

APPENDIX F: TOPOGRAPHIC SURVEY

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Telephone: 01257 795111

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Notes:

The survey has been related to the Ordnance Survey datum using Leica GPS SmartNet data

Tree spreads and boles are estimated

Only features that are accessible/visible at the time of survey can be detailed

There are no gaurantees offered on the drainage information supplied.

Before commencing works please check important dimensions on-site

Should there be any discrepancies, inconsistencies, omissions or queries please contact Quickdraw Surveys Ltd as soon as possible for a resolution

Abbreviations:

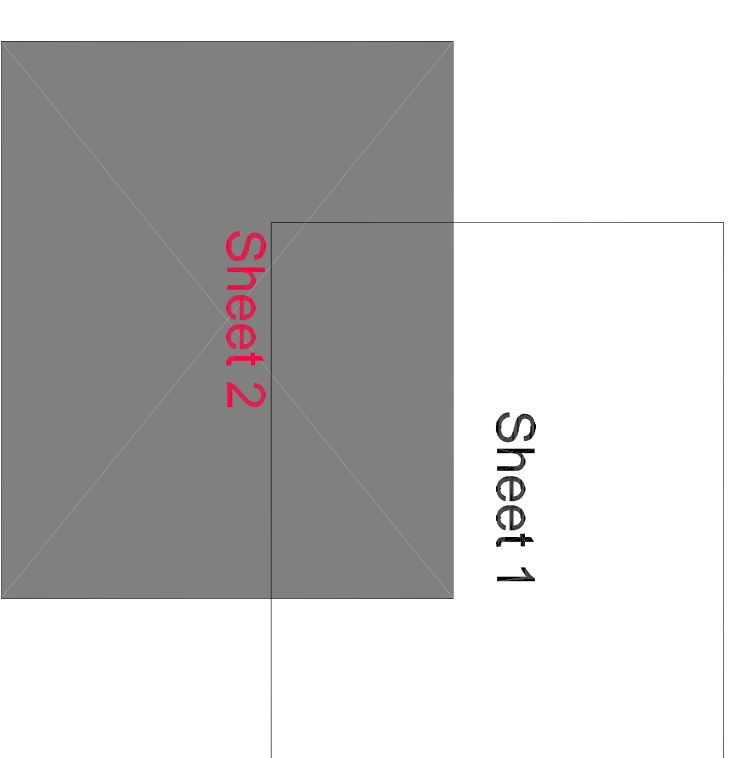
Topographical Surveys

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Station Co-ordinates

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4	37082.9	4002.3	1.4
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8	37089.0	4008.6	1.4
9	37090.0	4008.8	1.4
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Sheet Layout: Sheet 2 of 2



A0 Plot @ 1:200

Client

Dickens Property Group

Date June 2021

Topographical Survey

Brownhill Site,

Tottington, Bury.

Scale
1:200

Drawing Number	Revision
QDS / 350 / 1106 / TOP	B



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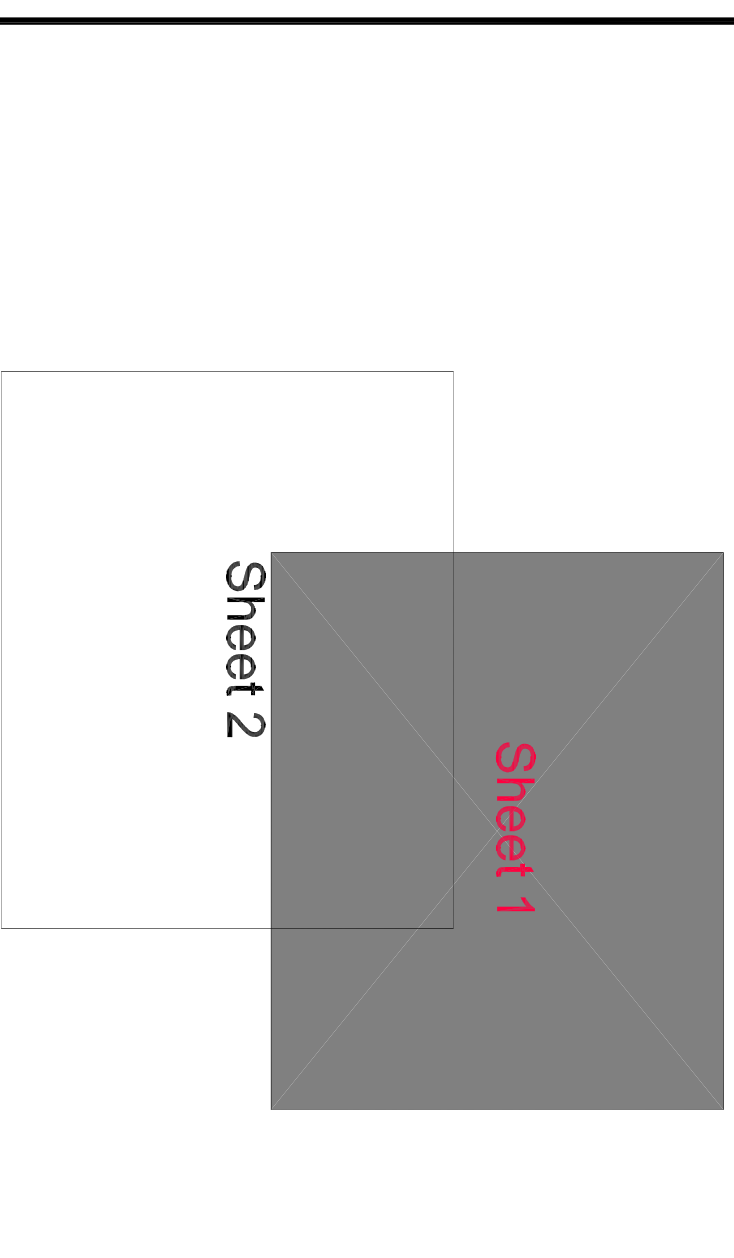
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Topographical Surveys

[illegible]

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S2N2	70.0	44.0	1.0
S2N3	70.0	44.0	1.0
S2N4	70.0	44.0	1.0
S2N5	70.0	44.0	1.0
S2N6	70.0	44.0	1.0
S2N7	70.0	44.0	1.0
S2N8	70.0	44.0	1.0
S2N9	70.0	44.0	1.0
S2N10	70.0	44.0	1.0
S2N11	70.0	44.0	1.0
S2N12	70.0	44.0	1.0
S2N13	70.0	44.0	1.0
S2N14	70.0	44.0	1.0
S2N15	70.0	44.0	1.0
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Sheet Layout: Sheet 1 of 2



A0 Plot @ 1:200

Client
Dickens Property Group

Date June 2021

Topographical Survey

Tottington, Bury.

