RCD

DRAINAGE STRATEGY

Proposed Development
Hollymount Farm
Hollymount Lane
Greenmount
Bury
BL8 4HP

Consultant: Ray Clark
B. Eng (Hons)

Position: Director

Report Ref: 1189-2303-B

Report Date: 28th March 2023

EXECUTIVE SUMMARY

RCD Consulting Ltd has been appointed to design the foul and surface water drainage aspects of the proposed development at Hollymount Farm, Hollymount Lane, Greenmount, Bury, BL8 4HP.

The site is Brownfield with an area of 0.45Ha, it is irregular in shape and includes an existing farmhouse and outbuildings with a total roof area of 1039m^2, an asphalt drive with an area of 224m^2 and a farmyard constructed in permeable plainings with an area of 1800m^2.

To the north and east is Hollymount Lane, to the south and west there are open fields.

The proposed development includes the construction of five houses with a total roof area of 805m^2 and permeable paved access road and drives with a total area of 1160m^2.

The Flood Warning Information Service website extracts below confirm that the site is in flood zone 1 and that there is no risk of surface water flooding. The mapping shows that there is a high risk of flooding to the southeast, but it can be seen from the topographical survey that the site levels fall towards the ditch to the south.

The report outlines the strategy for the surface water drainage for the proposed development with reference to Ciria 753, the SUDS manual, the NPPF, the National Planning Policy Framework and the Bury Local Flood Risk Management Strategy, dated April 2018.

It is advised that a combination of Sustainable Drainage Systems (SUDS) is used to reduce the risk of surface water flooding within and beyond the development site boundaries. This will include permeable paving to mimic Greenfield conditions. The Roof drainage will discharge to a piped network where surface water discharge to the ditch will be restricted, and attenuation will be provided by a pond and cellular storage tanks.

The British Geological Society website confirms that the site is underlain by superficial deposits of Till or the River Terrace Deposits over bedrock of the Pennine Lower Coal Measures Formation.

The location of the ditch implies a high groundwater table that would prevent the use of conventional soakaways.

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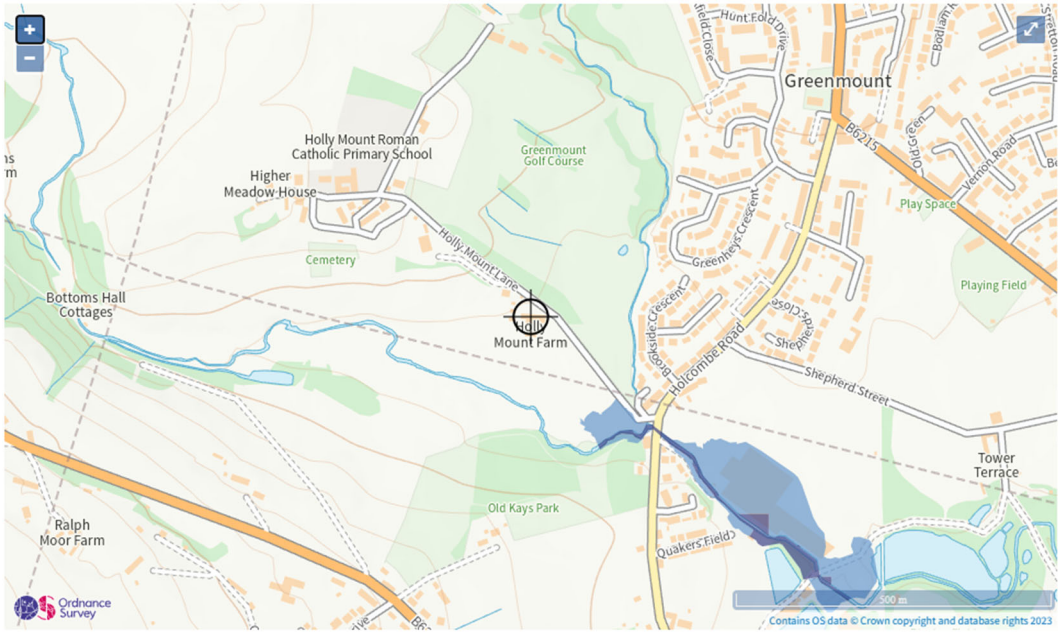
CONTENTS

EXECUTIVE SUMMARY i
1.1 FLUVIAL AND PLUVIAL FLOOD RISK 2
2.0 EXISTING DRAINAGE 3
3.0 PROPOSED DRAINAGE STRATEGY 4
4.0 SURFACE WATER DRAINAGE 4
4.1 SURFACE WATER FLOWS AND VOLUMES 5
4.2 STANDARDS 6
5.0 FOUL WATER DRAINAGE 7
5.1 STANDARDS 7
6.0 ATTENUATION 8
7.0 SUSTAINABLE URBAN DRAINAGE SYSTEMS (SUDS) 8
7.1 INFILTRATION DEVICES 9
7.2 BROWN, GREEN AND BLUE ROOFS 10
7.3 RAINWATER HARVESTING 11
7.4 POROUS PAVING 12
7.5 BELOW GROUND ATTENUATION 13
7.6 WETLANDS 14
7.7 SWALES 14
7.8 PONDS/RAIN GARDENS 14
8.0 MANAGEMENT AND MAINTENANCE OF SUDS 15
9.0 IMPLEMENTATION OF SUDS 15
APPENDIX A – Topographical survey 16
APPENDIX B – Pre-development surface water calculations 17
APPENDIX C – Drainage Strategy Layout 18
APPENDIX D – Post-Development calculations 19
APPENDIX E – Flood exceedance Plan 20

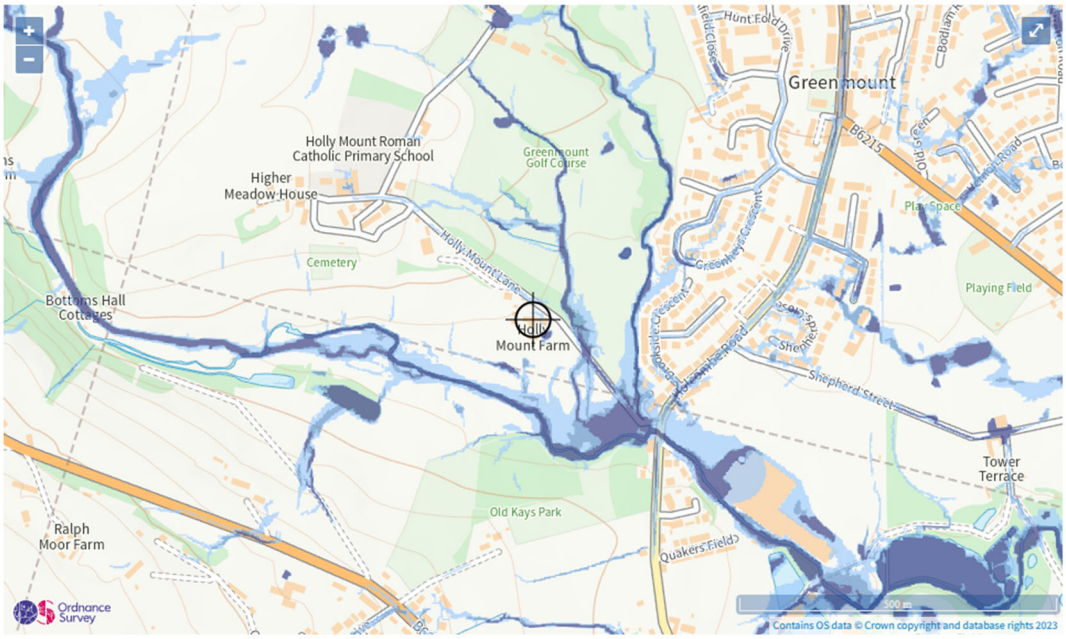
1.1 FLUVIAL AND PLUVIAL FLOOD RISK

The Flood Warning Information Service website extracts below confirm that the site is in flood zone 1 and that there is no risk of surface water flooding. The mapping shows that there is a high risk of flooding to the southeast, but it can be seen from the topographical survey that the site levels fall towards the ditch to the south.



Extent of flooding from rivers or the sea

High Medium Low Very low Location you selected



Extent of flooding from surface water

High Medium Low Very low Location you selected

2.0 EXISTING DRAINAGE

The site is Brownfield with an area of 0.56Ha, it is irregular in shape and includes an existing farmhouse and outbuildings with a total roof area of 1039m^2, an asphalt drive with an area of 224m^2 and a farmyard constructed in permeable plainings with an area of 1800m^2.

