



LAND AT
SCOTLAND FARM



Preliminary Flood Risk Assessment Report

Prepared on behalf of:

Dry Drayton Estate Ltd & Hallam Land Management

By:

Brookbanks

November / 2021

10744 Scotland Farm, Cambridgeshire

Technical Note 1 Rv4: Preliminary Flood Risk Assessment

23th November 2021

1 Introduction

- 1.1 Brookbanks (BCL) are appointed by Dry Drayton Estate Limited and Hallam Land Management (HLM) to complete a Preliminary Flood Risk Assessment at Scotland Farm in Cambridgeshire.
- 1.2 The objective of the study is to provide preliminary advice for the development at Scotland Farm and to ensure that the proposals are acceptable from a flooding risk viewpoint.
- 1.3 This report summarises the findings of the study and specifically addresses the following issues in the context of the current legislative regime:
 - Flood risk from EA open sources
 - Assess on the current publicly available information

2 Background Flooding Information

Location and Details

- 2.1 The development site is located approximately 8km west of Cambridge City centre.
- 2.2 The site is bound in the north and west with agricultural land, by Whitepits and Boundary Plantation to the east and Madingley Road (A428) to the south. The development site lies on undeveloped agricultural land.
- 2.3 The site location is shown in **Figure 2-1**.

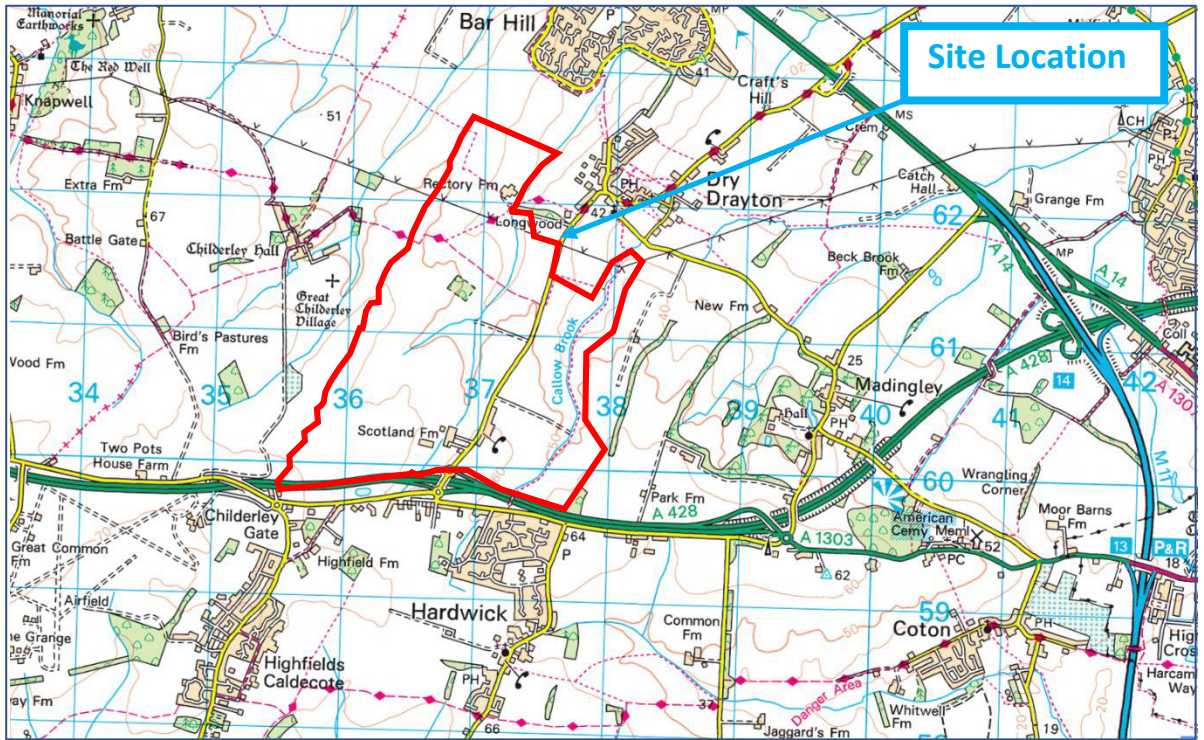


Figure 2-1: Site Location

Development Criteria

2.4 The site is approximately 400ha, with both commercial and residential areas being proposed.

Sources of Information

2.5 The following information has been available while completing the study:

- Environment Agency (EA)
- Published Geology
- Defra Flood risk portal
- British Geological Survey

3 Baseline Conditions

Topography & Site Survey

3.1 There has not been a topographic survey of the site however, reviewing latest LiDAR information (EA) of the site indicates the site falls generally in north easterly direction towards the unnamed watercourse in the western parcel and Callow Brook in the eastern parcel. Ground levels fall from a high point located at the south-west corner of the site just besides the boundary with A428 of circa 71m AOD, to a low point at the north of the site of circa 28m AOD.

Geology & Hydrogeology

- 3.2 With reference to the British Geological Survey map, the majority of the Site is shown to be underlain by Mudstone belonging to the Gault formation. There is a small area of sandstone belonging to the Woburn Sands Formations located in the south-west.
- 3.3 There are superficial deposits of Diamicton belonging to the Oadby Member across the whole site.
- 3.4 The published site geology is illustrated on **Figure 3-1**.

