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FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY

Land Adjacent to the Bull Inn Bethersden, Kent TN26 3LB

CLIENT: ESQUIRE DEVELOPMENTS LTD

June 2024
CS/JM/32891



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1 EXECUTIVE SUMMARY

1.1 OVERVIEW

- 1.1.1 The outline planning proposals comprise of residential development of 40 units on a greenfield site of 4.18 hectares on Land adjacent to the Bull Inn, Bethersden, , Kent TN26 3LB.
- 1.1.1 The site-specific flood risk assessment determined that the area of the site to be developed is located entirely in Flood Zone 1; low risk of flooding from rivers or other sources of flooding.
- 1.1.2 An area of the site to the south of the built development is located within Flood Zones 2 and 3, however this area will purely be used for landscaping associated with BNG.
- 1.1.3 NPPF Annex 3: "Flood Risk Vulnerability Classification", states that sites used for residential use can be classified as "more vulnerable". All classes of land development are appropriate in Flood Zone 1 and an Exception Test is not required.
- 1.1.4 The site is underlain by the Weald Clay Formation. This geology is not considered suitable for the use of infiltration-based SuDS.
- 1.1.5 A Sustainable Urban Drainage System (SuDS) has been provided as part of the surface water drainage layout to deal with the surface water generated from the development to ensure that flood risk is not increased elsewhere.
- 1.1.6 It is proposed that the site will drain via a network of gravity surface water sewers into an above ground attenuation basin with a controlled discharge via a new outfall into the River Beult located on the southern boundary equivalent to the greenfield rate.
- 1.1.7 The foul water from the development will be collected in a system of gravity sewers discharging into an onsite pumping station with a pumped outfall into the existing foul water sewer located at the junction of Station Road and Bull Lane.
- 1.1.8 The site-specific flood risk assessment also determines that the development site is at low risk of flooding from other sources.

2 INTRODUCTION

2.1 GENERAL

- 2.1.1 DHA has been commissioned by Esquire Developments Ltd to prepare a Flood Risk Assessment and Drainage Strategy for a 40-unit residential development on Land adjacent to the Bull Inn, Bethersden, Kent TN26 3LB.

2.2 SCOPE AND OBJECTIVES

- 2.2.1 Reference to the Environment Agency flood maps show the far south of the site to be located within Flood Zones 2 and 3. This FRA has been carried out in accordance with the National Planning Policy Framework (NPPF). The NPPF requires an FRA to be prepared for all developments located in Flood Zones 2 and 3.
- 2.2.2 The proposals are classed as major development and as such this report has been prepared to outline the surface water drainage for the site to support the outline planning application.
- 2.2.1 This report provides the following information.
- (i) An assessment of the flood risk to the site based upon flood data and the flood maps provided by the Environment Agency and Strategic Flood Risk Assessment;
 - (ii) An assessment of the impact of the new development in terms of surface water runoff;
 - (iii) Proposals for measures to mitigate the generation of surface water runoff from the proposed development in the form of a surface water drainage strategy incorporating SuDS;
 - (iv) Details of the disposal of foul water from the development.
 - (v) Proposals to mitigate any residual flood risks to the development; and
 - (vi) Proposals to mitigate any contamination to groundwater.
- 2.2.2 The findings, recommendations and conclusions of this report are based on information obtained from a variety of external sources which are understood to be reputable. DHA Environment cannot guarantee the reliability of any data from third parties and no liability can be accepted for any erroneous information or the conclusions drawn from it.

3 EXISTING CONDITIONS

3.1 SITE LOCATION

- 3.1.1 The site lies to the Southwest of Bull Inn, Bethersden and is centred on grid reference 583156, 165686. The overall site occupies a total area of 4.18 hectares and currently consists of greenfield.

3.2 EXISTING SITE

- 3.2.1 A topographical survey of the site was carried out by A N Surveys Ltd and is shown on drawing 32891-TS-01 contained within **Appendix A**. The site is rectangular in shape and falls from a high point of 38.5m AOD on the Northern boundary to a low point of 26m AOD to the South adjacent to the River Beult. The site has the following boundary conditions:

- North - Bull Lane.
- East - Ashford Road.
- South - River Beult.
- West - Greenspace.

