Our Ref: WRC-BWB-ZZ-XX-T-W-0004_Response to LLFA
Contact: Sian Renwick
Direct Dial: 0121 212 8704 / 07469 290 581
Email: Sian.Renwick@bwbconsulting.com

Date: 07 November 2025

Dear Sophie Lynes,

Consultation with the Lead Local Flood Authority on the Proposed Development at Land South-East of Rugby Road, Clifton-upon-Dunsmore

Thank you for your comments regarding the outline planning application for a proposed residential development and associated works at Land South-East of Rugby Road, Clifton-upon-Dunsmore (planning application reference: R25/0565; consultation reference: WCC003605/FRM/SL/001).

We have noted the concerns regarding the proposed drainage strategy and downstream flood risk and wish to further consult with the LLFA to discuss these. Specifically, the LLFA comments states that '*details relating to surface water drainage are insufficient*' and requests that further information is provided. These concerns and our response to these comments are provided below.

Capacity and Condition of the Ordinary Watercourse

Firstly, further information related to the ordinary watercourse and proposed point of outfall was requested. We have undertaken an assessment of the existing and proposed flows into the existing culverts associated with the unnamed ordinary watercourse (UOW), with consideration of climate change, and of the capacity of these culverts. This assessment is detailed in the appended Culvert Capacity Assessment Technical Note (reference: 244849-BWB-ZZ-XX-T-W-0003_CCA, dated November 2025) and can be seen in **Appendix 1**. It was concluded that the culverts downstream of the proposed outfall location have sufficient capacity to accommodate the post-development flow rates.

As part of this specific comment, the condition of the channel and culverts was raised. BWB Consulting visited the site in January and July 2025; it was observed that the UOW is subject to maintenance as shown in Figures 1 and 2. At this time, it is considered that as this watercourse and its associated structures are within the wider ownership, these will be subject to regular inspection and maintenance, where necessary, as part of riparian ownership responsibilities to ensure these remain in good operational condition and capable of conveying flows. This will be done in accordance with the relevant LLFA riparian guidance and best practice.

Figure 1: View from Culvert A (Pond Outfall) looking downstream

Figure 2: View towards Culvert C (Houlton Way) looking downstream

Additional Topographical Survey

The second point raised was that the topographical survey provided as part of the submission did not cover the entirety of the site boundary. Further survey was undertaken by BWB Consulting in October 2025 to capture the proposed route of the surface water drainage outfall as well as the UOW and associated culverts. The topographical survey is appended to the Culvert Capacity Assessment Technical Note within **Appendix 1**.

Following the additional survey, the surface water drainage strategy has been reviewed which has confirmed that a gravity-led outfall will be feasible. As part of this review, indicative cross-sections of the attenuation features have also been produced as suggested in the LLFA's comment and can be seen in **Appendix 2** (reference: 244849-BWB-ZZ-XX-D-W-0002). This has shown that it is suitable to locate the attenuation basins in the proposed locations within the site.

Incorporation of Further SuDS Features

The LLFA's comment notes the recommendation in the Sustainable Drainage Statement (SDS) produced by BWB Consulting (reference: 244849-BWB-ZZ-XX-T-W-0002_SDS, dated July 2025) that further levels of surface water treatment are provided through additional Sustainable Drainage System (SuDS) features. The comment raises a concern regarding how to ensure that SuDS features will be incorporated as the design progresses.

Given the outline nature of the application, it is considered at this stage that it is suitable to provide this recommendation in the SDS to encourage the implementation of SuDS features as part of a detailed design. This is under the reasonable assumption that as the development layout and drainage areas are fixed during the detailed design stage, the surface water drainage strategy will be updated and will incorporate SuDS features in line with the relevant national and local guidance, including the LLFA's Flood Risk Guidance for Development (Warwickshire County Council, June 2023). If the LLFA is minded to do so, it may be appropriate for them to condition the consideration and assessment of SuDS features at the detailed design stage.

Exceedance and Overland Flow Routing

The final concern that the LLFA have raised relates to consideration of exceedance and overland flow routing. Within the SDS, there is commentary on 'Residual Risk and Designing for Exceedance' within Section 3. This provides a recommendation related to the use of proposed road infrastructure to provide exceedance routes through the development at the detailed design stage. It also notes that a filter drain is proposed to capture overflow in the south-west corner of the site. Furthermore, the site generally falls south, meaning any exceedance will flow away from the proposed development. The proposed swale bordering the south of the development will also capture flows in case of exceedance. As such, our understanding is that exceedance and overland flow routing has been considered at a level appropriate for this outline application.

Further Comments

Regarding flood risk, we have noted the LLFA's agreement that the site is located within Flood Zone 1 and is largely at very low surface water flood risk.

The advisory suggesting that correspondence should be had with the Canal and River Trust (CRT), given the UOW ultimately discharges to the Oxford Canal, has been noted. We are undertaking further consultation with the CRT following receipt of their consultation comments.

We have also noted the informative regarding the need to obtain consent from the LLFA prior to undertaking works on the UOW.

Conclusion

To summarise, the LLFA's comments on the outline planning application for a proposed residential development and associated works at Land South-East of Rugby Road, Clifton-upon-Dunsmore have been gratefully received. We have reviewed these comments and have undertaken further work to address these, namely further topographical survey, an assessment of the capacity and condition of the UOW and associated culverts and additional surface water drainage drawings.

We hope that the above commentary and appended further information will satisfy the LLFA's request for further information and allow their objections to be overcome; however, should any further queries or concerns arise, please do not hesitate to contact us.

Yours sincerely,

Sian Renwick

Consultant

APPENDICES

Appendix 1: Culvert Capacity Assessment Technical Note

ADVISORY

Richborough
Land East of Rugby Road
Clifton-upon-Dunsmore, Rugby
Culvert Capacity Assessment Technical Note

November 2025

Document Number:	244849-BWB-ZZ-XX-T-W-0003_CCA
BWB Reference:	244849_CCA

Revision	Date of Issue	Status	Author:	Checked:	Approved:
P01	06/11/2025	S2	Sian Renwick MSci (Hons)	Cameron Leighton BSc (Hons) MSc	Rowan Jobling BEng (Hons)

Notice

1. INTRODUCTION

1.1 This report has been prepared on behalf of Richborough in respect of a planning application for a proposed residential development at Land East of Rugby Road in Clifton-upon-Dunsmore, Rugby.

1.2 A Flood Risk Assessment and a Sustainable Drainage Statement were previously prepared by BWB Consulting for the site (reference: 244849-BWB-ZZ-XX-T-W-0001_FRA and 244849-BWB-ZZ-XX-T-W-0002_SDS, dated July 2025). There reports were submitted to accompany an outline planning application (reference: R25/0565) submitted in August 2025.

1.3 Warwickshire County Council (WCC), as the Lead Local Flood Authority (LLFA), and the Canal and River Trust (CRT) have commented on the application (dated 22/09/2025 and 03/10/2025 respectively). Both consultees have requested additional details related to surface water drainage.

1.4 This report is intended to provide a technical summary for the assessment of the capacity of culverts along an Unnamed Ordinary Watercourse (UOW), which the surface water drainage strategy for the proposed development is proposed to discharge to. The location of the UOW and associated culverts is shown in **Figure 1.1**.