1:200 scale

Drawing Number QDS/ 350/1106/TOP Revision B

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APPENDIX G: PROPOSED PLANNING LAYOUT

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APPENDIX H: PFRA/SFRA PLANNING EXTRACTS

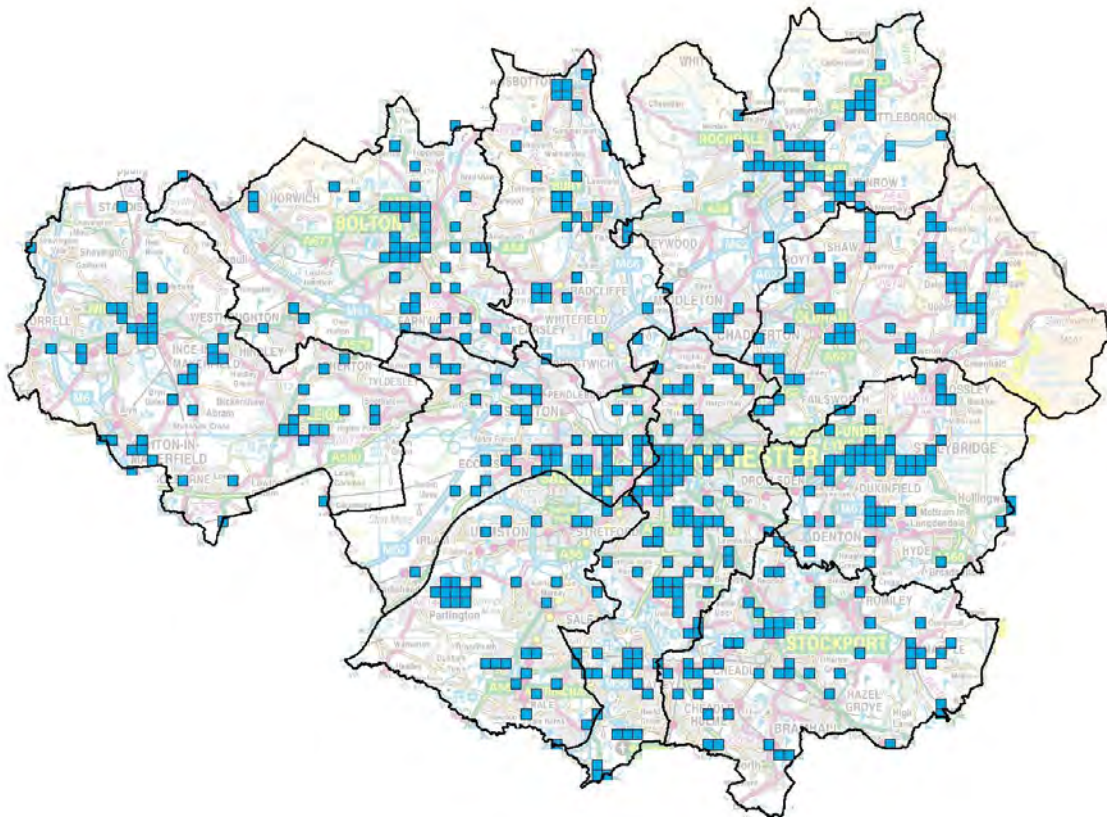
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5.6 Surface Water Flooding Hotspots - Results

5.6.1 Strategic Assessment

5,385 500m grid squares cover the ten districts of Greater Manchester. 536 grid squares meet or exceed the thresholds set in Table 4-4. Figure 5-8 illustrates the geographical spread of strategic hotspots across Greater Manchester.

Figure 5-8: Greater Manchester Strategic Hotspots



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Two points should be kept in mind when reviewing the hotspot work:

- Not all of the highlighted squares will be at flood risk. Indeed, the actual extent of flooding within a grid square may be a relatively small proportion of the whole square.
- The grid square flagging / hot-spotting process is a strategic screening process and should be used as a starting point. The numerous assumptions made throughout the process means that consistent and reliable quantification of flood risk in one square compared with another is not always present. Further assessment is always needed to confirm the nature and scale of flood risk within any grid square flagged as a hotspot. A key purpose of the analysis is to identify areas worthy of detailed assessment. The exact flood risk “score” should not be relied on in isolation.

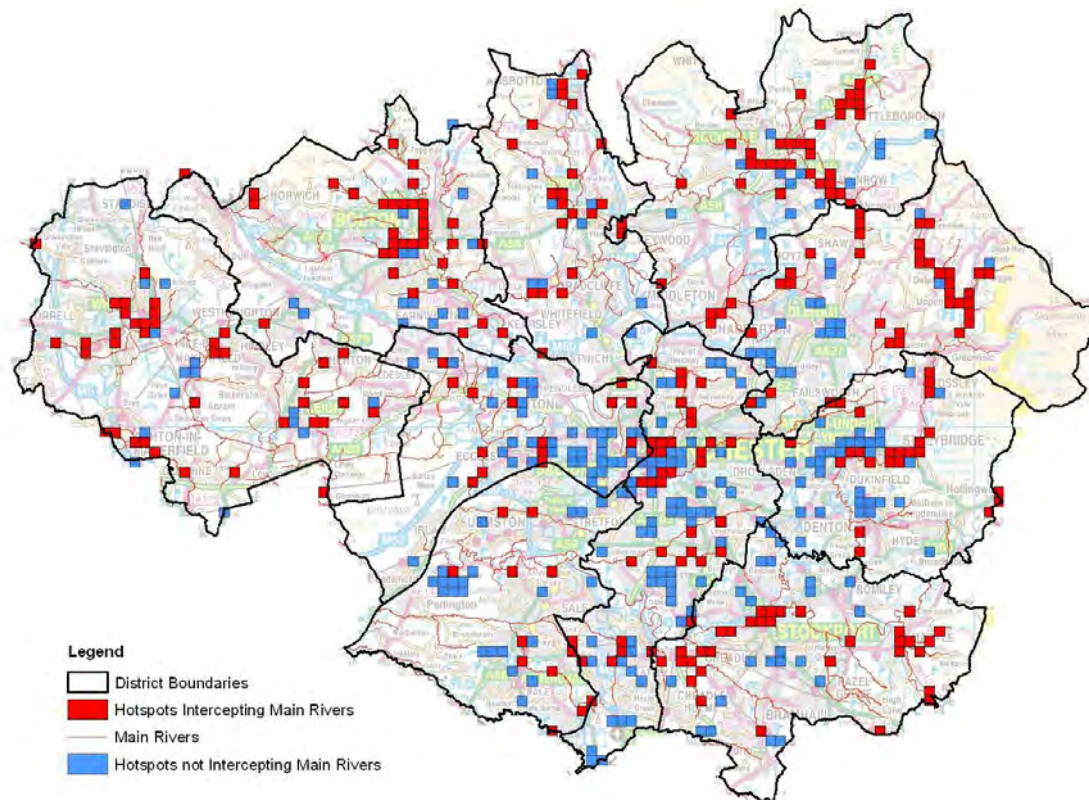
There is a geographical spread of hotspots across Greater Manchester and Table 5-2 lists the number of 500m grid squares, hotspots and percentage cover across each district.

