PIEZOMETER VARIABLE HEAD PERMEABILITY TEST

Project Name:	Nailcote Farm
Project Number:	221748
Borehole Ref:	FH06
Date:	14-Sep-23
Borehole Diameter (mm):	60
Resting Water Level (m bd):	1.20
Length (L) of Response Zone (m):	1.00

Base of Standpipe (m):	2.00
Geology:	Sandstone
Borehole Diameter (D) (m):	6.00E-02
Scenario (F):	d2
F Value	2.04E+00
Area (A) of Borehole (m^2)	2.83E-03

ime (mins	Hi(mbd)	H(head)	H/Ho
0.00	0.000	1.200	1.000
0.25	0.000	1.200	1.000
0.50	0.000	1.200	1.000
0.75	0.010	1.190	0.992
1.00	0.030	1.170	0.975
2.00	0.050	1.150	0.958
4.00	0.070	1.130	0.942
10.00	0.090	1.110	0.925
15.00	0.120	1.080	0.900
20.00	0.140	1.060	0.883
25.00	0.170	1.030	0.858
30.00	0.270	0.930	0.775
60.00	0.410	0.790	0.658
120.00	0.620	0.580	0.4833
150.00	0.650	0.550	0.458
360.00	1.020	0.180	0.150

Basic Time Lag Method (after BS5930:1999)

K= A/(F*T)

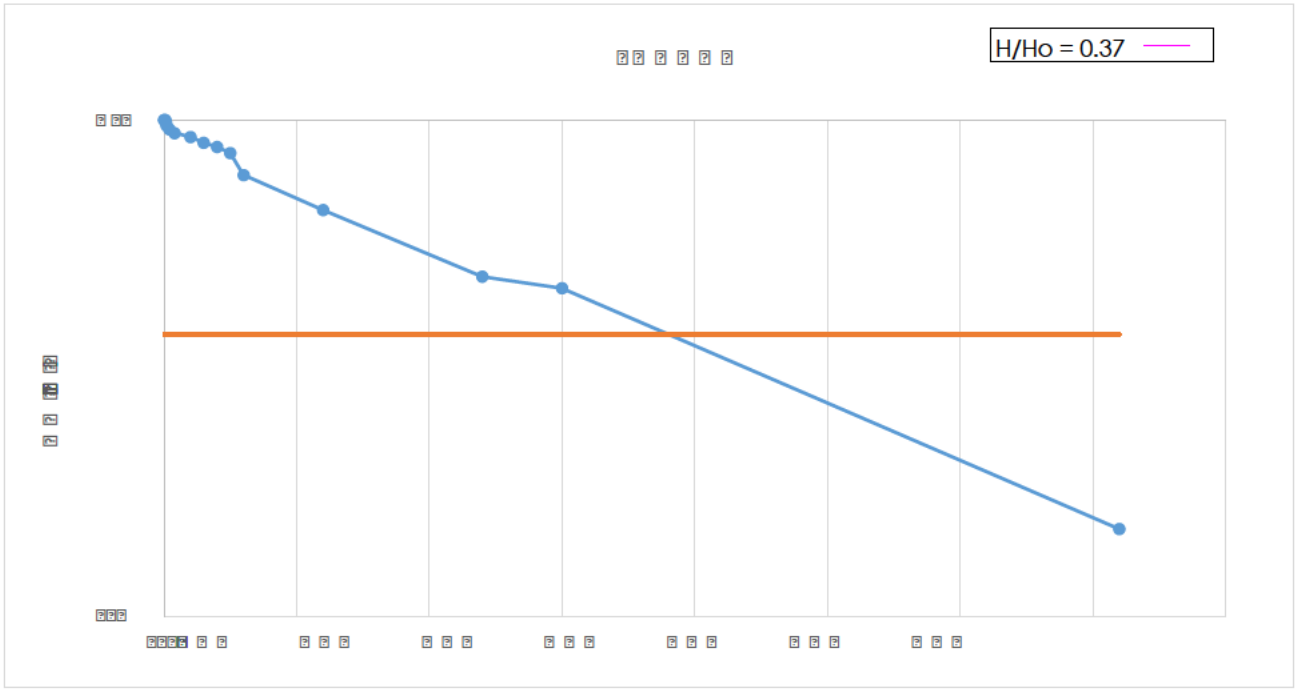
T= TIME FOR H/Ho:0.37

T=	185.00	(min)
T=	11100.00	(sec)
K=	**1.25E-07**	**(m/s)**
K=	**0.011**	**(m/d)**

General Method (after BS5930:1999)

$$k = \frac{A}{F(t_2 - t_1)} \log_e \frac{H_1}{H_2}$$

t1=	60.00	(min)
t2=	360.00	(min)
H(head)1=	0.79	(m)
H(head)2=	0.18	(m)
K=	**1.14E-07**	**(m/s)**
K=	**0.010**	**(m/d)**



PIEZOMETER VARIABLE HEAD PERMEABILITY TEST

Project Name:	Nailcote Farm
Project Number:	221748
Borehole Ref:	FH06
Date:	18-Sep-23
Borehole Diameter (mm):	60
Resting Water Level (m bd):	0.90
Length (L) of Response Zone (m):	1.00

Base of Standpipe (m):	2.00
Geology:	Sandstone
Borehole Diameter (D) (m):	6.00E-02
Scenario (F):	d2
F Value	2.04E+00
Area (A) of Borehole (m^2)	2.83E-03

ime (mins	Hi(mbd)	H(head)	H/Ho
0.00	0.000	0.900	1.000
0.25	0.000	0.900	1.000
0.50	0.000	0.900	1.000
0.75	0.000	0.900	1.000
1.00	0.010	0.890	0.989
2.00	0.020	0.880	0.978
4.00	0.030	0.870	0.967
6.00	0.050	0.850	0.944
8.00	0.050	0.850	0.944
10.00	0.060	0.840	0.933
15.00	0.090	0.810	0.900
20.00	0.120	0.780	0.867
25.00	0.140	0.760	0.844
30.00	0.180	0.720	0.8000
60.00	0.260	0.640	0.711
150.00	0.530	0.370	0.411
1000.00	0.899	0.001	0.001

Basic Time Lag Method (after BS5930:1999)

K= A/(F*T)

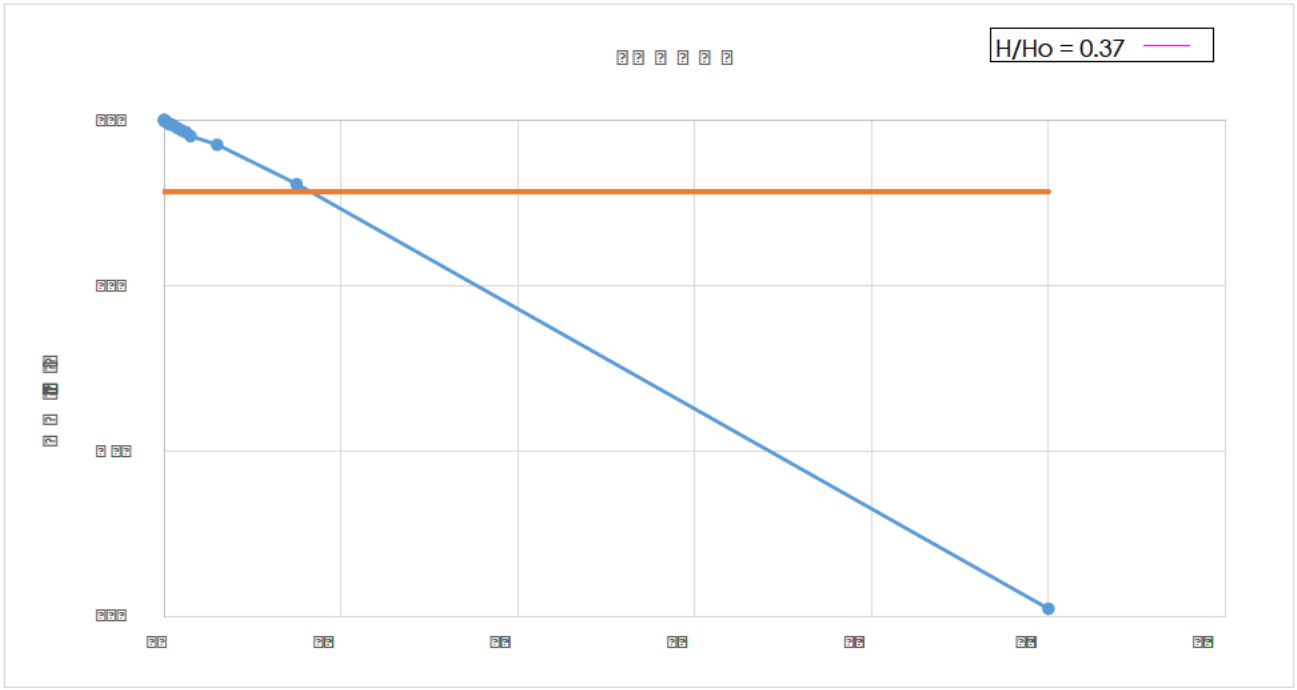
T= TIME FOR H/Ho:0.37

T=	150.00	(min)
T=	9000.00	(sec)
K=	**1.54E-07**	**(m/s)**
K=	**0.013**	**(m/d)**

General Method (after BS5930:1999)

$$k = \frac{A}{F(t_2 - t_1)} \log_e \frac{H_1}{H_2}$$

t1=	1.00	(min)
t2=	300.00	(min)
H(head)1=	1.99	(m)
H(head)2=	0.01	(m)
K=	**4.10E-07**	**(m/s)**
K=	**0.035**	**(m/d)**



PIEZOMETER VARIABLE HEAD PERMEABILITY TEST

Project Name:	Nailcote Farm
Project Number:	221748
Borehole Ref:	FH07
Date:	14-Sep-23
Borehole Diameter (mm):	60
Resting Water Level (m bd):	2.00
Length (L) of Response Zone (m):	1.00

Base of Standpipe (m):	2.00
Geology:	Mudstone
Borehole Diameter (D) (m):	6.00E-02
Scenario (F):	d2
F Value	2.04E+00
Area (A) of Borehole (m^2)	2.83E-03

ime (mins	Hi(mbd)	H(head)	H/Ho
0.00	0.000	2.000	1.000
0.25	0.150	1.850	0.925
0.50	0.200	1.800	0.900
0.75	0.200	1.800	0.900
1.00	0.200	1.800	0.900
2.00	0.200	1.800	0.900
4.00	0.200	1.800	0.900
6.00	0.200	1.800	0.900
8.00	0.200	1.800	0.900
12.00	0.200	1.800	0.900
16.00	0.200	1.800	0.900
60.00	0.200	1.800	0.900
120.00	0.220	1.780	0.890
240.00	0.250	1.750	0.8750
1440.00	1.000	1.000	0.500
		2.000	1.000
		2.000	1.000
		2.000	1.000
		2.000	1.000
		2.000	1.000

Basic Time Lag Method (after BS5930:1999)

K= A/(F*T)

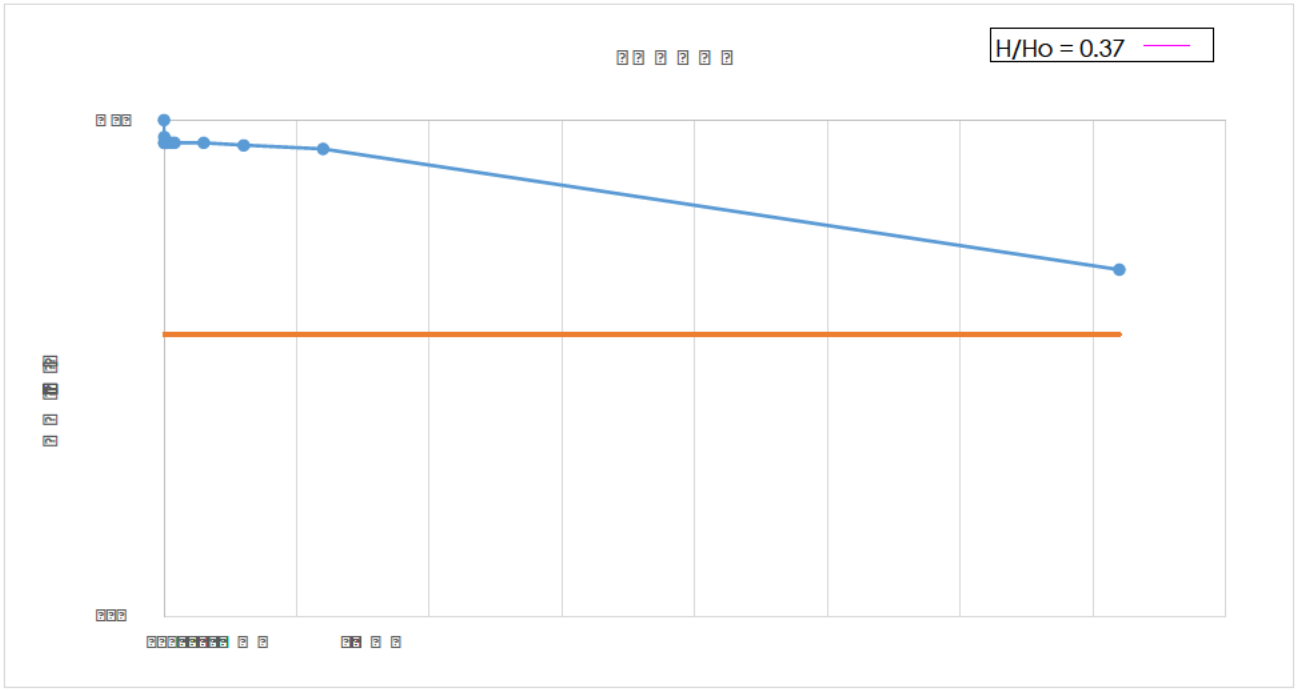
T= TIME FOR H/Ho:0.37

T=		(min)
T=	0.00	(sec)
K=	#DIV/0!	(m/s)
K=	#DIV/0!	(m/d)

