Flood Risk Assessment

Proposed Residential Development
Land North of Dukes Meadow Drive
Banbury

Revision C: October 2022
Report Reference: 802-FRA-01-C

Martin Andrews Consulting Limited | Regents Pavilion, 4 Summerhouse Road, Northampton, NN3 6BJ
T: 01604 340544 | E: info@mac-ltd.co.uk | W: preplanningengineering.co.uk

Report Originator(s)

Martin Andrews MEng (Hons) CEng MICE MCIHT
Director
martin.andrews@mac-ltd.co.uk

Revision Record

Revision	Date	Description	Written	Approved
0	25/07/22	Planning Issue - Draft	MJA	MJA
A	20/09/22	Planning Issue	MJA	MJA
B	26/09/22	Updated layout	MJA	MJA
C	04/10/22	Updated layout	MJA	MJA

Contents

Appendices

1.0 Introduction

1.1 Instructions

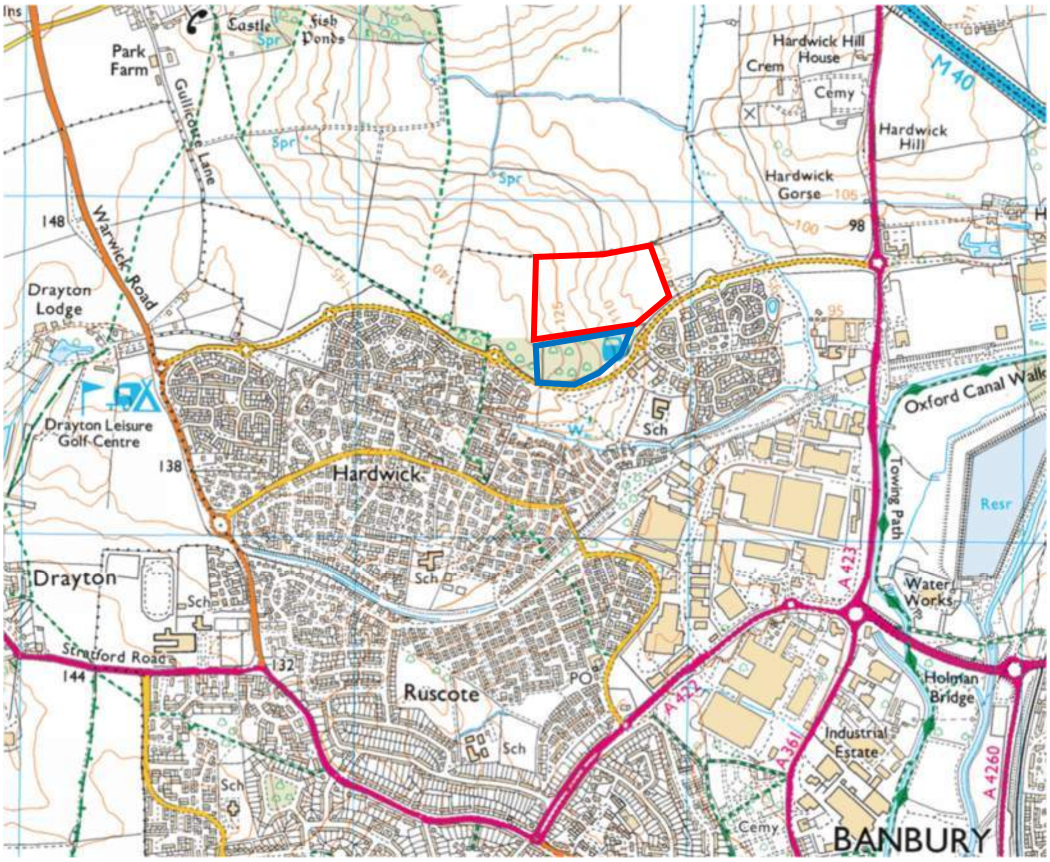
1.1.1 MAC have been commissioned by Manor Oak Homes to provide a Flood Risk Assessment to accompany an Outline planning application for a residential development on land north of Dukes Meadow Drive, Banbury, Oxfordshire.

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 E444731, N242718.

