

DRAINAGE STRATEGY REPORT

**PROPOSED RESIDENTIAL DEVELOPMENT
CALLIARDS MILL
SMITHY BRIDGE ROAD
LITTLEBOROUGH
ROCHDALE
OL15 8HP**

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Client: Hallmark Developments Ltd
Doc Ref: rep-tjba-hallmark-calliards mill-DSR-010725.docx

Revision	Date	Reason
0	Sept 2025	Original to address planning condition.
1	August 2026	Updated to include separate detention basins, LLFA & EA comments.

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1 Introduction.

1.1 Purpose of Assessment.

The primary purpose of this report is to identify drainage strategy from the proposed development. The proposal is for 9No residential dwellings.

A planning application has been submitted but no decision has been made. Presently there are no planning conditions to discharge.

The Site will be assessed in accordance with the national drainage hierarchy for surface water disposal & exceedance characteristics, also considering the proposed end adopters and their requirements.

Regarding Site assessment, this report will appraise the existing and local drainage infrastructure, assess the suitability of the proposed development, giving recommendations for drainage design & management, specifically for approval of the LLFA/EA/sewerage undertakers, as applicable.

Drainage from new developments is to be designed to follow the national drainage hierarchy for surface water discharge to the following networks in order of preference:

- infiltration.
- Watercourse.
- surface water sewer.
- combined sewer.

Flow rates (existing & proposed) are to be estimated for approval using the following methodology:

- Development should aim to deliver greenfield runoff on greenfield sites up to a 100yr rainfall event, considering climate change.
- Development should aim for a minimum reduction in surface water runoff rates of 50% for Brownfield sites on a 1yr rainfall event.
- Development should be designed so that there is no flooding to the development in a 30yr event, and so that there is no property flooding in a 100yr event considering climate change.

1.2 LLFA Consultation.

The LLFA have provided a consultation summarised as follows:

DRAINAGE & FLOOD OFFICER SUMMARY:

- | | |
|------|---|
| I. | Location of the attenuation pond within the flood zone should be reviewed. |
| II. | SuDS source controls e.g. tree pits and rain gardens should be incorporated. |
| III. | Outfall into the River Roch is to be agreed and confirmed with the Environment Agency. |
| IV. | Ground and FFLs should be reviewed. |
| V. | The above points should be addressed before the application is approved and should not be left to conditions. |

1.3 LPA Planning.

No planning comments at the time of writing.

2 Site Proposals.

See Location Plan in Appendix showing the area features.

The site is within the Smithy Bridge area of Littleborough, close to the River Roch, off Smithy Bridge Road. It is part of external areas to what remains of Calliards Mill (off site to the south east).

The River Roch is approximately 10m south. It flows NE-SW, flowing over a weir in the vicinity and approximately located halfway along the south boundary.

2.1 Site Plan.

The site is accessed off Stubley Mill Road from Smithy Bridge Road.

The historic extent of Calliards Mill was much larger than the present off-site building which remains to the present day. It comprised a larger mill building which encompassed the western half of the Application Site.

Historic mill ponds were formerly situated on the central and eastern parts of the site. They have since been infilled, and the site remained as external areas to the now off-site Calliards Mill which has been used as a residential dwelling.

The proposal is for the construction of 8No residential dwellings, associated gardens, driveways and site access. It is located to the rear of the former mill building, in an area of general vegetation. The red line boundary of the site retains a 10m buffer to the River Roch.

Refer to Proposed Plan in appendix.

2.2 Derivation of Data, Surveys and Models.

2.2.1 Existing and proposed topography.

A topographic survey has been undertaken recently c2025, noting features of the Site, levels, and contours.

The survey recorded the following levels in maOD:

Northwest corner adjacent Stubley Mill Road: 141.29.

Northeast corner adjacent Stubley Mill Road: 137.08.

West corner adjacent the extant offsite Calliards Mill: 137.25.

Southeast corner of red line boundary: 134.60

South corner of red line boundary: 135.90.

The River Roch bank is between approximately 135m aOD.

The weir central to the south boundary has a cill level of 134.39m aOD, and a toe of 133.00m aOD.

Upstream bed level is nominally 133.50m aOD.

Downstream bed level is nominally 132.30m aOD.

2.2.2 Geology.

BGS maps shows the area to be underlain by alluvium & boulder clay.

2.2.3 Drainage Surveys.

N/A – not yet undertaken.

2.2.4 Sewer Undertaker Records.

There is a 675dia combined sewer flowing northeast southwest through the site with a 4m easement either side.

There is a 150dia surface water sewer flowing nominally north to south through the centre of the site with a 3m easement either side. The SW sewer is indicated to be a 225mm sewer on plans, however – site surveys have recorded this as a 150dia sewer.

2.2.5 Site Investigations.

Site investigations have been undertaken which have recorded between 2-3m of clay MADE GROUND over the site.

Virgin CLAY was noted below this in all trial holes.

Due to the clay nature of the subsoil found, infiltration is not considered a suitable way of controlling surface water flows from the proposed development.

The site is also marshy, with a lower pond area adjacent to the watercourse.

3 Drainage Strategy.

3.1 Existing Site rainfall & drainage systems.

The site is considered greenfield for the purposes of the assessment.