Wigan, Rochdale, Oldham are the three largest districts by size. However, the city centre of Manchester and Salford has the largest percentage cover. Manchester has the largest number (105) of hotspots identified within its area. There are some locations, as illustrated in Figure 5-8, where hotspots are clustered together to identify much large areas including central Manchester and Salford, and outlying urban centres of Wigan, Bolton, Rochdale and

data such as depths, velocities, hazards available for each rainfall event can help with this process.

GIS analysis illustrates those hotspots that intercept with main rivers (Figure 5-9). Those hotspots that do not intercept with main rivers are more likely to be associated with surface water flooding.

Figure 5-9: Hotspots Intercepting Main Rivers



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5.6.2 Local Assessment (Hotspot Screening)

Figure 5-10 illustrates the combined risk score for each hotspot geographically (refer to Section 0 for an explanation of the methodology). It should be noted that this process is essentially a screening process that illustrates the range of risk levels across those hotspots identified.

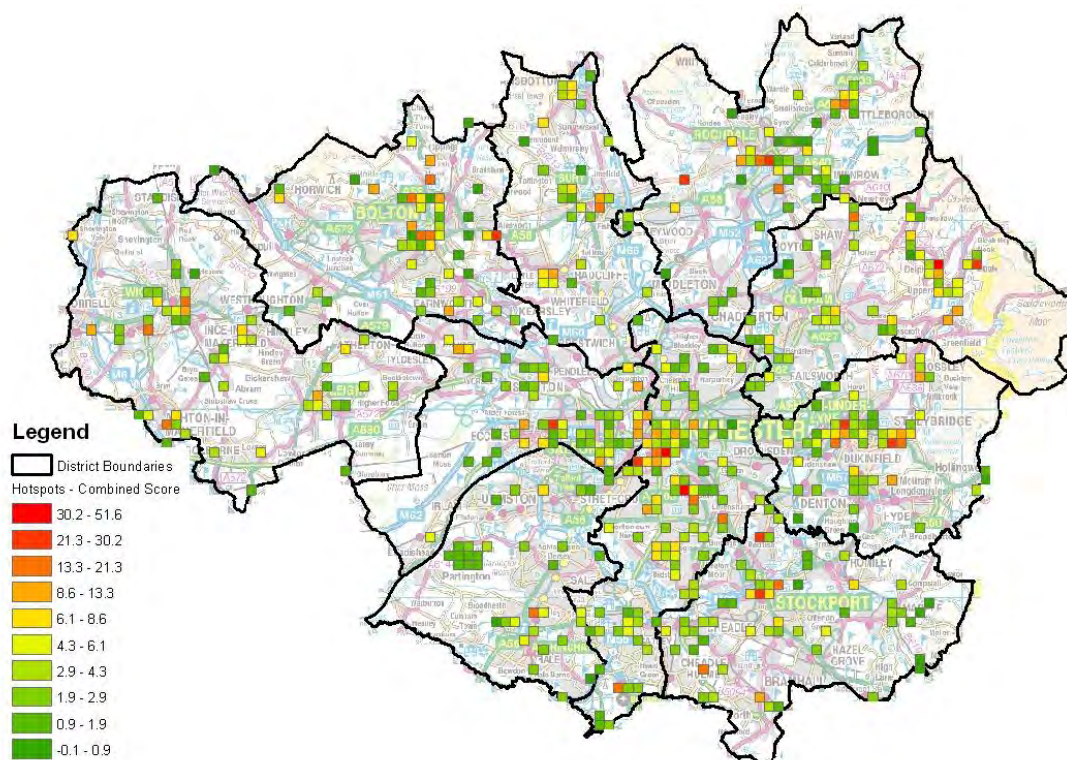
As shown in Figure 5-10, the majority of higher risk hotspots are located in and around Manchester city centre. Manchester also has a number of higher risk hotspots south of the A57 including Levenshulme, Rusholme and Wythenshawe areas.

Within the city centre, the high-risk nature of these hotspots can be attributed to the large number of residential properties identified with the surface water outlines. Within the Deansgate / Oxford Road area, there are around 1,800 residential properties at risk. This is likely to attribute to the number of apartment blocks in this area, with some blocks holding around 100 or more apartments. As a result, the local receptor dataset used could be skewing the representation of risk in the area. For instance, the majority of these apartment blocks could have car parking or commercial uses located on the ground floor, with little or no actual surface water risks to residences. But there may still be a level of impact to people if they become trapped for long periods. Conversely, if car parking or other use occupies basements of such apartment buildings then this could pose risk to the safety of people and possibly risk to life if flooded suddenly. This quick assessment shows that a local detailed analysis is required to truly understanding the nature of risk in some areas and that the strategic methodology adopted can only be used as a starting point. It is therefore also

important that end users of the SWMP data understand its limitations and stress the importance for a local interrogation of each hotspot using the receptor datasets provided.

This local level validation process is important for all hotspots, not just those within the city centre, as an understanding into the reasons why the thresholds have been exceeded is central in determining whether a hotspot represents a valid area at risk of surface water flooding, or is a result of the methodology and receptor dataset used.

