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Technical Note

Date 12th September 2017

Project: C161279 JDE factory site – Surface Water Drainage of Proposed Development and Culverting of Birds Brook

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Background

Please refer to drawing C161279-HYD-XX-XX-DR-C-200 – Site Location plan

The link building shown on the above mentioned plan has been demolished, the existing floor slab remains. A link road is to be constructed over the slab which join the existing eastern and western roads. A HGV parking area shall be incorporated within this development. The parking area shall be located in place of the previous link building.

This technical note has been produced in support of the Land Drainage consent application that is required to culvert a section of Birds Brook. It is also intended to support of the planning application which is required to gain consent for the surface water drainage strategy.

The Existing Site Drainage

Please refer to drawing C161279-HYD-XX-XX-DR-C-201 – Existing drainage layout.

The surface water drainage from the link building roof drained via rainwater downpipes to Birds Brook.

The existing road to the west of the link building drained via road gullies to Birds Brook. Within the site pipes of various sizes from the JDE premises discharge into Birds Brook. These are shown on the above drawing. The full bore capacities of each of these pipes are also shown. The capacities have been calculated using the Wallingford tables based on their gradient and size. A Ks value of 0.15 has been assumed for concrete pipes and 0.06 for clay pipes.

Proposed Drainage Strategy

Please refer to drawing C161279-HYD-XX-XX-DR-C-102 – Proposed Drainage Plan and C161279-HYD-XX-XX-DR-C-202 - Drainage Catchment Areas.

To enable the construction of the HGV parking area and link road a section of the Birds Brook shall require culverting as shown on the attached plans. The section of birds brook sits within an existing soft landscape area which shall become impermeable as part of the development. This shall increase the catchment by 1118m2.

An additional impermeable area shall be created to the east of the development, this shall increase the impermeable area by 391m2. Therefore, overall this scheme shall result in an additional catchment of 1509m2 draining to Birds Brook.

It is proposed to drain an area of 2975m2 to Point B (referred to on the catchment area plan) with no flow restriction, this is the equivalent area of the existing link building. The unrestricted flow rates shall be as follows (the Microdrainage calculations can be found within Appendix A of this note):

Return Period	Flow Rate l/s
1 in 2 yr	49.2
1 in 30 yr	92.6
1 in 100 yr + 40 % CC	145.9

An area equivalent to the total additional catchment shall drain at the greenfield QBAR rate to Point A (as referred to on the catchment area plan). This run off rate shall be in addition to the current run off rate generated by the western roadway (1134m2).

The QBAR greenfield runoff rate from the additional catchment has been calculated using Microdrainage and is effectively 0.0l/s. Using the Modified Rational Method the existing runoff from the western roadway can be calculated using the different rainfall intensities for each event. The results are as tabulated below.

Q = 2.78 x A(ha) x i(mm/hr)

Where A = area = 1134m2

Return Period	Rainfall intensity I (mm/hr)	QBAR runoff from additional catchment l/s	Proposed discharge rate at Point A (l/s)
QBAR	44.1	0.0	13.9
1 in 30 yr	74.9	0.0	23.6
1 in 100 yr	97.1	0.0	30.6
1 in 100 yr + 40% CC	135.95	0.0	42.9

In restricting the flow rate at point A to the above figures attenuation shall be required. Refer to Appendix A for the Microdrainage calcualtions showing compliance with the above proposals. The results show no flooding occurs during any of the storm events within Network A. Only minor flooding occurs within Network B (0.005m3) which is insignificant.

The existing surrounding buildings that drain to the brook shall continue to drain as they do currently through connections provided for them into the proposed culvert.

Culverting of Birds Brook

Previous correspondence with OCC dated 18/7/2017 has stated the culverting of this section of Birds Brook to be acceptable in principle.

The ReFH Flood modelling software has been used to calculate the expected flows through Birds Brook where located in the site using catchments generated from the FEH CD ROM. The catchment drawing and full calculations for this can be found within Appendix B.

