Pre-Planning Engineering

Flood Risk Assessment

Proposed Residential Development
Land North of Dukes Meadow Drive
Banbury

Revision 0: September 2021
Report Reference: 340-FRA-01-0

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Revision Record

Revision	Date	Description	Written	Approved
0	24/08/21	Draft issue	MJA	MJA
0	20/09/21	Draft issue 2	MJA	MJA
0	23/09/21	Planning Issue	AN	MJA

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1.0 Introduction

1.1 Instructions

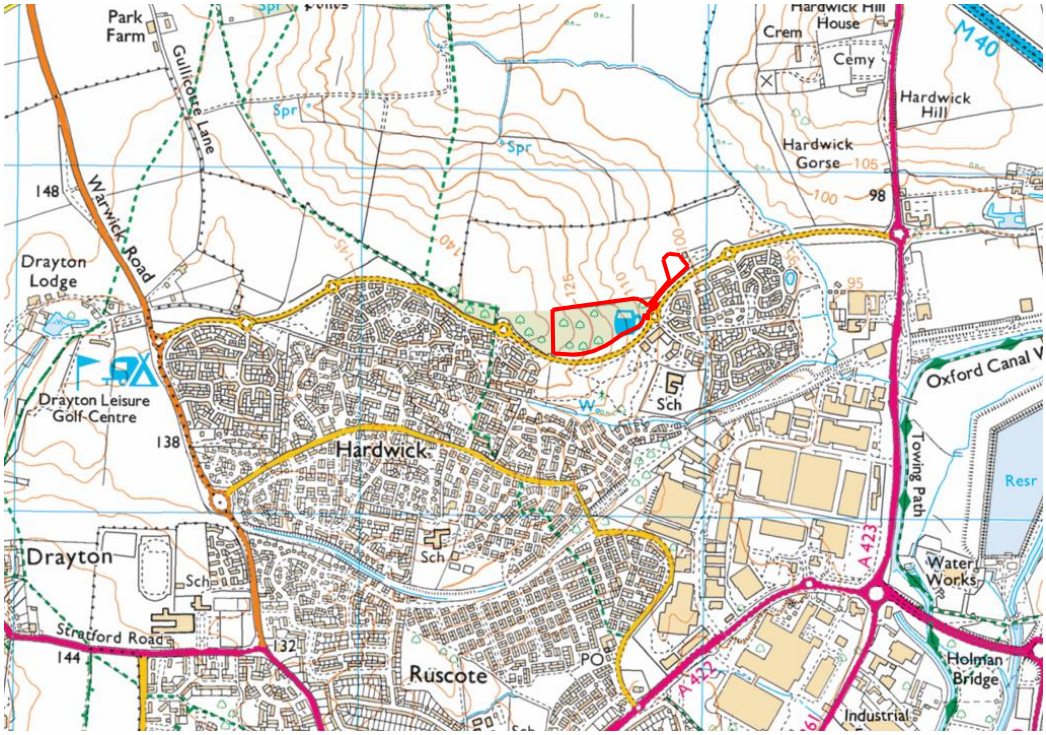
1.1.1 MAC have been commissioned by Manor Oak Homes to provide a Flood Risk Assessment to accompany an Outline planning application for a residential development on land north of Dukes Meadow Drive, Banbury, Oxfordshire.

1.1.2 The benefit of this report is to our instructing Client.

1.2 Site Location

1.2.1 The proposed development site is located on land north of Dukes Meadow Drive, Banbury, as shown in **Inset 1.1** below and enclosed in **Appendix A**. The approximate National Grid Reference for the site is E444697 N242543.

Inset 1.1: Site Location Plan



1.3 Current Use and Description

1.3.1 The site currently comprises undeveloped greenfield land. There has been no previous development on the site. The existing site is shown on the topographical survey enclosed in **Appendix B**.

1.4 Proposed Development

1.4.1 The proposed development will comprise up to 78 dwellings. An affordable housing element is likely to be provided at 30%. The proposed development layout is shown on the plan enclosed in **Appendix C**.

1.4.2 In line with paragraph 26 of the Planning Practice Guidance for 'Flood risk and climate change' the lifetime of a residential development is considered to be at least 100 years.

1.4.3 The 'Flood Risk Vulnerability Classification' of various development types is defined within Annex 3 of the National Planning Policy Framework (NPPF) – July 2021. A residential development is classified as a More Vulnerable development. The relevant extract from Annex 3 of the NPPF is set out below.

More Vulnerable

- Hospitals
- Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels.
- Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels.
- Non–residential uses for health services, nurseries and educational establishments.
- Landfill* and sites used for waste management facilities for hazardous waste.
- Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.