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 an Outline planning application for up to 176 dwellings and associated open space, drainage area and parking with all matters reserved other than access. 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.

1.5 Planning History

1.5.1 Land to the south of this site marked in blue in **Inset 1.1** has a resolution to grant outline planning approval (21/03426/OUT), subject to signing of a S106, for 78 dwellings.

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 – 22/07/22

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 - 22/07/22

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 – 22/07/22

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)	5.555, see **Appendix E**
SAAR (mm)	639
Soil Index / SPR	4 / 0.47
Region	6
Results	**Value**
Q_{Bar} (l/s)	24.1
Q1 (l/s)	20.5
Q30 (l/s)	47.0
Q100 (l/s)	59.8

3.2.2 The allowable discharge rate for the site is the Q_{Bar} rate of 24.1l/s.

3.2.3 It is proposed to combine the Phase 1 and Phase 2 attenuation as such there will be a combined outfall. The allowable discharge rate for the Phase 1 site was 6.1l/s. Therefore, the agreed discharge rate is 24.1 + 6.1 = 30.2l/s.

3.2.4 Surface water from the site post development will be restricted to a discharge rate of 30.2 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. This is the same geology as identified by the BGS maps on the Phase 1 site.

3.3.4 On the Phase 1 site infiltration testing was undertaken at two locations at depths of 1.5m to 2.0m and a further two locations at depths of 0.5m and 0.55m. All of the tests showed that there was no recorded water drop over a 24 hour period. Therefore the ground can be considered impermeable. An extract from the testing is enclosed in **Appendix G**.

3.3.5 Based on the above geology description and testing for the Phase 1 site we consider infiltration techniques to be unviable.

To a surface water body

3.3.6 There is a ditch located adjacent to the site's southern 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.

3.3.7 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 for the Phase 1 and 2 site to ensure that the rate of surface water run-off from the site does not increase as a result of the proposed development. The proposed Phase 1 basin will be enlarged to accommodate the Phase 2 site.

3.4.2 The proposed drainage strategy will comprise a:

- A piped network
- Hydrobrake flow control
- Detention Basin – online – to accommodate Phase 1 and 2
- 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)	7.661, see **Appendix E** includes 10% urban creep
Discharge Rate (l/s)	32.1
Results	**Value**
Storage Requirement (m^3)	6527

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 Explanation of Likely Forms of SuDS for the Site

4.1.1 The following **Table 4.1**, provides a summarised assessment for a range of SuDS features which have been considered for implementation at the development site, based on viability and a cost benefit analysis.

Table 4.1: SuDS Technique Viability Assessment for Development Site

SuDS Feature	Design Considerations	Will this Implemented?
Rainwater Harvesting	This will be incorporated in the form or rainwater butts attached to rainwater pipes, which can reduce future residents' dependence on a clean water supply when using water for garden related purposes.	**Yes** To be reviewed at the detailed design stage.
Green Roofs	This type of feature should typically be used for betterment as opposed to implementation on a Greenfield site. The hydraulic performance of this roof during extreme events is similar to a standard roof; therefore, additional attenuation would still be required. The cost of providing and maintaining green roofs on a large scale is likely to exceed the benefit it will bring to the site.	No
Filter Strips/ Filter Drains	The longitudinal slope for a filter strip should be constrained between 1% and 5%. Where filer strip slopes are great than 5%, a series of level spreaders can be used to maintain sheet flow as runoff flows over the strip. The longitudinal slope for a filter drain should not exceed 2% because low velocities are required for stable conveyance through the filter medium and or pollutant removal processes to occur (CIRIA C753). The existing overland flow path and gradients noted on MAC drawing no 340-FRA04, illustrate that the developable extent of the site slopes between 8.33% (1:12) and 11.1% (1:9). Therefore, the proposed development site would need to undergo a cut/fill exercise to enable the installation of these features. To review the implementation of these SuDS feature fully, it is considered best to wait until a fixed layout and proposed ground levels have been produced at the detailed design stage. See **Appendix E** for further details.	Maybe To be reviewed at the detailed design stage.
Swales	The longitudinal slope for a swale should be constrained between 0.5% and 6% (CIRIA C753). The existing overland flow path and gradients noted on MAC drawing no 340-FRA04, illustrate that the developable extent of the site slopes between 8.33% (1:12) and 11.1% (1:9). Therefore, the only suitable location to install a swale would be within the immediate vicinity of the designated outfall where the gradient range is between 3.33%(1:30) and 6.25% (1:16). See **Appendix E** for further details.	**Yes**

