Mr Trevor Brook

Bretton Mill
Haigh
Barnsley

Flood Risk Assessment
Prepared by EWE Associates Ltd
Final RevA January 2024

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CLIENT DETAILS

Mr Trevor Brook
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Bretton Mill
Haigh
Near Barnsley
S75 4BY

CONTRACT

This report describes work commissioned by Mr Trevor Brook following instruction during December 2023. Mr Trevor Brook representative for the contract was Mr Michael Townsend. Lea Favill of EWE Associates Ltd carried out the work.

Date: 2nd January 2024

Prepared by: ..... [redacted] ..... Lea Favill
Director

REVISION HISTORY

Draft Report Rev0 issued 20th December 2023 - 1No copy issued to Michael Townsend
Final Report RevA issued 2nd January 2024 - 1No copy issued to Michael Townsend

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1. INTRODUCTION

Terms of Reference

This report was commissioned by Mr Trevor Brook to support a planning application for the construction of 4 residential dwellings within an existing farm yard refereed to as Bretton Mill within Haigh near Barnsley. The location of the site is shown on Table 2-1.

The development site lies within Zone 1 of the Environment Agency Flood Map (version 2.8.2), being the zone with risk of 1 in 1,000 year (0.1% Annual Exceedance Probability) or less for river and tidal/coastal flooding. The development site is located directly to the north of existing development and is less than 1 hectare.

It is usual for the Agency to raise an objection to development applications within the floodplain or Zone 2 or 3 of the flood map until the question of flood risk has been properly evaluated. The Agency will also object to developments where the total site area is in excess of 1 hectare until suitable consideration has been given to surface water runoff.

Approach to the Assessment

As there are two sources of flood risk – River Dearne and onsite surface water runoff – it is necessary to determine flood water levels at the site for the desired return periods emanating from these sources. Consideration has also been given to the site flooding from either overland flow or ponding of localised rainfall within the site.

Wakefield Council commissioned JBA to undertake a level 1 SFRA for the area during 2016. References have been taken from the SFRA and used within this report.

The River Dearne is located directly to the south of the site and the bank top level is at least 3m lower than the existing site. The Environment Agency flood map and surface water flood map shows the site is not within the extreme flood area. It is therefore considered that the site is outside of the extreme flood area and the risk from the River Dearne is low and no further consideration has been given to this mechanism.

The proposed development will reduce the paved and roofed area within the site from 2490m² to 1462m². The roofed or paved areas within the site are supported by formalised drainage which conveys flows to the River Dearne. The existing method of draining the site will be appraised. EWE Associates Ltd have undertaken a drainage feasibility study for the proposed development.

A walk over of the site was conducted by Mr Lea Favill, a senior river engineer during December 2023; during the visit a photograph survey of the site was undertaken.

The requirements for flood risk assessments are generally as set out in National Planning Policy Framework (NPPF). The detail and complexity of the study required should be appropriate to the scale and potential impact of the development. For the purposes of this study, the following have been considered: -

- Available information on historical flooding in the area.

- Site level information.
- Details of structures, which may influence hydraulics of the watercourse and consideration of the effect of blockage of structures.
- Estimates of design levels, equivalent to a 200-year (coastal/tidal) and a 100-year (fluvial) return period flood event.
- Allowances for increased flows resulting from the effects of climate change.
- Allowances for sea level rise resulting from the effects of climate change.

Assess the existing runoff characteristics and the potential impact the proposed development will have on the runoff.

Further guidance is also provided in the CIRIA Research Project 624 “Development and Flood Risk: Guidance for the Construction Industry”.

Application of Sequential & Exceptions Test

The development site lies within Zone 1 of the Environment Agency Flood Map (version 2.8.2), being the zone with risk of 1 in 1,000 year (0.1% AEP) or less for river and tidal/coastal flooding. The proposed development is residential, as such considered to be more vulnerable.

Table 1-1: Flood Risk Vulnerability and Flood Zone 'Compatibility'

Flood Risk Vulnerability classification		Essential Infrastructure	Water compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone	Zone 1					
	Zone 2			Exception Test required		
	Zone 3a	Exception Test required		×	**Exception Test required**	
	Zone 3b	Exception Test required		×	×	×

Development is appropriate

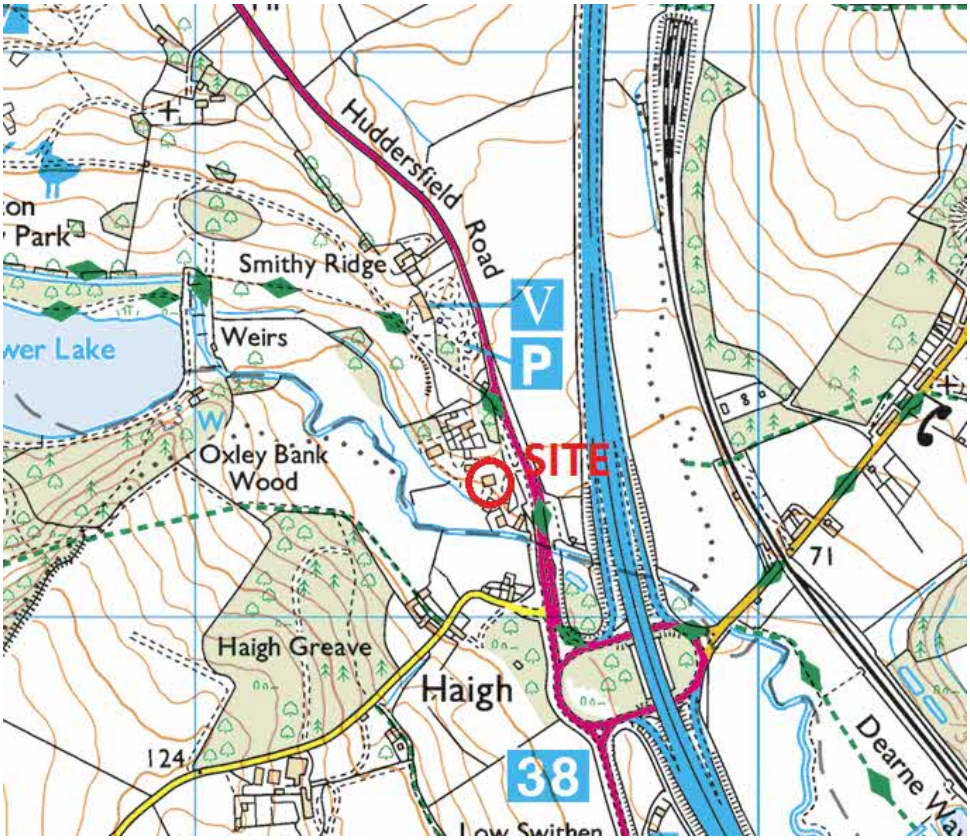
× Development should not be permitted

It is considered therefore, that a sequential test and exceptions test will not be required for this development project.