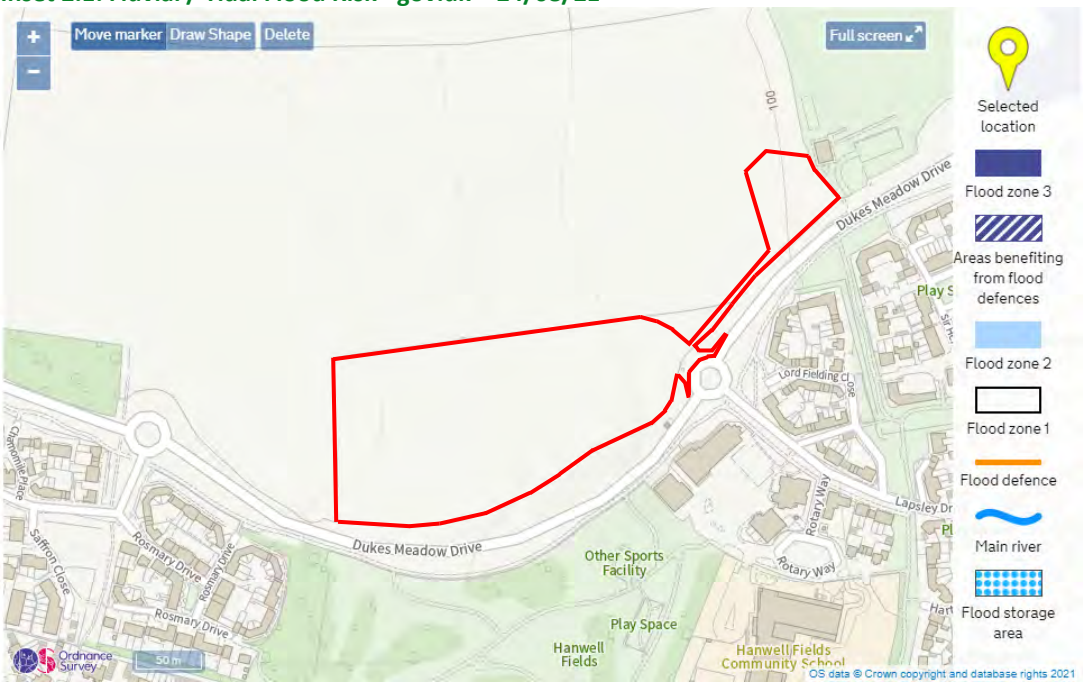
2.0 Site Specific Flood Risk

2.1 Risk of Fluvial / Tidal Flooding

2.1.1 The likelihood of fluvial and tidal flooding is defined on the Environment Agency's map 'Flood Map for Planning'. This flood map is published on the gov.uk website.

2.1.2 An extract of this flood map is provided below in **Inset 2.1**. The approximate site boundary is shown in red.

Inset 2.1: Fluvial / Tidal Flood Risk - gov.uk – 24/08/21



2.1.3 The Environment Agency's flood map shows that the proposed development site is located within Flood Zone 1 (Low Probability) and as such, the development is at a low (less than 1 in 1000 years) risk of flooding from rivers or the sea.

2.2 Risk of Surface Water Flooding

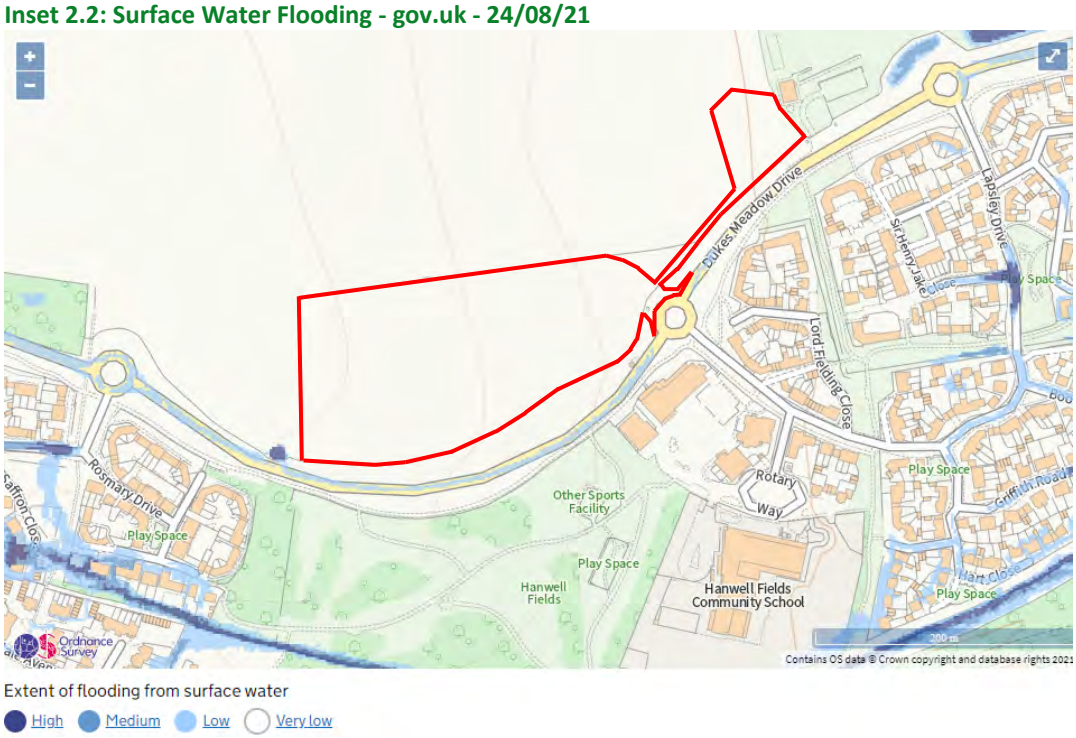
2.2.1 The likelihood of surface water flooding is defined on the Environment Agency's map 'Flood risk from surface water'. This flood map is published on the gov.uk website.

