Graven Hill Village, Bicester

Surface Water Drainage Strategy

September 2015

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Client Name:	Graven Hill Development
Document Reference:	CIV15119 DR Drainage Strategy A01
Project Number:	CIV15119

Quality Assurance – Approval Status

This document has been prepared and checked in accordance with
Waterman Group's IMS (BS EN ISO 9001: 2008, BS EN ISO 14001: 2004 and BS OHSAS 18001:2007)

Issue	Date	Prepared by	Checked by	Approved by
A01	01/09/15	Kim McKissock	Paul Scott	Robert Bone

Comments

A01	Issued for Planning

Comments

Disclaimer

Contents

Appendices

1. Introduction

This report provides technical information and calculations in support of the Drainage Strategy for the proposed development at Graven Hill near Bicester.

The report includes the following;

- Development Phases
- Drainage Catchments
- Restricting Discharge Rates
- Impermeable Area Calculations
- Attenuation Volumes

This report should be read in conjunction with Sustainable Drainage Design Code (CIV15119 ES 001 Rev A02) and Waterman Technical Note CIV15119 DR 002.

1.1 Site Details

The Site is approximately 186Ha in size and is to be transferred over to Cherwell District Council from the Ministry of Defence (MOD) in two phases. Land Transfer Area 1 which is approximately 104Ha in size will be transferred to Cherwell District Council in 2015 and Land Transfer Area 2 which is approximately 82Ha in size will be transferred to Cherwell District Council in 2019.

The Site will be developed to contain approximately 1,738 self-build dwellings. Land Transfer Area 1 should include approximately 700 self-build dwellings, commercial and office development, a community centre / nursery and strategic amenity space with associated infrastructure, car parking and landscaping. Landscape Transfer Area 2 should include approximately 1,038 self-build dwellings, commercial and office development and strategic amenity space with associated infrastructure, car parking and landscaping. It is also proposed that advance of the main construction of 750 dwellings that a demonstrator project of 10no. self-build dwellings is constructed.

1.2 Development Phasing

The Phasing of the development has been developed based on the availability of land and ownership transfer of the different areas of the MOD land. The detailed Construction Phasing plan (Glen Howells Drawing 1982-A-L-573 Rev H) can be seen in Appendix A. A breakdown of the Phases and the anticipated timescales for development are as follows;

Land Transfer Area 1 (LTA1) Phases;

- **Demonstrator Site**, comprising 10 My Grand Designs' Self build units and 11 show homes. - 4th Quarter 2015 to 2nd Quarter 2016.
- **Phase 1a**, comprising 'town centre' area (Central area of site) and main roads and infrastructure for Land Transfer Area 1 - 3rd Quarter 2016 to 1st Quarter 2018.
- **Phase 1b**, remaining residential area (Southwest area of site). - 2nd Quarter 2018 to 4th Quarter 2020.
- **The School**. - 3rd Quarter 2019 to 4th Quarter 2020.

Land Transfer Area 2 (LTA2) Phases;

- **Phase 3**, comprising residential areas to the Northwest of Phase 1a, playing pitches associated with the school and community areas, and main roads and infrastructure for Land Transfer Area 2. - 4th Quarter 2019 to 2nd Quarter 2021.
- **Phase 4**, comprising residential area to the Northeast of Graven Hill – 1st Quarter 2022 to 1st Quarter 2023.
- **Phase 5**, comprising residential area adjoining Phase 4 – 4th Quarter 2022 to 3rd Quarter 2023.
- **Phase 6**, comprising residential area to the south of Phases 5 and 6. – 3rd Quarter 2023 to 3rd Quarter 2024.
- **Phase 7,** comprising residential are to west of the site, adjacent to Phase 3. – 1st Quarter 2024 to 4th Quarter 2024.

The Phasing of the development allows for the main infrastructure corridors of each Land Transfer Area to be constructed at the earliest opportunity.

1.3 Drainage Strategy

The Drainage Strategy for the site has been developed to compliance with the drainage principals set out in the approved Sustainable Drainage Design Code (CIV15119 ES 001 Rev A02). The detailed design of each phase of the development will follow the drainage requirements set out in the report, including agreed restricting discharge rates and discharge locations.

The sustainable drainage system for the site has been designed so that no surface flooding occurs during a 1 in 100 year +30% for climate change storm event. However, for more extreme storm events (with a return period greater than 1 in 100 year +30% for climate change), the levels and layout of the development should be designed such that overland flood flows are routed to green corridors and open space and not routed towards proposed buildings or highways were access may be restricted.

The drainage of individual dwellings will be the responsibility of the individual house builder. However, the use of SuDs would be advocated and promoted to them in the developer pack provided to all plot purchasers.

Communal infrastructure such as highways and other hard surfaced external areas such as car parks are to be constructed by Cherwell District Council and would be drained by SuDs such as swales & ditches, filter drains & perforated pipes and filter strips & rills. But where space is restricted or road hierarchy doesn't permit the use of the above gullies, linear drainage channels and pipes would be used.

The allowable restricting discharge for the site has been estimated to be 11 l/s/ha, which has been agreed with both the EA and Oxfordshire County Council.

As previously agreed with Oxfordshire County Council no allowance has been made for attenuation or a reduction in the rate of runoff by pervious surfaces, in the design of attenuation volumes provided in swales, ponds, oversized pipes or geo-cellular tanks.

The development is located on a relatively steep hillside, with the proposed drainage following the route of road layout. This means that the pipework will fall along steep sections, followed by relatively horizontal traverses around the hill. This will give rise to a sequence of steep and shallow gradients within the pipe network.

2. Drainage Calculations

2.1 Catchment Areas

The site has been split into 4 main drainage catchments, with 4 approved discharge locations;

- **Drainage Catchment 1A** (LTA1 Central Site Area) – draining to Pond 1A, located to the North of the site, adjacent to the A41 Rodney House Roundabout. This catchment drains to a tributary of the Langford Brook, to the Northwest of the site.
- **Drainage Catchment 1B** (LTA1 Central West Area) – draining to Pond 1B, located to the West of the site.
- **Drainage Catchment 1C** (LTA1 East Area) – draining to Pond 1C, located to the East of the site, adjacent to the A41 Aylesbury Road.
- **Drainage Catchment 2A** (LTA2 Southwest Area) – draining to Pond 2A, located to the West of the site, adjacent to the railway crossing, leading to Langford Lane.

The Drainage Catchment drawing can be seen in Appendix B.

Waterman Technical Note reference CIV15119 DR 002 Rev A07, describes the proposed surface water discharge points and discharge rates for the Site. The Catchment discharge details and required attenuation volumes are summarised in Table 1 below.

Table 1: Catchment Discharges and Attenuation Volumes.

CATCHMENT	OUTFALL	CATCHMENT AREA (Ha)	1 in 100yr + CC ALLOWABLE DISCHARGE (l/s) (11l/s/ha)	IMP AREA (ha)	ATTENUATION (m^3)
CATCHMENT 1A	TRIB OF LANGFORD BROOK	22.2	244	12.09	5,800
CATCHMENT 1B	TRIB OF LANGFORD BROOK	11.4	173	6.3	2,600
CATCHMENT 1C	TRIB OF RIVER RAY	23.9	263	9.6	3,800
CATCHMENT 2A	TRIB OF LANGFORD BROOK	4.9	54	2.2	850

2.1.1 Demonstrator Project Site

The Demonstrator Site, comprising 10 My Grand Design Plots and 11 Show Homes, will be the first phase of the development to commence onsite. The total area of the Demonstrator Project site is 1.08ha (My Grand Designs 0.6ha and Show homes 0.48ha). The site is located along the Northern boundary of the Graven Hill site, and is separated from the main area of Land Transfer Area 1 by Phase 3 of the development, which is within Land Transfer Area 2. The Demonstrator Project location can be seen in Figure 1.

Figure 1: Demonstrator Project Site

In order to progress the development ahead of the availability of the adjacent land, separate drainage will be required for the My Grand Designs site and a temporary connection will be needed to enable the construction of the Show Homes.

It is proposed to drain the roof runoff to vegetated rills along the boundary of each property which will be conveyed to a discharge point on the adjacent unnamed watercourses. Road runoff from the My Grand Designs will be collected and conveyed in a swale along the Northern boundary and discharged via a Hydro Brake to the adjacent watercourse. Runoff from the Show Homes access road will be collected and conveyed in an oversized pipe, with attenuation provided in a temporary storage tank, prior to discharge via a Hydro Brake to the adjacent watercourse. The flows discharging from each site will be restricted to 6 l/s, based on a catchment discharge rate of 11 l/s/ha.

The proposed Drainage Layout drawing for the Demonstrator project can be seen in Appendix C, and the drainage calculations for the My Grand Designs site and Show Homes can be seen in Appendix D.

2.1.2 Drainage Catchment 1A

Drainage Catchment 1A, comprises Phase 1a, Phase 1b and the School, as shown on the Phasing Plan Phasing plan (Glen Howells Drawing 1982-A-L-573 Rev H) in Appendix A. Catchment 1A drains to Pond 1A which is located to the North of the site, as can be seen in Appendix B.

Figure 1 shows the catchment area contributing runoff to Pond 1A, and the table provides a breakdown of the associated impermeable areas.

Figure 2: Drainage Catchment 1A

Roof Areas (m²) =	42,434.10
Road (m²) =	62,831.50
School Area (m²) =	15,700
Total Impermeable (m²) =	120,965.6
Total Impermeable (ha) =	**12.09**

A storage design and full network model have been developed for Drainage Catchment 1A, using Micro Drainage software. The network was modelled using the proposed Masterplan layout and current development levels. The model was developed on the assumption that no upstream attenuation has been provided and that all impermeable runoff is conveyed within the pipe network to the proposed attenuation pond, Pond 1A.

The proposed drainage layout can be seen in Appendix E, and the Micro Drainage network calculations and results can be seen in Appendix F.

2.1.3 Drainage Catchment 1B

Total catchment area of Drainage Catchment 1B is 15.7ha, which is split into two areas of 11.4ha and 4.3ha, separated by Land Transfer Area 2. The catchment comprises the residential area of Phase 3 and the western section of Phase 1b, as shown on the Phasing Plan Phasing plan (Glen Howells Drawing 1982-A-L-573 Rev H) in Appendix A. The total proposed impermeable area contributing runoff from Catchment 1B is 6.335 ha.

The contributing area can be seen in Figure 2, with the proposed impermeable surfaces are broken down as follows;

Figure 3: Drainage Catchment 1B

Roof Areas (m²) =	21,535.14
Driveways (m²) =	5,063.68
Road (m²) =	15,458.80
Pavement (m²) =	3,892.41
Total Impermeable (m²) =	45,950.03
Total Impermeable (ha) =	**4.595**

Roof Areas (m²) =	7,735.5
Drives (m²) =	13,36.32
Road (m²) =	8,345.2
Total Impermeable (m²) =	17,417.02
Total Impermeable (ha) =	**1.74**

The attenuation storage has been calculated based on the contributing impermeable area. Micro Drainage Source Control calculations for Drainage Catchment 1B can be seen in Appendix G.

2.1.4 Drainage Catchment 1C

Total sub-catchment area of Catchment 1C is 23.9ha, which will comprise 9.6ha of impermeable development, and approximately 1.8ha of overland flow runoff. The catchment includes the main infrastructure as part of Phase 3, and development areas of Phase 4, Phase 5 and Phase 6, as shown on the Phasing Plan Phasing plan (Glen Howells Drawing 1982-A-L-573 Rev H) in Appendix A.

The proposed impermeable surfaces are broken down as follows;

Table 2: Drainage Catchment 1C

Roof Areas (m²) =	14,017.57
Driveways (m²) =	3,605.76
Road (m²) =	20,155.18
Pavement (m²) =	4,705.09
Total Impermeable (m²) =	42,483.6
Total Impermeable (ha) =	**4.25**

Roof Areas (m²) =	22,099
Driveways (m²) =	5,886.72
Road (m²) =	14,688
Pavement (m²) =	5,301.73
Total Impermeable (m²) =	47,975.45
Total Impermeable (ha) =	**4.80**

Roof Areas (m²) =	2,933.8
Driveways (m²) =	760.32
Road (m²) =	1,307.04
Parking (m²) =	117.6
Pavement (m²) =	444.7
Total Impermeable (m²) =	5,563.46
Total Impermeable (ha) =	**0.56**

The attenuation storage has been calculated based on the contributing impermeable area. Micro Drainage Source Control calculations for Drainage Catchment 1C can be seen in Appendix H.

2.1.5 Drainage Catchment 2A

Total sub-catchment area of Catchment 2A is 4.9ha, which will comprise 2.16ha of impermeable development. The catchment includes the infrastructure for Phase 7, as shown on the Phasing Plan Phasing plan (Glen Howells Drawing 1982-A-L-573 Rev H) in Appendix A.