Figure 5-10: Greater Manchester Strategic Hotspots - Combined Score



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5.7 Overlaps with other Flood Management Work

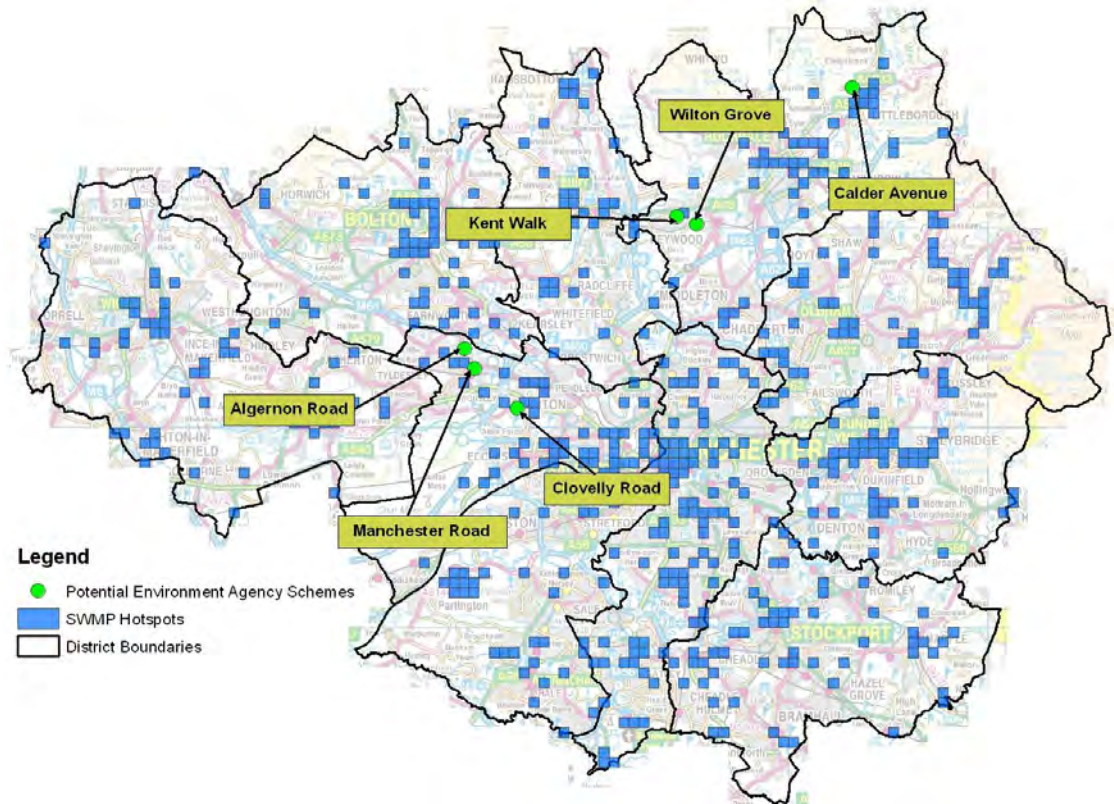
As part of the Greater Manchester SWMP, it is important to identify the full range of flood risk management projects / schemes being promoted. Whilst there will be other future funding opportunities such as FDGiA, RFCC, the key sources of information potential work is in the Environment Agency's medium term plan and United Utilities proposed AMP5 / 6 programme. The purpose of this section is to identify potential overlaps between the SWMP and such projects.

5.7.1 Environment Agency Flood Risk Management Studies and Schemes

The Environment Agency provided their Medium Term Plan 2012/13, which is a list of their capital works/bids. The document also contains details of some LLFA surface water bids for schemes. Whilst the Environment Agency has a good indication of what projects have funding, this list has not been officially approved.

Of the schemes put forward in the Environment Agency's **capital** programme bid, only the Irwell refurbishment at Salford has funding with the potential for funding for works at Littleborough. Whilst not all potential schemes have been put forward and received funding, the list of LLFA surface water bids provides a good indication of known high risk surface water problems across Greater Manchester. These problems are likely to be at the top of the local authority's priority list and therefore an opportunity presents itself, to review and potentially take forward such issues within Stage 2 of the SWMP.

Figure 5-11: Potential LLFA Schemes for inclusion in the EA Medium Term Plan



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5.7.2 United Utilities Flood Risk Management Schemes

The four United Utilities Catchment Managers that cover Greater Manchester supplied GIS files showing most of the major network capital investment schemes for their AMP5 period (2010-2015). Their AMP5 is separated between Unsatisfactory Intermittent Discharges (UIDs) and DG5s schemes.

The AMP5 UID projects aim to address combined sewer overflows, which affect water quality or the aesthetic appearance of watercourses. Whilst not directly aimed at addressing flooding, the presence of surface water in the combined sewer network is the key issue driving the need for these projects. These projects are included in the National Environment Programme and therefore have a high likelihood of going ahead.

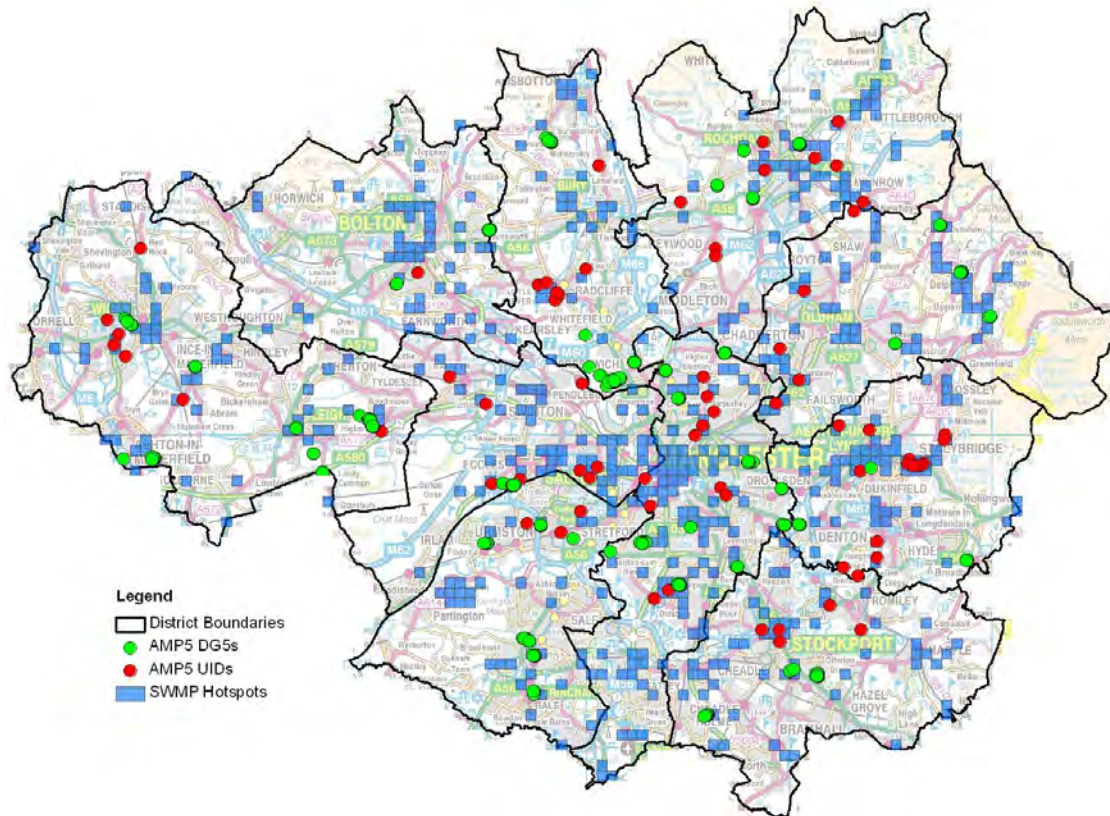
The AMP5 DG5 projects aim to address areas where the sewer network is hydraulically inadequate leading to the flooding of property. United Utilities prioritise the allocation of funds to projects to deal with flooding based on cost benefit analysis. It is only once a project is fully developed, including relevant assessment studies, that United Utilities can confirm that a flooding project will progress, as it may not be cost beneficial. Because of this, the DG5 programme is under constant review because circumstances can change over time with modelling updates so the locations provided in their AMP5 DG5 GIS files may not have future projects.