SuDS Feature	Design Considerations	Will this Implemented?
Bioretention Systems (including rain gardens)	Subject to the requirements of the Local Highway Authority, these features can be implemented adjacent to the main spine which passes through the site, as it will be tree lined. However, due to the topography of the site, it is likely that these features would be incorporated purely for additional treatment/ conveyance and not storage.	Maybe To be reviewed at the detailed design stage.
Pervious Pavements	Subject to the adoption requirements of the Local Highway Authority, these features can be implemented; however, may be limited to private areas only such as private drives. See **Appendix E** for an indicative extent of permeable paving used on all shared surface roads. Given the site's topography permeable paving should be installed parallel to the direction in which contours fall across the site (i.e. north to south), to ensure a minimum level difference across the surface. It should also be noted that it is not recommended to install permeable paving at gradient any steeper than 1:20, as it is unlikely rainfall will be able to infiltrate permeable surface during an extreme rainfall event.	**Yes** To be reviewed at the detailed design stage.
Attenuation Storage Tanks	This feature can be used; however, it is considered more sustainable to incorporate other SuDS features listed in this Table.	No
Detention Basins	The existing overland flow path and gradients noted on MAC drawing no 340-FRA04, illustrate that the developable extent of the site slopes between 8.33% (1:12) and 11.1% (1:9). Therefore, the most suitable location to install a detention basin without needing a significant amount of local land raising would be immediately upstream of the designated outfall where the gradient range is between 1.89% (1:53) and 3.70% (1:27). See **Appendix E** for further details.	**Yes**
Ponds and Wetlands	This feature can be installed; however, it is acknowledged that the placement of a large open water SuDS feature would be impractical within the developable extent of the development site. As a result, a pond/ wetland would need to be immediately upstream of the designated outfall where the topography I flattest. The location of this feature would be out of view from the majority of the proposed residential development; therefore, a detention basin is considered to be a better alternative in this site-specific instance.	No

4.2 Based on **Table 4.1** above, it can be concluded that the majority of the SuDS features which are considered viable for the development site have already been included in the proposed surface water drainage strategy which was submitted for Outline planning. Therefore, the submitted surface water drainage strategy is considered robust.

4.2.1 Based on the proposed setting out of the SuDS features to be implemented for the development, all parts of the development will discharge via an online swale and detention basin prior to discharging into the designated outfall. Given that this surface water conveyance route represents the minimum number of treatment trains site generated runoff will pass through, it is possible to determine the sufficiency of pollution mitigation indices for the selected SuDS components to be implemented on site.

Table 4.2: Pollution Hazard Indices – Proposed Residential Development

Runoff Area Land Use Description	Hazard Level	Suspended Solids	Metals	Hydrocarbons
Residential Roofing	Very Low	0.2	0.2	0.05
Residential Parking	Low	0.5	0.4	0.4
Roads (excluding low traffic roads, highly frequented lorry approaches to industrial estates, trunk roads/ motorways)	**Medium**	**0.7**	**0.6**	**0.7**

4.2.2 Based on **Table 4.2** above, it can be concluded that the roads associated with the proposed development, can be attributed with the highest pollution hazard indices.

4.2.3 The following Tables (**Table 4.3** and **Table 4.4**), list the proposed treatment trains in the order in which surface water will be conveyed through them. Using the values in **Table 4.3** enables the total SuDS mitigation index to be calculated. It should be noted that a factor of 0.5 is used to account for the reduced performance of secondary and tertiary components associated with already reduced inflow concentrations (CIRIA C753). **Table 4.4** provides

Table 4.3: Pollution Mitigation Indices – Proposed Residential Development

Treatment Train	SuDS Component Description	Suspended Solids	Metals	Hydrocarbons
First	Swale	0.5	0.6	0.6
Second	Detention Basin	0.5	0.5	0.6