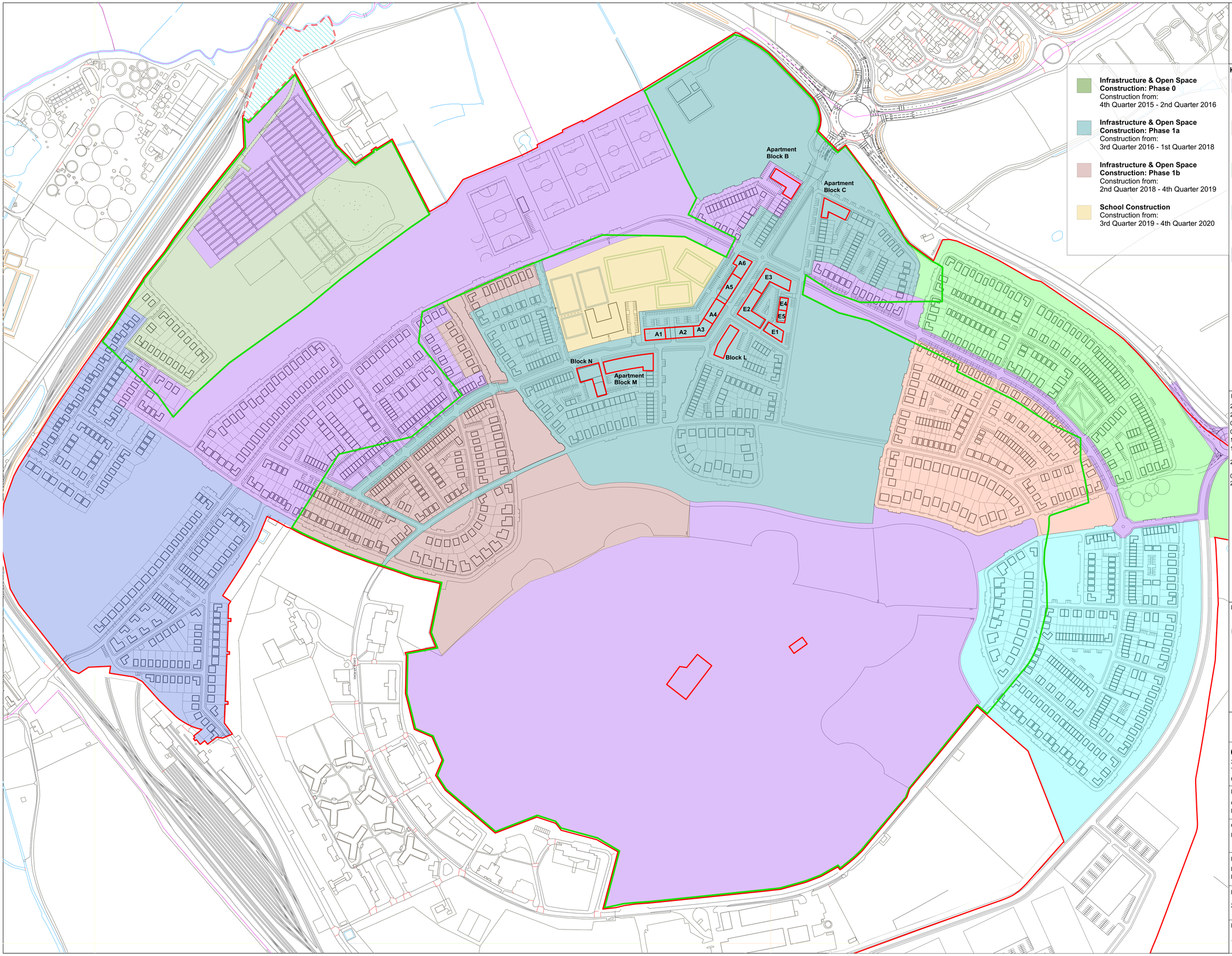
The proposed impermeable surfaces are broken down as follows;

Figure 4: Drainage Catchment 2A

Roof Areas (m²) =	8,281.75
Drives (m²) =	2,649.6
Road (m²) =	7,186.44
Pavement (m²) =	3,453.55
Total Impermeable (m²) =	21,571.34
Total Impermeable (ha) =	**2.16**

The attenuation storage has been calculated based on the contributing impermeable area. Micro Drainage Source Control calculations for Drainage Catchment 2A can be seen in Appendix I.

A. Construction Phasing



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KEY

Infrastructure & Open Space Construction: Phase 0
Construction from:
4th Quarter 2015 - 2nd Quarter 2016

Infrastructure & Open Space Construction: Phase 1a
Construction from:
3rd Quarter 2016 - 1st Quarter 2018

Infrastructure & Open Space Construction: Phase 1b
Construction from:
2nd Quarter 2018 - 4th Quarter 2019

School Construction
Construction from:
3rd Quarter 2019 - 4th Quarter 2020

Infrastructure & Open Space Construction: Phase 3
Construction from:
4th Quarter 2019 - 2nd Quarter 2021

Infrastructure & Open Space Construction: Phase 4
Construction from:
1st Quarter 2022 - 1st Quarter 2023

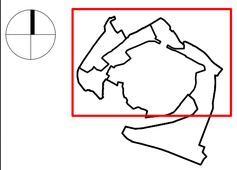
Infrastructure & Open Space Construction: Phase 5
Construction from:
4th Quarter 2022 - 3rd Quarter 2023

Infrastructure & Open Space Construction: Phase 6
Construction from:
3rd Quarter 2023 - 3rd Quarter 2024

Infrastructure & Open Space Construction: Phase 7
Construction from:
1st Quarter 2024 - 4th Quarter 2024

Date	Rev	By	Details
24.11.14	-	RS	Drawing issued
27.11.14	A	RS	Phasing values amended
03.12.14	B	RS	Apartment labels amended
09.03.15	C	DW	General amendments
11.03.15	D	RS	Phasing boundaries amended
16.04.15	E	DW	Phasing 0, 3 & 7 boundaries amended
27.04.15	F	KV	Phase 1a adjusted to include spine road
08.05.15	G	RS	Phase 1a & 1b areas amended
25.06.15	H	KV	Masterplan amended (9), phase boundaries & dates amended

LOCATION KEY



PLANNING

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Project
Graven Hill
Redevelopment of MoD Bicester

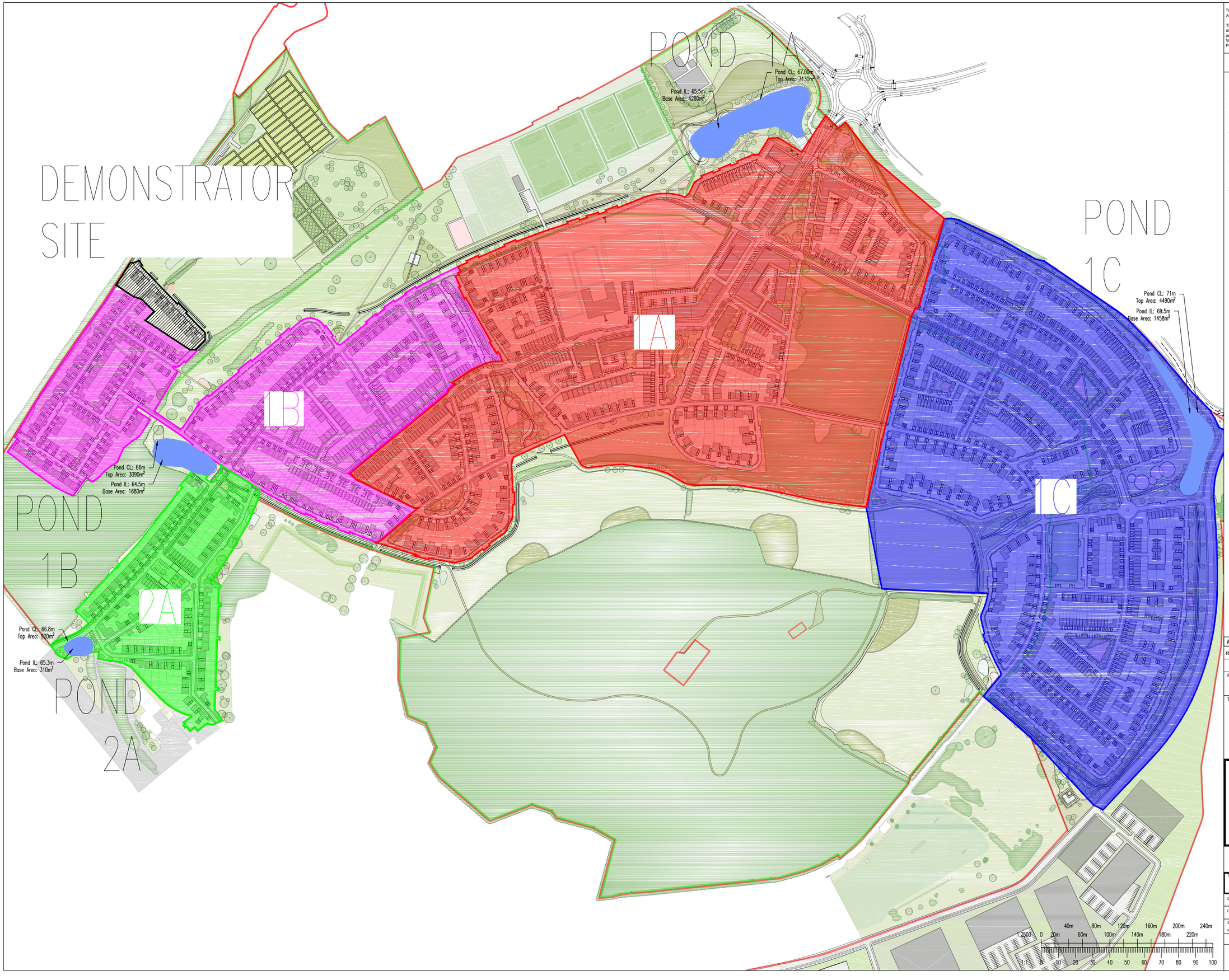
Client
EC Harris

Drawing Title
Proposed Construction Phasing Boundaries
Land Transfer 1 & 2

Date	Scale	Checked
24.11.14	1:2500@A1 1:5000@A3	JS

Project Ref.	Drawing No.	Revision
1982	A-L-573	H

B. Drainage Catchments



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4. ALL WORK BY THE CONTRACTOR MUST BE CARRIED OUT IN SUCH A WAY THAT ALL REQUIREMENTS UNDER THE HEALTH AND SAFETY AT WORK ACT ARE SATISFIED.
5. ALL WORK IS TO BE CARRIED OUT IN COMPLIANCE WITH THE REQUIREMENTS OF THE RELEVANT STATUTORY AUTHORITIES AND REGULATIONS.

Rev	Date	Description	By
A01	31.08.15	ISSUED FOR PLANNING	MC

Amendments

Project
GRAVEN HILL, BICESTER

Title
DRAINAGE CATCHMENTS

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Drawing Status
PLANNING

Designed by	KM	Checked by	KM
Drawn by	MC	Date	28.08.15
Scales @ A1 work to figured dimensions only	1:2500		

Project No
CIV15119

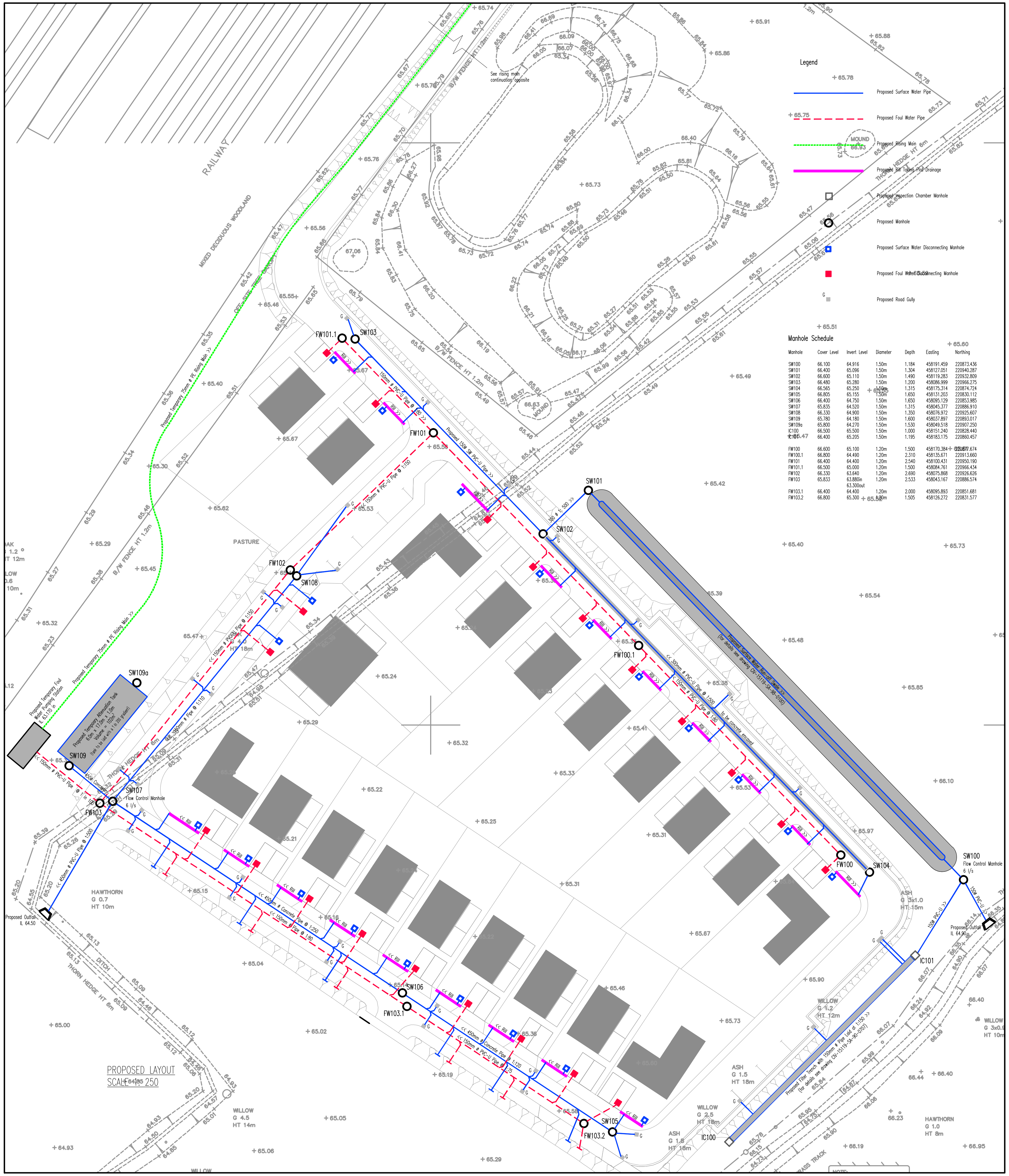
Computer File No
CIV-15119-SA-92-0500.dwg

