OXFORDSHIRE
STRATEGIC RAIL FREIGHT INTERCHANGE

DCO Submission

Environmental Statement

Chapter 9: Water Environment
Appendix 9.4: Sustainable Drainage Statement - Offsite and Highways Works

Document 6.9D (tracked)
Rev P0~~3~~4

On behalf of
Oxfordshire Railfreight Limited

Prepared by BWB Consulting Ltd
~~October~~May **2026**

PINS REF:	TR050008
Document Reference	6.9D
APFP Regulation	5(2)(a)
Author	BWB Consulting Ltd
Date	October~~May~~ 2026
Revision	P04~~3~~

A CAF GROUP COMPANY

ADVISORY

Oxfordshire Railfreight Limited
Oxfordshire Strategic Rail Freight Interchange
Oxfordshire
Sustainable Drainage Statement
Offsite Highway Works

www.bwbconsulting.com

ADVISORY

Oxfordshire Railfreight Limited
Oxfordshire Strategic Rail Freight Interchange
Oxfordshire
Sustainable Drainage Statement
Offsite Highway Works

Birmingham
Livery Place, 35 Livery Street, Colmore Business District, Birmingham, B3 2PB
T: 0121 233 3322

Leeds
Whitehall Waterfront, 2 Riverside Way, Leeds
LS1 4EH
T: 0113 233 8000

London
11 Borough High Street
London, SE1 9SE
T: 0207 407 3879

Manchester
11 Portland Street, Manchester, M1 3HU
0161 233 4260

Nottingham
Waterfront House, Station Street, Nottingham NG2 3DQ
T: 0115 924 1100

~~May~~October 2026

DOCUMENT ISSUE RECORD

Document Number:	OXSRFI-BWB-ZZ-XX-T-W-1051_SDS
BWB Reference:	NTH2479-1051-SDS

Revision	Date of Issue	Status	Author:	Checked:	Approved:
P01	20/02/2026	S2	[redacted]	[redacted]	[redacted]
P02	20/03/2026	S2	[redacted]	[redacted]	[redacted]
P03*	15/05/2026	S2	[redacted]	[redacted]	[redacted]
P04	13/10/2026	S2	[redacted]	[redacted]	[redacted]

~~* Updates to reflect latest Order Limits~~

Notice

All comments and proposals contained in this report, including any conclusions, are based on information available to BWB Consulting during investigations. The conclusions drawn by BWB Consulting could therefore differ if the information is found to be inaccurate or misleading. BWB Consulting accepts no liability should this be the case, nor if additional information exists or becomes available with respect to this scheme.

Except as otherwise requested by the client, BWB Consulting is not obliged to and disclaims any obligation to update the report for events taking place after: -

(i) The date on which this assessment was undertaken, and
(ii) The date on which the final report is delivered

BWB Consulting makes no representation whatsoever concerning the legal significance of its findings or the legal matters referred to in the following report.

All Environment Agency mapping data used under special license. Data is current as of ~~May~~October 2026 and is subject to change.

The information presented, and conclusions drawn, are based on statistical data and are for guidance purposes only. The study provides no guarantee against flooding of the study site or elsewhere, nor of the absolute accuracy of water levels, flow rates and associated probabilities.

This document has been prepared for the sole use of the Client in accordance with the terms of the appointment under which it was produced. BWB Consulting Limited accepts no responsibility for any use of or reliance on the contents of this document by any third party. No part of this document shall be copied or reproduced in any form without the prior written permission of BWB

CONTENTS

1. INTRODUCTION 4
Situational Context 5
Sustainable Drainage Guidance 0
Guidance Documents 0
Climate Change and Urban Creep Allowances 1
2. EXISTING CONDITIONS 3
Existing Watercourses 3
Hydraulic Flood Modelling 6
Existing Runoff Rates 12
Existing Runoff Volume 12
3. SURFACE WATER DRAINAGE PRINCIPLES 13
Drainage Hierarchy 13
Collection for non-potable use 13
Infiltration 13
Surface waterbodies 14
Peak Flow and Volume Control 15
Sustainable Drainage Systems 16
Water Quality 17
Simple Index Approach Methodology 17
Maintenance 19
Filter Strips 19
Filter Drains 20
Swales 21
Detention Basins 22
Attenuation Ponds 23
Flow Controls 24
Residual Risks and Designing for Exceedance 24
4. WORKS NO.12: HEYFORD PARK LINK ROAD DRAINAGE STRATEGY 25
Proposals 25
5. WORKS NO.14 TO 18: M40 JUNCTION 10 TO A43 AND B430 HIGHWAY IMPROVEMENT WORKS DRAINAGE STRATEGY 26
Proposals 26
Point of Discharge 26
Proposed Drainage Strategy 27
Baynard's Green Roundabout 28

Northwest Pond 29
Southwest Pond 29
Northeast Pond 30
Southeast Pond 30
A43 Southbound Eastern Embankments 31
Sustainable Drainage Systems 31
6. WORKS NO.19 TO 20: ARDLEY BYPASS DRAINAGE STRATEGY 33
Proposals 33
Point of Discharge 33
Drained Areas 34
Proposed Drainage Strategy 34
Sustainable Drainage Systems 34
7. WORKS NO.22: M40 JUNCTION 9 DRAINAGE STRATEGY 36
Proposals 36
Point of Discharge 36
Drained Areas 37
Proposed Drainage Strategy 37
Sustainable Drainage Systems 37
8. WORKS NO.23 AND 24: MIDDLETON STONEY RELIEF ROAD DRAINAGE STRATEGY 39
Proposals 39
Point of Discharge 39
Proposed Drainage Strategy 40
Northern Catchment 40
Southern Catchment 41
Bicester Road 41
Sustainable Drainage Systems 42
9. MINOR WORKS DRAINAGE STRATEGIES 44
10. SUMMARY 45

FIGURES

Figure 1.1: Site Location
Figure 2.1: Site Location and Watercourse Network
Figure 2.2: BGS Bedrock Geology for Site
Figure 2.3: BGS Superficial Deposits for Site
Figure 3.1: Modified Rational Method
Figure 4.1: Illustrative Works Boundary - Works No. 12
Figure 5.1: Illustrative Works – Works No. 14 to 18
Figure 6.1: Illustrative Works Boundary - Works No. 19 to 20
Figure 7.1: Illustrative Works Boundary - Works No. 22
Figure 8.1: Illustrative Works Boundary - Works No. 23 and 24

TABLES

Table 1.1: Summary of Offsite/Highway Works
Table 1.2: Site Details
Table 1.3: Peak Rainfall Allowances
Table 2.1: Aquifer Definitions
Table 2.2: Existing Runoff Rate per hectare from the Site
Table 3.1: Existing & Proposed Runoff Rates
Table 3.2: Pollution Hazard Indices for Different Land Use Classifications
Table 3.3: SuDS Mitigation Indices
Table 3.4: The SuDS Manual Typical Maintenance Schedule for Filter Strips
Table 3.5: The SuDS Manual Typical Maintenance Schedule for Filter Drains
Table 3.6: The SuDS Manual Typical Maintenance Schedule for Swales
Table 3.7: The SuDS Manual Typical Maintenance Schedule for Detention Basins
Table 3.8: The SuDS Manual Typical Maintenance Schedule for Attenuation Ponds
Table 3.9: Typical Maintenance Schedule for Flow Control Structures

APPENDICES

Appendix 1: Topographical Survey
Appendix 2: Greenfield Runoff Rate and Volume Calculations and Rainfall Intensities
Appendix 3: A43 HEWRAT Assessment Results
Appendix 4: M40 Junction 10 Drainage Drawings
Appendix 5: M40 Junction 10 Drainage Calculations
Appendix 6: Ardley Bypass Drainage Drawings
Appendix 7: Ardley Bypass Drainage Calculations
Appendix 8: M40 Junction 9 Drainage Drawings
Appendix 9: M40 Junction 9 Drainage Calculations
Appendix 10: Middleton Stoney Relief Road Drainage Drawings
Appendix 11: Middleton Stoney Relief Road Drainage Calculations
Appendix 12: Minor Works Calculations (Pedestrian / Cycle Path Filter Drain)
Appendix 13: Minor Works Drawing (Typical Filter Drain Detail)

1. INTRODUCTION

1.1 A Sustainable Drainage Statement (SDS) sets out the principles of drainage design for a development and summarises the reasoning behind the chosen design. This includes justification of specific flow rates, volumes of attenuated storage, as well as the appropriate level of treatment to be provided to surface water runoff.

1.2 This SDS has been produced by BWB Consulting on behalf of Oxfordshire Railfreight Limited in respect of a Development Consent Order (DCO) for Oxfordshire Strategic Rail Freight Interchange (OxSRFI).

1.3 A series of other Flood Risk Assessments (FRAs) and SDS reports have been prepared to support the DCO submission:

- OxSRFI Main Site FRA - "OXSRFI-ZZ-XX-T-W-1006_FRA (Main Development Site)";
- OxSRFI Main Site SDS - "OXSRFI-BWB-ZZ-XX-T-W-1050_SDS (Main Development Site~~)"~~)";
- OxSRFI Offsite and Highway Works Flood Risk Screening - "OXSRFI-BWB-ZZ-XX-T-W-1007_Offsite and Highway Works Flood Risk Screening"; and

1.4 This SDS has been produced in relation to the Offsite Highways Works. Drainage strategies for the SRFI Main Site Works are covered in the Main Site SDS report, with the exception of Heyford Park Link Road which is covered in both the Main Site SDS report and this report.

1.5 Some of the proposed works across the scheme do not require drainage, or do not include changes to impermeable areas or introduce features that would be detrimental to flood risk; these areas have been 'Screened Out' of this SDS. The justification for any this is provided in **Table 1.1**.

1.6 The proposed development is to be submitted for a DCO, and as such the details have been developed in consultation with the relevant statutory bodies relating to flood risk and drainage for the site.

1.7 The Lead Local Flood Authority (LLFA) for the site are Oxfordshire County Council (OCC). The LLFA are not the prescribed consultee under the DCO process; however, Cherwell District Council, the Local Planning Authority (LPA), are. As the LPA is not the LLFA for the site, the Environment Agency (EA) have been deferred to as the relevant body to comment on the surface water drainage strategy. Despite this, as the LLFA is the body responsible for surface water flood risk in relation to planning, OCC have been consulted through the DCO consultation stage and will comment of the surface water drainage proposals, via the EA.

1.8 Drainage assets within the strategic road network are the responsibility of National Highways. Drainage assets in other adopted highways are the responsibility of Oxfordshire County Council Highway Authority.

Situational Context

1.9 The proposed development comprises a number of interrelated component parts as follows, split into two groups based on the areas assessed within the technical SDS reports prepared by BWB, and collectively they are the Oxfordshire SRFI:

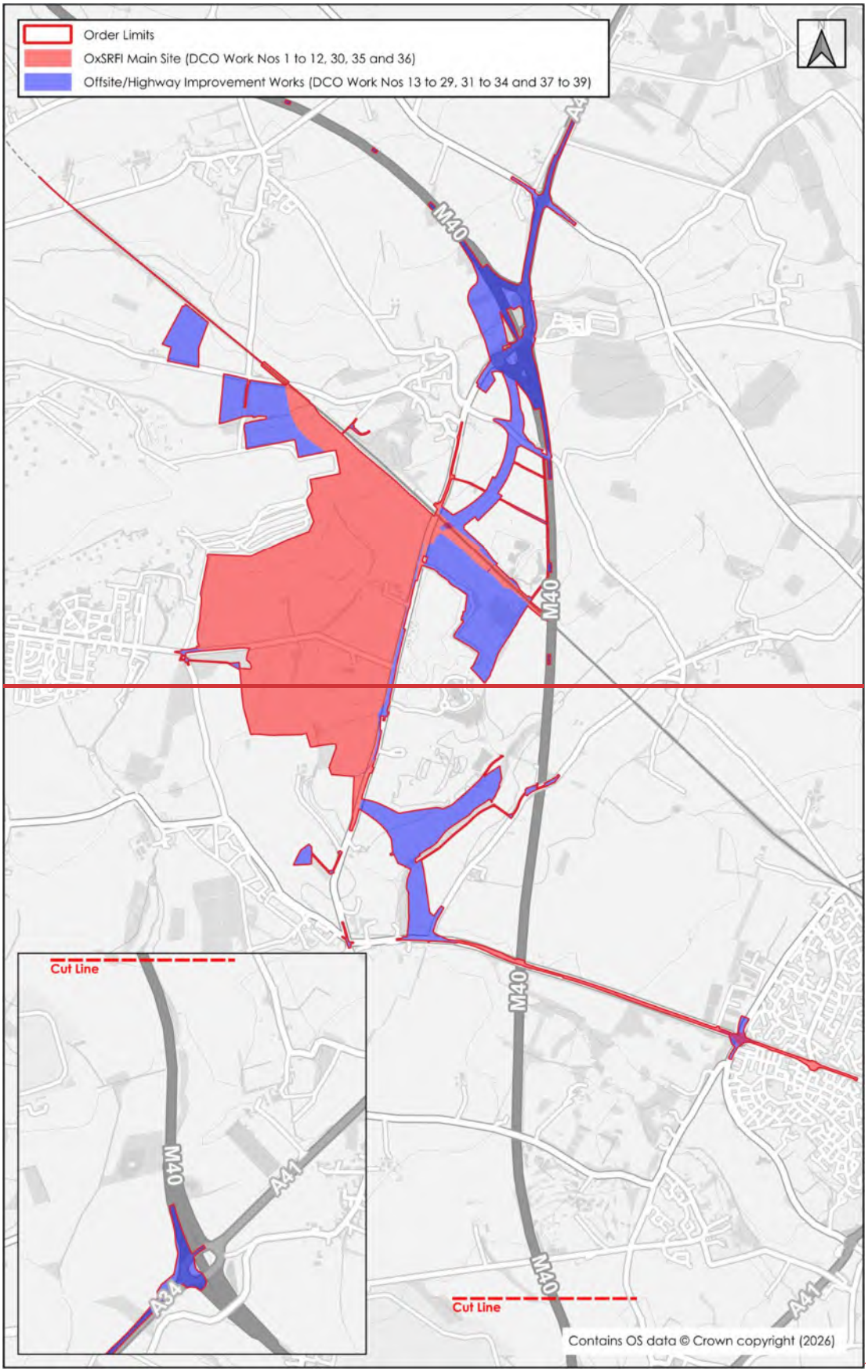
- **SRFI Main Site**
  - Works No. 1 to 10. SRFI Main Site.
  - Works No. 11 Principal access to the main site.
  - Works No. 12 Heyford Park Link Road.
  - Works No. 30 Biodiversity and landscaping enhancement area (South).
  - Works No. 35 Foul drainage outfall to Bicester.
  - Works No. ~~36 Foul drainage outfall to Ardley~~36 B430 Station Road.
- **Offsite/Highway Works**
  - Works No. 12 Heyford Park Link Road.
  - Works No. 13 Camp Road/Chilgrove Drive Junction and Bridleway.
  - Works No. 14 to 18 Junction 10 Highways Improvements.
  - Works No. 19 Ardley Road.
  - Works No. 20 Ardley Bypass.
  - Works No. 21 Ardley Bypass Public Right of Way (PROW).
  - Works No. 22 Junction 9 Highways Improvements.
  - Works No. 23 Middleton Stoney Relief Road (MSRR) pedestrian and cyclist connectivity.
  - Works No. 24 MSRR pedestrian and cyclist connectivity.
  - Works No. 25 B430 minor works.
  - Works No. 26 Quarry Cottages.
  - Works No. 27 Middleton Stoney Crossroads.
  - Works No. 28 Aves Ditch (North).
  - Works No. 29 Ecological Mitigation Area.
  - Works No. 31 Biodiversity and landscaping enhancement areas (Including Woodland Planting).
  - Works No. 32 Ecological Mitigation Area.
  - Works No. 33 Cycle link to Middleton Road (for pedestrian and cyclist connectivity).
  - Works No. 34 Landfill work.
  - Works No. 37. Ecological Mitigation Area.
  - Works No. 38 Ardley Tunnel works.
  - Works No. 39 A4095 / B4030 Roundabout.

1.10 It should be noted that Works 12 (Heyford Park Link Road) is covered within both the Main site SDS and this report, due to these works falling across two drainage catchments that are split between the main development site drainage system and the wider offsite highway works.

1.11 A site location plan is provided as **Figure 1.1**, for ease of reference and for the purpose of the SDSs, the individual components have been grouped together based upon the geographical location. Although Works No. 29 and 34 are located within areas that could be considered with in the 'OxSRFI Main Site', these works have been included within the 'Offsite' category for the purpose of the drainage strategy presented within this report.

1.12 Works that are included in this SDS report and works that have been 'screened out' of the assessment, are described in **Table 1.1**.

1.13 This SDS report includes specific sections for 'major works' that require the development of a drainage strategy. Within these sections, details are provided to outline each individual works drainage philosophy and present the accompanying drawings and calculations. For 'minor works', which require will require generic drainage mitigation but not a developed drainage strategy at this stage (for example, a new pedestrian / cycle route), these works have been grouped together to avoid duplication of the same drainage principles across the wider scheme. The 'major works' have been identified in **Table 1.1** in **bold**, with the minor works identified in *italics*.


Order Limits
OxSRFI Main Site (DCO Work Nos 1 to 12, 30, 35 and 36)
Offsite/Highway Improvement Works (DCO Work Nos 13 to 29, 31 to 34 and 37 to 39)
M40
A41
A34
Cut Line
Cut Line
Contains OS data © Crown copyright (2026)

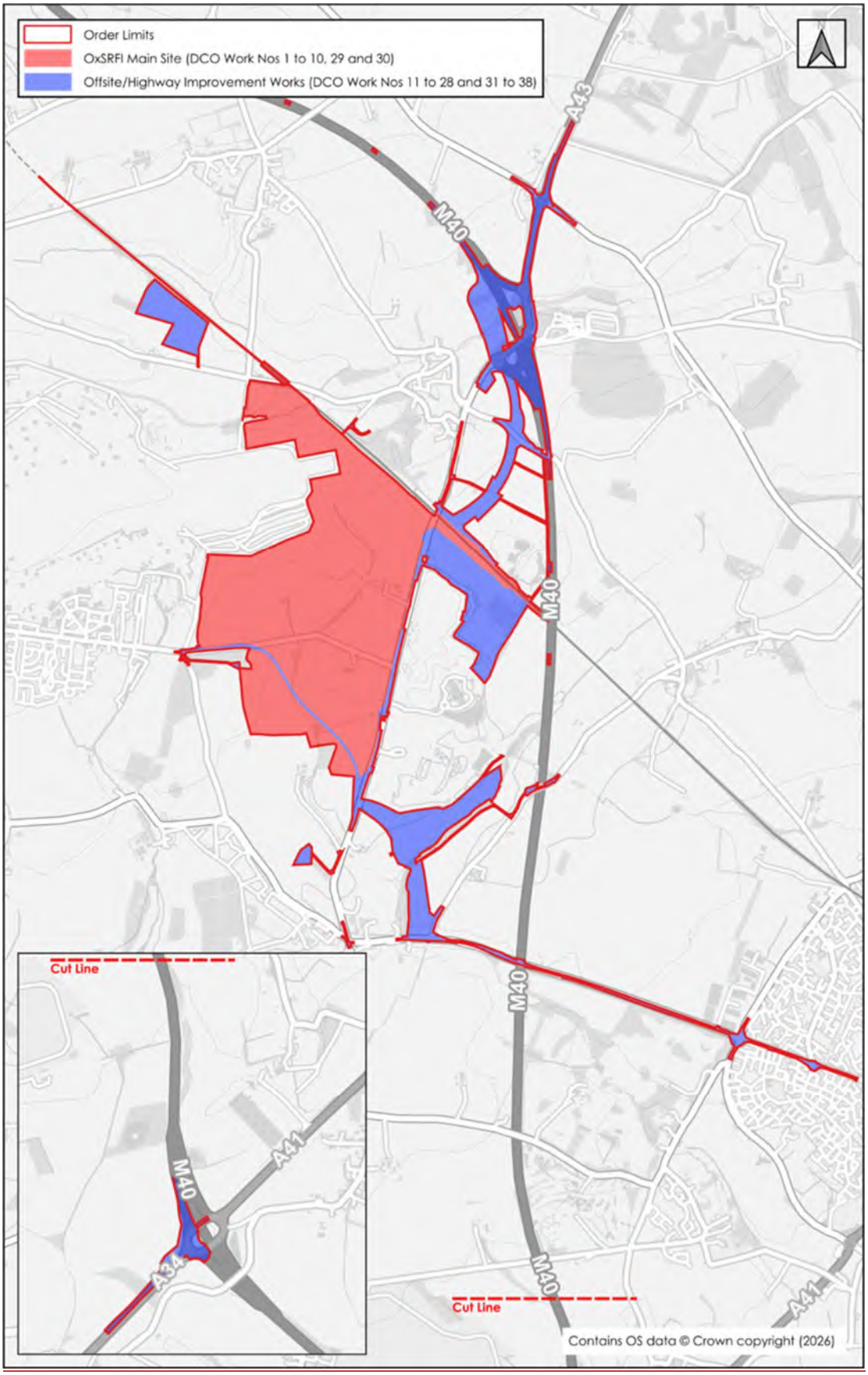


Figure 1.1: Site Location

Table 1.1: Summary of Offsite/Highway Works

Works No.	Name/Location	Description of Proposed Works	Screened In/Out
12	**Heyford Park Link Road**	**Heyford Park Link Road connecting at the west end to the Camp Road and Chilgrove Drive junction.**	Screened In.
13	*Camp Road*	*Camp Road/Chilgrove Drive Junction and Bridleway works.*	
14 to 18	**M40 Junction 10**	**M40 Junction 10 to A43 and B430 highway improvement works.**	
19	**Ardley Road**	**Ardley Road works to link to Ardley Bypass.**	
20	**Ardley Bypass**	**Ardley Bypass works.**	
21	*Ardley Bypass PROW*	*Amendments to existing PROW*	
22	**M40 Junction 9**	**Junction 9 Highway Improvement Works.**	
23	**Middleton Stoney Relief Road (MSRR)**	**MSRR works connecting B430 and B4030 with shared use cycle track.**	
24	*Middleton Road*	*MSRR pedestrian and cyclist connectivity.*	
25	*B430*	*Shared use cycle track on the western side of the B4030 connecting to that provided at the principal site access.*	
26	*Quarry Cottages*	*Quarry cottages turning head and public rights of way.*	

Works No.	Name/Location	Description of Proposed Works	Screened In/Out
27	Middleton Stoney	Middleton Stoney Crossroad Works.	Screened Out – Proposed works result in a negligible increase in impermeable surfacing (i.e., less than 90m^2), which will be drained via either the existing drainage system present.
28	Aves Ditch (North)	Improvements to field access through connection of the existing bridleway to provide access into the biodiversity and landscaping enhancement area.	Screened Out - No drainage is required, or proposed, to facilitate these works.
29	Main Site – North West	Ecological Mitigation Area	Screened Out – No drainage is required, or proposed, to facilitate these works.
31	Between B4030 and B430	Biodiversity and landscaping enhancement areas, including woodland planting.	
32	Between Middleton Road and B430	Ecological Mitigation Area	
33	*Between proposed MSRR and Middleton Road*	*Cycle lane to Middleton Road (for pedestrian and cyclist connectivity)*	Screened In.
34	Landfill Works	Works to the waste management site to remove material for the construction of the railway works to the Chiltern Main Line private railway and the principal main site access.	Screened Out – Any drainage works to be covered under separate technical works prepared by third party geotechnical designers.
37	Ardley Road	Ecological Mitigation Area	Screened Out – No drainage is required, or proposed, to facilitate these works.
38	Ardley Tunnel	Works to Ardley Tunnel to provide W8 loading gauge clearance through tunnel	Screened Out – Proposed works do not require any new drainage systems or amendments to the existing drainage system already in place.

Works No.	Name/Location	Description of Proposed Works	Screened In/Out
39	A4095 / B4030 Roundabout	Amendments to existing A4095 / B4030 roundabout	Screened Out – Proposed works will result in negligible change to existing impermeable area and existing drainage system will be amended as necessary (i.e., gully locations) to facilitate the works

1.14 Refer to DCO Document 2.5 for the parameters plan Document 2.2 for the Proposed Works Plans, Document 2.13 for the Components Plan and Document 2.7 for the Highways General Arrangement Plans. Contextual information for the site is provided within **Table 1.2**.

Table 1.2: Site Details

Site Name	Oxfordshire SRFI Offsite Highway Works (DCO Works No. **12 to 26 and 33**)
Location	Oxfordshire
NGR (approx.)	Various, Main Site at SP533261
Development Type	Rail Freight Interchange
Anticipated Development Lifetime	75-years*
Lead Local Flood Authority	Oxfordshire County Council
Local Planning Authority	Cherwell District Council
EA Area	Thames
Sewerage Undertaker	Thames Water (Anglian Water to the north)

* In accordance with Paragraph 006 of the Flood Risk and Coastal Change Planning Practice Guidance

Sustainable Drainage Guidance

Guidance Documents

1.15 This SDS and associated drainage strategy has been written with reference to the following guidance documents:

- OCC's Local Standards and Guidance for Surface Water Drainage on Major Development in Oxfordshire[1];
- OCC's Local Standards and Guidance for Major Development with Surface Water Drainage[2];
- The DEFRA Non-Statutory Technical Standards for SuDS (2015)[3];
- The National Standards for Sustainable Drainage Systems (SuDS) (2025)[4];
- The National Policy Statement for National Networks[5] (NPSNN); and
- The CIRIA C753 SuDS Manual[6].
- The Standards for Highways Design Manual for Roads and Bridges (DMRB)[7]

[1] Local Standards and Guidance for Surface Water Drainage on Major Development in Oxfordshire, V1.2 (Oxfordshire County Council, December 2021)
[2] Local Standards and Guidance for Major Development with Surface Water Drainage, V.2.0, June 2026 (Oxfordshire County Council)
[3] 2015, DEFRA. Non-statutory technical standards for sustainable drainage systems
[4] https://www.gov.uk/government/publications/national-standards-for-sustainable-drainage-systems/national-standards-for-sustainable-drainage-systems-suds#standard-7-design-of-drainage-for-construction-operation-maintenance-decommissioning-and-structural-integrity
[5] National Policy Statement for National Networks, Department for Transport, March 2024
[6] The SuDS Manual Version 6 (CIRIA, 2019)
[7] The Design Manual for Roads and Bridges, Standards for Highways. Available from: https://www.standardsforhighways.co.uk/dmrb

1.16 This drainage strategy has been prepared using OCC's 2021 v1.2 guidance, however this guidance was updated in June 2026 to v2.0. The 2026 update requires planning applications to adhere to the 2025 National Standards for Sustainable Drainage Systems. Any future revisions of this drainage strategy will consider these new guidance documents. A summary table is provided within OXSRFI-BWB-ZZ-XX-T-W-1050 SDS (Main Development Site) Document 6.9C to demonstrate how the current guidance is met with the submitted drainage strategies.

Climate Change and Urban Creep Allowances

~~1.16~~1.17 The proposed works are spread across two DEFRA management catchments. Northern areas comprising Junction 10 of the M40, and the top of the proposed Ardley Bypass are in the Upper and Bedford Ouse Management Catchment. The main site and other works are located within the Cherwell and Ray Management Catchment within the Thames River Basin District. Both Catchments are shown to have the same recommended climate change Allowances. Table 2 from the EA's 'Flood risk assessments: climate change allowances', included as **Table 1.3**, shows the anticipated changes in peak rainfall intensity for the site.

Table 1.3: Peak Rainfall Allowances

Cherwell and Ray Management Catchment & Upper and Bedford Ouse Management Catchment Allowances*	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%

* Both management catchments have identical climate change allowances

~~1.17 The proposed works are anticipated to have a lifespan of up to 75 years, therefore the 2070's epoch central allowance will be used to assess the impacts of Climate Change (CC) for the proposed surface water drainage strategy. Sensitivity testing has been undertaken using the 2070's epoch upper end allowance to ensure that there is no increase in flood risk elsewhere and the built development will be safe from surface water flooding over the anticipated lifetime of the proposed development. This meets the requirements of CG501- Design of Highway Drainage Systems.~~

~~1.18 Based on the above guidance, an allowance of 25% will be applied to the 1 in 100-year return period within the drainage design calculations, with sensitivity testing using a 40% allowance to the 1 in 100-year return period. During the detailed design stage a 25% climate change allowance, with a 35% sensitivity test, should be applied to the 1 in 30-~~

~~year return period within the drainage design calculations. As the development is built out, the latest EA climate change allowance should be reviewed and used for the detailed design calculations for each phase of the development.~~

1.18 OCC in their capacity as the Local Highway Authority and the LLFA have provided representations on the proposed drainage strategy. As part of this, they have requested that 40% betterment should be applied to existing runoff rates when modifying existing impermeable areas. Furthermore, 40% climate change should be applied to the critical 1 in 100 year storm event, and when the 1 year and 30 year storms are modelled as part of the detailed design process, 20% and 35% climate change allowances should be applied respectively.

1.19 OCC has also provided the following list of standards which should apply to the proposed highway drainage, which will be offered for adoption with OCC:

- *OCC require a minimum reduction of 40% on the current discharge rate. If the area is subject to flood zone 2 or zone 3 contact EA. This will possibly discharge at the current rate, and may require flood compensation.*
- *The attenuation volume will be calculated on 100-year 40% climate change plus 300mm freeboard.*
- *Storm durations will be 1 year, 30 year and 100 year all plus climate change all SUDs features must be calculated on this basis.*
- *Minimal use of pipe work should be exercised, Ditches, swales, basins, and ponds should all be checked for their potential to soakaway.*
- *Drainage over embankments to toe drains should be retained/reinforced as to not cause banks to slip.*
- *Where groundwater is present the designer is to consider lining drainage features.*
- *Consideration for easy to maintain and access storage ponds and any SUDs aids and interceptors including access roads and hard standings.*
- *Protection against BNG near drainage should be a priority. Root ingress and tree growth have a detrimental effect on drainage longevity.*
- *Porous surfacing asphalt materials are not to be used all surfaces are to be positively drained.*
- *Check dams, weirs, bunds, and berms can be used for slowing, retaining, and directing flows in and outside ditches and do not have to be made of concrete.*
- *CV value 1 or 0.9.*

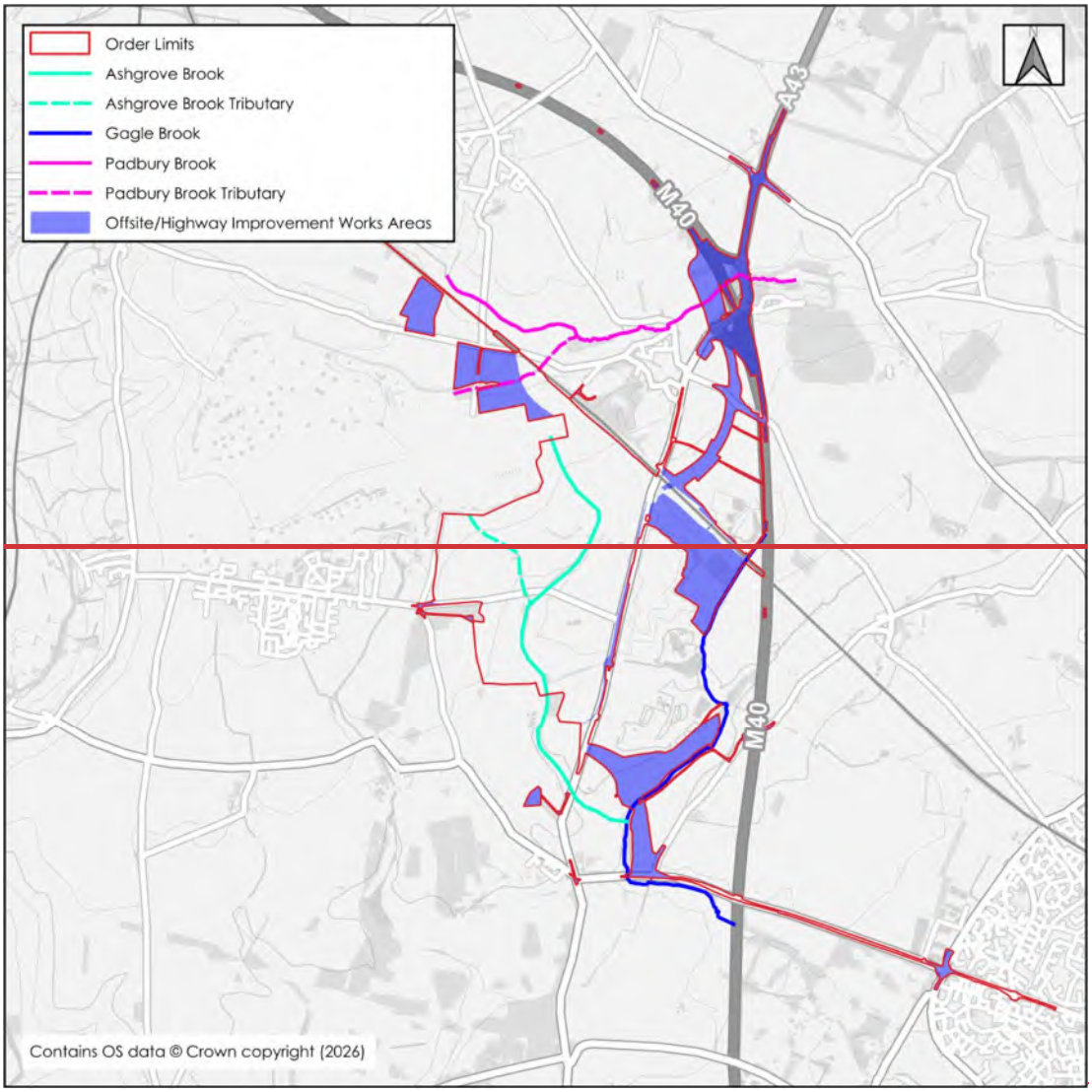
~~1.19~~1.20 Based on the proposed development use, no urban creep allowance has been applied to the drainage design calculations.

2. EXISTING CONDITIONS

2.1 The proposed works are spread across the Heyford, Ardley and Middleton Stoney in Oxfordshire as described in **Table 1.1.** The works comprise both new highways on greenfield land and modifications of existing highways. Further information is included in the drainage strategy for each part of the works in Section 3 below.