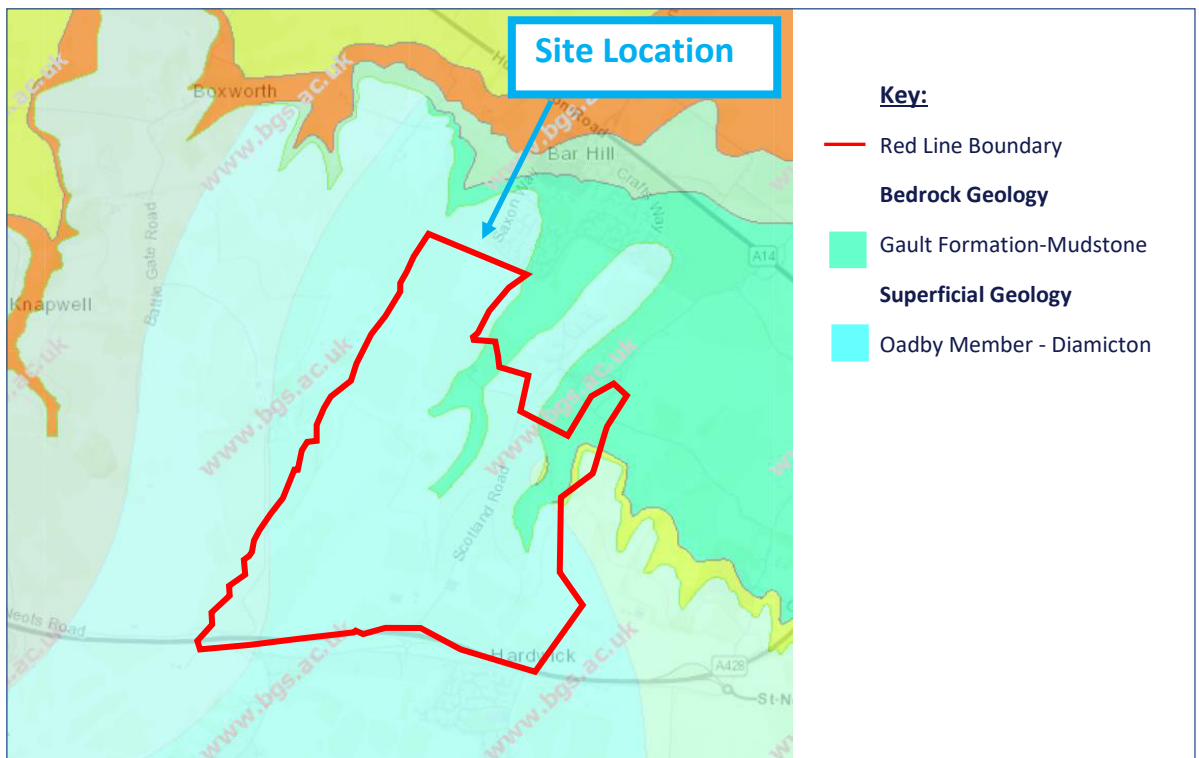


Figure 3-1: BGS Published Geology

- 3.5 The underlying bedrock geology forms a secondary (undifferentiated) aquifer across the whole site and the superficial deposits form a secondary A Aquifer (**Figure 3-2**). The EA provides the following definitions for Aquifers:

Principal Aquifers – These are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer.

Secondary Aquifers - These include a wide range of rock layers or drift deposits with an equally wide range of water permeability and storage. Secondary aquifers are subdivided into two types:

Secondary Undifferentiated - has been assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.

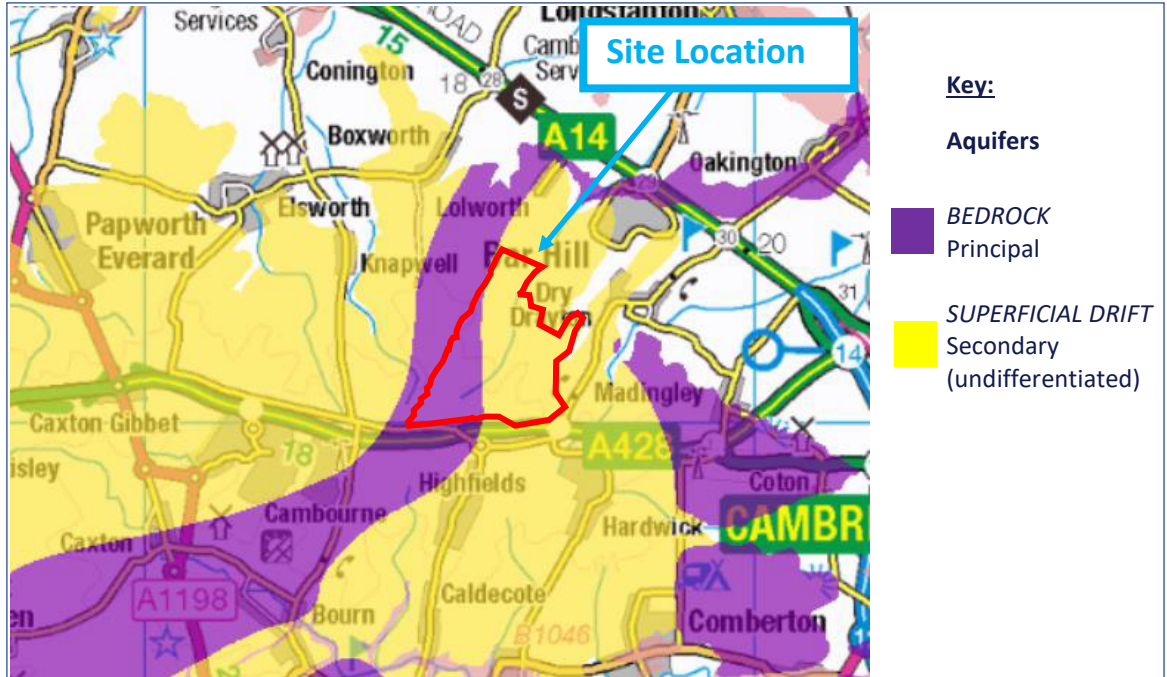


Figure 3-2: EA Aquifers Map

- 3.6 The EA Groundwater Vulnerability Zones (GVZ) Mapping summarises the overall risk to groundwater, taking into account groundwater vulnerability, the types of aquifer present (superficial and/or bedrock) and their designation status, as discussed previously.
- 3.7 The site is shown (Figure 3-3) to be situated within a ‘Medium and Low, in terms of groundwater vulnerability.