In summary, the flow rates were found to be:

Return Period	Resulting Flow rate m3/s
1 in 2 year	0.34
1 in 30 year	0.77
1 in 100 year	1.07
1 in 1000 year	2.04

As shown on drawing 0201, the existing twin 900mm diameter pipes which are upstream of the proposed culvert have a capacity of 3.88m3/s while the four 600mm diameter pipes downstream have a capacity of 2.06m3/s. This may elude to the downstream pipes acting as a flow restriction thereby making the watercourse at this point act as storage. However, the above table shows that even the flow during the 1 in 1000 year event would not exceed the capacity of downstream pipes, this confirms that the four 600mm diameter pipes therefore do not act as a flow restriction.

With the above in mind the capacity of the proposed culvert should be no less than the capacity of the four 600mm diameter pipes - 2.06m3/s.

With an available gradient of 1 in 79 which allows the existing upstream and downstream pipes to be connected (refer long section) a culvert of internal dimensions 1.8m wide and 1m high shall be sufficient to provide a capacity in excess of 4.0m3/s . This is based on a Ks value of 0.3. While this capacity is well in excess of that required the width allows the transition from the upstream pipes in a more efficient manner.

In conclusion a culvert of 1m high x 1.8m wide is proposed, this provides a capacity in excess of 4.0m3/s which is greater than the 2.06m3/s required. This additional capacity shall prevent detrimental effects upstream.

Pollution Control

There shall be two drainage networks, both of which shall drain through catchpits and trapped gullies before passing through full retention interceptors.

Access and Maintenance

Access shall be provided at each end of the culvert. The access shall be into rectangular chambers which allow the transition between the existing pipes upstream and downstream.

To enable the water treatment process to occur as intended the drainage network shall require maintenance. The maintenance strategy and responsibilities are as set out in the table below.

Component to be maintained	Actions	Frequency	Responsibility of:
Site wide external areas	Site to be generally kept free from litter and debris which may enter the drainage system.	On-going	JDE
On site below ground attenuation	Check inlets /outlets for condition and repair if needed CCTV survey the attenuation internally, remove sediment as required	Annually Every 5 years	JDE

APPENDIX A

MICRODRAINAGE RESULTS

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)	100	Add Flow / Climate Change (%)	0
M5-60 (mm)	19.700	Minimum Backdrop Height (m)	0.200
Ratio R	0.409	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	500	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Soffits

Network Design Table for Storm

- Indicates pipe length does not match coordinates
« - Indicates pipe capacity < flow

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
S1.000	12.410	0.200	62.1	0.225	5.00	0.0	0.600	o	300	Pipe/Conduit	
S1.001	3.000#	0.050	60.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.002	3.000#	0.025	120.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.003	3.152	0.025	126.1	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.004	3.971	0.050	79.4	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	162.03	5.10	95.350	0.225	0.0	0.0	0.0	2.00	141.3	98.7
S1.001	161.74	5.13	95.150	0.225	0.0	0.0	0.0	2.03	143.7	98.7
S1.002	161.33	5.16	95.100	0.225	0.0	0.0	0.0	1.43	101.4	98.7
S1.003	160.81	5.21	95.050	0.225	0.0	0.0	0.0	1.16	46.2«	98.7
S1.004	160.29	5.25	95.000	0.225	0.0	0.0	0.0	1.47	58.4«	98.7

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	1
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)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.700	Storm Duration (mins)	30
Ratio R	0.409		

Online Controls for Storm

Hydro-Brake Optimum® Manhole: S4, DS/PN: S1.003, Volume (m³): 2.4

Unit Reference	MD-SHE-0179-1390-0300-1390
Design Head (m)	0.300
Design Flow (l/s)	13.9
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	179
Invert Level (m)	95.050
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.300	13.9
Flush-Flo™	0.229	13.9
Kick-Flo®	0.287	13.6
Mean Flow over Head Range	-	9.1

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	6.3	1.200	26.9	3.000	41.8	7.000	63.5
0.200	13.8	1.400	29.0	3.500	44.6	7.500	65.8
0.300	13.9	1.600	30.9	4.000	47.8	8.000	68.0
0.400	15.9	1.800	32.7	4.500	50.7	8.500	70.1
0.500	17.7	2.000	34.4	5.000	53.5	9.000	72.1
0.600	19.3	2.200	36.0	5.500	56.2	9.500	74.1
0.800	22.1	2.400	37.5	6.000	58.7		
1.000	24.6	2.600	39.0	6.500	61.2		

