

**D & M Middleton Ltd**

**Proposed Mixed Development  
Scott Lane  
Cleckheaton**

## **Drainage Assessment**

**Prepared by EWE Associates Ltd  
Final RevE September 2023**



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## CLIENT DETAILS

D & M Middleton Ltd

## CONTRACT

This report describes work commissioned by D & M Middleton Ltd during January 2020. D & M Middleton Ltd representative for the contract was Mr Mark Brotherton of Fox Architecture & Design. Lea Favill of EWE Associates Ltd carried out the work.

Date: 22<sup>nd</sup> September 2023

Prepared by: .....  ..... Lea Favill  
Director

## REVISION HISTORY

Draft Report Rev0 issued 27<sup>th</sup> February 2020  
- 1No copy issued to Mr Mark Brotherton

Final Report RevA issued 8<sup>th</sup> April 2020  
- 1No copy issued to Mr Mark Brotherton

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- 1No copy issued to Mr Mark Brotherton

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- 1No copy issued to Mr Mark Brotherton

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- 1No copy issued to Mr Mark Brotherton

Final Report RevE issued 22<sup>nd</sup> September 2023  
- 1No copy issued to Mr Mark Brotherton

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### **APPENDICES:**

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**APPENDIX C: - DRAINAGE DRAWINGS**

**APPENDIX D: - 1 IN 100 YEAR+CC WINDES CALCULATION SHEETS**

## 1. INTRODUCTION

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### Terms of Reference

This report was commissioned by D & M Middleton Ltd to consider the surface water drainage for the proposed commercial development off Scott Lane, Cleckheaton.

The proposal involves the construction of commercial units. The development will also include an access road and parking areas. The drainage issues are being considered as part of the current planning application.

### Approach to the Assessment

For the purposes of this study, the following have been considered: -

- Site level information and proposed finished levels of the buildings and external works.
- Onsite construction.
- Options available to developer.
- NPPF guidelines with regards to the control of runoff.
- PPG3 pollution prevention guidelines.
- Future adoption and management of drainage system.
- Discharge rates into highway sewer.
- Flood risk to adjacent land users.

### Design Constraints

For the purposes of this study, the following constraints have been applied: -

- The design is based on the proposed layout provided by the client's representative. At this stage no modifications to the layout are proposed.
- The proposal is for a commercial development. The commercial units will be sold to individual owners as such any drainage features or attenuation structures will be maintained by the individual owner/maintenance company. As such, the primary drainage will remain in private ownership.
- SUDs features are to be recommended where practically possible.
- There is a system of combined sewers which run within and adjacent to the site. The sewers within the site generally sever only the site and as such the majority of these will be abandoned following the development via a S185 agreement with Yorkshire Water. The Yorkshire Water sewer plan is provided at Appendix A.
- The presence of the Made Ground and interbedded clay strata indicates that infiltration will not be suitable at the site due to the risk of groundwater

contamination from the Made Ground, the likely low infiltration rate and the potential for re-emergence due to the interbedded strata. Therefore, the use of infiltration systems has been discounted for the proposed development.

- It is assumed that the minimum design standard is 1 in 100 years plus climate change (40%) as the site is less vulnerable.
- No on site above ground flooding will be acceptable up to and including 1 in 100 years plus climate change (40%) storm.

## 2. DESIGN OF PROPOSED SURFACE WATER DRAINAGE SYSTEM

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### Existing Drainage

The existing development site is brownfield which is 3998m<sup>2</sup> in area which slopes west to east. There is currently 1225m<sup>2</sup> of existing roofed and paved area which is drained via a piped network to the combined sewer within Scott Lane. There is a further 2701m<sup>2</sup> of the site which is undrained and considered to be greenfield runoff.

**Table 2-1: ICPSUDs flows from existing site 2701m<sup>2</sup>**

Return Period	Flow in litres per second (l/s)
Qbar	1
1 in 1 year	0.9
1 in 30 year	1.8
1 in 100 year	2.1

The ICPSUDs has been used to calculate the existing runoff from the undrained part of the site. The calculation sheet is provided at Appendix B of this report.

**Table 2-2: Modified Rational flows from existing site 1225m<sup>2</sup>**

Return Period	Flow in litres per second (l/s)
1 in 1 year	17.28
1 in 30 year	44.23
1 in 100 year	73.48

The Modified Rational Calculation has been used to calculate the existing runoff from the drained part of the site. The calculation sheet is provided at Appendix B of this report. A 30% betterment is proposed on the 1 year runoff rate, hence a peak rate of 12.1l/s (17.28l/s x 70%) is proposed from this area.