Local rainfall characteristics are as follows:

M5-60 rainfall depth (mm) 	20 
'r' ratio M5-60 / M5-2day 	0.3 
FEH/FSR conversion factor 	1.12
Hydrological region 	10

DESIGN RAINFALL 1YR (THE WALLINGFORD PROCEDURE)**Design rainfall in accordance with the Wallingford Procedure**

Tedds calculation version 2.0.02

Design rainfall intensity

Location of catchment area Other
 Storm duration D = **30** min
 Return period Period = **1** yr
 Ratio 60 min to 2 day rainfall of 5 yr return period
 5-year return period rainfall of 60 minutes duration
 Increase of rainfall intensity due to global warming

$$r = \mathbf{0.300}$$

$$M5_60min = \mathbf{20.0} \text{ mm}$$

$$p_{climate} = \mathbf{0} \%$$

$$\text{Factor Z1 (Wallingford procedure)} \quad Z1 = \mathbf{0.77}$$

$$\text{Rainfall for 30min storm with 5 year return period} \quad M5_30min_i = Z1 \cdot M5_60min = \mathbf{15.4} \text{ mm}$$

$$\text{Factor Z2 (Wallingford procedure)} \quad Z2 = \mathbf{0.62}$$

$$\text{Rainfall for 30min storm with 1 year return period} \quad M1_30min = Z2 \cdot M5_30min_i = \mathbf{9.6} \text{ mm}$$

$$\text{Design rainfall intensity} \quad I_{max} = M1_30min / D = \mathbf{19.1} \text{ mm/hr}$$

DESIGN RAINFALL 30YR (THE WALLINGFORD PROCEDURE)**Design rainfall in accordance with the Wallingford Procedure**

Tedds calculation version 2.0.02

Design rainfall intensity

Location of catchment area Other
 Storm duration D = **30** min
 Return period Period = **30** yr
 Ratio 60 min to 2 day rainfall of 5 yr return period
 5-year return period rainfall of 60 minutes duration
 Increase of rainfall intensity due to global warming

$$r = \mathbf{0.300}$$

$$M5_60min = \mathbf{20.0} \text{ mm}$$

$$p_{climate} = \mathbf{0} \%$$

$$\text{Factor Z1 (Wallingford procedure)} \quad Z1 = \mathbf{0.77}$$

$$\text{Rainfall for 30min storm with 5 year return period} \quad M5_30min_i = Z1 \cdot M5_60min = \mathbf{15.4} \text{ mm}$$

$$\text{Factor Z2 (Wallingford procedure)} \quad Z2 = \mathbf{1.53}$$

$$\text{Rainfall for 30min storm with 30 year return period} \quad M30_30min = Z2 \cdot M5_30min_i = \mathbf{23.5} \text{ mm}$$

$$\text{Design rainfall intensity} \quad I_{max} = M30_30min / D = \mathbf{47.1} \text{ mm/hr}$$

DESIGN RAINFALL 100YR (THE WALLINGFORD PROCEDURE)**Design rainfall in accordance with the Wallingford Procedure**