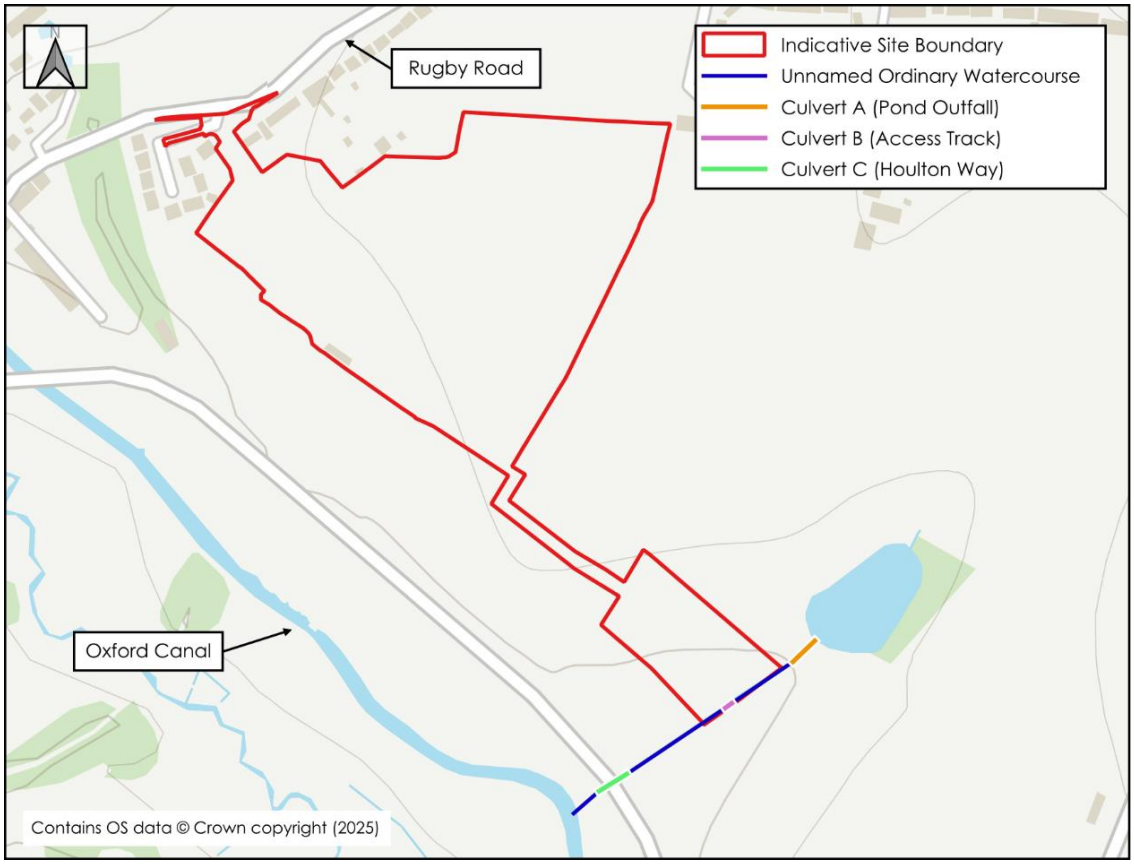

Figure 1.1: Unnamed Ordinary Watercourse and Culvert Network

1.5 To support this assessment, additional topographical survey has been undertaken; this is included as **Appendix 1**.

2. RELEVANT GUIDANCE

Warwickshire County Council LLFA Flood Risk Guidance for Development

2.1 WCC, as the LLFA, have produced a guidance document[1] relating to flood risk and drainage for new developments within the county. Key points from the guidance are included below:

- Surface water discharge rates from an undeveloped (greenfield) site should not exceed the QBar or QMed greenfield rate for the development.
- The capacity of the receiving watercourse should be assessed to ensure that additional flows will not increase flood risk elsewhere.

Climate Change Allowances

2.2 Predicted future changes in sea levels, peak river flows, and rainfall intensities caused by climate change are provided by the Environment Agency (EA) online[2]. A range of projections are applied to regionalised 'River Basin Districts', which are further subdivided into Management Catchments, to provide a series of climate change allowances. The appropriate climate change allowances are determined by a number of factors that include the source of flooding, the current level of risk, the vulnerability of the proposed development, and the lifespan of the development.

2.3 The site falls within the Avon Warwickshire Management Catchment of the Severn River Basin District. **Table 2.1** identifies the relevant peak rainfall climate change allowances.

Table 2.1: Peak Rainfall Allowances for the Avon Warwickshire Management Catchment

Avon Warwickshire Management Catchment Allowance	Total potential change anticipated for the '2050s' epoch (2022 to 2060)	Total potential change anticipated for the '2070s' epoch (2061 to 2125)
1 in 30-Year Rainfall Event		
Upper End	35%	35%
Central	20%	25%
1 in 100-Year Rainfall Event		
Upper End	40%	40%
Central	20%	25%

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

[1] Warwickshire County Council (June 2023) Flood Risk Guidance for Development.
[2] Environment Agency (May 2022) Flood Risk Assessments: Climate Change Allowances. Available at: https://www.gov.uk/guidance/flood-risk-assessments-climate-changeallowances. Last accessed November 2025.

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

2.5 **Table 2.2** provides a summary of the EA's guidance on determining the appropriate allowance(s).

Table 2.2: Application of Appropriate Peak Rainfall Climate Change Allowances – New Development Drainage Design

Area Assessed	Anticipated Development Life Span		
	up to 2060	between 2061 and 2100	up to or beyond 2100*
Development Sites^ Assess the 1 in 30-year and 1 in 100-year storm events with the respective climate change allowance(s) applied. Development to be designed so that with the climate change allowance applied to the 1 in 100-year storm: • there is no increase in flood risk elsewhere • the development will be safe from surface water flooding	Use the Central Allowance for the 2050s	Use the Central Allowance for the 2070s+	Use the Upper End Allowance for the 2070s+

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

2.6 The proposed development has an anticipated lifespan of 100+ years. As such, the Upper End allowance for the '2070s' epoch will be considered in this assessment.

3. HYDRAULIC ASSESSMENT

Existing Capacity

3.1 The existing maximum flows that the culverts could convey were estimated in litres per second (l/s), using the Colebrook-White equation. The culvert details (diameter and length) were taken from the topographical survey, included as **Appendix 1**. The fall of the pipe was estimated using the surveyed invert levels.

3.2 The existing culvert discharge assessment is summarised within **Table 3.1**; the flow calculation sheets are included as **Appendix 2**.

Table 3.1: Existing Culvert Flows

Culvert	Diameter (mm)	Length (m)	Overall Fall of Pipe (m)	Gradient (%)	Maximum Available Capacity (l/s)
Culvert A (Pond Outfall)	180	23.7	0.3	18.7	125.6
Culvert B (Access Track)	300	6.1	4.4	4.9	246.7
Culvert C (Houlton Way)	600	28.6	0.1	0.5	495.0

Existing Flow Rates

3.3 Inflows to the culverts were estimated using HR Wallingford's Greenfield Runoff Rate Estimation Tool[3]. A greenfield runoff rate estimation was undertaken on a litres per second per hectare (l/s/ha) basis and is included as **Appendix 3**.

3.4 The 1 in 100-year runoff rate, with 40% climate change allowance, was pro-rated based on the greenfield catchment area upstream of each culvert, as delineated using the QGIS watershed tool. This is summarised in **Table 3.2**. Whilst the uppermost extents of the catchment included a limited area of residential properties, the entirety of the topographical catchment area was used in the assessment (rather than adjusting for sewers, for instance), in order to provide a conservative assessment.

3.5 However, it is noted that the flows from the upper catchment are limited by Culvert A, which effectively throttles flows and limits the flow rate to the downstream culverts. As such, the existing flows through these culverts are not considered to be equivalent to greenfield rate. Therefore, the flows from the intervening catchments between the culverts, illustrated in **Figure 3.1**, were also estimated for use in the assessment.

[3] HR Wallingford (March 2025) Greenfield Runoff Rate Estimation Tool.