To the north and east is Hollymount Lane, to the south and west there are open fields.

The topographical survey shown in Appendix A confirms that site levels fall in a southerly direction towards the existing ditch.

The British Geological Society website confirms that the site is underlain by superficial deposits of Till or the River Terrace Deposits over bedrock of the Pennine Lower Coal Measures Formation.

The nearest watercourse is the Kirklees Brook approximately 1.2Km southeast of the development. The ditch to the south of the development is a tributary to the Brook.

There are no public sewers close to the development site, but the evidence of manhole covers implies that foul drainage discharges to a septic tank and that surface water discharges at an unrestricted rate to the ditch.

Greenfield surface water calculations are shown in Appendix B.

The presence of the ditch implies that there is a high groundwater table that would prevent the use of conventional soakaways.

3.0 PROPOSED DRAINAGE STRATEGY

The proposed development includes the construction of five houses with a total roof area of 805m^2 and permeable paved access road and drives with a total area of 1160m^2.

The roof drainage will discharge to a piped network where surface water discharge to the ditch will be restricted, and attenuation will be provided by a pond and cellular storage tanks.

Surface water discharge will be restricted to a maximum of 1.2l/s during the worst case 1 in 100 year storm event with a 40% climate change allowance.

The hard standing areas will be constructed in permeable materials to mimic existing Greenfield conditions.

The Drainage Strategy Layout is shown in Appendix C.

Post-development surface water calculations are shown in Appendix D.

The flood exceedance plan in Appendix E shows the route flood water will take in the unlikely event of SUDs failure. This will flow overland and discharge to the ditch.

4.0 SURFACE WATER DRAINAGE

In accordance with Ciria 753, SUDS Manual, flooding is permitted above ground during the 1 in 100 year storm event + 40% climate change allowance but all flood water is to be contained within the site boundaries. No flooding is permitted during the 1 in 30 year storm event.

The post development surface water calculations for the 1 in 100 year storm event with 40% climate change allowance confirm that no flooding occurs.

4.1 SURFACE WATER FLOWS AND VOLUMES

A summary of the existing and proposed peak flows are detailed in Table 1 below and include the 40% climate change allowance for the worst case 1 in 100 year storm event.

Return Period	Greenfield l/s	Post-development l/s
1 in 1 year	4.34	0.6
1 in 30 years	8.48	0.9
1 in 100 years	10.37	1.0
1 in 100 years +40% CC	-	1.2

Table 1: Summary of Existing and Proposed Surface Water Flows

The pre-development surface water flow calculations are shown in Appendix B and the post-development calculations are shown in Appendix D.

A summary of the existing and proposed peak volumes are detailed in Table 2 below and include the 40% climate change allowance for the worst case 1 in 100 year storm event. The volumes are based upon a pond design with zero outflow during the 360 minute storm event.

Return Period	Pre-development m^3	Post-development m^3
1 in 1 year	67.8	13.0
1 in 30 years	154.5	29.0
1 in 100 years	206.3	37.7
1 in 100 years +40% CC	-	52.7

Table 2: Summary of Existing and Proposed Surface Water Volumes

The pre-development surface water volume calculations are shown in Appendix B and the post-development surface water calculations are shown in Appendix D.

4.2 STANDARDS

The performance of the surface water drainage system will be designed to BS EN 752 Parts 3 and 4, and the most current issue of Part H of the Building Regulations.

In accordance with the Local Water Authority guidance a flood exceedance plan shown in Appendix E indicates the routes water will take in the unlikely event of SUDS failure.

The materials specification for the scheme will be in accordance with the Highways Agency Specification for Highway Works. For the purposes of the indicative design, the following material types have been assumed:

- Drainage pipes up to 300mm diameter – Vitrified clayware, plastic pipes will be permitted subject to ground conditions.
- Manholes and chambers - Precast concrete with concrete surround or PPIC
- Chamber covers – Class D400 infill type in hard paved areas.
- Pipe bedding - Imported granular material.
- Pipe Trench backfill - Selected as dug or imported material.
- Manholes should be located at every change of alignment or gradient; at the head of all sewers; at every junction of a public sewer.

The drainage shall be designed utilizing the following criteria:

- Minimum flow velocity 1.0m/s for self-cleansing
- Standard pipe roughness “Ks” of 0.6.

5.0 FOUL WATER DRAINAGE

Foul drainage from the buildings will be collected via pipes and discharge to the ditch via a biodisk sewerage treatment plant.

In accordance with sewers for adoption average flows will be 0.23l/s

5.1 STANDARDS

The performance of the foul drainage system has been designed BS EN 752 Parts 3 and 4, and the most current issue of Part H of the Building Regulations. The main criteria used are as follows.

- Drainage pipes up to 100mm diameter – Vitrified clayware, plastic pipes will be permitted subject to ground conditions.
- Manholes and chambers - Precast concrete with concrete surround or PPIC
- Chamber covers – Class D400 infill type in higher quality paved areas.
- Class D400 standard type in all other road / parking areas
- Class C250 standard type in all footpath areas
- Pipe bedding - Imported granular material.
- Pipe Trench backfill - Selected as dug or imported material.
- Manholes should be located at every change of alignment or gradient; at the head of all sewers; at every junction of a public sewer.

The drainage shall be designed utilizing the following criteria:

- Minimum flow velocity 0.75m/s for self-cleansing
- Standard pipe roughness “Ks” of 1.5.

6.0 ATTENUATION

It is proposed that Sustainable Urban Drainage Systems (SUDS) will be the primary consideration for surface water management. There are several different methods that may be used to provide sufficient attenuation of the surface water described in Section 7 below.

Attenuation should be positioned as close to the outfall as possible and would control the surface water discharge from the site. Implementation of one or all of the SUDS methods outlined in Section 7 of this report is highly recommended to reduce the requirement for below ground storage.

The proposed drainage design includes a 20m^3 cellular storage tank and a pond that have been designed to attenuate the worst case 1 in 100 year storm event with a 40% climate change allowance so that no flooding occurs.

7.0 SUSTAINABLE URBAN DRAINAGE SYSTEMS (SUDS)

The objective of SUDS is to minimise the impacts of the development on the quantity and quality of site runoff and maximise amenity and biodiversity opportunities. Surface water SUDS will be designed and installed in accordance with NPPF and associated technical guidance March 2012 and associated CIRIA documents.

The mix of SUDS to be used is determined by the conditions on site, in this case a development with areas of external space which can be utilised for SUDS. The methodology of surface water control is to slow the entry of the surface water into the system by using flow control devices (in this instance an orifice plate), then retain the runoff by using below ground storage (a pond and cellular storage tanks). The reduced impact of the development upon the drainage infrastructure will therefore reduce the potential for flooding.

7.1 INFILTRATION DEVICES

Infiltration devices drain water directly into the ground. Infiltration trenches and soakaways are more practicable for urban sites with limited space available. Infiltration devices can be integrated into and form part of the landscaped areas.

Infiltration trenches are completely below ground, and water should not occur on the surface.

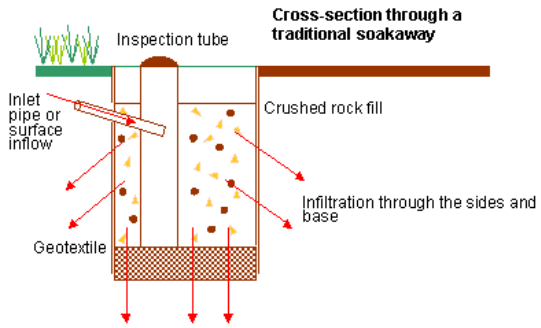


Figure 1 – Typical cross section through infiltration trench

Advantages – Reduces the volume of runoff, effective at pollutant removal, contributes to ground water recharge, simple and cost effective.

Disadvantages – Potentially high failure rates, comprehensive ground investigations required, offset from foundations (min. 5m away), risk of ground water pollution, reduced performance during prolonged wet periods.

Suitable for use – **No**, the nearby ditch implies there is a high groundwater table that would prevent conventional soakaways operating efficiently

7.2 BROWN, GREEN AND BLUE ROOFS

Green roofs comprise a multi-layered system that covers the roof of a building or podium structure with vegetation cover/landscaping over a drainage layer. They are designed to intercept and retain precipitation, increasing the time of concentration and reducing the volume of runoff and attenuation peak flows. Green roofs can be anything from a thin growing layer of sedums and mosses to plants, shrubs and large trees.