General Method (after BS5930:1999)

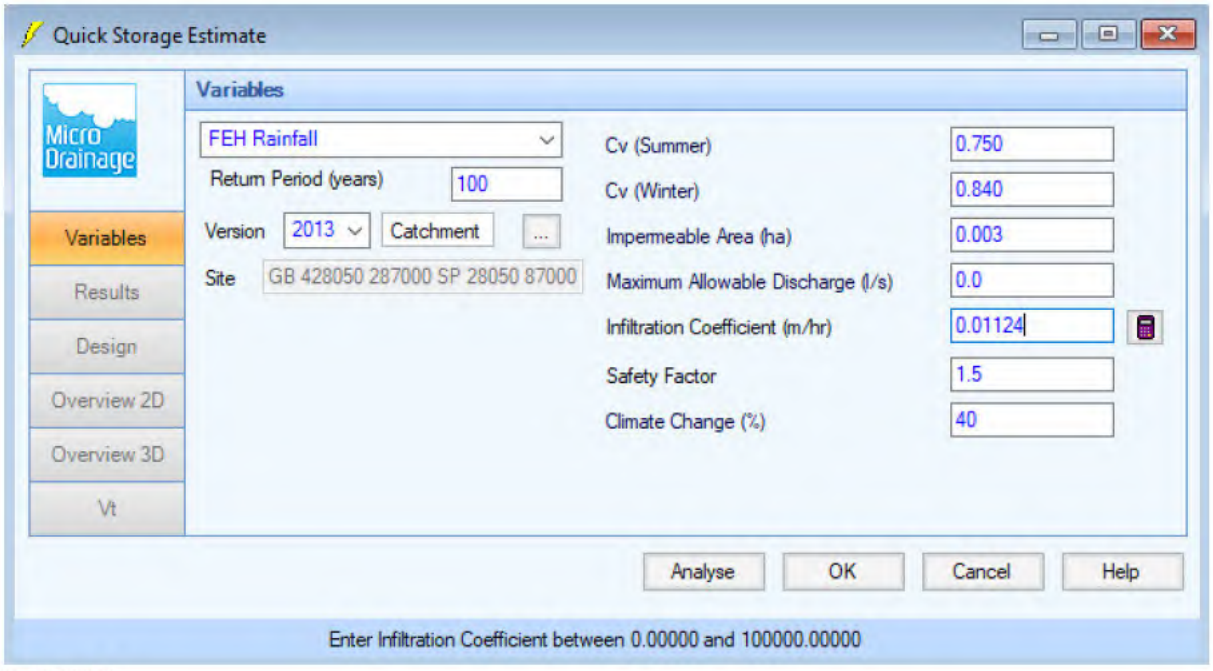
$$k = \frac{A}{F(t_2 - t_1)} \log_e \frac{H_1}{H_2}$$

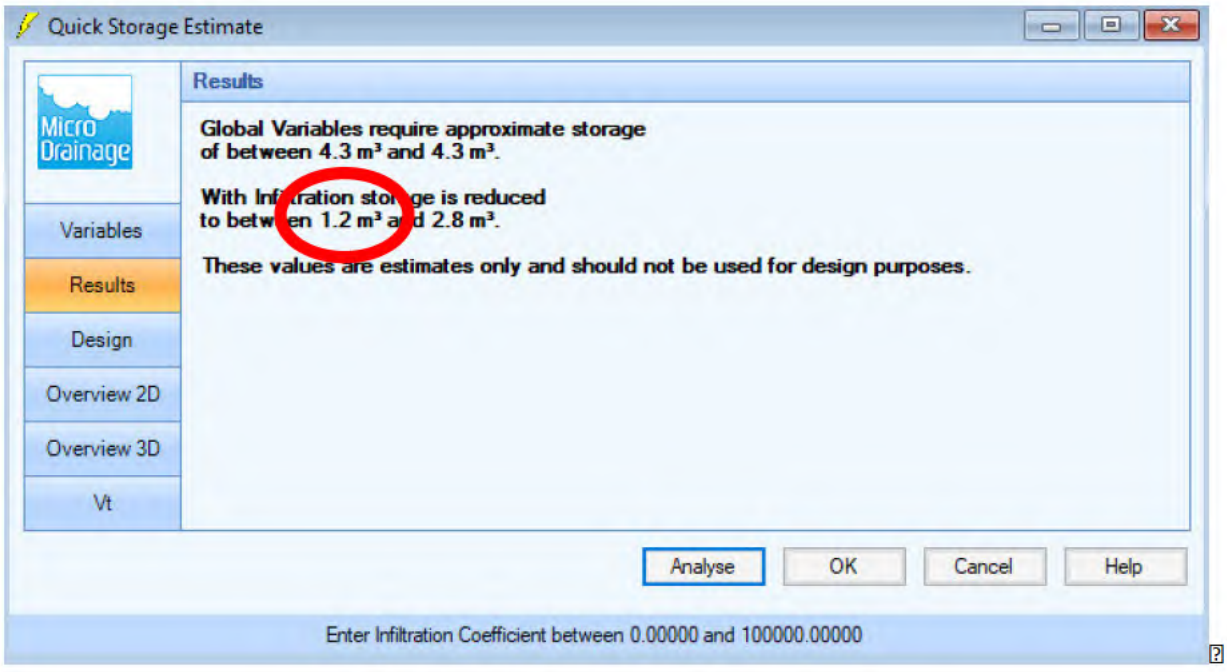
t1=	120.00	(min)
t2=	1440.00	(min)
H(head)1=	1.78	(m)
H(head)2=	1.00	(m)
K=	1.01E-08	(m/s)
K=	0.001	(m/d)

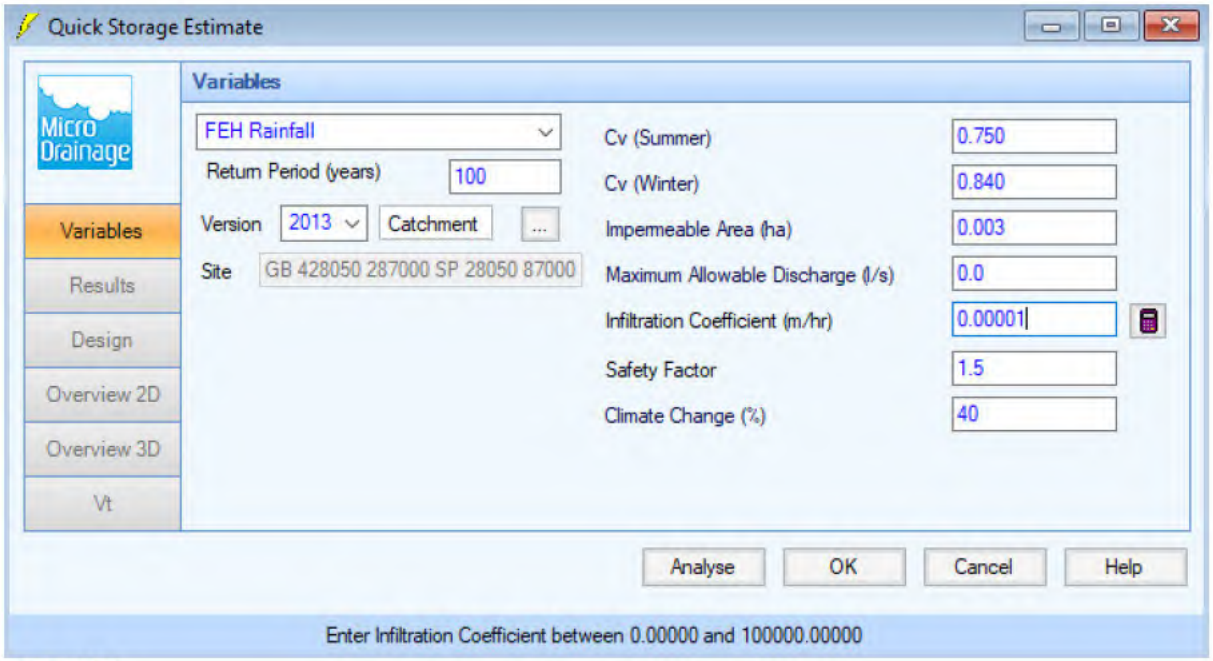


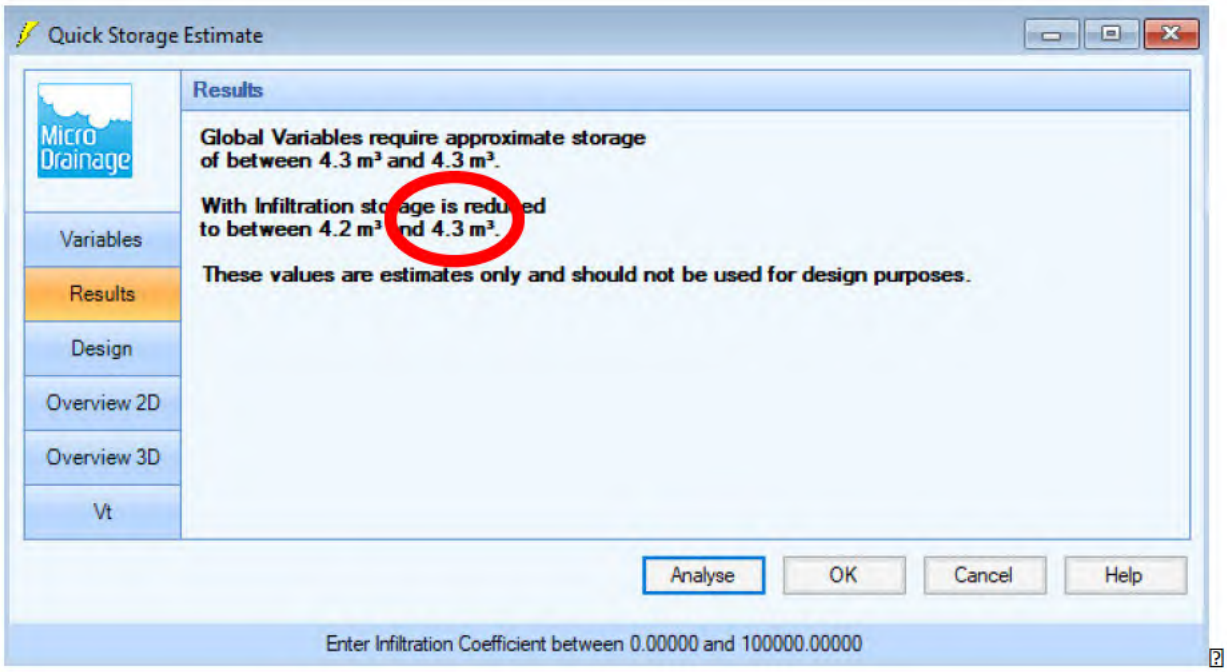
Appendix 4 - MicroDrainage Quick Storage Estimate Outputs

