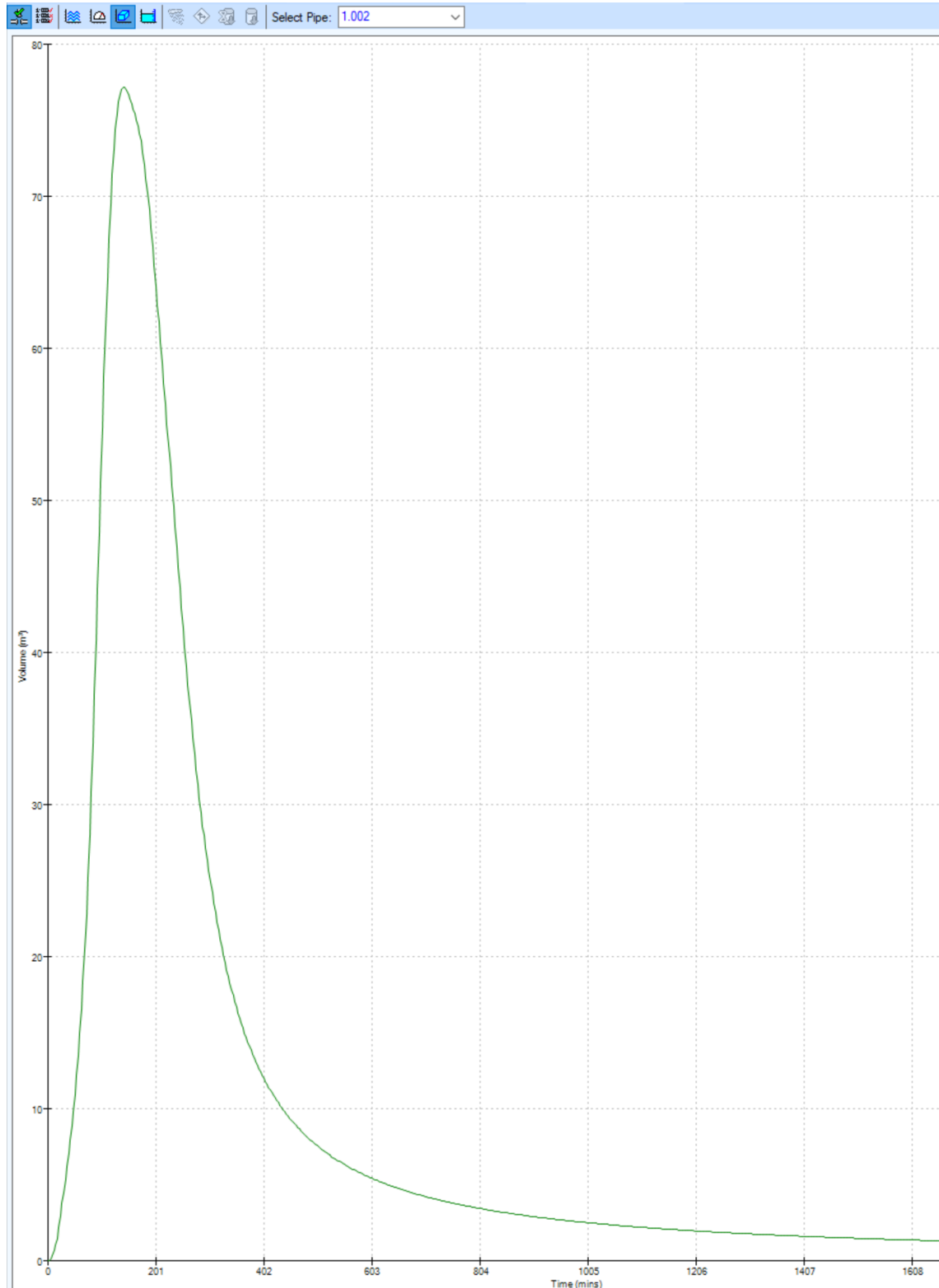
	Default	Edited
1 in 1 year (l/s):	2	2
1 in 30 years (l/s):	3.5	3.5
1 in 100 year (l/s):	4.8	4.8

Estimated storage volumes

	Default	Edited
Attenuation storage 1/100 years (m^3):	131	131
Long term storage 1/100 years (m^3):	28	28
Total storage 1/100 years (m^3):	159	159

3. MicroDrainage Model of Proposed System (100yr+45%)

From p 6 of the following calculations it can be seen that approximately 221m³ of attenuation storage will be provided in the attenuation pond. From the graph below it can be seen that the half drain down time of the attenuation tank is less than 24hours.