These roofs vary in specification and can be designed to attract bird and invertebrate species. Referring to CIRIA document C644, green and brown roofs also participate in attenuating rainwater. This would reduce the requirement for below ground storage attenuation on the site.

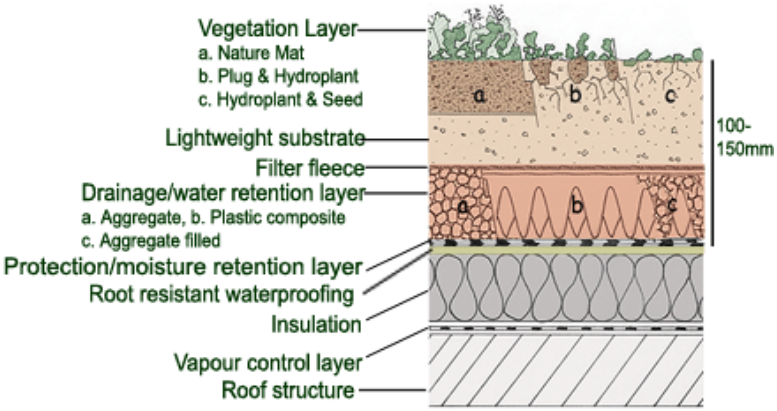


Figure 2 – Typical section through green roof build-up

Advantages – Mimic greenfield state of building footprint, good removal of pollutants, ecological and amenity benefits, improve air quality, insulates building.

Disadvantages – Costs, increased structural loading, roof height, design, maintenance and exposure may preclude use.

Suitable for use – **No**, the type of roof proposed will not support a Green Roof system.

7.3 RAINWATER HARVESTING

These tanks act as mini-storage chambers for surface water, reducing the extent of underground storage required. They provide a source of water for plant irrigation, washing machines and for flushing toilets.

Harvested rainwater is stored below ground and pumped to provide a substitute for potable mains water reducing both the site discharge and water consumption.

Figure 4 – Rainwater Harvesting

Advantages – Provided source control of storm water runoff, reduces demand on mains water.

Disadvantages – Costs, Risk to public health, use dependant on demand requirements and seasonal rainfall characteristics, maintenance of pumps & control systems.

Suitable for use – **No,** the cost of installing is not viable for a project of this size and type.

7.4 POROUS PAVING

Porous pavement is an alternative to conventional paving in which water permeates through the paved structure rather than draining off it. The surface water will be held in a reservoir structure (high void content sub-base) under the pavement for subsequent delayed discharge or infiltration into the sub-strata below.

The porous paving can be materials such as gravel, Grasscrete, porous (no fines) concrete, concrete blocks or porous asphalt. Pollutant removal rates have been shown to be high, as the majority of the removal occurs as a result of the filtration of the water through the aggregate sub-base.

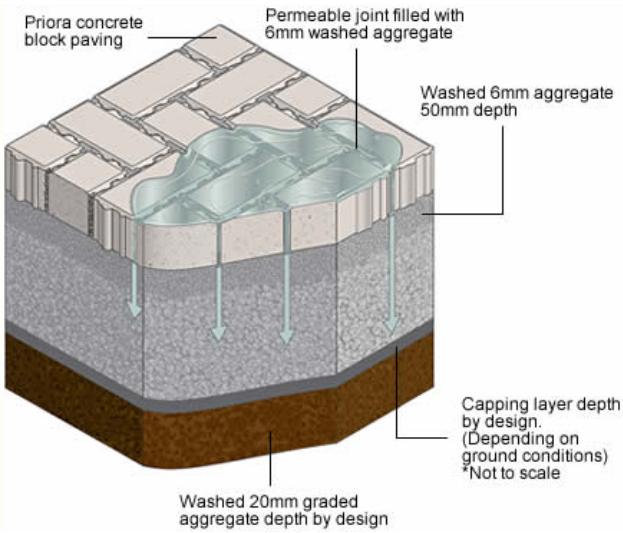


Figure 3 – Typical section through porous paving

Advantages – Effective in removing pollutants, lined systems can be used to avoid infiltration, reduces volume and rate of surface water runoff, suitable for high density developments. Mimics existing Greenfield conditions by filtering into the surrounding soft landscaped areas.

Disadvantages – Costs, used for low traffic volumes, low axel loads and speeds, risk of long-term clogging due to poor maintenance.

Suitable for use – **Yes,** permeable paving is proposed.

7.5 BELOW GROUND ATTENUATION

Attenuation involves the storing of surface water within pipework or underground tanks prior to controlled discharge into the public system. Attenuation tanks can also provide offline storage.

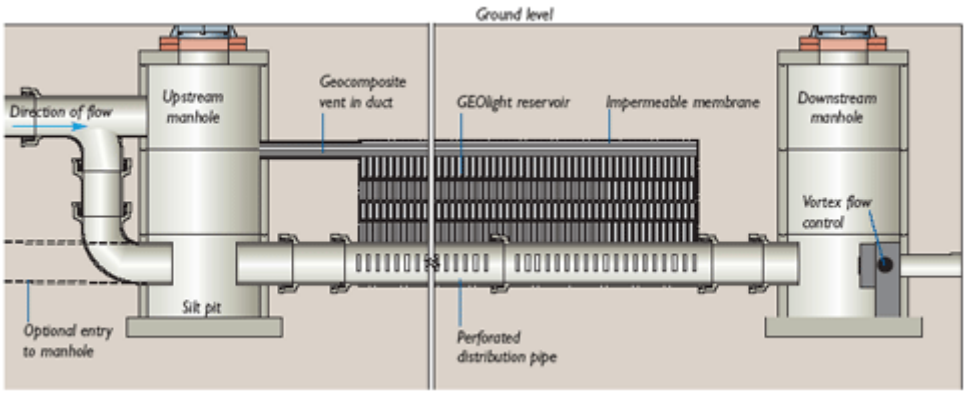


Figure 5 – Typical section through below ground attenuation chamber (cellular storage)

Advantages – Effective storage of surface water, can be used below trafficked areas, can be used below public open areas, minimum maintenance.

Disadvantages – No water quality treatment.

Suitable for use – **Yes,** cellular storage tanks are proposed.

7.6 WETLANDS

Wetlands provide both stormwater attenuation and treatment. They comprise shallow ponds and marshy areas, covered in aquatic vegetation. Wetlands provide settlement of sediment and remove contaminants.

Advantages – Effective storage of surface water, good pollutant removal, ecological and amenity benefits.

Disadvantages – Requires large surface area. Health & Safety issues associated with large bodies of water.

Suitable for use – **No,** there is no space available.

7.7 SWALES

Swales are vegetated drainage structures up to 500mm deep and used to provide flow control through attenuation. They can be used for infiltration, where possible.

Advantages – Can be incorporated into landscaping, good removal of contaminants, reduces discharge rates. Low costs.

Disadvantages – Requires large surface area. Limits the extent of trees used in landscaping. Health & Safety issues associated with large bodies of water following heavy rainfall.

Suitable for use – **No,** there is no space available.

7.8 PONDS/RAIN GARDENS

Ponds or rain gardens are irregular shaped vegetated drainage structures used to provide flow control through attenuation. They can be used for infiltration, where possible.

Advantages – Can be incorporated into landscaping, good removal of contaminants, reduces discharge rates. Low costs.

Disadvantages – Requires large surface area. Limits the extent of trees used in landscaping. Health & Safety issues associated with large bodies of water following heavy rainfall.

Suitable for use – **Yes,** a pond is proposed.

8.0 MANAGEMENT AND MAINTENANCE OF SUDS

A management company will be responsible for completion of routine maintenance of the development including all SUDs elements not within private ownership.

The flow control chambers, manholes, catchpits and cellular storage tank are to be inspected and cleaned out on an annual basis.

The pond will be inspected on an annual basis and all debris removed. Every ten years the pond base will be de-silted to ensure that capacity is maintained.

The permeable paving shall be weeded on a monthly basis and all debris removed.

Every twenty-five years or at a period recommended by the manufacturer the permeable paving shall be lifted and the laying course replaced or cleaned.

9.0 IMPLEMENTATION OF SUDS

Construction will commence shortly after planning consent has been granted and it is expected the development will take approximately two years to complete.