Quick Storage Estimate Outputs



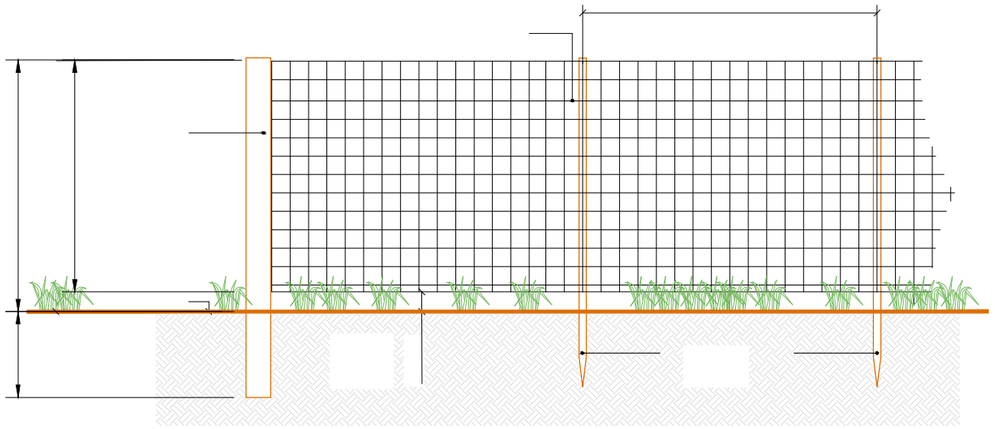


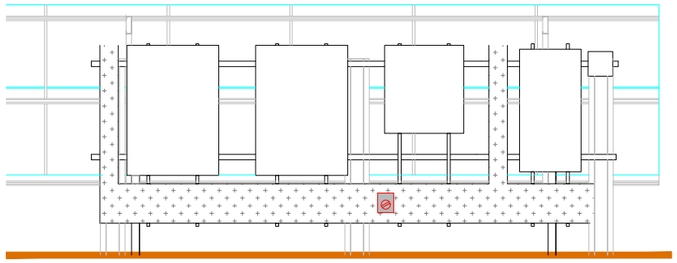

Quick Storage Estimate
Micro Drainage
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Variables
FEH Rainfall
Return Period (years) 100
Version 2013
Catchment
Site GB 428050 287000 SP 28050 87000
Cv (Summer) 0.750
Cv (Winter) 0.840
Impermeable Area (ha) 0.003
Maximum Allowable Discharge (l/s) 0.0
Infiltration Coefficient (m/hr) 0.00001
Safety Factor 1.5
Climate Change (%) 40
Analyse
OK
Cancel
Help
Enter Infiltration Coefficient between 0.00000 and 100000.00000

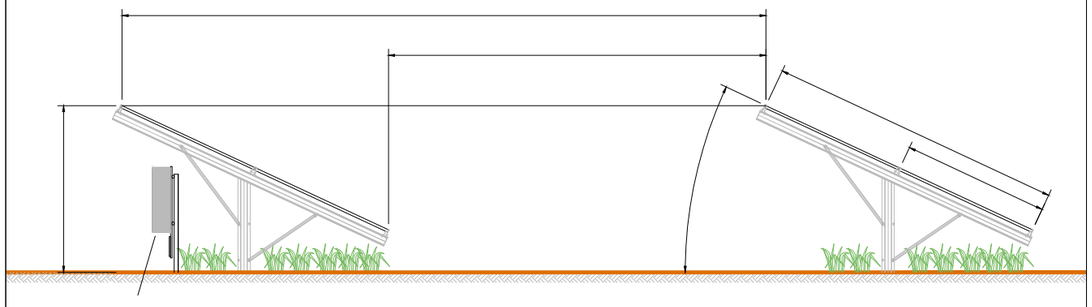

Quick Storage Estimate
Micro Drainage
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Results
Global Variables require approximate storage
of between 4.3 m³ and 4.3 m³.
With Infiltration storage is reduced
to between 4.2 m³ and 4.3 m³.
These values are estimates only and should not be used for design purposes.
Analyse
OK
Cancel
Help
Enter Infiltration Coefficient between 0.00000 and 100000.00000

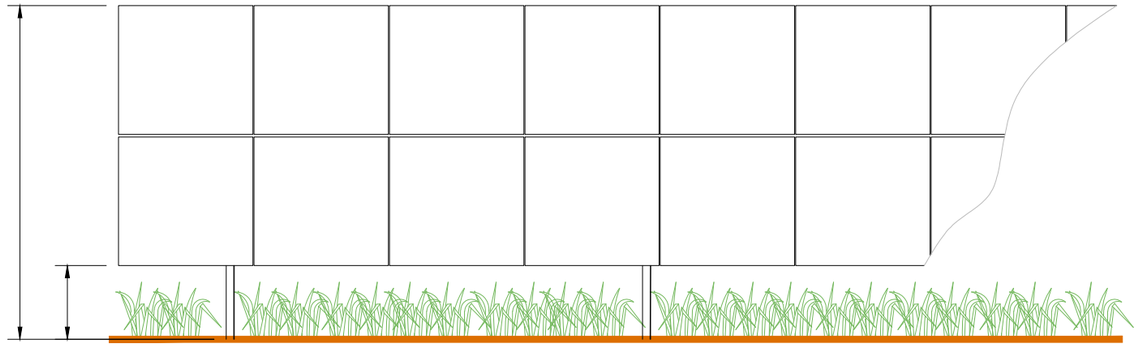
Appendix 2: Proposed Development Layout and Sections

N
Sinks
Issues
MERIDEN ROAD
Pond
B 4102
White House Farm
Track
M 6
Path (um)
ENVIROMENA

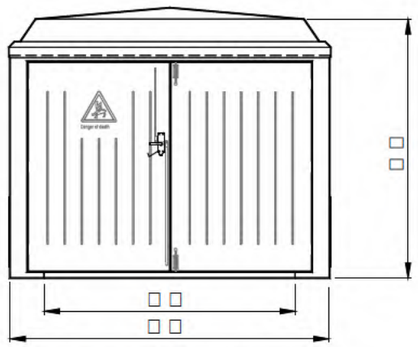


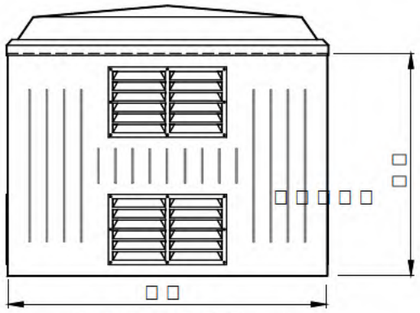


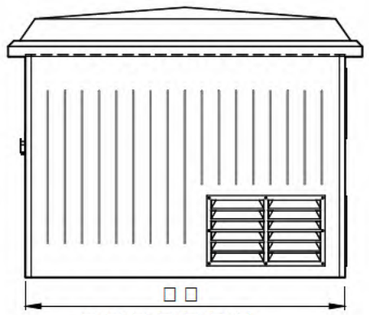


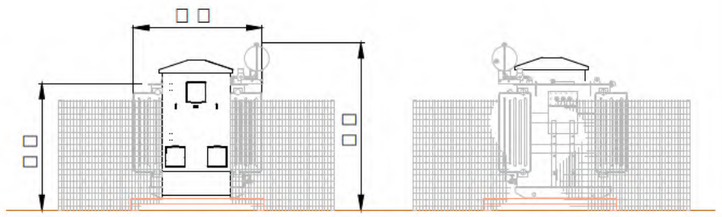


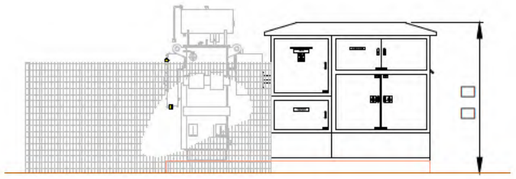
ENVIROMENA

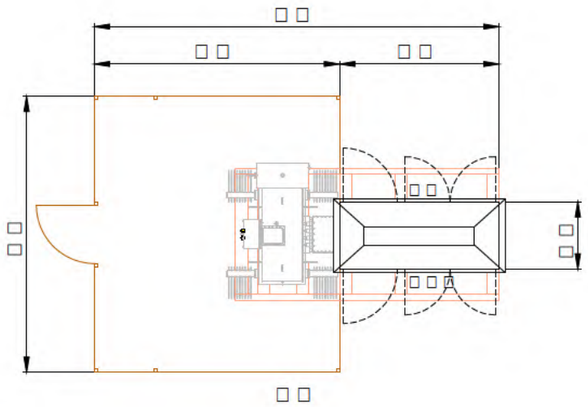


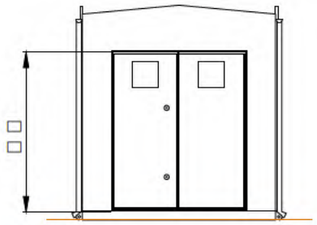


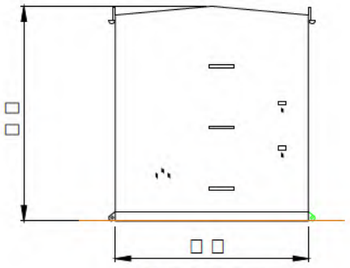


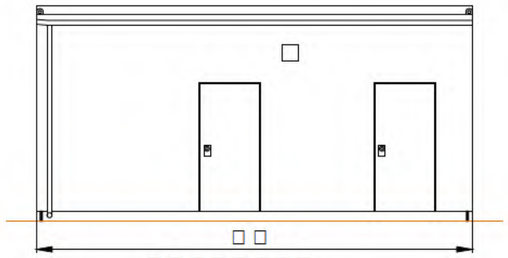


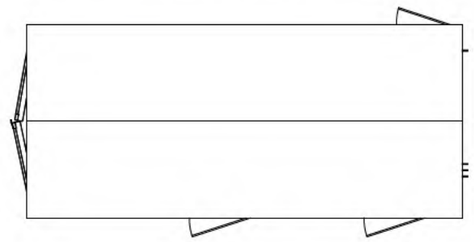












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ENVIROMENA

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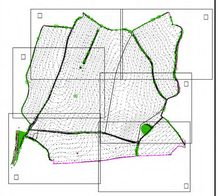
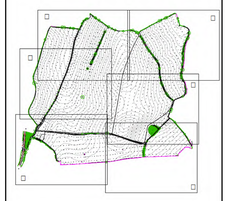
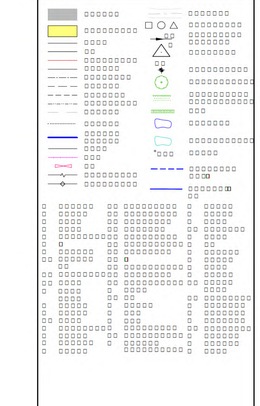
Appendix 3: Topographical Survey



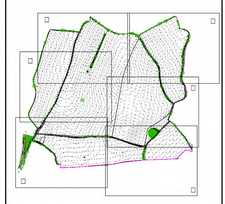
BWB
A CAF GROUP COMPANY

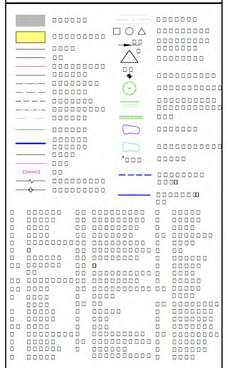




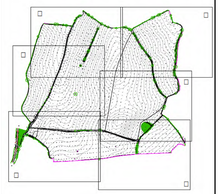
BWB
A CAF GROUP COMPANY

BWB
A GAF GROUP COMPANY





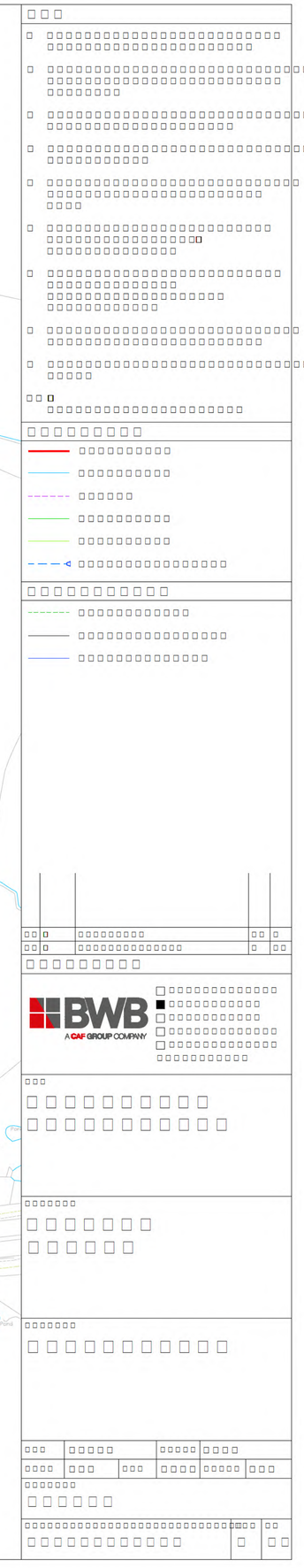
BWB
A CH2M GROUP COMPANY



BWB
A CAF GROUP COMPANY

Appendix 4: Conceptual Drainage Strategy and Basin Sections

BWB
A CAF GROUP COMPANY



Appendix 5: Pre and Post Development Runoff Calculations

IH 124 Mean Annual Flood

Input

Return Period (years)	100	Soil	0.150
Area (ha)	62.200	Urban	0.000
SAAR (mm)	700	Region Number	Region 4