3.3 EXISTING DRAINAGE REGIME AND SURFACE WATER RUN-OFF

- 3.3.1 There is no positive surface water outfall from the site so any rainfall will infiltrate to ground with any residual surface water flowing overland from North to South following the existing topography and into the River Beult.
- 3.3.2 The existing green field (pre-development) peak discharge rates have been calculated by using the Flood Studies Report ICP (SuDS) method based on the total developable catchment which as an area of 2.1 hectares. The calculations can be seen in **Appendix B** and have been summarised in Table 1 below:

Catchment Reference	Area	Qbar (l/s)	1 in 1 year	1 in 30 years	1 in 100 years
Catchment A	2.1.	9.2	7.8	20.9	29.9

Table 1 - Summary of pre-development greenfield runoff rate

- 3.3.3 Table 3.2 of Ashford Borough Council Sustainable Drainage SPD provides acceptable post development run-off rates for various areas within the borough. This site falls into the category of a green field site in the 'rest of the borough' and

as such this table encourages an acceptable runoff rate of 4l/s/ha, but must avoid any run-off rate in excess of the existing rate (where this can be established). Based on a total contributing area of 2.1 hectares this would equate to a rate of 8.2 l/s. This rate has been used for the purpose the of drainage design.

3.4 EXISTING PUBLIC SEWERS

- 3.4.1 Reference has been made to Southern Water asset plans found at **Appendix C** which indicate the location of public sewers in the area. These records do not indicate any private drainage that may be present.
- 3.4.2 In October 2011 the ownership of any private sewer serving more than one property was automatically transferred to the Water Authority although many of these sewers are yet to be recorded on the asset plans.

Surface Water

- 3.4.3 Southern Water asset plans show there to be no surface water sewers within the site, however there is system surface sewers draining Lovelace Court to the North of the site which drain away to the North.

Foul Water

- 3.4.4 Southern Water asset plans show there to be no foul water sewers within the site, however there is 150mm diameter running from the South to the North in Ashford Road commencing at the junction with Bull Lane.

Combined Water

- 3.4.5 Southern Water asset plans show there to be no combined sewers within the site or surrounding area.

3.5 GEOLOGY AND HYDROGEOLOGY

- 3.5.1 The online British Geological Survey maps indicate that the site is underlain by the Weald Clay Formation which comprises of mudstone.
- 3.5.2 Based on the above, this geology is not considered suitable for the use of infiltration-based SuDS.

4 SITE SPECIFIC FLOOD RISK ASSESSMENT

4.1 PROPOSED DEVELOPMENT

- 4.1.1 The proposals comprise the development of 40 residential units on Land adjacent to the Bull Inn, Bethersden, Kent TN26 3LB. The proposed illustrative masterplan is shown in **Appendix D**.

4.2 FLOOD RISK ZONES

- 4.2.1 The National Planning Policy Framework provides guidance on assessing flood risk and seeks to guide development away from areas at risk of flooding from all sources. Planning Practice Guidance defines several Flood Zones based on the probability of flooding and provides guidance on the most appropriate form of development within each zone. The flood risk zones can be summarised as follows:

Zone	Annual probability in any year	
	River Flooding	Sea Flooding
Zone 1 : Low probability	Less than 1:1000 (<0.1%)	Less than 1:1000 (<0.1%)
Zone 2: Medium probability	Between 1:1000 and 1 in 100 (0.1% -1%)	Between 1:1000 and 1 in 200 (0.1% - 0.5%)
Zone 3a : High probability	Greater than 1:100 (>1%)	Greater than 1:200 (>0.5%)
Zone 3b: Functional floodplain	Greater than 1 in 20 (>5%)	N/A

Table 2 – Planning Policy Guidance

- 4.2.2 Reference has been made to the Environment Agency flood risk maps, a copy of which is contained within **Appendix E**. This shows the area of the site which is to be developed is located entirely within Flood Zone 1 low probability of fluvial flooding.
- 4.2.3 An area of the site to the South of the built development is located within Flood Zones 2 and 3, however this area will purely be used for landscaping associated with BNG.

4.3 VULNERABILITY CLASSIFICATION

- 4.3.1 NPPF Annex 3: "Flood Risk Vulnerability Classification", states that sites used for residential use can be classified as "more vulnerable".

- 4.3.2 All forms of development are considered appropriate in Flood Zone 1 and as such the development is considered to pass the Sequential Test. An Exception test is not required for the development.

4.4 OTHER SOURCES OF FLOODING

- 4.4.1 Reference has been made to the Environment Agency flood risk maps which provide references on the risk of flooding from all sources including fluvial, surface water, groundwater, and artificial sources.

Surface water flooding

- 4.4.2 Environment Agency online mapping shows that there is a very low risk of surface water flooding on the area of the site which is to be developed.

Groundwater

- 4.4.3 Groundwater flooding occurs as excess water emerges at the ground surface. The Environment Agency online mapping indicates that flooding from groundwater is unlikely in this area.

Flooding from artificial sources

- 4.4.4 Flooding from reservoirs is extremely unlikely. An area is considered at risk if peoples' lives could be threatened in the event of a dam or reservoir failure. Reference has been made to the Environment Agency online mapping which indicate that flooding from reservoirs is considered unlikely.

