Althrey Farm

Drainage Strategy

95033-RP-D-0001

Rev: P01

June 2026

JPS CIVIL + STRUCTURAL ENGINEERS

Document History

Job Number: 100812		Document Ref: RP-D-0001		
P01	Drainage Strategy	RH	JP	25.06.2026
Revision	Purpose Description	Originated	Authorised	Date

Contents

Introduction

1.1 Commission

JP Structural Design were appointed by Mr Retief Jordaan to produce a Drainage Strategy for the proposed conversion of derelict barns at Althery Farm to residential use.

1.2 Limitations

The findings of this Strategy have been based on data available at the time of the study and on the review of available information that has been undertaken to date. They relate to the current development proposals as outlined in **Appendix A**. Should the proposed end use of the site change after the completion of this assessment, then the findings of this report will need to be reviewed and updated accordingly.

2 Existing Site and Proposed Development

2.1 Existing Site

The site covers an area of approximately 9,700m^2 off Overton Road, Bangor on Dee. The centre of the site is at National Grid Reference SJ379441 and currently comprises derelict barns / farm outbuildings.

2.2 Existing Drainage

On-site investigations confirmed that the site was not subject to any formal drainage with the barns / outbuildings discharging rainwater across the adjacent surface. The remainder of the site was either external slabs or unmade ground and frequently ponded during heavy rainfall events.

The nearest public sewer network system is believed to be in the village of Bangor on Dee approximately 1.5km away from the site, as shown by the plan in Appendix B.

2.3 Existing Flood Risk

The FRA map has been consulted which has confirmed the site to be free of flood risk, being significantly higher than the river and the adjacent race course.

2.4 Ground Conditions

Groundsolve were appointed to undertake investigations and percolation tests at the site. The site was found to be underlain by clayey substrata with the percolation tests undertaken deemed to have failed. The ground investigation report is contained in Appendix C.

2.5 Proposals

The proposed development consists of the conversion of derelict / redundant barns to residential use with Planning Permission originally granted by Wrexham County Council for the scheme in 2006 (ref P-2006-0527)

3 Foul Drainage Proposals

3.1 Foul Drainage

The foul drainage disposal is proposed to follow the requirements of Building Regulations 2010 Part H (2015 Edition) Drainage and Waste Disposal and Sewers for Adoption 7th Edition. Part H1 of the above document contains the following requirements:

"An adequate system of drainage shall be provided to carry foul water from appliances within the building on to the following, listed in order of priority."

a) A public sewer or where that is not reasonably practicable

b) A private sewer communicating with a public sewer, or where that is not reasonably practicable,

c) Either a septic tank which has appropriate form of secondary treatment or another wastewater treatment system; or, where that is not reasonably practicable,

d) A cesspool

As stated above the nearest public sewer system is believed to be over 1.5km away and it is therefore considered unpracticable to make any form of connection to this. We therefore are of the opinion the only viable drainage solution for the proposed development would be a private sewerage treatment plant with additional forms of treatment prior to discharge to the local ditch network which ultimately discharges to the River Dee.

The proposed drainage layout is shown in **Appendix D**

3.2 Treatment Train

As stated the intention is to provide a treatment train which will minimise the phosphate and nitrogen levels of the discharged effluent which eventually reach the point of discharge.

3.2.1 Private Packaged Sewage Treatment Plant

It is proposed to install a Klargester Biotec 8 with integral dosing unit. As per the manufacturers information in **Appendix E**, this is designed to cater for a population of up to 35 people has been tested to achieve the following;

Phosphorus Removal
Efficiency 95.4%
Effluent 0.3 mg/l

Total Nitrogen Removal
Efficiency 71.1%
Effluent 17.9 mg/l

3.2.2 Free Water Surface Wetlands

The effluent discharge from the private treatment plant will then be discharged to a purpose built Free Water Surface wetlands which is to be planted with Phragmites as a common reed as shown in the construction section in **Appendix F**. As per the Mitigation Measures Menu (also in Appendix F), this suggests a removal of Total Phosphorus & Nitrogen of up to 80%. We would hope it would also be acknowledged that this is the treated / dosed effluent from the Treatment plant.