Existing Watercourses

2.2 There are a number of watercourses located in the vicinity, as illustrated in **Figure 2.1.**


Order Limits
Ashgrove Brook
Ashgrove Brook Tributary
Gagle Brook
Padbury Brook
Padbury Brook Tributary
Offsite/Highway Improvement Works Areas
A43
M40
M40
Contains OS data © Crown copyright (2026)

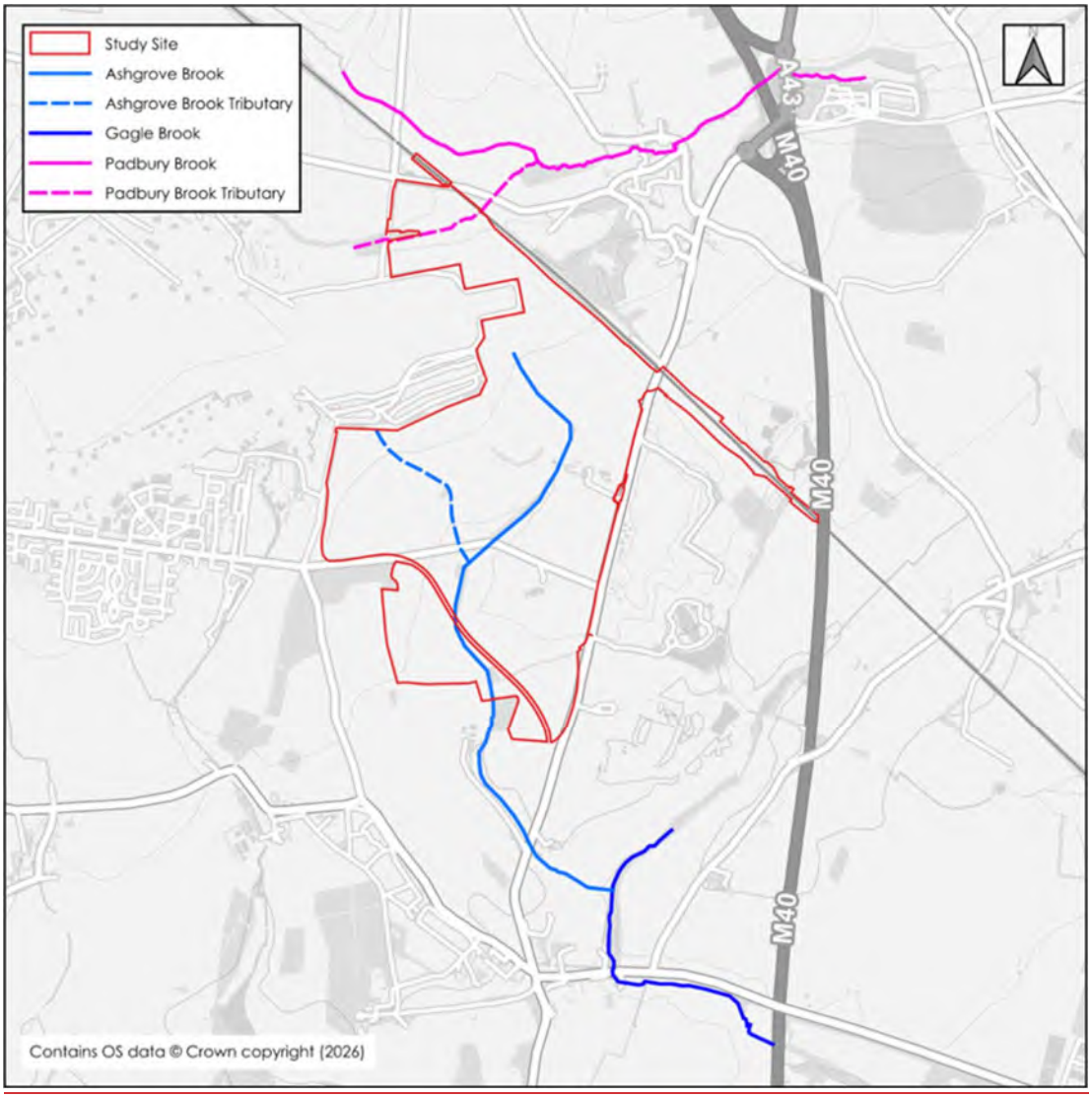


Figure 2.1: Site Location and Watercourse Network

2.3 The Ashgrove Brook, an ordinary watercourse, initially flows from Upper Heyford Airfield through the main development site in a south easterly direction. The watercourse then flows in a south-westerly and southerly direction where it is culverted beneath Camp Road and the B430 where it continues east to its confluence with the Gagle Brook, approximately 1.4km downstream of the site.

2.4 A tributary of the Ashgrove Brook also flows from Upper Heyford Airfield, through the main development site, in a south-easterly direction. The tributary is culverted beneath Camp Road where it then outfalls to the Ashgrove Brook.

2.5 The Gagle Brook flows in a south westerly and southerly direction to the east of Middleton Stoney. The watercourse is culverted beneath the B4030 where it then flows in an easterly direction towards and beneath the M40.

2.6 A tributary of the Padbury Brook rises to the north of Upper Heyford Airfield and flows in a north-easterly direction to its confluence with the Padbury Brook approximately 390m downstream of the main site.

2.7 The Padbury Brook rises to the north of the site within agricultural fields, east of Somerton. The watercourse generally flows in an easterly direction where it is culverted beneath the Chiltern Main Line Railway, M40 and A43. The watercourse then continues to flow in an easterly to north-easterly direction to its ultimate confluence with the Great River Ouse, approximately 30km downstream of the main site. The Padbury brook ultimately flows east towards the Upper Ouse Water Management Board catchment area, approximately 2km downstream of the A43.

2.8 Beyond the key watercourses described above and illustrated in **Figure 2.1**, there are numerous minor watercourses and drainage ditches in the area which will be described in further detail, where relevant within **Sections 4 – 10** of this report.

Hydraulic Flood Modelling

2.9 Baseline hydraulic modelling of the following watercourses has been undertaken by BWB Consulting Ltd (BWB) to support the FRAs for the proposed DCO:

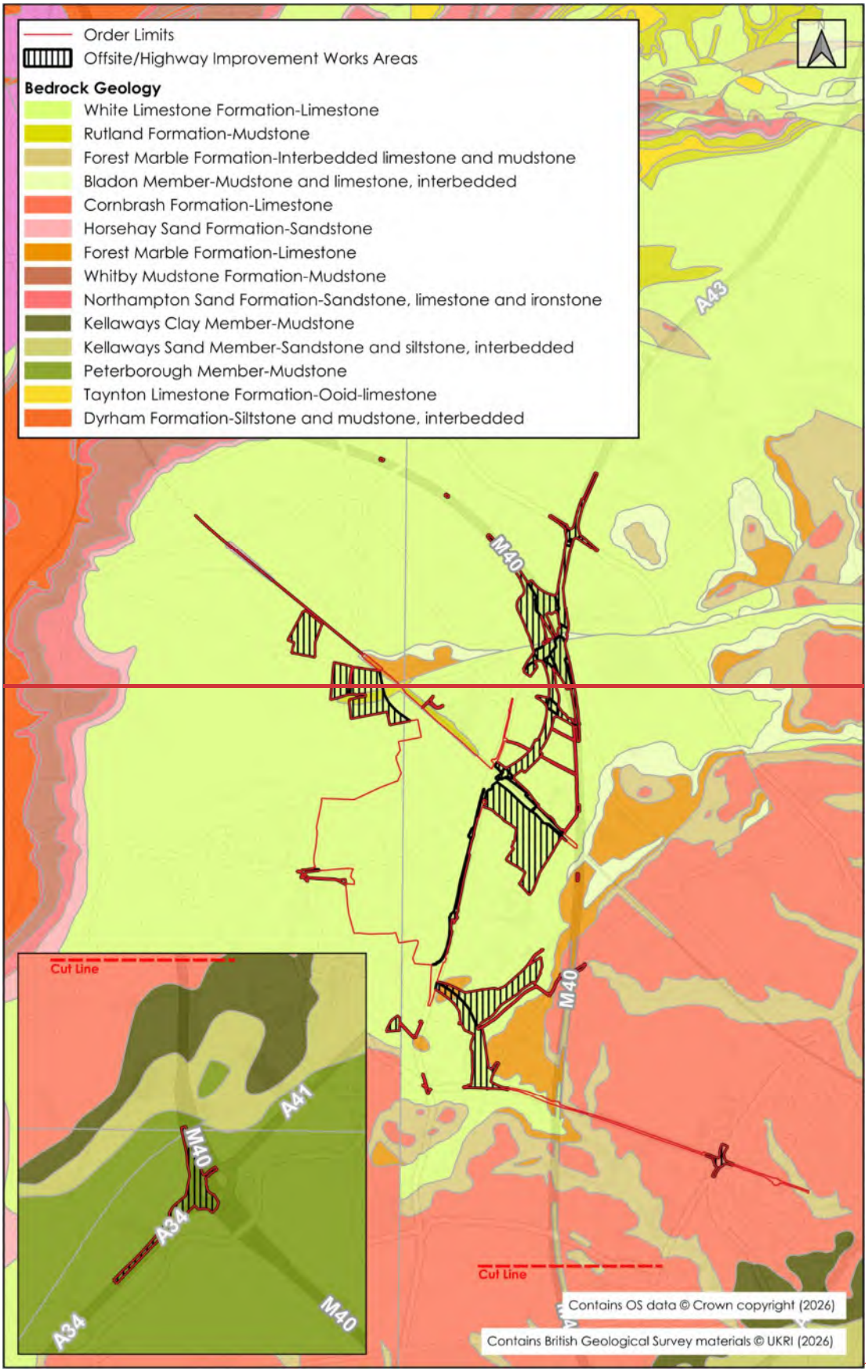
- Ashgrove Brook;
- Ashgrove Brook Tributary;
- Gagle Brook;
- Padbury Brook; and
- Padbury Brook Tributary.

2.10 The BWB hydraulic modelling has identified that there are existing fluvial flood extents affecting both the main site and offsite works, although the risk to the site and offsite works is considered to be low, providing the recommended mitigation measures are adhered to. More information on the existing flood risk constraints and proposed mitigation measures are presented within the highway works flood risk screening report. This report concludes that each of the separate works has a low risk of surface water flooding.

2.11 Due to the spatial distribution of the proposed works, the topography of each part will be briefly discussed in the relevant part of **Sections 4 - 10**. A full topographical survey (reference: 36646_T) included as **Appendix 1**.

2.12 British Geological Survey (BGS) Mapping indicates the area to be underlain predominantly by White Limestone Formation (Principal Aquifer). There are also small pockets of Rutland Formation Mudstone (Secondary B Aquifer), Forest Marble Formation – Limestone (Principal Aquifer) And Bladon Member - Mudstone and Limestone, Interbedded (Principal Aquifer) across the development area. Junction 9 of the M40 is underlain by Peterborough Member – Mudstone (No Aquifer). The bedrock geology for the site, as informed by BGS, is illustrated as **Figure 2.2**.

2.13 Superficial deposits of Alluvium - Clay, Silt, Sand and Gravel (Secondary A Aquifer) and Head - Clay, Silt, Sand and Gravel (Secondary Undifferentiated Aquifer) are shown along the alignment of the local watercourse network. The superficial geology for the site, as informed by BGS, is illustrated as **Figure 2.3**.


Order Limits
Offsite/Highway Improvement Works Areas
Bedrock Geology
White Limestone Formation-Limestone
Rutland Formation-Mudstone
Forest Marble Formation-Interbedded limestone and mudstone
Bladon Member-Mudstone and limestone, interbedded
Cornbrash Formation-Limestone
Horsehay Sand Formation-Sandstone
Forest Marble Formation-Limestone
Whitby Mudstone Formation-Mudstone
Northampton Sand Formation-Sandstone, limestone and ironstone
Kellaways Clay Member-Mudstone
Kellaways Sand Member-Sandstone and siltstone, interbedded
Peterborough Member-Mudstone
Taynton Limestone Formation-Ooid-limestone
Dyrham Formation-Siltstone and mudstone, interbedded
A43
M40
M40
Cut Line
A41
M40
A34
A34
M40
Cut Line
Contains OS data © Crown copyright (2026)
Contains British Geological Survey materials © UKRI (2026)

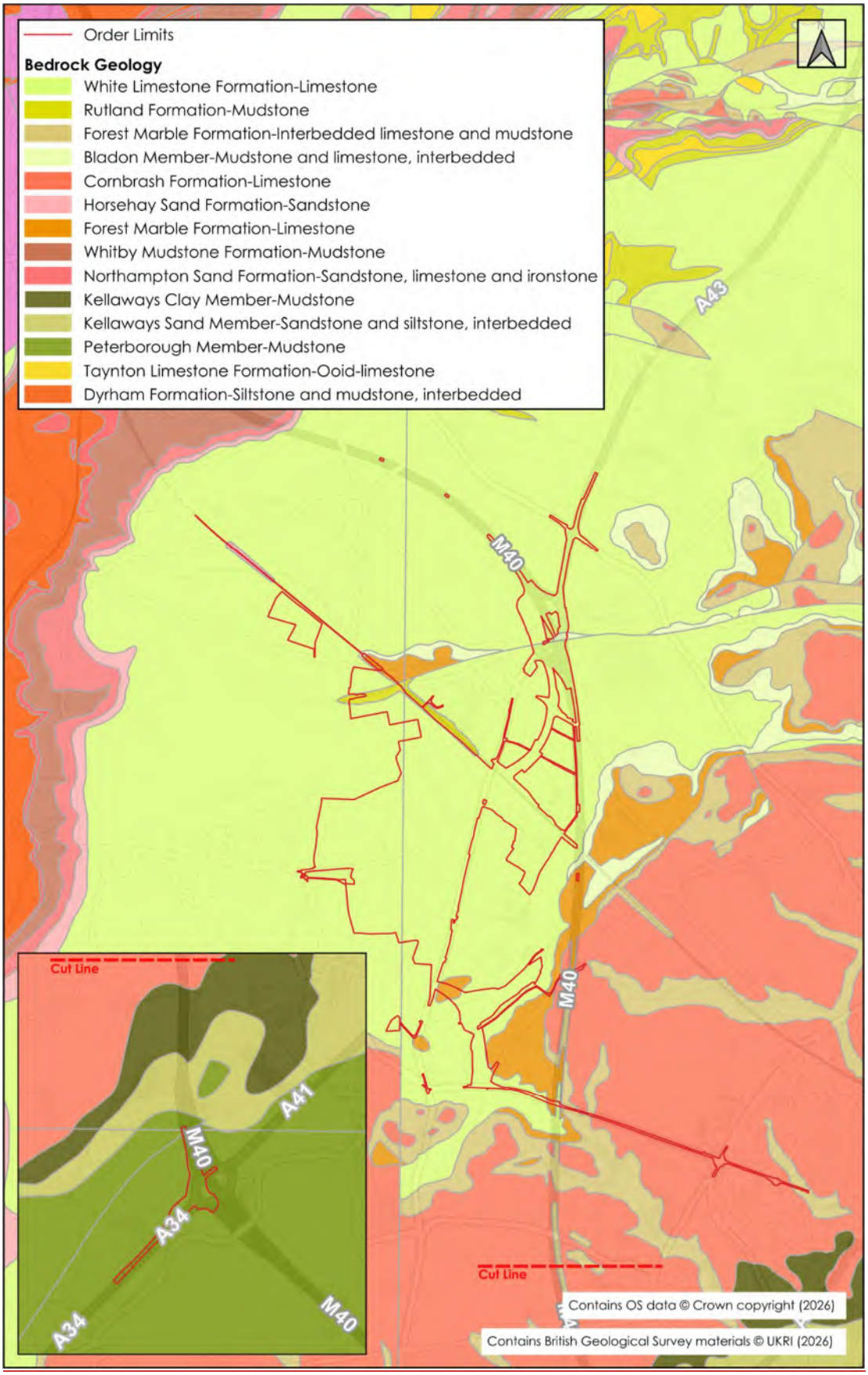
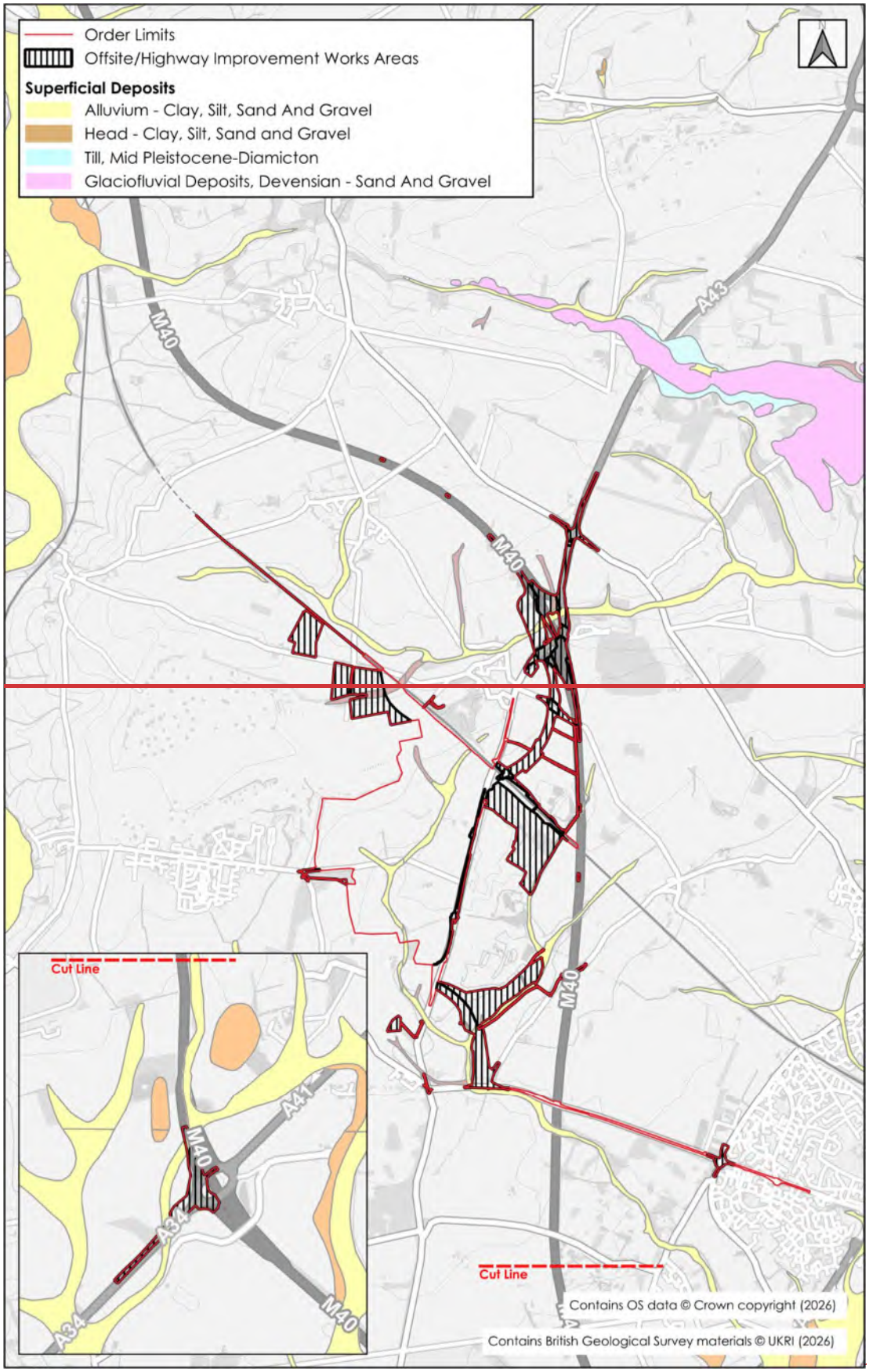


Figure 2.2: BGS Bedrock Geology for Site


Order Limits
Offsite/Highway Improvement Works Areas
Superficial Deposits
Alluvium - Clay, Silt, Sand And Gravel
Head - Clay, Silt, Sand and Gravel
Till, Mid Pleistocene-Diamicton
Glaciofluvial Deposits, Devensian - Sand And Gravel
M40
A43
M40
M40
Cut Line
A41
M40
A34
A34
M40
Cut Line
Contains OS data © Crown copyright (2026)
Contains British Geological Survey materials © UKRI (2026)

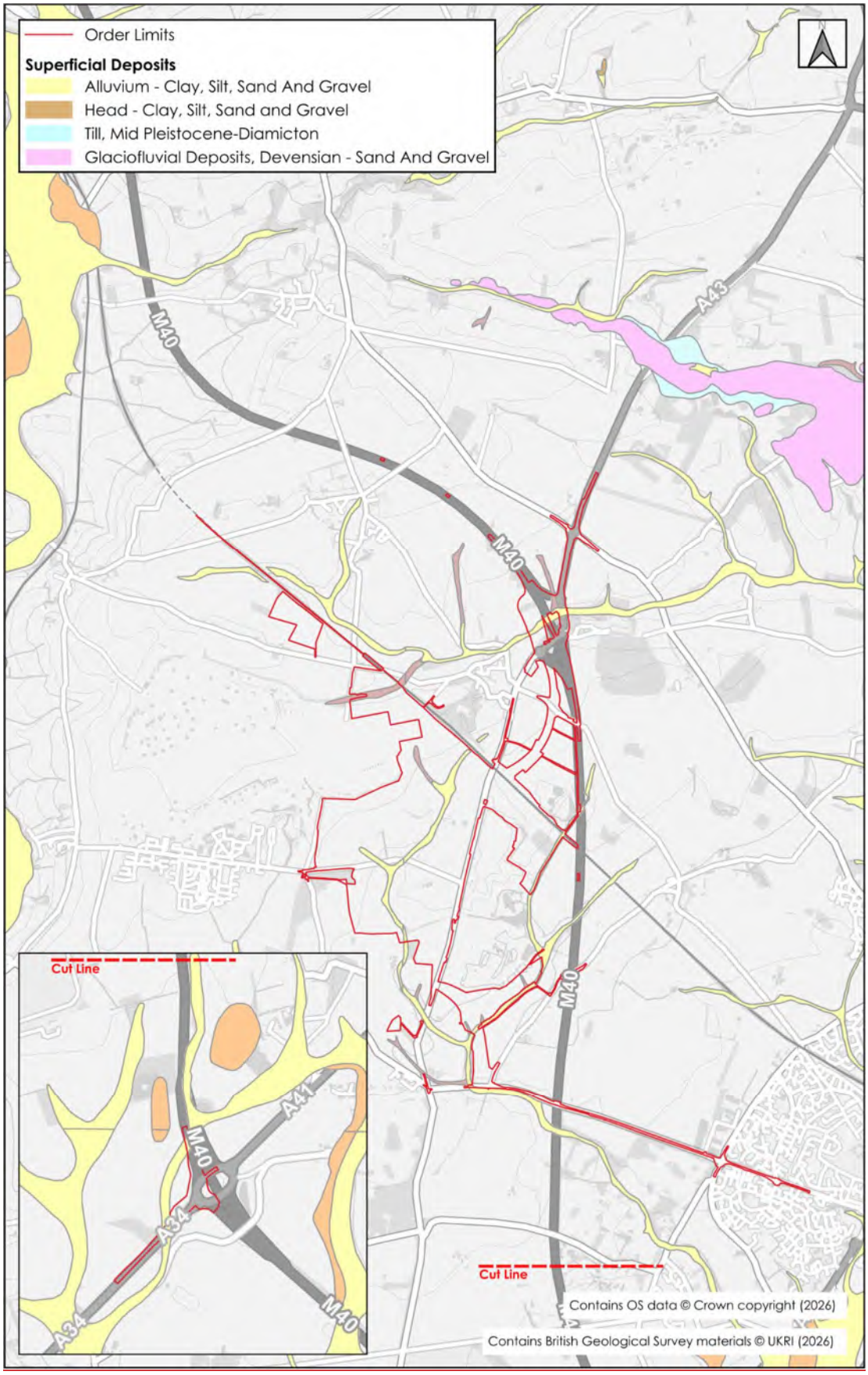


Figure 2.3: BGS Superficial Deposits for Site

2.14 Aquifer definitions, as outlined by the EA, are summarised in **Table 2.1**.

Table 2.1: Aquifer Definitions

Aquifer	Definition
Principal	Layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale.
Secondary A	Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.
Secondary B	Predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering.
Secondary Undifferentiated	Assigned in cases where it has not been possible to attribute either category A or B to a rock type.

2.15 Intrusive geotechnical testing has not been carried out at the offsite work locations. However, given that BGS mapping indicates relatively homogeneous strata in the area, it is reasonable to infer that infiltration test results would be broadly consistent with those obtained during the Phase 2 Geo-Environmental assessment on the main site.

2.16 The main site's Phase 2 Geo-Environmental Assessment undertaken by BWB (reference: OFRI-BWB-ZZ-XX-RP-YE-0001_Ph1) included soakaway testing in line with BRE365 guidance in eleven locations. Results varied between $4.3x10^{-06}$ and 1.66^{-04}m/s, indicating good infiltration potential. The report also recorded groundwater depths of less than 2.0mBGL in five of fourteen test locations. Further information can be found in the full report.

2.17 Geotechnical testing will be undertaken at each of the proposed works' locations, where practical, prior to detailed design.

2.18 Based on the above information, the existing drainage regime of the greenfield portions of the site is considered to consist of infiltration followed by surface water runoff into watercourses. Parts of the wider site which are served by existing drainage systems (i.e., existing highways) will drain via the existing network to either soakaways, or drainage ditches or the surrounding watercourses. Some minor roads in the area appear to have no formal drainage system in place and are anticipated to drain via overland runoff to surrounding verges and ultimately infiltration or drain to surrounding drainage ditches in the vicinity.

Existing Runoff Rates

2.19 An assessment of the existing surface water runoff rates has been undertaken on a litres per second per hectare basis and is summarised within **Table 2.2**, with the supporting calculations included within **Appendix 2**.

2.20 The runoff rates have been estimated using the IH124 method, with appropriate prorated adjustments for a site of less than 50ha, as recommended in Interim Code of Practice for Sustainable Drainage[8]. This was undertaken using the UKSUDS Greenfield Runoff Rate Estimation Tool[9], which makes the necessary adjustments for small sites automatically. A single point has been considered within the main site. This is considered representative of the wider works because of the relatively homogeneous underlying strata.

Table 2.2: Existing Runoff Rate per hectare from the Site

Return Period (Yrs.)	Runoff Rate (l/s/ha)
1	0.1
Mean Annual Flow Rate (QBAR)	0.2
30	0.4
100	0.5

2.21 The above existing greenfield runoff rates are representative of a site which has permeable soil characteristics and suggests that infiltration may be occurring across the site.

Existing Runoff Volume

2.22 An assessment of the existing surface water runoff rates from the site has been made for a 1 in 100-year, 6 hour storm, on a per hectare basis. The middle of the main site has been used as an indicative central location. This is considered representative of the wider works because of the relatively homogeneous underlying strata.

2.23 As most of the pre-development works areas are permeable, the runoff volume has been calculated using the 'pre-development discharge' calculator in Causeway Flow to be **48m³/ha**. The supporting calculations are provided within **Appendix 2**.

[8] The National SUDS Working Group (2004), Interim Code of Practice for Sustainable Drainage
[9] UKSUDS Greenfield Runoff Rate Estimation Tool, HR Wallingford, last accessed 09/12/2025. Available From: https://www.uksuds.com/tools/greenfield-runoff-rate-estimation

3. SURFACE WATER DRAINAGE PRINCIPLES

3.1 Individual drainage strategies have been devised for each part of the offsite works. The following principles have been applied across all locations.

- Cv values of 0.9 have been used in accordance with Oxfordshire's guidance for highways.
- It is assumed that 100% of carriageway areas, and pedestrian / cycle routes, will be drained. Where earthworks and landscaped areas are drained, it is assumed that 50% of the contributing area will be drained.
- Existing drainage infrastructure will be retained and used where possible, subject to surveys to confirm their condition and connectivity.
- The proposed contributing impermeable areas have been measured from the Highways General Arrangement Plans (DCO Document 2.7).

Drainage Hierarchy

3.2 The SuDS Manual[10] identifies that surface water runoff from a development should be disposed of as high up the following hierarchy as reasonably practicable:

i. Collection for non-potable uses;

~~i.~~ii. into the ground (infiltration);

~~ii.~~iii. to a surface water body;

~~iii.~~iv. to a surface water sewer, highway drain, or another drainage system;

~~iv.~~v. to a combined sewer.

3.3 The aim of this is approach is to manage surface water runoff close to where it falls and mimic natural drainage as closely as possible.

Collection for non-potable use

3.4 This report considers the proposed highways works only and there is no demand for the reuse of water in these areas and hence collection for non-potable use can be discounted for this element of the development proposals.

Infiltration

~~3.4~~3.5 Based on the ground investigation information discussed in **Section 2**, it is considered likely that the use of infiltration drainage techniques would be viable for most of the proposed works.

[10] The SuDS Manual (C753). CIRIA 2015.

3.53.6 There is a significant degree of earthworks required to deliver some areas of the proposed works, which will result in the finished levels changing.

3.63.7 The BRE365 soakaway testing was undertaken at depths approximately 2m below the existing ground level on the main site only. Further testing will be undertaken during the detailed design stage to determine correct rates for each works location at realistic levels. No assumptions will be made regarding infiltration in made ground until testing has been undertaken in placed and fully compacted ground. Infiltration rates should be greater than 1 x10^{-6}.

3.73.8 It should be noted that the use of soakaway drainage should be avoided in areas of significant fill, where finished levels are to be raised, as soakaways should not be sited in made ground unless there is a specific earthworks specification to facilitate this.

3.9 Furthermore, Groundwater monitoring should be undertaken for at least a year to inform the detailed design; available water data will also be used for the local area where available from the EA or other ground investigation studies (such as Magic, DEFRA/EA, local BGS reports, LLFA records, Water Companies). Monitoring will ensure infiltration designs will take into consideration peak groundwater levels.

3.83.10 The base of any infiltration features should be a minimum of 1m above the maximum recorded groundwater level at the location of each soakaway.infiltration structure. It is noted that there are pockets of shallow ground watergroundwater across the main site and this should be considered in the future detailed drainage design works.

3.93.11 Based on the above, it is considered that infiltration drainage is potentially viable as a means of discharge surface water from the proposed development; however, at this stage, a drainage strategy with an outfall has been provided, to demonstrate that a deliverable drainage strategy is viable, should future ground investigative works deem soakaway drainage unviable following the completion of the enabling earthworks.

3.103.12 If future infiltration testing and groundwater monitoring confirms soakaways to be viable for the proposed development, the use of infiltration will be prioritised within the detailed drainage design of the development.

Surface waterbodies

3.113.13 It is proposed that surface water from the development will discharge to the existing waterbodies within the area. Existing waterbodies are present within the order limits and these receptors can be drained to via gravity.

3.123.14 The proposed surface water outfall locations across the site are as follows:

- Ashgrove Brook;
- Padbury Brook;
- Gagle Brook; and
- Other local minor watercourses, drainage ditches and soakaways where existing drainage infrastructure is to be retained.

3.133.15 Ordinary watercourse consent will be required with the LLFA prior to the construction of any new outfalls to these watercourses being made.

Peak Flow and Volume Control

3.143.16 In order to comply with the Non-Statutory Technical Standards for Sustainable Drainage Systems S2-S3[11], runoff from greenfield developments should not exceed the equivalent greenfield rates for the 1 and 100-year return period events.

3.153.17 The Non-Statutory Technical Standards for Sustainable Drainage Systems S4-S6[12] states that where reasonably practical the runoff volume from a development for the 1 in 100-year 6 hour rainfall event should not exceed the runoff volume prior to development or redevelopment. Where it is not reasonably practicable to constrain the volume of runoff from a development at or below the existing volume, then the runoff must be discharged in a manner that does not adversely affect flood risk, i.e.:

i. The additional runoff volume resulting from the development (the 'long term storage volume') should be discharged separately from the site at a rate of 2l/s/ha or less. Or,
ii. All the runoff volume from the development should be discharged at a rate equivalent to the mean annual flow rate (QBAR) rate under greenfield conditions or less. Or,
iii. All the runoff volume from the development should be discharged at a rate of 2l/s/ha or less.

3.163.18 The LLFA's local SuDS guidance states that there are two options for providing storage in order to limit peak discharge rates and volumes from a developed site. It is proposed to utilise the 'Simple approach' outlined within the local guidance, at 2l/s/ha for all events up to the 1 in 100-year plus climate change critical storm.

3.173.19 Therefore, to comply with the peak flow and volume control criterion, it is proposed to restrict the discharge rate of surface water from the development to 2l/s/ha for all events up to and including the 1 in 100-year + 2540% critical storm~~, with sensitivity testing using a 40% allowance~~. This is summarised within **Table 3.1**.

Table 3.1: Existing & Proposed Runoff Rates

Return Period (Yr.)	Existing Runoff Rate (l/s/ha)	Proposed Discharge Rate (l/s/ha)
1	0.1	2.0
QBAR	0.2	
30	0.4	
100	0.5	
100 + CC%	-	

[11] 2015, DEFRA. Non-statutory technical standards for sustainable drainage systems
[12] 2015, DEFRA. Non-statutory technical standards for sustainable drainage systems

3.183.20 This approach fulfils the necessary peak runoff and volume control criteria. This will be applied to each section of the proposed works, where practical.

3.193.21 It should be noted that in instances across the proposed development area, where existing highways are to be amended and it is not practical to construct a separate drainage system for the modified highways area, or these areas cannot achieve a gravity connection into proposed new drainage systems, the peak flow control will be managed based on an existing peak rate calculated using the modified rational method, as described in **Figure 3.1**. In these instances, where impermeable areas increase as part of the proposed works, a flow control will be added onto the existing drainage system to ~~retain~~provide 40% betterment over the calculated existing peak ~~flows~~flow rate in the 1 in ~~100~~2-year ~~30~~15-minute storm.

Q = 2.78 x Ap x C x i

Where:
Q = runoff rate (l/s)
Ap = impermeable area (ha)
C = Runoff Coefficient
i = rainfall intensity (mm/hr)

Figure 3.1: Modified Rational Method

3.203.22 Where ~~the~~ existing ~~brownfield rate is proposed to be retained,~~features are modified, 40% betterment will be provided over existing peak flows. Details will be provided within the relevant works section; however, based on a ~~63mm~~103mm/hr ~~average~~peak rainfall intensity during the 1 in ~~100~~2-year ~~30~~15-minute storm, and a runoff coefficient of 90% (based in the LLFAs local guidance), ~~it is anticipated that~~ the existing peak discharge design rate is 257.7l/s/ha. Therefore, the proposed discharge rate will be ~~157.63~~154.6l/s/ha. The rainfall intensity ~~calculation~~information for the site is provided within **Appendix 2**.

Sustainable Drainage Systems

3.213.23 Generally, the proposed works are to be drain via a combination or gullys, kerb drainage, filter drains and swales. The following SuDS are proposed across the scheme, the details of which for each works will be confirmed in the relevant sections of this report:

- Filter Strips
- Filter Drains
- Swales
- Detention Basins
- Attenuation Ponds

3.223.24 The details of the proposed SuDS, including locations and design criteria, will be confirmed through detailed design. however, some overarching principles are outlined below.

3.233.25 Filter drains will be used to drain the proposed pedestrian / cycle routes, embankments, and areas of new highways, where practical. Where space allows, a short filter strip should be provided between the runoff surface and the filter drain, to provide pre-treatment to runoff.

3.243.26 Swales will have ~~minimum~~a maximum water depth of 200mm and 150mm of freeboard. Minimum side slopes of 1:3, with slacker slopes where space allows. Where over the edge drainage is present, the side slope should be 1:5 or less.

3.253.27 At this stage it is proposed that any new detention basins / attenuation ponds will have 1:4 internal ~~slide~~side slopes, with a minimum 300mm freeboard above the design maximum water storage level.

Water Quality

3.263.28 The proposed drainage systems will provide embedded mitigation in the form of SuDS to suitably manage water quality of storm water flows that drain to surrounding receptors.

3.273.29 Different areas of the proposed works will be adopted by different highways authorities, with some areas being adopted by NH, and others by the Local Highways Authority (LHA).

3.283.30 Where new highways are proposed to be adopted by NH, and assessment of water quality will be undertaken using the 'Highways England Water Risk Assessment Tool' (HEWRAT). Where existing NH assets are being modified, no HEWRAT will be undertaken, as it assumed that the existing drainage system provides sufficient water quality mitigation.

3.293.31 Other parts of the scheme, which are to be adopted by the LHA, will be assessed using the CIRIA SuDS Manual 'Simple Index Approach'.

3.303.32 The relevant water quality assessments for each proposed works will be confirmed at detailed design, once the drainage strategies are finalised. However, an example HEWRAT assessment for the A43 works has been undertaken at this stage and is included as **Appendix 3**. Furthermore, details of the Simple Index Approach methodology that will be used at detailed design, along with the proposed future land uses and mitigating SuDS is provided below.

Simple Index Approach Methodology

3.313.33 In accordance with the SuDS Manual a simple index approach to water quality risk management should be undertaken for the proposed development, unless another methodology for assessing water quality management is preferred (i.e., HEWRAT assessment for future NH assets). The simple index approach will be completed at detailed design to provide a comprehensive account of the water quality treatment provided by the proposed surface water drainage systems.

3.323.34 The SuDS Manual Mitigation Index will be used to assess the treatment levels proposed in relation to the pollution hazard posed from the proposed land use(s). This methodology is adopted to ensure that surface water flows receive adequate treatment through all areas of the site prior to final outfall.

3.333.35 **Table 3.2** shows the pollution hazard indices for the land use classification(s) that are relevant to the proposed development, as described within table 26.2 in the SuDS Manual.