APPENDIX A – Topographical survey

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SITE SPECIFIC HAZARDS

IN ACCORDANCE WITH THE REQUIREMENTS OF THE CDM REGULATIONS 2015 THE FOLLOWING SIGNIFICANT RESIDUAL HAZARDS HAVE NOT BEEN DESIGNED OUT OF THIS PROJECT AND MUST BE TAKEN INTO CONSIDERATION BY CONTRACTORS PLANNING TO UNDERTAKE THE WORKS SHOWN ON THIS DRAWING:

SCALE 1:200

0m 2 4 6 8 10 12

REV.	DATE	NOTES	INIT.
A	21013	PROJECT NO AMENDED	RSL

CLIENT / PROJECT

J.BUCKLEY PROPERTIES
HOLLYMOUNT FARM
GREENMOUNT

DRAWING TITLE

EXISTING SITE PLAN

-

STATUS

PLANNING

DATE	DRAWN	SCALE @ A1
MAR 22	SSS	1:200

PROJECT NUMBER	PLAN / BUILD	TYPE	NUMBER	REVISION LETTER
108	PLN	L	01	A

Site Location Plans	L	GA Plans	P	Elevations	E
Sections	S	Details	D	Prefix Colour	C

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APPENDIX B – Pre-development surface water calculations

Print | Close Report

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Ray Clark
Site name:	HOLLYMOUNT FARM
Site location:	GREENMOUNT

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:	53.62203° N
Longitude:	2.3451° W
Reference:	1559964537
Date:	Mar 18 2023 20:08

Runoff estimation approach IH124

Site characteristics

Total site area (ha): 0.56

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):	1181	1181
Hydrological region:	10	10
Growth curve factor 1 year:	0.87	0.87
Growth curve factor 30 years:	1.7	1.7
Growth curve factor 100 years:	2.08	2.08
Growth curve factor 200 years:	2.37	2.37

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):	4.99	4.99
1 in 1 year (l/s):	4.34	4.34
1 in 30 years (l/s):	8.48	8.48
1 in 100 year (l/s):	10.37	10.37
1 in 200 years (l/s):	11.82	11.82

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.

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Greenfield Runoff Volume

FSR Data

Return Period (years)	1
Storm Duration (mins)	360
Region	England and Wales
M5-60 (mm)	19.000
Ratio R	0.255
Areal Reduction Factor	1.00
Area (ha)	0.560
SAAR (mm)	1200
CWI	123.813
Urban	0.000
SPR	47.000

Results

Percentage Runoff (%)	46.70
Greenfield Runoff Volume (m^3)	67.796

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Greenfield Runoff Volume

FSR Data

Return Period (years)	30
Storm Duration (mins)	360
Region	England and Wales
M5-60 (mm)	19.000
Ratio R	0.255
Areal Reduction Factor	1.00
Area (ha)	0.560
SAAR (mm)	1200
CWI	123.813
Urban	0.000
SPR	47.000

Results

Percentage Runoff (%)	49.76
Greenfield Runoff Volume (m^3)	154.518

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Greenfield Runoff Volume

FSR Data

Return Period (years)	100
Storm Duration (mins)	360
Region	England and Wales
M5-60 (mm)	19.000
Ratio R	0.255
Areal Reduction Factor	1.00
Area (ha)	0.560
SAAR (mm)	1200
CWI	123.813
Urban	0.000
SPR	47.000

Results

Percentage Runoff (%)	51.71
Greenfield Runoff Volume (m^3)	206.340

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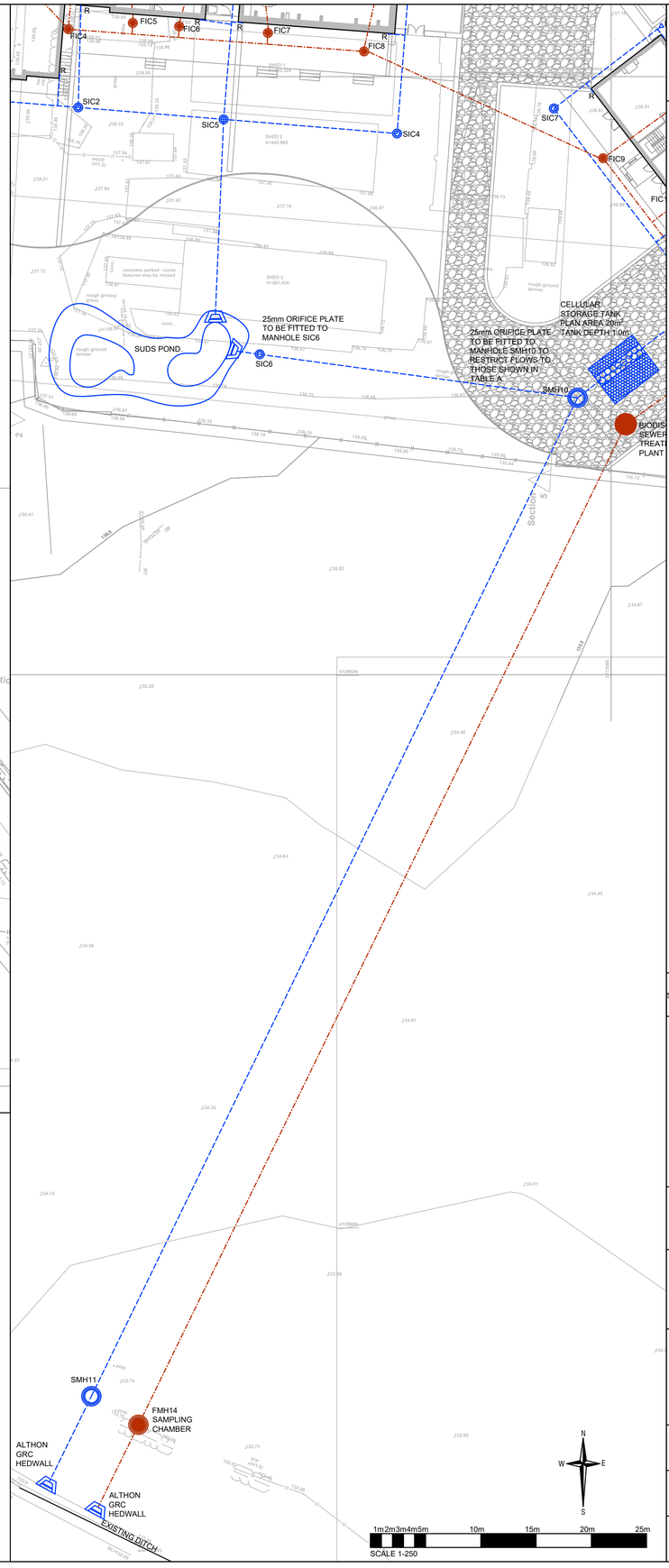
APPENDIX C – Drainage Strategy Layout



DRAWING LEGEND

SURFACE WATER DRAINAGE

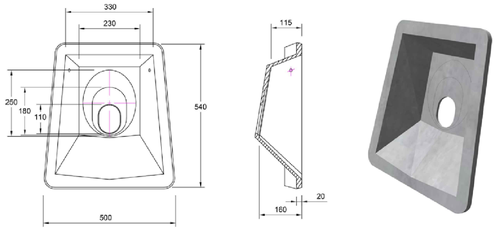
	1200Ø PCC MANHOLE
SIC	450Ø INSPECTION CHAMBER CP DENOTES CATCHPIT
RE	RODDING EYE
	SURFACE WATER SEWER
R	RAINWATER PIPE
	450mm DEEP PERMEABLE DRIVE CONSTRUCTION

FOUL WATER DRAINAGE

FMH	1200Ø PCC MANHOLE
FIC	450Ø INSPECTION CHAMBER
	PRIVATE FOUL WATER SEWER
DP	DRAINAGE POINT

TABLE A

STORM EVENT (1 IN)	HRWALLINGFORD FLOW RATE l/s	DESIGNED FLOW RATE l/s
QBAR	4.99	-
1	4.34	0.6
30	8.48	0.9
100	10.37	1.0
100 + 40%CC	-	1.2



ALTHON GRC HEADWALL DETAIL

NOTES

CONTRACTORS MUST VERIFY ALL DIMENSIONS ON SITE BEFORE COMMENCING ANY WORK ON SHOP DRAWINGS

DO NOT SCALE FROM THIS DRAWING

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NOTES

1. ALL DIMENSIONS IN MILLIMETERS UNLESS NOTED OTHERWISE.

2. THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL OTHER ENGINEERING DRAWINGS AND CALCULATIONS ASSOCIATED WITH THIS PROJECT.