3.2.3 Pond

Discharge from the wetlands will be controlled by a weir into the balancing pond where the discharge will also be mixed with surface water run-off before a 'dip pipe' chamber will control discharge to the pump station. The pond and dip pipe is all intended to act as a sediment trap, which again according to the Mitigation Measures Menu will remove a Total Phosphorous of up to 33% shown in **Appendix G**.

3.2.4 Outflow to Existing Ditch

From the pond the effluent will be pumped to the top of the hill with a gravity fed system then discharging to the ditch at the rear of Althrey Farm. This is approximately 130m from the River Dee itself. Again it is hoped that this will effectively act as a swale preventing further nutrient run-off, by allowing a mixture of infiltration into the soil and with the vegetation on the berm will hold water and nutrients better. The outfall drawing is shown in **Appendix H**.

3.3 Calculator – Nutrient Neutrality

We have previously submitted a Nutrient Budget Calculator for the scheme although as discussed would agree that this is limited in its function and does not effectively capture the detailed design or the intentions of the treatment train proposed.

However as per the above our intention is to provide the following

Treatment Feature	**Ph Removal**		**N Removal %**	
	%	Total mg/l	%	Total mg/l
Treatment Plant (and dosing unit)	95%	0.3 mg/l	71%	17.9 mg/l
Floating Wetlands	80%	0.06 mg/l	80%	3.58 mg/l
Pond / Dip Pipe Configurations	20%	0.048 mg/l	20%	2.86 mg/l
Swale	50%	0.024 mg/l	50%	1.43 mg/l

4 Surface Water Drainage

It is acknowledged that the satisfactory collection, control and discharge of storm water is now a principle planning and design consideration. Part H of the Building Regulations 2002 recommends that surface water run-off shall discharge to one of the following, listed in order of priority:

a) an adequate soakaway or some other adequate infiltration system, or where that is not reasonably practicable,

b) a watercourse, or, where that is not reasonably practicable,

c) a sewer.

It is necessary to identify the most appropriate method of controlling and discharging surface water. The design should seek to improve the local run-off profile by using systems that can either attenuate run-off and reduce peak flow rates or positively impact on the existing flood profile.

4.1 Ground Infiltration Techniques

As discussed earlier in the report, following on site testing Ground Infiltration techniques have been dismissed as unviable for this project.

4.2 Discharge To Watercourse

The intention is to restrict surface water run off from the site by providing and attenuation tank and utilising a flow control device to restrict discharge from the tank to the pond. As mentioned earlier in the report a pump station will then pump a combined surface water and treated effluent flow from the pond to discharge to the ditch system to the rear of Althrey farm.

4.3 Connection to Sewer

There are no sewers within the immediate vicinity of the site.

4.4 Surface Water Calculations

Surface water canulations are contained within Appendix I which show the surface water forward flow to be restricted to 5 l/s. The attenuation tank has then been sized to accommodate a 1 in 100 year event with a 40% allowance for climatic change.