At present, United Utilities do not have an AMP6 programme developed for either flooding or unsatisfactory overflows. For the future AMP6 (2015-2020) it seems likely that Ofwat will require Water Companies to base part of their programmes on theoretical flood risk from sewers, not just past flooding recorded on the DG5 Register.

Figure 5-12 illustrates the geographical distribution of schemes across Greater Manchester compared to the location of the SWMP hotspots. There is little correlation between the two. This is because DG5 issues are often associated with local issues or problems with specific systems. However, there is a good correlation between DG5 records with both the modelled

surface water and sewer discharge extents, which cannot easily be represented at a strategic scale.

Figure 5-12: Greater Manchester AMP5 UID and DG5 Schemes



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5.7.3 Green Infrastructure and WFD

Consideration of Green Infrastructure (GI) and Water Framework Directive related measures have a clear interface with surface water management, including project partnership / funding opportunities. Identifying synergies and constraints is essential, whether it be within this SWMP or in other strategy work. A good example is the joint AGMA and Environment Agency project (August 2011 - March 2012), which is exploring and identifying where Green Infrastructure opportunities can help delivery of the Water Framework Directive (WFD). The key aims of the research are:

- To identify opportunities for GI interventions to deliver key Environment Agency environmental priorities, primarily in relation to the WFD;
- To ensure that the research identifies a series of specific interventions which could be embedded in Environment Agency strategies and programmes and that the scope of the research is restricted to identification of those projects that are likely to receive additional funding (non- Environment Agency sources) and/or involve wider partnerships in delivery;
- More specifically the research provides a key opportunity to understand and embed Environment Agency requirements emerging from the Irwell WFD Pilot (includes Irwell, Croal, Roach, Irk and Medlock catchments) particularly the use of GI to improve the ecological status and potential of water bodies.

Funding opportunities exist for such work following the announcement in April 2011 by Defra of funding to help deliver Water Framework Directive (WFD) objectives covering the four years from 2011-2015. The funding is intended for a range of projects such as habitat improvements and tackling water pollution issues. Part of this funding will be used to establish

Table 5-1: Vulnerable and Critical Infrastructure at Risk across Greater Manchester

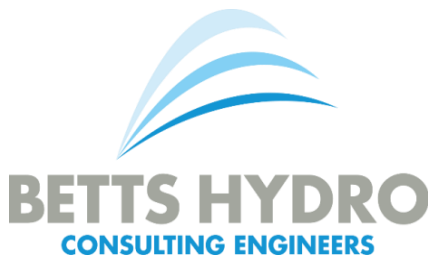
District	Source	Event	Res	Non-Res	Hospitals	Schools	Telecomm unications	Emergency Services	WwTW	Pumping Stations	Utilities	ENW Elec. Assets	Waste Sites	COMAH Sites
Bolton	Sewer Surface Water	30yr	184	310	0	0	5	0	0	0	2	0	0	0
		30yr	702	358	0	5	6	0	1	1	6	0	0	0
		200yr	1946	780	1	12	14	1	1	1	14	1	0	1
		200yr+cc	2563	970	1	13	18	1	1	1	24	2	0	1
Bury	Sewer Surface Water	30yr	939	197	1	4	0	0	0	2	7	0	0	0
		30yr	531	213	0	5	0	0	0	2	7	0	0	0
		200yr	1714	476	1	5	0	0	0	4	12	0	0	0
		200yr+cc	2266	599	1	7	0	0	0	4	20	0	0	0
Manchester	Sewer Surface Water	30yr	1394	212	3	20	1	0	0	0	2	0	0	0
		30yr	852	373	4	20	2	0	0	0	5	0	0	0
		200yr	6476	1014	5	51	6	0	0	0	25	3	0	1
		200yr+cc	9497	1441	5	61	8	0	0	0	42	4	0	1
Oldham	Sewer Surface Water	30yr	321	78	1	29	0	0	0	0	7	0	0	0
		30yr	1226	195	1	33	0	0	1	2	11	0	0	0
		200yr	2399	346	1	44	2	1	1	3	20	0	0	0
		200yr+cc	3022	437	1	47	2	1	1	3	21	0	0	0
Rochdale	Sewer Surface Water	30yr	428	176	1	3	0	0	0	0	3	0	0	1
		30yr	933	574	0	6	0	0	1	2	17	1	0	1
		200yr	1860	1105	0	8	0	0	1	4	34	1	0	1
		200yr+cc	2395	1413	0	9	0	0	1	4	41	1	0	1
Salford	Sewer Surface Water	30yr	564	118	0	22	2	0	0	1	3	0	0	1
		30yr	450	170	0	28	6	0	0	1	7	0	0	0
		200yr	2283	642	1	43	12	0	1	2	19	1	0	1