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File Proposd SW - tank in field.MDX	Checked by	
XP Solutions	Network 2020.1	

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	82.000	0.850	96.5	0.158	5.00	0.0		0.030	→ o →		Filter Drain	
S1.001	21.113	0.375	56.3	0.000	0.00	0.0		0.030	o	225	Pipe/Conduit	
S2.000	21.710	0.625	34.7	0.055	5.00	0.0	0.600		o	150	Pipe/Conduit	
S1.002	10.088	0.140	72.1	0.054	0.00	0.0	0.600		o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	75.00	7.81	13.300	0.158	0.0	0.0	0.0	0.49	78.8	32.1
S1.001	75.00	8.35	12.450	0.158	0.0	0.0	0.0	0.65	25.9«	32.1
S2.000	75.00	5.21	12.700	0.055	0.0	0.0	0.0	1.71	30.3	11.2
S1.002	75.00	8.50	12.000	0.267	0.0	0.0	0.0	1.19	21.0«	54.2

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
S-	14.300	1.000	Open Manhole	450	S1.000	13.300					
S-	14.500	2.050	Open Manhole	450	S1.001	12.450	225	S1.000	12.450		
S1	14.000	1.300	Open Manhole	450	S2.000	12.700	150				
S2	12.600	0.600	Open Manhole	1200	S1.002	12.000	150	S1.001	12.075	225	150
								S2.000	12.075	150	75
S	12.900	1.040	Open Manhole	0		OUTFALL		S1.002	11.860	150	

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

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XP Solutions	Network 2020.1	

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	→ ○ →		S-	14.300	13.300	0.000	Open Manhole	450
S1.001	o	225	S-	14.500	12.450	1.825	Open Manhole	450
S2.000	o	150	S1	14.000	12.700	1.150	Open Manhole	450
S1.002	o	150	S2	12.600	12.000	0.450	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)
S1.000	82.000	96.5	S-	14.500	12.450	1.050	Open Manhole	450
S1.001	21.113	56.3	S2	12.600	12.075	0.300	Open Manhole	1200
S2.000	21.710	34.7	S2	12.600	12.075	0.375	Open Manhole	1200
S1.002	10.088	72.1	S	12.900	11.860	0.890	Open Manhole	0

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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.158	0.158	0.158
1.001	-	-	100	0.000	0.000	0.000
2.000	-	-	100	0.055	0.055	0.055
1.002	-	-	100	0.054	0.054	0.054
				Total	Total	Total
				0.267	0.267	0.267

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)
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S1.002	S	12.900	11.860	0.000	0	0
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Simulation Criteria for Storm

Volumetric Runoff Coeff	0.840	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha	Storage 2.000
Hot Start (mins)	0	Inlet Coefficient	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)	2000
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	2

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Winter
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.700	Storm Duration (mins)	60
Ratio R	0.350		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: S2, DS/PN: S1.002, Volume (m³): 1.9

Unit Reference	MD-SHE-0134-7600-0600-7600
Design Head (m)	0.600
Design Flow (l/s)	7.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	134
Invert Level (m)	12.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.600	7.6	Kick-Flo®	0.445	6.6
Flush-Flo™	0.215	7.6	Mean Flow over Head Range	-	6.3