2.2.2 An extract of this flood map is provided below in **Inset 2.2**. The approximate site boundary is shown in red.

2.2.3 Regarding the accuracy of this map the EA state that:

"Flooding from surface water is difficult to predict as rainfall location and volume are difficult to forecast. In addition, local features can greatly affect the chance and severity of flooding. Because of this, we report the highest risk within 20m of a specific location, such as an individual property. This means reports for neighbouring properties may show different levels of risk."

Inset 2.2: Surface Water Flooding - gov.uk - 24/08/21



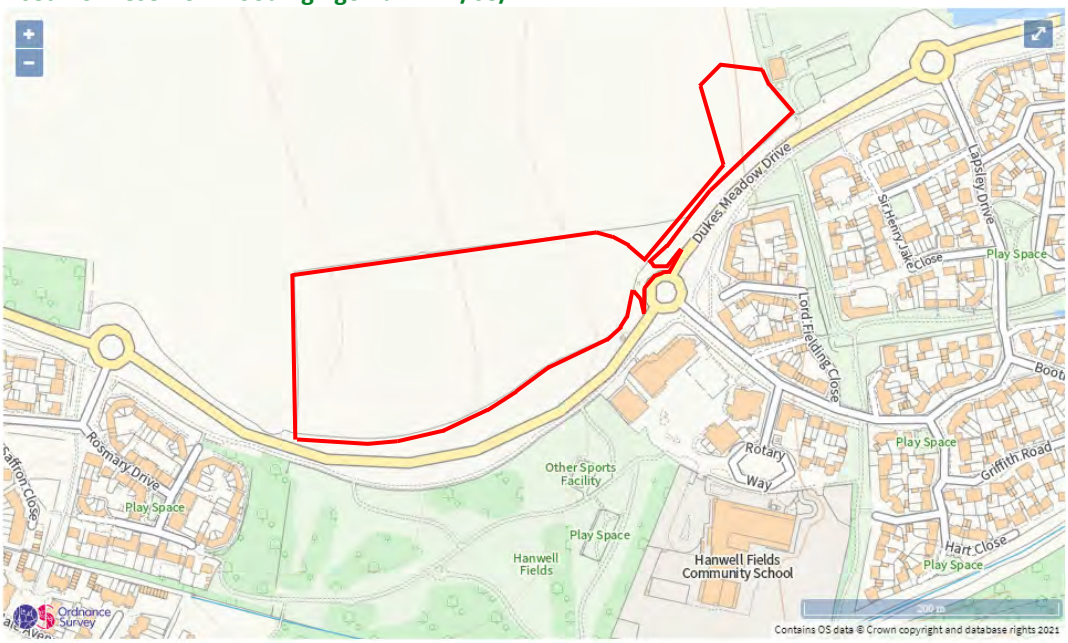
2.2.4 The site is located in an area of very low surface water flood risk.

2.3 Risk of Reservoirs, Canals and Other Artificial Sources Flooding

2.3.1 The likelihood of reservoir water flooding is defined on the Environment Agency's map 'Flood Risk from Reservoirs'. This flood map is published on the gov.uk website.

2.3.2 An extract of this flood map is provided below in **Inset 2.3**. The approximate site boundary is shown in red.

Inset 2.3: Reservoir Flooding - gov.uk – 24/08/21



2.3.3 The site is not at risk of reservoir flooding. We are not aware of any canals or other artificial sources which may cause flooding on the site.

2.4 Risk of Ground Water Flooding

2.4.1 We do not have any records of ground water flooding within the vicinity of the site. We therefore consider the risk of ground water sewer flooding to be low.

2.5 Risk of Sewer Flooding

2.5.1 We do not have any records of sewer flooding within the vicinity of the site. We therefore consider the risk of sewer flooding to be low.