Table 3.2: Pollution Hazard Indices for Different Land Use Classifications

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Pedestrian / Cycle paths and bridleways	Low	0.3	0.2	0.05
Low traffic roads	Low	0.5	0.4	0.4
All roads except motorways and trunk roads.	Medium	0.7	0.6	0.7
Trunk roads and motorways	High	0.8	0.8	0.9

3.343.36 The SuDS Mitigation Indices that are relevant to the proposed development, as described within table 26.3 of the SuDS Manual, are outlined in **Table 3.3.**

Table 3.3: SuDS Mitigation Indices

Type of SuDS Component	Mitigation Indices		
	TSS	Metals	Hydrocarbons
Filter Strip	0.4	0.4	0.5
Filter Drain	0.4	0.4	0.4
Swale	0.5	0.6	0.6
Detention Basin	0.5	0.5	0.6
Attenuation Pond	0.7	0.7	0.5

3.353.37 During the detailed design stage, the pollution hazard rating and proposed SuDS Mitigation Index for each drainage Catchment will need to be compared to demonstrate that a suitable level of water quality treatment is provided. Where more than one SuDS component is proposed, a factor of 0.5 has been applied to the downstream (i.e., secondary and/or tertiary) treatment stages to account for the reduced performance due to reduced inflow concentrations.

Maintenance

~~3.36~~3.38 Ultimately, future maintenance works will be undertaken by the adopting authority, which will be either NH or the LHA. NH and the LHA will have their own maintenance schedules; however, general maintenance requirements and schedules for the proposed SuDS are provided below, as informed by the CIRIA SuDS Manual. At detailed design, specific Operation and Maintenance (O&M) manuals will be prepared for each works area.

~~3.37~~3.39 Highways that form part of the strategic road network are adopted by NH. This includes the M40 and its junctions, the A43 and the A34. NH will be responsible for the ongoing maintenance of any upgrades or modifications to these roads.

~~3.38~~3.40 Minor roads including the B430, B4030, B4100 and Camp Road are adopted by Oxfordshire County Council Highways, the LHA. Maintenance of upgrades or modifications made to these roads will be the responsibility of the LHA.

~~3.39~~3.41 The proposed Heyford Park Link Road, Ardley Bypass and Middleton Stoney Relief Road will be adopted by the LHA. They will be responsible for ongoing maintenance of the roads.

Filter Strips

Table 3.4: The SuDS Manual Typical Maintenance Schedule for Filter Strips

Maintenance Schedule	Typical Frequency	Required Action
Regular Maintenance	Monthly (during growing season), or as required	• Remove litter and debris. • Cut the grass - to retain grass height within specified design range.
	Monthly (during the first year, then half yearly)	• Manage other vegetation and remove nuisance plants; • Inspect filter strip surface to identify evidence of erosion, poor vegetation growth, compaction, ponding, sedimentation and contamination (e.g. oils); • Check flow spreader and filter strip surface for even gradients; • Inspect gravel flow spreader upstream of filter strip for clogging; and • Inspect silt accumulation rates and establish appropriate removal frequencies.
Occasional Maintenance	As required or if bare soil is exposed over > 10% of the filter strip area	• Reseed areas of poor vegetation growth; alter plant types to better suit conditions, if required.
Remedial Action	As required	• Repair erosion or other damage by re-turfing or reseeding; • Relevel uneven surfaces and reinstate design levels;

Maintenance Schedule	Typical Frequency	Required Action
		• Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface; • Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip; and • Remove and dispose of oils or petrol residues using safe standard practices.

Filter Drains

Table 3.5: The SuDS Manual Typical Maintenance Schedule for Filter Drains

Maintenance Schedule	Typical Frequency	Required Action
Regular Maintenance	Monthly (or as required)	• Remove litter (including leaf litter) and debris from filter drain surface, access chambers and pre-treatment devices; and • Inspect filter drain surface, inlet/outlet pipework and control systems for blockages, clogging, standing water and structural damage.
	Six monthly (or as required)	• Remove sediment from pre-treatment devices; and • Inspect pre-treatment systems, inlets and perforated pipework for silt accumulation, and establish appropriate silt removal frequencies.
Occasional Maintenance	Five yearly, or as required	• At locations with high pollution loads, remove surface geotextiles and replace, and wash or replace overlying filter medium. • Remove or control tree roots where they are encroaching the sides of the filter drain, using recommended methods (e.g. NJUG, 2007 or BS 3998:2010); and • Clear perforated pipework of blockages.

Swales

Table 3.6: The SuDS Manual Typical Maintenance Schedule for Swales

Maintenance Schedule	Typical Frequency	Required Action
Regular Maintenance	Monthly (or as required)	• Inspect inlets, outlets and overflows for blockages, and clear if required; • Remove litter and debris; and • Inspect infiltration surfaces for ponding, compaction, silt accumulation, record areas where water is ponding for > 48 hours.
	Monthly (during growing season), or as required	• Cut grass – to retain grass height within specified design range.
	Monthly for first year, then as required	• Manage other vegetation and remove nuisance plants.
	Monthly for 6 months, quarterly for 2 years, then half yearly	• Inspect vegetation coverage.
	Half yearly	• Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies.
Occasional Maintenance	As required or if bare soil is exposed over > 10% of the swale treatment area	• Reseed areas of poor vegetation growth, alter plant types to better suit conditions, if required.
Remedial Action	As required	• Repair erosion or other damage by re-turfing or reseeding; • Relevel uneven surfaces and reinstate design levels; • Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface; • Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip; and • Remove and dispose of oils or petrol residues using safe standard practices.

Detention Basins

Table 3.7: The SuDS Manual Typical Maintenance Schedule for Detention Basins

Maintenance Schedule	Typical Frequency	Required Action
Regular Maintenance	Monthly	• Remove litter and debris; • Inspect inlets, outlets and overflows for blockages, and clear if required; and • Inspect banksides, structures, pipework etc for evidence of physical damage.
	Monthly (during growing season, or as required	• Cut grass – for spillways and access routes.
	Monthly for first year, then annually or as required	• Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.
	Monthly at start, then as required	• Manage other vegetation and remove nuisance plants.
	Half yearly (spring – before nesting season, and autumn	• Cut grass – meadow grass in and around basin.
	Annually or as required	• Check any penstocks and other mechanical devices; • Tidy all dead growth before start of growing season; • Manage wetland plants in outlet pool – where provided; and • Remove sediment from inlets, outlet and forebay.
Occasional Maintenance	As required	• Reseed areas of poor vegetation growth.
	Every 2 years, or as required	• Prune and trim any trees and remove cuttings.
	Every 5 years, or as required	• Remove sediment from inlets, outlets, forebay and main basin when required.
Remedial Action	As required	• Repair/rehabilitation of inlets, outlets and overflows; • Repair erosion and other damage by reseeding or returfing; • Realignment of rip-rap; and • Relevel uneven surfaces and reinstate design levels.

Attenuation Ponds

Table 3.8: The SuDS Manual Typical Maintenance Schedule for Attenuation Ponds

Maintenance Schedule	Typical Frequency	Required Action
Regular Maintenance	Monthly	• Inspect inlets, outlets, banksides, structures, pipework etc. for evidence of blockage and/or physical damage.
	Monthly (or as required)	• Remove litter and debris.
	Monthly (during growing season, or as required)	• Cut grass – public areas.
	Monthly for first three years, then as required	• Inspect marginal and bankside vegetation and remove nuisance plants.
	Monthly (May to October)	• Inspect water body for signs of poor water quality.
	Half yearly; spring (before nesting season) and autumn	• Cut grass – meadow grass.
	Half yearly	• Check any penstocks and other mechanical devices; and • Inspect silt accumulation rates in any forebay and in main body of the pond and establish appropriate removal frequencies; undertake contamination testing once some build-up has occurred, to inform management and disposal options.
	Annually	• Hand cut submerged and emergent aquatic plants (at minimum of 0.1m above pond base; include max 25% of pond surface); • Remove 25% of bank vegetation from water's edge to a minimum of 1m above water level; and • Tidy all dead growth (scrub clearance) before start of growing season. Note: tree maintenance is usually part of overall landscape management contract).
	Every 1-5 years (or as required)	• Remove sediment from any forebay.
	Every 5 years (or as required)	• Remove sediment and planting from one quadrant of the main body of ponds without sediment forebays.

Maintenance Schedule	Typical Frequency	Required Action
Occasional Maintenance	With effective pre-treatment, this will only be required rarely, e.g. every 25–50 years	• Remove sediment from the main body of big ponds when pool volume is reduced by 20%.
Remedial Action	As required	• Repair erosion or other damage; • Replant, where necessary; • Aerate pond when signs of eutrophication are detected; • Realign rip-rap or repair other damage; and • Repair/rehabilitate inlets, outlets and overflows.

Flow Controls

Table 3.9: Typical Maintenance Schedule for Flow Control Structures

Maintenance Schedule	Typical Frequency	Required Action
Regular Maintenance	Monthly	• Inspect and identify any areas that are not operating correctly (for three months following installation).
	Every 6 months	• Inspect and identify any areas that are not operating correctly. Take remedial action if required. • Remove sediment from pre-treatment structures.
Remedial Actions	Following all significant storm events	• Inspect and carry out any essential recovery works to return the feature to full working order.

Residual Risks and Designing for Exceedance

~~3.40~~3.42 For new drainage systems, each network has been designed to have a minimum of 300mm of freeboard in the critical 1 in 100 year + ~~25% climate change event. Sensitivity testing has been undertaken for the 1 in 100 year + 40% event, which shows a reduced freeboard and no flooding.~~40% event.

~~3.41~~3.43 In the event of a blockage or exceedance storm event, surface water will be directed to landscaped areas where possible. Exceedance flows will flow toward surrounding watercourse receptors in the vicinity of each works location.

4. WORKS NO.12: HEYFORD PARK LINK ROAD DRAINAGE STRATEGY

Proposals

4.1 The proposals include construction of the Heyford Park Link Road connecting at the west end to the Camp Road and Chilgrove Drive junction. The proposed works are illustrated in **Figure 4.1**.

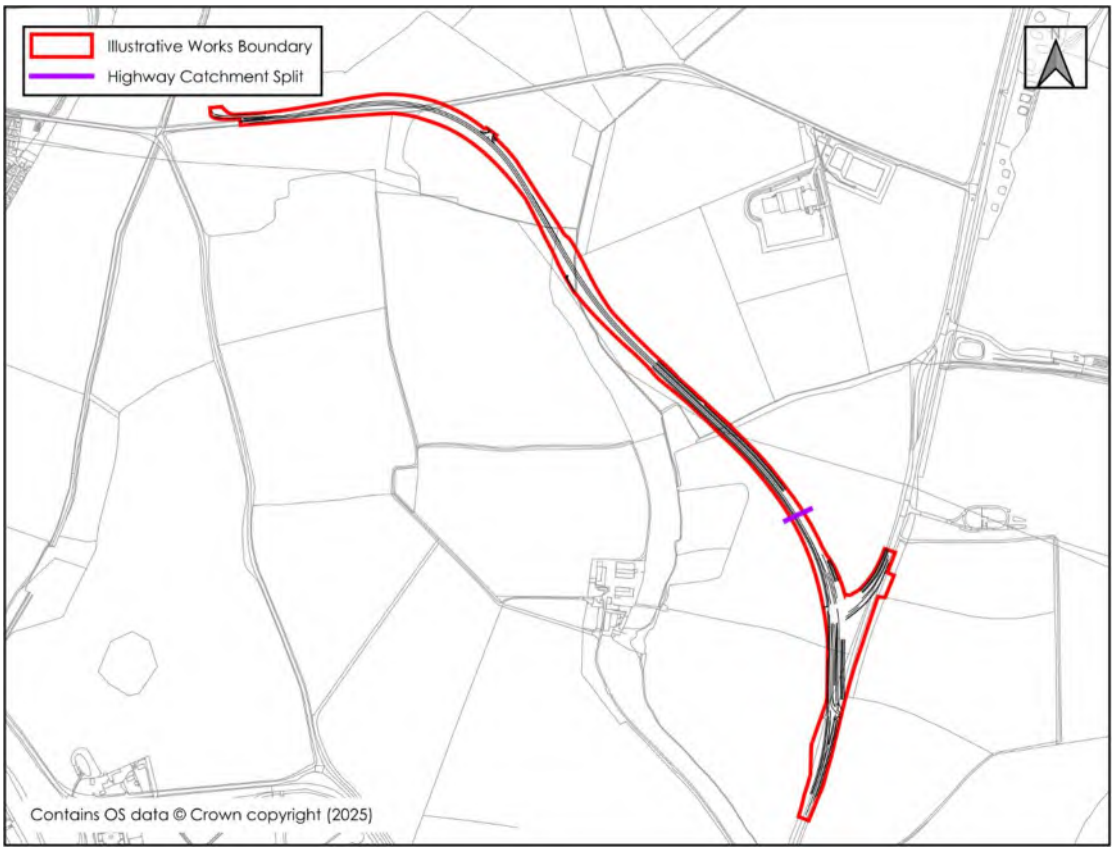


Figure 4.1: Illustrative Works Boundary - Works No. 12

4.2 Drainage from the Heyford Park link road will be split into 2 catchments. The southeasternmost 400m (approximately) will drain to the Gagle Brook as part of the Middleton Stoney Relief Road drainage system as described below in **Section 8.** The majority of the Link Road will drain into Ashgrove Brook, as per mast of the Main Development Site drainage system. The drainage strategy for this section of road is included within the Main Development Site drainage strategy (OXSRFI-BWB-ZZ-XX-T-W-1050_SDS (Main Development Site).

5. WORKS NO.14 TO 18: M40 JUNCTION 10 TO A43 AND B430 HIGHWAY IMPROVEMENT WORKS DRAINAGE STRATEGY

Proposals

5.1 In this location the proposed works comprise a series of upgrades/improvements to junction 10 of the M40 at its link with the A43 and B430, the extent of the works are shown in **Figure 5.1**.

5.2 The proposed highway works at Junction 10 are upstream of the Upper Ouse Water Management Board IDB. The drainage strategy will demonstrate sufficient mitigation is provided to treat and attenuate flows entering the watercourse upstream of the IDB catchment.

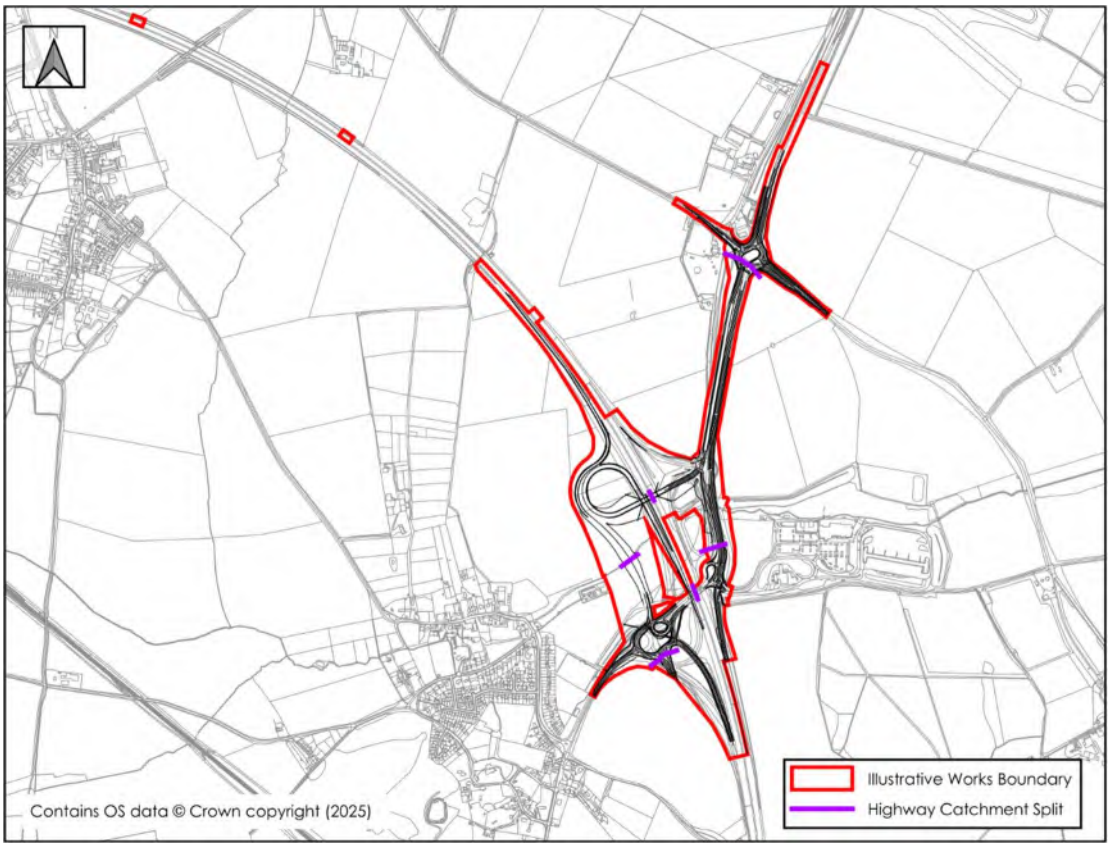


Figure 5.1: Illustrative Works – Works No. 14 to 18

Point of Discharge

~~5.2~~5.3 There are two existing detention basins located within the centre of Junction 10, located between the M40 and A43 eastern slip roads. These basins are understood to serve the M40 and A43 and potentially drain via infiltration with overflow weirs to Padbury Brook.

~~5.3~~5.4 It is anticipated that Barnards Green Roundabout and its east and west arms, with a portion of the A43 to the north is served by existing highway drainage that outfalls to an existing drainage ditch along the B4100 at an unrestricted rate, ultimately draining to Padbury Brook to the ~~south east~~southeast.

~~5.4~~5.5 The existing drainage arrangements described above are based on a review of National Highway's (NH) Geotechnical & Drainage Management Service (GDMS) and the existing drainage arrangements and catchment areas are to be confirmed as part of the detailed design works.

~~5.5~~5.6 As discussed in **Section 3**, the drainage strategy will assume that infiltration is not viable for new drainage systems, however this should be confirmed at the detailed design stage.

~~5.6~~5.7 Surface water runoff from the upgrades and improvements to Junction 10 will drain into Padbury Brook which flows beneath the junction. The drainage strategy will include:

- Two new attenuation basins on the western side of the M40.
- Modifications to the existing drainage pond/basin on the eastern side of the M40, north of Padbury Brook.
- The existing pond located east of the M40 and south of Padbury Brook will be retained in its current form as far as practicable.
- A filter drain located at the toe of embankment for the eastern A43 southbound slip road.
- Drainage around the Baynard's Green Roundabout which forms the intersection between the A43 and B4100 will continue to drain along the B4100 as per the existing situation. This also leads toward Padbury Brook.

~~5.7~~5.8 These discharge locations have been selected to align with the existing topography and mimic the existing drainage catchment as much as possible.

Proposed Drainage Strategy

~~5.8~~5.9 As stated in **Section 3**, surface water runoff from any new drained areas will be restricted to 2.0l/s/ha~~, with the exception of the~~. Highway amendment works to Baynard's Green Roundabout~~, which~~ will ~~continue~~be designed to ~~drain at the existing~~provide 40% betterment over the pre-development peak ~~brownfield~~runoff rate ~~for the 1~~ in ~~100~~the 2-year ~~30~~15-minute ~~storm.~~ event.

~~5.9~~5.10 The proposed drainage strategy will be split into 6 separate networks as described below:

- Baynard's Green Roundabout;
- Northwest Pond;
- Southwest Pond;
- Northeast Pond;
- Southeast Pond; and
- A43 Southbound Eastern Embankments.

~~5.10~~5.11 The proposed drainage strategy drawings and calculations are included in **Appendix 4** and **Appendix 5** respectively.

Baynard's Green Roundabout

5.115.12 Based on the NH GDMS data, topographical survey, and online mapping, it is assumed that the roundabout and a part of the A43 drain to the ditches alongside the roundabout that follow the B4100 to the east.

5.125.13 Adequate data is not available to confirm the size of the existing catchment, but GDMS indicates the A43 catchment extends 850m north of the roundabout. No existing attenuation features have been identified.

5.135.14 The drainage catchment for the existing drainage system will be confirmed through the detailed design works; however, at this stage it is assumed that that the total catchment draining through Baynard's Green Roundabout to the existing ditches to the east alongside the B4100 is 2.505ha, which equates to a peak flow of 394.9l645.6l/s during the 1 in 1002-year 3015-minute storm, as calculated using the Modified Rational Method described in **Figure 3.1**.

5.145.15 The proposed works will introduce the following additional drained areas:

- Total new impermeable carriageway and pedestrian / cycle paths: 0.65ha
- Total verges: 0.09ha (50% of 0.18ha)
- Total new drained area = 0.74ha
- Total drainage area following completion of highway modification works = 3.245ha

5.155.16 It is proposed that this will drain as per the existing scenario toward Padbury Brook via the ditches alongside the B4100. Given the local geology, it is assumed that a significant proportion of surface water runoff infiltrates into the ground before joining the watercourse.

5.165.17 The new drained areas will tie into the existing drainage system in place and an orifice plate will be placed system outfall, limiting flowsused to 394.9lprovide 40% betterment over the existing discharge rate. Discharge will be restricted to 387.4l/s (or 157.63l154.6l/s/ha of a future calculated existing drained catchment area) to the outfall ditch, to ensure the calculated peak flow does not increase as a result highway modification works.

5.175.18 Storage will be provided in the form of oversized pipes and filter drains to provide attenuation of peak flows for the new drained areas.

5.185.19 At this stage, there is insufficient data to recreate the existing drainage model to hydraulically assess the performance of network and to assess the proposed upgrades. However, a volumetric calculation has been undertaken to assess the assumed current attenuation required (which is assumed to currently be provided by the existing drainage system) for the assumed catchment area of 2.505ha, limited to 394.9l645.6l/s in the existing scenario, which has then been compared with the required attenuation for the new total drained area of 3.245ha, the results of which is provided below:

- Assumed pre-development storage requirement = 685m³548m³

- Assumed post-development storage requirement = ~~999m³~~1,005m³
- Difference between assumed pre- and post-development storage requirements = ~~314m³~~457m³

~~5.19~~5.20 Based on the above volumetric calculation, it is anticipated that approximately ~~314m³~~457m³ of new storage, in the form of filter drains and oversized pipes, will be required to attenuate the flows from the highway modifications and new pedestrian / cycle paths proposed at Baynard's Green Roundabout.

Northwest Pond

~~5.20~~5.21 A new attenuation pond will be constructed on the western side of the M40 to the north of Padbury Brook. This pond will attenuate surface water runoff from the proposed new slip roads on the northbound M40.

5.22 In addition, 6,401m² of the M40 carriageway will be diverted to drain into the basin. It is assumed that discharging motorway runoff at 2l/s/ha will provide betterment over the pre-development situation and thus reduce the rate of flow into the downstream IDB watercourses.

~~5.21~~5.23 The carriageway will be drained by kerb drainage and gullys. Embankments will be drained by filter drains.

~~5.22~~5.24 The drainage catchment for the new pond will comprise:

- Total new impermeable carriageway: 1.49ha
- Existing M40 diverted to basin: 0.64ha
- Total embankments and verges: 0.96ha (50% of 1.92ha)
- Total SuDS pond footprint: 0.~~28ha~~34ha
- Total design drained area = ~~2.74ha~~3.43ha

~~5.23~~5.25 This equates to a proposed discharge rate of ~~5.5l~~6.9l/s.

~~5.24~~5.26 Runoff will be discharged to Padbury Brook at an attenuated rate of ~~5.5l~~6.9l/s. Storage will be provided in the pond. In the critical 1 in 100 year +~~25~~40% climate change event, ~~2,244m~~3,209m³ of storage is required~~. Sensitivity testing for the 40% climate change event shows that 2,550m³ is stored in the critical event~~ and over 300mm of freeboard is available ~~for both design scenarios~~.

Southwest Pond

~~5.25~~5.27 A new attenuation pond will be constructed on the western side of the M40 to the south of Padbury Brook. This pond will attenuate surface water runoff from the new slip roads on the northbound M40, and the new roundabout replacing Ardley Roundabout, which currently drains to the southeast pond.

~~5.26~~5.28 The carriageway will be drained by kerb drainage and gullys. Embankments will be drained by filter drains.

~~5.27~~5.29 The drainage catchment for the new pond will comprise:

- Total new impermeable carriageway and pedestrian / cycle paths: 1.41ha
- Total embankments and verges: 0.72ha (50% of 1.44ha)
- Total SuDS pond footprint: 0.26ha
- Total design drained area = 2.39ha

~~5.28~~5.30 This equates to a proposed discharge rate of 4.8l/s.

~~5.29~~5.31 Runoff will be discharged to Padbury Brook at an attenuated rate of 4.8l/s. Storage will be provided in the pond. In the critical 1 in 100 year +~~25% climate change event, 1,960m³ of storage is required. Sensitivity testing for the~~ 40% climate change event ~~shows that~~, 2,~~227m³ is stored in the critical event~~226m³ of storage is required and over 300mm of freeboard is available ~~for both design scenarios~~.

Northeast Pond

~~5.30~~5.32 The existing northeast pond will be modified by the proposed works as a result of the new bridge over the M40 which will reduce the pond's footprint area.

~~5.31~~5.33 The catchment will be modified to include the length of the A43 to the south of Baynard's Green Roundabout, and carriageway areas around Junction 10. Part of the existing catchment will be transferred to the southeast basin because of the northeast pond's reduced capacity.

~~5.32~~5.34 The carriageway will be drained by kerb drainage and gullys. Embankments will be drained by filter drains.

~~5.33~~5.35 The drainage catchment for the modified pond will comprise:

- Total impermeable carriageway and pedestrian / cycle paths: 3.17ha
- Total embankments and verges: 0.90ha (50% of 1.80ha)
- Total SuDS pond footprint: 0.33ha
- Total design drained area = 4.41ha

~~5.34~~5.36 This equates to a proposed discharge rate of 8.8l/s.

~~5.35~~5.37 Runoff will be discharged to Padbury Brook at an attenuated rate of 8.8l/s. Storage will be provided in the pond. In the critical 1 in 100 year +~~25% climate change event, 3,594m³ of storage is required. Sensitivity testing for the~~ 40% climate change event ~~shows that~~, 4,086m³ ~~is stored in the critical event~~of storage is required and over 300mm of freeboard is available ~~for both design scenarios~~.

Southeast Pond

~~5.36~~5.38 The southeastern pond is an existing drainage feature to the south of Padbury Brook on the eastern side of the M40. The drainage information for the main M40

carriageway is not confirmed, but it is assumed to drain a significant part of the M40. GDMS shows that the pond currently drains Ardley roundabout on the western side of the M40. The pond has a weir overflow into Padbury Brook, however the design of this is unclear. It is assumed that routine rainfall events are drained primarily via infiltration.

~~5.37~~5.39 The carriageway will be drained by kerb drainage and gullys. Embankments will be drained by filter drains.

~~5.38~~5.40 It is proposed that the new roundabout replacing Ardley roundabout on the western side of the M40 will drain to the southwestern pond. This catchment area removed from the existing pond has been measured as approximately 1.13ha.

~~5.39~~5.41 It is proposed that the pond will drain new and modified carriageway on the western side of the M40. These additional areas comprise:

- Total of impermeable carriageway and pedestrian / cycle paths: 0.83ha
- Total embankments and verges: 0.15ha (50% of 0.30ha)
- Total drained area: 0.98ha

~~5.40~~5.42 The above transfer of catchment areas is illustrated on the BWB Existing Basin Catchment Transfer Plan, presented within **Appendix 4.**

~~5.41~~5.43 As the additional area drained to the pond is less than the catchment area which will be removed, it is proposed that the pond is left in its current design apart from a new headwall connecting the drainage from the new contributing catchment.

A43 Southbound Eastern Embankments

~~5.42~~5.44 Due to level constraints, and to avoid excessively deep pipework being installed below the A43 southbound slip road, it is proposed that the eastern embankments will be drained by filter drains located at the toe of embankment.

~~5.43~~5.45 The filter drains for these embankments will either drain surface water via infiltration, or to Padbury Brook at 2l/s/ha.

Sustainable Drainage Systems

~~5.44~~5.46 The proposed drainage strategy incorporates a combination of detention ponds and filter drains, delivering multiple benefits aligned with the four pillars of Sustainable Drainage Systems (SuDS).

~~5.45~~5.47 From a water quantity perspective, detention ponds and filter drains provide attenuation of surface water runoff, reducing peak flows and mitigating flood risk downstream. Vortex flow control devices will be used to control surface water discharge.

~~5.46~~5.48 In terms of water quality, filter drains promote sediment capture and pollutant removal through filtration and bio-retention processes, improving the quality of water discharged to receiving watercourses.

~~5.47~~5.49 The strategy also supports amenity by integrating ponds into the landscape, creating visually appealing features that can enhance the character of the surrounding environment.

~~5.48~~5.50 Finally, the inclusion of vegetated components contributes to biodiversity, offering habitats for flora and fauna and supporting ecological connectivity within the scheme.

~~5.49~~5.51 Collectively, these measures ensure compliance with SuDS principles while delivering a resilient and environmentally sensitive drainage solution.

6. WORKS NO.19 TO 20: ARDLEY BYPASS DRAINAGE STRATEGY

Proposals

6.1 The proposals include for construction of the B430 Ardley Bypass and associated works, this is shown in **Figure 6.1**.

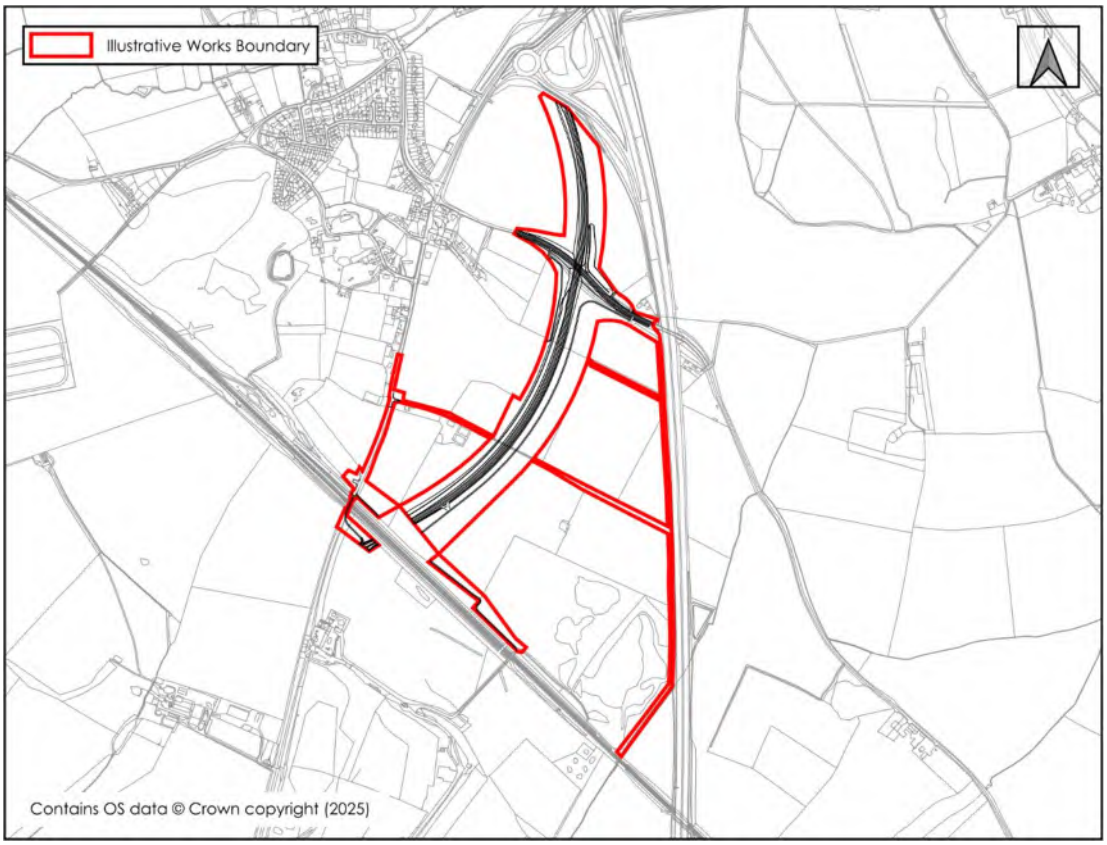


Figure 6.1: Illustrative Works Boundary - Works No. 19 to 20

Point of Discharge

6.2 As discussed in **Section 3**, the drainage strategy will assume that infiltration is not viable, however this should be confirmed at the detailed design stage.

6.3 Surface water runoff from the proposed Ardley Bypass will discharge into Gagle Brook at a single location to the southeast. Based on online mapping, the proposed connection point, located immediately adjacent to the M40, coincides with the origin of the watercourse. From the proposed outfall point, the watercourse flows to the south, under the railway line and onwards Middleton Stoney.

6.4 This discharge location has been selected to align with the existing topography and mimic the existing drainage catchment as much as possible.

Drained Areas

6.5 The proposed link road will introduce drained areas in the form of impermeable carriageway, surface level SuDS features, and embankments that will be drained with toe drains.

6.6 As outlined in **Section 3**, 100% of impermeable carriageway and SuDS pond footprints is assumed to drain to the system, while 50% of drained embankments and verges away from the main carriageway are assumed to drain into the system.

6.7 For the Ardley Bypass, the proposed drained areas are as follows:

- Total impermeable carriageway: 2.48ha
- Total embankments and verges: 1.92ha (50% of total)
- Total SuDS Pond footprint: 0.56ha
- Total design drainage area: 4.96ha

Proposed Drainage Strategy

6.8 As stated in **Section 3**, surface water runoff from any new drained areas will be restricted to 2.0l/s/ha.

6.9 The proposed carriageway will be drained into either gullys, filter drains, or adjacent swales, where levels allow. Embankments will be drained into filter drains. Swales, filter drains and pipework will be used to convey surface water runoff toward the attenuation pond situated adjacent to the roads low point.

6.10 The proposed drained area of 4.96ha equates to a discharge rate of 9.9l/s.

6.11 Runoff will be discharged to Gagle Brook at an attenuated rate of 9.9l/s. Storage will be provided in the pond. In the critical 1 in 100 year +~~25% climate change event, 4,038m³ of storage is required. Sensitivity testing for the~~ 40% climate change event ~~shows that,~~ 4,597m³ ~~is stored in the critical event~~of storage is required and over 300mm of freeboard is available ~~for both design scenarios~~.

6.12 The proposed drainage strategy drawings and calculations are included in **Appendix 6** and **Appendix 7** respectively.

Sustainable Drainage Systems

6.13 The proposed drainage strategy incorporates a combination of swales, detention ponds, and filter drains, delivering multiple benefits aligned with the four pillars of SuDS.

6.14 From a water quantity perspective, detention ponds and swales provide attenuation of surface water runoff, reducing peak flows and mitigating flood risk downstream. A vortex flow control device will be used to control surface water discharge.

6.15 In terms of water quality, filter drains and vegetated swales promote sediment capture and pollutant removal through filtration and bio-retention processes, improving the quality of water discharged to receiving watercourses.

6.16 The strategy also supports amenity by integrating swales and ponds into the landscape, creating visually appealing features that can enhance the character of the surrounding environment.

6.17 Finally, the inclusion of vegetated components contributes to biodiversity, offering habitats for flora and fauna and supporting ecological connectivity within the scheme.

6.18 Collectively, these measures ensure compliance with SuDS principles while delivering a resilient and environmentally sensitive drainage solution.

7. WORKS NO.22: M40 JUNCTION 9 DRAINAGE STRATEGY

Proposals

7.1 The proposed improvements in this location include alterations of the existing M40 Junction 9 roundabout. The extent of the works is illustrated in **Figure 7.1**.