Table 3.2: Greenfield Runoff Rates

Culvert	1 in 100-year runoff rate (l/s/ha)	1 in 100-year +40%CC runoff rate (l/s/ha)	Cumulative Upstream Greenfield Catchment Area (ha)	Catchment Greenfield Runoff Rate (l/s)
Culvert A (Pond Outfall)	11.2	15.7	23.9	375.0
Culvert B (Access Track)			26.9 (Intervening: 3.0)	421.9 (Intervening: 46.9)
Culvert C (Houlton Way)			34.4 (Intervening: 7.5)	539.7 (Intervening: 117.9)

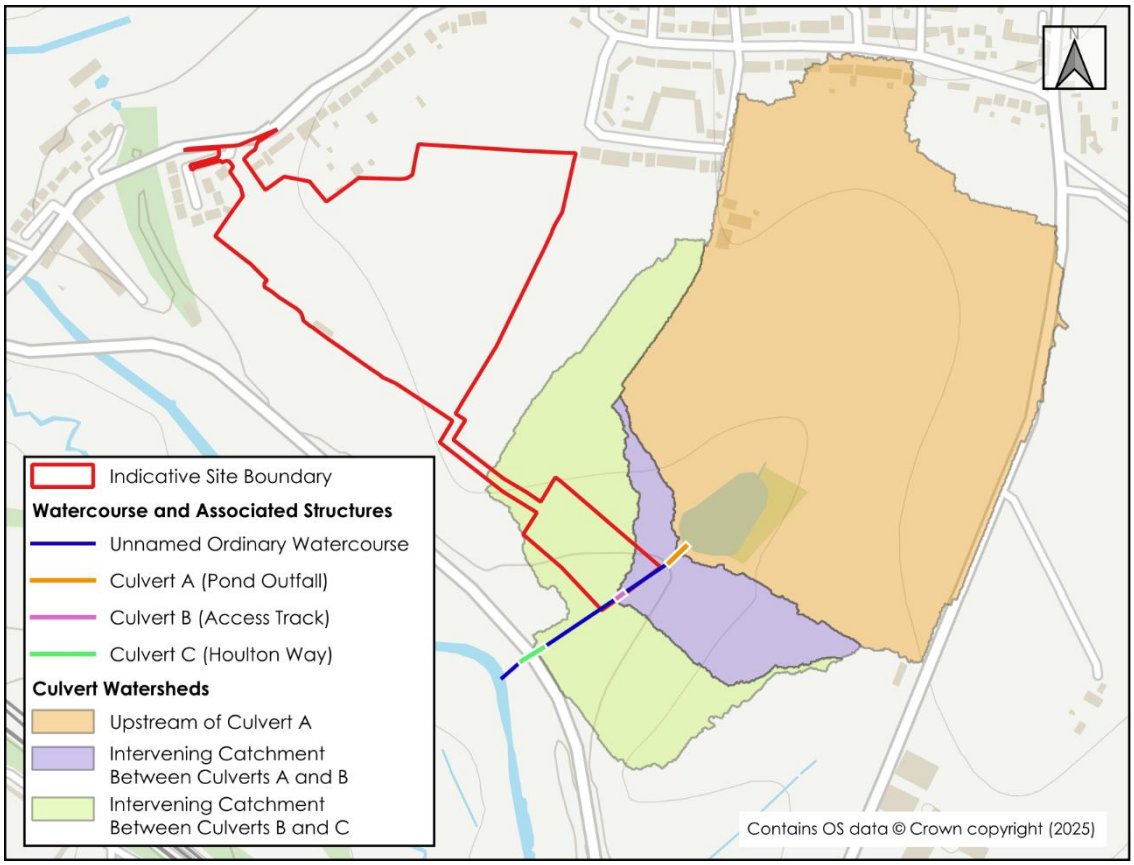

Figure 3.1: Catchment Areas

Proposed Flow Rates

3.6 As detailed in the Sustainable Drainage Statement produced by BWB Consulting (reference: 244849-BWB-ZZ-XX-T-W-0002_SDS, dated July 2025), it is proposed that the surface water discharge rate from the site is limited to 15.4l/s.

3.7 The site boundary in the vicinity of the watercourse does not comprise any built development except for drainage infrastructure. No impermeable surfaces are proposed in this area and as such, this is not included within the proposed discharge rate but is captured within the greenfield runoff rate from the catchment only.

3.8 The proposed outfall is to the UOW between Culverts A and B. This assessment will therefore establish if the culverts downstream of the proposed discharge point (Culverts B and C) have sufficient capacity to convey the proposed discharge from the development in addition to the existing flows.

3.9 The combined flow capacity requirements of the existing downstream culverts are shown in **Table 3.3**. The flow from Culvert A was assumed to be the pipe full flow (i.e. the maximum flow capacity) to enable a conservative assessment of flows downstream.

Table 3.3: Flow Capacity Requirement of Existing Downstream Culverts

Culvert	Flow from Upstream Culvert (l/s)	Proposed Development Surface Water Discharge Rate (l/s)	Runoff Rate from Intervening Greenfield Catchment (l/s)	Total Required Culvert Flow Capacity (l/s)
Culvert B (Access Track)	125.6	15.4	46.9	187.9
Culvert C (Houlton Way)	187.9*	-*	117.9	305.7

** For the capacity assessment of Culvert C, the proposed development surface water discharge rate is included within the flow from the upstream culvert (Culvert B).*

3.10 The required flow capacities with consideration to the proposed discharge rates were compared to the culvert capacities, as summarised in **Table 3.4**. Both Culvert B and Culvert C were shown to have sufficient flow capacity to accommodate the proposed flows in addition to existing flows.

Table 3.4: Comparison of Existing Culvert Capacity and Post-Development Flow Rates

Culvert	Existing Culvert Capacity (l/s)	Assessed Post-Development Flow Rates (l/s)
Culvert B (Access Track)	246.7	187.9
Culvert C (Houlton Way)	495.0	305.7

4. SUMMARY

4.1 This report has been prepared on behalf of Richborough in respect of a planning application for a proposed residential development at Land East of Rugby Road in Clifton-upon-Dunsmore, Rugby.

4.2 The surface water drainage strategy for the development proposes that surface water will be discharged to the UOW to the south-east of the site. Following the receipt of comments from the LLFA and the CRT, this report is intended to provide a technical summary for the assessment of the capacity of culverts along the UOW, with the aim of establishing if there is sufficient capacity within these structures.

4.3 The capacity of the existing culverts was calculated using surveyed dimensions and the existing flows, based on greenfield runoff rates and the capacity of upstream culverts, was estimated. Taking into account the proposed surface water discharge rate, the flow capacity required of culverts downstream of the proposed discharge location was estimated.

4.4 The required flow capacities were compared to the calculated existing culvert capacities. Both Culvert B and Culvert C were shown to have sufficient flow capacity to accommodate the proposed flows in addition to existing flows.

APPENDICES

Appendix 1: Topographical Survey

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 metres 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. No scale factor has been applied to this survey, therefore the os coordinates are to be treated as arbitrary. Please refer to survey station information below for on site control establishment.
6. All coordinates and height data relate to OSGB36(15). Control stations are coordinated by means of GPS receiving real time corrections via OS smart net.
7. All manhole data is collected from ground level therefore discrepancies may occur. More accurate data is only achievable via confined space entry.
8. OS license number: 100022432

Legend

- OS Buildings
- Surveyed Buildings
- Building
- Wall
- Kerb Channel Line
- Top of Kerb
- Edge of Surface
- Top of Bank
- Bottom of Bank
- Canopy / Overhang
- Line Marking
- Centre Line
- Watercourse Centre Line
- Barrier
- Fence
- Gate
- Overhead Powerline
- Overhead Utilities
- Contour Lines
- Inspection Chamber
- Flow direction and pipe diameter (0.25 / 1)
- Station and Name
- Monitoring Borehole (BH 1)
- Tree / Bush / Sapling
- Area of Vegetation/ Extent of Tree Canopy
- Hedge
- Body of Water
- Body of Water from OS
- Spot Level (+50.00)
- Assumed Surface Water Drainage Line
- Surface Water Drainage Line

AP	Anchor Point	FBW	Fence Barbed Wire	LB	Litter Bin
BG	Back Gully	FCB	Fence Closed Board	LP	Lamp Post
BO	Bollard	FCL	Fence Chain Link	MH	Manhole
BS	Bus Stop	FEL	Fence Electric	Mkr	Service Marker
BT	British Telecom	FMP	Fence Metal Panel	PB	Post Box
C	Crest	FMR	Fence Metal Railing	PT	Post
CL	Cover Level	FOB	Fence Open Board	RE	Rodding Eye
CMP	Cable Marker Post	FPW	Fence Post & Wire	SP	Sign Post
		FSP	Fence Steel Palisade	ST	Stop Tap
CCTV	Security Camera	FWM	Fence Wire Mesh	SV	Stop Valve
CTV	Cable TV	FFL	Finished Floor Level	TCB	Telephone Call Box
DC	Drainage Channel	FP	Flagpole	THL	Threshold Level
DK	Drop Kerb	Gas	Gas	TL	Traffic Light
DP	Down Pipe	GV	Gas Valve	TP	Telegraph Post
Elec	Electric	GY	Gully	TS	Traffic Signal
EP	Electricity Post	Ht	Height	UTS	Unable to Survey
ER	Earth Rod	IC	Inspection Chamber	WL	Water Level
FH	Fire Hydrant	IFL	Internal Floor Level	WM	Water Meter
FL	Floodlight	IL	Invert Level (as a reduced level)	WO	Wash Out