Storage Structures for Storm

Cellular Storage Manhole: S3, DS/PN: S1.002

Invert Level (m) 95.100 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	60.0	0.0	0.801	0.0	0.0
0.800	60.0	0.0			

2 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	1
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	0.408
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.700	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	250.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia 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)	2, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	15 Winter	2	+0%	30/30 Winter				95.475
S1.001	S3	15 Winter	2	+0%	30/15 Summer				95.329
S1.002	S3	30 Winter	2	+0%	30/15 Summer				95.309
S1.003	S4	30 Winter	2	+0%	2/15 Summer				95.309
S1.004	S6	30 Winter	2	+0%					95.104

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.175	0.000	0.36		40.0	OK	
S1.001	S3	-0.121	0.000	0.65		39.7	OK	
S1.002	S3	-0.091	0.000	0.24		13.9	OK	
S1.003	S4	0.034	0.000	0.46		13.7	SURCHARGED	
S1.004	S6	-0.121	0.000	0.44		13.7	OK	

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	1
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	0.408
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.700	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	250.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia 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)	2, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	30 Winter	30	+0%	30/30 Winter				95.710
S1.001	S3	30 Winter	30	+0%	30/15 Summer				95.607
S1.002	S3	30 Winter	30	+0%	30/15 Summer				95.552
S1.003	S4	30 Winter	30	+0%	2/15 Summer				95.549
S1.004	S6	30 Winter	30	+0%					95.115

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.060	0.000	0.53		58.9	SURCHARGED	
S1.001	S3	0.157	0.000	0.93		57.1	SURCHARGED	
S1.002	S3	0.152	0.000	0.30		16.9	SURCHARGED	
S1.003	S4	0.274	0.000	0.54		16.2	SURCHARGED	
S1.004	S6	-0.110	0.000	0.52		16.3	OK	

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	1
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	0.408
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.700	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	250.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia 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)	2, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	60 Winter	100	+40%	30/30 Winter				96.739
S1.001	S3	60 Winter	100	+40%	30/15 Summer				96.670
S1.002	S3	60 Winter	100	+40%	30/15 Summer				96.585
S1.003	S4	60 Winter	100	+40%	2/15 Summer				96.506
S1.004	S6	60 Winter	100	+40%					95.166

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	1.089	0.000	0.61		68.3	FLOOD RISK	
S1.001	S3	1.220	0.000	1.10		67.3	SURCHARGED	
S1.002	S3	1.185	0.000	0.51		29.5	SURCHARGED	
S1.003	S4	1.231	0.000	0.95		28.2	SURCHARGED	
S1.004	S6	-0.059	0.000	0.90		28.3	OK	

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)	2	Add Flow / Climate Change (%)	0
M5-60 (mm)	19.700	Minimum Backdrop Height (m)	0.200
Ratio R	0.409	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	500	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

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)	Section Type	Auto Design
S1.000	6.216	1.490	4.2	0.190	5.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S1.001	21.688	0.420	51.6	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S1.002	7.351	0.200	36.8	0.100	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S1.003	5.733	0.098	58.5	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	🔒

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	69.91	5.02	96.190	0.190	0.0	0.0	0.0	6.45	256.5	36.0
S1.001	68.75	5.21	94.700	0.190	0.0	0.0	0.0	1.82	72.5	36.0
S1.002	68.43	5.27	94.280	0.290	0.0	0.0	0.0	2.16	86.1	53.7
S1.003	68.17	5.32	94.080	0.290	0.0	0.0	0.0	2.06	145.6	53.7

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	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.700	Storm Duration (mins)	30
Ratio R	0.409		

2 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	0
Number of Online Controls	0	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 0.409
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.700	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	250.0	DVD Status	ON
Analysis Timestep	Fine	Inertia Status	ON
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)	2, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.000	S1	15 Winter	2	+0%	100/15 Summer			
S1.001	S2	15 Winter	2	+0%	30/15 Summer			
S1.002	S3	15 Winter	2	+0%	30/15 Summer	100/15 Winter		
S1.003	S4	15 Winter	2	+0%	30/15 Summer			