Tedds calculation version 2.0.02

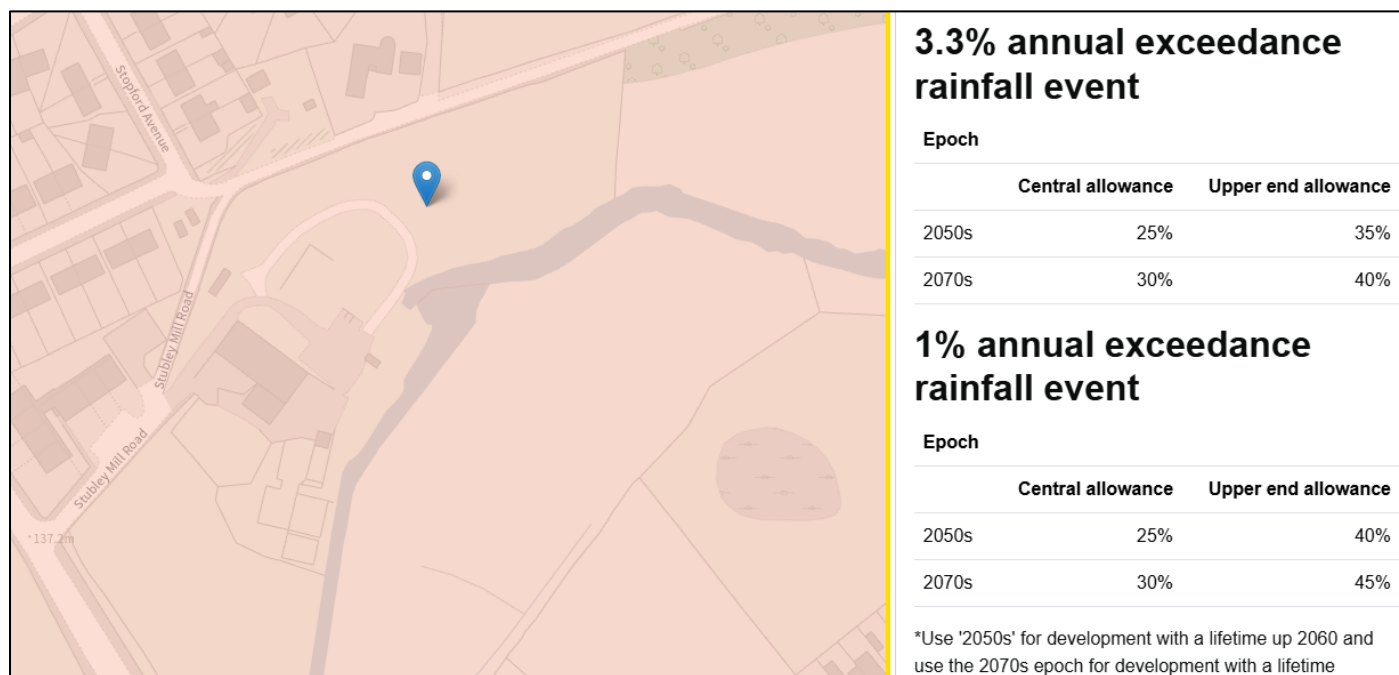
Design rainfall intensity

Location of catchment area Other

Storm duration	D = 30 min	
Return period	Period = 100 yr	
Ratio 60 min to 2 day rainfall of 5 yr return period		r = 0.300
5-year return period rainfall of 60 minutes duration		M5_60min = 20.0 mm
Increase of rainfall intensity due to global warming		p _{climate} = 0 %
	Factor Z1 (Wallingford procedure)	Z1 = 0.77
Rainfall for 30min storm with 5 year return period	M5_30min _i = Z1 ' M5_60min = 15.4 mm	
	Factor Z2 (Wallingford procedure)	Z2 = 1.99
Rainfall for 30min storm with 100 year return period	M100_30min = Z2 ' M5_30min _i = 30.7 mm	
Design rainfall intensity	I _{max} = M100_30min / D = 61.4 mm/hr	

3.2 Rainfall Climate Change Impacts.

Climate change allowances to peak rainfall intensity are given nationally across the whole of England, based upon river management catchment areas. Refer to graphic inset:



Given the proposed residential end use, the 2070s epoch is considered suitable for climate change estimation cross referenced with the upper end allowance potential; which suggests the following climate change estimations to be used:

30yr rainfalls +40% climate change allowance.

100yr rainfalls +45% climate change allowance.

3.3 Proposed Surface Water Drainage.

3.3.1 Infiltration.

BGS maps suggest the site is underlain by alluvium and boulder clay. In the local areas alluvium is generally sandy CLAY.

Site investigations recorded mixed clay lithology in all trial holes from historic infilling of both mill ponds which covered much of the site, as well as the general site area. Beneath this material, virgin CLAY has been encountered. Outside of the former pond areas, virgin CLAY was encountered at shallower depth.

Part of the site to the east and south is marshy suggesting generally impermeable ground.

Infiltration is not generally considered a suitable method of discharging surface water.

However, small external areas of the site such as patios and pathways on plot level basis may comprise permeable paving with shallow subbase storage. This will mimic and even better the greenfield flow rate of those areas by creating storing surface water in the subbase which can then permeate slowly into the ground, and which would otherwise runoff.

3.3.2 *On-site treatment & discharge to watercourse.*

Due to the available space on site for suds features, as well as the allowable levels to work within to ensure all SUDS features are above the fluvial flood zones, the site has been split into two equal areas. Each side of the site will discharge surface water to a detention basin. Both detention basins are identical in level and area, and the allowable flow rate has been split between these structures (see calcs for a single basin in the Appendix).

Prior to discharging to the detention basins, all rainwater pipes are to discharge through hydroplanters to offer additional flow and volume control.

Simulations show that the combined area of the detention basins will attenuate rainwater up to and including a 100yr+45% rainfall event, discharging at not greater than 5l/s to the River Roch. Refer to Microdrainage calculation in the Appendix which simulates a single detention basin. Both detention basins are to be the same size and level.

Refer also to the Indicative Drainage Plan in the Appendix.

3.3.3 *SW Sewer.*

Not required.

3.3.4 *Combined Sewer.*

Foul water connections only.

3.4 ***Proposed Foul Water Drainage.***

It is proposed to connect the site foul to the United Utilities combined sewer flowing through the site.

3.5 ***Adoption.***

The drainage systems drainage will remain private.

3.6 ***Maintenance & Management Plan.***

3.6.1 *Future Management.*

The site, all dwellings, and drainage systems are to remain as a private system under one ownership.

No adoption is proposed.

3.6.2 *Access.*

The detention basins and control are adjacent to the access roads, ensuring easy access for maintenance etc.

3.6.3 *Implementation Schedule for Drainage Systems, Attenuation Tanks & Silt Traps.*

IMPLEMENTATION PHASE	ACTION	REASON
Construction phase	All drainage pipes, gullies & manholes installed must be either covered, plugged or connections capped to isolate from construction SW flows.	To ensure construction debris does not enter the system while allowing general construction of the drainage system ready for plot completion.
Pre-habitation Phase	Only finished plots & associated drainage pipes, manholes & gullies may be brought online as long as they will not be subject to further construction flows & debris from upstream works.	To ensure adequate drainage of completed parts of the Site, while protecting the wider drainage system to parts of the Site still under construction from potential blockages.
Post Construction Phase	Site attenuation tank, control chamber/Hydrobrake or soakaways may only be brought online after construction of the Site has finished, and construction debris and silt entering the system is mitigated.	To ensure protection of the attenuation tank & hydrobrake, and to ensure they are not subject to SW flow overloaded with silt/debris which could damage or reduce long term storage capacity.
	All silt traps, control chambers and accessible soakaways to be checked for silt/debris, and cleaned accordingly	To ensure the system is free from silt/debris accumulation prior to sign off.