Publisher	Zone	Category	Number	Revision
CIV	SA	92	0500	A01

File Path: K:\Projects\CIV\15119_Graven Hill\04-DO\20_

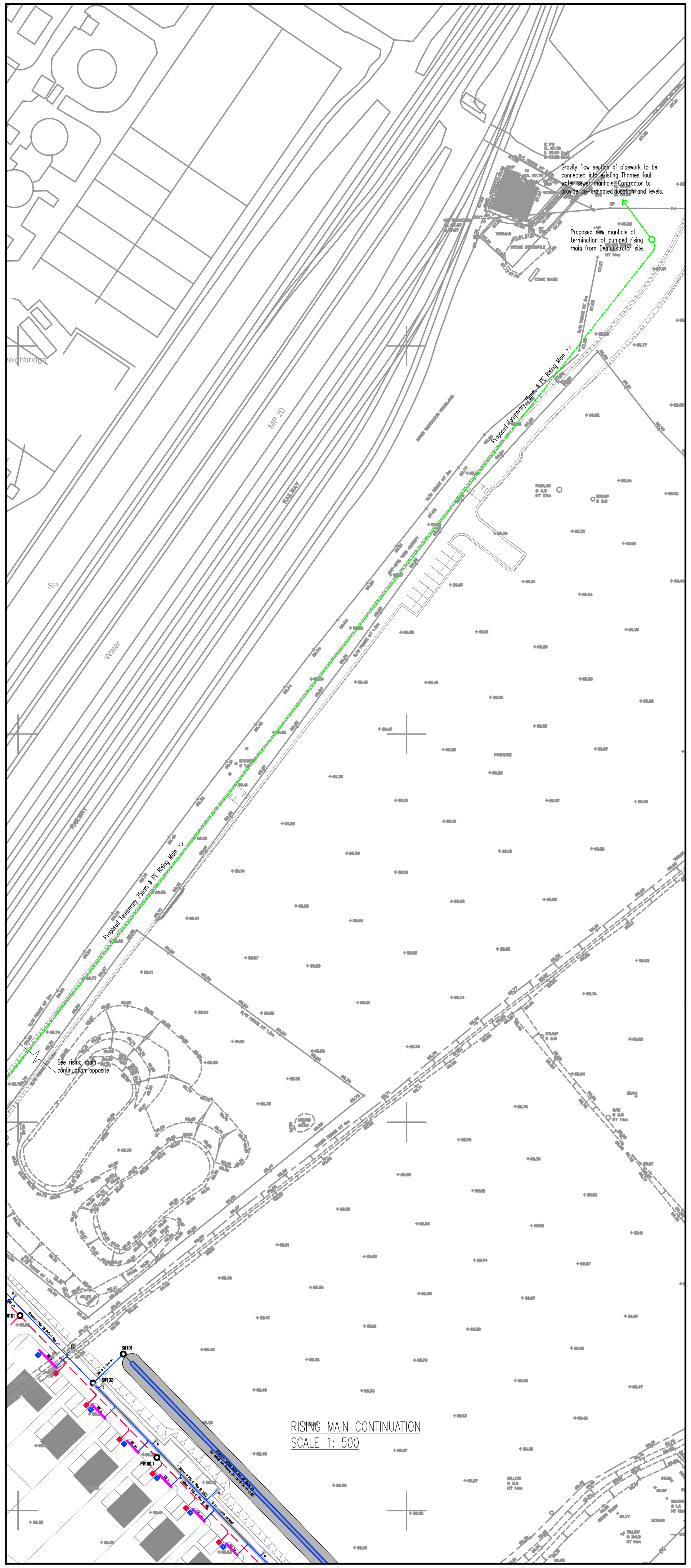
A1-Waterman-S_CIV-15119-L-T-01-DR_P_-L_-_CIV-15119-SA-NS-GA_P_-L_

C. Demonstrator Site Layout



Manhole Schedule

Manhole	Cover Level	Invert Level	Diameter	Depth	Easting	Northing
SW100	66.100	64.916	1.50m	1.184	458191.459	220873.436
SW101	66.400	65.096	1.50m	1.304	458127.051	220940.287
SW102	66.600	65.110	1.50m	1.490	458119.283	220932.809
SW103	66.480	65.280	1.50m	1.200	458086.999	220966.275
SW104	66.565	65.250	1.50m	1.315	458175.314	220874.724
SW105	66.805	65.155	1.50m	1.650	458131.203	220830.112
SW106	66.400	64.750	1.50m	1.650	458095.129	220853.985
SW107	65.835	64.520	1.50m	1.315	458045.377	220886.910
SW108	66.330	64.900	1.50m	1.350	458076.972	220925.607
SW109	65.780	64.180	1.50m	1.600	458037.897	220893.017
SW109a	65.800	64.270	1.50m	1.530	458049.518	220907.250
IC100	66.500	65.500	1.50m	1.000	458151.240	220828.440
IC101	66.400	65.205	1.50m	1.195	458183.175	220860.457
FW100	66.600	65.100	1.20m	1.500	458170.384	220877.674
FW100.1	66.800	64.490	1.20m	2.310	458135.671	220913.660
FW101	66.400	64.400	1.20m	2.540	458100.431	220950.190
FW101.1	66.500	65.000	1.20m	1.500	458084.761	220966.434
FW102	66.330	63.640	1.20m	2.690	458075.868	220926.626
FW103	65.833	63.880in 63.300out	1.20m	2.533	458043.167	220886.574
FW103.1	66.400	64.400	1.20m	2.000	458095.893	220851.681
FW103.2	66.800	65.300	1.20m	1.505	458126.272	220831.577



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5. ALL WORK IS TO BE CARRIED OUT IN COMPLIANCE WITH THE REQUIREMENTS OF THE RELEVANT STATUTORY AUTHORITIES AND REGULATIONS.
6. ALL MAIN UNDERGROUND SEWERS TO BE CONSTRUCTED USING TWIN WALL HDPE PIPEWORK.

Rev	Date	Description	By
A01	26.08.15	ISSUED FOR COMMENT	AG

Amendments

Project: GRAVEN HILL, BICESTER

Title: PROPOSED DRAINAGE LAYOUT 'MY GRAND DESIGNS'

Client: GRAVEN HILL DEVELOPMENT COMPANY

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Drawing Status: FOR APPROVAL

Designed by	ADP	Checked by		Project No
Drawn by	AG	Date	AUGUST 2015	CIV15119
Scales @ A0 work to figured dimensions only	AS SHOWN			Computer File No

Publisher	Zone	Category	Number	Revision
C	SA	90	0703	A01

20338 clean, A0-Wat-S, Demonstrator Interface Xref, MX Demonstrator Layout Xref_DrainageLayout

D. Demonstrator Site Drainage Calculations

My Grand Designs - Total Site Storage

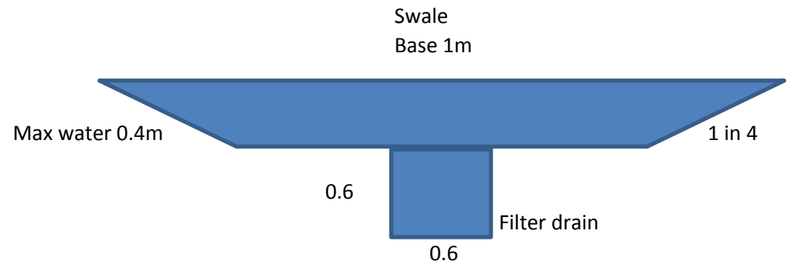
M5-60	20					
r	0.4		l/s/ha	11		
Area (ha)	0.595					
Area (m2)	5950		**l/s**	**6.545**		
Percentage Impermiable (%)	0.484336		**m3/s**	**0.006545**		
Imp Area (m2)	2881.8		**Storage time**	100	200	
Plot	1148.8	39.86 **%**	**(hours)**	4.84	6.00	
Road	1733	60.14 %				

Percentage of Flow

Plot	2.618	l/s
Road	3.927	l/s

Percentage of Storage

Plot	45.44	m3
Road	68.54	m3



100

Duration	Z1	M5-D	M100-D	Inflow (m3)	Outflow (m3)	Storage (m3)	"+30%"
5 (min)	0.37	7.47	13.89	40.02	1.9635	38.06	49.48
10 (min)	0.52	10.47	20.62	59.42	3.927	55.49	72.14
15 (min)	0.63	12.67	24.95	71.91	5.8905	66.02	85.83
30 (min)	0.80	16.07	31.81	91.68	11.781	79.89	103.86
							0.00
1 (hour)	1.00	20.00	38.60	111.24	23.562	87.68	113.98
2 (hour)	1.21	24.13	46.58	134.23	47.124	87.10	113.23
4 (hour)	1.45	28.93	54.68	157.59	94.248	63.34	82.34
6 (hour)	1.60	32.07	59.32	170.96	141.372	29.59	38.46
10 (hour)	1.79	35.87	66.35	191.22	235.62	-44.40	-57.72
24 (hour)	2.24	44.80	79.30	228.52	565.488	-336.97	-438.06

200

Duration	Z1	M5-D	M100-D	Inflow (m3)	Outflow (m3)	Storage (m3)	"+30%"
5 (min)	0.37	7.47	15.61	44.97	1.9635	43.01	55.91
10 (min)	0.52	10.47	21.88	63.04	3.927	59.11	76.85
15 (min)	0.63	12.67	26.47	76.29	5.8905	70.40	91.52
30 (min)	0.80	16.07	34.46	99.32	11.781	87.53	113.79
							0.00
1 (hour)	1.00	20.00	44.40	127.95	23.562	104.39	135.71
2 (hour)	1.21	24.13	54.06	155.79	47.124	108.66	141.26
4 (hour)	1.45	28.93	65.10	187.61	94.248	93.36	121.36
6 (hour)	1.60	32.07	71.99	207.46	141.372	66.09	85.91
10 (hour)	1.79	35.87	80.34	231.53	235.62	-4.09	-5.32
24 (hour)	2.24	44.80	99.23	285.97	565.488	-279.52	-363.38

2	
3	
4	
5	
10	
20	
30	
50	
100	

Storage Volumes

Swale Filter Drain			
Length	90	m	
Depth	0.6	m	
Width	0.6	m	
Voids	0.3		
Volume	**9.72**	**m3**	
Swale			
Length	90	m	
Max Water Depth	0.45	m	
Base Width	1	m	
Side Slopes	1.8		
Total CS Area	0.99	m2	
Volume	**89.1**	**m3**	**98.82 m3**
Rill			
Length per plot	5	m	
Total Length (10)	50	m	
Depth	0.6		
Width	0.6		
Voids	0.8		
Volume	**14.4**	**m3**	
Total Volume	**113.22**	**m3**	

Demonstrator Site Show Homes - Total Site Storage

M5-60	20						**Percentage of Flow**		
r	0.4		l/s/ha	11			Plot	2.112 l/s	
Area (ha)	0.48						Road	3.168 l/s	
Area (m2)	4800		**l/s**	**5.28**					
Percentage Impermiable (%)	0.574583		**m3/s**	**0.00528**			**Percentage of Storage**		
Imp Area (m2)	2758		**Storage time**	100	200		Plot	51.50 m3	A
Plot	1208	43.80 %	**(hours)**	6.19	7.60		Road	66.08 m3	B
Road	1550	56.20 %							

100								
Duration	Z1	M5-D	M100-D	Inflow (m3)	Outflow (m3)	Storage (m3)	"+30%"	
5 (min)	0.37	7.47	13.89	38.30	1.584	36.72	47.73	2
10 (min)	0.52	10.47	20.62	56.87	3.168	53.70	69.81	3
15 (min)	0.63	12.67	24.95	68.82	4.752	64.07	83.29	4
30 (min)	0.80	16.07	31.81	87.74	9.504	78.23	101.70	5
							0.00	10
1 (hour)	1.00	20.00	38.60	106.46	19.008	87.45	113.69	20
2 (hour)	1.21	24.13	46.58	128.46	38.016	90.44	**117.58**	30
4 (hour)	1.45	28.93	54.68	150.82	76.032	74.79	97.22	50
6 (hour)	1.60	32.07	59.32	163.61	114.048	49.57	64.44	100
10 (hour)	1.79	35.87	66.35	183.00	190.08	-7.08	-9.20	
24 (hour)	2.24	44.80	79.30	218.70	456.192	-237.49	-308.74	

200							
Duration	Z1	M5-D	M100-D	Inflow (m3)	Outflow (m3)	Storage (m3)	"+30%"
5 (min)	0.37	7.47	15.61	43.04	1.584	41.46	53.89
10 (min)	0.52	10.47	21.88	60.33	3.168	57.16	74.31
15 (min)	0.63	12.67	26.47	73.01	4.752	68.26	88.74
30 (min)	0.80	16.07	34.46	95.05	9.504	85.54	111.21
							0.00
1 (hour)	1.00	20.00	44.40	122.46	19.008	103.45	134.48
2 (hour)	1.21	24.13	54.06	149.09	38.016	111.08	144.40
4 (hour)	1.45	28.93	65.10	179.55	76.032	103.51	134.57
6 (hour)	1.60	32.07	71.99	198.55	114.048	84.50	109.85
10 (hour)	1.79	35.87	80.34	221.58	190.08	31.50	40.95
24 (hour)	2.24	44.80	99.23	273.68	456.192	-182.51	-237.26

Storage Volumes

Rill		
Length per plot	5	m
Total Length (11)	55	m
Depth	0.6	
Width	0.6	
Voids	0.8	
Volume	**15.84**	**m3**
Atteunation Tanks		
Total Volume	102	m3
Total Storage	**117.84**	**m3**

E. Catchment 1A Drainage Layout

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Rev	Date	Description	By
A01	28.08.15	ISSUED FOR PLANNING	MC

Amendments

Project: GRAVEN HILL, BICESTER

Title: LAND TRANSFER AREA 1
CATCHMENT 1A
DRAINAGE LAYOUT

Waterman
5th Floor One Cornwall Street Birmingham B3 2JN
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Drawing Status: PLANNING

Designed by: KM	Checked by: KM	Project No: CIV15119	
Drawn by: MC	Date: 28.08.15		
Scales @ A0 work to figured dimensions only	1:1000	Computer File No: CIV-15119-SA-92-0501.dwg	

Publisher	Zone	Category	Number	Revision
CIV	SA	92	0501	A01

File Path K:\Projects\CIV15119_Graven Hill\CAD\92\

A0-Waterman-S-Graven Hill, CIV-15119-LT-01-DR_P_-L_, CIV-15119-SA-NS-GA_P_-L_

F. Catchment 1A Drainage Calculations

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes 150 Manhole Sizes STANDARD

FEH Rainfall Model	
Return Period (years)	100
Site Location	GB 457700 220500 SP 57700 20500
C (1km)	-0.023
D1 (1km)	0.309
D2 (1km)	0.343
D3 (1km)	0.255
E (1km)	0.288
F (1km)	2.462
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
Add Flow / Climate Change (%)	30
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	1.00
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