2.6 Previous Flood Events

2.6.1 The Environment Agency's Historic Flood Map does not show any flooding within the boundary of the site. The Environment Agency's "Historic Flood Map is a GIS layer showing the maximum extent of all individual Recorded Flood Outlines from river, the sea and groundwater springs that meet a set criteria. It shows areas of land that have previously been subject to flooding in England. Records began in 1946 when predecessor bodies to the Environment Agency started collecting detailed information about flooding incidents".

2.7 Summary of Flood Risk

2.7.1 The proposed development site is located within Flood Zone 1 and is at a low risk of flooding from all other sources.

2.8 Flood Risk Vulnerability and Flood Zone 'Compatibility'

2.8.1 The suitability of different development types to be built and occupied within a particular Flood Zone is defined within Table 3 of the Planning Practice Guidance for 'Flood Risk and Coastal Change' to the National Planning Policy Framework. Table 3 is replicated below in **Table 2.1** below. This table maps vulnerability classes against the flood zones to indicate where development is 'appropriate' and where it should not be permitted.

2.8.2 The proposed residential development is located within Flood Zone 1 and is classified as a More Vulnerable development. Based on this categorisation of the development it is considered 'appropriate'.

Table 2.1: Flood risk vulnerability and flood zone 'compatibility'

Flood Zone	Flood Risk Vulnerability Classification				
	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
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.

† In Flood Zone 3a essential infrastructure should be designed and constructed to remain operational and safe in times of flood.

" * " In Flood Zone 3b (functional floodplain) essential infrastructure that has to be there and has passed the Exception Test, and water-compatible uses, should be designed and constructed to:

- remain operational and safe for users in times of flood;
- result in no net loss of floodplain storage;
- not impede water flows and not increase flood risk elsewhere.

3.0 Surface Water Management

3.1 Existing Drainage

3.1.1 The site is currently undeveloped with no positive drainage.

3.2 Existing Discharge Rate

3.2.1 The existing discharge rate for the site has been calculated using the IH124 method. Full calculations are enclosed in **Appendix F** whilst the input parameters and results are summarised in **Table 3.1** below.

Table 3.1: Existing Run-off Rate Calculation Parameters and Results

Parameter	Value
Proposed Drained Area (ha)	1.410, see **Appendix E**
SAAR (mm)	639
Soil Index / SPR	4 / 0.47
Region	6
Results	**Value**
Q_{Bar} (l/s)	6.1
Q1 (l/s)	5.2
Q30 (l/s)	11.9
Q100 (l/s)	15.2

3.2.2 The allowable discharge rate for the site is the Q_{Bar} rate of 6.1 l/s. Surface water from the site post development will be restricted to a discharge rate of 6.1 l/s via a hydrobrake.

3.3 Proposed Method of Discharge

3.3.1 Paragraph 80 of the Planning Practice Guidance for 'Flood Risk and Coastal Change' defines the hierarchy of drainage options. Where reasonably practicable the aim should be to discharge surface water run-off as high up the following hierarchy of drainage options as reasonably practicable:

1. into the ground (infiltration)
2. to a surface water body
3. to a surface water sewer, highway drain, or another drainage system
4. to a combined sewer

3.3.2 Each of these is considered separately below:

Into the ground

3.3.3 Inspection of the British Geological Survey's maps show that the underlying geology at the site are likely to comprise Charmouth Mudstone Formation to the west of the site the underlying geology is likely to comprise Dyrham Formation - Siltstone and Mudstone.

3.3.4 Based on the above geology description we would anticipate that infiltration techniques across the site would be unviable. Infiltration testing will be undertaken at the detailed design stage to confirm this assumption. Should infiltration be found to be viable the drainage strategy proposed for the development will be altered to take this into account.

To a surface water body

3.3.5 There is a ditch located adjacent to the site's northern boundary, however, due to the local topography it is proposed to locate the attenuation to the northeast of this ditch where the ground is flatter and better suited for surface water attenuation. Therefore, the surface water from this development will outfall into the ditch only slightly further downstream.

3.3.6 As a surface water body is viable the use of alternative drainage methods will not be considered further in this report.

3.4 Proposed Drainage Strategy

3.4.1 Surface water discharge from the proposed development outfall to into a watercourse. The surface water discharge rate from the site will be restricted to greenfield equivalent run-off rates to ensure that the rate of surface water run-off from the site does not increase as a result of the proposed development.

3.4.2 The proposed drainage strategy will comprise a:

- A piped network
- Hydrobrake flow control
- Detention Basin – online
- Permeable paving to private drives – tanked
- Swale

3.4.3 The proposed surface water drainage strategy is shown on the drawing enclosed in in **Appendix C**.

Design Parameters

3.4.4 Surface water drainage will be designed using the rainfall parameters from the Flood Estimation Handbook (FEH).

3.4.5 Climate change allowances are defined by the Environment Agency in their document 'Flood risk assessments: climate change allowances' first published in February 2016. Table 2 of this document shows anticipated changes in extreme rainfall intensity in small and urban catchments. The Environment Agency advise that flood risk assessments and strategic flood risk assessments, assess both the central and upper end allowances to understand the range of impact. Table 2 of the Environment Agency's guidance is replicated below in **Table 3.2**.