2. DETAILS OF THE SITE

Site Location

Table 2-1: Location Plan



Site Details

Table 2-2: Site Details

Site Name	Bretton Mill Haigh
Existing Land Use	Agricultural Buildings/Yard
Proposed Development	Residential
Grid Reference	SE 29520 12240
County	South Yorkshire
Local Planning Authority	Wakefield Council
Internal Drainage Board	Not Applicable
Others	Not Applicable
Post Code	S75 4BY

Site Description

The proposed development site is currently agricultural yard with several buildings. The existing buildings and paved areas within the site are formally drained to the River Dearne. An aerial photograph of the existing site is provided below.

The total site covers an area of 3200m². The existing roofed and paved area has been estimated at 2490m². The land within the site boundary lies at a level of between 73mOD up to 76mOD.

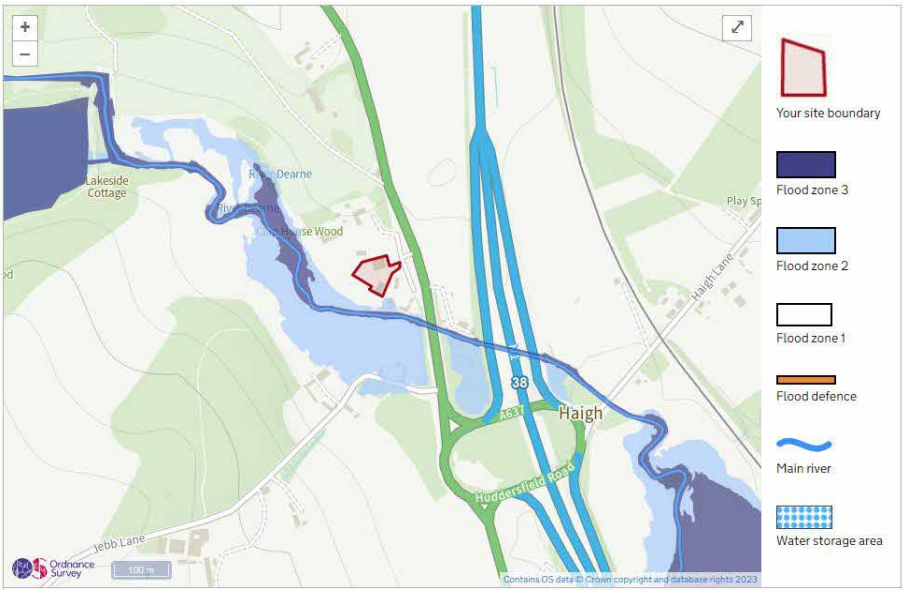
The site is located within the centre of Haigh which is to the north west of Barnsley and to the south west of Wakefield. There is existing development to all sides of the proposed development site and Huddersfield Road is to the east.

The proposal is to provide 4 residential dwellings which includes parking areas and an access road. The impermeable area within the proposed development site has been estimated at 1462m² and includes roofed areas and access roads. The proposed masterplan is provided at Appendix B of this report.