5 MANAGEMENT OF SURFACE AND FOUL WATER ON THE DEVELOPMENT

5.1 PROPOSED DEVELOPMENT

- 5.1.1 The proposals comprise the development of 40 residential units on Land adjacent to the Bull Inn, Bethersden, Kent TN26 3LB.
- 5.1.2 A draft layout and parameters plan is contained in **Appendix F** showing how a development of this size can be incorporated on the site, however this is subject to a detailed design at the reserved matters stage. These plans have been used as the basis for this Flood Risk Assessment.

5.2 AIMS

- 5.2.1 Sustainable Urban Drainage (SuDS) techniques will be used to deal with the surface water generated by the development. This will replicate the existing drainage regime by dealing with the surface water at source, to prevent increasing the risk of downstream flooding.

5.3 PROPOSED SURFACE WATER DRAINAGE STRATEGY

- 5.3.1 The proposed impermeable areas are shown on drawing 32891-D-01 contained in **Appendix F**. This shows that of the total developable site area of 2.1 hectares, the total impermeable area can be seen to be 0.722 hectares.
- 5.3.2 The proposed drainage scheme is shown on drawing 32891-D-02 contained in **Appendix F**.
- 5.3.3 It is proposed that the site will drain via a network of gravity surface water sewers into an above ground attenuation basin with a controlled discharge of 8.2l/s via a new outfall into the River Beult.
- 5.3.4 Reference has been made to the Environment Agency's online mapping guidance for peak rainfall allowance for climate change and shows the site to be located within the Medway Management Catchment.
- 5.3.5 Given the proposed development is to have a design life beyond 2100, a 45% allowance for climate change needs to be considered in the design of the surface water drainage system. This is based on the upper end allowance for the 2070's epoch.
- 5.3.6 Based on the above, the drainage system has been modelled using Windes to accommodate all return periods up to and including the 1 in 100 year + 45% climate

change. Calculations are shown in **Appendix F**. Features have been designed to half drain within 24 hours.

6 FOUL WATER DRAINAGE

6.1 PROPOSED FOUL WATER DRAINAGE

- 6.1.1 A peak foul water flow of 1.85 l/s has been calculated for a development of 40 residential units. This is based on the daily flow rate of 4,000 litres given in Sewers for Adoption 7th Edition for residential.
- 6.1.2 The foul water from the development will be collected in a system of gravity sewers discharging into an onsite pumping station with an outfall into the existing foul water sewer located at the junction of Ashford Road and Bull Lane.
- 6.1.3 The proposed sewers will be designed and constructed in accordance with Sewers for Adoption 7th Edition and will be offered to Southern Water who will maintain them in perpetuity.
- 6.1.4 Any reinforcement of the existing network will be covered by the Infrastructure Charge required for the connection of each property.
- 6.1.5 There are no plans to construct treatment works on the site, nor to discharge any effluent treated or not, to ground water.

7 MAINTENANCE

- 7.1.1 All the onsite surface water will remain under the control of either individual property owners or a site wide management company for drainage within shared areas who will be responsible for the ongoing maintenance.
- 7.1.2 The proposed foul water drainage will be designed and constructed in accordance with Sewers for Adoption 7th Edition and will be offered to Southern Water who will maintain them in perpetuity.

8 CONCLUSIONS AND RECOMMENDATIONS

- 8.1.1 The proposals comprise the development of 40 residential units on Land adjacent to Bull the Bull Inn, Bethersden, Ashford, Kent TN26 3LB.
- 8.1.2 The site-specific flood risk assessment determined that the area of the site to be developed is located entirely in Flood Zone 1; low risk of flooding from rivers or other sources of flooding. An area of the site to the south of the built development is located within Flood Zones 2 and 3, however this area will purely be used for landscaping associated with BNG.
- 8.1.3 The site is not at risk from any other source of flooding.
- 8.1.4 A Sustainable Urban Drainage System (SuDS) has been provided as part of the surface water drainage layout to deal with the surface water generated from the development to ensure that flood risk is not increased elsewhere.
- 8.1.5 It is proposed that the site will drain via a network of gravity surface water sewers into an above ground attenuation basin with a controlled discharge via a new outfall into the River Beult located on the southern boundary equivalent to the greenfield rate.
- 8.1.6 The foul water from the development will be collected in a system of gravity sewers discharging into an onsite pumping station with an outfall into the existing foul water sewer located at the junction of Ashford Road and Bull Lane.
- 8.1.7 This report demonstrates that the development proposals can be suitably drained and will not increase the risk of flooding either on or off site. As such the proposals accord with the requirements of the NPPF and PPG in respect of securing a suitable and sustainable drainage strategy for the development.