Hotspot / Project Location	Key Issue
	Canal, and the surface water drainage network. A number of the properties in the area have basements with a history of flooding.
Delph to Uppermill, Oldham	Surface water modelling results shows significant flood depths at the bottom of a steep valley surrounding the River Tame. Surface water extents do identify flow paths into the valley floor, but the dominant source of risk is likely to be from the main river itself.
Travis Brow to Carrington, Stockport	The Stage 1 surface water modelling does not show significant predicted flooding in this area, however the road network are known to flood due to the highway drainage/sewers being unable to discharge in a culverted main river.
Cheadle, Stockport	Large residential area at risk of flooding from a number of sources including Chorlton Brook (main river) and the surface water drainage network. Both surface water and sewer modelling results show significant flooding in this area.
Mossley, Tameside	Surface water modelling results shows significant flood depths at the bottom of a steep valley surrounding the River Tame, Micklehurst Brook, Staly Brook and a small reservoir. There is a history of flooding to properties from the reservoir, fed by both Brooks before discharging into the River Tame. Culvert blockage is also an issue in the area.
Ashton-under-Lyne, Tameside	Surface water modelling results shows a significant flood flow path through the town centre, which could be linked to Hurst Brook, which is a culvert ordinary watercourse. There is no known history of surface water flooding in this area.
Horwich, Bolton	The main river (Pearl Brook) runs through the town centre, which is located in a bowl surrounded by steep valley sides. There is a history of flooding to commercial and work units, attributed to a combination of both fluvial and surface water flooding.
Ainsworth Vale Works, Bolton & Bury	Surface water modelling results identifies flooding along a main river Blackshaw Brook. There is a history of Old Wood Lane flooding from overland flow and Blackshaw Brook. The flood mechanisms are linked with main river culvert and highway drainage.
Water Street, Bury	Surface water and sewer modelling results identifies large areas of flooding surrounding residential property and commercial units. Both the Environment Agency and United Utilities know of the issues in this area, attributed to drainage incapacity and interactions with watercourses and canals.
Gypsy Brook, Bury	Surface water modelling results identifies significant flooding along Gypsy Brook, not shown in the main river flood zones. There is a potential for significant consequences if such flooding occurs. There are also sections of the Brook with multiple riparian owners, which has resulted in poor maintenance.
Ramsbottom, Bury	Surface water modelling results identify runoff from rural land flowing into Ramsbottom from the east and flowing towards the River Irwell at the bottom of the valley. Surface water flooding is a known issue in the area, particularly along the A56, causing disruption to commuters. Some mitigation work has been completed but problems still exist.
Timperley Brook, Trafford	Timperley Brook is a main river that flows through a large residential area just north of Altrincham. There are known fluvial and sewer issues in the area, with the Environment Agency and United Utilities carrying out / designing flood risk management schemes. The surface water and sewer modelling results identifies large areas at risk, which coincide with historical records. Infrastructure such as the railway line

APPENDIX I: SURFACE WATER RUN-OFF CALCULATIONS

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SURFACE WATER RUN-OFF CALCULATION SHEET



Development	BROWNHILLS CLOSE, BURY		
Project No.	HYD543		

Revision	B	Completed by	MB
Date	22/06/2021	Checked by	KW

Areas			
Total Site	1.770	ha	
Development Area ¹	0.430	ha	
Existing Impermeable	0.000	ha	
Existing Impermeable ²	0.000	ha	
Existing Pervious	1.770	ha	
Existing Pervious ²	0.000	ha	
Proposed total impermeable	0.236	ha	55%

Catchment Characteristics			
SAAR	1159	mm	
SPR	0.51		
BFI	0.312		
i ₁	18.1	mm/hr	d ₁ 25.1 mm
i ₃₀	33.4	mm/hr	d ₃₀ 51.1 mm
i ₁₀₀	42.3	mm/hr	d ₁₀₀ 64.8 mm

Run-off Rates			
Pre-development			
Impermeable -----	1yr	0.0	l/s
	30yr	0.0	l/s
	100yr	0.0	l/s
	40mm/hr ³	0.0	l/s
Pervious ⁴ -----	1yr	5.3	l/s
	30yr	10.3	l/s
	100yr	12.6	l/s
	QBar ⁵	6.1	l/s
Total -----	1yr	5.3	l/s
	30yr	10.3	l/s
	100yr	12.6	l/s
Post-development (without control)			
Impermeable ⁶ -----	1yr	11.8	l/s
	30yr	21.9	l/s
	100yr+40%CC	38.9	l/s

Volumes			
Pre-development			
Impermeable -----	1yr	0.0	cu.m
	30yr	0.0	cu.m
	100yr	0.0	cu.m
Pervious ⁴ -----	1yr	50.2	cu.m
	30yr	114.8	cu.m
	100yr	153.7	cu.m
Total -----	1yr	50.2	cu.m
	30yr	114.8	cu.m
	100yr	153.7	cu.m
Post-development			
Impermeable ⁶ -----	1yr	5.9	cu.m
	30yr	12.1	cu.m
	100yr+40%CC	15.3	cu.m

Stormwater Storage Estimates					
Based on Greenfield run-off QBar					
Microdrainage Quick Storage Estimates (using FEH catchment data)					
Return Period	Rate	lower	upper	mean	
1yr	6.1 l/s	10	24	17	cu.m
30yr	6.1 l/s	43	66	54.5	cu.m
100yr+40%CC	6.1 l/s	97	141	119	cu.m

1/ The 'development area' removes areas of POS and/or landscaped areas of the wider site that are to remain as existing.
2/ On occasion the existing impermeable area cannot be evidenced to connect and a reduction is applied.
3/ 50mm/hr is used for BRegs calculations and often used by Water Companies when considering allowable post-development rates of discharge. (Rational Method)
4/ The Greenfield rates and of run-off have been calculated using the UK SUDS Calculator
5/ QBar is the estimated flood flow for the 2.33yr return period event and is often used as a post-development rate restriction.
6/ Post-development run-off is only considered from the impermeable area when the proposed post-development impermeable area >50% in accordance with the EA Guidance Preliminary rainfall runoff management for developments (W5-074/A/TR1/1 rev E (2012)).

NB. The catchment characteristics are from the FEH catchment, the UK SUDS Calculator and Microdrainage.
NB. The rainfall intensities and depths are calculated for the 6hr duration rainfall event (peak summer intensity)

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Megan Berry
Site name:	BROWNHILLS CLOSE
Site location:	BURY

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	53.60781° N
Longitude:	2.32715° W
Reference:	2816998890
Date:	Jun 24 2021 13:44

Runoff estimation approach

FEH Statistical

Site characteristics

Total site area (ha):	0.43
-----------------------	------

Methodology

Q _{MED} estimation method:	Calculate from BFI and SAAR
BFI and SPR method:	Specify BFI manually
HOST class:	N/A
BFI / BFIHOST:	0.312
Q _{MED} (l/s):	
Q _{BAR} / Q _{MED} factor:	1.08

Hydrological characteristics

	Default	Edited
SAAR (mm):	1137	1137
Hydrological region:	10	10
Growth curve factor 1 year:	0.87	0.87
Growth curve factor 30 years:	1.7	1.7
Growth curve factor 100 years:	2.08	2.08
Growth curve factor 200 years:	2.37	2.37

Notes

(1) Is $Q_{BAR} < 2.0$ l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is $SPR/SPRHOST \leq 0.3$?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Q _{BAR} (l/s):		6.07
1 in 1 year (l/s):		5.28
1 in 30 years (l/s):		10.32
1 in 100 year (l/s):		12.63
1 in 200 years (l/s):		14.39