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)	Auto Design
1.000	57.000	2.111	27.0	0.059	5.00	0.0	0.600	o	150	
1.001	51.846	1.920	27.0	0.097	0.00	0.0	0.600	o	225	
1.002	5.745	0.099	58.0	0.026	0.00	0.0	0.600	o	300	
1.003	66.147	0.441	150.0	0.045	0.00	0.0	0.600	o	300	
2.000	15.289	0.218	70.1	0.018	5.00	0.0	0.600	o	150	
2.001	20.000	0.400	50.0	0.035	0.00	0.0	0.600	o	150	

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	50.00	5.49	79.550	0.059	0.0	0.0	2.4	1.95	34.4	10.4
1.001	50.00	5.83	77.439	0.156	0.0	0.0	6.3	2.53	100.5	27.5
1.002	50.00	5.88	75.519	0.182	0.0	0.0	7.4	2.07	146.2	32.0
1.003	50.00	6.74	75.420	0.227	0.0	0.0	9.2	1.28	90.6	40.0
2.000	50.00	5.21	76.850	0.018	0.0	0.0	0.7	1.20	21.2	3.2
2.001	50.00	5.45	76.632	0.053	0.0	0.0	2.2	1.43	25.2	9.3

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)	Auto Design
2.002	19.000	0.475	40.0	0.042	0.00	0.0	0.600	o	225	
1.004	45.000	0.500	90.0	0.097	0.00	0.0	0.600	o	375	
1.005	51.000	0.879	58.0	0.051	0.00	0.0	0.600	o	375	
1.006	56.283	1.876	30.0	0.165	0.00	0.0	0.600	o	450	
1.007	96.270	0.535	179.9	0.151	0.00	0.0	0.600	o	600	
3.000	16.582	0.301	55.0	0.019	5.00	0.0	0.600	o	150	
3.001	15.000	0.250	60.0	0.037	0.00	0.0	0.600	o	150	
3.002	20.500	0.513	40.0	0.024	0.00	0.0	0.600	o	225	
4.000	39.272	0.262	149.9	0.038	5.00	0.0	0.600	o	150	
5.000	13.000	0.217	59.9	0.021	5.00	0.0	0.600	o	150	
3.003	70.433	1.565	45.0	0.155	0.00	0.0	0.600	o	300	
3.004	56.761	2.234	25.4	0.216	0.00	0.0	0.600	o	375	
1.008	16.500	0.110	150.0	0.077	0.00	0.0	0.600	o	600	
1.009	45.000	0.300	150.0	0.101	0.00	0.0	0.600	o	600	
6.000	53.309	0.888	60.0	0.057	5.00	0.0	0.600	o	150	

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)
2.002	50.00	5.60	76.157	0.095	0.0	0.0	3.9	2.07	82.5	16.7
1.004	50.00	7.13	74.904	0.419	0.0	0.0	17.0	1.91	211.0	73.8
1.005	50.00	7.49	74.404	0.470	0.0	0.0	19.1	2.38	263.2	82.7
1.006	50.00	7.74	73.450	0.635	0.0	0.0	25.8	3.72	592.0	111.8
1.007	50.00	8.62	71.424	0.786	0.0	0.0	31.9	1.81	512.4	138.4
3.000	50.00	5.20	76.850	0.019	0.0	0.0	0.8	1.36	24.0	3.3
3.001	50.00	5.40	76.474	0.056	0.0	0.0	2.3	1.30	23.0	9.9
3.002	50.00	5.56	76.149	0.080	0.0	0.0	3.2	2.08	82.5	14.1
4.000	50.00	5.80	75.400	0.038	0.0	0.0	1.5	0.82	14.5	6.7
5.000	50.00	5.17	75.700	0.021	0.0	0.0	0.9	1.30	23.0	3.7
3.003	50.00	6.30	74.988	0.294	0.0	0.0	11.9	2.35	166.1	51.8
3.004	50.00	6.56	73.423	0.510	0.0	0.0	20.7	3.61	398.4	89.8
1.008	50.00	8.76	70.889	1.373	0.0	0.0	55.8	1.99	561.6	241.7
1.009	50.00	9.14	70.779	1.474	0.0	0.0	59.9	1.99	561.6	259.5
6.000	50.00	5.68	80.750	0.057	0.0	0.0	2.3	1.30	23.0	10.0

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)	Auto Design
6.001	18.800	0.470	40.0	0.038	0.00	0.0	0.600	o	225	
6.002	52.000	1.793	29.0	0.067	0.00	0.0	0.600	o	225	
6.003	39.000	1.773	22.0	0.054	0.00	0.0	0.600	o	225	
7.000	35.000	0.401	87.3	0.020	5.00	0.0	0.600	o	150	
6.004	71.000	2.367	30.0	0.113	0.00	0.0	0.600	o	300	
6.005	60.000	1.000	60.0	0.101	0.00	0.0	0.600	o	300	
1.010	31.700	0.159	199.4	0.060	0.00	0.0	0.600	o	750	
8.000	51.101	0.852	60.0	0.065	5.00	0.0	0.600	o	150	
8.001	53.657	1.073	50.0	0.062	0.00	0.0	0.600	o	225	
8.002	73.202	2.440	30.0	0.132	0.00	0.0	0.600	o	300	
1.011	117.850	0.589	200.1	0.244	0.00	0.0	0.600	o	750	
1.012	70.096	0.350	200.3	0.394	0.00	0.0	0.600	o	900	
1.013	37.248	0.186	200.3	0.296	0.00	0.0	0.600	o	900	
9.000	22.000	0.440	50.0	0.025	5.00	0.0	0.600	o	225	
9.001	109.000	1.090	100.0	0.166	0.00	0.0	0.600	o	300	
9.002	34.500	0.345	100.0	0.064	0.00	0.0	0.600	o	300	

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)
6.001	50.00	5.83	79.787	0.095	0.0	0.0	3.9	2.07	82.5	16.7
6.002	50.00	6.19	79.317	0.162	0.0	0.0	6.6	2.44	97.0	28.5
6.003	50.00	6.42	77.524	0.216	0.0	0.0	8.8	2.80	111.4	38.0
7.000	50.00	5.54	76.000	0.020	0.0	0.0	0.8	1.08	19.0	3.5
6.004	50.00	6.83	75.524	0.349	0.0	0.0	14.2	2.88	203.7	61.4
6.005	50.00	7.32	73.157	0.450	0.0	0.0	18.3	2.03	143.7	79.2
1.010	50.00	9.41	70.329	1.984	0.0	0.0	80.6	1.98	874.0	349.3
8.000	50.00	5.65	75.400	0.065	0.0	0.0	2.6	1.30	23.0	11.4
8.001	50.00	6.14	74.523	0.127	0.0	0.0	5.2	1.85	73.7	22.4
8.002	50.00	6.56	73.450	0.259	0.0	0.0	10.5	2.88	203.7	45.6
1.011	50.00	10.40	70.170	2.487	0.0	0.0	101.0	1.97	872.4	437.8
1.012	50.00	10.93	69.431	2.881	0.0	0.0	117.0	2.21	1406.3	507.2
1.013	50.00	11.21	69.081	3.177	0.0	0.0	129.1	2.21	1406.3	559.3
9.000	50.00	5.20	73.250	0.025	0.0	0.0	1.0	1.85	73.7	4.4
9.001	50.00	6.35	72.735	0.191	0.0	0.0	7.8	1.57	111.1	33.6
9.002	50.00	6.72	71.645	0.255	0.0	0.0	10.4	1.57	111.1	44.9

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)	Auto Design
10.000	65.500	1.638	40.0	0.083	5.00	0.0	0.600	o	150	
10.001	53.000	1.325	40.0	0.076	0.00	0.0	0.600	o	225	
9.003	64.234	0.642	100.1	0.124	0.00	0.0	0.600	o	300	
1.014	22.000	0.110	200.0	0.100	0.00	0.0	0.600	o	900	
11.000	35.000	1.000	35.0	0.075	5.00	0.0	0.600	o	150	
12.000	39.000	1.000	39.0	0.075	5.00	0.0	0.600	o	150	
11.001	42.500	0.425	100.0	0.023	0.00	0.0	0.600	o	300	
1.015	49.500	0.275	180.0	0.117	0.00	48.0	0.600	o	1050	
13.000	48.000	0.960	50.0	0.084	5.00	0.0	0.600	o	150	
13.001	26.000	0.520	50.0	0.052	0.00	0.0	0.600	o	225	
13.002	26.500	0.883	30.0	0.028	0.00	0.0	0.600	o	225	
13.003	19.000	0.633	30.0	0.031	0.00	0.0	0.600	o	225	
13.004	17.450	0.582	30.0	0.030	0.00	0.0	0.600	o	225	
13.005	26.000	0.867	30.0	0.020	0.00	0.0	0.600	o	300	

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)
10.000	50.00	5.68	75.200	0.083	0.0	0.0	3.4	1.60	28.2	14.6
10.001	50.00	6.11	73.562	0.159	0.0	0.0	6.5	2.07	82.5	28.0
9.003	50.00	7.40	71.300	0.538	0.0	0.0	21.9	1.57	111.1	94.7
1.014	50.00	11.38	68.895	3.815	0.0	0.0	155.0	2.21	1407.2	671.6
11.000	50.00	5.34	70.500	0.075	0.0	0.0	3.0	1.71	30.2	13.2
12.000	50.00	5.40	70.500	0.075	0.0	0.0	3.0	1.62	28.6	13.2
11.001	50.00	5.85	69.350	0.173	0.0	0.0	7.0	1.57	111.1	30.5
1.015	50.00	11.70	68.175	4.105	48.0	0.0	181.2	2.57	2221.5	785.0
13.000	50.00	5.56	78.000	0.084	0.0	0.0	3.4	1.43	25.2	14.8
13.001	50.00	5.79	77.040	0.136	0.0	0.0	5.5	1.85	73.7	23.9
13.002	50.00	5.98	76.520	0.164	0.0	0.0	6.7	2.40	95.3	28.9
13.003	50.00	6.11	75.637	0.195	0.0	0.0	7.9	2.40	95.3	34.3
13.004	50.00	6.23	75.004	0.225	0.0	0.0	9.1	2.40	95.4	39.6
13.005	50.00	6.38	74.347	0.245	0.0	0.0	10.0	2.88	203.7	43.1

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)	Auto Design
13.006	6.389	0.319	20.0	0.026	0.00	0.0	0.600	o	300	
14.000	35.000	0.538	65.1	0.018	5.00	0.0	0.600	o	225	
15.000	46.920	1.564	30.0	0.087	5.00	0.0	0.600	o	225	
14.001	63.644	0.636	100.1	0.114	0.00	0.0	0.600	o	300	
14.002	51.302	0.513	100.0	0.133	0.00	0.0	0.600	o	375	
13.007	72.000	1.440	50.0	0.085	0.00	0.0	0.600	o	375	
13.008	31.000	1.158	26.8	0.056	0.00	0.0	0.600	o	375	
16.000	16.346	0.817	20.0	0.026	5.00	0.0	0.600	o	150	
16.001	56.175	0.702	80.0	0.080	0.00	0.0	0.600	o	225	
17.000	56.500	0.942	60.0	0.113	5.00	0.0	0.600	o	225	
16.002	37.303	0.466	80.0	0.088	0.00	0.0	0.600	o	300	
13.009	21.622	0.235	92.0	0.074	0.00	0.0	0.600	o	375	
1.016	52.500	0.427	123.0	0.250	0.00	0.0	0.600	o	1050	

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)
13.006	50.00	6.41	73.480	0.271	0.0	0.0	11.0	3.53	249.5	47.7
14.000	50.00	5.36	73.700	0.018	0.0	0.0	0.7	1.62	64.6	3.2
15.000	50.00	5.33	76.000	0.087	0.0	0.0	3.5	2.40	95.3	15.3
14.001	50.00	6.03	73.087	0.219	0.0	0.0	8.9	1.57	111.1	38.6
14.002	50.00	6.51	72.451	0.352	0.0	0.0	14.3	1.81	200.1	62.0
13.007	50.00	6.97	71.938	0.708	0.0	0.0	28.8	2.57	283.6	124.6
13.008	50.00	7.12	70.498	0.764	0.0	0.0	31.0	3.51	388.1	134.5
16.000	50.00	5.12	72.800	0.026	0.0	0.0	1.1	2.26	40.0	4.6
16.001	50.00	5.76	71.908	0.106	0.0	0.0	4.3	1.46	58.2	18.7
17.000	50.00	5.56	73.150	0.113	0.0	0.0	4.6	1.69	67.3	19.9
16.002	50.00	6.11	71.206	0.307	0.0	0.0	12.5	1.76	124.3	54.0
13.009	50.00	7.31	69.265	1.145	0.0	0.0	46.5	1.89	208.7	201.6
1.016	50.00	11.98	67.900	5.500	48.0	0.0	237.8	3.11	2690.3	1030.6

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)	Auto Design
18.000	17.500	0.583	30.0	0.074	5.00	0.0	0.600	o	150	
18.001	32.413	0.540	60.0	0.022	0.00	0.0	0.600	o	225	
19.000	39.000	0.650	60.0	0.073	5.00	0.0	0.600	o	225	
18.002	40.500	1.879	21.6	0.058	0.00	0.0	0.600	o	225	
1.017	11.500	0.058	198.3	0.052	0.00	0.0	0.600	o	1050	
1.018	85.500	0.428	199.8	0.165	0.00	0.0	0.600	o	1050	
20.000	40.305	0.500	80.6	0.178	5.00	0.0	0.600	o	225	
20.001	84.343	0.562	150.0	0.106	0.00	0.0	0.600	o	300	
21.000	43.500	0.690	63.0	0.053	5.00	0.0	0.600	o	150	
20.002	13.000	0.087	149.4	0.000	0.00	0.0	0.600	o	300	
22.000	44.000	0.550	80.0	0.040	5.00	0.0	0.600	o	150	
22.001	55.500	1.110	50.0	0.085	0.00	0.0	0.600	o	225	
22.002	62.203	1.555	40.0	0.114	0.00	0.0	0.600	o	300	
22.003	51.288	0.641	80.0	0.095	0.00	0.0	0.600	o	375	