Results	**l/s**
QBAR Rural	24.6
QBAR Urban	24.6
Q100 years	63.2
Q1 year	20.4
Q2 years	22.0
Q5 years	30.2
Q10 years	36.6
Q20 years	43.7
Q25 years	46.2
Q30 years	48.2
Q50 years	54.1
Q100 years	63.2
Q200 years	74.3
Q250 years	78.0
Q1000 years	102.3

IH 124 Mean Annual Flood

Input

Return Period (years)	100	Soil	0.150
Area (ha)	62.200	Urban	0.000
SAAR (mm)	980	Region Number	Region 4

Results	**l/s**
QBAR Rural	36.5
QBAR Urban	36.5
Q100 years	93.7
Q1 year	30.3
Q2 years	32.7
Q5 years	44.8
Q10 years	54.3
Q20 years	64.8
Q25 years	68.5
Q30 years	71.4
Q50 years	80.3
Q100 years	93.7
Q200 years	110.1
Q250 years	115.6
Q1000 years	151.7

IH 124 Mean Annual Flood

Input

Return Period (years)	100	Soil	0.150
Area (ha)	62.200	Urban	0.001
SAAR (mm)	700	Region Number	Region 4

Results	**l/s**
QBAR Rural	24.6
QBAR Urban	24.7
Q100 years	63.4
Q1 year	20.5
Q2 years	22.1
Q5 years	30.4
Q10 years	36.8
Q20 years	43.8
Q25 years	46.3
Q30 years	48.3
Q50 years	54.3
Q100 years	63.4
Q200 years	74.5
Q250 years	78.2
Q1000 years	102.5

IH 124 Mean Annual Flood

Input

Return Period (years)	100	Soil	0.150
Area (ha)	62.200	Urban	0.001
SAAR (mm)	980	Region Number	Region 4

Results	**l/s**
QBAR Rural	36.5
QBAR Urban	36.5
Q100 years	93.9
Q1 year	30.3
Q2 years	32.8
Q5 years	45.0
Q10 years	54.4
Q20 years	64.9
Q25 years	68.6
Q30 years	71.6
Q50 years	80.4
Q100 years	93.9
Q200 years	110.3
Q250 years	115.8
Q1000 years	151.9

Appendix 6: Pre and Post Development Runoff Volumes

Greenfield Runoff Volume

FEH Data

Return Period (years)	100
Storm Duration (mins)	360
FEH Rainfall Version	2013
Site Location	GB 428050 287000 SP 28050 87000
Data Type	Catchment
Areal Reduction Factor	1.00
Area (ha)	62.200
SAAR (mm)	709
CWI	106.161
SPR Host	32.470
URBEXT (1990)	0.0107

Results

Percentage Runoff (%)	32.22
Greenfield Runoff Volume (m^3)	12906.902

Greenfield Runoff Volume

FEH Data

Return Period (years)	100
Storm Duration (mins)	360
FEH Rainfall Version	2013
Site Location	GB 428050 287000 SP 28050 87000
Data Type	Catchment
Areal Reduction Factor	1.00
Area (ha)	62.160
SAAR (mm)	709
CWI	106.161
SPR Host	32.470
URBEXT (1990)	0.0107

Results

Percentage Runoff (%)	32.22
Greenfield Runoff Volume (m^3)	12898.601

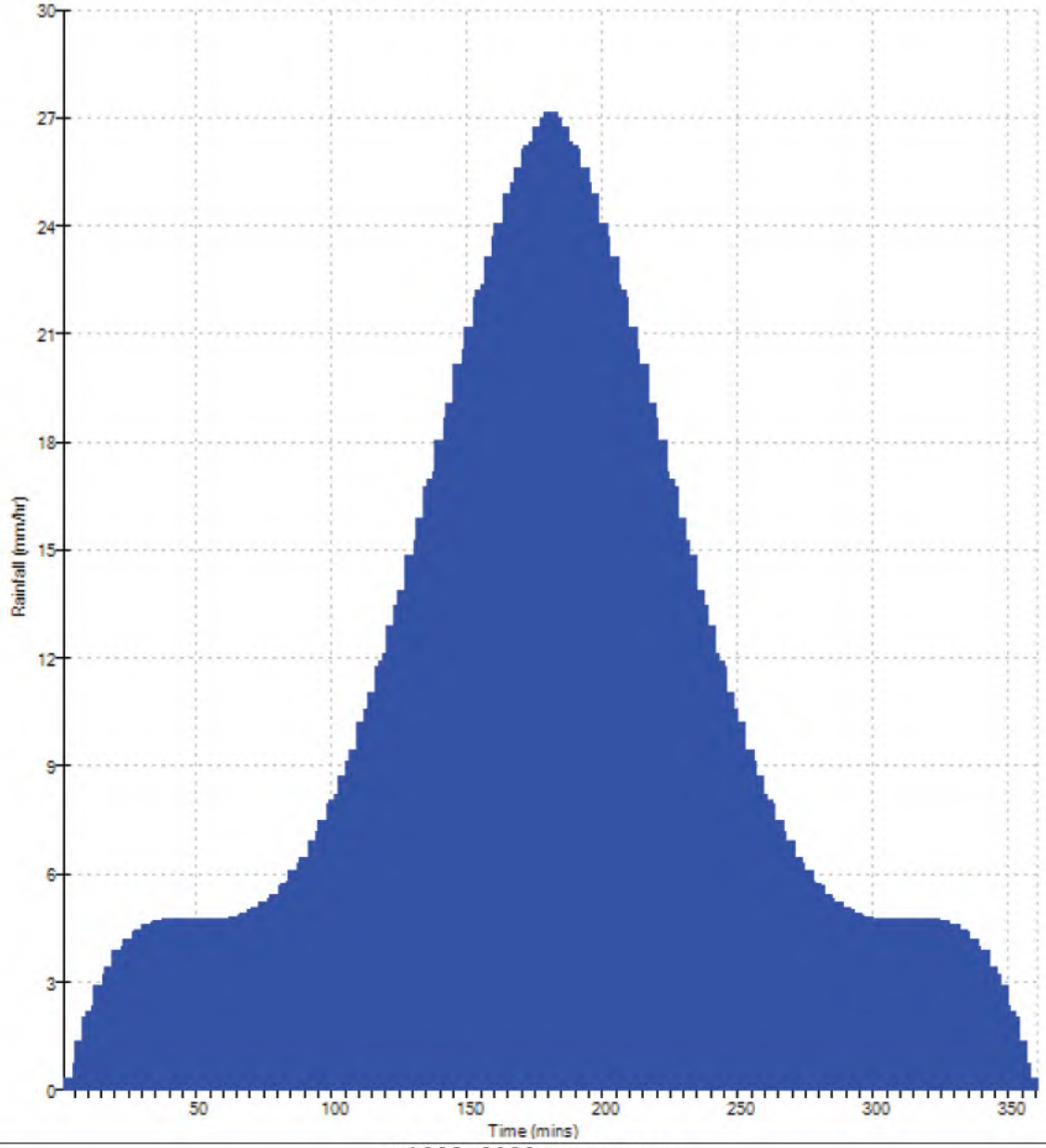
Appendix 7: Rainfall Profile

Rainfall profile

Storm duration (mins) 360

FEH Data

FEH Rainfall Version	2013
Site Location	GB 428050 287000 SP 28050 87000
Data Type	Catchment
Peak Intensity (mm/hr)	27.146
Ave. Intensity (mm/hr)	10.733
Return Period (years)	100.0



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ENVIRONMENT

Enviromena Project Management UK Limited
Nailcote Farm
Warwickshire
Flood Risk Assessment

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Warwickshire
Flood Risk Assessment

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P05	07/03/23	S2	Updated site layout	WJ	MB	KA
P06	22/11/23	S2	Updated site layout	MB	LR	KA
P07	29/04/24	S2	Updated site layout to account for basins	KA	LR	MB

Notice

EXECUTIVE SUMMARY

This Flood Risk Assessment (FRA) has been prepared in accordance with the requirements set out in the National Planning Policy Framework (NPPF) and the associated Planning Practice Guidance (PPG). It has been produced on behalf of Enviromena Project Management UK Limited in respect of a planning application for a proposed temporary solar farm at Nailcote Farm, Warwickshire. This report demonstrates that the proposed development is at an acceptable level of flood risk subject to the recommended flood mitigation strategies being implemented.

This FRA (dated April 2024) will be resubmitted to the live planning application "PAP/2023/0071". Therefore, the flood risk guidance at the time of the planning application validation (24/02/2023) has been used within this updated FRA.

The Site is located wholly within Flood Zone 1 (Low Probability). However, extents of Flood Zone 2 and 3 are shown adjacent to the northwest Site boundary, associated with Bourne Brook. Bourne Brook and an Unnamed Ordinary Watercourse (UOW) cross the site from the southern boundary to the northern boundary and from the southern boundary to the eastern boundary respectively. Within the Site there are several ditches; these outfall into either the Bourne Brook or UOW, with the exception of the ditch located at the centre of the Site which has no visible connectivity.

These UOWs are not included within the Environment Agency's (EA) Flood Map for Planning due to their small catchment size (i.e., < 3km^2), therefore EA surface water flood mapping has been used to indicate the potential floodplain extents associated with the UOWs.

The development should be set back an appropriate easement from the top of bank from Bourne Brook, the UOW and all ditches, in accordance with local guidance. A series of shallow detention basins are also proposed alongside the two UOWs that run through the site, in order to provide additional storage during any potential exceedance event. Their exact size and location are to be confirmed through detailed design.

These basins have been proposed post approval with conditions, by the Lead Local Flood Authority (LLFA) and following further discussions on site with members of the Fillongley Flood Action Group, Client, LLFA and BWB. Such measures are additional to the swales that were already being proposed to intercept surface water flows and that were deemed appropriate by the LLFA.

It is recommended that all ancillary equipment is raised 150mm above the external ground level to discourage water ingress. External levels adjacent to the ancillary equipment should be profiled away from the equipment to provide further mitigation against the residual risk of flooding.

Other flood risk sources such as sewer, groundwater and reservoirs have also been assessed and are considered to pose a low risk to the site.

A more detailed surface water drainage strategy has been produced to accompany this report. In compliance with the requirements of NPPF, and subject to the mitigation measures proposed, the development could proceed without being subject to significant flood risk.

Moreover, the development will not increase flood risk to the wider catchment area as a result of suitable management of surface water runoff discharging from the site.

CONTENTS

FIGURES

TABLES

APPENDICES

1. INTRODUCTION

1.1 This Flood Risk Assessment (FRA) has been prepared in accordance with the requirements set out in the National Planning Policy Framework (NPPF) and the associated Planning Practice Guidance. The FRA has been produced on behalf of Enviromena Project Management UK Limited in respect of a planning application for a proposed temporary solar farm at Nailcote Farm, Warwickshire.

1.2 This FRA is intended to support a full planning application (PAP/2023/0071), the level of detail included is commensurate and subject to the nature of the proposals at the planning stage. Summary information is included as **Table 1.1**.

1.3 This FRA (dated April 2024) will be resubmitted to the live planning application "PAP/2023/0071". Therefore, the flood risk guidance at the time of the planning application validation (24/02/2023) will be used within this updated FRA.

1.4 The flood risk and drainage details have been approved with conditions by the LLFA, following review of the P06 version of the FRA and DS (Drainage Strategy), ahead of the application going to planning committee.

1.5 Following the planning committee meeting, an on-site discussion was had with the Fillongley Flood Action Group, Enviromena, BWB and the LLFA. Where various flood risk matters were discussed. The inclusion of detention basins within the development, linked to the existing watercourses, was discussed as a form of natural flood management to assist with flood risk to the village of Fillongley.