Rev	Date	Details of issue / revision	Drw	Rev
P1	17.10.25	First Issue	SDS	PQ

Issues & Revisions

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Client

Richborough Estates Limited

Project Title

Land East of Rugby Road

Drawing Title

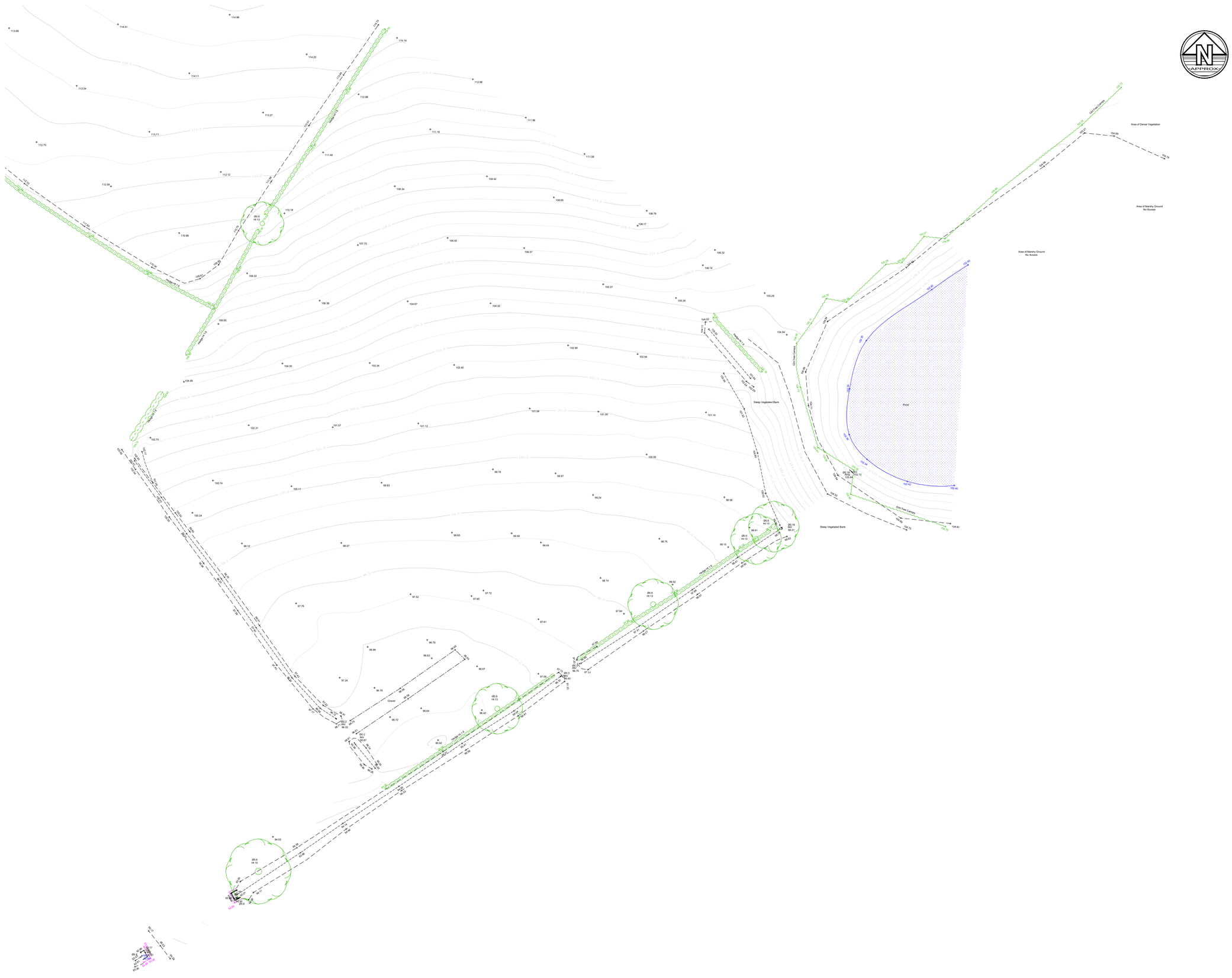
Existing Site Plan Sheet 1 of 2

Drawn:	S. D. Shreeves		Reviewed:	P. Quelch	
BWB Ref:	244849	Date:	17.10.25	Scale@A1:	1:500

Drawing Status

INFORMATION

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
244849-BWB-00-01-DR-G-001	**S2**	**P1**



Notes

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8. OS license number: 100022432

Legend

OS Buildings
Surveyed Buildings
Building
Wall
Kerb Channel Line
Top of Kerb
Edge of Surface
Top of Bank
Bottom of Bank
Canopy / Overhang
Line Marking
Centre Line
Watercourse Centre Line
Barrier
Fence
Gate
Overhead Powerline
Overhead Utilities

Contour Lines
Inspection Chamber
0.25 / 1 — Flow direction and pipe diameter
Station and Name
BH 1 — Monitoring Borehole
Tree / Bush / Sapling
Area of Vegetation/ Extent of Tree Canopy
Hedge
Body of Water
Body of Water from OS
+50.00 — Spot Level
Assumed Surface Water Drainage Line
Surface Water Drainage Line

AP	Anchor Point	FBW	Fence Barbed Wire	LB	Litter Bin
BG	Back Gully	FCB	Fence Closed Board	LP	Lamp Post
BO	Bollard	FCL	Fence Chain Link	MH	Manhole
BS	Bus Stop	FEL	Fence Electric	Mkr	Service Marker
BT	British Telecom	FMP	Fence Metal Panel	PB	Post Box
C	Crest	FMR	Fence Metal Railing	PT	Post
CL	Cover Level	FOB	Fence Open Board	RE	Rodding Eye
CMP	Cable Marker Post	FPW	Fence Post & Wire	SP	Sign Post
		FSP	Fence Steel Palisade	ST	Stop Tap
CCTV	Security Camera	FWM	Fence Wire Mesh	SV	Stop Valve
CTV	Cable TV	FFL	Finished Floor Level	TCB	Telephone Call Box
DC	Drainage Channel	FP	Flagpole	THL	Threshold Level
		Gas	Gas	TL	Traffic Light
DK	Drop Kerb	GV	Gas Valve	TP	Telegraph Post
DP	Down Pipe	GY	Gully	TS	Traffic Signal
Elec	Electric	Ht	Height	UTS	Unable to Survey
EP	Electricity Post	IC	Inspection Chamber	WL	Water Level
ER	Earth Rod	IFL	Internal Floor Level	WM	Water Meter
FH	Fire Hydrant	IL	Invert Level (as a reduced level)	WO	Wash Out
FL	Floodlight				

Rev	Date	Details of issue / revision	Drw	Rev
P1	17.10.25	First Issue	SDS	PQ

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Client
Richborough Estates Limited

Project Title
Land East of Rugby Road

Drawing Title
Existing Site Plan Sheet 2 of 2

Drawn:	S. D. Shreeves	Reviewed:	P. Quelch		
BWB Ref:	244849	Date:	17.10.25	Scale@A1:	1:500

Drawing Status
INFORMATION

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
244849-BWB-00-02-DR-G-001	S2	P1

Appendix 2: Pipe Flow Calculations

Consultancy | Environment | Infrastructure | Buildings

BWB

Job Number: 244849	**Calc number: 1**	**Rev: 1**
Project: Land East of Rugby Road	**Date: 22.10.25**	**Prepared by: SR**
Title: Pipe Full Flow - Culvert A (Pond Outfall)		**Authorised by: CL**

Colebrook-White Formula

$$V = -2\left(2gDS\right)^{0.5} \log\left(\frac{k}{3.7D} + \frac{2.5\nu}{D\left(2gDS\right)^{0.5}}\right)$$

k = Colebrook-White roughness coefficient, in metres

V = velocity, in metres per second

D = circular cross-section pipe, inside diameter, in metres

S = slope, in metres per metre

ν = kinematic viscosity of water, in square metres per second.