APPENDIX

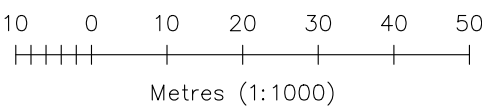
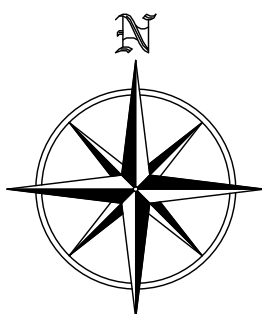
A



Topographical survey



NOTES



- PROPOSED SITE BOUNDARY
- DEVELOPMENT BOUNDARY

P2	RED LINE BOUNDARY	09.07.24	CS
P1	FIRST ISSUE	24.06.24	CS
REV	AMENDMENTS	DATE	CHK
Client			
ESQUIRE DEVELOPMENTS LTD			
Project			
LAND ADJACENT TO BULL INN, BULL LANE, BETHERSDEN			
Title			
TOPOGRAPHICAL SURVEY			
Drwg	Rev	Scale	Date
32891-TS-01	P2	1:1000@A	124.06.24
Eclipse House, Eclipse Park, Sittingbourne Road Maidstone, Kent, ME14 3EN t: 01622 776226 f: 01622 776227 e: info@dhaplanning.co.uk w: www.dhaplanning.co.uk			
CAD Reference:			A1

APPENDIX B



Greenfield Runoff Calculations

DHA Transport Ltd		Page 1																								
Eclipse House Sittingbourne Road Maidstone ME14 3EN	Bethersden																									
Date 21/06/2024 14:27	Designed by Chris																									
File	Checked by																									
Causeway	Source Control 2019.1																									
<u>ICP SUDS Mean Annual Flood</u> Input <table><tr><td>Return Period (years)</td><td>100</td><td>Soil</td><td>0.450</td></tr><tr><td>Area (ha)</td><td>2.100</td><td>Urban</td><td>0.000</td></tr><tr><td>SAAR (mm)</td><td>700</td><td>Region Number</td><td>Region 6</td></tr></table> Results 1/s <table><tr><td>QBAR Rural</td><td>9.2</td></tr><tr><td>QBAR Urban</td><td>9.2</td></tr><tr><td>Q100 years</td><td>29.4</td></tr><tr><td>Q1 year</td><td>7.8</td></tr><tr><td>Q30 years</td><td>20.9</td></tr><tr><td>Q100 years</td><td>29.4</td></tr></table>			Return Period (years)	100	Soil	0.450	Area (ha)	2.100	Urban	0.000	SAAR (mm)	700	Region Number	Region 6	QBAR Rural	9.2	QBAR Urban	9.2	Q100 years	29.4	Q1 year	7.8	Q30 years	20.9	Q100 years	29.4
Return Period (years)	100	Soil	0.450																							
Area (ha)	2.100	Urban	0.000																							
SAAR (mm)	700	Region Number	Region 6																							
QBAR Rural	9.2																									
QBAR Urban	9.2																									
Q100 years	29.4																									
Q1 year	7.8																									
Q30 years	20.9																									
Q100 years	29.4																									
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APPENDIX

C



Southern Water Sewer Records



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Data updated: 21/11/23

Scale: 1:1250
Map Centre: 592354.139773

Date: 05/02/24
Our Ref: 1387183 - 1

Wastewater Plan A2
Powered by digdat

Foul Gravity Sewer

Combined Gravity Sewer

Diverted Water Course or Treated Effluent

Surface Water Gravity Sewer

Rising Main, Vacuum or Syphon

Combined Outfall

Foul Outfall

Surface Water Outfall

Surface Water Inlet

Combined Pumping Station

Surface Water Pumping Station

Foul Pumping Station

Water Treatment Works

Section 104 Area

Building Over Agreement Area

Foul Manhole

Combined Manhole

Surface Water Manhole

Side Entry Manhole, Discharge Chamber, Dummy Manhole or Surface Water Soakaway

james.marsh@dhatransport.co.uk

Bull Inn



The positions of pipes shown on this plan are believed to be correct, but Southern Water Services Ltd accept no responsibility in the event of inaccuracy. The actual positions should be determined on site. This plan is produced by Southern Water Services Ltd (c) Crown copyright and database rights 2024 Ordnance Survey 100031673. This map is to be used for the purposes of viewing the location of Southern Water plant only. Any other uses of the map data or further copies is not permitted.

WARNING: BAC pipes are constructed of Bonded Asbestos Cement.

WARNING: Unknown (UNK) materials may include Bonded Asbestos Cement.