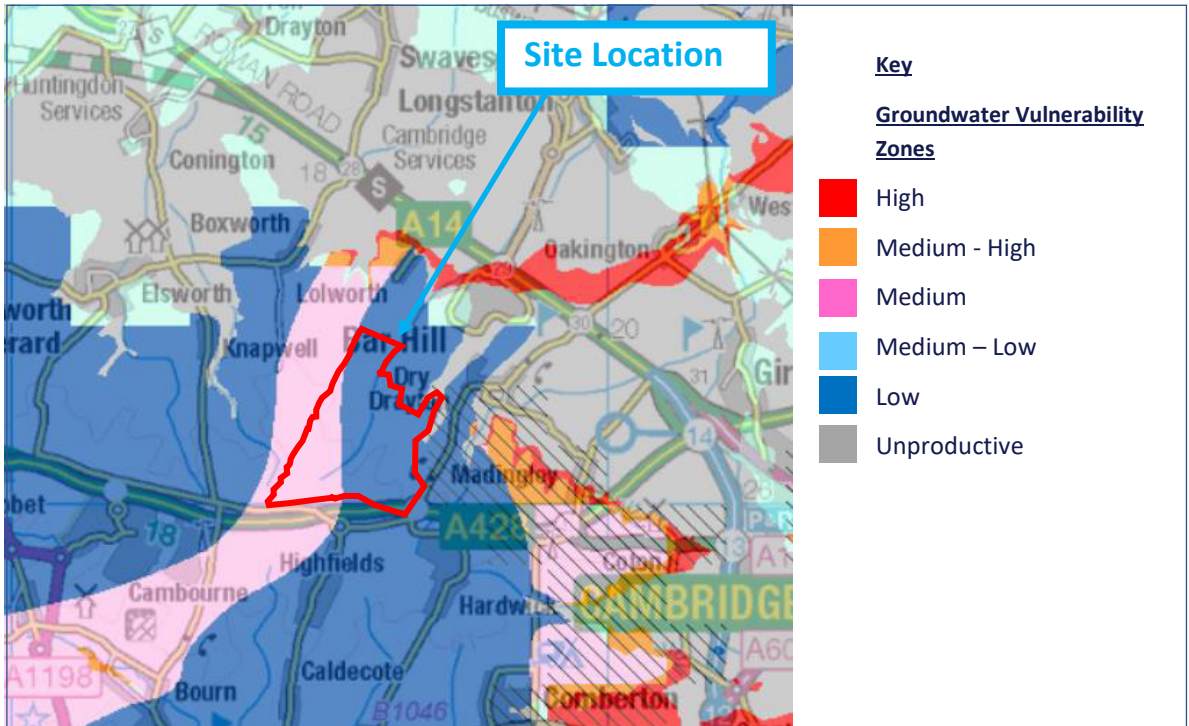


Figure 3-3: EA Groundwater Vulnerability Zones Map

3.8 The EA provides the following definition for the underlying GVZ:

Medium - these are medium priority groundwater resources that have some natural protection resulting in a moderate overall groundwater risk. Activities in these areas should as a minimum follow good practice to ensure they do not cause groundwater pollution.

Low - these are low priority groundwater resources that have a high degree of natural protection. This reduces their overall risk of pollution from surface activities. However, activities in these areas may be a risk to surface water due to increased run-off from lower permeability soils and near-surface deposits. Activities in these areas should be adequately managed.

Drainage Network and FEH Catchment Data

3.9 Reference to the online Flood Estimation Handbook (FEH) online shows that the Site lies between two different sub-catchments where the watershed is located at Scotland Road.

3.10 The western area of the site lies within the unnamed watercourse catchment. This watercourse flows through the centre of the site and is a tributary of Cottenham Lode and part River Great Ouse network. The confluence with Cottenham Lode is located approximately 5.6km downstream of the development site.

3.11 The eastern area lies within the Callow Brook catchment, part of the River Ouse network.

3.12 The site is shown to have no urban development on Site. **Figure 3-4** below illustrates the watercourses and feature described above.

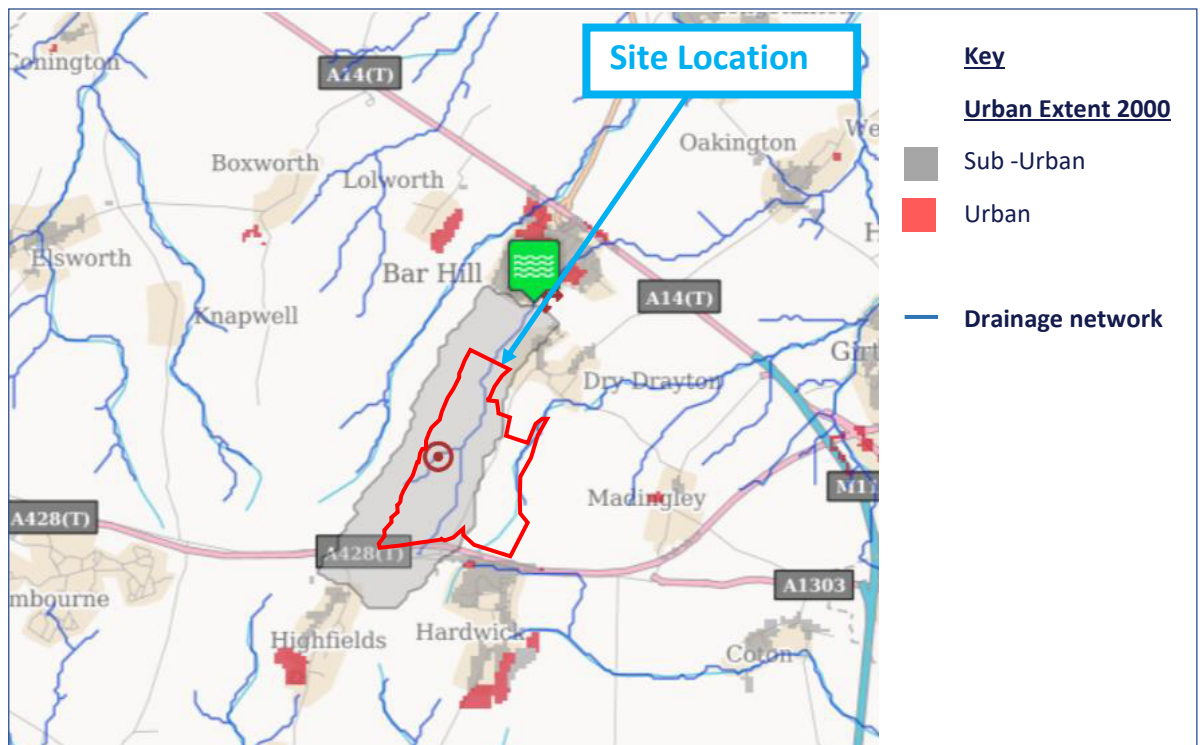


Figure 3-4: FEH web service – Urban Extent 2000 and Drainage Network

3.13 The unnamed watercourse catchment drains approximately an area of 4.6km², and Callow Brook catchment is 1.8km². According to the Wallingford Greenfield-runoff tool the catchment has an average annual rainfall

value of 536mm.

- 3.14** FEH catchment information for both catchments needs to be acquired. This information will be used in the modelling that determines the size of the SuDS required for the proposed development and runoff-rates for modelling purposes if required. The sub-catchment of the unnamed watercourse is located at the **Appendix A**.

4 Flood Risk

Flood Mechanisms

- 4.1** Having completed a site preliminary desk study, the possible flooding mechanisms at the site are identified as follows in **Table 4-1**.

Mechanisms	Potential	Comment
Fluvial	Y	The unnamed watercourse that lies within the development site and has the potential to impact upon the proposed development.
Coastal & Tidal	N	No tidal watercourses lie within an influencing distance of the proposed development.
Overland Flow (Pluvial)	Y	Surface water flood mapping shows a high to very low risk of surface water flooding across the site.
Groundwater	N	Geology underlying the site is of a potentially low permeability. No groundwater flooding was identified within the SFRA and therefore the risk of same is considered low.
Sewers	N	There is no evidence of any sewer or pipes crossing the site.
Reservoirs, Canals etc	N	There is no risk of flooding from reservoirs.