g =	Gravity		9.81 m/s^2
n =	kinematic viscosity of water		1.141E-06 m^2/s
k =	Colebrook-White roughl	= 0.600 mm	= 6.000E-04 m
D =	Inside diameter	= 180 mm	= 0.180 m
S =	Slope, in metres per metre		18.720%
=	(Hydraulic Gradient)		1: 5.34

Discharge:

Q = V x A

V= 4.94 m/s

A = 0.025 m^2

Q = 0.126 m^3/s = 125.6 l/s

Job Number: 244849	**Calc number: 2**	**Rev: 1**
Project: Land East of Rugby Road	**Date: 22.10.25**	**Prepared by: SR**
Title: Pipe Full Flow - Culvert B (Access Track)		**Authorised by: CL**

Colebrook-White Formula

$$V = -2\left(2gDS\right)^{0.5} \log\left(\frac{k}{3.7D} + \frac{2.5\nu}{D\left(2gDS\right)^{0.5}}\right)$$

k = Colebrook-White roughness coefficient, in metres

V = velocity, in metres per second

D = circular cross-section pipe, inside diameter, in metres

S = slope, in metres per metre

ν = kinematic viscosity of water, in square metres per second.

g =	Gravity		9.81 m/s^2
n =	kinematic viscosity of water		1.141E-06 m^2/s
k =	Colebrook-White roughl	= 0.600 mm	= 6.000E-04 m
D =	Inside diameter	= 300 mm	= 0.300 m
S =	Slope, in metres per metre		4.890%
=	(Hydraulic Gradient)		1: 20.44

Discharge:

Q = V x A

V= 3.49 m/s

A = 0.071 m^2

Q = 0.247 m^3/s = 246.7 l/s

Consultancy | Environment | Infrastructure | Buildings

BWB

Job Number: 244849	**Calc number: 3**	**Rev: 1**
Project: Land East of Rugby Road	**Date: 22.10.25**	**Prepared by: SR**
Title: Pipe Full Flow - Culvert C (Houlton Way)		**Authorised by: CL**

Colebrook-White Formula

$$V = -2\left(2gDS\right)^{0.5} \log\left(\frac{k}{3.7D} + \frac{2.5\nu}{D\left(2gDS\right)^{0.5}}\right)$$

k = Colebrook-White roughness coefficient, in metres

V = velocity, in metres per second

D = circular cross-section pipe, inside diameter, in metres

S = slope, in metres per metre

ν = kinematic viscosity of water, in square metres per second.

g =	Gravity		9.81 m/s^2
n =	kinematic viscosity of water		1.141E-06 m^2/s
k =	Colebrook-White roughness	= 0.600 mm	= 6.000E-04 m
D =	Inside diameter	= 600 mm	= 0.600 m
S =	Slope, in metres per metre		0.520%
=	(Hydraulic Gradient)		1: 190.59

Discharge:

Q = V x A

V= 1.75 m/s

A = 0.283 m^2

Q = 0.495 m^3/s = 495.0 l/s

Appendix 3: Greenfield Runoff Rate Estimation

Greenfield runoff rate estimation tool

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

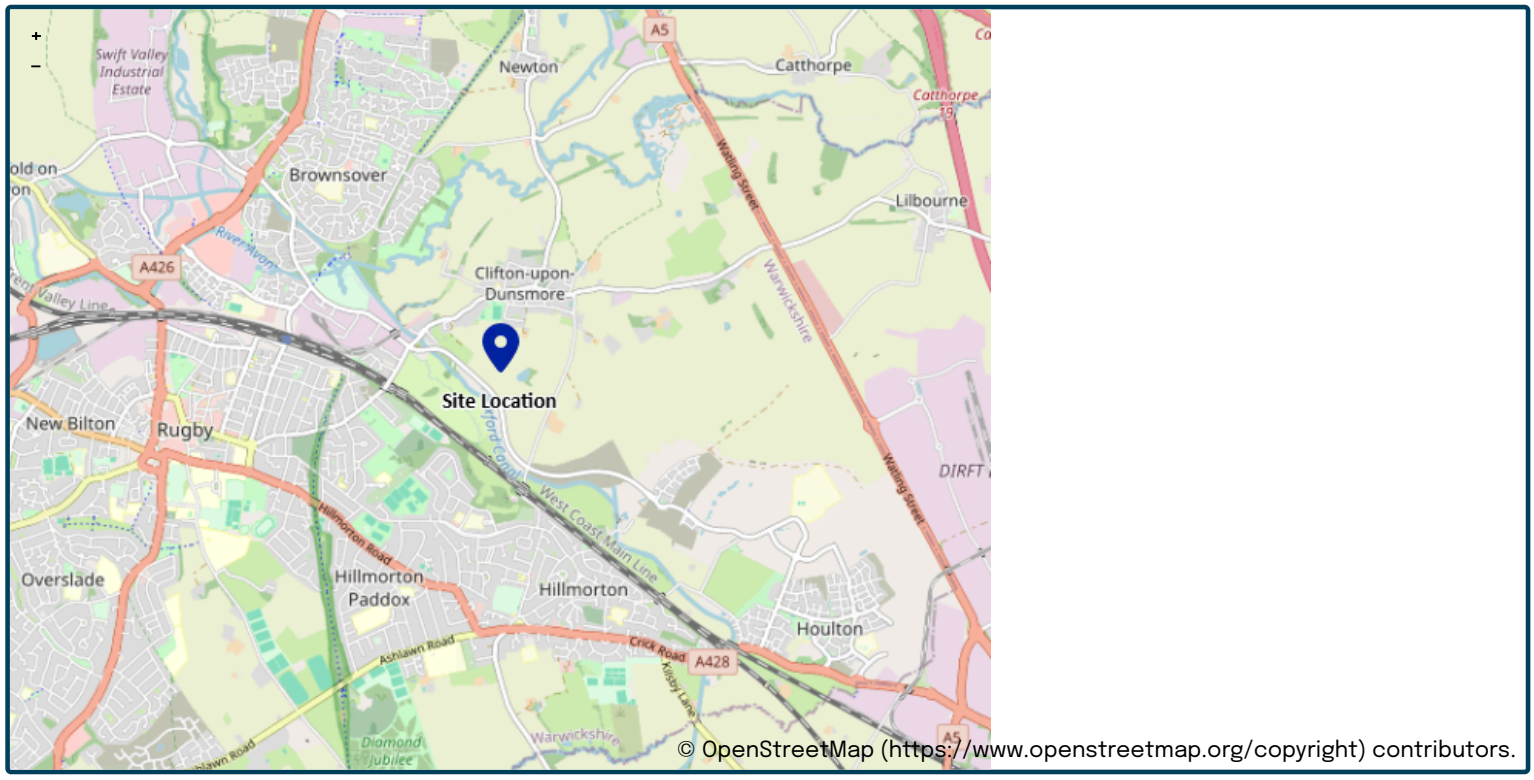
This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance “Rainfall runoff management for developments”, SC030219 (2013), the SuDS Manual C753 (CIRIA, 2015) and the non-statutory standards for SuDS (Defra, 2015). 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	21/10/2025
Calculated by	Sian Renwick
Reference	244849
Model version	2.2.1

Location

Site name	Land East of Rugby Road
Site location	Clifton-upon-Dunsmore



Site easting (British National Grid)	452833
Site northing (British National Grid)	275521

Site details

Total site area (ha)	1 ha

Greenfield runoff

Method

Method	IH124

IH124

	My value		Map value
SAAR (mm)	639 mm		639
How should SPR be derived?	WRAP soil type		
WRAP soil type	4		4
SPR	0.47		
QBar (IH124) (l/s)	4.3 l/s		

Growth curve factors

	My value		Map value
Hydrological region	4		4
1 year growth factor	0.83		
2 year growth factor	0.89		
10 year growth factor	1.49		
30 year growth factor	2		
100 year growth factor	2.57		
200 year growth factor	3.04		