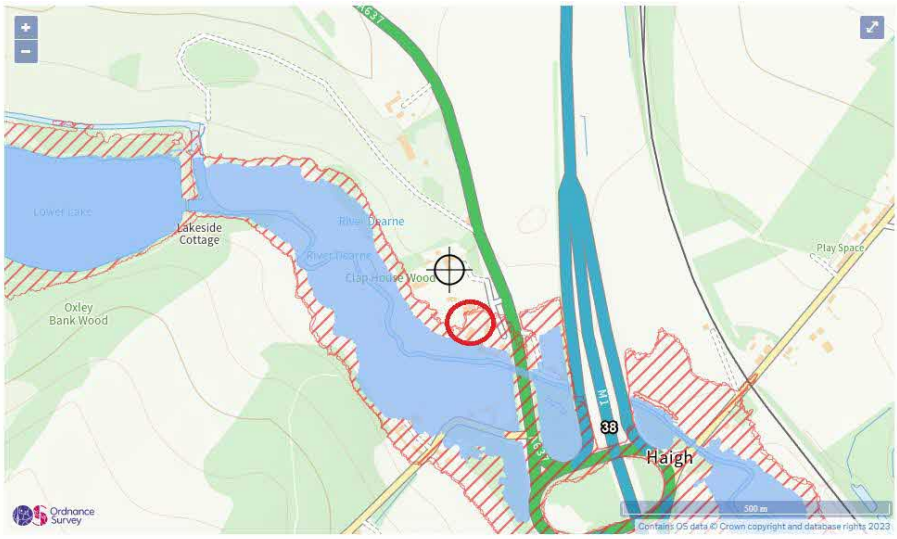
Site Photographs

3. INITIAL ASSESSMENT

Environment Agency Flood Map



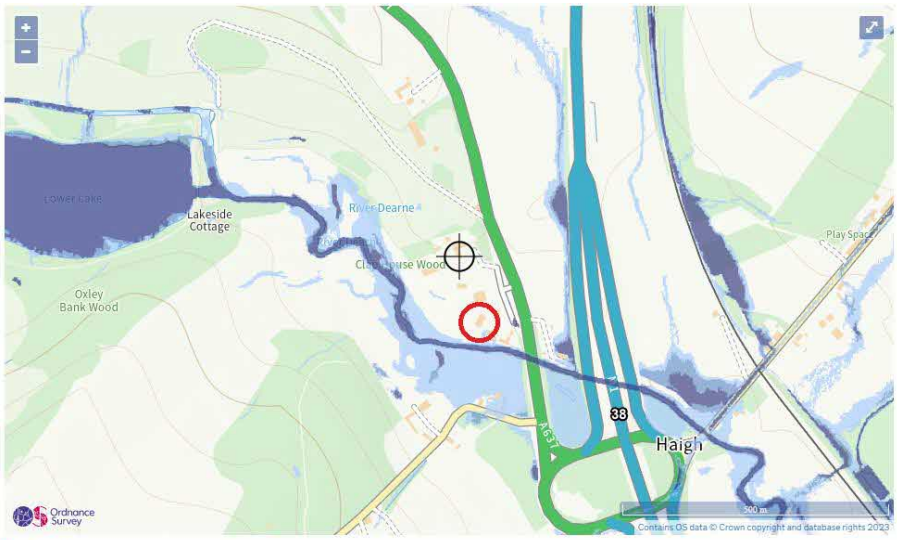
Environment Agency Reservoir Flood Map



Maximum extent of flooding from reservoirs:

when river levels are normal | when there is also flooding from rivers | Location you selected

Environment Agency Surface Water Flood Map



Past Flooding History

A search on the British Hydrological Society Chronology of British Hydrological Events website[1] found no records of past flooding within the site.

Undertaking an internet-based search for flooding in the area provided no further information.

SFRA Flooding History

The SFRA contained no references to the site being flooded.

Environment Agency Flooding History

The Environment Agency provided no further information.

Environment Agency Reservoir Flood Risk

The Environment Agency reservoir risk map shows that the site to be located just outside an area which could be affected by a reservoir failure. However, if the failure occurs during an extreme event within the River Dearne the site could be affected. The area appears to be at risk from the Lower Lake which is to the west utilising the River Dearne as a flood route conduit to the site. The reservoir flood map shows the consequences of a full breach of the dam structure with the reservoir at full capacity, as such a worst-case scenario. However, the flood maps do not consider the

1 http://www.dundee.ac.uk/geography/cbhe/

probability of such a failure. Following discussions with Yorkshire Water who are responsible for reservoirs it was commented that the probability of failure is low as the reservoir is inspected and maintained in accordance with the Reservoirs Act. As such the dam is regularly inspected for defects and any necessary works undertaken prior to a failure. As such the probability of a failure is extremely low.

Environment Agency Surface Water Flood Risk

The Environment Agency surface water risk map that the site is within a very low risk area. There is some shallow ponding within the River Dearne to the south, however, this will not impact on the proposed development.

Overland Flow & Ponding

There is higher ground to the north which is likely to flood route towards the site into the watercourse to the south. There are no depressed areas within the site which could encourage ponding, therefore, this flood mechanism has not been considered further.

Groundwater Flooding

Information on groundwater flooding is limited within the area. The SFRA makes no comment regards the potential for ground water flooding in the district. The site is underlain with permeable soils allowing good infiltration. As such, the risk of high ground water levels are considered to be low.

Sewer Flooding

Yorkshire Water is the statutory water undertaker and is responsible for the public sewer systems within the area. Yorkshire Water maintains a register of historical sewer flooding events (DG5 Register) within the area. There are no reported incidents close to the site. The SFRA provided no further information.

Possible Flooding Mechanisms

As there is a single remaining source of flood risk – onsite runoff– it is necessary to determine flood water levels at the site for the desired return periods emanating from this source.

The proposed development will reduce the impermeable area within the site; however, consideration will need to be given to the existing drainage route and the drainage characteristics in order to evaluate the impact that surface water runoff from the site will have on the site and elsewhere.

4. FLOOD RISK ASSESSMENT

Requirements of the Environment Agency

The Environment Agency, as part of its development control procedures, generally require finished floor levels to be set above the 1% AEP plus climate change flood water level at the site. The development is residential in nature, as such, it is considered that access and egress from the development site will be essential during times of extreme floods.

Increase in Surface Water Runoff due to Development

Existing Drainage

The existing site is approximately 3200m² in area and is agricultural yard and buildings that appears to be supported by any formalised drainage which discharges to the adjacent River Dearne. The existing buildings and paved areas within the site equate to 2490m².

There is a disused mill race which runs through the site and the River Dearne to the south. There are no surface water or combined sewer within close proximity of the site either.

Based on previous work in the area and the soil maps the site is assumed to be of a low permeability as such infiltration drainage is unlikely to be a practical option for the development. Using the Modified Rational brownfield runoff estimation method a 1 year runoff rate of 28.6l/s has been estimated. The calculation sheet is provided at Appendix D of this report. Adopting a 30% reduction for betterment provides a discharge restriction of 20l/s.

Catchment Area

The catchment area was calculated from proposed layout drawing provide by the architect. The total impermeable area has been estimated at 1462m².

Drainage Strategy

The proposed drainage strategy is as follows and is illustrated on the drainage layout drawing provided at Appendix C of this report.

> Individual parking areas and access roads will be supported by shallow permeable paving which will be connected to a tradition piped system. The piped drainage will discharge into a crate tank located within the lower part of the site with a discharge to the adjacent River Dearne. All attenuation systems will be designed up to and including 1 in 100 year plus climate change 40% event.

All roof drainage will be linked into the adjacent drainage system.

Proposed Surface Water Drainage – Pond

The dwellings, parking areas and access road will have a total impermeable area of 1462m². The surface water drainage will discharge into a 0.8m deep crate tank. Primary water quality treatment will be provided within the permeable paving.

An assessment of the required balance volume for the areas has been made using the estimated post development impermeable areas for each of the sub catchments. Using WinDes Source Control software developed by Microdrainage the required attenuation has been calculated for the 1 in 100 year plus climate change (40%) event based on a discharge rate of 20l/s.

The outputs from calculations using the WinDes Source Control Software developed by Micro Drainage is provided at Appendix E of this report.

Table 2-1: Size of Infiltration Devices for 100yr+CC40% event

Area	Size of storage Device (m)
Dwellings and access road - Maximum drained area = 1462m²	Crate tank 52m2 by 0.8m deep Peak volume of 44.1m3 required

Sustainable Urban Drainage

The Environment Agency requires that adequate pollution control is incorporated into the proposed drainage system in order to prevent deterioration of the quality of the water environment. However, this is only applicable for surface water originating from access roads and communal parking areas, which needs to be passed through a petrol/oil interceptor or equivalent system prior to discharge into the existing surface water sewer or infiltration system. It is noted however, that this will not apply to surface water originating from roof drainage.