3.6.4 Operation & Maintenance Requirements for Permeable Paving.

MAINTENANCE SCHEDULE	REQUIRED ACTION	TYPICAL FREQUENCY
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphosate applied directly into the weeds by an applicator rather than spraying	As required - once per year on less frequently used pavements
Remedial actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48 h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

3.6.5 Ciria C753 Table 22.1 Operation & Maintenance Requirements for Detention Basins.

MAINTENANCE SCHEDULE	REQUIRED ACTION	TYPICAL FREQUENCY
Regular maintenance	Remove litter and debris	Monthly
	Cut grass - for spillways and access routes	Monthly (during growing season), or as required
	Cut grass - meadow grass in and around basin	Half yearly (spring - before nesting season, and autumn)
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Manage inlets, outlets and overflows for blockages, and clear if required	Monthly

	Inspect banksides, structures, pipework etc, for evidence of physical damage	Monthly
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies	Monthly (for first year), then annually or as required
	Check any penstocks and other mechanical devices	Annually
	Tidy all dead growth before start of growing season	Annually
	Remove sediment from inlets, outlet and forebay	Annually (or as required)
	Manage wetland plants in outlet pool - where provided	Annually (as set out in chapter 23)
Remedial actions	Reseed areas of poor vegetation growth	As required
	Prune and trim any trees and remove cuttings	Every 2 years, or as required
	Remove sediment from inlets, outlets, forebay and main basin when required	Every 5 years, or as required (likely to be minimal requirements where effective upstream source control is provided)
Monitoring	Repair erosion or other damage by reseedling or re-turfing	As required
	Re alignment of rip-rap	As required
	Repair/rehabilitation of inlets, outlets and overflows	As required
	Relevel uneven surfaces and reinstate design levels	As required

4 Conclusion & Residual risks.

This report should be suitable for initial planning validation.

Detailed design will be undertaken in due course.

5 Commentary on LLFA consultation.

I. Location of the attenuation pond within the flood zone should be reviewed.

Detention basins/swales added instead of an attenuation pond. These have been located outside of the flood zone.

II. SuDS source controls e.g. tree pits and rain gardens should be incorporated.

Planted detention basins/swales are located at either side of the proposed site. These are to be planted with various trees & shrubbery. Hydroplanters have been included on all RWP's.

III. Outfall into the River Roch is to be agreed and confirmed with the Environment Agency.

Environment Agency consulted on the planning application have no comments on the drainage design, only with the FRA which is being addressed.

IV. Ground and FFLs should be reviewed.

Ground levels are to remain the same with the site utilising the existing ground contours/levels. No increase in topography will occur in the flood zones below 135.51m aOD.

V. The above points should be addressed before the application is approved and should not be left to conditions.

Signed.....



D.S. Slattery BSc (Hons).