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

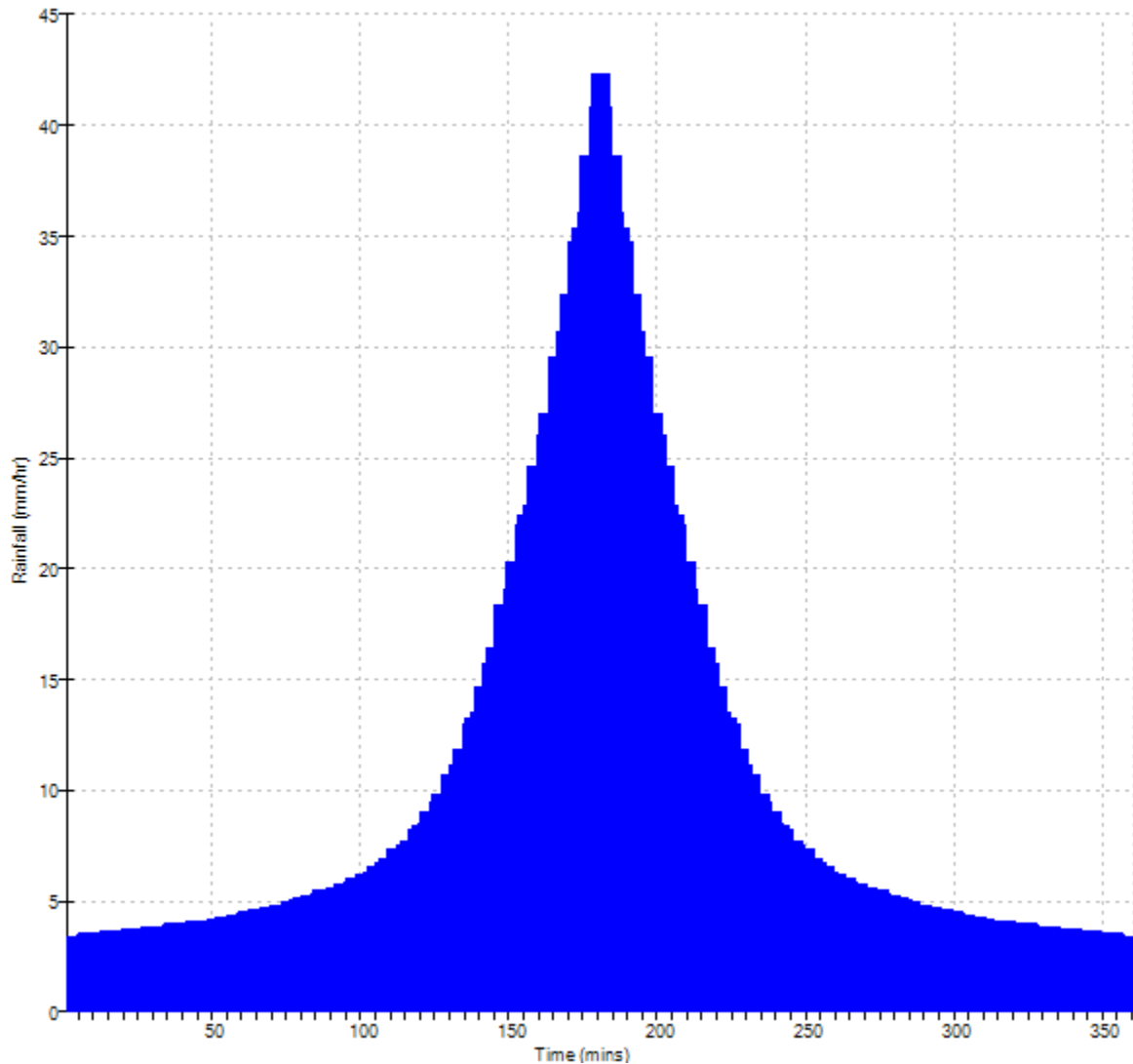
Betts Associates Ltd		Page 1
Old Marsh Farm Barns Welsh Road Sealand Flintshire CH5 2LY		
Date 22/06/2021 09:59	Designed by MeganBerry	
File	Checked by	
Micro Drainage		Network 2018.1

Rainfall profile

Storm duration (mins) 360

FEH Data

FEH Rainfall Version	2013
Site Location	GB 378411 412404 SD 78411 12404
Data Type	Point
Peak Intensity (mm/hr)	42.335
Ave. Intensity (mm/hr)	10.800
Return Period (years)	100.0



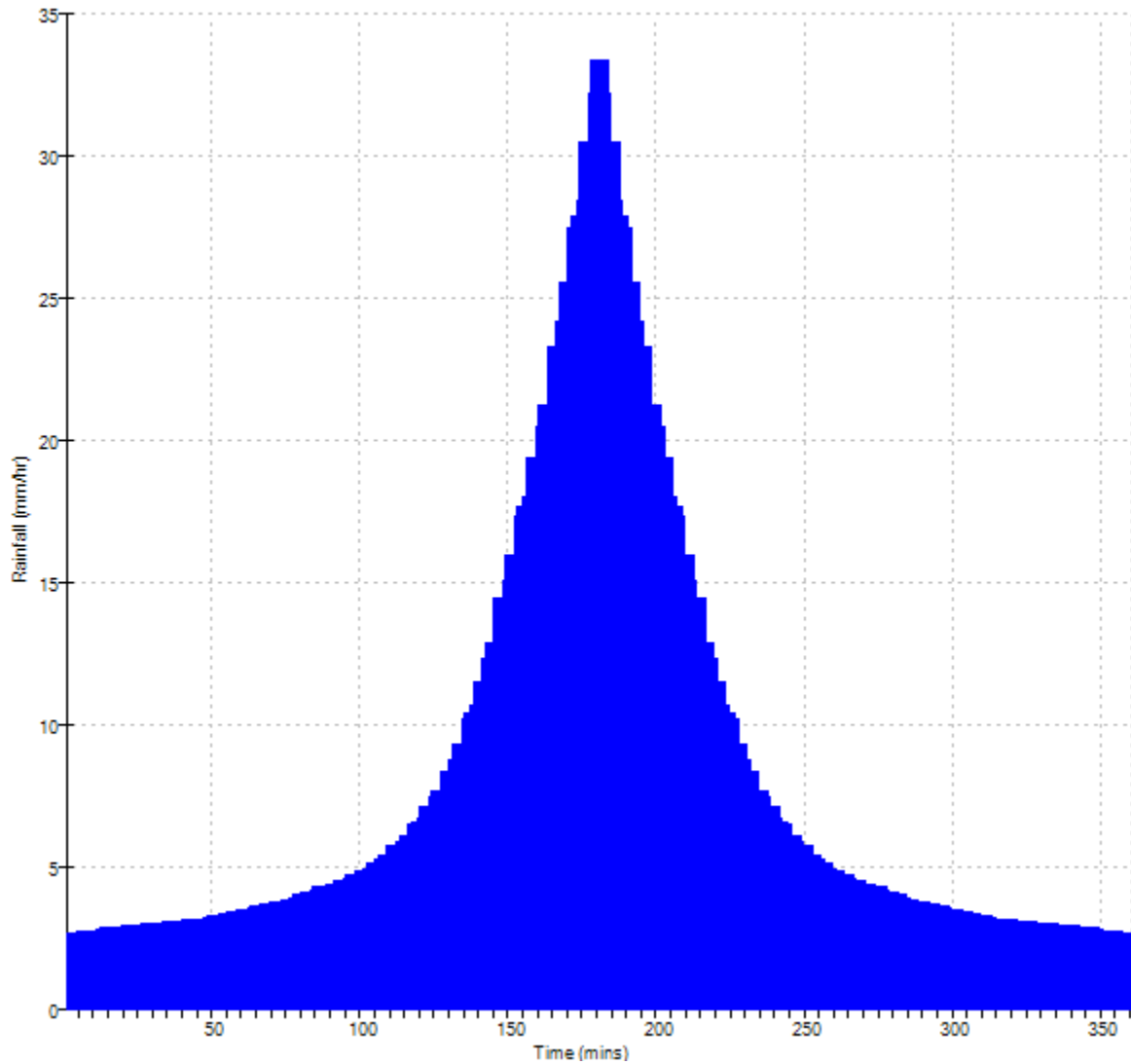
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Date 22/06/2021 09:58	Designed by MeganBerry	
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Micro Drainage		Network 2018.1

