



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

Surface Water Drainage Strategy

May 2022



Pitman Associates Ltd.

1 Beech Copse
Exeter
Devon
EX2 7SZ

+44 (0)1392 824616
admin@pitmanassociates.com
www.pitmanassociates.com

Telephone
E-mail
Internet

Document title	Surface Water Drainage Strategy
Status	Rev A - Initial Issue
Date	Rev A – May 2022
Project name	Building 9, Broadway Farm, Broad Oak, SO30 2EU
Project number	0561
Client	CCW Services Ltd

CONTENTS

1.	INTRODUCTION	1
2.	SUSTAINABLE DRAINAGE PRINCIPLES FOR THE DEVELOPMENT	2
3.	EXISTING FLOWPATHS.....	3
4.	PROPOSED DESTINATION FOR SURFACE WATER POST-DEVELOPMENT.....	3
5.	GROUND INVESTIGATION RESULTS.....	4
6.	EXISTING WATERCOURSES.....	4
7.	EXISTING AND PROPOSED SURFACE WATER SEWERS AND PUMPING STATIONS.....	4
8.	SURFACE WATER FLOWS ONTO THE SITE AND FLOW PATHS THROUGH THE DEVELOPMENT.....	5
9.	OFFSITE WORKS REQUIRED TO MITIGATE FLOOD RISK.....	5
10.	SENSITIVE RECEPTORS.....	5
11.	COMPLIANCE WITH THE DEFRA NON-STATUTORY TECHNICAL STANDARDS.....	6
12.	CONSENTS REQUIRED.....	6
13.	SURFACE WATER STORAGE VOLUMES AND LOCATIONS.....	6
14.	TREATMENT TRAIN COMPONENTS.....	7
15.	PROPOSED LANDSCAPING AND VEGETATIVE SYSTEMS.....	7
16.	DESIGN CALCULATIONS.....	8
17.	MULTI-USE AREAS.....	9
18.	EXCEEDANCE ROUTES.....	9
19.	TEMPORARY DRAINAGE DURING CONSTRUCTION.....	9
20.	CLIMATE CHANGE ALLOWANCES.....	9
21.	FUTURE DEVELOPMENT ALLOWANCES.....	9
22.	SUDS MAINTENANCE.....	9
23.	STRUCTURAL INTEGRITY OF SUDS.....	11

APPENDIX A – DRAWINGS

APPENDIX B – CALCULATIONS

1. INTRODUCTION

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

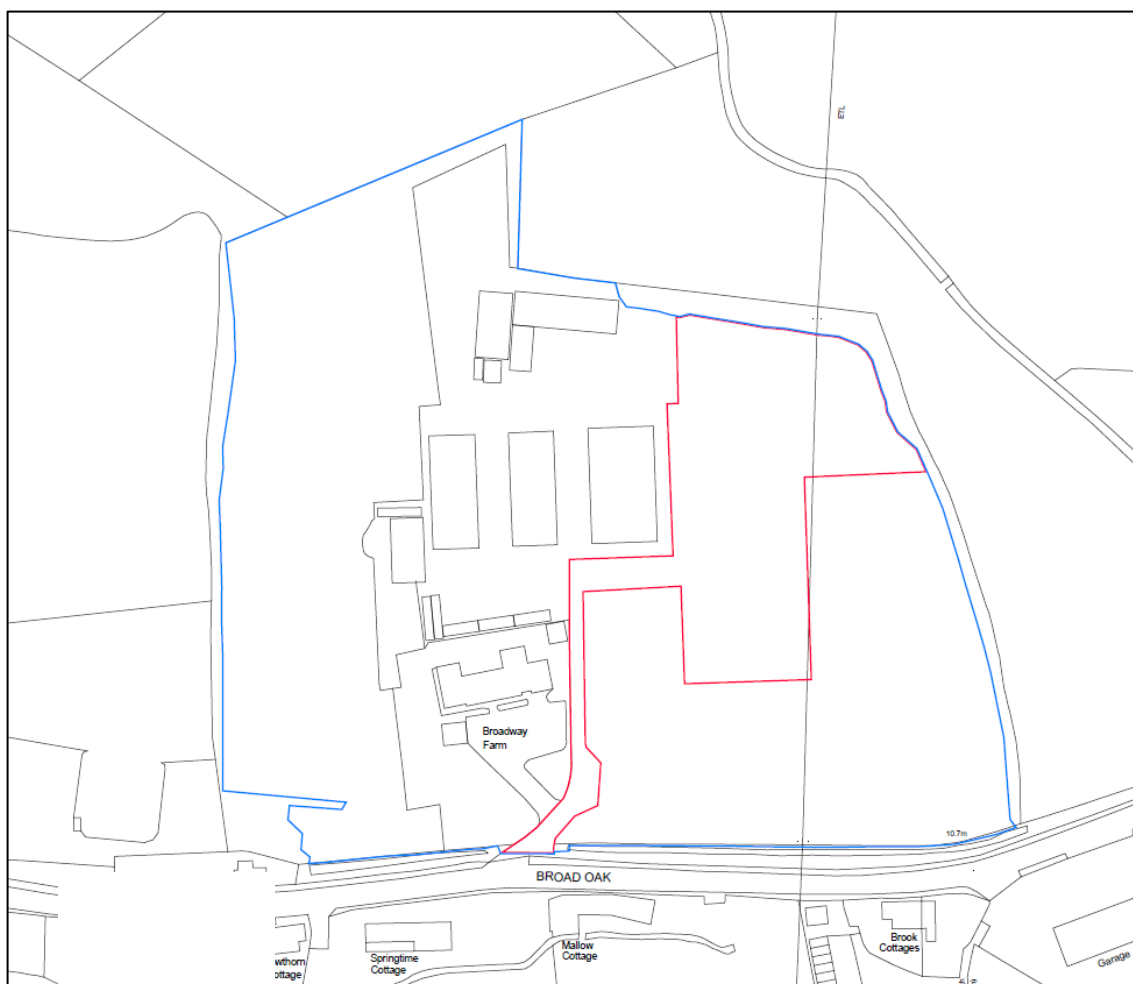


Figure 1. Location Plan

- 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.
- 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.	Insufficient space within the footprint of the site.
5. Attenuate rainwater by storing in tanks for gradual release.	Buried attenuation tanks are to be provided.
6. Discharge rainwater direct to a watercourse.	Proposed.
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.