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	96.258	-0.157	0.000	0.20		33.9	OK	
S1.001	S2	94.815	-0.110	0.000	0.51		33.5	OK	
S1.002	S3	94.432	-0.073	0.000	0.78		49.0	OK	1
S1.003	S4	94.253	-0.127	0.000	0.63		49.2	OK	

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	0
Number of Online Controls	0	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	0.409
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.700	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	250.0	DVD Status	ON
Analysis Timestep	Fine	Inertia Status	ON
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)	2, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.000	S1	15 Winter	30	+0%	100/15 Summer			
S1.001	S2	15 Winter	30	+0%	30/15 Summer			
S1.002	S3	15 Winter	30	+0%	30/15 Summer	100/15 Winter		
S1.003	S4	15 Winter	30	+0%	30/15 Summer			

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	96.286	-0.129	0.000	0.37		64.3	OK	
S1.001	S2	95.237	0.312	0.000	0.95		62.9	SURCHARGED	
S1.002	S3	94.853	0.348	0.000	1.48		93.4	SURCHARGED	1
S1.003	S4	94.409	0.029	0.000	1.18		92.6	SURCHARGED	

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	0
Number of Online Controls	0	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	0.409
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.700	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	250.0	DVD Status	ON
Analysis Timestep	Fine	Inertia Status	ON
DTS Status	ON		

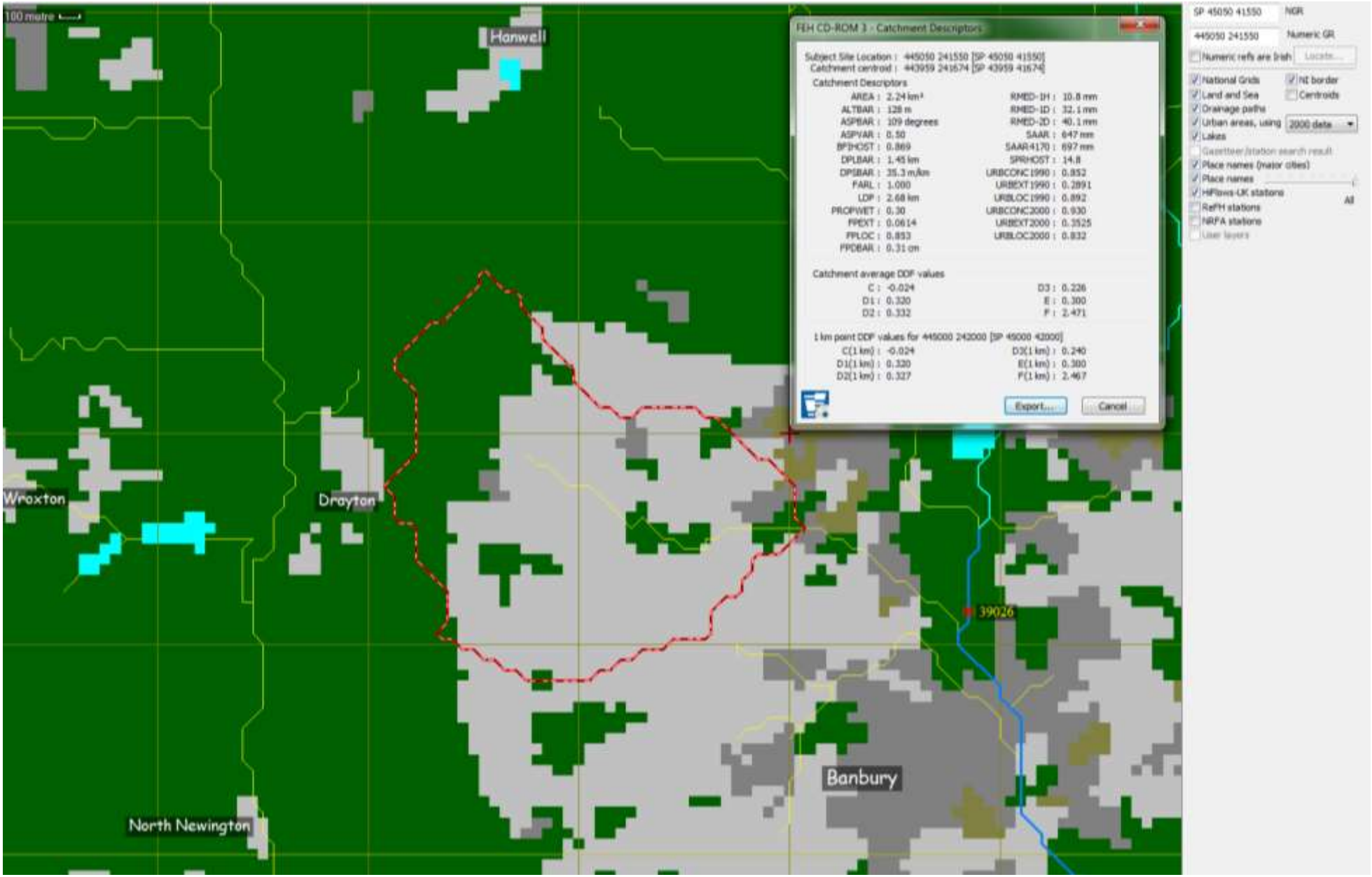
Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.000	S1	15 Winter	100	+40%	100/15 Summer			
S1.001	S2	15 Winter	100	+40%	30/15 Summer			
S1.002	S3	15 Winter	100	+40%	30/15 Summer	100/15 Winter		
S1.003	S4	15 Winter	100	+40%	30/15 Summer			