Therefore, the peak discharge rate from the whole site has been estimated at 13.1l/s (12.1l/s + 1l/s).

Any discharge from the site into the combined sewers will require the consent of the sewer authority.

## **Proposed Drainage Strategy**

It is proposed to ultimately discharge any surface water flows generated by the development of the site which cannot drain via infiltration to the combined sewer located within Scott Road to the north.

The proposed impermeable area for the development site has been calculated to be approximately 0.354 ha.

The drainage strategy utilises an appropriately sized hydro brake to restrict the flow rates to 13.1l/s. This allows the discharge through the hydro brake to vary as the head increases due to the increase in upstream flows. As such, the flow will vary for each of the design storms shown above and it is expected that during the more extreme return periods there will be a considerable betterment as the hydro brake is likely to restrict flows to a lesser rate than estimated at present.

Oversized pipes will be located within the access road/car parking area within the site directly upstream of the combined sewer and the control structure.

The oversized pipes will be used to accommodate the storage during 1 in 1 year, 30 year, 100 year and 100 year +CC storms (worst case scenario).

The proposed drainage strategy for the site is provided at Appendix C of this report.

## **Hydraulic Modelling Results**

The proposed MicroDrainage models have been simulated with the 1 in 100 year plus climate change (30%) return period design storm events with durations of 15, 45, 60, 90, 120, 180, 360, 600, 900 and 1440 minutes. At the request of the Environment Agency seven day 10080 minute duration was also undertaken. The durations were run in both Winter and Summer profiles. It was found that the Winter profile was critical.

The table below shows a summary of the 1 in 100 year plus climate change model runs and the impact on the drainage system in terms of peak depth within the system and flow through the hydro-brake.

The 90 minute duration produced the largest flow through the control manhole (13.0l/s) which is less than the restricted runoff rate (13.1l/s). The modelled result for the 90 minute Winter model run is provided at Appendix D.

Return Period	Profile	Duration (min)	Peak water level in tank	Peak flow into sewer	Status
100 year+CC	Winter FSR	15min	87.319	8.8	OK
100 year+CC	Winter FSR	45min	87.690	10.6	Surcharge
100 year+CC	Winter FEH	60min	88.155	12.5	Flood risk
100 year+CC	Winter FEH	90min	88.286	13.0	Flood risk
100 year+CC	Winter FEH	120min	88.204	12.7	Flood risk
100 year+CC	Winter FEH	180min	88.094	12.3	Flood risk
100 year+CC	Winter FEH	360min	87.602	10.2	Surcharge
100 year+CC	Winter FEH	600min	87.405	9.3	Surcharge
100 year+CC	Winter FEH	900min	87.263	8.5	OK
100 year+CC	Winter FEH	1440min	87.052	8.0	OK
100 year+CC	Winter FEH	10800min	86.680	2.5	OK

### Blockages and exceedance

The proposed surface water drainage system provides for a 1 in 100 year plus climate change 40% storm. The peak flow through the hydro brake and water level occurs during a 90 minute winter storm. The proposal includes 79m of double 1m diameter tank sewer which due to the size of pipes and manholes represents a low blockage risk. Subsequently, the main blockage risk is from the control manhole at the downstream end of the site adjacent to the site entrance. Any blockage of the hydrobrake manhole would result in flood water escaping via the cover and conveying downstream onto the adjacent highway and back into the drainage system as shown by the exceedance routing on the drainage plan at Appendix C.

### Construction Phase Drainage

It is recommended that during the construction phase a debris screen is placed on the outlet within SW10 to ensure no debris from the site is passed forward. The manhole should be inspected and cleared on a daily basis.

### Petrol Interceptor

Due to the size of the site, the proposed layout of buildings and the need for a large piped tank sewer through the entre of the site it is difficult to provide separate systems for roofed and paved water. As such, both roof and pavement drainage will pass through the interceptor before discharging into the public sewer.

## **Adoption & Maintenance**

The access road and drainage system will remain in private ownership. The main drainage issue will be the inspection and cleaning of the control manhole. This should be undertaken on a 3 monthly basis.