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)
18.000	50.00	5.16	71.300	0.074	0.0	0.0	3.0	1.84	32.6	13.0
18.001	50.00	5.48	70.717	0.096	0.0	0.0	3.9	1.69	67.2	16.9
19.000	50.00	5.38	71.100	0.073	0.0	0.0	3.0	1.69	67.3	12.9
18.002	50.00	5.72	70.177	0.227	0.0	0.0	9.2	2.83	112.6	40.0
1.017	50.00	12.06	67.473	5.779	48.0	0.0	249.2	2.44	2116.2	1079.7
1.018	50.00	12.64	67.415	5.944	48.0	0.0	255.9	2.43	2108.2	1108.8
20.000	50.00	5.46	70.000	0.178	0.0	0.0	7.2	1.46	58.0	31.3
20.001	50.00	6.56	69.425	0.284	0.0	0.0	11.5	1.28	90.6	50.0
21.000	50.00	5.57	69.300	0.053	0.0	0.0	2.2	1.27	22.4	9.3
20.002	50.00	6.73	68.460	0.337	0.0	0.0	13.7	1.28	90.8	59.3
22.000	50.00	5.65	73.550	0.040	0.0	0.0	1.6	1.12	19.9	7.0
22.001	50.00	6.15	72.925	0.125	0.0	0.0	5.1	1.85	73.7	22.0
22.002	50.00	6.57	71.740	0.239	0.0	0.0	9.7	2.49	176.2	42.1
22.003	50.00	6.99	70.110	0.334	0.0	0.0	13.6	2.03	223.9	58.8

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)	Auto Design
22.004	65.799	1.880	35.0	0.274	0.00	0.0	0.600	o	375	
1.019	38.400	0.175	219.4	0.297	0.00	0.0	0.600	o	1050	
1.020	17.000	0.077	220.8	0.384	0.00	0.0	0.600	o	1050	
1.021	52.625	0.251	209.7	0.103	0.00	0.0	0.600	o	1050	
1.022	25.760	0.129	199.7	0.335	0.00	0.0	0.600	o	1200	
23.000	80.246	2.006	40.0	0.097	5.00	0.0	0.600	o	225	
23.001	64.014	1.000	64.0	0.158	0.00	0.0	0.600	o	300	
23.002	124.800	0.832	150.0	0.164	0.00	0.0	0.600	o	450	
24.000	32.293	0.206	156.8	0.097	5.00	0.0	0.600	o	225	
24.001	61.450	0.615	99.9	0.118	0.00	0.0	0.600	o	300	
25.000	53.911	0.771	69.9	0.070	5.00	0.0	0.600	o	225	
24.002	64.686	0.634	102.0	0.146	0.00	0.0	0.600	o	375	
23.003	13.686	0.064	213.8	0.112	0.00	0.0	0.600	o	450	
23.004	261.869	1.047	250.1	0.000	0.00	0.0	0.600	o	600	
1.023	100.464	0.521	192.8	1.570	0.00	0.0	0.600	o	1200	

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)
22.004	50.00	7.35	69.469	0.608	0.0	0.0	24.7	3.07	339.2	107.0
1.019	50.00	12.92	66.914	7.186	48.0	0.0	306.3	2.32	2011.0	1327.4
1.020	50.00	13.04	66.739	7.570	48.0	0.0	321.9	2.32	2004.8	1395.0
1.021	50.00	13.41	66.662	7.673	48.0	0.0	326.1	2.38	2057.6	1413.1
1.022	50.00	13.57	66.261	8.008	48.0	0.0	339.7	2.64	2990.3	1472.1
23.000	50.00	5.64	72.150	0.097	0.0	0.0	3.9	2.07	82.5	17.1
23.001	50.00	6.19	70.069	0.255	0.0	0.0	10.4	1.97	139.1	44.9
23.002	50.00	7.44	68.919	0.419	0.0	0.0	17.0	1.66	263.6	73.8
24.000	50.00	5.52	71.450	0.097	0.0	0.0	3.9	1.04	41.4	17.1
24.001	50.00	6.17	71.244	0.215	0.0	0.0	8.7	1.57	111.2	37.8
25.000	50.00	5.57	70.450	0.070	0.0	0.0	2.8	1.57	62.3	12.3
24.002	50.00	6.77	69.604	0.431	0.0	0.0	17.5	1.79	198.1	75.9
23.003	50.00	7.61	68.087	0.962	0.0	0.0	39.1	1.39	220.5	169.3
23.004	50.00	10.45	68.023	0.962	0.0	0.0	39.1	1.54	434.1	169.3
1.023	50.00	14.19	66.132	10.540	48.0	0.0	442.6	2.69	3043.3	1917.8

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)	Auto Design
26.000	86.290	1.079	80.0	0.000	5.00	55.0	0.600	o	300	
26.001	8.785	0.146	60.2	0.000	0.00	0.0	0.600	o	300	
27.000	45.214	0.565	80.0	0.109	5.00	0.0	0.600	o	225	
28.000	46.587	0.582	80.0	0.109	5.00	0.0	0.600	o	225	
28.001	19.580	0.245	79.9	0.031	0.00	0.0	0.600	o	300	
27.001	39.640	0.330	120.1	0.067	0.00	0.0	0.600	o	450	
29.000	55.752	0.697	80.0	0.340	5.00	0.0	0.600	o	300	
29.001	81.591	1.020	80.0	0.127	0.00	0.0	0.600	o	375	
29.002	5.702	0.114	50.0	0.026	0.00	0.0	0.600	o	450	
27.002	12.446	0.083	150.0	0.000	0.00	0.0	0.600	o	525	
26.002	100.878	0.560	180.1	0.000	0.00	0.0	0.600	o	600	
30.000	57.500	0.575	100.0	0.090	5.00	0.0	0.600	o	225	
30.001	57.500	0.719	80.0	0.157	0.00	0.0	0.600	o	300	

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)
26.000	50.00	5.82	69.300	0.000	55.0	0.0	16.5	1.76	124.4	71.5
26.001	50.00	5.89	68.221	0.000	55.0	0.0	16.5	2.03	143.5	71.5
27.000	50.00	5.52	69.150	0.109	0.0	0.0	4.4	1.46	58.2	19.2
28.000	50.00	5.53	69.150	0.109	0.0	0.0	4.4	1.46	58.2	19.2
28.001	50.00	5.72	68.493	0.140	0.0	0.0	5.7	1.76	124.4	24.6
27.001	50.00	6.07	68.098	0.316	0.0	0.0	12.8	1.85	294.9	55.6
29.000	50.00	5.53	69.700	0.340	0.0	0.0	13.8	1.76	124.4	59.9
29.001	50.00	6.20	68.928	0.467	0.0	0.0	19.0	2.03	223.9	82.2
29.002	50.00	6.23	67.833	0.493	0.0	0.0	20.0	2.88	458.1	86.8
27.002	50.00	6.35	67.644	0.809	0.0	0.0	32.9	1.83	395.5	142.4
26.002	50.00	7.27	67.486	0.809	55.0	0.0	49.4	1.81	512.1	213.9
30.000	50.00	5.73	69.050	0.090	0.0	0.0	3.7	1.31	52.0	15.8
30.001	50.00	6.28	68.475	0.247	0.0	0.0	10.0	1.76	124.4	43.5

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)	Auto Design
31.000	36.093	0.451	80.0	0.028	5.00	0.0	0.600	o	150	
32.000	28.800	0.360	80.0	0.039	5.00	0.0	0.600	o	150	
32.001	34.497	0.172	200.6	0.048	0.00	0.0	0.600	o	225	
31.001	77.742	0.389	199.9	0.103	0.00	0.0	0.600	o	375	
33.000	96.394	0.803	120.0	0.193	5.00	0.0	0.600	o	300	
31.002	12.851	0.064	200.8	0.029	0.00	0.0	0.600	o	375	
30.002	21.420	0.214	100.1	0.056	0.00	0.0	0.600	o	375	
26.003	115.198	0.640	180.0	0.000	0.00	0.0	0.600	o	600	
1.024	103.208	0.206	501.0	0.000	0.00	0.0	0.600	o	1500	
1.025	62.114	0.311	199.7	0.000	0.00	0.0	0.600	o	1500	

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)
31.000	50.00	5.53	69.400	0.028	0.0	0.0	1.1	1.12	19.9	4.9
32.000	50.00	5.43	68.500	0.039	0.0	0.0	1.6	1.12	19.9	6.9
32.001	50.00	6.05	68.065	0.087	0.0	0.0	3.5	0.92	36.6	15.3
31.001	50.00	7.07	67.743	0.218	0.0	0.0	8.9	1.28	141.2	38.4
33.000	50.00	6.12	68.500	0.193	0.0	0.0	7.8	1.43	101.4	34.0
31.002	50.00	7.23	67.354	0.440	0.0	0.0	17.9	1.27	140.8	77.5
30.002	50.00	7.43	67.290	0.743	0.0	0.0	30.2	1.81	200.0	130.8
26.003	50.00	8.49	66.851	1.552	55.0	0.0	79.5	1.81	512.3	344.7
1.024	50.00	15.10	65.311	12.092	103.0	0.0	522.1	1.91	3374.3	2262.5
1.025	50.00	15.44	65.105	12.092	103.0	0.0	522.1	3.03	5357.6	2262.5

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)
1.025		67.500	64.794	66.500	2000	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)	1000.000
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	3
Number of Online Controls	1	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)	200	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Storm Duration (mins)	15
Ratio R	0.401		

Online Controls for Storm

Hydro-Brake Optimum® Manhole: 115, DS/PN: 1.024, Volume (m³): 160.2

Unit Reference	MD-SHE-0558-2440-2000-2440
Design Head (m)	2.000
Design Flow (l/s)	244.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	558
Invert Level (m)	65.311
Minimum Outlet Pipe Diameter (mm)	Error (Contact Hydro International)
Suggested Manhole Diameter (mm)	Site Specific Design (Contact Hydro International)

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	242.4
Flush-Flo™	0.853	242.7
Kick-Flo®	1.538	213.3
Mean Flow over Head Range	-	196.9

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)
0.100	13.4	1.200	235.9	3.000	295.7	7.000	448.3
0.200	49.9	1.400	225.7	3.500	318.9	7.500	463.8
0.300	102.9	1.600	217.4	4.000	340.5	8.000	478.7
0.400	163.8	1.800	230.3	4.500	360.7	8.500	493.2
0.500	220.9	2.000	242.4	5.000	379.9	9.000	507.3
0.600	236.7	2.200	254.0	5.500	398.1	9.500	521.0
0.800	242.5	2.400	265.0	6.000	415.5		
1.000	241.3	2.600	275.6	6.500	432.2		

Storage Structures for Storm

Swale Manhole: 95, DS/PN: 26.001

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	8.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	4.0
Safety Factor	2.0	Slope (1:X)	200.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	69.071	Cap Infiltration Depth (m)	0.000
Base Width (m)	2.0	Include Swale Volume	Yes

Swale Manhole: 104, DS/PN: 26.002

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	102.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	4.0
Safety Factor	2.0	Slope (1:X)	200.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	68.005	Cap Infiltration Depth (m)	0.000
Base Width (m)	2.0	Include Swale Volume	Yes

Tank or Pond Manhole: 115, DS/PN: 1.024

Invert Level (m) 65.311

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	4280.0	0.600	5380.0	1.200	6530.0	1.800	7750.0
0.300	4820.0	0.900	5950.0	1.500	7130.0	2.100	8360.0

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)	1000.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Storage Structures 3
Number of Online Controls 1 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 0.401
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 20.000 Cv (Winter) 0.840

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

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, 30, 30

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	15 Winter	100	+30%	100/15 Winter				
1.001	15 Winter	100	+30%	100/15 Summer				
1.002	15 Winter	100	+30%	30/15 Summer				
1.003	15 Winter	100	+30%	30/15 Summer				
2.000	15 Winter	100	+30%	100/15 Summer				
2.001	15 Winter	100	+30%	30/15 Winter				
2.002	15 Winter	100	+30%					
1.004	15 Winter	100	+30%	100/15 Summer				
1.005	15 Winter	100	+30%					
1.006	15 Winter	100	+30%					
1.007	15 Winter	100	+30%	100/15 Summer				
3.000	15 Winter	100	+30%					
3.001	15 Winter	100	+30%	30/15 Summer				
3.002	15 Winter	100	+30%					
4.000	15 Winter	100	+30%	30/15 Summer				
5.000	15 Winter	100	+30%					
3.003	15 Winter	100	+30%	100/15 Summer				
3.004	15 Winter	100	+30%					
1.008	15 Winter	100	+30%	30/15 Summer				
1.009	15 Winter	100	+30%	30/15 Summer				
6.000	15 Winter	100	+30%	30/15 Summer				
6.001	15 Winter	100	+30%					

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

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
6.002	15 Winter	100	+30%	100/15 Winter				
6.003	15 Winter	100	+30%	100/15 Summer				
7.000	15 Winter	100	+30%	100/15 Summer				
6.004	15 Winter	100	+30%	100/15 Summer				
6.005	15 Winter	100	+30%	30/15 Summer				
1.010	15 Winter	100	+30%	30/15 Summer				
8.000	15 Winter	100	+30%	30/15 Summer				
8.001	15 Winter	100	+30%					
8.002	15 Winter	100	+30%					
1.011	15 Winter	100	+30%	30/15 Winter				
1.012	15 Winter	100	+30%	100/15 Summer				
1.013	15 Winter	100	+30%	30/15 Winter				
9.000	15 Winter	100	+30%	100/15 Summer				
9.001	15 Winter	100	+30%	30/15 Summer				
9.002	15 Winter	100	+30%	30/15 Summer				
10.000	15 Winter	100	+30%	30/15 Summer				
10.001	15 Winter	100	+30%	100/15 Summer				
9.003	15 Winter	100	+30%	30/15 Summer				
1.014	15 Winter	100	+30%	30/15 Winter				
11.000	15 Winter	100	+30%	30/15 Summer				
12.000	15 Winter	100	+30%	30/15 Summer				
11.001	15 Winter	100	+30%	100/15 Summer				
1.015	15 Winter	100	+30%	30/15 Winter				
13.000	15 Winter	100	+30%	30/15 Summer				
13.001	15 Winter	100	+30%	100/15 Winter				
13.002	15 Winter	100	+30%	100/15 Summer				
13.003	15 Winter	100	+30%	100/15 Summer				
13.004	15 Winter	100	+30%	30/15 Summer				
13.005	15 Winter	100	+30%					
13.006	15 Winter	100	+30%	100/15 Winter				
14.000	15 Winter	100	+30%	100/15 Summer				
15.000	15 Winter	100	+30%					
14.001	15 Winter	100	+30%	100/15 Summer				
14.002	15 Winter	100	+30%	30/15 Summer				
13.007	15 Winter	100	+30%	30/15 Summer				
13.008	15 Winter	100	+30%	30/15 Summer				
16.000	15 Winter	100	+30%					
16.001	15 Winter	100	+30%	30/15 Summer				
17.000	15 Winter	100	+30%					
16.002	15 Winter	100	+30%	30/15 Summer				
13.009	15 Winter	100	+30%	30/15 Summer				
1.016	15 Winter	100	+30%	30/15 Summer				
18.000	15 Winter	100	+30%	30/15 Summer				
18.001	15 Winter	100	+30%	100/15 Summer				
19.000	15 Winter	100	+30%					
18.002	15 Winter	100	+30%	100/15 Summer				
1.017	15 Winter	100	+30%	30/15 Summer				
1.018	30 Winter	100	+30%	30/15 Summer				
20.000	15 Winter	100	+30%	30/15 Summer				
20.001	15 Winter	100	+30%	30/15 Summer				
21.000	15 Winter	100	+30%	30/15 Summer				