To reduce the impact of surface water runoff from the development in accordance with the requirements of the Environment Agency and Local Authority, the employment of SUDS techniques to limit runoff volumes and rates from the site are recommended. SUDS techniques can also be used to provide an appropriate level of treatment to the runoff.

It is normal practice to ensure that the 1 in 30 year event is maintained within the drainage system and the 1 in 100 year is permitted to flood the surface as long as there is no flooding to buildings and the flood volume is contained within the site boundary in specific areas proposed for this purpose.

The following section will provide some possible SUDS techniques which could be employed on the site to balance flows in excess of the 1 in 30 year event. SUDS techniques will also provide treatment to the runoff to remove a proportion of the pollution and protect the quality of the downstream watercourses. Following guidance from CIRIA Report C522 the following levels of treatment will be provided:

- Roofs – 1 level
- Driveways – 1 level

- Roads and communal parking areas – 2 levels.

The level of treatment indicates the number of SUDS techniques that will be used to treat pollution. For example if two levels are required the runoff may enter a filter drain that leads to a basin or pond before outfall. It is recommended that source control techniques are used. In practice there will be little outflow from these techniques for a 1 in 2 year storm as most of the rainfall will be held within the system and will disperse via evapotranspiration. Further detail of the potential to use SUDS within this site it provided overleaf within Table 4-1. The precise combination of methods used will be dependent upon the site constraints identified at the final design stage.

Initial data suggests that the site is underlain by an impermeable layer which is unlikely to allow infiltration at a reasonable rate therefore making infiltration drainage impractical.

The impermeable area within the site has been estimated at 1462m² following development. It is considered that the site currently drains to the River Dearne to the south.

The development site is considered to be small with limited space set aside, in which to incorporate appropriate SUDs techniques. As such, the following SUDS techniques shown below in Table 4-1 have been considered for use at this site.

Table 4-1: SUDS Techniques

SUDs Group	Suitability for Proposed Development
Retention	×
Wetland	×
Infiltration	×
Filtration	×
Detention	×
Open Channel	×
Source Control	**Permeable paving to parking and access roads**

5. FOUL DRAINAGE

Existing Foul Drainage

There are no foul sewers within the development site or close by which are accessible. Adjacent developments use septic tanks and package treatment plants with outfalls to the adjacent river. The sewer plan is provided at Appendix G.

Proposed Foul Drainage

Consideration should be given to a package treatment plant with a discharge to the watercourse.

6. ADOPTION & MAINTENACE

Adoption & Maintenance

The piped drainage system, crate tank and permeable paving within the site will be the responsibility of the private land owner.

Management Company Details

Mr Trevor Brook

Construction

The Proposed drainage system is simple in design however, its construction is essential to ensure that the system functions as it has been designed. As such it is recommended that construction inspection check list is adopted during the construction phase of the works to ensure that the drainage system is correctly installed. The inspection checklist is provided at Appendix F of this report and has been taken from the CIRIA Sustainable Drainage Systems Manual.

Crate Tank Maintenance

Following construction regular inspection is recommended. The main concern is to reduce the level of siltation and vegetation within the bed of the tank. It is recommended that this tank is inspected on a 6 monthly basis and the tank is cleared once a year. A log book should be completed which will show the inspection and maintenance history of the system. The log book, site plan and construction check list should form maintenance manual for the system.

The maintenance plan has been tabulated below and will be the responsibility of the appointed management company.

Maintenance Schedule	Required action	Frequency
Monitoring	Inspect tank for debris, siltation and vegetation build-up.	6 Monthly
	Inspect outlet structures	6 monthly
	Inspect tank for deformation	6 monthly
Regular Maintenance	Debris removal from tank bed and manholes	6 Monthly
	Remove silt and vegetation from tank	12 Monthly
Occasional Maintenance	Repairs to manholes and tank	12 monthly
Remedial actions	Repair deformation of topsoil once settlement stopped	As required
	Repair deformation of areas adjacent to manholes once settlement stopped	As required

7. MITIGATION MEASURES

Raising Floor Levels/Land Raising

The flood risk from tidal, fluvial, and ordinary watercourses is considered to be low. Ground floor levels of any buildings should be elevated a minimum of 150mm above the external ground level to reduce risk of localised flooding.

Emergency Access & Egress

It is considered that dry access and egress will be available at all times from the development.