Results

Method	IH124
Flow rate 1 year (l/s)	3.6 l/s
Flow rate 2 year (l/s)	3.9 l/s
Flow rate 10 years (l/s)	6.5 l/s
Flow rate 30 years (l/s)	8.7 l/s
Flow rate 100 years (l/s)	11.2 l/s
Flow rate 200 years (l/s)	13.2 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

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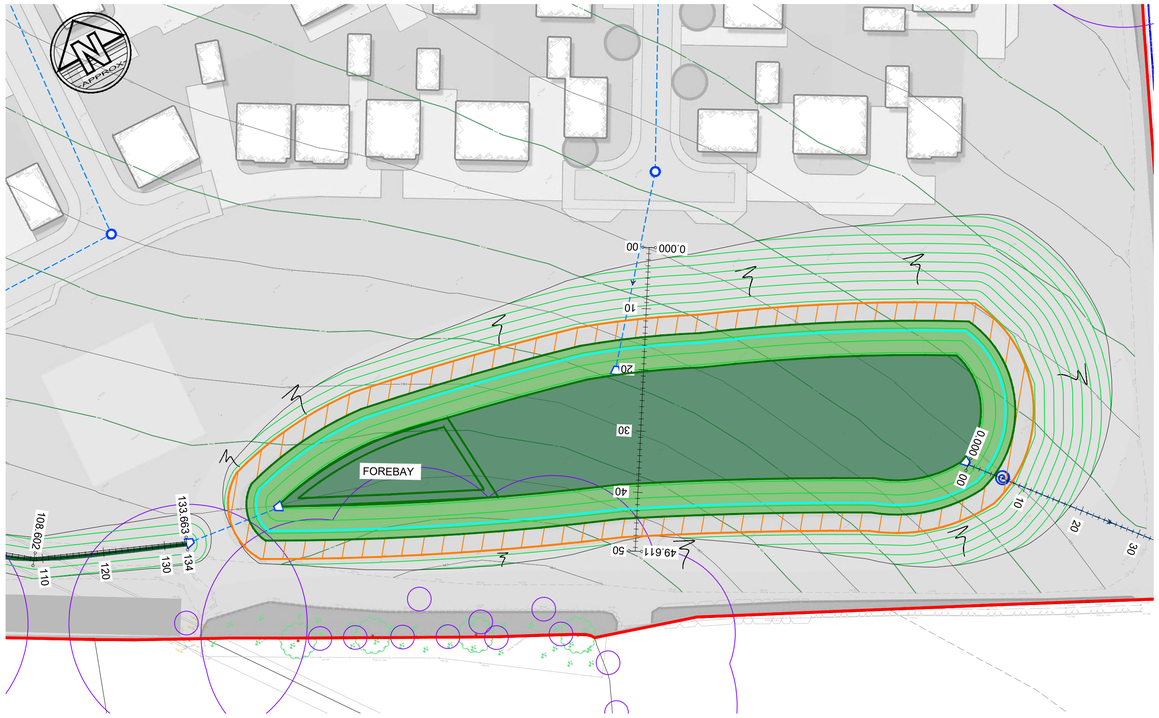
Appendix 2: SuDS Cross Sections

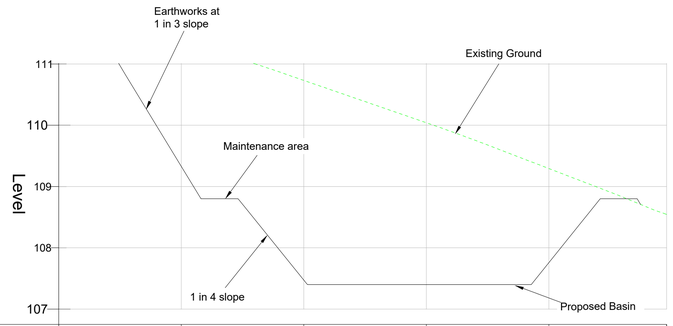


DETENTION BASIN 1 PLAN VIEW
1:500

KEY

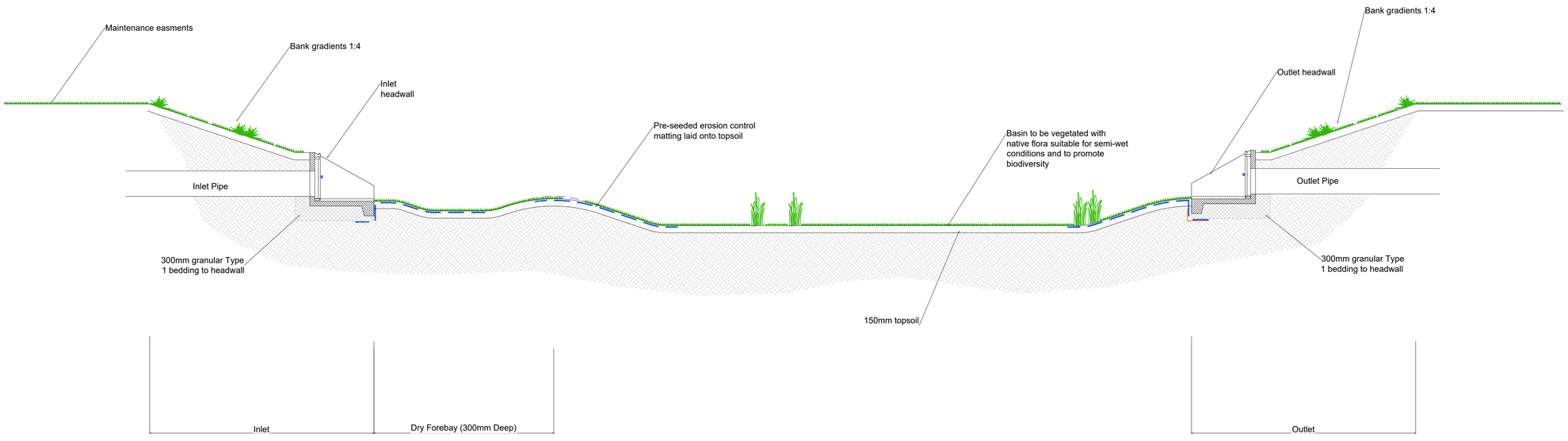
Existing Ground

Proposed Basin



Chainage	0.000	10.000	20.000	30.000	40.000	49.611
Existing Levels	112.015	111.394	110.732	110.041	109.293	108.545
Proposed Levels			107.472	107.400	107.757	
Level Difference			3.259	2.641	1.536	

DETENTION BASIN 1 CROSS SECTION
SCALE: H 1:250,V 1:50. DATUM: 107.000



ILLUSTRATIVE DETENTION BASIN
NOT TO SCALE

Notes

1. Do not scale this drawing. All dimensions must be checked/ verified on site. If in doubt ask.
2. All dimensions in millimetres unless noted otherwise. All levels in metres unless noted otherwise.
3. This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.
4. Any discrepancies noted on site are to be reported to the engineer immediately.
5. Strategy based on Masterplan from Marrons Framework Plan dated 08.05.25.
6. The impermeable area is assumed to be 65% of the developable area. An additional 10% allowance has been included to account for urban creep.
7. All detention basins to have minimum 1:4 internal side slopes. Basin forebays and erosion protection should be considered at detailed design.
8. This design is a proof of concept only and all details are to be confirmed at the detailed design stage in agreement with all relevant statutory consultees. Do not construct based on this drawing.
9. Topographical surveys based on Greenhatch drawing reference '53046_T' dated January 2025 and BWB drawing reference '244849-BWB-00-02-DR-G-001' dated October 2025.
10. Drawing to be read in conjunction with the Illustrative Drainage Strategy drawing reference '244849-BWB-ZZ-XX-D-W-0001'

Legend

Rev	Date	Details of issue / revision	Drw	Rev
P01	07.11.25	Preliminary Issue	AS	RJ