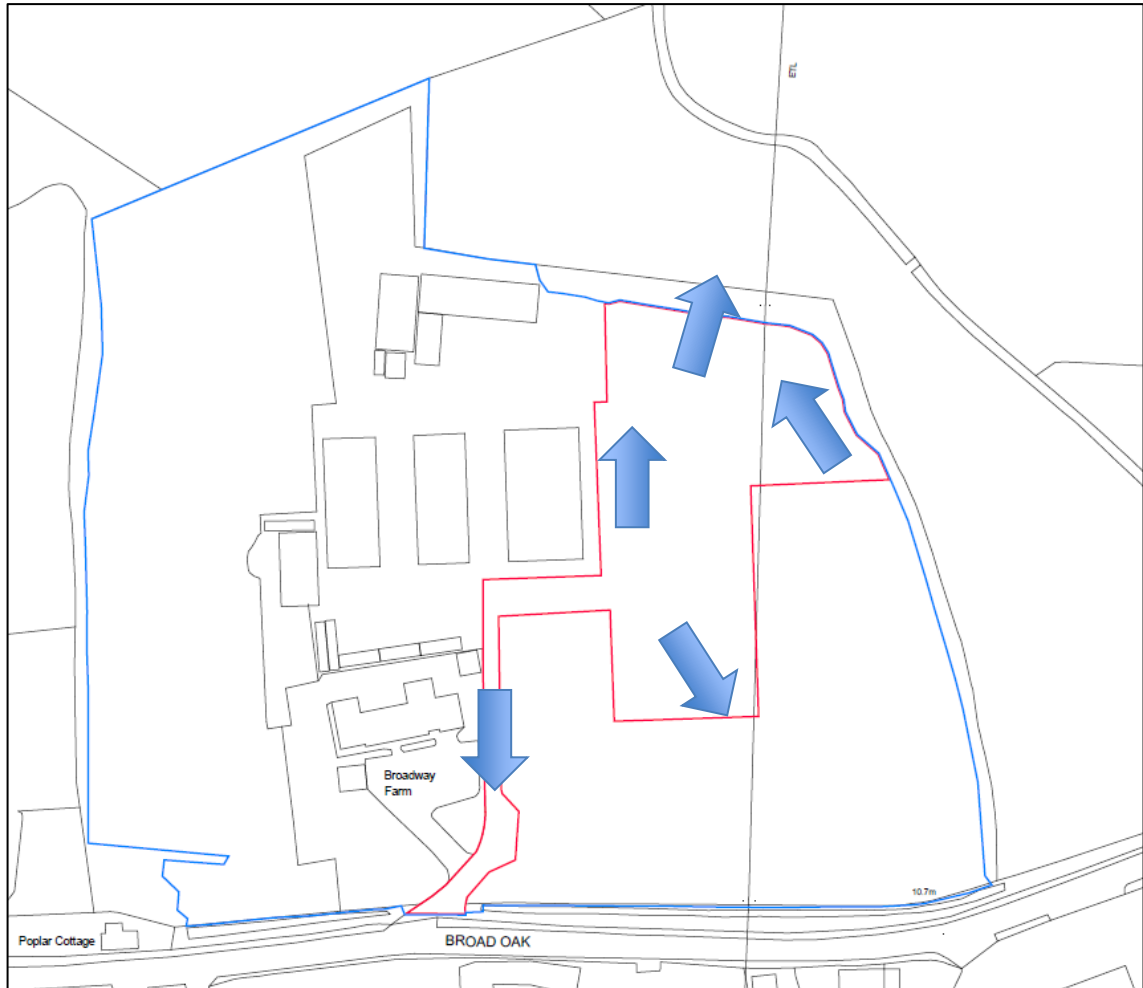


Figure 2. Existing Flowpaths

4. PROPOSED DESTINATION FOR SURFACE WATER POST-DEVELOPMENT

- 4.1 Post-development it is proposed to discharge runoff 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.

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."*
- 5.5 On the basis of the above it is concluded that infiltration will not be feasible for the disposal of runoff.

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.

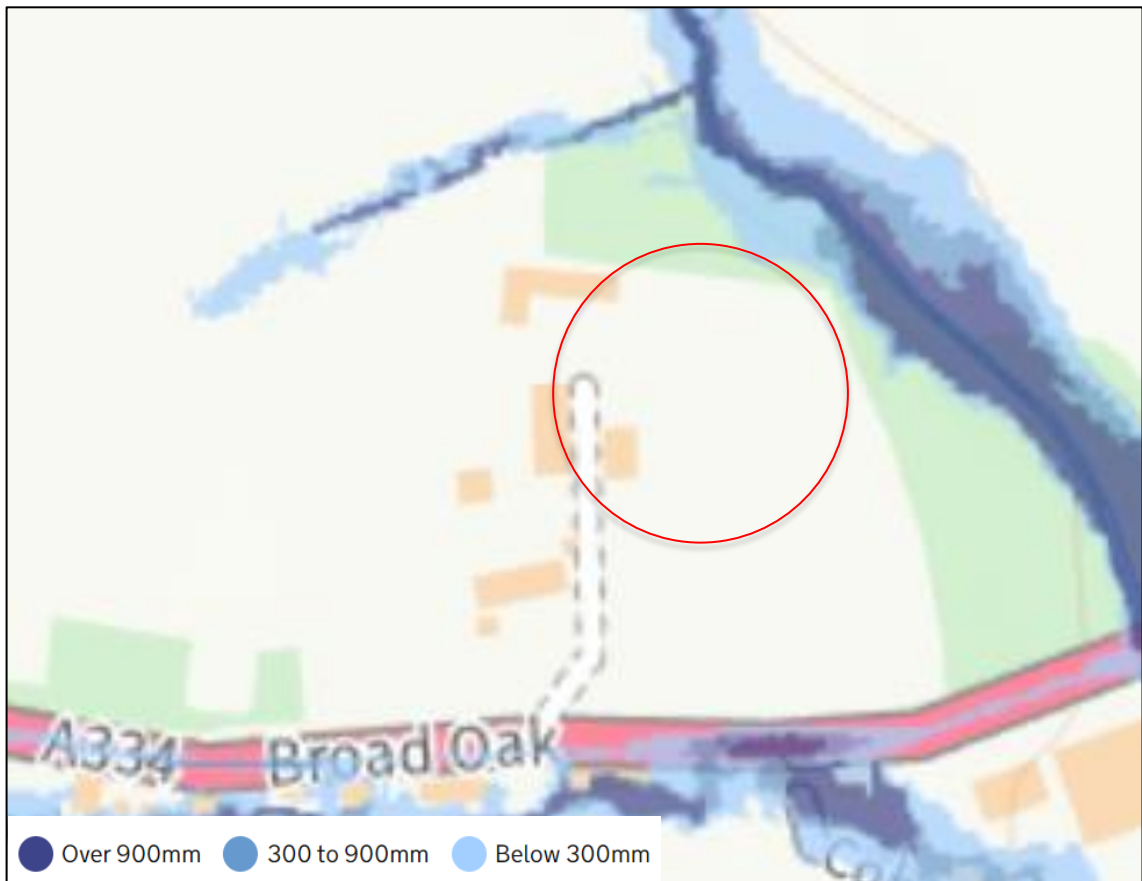


Figure 3. Extract from Gov.UK Map Showing Risk of Surface Water Flooding

- 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

- 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 188m³ 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.