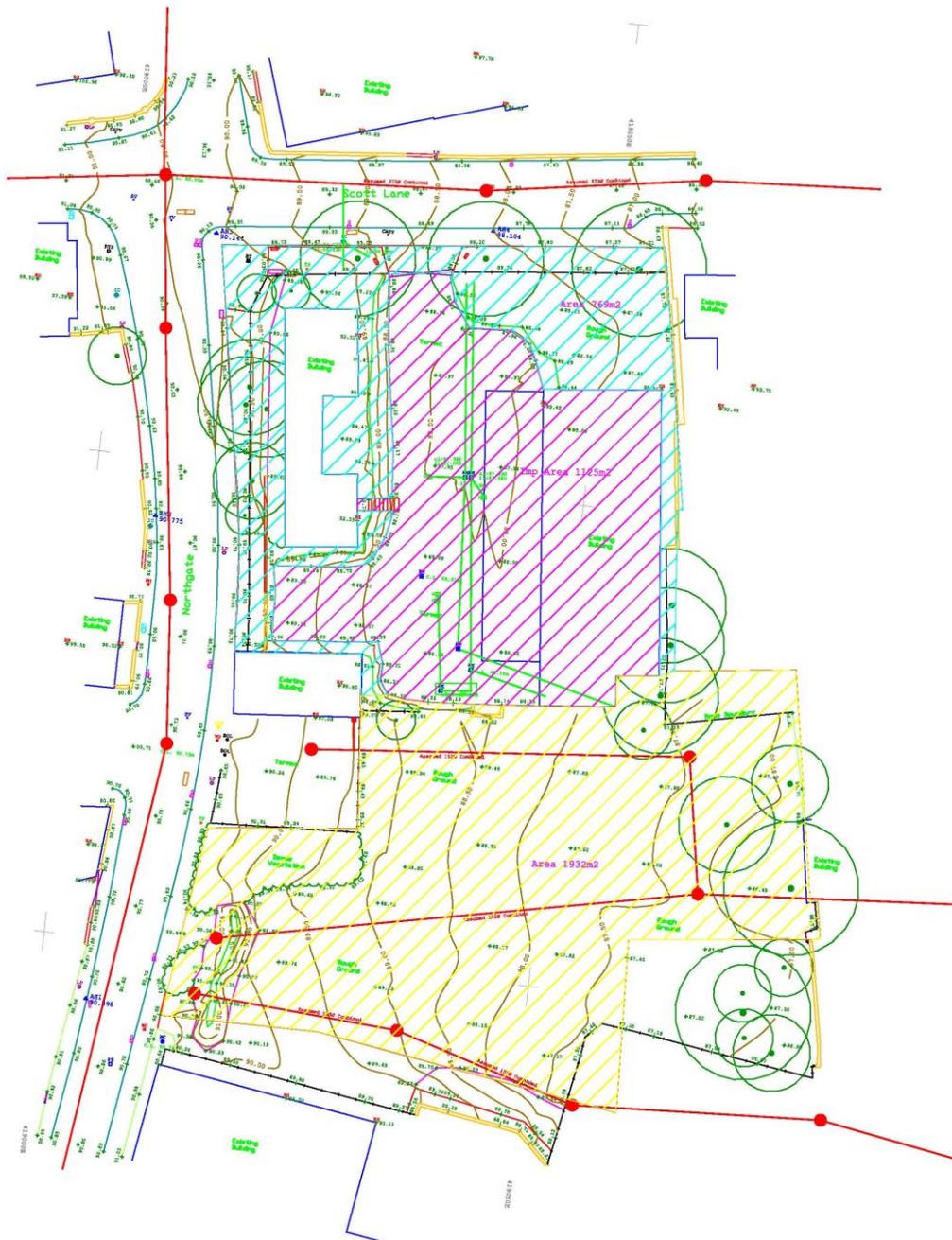
### **3. DESIGN OF PROPOSED FOUL WATER DRAINAGE SYSTEM**

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The site will drain via gravity to the combined sewer within Scott Lane.