Rainfall profile

Storm duration (mins) 360

FEH Data

FEH Rainfall Version	2013
Site Location	GB 378411 412404 SD 78411 12404
Data Type	Point
Peak Intensity (mm/hr)	33.431
Ave. Intensity (mm/hr)	8.528
Return Period (years)	30.0



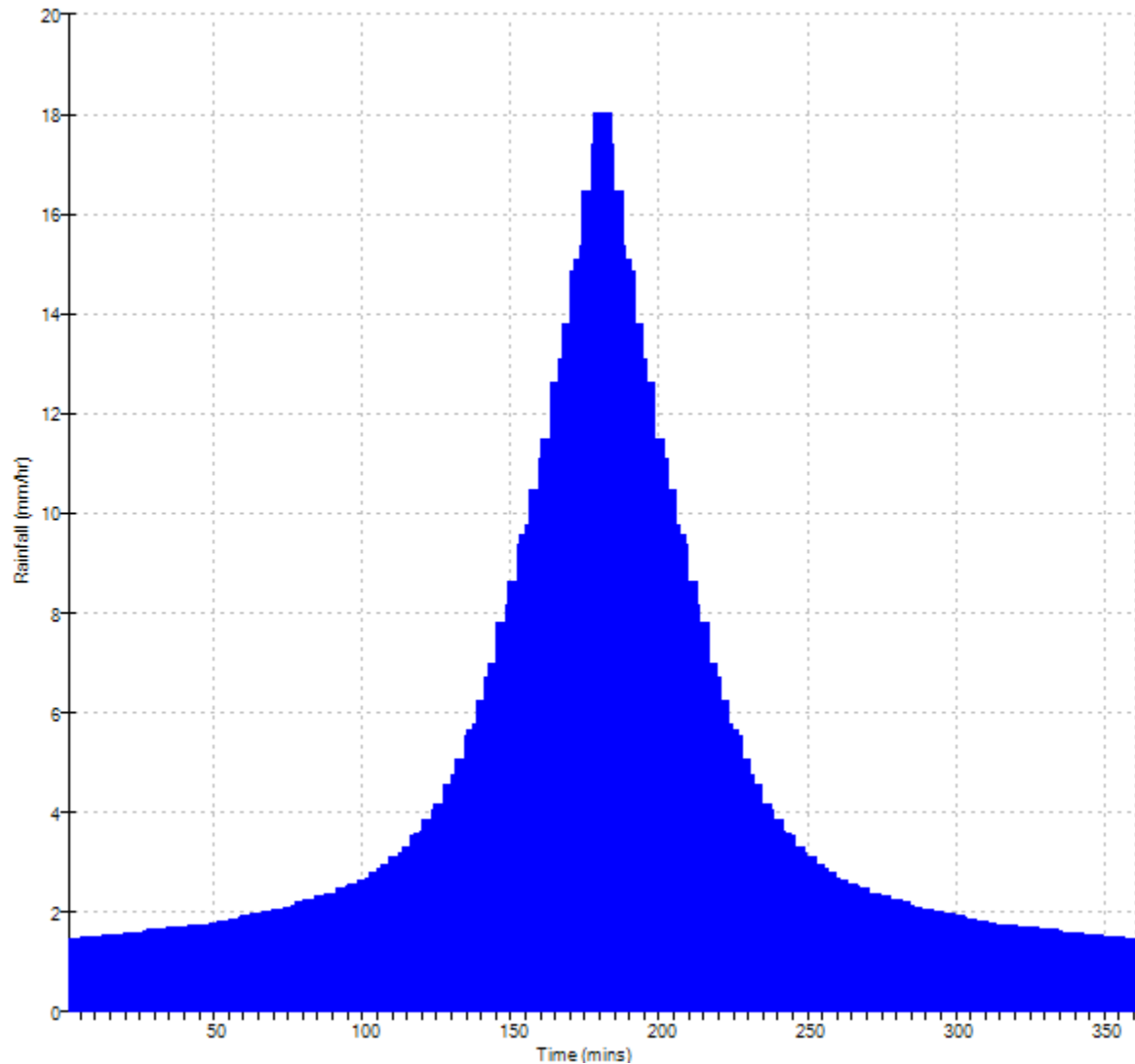
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Date 22/06/2021 09:56	Designed by MeganBerry	
File	Checked by	
Micro Drainage		Network 2018.1

Rainfall profile

Storm duration (mins) 360

FEH Data

FEH Rainfall Version	2013
Site Location GB 378411 412404 SD 78411 12404	
Data Type	Point
Peak Intensity (mm/hr)	18.058
Ave. Intensity (mm/hr)	4.607
Return Period (years)	2.0



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Date 24/06/2021 13:47 File	Designed by MeganBerry Checked by																											
Micro Drainage		Source Control 2018.1																										
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