Table 4.4: Combined Pollution Mitigation Indices for the Runoff Area

Treatment Train	SuDS Component Description	Suspended Solids	Metals	Hydrocarbons
First	Swale	0.5	0.6	0.6
Second	Detention Basin	(0.5 x 0.5) = 0.25	(0.5 x 0.5) = 0.25	(0.5 x 0.6) = 0.3
Total SuDS Mitigation Indices		**0.75**	**0.85**	**0.9**

4.2.4 By comparing the total SuDS mitigation indices provided in **Table 4.4**, against the pollution hazard indices above noted for 'Roads' in **Table 4.2**; it can be confirmed that the implementation of an online swale and detention basin will provide a sufficient level of mitigation against the pollution hazard indices associated with the development roads. Therefore, the proposed drainage strategy is considered to provide an acceptable level of water quality treatment.

4.2.5 Notwithstanding the above, it should be noted that the use of additional SuDS features such as permeable paving, and rain gardens in the form of tree pits will also be reviewed at the detailed stage. The implementation of these features would further increase the level of water quality treatment being provided to surface water runoff, which would ensure the development site's drainage strategy is operating above the accepted thresholds enforced by the Lead Local Flood Authority.

4.2.6 Dependent on the adoption procedures for the Local Highway Authority, it is likely that the use of permeable paving and tree pits may be limited to use within private land areas only. As a result, this may reduce the available area that at can used to construct these SuDS features

5.0 Foul Water Management

5.1 Existing Drainage

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

5.2 Proposed Drainage Strategy

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

5.3 Maintenance Requirements

5.3.1 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.

5.3.2 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 5.1**.

Table 5.1: Foul Water Maintenance

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

6.0 Conclusions

6.1 Site location and proposed development

6.1.1 The proposed development site is located on land north of Dukes Meadow Drive, Banbury. The proposed development will comprise up to 76 dwellings.

6.2 Flood Risk

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

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

6.3 Surface Water Management

6.3.1 The key proposed surface water parameters are:

- Discharge rate: 31.2 l/s – combined Phase 1 and 2
- Outfall: watercourse
- Attenuation requirement: 6527m^3 – combined Phase 1 and 2
- SUDS features
  - Hydrobrake flow control
  - Detention Basin – online – combined Phase 1 and 2
  - Permeable paving to private drives – tanked
  - Swale