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

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	4.8	0.800	8.7	2.000	13.4	4.000	18.7	7.000	24.4
0.200	7.6	1.000	9.7	2.200	14.0	4.500	19.7	7.500	25.2
0.300	7.5	1.200	10.5	2.400	14.6	5.000	20.8	8.000	26.1
0.400	7.1	1.400	11.3	2.600	15.2	5.500	21.7	8.500	26.9
0.500	7.0	1.600	12.1	3.000	16.3	6.000	22.7	9.000	27.7
0.600	7.6	1.800	12.8	3.500	17.5	6.500	23.5	9.500	28.4

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XP Solutions	Network 2020.1	

Storage Structures for Storm

Filter Drain Pipe: S1.000

Manning's N	0.030	Trench Length (m)	82.0
Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.150
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.100
Safety Factor	2.0	Number of Pipes	1
Porosity	0.30	Slope (1:X)	96.5
Invert Level (m)	13.300	Cap Volume Depth (m)	0.000
Trench Width (m)	0.5	Cap Infiltration Depth (m)	0.000

Tank or Pond Manhole: S2, DS/PN: S1.002

Invert Level (m) 12.000

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	270.0	0.600	467.0

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XP Solutions	Network 2020.1	

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

Simulation Criteria

Volumetric Runoff Coeff 0.840 Foul Sewage per hectare (l/s) 0.000
 Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
 Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
 Hot Start Level (mm) 0 Inlet Coefficient 0.800
 Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
 Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
 Number of Online Controls 1 Number of Storage Structures 2 Number of Real Time Controls 0
 Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
 Analysis Timestep Fine Inertia Status OFF
 DTS Status ON

Profile(s) Summer and Winter
 Duration(s) (mins) 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440,
 2160, 2880, 4320, 5760, 7200
 Return Period(s) (years) 100, 1000
 Climate Change (%) 45, 0

								Water Surcharged	
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) SurchARGE	First (Y) Flood	First (Z) Overflow	Overflow Act.	Level (m)
S1.000	S-	60 Summer	100	+45%					14.066
S1.001	S-	60 Summer	100	+45%	100/60 Summer				13.696
S2.000	S1	60 Summer	100	+45%					12.800
S1.002	S2	180 Winter	100	+45%	100/60 Summer				12.378

		Flooded		Half Drain		Pipe		
PN	US/MH Name	Volume (m³)	Flow / Cap.	Overflow (l/s)	Time (mins)	Flow (l/s)	Status	Level Exceeded
S1.000	S-	0.000	0.63		12	49.7	FLOOD RISK	
S1.001	S-	0.000	1.90			48.7	SURCHARGED	
S2.000	S1	0.000	0.77			21.9	OK	
S1.002	S2	0.000	0.41			7.6	FLOOD RISK	

Pitman Associates Ltd		Page 8
South Lodge Exminster Devon EX6 8AT		
Date 20/10/2022 15:45	Designed by Karl	
File Proposd SW - tank in field.MDX	Checked by	
XP Solutions	Network 2020.1	

1000 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Volumetric Runoff Coeff 0.840 Foul Sewage per hectare (l/s) 0.000
 Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
 Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
 Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
 Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000

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

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

Profile(s) Summer and Winter
 Duration(s) (mins) 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440,
 2160, 2880, 4320, 5760, 7200
 Return Period(s) (years) 100, 1000
 Climate Change (%) 45, 0

								Water Surcharged	
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Level (m)
S1.000	S-	60 Summer	1000	+0%					14.193
S1.001	S-	60 Summer	1000	+0%	100/60 Summer				13.905
S2.000	S1	60 Summer	1000	+0%					12.812
S1.002	S2	180 Winter	1000	+0%	100/60 Summer				12.443

		Flooded		Half Drain		Pipe		
PN	US/MH Name	Volume (m³)	Flow / Cap.	Overflow (l/s)	Time (mins)	Flow (l/s)	Status	Level Exceeded
S1.000	S-	0.000	0.68		14	53.5	FLOOD RISK	
S1.001	S-	0.000	2.07			53.0	SURCHARGED	
S2.000	S1	0.000	0.89			25.5	OK	
S1.002	S2	0.000	0.40			7.5	FLOOD RISK	