Table 4-1: Flooding Mechanisms

- 4.2** It recommended to undertake a site visit to understand and identify more closely any potential flooding sources that at first instance may not be identified at this report.

Fluvial Flooding

- 4.3** The Environment Agency’s (EA) National Generalised Modelling (NGM) Flood Zones Plan indicates predicted flood envelopes of Main Rivers across the UK. In many circumstances, the NGM is based on basic catchment characteristic data and modelling techniques. Where appropriate, more accurate Section 105 / SFRM models are produced using more robust analysis techniques.
- 4.4** The mapping illustrated on **Figure 4-1** shows that the entire site lies within Flood Zone 1; being an area of Low Probability of flooding and outside both the 1 in 100 (1% AEP) and 1 in 1,000 (0.1% AEP) year flood events.

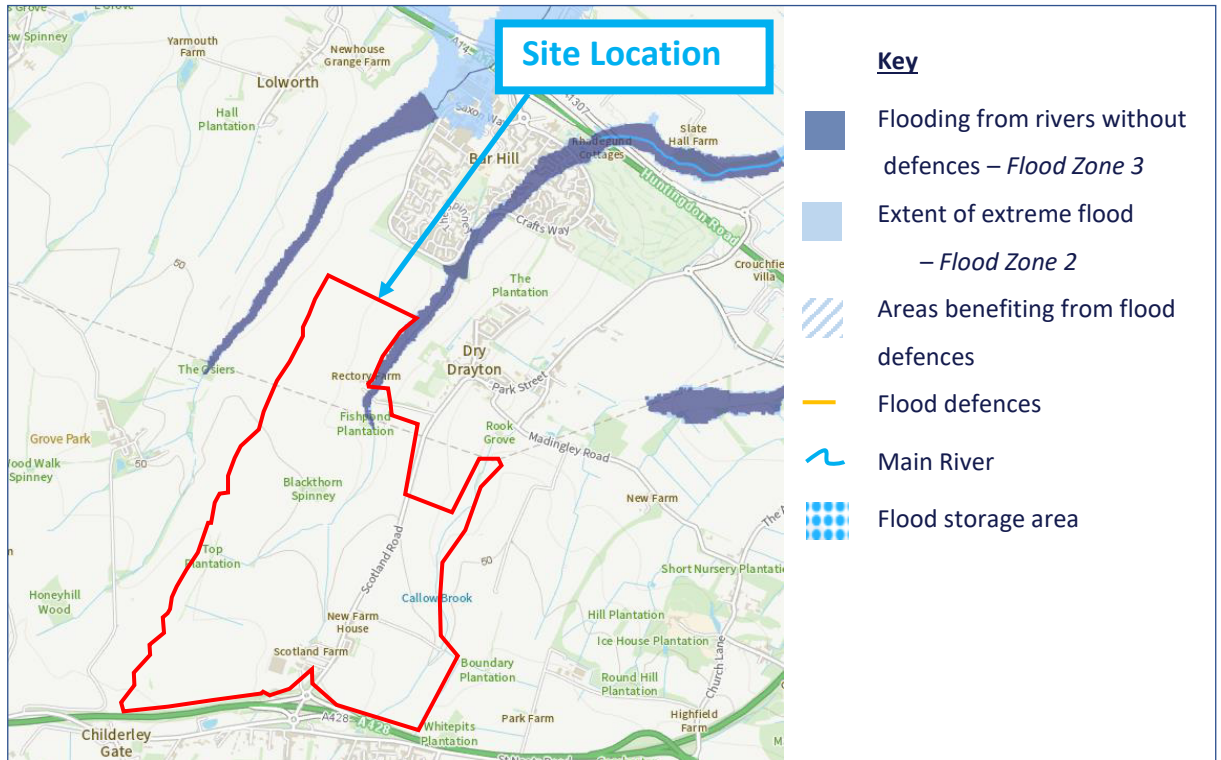


Figure 4-1: EA Flood Zone Plan showing 1 in 100 & 1 in 1,000 year floodplains

Coastal Flooding

4.5 The site lies a significant distance from the nearest tidal watercourse and the coast. As such there is no risk of tidal or coastal flooding at this location.

Overland Flow (Pluvial)

4.6 Overland flow mechanisms result from the inability of unpaved ground to infiltrate rainfall or due to inadequacies of drainage systems in paved areas to accommodate flow directed to gullies, drainage downpipes or similar. In minor cases, local ponding may occur. In more extreme events, flows accumulate and may be conveyed across land following the topography.

4.7 The Environment Agency, in partnership with lead local flood authorities, produced a series of surface water flood maps for many parts of the UK. **Figure 4-2**, illustrates areas of low to high risk from surface water flooding:

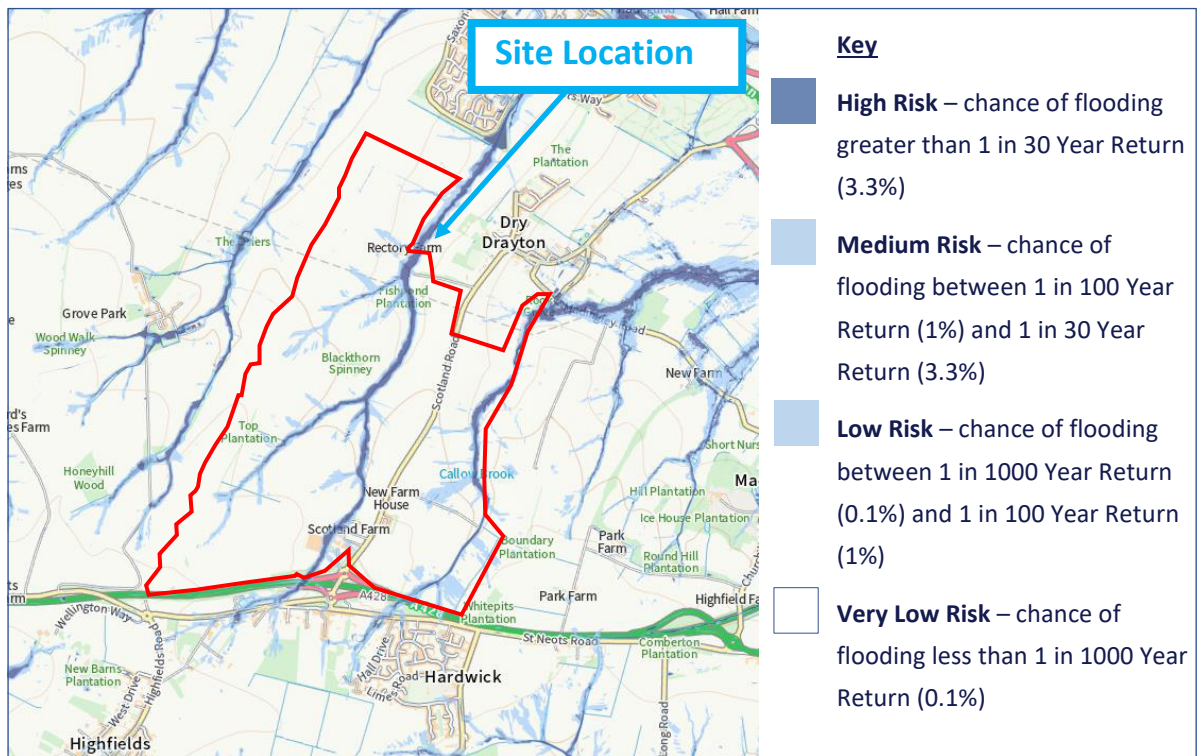


Figure 4-2: EA Long Term Flood Risk Maps – Flood risk from Surface Water (Gov.Uk website)

- 4.8 The mapping above identifies that the majority of the Site has a very low risk of surface water flooding. However, land located adjacent to the unnamed watercourse banks is shown to have a High Risk from surface water flooding.
- 4.9 Initial investigations suggest that the risk of overland flow relates primarily to the topography of the site; low areas of the site naturally store water limiting the surface runoff in concentrated areas. As part of the development, the topography will be altered, providing a rationalised surface for water runoff.

Artificial Water Bodies - Reservoirs & Canals

- 4.10 Non-natural or artificial sources of flooding comprises of reservoirs, canals and lakes where water is retained above the natural ground level.
- 4.11 However unlikely, reservoirs, canals and other artificial sources have a potential to cause flooding due to the release of large volumes of water, resulting from a dam or bank failure.
- 4.12 Within Scotland Farm site there are no canals or reservoirs, close to the development site. Therefore, the risk of flooding from this source is considered negligible.

5 Storm Drainage

Drainage Options

- 5.1** The following paragraphs in this section outline the proposed drainage strategy to meet national and local design requirements and guidance.
- 5.2** Current guidance¹ requires that new developments implement means of storm water control, known as SuDS (Sustainable Drainage Systems), to maintain flow rates discharged to the surface water receptor at the pre-development 'baseline conditions' and improve the quality of water discharged from the land.
- 5.3** It is proposed to implement a SuDS scheme consistent with local and national policy at the proposed development.
- 5.4** When appraising suitable storm water discharge options for a development site, Part H of the Building Regulations 2002 (and associated guidance) provides the following search sequence for identification of the most appropriate drainage methodology.

"Rainwater from a system provided pursuant to sub-paragraphs (1) or (2) shall discharge to one of the following, listed in order of priority -

- a) an adequate soakaway or some other adequate infiltration system; or where that is not reasonably practicable,***
- b) a watercourse; or where that is not reasonably practicable,***
- c) a sewer. "***

- 5.5** Dealing with the search order in sequence:

- a) Source control systems treat water close to the point of collection, in features such as soakaways, porous pavements, infiltration trenches and basins. The use of same can have the benefit of discharging surface water back to ground rather than just temporarily attenuating peak flows before discharging it to a receiving watercourse or sewer.

As source control measures generally rely upon the infiltration of surface water to ground, it is a prerequisite that the ground conditions are appropriate for such. Site ground investigations specific to flood risk have yet to be completed however published geology suggests the presence of potentially impermeable formations within the site. While the ground formations may not be possible for a wholesale infiltration-based drainage strategy, where subsequent investigations show infiltration is viable locally to work, this may be incorporated into the design.

As such, source control measures will therefore be primarily restricted to detention and conveyance systems placed close to source.

- b) Next in the search sequence, defined by Part H, is discharge to a watercourse or suitable receiving water body. Where coupled with appropriate upstream attenuation measures, this means of

¹ NPPF, CIRIA C522, C609, C753 et al.

discharge can provide a sustainable drainage scheme that ensures that peak discharges and flood risk in the receiving water body are not increased.

The unnamed watercourse and Callow Brook crosses the site and as such represents an appropriate receptor for storm water discharge, have the potential to receive flows from the proposed development once restricted to the pre-existing 'greenfield' rates of run-off.

- c) Last in the search sequence is discharge to a sewer. In the context of SuDS this is the least preferable scheme as it relies on 'engineered' methods to convey large volumes of water from development areas, has a higher likelihood of flooding due to blockage and provides less intrinsic treatment to the water.

Anglian Water will need to confirm the presence of any sewers in the site and surrounding area.

- 5.6 The search sequence outlined above indicates that the existing onsite watercourse is the most appropriate receptor of storm water from the proposed development, having the potential to employ source control measures and on-line SuDS to control peak discharges to no greater than the baseline conditions.

Detention Basins

- 5.7 National policy requires that new developments control the peak discharge of storm water from a site to the baseline, undeveloped, site conditions. The baseline IoH run-off rates are shown on **Table 5-1** below:

Event	IoH 124 (385ha)	IoH 124 Scaled to 1ha
1 in 1 year (l/s)	984.56	2.56
Qbar (l/s)	1131.68	2.94
1 in 100 year (l/s)	4029.10	10.47

Table 5-1: IoH124 Baseline Discharge Rates

- 5.8 In order to determine the permitted rates of run-off from the development, the future impermeable catchment areas must be derived. This has been based on a BCL measured ratio from previous projects. Calculations below show these ratios and areas and how these correlate to the rates of discharge.

- 5.9 Two different approach has been tested for the western site:

- Dividing the land in 12 different basins, &
- Online basins located at the ditch.

- 5.10 For the eastern area it is proposed three online cascading basins within Callow Brook.

Multiple Basins

- 5.11 This approach divides the land in 12 different sub-catchments according to the use and flow direction.