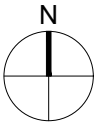
APPENDIX D



Proposed Masterplan



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For Construction & Fabrication Purposes - Do not scale from this drawing, use only the illustrated dimensions herein. Additional dimensions are to be requested and checked directly.
Illustrated information from 3rd party consultants/specialists is shown as indicatively only. See other consultant / specialist drawings for full information and detail.
All aspects of the architectural design concerning fire performance / fire safety (whether or not illustrated / annotated) are to be considered as 'For Approval' only, irrespective of the drawing status / suitability.



Revision Note & Date		Amended		Checked
Rev	Date	Note		



Canterbury Studio
Logan House, St Andrews Close
Canterbury,
CT1 2RP
info@onarchitecture.co.uk
onarchitecture.co.uk
01227 634334

Project Title
**Proposed Residential Development
Land Adjacent to Bull Inn Bethersden
Esquire Developments**

Drawing Title
Site Location Plan

Scale		Date	Drawn	Checked
1:1250@A3		January 2024	PTW	DK
Drawing Status				

Project No.	Drawing No.	Status	Revision
23.073	0001		P1



Scale:
0 10 30 50 100m

Illustrative Site Layout Plan

Proposed Residential Development, Land adjacent to The Bull at Bethersden

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Revision Note & Date				Initial
Rev	Date	Note		
P1	05/07/24	Biodiversity Net Gain Line updated following client comments.		KY

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Canterbury Studio
Logan House, St Andrews Close
Canterbury
CT1 2RP

info@onarchitecture.co.uk
onarchitecture.co.uk
01227 634334

Project Title
Proposed Residential Development,
Land adjacent to The Bull at Bethersden
Client Details
Esquire Developments

Drawing Title
Illustrative Site Layout Plan

BM Number

Scale 1:1000@A1	Date June 2024	Drawn RDT	Checked DK
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Drawing Status

Project Number 23.073	Drawing Number 100	Drawing Revision P1
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APPENDIX E



EA Flood Risk Map

Flood map for planning

Your reference
<Unspecified>

Location (easting/northing)
592210/139750

Created
21 Jun 2024 13:27

Your selected location is in flood zone 3, an area with a high probability of flooding.

This means:

- you must complete a flood risk assessment for development in this area
- you should follow the Environment Agency's standing advice for carrying out a flood risk assessment (see www.gov.uk/guidance/flood-risk-assessment-standing-advice)