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

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
20.002	15 Winter	100	+30%	30/15 Summer				
22.000	15 Winter	100	+30%	100/15 Summer				
22.001	15 Winter	100	+30%	100/15 Winter				
22.002	15 Winter	100	+30%					
22.003	15 Winter	100	+30%	100/15 Summer				
22.004	15 Winter	100	+30%	100/15 Summer				
1.019	15 Winter	100	+30%	30/15 Summer				
1.020	15 Winter	100	+30%	30/15 Summer				
1.021	30 Winter	100	+30%	30/15 Winter				
1.022	30 Winter	100	+30%	100/15 Summer				
23.000	15 Winter	100	+30%					
23.001	15 Winter	100	+30%	100/15 Summer				
23.002	15 Winter	100	+30%	100/15 Summer				
24.000	15 Winter	100	+30%	30/15 Summer				
24.001	15 Winter	100	+30%	100/15 Summer				
25.000	15 Winter	100	+30%					
24.002	15 Winter	100	+30%	100/15 Summer				
23.003	15 Winter	100	+30%	30/15 Summer				
23.004	15 Winter	100	+30%	100/15 Summer				
1.023	30 Winter	100	+30%	100/15 Summer				
26.000	30 Winter	30	+30%					
26.001	60 Winter	100	+30%					
27.000	15 Winter	100	+30%	100/15 Summer				
28.000	15 Winter	100	+30%	100/15 Summer				
28.001	15 Winter	100	+30%					
27.001	15 Winter	100	+30%					
29.000	15 Winter	100	+30%	30/15 Summer				
29.001	15 Winter	100	+30%	100/15 Summer				
29.002	15 Winter	100	+30%	30/15 Summer				
27.002	15 Winter	100	+30%	30/15 Summer				
26.002	15 Winter	100	+30%	100/15 Summer				
30.000	15 Winter	100	+30%	100/15 Summer				
30.001	15 Winter	100	+30%	100/15 Summer				
31.000	15 Winter	100	+30%					
32.000	15 Winter	100	+30%	30/15 Winter				
32.001	15 Winter	100	+30%	30/15 Summer				
31.001	15 Winter	100	+30%	30/15 Summer				
33.000	15 Winter	100	+30%	100/15 Summer				
31.002	15 Winter	100	+30%	30/15 Summer				
30.002	15 Winter	100	+30%	30/15 Summer				
26.003	15 Winter	100	+30%	30/15 Summer				
1.024	480 Winter	100	+30%					
1.025	600 Winter	100	+30%					

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
1.000	1	79.760	0.060	0.000	0.96	0.0	32.4	SURCHARGED
1.001	2	77.814	0.150	0.000	0.88	0.0	84.7	SURCHARGED
1.002	3	76.373	0.554	0.000	1.23	0.0	96.6	SURCHARGED

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

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m^3)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
1.003	4	76.204	0.484	0.000	1.35	0.0	117.1	SURCHARGED
2.000	5	77.036	0.036	0.000	0.52	0.0	10.2	SURCHARGED
2.001	6	76.974	0.192	0.000	1.21	0.0	28.6	SURCHARGED
2.002	7	76.301	-0.081	0.000	0.71	0.0	52.7	OK
1.004	8	75.384	0.105	0.000	1.09	0.0	211.9	SURCHARGED
1.005	9	74.726	-0.053	0.000	0.96	0.0	233.8	OK
1.006	10	73.711	-0.189	0.000	0.58	0.0	315.3	OK
1.007	11	73.133	1.109	0.000	0.70	0.0	333.8	FLOOD RISK
3.000	12	76.992	-0.008	0.000	0.47	0.0	10.6	OK
3.001	13	76.911	0.287	0.000	1.45	0.0	30.7	SURCHARGED
3.002	14	76.277	-0.097	0.000	0.60	0.0	44.6	OK
4.000	15	75.897	0.347	0.000	1.44	0.0	20.2	SURCHARGED
5.000	16	75.783	-0.067	0.000	0.57	0.0	12.1	OK
3.003	17	75.366	0.078	0.000	1.02	0.0	161.5	SURCHARGED
3.004	18	73.695	-0.103	0.000	0.77	0.0	285.7	OK
1.008	19	72.913	1.424	0.000	1.75	0.0	607.9	SURCHARGED
1.009	20	72.639	1.260	0.000	1.33	0.0	648.1	SURCHARGED
6.000	21	81.449	0.549	0.000	1.26	0.0	28.2	SURCHARGED
6.001	22	79.923	-0.089	0.000	0.65	0.0	48.5	OK
6.002	23	79.588	0.046	0.000	0.93	0.0	86.7	SURCHARGED
6.003	24	78.250	0.501	0.000	1.00	0.0	105.8	SURCHARGED
7.000	25	76.582	0.432	0.000	0.73	0.0	13.4	SURCHARGED
6.004	26	76.476	0.652	0.000	0.83	0.0	162.8	SURCHARGED
6.005	27	74.813	1.356	0.000	1.53	0.0	209.0	SURCHARGED
1.010	28	72.295	1.216	0.000	1.38	0.0	861.4	SURCHARGED
8.000	29	76.332	0.782	0.000	1.37	0.0	30.7	SURCHARGED
8.001	30	74.708	-0.040	0.000	0.90	0.0	63.7	OK
8.002	31	73.645	-0.105	0.000	0.74	0.0	143.8	OK
1.011	32	72.088	1.168	0.000	1.25	0.0	1010.1	SURCHARGED
1.012	33	71.410	1.079	0.000	0.86	0.0	1035.5	SURCHARGED
1.013	34	71.170	1.189	0.000	1.12	0.0	1084.6	SURCHARGED
9.000	35	74.497	1.022	0.000	0.26	0.0	17.3	FLOOD RISK
9.001	36	74.491	1.456	0.000	0.74	0.0	79.7	SURCHARGED
9.002	37	73.958	2.013	0.000	0.98	0.0	99.8	SURCHARGED
10.000	38	76.816	1.466	0.000	1.23	0.0	34.1	FLOOD RISK
10.001	39	74.421	0.634	0.000	0.89	0.0	70.3	SURCHARGED
9.003	40	73.622	2.022	0.000	2.02	0.0	214.4	SURCHARGED
1.014	41	70.989	1.194	0.000	1.31	0.0	1252.9	SURCHARGED
11.000	42	71.336	0.686	0.000	1.25	0.0	36.4	SURCHARGED
12.000	43	71.448	0.798	0.000	1.27	0.0	35.2	SURCHARGED
11.001	44	70.788	1.138	0.000	0.78	0.0	81.3	SURCHARGED
1.015	45	70.687	1.462	0.000	0.85	0.0	1371.8	SURCHARGED
13.000	46	79.560	1.410	0.000	1.55	0.0	38.0	FLOOD RISK
13.001	47	77.286	0.021	0.000	0.92	0.0	62.7	SURCHARGED
13.002	48	76.858	0.113	0.000	0.85	0.0	75.1	SURCHARGED
13.003	49	76.214	0.352	0.000	1.04	0.0	89.5	SURCHARGED
13.004	50	75.519	0.290	0.000	1.22	0.0	104.2	SURCHARGED
13.005	51	74.521	-0.126	0.000	0.62	0.0	113.5	OK
13.006	52	73.985	0.205	0.000	0.87	0.0	123.2	SURCHARGED
14.000	53	74.512	0.587	0.000	0.19	0.0	11.8	SURCHARGED

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

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m^3)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
15.000	54	76.121	-0.104	0.000	0.55	0.0	50.0	OK
14.001	55	74.485	1.098	0.000	1.00	0.0	105.9	SURCHARGED
14.002	56	74.035	1.209	0.000	0.86	0.0	159.1	SURCHARGED
13.007	57	73.786	1.473	0.000	1.09	0.0	292.1	SURCHARGED
13.008	58	72.392	1.519	0.000	0.83	0.0	286.6	SURCHARGED
16.000	59	72.880	-0.070	0.000	0.40	0.0	14.8	OK
16.001	60	72.743	0.610	0.000	1.01	0.0	56.5	SURCHARGED
17.000	61	73.368	-0.007	0.000	1.00	0.0	64.6	OK
16.002	62	72.033	0.527	0.000	1.44	0.0	164.9	SURCHARGED
13.009	63	71.567	1.927	0.000	2.57	0.0	454.8	SURCHARGED
1.016	64	70.484	1.534	0.000	0.88	0.0	1774.3	SURCHARGED
18.000	65	71.942	0.492	0.000	1.23	0.0	37.5	SURCHARGED
18.001	66	71.176	0.234	0.000	0.75	0.0	47.0	SURCHARGED
19.000	67	71.236	-0.089	0.000	0.65	0.0	41.5	OK
18.002	68	70.967	0.565	0.000	1.03	0.0	109.7	SURCHARGED
1.017	69	70.145	1.622	0.000	1.66	0.0	1838.0	SURCHARGED
1.018	70	69.793	1.328	0.000	1.02	0.0	1841.1	SURCHARGED
20.000	71	71.958	1.733	0.000	1.64	0.0	90.1	SURCHARGED
20.001	72	70.605	0.880	0.000	1.57	0.0	137.2	SURCHARGED
21.000	73	70.048	0.598	0.000	1.18	0.0	25.8	SURCHARGED
20.002	74	69.608	0.848	0.000	1.98	0.0	146.1	SURCHARGED
22.000	75	73.850	0.150	0.000	1.12	0.0	21.6	SURCHARGED
22.001	76	73.151	0.001	0.000	0.99	0.0	70.5	SURCHARGED
22.002	77	71.954	-0.086	0.000	0.83	0.0	138.5	OK
22.003	78	70.602	0.117	0.000	0.89	0.0	185.3	SURCHARGED
22.004	79	70.182	0.338	0.000	1.00	0.0	319.8	SURCHARGED
1.019	80	69.360	1.396	0.000	1.51	0.0	2130.1	SURCHARGED
1.020	81	68.881	1.092	0.000	1.83	0.0	2189.5	SURCHARGED
1.021	82	68.367	0.655	0.000	1.44	0.0	2217.7	SURCHARGED
1.022	83	67.833	0.372	0.000	1.18	0.0	2272.5	SURCHARGED
23.000	84	72.291	-0.084	0.000	0.69	0.0	55.5	OK
23.001	85	70.754	0.385	0.000	0.99	0.0	131.7	SURCHARGED
23.002	86	69.830	0.461	0.000	0.79	0.0	198.9	SURCHARGED
24.000	87	72.061	0.386	0.000	1.38	0.0	53.7	SURCHARGED
24.001	88	71.689	0.145	0.000	1.10	0.0	116.0	SURCHARGED
25.000	89	70.641	-0.034	0.000	0.65	0.0	38.8	OK
24.002	90	70.316	0.337	0.000	1.24	0.0	230.8	SURCHARGED
23.003	91	69.389	0.852	0.000	2.69	0.0	444.8	SURCHARGED
23.004	92	68.756	0.133	0.000	0.98	0.0	412.7	SURCHARGED
1.023	93	67.512	0.180	0.000	1.20	0.0	3138.8	SURCHARGED
26.000	94	69.442	-0.158	0.000	0.46	0.0	55.4	OK
26.001	95	68.418	-0.103	0.000	0.58	0.0	55.7	OK
27.000	96	69.504	0.129	0.000	1.10	0.0	61.3	SURCHARGED
28.000	97	69.505	0.130	0.000	1.10	0.0	61.3	SURCHARGED
28.001	98	68.688	-0.105	0.000	0.72	0.0	77.9	OK
27.001	99	68.496	-0.052	0.000	0.66	0.0	171.7	OK
29.000	100	71.099	1.099	0.000	1.44	0.0	169.9	FLOOD RISK
29.001	101	69.623	0.320	0.000	1.03	0.0	220.2	SURCHARGED
29.002	102	68.584	0.301	0.000	1.16	0.0	220.6	SURCHARGED
27.002	103	68.403	0.234	0.000	1.55	0.0	384.6	SURCHARGED

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

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m^3)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
26.002	104	68.222	0.136	0.000	0.83	0.0	396.2	SURCHARGED
30.000	105	69.545	0.270	0.000	0.93	0.0	46.5	SURCHARGED
30.001	106	69.036	0.261	0.000	1.07	0.0	125.7	SURCHARGED
31.000	107	69.509	-0.041	0.000	0.83	0.0	16.0	OK
32.000	108	69.303	0.653	0.000	0.90	0.0	17.2	SURCHARGED
32.001	109	69.042	0.752	0.000	1.12	0.0	38.4	SURCHARGED
31.001	110	68.884	0.766	0.000	0.75	0.0	100.4	SURCHARGED
33.000	111	69.303	0.503	0.000	0.95	0.0	93.6	SURCHARGED
31.002	112	68.761	1.032	0.000	1.72	0.0	183.9	SURCHARGED
30.002	113	68.551	0.886	0.000	1.77	0.0	300.3	SURCHARGED
26.003	114	67.922	0.471	0.000	1.34	0.0	643.0	SURCHARGED
1.024	115	66.569	-0.242	0.000	0.08	0.0	235.0	OK
1.025	116	65.362	-1.243	0.000	0.07	0.0	242.2	OK