1.6 Following the site visit the LLFA issued a statement (**Appendix 1**) that covered a number of key areas, but that fundamentally their stance remained unchanged, with them approving the scheme on flood risk and drainage grounds, with conditions.

1.7 Within the statement the LLFA noted that swales that had been incorporated within the layout and that they would provide betterment with regards to surface water runoff and volume. Further to this, it was noted that the additional planting being proposed as part of the landscape strategy for the site, would also aid in" slowing the flow" of runoff, ahead of it reaching the watercourse.

1.8 Following the site visit plans were worked up with regard to the incorporation of three detention basins within the proposed layout, which although supported by the LLFA, were considered beyond the normal requirements for a site such as this one.

1.9 Further details on the proposed detention basins are included within the mitigation section of this report, as well as with the Drainage Strategy report for the site.

Table 1.1: Site Summary

Site Name	Nailcote Farm
Location	Warwickshire
NGR (approx.)	SP 275 860
Application Site Area (ha)	62.2 (Approx.)
Development Type	Solar Farm
Flood Zone Classification	Flood Zone 1
NPPF Vulnerability	Essential Infrastructure
Anticipated Development Lifetime	40 years
Environment Agency Office	West Midlands
Lead Local Flood Authority	Warwickshire County Council
Local Planning Authority	North Warwickshire Borough Council
Planning Application	PAP/2023/0071

Sources of Data

i. Topographical Survey by BWB Consulting, reference NFW-BWB-00-ZZ-M2-G-001
ii. OS Explorer Series mapping
iii. Warwickshire County City Council Consultation
iv. Environment Agency (EA) Risk of Flooding from Surface Water Data
v. Warwickshire County Council Strategic Flood Risk Assessment
vi. Warwickshire County Council Preliminary Flood Risk Assessment
vii. North Warwickshire Borough Council Local Plan
viii. Site visit by BWB Consulting Ltd, March 2024
ix. Ground Investigations undertaken by DUNELM Geotechnical & Environmental (reference: D10836)
x. British Geological Survey Drift & Geology Maps

Existing Site

1.10 The Site is located approximately 785m south-west of Fillongley and 9km northwest of Coventry city centre. The Site's location is illustrated within **Figure 0.1**.

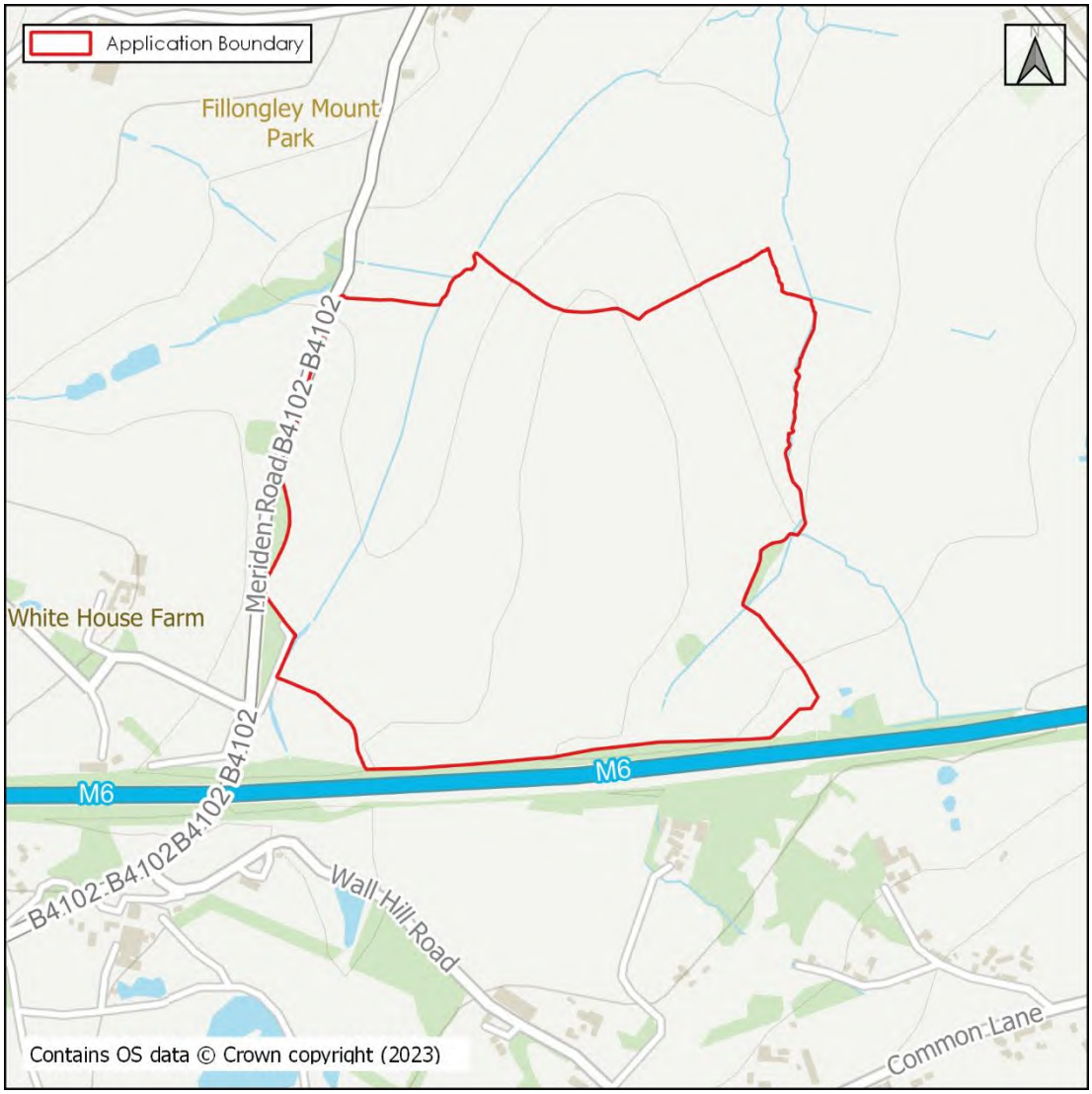

Figure 0.1: Site Location

1.11 The existing Site access is via a dirt track off Meriden Road (B4102). The Site is bound to the north by agricultural fields, to with further agricultural fields and an unnamed ordinary watercourse (UOW) to the east. The southern boundary of the Site is bound by the M6 motorway and Fillongley Shooting Club, the west of the Site is bound by Meriden Road (B4102).

1.12 Within the Site there is the UOW along the east boundary, as well as Bourne Brook which cuts through the west of the Site on a south to north axis and exits along the northern boundary.

1.13 A topographical Survey (**Appendix 2**) shows the levels within the Site to undulate; however, the Site generally falls from the high points located at the centre of the Site towards the southern boundary and the ditches located within the Site to the east and west. The levels at the Site range from the highest point at approximately 148.7m Above Ordnance Datum (AOD) in the southern centre of the Site to approximately 122.3m AOD in the northeast Site corner.

1.14 The existing Site access levels range from 132.7m AOD to 133.6m AOD.

Proposed Development

1.15 The proposed development is for the construction of a temporary Solar Farm, to include the installation of ground-mounted solar panels together with associated works, equipment and necessary infrastructure.

1.16 The existing access road will remain unchanged.

1.17 A series of shallow detention basins are also proposed alongside the two UOWs that run through the site, in order to provide additional storage during any potential exceedance event. Their exact size and location are to be confirmed through detailed design.

1.18 These basins have been proposed post approval with conditions, by the Lead Local Flood Authority (LLFA) and following further discussions on site with members of the Fillongley Flood Action Group, Client, LLFA and BWB.

1.19 A proposed development plan is presented in **Appendix 3**.

2. FLOOD RISK PLANNING POLICY & GUIDANCE

National Planning Policy Framework

2.1 The NPPF[1] sets out the Government's national policies on different aspects of land use planning in England in relation to flood risk. Planning Practice Guidance (PPG) is also available online[2].

2.2 The PPG sets out the vulnerability to flooding of different land uses. It encourages development to be located in areas of lower flood risk where possible and stresses the importance of preventing increases in flood risk off site to the wider catchment area.

2.3 The PPG also states that alternative sources of flooding, other than fluvial (river flooding), should be considered when preparing an FRA.

2.4 The PPG includes a series of tables that define Flood Zones (Table 1), the flood risk vulnerability classification of development land uses (Table 2) and 'compatibility' of development within the defined Flood Zones (Table 3). Further details on this are included as **Appendix 4.**

2.5 This FRA is written in accordance with the NPPF and the PPG.

Flood Map for Planning

2.6 With particular reference to planning and development, the Flood Map for Planning identifies Flood Zones in accordance with Table 1 of the Planning Practice Guidance. Further details on the Flood Zone classifications are outlined in **Table 2.1**.

Table 2.1: Flood Zone Classifications

Flood Zone	Description
Flood Zone 1 (Low Probability)	Land having less than a 1 in 1000 annual probability of river or sea flooding (<0.1% Annual Exceedance Probability). All land outside of Flood Zone 2 and 3.
Flood Zone 2 (Medium Probability)	Land having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1% AEP); or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% - 0.1% AEP).
Flood Zone 3a (High Probability)	Land having a 1 in 100 or greater annual probability of river flooding (>1% AEP); or land having a 1 in 200 or greater annual probability of flooding from the sea (>0.5% AEP). This is represented by "Flood Zone 3" on the Flood Map for Planning.
Flood Zone 3b (The Functional Floodplain)	Flood Zone 3b (The Functional Floodplain) is defined as land where water must flow or be stored in times of

[1] Revised National Planning Policy Framework, Ministry of Housing, Communities & Local Government, amended 2021
[2] Planning Practice Guidance: https://www.gov.uk/government/collections/planning-practice-guidance

Flood Zone	Description
	flood. This is not identified or separately distinguished from Zone 3a on the Flood Map for Planning.

2.7 The site is shown to be located entirely within Flood Zone 1, as shown in **Figure 2.1**.

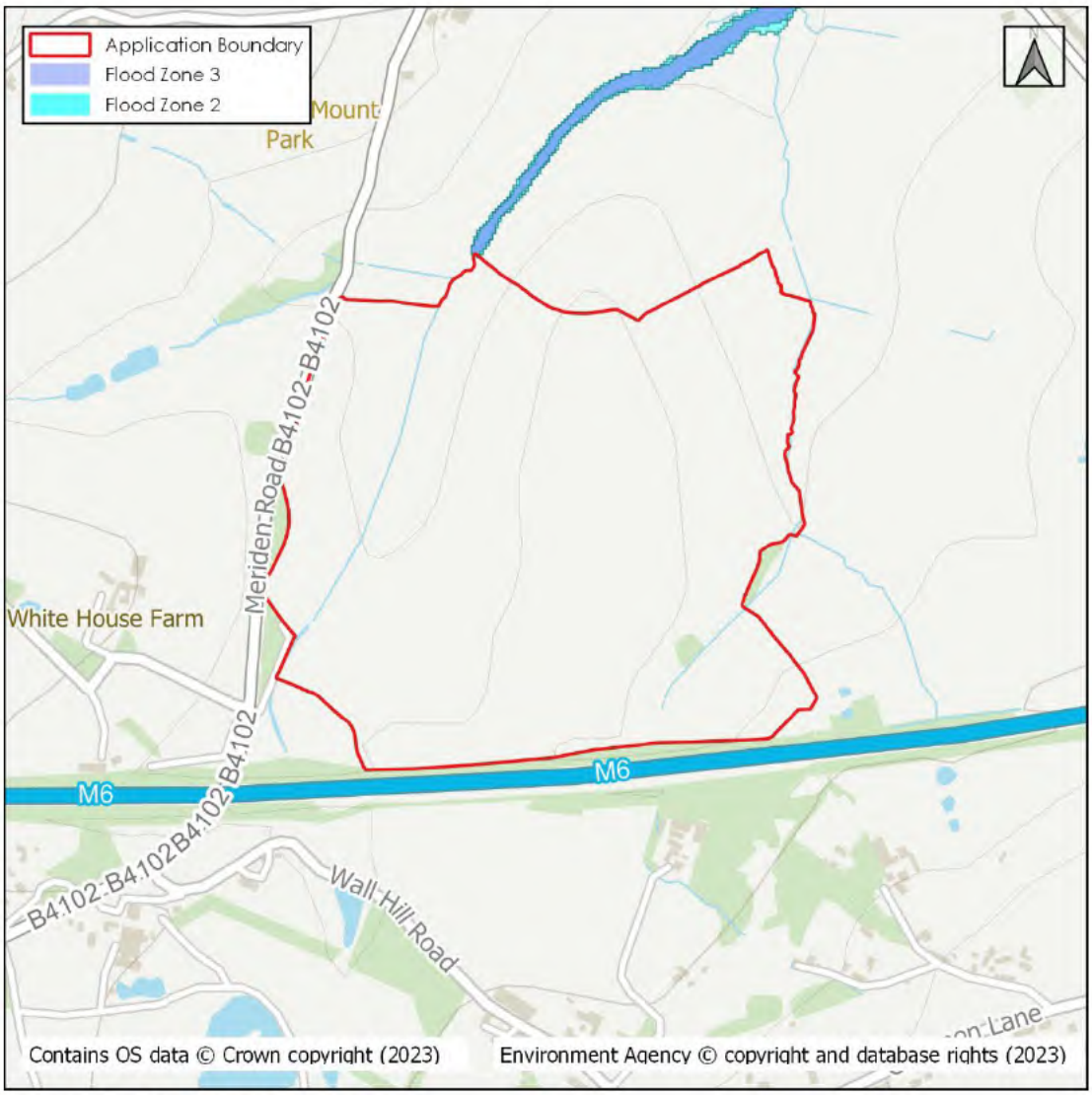

Figure 2.1: Flood Map for Planning

The Design Flood

2.8 The PPG identifies that new developments should be designed to provide adequate flood risk management, mitigation, and resilience against the 'design flood' for their lifetime.