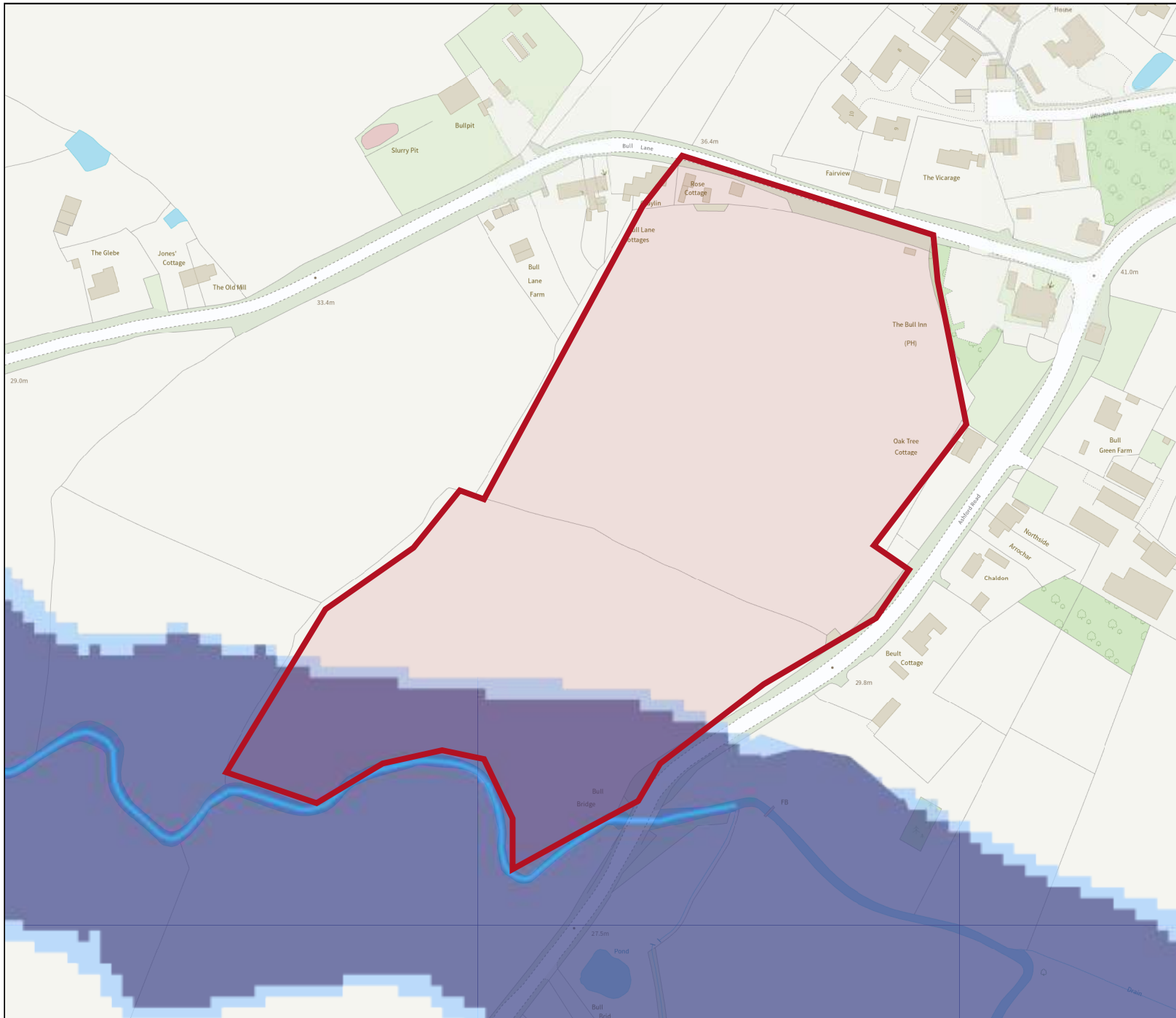
Notes

The flood map for planning shows river and sea flooding data only. It doesn't include other sources of flooding. It is for use in development planning and flood risk assessments.

This information relates to the selected location and is not specific to any property within it. The map is updated regularly and is correct at the time of printing.

Flood risk data is covered by the Open Government Licence which sets out the terms and conditions for using government data. <https://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/>

Use of the address and mapping data is subject to Ordnance Survey public viewing terms under Crown copyright and database rights 2022 OS 100024198. <https://flood-map-for-planning.service.gov.uk/os-terms>



Flood map for planning

Your reference
<Unspecified>

Location (easting/northing)
592210/139750

Scale
1:2500

Created
21 Jun 2024 13:27

-  Selected area
-  Flood zone 3
-  Flood zone 2
-  Flood zone 1
-  Flood defence
-  Main river
-  Water storage area

0 20 40 60m

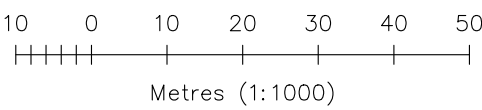
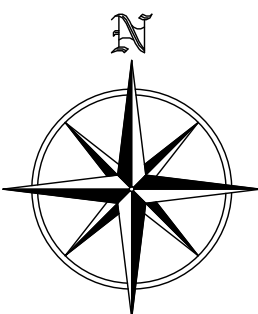
APPENDIX F



Drainage Plans and Calculations



NOTES



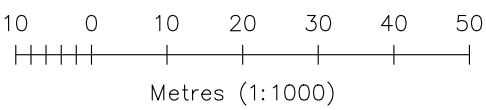
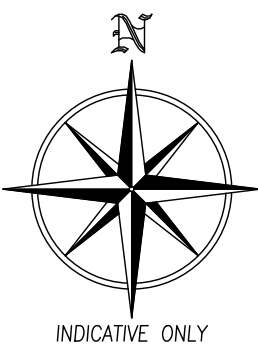
- PROPOSED SITE BOUNDARY
- DEVELOPMENT BOUNDARY
- EXTENT OF FLOOD ZONE 2
- PROPOSED HARDSTANDING
3,921m²
- PROPOSED ROOFS
3,297m²
- TOTAL IMPERMEABLE AREA
7,218m²

100m

P2	UPDATED RED LINE	09.07.24	CS
P1	FIRST ISSUE	24.06.24	CS
REV	AMENDMENTS	DATE	CHK
Client			
ESQUIRE DEVELOPMENTS LTD			
Project			
LAND ADJACENT TO BULL INN, BULL LANE, BETHERSDEN			
Title			
CONTRIBUTING AREAS PLAN			
Drwg	Rev	Scale	Date
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f: 01622 776227 w: www.dhaplanning.co.uk			
CAD Reference:			A1