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 site 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 shortfall in treatment will be mitigated by passing all runoff through a Downstream Defender (by Hydro-International), the treatment parameters for which are as follows:

- Total suspended solids = 0.5
- Metals = 0.4
- Hydro-carbons = 0.8

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 = $0.4 + (0.5/2)$ = 0.65
- Metals = $0.4 + (0.4/2)$ = 0.60
- Hydro-carbons = $0.4 + (0.8/2)$ = 0.80

14.5 When rounded, the mitigation indices are equal to the pollution indices, and the treatment measures are deemed to be appropriate.

15. PROPOSED LANDSCAPING AND VEGETATIVE SYSTEMS

15.1 There is no scope for incorporating landscaping or vegetative systems within the drainage system.

16. DESIGN CALCULATIONS

16.1 Greenfield Runoff

- 16.1.1 The greenfield runoff rates from the site 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	2.38
1	2.03
30	5.48
100	7.60

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 40% 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 30year return period rainfall event. For the 100year + 40% rainfall event there will be approximately 14m³ of surface flooding. From DR-001 in Appendix A it can be seen that an existing earth bund along the northern boundary of the site will ensure that this volume is retained on site.

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 95m³. This is less than the volume of the proposed attenuation tanks – see 16.5.1 below.

16.5 Storage Requirements

- 16.5.1 207m³ of attenuation storage will be provided in a buried geocellular attenuation tanks.

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

- 17.1 There is no scope for multi-use areas within the drainage system.

18. EXCEEDANCE FLOWS

- 18.1 Exceedance flows have been established by simulating the hydraulic model with the 1000yr rainfall event. Flooding is predicted at the following manholes:

- 1.000 1.6m³
- 1.002 24.5m³

- 18.2 The storage areas and flow paths associated with these exceedance flows 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.

20. CLIMATE CHANGE ALLOWANCES

- 20.1 EA guidance on climate change allowances requires that both the 20% and 40% 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 40% 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	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then annually
	Remove debris from the catchment surface (where it may cause risks to performance)	Monthly
	For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae or other matter; remove and replace surface infiltration medium as necessary.	Annually
	Remove sediment from pre-treatment structures and/or internal forebays	Annually, or as required
Remedial actions	Repair/rehabilitate inlets, outlet, overflows and vents	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually
	Survey inside of tank for sediment build-up and remove if necessary	Every 5 years or as required

Table 22.2 - Maintenance Schedule for Attenuation Tanks © 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
Buried Attenuation tank	60years

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

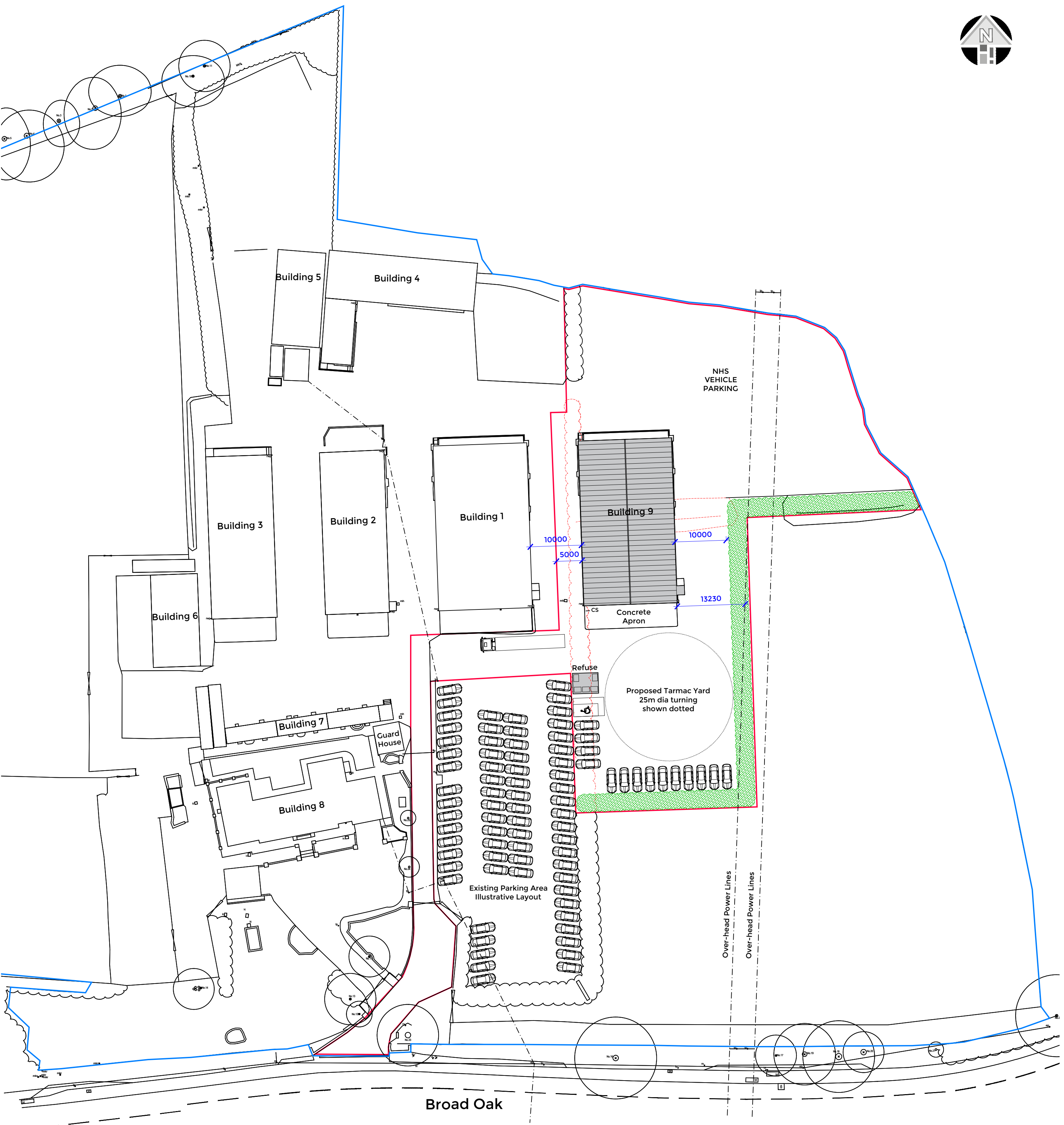
Proposed Site Plan

DR-001 Surface Water Drainage Strategy

DR-002 Surface Water Drainage – Area Take-Off

DR-003 Temporary Surface Water Drainage Arrangements

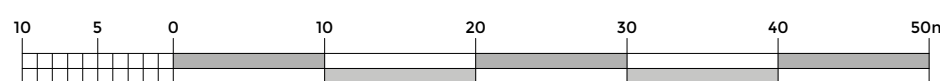
DR-004 Surface Water Exceedance Flows



KEY

- Application Boundary
- Land in Applicant's Ownership
- Proposed demolitions
- Proposed Building
See detailed proposals
- Proposed Landscape Buffer
See proposals (by others)
- CS
Sheffield Cycle Stand