2.9 This is a flood event of a given annual flood probability, which is generally taken as fluvial (river) and surface water (pluvial) flooding likely to occur with a 1% annual probability (a 1 in 100 chance each year), or tidal flooding with a 0.5% annual probability (1 in 200

chance each year), against which the suitability of a proposed development is assessed and mitigation measures, if any, are designed.

Climate Change

Peak River Flow

2.10 Predicted future changes in peak river flows caused by climate change are provided by the EA[3], with a range of projections applied to regionalised 'River Basin Districts', which are further subdivided into Management Catchments.

2.11 The Site falls within the Tame Anker and Mease Management Catchment of the Humber River Basin District. **Table 2.2** identifies the relevant peak river flow climate change allowances from this Management Catchment.

Table 2.2: Peak River Flow Climate Change Allowances for the Tame Anker and Mease Management Catchment within the Humber River Basin District

Allowance Category	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 2125)
Upper End	24%	30%	51%
Higher Central	15%	17%	30%
Central	10%	11%	22%

2.12 When determining the appropriate allowance for use in a FRA the Flood Zone classification, flood risk vulnerability and the anticipated lifespan of the development should be considered. **Table 2.3** provides a matrix summarising the EA's guidance on determining the appropriate allowance(s).

Table 2.3: Application of Appropriate Peak River Flow Climate Change Allowances

Flood Zone	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
1	Use the central allowance where a location may fall within Flood Zone 2 or 3 in the future.				
2	Use the higher central allowance	Use the central allowance			
3a	Use the higher central allowance	Development should not be permitted	Use the central allowance		

[3] Environment Agency, Flood risk assessments: climate change allowances: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances. Last Accessed January 2023.

Flood Zone	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
3b	Use the higher central allowance	Development should not be permitted			Use the central allowance
If development is considered appropriate by the local authority when not in accordance with Flood Zone vulnerability categories, then it would be appropriate to use the higher central allowance.					

2.13 The site is located entirely within Flood Zone 1, the proposed development is classified as essential infrastructure, and it has an anticipated lifespan of 40 years. Therefore, the Central allowance for the 2050s epoch will be considered.

2.14 Therefore, to ensure the development is designed adequately for its lifetime an allowance of 11% will be applied to the design flood to identify minimum development levels.

Peak Rainfall

2.15 Predicted future changes in peak rainfall intensity caused by climate change are provided by the EA[4], with a range of projections applied to River Basin District Management Catchments.

2.16 The site falls within the Tame Anker and Mease Management Catchment. **Table 2.4** identifies the relevant peak rainfall climate change allowances from this Management Catchment.

Table 2.4: Peak Rainfall Climate Change Allowances for the Tame Anker and Mease Management Catchment

Tame Anker and Mease Management Catchment Allowance	Total Potential Change Anticipated for the '2050s' (Lifetime up to 2060)	Total Potential Change Anticipated for the '2070s' (2061 to 2125)
1 in 30-Year Rainfall Event		
Upper End	35%	35%
Central	20%	25%
1 in 100-Year Rainfall Event		
Upper End	40%	40%
Central	20%	25%

2.17 The future increase in rainfall will need to be considered when designing a development to ensure its drainage system is sufficient for its lifetime and that it does not increase flood

[4] Environment Agency, Flood risk assessments: climate change allowances: Environment Agency, Flood risk assessments: climate change allowances: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances. Last Accessed January 2023.

risk elsewhere. When determining the appropriate allowance(s) the anticipated lifespan of the development should be considered.

2.18 **Table 2.5** provides a summary of the EA's guidance on determining the appropriate allowance(s).

Table 2.5: Application of Appropriate Peak Rainfall Climate Change Allowances

<table>
<tr><th rowspan="2">Area Assessed</th><th colspan="3">Anticipated Development Life Span</th></tr>
<tr><th>up to 2060</th><th>between 2061 and 2100</th><th>up to or beyond 2100*</th></tr>
<tr><td>Development Sites^

Assess the 1 in 30-year and 1 in 100-year storm events with the respective climate change allowance(s) applied.

Development to be designed so that with the climate change allowance applied to the 1 in 100-year storm:
• there is no increase in flood risk elsewhere
the development will be safe from surface water flooding</td><td rowspan="3">Use the Central Allowance for the 2050s</td><td rowspan="3">Use the Central Allowance for the 2070s+</td><td rowspan="3">Use the Upper End Allowance for the 2070s+</td></tr>
<tr><td>Urban Catchments

Assess the flood risk at the 1 in 30-year and 1 in 100-year storm events with the respective allowance(s) applied.</td></tr>
<tr><td>Rural Catchments <5km²

Assess the flood risk at the 1 in 30-year and 1 in 100-year storm events with the respective central climate change allowances applied.</td></tr>
<tr><td>Rural Catchments >5km²</td><td colspan="3">Direct rainfall analysis is not appropriate, use flood flow estimation methods.</td></tr>
</table>

**Includes all residential developments*
^the Lead Local Flood Authority may have local standards that also need to be considered.
+unless the 2050s allowance is greater

2.19 The development site has an anticipated lifespan of 40 years. Therefore, the Central allowance for the '2070s' epoch will need to be considered in the design of the associated drainage infrastructure.

Strategic Flood Risk Assessment

2.20 A Strategic Flood Risk Assessment (SFRA) is a study carried out by one or more local planning authorities to assess the risk to an area from flooding from all sources, now and in the future.

2.21 The Stratford-on-Avon District Council, Warwickshire County Council, Warwickshire Borough Council & Rugby Borough Council Level 1 SFRA[5] has been reviewed in the production of this FRA. The SFRA provides information specific to the site location in the form of fluvial, surface water and groundwater flood risk mapping, as well as records of historical flooding. It also includes flood risk policy and guidance for the area. Information from the Level 1 SFRA has been referenced within **Section 3** where applicable.

Preliminary Flood Risk Assessment

2.22 A Preliminary Flood Risk Assessment (PFRA) is an assessment of floods that have taken place in the past and floods that could take place in the future. It generally considers flooding from surface water runoff, groundwater and ordinary watercourses, and is prepared by the Lead Local Flood Authorities (LLFAs).

2.23 The Warwickshire PFRA[6] considers flooding from surface water runoff, groundwater, ordinary watercourses and canals. It also references the historical river flooding which occurred in the local area in 1998, 2007 and 2008.

2.24 In 2017 an Addendum[7] was produced for the PFRA, this states that they are publishing several Section 19 reports from the March 2016 flood event, an update to the Flood Map for surface Water and Risk of Flooding from Surface Water maps, Upon review no applicable information in relation to flood risk at the site was identified within the PFRA Addendum.

Local Flood Risk Management Strategy

2.25 A Local Flood Risk Management Strategy (LFRMS) is prepared by an LLFA to help understand and manage flood risk at a local level.

2.26 The LFRMS aims to ensure that the knowledge of local flood risk issues is communicated effectively so that they can be better managed. The LFRMS also aims to promote sustainable development and environmental protection. The Warwickshire County Council LFRMS[8] has been reviewed during the production of this report.

River Basin Flood Risk Management Plan

2.27 Flood Risk Management Plans (FRMPs) explain the risk of flooding from rivers, the sea, surface water, groundwater and reservoirs. FRMPs set out how risk management authorities will work with communities to manage flood and coastal risk. Risk management authorities include the EA, Natural Resources Wales, local councils, internal drainage boards, Highways England and LLFAs.

[5] Stratford-on-Avon District Council, Warwickshire County Council, Warwickshire Borough Council & Rugby Borough Council Level 1 Level 1 Strategic Flood Risk Assessment (URS, September 2013)
[6] Warwickshire Preliminary Flood Risk Assessment (Royal Haskoning, May 2011)
[7] Preliminary flood risk assessment: Warwickshire County Council Addendum available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/698528/PFRA_Warwickshire_County_Council_2017.pdf
[8] Warwickshire County Council Local Flood Risk Management Strategy (Michael Green, Richard Stevens, Andy Smith, April 2016)

2.28 The first FRMPs were published in March 2016 with the latest FRMP was published in December 2022. They describe actions to manage flood risk across England between 2021 to 2027.

2.29 The site is located within the Humber River Basin District, and the Humber River Basin District FRMP[9] has been reviewed and the relevant site scale objectives have been considered in **Section 4** of this report.

Local Plan

2.30 The North Warwickshire Local Plan 2021[10] is the Statutory Development Plan for North Warwickshire and is the basis for determining planning applications. This Local Plan Strategy document sets out the overall vision and planning strategy for development in the borough and contains planning policies to ensure that new development addresses the economic, environmental and social needs of the area.

2.31 Policy LP29: Development Considerations within the Local Plan states that developments should 'manage the impacts of climate change through the design and location of development, including sustainable building design and materials, sustainable drainage, water efficiency measures, use of trees and natural vegetation and ensuring no net loss of flood storage capacity'.

2.32 It is also stated in policy LP29 that the development must 'protect the quality and hydrology of ground or surface water sources so as to reduce the risk of pollution and flooding, on site or elsewhere'.

[9] Humber River Basin District Flood Risk Management Plan (Environment Agency, December 2022) available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1120221/Humber-FRMP-2021-2027.pdf
[10] North Warwickshire Local Plan (September 2021, North Warwickshire Borough Council)

3. POTENTIAL SOURCES OF FLOOD RISK

3.1 Flooding can occur from a variety of sources, or combination of sources, which may be natural or artificial. **Table 3.1** below identifies the potential sources of flood risk to the site in its current condition, and the impacts which the development could have in the wider catchment, prior to mitigation. These are discussed in greater detail in the forthcoming section. The mitigation measures proposed to address flood risk issues and ensure the development is appropriate for its location are discussed within **Section 4**.

Table 3.1: Pre-Mitigation Sources of Flood Risk

Flood Source	Potential Risk				Description
	High	Medium	Low	None	
Fluvial			X		The site is located in Flood Zone 1. However, extents of Flood Zones 2 and 3 associated with Bourne Brook are located adjacent to the northwest site boundary.
		X			There are several ditches and UOW's located within the Site. These generally convey water towards Bourne Brook.
Coastal				X	This Site is not tidally influenced.
Canals				X	There are no canals in the vicinity.
Groundwater			X		SFRA groundwater susceptibility mapping indicates the Site to be at 25% or lower susceptibility to groundwater flooding.
Reservoirs and waterbodies			X		The Site is shown to fall far outside the nearest mapped maximum reservoir failure extent and is not situated downstream of an impounded artificial body of water.
Pluvial runoff			X		EA surface water flood risk mapping shows several low to high-risk surface water flow routes. These are to be associated with the UOW's. The high-risk areas are generally contained within the UOW's channel.
Sewers			X		There is no evidence of public or private sewers within the site or the immediate vicinity.

Flood Source	Potential Risk				Description
	High	Medium	Low	None	
Effect of Development on Wider Catchment			X		Given the nature of the proposed development. There is a negligible risk of impedance of flood routes and/or displacement of floodplains from the solar arrays. There is a residual risk of the ancillary equipment impeding / displacing flood routes / if situated within areas of pluvial flood risk.
			X		The nature of the proposed development will have a negligible impact on the surface water runoff and volume regime within the Site. However, residual risks remain.