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	97.083	0.668	0.000	0.57		97.2	FLOOD RISK	
S1.001	S2	96.592	1.667	0.000	1.51		99.7	FLOOD RISK	
S1.002	S3	95.710	1.205	0.005	2.32		146.3	FLOOD	1
S1.003	S4	94.611	0.231	0.000	1.86		145.9	SURCHARGED	

APPENDIX B

ReFH MODELLING RESULTS


100 metre
Hanwell
Wroxton
Drayton
North Newington
Banbury
39026
FEH CD-ROM 3 - Catchment Descriptors
Subject Site Location : 445050 241550 [SP 45050 41550]
Catchment centroid : 443959 241674 [SP 43959 41674]
Catchment Descriptors
AREA : 2.24 km²
ALTBAR : 128 m
ASPBAR : 109 degrees
ASPVAR : 0.50
BFIHOST : 0.869
DPLBAR : 1.45 km
DPSBAR : 35.3 m/km
FARL : 1.000
LDP : 2.68 km
PROPWET : 0.30
PPEXT : 0.0614
PPLOC : 0.853
PPDBAR : 0.31 on
RMED-1H : 10.8 mm
RMED-1D : 32.1 mm
RMED-2D : 40.1 mm
SAAR : 647 mm
SAAR4170 : 697 mm
SPRHOST : 14.8
URBCONC1990 : 0.852
URBEXT1990 : 0.2891
URBLOC1990 : 0.892
URBCONC2000 : 0.930
URBEXT2000 : 0.3525
URBLOC2000 : 0.832
Catchment average DDF values
C : -0.024
D1 : 0.320
D2 : 0.332
D3 : 0.226
E : 0.300
F : 2.471
1 km point DDF values for 445000 242000 [SP 45000 42000]
C(1 km) : -0.024
D1(1 km) : 0.320
D2(1 km) : 0.327
D3(1 km) : 0.240
E(1 km) : 0.300
F(1 km) : 2.467
Export...
Cancel
SP 45050 41550
NGR
445050 241550
Numeric GR
Numeric refs are Irish
Locate...
National Grids
NI border
Land and Sea
Centroids
Drainage paths
Urban areas, using
2000 data
Lakes
Gazetteer/station search result
Place names (major cities)
Place names
All
HiFlows-UK stations
ReFH stations
NRFA stations
User layers

UK Design Flood Estimation

Generated on Monday, September 11, 2017 4:40:38 PM by simonmirams
Printed from the ReFH Flood Modelling software package, version 2.2.6029.28099

Summary of estimate using the Flood Estimation Handbook revitalised flood hydrograph method (ReFH)