Control of Runoff

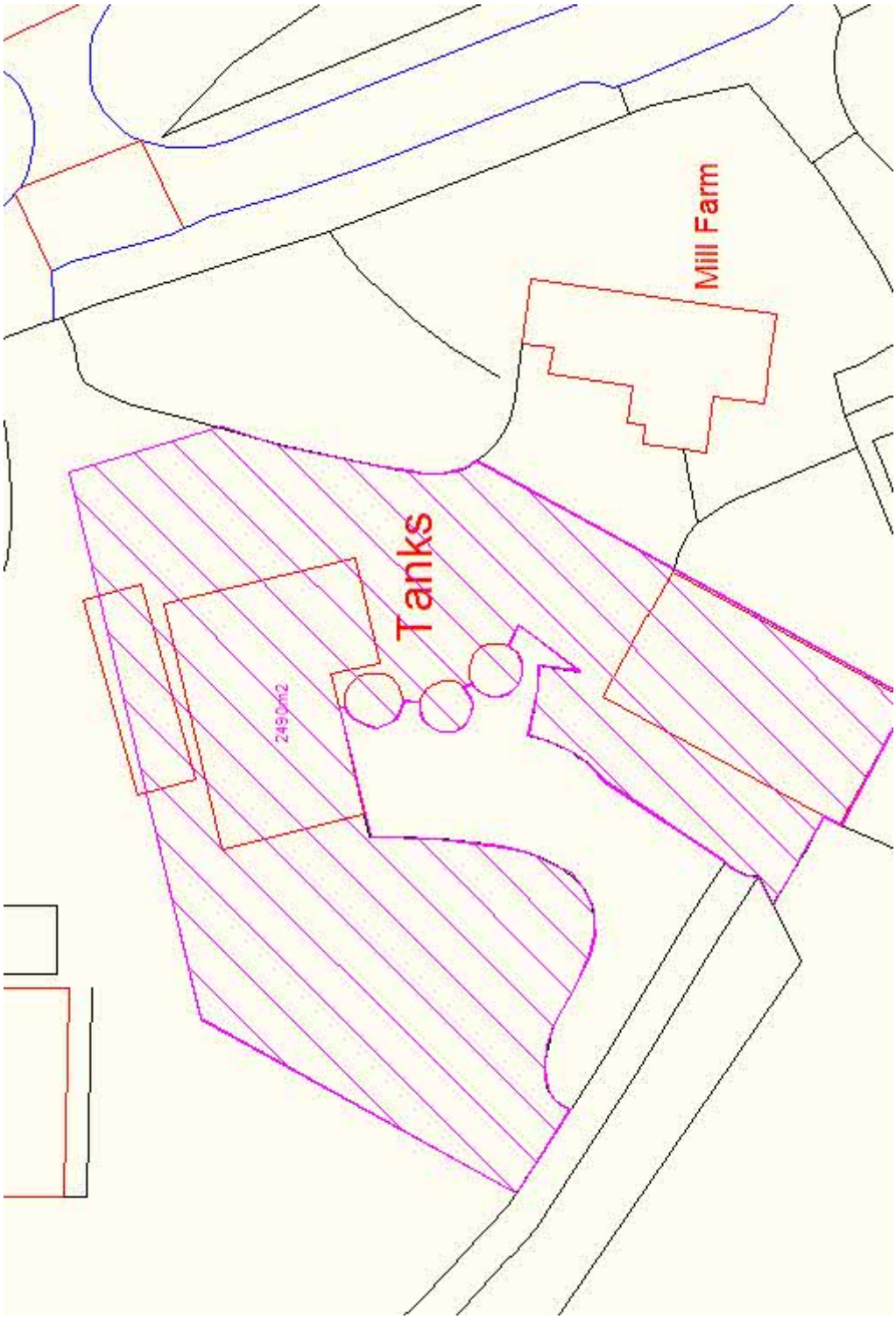
Consideration has been given to the hierarchy for surface water disposal which recommends the SUDs approach which includes infiltration as the first tier. At this stage it is considered that infiltration drainage is not a practical solution therefore a discharge to the watercourse is required.

It is considered that following the development there will be a reduction in impermeable area and subsequently runoff from the site will also be reduced to approximately 1462m². The proposal includes a crate tank and restricted discharge to the watercourse of 20l/s.

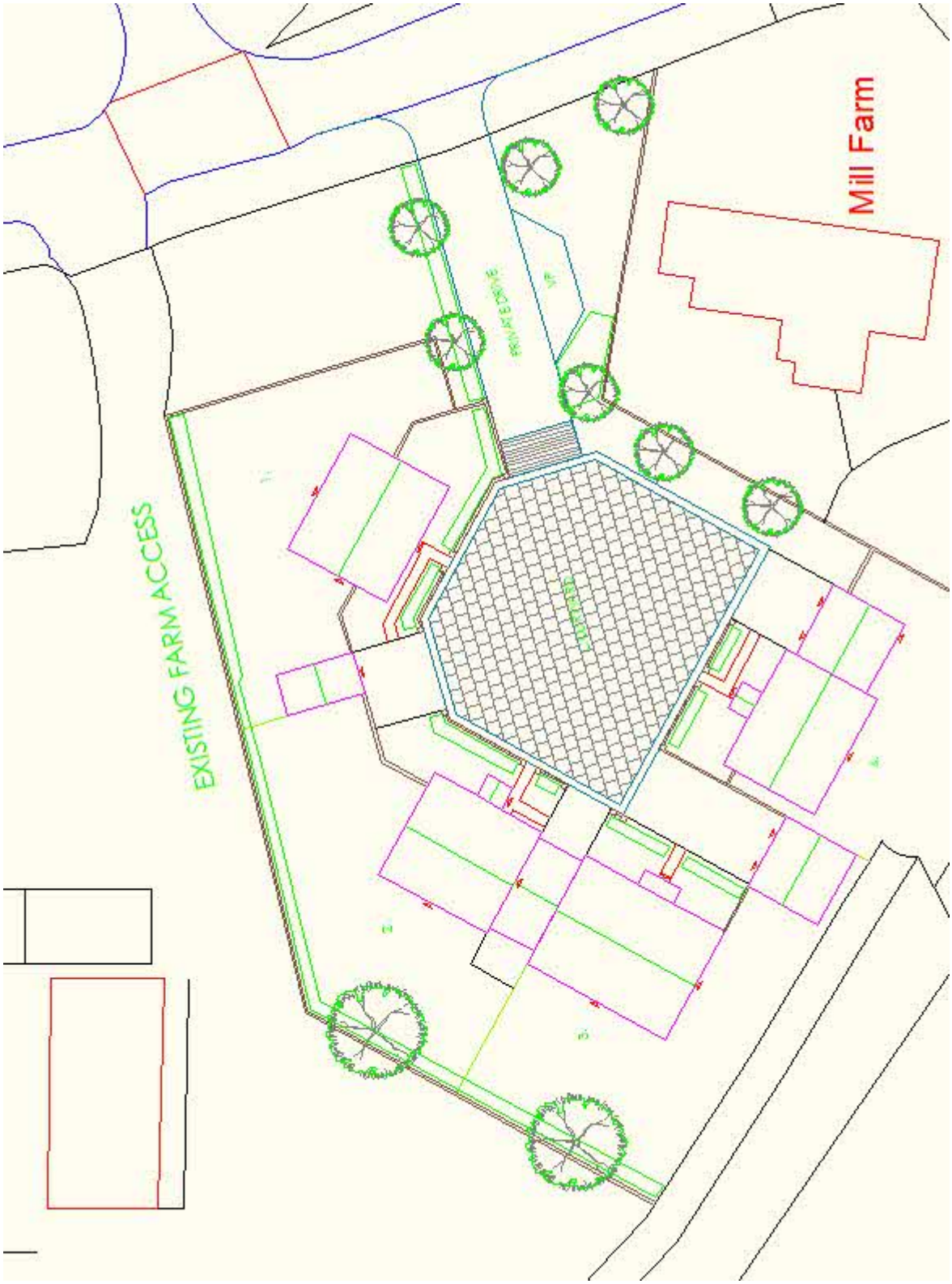
8. CONCLUSION

It is concluded that there is a low risk of flooding from fluvial sources. A SUDs based drainage strategy has been developed which ensures that onsite runoff is treated and control in the appropriate manner.