3. ALL COMPONENTS AND MATERIALS ARE TO BE MANUFACTURED AND SUPPLIED IN ACCORDANCE WITH THE RELEVANT BRITISH STANDARDS, AND LAID AND BACKFILLED IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS AND THE RELEVANT BRITISH STANDARDS.

4. THE CONTRACTOR SHALL, BEFORE COMMENCING THE WORKS, VERIFY ALL SITE AND SETTING OUT DIMENSIONS. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE TRUE AND PROPER SETTING OUT OF THE WORKS AND FOR THE CORRECTNESS OF THE POSITION, LEVELS, DIMENSIONS, AND ALIGNMENT OF ALL PARTS OF THE WORKS.

5. ALL BUILDING DRAINAGE TO BE INSTALLED AND TESTED IN COMPLIANCE WITH THE BUILDING REGULATIONS 2000 DRAINAGE AND WASTE DISPOSAL APPROVED DOCUMENT H 2002 EDITION.

6. SMALL LIGHTWEIGHT ACCESS COVERS SHOULD BE SECURED (FOR EXAMPLE WITH SCREWS) TO DETER UNAUTHORISED ACCESS.

7. ALL ABOVE GROUND DRAINAGE TO INCORPORATE RODDING ACCESS FACILITIES.

8. INSITU CONCRETE FOR USE IN GENERAL DRAINAGE WORKS, GRADE TO BS: 5328.

9. FOR INTERNAL DRAINAGE POSITIONS REFER TO ARCHITECT'S CURRENT WORKING DRAWINGS.

10. FOR LANDSCAPING SURFACE MATERIAL FINISHES REFER TO ARCHITECT'S CURRENT WORKING DRAWINGS.

11. ALL PIPES TO BE 100mm DIAMETER UNLESS NOTED OTHERWISE.

REV	AMENDMENT	DATE	CHKD
P2	POND ADDED AND CALCULATIONS UPDATED.	28.03.2023	RAC
P1	PRELIMINARY ISSUE	20.03.2023	RAC

DRAWING STATUS

PRELIMINARY

RCD

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CLIENT

J. BUCKLEY PROPERTIES

PROJECT

PROPOSED RESIDENTIAL DEVELOPMENT
HOLLYMOUNT FARM
GREENMOUNT

DRAWING TITLE

DRAINAGE STRATEGY LAYOUT

CIVILS

SCALE	DRAWN BY	CHECKED	DATE
1:250 @ A1 1:500 @ A3	STC	RAC	MAR 2023

DRAWING NUMBER	REVISION
1189-2203-CIV-DS10	P2

APPENDIX D – Post-Development calculations

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	PIMP (%)	100
M5-60 (mm)	19.000	Add Flow / Climate Change (%)	0
Ratio R	0.400	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	0	Maximum Backdrop Height (m)	10.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.030	4-8	0.045

Total Area Contributing (ha) = 0.075

Total Pipe Volume (m³) = 3.921

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	17.000	0.900	18.9	0.019	5.00	0.0	0.600	o	100	Pipe/Conduit	
1.001	13.000	1.400	9.3	0.010	0.00	0.0	0.600	o	100	Pipe/Conduit	
2.000	16.000	0.150	106.7	0.014	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	18.000	0.150	120.0	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)
1.000	0.00	5.16	138.600	0.019	0.0	0.0	0.0	1.79	14.0	0.0
1.001	0.00	5.24	137.700	0.029	0.0	0.0	0.0	2.55	20.0	0.0
2.000	0.00	5.27	136.400	0.014	0.0	0.0	0.0	0.97	17.2	0.0
1.002	0.00	5.60	136.250	0.043	0.0	0.0	0.0	0.92	16.2	0.0

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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.003	2.000	0.050	40.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.004	29.000	1.000	29.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
3.000	22.000	0.300	73.3	0.016	5.00	0.0	0.600	o	100	Pipe/Conduit	
4.000	22.000	0.300	73.3	0.016	5.00	0.0	0.600	o	100	Pipe/Conduit	
3.001	14.000	0.100	140.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.005	100.000	1.950	51.3	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.006	10.000	0.350	28.6	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)
1.003	0.00	5.62	136.100	0.043	0.0	0.0	0.0	1.60	28.2	0.0
1.004	0.00	5.88	136.050	0.043	0.0	0.0	0.0	1.88	33.2	0.0
3.000	0.00	5.41	136.200	0.016	0.0	0.0	0.0	0.90	7.1	0.0
4.000	0.00	5.41	136.200	0.016	0.0	0.0	0.0	0.90	7.1	0.0
3.001	0.00	5.68	135.150	0.032	0.0	0.0	0.0	0.85	15.0	0.0
1.005	0.00	7.06	135.050	0.075	0.0	0.0	0.0	1.41	24.9	0.0
1.006	0.00	7.15	133.100	0.075	0.0	0.0	0.0	1.89	33.4	0.0

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	139.200	0.600	Open Manhole	450	1.000	138.600	100				
2	138.300	0.600	Open Manhole	450	1.001	137.700	100	1.000	137.700	100	
4	137.000	0.600	Open Manhole	450	2.000	136.400	150				
5	138.300	2.050	Open Manhole	450	1.002	136.250	150	1.001	136.300	100	
								2.000	136.250	150	
POND	137.000	0.900	Open Manhole	150	1.003	136.100	150	1.002	136.100	150	
6	137.000	0.950	Open Manhole	450	1.004	136.050	150	1.003	136.050	150	
7	136.800	0.600	Open Manhole	450	3.000	136.200	100				
8	136.800	0.600	Open Manhole	450	4.000	136.200	100				
9	136.800	1.650	Open Manhole	450	3.001	135.150	150	3.000	135.900	100	700
								4.000	135.900	100	700
10	136.700	1.650	Open Manhole	1200	1.005	135.050	150	1.004	135.050	150	
								3.001	135.050	150	
11	133.700	0.600	Open Manhole	1200	1.006	133.100	150	1.005	133.100	150	
DITCH	133.500	0.750	Open Manhole	150		OUTFALL		1.006	132.750	150	

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

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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	100	1	139.200	138.600	0.500	Open Manhole	450
1.001	o	100	2	138.300	137.700	0.500	Open Manhole	450
2.000	o	150	4	137.000	136.400	0.450	Open Manhole	450
1.002	o	150	5	138.300	136.250	1.900	Open Manhole	450
1.003	o	150	POND	137.000	136.100	0.750	Open Manhole	150
1.004	o	150	6	137.000	136.050	0.800	Open Manhole	450
3.000	o	100	7	136.800	136.200	0.500	Open Manhole	450
4.000	o	100	8	136.800	136.200	0.500	Open Manhole	450
3.001	o	150	9	136.800	135.150	1.500	Open Manhole	450
1.005	o	150	10	136.700	135.050	1.500	Open Manhole	1200
1.006	o	150	11	133.700	133.100	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)
1.000	17.000	18.9	2	138.300	137.700	0.500	Open Manhole	450
1.001	13.000	9.3	5	138.300	136.300	1.900	Open Manhole	450
2.000	16.000	106.7	5	138.300	136.250	1.900	Open Manhole	450
1.002	18.000	120.0	POND	137.000	136.100	0.750	Open Manhole	150
1.003	2.000	40.0	6	137.000	136.050	0.800	Open Manhole	450
1.004	29.000	29.0	10	136.700	135.050	1.500	Open Manhole	1200
3.000	22.000	73.3	9	136.800	135.900	0.800	Open Manhole	450
4.000	22.000	73.3	9	136.800	135.900	0.800	Open Manhole	450
3.001	14.000	140.0	10	136.700	135.050	1.500	Open Manhole	1200
1.005	100.000	51.3	11	133.700	133.100	0.450	Open Manhole	1200
1.006	10.000	28.6	DITCH	133.500	132.750	0.600	Open Manhole	150

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Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.006	DITCH	133.500	132.750	132.750	150	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Storm Duration (mins)	30
Ratio R	0.400		

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Online Controls for Storm

Orifice Manhole: 6, DS/PN: 1.004, Volume (m³): 0.2

Diameter (m) 0.025 Discharge Coefficient 0.600 Invert Level (m) 136.050

Orifice Manhole: 10, DS/PN: 1.005, Volume (m³): 2.6

Diameter (m) 0.025 Discharge Coefficient 0.600 Invert Level (m) 135.050

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Storage Structures for Storm

Tank or Pond Manhole: POND, DS/PN: 1.003

Invert Level (m) 136.100

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	50.0	0.900	120.0

Cellular Storage Manhole: 10, DS/PN: 1.005

Invert Level (m) 135.050 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	20.0	20.0	1.001	0.0	37.9
1.000	20.0	37.9			