Table 3.2: Table 2 Peak rainfall intensity allowance in small and urban catchments

Applies across all of England	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Upper end	10%	20%	40%
Central	5%	10%	20%

3.4.6 To ensure a worst-case assessment is undertaken a 40% climate change allowance will be used throughout.

3.5 Attenuation Design

3.5.1 Surface water attenuation is required to store excess water during an extreme event whilst maintaining a greenfield discharge rate of 6.1 l/s. Surface water will be attenuated within a detention basin. Full calculations are enclosed in **Appendix F** whilst design parameters are set out below.

Table 3.3: Attenuation Calculation Parameters and Results

Parameter	Value
Return Period (years)	100 + 40% Climate Change
Rainfall Parameters	FEH13
Drained Area (ha)	6.1, see **Appendix E** includes 10% urban creep
Discharge Rate (l/s)	6.1
Results	**Value**
Storage Requirement (m^3)	1449

3.6 Maintenance Requirements

3.6.1 The drainage will be designed in line with Building Regulations, Design and Construction Guidance for foul and surface water sewers offered for adoption under the Code for adoption agreements for water and sewerage companies operating wholly or mainly in England ("the Code"); as well as local SUDS guidance to ensure compliance with best practice guidance, thus minimising the maintenance requirements. A full maintenance plan for the site will be developed at the detailed design stage.

3.6.2 The person / authority responsible for maintenance of the drainage will depend on ownership which will vary across the site; as detailed design and adoption progresses the exact body responsible for adoption of the various surface water aspects will become clear. Typical responsibilities are set out below in **Table 3.4**.

Table 3.4: Surface Water Maintenance

Drainage	Maintainer
Drains	Home owner
Private Sewers	Home owner / management company
Household SUDS	Home owner
Communal SUDS - private	Management company / home owner.
Adopted SUDS	SUDS Body: Local Authority / water company / other SUDS adopting body.
Adopted sewers	Water company

4.0 Foul Water Management

4.1 Existing Drainage

4.1.1 The site is currently a field, therefore does not have any existing foul water infrastructure.

4.2 Proposed Drainage Strategy

4.2.1 Foul water will discharge to Severn Trent Water's sewer located within to the south of the site.

4.3 Maintenance Requirements

4.3.1 The drainage will be designed in line with Building Regulations, Sewers for Adoption to ensure compliance with best practice guidance thus minimising the maintenance requirements. A full maintenance plan for the site will be developed at the detailed design stage.

4.3.2 The person / authority responsible for maintenance of the drainage will depend on ownership which will vary across the site as detailed design and adoption progresses the exact body responsible for adoption of the various surface water aspects will become clear. Typical responsibilities are set out below in **Table 4.1**.

Table 4.1: Foul Water Maintenance

Drainage	Maintainer
Drains	Home owner
Private Sewers	Home owner / Management company
Adopted sewers	Water company

5.0 Conclusions

5.1 Site location and proposed development

5.1.1 The proposed development site is located on land north of Dukes Meadow Drive, Banbury. The proposed development will comprise up to 78 dwellings.

5.2 Flood Risk

5.2.1 The proposed development site is located within Flood Zone 1 and is at a low risk of flooding from all other sources.

5.2.2 The proposed development's vulnerability classification is compatible with the Flood Zone therefore the development is appropriate.