Fluvial Flood Risk

3.2 Flooding from watercourses occurs when flows exceed the capacity of the channel, or where a restrictive structure is encountered, which leads to water overtopping the banks into the floodplain. This process can be exacerbated when debris is mobilised by high flows and accumulates at structures.

EA Flood Map for Planning

3.3 The Site is entirely located within Flood Zone 1 (Low Probability). However, extents of Flood Zone 2 and 3 are present adjacent to the northwest Site boundary, associated with Bourne Brook downstream from the Site.

3.4 A 'Product 4' request has been sent to the EA requesting any hydraulic modelled flood data associated with the Bourne Brook at the Site. The response from the EA is included in **Appendix 5**. The EA did not have any hydraulic modelling information to provide regarding the Site.

3.5 The areas of Flood Zone 2 and 3 are shown not to be extensive and constrained to the channel. Without results relating to the potential impacts of climate change, the Flood Zone 2 extent (1 in 1000-year event) can be used as a proxy.

Ordinary Watercourse and Ditches

3.6 The UOW's and ditches present within the Site are not included in the EA's Flood Zone mapping, due to the small catchments (i.e., <3km^2) associated with them. The indicative locations of the watercourses are shown in **Figure 3.1**.

3.7 In the absence of Flood Zone mapping and the EA hydraulic model flood data, the EA's surface water flood risk map can provide a useful indicator of the potential floodplain extents associated with the UOW's. This is shown **Figure 3.2** in with mappings showing the potential flood depths during the 1 in 100-year rainfall event presented as **Figure 3.3**.

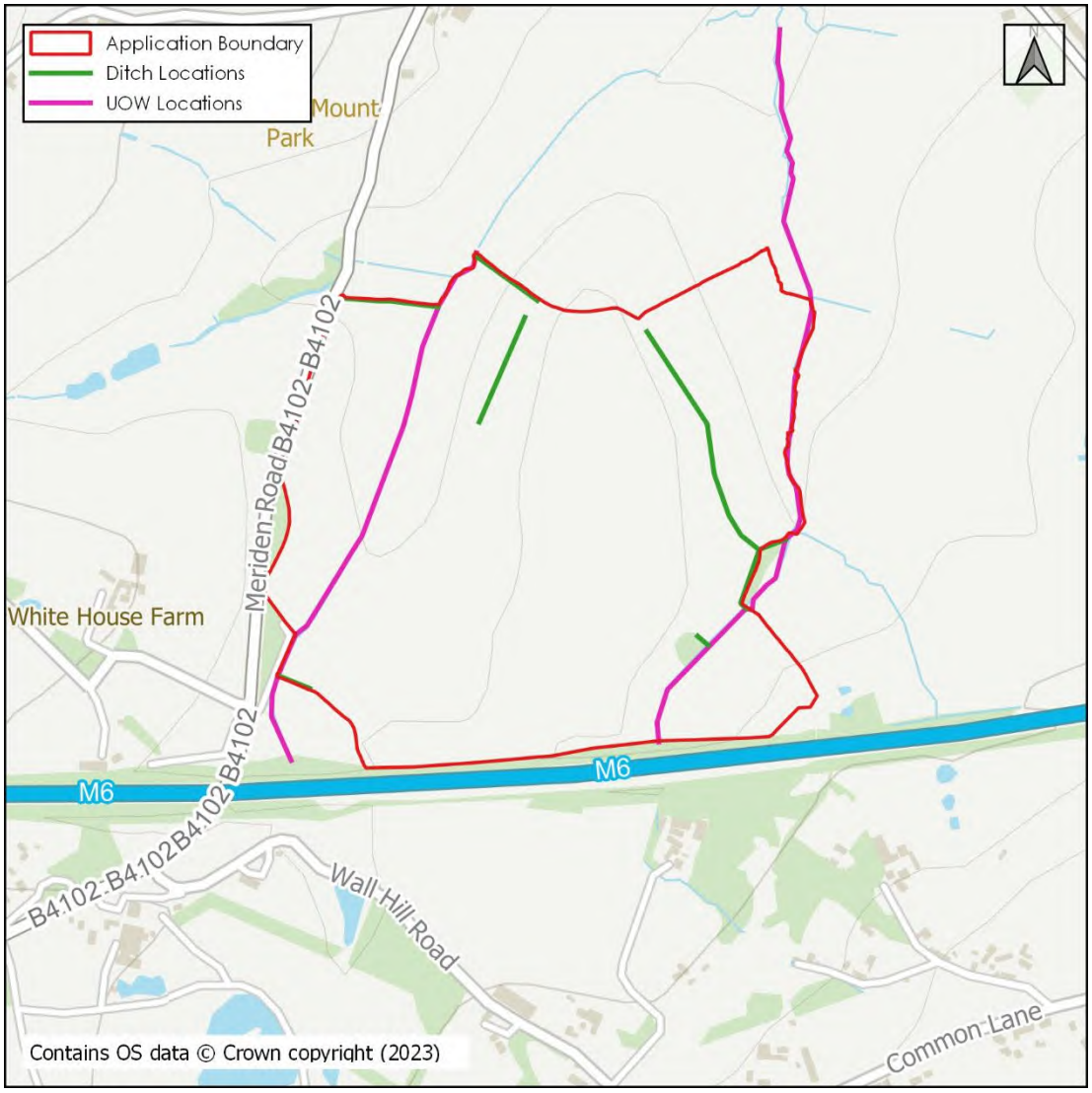

Figure 3.1: Location of UOWs and Ditches

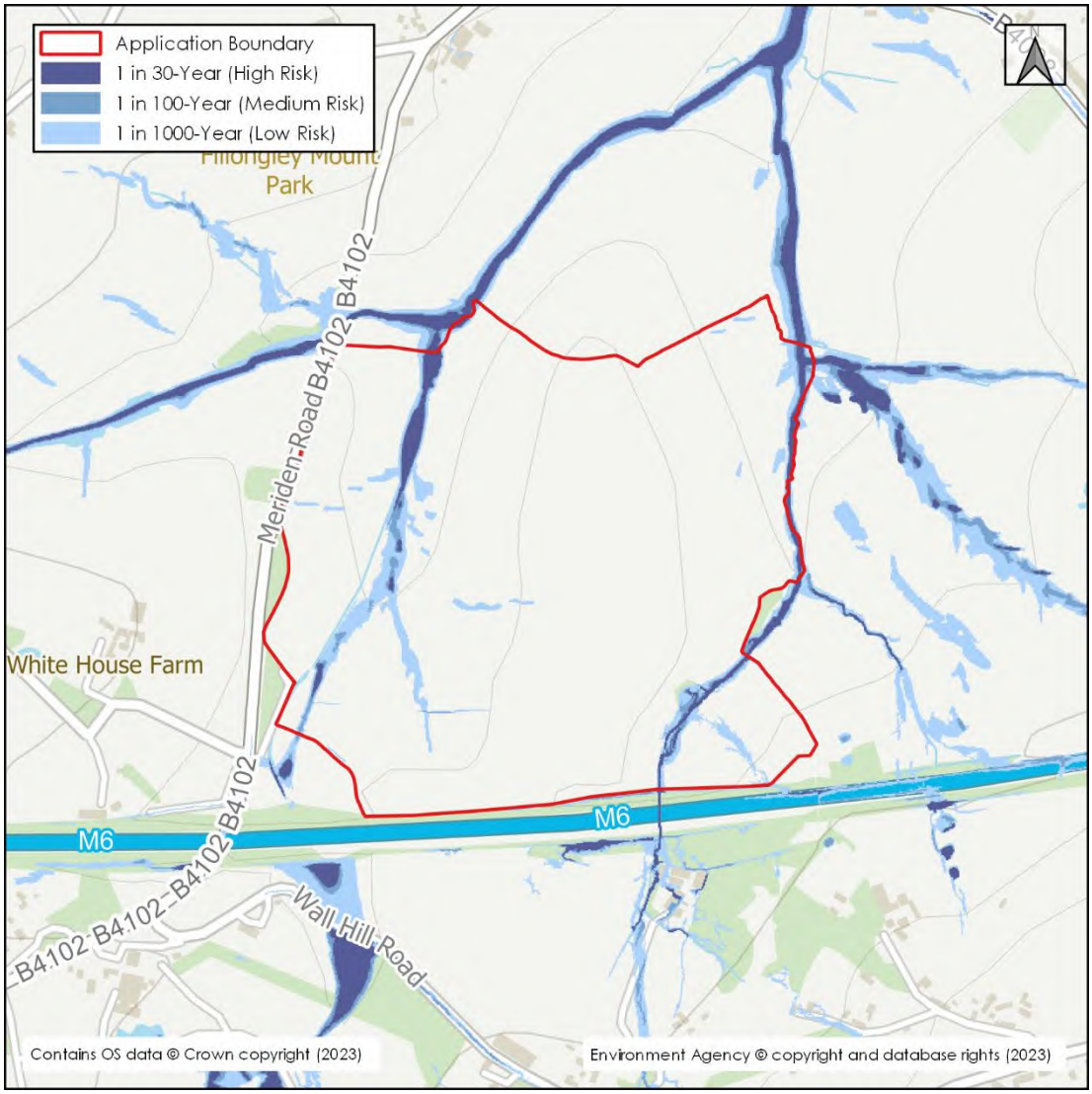

Figure 3.2: EA Surface Water Flood Extents

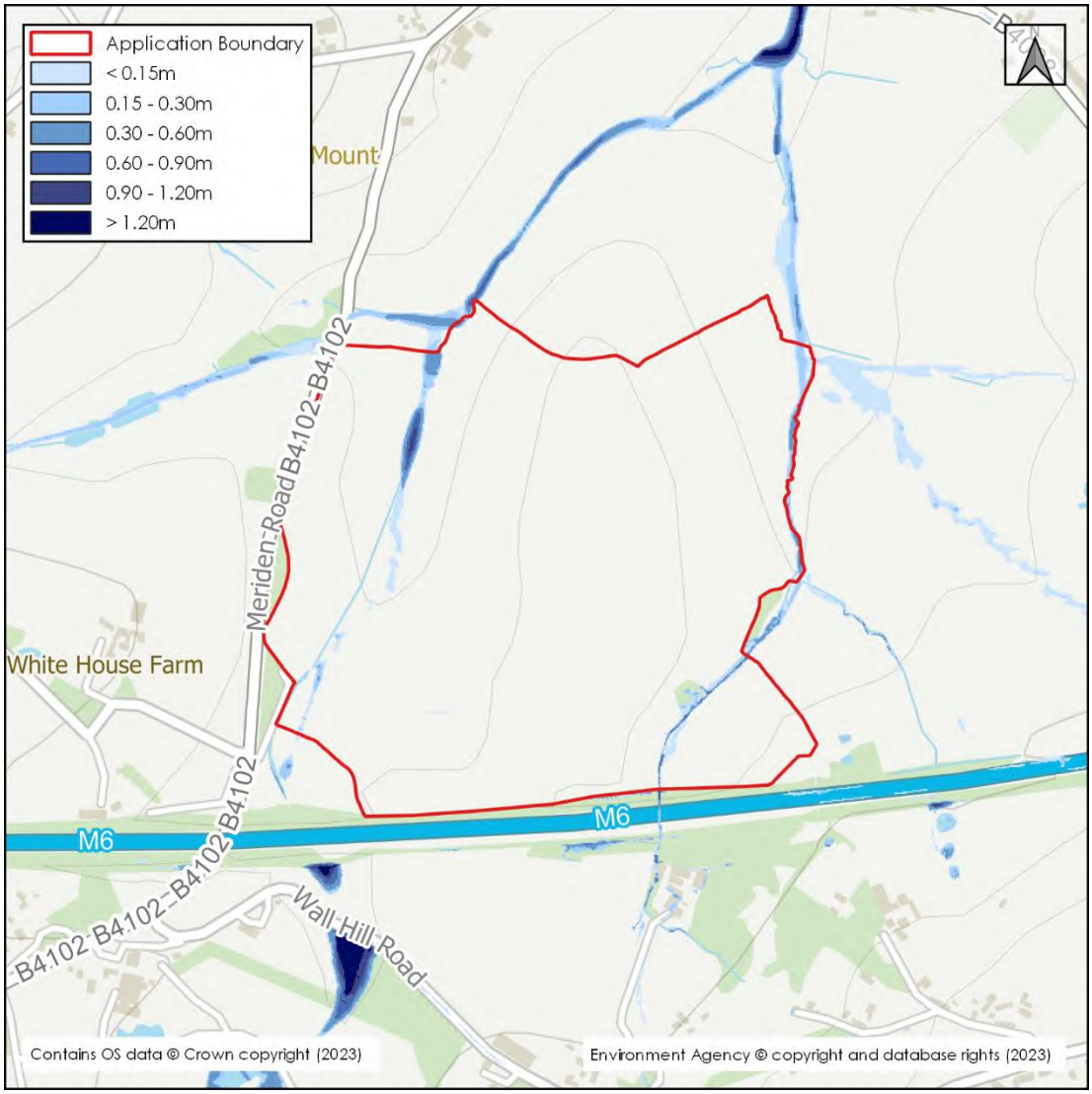

Figure 3.3: EA Surface Water Flood Depths Mapping for 1 in 100-year Event

3.8 From a review of the topographical survey and surface water flood risk mapping, the pluvial flow routes are shown to be relatively confined to the UOWs and therefore it is expected that flows are likely to remain in channel during the 1 in 30-year and 1 in 100-year events, with some exceedance during the 1 in 1000-year return period. Any exceedance flows are shown to remain close to the channel as they are conveyed towards the UOW or Bourne Brook. Typically, the depths are shown not to exceed 600mm.