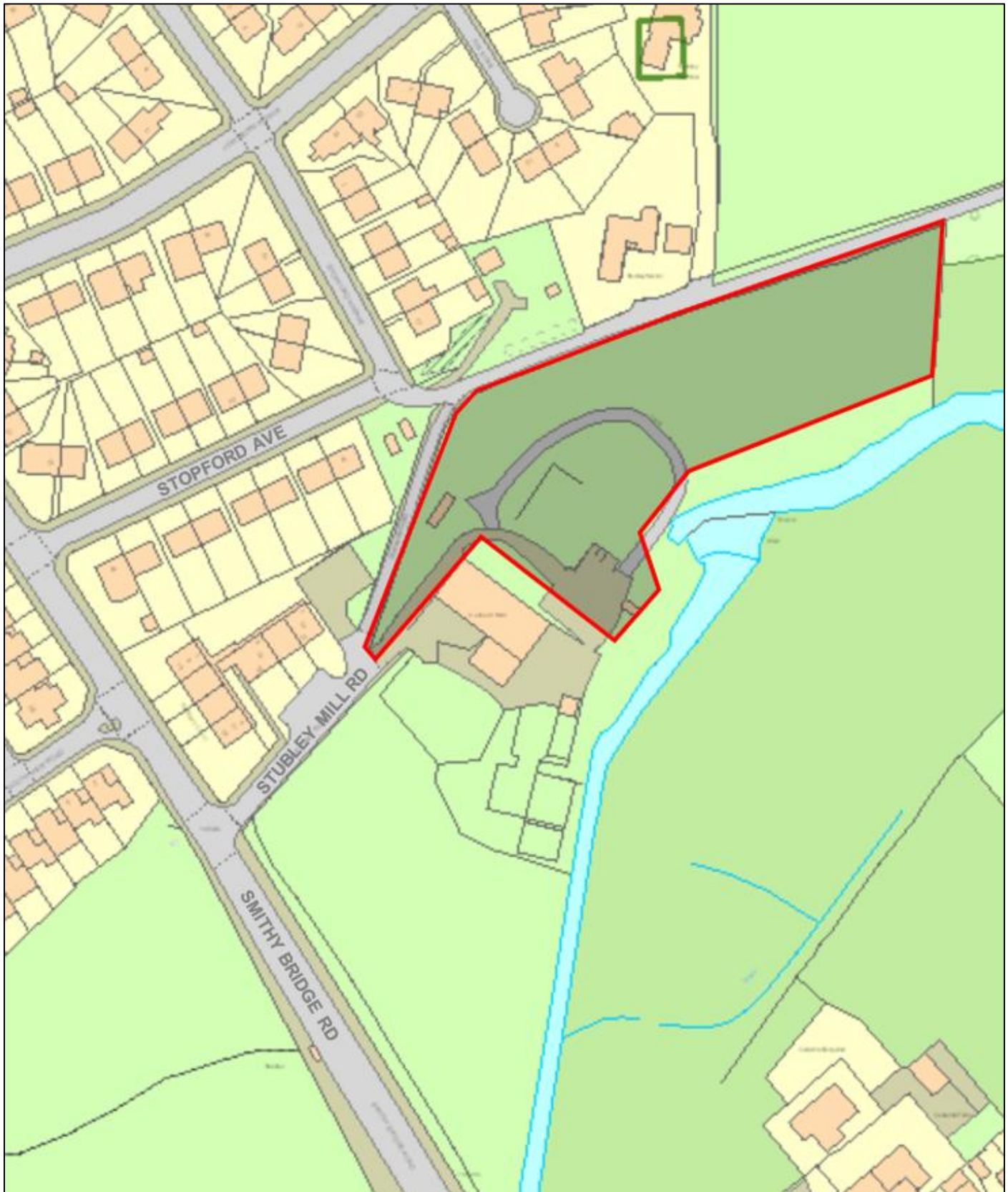
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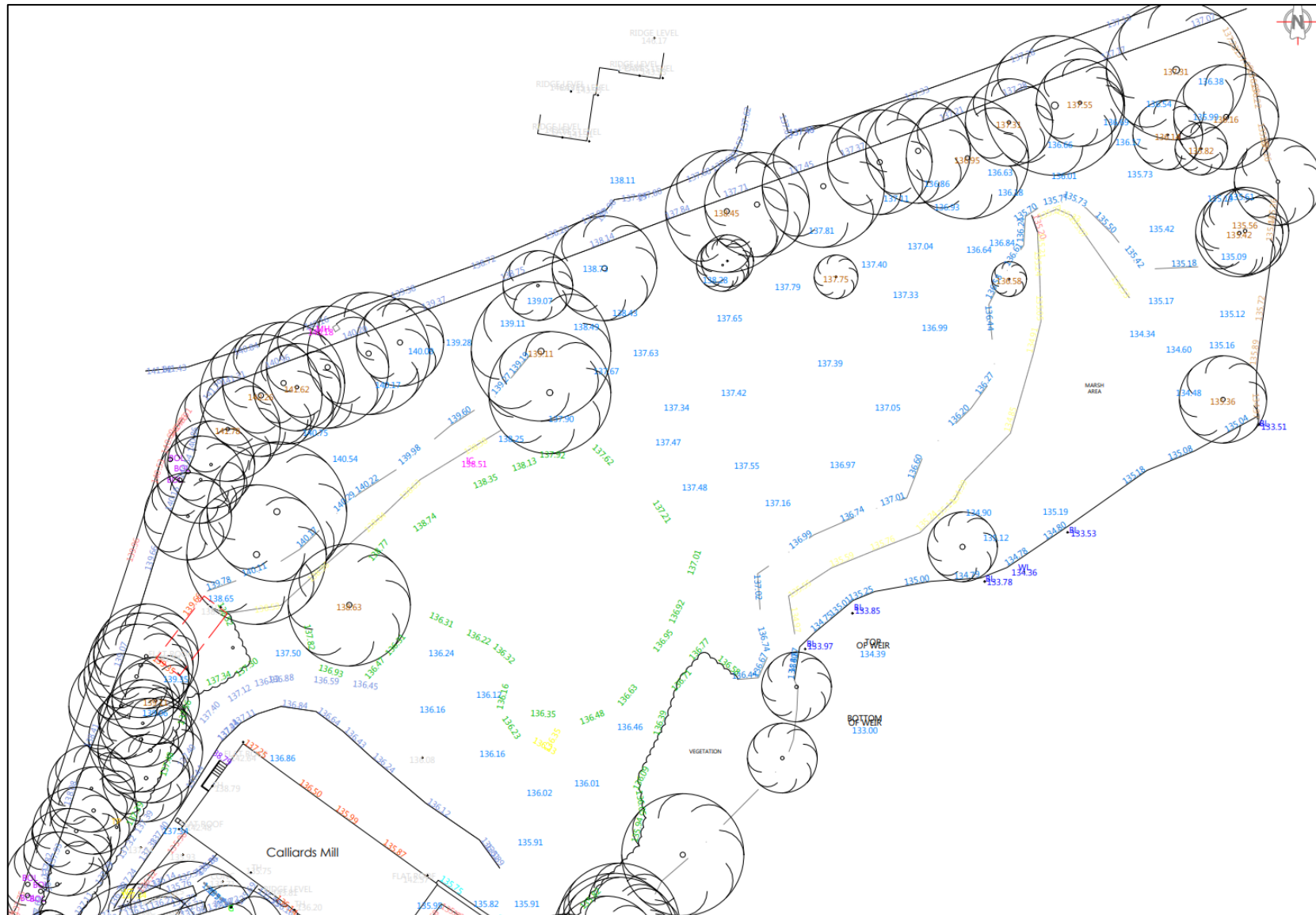


T J Booth BSc (Hons), C. Eng. C. Env. MICE.

T J Booth Associates.