Appendix B: - Existing Runoff Calculation



EWE Associates Ltd		Page 1
Windy Ridge Barn Thealby Lane Winterton DN15 9TG		
Date 26/02/2020 10:18 File	Designed By Windows7 Checked By	
Micro Drainage	Source Control W.12.4	
<u>ICP SUDS Mean Annual Flood</u>		
Input		
Return Period (years)	1	Soil 0.400
Area (ha)	0.270	Urban 0.000
SAAR (mm)	774	Region Number Region 3
<b>Results 1/s</b>		
QBAR Rural	1.0	
QBAR Urban	1.0	
Q1 year	0.9	
Q1 year	0.9	
Q30 years	1.8	
Q100 years	2.1	
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**Modified Rational Method**

Length (m)	42	m
Area (ha)	0.123	Ha
Max Height	89.5	mAOD
Min Height	88.4	mAOD
DeltaH	1.1	
Slope (%)	2.55	
Te (mins)	9.48	mins
ARF	0.999	
SAAR	774.000	mm
UCWI	75	mm
PIMP	100.0	%
SOIL	0.40	
Percentage Runoff PR	78.05	
DEEPSTOR	0.45	
Cv	0.7805	
Cr	1.3	
allowable outflow		
1 year	17.28	l/s

Post Development		Return Period	flood	1	2	years	years
Rainfall Duration (hours)	Rainfall Duration (days)	Rainfall Depth (mm)	Effective Depth (mm)	Rainfall Intensity (mm/hr)	FLOW (l/s)	FLOW (l/s/ha)	
0.15	0.006	7.5	7.6	50.0	17.3	141.0	
0.25	0.010	8.22	8.3	32.9	11.4	92.7	
0.5	0.021	10.52	10.7	21.0	7.3	59.3	
0.75	0.031	12.13	12.3	16.2	5.6	45.6	
1	0.042	13.42	13.6	13.4	4.6	37.9	
1.25	0.052	14.51	14.7	11.6	4.0	32.7	
1.5	0.063	15.46	15.7	10.3	3.6	29.1	
1.75	0.073	16.31	16.5	9.3	3.2	26.3	
2	0.083	17.09	17.3	8.5	3.0	24.1	
2.25	0.094	17.8	18.1	7.9	2.7	22.3	
2.5	0.104	18.46	18.7	7.4	2.6	20.8	
2.75	0.115	19.08	19.4	6.9	2.4	19.6	
3	0.125	19.67	20.0	6.6	2.3	18.5	
3.25	0.135	20.22	20.5	6.2	2.1	17.5	
3.5	0.146	20.74	21.0	5.9	2.0	16.7	
3.75	0.156	21.24	21.6	5.7	2.0	16.0	
4	0.167	21.72	22.0	5.4	1.9	15.3	
4.25	0.177	22.18	22.5	5.2	1.8	14.7	

**Modified Rational Method**

Length (m)	42	m
Area (ha)	0.123	Ha
Max Height	89.5	mAOD
Min Height	88.4	mAOD
DeltaH	1.1	
Slope (%)	2.55	
Te (mins)	9.48	mins
ARF	0.999	
SAAR	774.000	mm
UCWI	75	mm
PIMP	100.0	%
SOIL	0.40	
Percentage Runoff PR	78.05	
DEEPSTOR	0.45	
Cv	0.7805	
Cr	1.3	
allowable outflow		
30 year	44.23	l/s

Post Development		Return Period	flood	30	50	years	years
Rainfall Duration (hours)	Rainfall Duration (days)	Rainfall Depth (mm)	Effective Depth (mm)	Rainfall Intensity (mm/hr)	FLOW (l/s)	FLOW (l/s/ha)	
0.15	0.006	19.2	21.2	125.0	44.2	361.1	
0.25	0.010	26.8	27.2	107.2	37.0	302.4	
0.5	0.021	32.34	32.8	64.7	22.3	182.4	
0.75	0.031	36.04	36.6	48.1	16.6	135.5	
1	0.042	38.9	39.5	38.9	13.4	109.7	
1.25	0.052	41.27	41.9	33.0	11.4	93.1	
1.5	0.063	43.3	43.9	28.9	10.0	81.4	
1.75	0.073	45.09	45.8	25.8	8.9	72.7	
2	0.083	46.7	47.4	23.4	8.1	65.9	
2.25	0.094	48.17	48.9	21.4	7.4	60.4	
2.5	0.104	49.51	50.2	19.8	6.8	55.9	
2.75	0.115	50.76	51.5	18.5	6.4	52.1	
3	0.125	51.93	52.7	17.3	6.0	48.8	
3.25	0.135	53.03	53.8	16.3	5.6	46.0	
3.5	0.146	54.06	54.9	15.4	5.3	43.6	
3.75	0.156	55.04	55.8	14.7	5.1	41.4	
4	0.167	55.97	56.8	14.0	4.8	39.5	
4.25	0.177	56.86	57.7	13.4	4.6	37.7	