Volume Summary (Static)

Length Calculations based on Centre-Centre

Pipe Number	USMH Name	Manhole Volume (m³)	Pipe Volume (m³)	Storage Structure Volume (m³)	Total Volume (m³)
1.000	1	0.095	0.134	0.000	0.229
1.001	2	0.095	0.102	0.000	0.198
2.000	4	0.095	0.283	0.000	0.378
1.002	5	0.326	0.318	0.000	0.644
1.003	POND	0.016	0.035	74.238	74.289
1.004	6	0.151	0.512	0.000	0.664
3.000	7	0.095	0.173	0.000	0.268
4.000	8	0.095	0.173	0.000	0.268
3.001	9	0.262	0.247	0.000	0.510
1.005	10	1.866	1.767	19.006	22.640
1.006	11	0.679	0.177	0.000	0.855
Total		3.777	3.921	93.244	100.943

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Volume Summary (Static)

Length Calculations based on True Length

Pipe Number	USMH Name	Manhole Volume (m³)	Pipe Volume (m³)	Storage Structure Volume (m³)	Total Volume (m³)
1.000	1	0.095	0.130	0.000	0.225
1.001	2	0.095	0.099	0.000	0.194
2.000	4	0.095	0.275	0.000	0.370
1.002	5	0.326	0.313	0.000	0.639
1.003	POND	0.016	0.030	74.238	74.284
1.004	6	0.151	0.498	0.000	0.649
3.000	7	0.095	0.169	0.000	0.265
4.000	8	0.095	0.169	0.000	0.265
3.001	9	0.262	0.233	0.000	0.495
1.005	10	1.866	1.746	19.006	22.618
1.006	11	0.679	0.165	0.000	0.843
Total		3.777	3.826	93.244	100.848

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

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	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
Foul Sewage per hectare (l/s)	0.000		

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

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	450.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	1	+0%					138.629
1.001	2	15 Winter	1	+0%					137.730
2.000	4	15 Winter	1	+0%					136.434
1.002	5	15 Winter	1	+0%	100/15 Summer				136.313
1.003	POND	120 Winter	1	+0%	30/60 Winter				136.166
1.004	6	240 Winter	1	+0%	30/15 Summer				136.195
3.000	7	15 Winter	1	+0%					136.238
4.000	8	15 Winter	1	+0%					136.238
3.001	9	360 Winter	1	+0%	30/30 Summer				135.246
1.005	10	360 Winter	1	+0%	1/60 Winter				135.246
1.006	11	360 Winter	1	+0%					133.113

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.071	0.000	0.19			2.5	OK	
1.001	2	-0.070	0.000	0.19			3.6	OK	
2.000	4	-0.116	0.000	0.11			1.8	OK	
1.002	5	-0.087	0.000	0.36			5.4	OK	
1.003	POND	-0.084	0.000	0.04			0.6	OK	
1.004	6	-0.005	0.000	0.01			0.4	OK	
3.000	7	-0.062	0.000	0.30			2.1	OK	
4.000	8	-0.062	0.000	0.30			2.1	OK	
3.001	9	-0.054	0.000	0.05			0.6	OK	
1.005	10	0.046	0.000	0.02		198	0.6	SURCHARGED	
1.006	11	-0.137	0.000	0.02			0.6	OK	

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

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	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
Foul Sewage per hectare (l/s)	0.000		

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

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	450.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 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) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	30	+0%					138.648
1.001	2	15 Winter	30	+0%					137.751
2.000	4	15 Winter	30	+0%					136.455
1.002	5	15 Winter	30	+0%	100/15 Summer				136.365
1.003	POND	120 Winter	30	+0%	30/60 Winter				136.273
1.004	6	180 Winter	30	+0%	30/15 Summer				136.451
3.000	7	15 Winter	30	+0%					136.266
4.000	8	15 Winter	30	+0%					136.266
3.001	9	240 Winter	30	+0%	30/30 Summer				135.499
1.005	10	240 Winter	30	+0%	1/60 Winter				135.498
1.006	11	240 Winter	30	+0%					133.117

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.052	0.000	0.46			6.1	OK	
1.001	2	-0.049	0.000	0.50			9.5	OK	
2.000	4	-0.095	0.000	0.28			4.5	OK	
1.002	5	-0.035	0.000	0.92			13.9	OK	
1.003	POND	0.023	0.000	0.09			1.3	SURCHARGED	
1.004	6	0.251	0.000	0.02			0.6	SURCHARGED	
3.000	7	-0.034	0.000	0.75			5.1	OK	
4.000	8	-0.034	0.000	0.75			5.1	OK	
3.001	9	0.199	0.000	0.14			2.0	SURCHARGED	
1.005	10	0.298	0.000	0.04			0.9	SURCHARGED	
1.006	11	-0.133	0.000	0.03			0.9	OK	

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

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 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
Foul Sewage per hectare (l/s) 0.000

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

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.400
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 19.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 450.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 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) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	100	+0%					138.656
1.001	2	15 Winter	100	+0%					137.760
2.000	4	15 Winter	100	+0%					136.474
1.002	5	15 Winter	100	+0%	100/15 Summer				136.449
1.003	POND	180 Winter	100	+0%	30/60 Winter				136.332
1.004	6	180 Winter	100	+0%	30/15 Summer				136.564
3.000	7	15 Winter	100	+0%					136.280
4.000	8	15 Winter	100	+0%					136.280
3.001	9	240 Winter	100	+0%	30/30 Summer				135.641
1.005	10	240 Winter	100	+0%	1/60 Winter				135.640
1.006	11	240 Winter	100	+0%					133.118

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.044	0.000	0.59			8.0	OK	
1.001	2	-0.040	0.000	0.65			12.4	OK	
2.000	4	-0.076	0.000	0.36			5.7	OK	
1.002	5	0.049	0.000	1.17			17.6	SURCHARGED	
1.003	POND	0.082	0.000	0.10			1.4	SURCHARGED	
1.004	6	0.364	0.000	0.02			0.7	FLOOD RISK	
3.000	7	-0.020	0.000	0.97			6.6	OK	
4.000	8	-0.020	0.000	0.97			6.6	OK	
3.001	9	0.341	0.000	0.19			2.6	SURCHARGED	
1.005	10	0.440	0.000	0.04			1.0	SURCHARGED	
1.006	11	-0.132	0.000	0.03			1.0	OK	

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	PIMP (%)	100
M5-60 (mm)	19.000	Add Flow / Climate Change (%)	0
Ratio R	0.400	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	0	Maximum Backdrop Height (m)	10.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.030	4-8	0.045

Total Area Contributing (ha) = 0.075

Total Pipe Volume (m³) = 3.921

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	17.000	0.900	18.9	0.019	5.00	0.0	0.600	o	100	Pipe/Conduit	
1.001	13.000	1.400	9.3	0.010	0.00	0.0	0.600	o	100	Pipe/Conduit	
2.000	16.000	0.150	106.7	0.014	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	18.000	0.150	120.0	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)
1.000	0.00	5.16	138.600	0.019	0.0	0.0	0.0	1.79	14.0	0.0
1.001	0.00	5.24	137.700	0.029	0.0	0.0	0.0	2.55	20.0	0.0
2.000	0.00	5.27	136.400	0.014	0.0	0.0	0.0	0.97	17.2	0.0
1.002	0.00	5.60	136.250	0.043	0.0	0.0	0.0	0.92	16.2	0.0

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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.003	2.000	0.050	40.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.004	29.000	1.000	29.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
3.000	22.000	0.300	73.3	0.016	5.00	0.0	0.600	o	100	Pipe/Conduit	
4.000	22.000	0.300	73.3	0.016	5.00	0.0	0.600	o	100	Pipe/Conduit	
3.001	14.000	0.100	140.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.005	100.000	1.950	51.3	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.006	10.000	0.350	28.6	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)
1.003	0.00	5.62	136.100	0.043	0.0	0.0	0.0	1.60	28.2	0.0
1.004	0.00	5.88	136.050	0.043	0.0	0.0	0.0	1.88	33.2	0.0
3.000	0.00	5.41	136.200	0.016	0.0	0.0	0.0	0.90	7.1	0.0
4.000	0.00	5.41	136.200	0.016	0.0	0.0	0.0	0.90	7.1	0.0
3.001	0.00	5.68	135.150	0.032	0.0	0.0	0.0	0.85	15.0	0.0
1.005	0.00	7.06	135.050	0.075	0.0	0.0	0.0	1.41	24.9	0.0
1.006	0.00	7.15	133.100	0.075	0.0	0.0	0.0	1.89	33.4	0.0