6 Appendix.**6.1 Location Plan.**

6.2 Existing Plan.



6.3 Proposed Plan.



6.4 Indicative Proposed Drainage Plan



6.5 Microdrainage Calculations (single detention basin).

T J Booth Associates				Page 1		
104 Yorkshire St		detention basin				
Rochdale		hallmark				
Lancashire OL16 1JY		calliards mill				
Date july 2026		Designed By ds				
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Micro Drainage		Source Control W.10.4				
Summary of Results for 1 year Return Period						
Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
15 Summer	0.4	0.4	135.5878	0.0377	5.4	O K
30 Summer	0.6	0.6	135.5997	0.0498	7.0	O K
60 Summer	0.8	0.8	135.6107	0.0608	8.7	O K
120 Summer	0.9	0.9	135.6208	0.0708	10.1	O K
180 Summer	1.0	1.0	135.6263	0.0763	11.0	O K
240 Summer	1.0	1.0	135.6298	0.0798	11.5	O K
360 Summer	1.0	1.0	135.6328	0.0828	11.9	O K
480 Summer	1.0	1.0	135.6333	0.0833	12.0	O K
600 Summer	1.0	1.0	135.6328	0.0828	11.9	O K
720 Summer	1.0	1.0	135.6318	0.0818	11.8	O K
960 Summer	1.0	1.0	135.6288	0.0788	11.3	O K
1440 Summer	0.9	0.9	135.6223	0.0723	10.3	O K
2160 Summer	0.9	0.9	135.6143	0.0642	9.2	O K
2880 Summer	0.8	0.8	135.6093	0.0592	8.5	O K
4320 Summer	0.6	0.6	135.6022	0.0522	7.4	O K
5760 Summer	0.6	0.6	135.5973	0.0472	6.7	O K
7200 Summer	0.5	0.5	135.5938	0.0437	6.2	O K
8640 Summer	0.4	0.4	135.5912	0.0412	5.8	O K
10080 Summer	0.4	0.4	135.5888	0.0388	5.5	O K
15 Winter	0.5	0.5	135.5923	0.0422	6.0	O K
30 Winter	0.7	0.7	135.6053	0.0553	7.9	O K
60 Winter	0.9	0.9	135.6183	0.0683	9.7	O K
120 Winter	1.0	1.0	135.6288	0.0788	11.3	O K
180 Winter	1.1	1.1	135.6348	0.0848	12.2	O K
240 Winter	1.1	1.1	135.6373	0.0873	12.6	O K
360 Winter	1.1	1.1	135.6383	0.0883	12.7	O K
480 Winter	1.1	1.1	135.6367	0.0868	12.5	O K
600 Winter	1.1	1.1	135.6348	0.0848	12.2	O K
720 Winter	1.0	1.0	135.6318	0.0818	11.8	O K
960 Winter	1.0	1.0	135.6263	0.0763	11.0	O K
Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)				
15 Summer	28.17	18				
30 Summer	19.18	32				
60 Summer	12.80	60				
120 Summer	8.41	94				
180 Summer	6.56	128				
240 Summer	5.47	162				
360 Summer	4.21	230				
480 Summer	3.50	298				
600 Summer	3.03	364				
720 Summer	2.70	428				
960 Summer	2.25	558				
1440 Summer	1.73	806				
2160 Summer	1.33	1164				
2880 Summer	1.11	1528				
4320 Summer	0.85	2248				
5760 Summer	0.71	2992				
7200 Summer	0.61	3680				
8640 Summer	0.54	4408				
10080 Summer	0.49	5144				
15 Winter	28.17	18				
30 Winter	19.18	32				
60 Winter	12.80	60				
120 Winter	8.41	98				
180 Winter	6.56	136				
240 Winter	5.47	174				
360 Winter	4.21	248				
480 Winter	3.50	318				
600 Winter	3.03	386				
720 Winter	2.70	454				
960 Winter	2.25	580				
(c)1982-2006 Micro Drainage						

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Micro Drainage

detention basin
hallmark
calliards millDesigned By ds
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Source Control W.10.4

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Summary of Results for 1 year Return Period

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
1440 Winter	0.9	0.9	135.6168	0.0668	9.5	O K
2160 Winter	0.7	0.7	135.6078	0.0577	8.3	O K
2880 Winter	0.6	0.6	135.6022	0.0522	7.4	O K
4320 Winter	0.5	0.5	135.5952	0.0452	6.4	O K
5760 Winter	0.4	0.4	135.5903	0.0402	5.7	O K
7200 Winter	0.4	0.4	135.5872	0.0372	5.2	O K
8640 Winter	0.3	0.3	135.5847	0.0347	4.9	O K
10080 Winter	0.3	0.3	135.5823	0.0322	4.5	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
1440 Winter	1.73	824
2160 Winter	1.33	1192
2880 Winter	1.11	1556
4320 Winter	0.85	2252
5760 Winter	0.71	3008
7200 Winter	0.61	3744
8640 Winter	0.54	4480
10080 Winter	0.49	5144

(c)1982-2006 Micro Drainage

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Micro Drainage

detention basin
hallmark
calliards millDesigned By ds
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Source Control W.10.4

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Rainfall Details

Region	ENG+WAL	Cv (Summer)	0.750	Summer Storms	Yes
Return Period (years)	1	Cv (Winter)	0.840	Winter Storms	Yes
M5-60 (mm)	20.000	Shortest Storm (mins)	15	Climate Change %	+0
Ratio-R	0.300	Longest Storm (mins)	10080		

Time / Area Diagram

Total Area (ha) = 0.105

Time	(mins)	Area
from:	to:	(ha)
0	4	0.105

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104 Yorkshire St
Rochdale
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Micro Drainage

detention basin
hallmark
calliards millDesigned By ds
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Tank/Pond Details

Invert Level (m) 135.550 Ground Level (m) 136.050

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.00	139.0	0.50	199.0	1.00	1000.0	1.50	1000.0	2.00	1000.0	2.50	1000.0
0.10	151.0	0.60	1000.0	1.10	1000.0	1.60	1000.0	2.10	1000.0		
0.20	162.0	0.70	1000.0	1.20	1000.0	1.70	1000.0	2.20	1000.0		
0.30	174.0	0.80	1000.0	1.30	1000.0	1.80	1000.0	2.30	1000.0		
0.40	186.0	0.90	1000.0	1.40	1000.0	1.90	1000.0	2.40	1000.0		

Orifice Outflow Control

Diameter (m) 0.045 Discharge Coefficient 0.600 Invert Level (m) 135.550

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Summary of Results for 30 year Return Period (+40%)