6.4 Foul Water Management

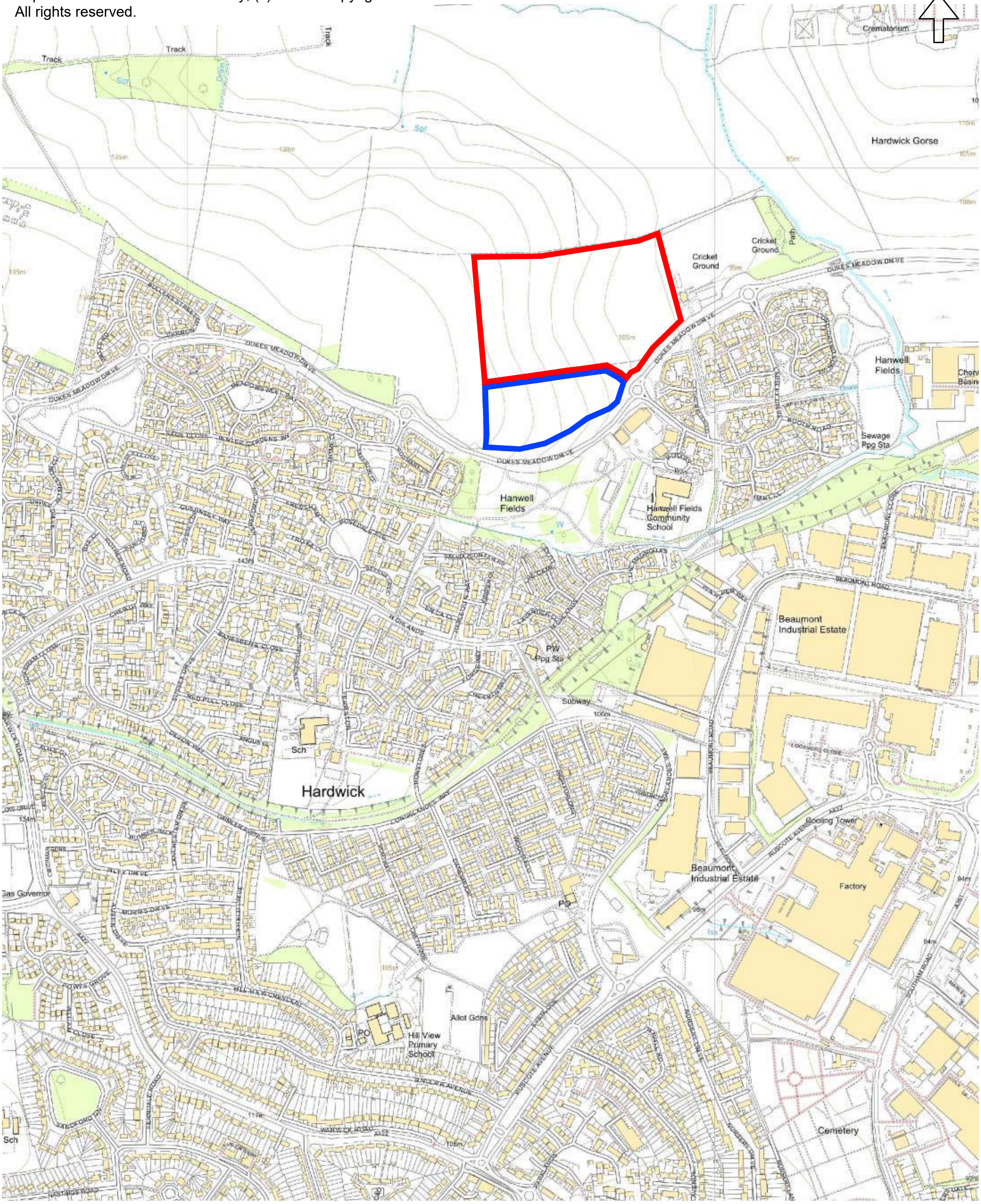
6.4.1 Foul water will discharge to the adopted sewer located to the south of the site.