5.12 The calculations for this are shown in **Table 5-2** below:

Catchment	Land Use	Developable Area (ha)	Impermeable Area (ha)	Existing 100 Year Run-off (l/s)	Proposed 100 Year Run-off (l/s)
A	Residential	15.50	9.38	98.14	27.56
B	High Res	13.03	8.58	89.78	25.22
C	Education	12.01	7.58	79.28	22.27
D	Residential	7.40	4.48	46.85	13.16
E	Residential	6.07	3.67	38.43	10.79
F	High Res	12.57	7.85	81.05	23.08
G	Residential	6.38	3.86	40.39	11.35
H	High Res	29.40	19.68	206.00	57.86
I	Education	7.03	4.47	46.74	13.13
J	Residential	7.79	4.71	49.32	13.85
K	Education	24.96	15.57	162.94	45.77
I	Commercial	20.80	16.42	171.00	48.27
		162.94	106.25	1109.92	312.32

Table 5-2: Run-off Calculation

5.13 Accordingly, a plan showing the conceptual drainage masterplan of the site for this option is contained within the **Appendix B** as drawing 10744-DR-01 B.

Online Basins

5.14 This approach contains two online basins located at the ditch.

5.15 The calculations for this are shown in **Table 5-3** below:

Catchment	Land Use	Developable Area (ha)	Impermeable Area (ha)	Existing 100 Year Run-off (l/s)	Proposed 100 Year Run-off (l/s)
A	Mixed Use	47.94	30.01	314.20	88.21
B	Mixed use	115.00	76.24	795.72	224.11
		162.94	106.25	1109.92	312.32

Table 5-3: Run-off Calculation

5.16 This approach contains three online basins located at Callow Brook.

5.17 The calculations for this are shown in **Table 5-4** below:

Catchment	Land Use	Developable Area (ha)	Impermeable Area (ha)	Existing 100 Year Run-off (l/s)	Proposed 100 Year Run-off (l/s)
C	Residential	11.18	6.76	70.79	19.88
D	Residential	20.65	12.49	130.74	36.72
E	Mixed use	15.24	9.02	94.35	26.50
		47.07	28.27	295.88	83.11

Table 5-4: Run-off Calculation

5.18 Accordingly, a plan showing the conceptual drainage masterplan of the site for this option is contained within **Appendix C** as drawing 10744-DR-03 A.

5.19 Using these methods, development at the site will comply with the requirements set out in paragraph 9 of the Technical Guide to the National Planning Policy Framework (NPPF), with the discharge of surface water from the proposed developments not exceeding that of the existing greenfield sites, thus ensuring that there is no material increase in the flood risk to surrounding areas.

5.20 Assessments have thereafter been completed to determine the characteristics of proposed SuDS features to be situated within the development. Best practice methods have been employed by performing detention routing calculations for both the 1 in 1 and 1 in 100 years + 40% climate change storm events.

6 Conclusions

6.1 This FRA has identified no prohibitive engineering constraints in developing the proposed site for the proposed developments.

6.2 Assessment of fluvial flood risk shows the land to lie within Flood Zone 1 and hence be a preferable location for development when considered in the context of the NPPF Sequential Test. Assessment of other potential flooding mechanisms shows the land to have a low probability of flooding from overland flow, groundwater and sewer flooding.

6.3 Storm water discharged from development will be disposed of by way of SuDS measures to the existing watercourse within the site.

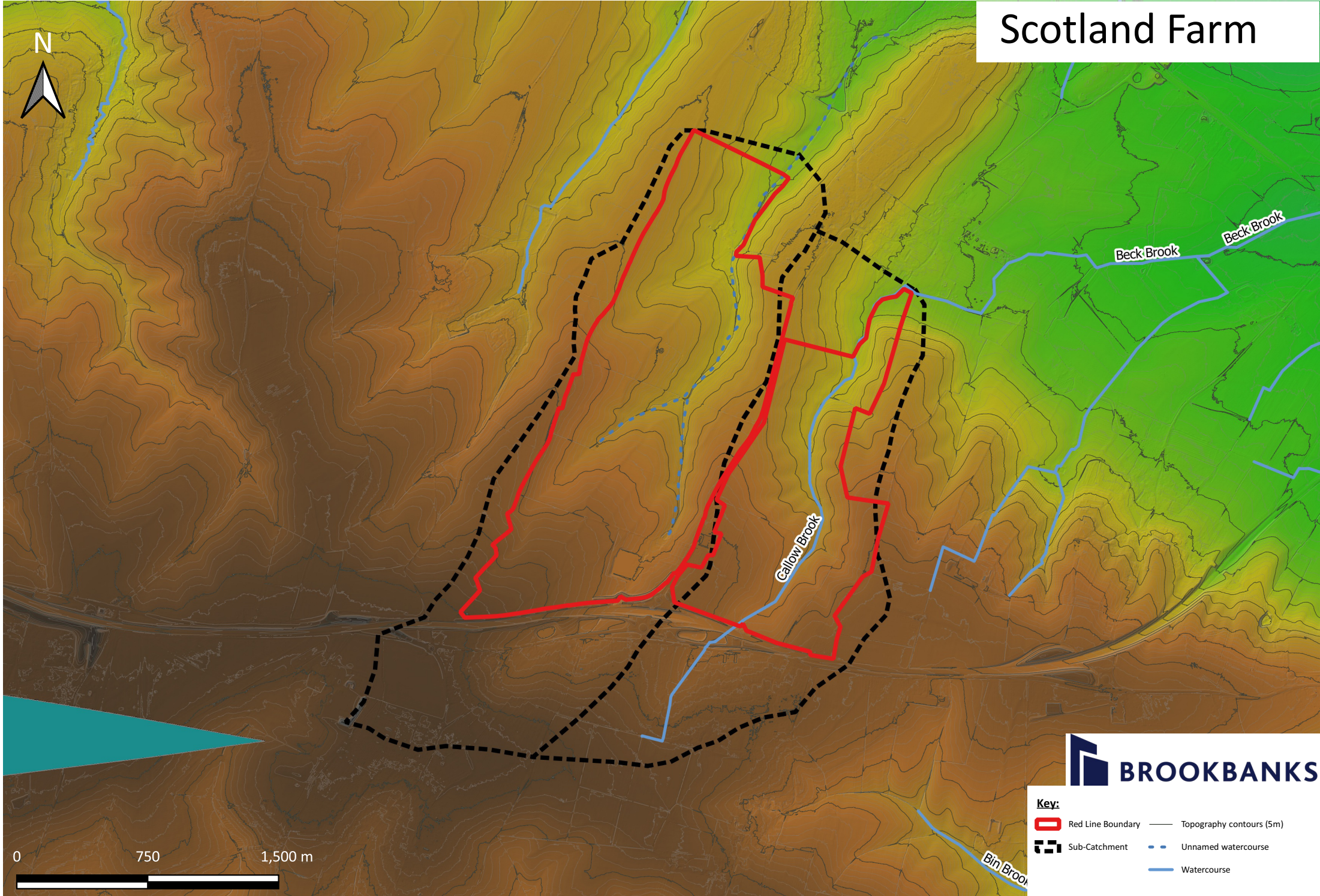
6.4 The site is fully able to comply with NPPF guidance together with associated local and national policy guidance.