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
15 Summer	1.4	1.4	135.6748	0.1248	18.2	O K
30 Summer	1.6	1.6	135.7133	0.1632	24.3	O K
60 Summer	1.8	1.8	135.7507	0.2007	30.2	O K
120 Summer	1.9	1.9	135.7793	0.2292	34.9	O K
180 Summer	2.0	2.0	135.7892	0.2392	36.6	O K
240 Summer	2.0	2.0	135.7948	0.2447	37.5	O K
360 Summer	2.0	2.0	135.7998	0.2497	38.4	O K
480 Summer	2.0	2.0	135.7998	0.2497	38.3	O K
600 Summer	2.0	2.0	135.7968	0.2467	37.9	O K
720 Summer	2.0	2.0	135.7928	0.2427	37.2	O K
960 Summer	1.9	1.9	135.7827	0.2327	35.5	O K
1440 Summer	1.8	1.8	135.7608	0.2107	31.9	O K
2160 Summer	1.7	1.7	135.7318	0.1817	27.2	O K
2880 Summer	1.6	1.6	135.7088	0.1587	23.5	O K
4320 Summer	1.4	1.4	135.6752	0.1253	18.4	O K
5760 Summer	1.2	1.2	135.6533	0.1033	15.0	O K
7200 Summer	1.1	1.1	135.6383	0.0882	12.7	O K
8640 Summer	1.0	1.0	135.6273	0.0772	11.1	O K
10080 Summer	0.9	0.9	135.6192	0.0692	9.9	O K
15 Winter	1.4	1.4	135.6888	0.1388	20.5	O K
30 Winter	1.7	1.7	135.7323	0.1822	27.3	O K
60 Winter	1.9	1.9	135.7742	0.2242	34.1	O K
120 Winter	2.1	2.1	135.8078	0.2577	39.7	O K
180 Winter	2.1	2.1	135.8183	0.2682	41.4	O K
240 Winter	2.1	2.1	135.8228	0.2727	42.3	O K
360 Winter	2.1	2.1	135.8257	0.2757	42.8	O K
480 Winter	2.1	2.1	135.8228	0.2727	42.2	O K
600 Winter	2.1	2.1	135.8163	0.2662	41.2	O K
720 Winter	2.1	2.1	135.8087	0.2587	39.9	O K
960 Winter	2.0	2.0	135.7917	0.2417	37.0	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	68.99	18
30 Summer	47.08	33
60 Summer	30.81	62
120 Summer	19.53	120
180 Summer	14.75	150
240 Summer	12.05	180
360 Summer	9.05	248
480 Summer	7.38	318
600 Summer	6.29	386
720 Summer	5.52	456
960 Summer	4.49	588
1440 Summer	3.35	852
2160 Summer	2.49	1232
2880 Summer	2.02	1588
4320 Summer	1.50	2332
5760 Summer	1.21	3048
7200 Summer	1.03	3752
8640 Summer	0.90	4488
10080 Summer	0.81	5144
15 Winter	68.99	18
30 Winter	47.08	32
60 Winter	30.81	60
120 Winter	19.53	116
180 Winter	14.75	168
240 Winter	12.05	190
360 Winter	9.05	268
480 Winter	7.38	344
600 Winter	6.29	418
720 Winter	5.52	492
960 Winter	4.49	634

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Summary of Results for 30 year Return Period (+40%)

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
1440 Winter	1.8	1.8	135.7588	0.2087	31.6	O K
2160 Winter	1.6	1.6	135.7182	0.1683	25.1	O K
2880 Winter	1.4	1.4	135.6888	0.1388	20.4	O K
4320 Winter	1.2	1.2	135.6508	0.1008	14.6	O K
5760 Winter	1.0	1.0	135.6288	0.0788	11.3	O K
7200 Winter	0.9	0.9	135.6158	0.0657	9.4	O K
8640 Winter	0.8	0.8	135.6098	0.0597	8.5	O K
10080 Winter	0.7	0.7	135.6053	0.0552	7.8	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
1440 Winter	3.35	898
2160 Winter	2.49	1280
2880 Winter	2.02	1648
4320 Winter	1.50	2376
5760 Winter	1.21	3056
7200 Winter	1.03	3744
8640 Winter	0.90	4408
10080 Winter	0.81	5144

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Rainfall Details

Region	ENG+WAL	Cv (Summer)	0.750	Summer Storms	Yes
Return Period (years)	30	Cv (Winter)	0.840	Winter Storms	Yes
M5-60 (mm)	20.000	Shortest Storm (mins)	15	Climate Change %	+40
Ratio-R	0.300	Longest Storm (mins)	10080		

Time / Area Diagram

Total Area (ha) = 0.105

Time from:	(mins) to:	Area (ha)
0	4	0.105

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Tank/Pond Details

Invert Level (m) 135.550 Ground Level (m) 136.050

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.00	139.0	0.50	199.0	1.00	1000.0	1.50	1000.0	2.00	1000.0	2.50	1000.0
0.10	151.0	0.60	1000.0	1.10	1000.0	1.60	1000.0	2.10	1000.0		
0.20	162.0	0.70	1000.0	1.20	1000.0	1.70	1000.0	2.20	1000.0		
0.30	174.0	0.80	1000.0	1.30	1000.0	1.80	1000.0	2.30	1000.0		
0.40	186.0	0.90	1000.0	1.40	1000.0	1.90	1000.0	2.40	1000.0		

Orifice Outflow Control

Diameter (m) 0.045 Discharge Coefficient 0.600 Invert Level (m) 135.550

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Summary of Results for 100 year Return Period (+45%)