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	139.200	0.600	Open Manhole	450	1.000	138.600	100				
2	138.300	0.600	Open Manhole	450	1.001	137.700	100	1.000	137.700	100	
4	137.000	0.600	Open Manhole	450	2.000	136.400	150				
5	138.300	2.050	Open Manhole	450	1.002	136.250	150	1.001	136.300	100	
								2.000	136.250	150	
POND	137.000	0.900	Open Manhole	150	1.003	136.100	150	1.002	136.100	150	
6	137.000	0.950	Open Manhole	450	1.004	136.050	150	1.003	136.050	150	
7	136.800	0.600	Open Manhole	450	3.000	136.200	100				
8	136.800	0.600	Open Manhole	450	4.000	136.200	100				
9	136.800	1.650	Open Manhole	450	3.001	135.150	150	3.000	135.900	100	700
								4.000	135.900	100	700
10	136.700	1.650	Open Manhole	1200	1.005	135.050	150	1.004	135.050	150	
								3.001	135.050	150	
11	133.700	0.600	Open Manhole	1200	1.006	133.100	150	1.005	133.100	150	
DITCH	133.500	0.750	Open Manhole	150		OUTFALL		1.006	132.750	150	

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

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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	100	1	139.200	138.600	0.500	Open Manhole	450
1.001	o	100	2	138.300	137.700	0.500	Open Manhole	450
2.000	o	150	4	137.000	136.400	0.450	Open Manhole	450
1.002	o	150	5	138.300	136.250	1.900	Open Manhole	450
1.003	o	150	POND	137.000	136.100	0.750	Open Manhole	150
1.004	o	150	6	137.000	136.050	0.800	Open Manhole	450
3.000	o	100	7	136.800	136.200	0.500	Open Manhole	450
4.000	o	100	8	136.800	136.200	0.500	Open Manhole	450
3.001	o	150	9	136.800	135.150	1.500	Open Manhole	450
1.005	o	150	10	136.700	135.050	1.500	Open Manhole	1200
1.006	o	150	11	133.700	133.100	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)
1.000	17.000	18.9	2	138.300	137.700	0.500	Open Manhole	450
1.001	13.000	9.3	5	138.300	136.300	1.900	Open Manhole	450
2.000	16.000	106.7	5	138.300	136.250	1.900	Open Manhole	450
1.002	18.000	120.0	POND	137.000	136.100	0.750	Open Manhole	150
1.003	2.000	40.0	6	137.000	136.050	0.800	Open Manhole	450
1.004	29.000	29.0	10	136.700	135.050	1.500	Open Manhole	1200
3.000	22.000	73.3	9	136.800	135.900	0.800	Open Manhole	450
4.000	22.000	73.3	9	136.800	135.900	0.800	Open Manhole	450
3.001	14.000	140.0	10	136.700	135.050	1.500	Open Manhole	1200
1.005	100.000	51.3	11	133.700	133.100	0.450	Open Manhole	1200
1.006	10.000	28.6	DITCH	133.500	132.750	0.600	Open Manhole	150

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Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.006	DITCH	133.500	132.750	132.750	150	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Storm Duration (mins)	30
Ratio R	0.400		

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Online Controls for Storm

Orifice Manhole: 6, DS/PN: 1.004, Volume (m³): 0.2

Diameter (m) 0.025 Discharge Coefficient 0.600 Invert Level (m) 136.050

Orifice Manhole: 10, DS/PN: 1.005, Volume (m³): 2.6

Diameter (m) 0.025 Discharge Coefficient 0.600 Invert Level (m) 135.050

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Storage Structures for Storm

Tank or Pond Manhole: POND, DS/PN: 1.003

Invert Level (m) 136.100

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	50.0	0.900	120.0

Cellular Storage Manhole: 10, DS/PN: 1.005

Invert Level (m) 135.050 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	20.0	20.0	1.001	0.0	37.9
1.000	20.0	37.9			

Volume Summary (Static)

Length Calculations based on Centre-Centre

Pipe Number	USMH Name	Manhole Volume (m³)	Pipe Volume (m³)	Storage Structure Volume (m³)	Total Volume (m³)
1.000	1	0.095	0.134	0.000	0.229
1.001	2	0.095	0.102	0.000	0.198
2.000	4	0.095	0.283	0.000	0.378
1.002	5	0.326	0.318	0.000	0.644
1.003	POND	0.016	0.035	74.238	74.289
1.004	6	0.151	0.512	0.000	0.664
3.000	7	0.095	0.173	0.000	0.268
4.000	8	0.095	0.173	0.000	0.268
3.001	9	0.262	0.247	0.000	0.510
1.005	10	1.866	1.767	19.006	22.640
1.006	11	0.679	0.177	0.000	0.855
Total		3.777	3.921	93.244	100.943

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Volume Summary (Static)

Length Calculations based on True Length

Pipe Number	USMH Name	Manhole Volume (m³)	Pipe Volume (m³)	Storage Structure Volume (m³)	Total Volume (m³)
1.000	1	0.095	0.130	0.000	0.225
1.001	2	0.095	0.099	0.000	0.194
2.000	4	0.095	0.275	0.000	0.370
1.002	5	0.326	0.313	0.000	0.639
1.003	POND	0.016	0.030	74.238	74.284
1.004	6	0.151	0.498	0.000	0.649
3.000	7	0.095	0.169	0.000	0.265
4.000	8	0.095	0.169	0.000	0.265
3.001	9	0.262	0.233	0.000	0.495
1.005	10	1.866	1.746	19.006	22.618
1.006	11	0.679	0.165	0.000	0.843
Total		3.777	3.826	93.244	100.848

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

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	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
Foul Sewage per hectare (l/s)	0.000		

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

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	450.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	100
Climate Change (%)	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) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	100	+40%					138.670
1.001	2	15 Winter	100	+40%					137.799
2.000	4	15 Winter	100	+40%	100/15 Summer				136.682
1.002	5	15 Winter	100	+40%	100/15 Summer				136.645
1.003	POND	180 Winter	100	+40%	100/15 Summer				136.426
1.004	6	180 Winter	100	+40%	100/15 Summer				136.715
3.000	7	15 Winter	100	+40%	100/15 Summer				136.498
4.000	8	15 Winter	100	+40%	100/15 Summer				136.498
3.001	9	240 Winter	100	+40%	100/15 Summer				135.889
1.005	10	240 Winter	100	+40%	100/15 Summer				135.888
1.006	11	240 Winter	100	+40%					133.119

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.030	0.000	0.83			11.1	OK	
1.001	2	-0.001	0.000	0.90			17.1	OK	
2.000	4	0.132	0.000	0.50			8.0	FLOOD RISK	
1.002	5	0.245	0.000	1.63			24.6	SURCHARGED	
1.003	POND	0.176	0.000	0.12			1.7	SURCHARGED	
1.004	6	0.515	0.000	0.02			0.8	FLOOD RISK	
3.000	7	0.198	0.000	1.28			8.7	FLOOD RISK	
4.000	8	0.198	0.000	1.28			8.7	FLOOD RISK	
3.001	9	0.589	0.000	0.26			3.6	SURCHARGED	
1.005	10	0.688	0.000	0.05			1.2	SURCHARGED	
1.006	11	-0.131	0.000	0.04			1.2	OK	

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Summary of Results for 1 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Volume (m³)	Status
360 min Summer	135.194	0.194	11.6	O K
360 min Winter	135.217	0.217	13.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
360 min Summer	3.448	0.0	368
360 min Winter	3.448	0.0	368

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Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Volume (m³)	Status
360 min Summer	135.431	0.431	25.9	O K
360 min Winter	135.483	0.483	29.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
360 min Summer	7.666	0.0	368
360 min Winter	7.666	0.0	368

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Volume (m³)	Status
360 min Summer	135.561	0.561	33.6	O K
360 min Winter	135.628	0.628	37.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
360 min Summer	9.967	0.0	368
360 min Winter	9.967	0.0	368

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Volume (m³)	Status
360 min Summer	135.785	0.785	47.1	Flood Risk
360 min Winter	135.879	0.879	52.7	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
360 min Summer	13.954	0.0	368
360 min Winter	13.954	0.0	368

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	360
Ratio R	0.400	Longest Storm (mins)	360
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.075