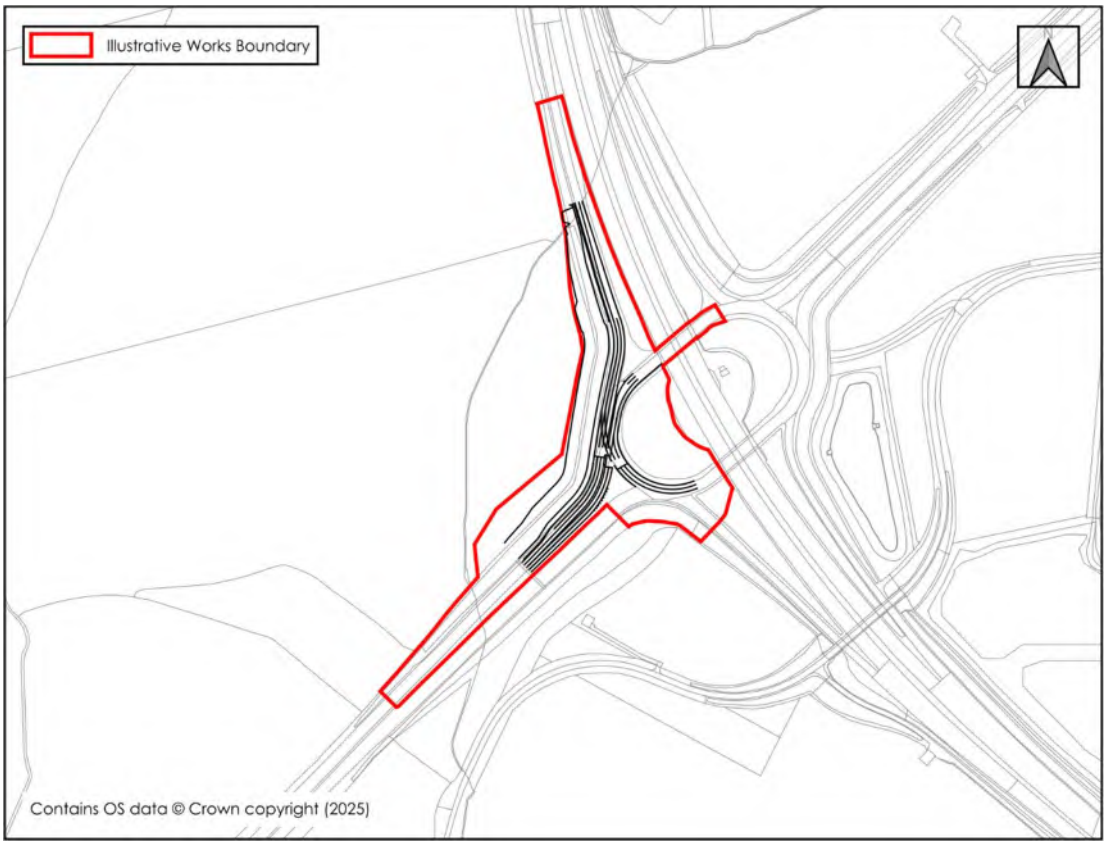


Figure 7.1: Illustrative Works Boundary - Works No. 22

Point of Discharge

7.2 The western arm of the Junction 9 roundabout is shown, on NH GDMS, to be served by an existing drainage system that is assumed to outfall to an existing drainage ditch located to the south of the western arm of the Junction 9 roundabout.

7.3 A portion of existing drainage run located at the base of the Junction 9 western arm embankment, will need to be abandoned and diverted to facilitate the proposed highway modification works.

7.4 It is proposed that the existing drain, located at the bottom of the existing embankment, will be replaced by a new filter drain run, to be located at the new post-development embankment toe, which will drain back into the existing NH drainage system prior to the network crossing the A34 towards the proposed network outfall point.

Drained Areas

7.5 Adequate data is not available to confirm the size of the existing catchment, but GDMS indicates the A34 catchment for the existing drainage run serving the western arm of the Junction 9 roundabout is approximately 0.376ha, which equates to a peak flow of ~~59.3l~~96.9l/s during the 1 in ~~100~~2-year ~~30~~15-minute storm, as calculated using the Modified Rational Method described in **Figure 3.1**. No existing attenuation features have been identified.

7.6 The drainage catchment for the existing drainage system will be confirmed through the detailed design works.

7.7 The proposed works will introduce the following additional drained areas:

- Total new impermeable carriageway: 0.115ha
- Total drainage area following completion of highway modification works = 0.491ha

Proposed Drainage Strategy

7.8 It is proposed that this will drain as per the existing scenario toward the existing drainage ditch via the existing NH network.

7.9 The extended carriageway will be drained via kerb drainage into a filter drain to be located at the toe of the amended embankment for the western arm of the Junction 9 roundabout.

7.10 Upstream of the connection back into the existing NH network, an orifice plate will be utilised to ~~limit the peak flows from the new filter drain to 59.3l/s (or 157.63l/s/ha of a future calculated existing drained catchment area) to ensure the calculated peak flow does not increase as a result of the highway modification works.~~provide betterment over the existing peak discharge rate. A discharge rate of 55 l/s is proposed, which equates to a betterment of over 40%.

7.11 A series of orifice plates will be used across the length of the filter drain to maximise the storage capacity of the new drainage system.

7.12 Storage will be provided in the form of a filter drain to provide attenuation of peak flows for the new drained areas. In the critical 1 in 100 year +~~25~~40% climate change event, ~~123m~~134m³ of storage is required~~. Sensitivity testing for the 40% climate change event shows that 140m³ is stored in the critical event~~.

7.13 The proposed drainage strategy drawings and calculations are included in **Appendix 8** and **Appendix 9** respectively.

Sustainable Drainage Systems

7.14 Due to the nature of these works consisting of amendments to an existing drainage system within a confined area, there is limited scope for the addition of new SuDS. However, the proposed drainage strategy incorporates filter drains.

7.15 From a water quantity perspective, filter drain provides attenuation of surface water runoff, reducing peak flows and mitigating flood risk downstream. An orifice flow control will be used to control surface water discharge.

7.16 In terms of water quality, filter drains promote sediment capture and pollutant removal through filtration and bio-retention processes, improving the quality of water discharged to receiving watercourses.

8. WORKS NO.23 AND 24: MIDDLETON STONEY RELIEF ROAD DRAINAGE STRATEGY

Proposals

8.1 The proposals include for construction of the MSRR connecting B430 and B4030 including a shared use cycle track. The extent of the proposed works is shown in **Figure 8.1**. The southeastern 400m of Heyford Park Link Road will also be included in the drainage catchment because of the local topography.

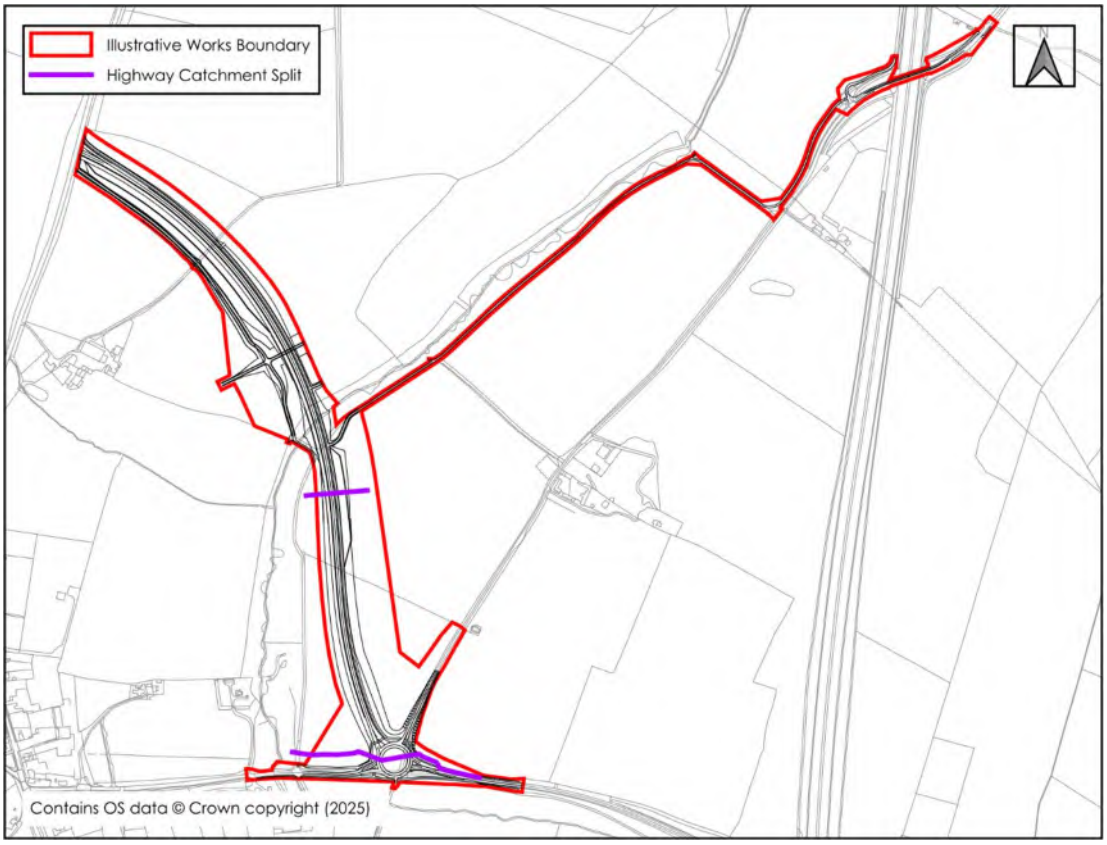


Figure 8.1: Illustrative Works Boundary - Works No. 23 and 24

Point of Discharge

8.2 As discussed in **Section 3**, the drainage strategy will assume that infiltration is not viable, however this should be confirmed at the detailed design stage.

8.3 Based on the topography of the works location and levels of the proposed new highways, the drainage system will be split into three catchments, with two outfall points to Gagle Brook. The proposed catchment split is illustrated on **Figure 8.1**.

8.4 Surface water runoff from the proposed MSRR will discharge into Gagle Brook at two locations. Gagle Brook flows to the ~~south west~~southwest beneath the proposed new highway before running broadly parallel to the southern section of the relief road and then onwards to the ~~south east~~southeast.

8.5 The first discharge point is situated near the midpoint of the relief road, prior to Gagle Brook crossing beneath the proposed alignment; this connection will be made to the east of the carriageway. The second discharge point is located at the southern end of the scheme, upstream of the brook passing beneath Bicester Road at an existing bridge west of the proposed new roundabout. These discharge locations have been selected to align with the existing topography and mimic the existing drainage catchment as much as possible.

8.6 Where Bicester Road is to be upgraded to a new roundabout, it is not possible to drain the southern portion of the new roundabout, or southern arm which ~~tie~~ties into Bicester Road, to the new MSRR drainage system attenuation basins. Therefore, this portion of the development will drain downstream of the southern catchment flow control, ~~with~~and will provide 40% betterment over the ~~Bicestyer Road catchment being limited to~~brownfield rate for the ~~peak~~ 1 in ~~100~~2-year ~~30-mintue~~, 15-minute storm ~~brownfield discharge rate~~.

8.7 The drainage strategy will include:

- Two attenuation ponds for the northern catchment.
- Two attenuation ponds for the southern catchment.
- Filter drains for the Bicester Road catchment.

Proposed Drainage Strategy

8.8 As stated in **Section 3**, surface water runoff from any new drained areas will be restricted to 2.0l/s/ha, with the exception of the highway amendment works to Bicester Road, which will ~~continue~~ be attenuated to ~~drain at~~provide 40% betterment over the existing peak brownfield rate for the 1 in ~~100~~2-year ~~30~~15-minute storm.

8.9 The proposed drainage strategy will be split into 3 separate networks as described below:

- Northern Catchment;
- Southern Catchment; and
- Bicester Road.

8.10 The proposed drainage strategy drawings and calculations are included in **Appendix 10** and **Appendix 11** respectively.

Northern Catchment

8.11 The northern part of the relief road and the southeastern 400m of Heyford Park Link Road will discharge into Gagle brook via two attenuation basins. Surface water will be conveyed using swales, where possible, or gullys. Embankments and foot/cycleways away from the carriageway will be drained using filter drains and toe drains.

8.12 For the Northern Catchment, the proposed drained areas are as follows:

- Total impermeable carriageway: 2.76ha
- Total embankments and verges: 1.87ha (50% of total)
- Total SuDS Pond footprint: 0.67ha
- Total design drainage area: 10.6ha

8.13 The proposed drained area has been measured as 5.30ha, which equates to a proposed discharge rate of 10.6l/s. Storage will be provided in the attenuation basins. In the critical 1 in 100 year +~~25~~40% climate change event, 5,~~326m~~805m³ of storage is required~~. Sensitivity testing for the 40% climate change event shows that 5,804m³ is stored in the critical event~~ and over 300mm of freeboard is available~~ for both design scenarios~~.

8.14 It is acknowledged there are existing ditches around the southern portion of Heyford Park Link Road and these may present a viable outfall solution for that part of the road. At this stage, we have conservatively provided sufficient attenuation as part of the MSRR drainage strategy.

Southern Catchment

8.15 The southern part of the relief road will discharge into Gagle brook via two attenuation basins. Surface water will be conveyed using swales where possible, where possible, or gullys and filter drains. Embankments and foot/cycleways away from the carriageway will be drained using filter drains and toe drains.

8.16 For the Northern Catchment, the proposed drained areas are as follows:

- Total impermeable carriageway: 0.84ha
- Total embankments and verges: 1.05ha (50% of total)
- Total SuDS Pond footprint: 0.28ha
- Total design drainage area: 2.17ha

8.17 The proposed drained area has been measured as 2.17ha, which equates to a proposed discharge rate of 4.3l/s. Storage will be provided in the attenuation basins. In the critical 1 in 100 year ~~+25% climate change event, 1,916m³ of storage is required. Sensitivity testing for the~~ 40% climate change event~~ shows that~~, 2,152m³ ~~is stored in the critical event~~of storage is required and over 300mm of freeboard is available~~ for both design scenarios~~.

Bicester Road

8.18 Due to the area's topography, the section of Bicester Road due to be modified into a roundabout is unable to connect into the proposed attenuation ponds via gravity.

8.19 Due to limited space and depth available in the area, the proposed drainage strategy for this area will ~~match~~provide 40% betterment over the existing peak runoff rate as

calculated using the modified rational method ~~to calculate the existing peak rate~~ during the 1 in ~~100~~2-year ~~30~~15-minute storm.

8.20 The existing highway ~~runoff~~area running off from Bicester Road into Gagle Brook has been estimated to be 0.20ha, which equates to a peak flow of ~~31~~51.5l/s (257.7l/s/ha) during the 1 in ~~100~~2-year ~~30~~15-minute storm, as calculated using the Modified Rational Method described in **Figure 3.1**

8.21 The proposed works will introduce the following additional drained areas:

- Total new impermeable carriageway and pedestrian / cycle paths: 0.41ha
- Total verges: 0.25ha (50% of 0.50ha)
- Total new drained area = 0.66ha

8.22 It is proposed that this will drain as per the existing scenario toward Gagle Brook via the new outfall associated with the Southern Catchment. A vortex flow will be placed system outfall, limiting flows to ~~31.5l/s (or 157.63l/s/ha of a future~~provide 40% betterment over the calculated existing ~~drained catchment area~~runoff rate. The proposed discharge rate will be 30.9l/s (or 154.6l/s/ha) to the Southern Catchment drainage system, downstream from this catchment's flow control, to ensure the calculated peak flow does not increase as a result highway modification works.

~~8.23~~ Storage will be provided in the form of oversized pipes and filter drains to provide attenuation of peak flows for the new drained areas. A vortex flow control will also be placed upstream within the system; to maximise the storage capacity of the filter drains across the network.

~~8.24~~8.23 ~~Storage will be provided in the form of a filter drain to provide attenuation of peak flows for the new drained areas. In the critical 1 in 100 year +25% climate change event, 192m³ of storage is required. Sensitivity testing for the 40% climate change event shows that 207m³ is stored in the critical event. During the 1 in 100 year + 40% critical event, there is minor flooding of the system anticipated; however, this exceedance water will pool within verge between the proposed filter drains and be temporarily stored on site, above ground, until water levels in the system drop.~~ In the critical 1 in 100 year +40% climate change event, 226m³ of storage is required.

Sustainable Drainage Systems

~~8.25~~8.24 The proposed drainage strategy incorporates a combination of swales, detention ponds, and filter drains, delivering multiple benefits aligned with the four pillars of SuDS.

~~8.26~~8.25 From a water quantity perspective, detention ponds, swales and filter drains provide attenuation of surface water runoff, reducing peak flows and mitigating flood risk downstream. Vortex flow control devices will be used to control surface water discharge.

~~8.27~~8.26 In terms of water quality, filter drains and vegetated swales promote sediment capture and pollutant removal through filtration and bio-retention processes, improving the quality of water discharged to receiving watercourses.

~~8.28~~8.27 The strategy also supports amenity by integrating swales and ponds into the landscape, creating visually appealing features that can enhance the character of the surrounding environment.

~~8.29~~8.28 Finally, the inclusion of vegetated components contributes to biodiversity, offering habitats for flora and fauna and supporting ecological connectivity within the scheme.

~~8.30~~8.29 Collectively, these measures ensure compliance with SuDS principles while delivering a resilient and environmentally sensitive drainage solution.

9. MINOR WORKS DRAINAGE STRATEGIES

9.1 The minor works proposed that have been scoped into this SDS are as follows:

- Works No. 13 – Camp Road/Chilgrove Drive Junction and Bridleway
- Works No. 21 – Ardley Bypass PROW
- Works No. 24 – MSRR Pedestrian and cyclist connectivity
- Works No. 25 – B430 shared use cycle track
- Works No. 26 – Quarry Cottages turning head and PROW
- Works No. 33 – Cycle lane to Middleton Road

9.2 The above works have been grouped together as they will all share the same proposed minor drainage mitigation works to locally manage flows from these works.

9.3 These areas will be drained via local filter drains, positioned adjacent to the new minor impermeable areas, which will either discharge via infiltration, subject to successful localised testing at detailed design, or to the nearest local drainage receptor at 2l/s/ha.

9.4 On the basis that the new pedestrian / cycle paths will be surfaced with bound materials, a generic attenuation calculation for a 25m filter drain run has been undertaken. It has been assumed that the paths will be 3m wide, which results in an assumed 75m^3 of impermeable surfacing per 25m length of Path.

9.5 A conservative infiltration rate of 5x10^{-6}m/s has been assumed to demonstrate that a filter drain would be sufficient to drain these new minor impermeable surfaces associated with the minor works. The supporting calculation is presented as **Appendix 12**. Minor flooding in the region of 0.5m^3 per 25m stretch of a filter drain run is anticipated during the 1 in 100-year + 40% critical storm; however, these exceedance flows would be locally stored above ground on site, on the adjacent pedestrian / cycle paths, before draining back into the system once water levels drop.

9.6 If any new paths are to be surfaced with unbound materials, surface water flows will infiltrate to the ground and drain as existing. In these instances, no filter drain would be necessary.

9.7 A typical section of the proposed pedestrian / cycle paths and the proposed filter drains is provided as **Appendix 13**.

10. SUMMARY

10.1 This statement and supporting appendices demonstrate that the drainage design for the development will comply with the relevant local and national standards, specifically the hierarchy of discharge, runoff rate and volume criterion.

10.2 This SDS is intended to support a Development Consent Order application and as such the level of detail included is commensurate and subject to the nature of the proposals.

10.3 It is envisaged that the final drainage strategy will be determined during the detailed design stage, as the development layout is finalised and additional survey works have been undertaken to the confirm the existing drainage arrangements that are currently unknown.

APPENDICES

Appendix 1: Topographical Survey


Fritwell
Fewcott
Upper Heyford Airfield
(disused)
Caulcott
Stoke Wood
Kennel Copse
Earthworks
Ardley Wood
Ardley Hill
Ardley Cottages
Ardley Field Farm
Fewcott Farm
Willowbank Farm
Cross Roads Farm
Lodge Farm
Glebe Farm
Manor Farm
Sewage Works
Caravan Park
Heyford Farm
Field Barn Farm
Manor Farm Barn
Park Farm
Middleton Stoney
Sandyhill Clump
Timberyard Clump
Pedigree Plantation
Needles Farm
Allington Farm
Motorway Service Area
Sycamore Grove
Baynard's Green Farm
Kilby's Barn
Kilby's Copse
Clipping Copse
Woodfield Farm
The Plantation
Hunkin's Farm
Swan Farm Quarry
Quarry (disused)
Recycling Centre
RAILWAY LAND NO VISIBILITY FROM SURROUNDING AREA
EXISTING ACCESS ARRANGEMENTS
The Gorse
The Heath
Old Nursery
Cricket Ground
Home Wood
Gardener's Cottages
Villiers Piggery
Manor Farm Cottages
Roundabout
Playing Field
Works
Workings (disused)
Gravel Pit
Sewage Works
Caravan Park
Recycling Centre
Quarry
Tank
Pond
Well
Track
Wall
Fence
Hedge
Ditch
Bank
Path
Road
Tree
Wood
Scrub
Grass
Crop
Orchard
Meadow
Pasture
Building
Farm
Cottage
House
Barn
Stable
Shed
Garage
Church
School
Hall
Pub
Shop
Post Office
Village Hall
Caravan Park
Car Park
Allotments
Sewage Works

Appendix 2: Greenfield Runoff Rate and Volume Calculations and Rainfall Intensities

Greenfield runoff rate estimation tool

www.uksuds.com | Greenfield runoff rate estimation tool (https://www.uksuds.com/)

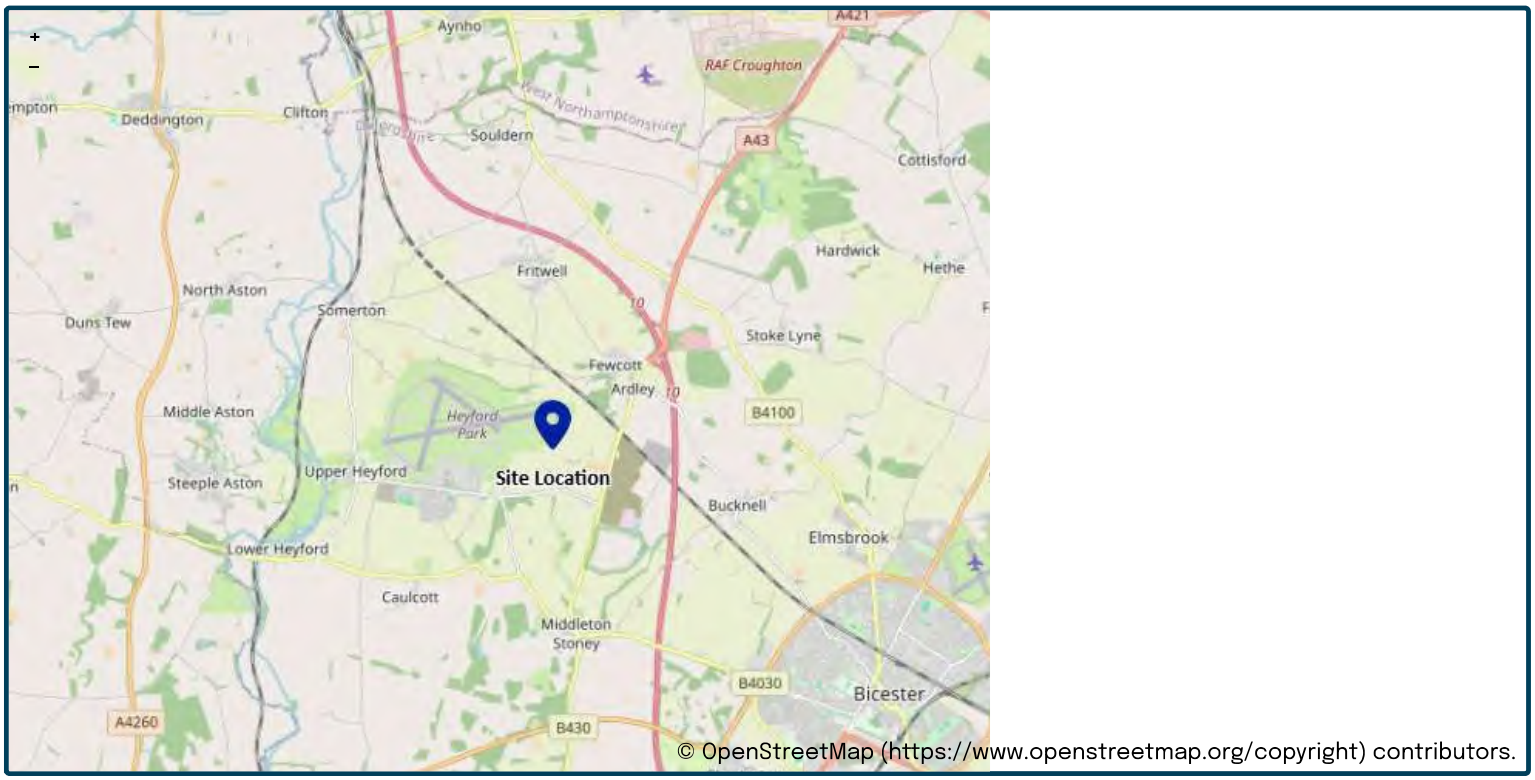
This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (CIRIA, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Project details

Date	09/12/2025
Calculated by	[redacted]
Reference	OxSRFI - IH124
Model version	2.2.2

Location

Site name	OxSRFI
Site location	Oxfordshire



Site easting (British National Grid)	453018
Site northing (British National Grid)	226084

Site details

Total site area (ha)	1 ha

Greenfield runoff

Method

Method	IH124

IH124

	My value		Map value
SAAR (mm)	659 mm		659
How should SPR be derived?	WRAP soil type		
WRAP soil type	1		1
SPR	0.1		
QBar (IH124) (l/s)	0.2 l/s		

Growth curve factors

	My value		Map value
Hydrological region	6		6
1 year growth factor	0.85		
2 year growth factor	0.88		
10 year growth factor	1.62		
30 year growth factor	2.3		
100 year growth factor	3.19		
200 year growth factor	3.74		

Results

Method	IH124
Flow rate 1 year (l/s)	0.1 l/s
Flow rate 2 year (l/s)	0.1 l/s
Flow rate 10 years (l/s)	0.3 l/s
Flow rate 30 years (l/s)	0.4 l/s
Flow rate 100 years (l/s)	0.5 l/s
Flow rate 200 years (l/s)	0.6 l/s

Please note runoff estimation is subject to significant uncertainty. Results are therefore normally reported to only 1 decimal place. Where 2 decimal places are provided, this does not indicate accuracy to this level, it has been adopted to prevent 'zero' figures from being reported. Outputs less than 0.01 l/s are reported as 0.01 l/s.

Disclaimer

This report was produced using the Greenfield runoff rate estimation tool (2.2.2) developed by HR Wallingford and available at uksuds.com (https://www.uksuds.com/). The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at uksuds.com/terms-conditions (https://www.uksuds.com/terms-conditions). The outputs from this tool have been used to estimate Greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, Centre for Ecology and Hydrology, Wallingford Hydrosolutions or any other organisation for the use of these data in the design or operational characteristics of any drainage scheme.

Simulation Settings

Rainfall Methodology	FEH-22	Winter CV	0.840	Drain Down Time (mins)	240	Check Discharge Rate(s)	x
Rainfall Events	Singular	Analysis Speed	Normal	Additional Storage (m³/ha)	20.0	Check Discharge Volume	✓
Summer CV	0.750	Skip Steady State	x	Starting Level (m)		100 year 360 minute (m³)	48

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

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

Pre-development Discharge Volume

Site Makeup	Greenfield	Soil Index	1	Return Period (years)	100	Betterment (%)	0
Greenfield Method	FSR/FEH	SPR	0.10	Climate Change (%)	0	PR	0.078
Positively Drained Area (ha)	1.000	CWI	100.444	Storm Duration (mins)	360	Runoff Volume (m³)	48

Flow+ v14.0 Copyright © 1988-2025 Causeway Technologies Ltd

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
2 year 15 minute summer	102.933	29.126	2 year 15 minute winter	72.234	29.126

Flow+ v17.0 Copyright © 1988-2026 Causeway Technologies Ltd

Appendix 3: A43 HEWRAT Assessment Results

DETAILED RESULTS

Back To Top | Go To Interface

Summary of predictions

Prediction of impact		Soluble - Acute Impact: Copper	Soluble - Acute Impact: Zinc	Sediment - Chronic Impact: Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
	Step1										
	Step2										
	Step3										

In Runoff

Step 1

	Copper	Zinc
RST24		
Allowable Exceedances/year	1	1
No. of exceedances/year	~~60.80~~	~~39.10~~
No. of exceedances/worst year	~~76~~	~~48~~
RST6		
Allowable Exceedances/year	1	1
No. of exceedances/year	~~20.40~~	~~12.80~~
No. of exceedances/worst year	~~29~~	~~18~~
	(ug/l)	(ug/l)
Thresholds RST24	21	385
Thresholds RST6	42	770
Event Statistics Mean	~~26.43~~	~~58.25~~
90%ile	~~50.59~~	~~122.59~~
95%ile	~~66.30~~	~~162.04~~
99%ile	~~104.70~~	~~307.07~~

Step 1

	Copper	Zinc	Cadmium	Total PAH	Pyrene	Fluoranthene	Anthracene	Phenanthrene
				Toxicity Threshold				
Allowable Exceedances/year	1	1	1	1	1	1	1	1
No. of exceedances/year	~~80.70~~	~~96.40~~	~~1.30~~	~~15.30~~	~~52.30~~	~~15.30~~	~~13.20~~	~~28.60~~
No. of exceedances/worst year	~~93~~	~~106~~	~~5~~	~~27~~	~~66~~	~~27~~	~~21~~	~~38~~
	(mg/kg)	(mg/kg)	(mg/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)
Toxicity	197	315	3.5	16770	875	2355	245	515
Mean	~~405~~	~~1316~~	~~1~~	~~10600~~	~~1834~~	~~1760~~	~~112~~	~~496~~
90%ile	~~876~~	~~2971~~	~~1~~	~~28184~~	~~4876~~	~~4679~~	~~299~~	~~1319~~
95%ile	~~1155~~	~~4029~~	~~2~~	~~56234~~	~~9729~~	~~9335~~	~~596~~	~~2632~~
99%ile	~~1615~~	~~7123~~	~~4~~	~~112202~~	~~19411~~	~~18626~~	~~1189~~	~~5251~~

In River (no mitigation)

Step 2

	Copper	Zinc
RST24		
Allowable Exceedances/year	2	2
No. of exceedances/year	~~0~~	~~0~~
No. of exceedances/worst year	~~0~~	~~0~~
No. of exceedances/summer	~~0~~	~~0~~
No. of exceedances/worst summer	~~0~~	~~0~~
RST6		
Allowable Exceedances/year	1	1
No. of exceedances/year	~~0~~	~~0~~
No. of exceedances/worst year	~~0~~	~~0~~
No. of exceedances/summer	~~0~~	~~0~~
No. of exceedances/worst summer	~~0~~	~~0~~
Annual average concentration (ug/l)	~~0.22~~	~~0.59~~
	(ug/l)	(ug/l)
Thresholds RST24	21	385
Thresholds RST6	42	770
Event Statistics Mean	~~0.86~~	~~2.02~~
90%ile	~~2.20~~	~~5.23~~
95%ile	~~3.39~~	~~10.39~~
99%ile	~~10.57~~	~~25.63~~

Step 2

Velocity 0.56 m/s — **Tier 2** is used for the calculation

DI -

Minimum % settlement needed - %

In River (with mitigation)

Step 3

	Copper	Zinc
RST24		
Allowable Exceedances/year	2	2
No. of exceedances/year	-	-
No. of exceedances/worst year	-	-
No. of exceedances/summer	-	-
No. of exceedances/worst summer	-	-
RST6		
Allowable Exceedances/year	1	1
No. of exceedances/year	-	-
No. of exceedances/worst year	-	-
No. of exceedances/summer	-	-
No. of exceedances/worst summer	-	-
Annual average concentration (ug/l)	-	-
	(ug/l)	(ug/l)
Thresholds hresholds RST24	21	385
Thresholds RST6	42	770
Event Statistics Mean	-	-
90%ile	-	-
95%ile	-	-
99%ile	-	-

DI -

Details of the chosen rainfall site

SAAR (mm)	**750**
Altitude (m)	**120**
Easting	**4073**
Northing	**2872**
Coastal distance (km)	**120**

highways england

View Parameters | Reset Spillage Risk | Go To Interface

Assessment of Priority Outfalls

Method D - assessment of risk from accidental spillage

		A (main road)	Additional columns for use if other roads drain to the same outfall: B	C	D	E	F	Totals	Return Period (years)
D1	Water body type	Surface watercourse	Surface watercourse	Surface watercourse	Surface watercourse				
D2	Length of road draining to outfall *(m)*	7,800	201	490	3,245				
D3	Road Type *(A-road or Motorway)*	A	A	A	M				
D4	If A road, is site urban or rural?	Rural	Rural	Rural	Rural				
D5	Junction type	No junction	No junction	No junction	Slip road				
D6	Location (response time for emergency services)	< 20 minutes	< 20 minutes	< 20 minutes	< 20 minutes				
D7	Traffic flow (AADT two way)	42,253	201	15,889	14,049				
D8	% HGV	13.9	2.9	8.4	19.8				
D8	Spillage factor *(no/10^9 HGVkm/year)*	0.29	0.29	0.29	0.29				
D9	Risk of accidental spillage	0.00485	0.00000	0.00007	0.00096	0.00000	0.00000		
D10	Probability factor	0.45	0.45	0.45	0.45				
D11	Risk of pollution incident	0.00218	0.00000	0.00003	0.00043	0.00000	0.00000		
D12	Is risk greater than 0.01?	**No**	**No**	**No**	**No**				
D13	Return period without pollution reduction measures	0.00218	0.00000	0.00003	0.00043	0.00000	0.00000	0.0026	378
D14	Existing measures factor	0.5	0.5	0.5	1				
D15	Return period with existing pollution reduction measures	0.00109	0.00000	0.00002	0.00043	0.00000	0.00000	0.0015	651
D16	Proposed measures factor	0.5	0.5	0.5	0.5				
D17	Residual with proposed Pollution reduction measures	0.00055	0.00000	0.00001	0.00021	0.00000	0.00000	0.0008	1302

Justification for choice of existing measures factors:

Individual routes amalgamated and calculated together with mean average traffic data taken. This has been carried out holistically to look at all routes using the same outfall.

Four columns are calculated as shown below:

Column A = A43
Column B = B430
Column C = B4100
Column D = Slip Road

The individual routes are shown in choice justification column.

Justification for choice of proposed measures factors:

M40 J10 NB diverge (to Ardley Roundabout)
B430 (north of Ardley Road)
M40 J10 NB merge (from Ardley Roundabout)
New Link - M40 J10A NB diverge
M40 J10 SB diverge (to Padbury junction)
B4100 east of Baynard's Green
B4100 west of Baynard's Green
A43 between Ardley and Cherwell junctions
A43 between Cherwell and Padbury junctions
A43 between Padbury and Baynard's Green junctions
A43 north of Baynard's Green
M40 SB merge at J10

Spillage Factor

	Serious Accidental Spillages *(Billion HGV km/ year)*	Motorways	Rural Trunk	Urban Trunk
Location	No junction	0.36	0.29	0.31
	Slip road	0.43	0.83	0.36
	Roundabout	3.09	3.09	5.35
	Cross road	-	0.88	1.46
	Side road	-	0.93	1.81
	Total	0.37	0.45	0.85

Indicative Pollution Risk Reduction Factors for Spillages

System	Optimum Risk Reduction Factor
Filter Drain	0.6
Grassed Ditch / Swale	0.6
Pond	0.5
Wetland	0.4
Soakaway / Infiltration basin	0.6
Sediment Trap	0.6
Unlined Ditch	0.7
Penstock / valve	0.4
Notched Weir	0.6
Oil Separator	0.5

The worksheet should be read in conjunction with DMRB 11.3.10.