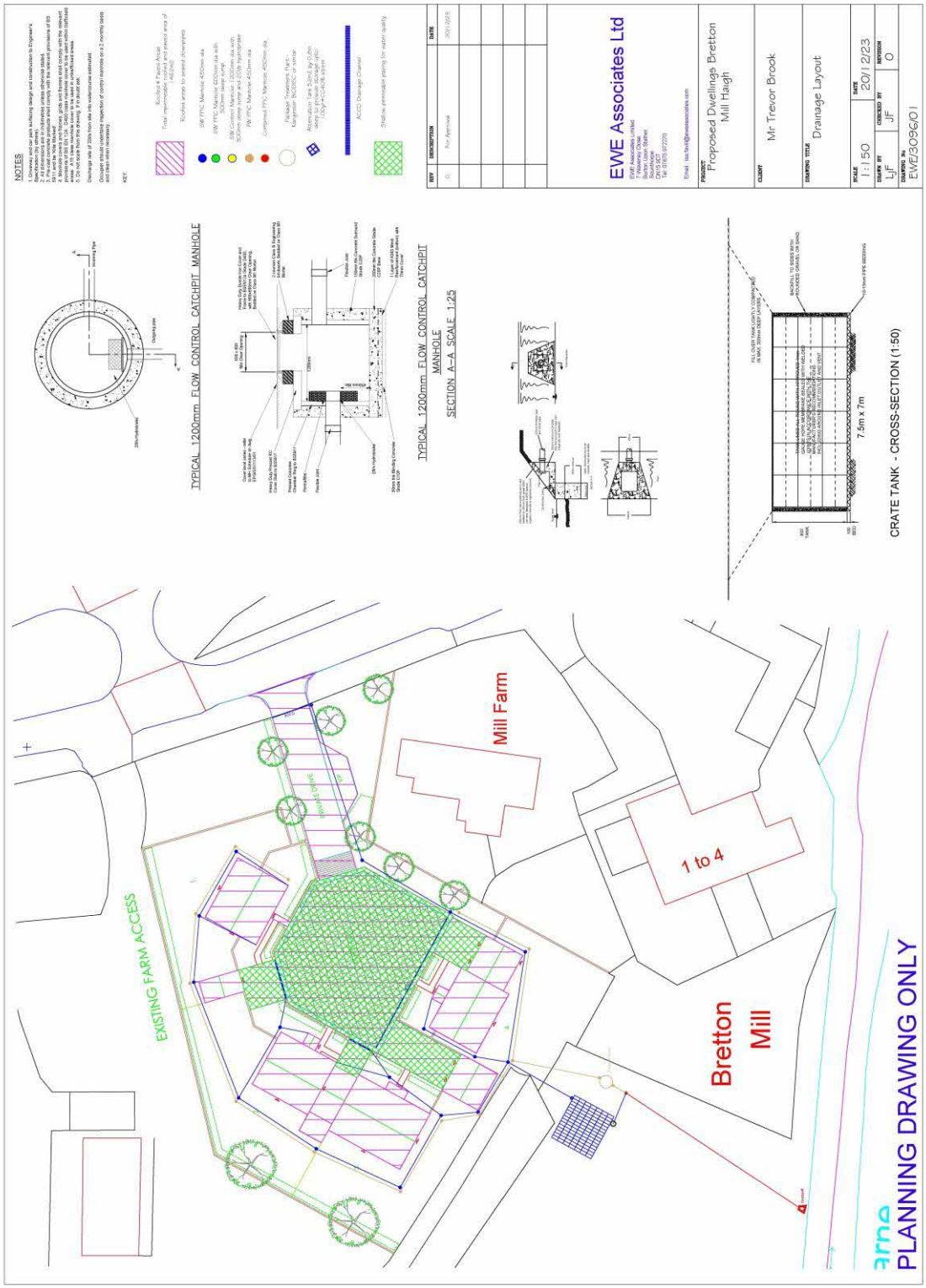
Appendix A: - Existing Site



Appendix B: - Masterplan



Appendix C: - Drainage Strategy Plan



Appendix D: - Runoff Calculation

Modified Rational Method

Return Period: flood 1 years; Post Development Rainfall 2 years

Length (m)	76	m
Area (ha)	0.249	Ha
Max Height	76.0	mAOD
Min Height	73.0	mAOD
DeltaH	3.0	
Slope (%)	3.95	
Te (mins)	9.09	mins
ARF	0.998	
SAAR	648.000	mm
UCWI	75	mm
PIMP	100.0	%
SOIL	0.40	
Percentage Runoff PR	78.05	
DEEPSTOR	0.37	

Cv	0.7805	
Cr	1.3	
allowable outflow		
1 year	28.56	l/s

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	6.1	6.2	40.7	28.6	114.7
0.25	0.010	6.24	6.3	25.0	17.5	70.4
0.5	0.021	8.28	8.4	16.6	11.6	46.7
0.75	0.031	9.75	9.9	13.0	9.1	36.7
1	0.042	10.95	11.1	11.0	7.7	30.9
1.25	0.052	11.98	12.2	9.6	6.7	27.0
1.5	0.063	12.88	13.1	8.6	6.0	24.2
1.75	0.073	13.7	13.9	7.8	5.5	22.1
2	0.083	14.45	14.7	7.2	5.1	20.4
2.25	0.094	15.15	15.4	6.7	4.7	19.0
2.5	0.104	15.8	16.0	6.3	4.4	17.8
2.75	0.115	16.41	16.7	6.0	4.2	16.8
3	0.125	16.99	17.2	5.7	4.0	16.0
3.25	0.135	17.54	17.8	5.4	3.8	15.2
3.5	0.146	18.06	18.3	5.2	3.6	14.6
3.75	0.156	18.56	18.8	4.9	3.5	14.0
4	0.167	19.05	19.3	4.8	3.3	13.4
4.25	0.177	19.51	19.8	4.6	3.2	12.9