PLANNING





BOYLE+SUMMERS
ARCHITECTURE AND MASTERPLANNING

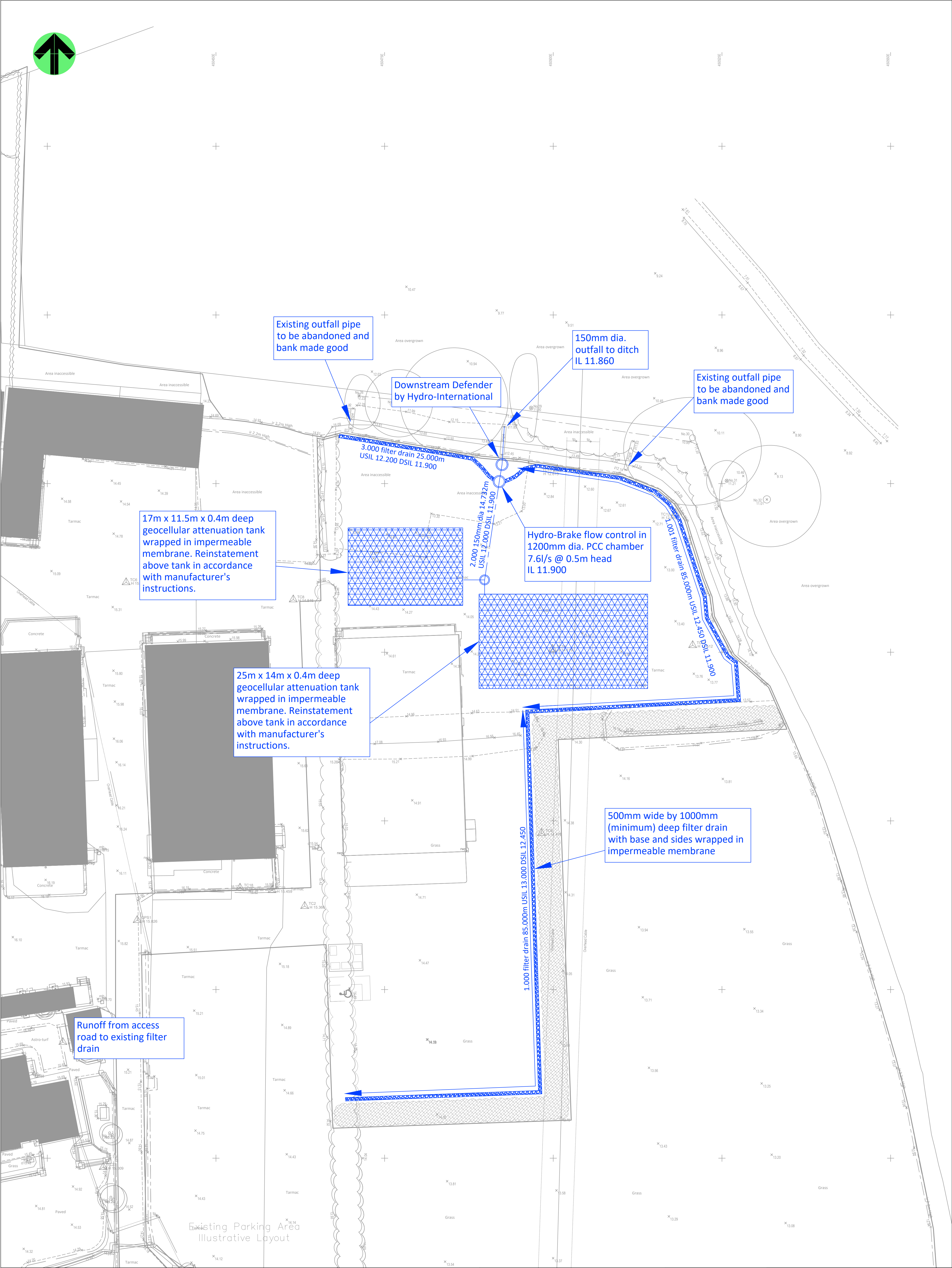
Canute Chambers
Canute Road
Southampton
Hampshire
SO14 3AB

Client	CCW Services Ltd				
Project	Building 9, Broadway Farm, Broad Oak				
Title	Proposed Site Plan				

B31192	CCW- BSL - ZZ - XX - DR - A				2001 - PL					
	Project	Originator	Volume	Level	Type	Role	Series	Number	Suitability	Revision
B+S Ref.	Date	Scale @ A2	Drawn	Checked						
21003	Sep 2021	1:500	FN	SD						
Tel: 023 8063 1432		www.boyleandsummers.co.uk								

Other than for the purposes of planning, do not scale these drawings. Use written dimensions only. All dimensions to be checked on site prior to commencement of work.

This drawing is © Boyle+Summers Ltd and may not be reproduced, copied or altered in any way without written authority.