Appendix 4: M40 Junction 10 Drainage Drawings

Existing A43 highway drain catchment extends beyond extent of survey to approximately 850m north of the A43 - B4100 roundabout. GDMS drainage plans show the drainage run to end alongside the roundabout. It is unclear where exactly the outfall point is. Drainage ditches on the eastern side of the roundabout are a potential outfall location.

Highway widening to drain as existing

A43 shown by GDMS to drain to watercourse. Existing assets to be retained where possible and diverted to new ditch.

Existing ditches will need to be recreated with new roundabout. The new ditches will tie into the existing network.

No highway gullies are visible east of this location. Beyond this point drainage runs off into adjoining swales. Estimated drained catchment length from the roundabout is 65m. This catchment is assumed to also drain into adjacent ditches.

Assumed existing extent of catchment draining directly to the unnamed tributary of Padbury Brook via the A43 highway drainage system (TBC)

Existing development - drainage outfall unknown

Widened A43 to utilise existing drainage infrastructure where possible

CHANNEL CARRIER DRAIN

No highway gullies are visible west of this location. Beyond this point drainage runs off into adjoining swales. Estimated drained catchment length from the roundabout is 200m. This catchment is assumed to drain into the dirches adjacent to the roundabout (TBC).

Sheet 2 (Drawing 00512)

A43 B4100 ROUNDABOUT PROPOSED DRAINAGE AREAS

Existing catchment and flow routes unconfirmed.

Based on topographical data, online imagery and the GDMS database, it is assumed that the roundabout, 200m of the B4100 and 850m of the A43 drain to the ditches along the westbound B4100 exit. This ultimately connects into the unnamed ordinary watercourse which is a tributary of Padbury Brook.

Existing catchment estimated as:
B4100: 200 x 10 = 4,000
A43: 850 x 22 = 18,700
Roundabout: 2,350
TOTAL: 25,050m²

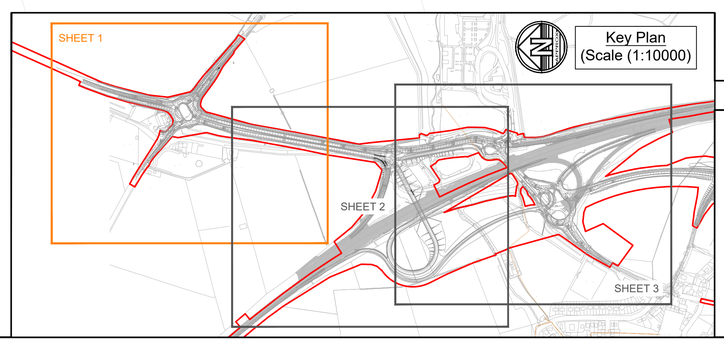
Existing catchment runoff estimated using the Modified Rational Method:
Q = 2.78 x C x i x A
C = 0.9
A = 2.505ha
i = 103mm/hr (based on 1 in 2-year, 15-minute, storm)
Q = 645.6l/s
Proposed runoff rate to provide 40% betterment **Q = 387.4**l/s

ADDITIONAL HIGHWAY AREAS TO BE DRAINED TO EXISTING DITCHES (@100%): 6,458m²
ADDITIONAL VERGES TO BE DRAINED TO EXISTING DITCHES (@ 50%): 948m²
TOTAL ADDITIONAL DRAINED AREAS TO EXISTING DITCHES: 7,406m²
(DITCHES REROUTED WHERE NECESSARY)

Additional areas to be drained via amended pipe work, filter drains and swales and to be limited to a maximum discharge rate of 387.4l/s, based on 40% betterment over the existing peak runoff rate in a 2-year 15-minute storm.

A volumetric calculation has been undertaken based on the existing assumed impermeable area of 2.505ha draining at 645.6l/s, and proposed assumed impermeable area of 3.245ha, draining at 387.4l/s, to estimate the required attenuation for the new impermeable surfaces proposed.

An additional **457m³** of attenuation is to be provided across the amended drainage system in the form of oversized pipes, manholes and filter drains, where practical, to manage flows from the drainage system up to the 1 in 100-year + 40% critical storm, to be determined during the detailed design stage.



Key Plan
(Scale (1:10000)

Legend

- DEVELOPMENT CONSENT ORDER BOUNDARY
- PROPOSED CATCHMENT SPLIT
- PROPOSED CHANNEL CARRIER DRAIN
- PROPOSED FILTER DRAIN
- PROPOSED SWALE
- PROPOSED IMPERMEABLE HIGHWAY AND FOOT/CYCLE PATH AREAS
- EXTENT OF VERGES AND BANKS

General Notes

1. Do not scale this drawing. All dimensions must be checked/ verified on site. If in doubt ask.
2. This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.
3. All dimensions in millimetres unless noted otherwise. All levels in metres unless noted otherwise.
4. Any discrepancies noted on site are to be reported to the engineer immediately.
5. Drawing provided for illustrative purposes only. Design subject to further coordination and approvals.
6. Enclosed topographical survey based on greenhatch group drawing '36646_T_REV9' dated 03/04/23.
7. Enclosed highway GA based on drawings:
   OxSRFI-BWB-LSI-01-DR-CH-0101 and
   OxSRFI-BWB-LSI-02-DR-CH-0102

Drainage Notes

1. The following impermeable area assumptions have been used, as measured from OxSRFI-BWB-LSI-01-DR-CH-101 and OxSRFI-BWB-LSI-02-DR-CH-102
   - Highways and Foot/Cycle paths = 100%
   - Embankments, bunds and verges = 50%
   - Attenuating SuDS basins = 100%
2. Flows will be directed through swales where site levels allow, subject to detailed review once levels are finalised.
3. A Volumetric Runoff Coefficient (Cv) value of 0.9 has been used for the highway drainage calculations, in accordance with the Lead Local Flood Authorities SuDS Guidance.
4. SuDS ponds have been designed with maximum side slopes and external tie in batters of 1:3 and a minimum 300mm freeboard during the 1 in 100-year + 40% critical storm event.
5. Proposed discharge rates based on 2l/s/ha. To be agreed with the LLFA.
6. Detention basins to have low flow channel and incorporation of ecological features is to be confirmed at detailed design.
7. The proposed drainage concept is subject to review against the final proposed levels and earthworks strategy.
8. Drainage for the proposed highway works is to be split into 6 catchments which each ultimately discharge into the unnamed tributary of Padbury Brook.
9. The widened Baynard's Green roundabout will drain as existing via ditches which will be diverted. 40% betterment will be provided over the existing peak runoff rate.
10. Junction 10 of the M40 will be split into 4 basins and a filter drain:
    - The northwest and southwestern basins are new and will drain nearby proposed roads to the watercourse at an attenuated rate of 2l/s/ha. No infiltration has been applied at this stage, but it will be considered after testing.
    - The northeast basin is an existing basin that will be modified by the proposals. It will drain nearby roads to the watercourse at an attenuated rate of 2l/s/ha. No infiltration has been applied at this stage, but it will be considered after testing.
    - The southeast basin is an existing basin which is currently assumed to discharge primarily via infiltration, There is a a weir overflow for extreme events. It is assumed to drain a significant length of the M40 (to be confirmed). It is proposed to add additional area to this basin, and remove part of its existing catchment such that the net change is negligible. Thus no changes are proposed for the basin. Refer to drawing 'OxSRFI-BWB-EWE-ZZ-DR-CD-00516' for more details.
    - Due to level constraints, the eastern junction embankments will be drained via a filter drain located at the toe of the embankment that will drain either via infiltration or to the unnamed tributary of Padbury Brook at 2l/s/ha.
10. Piped drainage networks are shown indicatively to demonstrate catchment areas and connectivity and are subject to detailed design.

Rev	Date	Details of issue / revision	Drw	Rev
P03	12.10.26	Baynards green updated to provide betterment	TLB	RJ
P02	20.02.26	Preliminary issue	TLB	RJ
P01	20.01.26	Draft issue	TLB	

Issues & Revisions

BWB CONSULTANCY | ENVIRONMENT INFRASTRUCTURE | BUILDINGS
☐ Birmingham | 0121 233 3322
☐ Leeds | 0113 233 8000
☐ London | 020 7407 3879
☐ Manchester | 0161 233 4260
■ Nottingham | 0115 924 1100
www.bwbconsulting.com

Client
OXFORDSHIRE RAILFREIGHT LTD.

Project Title
OxSRFI OXFORDSHIRE STRATEGIC RAIL FREIGHT INTERCHANGE

Drawing Title
M40 JUNCTION 10 MODIFICATIONS DRAINAGE STRATEGY (SHEET 1 OF 3)

Drawn:	TLB	Reviewed:	RJ	
BWB Ref:	NTH2479	Date:	20.01.26	Scale@A1: 1:1250

Drawing Status
PRELIMINARY

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
OxSRFI-BWB-EWE-ZZ-DR-CD-00511	S1	P03

© Copyright BWB Consulting Ltd

Unnamed ordinary watercourse. A tributary of Padbury Brook which forms part of the River Great Ouse basin.

Existing Anglian Water foul rising main

Modified junction to utilise existing drainage infrastructure where possible

Embankments to drain either via infiltration or to existing unnamed ordinary watercourse at 2l/s/ha. Attenuation to be provided by filter drain at toe of embankment

New connection proposed to existing drainage basin

A43

Widened A43 to utilise existing drainage infrastructure where possible

CHANNEL CARRIER DRAIN

CHANNEL CARRIER DRAIN LOW POINT

Vortex flow control 8.8l/s

Existing southeast drainage basin assumed to drain primarily via infiltration. The basin catchment will be modified but the overall contributing area will remain approximately the same. Thus no changes are proposed.

Slope will be retained to not impact basin

Weir overflow

Existing northeast drainage basin (Capacity reduced)
1 in 4 side slopes + 300mm freeboard
Volume to freeboard: 4,086m³
CL:111.00
IL:108.90
Earthwork tie-in batters to be confirmed through detailed design

Additional survey required along watercourse to confirm levels

Proposed southwest drainage basin
1 in 4 side slopes + 300mm freeboard
Volume to freeboard: 2,226m³
CL:110.50
IL:109.00
Earthwork tie-in batters to be confirmed through detailed design

Vortex flow control 4.8l/s

Basin capacity will be reduced by highway embankment

WL:108.82

Vortex flow control 6.9l/s

Watercourse to be culverted

6,401m² of existing M40 will be diverted into the proposed northwest basin in order to provide attenuation and betterment over the existing drainage situation.

Proposed northwest drainage basin
1 in 4 side slopes + 300mm freeboard
Volume to freeboard: 3,209m³
CL:110.50
IL:109.00
Earthwork tie-in batters to be confirmed through detailed design

Existing M40 drainage is not shown in the Geotechnical & Drainage Management Service (GDMS). Based on topographical data for the area, the existing basins could serve up to 16.07ha of the motorway. It is asssumed that it currently drains to the southeast basin.

Estimated M40 drainage catchment:
45m wide x 3,572m long
160,740m² (16.07ha)

M40 JUNCTION 10 PROPOSED DRAINAGE AREAS

EXISTING NORTHEAST BASIN
(EXISTING DRAINAGE CATCHMENT TO BE CONFIRMED, BASIN SIZE REDUCED DUE TO TRANSFER OF CATCHMENT AREA TO SOUTH EAST BASIN)
PROPOSED ROAD AREA AND FOOTWAYS: 31,740m²
PROPOSED EARTHWORKS AND VERGES: 18,035m²
50% OF EARTHWORKS AND VERGES DRAINED: 9,020m²
BASIN AREA: 3,300m²
TOTAL DRAINED AREA: 44,060m² (4.406ha)
PROPOSED DISCHARGE RATE: 8.8l/s

EXISTING SOUTHEAST BASIN
IMPERMEABLE AREAS CURRENTLY DRAINING TO THE BASIN WILL BE REMOVED. ADDITIONAL AREAS WILL BE DRAINED TO THE BASIN.

REFER TO DRAWING 'OxSRFI-BWB-EWE-ZZ-DR-CD-00514' FOR FURTHER DETAILS OF REMOVED AND ADDED AREAS TO EXISTING BASIN.

ESTIMATED M40 CATCHMENT (UNCHANGED AND UNCONFIRMED)
45m(w) x 3,572m(l) = 16.07ha
Basin: 0.81ha

PRE DEVELOPMENT CATCHMENT AREA TO BE REMOVED:
ARDLEY ROUNDABOUT AND SLIP ROADS, A43 AND B430:
1.13ha

POST DEVELOPMENT NEW AREAS DRAINED TO BASIN:
PROPOSED ROAD AREA: 7,625m²
PROPOSED EARTHWORKS AND VERGES: 3,000m²
50% OF FOOTWAYS AND EARTHWORKS DRAINED: 1,500m²
WIDENED SLIP ROADS: 665m²
TOTAL NEW AREA: 9,790m² (0.98ha)

TOTAL PRE DEVELOPMENT DRAINED: 18.01ha
TOTAL POST DEVELOPMENT DRAINED: 17.86ha
THE TOTAL AREA DRAINED TO THE BASIN WILL REMAIN APPROXIMATELY THE SAME, OR REDUCE SLIGHTLY. THUS NO CHANGES WILL BE PROPOSED TO THE BASIN.

PROPOSED NORTHWEST BASIN
PROPOSED ROAD AREA: 14,938m²
EXISTING M40 AREA DIVERTED TO BASIN: 6,401m²
PROPOSED FOOTWAYS AND EARTHWORKS: 19,164m²
50% OF FOOTWAYS AND EARTHWORKS DRAINED: 9,582m²
BASIN AREA: 3,431m²
TOTAL DRAINED AREA: 34,352m² (3.43ha)
PROPOSED DISCHARGE RATE: 6.9l/s

PROPOSED SOUTHWEST BASIN
PROPOSED ROAD AREA: 14,127m²
PROPOSED FOOTWAYS AND EARTHWORKS: 14,316m²
50% OF FOOTWAYS AND EARTHWORKS DRAINED: 7,158m²
BASIN AREA: 2,613m²
TOTAL DRAINED AREA: 23,898m² (2.39ha)
PROPOSED DISCHARGE RATE: 4.8l/s

Sheet 1 (Drawing 00511)

Sheet 3 (Drawing 00513)

General Notes

1. Do not scale this drawing. All dimensions must be checked/ verified on site. If in doubt ask.
2. This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.
3. All dimensions in millimetres unless noted otherwise. All levels in metres unless noted otherwise.
4. Any discrepancies noted on site are to be reported to the engineer immediately.
5. Drawing provided for illustrative purposes only. Design subject to further coordination and approvals.
6. Enclosed topographical survey based on greenhatch group drawing '36646_T_REV9' dated 03/04/23.
7. Enclosed highway GA based on drawings:
   OxSRFI-BWB-LSI-01-DR-CH-0101 and
   OxSRFI-BWB-LSI-02-DR-CH-0102

Drainage Notes

1. The following impermeable area assumptions have been used, as measured from OxSRFI-BWB-LSI-01-DR-CH-101 and OxSRFI-BWB-LSI-02-DR-CH-102
   - Highways and Foot/Cycle paths = 100%
   - Embankments, bunds and verges = 50%
   - Attenuating SuDS basins = 100%
2. Flows will be directed through swales where site levels allow, subject to detailed review once levels are finalised.
3. A Volumetric Runoff Coefficient (Cv) value of 0.9 has been used for the highway drainage calculations, in accordance with the Lead Local Flood Authorities SuDS Guidance.
4. SuDS ponds have been designed with maximum side slopes and external tie in batters of 1:3 and a minimum 300mm freeboard during the 1 in 100-year + 40% critical storm event.
5. Proposed discharge rates based on 2l/s/ha. To be agreed with the LLFA.
6. Detention basins to have low flow channel and incorporation of ecological features is to be confirmed at detailed design.
7. The proposed drainage concept is subject to review against the final proposed levels and earthworks strategy.
8. Drainage for the proposed highway works is to be split into 6 catchments which each ultimately discharge into the unnamed tributary of Padbury Brook.
9. The widened Baynard's Green roundabout will drain as existing via ditches which will be diverted. 40% betterment will be provided over the existing peak runoff rate.
10. Junction 10 of the M40 will be split into 4 basins and a filter drain:
    - The northwest and southwestern basins are new and will drain nearby proposed roads to the watercourse at an attenuated rate of 2l/s/ha. No infiltration has been applied at this stage, but it will be considered after testing.
    - The northeast basin is an existing basin that will be modified by the proposals. It will drain nearby roads to the watercourse at an attenuated rate of 2l/s/ha. No infiltration has been applied at this stage, but it will be considered after testing.
    - The southeast basin is an existing basin which is currently assumed to discharge primarily via infiltration, There is a a weir overflow for extreme events. It is assumed to drain a significant length of the M40 (to be confirmed). It is proposed to add additional area to this basin, and remove part of its existing catchment such that the net change is negligible. Thus no changes are proposed for the basin. Refer to drawing 'OxSRFI-BWB-EWE-ZZ-DR-CD-00516' for more details.
    - Due to level constraints, the eastern junction embankments will be drained via a filter drain located at the toe of the embankment that will drain either via infiltration or to the unnamed tributary of Padbury Brook at 2l/s/ha.
10. Piped drainage networks are shown indicatively to demonstrate catchment areas and connectivity and are subject to detailed design.

P03	12.10.26	Baynards green updated to provide betterment, existing M40 area diverted to NW basin	TLB	RJ
P02	20.02.26	Preliminary issue	TLB	RJ
P01	20.01.26	Draft issue	TLB	RJ
Rev	Date	Details of issue / revision	Drw	Rev

Issues & Revisions

BWB CONSULTANCY | ENVIRONMENT INFRASTRUCTURE | BUILDINGS
☐ Birmingham | 0121 233 3322
☐ Leeds | 0113 233 8000
☐ London | 020 7407 3879
☐ Manchester | 0161 233 4260
■ Nottingham | 0115 924 1100
www.bwbconsulting.com

Client
OXFORDSHIRE RAILFREIGHT LTD.

Project Title
OxSRFI OXFORDSHIRE STRATEGIC RAIL FREIGHT INTERCHANGE

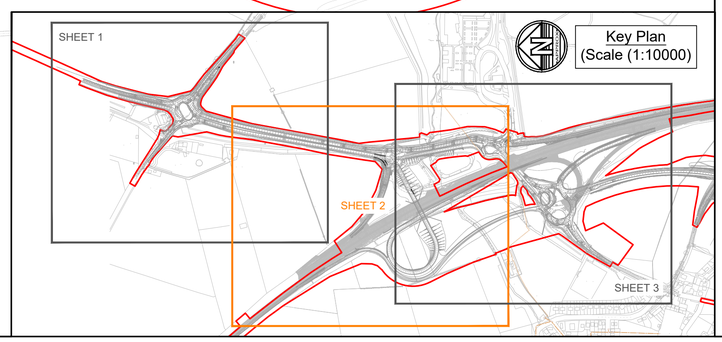
Drawing Title
M40 JUNCTION 10 MODIFICATIONS DRAINAGE STRATEGY (SHEET 2 OF 3)

Drawn:	TLB		Reviewed:	RJ	
BWB Ref:	NTH2479	Date:	20.01.26	Scale@A1:	1:1250

Drawing Status
PRELIMINARY

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
OxSRFI-BWB-EWE-ZZ-DR-CD-00512	S1	P03

Key Plan (Scale (1:10000))



Legend

- DEVELOPMENT CONSENT ORDER BOUNDARY
- CATCHMENT SPLIT
- PROPOSED CHANNEL CARRIER DRAIN
- EXISTING WATERCOURSE (OPEN CHANNEL)
- EXISTING WATERCOURSE (CULVERTED)
- PROPOSED SURFACE WATER NETWORK
- PROPOSED FILTER DRAIN
- PROPOSED SWALE
- PROPOSED ATTENUATION BASIN
- PROPOSED IMPERMEABLE HIGHWAY AND FOOT/CYCLE PATH AREAS
- EXTENT OF VERGES AND BANKS
- EMBANKMENT TO DRAIN VIA INFILTRATION OR TO WATERCOURSE

© Copyright BWB Consulting Ltd

Unnamed ordinary watercourse. A tributary of Padbury Brook which forms part of the River Great Ouse basin.

Existing Anglian Water foul rising main

Modified junction to utilise existing drainage infrastructure where possible

Modified slip road to utilise existing drainage infrastructure where possible

Modified slip road to connect into M40 drainage system (0.76ha)

Embankments to drain either via infiltration or to existing unnamed ordinary watercourse at 2l/s/ha. Attenuation to be provided by filter drain at toe of embankment

New connection proposed to existing drainage basin

A43

Existing M40 drainage is not shown in the Geotechnical & Drainage Management Service (GDMS). Based on topographical data for the area, the existing basins could serve up to 16.07ha of the motorway. It is asssumed that it currently drains to the southeast basin.

Modified slip road to connect into M40 drainage system (0.08ha)

Vortex flow control 8.8l/s

Existing southeast drainage basin assumed to drain primarily via infiltration. The basin catchment will be modified but the overall contributing area will remain approximately the same. Thus no changes are proposed.

Slope will be retained to not impact basin

Weir overflow

Existing northeast drainage basin (Capacity reduced)
1 in 4 side slopes + 300mm freeboard
Volume to freeboard: 4,086m³
CL:111.00
IL:108.90
Earthwork tie-in batters to be confirmed through detailed design

Additional survey required along watercourse to confirm levels

Proposed southwest drainage basin
1 in 4 side slopes + 300mm freeboard
Volume to freeboard: 2,226m³
CL:110.50
IL:109.00
Earthwork tie-in batters to be confirmed through detailed design

Vortex flow control 4.8l/s

A43

See Ardley bypass drainage strategy drawing 'OxSRFI0BWB-EWE-ZZ-DR-CD-00506'.

Ardley Roundabout

Ardley

Basin capacity will be reduced by highway embankment

WL:108.82

Vortex flow control 6.9l/s

The proposed highway is approximately 2.6m to 2.9m above the existing ground level at the point where is crosses the Anglian Water rising main.

Highway levels at crossing point:
118.45m to 118.875m
Existing ground levels:
115.85m to 116.00m

Watercourse to be culverted

6,401m² of existing M40 will be diverted into the proposed northwest basin in order to provide attenuation and betterment over the existing drainage situation.

Sheet 2 (Drawing 00512)

Proposed northwest drainage basin
1 in 4 side slopes + 300mm freeboard
Volume to freeboard: 3,209m³
CL:110.50
IL:109.00
Earthwork tie-in batters to be confirmed through detailed design

M40 JUNCTION 10 PROPOSED DRAINAGE AREAS

EXISTING NORTHEAST BASIN
(EXISTING DRAINAGE CATCHMENT TO BE CONFIRMED, BASIN SIZE REDUCED DUE TO TRANSFER OF CATCHMENT AREA TO SOUTH EAST BASIN)
PROPOSED ROAD AREA AND FOOTWAYS: 31,740m²
PROPOSED EARTHWORKS AND VERGES: 18,035m²
50% OF EARTHWORKS AND VERGES DRAINED: 9,020m²
BASIN AREA: 3,300m²
TOTAL DRAINED AREA: 44,060m² (4.406ha)
PROPOSED DISCHARGE RATE: 8.8l/s

EXISTING SOUTHEAST BASIN
IMPERMEABLE AREAS CURRENTLY DRAINING TO THE BASIN WILL BE REMOVED. ADDITIONAL AREAS WILL BE DRAINED TO THE BASIN.

REFER TO DRAWING 'OxSRFI-BWB-EWE-ZZ-DR-CD-00514' FOR FURTHER DETAILS OF REMOVED AND ADDED AREAS TO EXISTING BASIN.

ESTIMATED M40 CATCHMENT (UNCHANGED AND UNCONFIRMED)
45m(w) x 3,572m(l) = 16.07ha
Basin: 0.81ha

PRE DEVELOPMENT CATCHMENT AREA TO BE REMOVED:
ARDLEY ROUNDABOUT AND SLIP ROADS, A43 AND B430:
1.13ha

POST DEVELOPMENT NEW AREAS DRAINED TO BASIN:
PROPOSED ROAD AREA: 7,625m²
PROPOSED EARTHWORKS AND VERGES: 3,000m²
50% OF FOOTWAYS AND EARTHWORKS DRAINED: 1,500m²
WIDENED SLIP ROADS: 665m²
TOTAL NEW AREA: 9,790m² (0.98ha)

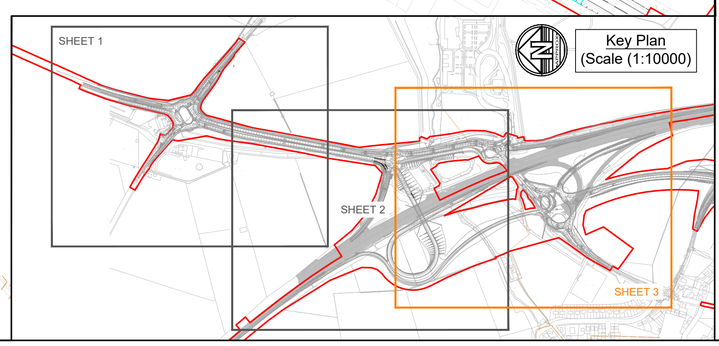
TOTAL PRE DEVELOPMENT DRAINED: 18.01ha
TOTAL POST DEVELOPMENT DRAINED: 17.86ha
THE TOTAL AREA DRAINED TO THE BASIN WILL REMAIN APPROXIMATELY THE SAME, OR REDUCE SLIGHTLY. THUS NO CHANGES WILL BE PROPOSED TO THE BASIN.

PROPOSED NORTHWEST BASIN
PROPOSED ROAD AREA: 14,938m²
EXISTING M40 AREA DIVERTED TO BASIN: 6,401m²
PROPOSED FOOTWAYS AND EARTHWORKS: 19,164m²
50% OF FOOTWAYS AND EARTHWORKS DRAINED: 9,582m²
BASIN AREA: 3,431m²
TOTAL DRAINED AREA: 34,352m² (3.43ha)
PROPOSED DISCHARGE RATE: 6.9l/s

PROPOSED SOUTHWEST BASIN
PROPOSED ROAD AREA: 14,127m²
PROPOSED FOOTWAYS AND EARTHWORKS: 14,316m²
50% OF FOOTWAYS AND EARTHWORKS DRAINED: 7,158m²
BASIN AREA: 2,613m²
TOTAL DRAINED AREA: 23,898m² (2.39ha)
PROPOSED DISCHARGE RATE: 4.8l/s

Legend

- DEVELOPMENT CONSENT ORDER BOUNDARY
- CATCHMENT SPLIT
- PROPOSED CHANNEL CARRIER DRAIN
- EXISTING WATERCOURSE (OPEN CHANNEL)
- EXISTING WATERCOURSE (CULVERTED)
- PROPOSED SURFACE WATER NETWORK
- PROPOSED FILTER DRAIN
- PROPOSED SWALE
- PROPOSED ATTENUATION BASIN
- PROPOSED IMPERMEABLE HIGHWAY AND FOOT/CYCLE PATH AREAS
- EXTENT OF VERGES AND BANKS
- EMBANKMENT TO DRAIN VIA INFILTRATION OR TO WATERCOURSE



Key Plan
(Scale (1:10000)

General Notes

1. Do not scale this drawing. All dimensions must be checked/ verified on site. If in doubt ask.
2. This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.
3. All dimensions in millimetres unless noted otherwise. All levels in metres unless noted otherwise.
4. Any discrepancies noted on site are to be reported to the engineer immediately.
5. Drawing provided for illustrative purposes only. Design subject to further coordination and approvals.
6. Enclosed topographical survey based on greenhatch group drawing '36646_T_REV9' dated 03/04/23.
7. Enclosed highway GA based on drawings: OxSRFI-BWB-LSI-01-DR-CH-0101 and OxSRFI-BWB-LSI-02-DR-CH-0102

Drainage Notes

1. The following impermeable area assumptions have been used, as measured from OxSRFI-BWB-LSI-01-DR-CH-101 and OxSRFI-BWB-LSI-02-DR-CH-102
   - Highways and Foot/Cycle paths = 100%
   - Embankments, bunds and verges = 50%
   - Attenuating SuDS basins = 100%
2. Flows will be directed through swales where site levels allow, subject to detailed review once levels are finalised.
3. A Volumetric Runoff Coefficient (Cv) value of 0.9 has been used for the highway drainage calculations, in accordance with the Lead Local Flood Authorities SuDS Guidance.
4. SuDS ponds have been designed with maximum side slopes and external tie in batters of 1:3 and a minimum 300mm freeboard during the 1 in 100-year + 40% critical storm event.
5. Proposed discharge rates based on 2l/s/ha. To be agreed with the LLFA.
6. Detention basins to have low flow channel and incorporation of ecological features is to be confirmed at detailed design.
7. The proposed drainage concept is subject to review against the final proposed levels and earthworks strategy.
8. Drainage for the proposed highway works is to be split into 6 catchments which each ultimately discharge into the unnamed tributary of Padbury Brook.
9. The widened Baynard's Green roundabout will drain as existing via ditches which will be diverted. 40% betterment will be provided over the existing peak runoff rate.
10. Junction 10 of the M40 will be split into 4 basins and a filter drain:
    - The northwest and southwestern basins are new and will drain nearby proposed roads to the watercourse at an attenuated rate of 2l/s/ha. No infiltration has been applied at this stage, but it will be considered after testing.
    - The northeast basin is an existing basin that will be modified by the proposals. It will drain nearby roads to the watercourse at an attenuated rate of 2l/s/ha. No infiltration has been applied at this stage, but it will be considered after testing.
    - The southeast basin is an existing basin which is currently assumed to discharge primarily via infiltration. There is a a weir overflow for extreme events. It is assumed to drain a significant length of the M40 (to be confirmed). It is proposed to add additional area to this basin, and remove part of its existing catchment such that the net change is negligible. Thus no changes are proposed for the basin. Refer to drawing 'OxSRFI-BWB-EWE-ZZ-DR-CD-00516' for more details.
    - Due to level constraints, the eastern junction embankments will be drained via a filter drain located at the toe of the embankment that will drain either via infiltration or to the unnamed tributary of Padbury Brook at 2l/s/ha.
10. Piped drainage networks are shown indicatively to demonstrate catchment areas and connectivity and are subject to detailed design.

Issues & Revisions

Rev	Date	Details of issue / revision	Drw	Rev
P03	12.10.26	Baynards green updated to provide betterment, existing M40 area diverted to NW basin	TLB	RJ
P02	20.02.26	Preliminary issue	TLB	RJ
P01	20.01.26	Draft issue	TLB	RJ

BWB CONSULTANCY | ENVIRONMENT INFRASTRUCTURE | BUILDINGS

☐ Birmingham | 0121 233 3322
☐ Leeds | 0113 233 8000
☐ London | 020 7407 3879
☐ Manchester | 0161 233 4260
■ Nottingham | 0115 924 1100
www.bwbconsulting.com

Client

OXFORDSHIRE RAILFREIGHT LTD.

Project Title

OxSRFI OXFORDSHIRE STRATEGIC RAIL FREIGHT INTERCHANGE

Drawing Title

M40 JUNCTION 10 MODIFICATIONS DRAINAGE STRATEGY (SHEET 3 OF 3)

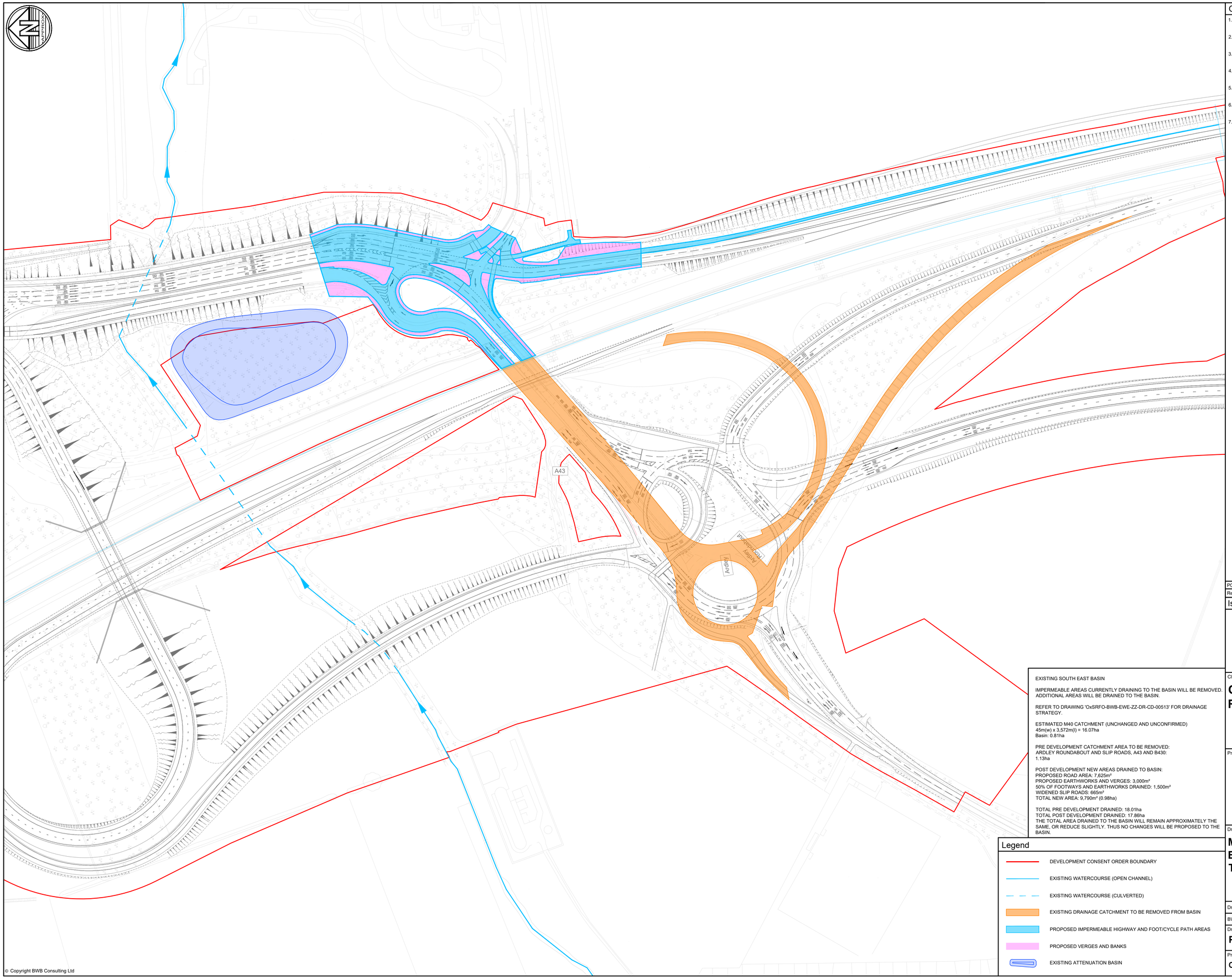
Drawn:	TLB		Reviewed:	RJ	
BWB Ref:	NTH2479	Date:	20.01.26	Scale@A1:	1:1250

Drawing Status

PRELIMINARY

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
OxSRFI-BWB-EWE-ZZ-DR-CD-00513	S1	P03

© Copyright BWB Consulting Ltd



General Notes

1. Do not scale this drawing. All dimensions must be checked/ verified on site. If in doubt ask.
2. This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.
3. All dimensions in millimetres unless noted otherwise. All levels in metres unless noted otherwise.
4. Any discrepancies noted on site are to be reported to the engineer immediately.
5. Drawing provided for illustrative purposes only. Design subject to further coordination and approvals.
6. Enclosed topographical survey based on greenhatch group drawing '36646_T_REV9' dated 03/04/23.
7. Enclosed highway GA based on drawings: OxSRFI-BWB-LSI-01-DR-CH-0101 and OxSRFI-BWB-LSI-02-DR-CH-0102

EXISTING SOUTH EAST BASIN

IMPERMEABLE AREAS CURRENTLY DRAINING TO THE BASIN WILL BE REMOVED. ADDITIONAL AREAS WILL BE DRAINED TO THE BASIN.

REFER TO DRAWING 'OxSRFO-BWB-EWE-ZZ-DR-CD-00513' FOR DRAINAGE STRATEGY.