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
15 Summer	1.6	1.6	135.7148	0.1647	24.5	O K
30 Summer	1.9	1.9	135.7677	0.2177	33.1	O K
60 Summer	2.1	2.1	135.8197	0.2697	41.7	O K
120 Summer	2.3	2.3	135.8598	0.3097	48.7	FLOOD RISK
180 Summer	2.3	2.3	135.8717	0.3217	50.7	FLOOD RISK
240 Summer	2.3	2.3	135.8777	0.3277	51.8	FLOOD RISK
360 Summer	2.4	2.4	135.8828	0.3327	52.7	FLOOD RISK
480 Summer	2.4	2.4	135.8822	0.3322	52.6	FLOOD RISK
600 Summer	2.3	2.3	135.8783	0.3282	51.9	FLOOD RISK
720 Summer	2.3	2.3	135.8732	0.3232	51.0	FLOOD RISK
960 Summer	2.3	2.3	135.8598	0.3097	48.7	FLOOD RISK
1440 Summer	2.2	2.2	135.8318	0.2817	43.8	O K
2160 Summer	2.0	2.0	135.7933	0.2432	37.3	O K
2880 Summer	1.8	1.8	135.7623	0.2122	32.2	O K
4320 Summer	1.6	1.6	135.7173	0.1672	24.9	O K
5760 Summer	1.4	1.4	135.6862	0.1363	20.1	O K
7200 Summer	1.3	1.3	135.6647	0.1148	16.7	O K
8640 Summer	1.2	1.2	135.6492	0.0993	14.4	O K
10080 Summer	1.1	1.1	135.6373	0.0872	12.6	O K
15 Winter	1.7	1.7	135.7337	0.1837	27.5	O K
30 Winter	2.0	2.0	135.7928	0.2427	37.2	O K
60 Winter	2.2	2.2	135.8503	0.3002	47.0	FLOOD RISK
120 Winter	2.4	2.4	135.8967	0.3467	55.2	FLOOD RISK
180 Winter	2.5	2.5	135.9113	0.3612	57.9	FLOOD RISK
240 Winter	2.5	2.5	135.9158	0.3657	58.6	FLOOD RISK
360 Winter	2.5	2.5	135.9193	0.3692	59.3	FLOOD RISK
480 Winter	2.5	2.5	135.9158	0.3657	58.6	FLOOD RISK
600 Winter	2.4	2.4	135.9082	0.3582	57.3	FLOOD RISK
720 Winter	2.4	2.4	135.8987	0.3487	55.6	FLOOD RISK
960 Winter	2.3	2.3	135.8777	0.3277	51.8	FLOOD RISK

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	89.23	18
30 Summer	61.54	33
60 Summer	40.51	62
120 Summer	25.63	120
180 Summer	19.23	160
240 Summer	15.63	192
360 Summer	11.65	256
480 Summer	9.44	326
600 Summer	8.01	394
720 Summer	7.00	462
960 Summer	5.65	598
1440 Summer	4.17	866
2160 Summer	3.07	1252
2880 Summer	2.46	1616
4320 Summer	1.81	2336
5760 Summer	1.45	3056
7200 Summer	1.23	3752
8640 Summer	1.07	4496
10080 Summer	0.95	5240
15 Winter	89.23	18
30 Winter	61.54	32
60 Winter	40.51	60
120 Winter	25.63	118
180 Winter	19.23	172
240 Winter	15.63	204
360 Winter	11.65	274
480 Winter	9.44	352
600 Winter	8.01	428
720 Winter	7.00	500
960 Winter	5.65	644

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Summary of Results for 100 year Return Period (+45%)

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m ³)	Status
1440 Winter	2.2	2.2	135.8353	0.2852	44.4	O K
2160 Winter	1.9	1.9	135.7823	0.2322	35.4	O K
2880 Winter	1.7	1.7	135.7413	0.1912	28.7	O K
4320 Winter	1.4	1.4	135.6873	0.1373	20.2	O K
5760 Winter	1.2	1.2	135.6553	0.1053	15.3	O K
7200 Winter	1.1	1.1	135.6348	0.0848	12.2	O K
8640 Winter	0.9	0.9	135.6217	0.0718	10.3	O K
10080 Winter	0.8	0.8	135.6133	0.0632	9.1	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
1440 Winter	4.17	922
2160 Winter	3.07	1316
2880 Winter	2.46	1676
4320 Winter	1.81	2420
5760 Winter	1.45	3112
7200 Winter	1.23	3816
8640 Winter	1.07	4496
10080 Winter	0.95	5152

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Rainfall Details

Region	ENG+WAL	Cv (Summer)	0.750	Summer Storms	Yes
Return Period (years)	100	Cv (Winter)	0.840	Winter Storms	Yes
M5-60 (mm)	20.000	Shortest Storm (mins)	15	Climate Change %	+45
Ratio-R	0.300	Longest Storm (mins)	10080		

Time / Area Diagram

Total Area (ha) = 0.105

Time	(mins)	Area
from:	to:	(ha)
0	4	0.105

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Tank/Pond Details

Invert Level (m) 135.550 Ground Level (m) 136.050

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.00	139.0	0.50	199.0	1.00	1000.0	1.50	1000.0	2.00	1000.0	2.50	1000.0
0.10	151.0	0.60	1000.0	1.10	1000.0	1.60	1000.0	2.10	1000.0		
0.20	162.0	0.70	1000.0	1.20	1000.0	1.70	1000.0	2.20	1000.0		
0.30	174.0	0.80	1000.0	1.30	1000.0	1.80	1000.0	2.30	1000.0		
0.40	186.0	0.90	1000.0	1.40	1000.0	1.90	1000.0	2.40	1000.0		

Orifice Outflow Control

Diameter (m) 0.045 Discharge Coefficient 0.600 Invert Level (m) 135.550

6.6 Microdrainage Calculations.