**Modified Rational Method**

Length (m)	42	m
Area (ha)	0.123	Ha
Max Height	89.5	mAOD
Min Height	88.4	mAOD
DeltaH	1.1	
Slope (%)	2.55	
Te (mins)	9.48	mins
ARF	0.999	
SAAR	774.000	mm
UCWI	75	mm
PIMP	100.0	%
SOIL	0.40	
Percentage Runoff PR	78.05	
DEEPSTOR	0.45	
Cv	0.7805	
Cr	1.3	
allowable outflow		
100 year	73.48	l/s

Post Development		Return Period	flood	100	140	years	years
Rainfall Duration (hours)	Rainfall Duration (days)	Rainfall Depth (mm)	Effective Depth (mm)	Rainfall Intensity (mm/hr)	FLOW (l/s)	FLOW (l/s/ha)	
0.15	0.006	31.9	32.4	212.7	73.5	599.9	
0.25	0.010	37.9	38.5	151.6	52.4	427.6	
0.5	0.021	44.94	45.6	89.9	31.1	253.5	
0.75	0.031	49.58	50.3	66.1	22.8	186.5	
1	0.042	53.14	53.9	53.1	18.4	149.9	
1.25	0.052	56.06	56.9	44.8	15.5	126.5	
1.5	0.063	58.55	59.4	39.0	13.5	110.1	
1.75	0.073	60.74	61.6	34.7	12.0	97.9	
2	0.083	62.7	63.6	31.4	10.8	88.4	
2.25	0.094	64.48	65.4	28.7	9.9	80.8	
2.5	0.104	66.11	67.1	26.4	9.1	74.6	
2.75	0.115	67.62	68.6	24.6	8.5	69.4	
3	0.125	69.02	70.0	23.0	7.9	64.9	
3.25	0.135	70.34	71.4	21.6	7.5	61.0	
3.5	0.146	71.58	72.6	20.5	7.1	57.7	
3.75	0.156	72.75	73.8	19.4	6.7	54.7	
4	0.167	73.87	75.0	18.5	6.4	52.1	
4.25	0.177	74.93	76.0	17.6	6.1	49.7	