Issues & Revisions

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Client
RICHBOROUGH

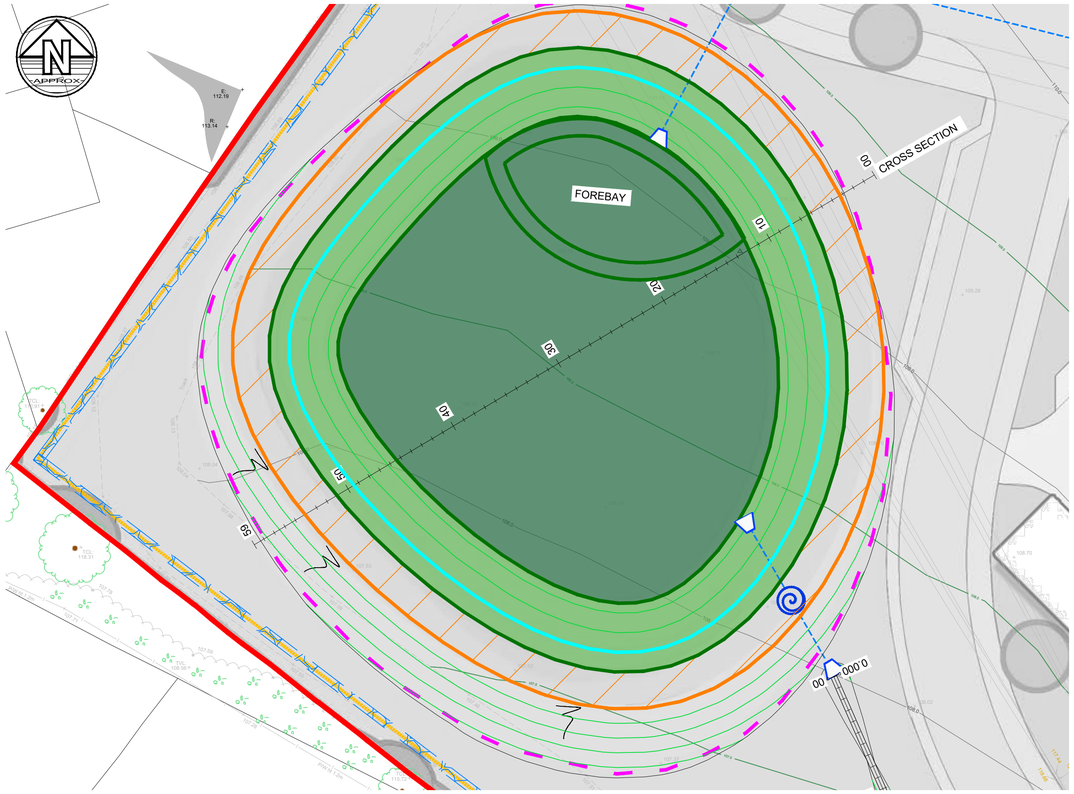
Project Title
LAND EAST OF RUGBY ROAD

Drawing Title
SuDS design cross sections Sheet 1

Drawn:	A. Shademani	Reviewed:	R. Jobling
BWB Ref:	244849	Date:	07/11/25
Scale@A1:	As Shown		

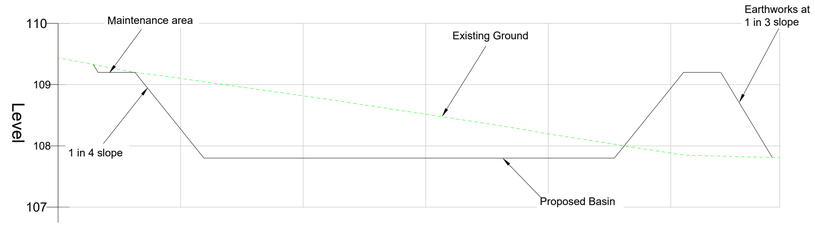
Drawing Status
PRELIMINARY

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
244849-BWB-ZZ-XX-D-W-0002	**S2**	**P01**



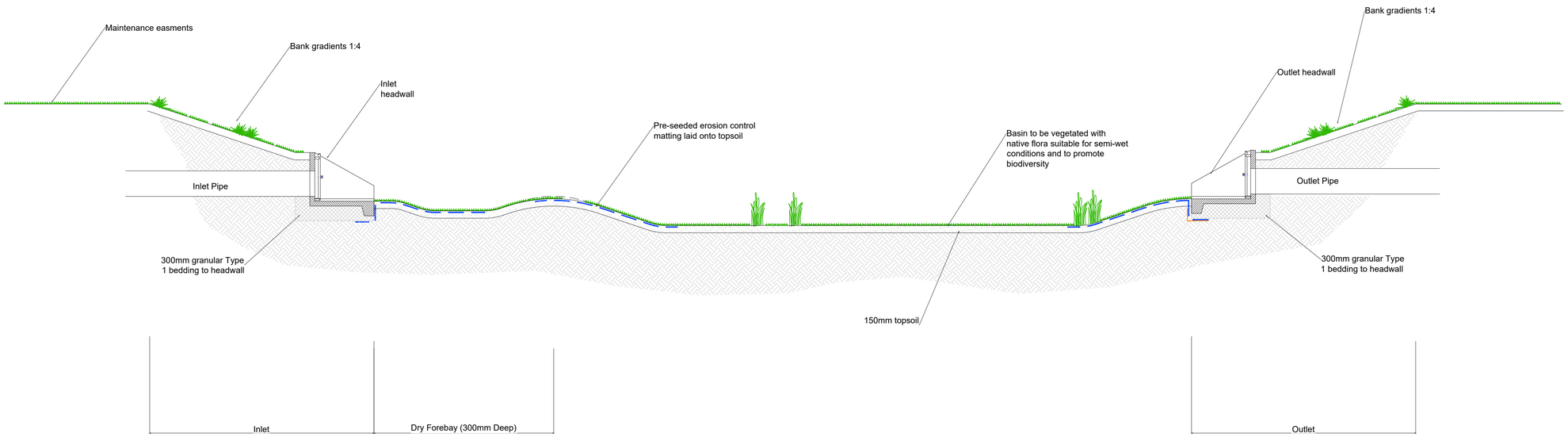
DETENTION BASIN 2 PLAN VIEW
1:250

KEY
Existing Ground
Proposed Basin



Chainage	00	10.000	20.000	30.000	40.000	50.000	58.906
Existing Levels		109.101	108.816	108.516	108.198	107.882	
Proposed Levels		108.275	107.800	107.800	107.800	108.938	
Level Difference		0.827	1.016	0.716	0.398	1.056	