7 Limitations

- 7.1** The conclusions and recommendations contained herein are limited to those given the general availability of background information and the planned usage of the site.
- 7.2** Third party information has been used in the preparation of this report, which Brookbanks by necessity assumes is correct at the time of writing. While all reasonable checks have been made on data sources and the accuracy of data, Brookbanks accepts no liability.
- 7.3** The benefits of this report are provided to Dry Drayton Estate Limited and Hallam Land Management, for the proposed development on land at Scotland Farm only.
- 7.4** Brookbanks excludes third party rights for the information contained in the report.

Appendix A – Catchment Delimitation

Scotland Farm

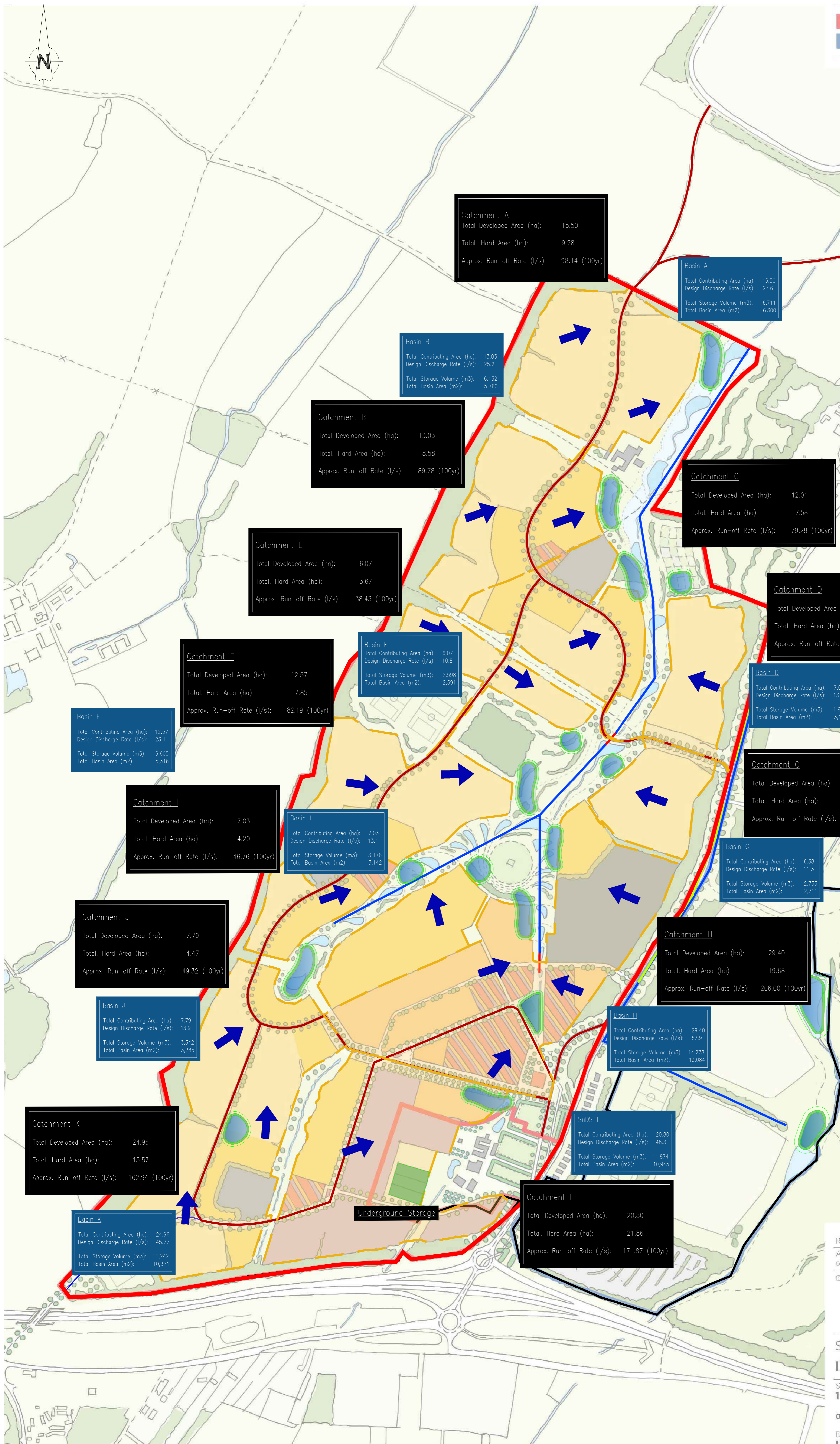


- Key:**
-  Red Line Boundary
 -  Sub-Catchment
 -  Topography contours (5m)
 -  Unnamed watercourse
 -  Watercourse

Appendix B - Drainage Plan Option 1

Construction Design and Management (CDM)
Key Residual Risks
 Contractors entering the site should gain permission from the relevant land owners and/or principle contractor working on site at the time of entry. Contractors shall be responsible for carrying out their own risk assessments and for liaising with the relevant services companies and authorities. Listed below are Site Specific key risks associated with the project.

- 1) Overhead and underground services
- 2) Street Lighting Cables
- 3) Working adjacent to water courses and flood plain
- 4) Soft ground conditions
- 5) Working adjacent to live highways and railway line
- 6) Unchartered services
- 7) Existing buildings with potential asbestos hazards



- NOTES:**
1. Do not scale from this drawing.
 2. All dimensions are in metres unless otherwise stated.
 3. Brookbanks Consulting Ltd has prepared this drawing for the sole use of the client. The drawing may not be relied upon by any other party without the express agreement of the client and Brookbanks Consulting Ltd. Where any data supplied by the client or from other sources has been used, it has been assumed that the information is correct. No responsibility can be accepted by Brookbanks Consulting Ltd for inaccuracies in the data supplied by any other party. The drawing has been produced based on the assumption that all relevant information has been supplied by those bodies from whom it was requested.
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B Updated Basins	AM	DS	DS	06.08.21
A Updated Basins	AM	DS	DS	19.05.21
- First Issue	AM	DS	DS	30.04.21