Modified Rational Method

Return Period: flood 30 years; Post Development Rainfall 50 years

Length (m)	76	m
Area (ha)	0.249	Ha
Max Height	76.0	mAOD
Min Height	73.0	mAOD
DeltaH	3.0	
Slope (%)	3.95	
Te (mins)	9.09	mins
ARF	0.998	
SAAR	648.000	mm
UCWI	75	mm
PIMP	100.0	%
SOIL	0.40	
Percentage Runoff PR	78.05	
DEEPSTOR	0.37	

Cv	0.7805	
Cr	1.3	
allowable outflow		
30 year	95.52	l/s

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	20.4	21.2	136.0	95.5	383.6
0.25	0.010	21.23	21.5	84.9	59.6	239.5
0.5	0.021	26.37	26.8	52.7	37.0	148.8
0.75	0.031	29.88	30.3	39.8	28.0	112.4
1	0.042	32.65	33.1	32.7	22.9	92.1
1.25	0.052	34.95	35.5	28.0	19.6	78.9
1.5	0.063	36.95	37.5	24.6	17.3	69.5
1.75	0.073	38.73	39.3	22.1	15.5	62.4
2	0.083	40.33	40.9	20.2	14.2	56.9
2.25	0.094	41.8	42.4	18.6	13.0	52.4
2.5	0.104	43.16	43.8	17.3	12.1	48.7
2.75	0.115	44.42	45.1	16.2	11.3	45.6
3	0.125	45.61	46.3	15.2	10.7	42.9
3.25	0.135	46.73	47.4	14.4	10.1	40.6
3.5	0.146	47.79	48.5	13.7	9.6	38.5
3.75	0.156	48.79	49.5	13.0	9.1	36.7
4	0.167	49.75	50.5	12.4	8.7	35.1
4.25	0.177	50.67	51.4	11.9	8.4	33.6

Modified Rational Method

Return Period: flood 100 years; Post Development Rainfall 140 years

Length (m)	76	m
Area (ha)	0.249	Ha
Max Height	76.0	mAOD
Min Height	73.0	mAOD
DeltaH	3.0	
Slope (%)	3.95	
Te (mins)	9.09	mins
ARF	0.998	
SAAR	648.000	mm
UCWI	75	mm
PIMP	100.0	%
SOIL	0.40	
Percentage Runoff PR	78.05	
DEEPSTOR	0.37	

Cv	0.7805	
Cr	1.3	
allowable outflow		
100 year	136.73	l/s

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	29.2	29.6	194.7	136.7	549.1
0.25	0.010	35.2	35.7	140.8	98.9	397.2
0.5	0.021	37.03	37.6	74.1	52.0	208.9
0.75	0.031	41.49	42.1	55.3	38.9	156.0
1	0.042	44.97	45.6	45.0	31.6	126.8
1.25	0.052	47.84	48.5	38.3	26.9	108.0
1.5	0.063	50.32	51.1	33.5	23.6	94.6
1.75	0.073	52.52	53.3	30.0	21.1	84.7
2	0.083	54.49	55.3	27.2	19.1	76.9
2.25	0.094	56.29	57.1	25.0	17.6	70.6
2.5	0.104	57.94	58.8	23.2	16.3	65.4
2.75	0.115	59.48	60.4	21.6	15.2	61.0
3	0.125	60.92	61.8	20.3	14.3	57.3
3.25	0.135	62.27	63.2	19.2	13.5	54.0
3.5	0.146	63.55	64.5	18.2	12.8	51.2
3.75	0.156	64.76	65.7	17.3	12.1	48.7
4	0.167	65.92	66.9	16.5	11.6	46.5
4.25	0.177	67.02	68.0	15.8	11.1	44.5

Appendix E: - WINDES Calc

EWE Associates Ltd		Page 1
Windy Ridge Barn Thealby Lane Winterton DN15 9TG		Micro Drainage
Date 20/12/2023 19:16	Designed By Lea	
File 100yr+CC40% tank ...	Checked By	
Micro Drainage	Source Control W.12.4	

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 24 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	72.181	0.781	0.0	17.1	17.1	38.6	O K
30 min Summer	72.188	0.788	0.0	17.1	17.1	38.9	O K
60 min Summer	72.142	0.742	0.0	17.1	17.1	36.6	O K
120 min Summer	72.011	0.611	0.0	17.0	17.0	30.2	O K
180 min Summer	71.871	0.471	0.0	17.1	17.1	23.3	O K
240 min Summer	71.751	0.351	0.0	17.1	17.1	17.4	O K
360 min Summer	71.653	0.253	0.0	16.0	16.0	12.5	O K
480 min Summer	71.614	0.214	0.0	13.7	13.7	10.6	O K
600 min Summer	71.591	0.191	0.0	11.9	11.9	9.4	O K
720 min Summer	71.575	0.175	0.0	10.5	10.5	8.6	O K
960 min Summer	71.557	0.157	0.0	8.8	8.8	7.7	O K
1440 min Summer	71.535	0.135	0.0	6.8	6.8	6.7	O K
2160 min Summer	71.517	0.117	0.0	5.2	5.2	5.8	O K
2880 min Summer	71.506	0.106	0.0	4.3	4.3	5.2	O K
4320 min Summer	71.490	0.090	0.0	3.1	3.1	4.4	O K
5760 min Summer	71.480	0.080	0.0	2.4	2.4	3.9	O K
7200 min Summer	71.473	0.073	0.0	2.0	2.0	3.6	O K
8640 min Summer	71.468	0.068	0.0	1.7	1.7	3.4	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Summer	172.925	16
30 min Summer	101.645	26
60 min Summer	59.747	42
120 min Summer	35.119	76
180 min Summer	25.737	108
240 min Summer	20.643	134
360 min Summer	15.128	190
480 min Summer	12.134	248
600 min Summer	10.226	308
720 min Summer	8.892	368
960 min Summer	7.330	490
1440 min Summer	5.583	734
2160 min Summer	4.252	1096
2880 min Summer	3.505	1460
4320 min Summer	2.502	2192
5760 min Summer	1.969	2872
7200 min Summer	1.636	3664
8640 min Summer	1.406	4376