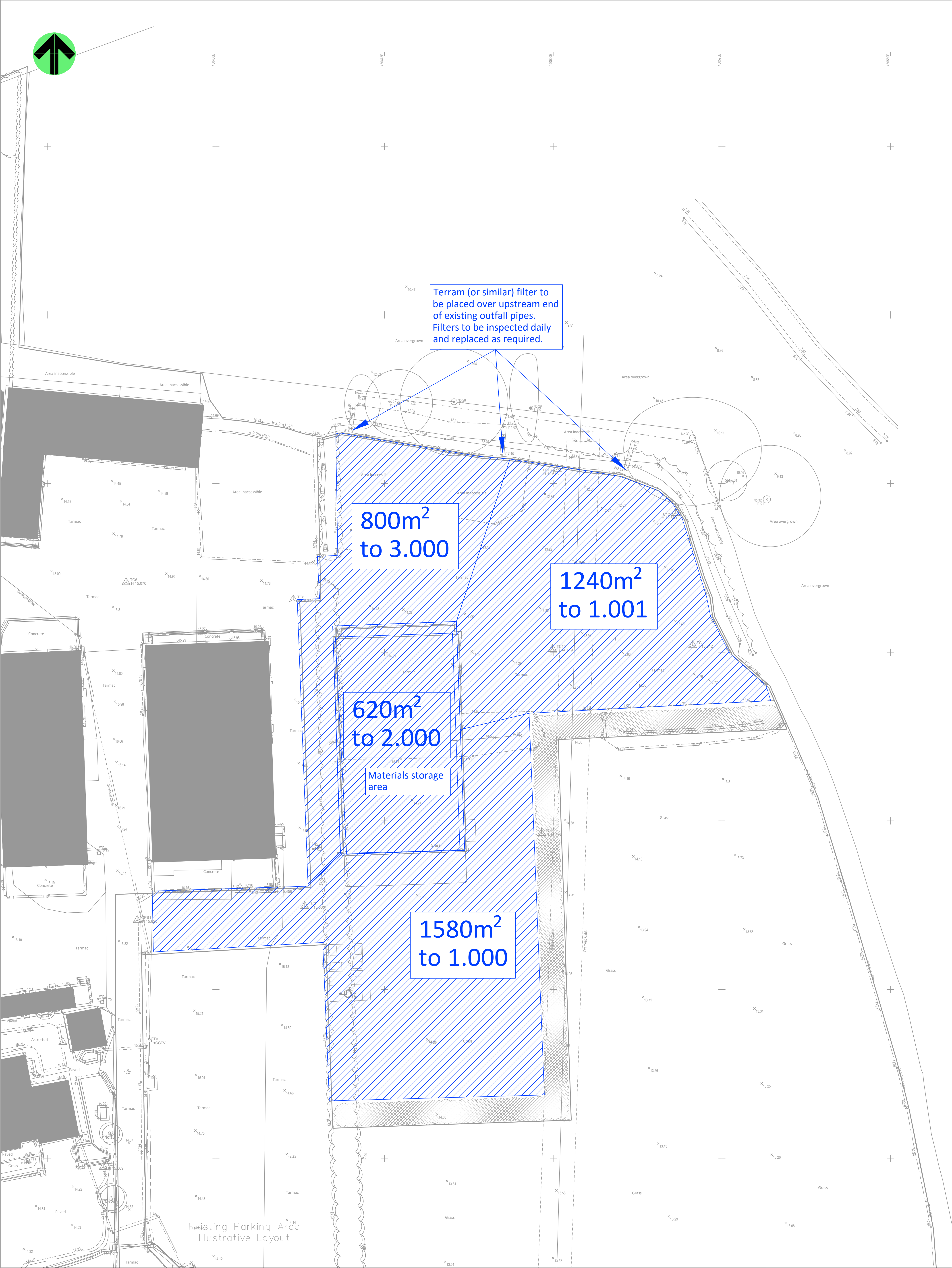


NOTES
1. Refer to DR-002 for extent of contributing areas.
2. All drainage upstream of attenuation tanks to be designed and constructed in accordance with Part H of the Building Regulations.

A	03.05.2022	Initial issue
REV	DATE	DESCRIPTION
CLIENT:		

PROJECT: BUILDING 9, BROADWAY FARM		
TITLE: SURFACE WATER DRAINAGE STRATEGY		
REV: A	PROJECT No: 0591	DRAWING No: DR-001
SCALE @ A1: 1:250		



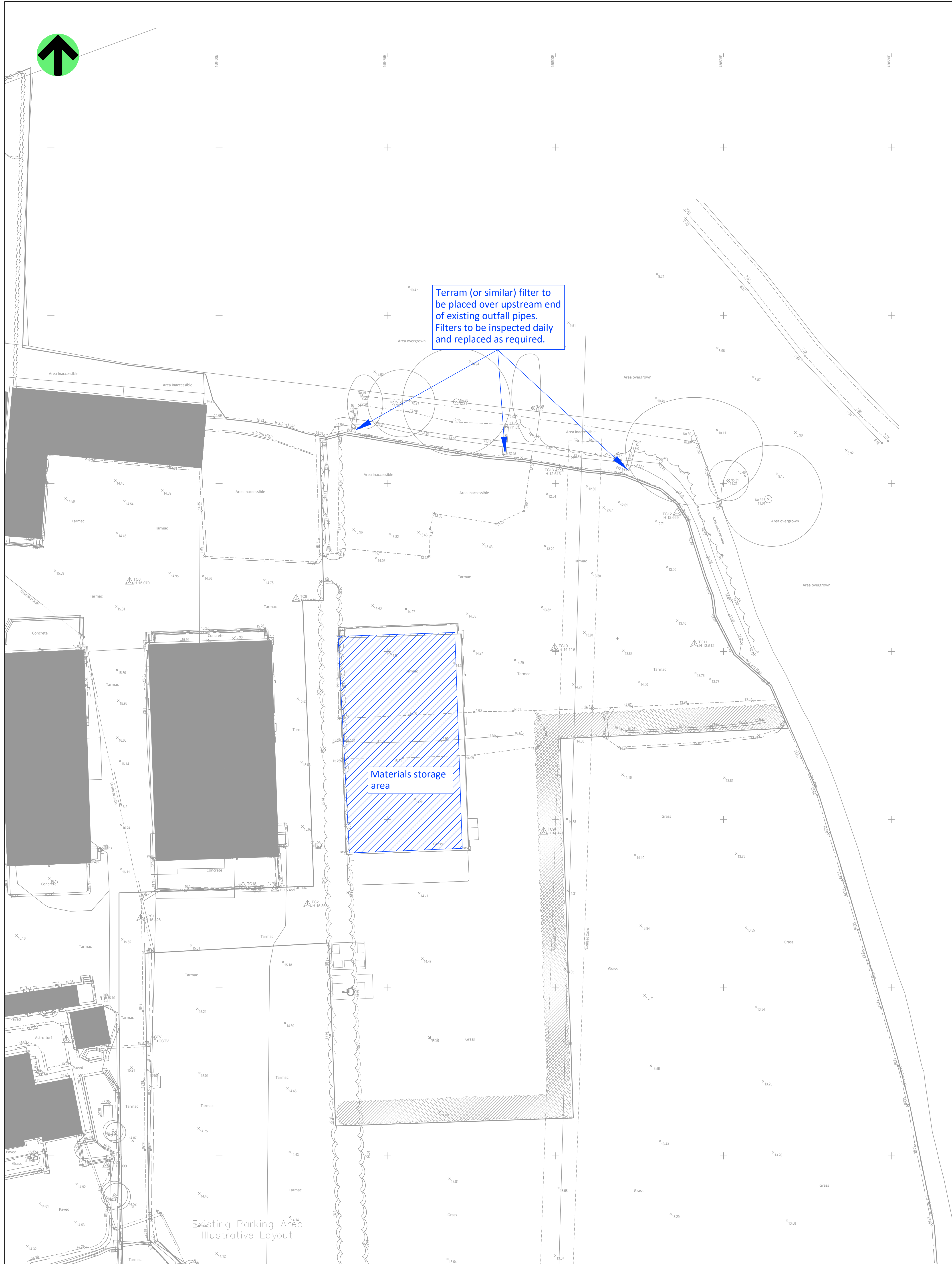


NOTES
1. This drawing to be read in conjunction with DR-001.