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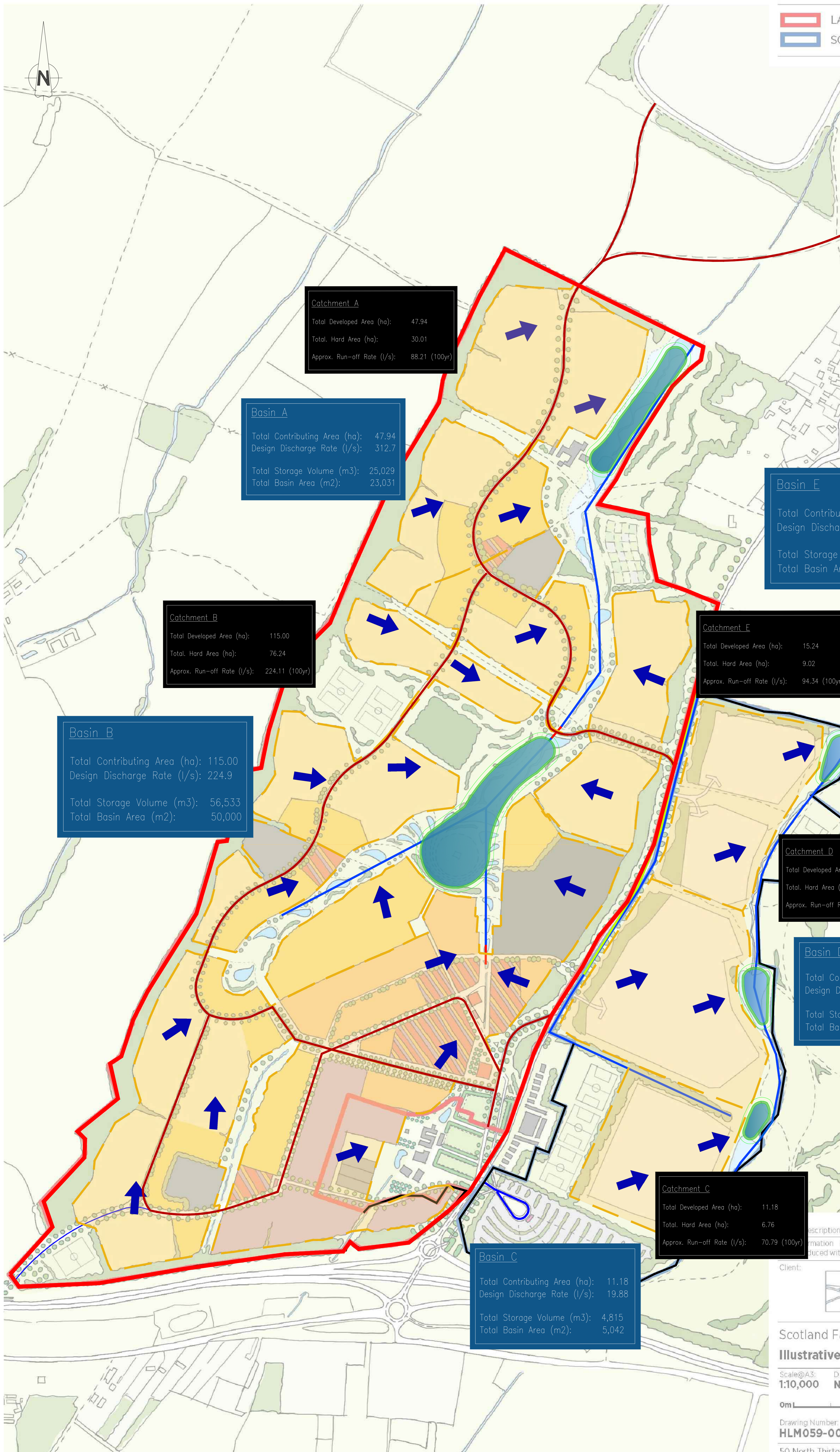
**Illustrative Surface Water
 Drainage Strategy Plan**

Status	Status Date	
Draft	MAY 2021	
Drawn	Checked	Date
AM	DS	06.05.2021
Scale	Number	Rev
1:5000	10744-DR-01	B

0 100 200 300 400 500
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Appendix C - Drainage Plan Option 2



Construction Design and Management (CDM)
Key Residual Risks

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Catchment A

Total Developed Area (ha): 47.94
 Total Hard Area (ha): 30.01
 Approx. Run-off Rate (l/s): 88.21 (100yr)

Basin A

Total Contributing Area (ha): 47.94
 Design Discharge Rate (l/s): 312.7
 Total Storage Volume (m3): 25,029
 Total Basin Area (m2): 23,031

Basin E

Total Contributing Area (ha): 15.24
 Design Discharge Rate (l/s): 83.40
 Total Storage Volume (m3): 6,449
 Total Basin Area (m2): 6,637

Catchment B

Total Developed Area (ha): 115.00
 Total Hard Area (ha): 76.24
 Approx. Run-off Rate (l/s): 224.11 (100yr)

Basin B

Total Contributing Area (ha): 115.00
 Design Discharge Rate (l/s): 224.9
 Total Storage Volume (m3): 56,533
 Total Basin Area (m2): 50,000

Catchment E

Total Developed Area (ha): 15.24
 Total Hard Area (ha): 9.02
 Approx. Run-off Rate (l/s): 94.34 (100yr)

Catchment D

Total Developed Area (ha): 20.65
 Total Hard Area (ha): 12.49
 Approx. Run-off Rate (l/s): 130.74 (100yr)

Basin D

Total Contributing Area (ha): 20.65
 Design Discharge Rate (l/s): 56.8
 Total Storage Volume (m3): 8,967
 Total Basin Area (m2): 8,806

Catchment C

Total Developed Area (ha): 11.18
 Total Hard Area (ha): 6.76
 Approx. Run-off Rate (l/s): 70.79 (100yr)

Basin C

Total Contributing Area (ha): 11.18
 Design Discharge Rate (l/s): 19.88
 Total Storage Volume (m3): 4,815
 Total Basin Area (m2): 5,042

A	Second Issue	AM	DS	DS	14.07.21
-	First Issue	AM	DS	DS	06.05.21

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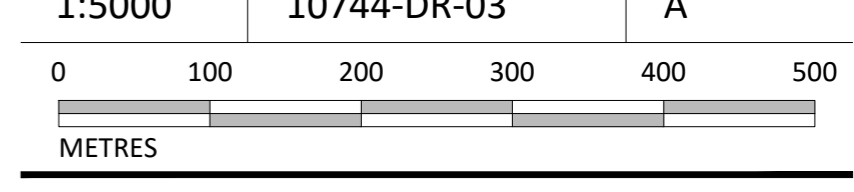
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Illustrative Surface Water Drainage Strategy Plan

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Draft	JULY 2021	
Drawn	Checked	Date
AM	DS	14.07.2021
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1:5000	10744-DR-03	A



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