NOTES



- PROPOSED SITE BOUNDARY
- DEVELOPMENT BOUNDARY
- EXTENT OF FLOOD ZONE 2

P2	UPDATED RED LINE	09.07.24	CS
P1	FIRST ISSUE	24.06.24	CS
REV	AMENDMENTS	DATE	CHK
Client			
ESQUIRE DEVELOPMENTS LTD			
Project			
LAND ADJACENT TO BULL INN, BULL LANE, BETHERSDEN			
Title			
PROPOSED DRAINAGE PLAN			
Drwg	Rev	Scale	Date
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f: 01622 776227 w: www.dhaplanning.co.uk			
CAD Reference:			A1

DHA Transport Ltd					Page 1	
Eclipse House Eclipse Park Sittingbourne Road Maidstone ME14 3EN			Bethersden			
Date 24/06/2024 15:38 File pond.SRCX			Designed by Chris Checked by			
Causeway			Source Control 2019.1			
<u>Summary of Results for 100 year Return Period (+45%)</u>						
Storm Event		Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer		27.790	0.490	8.2	282.2	O K
30 min Summer		27.893	0.593	8.2	362.9	O K
60 min Summer		27.979	0.679	8.2	436.5	O K
120 min Summer		28.044	0.744	8.2	496.0	O K
180 min Summer		28.075	0.775	8.2	525.6	O K
240 min Summer		28.091	0.791	8.2	541.7	O K
360 min Summer		28.103	0.803	8.2	553.7	O K
480 min Summer		28.101	0.801	8.2	551.7	O K
600 min Summer		28.092	0.792	8.2	542.3	O K
720 min Summer		28.079	0.779	8.2	530.1	O K
960 min Summer		28.053	0.753	8.2	504.9	O K
1440 min Summer		28.002	0.702	8.2	457.7	O K
2160 min Summer		27.931	0.631	8.2	394.6	O K
2880 min Summer		27.862	0.562	8.2	337.9	O K
4320 min Summer		27.737	0.437	8.2	243.6	O K
5760 min Summer		27.633	0.333	8.2	174.6	O K
7200 min Summer		27.556	0.256	8.0	127.9	O K
8640 min Summer		27.501	0.201	7.8	97.1	O K
10080 min Summer		27.465	0.165	7.4	77.8	O K
15 min Winter		27.835	0.535	8.2	316.6	O K
30 min Winter		27.946	0.646	8.2	407.9	O K
Storm Event		Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
15 min Summer		192.260	0.0	283.5	19	
30 min Summer		124.873	0.0	368.6	34	
60 min Summer		76.528	0.0	456.9	64	
120 min Summer		45.025	0.0	537.8	122	
180 min Summer		32.838	0.0	588.3	182	
240 min Summer		26.190	0.0	625.6	242	
360 min Summer		18.990	0.0	680.4	362	
480 min Summer		15.094	0.0	721.0	480	
600 min Summer		12.621	0.0	753.5	598	
720 min Summer		10.899	0.0	780.7	656	
960 min Summer		8.640	0.0	824.8	760	
1440 min Summer		6.218	0.0	889.3	996	
2160 min Summer		4.466	0.0	963.3	1384	
2880 min Summer		3.528	0.0	1014.6	1784	
4320 min Summer		2.529	0.0	1089.7	2508	
5760 min Summer		1.999	0.0	1150.9	3224	
7200 min Summer		1.666	0.0	1198.7	3888	
8640 min Summer		1.436	0.0	1239.1	4576	
10080 min Summer		1.266	0.0	1273.6	5240	
15 min Winter		192.260	0.0	317.7	19	
30 min Winter		124.873	0.0	412.7	33	
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Causeway		Source Control 2019.1			
<u>Summary of Results for 100 year Return Period (+45%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	28.039	0.739	8.2	491.7	O K
120 min Winter	28.111	0.811	8.2	561.4	O K
180 min Winter	28.145	0.845	8.2	596.4	O K
240 min Winter	28.164	0.864	8.2	616.2	O K
360 min Winter	28.181	0.881	8.2	633.7	O K
480 min Winter	28.183	0.883	8.2	635.8	O K
600 min Winter	28.177	0.877	8.2	629.7	O K
720 min Winter	28.167	0.867	8.2	618.7	O K
960 min Winter	28.138	0.838	8.2	588.8	O K
1440 min Winter	28.080	0.780	8.2	530.5	O K
2160 min Winter	27.975	0.675	8.2	432.8	O K
2880 min Winter	27.871	0.571	8.2	344.9	O K
4320 min Winter	27.682	0.382	8.2	206.1	O K
5760 min Winter	27.544	0.244	8.0	120.8	O K
7200 min Winter	27.464	0.164	7.4	77.4	O K
8640 min Winter	27.436	0.136	6.7	62.7	O K
10080 min Winter	27.421	0.121	5.9	55.3	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
60 min Winter	76.528	0.0	511.8	62	
120 min Winter	45.025	0.0	602.3	122	
180 min Winter	32.838	0.0	659.0	180	
240 min Winter	26.190	0.0	700.7	238	
360 min Winter	18.990	0.0	762.0	354	
480 min Winter	15.094	0.0	807.3	466	
600 min Winter	12.621	0.0	843.6	578	
720 min Winter	10.899	0.0	874.0	686	
960 min Winter	8.640	0.0	923.0	878	
1440 min Winter	6.218	0.0	994.0	1098	
2160 min Winter	4.466	0.0	1079.0	1516	
2880 min Winter	3.528	0.0	1136.4	1928	
4320 min Winter	2.529	0.0	1221.0	2636	
5760 min Winter	1.999	0.0	1289.1	3280	
7200 min Winter	1.666	0.0	1342.6	3824	
8640 min Winter	1.436	0.0	1388.0	4488	
10080 min Winter	1.266	0.0	1427.0	5144	
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Causeway	Source Control 2019.1	