DETENTION BASIN 2 CROSS SECTION
SCALE: H 1:250,V 1:50. DATUM: 107.000



ILLUSTRATIVE DETENTION BASIN
NOT TO SCALE

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Legend

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Client
RICHBOROUGH

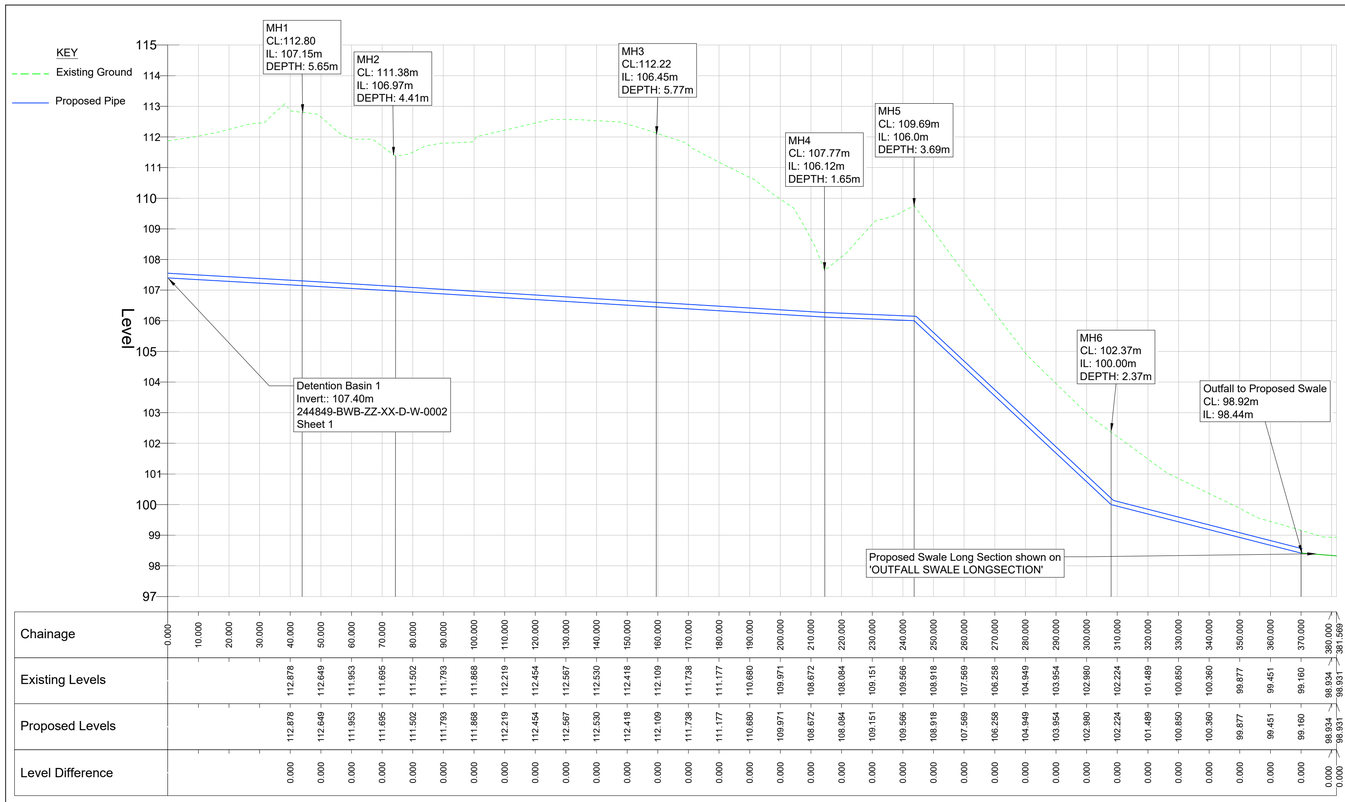
Project Title
LAND EAST OF RUGBY ROAD

Drawing Title
SuDS design cross sections Sheet 2

Drawn:	A. Shademani	Reviewed:	R. Jobling
BWB Ref:	244849	Date:	07/11/25
Scale@A1:	As Shown		

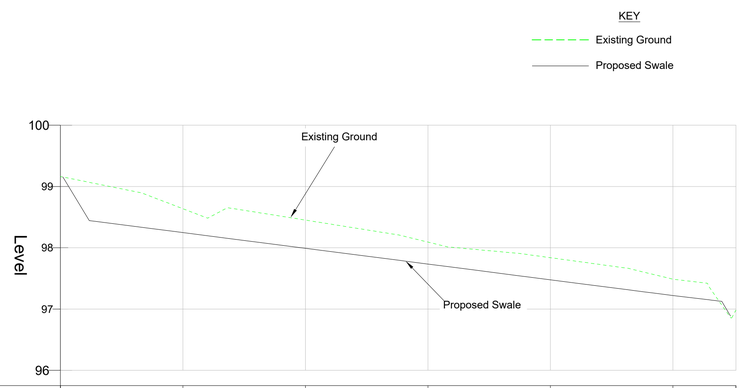
Drawing Status
PRELIMINARY

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
244849-BWB-ZZ-XX-D-W-0002	**S2**	**P01**



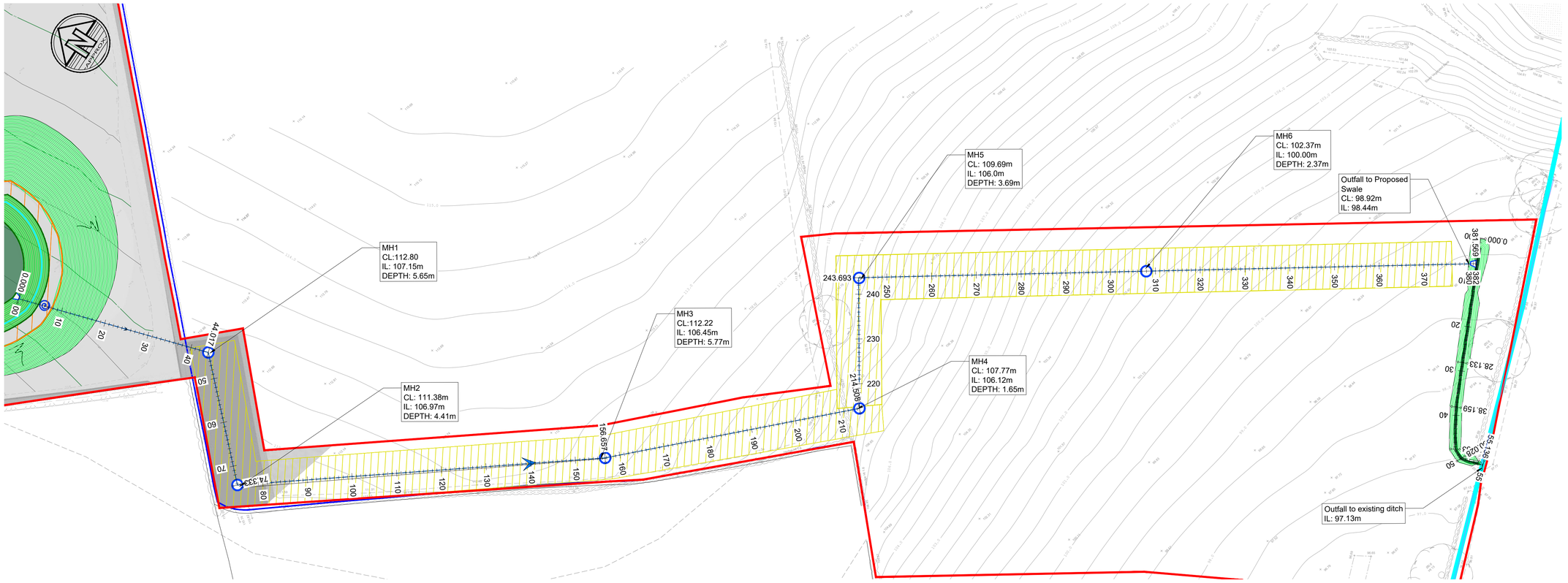
Chainage	0.000	10.000	20.000	30.000	40.000	50.000	60.000	70.000	80.000	90.000	100.000	110.000	120.000	130.000	140.000	150.000	160.000	170.000	180.000	190.000	200.000	210.000	220.000	230.000	240.000	250.000	260.000	270.000	280.000	290.000	300.000	310.000	320.000	330.000	340.000	350.000	360.000	370.000	380.000	381.569
Existing Levels					112.878	112.649	111.953	111.695	111.502	111.793	111.868	112.219	112.454	112.567	112.530	112.418	112.109	111.738	111.177	110.680	109.971	108.672	108.084	109.151	109.566	108.918	107.569	106.258	104.949	103.954	102.980	102.224	101.489	100.850	100.360	99.877	99.451	99.160	98.934	98.931
Proposed Levels					112.878	112.649	111.953	111.695	111.502	111.793	111.868	112.219	112.454	112.567	112.530	112.418	112.109	111.738	111.177	110.680	109.971	108.672	108.084	109.151	109.566	108.918	107.569	106.258	104.949	103.954	102.980	102.224	101.489	100.850	100.360	99.877	99.451	99.160	98.934	98.931
Level Difference					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

OUTFALL PIPE LONGSECTION
SCALE: H 1:250,V 1:25. DATUM: 97.000



Chainage	0.000	10.000	20.000	30.000	40.000	50.000	55.136
Existing Levels	99.163	98.637	98.452	98.053	97.838	97.488	96.983
Proposed Levels		98.247	97.992	97.734	97.476	97.221	
Level Difference		0.390	0.460	0.359	0.362	0.267	

OUTFALL SWALE LONGSECTION
SCALE: H 1:250,V 1:50. DATUM: 96.000



OUTFALL PIPE
1:500

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Client
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Project Title
LAND EAST OF RUGBY ROAD

Drawing Title
SuDS design cross sections Sheet 3

Drawn:	A. Shademani	Reviewed:	R. Jobling
BWB Ref:	244849	Date:	07/11/25
Scale@A1:	As Shown		

Drawing Status
PRELIMINARY

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
244849-BWB-ZZ-XX-D-W-0002	S2	P01