5.3 Surface Water Management

5.3.1 The key proposed surface water parameters are:

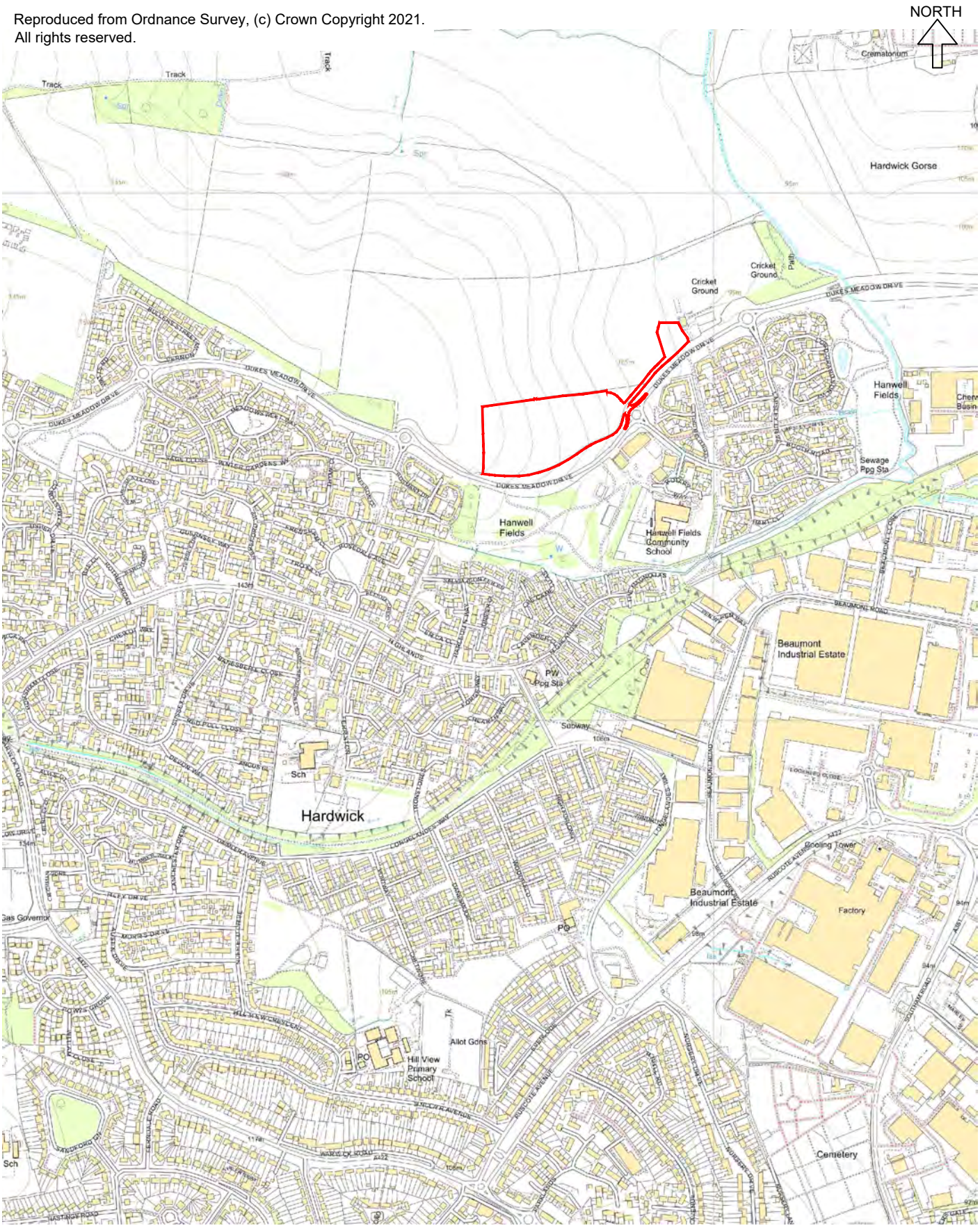
- Discharge rate: 6.1 l/s
- Outfall: watercourse
- Attenuation requirement: 1449m^3
- SUDS features
  - Hydrobrake flow control
  - Detention Basin – online
  - Permeable paving to private drives – tanked
  - Swale

5.4 Foul Water Management

5.4.1 Foul water will discharge to the adopted sewer located to the south of the site..

Appendix A

Location Plan
MAC drawing no. 340-FRA03



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Martin Andrews Consulting Ltd

Client: Manor OaK Homes	Project: Land North of Dukes Meadow Drive Banbury		Date: 24/09/21
			Drw: AN
Title: Location Plan			Chk: MJA
			Scale: 1:10,000
			Size: A4
Drawing No. 340-FRA01	Revision -	• Transport Assessments • Flood Risk Assessments • Highway Advice • Drainage Strategies	

Appendix B

Topographical Survey Whole Site
Woods Hardwick drawing no. 17525-7-865

Notes

1. Contractors must check all dimensions on site. Only figured dimensions are to be worked from. Discrepancies must be reported to the Architect or Engineer before proceeding. © This drawing is copyright.
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KEY

SURVEY STATION
BANKING (TOP / BOTTOM)
HEDGE SPREADS SHOWN TO SCALE
FOLIAGE
TREES (SPREAD, HEIGHT SHOWN TO P SCALE, HHHEIGHT)
DEAD TREE (SPREAD, HEIGHT SHOWN TO SCALE, HHHEIGHT)
GATE POST
ROAD WITH FULLY AND PART DEPTH DROPPED KERB
KERB
TRACK
VERGE
FENCE
WALL
OVERHEAD ELECTRIC
OVERHEAD TELECOM
BUILDING
MAJOR CONTOUR INTERVAL WITH LEVEL
CONTOUR INTERVAL
SPOT LEVEL +127.13
BORE HOLE BH
TRIAL PIT Tr Pit

SEWER DETAILS

SEWERS FOUL
SEWERS STORM
COVER LEVEL MHCL=
INVERT LEVEL IL=
BACKDROP INVERT BDIL=
SOAKAWAY SA
CATCHPIT INVERT CPIL=
SOFFIT LEVEL SL=
NOTE: INVERTS, PIPE SIZES, CONNECTIONS SHOWN ARE OBTAINED FROM SURFACE INVESTIGATIONS ONLY.