Appendix A

Location Plan

MAC drawing no. 802-TA01

NORTH

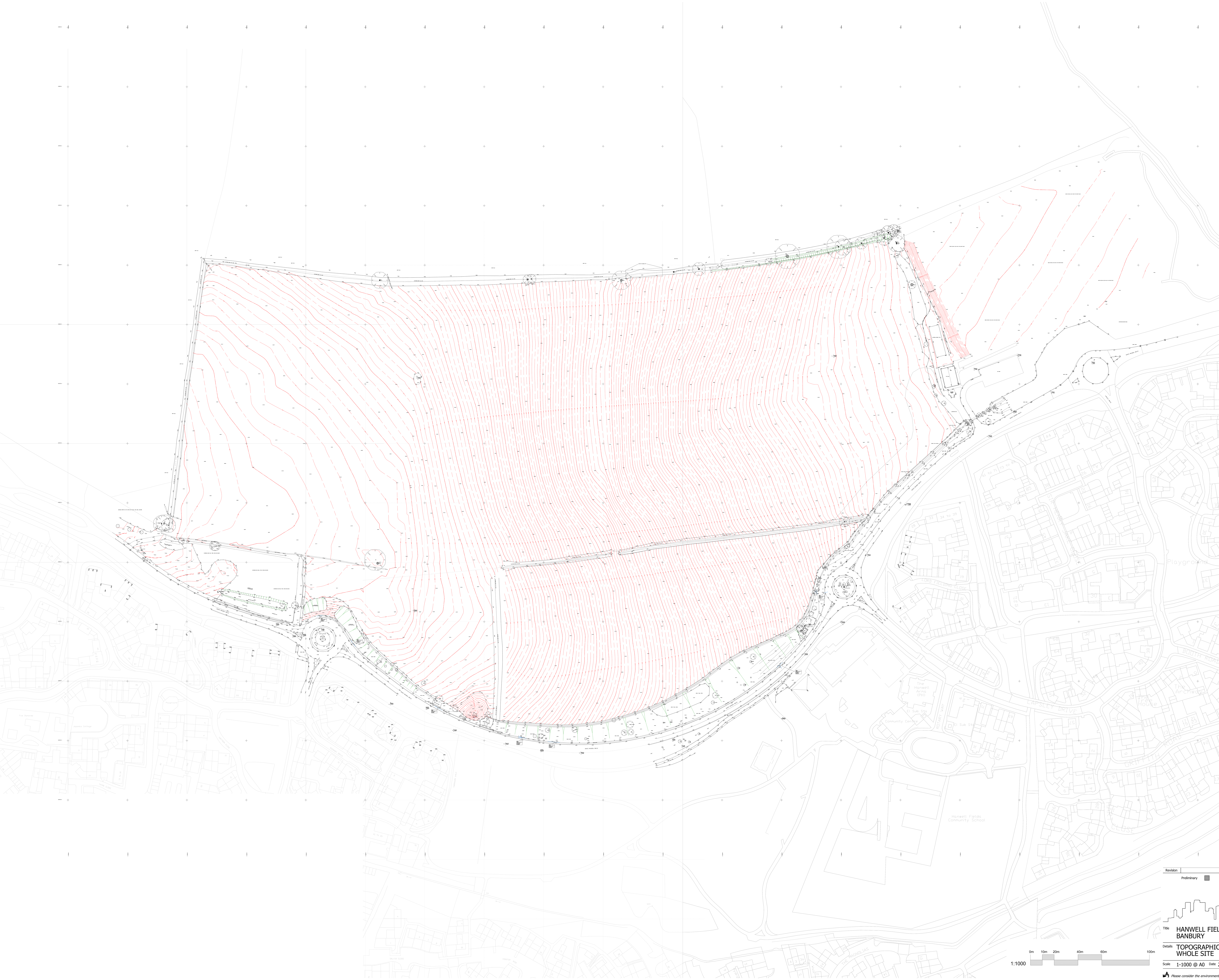


Client: Manor Oak Homes		Project: Hanwell Fields Banbury	Date: 21/07/22
			Drw: SH
			Chk: MJA
Title: Location Plan			Scale: 1:10,000
			Size: A4
Drawing No. 802-TA01	Revision -	• Transport Assessments • Highway Advice	• Flood Risk Assessments • Drainage Strategies

T: 01604 340544 Northampton Office
E: info@mac-ltd.co.uk W: mac-ltd.co.uk
Martin Andrews Consulting Ltd

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
2. Reproduced from OS Sitemap ® by permission of Ordnance Survey® on behalf of The Controller of Her Majesty's Stationery Office. © Crown copyright 2008. All rights reserved. Licence number 100007126.

KEY

SURVEY STATION
BANKING (TOP / BOTTOM)
HEDGE SPREADS SHOWN TO SCALE
FOLIAGE
TREES — SPREAD & TRUNK SHOWN TO SCALE H=HEIGHT
DEAD TREE — SPREAD & TRUNK SHOWN TO SCALE H=HEIGHT
GATE POST — GP
ROAD WITH GULLY AND KERB OFFLET DROPPED KERB — GY, KO
KERB
TRACK
VERGE
FENCE
WALL
OVERHEAD ELECTRIC
OVERHEAD TELECOM
BUILDING
MAJOR CONTOUR INTERVAL — 25.50
MINOR 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
CABLE TV COVER	CTV
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	ICCL
INVERT LEVEL	IL
KERB OFFLET	KO
LAMP POST	LP
LETTER BOX	LB
MANHOLE	MHCL
MARKER POST	MK
METER	MR
MILESTONE	MS
ORDNANCE SURVEY BENCH MARK	OSBM
RODDING EYE	RE
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	WRLV
WATER VALVE	WV
WASH OUT	WO