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Windy Ridge Barn Thealby Lane Winterton DN15 9TG		Micro Drainage
Date 20/12/2023 19:16	Designed By Lea	
File 100yr+CC40% tank ...	Checked By	
Micro Drainage	Source Control W.12.4	

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Summer	71.464	0.064	0.0	1.5	1.5	3.2	O K
15 min Winter	72.322	0.922	0.0	17.1	17.1	43.7	O K
30 min Winter	72.345	0.945	0.0	17.1	17.1	44.1	O K
60 min Winter	72.224	0.824	0.0	17.0	17.0	40.7	O K
120 min Winter	72.019	0.619	0.0	17.1	17.1	30.6	O K
180 min Winter	71.783	0.383	0.0	17.1	17.1	18.9	O K
240 min Winter	71.671	0.271	0.0	16.5	16.5	13.4	O K
360 min Winter	71.605	0.205	0.0	13.0	13.0	10.1	O K
480 min Winter	71.576	0.176	0.0	10.6	10.6	8.7	O K
600 min Winter	71.558	0.158	0.0	9.0	9.0	7.8	O K
720 min Winter	71.546	0.146	0.0	7.8	7.8	7.2	O K
960 min Winter	71.531	0.131	0.0	6.5	6.5	6.5	O K
1440 min Winter	71.513	0.113	0.0	4.9	4.9	5.6	O K
2160 min Winter	71.499	0.099	0.0	3.8	3.8	4.9	O K
2880 min Winter	71.490	0.090	0.0	3.1	3.1	4.4	O K
4320 min Winter	71.477	0.077	0.0	2.2	2.2	3.8	O K
5760 min Winter	71.469	0.069	0.0	1.8	1.8	3.4	O K
7200 min Winter	71.463	0.063	0.0	1.5	1.5	3.1	O K
8640 min Winter	71.459	0.059	0.0	1.2	1.2	2.9	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
10080 min Summer	1.237	5136
15 min Winter	172.925	16
30 min Winter	101.645	27
60 min Winter	59.747	46
120 min Winter	35.119	82
180 min Winter	25.737	110
240 min Winter	20.643	134
360 min Winter	15.128	190
480 min Winter	12.134	250
600 min Winter	10.226	308
720 min Winter	8.892	370
960 min Winter	7.330	490
1440 min Winter	5.583	736
2160 min Winter	4.252	1100
2880 min Winter	3.505	1456
4320 min Winter	2.502	2152
5760 min Winter	1.969	2872
7200 min Winter	1.636	3656
8640 min Winter	1.406	4400

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Windy Ridge Barn Thealby Lane Winterton DN15 9TG		Micro Drainage
Date 20/12/2023 19:16 File 100yr+CC40% tank ...	Designed By Lea Checked By	
Micro Drainage	Source Control W.12.4	

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Winter	71.456	0.056	0.0	1.1	1.1	2.7	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
10080 min Winter	1.237	4984

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Micro Drainage	Source Control W.12.4	

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
Site Location	429600 412250 SE 29600 12250
C (1km)	-0.026
D1 (1km)	0.353
D2 (1km)	0.448
D3 (1km)	0.288
E (1km)	0.301
F (1km)	2.369
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time / Area Diagram

Total Area (ha) 0.150

Time (mins)	Area (ha)
0-4	0.150

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Windy Ridge Barn Thealby Lane Winterton DN15 9TG		Micro Drainage
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Micro Drainage	Source Control W.12.4	

Model Details

Storage is Online Cover Level (m) 73.000

Cellular Storage Structure

Invert Level (m) 71.400 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	52.0	52.0	2.600	0.0	78.0
0.200	52.0	57.8	2.800	0.0	78.0
0.400	52.0	63.5	3.000	0.0	78.0
0.600	52.0	69.3	3.200	0.0	78.0
0.800	52.0	75.1	3.400	0.0	78.0
1.000	0.0	78.0	3.600	0.0	78.0
1.200	0.0	78.0	3.800	0.0	78.0
1.400	0.0	78.0	4.000	0.0	78.0
1.600	0.0	78.0	4.200	0.0	78.0
1.800	0.0	78.0	4.400	0.0	78.0
2.000	0.0	78.0	4.600	0.0	78.0
2.200	0.0	78.0	4.800	0.0	78.0
2.400	0.0	78.0	5.000	0.0	78.0

Hydro-Brake® Outflow Control

Design Head (m) 1.350 Hydro-Brake® Type Md4 Invert Level (m) 71.400
Design Flow (l/s) 20.0 Diameter (mm) 149

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.8	1.200	18.8	3.000	29.8	7.000	45.5
0.200	12.6	1.400	20.3	3.500	32.2	7.500	47.1
0.300	16.9	1.600	21.8	4.000	34.4	8.000	48.6
0.400	15.7	1.800	23.1	4.500	36.5	8.500	50.1
0.500	14.2	2.000	24.3	5.000	38.4	9.000	51.6
0.600	14.1	2.200	25.5	5.500	40.3	9.500	53.0
0.800	15.5	2.400	26.6	6.000	42.1		
1.000	17.2	2.600	27.7	6.500	43.8		

Appendix F: - Construction Checklist

A7 Construction inspection checklist

Phase and inspection item	Inspection date	Condition*	Date phase completed	Remarks/remedial works
Pre-excavation				
Runoff from areas of bare soil diverted to site control				
Runoff from contaminated areas diverted to site control				
Excavation				
Soil is not smeared or compacted so that permeability is reduced				
Excavation is to required size and gradient and is located in correct position				
Side slopes are correct				
All debris (eg loose roots) removed from base feature				
There is no groundwater seepage in the base of the feature				
Depth of excavation is correct				
Construction				
Earthworks materials to specification with test results				
Filter materials in accordance with specification with test results				
Compaction acceptable				
Inlets and outlets constructed in accordance with drawings and specification and drawings				
Construction to required line and levels				
Planting				
Planting in accordance with specification				
Planting established				
Handover inspection				
No silting from construction				
No erosion or bare areas of planting				
All litter removed and inlets and outlets operating correctly				

* Acceptable or unacceptable

CIRIA C609 303

Appendix G: - Sewer Plan

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