GENERAL ABBREVIATIONS

AIR VALVE	AV
BACK DROP	BD
BRICK	BK
BOLLARD	BO
BUS STOP	BUS
BT INSPECTION COVER	BT
BT MANHOLE COVER	BTMV
COVER LEVEL	CL
DOWN PIPE	DP
DROP KERB	DK
ELECTRICITY COVER	ELC
ELECTRICITY POLE	EP
EARTH ROD	ER
FIRE HYDRANT	FH
FLOOR LEVEL	FFL
FOUL WATER SEWER	FWS
GAS VALVE	GAS
GATE POST	GP
GULLY	GY
INSPECTION COVER	ICVCL
INVERT LEVEL	IL
KERB DEFLECTOR	KD
LAMP POST	LP
LETTER BOX	LB
MANHOLE	MHCL
MARKER POST	MK
METER	MR
MILESTONE	MS
ORDNANCE SURVEY BENCH MARK	OSBM
POLE MARKER	PM
ROAD SIGN	RS
SERVICE VALVE	SV
STOP COCK	SC
STORM WATER SEWER	SWS
TELEGRAPH POLE	TP
TACTILE PAVING	TT
UNABLE TO LIFT	UTL
VENT PIPE	VP
WATER LEVEL	WKLV
WATER METER	WM
WASH OUT	WO

FENCE ABBREVIATIONS

BARBED WIRE FENCE	BWF
CHAINLINK FENCE	CLF
CHESTNUT PALING	CPF
CLOSE BOARDED FENCE	CBF
CONCRETE POST FENCE	CPOF
CRASH BARRIER	CRF
ELECTRIC FENCE	ELF
HAND RAIL FENCE	HRF
IRON RAILINGS	IRF
LARCHLAP FENCE	LLF
POST AND RAIL FENCE	PRF
STEEL MESH FENCE	SMF
STOCK PROOF FENCE	SPF
TIMBER PANEL FENCE	TPF
WIRE MESH FENCE	WMF

WALL ABBREVIATIONS

BLOCK WALL	BLW
BRICK WALL	BRW
CONCRETE WALL	CNW
RETAINING WALL	RTW
SANGBAG WALL	SBW
SLEEPER WALL	SLW
STONE WALL	STW

ORDINATE SYSTEM
GRID AND LEVELS TO OS GPS NETWORK
SCALE FACTOR = 1.000 BASED UPON STATION J

Coordinate Table

Station	Description	Easting	Northing	Height
D	PK	444800.077	242468.520	110.605
E	PK	444719.960	242443.878	116.274
G	PK	444523.564	242458.551	131.221
H	PEG	444490.277	242559.298	136.061
J	PEG	444493.193	242755.123	134.544
K	PEG	444842.531	242773.519	102.154
L	XCut/Mark	444905.451	242648.959	102.486
M	PK	444849.946	242549.420	106.693
N	XCut/Mark	445062.844	242770.114	96.436
P	BOLT	444998.251	242774.189	97.302
Q	PK	444965.605	242761.996	98.329
R	PK	444392.429	242539.353	135.012
T	PK	444566.705	242447.231	128.143
U	PK	444630.074	242439.569	123.138
V	PK	444818.556	242522.930	107.665
W	PK	444871.137	242606.029	105.370
X	PK	444973.058	242705.989	98.876
Y	PK	445025.947	242744.191	96.966

Revision	Description	Drawn	Checked	Date
Preliminary	Information	Tender	Construction	As Built

1:1000 — 0m 10m 20m 40m 60m 100m

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Title: HANWELL FIELDS
BANBURY

Details: TOPOGRAPHIC SURVEY
WHOLE SITE

Scale: 1-1000 @ A0 Date: 24-03-2016 Drawn: NC Chk: SGB

17525-7-865

Please consider the environment before printing this drawing

Appendix C

Sketch Layout - 01
Thrive Architects drawing no. MANO210710 SKL-01 Rev P7, dated 23.09.21

A0

PRIVATE

House Type	No of Bedrooms	Sqft	No	Total Sqft
2B Flat	2	755	6	4530
2B Maisonette	2	850	9	7650
3B Bungalow	3	1025	6	6150
3B.1	3	1001	11	11011
3B.2	3	1125	15	16875
4B.1	4	1560	7	10920
TOTALS			54	57136

Private housing plot areas (sqft)		57136
Net developable area (acres)	---	3.824
Coverage sqft/acre	---	14941

AFFORDABLE

House Type	No of Bedrooms	Sqft	No	Total Sqft
1B Maisonette	1	625	6	3750
2B Bungalow	2	755	2	1510
2B	2	850	4	3400
3B	3	1001	4	4004
4B	4	1140	1	1140
TOTALS			17	13804

Affordable Housing plot areas (sqft)	13804
Net developable area (acres)	0.79
Coverage sqft/acre	17473