FENCE ABBREVIATIONS

BARBED WIRE FENCE	BWF
CHAINLINK FENCE	CLF
CHESTNUT PALING	CPF
CLOSE BOARDED FENCE	CBF
CORRUGATED IRON FENCE	CIF
CRASH BARRIER	CRF
ELECTRIC FENCE	ELF
HAND RAIL FENCE	HRF
IRON RAILINGS	IRF
KNEE RAIL FENCE	KRF
LARCHLAP FENCE	LLF
POST AND RAIL FENCE	PRF
POST AND WIRE FENCE	PWF
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
SANDBAG WALL	SDW
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

0m 10m 20m 40m 60m 100m
1:1000

Revision	Desciption	Drawn	Checked	Date

Preliminary / Information / Tender / Construction / As Built

Woods Hardwick
Architects, Engineers and Development Consultants

15-17 Goldington Road
Bedford
MK40 3NH
United Kingdom
T. +44 (0)1234 268862
F. +44 (0)1234 353034
mail@woodshardwick.com
www.woodshardwick.com

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 Illustrative - 02
Thrive Architects drawing no. MANO220426 SKL-02 Rev A

Romsey
T: 01794 367703
F: 01794 367276

Portishead
T: 01275 407000
F: 01794 367276

Camberley
T: 01276 749050
F: 01794 367276

Rev	Description	Date	Au	Ch
A	Planning Issue	26.09.22	AA/AB	AB/--
B	Minor Adjustment	03.10.22	AA/AB	AB/--

www.thrivearchitects.co.uk

Project	Hanwell Fields, Banbury Phase 2				
Drawing	Concept Master Plan - 01 -				
Client	MANOR OAK HOMES				
Job no. Dwg no.	MANO220426 CMP-01			Date Rev.	26.09.22 B
Author	AA/AB	Checked	AB/PM	Scale	1:1000@A1
Status	PLANNING			Office	Romsey
Client ref.	-				

thrive. architects

Appendix D

Proposed Drainage Strategy – Serves P1 and P2 (Option 2)
MAC drawing no. 340– FRA04F

NORTH

Notes:

1. Based on Woods Hardwick 'Topographical Survey', drawing number 17525-7-853 dated 24.03.2016.
2. Drawing based on Ordnance Survey mapping. Ordnance Survey (c) Crown Copyright 2015. All rights reserved. Licence number 100022432
3. Based on Thirve 'Concept Master Plan -01, drawing number CMP-01-P1 dated 03.10.2022.

Key

Site Boundary

Proposed Surface Water Attenuation (Detention Basin)

MAC

T: 01604 340544 Northampton Office
E: info@mac-ltd.co.uk W: mac-ltd.co.uk
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 Draiange Strategy - Serves P1 and P2 Planning Issue			Date: 04/10/22
			Drw: LT/MJA
			Chk: MJA
Drawing No: 802-FRA04	Revision: G		Scale: 1:1250
			Size: A3

Appendix E

Proposed Impermeable Area
MAC drawing no.802 – FRA02B

NORTH

Notes:

1. Based on Woods Hardwick 'Topographical Survey', drawing number 17525-7-853 dated 24.03.2016.
2. Drawing based on Ordnance Survey mapping. Ordnance Survey (c) Crown Copyright 2015. All rights reserved. Licence number 100022432
3. Based on Thirve 'Concept Master Plan -01, drawing number CMP-01-P1 dated 03.10.2022.

Key:

Phase 1
Proposed Impermeable Area = 55,548m²
with Urban Creep = 61,103m²

Phase 2
Proposed Impermeable Area = 13,958m²
with Urban Creep = 15,353m²

MAC

T: 01604 340544 Northampton Office
E: info@mac-ltd.co.uk W: mac-ltd.co.uk
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: 04/10/22
			Drw: MJA
			Chk: MJA
Drawing No: 802-FRA02		Revision: C	Scale: 1:2000
			Size: A3

Appendix F

Drainage Design Calculations

Design Settings

Rainfall Methodology	FEH-13	Minimum Velocity (m/s)	1.00
Return Period (years)	2	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	0.750	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
Basin	7.661	5.00	100.000	1500	100.000	100.000	2.000

Simulation Settings

Rainfall Methodology	FEH-13	Skip Steady State	x	1 year (l/s)	20.5
Summer CV	0.750	Drain Down Time (mins)	240	30 year (l/s)	47.0
Winter CV	0.840	Additional Storage (m^3/ha)	20.0	100 year (l/s)	59.8
Analysis Speed	Normal	Check Discharge Rate(s)	✓	Check Discharge Volume	x