Site details Checksum: 6606-5B23

Site name: Catchment Descriptors

Easting: 445050

Northing: 241550

Country: England, Wales or Northern Ireland

Catchment Area (km²): 2.24

Using plot scale calculations: No

Site description: None

Model run: 2 year

Summary of results

Rainfall - FEH 1999 (mm):	21.10	Total runoff (ML):	4.60
Total Rainfall (mm):	13.43	Total flow (ML):	5.69
Peak Rainfall (mm):	3.65	Peak flow (m³/s):	0.34

Parameters

Where the user has overriden a system-generated value, this original value is shown in square brackets after the value used.
** Indicates that the user locked the duration/timestep*

Rainfall parameters (Rainfall - FEH 1999 model)

Name	Value	User-defined?
Duration (hh:mm:ss)	04:30:00	No
Timestep (hh:mm:ss)	00:30:00	No
SCF (Seasonal correction factor)	0.66	No
ARF (Areal reduction factor)	0.97	No
Seasonality	Winter	n/a

Loss model parameters

Name	Value	User-defined?
Cini (mm)	41.74	No
Cmax (mm)	1093.69	No
Use alpha correction factor	Yes	No
Alpha correction factor	1	No

Routing model parameters

Name	Value	User-defined?
Tp (hr)	3.01	No
Up	0.65	No
Uk	0.8	No

Baseflow model parameters

Name	Value	User-defined?
BF0 (m^3/s)	0	No
BL (hr)	53.53	No
BR	2.22	No

Urbanisation parameters

Name	Value	User-defined?
Urban area (km^2)	1.24	No
Urbext 2000	0.35	No
Impervious runoff factor	0.7	No
Imperviousness factor	0.3	No
Tp scaling factor	0.5	No
Sewered area (km^2)	0.00	Yes
Sewer capacity (m^3/s)	0.00	Yes

UK Design Flood Estimation

Generated on Monday, September 11, 2017 4:40:10 PM by simonmirams
Printed from the ReFH Flood Modelling software package, version 2.2.6029.28099

Summary of estimate using the Flood Estimation Handbook revitalised flood hydrograph method (ReFH)

Site details Checksum: 6606-5B23

Site name: Catchment Descriptors

Easting: 445050

Northing: 241550

Country: England, Wales or Northern Ireland

Catchment Area (km²): 2.24

Using plot scale calculations: No

Site description: None

Model run: 30 year

Summary of results

Rainfall - FEH 1999 (mm):	46.81	Total runoff (ML):	10.55
Total Rainfall (mm):	29.79	Total flow (ML):	13.31
Peak Rainfall (mm):	8.10	Peak flow (m³/s):	0.77

Parameters

Where the user has overriden a system-generated value, this original value is shown in square brackets after the value used.
** Indicates that the user locked the duration/timestep*

Rainfall parameters (Rainfall - FEH 1999 model)

Name	Value	User-defined?
Duration (hh:mm:ss)	04:30:00	No
Timestep (hh:mm:ss)	00:30:00	No
SCF (Seasonal correction factor)	0.66	No
ARF (Areal reduction factor)	0.97	No
Seasonality	Winter	n/a

Loss model parameters

Name	Value	User-defined?
Cini (mm)	41.74	No
Cmax (mm)	1093.69	No
Use alpha correction factor	Yes	No
Alpha correction factor	0.97	No

Routing model parameters

Name	Value	User-defined?
Tp (hr)	3.01	No
Up	0.65	No
Uk	0.8	No

Baseflow model parameters

Name	Value	User-defined?
BF0 (m^3/s)	0	No
BL (hr)	53.53	No
BR	2.22	No

Urbanisation parameters

Name	Value	User-defined?
Urban area (km^2)	1.24	No
Urbext 2000	0.35	No
Impervious runoff factor	0.7	No
Imperviousness factor	0.3	No
Tp scaling factor	0.5	No
Sewered area (km^2)	0.00	Yes
Sewer capacity (m^3/s)	0.00	Yes

UK Design Flood Estimation

Generated on Monday, September 11, 2017 4:40:00 PM by simonmirams
Printed from the ReFH Flood Modelling software package, version 2.2.6029.28099