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow Σ (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	66.080	0.580	229.3	0.0	229.3	2784.3	O K
30 min Summer	66.219	0.719	262.8	0.0	262.8	3547.5	O K
60 min Summer	66.335	0.835	274.6	0.0	274.6	4207.0	O K
120 min Summer	66.401	0.901	276.1	0.0	276.1	4600.7	O K
180 min Summer	66.416	0.916	276.1	0.0	276.1	4685.7	O K
240 min Summer	66.416	0.916	276.1	0.0	276.1	4685.1	O K
360 min Summer	66.400	0.900	276.1	0.0	276.1	4594.5	O K
480 min Summer	66.376	0.876	275.9	0.0	275.9	4448.1	O K
600 min Summer	66.346	0.846	275.1	0.0	275.1	4276.1	O K
720 min Summer	66.316	0.816	273.5	0.0	273.5	4097.0	O K
960 min Summer	66.256	0.756	267.9	0.0	267.9	3753.6	O K
1440 min Summer	66.155	0.655	250.6	0.0	250.6	3194.1	O K
2160 min Summer	66.052	0.552	219.8	0.0	219.8	2638.5	O K
2880 min Summer	65.983	0.483	192.8	0.0	192.8	2278.5	O K
4320 min Summer	65.897	0.397	153.8	0.0	153.8	1838.6	O K
5760 min Summer	65.844	0.344	128.2	0.0	128.2	1575.7	O K
7200 min Summer	65.806	0.306	109.8	0.0	109.8	1393.2	O K
8640 min Summer	65.779	0.279	96.5	0.0	96.5	1264.7	O K
10080 min Summer	65.758	0.258	86.4	0.0	86.4	1164.7	O K
15 min Winter	66.142	0.642	247.4	0.0	247.4	3122.8	O K
30 min Winter	66.298	0.798	272.2	0.0	272.2	3994.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	128.285	0.0	2814.7	0.0	18
30 min Summer	84.226	0.0	3718.7	0.0	33
60 min Summer	52.662	0.0	4738.1	0.0	62
120 min Summer	31.800	0.0	5728.2	0.0	116
180 min Summer	23.353	0.0	6312.5	0.0	144
240 min Summer	18.644	0.0	6721.2	0.0	176
360 min Summer	13.543	0.0	7325.1	0.0	244
480 min Summer	10.792	0.0	7783.7	0.0	310
600 min Summer	9.043	0.0	8152.5	0.0	378
720 min Summer	7.823	0.0	8462.5	0.0	442
960 min Summer	6.219	0.0	8966.9	0.0	570
1440 min Summer	4.493	0.0	9705.5	0.0	822
2160 min Summer	3.241	0.0	10558.2	0.0	1188
2880 min Summer	2.568	0.0	11149.0	0.0	1552
4320 min Summer	1.847	0.0	12000.2	0.0	2252
5760 min Summer	1.461	0.0	12704.7	0.0	3000
7200 min Summer	1.217	0.0	13225.8	0.0	3704
8640 min Summer	1.048	0.0	13657.2	0.0	4416
10080 min Summer	0.923	0.0	14011.5	0.0	5144
15 min Winter	128.285	0.0	3161.4	0.0	18
30 min Winter	84.226	0.0	4174.0	0.0	32

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow Σ (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
60 min Winter	66.428	0.928	276.1	0.0	276.1	4761.7	O K
120 min Winter	66.512	1.012	276.1	0.0	276.1	5272.0	O K
180 min Winter	66.523	1.023	276.1	0.0	276.1	5337.9	O K
240 min Winter	66.515	1.015	276.1	0.0	276.1	5290.1	O K
360 min Winter	66.485	0.985	276.1	0.0	276.1	5103.3	O K
480 min Winter	66.442	0.942	276.1	0.0	276.1	4840.9	O K
600 min Winter	66.393	0.893	276.1	0.0	276.1	4552.7	O K
720 min Winter	66.345	0.845	275.1	0.0	275.1	4267.6	O K
960 min Winter	66.256	0.756	267.9	0.0	267.9	3754.3	O K
1440 min Winter	66.121	0.621	241.7	0.0	241.7	3006.0	O K
2160 min Winter	65.998	0.498	199.0	0.0	199.0	2357.0	O K
2880 min Winter	65.925	0.425	166.9	0.0	166.9	1978.6	O K
4320 min Winter	65.838	0.338	125.5	0.0	125.5	1550.2	O K
5760 min Winter	65.788	0.288	100.9	0.0	100.9	1308.2	O K
7200 min Winter	65.755	0.255	84.9	0.0	84.9	1150.7	O K
8640 min Winter	65.731	0.231	73.6	0.0	73.6	1036.9	O K
10080 min Winter	65.713	0.213	65.0	0.0	65.0	950.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
60 min Winter	52.662	0.0	5310.4	0.0	60
120 min Winter	31.800	0.0	6419.3	0.0	116
180 min Winter	23.353	0.0	7073.9	0.0	168
240 min Winter	18.644	0.0	7531.7	0.0	190
360 min Winter	13.543	0.0	8208.2	0.0	266
480 min Winter	10.792	0.0	8722.0	0.0	338
600 min Winter	9.043	0.0	9135.4	0.0	410
720 min Winter	7.823	0.0	9482.8	0.0	478
960 min Winter	6.219	0.0	10048.6	0.0	606
1440 min Winter	4.493	0.0	10878.1	0.0	852
2160 min Winter	3.241	0.0	11827.8	0.0	1212
2880 min Winter	2.568	0.0	12490.4	0.0	1584
4320 min Winter	1.847	0.0	13448.9	0.0	2292
5760 min Winter	1.461	0.0	14230.8	0.0	3008
7200 min Winter	1.217	0.0	14815.2	0.0	3744
8640 min Winter	1.048	0.0	15300.2	0.0	4488
10080 min Winter	0.923	0.0	15703.3	0.0	5152

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 12.090

Time (mins) From:	To:	Area (ha)
0	4	12.090

Model Details

Storage is Online Cover Level (m) 67.000

Tank or Pond Structure

Invert Level (m) 65.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	4280.0	0.600	5380.0	1.200	6530.0
0.300	4820.0	0.900	5950.0	1.500	7130.0

Hydro-Brake® Outflow Control

Design Head (m) 1.500 Diameter (mm) 513
Design Flow (l/s) 244.0 Invert Level (m) 65.500
Hydro-Brake® Type Md12 SW Only

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	19.9	1.200	258.2	3.000	301.5	7.000	460.2
0.200	59.2	1.400	246.3	3.500	325.5	7.500	476.4
0.300	106.7	1.600	242.5	4.000	347.9	8.000	492.0
0.400	155.3	1.800	245.4	4.500	369.0	8.500	507.2
0.500	199.7	2.000	252.3	5.000	389.0	9.000	521.9
0.600	235.7	2.200	261.3	5.500	408.0	9.500	536.2
0.800	272.4	2.400	271.2	6.000	426.1		
1.000	273.0	2.600	281.3	6.500	443.5		

Pre-initialised control selected, excessive flows may result.

Pipe Overflow Control

Diameter (m) 0.150 Entry Loss Coefficient 0.500
Slope (1:X) 100.0 Coefficient of Contraction 0.600
Length (m) 5.000 Upstream Invert Level (m) 67.000
Roughness k (mm) 0.600

G. Catchment 1B Drainage Calculations

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	65.211	0.711	193.9	0.0	193.9	1410.6	O K
30 min Summer	65.366	0.866	195.7	0.0	195.7	1779.7	O K
60 min Summer	65.480	0.980	195.7	0.0	195.7	2066.2	O K
120 min Summer	65.527	1.027	195.7	0.0	195.7	2187.0	O K
180 min Summer	65.523	1.023	195.7	0.0	195.7	2178.3	O K
240 min Summer	65.502	1.002	195.7	0.0	195.7	2122.8	O K
360 min Summer	65.443	0.943	195.7	0.0	195.7	1972.0	O K
480 min Summer	65.379	0.879	195.7	0.0	195.7	1810.6	O K
600 min Summer	65.316	0.816	195.7	0.0	195.7	1657.5	O K
720 min Summer	65.258	0.758	195.5	0.0	195.5	1519.9	O K
960 min Summer	65.163	0.663	190.3	0.0	190.3	1300.3	O K
1440 min Summer	65.037	0.537	170.4	0.0	170.4	1022.9	O K
2160 min Summer	64.931	0.431	139.9	0.0	139.9	801.1	O K
2880 min Summer	64.869	0.369	117.8	0.0	117.8	676.3	O K
4320 min Summer	64.796	0.296	89.5	0.0	89.5	533.9	O K
5760 min Summer	64.754	0.254	72.8	0.0	72.8	453.3	O K
7200 min Summer	64.726	0.226	61.5	0.0	61.5	399.9	O K
8640 min Summer	64.705	0.205	53.4	0.0	53.4	360.9	O K
10080 min Summer	64.688	0.188	47.1	0.0	47.1	331.1	O K
15 min Winter	65.287	0.787	195.7	0.0	195.7	1588.4	O K
30 min Winter	65.461	0.961	195.7	0.0	195.7	2016.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	128.285	0.0	1511.9	0.0	18
30 min Summer	84.226	0.0	1988.4	0.0	32
60 min Summer	52.662	0.0	2497.6	0.0	60
120 min Summer	31.800	0.0	3017.1	0.0	100
180 min Summer	23.353	0.0	3323.8	0.0	132
240 min Summer	18.644	0.0	3538.4	0.0	166
360 min Summer	13.543	0.0	3855.7	0.0	232
480 min Summer	10.792	0.0	4096.8	0.0	298
600 min Summer	9.043	0.0	4290.9	0.0	362
720 min Summer	7.823	0.0	4454.2	0.0	422
960 min Summer	6.219	0.0	4720.6	0.0	542
1440 min Summer	4.493	0.0	5114.2	0.0	780
2160 min Summer	3.241	0.0	5541.0	0.0	1144
2880 min Summer	2.568	0.0	5853.0	0.0	1500
4320 min Summer	1.847	0.0	6310.7	0.0	2208
5760 min Summer	1.461	0.0	6661.5	0.0	2944
7200 min Summer	1.217	0.0	6936.4	0.0	3672
8640 min Summer	1.048	0.0	7166.0	0.0	4408
10080 min Summer	0.923	0.0	7361.2	0.0	5136
15 min Winter	128.285	0.0	1694.6	0.0	18
30 min Winter	84.226	0.0	2228.3	0.0	32

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow Σ (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
60 min Winter	65.593	1.093	195.7	0.0	195.7	2362.4	O K
120 min Winter	65.649	1.149	195.7	0.0	195.7	2514.4	O K
180 min Winter	65.633	1.133	195.7	0.0	195.7	2470.4	O K
240 min Winter	65.599	1.099	195.7	0.0	195.7	2380.0	O K
360 min Winter	65.508	1.008	195.7	0.0	195.7	2137.1	O K
480 min Winter	65.407	0.907	195.7	0.0	195.7	1880.2	O K
600 min Winter	65.311	0.811	195.7	0.0	195.7	1646.2	O K
720 min Winter	65.229	0.729	194.7	0.0	194.7	1451.2	O K
960 min Winter	65.105	0.605	183.2	0.0	183.2	1170.9	O K
1440 min Winter	64.965	0.465	151.0	0.0	151.0	871.7	O K
2160 min Winter	64.862	0.362	115.3	0.0	115.3	662.7	O K
2880 min Winter	64.805	0.305	93.1	0.0	93.1	551.5	O K
4320 min Winter	64.742	0.242	68.0	0.0	68.0	431.2	O K
5760 min Winter	64.707	0.207	54.1	0.0	54.1	364.8	O K
7200 min Winter	64.683	0.183	45.3	0.0	45.3	321.5	O K
8640 min Winter	64.666	0.166	39.1	0.0	39.1	290.3	O K
10080 min Winter	64.653	0.153	34.5	0.0	34.5	266.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
60 min Winter	52.662	0.0	2797.8	0.0	60
120 min Winter	31.800	0.0	3379.6	0.0	114
180 min Winter	23.353	0.0	3723.1	0.0	144
240 min Winter	18.644	0.0	3963.5	0.0	180
360 min Winter	13.543	0.0	4318.9	0.0	254
480 min Winter	10.792	0.0	4589.0	0.0	322
600 min Winter	9.043	0.0	4806.4	0.0	384
720 min Winter	7.823	0.0	4989.4	0.0	444
960 min Winter	6.219	0.0	5287.9	0.0	560
1440 min Winter	4.493	0.0	5729.1	0.0	794
2160 min Winter	3.241	0.0	6206.3	0.0	1148
2880 min Winter	2.568	0.0	6555.9	0.0	1504
4320 min Winter	1.847	0.0	7069.4	0.0	2244
5760 min Winter	1.461	0.0	7461.1	0.0	2944
7200 min Winter	1.217	0.0	7769.1	0.0	3672
8640 min Winter	1.048	0.0	8026.6	0.0	4408
10080 min Winter	0.923	0.0	8246.2	0.0	5136

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 6.335

Time (mins) From:	To:	Area (ha)
0	4	6.335

Model Details

Storage is Online Cover Level (m) 66.000

Tank or Pond Structure

Invert Level (m) 64.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1680.0	0.600	2200.0	1.200	2800.0
0.300	1930.0	0.900	2490.0	1.500	3090.0

Hydro-Brake® Outflow Control

Design Head (m) 1.500 Diameter (mm) 447
Design Flow (l/s) 173.0 Invert Level (m) 64.500
Hydro-Brake® Type Md12 SW Only

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	17.6	1.200	175.2	3.000	228.8	7.000	349.4
0.200	51.6	1.400	171.9	3.500	247.1	7.500	361.7
0.300	91.0	1.600	174.6	4.000	264.1	8.000	373.6
0.400	129.2	1.800	180.8	4.500	280.2	8.500	385.1
0.500	161.1	2.000	188.5	5.000	295.3	9.000	396.2
0.600	182.5	2.200	196.7	5.500	309.7	9.500	407.1
0.800	195.6	2.400	205.0	6.000	323.5		
1.000	185.9	2.600	213.1	6.500	336.7		

Pre-initialised control selected, excessive flows may result.