ESTIMATED M40 CATCHMENT (UNCHANGED AND UNCONFIRMED)
45m(w) x 3,572m(l) = 16.07ha
Basin: 0.81ha

PRE DEVELOPMENT CATCHMENT AREA TO BE REMOVED:
ARDLEY ROUNDABOUT AND SLIP ROADS, A43 AND B430:
1.13ha

POST DEVELOPMENT NEW AREAS DRAINED TO BASIN:
PROPOSED ROAD AREA: 7,625m²
PROPOSED EARTHWORKS AND VERGES: 3,000m²
50% OF FOOTWAYS AND EARTHWORKS DRAINED: 1,500m²
WIDENED SLIP ROADS: 665m²
TOTAL NEW AREA: 9,790m² (0.98ha)

TOTAL PRE DEVELOPMENT DRAINED: 18.01ha
TOTAL POST DEVELOPMENT DRAINED: 17.86ha
THE TOTAL AREA DRAINED TO THE BASIN WILL REMAIN APPROXIMATELY THE SAME, OR REDUCE SLIGHTLY. THUS NO CHANGES WILL BE PROPOSED TO THE BASIN.

Legend

- DEVELOPMENT CONSENT ORDER BOUNDARY
- EXISTING WATERCOURSE (OPEN CHANNEL)
- EXISTING WATERCOURSE (CULVERTED)
- EXISTING DRAINAGE CATCHMENT TO BE REMOVED FROM BASIN
- PROPOSED IMPERMEABLE HIGHWAY AND FOOT/CYCLE PATH AREAS
- PROPOSED VERGES AND BANKS
- EXISTING ATTENUATION BASIN

Rev	Date	Details of issue / revision	Drw	Rev
P01	20.02.26	Preliminary issue	MPB	RJ

Issues & Revisions

BWB CONSULTANCY | ENVIRONMENT INFRASTRUCTURE | BUILDINGS

- ☐ Birmingham | 0121 233 3322
- ☐ Leeds | 0113 233 8000
- ☐ London | 020 7407 3879
- ☐ Manchester | 0161 233 4260
- ■ Nottingham | 0115 924 1100

www.bwbconsulting.com

Client

OXFORDSHIRE RAILFREIGHT LTD.

Project Title

OxSRFI OXFORDSHIRE STRATEGIC RAIL FREIGHT INTERCHANGE

Drawing Title

M40 JUNCTION 10 EXISTING BASIN CATCHMENT TRANSFER PLAN

Drawn:	MPB		Reviewed:	RJ	
BWB Ref:	NTH2479	Date:	20.02.26	Scale@A1:	1:1250

Drawing Status

PRELIMINARY

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
OxSRFI-BWB-EWE-ZZ-DR-CD-00514	S1	P01

© Copyright BWB Consulting Ltd

Appendix 5: M40 Junction 10 Drainage Calculations

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Easting (m)	Northing (m)	Depth (m)	Invert Level (m)
Existing Area	2.505	5.00	2.000	9.044	123.773	2.000	0.000
Existing + Proposed Area	3.245	5.00	2.200	8.966	101.075	2.200	0.000

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Detailed	Starting Level (m)	
Rainfall Events	Singular	Skip Steady State	x	Check Discharge Rate(s)	x
Summer CV	0.900	Drain Down Time (mins)	240	Check Discharge Volume	x
Winter CV	0.900	Additional Storage (m³/ha)	20.0		

Storm Durations

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

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
100	0	0	0
100	25	0	0
100	40	0	0

Node Existing Area Online Orifice Control

Flap Valve	x	Design Depth (m)	1.000	Discharge Coefficient	0.600
Replaces Downstream Link	x	Design Flow (l/s)	645.6		
Invert Level (m)	0.000	Diameter (m)	0.609		

Node Existing + Proposed Area Online Orifice Control

Flap Valve	x	Design Depth (m)	1.000	Discharge Coefficient	0.600
Replaces Downstream Link	x	Design Flow (l/s)	387.4		
Invert Level (m)	0.000	Diameter (m)	0.460		

Node Existing Area Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	0.000
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	15

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	523.0	0.0	1.000	523.0	0.0	1.001	0.0	0.0

Node Existing + Proposed Area Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	0.000
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	39

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	975.0	0.0	1.000	975.0	0.0	1.001	0.0	0.0

Flow+ v17.0 Copyright © 1988-2026 Causeway Technologies Ltd

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year 15 minute summer	342.411	96.891
100 year 15 minute winter	240.289	96.891
100 year 30 minute summer	222.646	63.001
100 year 30 minute winter	156.243	63.001
100 year 60 minute summer	147.810	39.062
100 year 60 minute winter	98.202	39.062
100 year 120 minute summer	88.776	23.461
100 year 120 minute winter	58.981	23.461
100 year 180 minute summer	67.719	17.426
100 year 180 minute winter	44.019	17.426
100 year 240 minute summer	53.354	14.100
100 year 240 minute winter	35.447	14.100
100 year 360 minute summer	40.515	10.426
100 year 360 minute winter	26.336	10.426
100 year 480 minute summer	31.720	8.383
100 year 480 minute winter	21.074	8.383
100 year 600 minute summer	25.799	7.057
100 year 600 minute winter	17.627	7.057
100 year 720 minute summer	22.827	6.118
100 year 720 minute winter	15.341	6.118
100 year 960 minute summer	18.466	4.862
100 year 960 minute winter	12.232	4.862
100 year 1440 minute summer	13.009	3.486
100 year 1440 minute winter	8.743	3.486
100 year 2160 minute summer	8.963	2.477
100 year 2160 minute winter	6.176	2.477
100 year 2880 minute summer	7.263	1.946
100 year 2880 minute winter	4.881	1.946
100 year 4320 minute summer	5.360	1.401
100 year 4320 minute winter	3.530	1.401
100 year 5760 minute summer	4.386	1.123
100 year 5760 minute winter	2.839	1.123
100 year 7200 minute summer	3.760	0.959
100 year 7200 minute winter	2.426	0.959
100 year 8640 minute summer	3.336	0.851
100 year 8640 minute winter	2.153	0.851
100 year 10080 minute summer	3.039	0.775
100 year 10080 minute winter	1.962	0.775
100 year +25% CC 15 minute summer	428.014	121.113
100 year +25% CC 15 minute winter	300.361	121.113
100 year +25% CC 30 minute summer	278.308	78.751
100 year +25% CC 30 minute winter	195.304	78.751
100 year +25% CC 60 minute summer	184.763	48.827
100 year +25% CC 60 minute winter	122.752	48.827
100 year +25% CC 120 minute summer	110.970	29.326
100 year +25% CC 120 minute winter	73.726	29.326
100 year +25% CC 180 minute summer	84.648	21.783
100 year +25% CC 180 minute winter	55.023	21.783
100 year +25% CC 240 minute summer	66.693	17.625
100 year +25% CC 240 minute winter	44.309	17.625
100 year +25% CC 360 minute summer	50.644	13.032
100 year +25% CC 360 minute winter	32.920	13.032
100 year +25% CC 480 minute summer	39.650	10.478
100 year +25% CC 480 minute winter	26.343	10.478
100 year +25% CC 600 minute summer	32.249	8.821

Flow+ v17.0 Copyright © 1988-2026 Causeway Technologies Ltd

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year +25% CC 600 minute winter	22.034	8.821
100 year +25% CC 720 minute summer	28.534	7.647
100 year +25% CC 720 minute winter	19.177	7.647
100 year +25% CC 960 minute summer	23.082	6.078
100 year +25% CC 960 minute winter	15.290	6.078
100 year +25% CC 1440 minute summer	16.261	4.358
100 year +25% CC 1440 minute winter	10.928	4.358
100 year +25% CC 2160 minute summer	11.203	3.096
100 year +25% CC 2160 minute winter	7.719	3.096
100 year +25% CC 2880 minute summer	9.078	2.433
100 year +25% CC 2880 minute winter	6.101	2.433
100 year +25% CC 4320 minute summer	6.700	1.752
100 year +25% CC 4320 minute winter	4.413	1.752
100 year +25% CC 5760 minute summer	5.483	1.404
100 year +25% CC 5760 minute winter	3.549	1.404
100 year +25% CC 7200 minute summer	4.699	1.199
100 year +25% CC 7200 minute winter	3.033	1.199
100 year +25% CC 8640 minute summer	4.170	1.064
100 year +25% CC 8640 minute winter	2.692	1.064
100 year +25% CC 10080 minute summer	3.799	0.969
100 year +25% CC 10080 minute winter	2.452	0.969
100 year +40% CC 15 minute summer	479.376	135.647
100 year +40% CC 15 minute winter	336.404	135.647
100 year +40% CC 30 minute summer	311.705	88.202
100 year +40% CC 30 minute winter	218.740	88.202
100 year +40% CC 60 minute summer	206.934	54.687
100 year +40% CC 60 minute winter	137.482	54.687
100 year +40% CC 120 minute summer	124.287	32.845
100 year +40% CC 120 minute winter	82.573	32.845
100 year +40% CC 180 minute summer	94.806	24.397
100 year +40% CC 180 minute winter	61.626	24.397
100 year +40% CC 240 minute summer	74.696	19.740
100 year +40% CC 240 minute winter	49.626	19.740
100 year +40% CC 360 minute summer	56.721	14.596
100 year +40% CC 360 minute winter	36.870	14.596
100 year +40% CC 480 minute summer	44.408	11.736
100 year +40% CC 480 minute winter	29.504	11.736
100 year +40% CC 600 minute summer	36.119	9.879
100 year +40% CC 600 minute winter	24.678	9.879
100 year +40% CC 720 minute summer	31.958	8.565
100 year +40% CC 720 minute winter	21.478	8.565
100 year +40% CC 960 minute summer	25.852	6.807
100 year +40% CC 960 minute winter	17.125	6.807
100 year +40% CC 1440 minute summer	18.212	4.881
100 year +40% CC 1440 minute winter	12.240	4.881
100 year +40% CC 2160 minute summer	12.548	3.468
100 year +40% CC 2160 minute winter	8.646	3.468
100 year +40% CC 2880 minute summer	10.168	2.725
100 year +40% CC 2880 minute winter	6.833	2.725
100 year +40% CC 4320 minute summer	7.504	1.962
100 year +40% CC 4320 minute winter	4.942	1.962
100 year +40% CC 5760 minute summer	6.141	1.572
100 year +40% CC 5760 minute winter	3.975	1.572
100 year +40% CC 7200 minute summer	5.263	1.343
100 year +40% CC 7200 minute winter	3.397	1.343

Flow+ v17.0 Copyright © 1988-2026 Causeway Technologies Ltd

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year +40% CC 8640 minute summer	4.671	1.192
100 year +40% CC 8640 minute winter	3.015	1.192
100 year +40% CC 10080 minute summer	4.255	1.086
100 year +40% CC 10080 minute winter	2.746	1.086

Flow+ v17.0 Copyright © 1988-2026 Causeway Technologies Ltd

Results for 100 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute summer	Existing Area	22	0.716	0.716	1124.5	392.1950	0.0000	OK
60 minute summer	Existing + Proposed Area	42	0.708	0.708	1076.2	710.9807	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
30 minute summer	Existing Area	Orifice	496.5	706.2
60 minute summer	Existing + Proposed Area	Orifice	305.4	1113.8

Flow+ v17.0 Copyright © 1988-2026 Causeway Technologies Ltd

Results for 100 year +25% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute summer	Existing Area	22	0.891	0.891	1405.6	488.1104	0.0000	OK
60 minute summer	Existing + Proposed Area	42	0.889	0.889	1345.2	893.1100	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
30 minute summer	Existing Area	Orifice	592.8	883.5
60 minute summer	Existing + Proposed Area	Orifice	358.7	1397.0

Flow+ v17.0 Copyright © 1988-2026 Causeway Technologies Ltd

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute summer	Existing Area	22	0.999	0.999	1574.2	547.6481	0.0000	OK
60 minute summer	Existing + Proposed Area	42	1.000	1.000	1506.6	1004.5130	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
30 minute summer	Existing Area	Orifice	645.4	989.8
60 minute summer	Existing + Proposed Area	Orifice	387.7	1566.9

Flow+ v17.0 Copyright © 1988-2026 Causeway Technologies Ltd

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)	Invert Level (m)
Northeast Basin	4.406	5.00	111.000		19.538	54.148	2.000	109.000
Northwest Basin	3.440	5.00	110.500		38.598	30.228	1.500	109.000
Southwest Basin	2.390	5.00	110.500		48.014	36.029	1.500	109.000
2			110.500	1200	40.734	33.612	1.650	108.850
3			110.500	1200	42.688	34.797	1.700	108.800
4			110.500	1200	23.633	57.694	1.650	108.850

Links (Input)

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	Northwest Basin	2	20.000	0.600	109.000	108.850	0.150	133.3	150	5.38	50.0
3.000	Southwest Basin	3	15.000	0.600	109.000	108.800	0.200	75.0	150	5.22	50.0
2.000	Northeast Basin	4	15.000	0.600	109.000	108.850	0.150	100.0	150	5.25	50.0

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Starting Level (m)	
Rainfall Events	Singular	Skip Steady State	x	Check Discharge Rate(s)	x
Summer CV	0.900	Drain Down Time (mins)	240	Check Discharge Volume	x
Winter CV	0.900	Additional Storage (m³/ha)	20.0		

Storm Durations

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

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
100	25	0	0
100	40	0	0

Node Northeast Basin Online ACO Q-Brake Control

Flap Valve	x	Invert Level (m)	109.000	Min Outlet Diameter (m)	0.145
Downstream Link	2.000	Design Depth (m)	1.800	Min Node Diameter (mm)	1050
Replaces Downstream Link	x	Design Flow (l/s)	8.8	Orifice Diameter (m)	0.118

Node Northwest Basin Online ACO Q-Brake Control

Flap Valve	x	Invert Level (m)	109.000	Min Outlet Diameter (m)	0.145
Downstream Link	1.000	Design Depth (m)	1.200	Min Node Diameter (mm)	1050
Replaces Downstream Link	x	Design Flow (l/s)	6.9	Orifice Diameter (m)	0.111

Node Southwest Basin Online ACO Q-Brake Control

Flap Valve	x	Invert Level (m)	109.000	Min Outlet Diameter (m)	0.095
Downstream Link	3.000	Design Depth (m)	1.200	Min Node Diameter (mm)	1050
Replaces Downstream Link	x	Design Flow (l/s)	4.8	Orifice Diameter (m)	0.094

Node Northeast Basin Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	108.900
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Flow+ v17.0 Copyright © 1988-2026 Causeway Technologies Ltd

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1501.0	1501.0	2.100	3300.0	3335.3

Node Northwest Basin Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	109.000
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)
0.000	2214.0	2214.0	1.500	3431.0	3463.0

Node Southwest Basin Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	109.000
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)
0.000	1567.0	1567.0	1.500	2613.0	2640.4

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year +25% CC 15 minute summer	428.014	121.113
100 year +25% CC 15 minute winter	300.361	121.113
100 year +25% CC 30 minute summer	278.308	78.751
100 year +25% CC 30 minute winter	195.304	78.751
100 year +25% CC 60 minute summer	184.763	48.827
100 year +25% CC 60 minute winter	122.752	48.827
100 year +25% CC 120 minute summer	110.970	29.326
100 year +25% CC 120 minute winter	73.726	29.326
100 year +25% CC 180 minute summer	84.648	21.783
100 year +25% CC 180 minute winter	55.023	21.783
100 year +25% CC 240 minute summer	66.693	17.625
100 year +25% CC 240 minute winter	44.309	17.625
100 year +25% CC 360 minute summer	50.644	13.032
100 year +25% CC 360 minute winter	32.920	13.032
100 year +25% CC 480 minute summer	39.650	10.478
100 year +25% CC 480 minute winter	26.343	10.478
100 year +25% CC 600 minute summer	32.249	8.821
100 year +25% CC 600 minute winter	22.034	8.821
100 year +25% CC 720 minute summer	28.534	7.647
100 year +25% CC 720 minute winter	19.177	7.647
100 year +25% CC 960 minute summer	23.082	6.078
100 year +25% CC 960 minute winter	15.290	6.078
100 year +25% CC 1440 minute summer	16.261	4.358
100 year +25% CC 1440 minute winter	10.928	4.358
100 year +25% CC 2160 minute summer	11.203	3.096
100 year +25% CC 2160 minute winter	7.719	3.096
100 year +25% CC 2880 minute summer	9.078	2.433
100 year +25% CC 2880 minute winter	6.101	2.433
100 year +25% CC 4320 minute summer	6.700	1.752
100 year +25% CC 4320 minute winter	4.413	1.752
100 year +25% CC 5760 minute summer	5.483	1.404
100 year +25% CC 5760 minute winter	3.549	1.404
100 year +25% CC 7200 minute summer	4.699	1.199

Flow+ v17.0 Copyright © 1988-2026 Causeway Technologies Ltd

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year +25% CC 7200 minute winter	3.033	1.199
100 year +25% CC 8640 minute summer	4.170	1.064
100 year +25% CC 8640 minute winter	2.692	1.064
100 year +25% CC 10080 minute summer	3.799	0.969
100 year +25% CC 10080 minute winter	2.452	0.969
100 year +40% CC 15 minute summer	479.376	135.647
100 year +40% CC 15 minute winter	336.404	135.647
100 year +40% CC 30 minute summer	311.705	88.202
100 year +40% CC 30 minute winter	218.740	88.202
100 year +40% CC 60 minute summer	206.934	54.687
100 year +40% CC 60 minute winter	137.482	54.687
100 year +40% CC 120 minute summer	124.287	32.845
100 year +40% CC 120 minute winter	82.573	32.845
100 year +40% CC 180 minute summer	94.806	24.397
100 year +40% CC 180 minute winter	61.626	24.397
100 year +40% CC 240 minute summer	74.696	19.740
100 year +40% CC 240 minute winter	49.626	19.740
100 year +40% CC 360 minute summer	56.721	14.596
100 year +40% CC 360 minute winter	36.870	14.596
100 year +40% CC 480 minute summer	44.408	11.736
100 year +40% CC 480 minute winter	29.504	11.736
100 year +40% CC 600 minute summer	36.119	9.879
100 year +40% CC 600 minute winter	24.678	9.879
100 year +40% CC 720 minute summer	31.958	8.565
100 year +40% CC 720 minute winter	21.478	8.565
100 year +40% CC 960 minute summer	25.852	6.807
100 year +40% CC 960 minute winter	17.125	6.807
100 year +40% CC 1440 minute summer	18.212	4.881
100 year +40% CC 1440 minute winter	12.240	4.881
100 year +40% CC 2160 minute summer	12.548	3.468
100 year +40% CC 2160 minute winter	8.646	3.468
100 year +40% CC 2880 minute summer	10.168	2.725
100 year +40% CC 2880 minute winter	6.833	2.725
100 year +40% CC 4320 minute summer	7.504	1.962
100 year +40% CC 4320 minute winter	4.942	1.962
100 year +40% CC 5760 minute summer	6.141	1.572
100 year +40% CC 5760 minute winter	3.975	1.572
100 year +40% CC 7200 minute summer	5.263	1.343
100 year +40% CC 7200 minute winter	3.397	1.343
100 year +40% CC 8640 minute summer	4.671	1.192
100 year +40% CC 8640 minute winter	3.015	1.192
100 year +40% CC 10080 minute summer	4.255	1.086
100 year +40% CC 10080 minute winter	2.746	1.086

Flow+ v17.0 Copyright © 1988-2026 Causeway Technologies Ltd

Results for 100 year +25% CC Critical Storm Duration. Lowest mass balance: 99.96%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute winter	Northeast Basin	1440	110.563	1.563	120.4	3594.0750	0.0000	SURCHARGED
2160 minute winter	Northwest Basin	2100	110.052	1.052	66.4	2826.3310	0.0000	SURCHARGED
2160 minute winter	Southwest Basin	2100	110.005	1.005	46.1	1959.6600	0.0000	SURCHARGED
5760 minute summer	2	2700	108.920	0.070	6.9	0.0000	0.0000	OK
15 minute summer	3	44	108.849	0.049	4.8	0.0000	0.0000	OK
60 minute winter	4	32	108.924	0.074	8.8	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
1440 minute winter	Northeast Basin	2.000	4	8.8	0.993	0.496	0.1329	661.2
2160 minute winter	Northwest Basin	1.000	2	6.9	0.843	0.449	0.1635	706.3
2160 minute winter	Southwest Basin	3.000	3	4.8	0.942	0.234	0.0764	494.2

Flow+ v17.0 Copyright © 1988-2026 Causeway Technologies Ltd

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.96%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
2160 minute winter	Northeast Basin	2100	110.725	1.725	95.2	4086.1400	0.0000	FLOOD RISK
2160 minute winter	Northwest Basin	2100	110.173	1.173	74.4	3209.3380	0.0000	SURCHARGED
2160 minute winter	Southwest Basin	2100	110.119	1.119	51.7	2226.7480	0.0000	SURCHARGED
15 minute summer	2	64	108.920	0.070	6.9	0.0000	0.0000	OK
180 minute winter	3	88	108.849	0.049	4.8	0.0000	0.0000	OK
30 minute summer	4	18	108.924	0.074	8.8	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
2160 minute winter	Northeast Basin	2.000	4	8.8	0.993	0.496	0.1329	971.5
2160 minute winter	Northwest Basin	1.000	2	6.9	0.842	0.448	0.1633	739.3
2160 minute winter	Southwest Basin	3.000	3	4.8	0.942	0.234	0.0764	516.5

Flow+ v17.0 Copyright © 1988-2026 Causeway Technologies Ltd

Appendix 6: Ardley Bypass Drainage Drawings

See M40 Junction 10 drainage strategy drawings
OxSRFI-BWB-EWE-ZZ-DR-CD-0511 - 0513

CL:121.900
IL:120.550

CL:123.000
IL:119.550

High point

CL:123.150
IL:121.800

CL:118.300
IL:116.800

CL:123.150
IL:121.800

CL:118.300
IL:116.800

CL:121.550
IL:120.200

CL:117.500
IL:115.300

Sheet 1
Sheet 2

Low point

CL:115.650
IL:113.700

VORTEX FLOW CONTROL 9.9l/s
IL:113.500

IMPERMEABLE AREAS:
HIGHWAY AREA (100% drained): 2.48ha
VERGES / BANKS AREA: 3.83ha
VERGES / BANKS AREA (50% drained): 1.92ha
BASIN AREA: 0.56ha
TOTAL AREA DRAINED TO BASIN: 4.96ha
PROPOSED DISCHARGE RATE: 9.9l/s

DRAINAGE POND
VOLUME: 4,597m³
3m MAINTENANCE STRIP
1 IN 4 SIDE SLOPES
+ 300mm FREEBOARD
CL: 115.000
IL: 113.500

IL:111.550

The Barn House

SHEET 1
VIEWPORT 1

SHEET 1
VIEWPORT 2

SHEET 2

General Notes

1. Do not scale this drawing. All dimensions must be checked/ verified on site. If in doubt ask.
2. This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.
3. All dimensions in millimetres unless noted otherwise. All levels in metres unless noted otherwise.
4. Any discrepancies noted on site are to be reported to the engineer immediately.
5. Drawing provided for illustrative purposes only. Design subject to further coordination and approvals.
6. Enclosed topographical survey based on greenhatch group drawing '36646_T_REV9' dated 03/04/23.
7. Enclosed highway GA based on OxSRFI-BWB-LSI-02-DR-CH-102_S3_P03 and OxSRFI-BWB-LSI-03-DR-CH-103_S3_P03

Drainage Notes

1. The following impermeable area assumptions have been used, as measured from OxSRFI-BWB-LSI-01-DR-CH-101 and OxSRFI-BWB-LSI-02-DR-CH-102
   - Highways and Foot/Cycle paths = 100%
   - Embankments, bunds and verges = 50%
   - Attenuating SuDS basins = 100%
2. Flows will be directed through swales where site levels allow, subject to detailed review once levels are finalised.
3. A Volumetric Runoff Coefficient (Cv) value of 0.9 has been used for the highway drainage calculations, in accordance with the Lead Local Flood Authorities SuDS Guidance.
4. SuDS ponds have been designed with maximum side slopes and external tie in batters of 1:4 and a minimum 300mm freeboard during the 1 in 100-year + 40% critical storm.
5. Proposed discharge rates based on 2l/s/ha. To be agreed with the LLFA.
6. Detention basins to have low flow channel and incorporation of ecological features is to be confirmed at detailed design.
7. The proposed drainage concept is subject to review against the final proposed levels and earthworks strategy.
8. Piped drainage networks are shown indicatively to demonstrate catchment areas and connectivity and are subject to detailed design.

Legend

- DEVELOPMENT CONSENT ORDER BOUNDARY
- EXISTING WATERCOURSE
- PROPOSED SURFACE WATER NETWORK
- PROPOSED FILTER DRAIN
- PROPOSED SWALE
- PROPOSED ATTENUATION BASIN
- PROPOSED IMPERMEABLE HIGHWAY AREA
- EXTENT OF VERGES AND BANKS

Rev	Date	Details of issue / revision	Drw	Rev
P03	09.10.26	Basin design criteria updated	TLB	RJ
P02	20.02.26	Drainage adjusted to latest highway arrangement	TLB	RJ
P01	23.03.23	Issued for comment	LDR	DG

Issues & Revisions

BWB CONSULTANCY | ENVIRONMENT INFRASTRUCTURE | BUILDINGS
☐ Birmingham | 0121 233 3322
☐ Leeds | 0113 233 8000
☐ London | 020 7407 3879
☐ Manchester | 0161 233 4260
■ Nottingham | 0115 924 1100
www.bwbconsulting.com

Client
OXFORDSHIRE RAILFREIGHT LTD.

Project Title
OxSRFI OXFORDSHIRE STRATEGIC RAIL FREIGHT INTERCHANGE

Drawing Title
ARDLEY BYPASS ROAD DRAINAGE STRATEGY SHEET 1

Drawn:	LDR	Reviewed:	DG
BWB Ref:	NTH2479	Date: 23.03.23	Scale@A1: 1:1250

Drawing Status
PRELIMINARY

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
OxSRFI-BWB-EWE-ZZ-DR-CD-00506	S1	P03

© Copyright BWB Consulting Ltd

APPROX

Sheet 1
Sheet 2

Low point
CL:115.650
IL:113.700

IMPERMEABLE AREAS:
HIGHWAY AREA (100% drained): 2.48ha
VERGES / BANKS AREA: 3.83ha
VERGES / BANKS AREA (50% drained): 1.92ha
BASIN AREA: 0.56ha
TOTAL AREA DRAINED TO BASIN: 4.96ha
PROPOSED DISCHARGE RATE: 9.9l/s

DRAINAGE POND
VOLUME: 4,597m³
3m MAINTENANCE STRIP
1 IN 4 SIDE SLOPES
+ 300mm FREEBOARD
CL: 115.000
IL: 113.500

IL:111.550

CL:117.500
IL:116.375

APPROXIMATE EXTENT OF EARTHWORKS REQUIRED TO TIE-IN WITH EXISTING. FULL EXTENT TO BE DETERMINED THROUGH DETAILED ASSESSMENT

Nevilles Farm

IL:109.350

PROPOSED PIPE/SWALE DEPENDING ON THE TOPOGRAPHY OF THE CONNECTING CORRIDOR
AVERAGE GRADIENT OF CONNECTION: 1 in 100

CL:119.200
IL:118.000

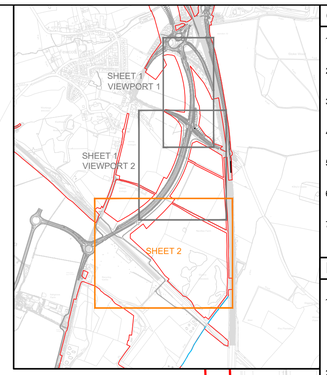
See main site drainage strategy drawing:
OxSRFI-BWB-ZZ-XX-SK-DR-SK117

IL:107.800

Recycling Centre

Quarry (disused)

SURFACE WATER OUTFALL TO GAGGLE BROOK
ESTIMATED IL: 105.250



General Notes

1. Do not scale this drawing. All dimensions must be checked/ verified on site. If in doubt ask.
2. This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.
3. All dimensions in millimetres unless noted otherwise. All levels in metres unless noted otherwise.
4. Any discrepancies noted on site are to be reported to the engineer immediately.
5. Drawing provided for illustrative purposes only. Design subject to further coordination and approvals.
6. Enclosed topographical survey based on greenhatch group drawing '36646_T_REV9' dated 03/04/23.
7. Enclosed highway GA based on OxSRFI-BWB-LSI-02-DR-CH-102_S3_P03 and OxSRFI-BWB-LSI-03-DR-CH-103_S3_P03

Drainage Notes

1. The following impermeable area assumptions have been used, as measured from OxSRFI-BWB-LSI-01-DR-CH-101 and OxSRFI-BWB-LSI-02-DR-CH-102
   - Highways and Foot/Cycle paths = 100%
   - Embankments bunds and verges = 50%
   - Attenuating SuDS basins = 100%
2. Flows will be directed through swales where site levels allow, subject to detailed review once levels are finalised.
3. A Volumetric Runoff Coefficient (Cv) value of 0.9 has been used for the highway drainage calculations, in accordance with the Lead Local Flood Authorities SuDS Guidance.
4. SuDS ponds have been designed with maximum side slopes and external tie in batters of 1:4 and a minimum 300mm freeboard during the 1 in 100-year + 40% critical storm event.
5. Proposed discharge rates based on 2l/s/ha. To be agreed with the LLFA.
6. Detention basins to have low flow channel and incorporation of ecological features is to be confirmed at detailed design.
7. The proposed drainage concept is subject to review against the final proposed levels and earthworks strategy.
8. Piped drainage networks are shown indicatively to demonstrate catchment areas and connectivity and are subject to detailed design.

Legend

- DEVELOPMENT CONSENT ORDER BOUNDARY
- EXISTING WATERCOURSE
- PROPOSED SURFACE WATER NETWORK
- PROPOSED FILTER DRAIN
- PROPOSED SWALE
- PROPOSED ATTENUATION BASIN
- PROPOSED IMPERMEABLE HIGHWAY AREA
- EXTENT OF VERGES AND BANKS

Rev	Date	Details of issue / revision	Drw	Rev
P03	09.10.26	Basin design criteria updated	TLB	RJ
P02	20.02.26	Drainage adjusted to latest highway arrangement	TLB	RJ
P01	23.03.23	Issued for comment	LDR	DG

Issues & Revisions

BWB CONSULTANCY | ENVIRONMENT INFRASTRUCTURE | BUILDINGS
Birmingham | 0121 233 3322
Leeds | 0113 233 8000
London | 020 7407 3879
Manchester | 0161 233 4260
Nottingham | 0115 924 1100
www.bwbconsulting.com

Client
OXFORDSHIRE RAILFREIGHT LTD.