Summary of estimate using the Flood Estimation Handbook revitalised flood hydrograph method (ReFH)

Site details Checksum: 6606-5B23

Site name: Catchment Descriptors

Easting: 445050

Northing: 241550

Country: England, Wales or Northern Ireland

Catchment Area (km²): 2.24

Using plot scale calculations: No

Site description: None

Model run: 100 year

Summary of results

Rainfall - FEH 1999 (mm):	64.54	Total runoff (ML):	14.82
Total Rainfall (mm):	41.07	Total flow (ML):	18.88
Peak Rainfall (mm):	11.17	Peak flow (m³/s):	1.07

Parameters

Where the user has overriden a system-generated value, this original value is shown in square brackets after the value used.
** Indicates that the user locked the duration/timestep*

Rainfall parameters (Rainfall - FEH 1999 model)

Name	Value	User-defined?
Duration (hh:mm:ss)	04:30:00	No
Timestep (hh:mm:ss)	00:30:00	No
SCF (Seasonal correction factor)	0.66	No
ARF (Areal reduction factor)	0.97	No
Seasonality	Winter	n/a

Loss model parameters

Name	Value	User-defined?
Cini (mm)	41.74	No
Cmax (mm)	1093.69	No
Use alpha correction factor	Yes	No
Alpha correction factor	0.92	No

Routing model parameters

Name	Value	User-defined?
Tp (hr)	3.01	No
Up	0.65	No
Uk	0.8	No

Baseflow model parameters

Name	Value	User-defined?
BF0 (m^3/s)	0	No
BL (hr)	53.53	No
BR	2.22	No

Urbanisation parameters

Name	Value	User-defined?
Urban area (km^2)	1.24	No
Urbext 2000	0.35	No
Impervious runoff factor	0.7	No
Imperviousness factor	0.3	No
Tp scaling factor	0.5	No
Sewered area (km^2)	0.00	Yes
Sewer capacity (m^3/s)	0.00	Yes

UK Design Flood Estimation

Generated on Monday, September 11, 2017 4:39:38 PM by simonmirams
Printed from the ReFH Flood Modelling software package, version 2.2.6029.28099

Summary of estimate using the Flood Estimation Handbook revitalised flood hydrograph method (ReFH)

Site details Checksum: 6606-5B23

Site name: Catchment Descriptors

Easting: 445050

Northing: 241550

Country: England, Wales or Northern Ireland

Catchment Area (km²): 2.24

Using plot scale calculations: No

Site description: None

Model run: 1000 year

Summary of results

Rainfall - FEH 1999 (mm):	118.68	Total runoff (ML):	28.67
Total Rainfall (mm):	75.53	Total flow (ML):	37.54
Peak Rainfall (mm):	20.54	Peak flow (m³/s):	2.04

Parameters

Where the user has overriden a system-generated value, this original value is shown in square brackets after the value used.
** Indicates that the user locked the duration/timestep*

Rainfall parameters (Rainfall - FEH 1999 model)

Name	Value	User-defined?
Duration (hh:mm:ss)	04:30:00	No
Timestep (hh:mm:ss)	00:30:00	No
SCF (Seasonal correction factor)	0.66	No
ARF (Areal reduction factor)	0.97	No
Seasonality	Winter	n/a

Loss model parameters

Name	Value	User-defined?
Cini (mm)	41.74	No
Cmax (mm)	1093.69	No
Use alpha correction factor	Yes	No
Alpha correction factor	0.77	No

Routing model parameters

Name	Value	User-defined?
Tp (hr)	3.01	No
Up	0.65	No
Uk	0.8	No

Baseflow model parameters

Name	Value	User-defined?
BF0 (m^3/s)	0	No
BL (hr)	53.53	No
BR	2.22	No

Urbanisation parameters

Name	Value	User-defined?
Urban area (km^2)	1.24	No
Urbext 2000	0.35	No
Impervious runoff factor	0.7	No
Imperviousness factor	0.3	No
Tp scaling factor	0.5	No
Sewered area (km^2)	0.00	Yes
Sewer capacity (m^3/s)	0.00	Yes