Pipe Overflow Control

Diameter (m) 0.150 Entry Loss Coefficient 0.500
Slope (1:X) 100.0 Coefficient of Contraction 0.600
Length (m) 5.000 Upstream Invert Level (m) 66.000
Roughness k (mm) 0.600

H. Catchment 1C Drainage Calculations

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	70.398	0.898	296.5	0.0	296.5	2066.2	O K
30 min Summer	70.567	1.067	296.7	0.0	296.7	2637.4	O K
60 min Summer	70.685	1.185	296.7	0.0	296.7	3079.8	O K
120 min Summer	70.727	1.227	296.7	0.0	296.7	3241.2	Flood Risk
180 min Summer	70.717	1.217	296.7	0.0	296.7	3202.0	Flood Risk
240 min Summer	70.690	1.190	296.7	0.0	296.7	3097.2	O K
360 min Summer	70.622	1.122	296.7	0.0	296.7	2838.1	O K
480 min Summer	70.549	1.049	296.7	0.0	296.7	2574.6	O K
600 min Summer	70.478	0.978	296.7	0.0	296.7	2328.7	O K
720 min Summer	70.412	0.912	296.7	0.0	296.7	2110.2	O K
960 min Summer	70.300	0.800	290.5	0.0	290.5	1762.8	O K
1440 min Summer	70.147	0.647	262.2	0.0	262.2	1330.2	O K
2160 min Summer	70.019	0.519	216.4	0.0	216.4	999.7	O K
2880 min Summer	69.942	0.442	181.8	0.0	181.8	820.0	O K
4320 min Summer	69.854	0.354	138.0	0.0	138.0	628.0	O K
5760 min Summer	69.803	0.303	111.6	0.0	111.6	522.0	O K
7200 min Summer	69.768	0.268	94.1	0.0	94.1	454.1	O K
8640 min Summer	69.743	0.243	81.4	0.0	81.4	405.3	O K
10080 min Summer	69.723	0.223	71.9	0.0	71.9	369.0	O K
15 min Winter	70.479	0.979	296.7	0.0	296.7	2331.4	O K
30 min Winter	70.662	1.162	296.7	0.0	296.7	2991.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	128.285	0.0	2301.7	0.0	22
30 min Summer	84.226	0.0	3024.3	0.0	34
60 min Summer	52.662	0.0	3788.9	0.0	62
120 min Summer	31.800	0.0	4576.3	0.0	102
180 min Summer	23.353	0.0	5041.2	0.0	134
240 min Summer	18.644	0.0	5366.5	0.0	168
360 min Summer	13.543	0.0	5847.5	0.0	234
480 min Summer	10.792	0.0	6213.1	0.0	300
600 min Summer	9.043	0.0	6507.4	0.0	364
720 min Summer	7.823	0.0	6755.2	0.0	426
960 min Summer	6.219	0.0	7159.6	0.0	544
1440 min Summer	4.493	0.0	7758.4	0.0	780
2160 min Summer	3.241	0.0	8399.3	0.0	1132
2880 min Summer	2.568	0.0	8873.0	0.0	1496
4320 min Summer	1.847	0.0	9570.7	0.0	2208
5760 min Summer	1.461	0.0	10096.1	0.0	2936
7200 min Summer	1.217	0.0	10513.3	0.0	3672
8640 min Summer	1.048	0.0	10862.5	0.0	4408
10080 min Summer	0.923	0.0	11161.8	0.0	5136
15 min Winter	128.285	0.0	2578.6	0.0	22
30 min Winter	84.226	0.0	3388.0	0.0	35

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
60 min Winter	70.796	1.296	296.7	0.0	296.7	3520.6	Flood Risk
120 min Winter	70.849	1.349	296.7	0.0	296.7	3736.7	Flood Risk
180 min Winter	70.827	1.327	296.7	0.0	296.7	3646.2	Flood Risk
240 min Winter	70.788	1.288	296.7	0.0	296.7	3487.1	Flood Risk
360 min Winter	70.687	1.187	296.7	0.0	296.7	3085.7	O K
480 min Winter	70.577	1.077	296.7	0.0	296.7	2673.1	O K
600 min Winter	70.469	0.969	296.7	0.0	296.7	2299.8	O K
720 min Winter	70.374	0.874	295.8	0.0	295.8	1989.1	O K
960 min Winter	70.226	0.726	280.0	0.0	280.0	1546.9	O K
1440 min Winter	70.056	0.556	231.4	0.0	231.4	1091.5	O K
2160 min Winter	69.931	0.431	176.2	0.0	176.2	794.7	O K
2880 min Winter	69.863	0.363	142.3	0.0	142.3	645.4	O K
4320 min Winter	69.787	0.287	103.7	0.0	103.7	490.9	O K
5760 min Winter	69.745	0.245	82.4	0.0	82.4	408.8	O K
7200 min Winter	69.717	0.217	68.8	0.0	68.8	356.5	O K
8640 min Winter	69.696	0.196	59.2	0.0	59.2	319.6	O K
10080 min Winter	69.681	0.181	52.2	0.0	52.2	291.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
60 min Winter	52.662	0.0	4243.9	0.0	62
120 min Winter	31.800	0.0	5125.8	0.0	116
180 min Winter	23.353	0.0	5646.5	0.0	146
240 min Winter	18.644	0.0	6010.8	0.0	184
360 min Winter	13.543	0.0	6549.5	0.0	256
480 min Winter	10.792	0.0	6959.0	0.0	324
600 min Winter	9.043	0.0	7288.7	0.0	386
720 min Winter	7.823	0.0	7566.2	0.0	446
960 min Winter	6.219	0.0	8019.3	0.0	562
1440 min Winter	4.493	0.0	8690.2	0.0	794
2160 min Winter	3.241	0.0	9407.4	0.0	1148
2880 min Winter	2.568	0.0	9938.1	0.0	1500
4320 min Winter	1.847	0.0	10720.1	0.0	2208
5760 min Winter	1.461	0.0	11307.8	0.0	2944
7200 min Winter	1.217	0.0	11775.1	0.0	3672
8640 min Winter	1.048	0.0	12166.4	0.0	4408
10080 min Winter	0.923	0.0	12502.4	0.0	5136

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 9.600

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	4.800	4	8	3.600	8	12	1.200

Model Details

Storage is Online Cover Level (m) 71.000

Tank or Pond Structure

Invert Level (m) 69.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1458.0	0.600	2600.0	1.200	3900.0
0.300	2000.0	0.900	3200.0	1.500	4490.0

Hydro-Brake® Outflow Control

Design Head (m) 1.500 Diameter (mm) 528
Design Flow (l/s) 263.0 Invert Level (m) 69.500
Hydro-Brake® Type Md12 SW Only

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	20.4	1.200	280.4	3.000	319.5	7.000	487.5
0.200	60.9	1.400	266.6	3.500	344.8	7.500	504.7
0.300	110.2	1.600	260.8	4.000	368.6	8.000	521.2
0.400	161.1	1.800	262.4	4.500	390.9	8.500	537.2
0.500	208.3	2.000	268.7	5.000	412.0	9.000	552.8
0.600	247.5	2.200	277.6	5.500	432.2	9.500	568.0
0.800	290.5	2.400	287.7	6.000	451.4		
1.000	294.9	2.600	298.3	6.500	469.8		

Pre-initialised control selected, excessive flows may result.

Pipe Overflow Control

Diameter (m) 0.150 Entry Loss Coefficient 0.500
Slope (1:X) 100.0 Coefficient of Contraction 0.600
Length (m) 5.000 Upstream Invert Level (m) 71.000
Roughness k (mm) 0.600

I. Catchment 2A Drainage Calculations

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	66.281	0.981	56.0	0.0	56.0	473.7	O K
30 min Summer	66.459	1.159	56.0	0.0	56.0	601.5	O K
60 min Summer	66.580	1.280	56.0	0.0	56.0	696.7	Flood Risk
120 min Summer	66.613	1.313	56.0	0.1	56.0	724.6	Flood Risk
180 min Summer	66.595	1.295	56.0	0.0	56.0	709.3	Flood Risk
240 min Summer	66.564	1.264	56.0	0.0	56.0	683.8	Flood Risk
360 min Summer	66.494	1.194	56.0	0.0	56.0	628.8	O K
480 min Summer	66.424	1.124	56.0	0.0	56.0	575.6	O K
600 min Summer	66.354	1.054	56.0	0.0	56.0	524.2	O K
720 min Summer	66.282	0.982	56.0	0.0	56.0	474.7	O K
960 min Summer	66.136	0.836	56.0	0.0	56.0	380.2	O K
1440 min Summer	65.845	0.545	56.0	0.0	56.0	218.7	O K
2160 min Summer	65.654	0.354	51.5	0.0	51.5	130.4	O K
2880 min Summer	65.583	0.283	43.4	0.0	43.4	100.8	O K
4320 min Summer	65.515	0.215	32.2	0.0	32.2	74.2	O K
5760 min Summer	65.480	0.180	25.6	0.0	25.6	60.9	O K
7200 min Summer	65.458	0.158	21.5	0.0	21.5	52.8	O K
8640 min Summer	65.442	0.142	18.5	0.0	18.5	47.1	O K
10080 min Summer	65.430	0.130	16.3	0.0	16.3	42.8	O K
15 min Winter	66.369	1.069	56.0	0.0	56.0	534.9	O K
30 min Winter	66.560	1.260	56.0	0.0	56.0	681.0	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	128.285	0.0	519.2	0.0	21
30 min Summer	84.226	0.0	681.8	0.0	35
60 min Summer	52.662	0.0	853.0	0.0	62
120 min Summer	31.800	0.0	1030.2	0.2	108
180 min Summer	23.353	0.0	1134.8	0.0	140
240 min Summer	18.644	0.0	1208.0	0.0	172
360 min Summer	13.543	0.0	1316.2	0.0	242
480 min Summer	10.792	0.0	1398.5	0.0	310
600 min Summer	9.043	0.0	1464.8	0.0	378
720 min Summer	7.823	0.0	1520.5	0.0	444
960 min Summer	6.219	0.0	1611.6	0.0	572
1440 min Summer	4.493	0.0	1746.7	0.0	792
2160 min Summer	3.241	0.0	1890.1	0.0	1124
2880 min Summer	2.568	0.0	1996.8	0.0	1472
4320 min Summer	1.847	0.0	2154.4	0.0	2204
5760 min Summer	1.461	0.0	2271.7	0.0	2936
7200 min Summer	1.217	0.0	2365.6	0.0	3672
8640 min Summer	1.048	0.0	2444.4	0.0	4376
10080 min Summer	0.923	0.0	2512.3	0.0	5128
15 min Winter	128.285	0.0	581.5	0.0	21
30 min Winter	84.226	0.0	763.7	0.0	35

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Outflow Σ (l/s)	Max Volume (m³)	Status
60 min Winter	66.693	1.393	57.5	5.0	62.4	792.5	Flood Risk
120 min Winter	66.731	1.431	58.2	8.2	66.4	825.3	Flood Risk
180 min Winter	66.711	1.411	57.8	6.4	64.2	808.2	Flood Risk
240 min Winter	66.677	1.377	57.1	3.4	60.6	778.7	Flood Risk
360 min Winter	66.588	1.288	56.0	0.0	56.0	703.5	Flood Risk
480 min Winter	66.488	1.188	56.0	0.0	56.0	624.0	O K
600 min Winter	66.385	1.085	56.0	0.0	56.0	546.4	O K
720 min Winter	66.276	0.976	56.0	0.0	56.0	470.6	O K
960 min Winter	66.029	0.729	56.0	0.0	56.0	317.2	O K
1440 min Winter	65.683	0.383	53.5	0.0	53.5	142.7	O K
2160 min Winter	65.565	0.265	40.7	0.0	40.7	93.6	O K
2880 min Winter	65.517	0.217	32.6	0.0	32.6	74.9	O K
4320 min Winter	65.468	0.168	23.5	0.0	23.5	56.7	O K
5760 min Winter	65.442	0.142	18.6	0.0	18.6	47.3	O K
7200 min Winter	65.426	0.126	15.6	0.0	15.6	41.4	O K
8640 min Winter	65.414	0.114	13.4	0.0	13.4	37.2	O K
10080 min Winter	65.404	0.104	11.8	0.0	11.8	34.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
60 min Winter	52.662	0.0	955.4	5.5	62
120 min Winter	31.800	0.0	1153.8	21.3	114
180 min Winter	23.353	0.0	1271.0	20.1	144
240 min Winter	18.644	0.0	1353.0	9.0	184
360 min Winter	13.543	0.0	1474.2	0.0	262
480 min Winter	10.792	0.0	1566.4	0.0	336
600 min Winter	9.043	0.0	1640.6	0.0	408
720 min Winter	7.823	0.0	1703.0	0.0	478
960 min Winter	6.219	0.0	1805.0	0.0	602
1440 min Winter	4.493	0.0	1956.3	0.0	780
2160 min Winter	3.241	0.0	2116.9	0.0	1124
2880 min Winter	2.568	0.0	2236.4	0.0	1472
4320 min Winter	1.847	0.0	2412.9	0.0	2204
5760 min Winter	1.461	0.0	2544.3	0.0	2936
7200 min Winter	1.217	0.0	2649.5	0.0	3672
8640 min Winter	1.048	0.0	2737.8	0.0	4392
10080 min Winter	0.923	0.0	2813.8	0.0	5032

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 2.160

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	1.080	4	8	1.080

Model Details

Storage is Online Cover Level (m) 66.800

Tank or Pond Structure

Invert Level (m) 65.300

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	310.0	0.600	520.0	1.200	780.0
0.300	410.0	0.900	640.0	1.500	920.0

Hydro-Brake® Outflow Control

Design Head (m) 1.200 Diameter (mm) 271
Design Flow (l/s) 54.0 Invert Level (m) 65.300
Hydro-Brake® Type Md12 SW Only

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	11.1	1.200	53.7	3.000	84.1	7.000	128.4
0.200	29.4	1.400	57.6	3.500	90.8	7.500	132.9
0.300	45.7	1.600	61.4	4.000	97.1	8.000	137.3
0.400	54.4	1.800	65.1	4.500	103.0	8.500	141.5
0.500	55.8	2.000	68.7	5.000	108.5	9.000	145.6
0.600	53.4	2.200	72.0	5.500	113.8	9.500	149.6
0.800	49.3	2.400	75.2	6.000	118.9		
1.000	50.4	2.600	78.3	6.500	123.8		

Pre-initialised control selected, excessive flows may result.

Pipe Overflow Control

Diameter (m) 0.150 Entry Loss Coefficient 0.500
Slope (1:X) 100.0 Coefficient of Contraction 0.600
Length (m) 5.000 Upstream Invert Level (m) 66.600
Roughness k (mm) 0.600