Storm Durations

60	180	360	600	960	2160	4320	7200	10080
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)	5.555	Betterment (%)	0
SAAR (mm)	639	QBar	24.1
Soil Index	4	Q 1 year (l/s)	20.5
SPR	0.47	Q 30 year (l/s)	47.0
Region	6	Q 100 year (l/s)	59.8
Growth Factor 1 year	0.85		

Node Basin Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	98.000	Product Number	CTL-SHE-0237-3020-1000-3020
Design Depth (m)	1.000	Min Outlet Diameter (m)	0.300
Design Flow (l/s)	30.2	Min Node Diameter (mm)	1500

Node Basin 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	5686.2	0.0	1.000	6820.6	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
960 minute winter	Basin	945	98.997	0.997	329.5	6313.5540	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
960 minute winter	Basin	Hydro-Brake®	30.2	1663.0

Appendix G

Infiltration Commentary

It must be noted that samples of Charmouth Mudstone Formation recorded total potential sulphate concentrations of between 6.0% and 8.4% which would classify these soils as corresponding to DS-5. However, BRE SD1 allows that a limitation to DS-4 can be applied where the sulphate class for the site based on soil water extract results are DS-3 or less. This limitation has been applied in this case.

Where Charmouth Mudstone Formation soils are used as fill at shallower depth, the ACEC class of the fill material should be considered in the design of buried concrete. A plot by plot assessment of ACEC Class would be required as part of detailed foundation design. Further investigation and testing may potentially result in a reduction in ACEC Class for the deeper soils.

5.6 Soakaways

Soakage testing was undertaken in SA01 to SA04 at depths between 1.50m and 2.00m bgl as depths of likely conventional soakaway construction. Testing at depths of 0.50m and 0.55m bgl was undertaken in SA01-S and SA03-S at depths of likely permeable paving construction. Testing was undertaken in broad accordance with BRE Digest 365. The soakage test results are included as Appendix D.

None of the tests recorded a drop in water level over a 24 hour period sufficient to calculate a rate of infiltration. As such, the tests are considered to have failed.

As a result, on-site storage and attenuation together with alternative storm water disposal options should be considered. It is understood that the current drainage strategy includes an attenuation basin in the northeast of the site.

5.7 Preliminary Slope Assessment

The slope across the site was calculated to be a gradient of approximately 1v:10h (6˚) based on the topographic survey of the site (drawing no. 17525-7-865 by Woods Hardwick, dated 24th March 2016). No visible evidence of slope instability was noted on the site surface during the investigation (e.g. solifluction lobes). No shear surfaces were observed within soils encountered within the trial pits. Given these observed conditions, the current slope across the site is not anticipated to adversely affect the proposed development in terms of instability. This assessment assumes that any proposed cut and fill does not create unretained slopes with a gradient greater than 1v:3h and over 5m in height.

A slope was present outside of the southern site boundary descending to Dukes Meadow Drive. Based on the topographic survey, the slope ranged in gradient between approximately 1v:5h (11˚) to 1v:2.7h (20˚). It is understood that proposals include construction of estate roads at the top of this slope, albeit set back from the crest. Buildings are also proposed near the top of the slope. Given the recorded slope angles and indicative development layout provided to Geo-Environmental at the time of writing, foundations would not be expected to have an adverse effect on the stability of the slope (assuming a 45° 'load shed' envelope beneath the foundation. As such, preliminary stability modelling has been undertaken for a proposed estate road located to the rear of the slope.

The soil parameters set out in Table 5.2 have been used for the stability modelling and are based on the encountered materials from the intrusive investigation locations, results of geotechnical laboratory testing and published sources to determine reasonably characteristic values. Topsoil has not been included in the stability model but based on visual inspection, is anticipated to be present as a covering layer and vegetated with grass and trees.

Stratum material	c' (kPa)	φ'(°)	γ (kN/m³)
Clay soils	1	22	20
Mudstone	1	28	20

Table 5.2 Preliminary Slope Stability Model Soil Parameters