3.9 The depth of ditches vary across the Site ranging from 0.3m deep to 1m deep, the majority of the ditches can be measured to 0.8m deep. The Site noticeably raised above most of the ditches with the exception of the land directly west of the ditch located in the middle of the Site and the land directly east of the ditch located within the east of the Site.

3.10 The overland flow route associated with the western UOW differs marginally compared to the indicative route shown in **Figure 3.1;** however, this is considered to have occurred due to the EA's surface water mapping not fully representing the connectivity within the UOW, as it runs through the site. It is therefore considered that the overland flow route should be aligned to the UOW.

3.11 When considering the future impacts of climate change on the flows within the UOW's, it is expected that there will be an increase in the floodplain extents and depths. However, due to the minimal increase, it is expected that the majority of the site will be unaffected by any potential flooding from these watercourses.

Historical Flood Events

3.12 There are no historical records referenced within the EA recorded flood outlines or within the SFRA of fluvial flooding known to have occurred within the site.

3.13 It is noted through correspondence received by the Fillongley Flood Action Group and following discussions had on site on the 18th March 2024, that flooding has occurred within Fillongley village in the past.

3.14 The previous flooding incidents are understood to have occurred in two main areas; where three UOWs join and where there is a culvert that passes beneath Coventry Road.

3.15 The confluence of the three UOWs is located approximately 600m north of the site's northern boundary, and it is understood that flooding in this area is a result of minor exceedance of the channels. There is no information to indicate that the site has been impacted.

3.16 The culverted section of watercourse beneath Coventry Road, within the centre of Fillongley, is understood to have caused flooding to the centre of Fillongley. The flooding is understood to have been due to a trash screen at the upstream entrance to the culvert becoming blocked. Again, there is no information to suggest that the site was impacted by this event.

Pluvial Flood Risk

3.17 Pluvial flooding can occur during prolonged or intense storm events when the infiltration potential of soils, or capacity of drainage infrastructure is overwhelmed leading to the accumulation of surface water and the generation of overland flow routes.

3.18 Risk of flooding from surface water mapping has been prepared by the EA, this shows the potential flooding which could occur when rainwater does not drain away through the normal drainage systems or soak into the ground, but lies on or flows over the ground instead. An extract from the mapping is included in **Figure 3.2**.

3.19 As shown in **Figure 3.2,** the majority of the site is shown to be at very low risk of surface water flooding. There are several pluvial flow routes located within the Site, presenting a low to high risk of surface water flooding, associated with Bourne Brook and the UOWs. The risk associated with these features has been assessed above in the fluvial section.

3.20 There are small pockets of low-medium risk of surface water flooding, these are isolated and assumed to be related to topographical depressions.

3.21 The access road is shown to be at low risk of pluvial flooding and the site can be access and egressed via Meriden Road which is generally at very low risk of pluvial flooding.

3.22 Overall, the Site is considered to be at low risk of surface water flooding.

Groundwater Flood Risk

3.23 Groundwater flooding occurs when the water table rises above ground elevations. It is most likely to happen in low lying areas underlain by permeable geology. This is most common on regional scale chalk aquifers, but there may also be a risk on sandstone and limestone aquifers or on think deposits of sands and gravels underlain by less permeable strata such as that in a river valley.

3.24 British Geological Survey (BGS) mapping shows the Site predominantly to be underlain by Keresley Member - Sandstone, a small pocket along the eastern UOW is underlain by Keresley Member – Argillaceous rocks and sandstone and conglomerate, interbedded.

3.25 Within the Site there are three superficial deposits. Along the north-western boundary there are deposits of Alluvium – clay, silt sand and gravel. A large area of Thrussington Member – Diamicton is located in the middle of the Site from the south boundary to the northern boundary. Along the UOW to the south of the Site there are traces of glaciolacustrine deposits, mid Pleistocene, clay and silt. Rest of the Site has no recorded superficial deposits. **Figure 3.4** shows the arrangement of Bedrock Geology and Superficial Deposits within the Site

3.26 The geology is also supported by the report published by DUNELM Geotechnical & Environmental (report number: D10836). Within 'Appendix C' of this report is a Groundsure report which states that the risk of groundwater flooding is to be considered 'low-risk'.

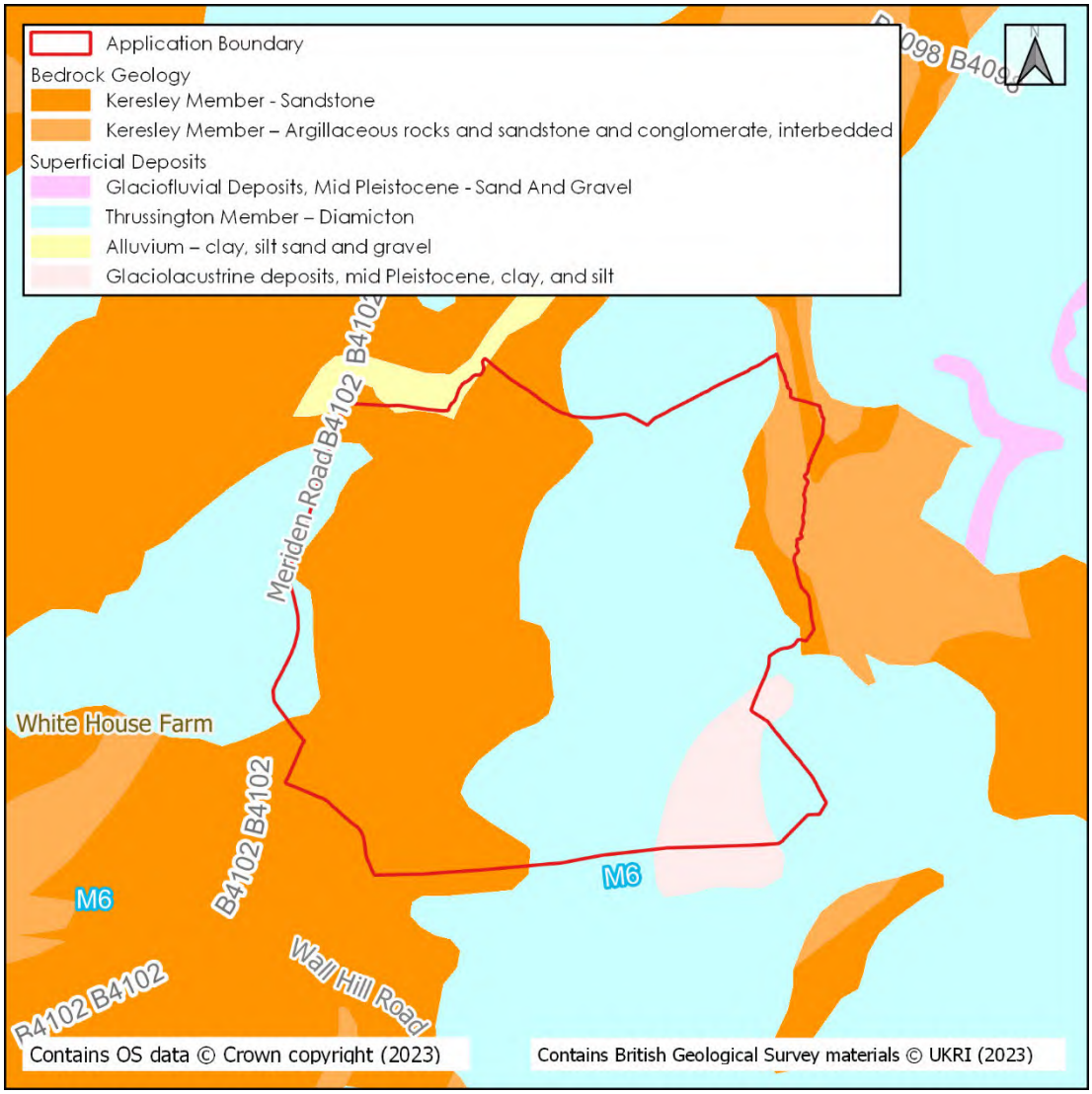

Figure 3.4: Bedrock Geology and Superficial Deposit

3.27 The EA designates the bedrock strata to be principal aquifers, this means the bedrock holds a significant amount of groundwater that is used to support water supply, base flows to rivers, lakes and wetlands on a strategic scale.

3.28 The areas of superficial deposits are classed as unproductive strata. There are several areas within the site (mainly the central area of the site) which is classed as a Secondary (undifferentiated) Aquifer, this means that the superficial deposit contain both characteristic traits of Secondary A and Secondary B Aquifers. There is also an area which seems to align with the area of Alluvium which is classed as a Secondary A Aquifer which is defined as a permeable layer which can support local water supplies and may form a base flow of a river.

3.29 A review of BGS borehole logs identifies records of two previous boreholes located within the Site, these are SP28NE128 and SP28NE68, which were excavated to depths of 705.24m and 716.57m, respectively. These show no recorded of ground water being struck.

3.30 The site is located in a Groundwater Source Protection Zone III.

3.31 The Warwickshire SFRA reports the susceptibility of areas to groundwater flooding at a 1km^2 grid tile scale. The site is located within a series of tiles where the geological and hydrogeological properties of the land indicate that the susceptibility to groundwater flooding (groundwater emergence) is <25%.

3.32 Neither the Warwickshire County Council nor Warwickshire County Council SFRA have provided any evidence to suggest that the site has historically flooded from groundwater sources.

3.33 The overall risk posed by groundwater source is therefore considered to be low.

Flood Risk from Sewer

3.34 Sewer flooding can occur when the capacity of the infrastructure is exceeded by excessive flows, or as a result of a reduction in capacity due to collapse or blockage, or if the downstream system becomes surcharged. This can lead to the sewers flooding onto the surrounding ground via manholes and gullies, which can generate overland flows.

3.35 From the obtained Severn Trent Water (STW) sewer records which are included in **Appendix 6**, there are no recorded public sewers within the Site.

3.36 A review of the topographical survey included as **Appendix 2**, shows a series of manholes within the far southern portion of the site. These are considered to relate to surface water drainage infrastructure, associated with the M6 motorway. The drainage feature is then considered to discharges into the eastern ditch, via a headwall structure.

3.37 The potential risk posed by this private drainage is considered low, with it expected to have been designed and constructed to appropriate standards. In the unlikely event there was an exceedance event, any overland flows are expected to managed within the site, along with some flows heading overland in an easterly direction, towards the watercourse.

3.38 The overall risk posed by the sewer source is considered to be low.

Effect of Development on Wider Catchment

<u>Displacement of Floodplain and Impedance of Flood Flows</u>

3.39 The nature of the development is such that there will be negligible displacement of the floodplain or impedance of flood flows, with the raised nature of the panels enabling flows to pass beneath them freely.

3.40 The most significant risk for the impedance of flood flows associated with the proposed development is the proposed fence and ancillary equipment if located within the regions of the Site shown to at risk of surface water flooding. These areas are however

considered minimal due to flows being contained with the various ditches within the site. Appropriate mitigation for the residual risk is outlined within **Section 4**.

Development Land Use/Drainage Considerations

3.41 The runoff regime will not be significantly impacted as a result of the proposed development. The surface water drainage considerations and mitigation have been assessed in more detail within an accompanying Drainage Statement (DS, reference: NFW-BWB-ZZ-XX-RP-CD-0001_DS).

3.42 The proposed development will result in a negligible increase in impermeable surfaces, leading to a minor increase in runoff rates and volumes. Appropriate mitigation measures to manage the residual risks are outlined in the accompanying DS