SHARED OWNERSHIP

House Type	No of Bedrooms	Sqft	No	Total Sqft
2B	2	850	4	3400
3B	3	1001	3	3003
TOTALS			7	6403

Affordable Housing plot areas (sqft)	6403
Net developable area (acres)	0.345
Coverage sqft/acre	18559

SITE TOTALS		
	78	77343

Total Housing plot areas (sqft)	77343
Total Net developable area (acres)	4.959
Total Coverage sqft/acre	15596

- Site Boundary
- Other Land in Ownership
- 26 Plot Number
- 3B.2 House Type
- Affordable Rented
- Intermediate
- Maintenance Access

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Rev	Description	Date	Au	Ch
P1	Preliminary Issue	13.08.21	PM/hm	--/--
P2	Revised Layout	27.08.21	PM/SWD	HM
P3	Minor updates to notes	06.09.21	PM/SWD	--
P4	Updated Redline and notes further to client feedback	08.09.21	PM/SWD	--
P5	Revised boundary	09.09.21	PM/hm	
P6	Revised boundary	22.09.21	PM/hm	
P7	Revised boundary	23.09.21	PM/hm	

Project	Hanwell Fields, Banbury				
Drawing	Sketch Layout - 01				
Client	Manor Oak Homes				
Job no.	MANO210710			Date	13.08.21
Dwg no.	SKL-01			Rev.	P7
Author	PM/hm	Checked	--/--	Scale	1:500@A1
Status	PRELIMINARY			Office	Romsey
Client ref.					

thrive. architects

Appendix D

Proposed Drainage Strategy
MAC drawing no. 340– FRA03C

NORTH

Notes:

1. Based on Woods Hardwick 'Topographical Survey', drawing number 17525-7-853 dated 24-03-2016.
2. Based on Thirve 'Sketch Layout - 01', drawing number MANO210710 SKL-01 P7 dated 23.09.21

Key

- Site Boundary
- Proposed Surface Water Drainage
- Proposed Surface Water Attenuation
- Proposed Swale

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- Flood Risk Assessments
- Highway Advice
- Access Design
- Drainage Strategies
- Vehicle tracking

Client: Manor Oak Homes	Project: Hanwell Fields, Banbury	
Title: Proposed Drainage Strategy		Date: 24/09/21
		Drw: AN
		Chk: MJA
Drawing No: 340-FRA03	Revision: C	Scale: 1:1000
		Size: A3

Appendix E

Proposed Impermeable Area
MAC drawing no.340 – FRA02A

NORTH

Notes:

1. Based on Woods Hardwick 'Topographical Survey', drawing number 17525-7-853 dated 24-03-2016.
2. Based on Thirve 'Sketch Layout - 01', drawing number MANO210710 SKL-01 P7 dated 23.09.21

Key:

Proposed Impermeable Area = 14,100m²
with 10% urban creep - 15,510m²

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Martin Andrews Consulting Ltd

- Transport Assessments
- Flood Risk Assessments
- Highway Advice
- Access Design
- Drainage Strategies
- Vehicle tracking

Client: Manor Oak Homes	Project: Hanwell Fields, Banbury	
Title: Proposed Impermeable Area		Date: 24/09/21
		Drw: AN
		Chk: MJA
Drawing No: 340-FRA02	Revision: -	Scale: 1:1000
		Size: A3

Appendix F

Drainage Design Calculations

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)		Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)		Minimum Backdrop Height (m)	0.200
Ratio-R		Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)		Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1	1.551	5.00	100.000	1200	150.000	150.000	2.000

Simulation Settings

Rainfall Methodology	FEH-13	Skip Steady State	x	1 year (l/s)	5.2
Summer CV	0.750	Drain Down Time (mins)	240	30 year (l/s)	11.9
Winter CV	0.840	Additional Storage (m³/ha)	20.0	100 year (l/s)	15.2
Analysis Speed	Normal	Check Discharge Rate(s)	✓	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
100	40	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	1.95
Greenfield Method	IH124	Growth Factor 100 year	2.48
Positively Drained Area (ha)	1.410	Betterment (%)	0
SAAR (mm)	639	QBar	6.1
Soil Index	4	Q 1 year (l/s)	5.2
SPR	0.47	Q 30 year (l/s)	11.9
Region	6	Q 100 year (l/s)	15.2
Growth Factor 1 year	0.85		

Node 1 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	98.000	Product Number	CTL-SHE-0116-6100-1000-6100
Design Depth (m)	1.000	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	6.1	Min Node Diameter (mm)	1200

Node 1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	98.000
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1449.0	0.0	1.000	1449.0	0.0	1.001	0.0	0.0

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
720 minute winter	1	720	98.998	0.997	96.6	1461.9740	0.0000	OK

Link Event (Outflow)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
15 minute summer	1	Hydro-Brake®	6.1	90.3