A	03.05.2022	Initial issue
REV	DATE	DESCRIPTION
CLIENT:		

PROJECT: BUILDING 9, BROADWAY FARM		
TITLE: SURFACE WATER DRAINAGE - AREA TAKE-OFF		
REV: A	PROJECT No: 0591	DRAWING No: DR-002
SCALE @ A1: 1:250		

DESIGN BY:



Materials storage area

NOTES

1. All surface water drainage works to be completed prior to commencement of construction of the proposed building.
2. Filter drains to be constructed with a geotextile membrane (Terram 1000 or similar) 75mm below ground level. On completion of construction the stone fill above the membrane shall be removed and washed prior to being replaced on a new layer of geotextile membrane.

PROJECT:		
BUILDING 9, BROADWAY FARM		
TITLE:		
CONSTRUCTION STAGE SURFACE WATER DRAINAGE ARRANGEMENTS		
REV:	PROJECT No:	DRAWING No:
A	0591	DR-003
SCALE @ A1:		
1:250		

DESIGN BY:



pitman
associates

**CONSULTING
ENGINEERS**



NOTES
1. Predicted flooding for 1000year return period rainfall event:
1.000 = 1.2m3 (average depth <10mm)
1.002 = 24.54m3 (average depth <100mm)

A	03.05.2022	Initial issue
REV	DATE	DESCRIPTION
CLIENT:		

PROJECT: BUILDING 9, BROADWAY FARM		
TITLE: SURFACE WATER DRAINAGE EXCEEDANCE FLOWS		
REV: A	PROJECT No: 0591	DRAWING No: DR-004
SCALE @ A1: 1:250		



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+40%)**
- 4. Exceedance Flows (1000yr+40%)**

1. Greenfield Runoff Rates



Greenfield runoff rate
estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:

Site name:

Site location:

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:

Longitude:

Reference:

Date:

Runoff estimation approach

Site characteristics

Total site area (ha):

Methodology

Q_{BAR} estimation method:

SPR estimation method:

Soil characteristics

SOIL type:

HOST class:

SPR/SPRHOST:

Hydrological characteristics

SAAR (mm):

Hydrological region:

Growth curve factor 1 year:

Growth curve factor 30 years:

Growth curve factor 100 years:

Growth curve factor 200 years:

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):	2.38	2.38
1 in 1 year (l/s):	2.03	2.03
1 in 30 years (l/s):	5.48	5.48
1 in 100 year (l/s):	7.6	7.6
1 in 200 years (l/s):	8.91	8.91

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

2. Initial Estimate of Storage Volumes



Surface water storage requirements for sites

www.uksuds.com | Storage estimation tool

Calculated by:	Karl Pitman
Site name:	Boradway Farm
Site location:	Broad Oak

This is an estimation of the storage volume requirements that are needed to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). It is not to be used for detailed design of drainage systems. It is recommended that hydraulic modelling software is used to calculate volume requirements and design details before finalising the design of the drainage scheme.

Site Details

Latitude:	50.91645° N
Longitude:	1.28365° W
Reference:	171988842
Date:	Apr 29 2022 14:06

Site characteristics

Total site area (ha):	0.424
Significant public open space (ha):	0
Area positively drained (ha):	0.424
Impermeable area (ha):	0.424
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):	0.42
Net impermeable area for storage volume design (ha):	0.42
Pervious area contribution to runoff (%):	30

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

Design criteria

Climate change allowance factor:	1.4
Urban creep allowance factor:	1.0
Volume control approach	Flow control to max of 2 l/s/ha or
Interception rainfall depth (mm):	Q_{bar} 5
Minimum flow rate (l/s):	9

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):	2.38	2.38
Q_{BAR} for net site area (l/s):	2.38	2.38

Site discharge rates

	Default	Edited
1 in 1 year (l/s):	9	9
1 in 30 years (l/s):	9	9
1 in 100 year (l/s):	9	9

Estimated storage volumes

	Default	Edited
Attenuation storage 1/100 years (m^3):	188	188
Long term storage 1/100 years (m^3):	0	0
Total storage 1/100 years (m^3):	188	188

This report was produced using the storage estimation tool developed by HRWallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at <http://uksuds.com/terms-and-conditions.htm>. The outputs from this tool have been used to estimate storage volume requirements. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of these data in the design or operational characteristics of any drainage scheme.