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.033	4	8	0.042

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Model Details

Storage is Online Cover Level (m) 136.000

Tank or Pond Structure

Invert Level (m) 135.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	60.0	1.000	60.0

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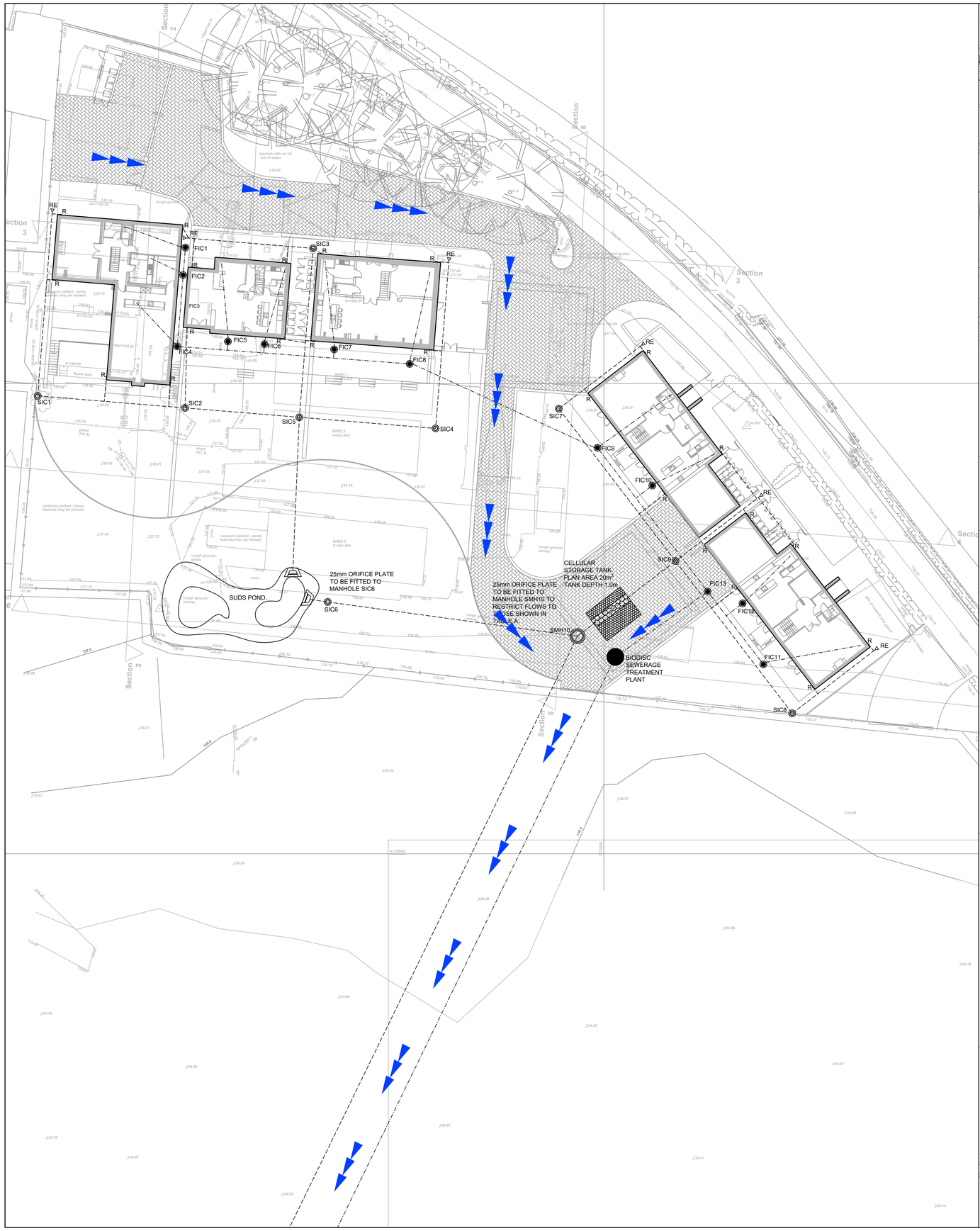
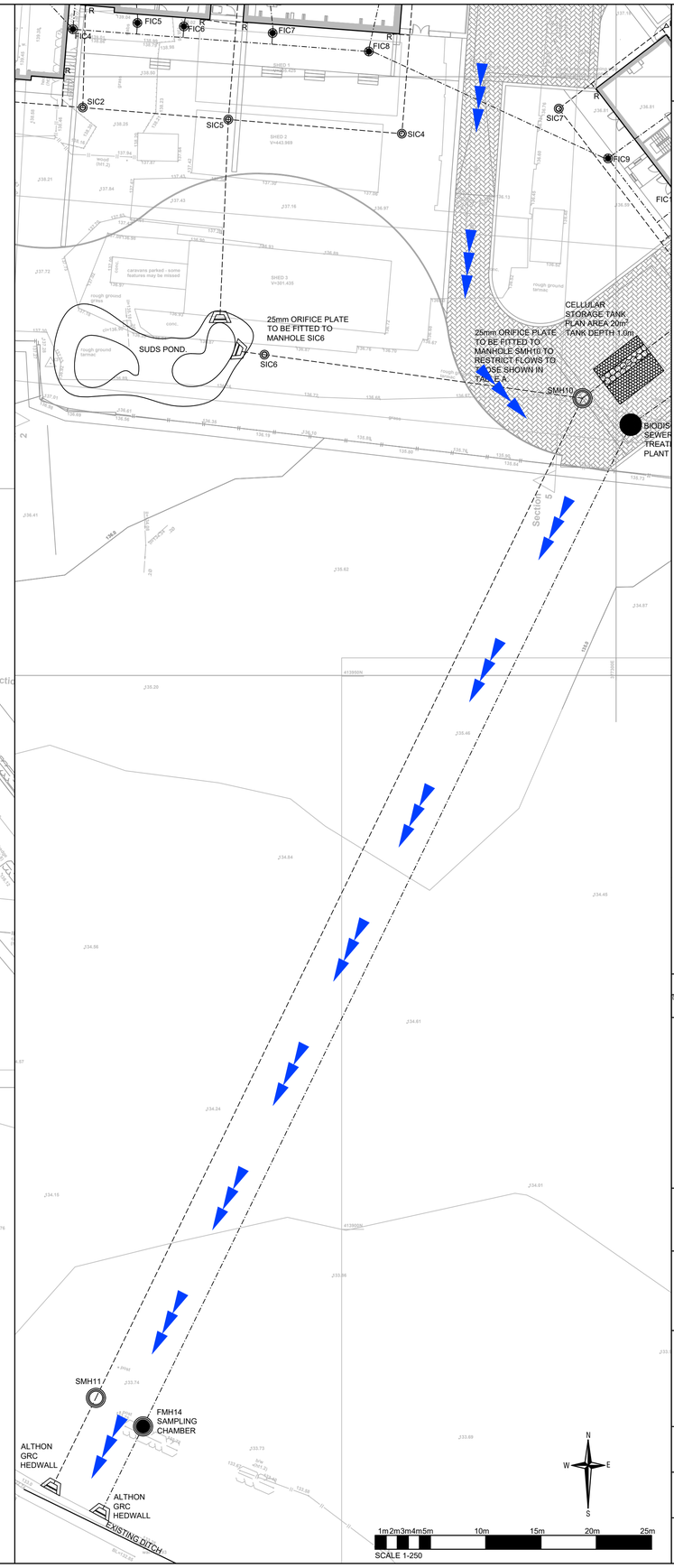
APPENDIX E – Flood exceedance Plan





NOTES

CONTRACTORS MUST VERIFY ALL DIMENSIONS ON SITE BEFORE COMMENCING ANY WORK ON SHOP DRAWINGS

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FLOOD EXCEEDANCE ROUTE

REV	AMENDMENT	DATE	CHKD
P2	POND ADDED AND CALCULATIONS UPDATED.	28.03.2023	RAC
P1	PRELIMINARY ISSUE	20.03.2023	RAC

DRAWING STATUS

PRELIMINARY

RCD

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CLIENT

J. BUCKLEY PROPERTIES

PROJECT

PROPOSED RESIDENTIAL DEVELOPMENT
HOLLYMOUNT FARM
GREENMOUNT

DRAWING TITLE

FLOOD EXCEEDANCE PLAN

CIVILS

SCALE	DRAWN BY	CHECKED	DATE
1:250 @ A1 1:500 @ A3	STC	RAC	MAR 2023

DRAWING NUMBER	REVISION
1189-2203-CIV-DS11	P2