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	26.250	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+45

Time Area Diagram

Total Area (ha) 0.800

Time (mins)		Area
From:	To:	(ha)
0	4	0.800

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Model Details Storage is Online Cover Level (m) 28.500 Tank or Pond Structure Invert Level (m) 27.300 <table><thead><tr><th>Depth (m)</th><th>Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th></tr></thead><tbody><tr><td>0.000</td><td>423.0</td><td>1.400</td><td>1579.0</td></tr></tbody></table> Hydro-Brake® Optimum Outflow Control Unit Reference MD-SHE-0130-8200-1200-8200 Design Head (m) 1.200 Design Flow (l/s) 8.2 Flush-Flo™ Calculated Objective Minimise upstream storage Application Surface Sump Available Yes Diameter (mm) 130 Invert Level (m) 27.300 Minimum Outlet Pipe Diameter (mm) 150 Suggested Manhole Diameter (mm) 1200 Control Points <table><thead><tr><th></th><th>Head (m)</th><th>Flow (l/s)</th></tr></thead><tbody><tr><td>Design Point (Calculated)</td><td>1.200</td><td>8.2</td></tr><tr><td>Flush-Flo™</td><td>0.357</td><td>8.2</td></tr><tr><td>Kick-Flo®</td><td>0.768</td><td>6.7</td></tr><tr><td>Mean Flow over Head Range</td><td>-</td><td>7.1</td></tr></tbody></table> The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated <table><thead><tr><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th></tr></thead><tbody><tr><td>0.100</td><td>4.7</td><td>1.200</td><td>8.2</td><td>3.000</td><td>12.6</td><td>7.000</td><td>18.9</td></tr><tr><td>0.200</td><td>7.7</td><td>1.400</td><td>8.8</td><td>3.500</td><td>13.6</td><td>7.500</td><td>19.6</td></tr><tr><td>0.300</td><td>8.1</td><td>1.600</td><td>9.4</td><td>4.000</td><td>14.5</td><td>8.000</td><td>20.2</td></tr><tr><td>0.400</td><td>8.2</td><td>1.800</td><td>9.9</td><td>4.500</td><td>15.3</td><td>8.500</td><td>20.8</td></tr><tr><td>0.500</td><td>8.0</td><td>2.000</td><td>10.4</td><td>5.000</td><td>16.1</td><td>9.000</td><td>21.4</td></tr><tr><td>0.600</td><td>7.8</td><td>2.200</td><td>10.9</td><td>5.500</td><td>16.9</td><td>9.500</td><td>21.9</td></tr><tr><td>0.800</td><td>6.8</td><td>2.400</td><td>11.4</td><td>6.000</td><td>17.6</td><td></td><td></td></tr><tr><td>1.000</td><td>7.5</td><td>2.600</td><td>11.8</td><td>6.500</td><td>18.3</td><td></td><td></td></tr></tbody></table>					Depth (m)	Area (m²)	Depth (m)	Area (m²)	0.000	423.0	1.400	1579.0		Head (m)	Flow (l/s)	Design Point (Calculated)	1.200	8.2	Flush-Flo™	0.357	8.2	Kick-Flo®	0.768	6.7	Mean Flow over Head Range	-	7.1	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	0.100	4.7	1.200	8.2	3.000	12.6	7.000	18.9	0.200	7.7	1.400	8.8	3.500	13.6	7.500	19.6	0.300	8.1	1.600	9.4	4.000	14.5	8.000	20.2	0.400	8.2	1.800	9.9	4.500	15.3	8.500	20.8	0.500	8.0	2.000	10.4	5.000	16.1	9.000	21.4	0.600	7.8	2.200	10.9	5.500	16.9	9.500	21.9	0.800	6.8	2.400	11.4	6.000	17.6			1.000	7.5	2.600	11.8	6.500	18.3		
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