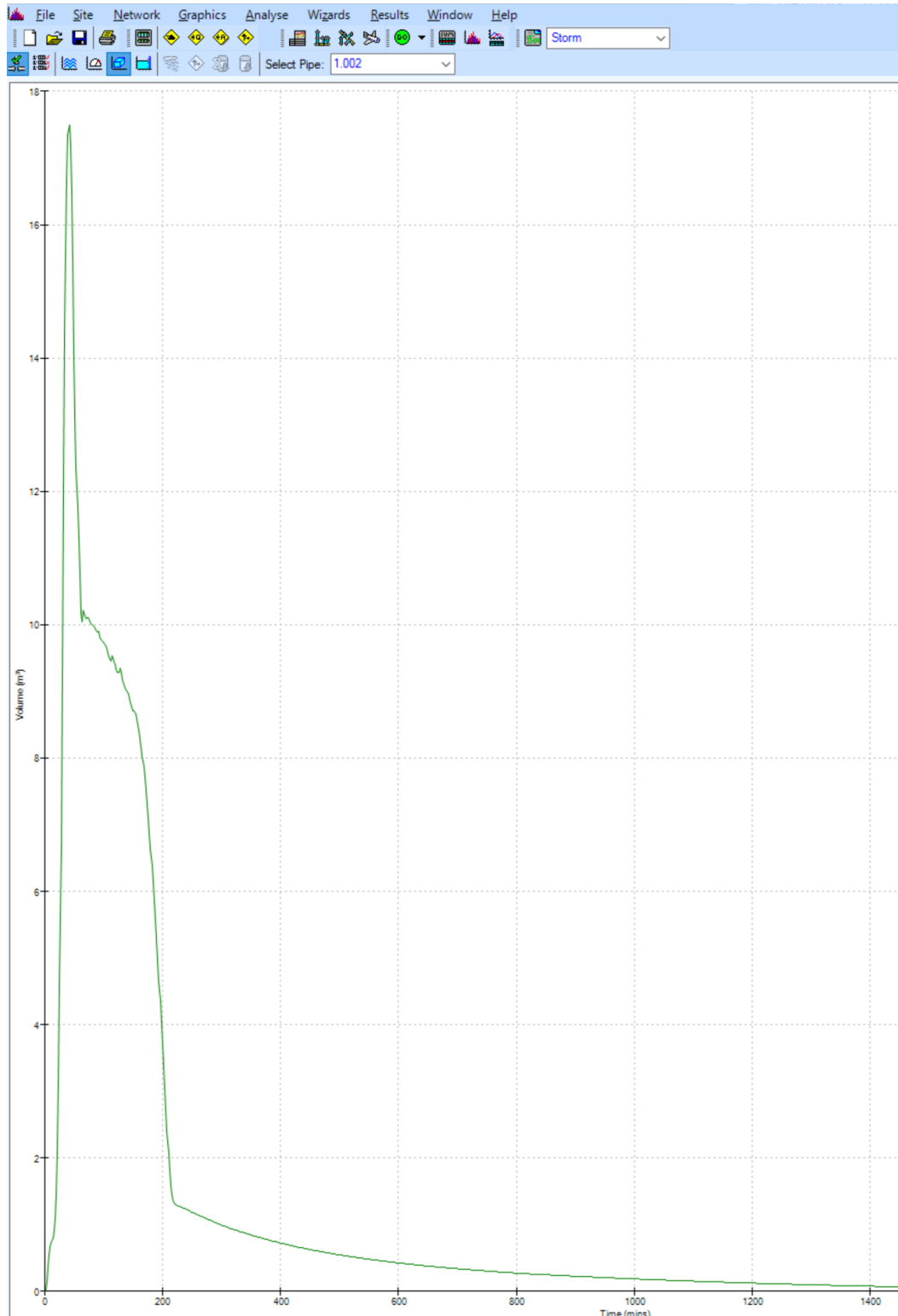
Surface Water Drainage Strategy

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



3. MicroDrainage Model of Proposed System (100yr+40%)

From p 4 of the following calculations it can be seen that approximately 209m³ of attenuation storage will be provided in attenuation tanks. From the graph below it can be seen that the half drain down time of the attenuation tank is less than 24hours.



Pitman Associates Ltd		Page 1
South Lodge Exminster Devon EX6 8AT		
Date 03/05/2022 17:19 File Proposd SW.MDX	Designed by Karl 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	85.000	0.550	154.5	0.158	5.00	0.0		0.030	→ ○ →		Filter Drain	
S1.001	85.000	0.550	154.5	0.124	0.00	0.0		0.030	→ ○ →		Filter Drain	
S2.000	14.732	0.100	147.3	0.062	5.00	0.0	0.600		o	150	Pipe/Conduit	
S3.000	25.000	0.100	250.0	0.080	5.00	0.0		0.030	→ ○ →		Filter Drain	
S1.002	5.000	0.040	125.0	0.000	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	8.69	13.000	0.158	0.0	0.0	0.0	0.38	62.3	32.1
S1.001	75.00	12.39	12.450	0.282	0.0	0.0	0.0	0.38	62.3	57.3
S2.000	75.00	5.30	12.000	0.062	0.0	0.0	0.0	0.83	14.6	12.6
S3.000	75.00	6.38	12.000	0.080	0.0	0.0	0.0	0.30	49.0	16.2
S1.002	75.00	12.48	11.900	0.424	0.0	0.0	0.0	0.90	15.9«	86.1

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-	14.000	1.000	Open Manhole	500	S1.000	13.000					
S-	14.500	2.050	Open Manhole	500	S1.001	12.450		S1.000	12.450		
S1	13.700	1.700	Open Manhole	1200	S2.000	12.000	150				
S-	13.320	1.320	Open Manhole	500	S3.000	12.000					
S2	13.000	1.100	Open Manhole	1200	S1.002	11.900	150	S1.001	11.900		
								S2.000	11.900	150	
								S3.000	11.900		
S	12.900	1.040	Open Manhole	0		OUTFALL		S1.002	11.860	150	

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

Pitman Associates Ltd		Page 3
South Lodge Exminster Devon EX6 8AT		
Date 03/05/2022 17:19 File Proposd SW.MDX	Designed by Karl Checked by	
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-	14.000	13.000	0.000	Open Manhole	500
S1.001	→ ○ →		S-	14.500	12.450	1.050	Open Manhole	500
S2.000	○	150	S1	13.700	12.000	1.550	Open Manhole	1200
S3.000	→ ○ →		S-	13.320	12.000	0.320	Open Manhole	500
S1.002	○	150	S2	13.000	11.900	0.950	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	85.000	154.5	S-	14.500	12.450	1.050	Open Manhole	500
S1.001	85.000	154.5	S2	13.000	11.900	0.100	Open Manhole	1200
S2.000	14.732	147.3	S2	13.000	11.900	0.950	Open Manhole	1200
S3.000	25.000	250.0	S2	13.000	11.900	0.100	Open Manhole	1200
S1.002	5.000	125.0	S	12.900	11.860	0.890	Open Manhole	0

Pitman Associates Ltd		Page 4
South Lodge Exminster Devon EX6 8AT		
Date 03/05/2022 17:19	Designed by Karl	
File Proposd SW.MDX	Checked by	
XP Solutions	Network 2020.1	

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	0.124	0.124	0.124
2.000	-	-	100	0.062	0.062	0.062
3.000	-	-	100	0.080	0.080	0.080
1.002	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.424	0.424	0.424

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
---------------------	--------------	--------------	--------------	------------------	----------	--------

S1.002	S	12.900	11.860	0.000	0	0
--------	---	--------	--------	-------	---	---

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	4	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		

Pitman Associates Ltd		Page 5
South Lodge Exminster Devon EX6 8AT		
Date 03/05/2022 17:19	Designed by Karl	
File Proposd SW.MDX	Checked by	
XP Solutions	Network 2020.1	

Online Controls for Storm

Hydro-Brake® Optimum Manhole: S2, DS/PN: S1.002, Volume (m³): 19.1

Unit Reference MD-SHE-0128-7600-1000-7600
Design Head (m) 1.000
Design Flow (l/s) 7.6
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 128
Invert Level (m) 11.900
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)	1.000	7.6	Kick-Flo®	0.660	6.3
Flush-Flo™	0.300	7.6	Mean Flow over Head Range	-	6.6

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	4.6	0.800	6.8	2.000	10.5	4.000	14.6	7.000	19.1
0.200	7.4	1.000	7.6	2.200	11.0	4.500	15.5	7.500	19.8
0.300	7.6	1.200	8.3	2.400	11.5	5.000	16.3	8.000	20.4
0.400	7.5	1.400	8.9	2.600	11.9	5.500	17.0	8.500	21.0
0.500	7.3	1.600	9.5	3.000	12.8	6.000	17.8	9.000	21.6
0.600	6.8	1.800	10.0	3.500	13.7	6.500	18.5	9.500	22.1

Pitman Associates Ltd		Page 6
South Lodge Exminster Devon EX6 8AT		
Date 03/05/2022 17:19	Designed by Karl	
File Proposd SW.MDX	Checked by	
XP Solutions		Network 2020.1

Storage Structures for Storm

Filter Drain Pipe: S1.000

Manning's N	0.030	Trench Length (m)	85.0
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)	154.5
Invert Level (m)	13.000	Cap Volume Depth (m)	0.000
Trench Width (m)	0.5	Cap Infiltration Depth (m)	0.000

Cellular Storage Manhole: S-, DS/PN: S1.001

Invert Level (m)	12.450	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

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	545.5	0.0	0.400	545.5	0.0	0.401	0.0	0.0