Project Title
OxSRFI OXFORDSHIRE STRATEGIC RAIL FREIGHT INTERCHANGE

Drawing Title
ARDLEY BYPASS ROAD DRAINAGE STRATEGY SHEET 2

Drawn:	LR		Reviewed:	DG	
BWB Ref:	NTH2479	Date:	23.03.23	Scale@A1:	1:1250

Drawing Status
PRELIMINARY

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
OxSRFI-BWB-EWE-ZZ-DR-CD-00507	S1	P03

© Copyright BWB Consulting Ltd

Appendix 7: Ardley Bypass Drainage Calculations

Design Settings

Rainfall Methodology	FEH-22	Maximum Time of Concentration (mins)	30.00	Preferred Cover Depth (m)	1.200
Return Period (years)	100	Maximum Rainfall (mm/hr)	50.0	Include Intermediate Ground	✓
Additional Flow (%)	40	Minimum Velocity (m/s)	1.00	Enforce best practice design rules	✓
CV	1.000	Connection Type	Level Soffits		
Time of Entry (mins)	5.00	Minimum Backdrop Height (m)	0.200		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Easting (m)	Northing (m)	Depth (m)	Invert Level (m)
Pond	4.960	5.00	115.000	20.816	32.824	1.500	113.500

Simulation Settings

Rainfall Methodology	FEH-22	Winter CV	0.900	Drain Down Time (mins)	240	Check Discharge Rate(s)	x
Rainfall Events	Singular	Analysis Speed	Normal	Additional Storage (m³/ha)	20.0	Check Discharge Volume	x
Summer CV	0.900	Skip Steady State	x	Starting Level (m)			

Storm Durations

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

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
100	25	0	0	100	40	0	0

Node Pond Online ACO Q-Brake Control

Flap Valve	x	Invert Level (m)	113.500	Design Flow (l/s)	9.9	Min Node Diameter (mm)	1050
Replaces Downstream Link	x	Design Depth (m)	1.200	Min Outlet Diameter (m)	0.145	Orifice Diameter (m)	0.130

Node Pond Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	113.500
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)
0.000	3370.0	3370.0	1.500	5600.0	5627.8

Flow+ v16.0 Copyright © 1988-2026 Causeway Technologies Ltd

Results for 100 year +25% 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
2160 minute winter	Pond	2100	114.471	0.971	96.0	4037.9230	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
2160 minute winter	Pond	ACO Q-Brake	9.9	1064.9

Flow+ v16.0 Copyright © 1988-2026 Causeway Technologies Ltd

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

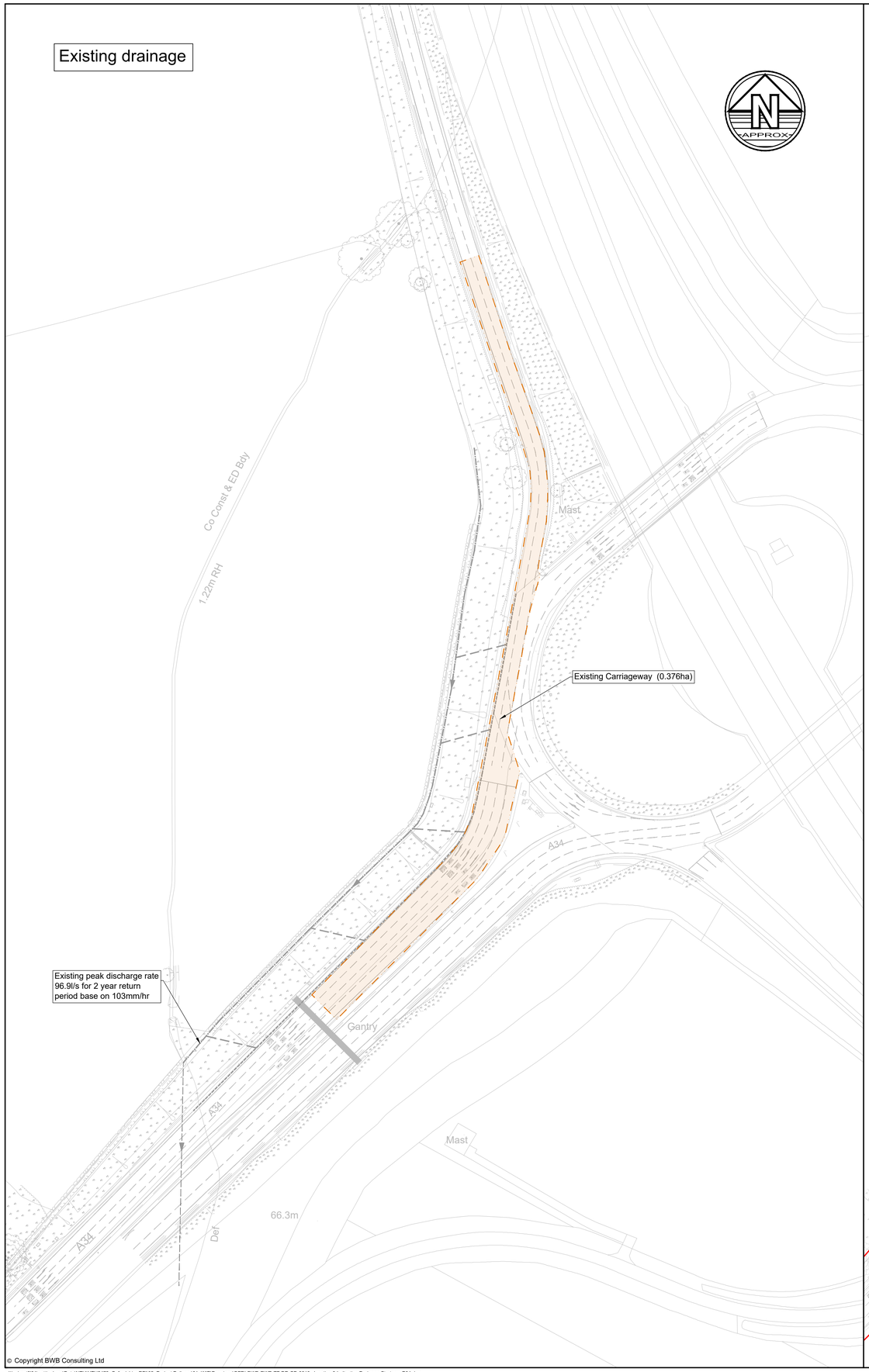
Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
2160 minute winter	Pond	2100	114.584	1.084	107.5	4597.2430	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
2160 minute winter	Pond	ACO Q-Brake	9.9	1107.9

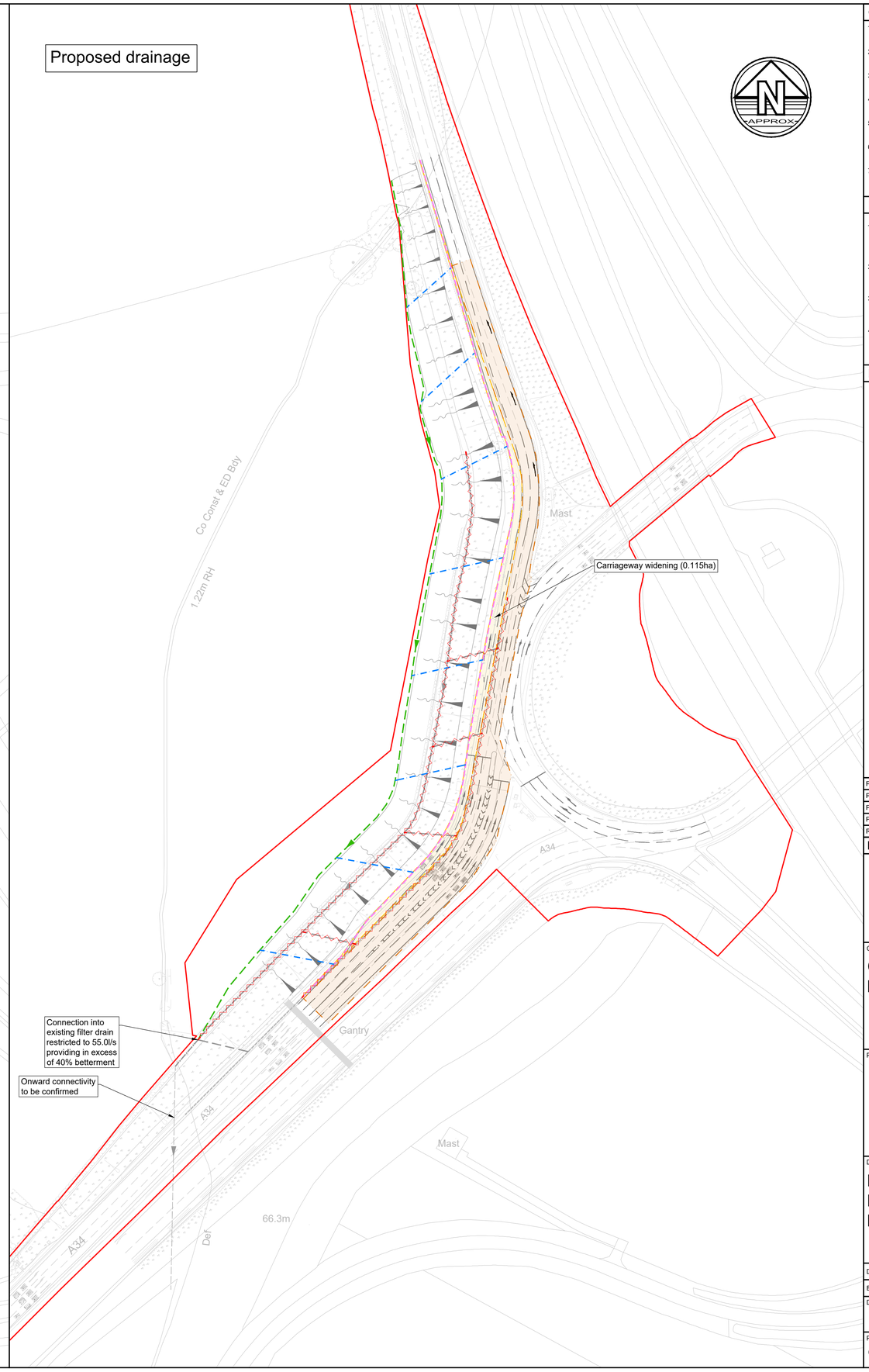
Flow+ v16.0 Copyright © 1988-2026 Causeway Technologies Ltd

Appendix 8: M40 Junction 9 Drainage Drawings

Existing drainage



Proposed drainage



General Notes

1. Do not scale this drawing. All dimensions must be checked/ verified on site. If in doubt ask.
2. This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.
3. All dimensions in millimetres unless noted otherwise. All levels in metres unless noted otherwise.
4. Any discrepancies noted on site are to be reported to the engineer immediately.
5. Drawing provided for illustrative purposes only. Design subject to further coordination and approvals.
6. Enclosed topographical survey based on greenhatch group drawing '36646_T_REV9' dated 03/04/23.
7. Enclosed highway GA based on drawings:
   OxSRFI-BWB-LSI-01-DR-CH-0101 and
   OxSRFI-BWB-LSI-02-DR-CH-0102

Drainage Notes

1. The following impermeable area assumptions have been used, as measured from OxSRFI-BWB-LSI-01-DR-CH-101 and OxSRFI-BWB-LSI-02-DR-CH-102
   - Highways and Foot/Cycle paths = 100%
2. A Volumetric Runoff Coefficient (Cv) value of 0.9 has been used for the highway drainage calculations, in accordance with the Lead Local Flood Authorities SuDS Guidance.
3. Existing discharge rate calculated using the modified rational method:
   2.78 x Imp Area (ha) x Rainfall (mm) x C = Q(l/s)
   2.78 x 0.376ha x 103mm/h x 0.9 = 96.9l/s.
4. Discharge from the filter drain will be restricted to **55.0l/s** in the 1 in 100 year + 40% climate change event which provides in excess of 40% betterment over the existing unrestricted rate.

Legend

- DEVELOPMENT CONSENT ORDER BOUNDARY

EXISTING

- KERB DRAIN
- FILTER DRAIN
- SURFACE WATER OUTLET

PROPOSED

- EXISTING DRAINAGE TO BE REMOVED
- KERB DRAIN
- FILTER DRAIN
- SURFACE WATER PIPES AND DRAINS
- NEW IMPERMEABLE HIGHWAY AREA
- EXISTING IMPERMEABLE HIGHWAY AREA

Rev	Date	Details of issue / revision	Drw	Rev
P04	12.10.26	Design criteria updated to provide betterment	TLB	RJ
P03	20.02.26	Updated to Calculations	GSL	RJ
P02	27.01.26	Updated inline with latest proposals	TLB	RJ
P01	13.03.23	Preliminary Issue	LDR	RJ

Issues & Revisions

BWB A CAF GROUP COMPANY

☐ Birmingham | 0121 233 3322
☐ Leeds | 0113 233 8000
☐ London | 020 7407 3879
☐ Manchester | 0161 233 4260
■ Nottingham | 0115 924 1100
www.bwbconsulting.com

Client

OXFORDSHIRE RAILFREIGHT LTD

Project Title

OxSRFI OXFORDSHIRE STRATEGIC RAIL FREIGHT INTERCHANGE

Drawing Title

M40 JUNCTION 9 MODIFICATIONS DRAINAGE STRATEGY

Drawn:	L. Ream		Reviewed:	[redacted]	
BWB Ref:	NTH 2479	Date:	13/03/23	Scale@A1:	1:1000

Drawing Status

PRELIMINARY

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
OxSFRI-BWB-EWE-ZZ-DR-CD-00510	**S1**	**P04**

© Copyright BWB Consulting Ltd

Appendix 9: M40 Junction 9 Drainage Calculations

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)	Invert Level (m)
1		5.00	67.300	1200	455140.097	219396.965	1.050	66.250
2	0.037	5.00	74.000	1200	455166.808	219360.934	1.050	72.950
3			67.500	1200	455147.436	219343.625	1.446	66.054
4	0.046	5.00	75.200	1200	455176.384	219324.782	1.050	74.150
5			68.000	1200	455153.359	219303.012	2.170	65.830
6	0.054	5.00	75.900	1200	455190.117	219285.417	1.050	74.850
7			68.200	1200	455162.687	219271.549	2.441	65.759
8	0.029	5.00	76.200	1200	455188.378	219238.486	1.050	75.150
9			68.300	1200	455157.337	219231.307	2.629	65.671
10	0.026	5.00	75.800	1200	455180.130	219196.484	1.050	74.750
11			68.200	1200	455149.734	219188.882	2.697	65.503
12	0.062	5.00	75.300	1200	455172.624	219152.381	1.050	74.250
13			67.800	1200	455142.536	219144.569	2.365	65.435
14	0.114	5.00	74.800	1200	455151.645	219106.495	1.050	73.750
15			67.300	1350	455118.306	219111.622	2.002	65.298
16	0.124	5.00	74.000	1200	455116.926	219067.312	1.050	72.950
17			66.500	1350	455085.428	219073.260	1.275	65.225
18			66.200	1350	455059.633	219035.498	1.275	64.925
19			66.000	1350	455049.952	219024.501	1.600	64.400
20			66.000	1350	455048.282	218929.780	2.000	64.000

Links (Input)

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	1	3	53.843	0.600	66.250	66.054	0.196	274.7	150	6.49	50.0
2.000	2	3	25.978	0.600	72.950	66.450	6.500	4.0	150	5.09	50.0
1.001	3	5	41.043	0.600	66.054	65.905	0.149	275.5	150	7.63	50.0
3.000	4	5	31.687	0.600	74.150	66.950	7.200	4.4	150	5.11	50.0
1.002	5	7	32.817	0.600	65.830	65.759	0.071	462.2	225	8.54	50.0
4.000	6	7	30.736	0.600	74.850	67.150	7.700	4.0	150	5.10	50.0
1.003	7	9	40.596	0.600	65.759	65.671	0.088	461.3	225	9.66	50.0
5.000	8	9	31.860	0.600	75.150	67.250	7.900	4.0	150	5.11	50.0
1.004	9	11	43.101	0.600	65.671	65.578	0.093	463.5	300	10.66	50.0
6.000	10	11	31.332	0.600	74.750	67.150	7.600	4.1	150	5.10	50.0
1.005	11	13	44.894	0.600	65.503	65.435	0.068	660.2	300	11.90	50.0
7.000	12	13	31.086	0.600	74.250	66.750	7.500	4.1	150	5.10	50.0
1.006	13	15	40.897	0.600	65.435	65.373	0.062	659.6	375	12.87	50.0
8.000	14	15	33.731	0.600	73.750	66.250	7.500	4.5	150	5.12	50.0
1.007	15	17	50.523	0.600	65.298	65.225	0.073	692.1	375	14.11	47.8
9.000	16	17	32.055	0.600	72.950	65.450	7.500	4.3	150	5.11	50.0
1.008	17	18	45.736	0.600	65.225	64.925	0.300	152.5	375	14.63	46.8
1.009	18	19	14.658	0.600	64.925	64.725	0.200	73.3	375	14.74	46.6
1.010	19	20	94.736	0.600	64.400	64.000	0.400	236.8	375	16.09	42.6

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Starting Level (m)	
Rainfall Events	Singular	Skip Steady State	✓	Check Discharge Rate(s)	x
Summer CV	0.900	Drain Down Time (mins)	360	Check Discharge Volume	x
Winter CV	0.900	Additional Storage (m³/ha)	0.0		

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Flow+ v17.0 Copyright © 1988-2026 Causeway Technologies Ltd

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
100	0	0	0
100	25	0	0
100	40	0	0

Node 18 Online Orifice Control

Flap Valve	x	Design Depth (m)	1.200	Discharge Coefficient	0.600
Replaces Downstream Link	x	Design Flow (l/s)	55.0		
Invert Level (m)	64.925	Diameter (m)	0.157		

Node 15 Online Orifice Control

Flap Valve	x	Design Depth (m)	2.000	Discharge Coefficient	0.600
Replaces Downstream Link	x	Design Flow (l/s)	10.0		
Invert Level (m)	65.298	Diameter (m)	0.120		

Node 5 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.01800	Porosity	0.30	Link	1.001
Side Inf Coefficient (m/hr)	0.01800	Invert Level (m)	65.905	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	53	Diameter (mm)	600

Node 7 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.01800	Porosity	0.30	Link	1.002
Side Inf Coefficient (m/hr)	0.01800	Invert Level (m)	65.759	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	56	Diameter (mm)	600

Node 9 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.01800	Porosity	0.30	Link	1.003
Side Inf Coefficient (m/hr)	0.01800	Invert Level (m)	65.671	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	63	Diameter (mm)	750

Node 11 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.01800	Porosity	0.30	Link	1.004
Side Inf Coefficient (m/hr)	0.01800	Invert Level (m)	65.578	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	61	Diameter (mm)	750

Node 13 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.01800	Porosity	0.30	Link	1.005
Side Inf Coefficient (m/hr)	0.01800	Invert Level (m)	65.435	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	69	Diameter (mm)	750

Node 15 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.01800	Porosity	0.30	Link	1.006
Side Inf Coefficient (m/hr)	0.01800	Invert Level (m)	65.373	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	65	Diameter (mm)	750

Node 17 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.01800	Porosity	0.30	Link	1.007
Side Inf Coefficient (m/hr)	0.01800	Invert Level (m)	65.225	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	20	Diameter (mm)	750

Flow+ v17.0 Copyright © 1988-2026 Causeway Technologies Ltd

Node 18 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.01800	Porosity	0.30	Link	1.008
Side Inf Coefficient (m/hr)	0.01800	Invert Level (m)	64.925	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	38	Diameter (mm)	750

Node 3 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.01800	Porosity	0.30	Link	1.000
Side Inf Coefficient (m/hr)	0.01800	Invert Level (m)	66.054	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	48	Diameter (mm)	600

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year 15 minute summer	342.411	96.891
100 year 15 minute winter	240.289	96.891
100 year 30 minute summer	222.646	63.001
100 year 30 minute winter	156.243	63.001
100 year 60 minute summer	147.810	39.062
100 year 60 minute winter	98.202	39.062
100 year 120 minute summer	88.776	23.461
100 year 120 minute winter	58.981	23.461
100 year 180 minute summer	67.719	17.426
100 year 180 minute winter	44.019	17.426
100 year 240 minute summer	53.354	14.100
100 year 240 minute winter	35.447	14.100
100 year 360 minute summer	40.515	10.426
100 year 360 minute winter	26.336	10.426
100 year 480 minute summer	31.720	8.383
100 year 480 minute winter	21.074	8.383
100 year 600 minute summer	25.799	7.057
100 year 600 minute winter	17.627	7.057
100 year 720 minute summer	22.827	6.118
100 year 720 minute winter	15.341	6.118
100 year 960 minute summer	18.466	4.862
100 year 960 minute winter	12.232	4.862
100 year 1440 minute summer	13.009	3.486
100 year 1440 minute winter	8.743	3.486
100 year +25% CC 15 minute summer	428.014	121.113
100 year +25% CC 15 minute winter	300.361	121.113
100 year +25% CC 30 minute summer	278.308	78.751
100 year +25% CC 30 minute winter	195.304	78.751
100 year +25% CC 60 minute summer	184.763	48.827
100 year +25% CC 60 minute winter	122.752	48.827
100 year +25% CC 120 minute summer	110.970	29.326
100 year +25% CC 120 minute winter	73.726	29.326
100 year +25% CC 180 minute summer	84.648	21.783
100 year +25% CC 180 minute winter	55.023	21.783
100 year +25% CC 240 minute summer	66.693	17.625
100 year +25% CC 240 minute winter	44.309	17.625
100 year +25% CC 360 minute summer	50.644	13.032
100 year +25% CC 360 minute winter	32.920	13.032
100 year +25% CC 480 minute summer	39.650	10.478
100 year +25% CC 480 minute winter	26.343	10.478
100 year +25% CC 600 minute summer	32.249	8.821
100 year +25% CC 600 minute winter	22.034	8.821
100 year +25% CC 720 minute summer	28.534	7.647

Flow+ v17.0 Copyright © 1988-2026 Causeway Technologies Ltd

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year +25% CC 720 minute winter	19.177	7.647
100 year +25% CC 960 minute summer	23.082	6.078
100 year +25% CC 960 minute winter	15.290	6.078
100 year +25% CC 1440 minute summer	16.261	4.358
100 year +25% CC 1440 minute winter	10.928	4.358
100 year +40% CC 15 minute summer	479.376	135.647
100 year +40% CC 15 minute winter	336.404	135.647
100 year +40% CC 30 minute summer	311.705	88.202
100 year +40% CC 30 minute winter	218.740	88.202
100 year +40% CC 60 minute summer	206.934	54.687
100 year +40% CC 60 minute winter	137.482	54.687
100 year +40% CC 120 minute summer	124.287	32.845
100 year +40% CC 120 minute winter	82.573	32.845
100 year +40% CC 180 minute summer	94.806	24.397
100 year +40% CC 180 minute winter	61.626	24.397
100 year +40% CC 240 minute summer	74.696	19.740
100 year +40% CC 240 minute winter	49.626	19.740
100 year +40% CC 360 minute summer	56.721	14.596
100 year +40% CC 360 minute winter	36.870	14.596
100 year +40% CC 480 minute summer	44.408	11.736
100 year +40% CC 480 minute winter	29.504	11.736
100 year +40% CC 600 minute summer	36.119	9.879
100 year +40% CC 600 minute winter	24.678	9.879
100 year +40% CC 720 minute summer	31.958	8.565
100 year +40% CC 720 minute winter	21.478	8.565
100 year +40% CC 960 minute summer	25.852	6.807
100 year +40% CC 960 minute winter	17.125	6.807
100 year +40% CC 1440 minute summer	18.212	4.881
100 year +40% CC 1440 minute winter	12.240	4.881

Flow+ v17.0 Copyright © 1988-2026 Causeway Technologies Ltd

Results for 100 year Critical Storm Duration. Lowest mass balance: 99.24%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute summer	1	27	66.684	0.434	7.1	0.4904	0.0000	SURCHARGED
15 minute summer	2	10	72.996	0.046	18.3	0.0000	0.0000	OK
30 minute summer	3	26	66.682	0.628	19.7	4.8493	0.0000	SURCHARGED
15 minute summer	4	10	74.203	0.053	22.9	0.0000	0.0000	OK
60 minute summer	5	43	66.671	0.841	23.0	4.8950	0.0000	SURCHARGED
15 minute summer	6	10	74.907	0.057	26.9	0.0000	0.0000	OK
60 minute summer	7	43	66.666	0.907	30.0	4.7579	0.0000	SURCHARGED
15 minute summer	8	10	75.191	0.041	14.8	0.0000	0.0000	OK
60 minute summer	9	43	66.650	0.979	30.6	8.0561	0.0000	SURCHARGED
15 minute summer	10	10	74.789	0.039	13.3	0.0000	0.0000	OK
60 minute summer	11	43	66.644	1.141	26.2	8.9759	0.0000	SURCHARGED
15 minute summer	12	10	74.312	0.062	31.3	0.0000	0.0000	OK
60 minute summer	13	43	66.634	1.199	25.3	10.8176	0.0000	SURCHARGED
15 minute summer	14	10	73.841	0.091	57.2	0.0000	0.0000	OK
30 minute summer	15	25	66.630	1.332	55.3	9.9249	0.0000	SURCHARGED
15 minute summer	16	10	73.044	0.094	62.0	0.0000	0.0000	OK
30 minute summer	17	23	65.778	0.552	70.7	4.1895	0.0000	SURCHARGED
30 minute summer	18	23	65.756	0.831	54.8	5.4912	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
30 minute summer	1	1.000	3	-7.1	-0.437	-0.664	0.9479	
15 minute summer	2	2.000	3	18.3	4.006	0.204	0.1847	
30 minute summer	3	1.001	5	10.3	0.685	0.970	0.7226	
30 minute summer	3	Infiltration		0.2				
15 minute summer	4	3.000	5	22.8	4.113	0.267	0.1759	
60 minute summer	5	1.002	7	15.3	0.512	0.641	1.3052	
60 minute summer	5	Infiltration		0.2				
15 minute summer	6	4.000	7	26.8	4.459	0.299	0.1850	
60 minute summer	7	1.003	9	23.7	0.741	0.988	1.6145	
60 minute summer	7	Infiltration		0.2				
15 minute summer	8	5.000	9	14.7	3.751	0.164	0.1248	
60 minute summer	9	1.004	11	20.9	0.658	0.409	3.0351	
60 minute summer	9	Infiltration		0.3				
15 minute summer	10	6.000	11	13.2	3.609	0.150	0.1147	
60 minute summer	11	1.005	13	18.3	0.448	0.428	3.1614	
60 minute summer	11	Infiltration		0.3				
15 minute summer	12	7.000	13	31.2	4.578	0.354	0.2118	
60 minute summer	13	1.006	15	22.4	0.417	0.291	4.5108	
60 minute summer	13	Infiltration		0.3				
15 minute summer	14	8.000	15	57.0	5.155	0.674	0.4080	
30 minute summer	15	1.007	17	30.5	0.777	0.405	5.5725	
30 minute summer	15	Infiltration		0.3				
15 minute summer	16	9.000	17	61.8	5.352	0.713	0.4362	
30 minute summer	17	1.008	18	54.8	0.653	0.339	5.0445	
30 minute summer	17	Infiltration		0.2				
30 minute summer	18	1.009	19	43.6	1.604	0.186	0.3984	

Flow+ v17.0 Copyright © 1988-2026 Causeway Technologies Ltd

Results for 100 year Critical Storm Duration. Lowest mass balance: 99.24%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute summer	19	24	64.551	0.151	43.6	0.2155	0.0000	OK
30 minute summer	20	24	64.147	0.147	43.6	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
30 minute summer	18	Infiltration		0.2				
30 minute summer	19	1.010	20	43.6	1.070	0.337	3.8613	133.5

Flow+ v17.0 Copyright © 1988-2026 Causeway Technologies Ltd

Results for 100 year +25% CC Critical Storm Duration. Lowest mass balance: 99.22%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute summer	1	45	67.038	0.788	6.5	0.8909	0.0000	FLOOD RISK
15 minute summer	2	10	73.002	0.052	22.9	0.0000	0.0000	OK
60 minute summer	3	45	67.038	0.984	22.2	8.3004	0.0000	SURCHARGED
15 minute summer	4	10	74.210	0.060	28.6	0.0000	0.0000	OK
60 minute summer	5	44	67.027	1.197	22.2	7.5252	0.0000	SURCHARGED
15 minute summer	6	10	74.914	0.064	33.7	0.0000	0.0000	OK
60 minute summer	7	44	67.022	1.263	29.3	6.8607	0.0000	SURCHARGED
15 minute summer	8	10	75.196	0.046	18.5	0.0000	0.0000	OK
60 minute summer	9	44	67.004	1.333	27.8	11.2864	0.0000	SURCHARGED
15 minute summer	10	10	74.794	0.044	16.7	0.0000	0.0000	OK
60 minute summer	11	44	66.998	1.495	22.6	12.4008	0.0000	SURCHARGED
15 minute summer	12	10	74.320	0.070	39.1	0.0000	0.0000	OK
60 minute summer	13	43	66.986	1.551	27.5	14.3748	0.0000	SURCHARGED
15 minute summer	14	10	73.856	0.106	71.6	0.0000	0.0000	OK
60 minute summer	15	44	66.981	1.683	50.1	13.1546	0.0000	SURCHARGED
15 minute summer	16	10	73.061	0.111	77.5	0.0000	0.0000	OK
30 minute summer	17	23	66.004	0.779	94.0	6.7595	0.0000	SURCHARGED
30 minute summer	18	23	65.976	1.051	65.5	7.7560	0.0000	FLOOD RISK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
60 minute summer	1	1.000	3	-6.5	-0.440	-0.615	0.9479	
15 minute summer	2	2.000	3	22.9	4.263	0.255	0.2710	
60 minute summer	3	1.001	5	8.7	0.689	0.821	0.7226	
60 minute summer	3	Infiltration		0.3				
15 minute summer	4	3.000	5	28.5	4.370	0.334	0.2068	
60 minute summer	5	1.002	7	15.7	0.513	0.657	1.3052	
60 minute summer	5	Infiltration		0.3				
15 minute summer	6	4.000	7	33.6	4.736	0.374	0.2180	
60 minute summer	7	1.003	9	21.6	0.716	0.904	1.6145	
60 minute summer	7	Infiltration		0.3				
15 minute summer	8	5.000	9	18.4	3.998	0.206	0.1465	
60 minute summer	9	1.004	11	17.9	0.645	0.350	3.0351	
60 minute summer	9	Infiltration		0.3				
15 minute summer	10	6.000	11	16.6	3.851	0.188	0.1349	
60 minute summer	11	1.005	13	20.8	0.468	0.487	3.1614	
60 minute summer	11	Infiltration		0.4				
15 minute summer	12	7.000	13	39.0	4.854	0.442	0.2495	
60 minute summer	13	1.006	15	25.6	0.397	0.332	4.5108	
60 minute summer	13	Infiltration		0.4				
15 minute summer	14	8.000	15	71.3	5.382	0.843	0.4826	
60 minute summer	15	1.007	17	32.6	0.785	0.433	5.5725	
60 minute summer	15	Infiltration		0.4				
15 minute summer	16	9.000	17	77.2	5.569	0.890	0.4954	
30 minute summer	17	1.008	18	65.5	0.684	0.405	5.0445	
30 minute summer	17	Infiltration		0.3				
30 minute summer	18	1.009	19	49.6	1.659	0.212	0.4382	

Flow+ v17.0 Copyright © 1988-2026 Causeway Technologies Ltd

Results for 100 year +25% CC Critical Storm Duration. Lowest mass balance: 99.22%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute summer	19	24	64.562	0.162	49.6	0.2317	0.0000	OK
30 minute summer	20	24	64.158	0.158	49.6	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
30 minute summer	18	Infiltration		0.3				
30 minute summer	19	1.010	20	49.6	1.106	0.383	4.2481	166.3

Flow+ v17.0 Copyright © 1988-2026 Causeway Technologies Ltd

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.18%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute summer	1	46	67.254	1.004	6.2	1.1360	0.0000	FLOOD RISK
15 minute summer	2	10	73.005	0.055	25.7	0.0000	0.0000	OK
60 minute summer	3	45	67.253	1.199	25.2	10.3894	0.0000	FLOOD RISK
15 minute summer	4	10	74.214	0.064	32.1	0.0000	0.0000	OK
60 minute summer	5	45	67.243	1.413	25.5	9.1134	0.0000	SURCHARGED
15 minute summer	6	10	74.918	0.068	37.7	0.0000	0.0000	OK
60 minute summer	7	45	67.237	1.478	29.0	8.1266	0.0000	SURCHARGED
15 minute summer	8	10	75.199	0.049	20.7	0.0000	0.0000	OK
60 minute summer	9	44	67.217	1.546	26.7	13.2371	0.0000	SURCHARGED
15 minute summer	10	10	74.797	0.047	18.6	0.0000	0.0000	OK
60 minute summer	11	44	67.209	1.706	22.7	14.4512	0.0000	SURCHARGED
15 minute summer	12	10	74.325	0.075	43.8	0.0000	0.0000	OK
60 minute summer	13	44	67.199	1.764	33.1	16.5194	0.0000	SURCHARGED
15 minute summer	14	10	73.867	0.117	80.2	0.0000	0.0000	OK
60 minute summer	15	43	67.193	1.895	53.0	15.1039	0.0000	FLOOD RISK
15 minute summer	16	11	73.067	0.117	86.8	0.0000	0.0000	OK
30 minute summer	17	23	66.145	0.920	103.0	8.3647	0.0000	SURCHARGED
30 minute summer	18	23	66.113	1.188	73.7	9.1646	0.0000	FLOOD RISK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
60 minute summer	1	1.000	3	-6.2	-0.439	-0.586	0.9479	
15 minute summer	2	2.000	3	25.7	4.401	0.286	0.2924	
60 minute summer	3	1.001	5	-8.9	0.679	-0.842	0.7226	
60 minute summer	3	Infiltration		0.4				
15 minute summer	4	3.000	5	32.0	4.506	0.374	0.2250	
60 minute summer	5	1.002	7	15.1	0.513	0.630	1.3052	
60 minute summer	5	Infiltration		0.3				
15 minute summer	6	4.000	7	37.6	4.878	0.419	0.2368	
60 minute summer	7	1.003	9	20.8	0.701	0.867	1.6145	
60 minute summer	7	Infiltration		0.3				
15 minute summer	8	5.000	9	20.7	4.129	0.231	0.1594	
60 minute summer	9	1.004	11	17.0	0.651	0.333	3.0351	
60 minute summer	9	Infiltration		0.4				
15 minute summer	10	6.000	11	18.5	3.971	0.209	0.1458	
60 minute summer	11	1.005	13	21.7	0.478	0.509	3.1614	
60 minute summer	11	Infiltration		0.4				
15 minute summer	12	7.000	13	43.6	4.995	0.495	0.3319	
60 minute summer	13	1.006	15	27.6	0.388	0.359	4.5108	
60 minute summer	13	Infiltration		0.5				
15 minute summer	14	8.000	15	79.8	5.458	0.944	0.5335	
60 minute summer	15	1.007	17	33.7	0.788	0.448	5.5725	
60 minute summer	15	Infiltration		0.4				
15 minute summer	16	9.000	17	86.4	5.589	0.996	0.5178	
30 minute summer	17	1.008	18	73.7	0.699	0.456	5.0445	
30 minute summer	17	Infiltration		0.3				
30 minute summer	18	1.009	19	53.0	1.689	0.227	0.4603	

Flow+ v17.0 Copyright © 1988-2026 Causeway Technologies Ltd

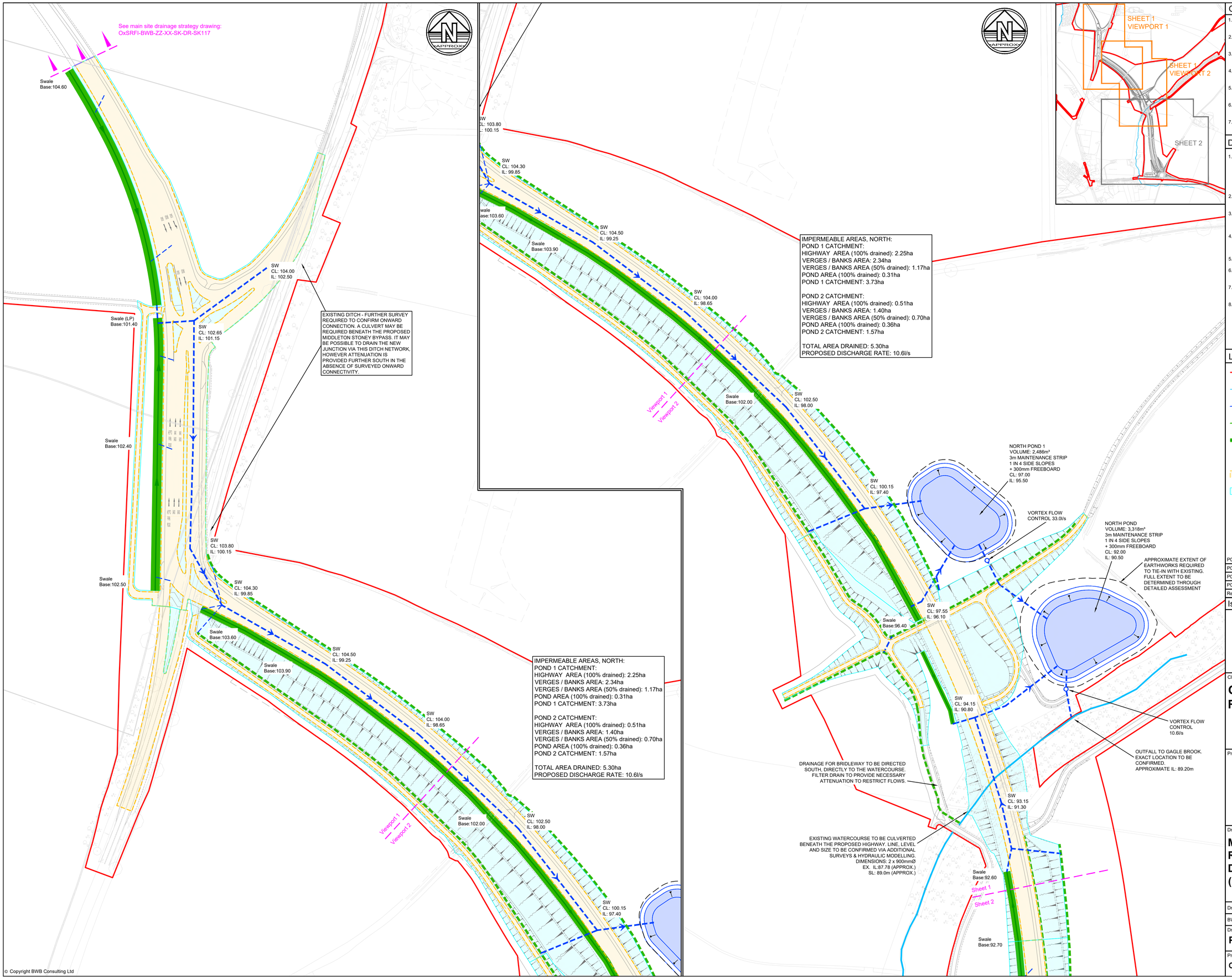
Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.18%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute summer	19	24	64.568	0.168	53.0	0.2407	0.0000	OK
30 minute summer	20	24	64.164	0.164	53.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
30 minute summer	18	Infiltration		0.3				
30 minute summer	19	1.010	20	53.0	1.126	0.409	4.4636	186.1

Flow+ v17.0 Copyright © 1988-2026 Causeway Technologies Ltd

Appendix 10: Middleton Stoney Relief Road Drainage Drawings



© Copyright BWB Consulting Ltd

General Notes

1. Do not scale this drawing. All dimensions must be checked/ verified on site. If in doubt ask.
2. This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.
3. All dimensions in millimetres unless noted otherwise. All levels in metres unless noted otherwise.
4. Any discrepancies noted on site are to be reported to the engineer immediately.
5. Drawing provided for illustrative purposes only. Design subject to further coordination and approvals.
6. Enclosed topographical survey based on greenhatch group drawing '36646_T_REV9' dated 03/04/23.
7. Enclosed highway GA based on OxSRFI-BWB-LSI-05-DR-CH-105_S3_P03

Drainage Notes

1. The following impermeable area assumptions have been used, as measured from OxSRFI-BWB-LSI-01-DR-CH-101 and OxSRFI-BWB-LSI-02-DR-CH-102
   - Highways and Foot/Cycle Paths = 100%
   - Embankments, bunds and verges = 50%
   - Attenuating SuDS basins = 100%
2. Flows will be directed through swales where site levels allow, subject to detailed review once levels are finalised.
3. A Volumetric Runoff Coefficient (Cv) value of 0.9 has been used for the highway drainage calculations, in accordance with the Lead Local Flood Authorities SuDS Guidance.
4. SuDS ponds have been designed with maximum side slopes and external tie in batters of 1:4 and a minimum 300mm freeboard during the 1 in 100-year + 40% critical storm event.
5. Proposed discharge rates based on 2l/s/ha. To be agreed with the LLFA.
6. Detention basins to have low flow channel and incorporation of ecological features is to be confirmed at detailed design.
7. The proposed drainage concept is subject to review against the final proposed levels and earthworks strategy.
8. Piped drainage networks are shown indicatively to demonstrate catchment areas and connectivity and are subject to detailed design.