## Appendix C: - Drainage Drawings

## Appendix D: - 1 in 100 year+CC WinDes Calculation Sheets

EWE Associates Ltd		Page 1							
Windy Ridge Barn Thealby Lane Winterton DN15 9TG									
Date 18/11/2020 17:24 File 100yr+CC40%Winter...	Designed By Windows7 Checked By								
Micro Drainage		Network W.12.4							
<u>Existing Network Details for Storm</u>									
<b>FN</b>	<b>Length (m)</b>	<b>Fall (m)</b>	<b>Slope (1:X)</b>	<b>Area (ha)</b>	<b>T.E. (mins)</b>	<b>k (mm)</b>	<b>HYD SECT</b>	<b>DIA (mm)</b>	
1.000	49.000	0.100	490.0	0.184	5.00	0.600	∞	1000	
1.001	30.000	0.060	500.0	0.170	0.00	0.600	∞	1000	
1.002	10.000	0.100	100.0	0.000	0.00	0.600	o	1050	
<b>FN</b>	<b>US/MH Name</b>	<b>US/CL (m)</b>	<b>US/IL (m)</b>	<b>US C.Depth (m)</b>	<b>DS/CL (m)</b>	<b>DS/IL (m)</b>	<b>DS C.Depth (m)</b>	<b>Ctrl</b>	<b>US/MH (mm)</b>
1.000	1	89.500	86.660	1.840	88.500	86.560	0.940		2400
1.001	2	88.500	86.560	0.940	88.400	86.500	0.900		2400
1.002	3	88.400	86.500	0.850	88.200	86.400	0.750	Hydro-Brake®	1800
<u>Free Flowing Outfall Details for Storm</u>									
<b>Outfall Pipe Number</b>	<b>Outfall Name</b>	<b>C. Level (m)</b>	<b>I. Level (m)</b>	<b>Min I. Level (m)</b>	<b>D,L (mm)</b>	<b>W (mm)</b>			
1.002		88.200	86.400	86.400	0	0			
<u>Simulation Criteria for Storm</u>									
Volumetric Runoff Coeff	0.840	Foul Sewage per hectare (l/s)	0.000						
PIMP (% impervious)	100	Additional Flow - % of Total Flow	40.000						
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000						
Hot Start (mins)	0	Run Time (mins)	180						
Hot Start Level (mm)	0	Output Interval (mins)	3						
Manhole Headloss Coeff (Global)	0.500								
Number of Input Hydrographs	0	Number of Storage Structures	0						
Number of Online Controls	1	Number of Time/Area Diagrams	0						
Number of Offline Controls	0								
<u>Synthetic Rainfall Details</u>									
Rainfall Model			FEH						
Return Period (years)			100						
Site Location	418650	426150	SE	18650	26150				
C (1km)			-0.026						
D1 (1km)			0.372						
D2 (1km)			0.432						
D3 (1km)			0.280						
E (1km)			0.302						
F (1km)			2.332						
Summer Storms			No						
Winter Storms			Yes						
Cv (Summer)			0.750						
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EWE Associates Ltd		Page 2
Windy Ridge Barn Thealby Lane Winterton DN15 9TG		
Date 18/11/2020 17:24 File 100yr+CC40%Winter...	Designed By Windows7 Checked By	
Micro Drainage	Network W.12.4	
<u>Synthetic Rainfall Details</u>		
Cv (Winter) 0.840 Storm Duration (mins) 90		
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Windy Ridge Barn Thealby Lane Winterton DN15 9TG			
Date 18/11/2020 17:24	Designed By Windows7		
File 100yr+CC40%Winter...	Checked By		
Micro Drainage	Network W.12.4		
<u>Online Controls for Storm</u>			
<u>Hydro-Brake@ Manhole: 3, DS/PN: 1.002, Volume (m³): 48.7</u>			
Design Head (m)	1.800	Hydro-Brake@ Type	Md4
Invert Level (m)	86.500	Diameter (mm)	112
Design Flow (l/s)	13.1		
<b>Depth (m)</b>	<b>Flow (l/s)</b>	<b>Depth (m)</b>	<b>Flow (l/s)</b>
0.100	3.3	1.200	10.7
0.200	8.0	1.400	11.6
0.300	7.8	1.600	12.4
0.400	6.9	1.800	13.1
0.500	7.1	2.000	13.9
0.600	7.6	2.200	14.5
0.800	8.7	2.400	15.1
1.000	9.8	2.600	15.8
		3.000	16.9
		3.500	18.3
		4.000	19.6
		4.500	20.7
		5.000	21.9
		5.500	22.9
		6.000	23.9
		6.500	24.9
		7.000	25.9
		7.500	26.8
		8.000	27.6
		8.500	28.5
		9.000	29.3
		9.500	30.1
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Windy Ridge Barn Thealby Lane Winterton DN15 9TG		
Date 18/11/2020 17:24 File 100yr+CC40%Winter...	Designed By Windows7 Checked By	
Micro Drainage	Network W.12.4	
<u>Summary of Results for 90 minute 100 year Winter (Storm)</u>		
Margin for Flood Risk Warning (mm) 450.0 DVD Status OFF		
Analysis Timestep Fine Inertia Status OFF		
DTS Status ON		
	<b>Water</b>	<b>Surcharged</b>
	<b>Level</b>	<b>Depth</b>
	<b>(m)</b>	<b>(m)</b>
	<b>Flooded</b>	<b>Flow /</b>
	<b>Volume</b>	<b>Overflow</b>
	<b>(m<sup>3</sup>)</b>	<b>Flow</b>
	<b>Flow /</b>	<b>Flow</b>
	<b>Cap.</b>	<b>Flow</b>
	<b>(l/s)</b>	<b>Flow</b>
	<b>(l/s)</b>	<b>Flow</b>
	<b>(l/s)</b>	<b>Flow</b>
	<b>Status</b>	
<b>PN</b>	<b>US/MH Name</b>	<b>Status</b>
1.000	1 88.286	0.626 0.000 0.02 0.0 42.2 SURCHARGED
1.001	2 88.286	0.726 0.000 0.02 0.0 35.8 FLOOD RISK
1.002	3 88.286	0.736 0.000 0.01 0.0 13.0 FLOOD RISK
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