Filter Drain Pipe: S1.001

Manning's N	0.030	Trench Length (m)	85.0
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)	154.5
Invert Level (m)	12.450	Cap Volume Depth (m)	1.000
Trench Width (m)	0.5	Cap Infiltration Depth (m)	0.000

Filter Drain Pipe: S3.000

Manning's N	0.030	Trench Length (m)	25.0
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)	250.0
Invert Level (m)	12.000	Cap Volume Depth (m)	1.000
Trench Width (m)	0.5	Cap Infiltration Depth (m)	0.000

Pitman Associates Ltd		Page 7
South Lodge Exminster Devon EX6 8AT		
Date 03/05/2022 17:19	Designed by Karl	
File Proposd SW.MDX	Checked by	
XP Solutions	Network 2020.1	

30 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 4 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
 Return Period(s) (years) 30, 100, 101
 Climate Change (%) 0, 20, 40

								Water Surcharged	
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Level (m)
S1.000	S-	60 Summer	30	+0%					13.495
S1.001	S-	180 Winter	30	+0%					12.608
S2.000	S1	60 Winter	30	+0%	30/60 Summer				12.858
S3.000	S-	60 Winter	30	+0%	100/60 Summer				12.847
S1.002	S2	60 Winter	30	+0%	30/60 Summer	100/60 Summer			12.831

		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	0.52		10	32.1	OK	
S1.001	S-	0.000	0.12		198	7.1	OK	
S2.000	S1	0.000	0.64			8.7	SURCHARGED	
S3.000	S-	0.000	0.20		58	9.6	OK	
S1.002	S2	0.000	0.60			7.6	FLOOD RISK	14

Pitman Associates Ltd		Page 8
South Lodge Exminster Devon EX6 8AT		
Date 03/05/2022 17:19	Designed by Karl	
File Proposd SW.MDX	Checked by	
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 4 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
 Return Period(s) (years) 30, 100, 101
 Climate Change (%) 0, 20, 40

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Surcharged	
									Level (m)	Depth (m)
S1.000	S-	60 Summer	100	+20%					13.789	-0.211
S1.001	S-	180 Winter	100	+20%					12.745	-0.705
S2.000	S1	60 Summer	100	+20%	30/60 Summer				13.207	1.057
S3.000	S-	60 Summer	100	+20%	100/60 Summer				13.049	0.049
S1.002	S2	60 Winter	100	+20%	30/60 Summer	100/60 Summer			13.008	0.958

PN	US/MH Name	Flooded		Half Drain Time (mins)	Pipe	Status	Level Exceeded
		Volume (m³)	Flow / Cap. (l/s)		Flow (l/s)		
S1.000	S-	0.000	0.80	10	49.9	FLOOD RISK	
S1.001	S-	0.000	0.21		13.2	OK	
S2.000	S1	0.000	1.28		17.3	SURCHARGED	
S3.000	S-	0.000	0.48		23.1	FLOOD RISK	
S1.002	S2	8.065	0.61		7.6	FLOOD	14

Pitman Associates Ltd		Page 9
South Lodge Exminster Devon EX6 8AT		
Date 03/05/2022 17:19 File Proposd SW.MDX	Designed by Karl Checked by	
XP Solutions	Network 2020.1	

101 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 4 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
 Return Period(s) (years) 30, 100, 101
 Climate Change (%) 0, 20, 40

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Surcharged	
									Level (m)	Depth (m)
S1.000	S-	60 Summer	101	+40%					13.932	-0.068
S1.001	S-	240 Winter	101	+40%					12.813	-0.637
S2.000	S1	60 Summer	101	+40%	30/60 Summer				13.293	1.143
S3.000	S-	60 Summer	101	+40%	100/60 Summer				13.060	0.060
S1.002	S2	60 Winter	101	+40%	30/60 Summer	100/60 Summer			13.015	0.965

PN	US/MH Name	Flooded		Flow / Overflow (l/s)	Half Drain	Pipe	Status	Level Exceeded
		Volume (m³)	Flow / Cap.		Time (mins)	Flow (l/s)		
S1.000	S-	0.000	0.92		10	57.3	FLOOD RISK	
S1.001	S-	0.000	0.14			8.9	OK	
S2.000	S1	0.000	1.69			22.7	SURCHARGED	
S3.000	S-	0.000	0.62			30.0	FLOOD RISK	
S1.002	S2	14.626	0.61			7.6	FLOOD	14

Discharge Wizard Results for Storm

Summary

Discharge Rates Check - Pass

Discharge Volumes Check - Fail

Minimal Discharge Check - Not Run

Discharge Rates Check

PN	RP(yrs)/ CC(%)	Pre-development Discharge Rate (l/s)	Post-development Discharge Rate (l/s)	Pass/Fail
1.002	30yr +0%	7.6	7.6	Pass
1.002	100yr +20%	7.6	7.6	Pass
1.002	101yr +40%	7.6	7.6	Pass

Discharge Volumes Check

PN	Volume Calculation Method	Pre-development Volume (m³)	Post-development Volume (m³)	Pass/Fail
1.002	Greenfield	135.980	230.604	Fail

(Pre-development runoff volume (except those marked with '**') for the 100 year, 360 minutes, Winter storm)

(Post-development runoff volume for the 100 year, 360 minutes, Winter storm with 0% climate change)

Warning - The network was still discharging at the end of the discharge volume test and so it is unlikely the system has fully drained down. It is advisable you rerun the simulation using a longer analysis time to allow the system to fully drain down.

Surface Water Drainage Strategy

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



4. Exceedance Flows (1000yr+40%)

Pitman Associates Ltd		Page 1
South Lodge Exminster Devon EX6 8AT		
Date 03/05/2022 17:20	Designed by Karl	
File Proposd SW.MDX	Checked by	
XP Solutions	Network 2020.1	

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 4 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
 Return Period(s) (years) 1000
 Climate Change (%) 0

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S-	60 Summer	1000	+0%	1000/60 Summer	1000/60 Summer			14.002
S1.001	S-	240 Winter	1000	+0%		1000/600 Winter			13.084
S2.000	S1	60 Summer	1000	+0%	1000/60 Summer				13.443
S3.000	S-	60 Summer	1000	+0%	1000/60 Summer	1000/600 Winter			13.077
S1.002	S2	60 Winter	1000	+0%	1000/60 Summer	1000/60 Summer			13.025

PN	US/MH Name	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S-	0.002	1.623	1.01		6	62.6	FLOOD	1
S1.001	S-	-0.366	0.000	0.20			12.5	OK	
S2.000	S1	1.293	0.000	2.07			27.8	FLOOD RISK	
S3.000	S-	0.077	0.000	0.76			36.6	FLOOD RISK	
S1.002	S2	0.975	24.546	0.61			7.6	FLOOD	19