Legend

- DEVELOPMENT CONSENT ORDER BOUNDARY
- EXISTING WATERCOURSE
- INDICATIVE SURFACE WATER NETWORK
- PROPOSED FILTER DRAIN
- PROPOSED SWALE
- PROPOSED ATTENUATION BASIN
- PROPOSED IMPERMEABLE HIGHWAY AREA
- EXTENT OF VERGES AND BANKS

Rev	Date	Details of issue / revision	Drw	Rev
P04	07.10.26	Updated in response to comments	TLB	RJ
P03	20.02.26	Updated to latest highways proposals	TLB	RJ
P02	25.01.23	Updated to latest highways proposals	RJ	CD
P01	09.11.21	Preliminary issue	RJ	CD

Issues & Revisions

BWB CONSULTANCY | ENVIRONMENT INFRASTRUCTURE | BUILDINGS
☐ Birmingham | 0121 233 3322
☐ Leeds | 0113 233 8000
☐ London | 020 7407 3879
☐ Manchester | 0161 233 4260
■ Nottingham | 0115 924 1100
www.bwbconsulting.com

Client

OXFORDSHIRE RAILFREIGHT LTD.

Project Title

OxSRFI OXFORDSHIRE STRATEGIC RAIL FREIGHT INTERCHANGE

Drawing Title

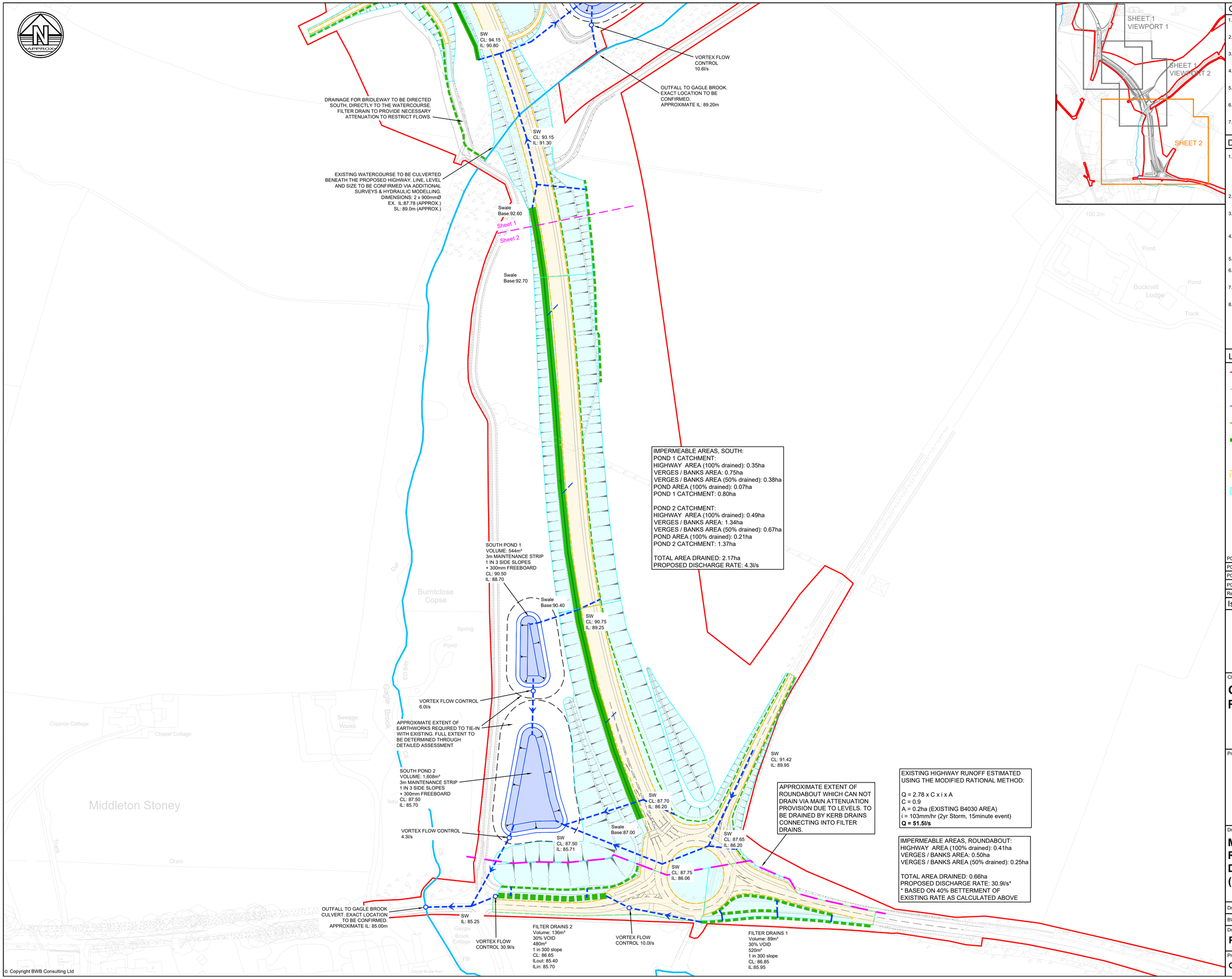
MIDDLETON STONEY RELIEF ROAD DRAINAGE STRATEGY (SHEET 1 OF 2)

Drawn:	RJ		Reviewed:	CD	
BWB Ref:	NTH2479	Date:	21.01.26	Scale@A1:	1:1250

Drawing Status

PRELIMINARY

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
OxSRFI-BWB-EWE-ZZ-DR-CD-00503	S1	P04



General Notes

1. Do not scale this drawing. All dimensions must be checked/ verified on site. If in doubt ask.
2. This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.
3. All dimensions in millimetres unless noted otherwise. All levels in metres unless noted otherwise.
4. Any discrepancies noted on site are to be reported to the engineer immediately.
5. Drawing provided for illustrative purposes only. Design subject to further coordination and approvals.
6. Enclosed topographical survey based on greenhatch group drawing '36646_T_REV9' dated 03/04/23.
7. Enclosed highway GA based on OxSRFI-BWB-LSI-05-DR-CH-105_S3_P03

Drainage Notes

1. The following impermeable area assumptions have been used, as measured from OxSRFI-BWB-LSI-01-DR-CH-101 and OxSRFI-BWB-LSI-02-DR-CH-102
   - Highways and Foot/Cycle Paths = 100%
   - Embankments, bunds and verges = 50%
   - Attenuating SuDS basins = 100%
2. Flows will be directed through swales where site levels allow, subject to detailed review once levels are finalised.
3. A Volumetric Runoff Coefficient (Cv) value of 0.9 has been used for the highway drainage calculations, in accordance with the Lead Local Flood Authorities SuDS Guidance.
4. SuDS ponds have been designed with maximum side slopes and external tie in batters of 1:4 and a minimum 300mm freeboard during the 1 in 100-year + 40% critical storm event.
5. Proposed discharge rates based on 2l/s/ha. To be agreed with the LLFA.
6. Detention basins to have low flow channel and incorporation of ecological features is to be confirmed at detailed design.
7. The proposed drainage concept is subject to review against the final proposed levels and earthworks strategy.
8. Piped drainage networks are shown indicatively to demonstrate catchment areas and connectivity and are subject to detailed design.

Legend

- DEVELOPMENT CONSENT ORDER BOUNDARY
- EXISTING WATERCOURSE
- INDICATIVE SURFACE WATER NETWORK
- PROPOSED FILTER DRAIN
- PROPOSED SWALE
- PROPOSED ATTENUATION BASIN
- PROPOSED IMPERMEABLE HIGHWAY AREA
- EXTENT OF VERGES AND BANKS

Rev	Date	Details of issue / revision	Drw	Rev
P04	07.10.26	Updated in response to comments	TLB	RJ
P03	20.02.26	Updated to latest highways proposals	TLB	RJ
P02	25.01.23	Updated to latest highways proposals	RJ	CD
P01	21.01.26	Preliminary issue	TLB	RJ

Issues & Revisions

BWB CONSULTANCY | ENVIRONMENT INFRASTRUCTURE | BUILDINGS

☐ Birmingham | 0121 233 3322
☐ Leeds | 0113 233 8000
☐ London | 020 7407 3879
☐ Manchester | 0161 233 4260
■ Nottingham | 0115 924 1100
www.bwbconsulting.com

Client

OXFORDSHIRE RAILFREIGHT LTD.

Project Title

OxSRFI OXFORDSHIRE STRATEGIC RAIL FREIGHT INTERCHANGE

Drawing Title

MIDDLETON STONEY RELIEF ROAD DRAINAGE STRATEGY (SHEET 2 OF 2)

Drawn:	TLB		Reviewed:	RJ	
BWB Ref:	NTH2479	Date:	21.01.26	Scale@A1:	1:1250

Drawing Status

PRELIMINARY

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
OxSRFI-BWB-EWE-ZZ-DR-CD-00519	S1	P04

© Copyright BWB Consulting Ltd

Appendix 11: Middleton Stoney Relief Road Drainage Calculations

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)	Invert Level (m)
North Pond 1	3.730	5.00	97.000		-36.631	79.922	1.500	95.500
North Pond 2	1.570	5.00	92.000		-29.443	70.549	1.500	90.500
South Pond 1	0.800	5.00	90.500		-36.169	20.114	1.800	88.700
South Pond 2	1.370	5.00	87.500		-35.828	10.143	1.800	85.700
1			86.500		-40.984	2.606	1.250	85.250
Filter Drain 1	0.240	5.00	86.850		-20.255	1.347	0.900	85.950
Filter Drain 2	0.410	5.00	86.650		-35.048	3.269	1.250	85.400
2			86.500	1200	-44.494	2.460	1.500	85.000

Links (Input)

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
2.000	South Pond 1	South Pond 2	35.000	0.600	88.700	85.700	3.000	11.7	150	5.20	50.0
2.001_1	South Pond 2	1	67.700	0.600	85.700	85.250	0.450	150.4	150	6.58	50.0
3.000_1	North Pond 1	North Pond 2	75.000	0.600	95.500	90.500	5.000	15.0	300	5.31	50.0
3.000	Filter Drain 1	Filter Drain 2	100.000	0.600	85.950	85.700	0.250	400.0	300	7.14	50.0
2.001	Filter Drain 2	1	22.000	0.600	85.400	85.250	0.150	146.7	300	7.42	50.0
1.002	1	2	33.500	0.600	85.250	85.000	0.250	134.0	300	7.83	50.0

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Starting Level (m)	
Rainfall Events	Singular	Skip Steady State	x	Check Discharge Rate(s)	x
Summer CV	0.900	Drain Down Time (mins)	240	Check Discharge Volume	x
Winter CV	0.900	Additional Storage (m³/ha)	0.0		

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0
100	0	0	0
100	25	0	0
100	40	0	0

Node North Pond 2 Online ACO Q-Brake Control

Flap Valve	x	Design Depth (m)	1.200	Min Node Diameter (mm)	1050
Replaces Downstream Link	x	Design Flow (l/s)	10.6	Orifice Diameter (m)	0.135
Invert Level (m)	90.500	Min Outlet Diameter (m)	0.145		

Node South Pond 2 Online ACO Q-Brake Control

Flap Valve	x	Invert Level (m)	85.700	Min Outlet Diameter (m)	0.095
Downstream Link	2.001_1	Design Depth (m)	1.500	Min Node Diameter (mm)	1050
Replaces Downstream Link	x	Design Flow (l/s)	4.3	Orifice Diameter (m)	0.087

Node South Pond 1 Online ACO Q-Brake Control

Flap Valve	x	Invert Level (m)	88.700	Min Outlet Diameter (m)	0.145
Downstream Link	2.000	Design Depth (m)	1.500	Min Node Diameter (mm)	1050
Replaces Downstream Link	x	Design Flow (l/s)	6.0	Orifice Diameter (m)	0.101

Flow+ v17.0 Copyright © 1988-2026 Causeway Technologies Ltd

Node North Pond 1 Online ACO Q-Brake Control

Flap Valve	x	Invert Level (m)	95.500	Min Outlet Diameter (m)	0.295
Downstream Link	3.000_1	Design Depth (m)	1.200	Min Node Diameter (mm)	1200
Replaces Downstream Link	x	Design Flow (l/s)	33.0	Orifice Diameter (m)	0.224

Node Filter Drain 2 Online ACO Q-Brake Control

Flap Valve	x	Invert Level (m)	85.400	Min Outlet Diameter (m)	0.220
Downstream Link	2.001	Design Depth (m)	1.150	Min Node Diameter (mm)	1200
Replaces Downstream Link	x	Design Flow (l/s)	30.9	Orifice Diameter (m)	0.219

Node Filter Drain 1 Online ACO Q-Brake Control

Flap Valve	x	Invert Level (m)	85.950	Min Outlet Diameter (m)	0.145
Downstream Link	3.000	Design Depth (m)	0.800	Min Node Diameter (mm)	1050
Replaces Downstream Link	x	Design Flow (l/s)	10.0	Orifice Diameter (m)	0.138

Node North Pond 2 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	90.500
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)
0.000	2400.0	2400.0	1.500	3630.0	3663.8

Node South Pond 1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	88.700
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)
0.000	187.0	187.0	1.800	750.0	765.0

Node South Pond 2 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	85.700
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)
0.000	1143.0	1143.0	1.800	2139.0	2171.2

Node North Pond 1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	95.500
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)
0.000	1998.0	1998.0	1.500	3128.0	3159.2

Node Filter Drain 1 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	85.950	Slope (1:X)	300.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	103	Depth (m)	
Safety Factor	2.0	Width (m)	4.000	Inf Depth (m)	
Porosity	0.30	Length (m)	130.000		

Flow+ v17.0 Copyright © 1988-2026 Causeway Technologies Ltd

Node Filter Drain 2 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	85.400	Slope (1:X)	300.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	76	Depth (m)	
Safety Factor	2.0	Width (m)	4.000	Inf Depth (m)	
Porosity	0.30	Length (m)	120.000		

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
2 year 15 minute summer	102.933	29.126
2 year 15 minute winter	72.234	29.126
2 year 30 minute summer	65.602	18.563
2 year 30 minute winter	46.037	18.563
2 year 60 minute summer	43.068	11.382
2 year 60 minute winter	28.613	11.382
2 year 120 minute summer	29.997	7.927
2 year 120 minute winter	19.930	7.927
2 year 180 minute summer	24.273	6.246
2 year 180 minute winter	15.778	6.246
2 year 240 minute summer	19.757	5.221
2 year 240 minute winter	13.126	5.221
2 year 360 minute summer	15.546	4.001
2 year 360 minute winter	10.105	4.001
2 year 480 minute summer	12.404	3.278
2 year 480 minute winter	8.241	3.278
2 year 600 minute summer	10.213	2.793
2 year 600 minute winter	6.978	2.793
2 year 720 minute summer	9.116	2.443
2 year 720 minute winter	6.127	2.443
2 year 960 minute summer	7.463	1.965
2 year 960 minute winter	4.944	1.965
2 year 1440 minute summer	5.371	1.440
2 year 1440 minute winter	3.610	1.440
100 year 15 minute summer	342.811	97.004
100 year 15 minute winter	240.569	97.004
100 year 30 minute summer	223.495	63.241
100 year 30 minute winter	156.839	63.241
100 year 60 minute summer	148.570	39.263
100 year 60 minute winter	98.706	39.263
100 year 120 minute summer	88.699	23.441
100 year 120 minute winter	58.930	23.441
100 year 180 minute summer	67.533	17.378
100 year 180 minute winter	43.898	17.378
100 year 240 minute summer	53.176	14.053
100 year 240 minute winter	35.329	14.053
100 year 360 minute summer	40.384	10.392
100 year 360 minute winter	26.251	10.392
100 year 480 minute summer	31.662	8.367
100 year 480 minute winter	21.035	8.367
100 year 600 minute summer	25.789	7.054
100 year 600 minute winter	17.621	7.054
100 year 720 minute summer	22.849	6.124
100 year 720 minute winter	15.356	6.124
100 year 960 minute summer	18.523	4.877
100 year 960 minute winter	12.270	4.877
100 year 1440 minute summer	13.073	3.504
100 year 1440 minute winter	8.786	3.504

Flow+ v17.0 Copyright © 1988-2026 Causeway Technologies Ltd

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year +25% CC 15 minute summer	428.513	121.254
100 year +25% CC 15 minute winter	300.711	121.254
100 year +25% CC 30 minute summer	279.369	79.052
100 year +25% CC 30 minute winter	196.048	79.052
100 year +25% CC 60 minute summer	185.713	49.078
100 year +25% CC 60 minute winter	123.383	49.078
100 year +25% CC 120 minute summer	110.874	29.301
100 year +25% CC 120 minute winter	73.662	29.301
100 year +25% CC 180 minute summer	84.416	21.723
100 year +25% CC 180 minute winter	54.872	21.723
100 year +25% CC 240 minute summer	66.470	17.566
100 year +25% CC 240 minute winter	44.161	17.566
100 year +25% CC 360 minute summer	50.480	12.990
100 year +25% CC 360 minute winter	32.813	12.990
100 year +25% CC 480 minute summer	39.577	10.459
100 year +25% CC 480 minute winter	26.294	10.459
100 year +25% CC 600 minute summer	32.237	8.817
100 year +25% CC 600 minute winter	22.026	8.817
100 year +25% CC 720 minute summer	28.561	7.655
100 year +25% CC 720 minute winter	19.195	7.655
100 year +25% CC 960 minute summer	23.153	6.097
100 year +25% CC 960 minute winter	15.337	6.097
100 year +25% CC 1440 minute summer	16.341	4.380
100 year +25% CC 1440 minute winter	10.982	4.380
100 year +40% CC 15 minute summer	479.935	135.805
100 year +40% CC 15 minute winter	336.796	135.805
100 year +40% CC 30 minute summer	312.893	88.538
100 year +40% CC 30 minute winter	219.574	88.538
100 year +40% CC 60 minute summer	207.998	54.968
100 year +40% CC 60 minute winter	138.189	54.968
100 year +40% CC 120 minute summer	124.179	32.817
100 year +40% CC 120 minute winter	82.501	32.817
100 year +40% CC 180 minute summer	94.546	24.330
100 year +40% CC 180 minute winter	61.457	24.330
100 year +40% CC 240 minute summer	74.446	19.674
100 year +40% CC 240 minute winter	49.460	19.674
100 year +40% CC 360 minute summer	56.538	14.549
100 year +40% CC 360 minute winter	36.751	14.549
100 year +40% CC 480 minute summer	44.327	11.714
100 year +40% CC 480 minute winter	29.450	11.714
100 year +40% CC 600 minute summer	36.105	9.876
100 year +40% CC 600 minute winter	24.669	9.876
100 year +40% CC 720 minute summer	31.989	8.573
100 year +40% CC 720 minute winter	21.498	8.573
100 year +40% CC 960 minute summer	25.932	6.828
100 year +40% CC 960 minute winter	17.178	6.828
100 year +40% CC 1440 minute summer	18.302	4.905
100 year +40% CC 1440 minute winter	12.300	4.905

Flow+ v17.0 Copyright © 1988-2026 Causeway Technologies Ltd

Results for 2 year Critical Storm Duration. Lowest mass balance: 99.97%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
480 minute summer	North Pond 1	328	95.761	0.261	115.7	546.1544	0.0000	OK
1440 minute winter	North Pond 2	1440	90.861	0.361	32.5	921.0760	0.0000	OK
360 minute summer	South Pond 1	248	89.102	0.402	31.1	100.3953	0.0000	SURCHARGED
1440 minute winter	South Pond 2	1320	86.059	0.359	17.1	446.5968	0.0000	SURCHARGED
30 minute summer	1	24	85.357	0.107	25.9	0.0000	0.0000	OK
30 minute summer	Filter Drain 1	24	86.197	0.247	31.7	10.9819	0.0000	OK
30 minute summer	Filter Drain 2	23	85.712	0.312	60.3	17.5411	0.0000	SURCHARGED
30 minute summer	2	24	85.105	0.105	25.9	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
480 minute summer	North Pond 1	3.000_1	North Pond 2	24.8	2.010	0.086	2.8617	
1440 minute winter	North Pond 2	ACO Q-Brake		10.6				719.7
360 minute summer	South Pond 1	2.000	South Pond 2	6.0	1.472	0.114	0.3611	
1440 minute winter	South Pond 2	2.001_1	1	4.3	0.817	0.296	0.4175	
30 minute summer	1	1.002	2	25.9	1.158	0.270	0.7489	87.9
30 minute summer	Filter Drain 1	3.000	Filter Drain 2	8.4	0.614	0.152	1.3673	
30 minute summer	Filter Drain 2	2.001	1	24.0	1.088	0.263	0.4868	

Flow+ v17.0 Copyright © 1988-2026 Causeway Technologies Ltd

Results for 100 year Critical Storm Duration. Lowest mass balance: 99.92%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
360 minute winter	North Pond 1	344	96.210	0.710	244.7	1608.4670	0.0000	SURCHARGED
1440 minute winter	North Pond 2	1680	91.483	0.983	66.2	2756.2510	0.0000	OK
480 minute winter	South Pond 1	464	89.736	1.036	42.1	361.5215	0.0000	SURCHARGED
1440 minute winter	South Pond 2	1680	86.542	0.842	35.7	1157.9800	0.0000	SURCHARGED
180 minute winter	1	116	85.377	0.127	35.2	0.0000	0.0000	OK
60 minute winter	Filter Drain 1	57	86.526	0.576	57.8	56.1352	0.0000	SURCHARGED
60 minute summer	Filter Drain 2	49	86.182	0.782	146.6	83.8222	0.0000	SURCHARGED
180 minute winter	2	116	85.124	0.124	35.2	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
360 minute winter	North Pond 1	3.000_1	North Pond 2	33.0	2.161	0.114	3.0900	
1440 minute winter	North Pond 2	ACO Q-Brake		10.6				763.1
480 minute winter	South Pond 1	2.000	South Pond 2	6.0	1.557	0.114	0.3611	
1440 minute winter	South Pond 2	2.001_1	1	4.3	0.747	0.298	0.5703	
180 minute winter	1	1.002	2	35.2	1.256	0.367	0.9390	391.8
60 minute winter	Filter Drain 1	3.000	Filter Drain 2	11.6	0.644	0.211	6.4741	
60 minute summer	Filter Drain 2	2.001	1	30.9	1.147	0.337	0.5995	

Flow+ v17.0 Copyright © 1988-2026 Causeway Technologies Ltd

Results for 100 year +25% CC Critical Storm Duration. Lowest mass balance: 99.92%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
480 minute winter	North Pond 1	464	96.417	0.917	245.2	2149.8480	0.0000	SURCHARGED
1440 minute winter	North Pond 2	1680	91.612	1.112	76.0	3175.8240	0.0000	OK
600 minute winter	South Pond 1	585	89.942	1.242	44.1	473.7509	0.0000	SURCHARGED
1440 minute winter	South Pond 2	1680	86.713	1.013	41.8	1442.1980	0.0000	SURCHARGED
30 minute summer	1	76	85.377	0.127	35.2	0.0000	0.0000	OK
60 minute winter	Filter Drain 1	59	86.656	0.706	72.3	76.3240	0.0000	FLOOD RISK
60 minute winter	Filter Drain 2	59	86.415	1.015	133.2	117.4314	0.0000	FLOOD RISK
30 minute winter	2	76	85.124	0.124	35.2	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
480 minute winter	North Pond 1	3.000_1	North Pond 2	33.0	2.156	0.114	3.0900	
1440 minute winter	North Pond 2	ACO Q-Brake		10.6				793.1
600 minute winter	South Pond 1	2.000	South Pond 2	6.0	1.535	0.114	0.3610	
1440 minute winter	South Pond 2	2.001_1	1	4.3	0.769	0.298	0.5950	
30 minute summer	1	1.002	2	35.2	1.256	0.367	0.9390	296.6
60 minute winter	Filter Drain 1	3.000	Filter Drain 2	13.3	0.644	0.241	7.0419	
60 minute winter	Filter Drain 2	2.001	1	30.9	1.147	0.337	0.5983	

Flow+ v17.0 Copyright © 1988-2026 Causeway Technologies Ltd

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.92%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
600 minute winter	North Pond 1	585	96.540	1.040	230.0	2486.3850	0.0000	SURCHARGED
1440 minute winter	North Pond 2	1680	91.655	1.155	81.3	3318.2260	0.0000	OK
600 minute winter	South Pond 1	585	90.060	1.360	49.3	543.7408	0.0000	SURCHARGED
1440 minute winter	South Pond 2	1680	86.809	1.109	46.6	1608.0330	0.0000	SURCHARGED
240 minute summer	1	124	85.377	0.127	35.2	0.0000	0.0000	OK
60 minute winter	Filter Drain 1	60	86.739	0.789	80.9	89.3234	0.0000	FLOOD RISK
60 minute winter	Filter Drain 2	59	86.547	1.147	147.3	136.3645	0.0000	FLOOD RISK
240 minute summer	2	124	85.124	0.124	35.2	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
600 minute winter	North Pond 1	3.000_1	North Pond 2	33.0	2.145	0.114	3.0899	
1440 minute winter	North Pond 2	ACO Q-Brake		10.6				809.4
600 minute winter	South Pond 1	2.000	South Pond 2	6.0	1.525	0.114	0.3611	
1440 minute winter	South Pond 2	2.001_1	1	4.3	0.779	0.297	0.6055	
240 minute summer	1	1.002	2	35.2	1.256	0.367	0.9389	538.1
60 minute winter	Filter Drain 1	3.000	Filter Drain 2	16.4	0.646	0.297	7.0419	
60 minute winter	Filter Drain 2	2.001	1	30.9	1.148	0.337	0.5965	

Flow+ v17.0 Copyright © 1988-2026 Causeway Technologies Ltd

Appendix 12: Minor Works Calculations (Pedestrian / Cycle Path Filter Drain)

Design Settings

Rainfall Methodology	FEH-22	Maximum Time of Concentration (mins)	30.00	Preferred Cover Depth (m)	0.600
Return Period (years)	2	Maximum Rainfall (mm/hr)	50.0	Include Intermediate Ground	✓
Additional Flow (%)	0	Minimum Velocity (m/s)	0.30	Enforce best practice design rules	✓
CV	0.750	Connection Type	Level Soffits		
Time of Entry (mins)	5.00	Minimum Backdrop Height (m)	0.200		

Nodes

Name	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)	Invert Level (m)
1	5.00	100.100	1200	50.261	74.814	0.950	99.150
2		100.000	1200	50.261	49.966	0.900	99.100
3		101.000		50.499	46.032	1.210	99.790

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	1	2	25.000	0.060	99.150	99.100	0.050	500.0	150	5.78	49.3
1.001	2	3	3.941	0.060	99.800	99.790	0.010	394.1	100	5.92	48.7

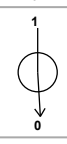
Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.535	9.4	1.3	0.800	0.750	0.010	0.0	35	0.428
1.001	0.463	3.6	1.3	0.100	1.110	0.010	0.0		

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	25.000	500.0	150	filter drain	100.100	99.150	0.800	100.000	99.100	0.750
1.001	3.941	394.1	100	Circular	100.000	99.800	0.100	101.000	99.790	1.110

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	1	1200	Manhole	Adoptable	2	1200	Manhole	Adoptable
1.001	2	1200	Manhole	Adoptable	3		Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
1	50.261	74.814	100.100	0.950	1200		0	1.000	99.150	150
2	50.261	49.966	100.000	0.900	1200		1	1.000	99.100	150
							0	1.001	99.800	100
3	50.499	46.032	101.000	1.210			1	1.001	99.790	100

Simulation Settings

Rainfall Methodology	FEH-22	Winter CV	0.900	Drain Down Time (mins)	1440	Check Discharge Rate(s)	x
Rainfall Events	Singular	Analysis Speed	Detailed	Additional Storage (m³/ha)	0.0	Check Discharge Volume	x
Summer CV	0.900	Skip Steady State	✓	Starting Level (m)			

Storm Durations

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

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0	100	0	0	0
10	0	0	0	100	40	0	0
30	0	0	0				

Node 2 Online Orifice Control

Flap Valve	x	Invert Level (m)	99.800	Discharge Coefficient	0.600
Replaces Downstream Link	x	Diameter (m)	0.001		

Flow+ v16.0 Copyright © 1988-2026 Causeway Technologies Ltd

Results for 1 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
720 minute summer	1	465	99.231	0.081	0.0	0.0911	0.0000	OK
720 minute summer	1.000:50%	465	99.231	0.106	0.2	0.1570	0.0000	OK
720 minute summer	2	465	99.231	0.131	0.1	0.4613	0.0000	OK
15 minute summer	3	1	99.790	0.000	0.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
720 minute summer	1	1.000	1.000:50%	0.0	-0.030	-0.004	0.1430	
720 minute summer	1	1.000	2	0.1	0.222	0.012	0.1845	
720 minute summer	2	1.001	3	0.0	0.000	0.000	0.0000	0.0
720 minute summer	2	Infiltration (1.000)		0.1				

Flow+ v16.0 Copyright © 1988-2026 Causeway Technologies Ltd

Results for 10 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
480 minute winter	1	448	99.481	0.331	0.1	0.3745	0.0000	SURCHARGED
480 minute winter	1.000:50%	448	99.481	0.356	0.3	0.5143	0.0000	SURCHARGED
480 minute winter	2	448	99.481	0.381	0.2	1.1563	0.0000	OK
15 minute summer	3	1	99.790	0.000	0.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
480 minute winter	1	1.000	1.000:50%	-0.1	-0.012	-0.008	0.2201	
480 minute winter	1	1.000	2	0.2	0.222	0.021	0.2201	
480 minute winter	2	1.001	3	0.0	0.000	0.000	0.0000	0.0
480 minute winter	2	Infiltration (1.000)		0.1				

Flow+ v16.0 Copyright © 1988-2026 Causeway Technologies Ltd

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.15%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
600 minute summer	1	405	99.610	0.460	0.1	0.5203	0.0000	SURCHARGED
600 minute summer	1.000:50%	405	99.610	0.485	0.5	0.7314	0.0000	SURCHARGED
600 minute summer	2	405	99.610	0.510	0.3	1.5199	0.0000	OK
15 minute summer	3	1	99.790	0.000	0.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
600 minute summer	1	1.000	1.000:50%	-0.1	-0.014	-0.010	0.2201	
600 minute summer	1	1.000	2	0.3	0.222	0.031	0.2201	
600 minute summer	2	1.001	3	0.0	0.000	0.000	0.0000	0.0
600 minute summer	2	Infiltration (1.000)		0.1				

Flow+ v16.0 Copyright © 1988-2026 Causeway Technologies Ltd

Results for 100 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
720 minute summer	1	480	99.786	0.636	0.1	0.7192	0.0000	SURCHARGED
720 minute summer	1.000:50%	480	99.786	0.661	0.6	1.0281	0.0000	SURCHARGED
720 minute summer	2	480	99.786	0.686	0.3	2.0151	0.0000	OK
15 minute summer	3	1	99.790	0.000	0.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
720 minute summer	1	1.000	1.000:50%	-0.1	-0.014	-0.011	0.2201	
720 minute summer	1	1.000	2	0.3	0.222	0.036	0.2201	
720 minute summer	2	1.001	3	0.0	0.000	0.000	0.0000	0.0
720 minute summer	2	Infiltration (1.000)		0.1				

Flow+ v16.0 Copyright © 1988-2026 Causeway Technologies Ltd

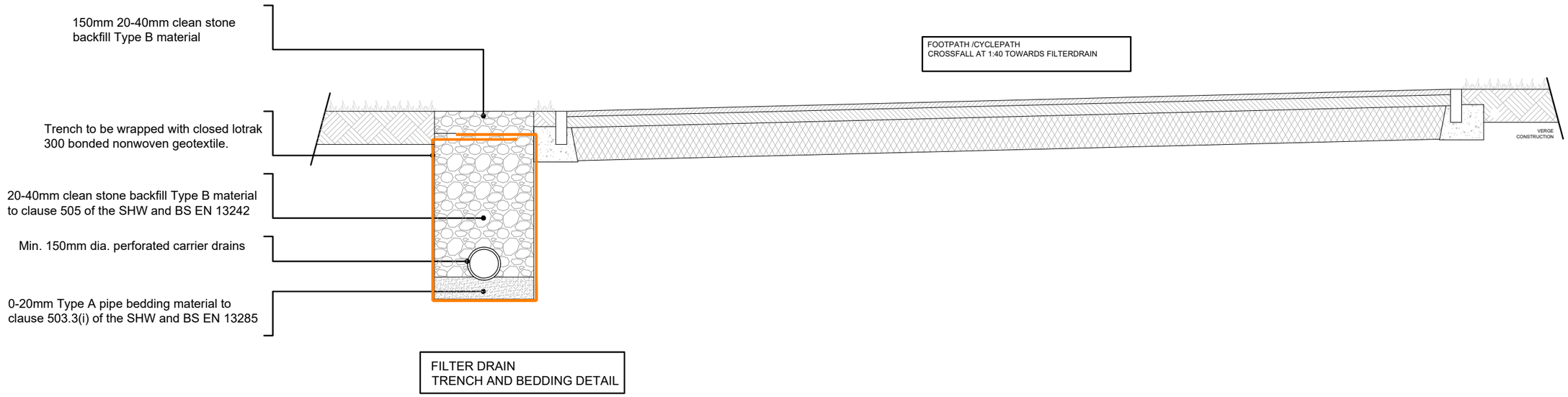
Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.50%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
600 minute summer	1	375	100.001	0.851	0.2	0.9624	0.0000	FLOOD RISK
480 minute summer	1.000:50%	304	100.001	0.876	1.1	1.3908	0.0000	SURCHARGED
720 minute summer	2	435	100.000	0.900	0.5	2.6197	0.5208	FLOOD
480 minute summer	3	312	99.790	0.000	0.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
600 minute summer	1	1.000	1.000:50%	-0.2	-0.009	-0.017	0.2201	
600 minute summer	1	1.000	2	0.5	0.222	0.054	0.2201	
720 minute summer	2	1.001	3	0.0	0.000	0.000	0.0001	0.0
720 minute summer	2	Infiltration (1.000)		0.2				

Flow+ v16.0 Copyright © 1988-2026 Causeway Technologies Ltd

Appendix 13: Minor Works Drawing (Typical Filter Drain Detail)



FILTER DRAIN
TRENCH AND BEDDING DETAIL

Notes

1. Do not scale this drawing. All dimensions must be checked/ verified on site. If in doubt ask.
2. This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.
3. All dimensions in millimetres unless noted otherwise. All levels in metres unless noted otherwise.
4. Any discrepancies noted on site are to be reported to the engineer immediately.

© Copyright BWB Consulting Ltd

Key Plan

Issues & Revisions

Rev	Date	Details of issue / revision	Drw	Rev
P1	20.02.26	PRELIMINARY ISSUE	GSL	RJ

BWB
A CAF GROUP COMPANY
Birmingham | 0121 233 3322
Leeds | 0113 233 8000
London | 020 7234 9122
Manchester | 0161 233 4260
Nottingham | 0115 924 1100
www.bwbconsulting.com

Client
OXFORDSHIRE RAILFREIGHT LTD

Project Title
OxSRFI OXFORDSHIRE STRATEGIC RAIL FREIGHT INTERCHANGE

Drawing Title
CYCLEPATH / FOOTPATH DRAINAGE

Drawn:	[redacted]	Reviewed:	[redacted]

BWB Ref:	NTH 2479	Date:	20.02.26	Scale@A3:	1:50

Drawing Status
PRELIMINARY

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
OFRI-BWB-EWE-ZZ-DR-CD-0520	S2	P01

\\bwbnotfil01\nottingham\Data\NTH\NTH2479_Oxfordshire RFI\02. Project Delivery\01. WIP\Drawings\OFRI-BWB-EWE-ZZ-DR-CD-0520_NMU Route Drainage_P01.dwg

BWB

A CAF GROUP COMPANY

www.bwbconsulting.com