4.5 Water Quality

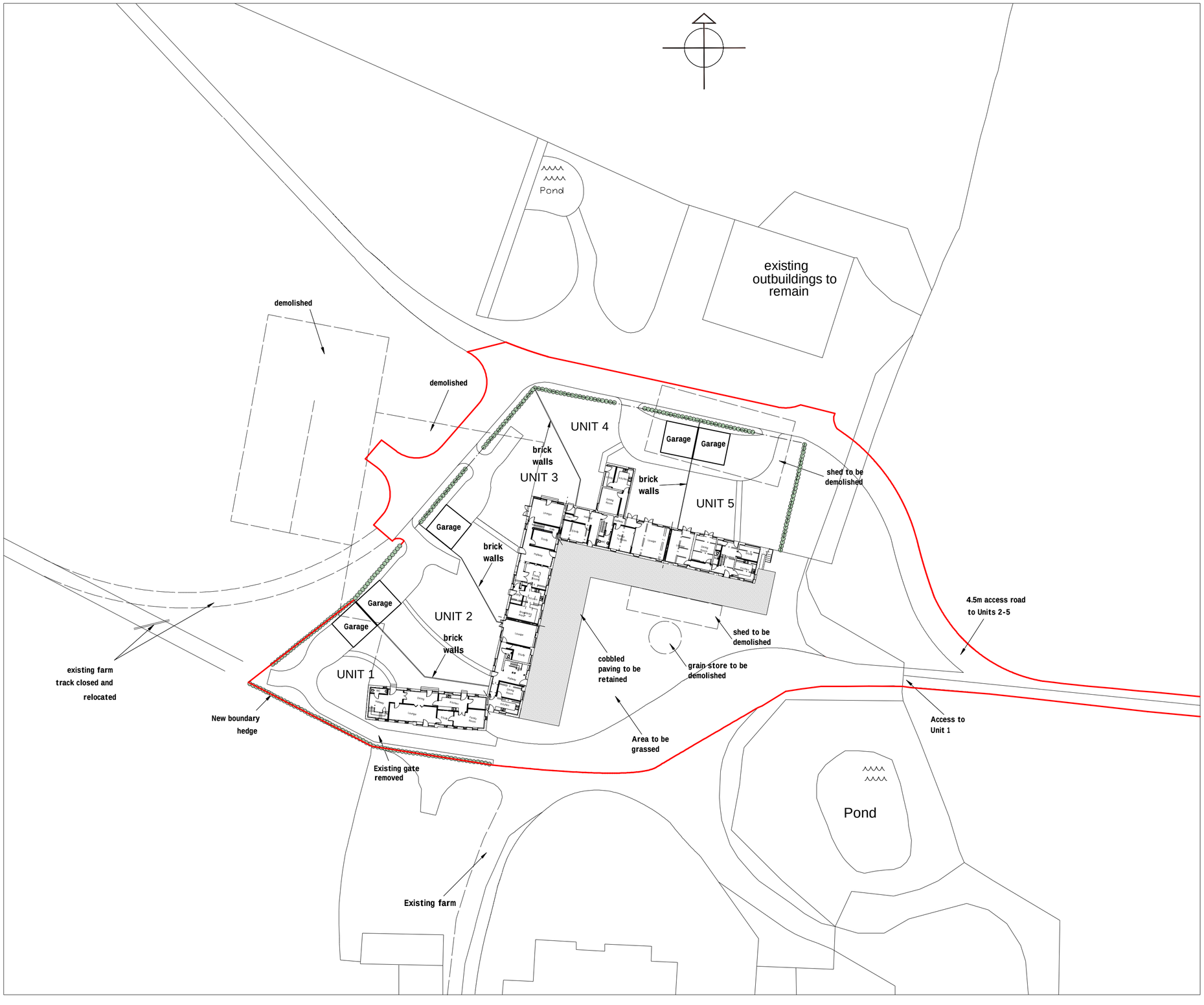
In terms of water quality, the residential roof areas should be very low in pollution and utilising permeable paving systems for the external areas which will act as filters, removing many pollutants through collection and biodegradation. Settlement will also occur in the basin, ensuring that excessive sediment is not added to the watercourse

5 Conclusions

5.1 Conclusions

The proposed site is free from any existing flood risk and in lieu of a viable alternative to drain the site, a connection to the existing brook remains the preferred solution. It is acknowledged that the ditch discharges to the River Dee and the proposed drainage system has therefore been designed as a Treatment Train with a number of features to ensure the effluent and surface water run off generated from the site has been cleansed as a best as possible.

Appendix A – Site Proposals



Site Plan 1:500

Rev	Date	Detail	Initial

Project:
Proposed residential development at
Bangor on Dee,
Wrexham,
LL13 0DA.

Title: Site Plan

Scale: (A3) 1:500

Drawn By: E Jackson

Date: Jan 2018

Drawing No: S043/005

Sheet: 1 of 1

blueprint architectural services

partner LABC

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Redwither Business Tower,
Wrexham. LL13 9XT
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Appendix B – Sewer Distance

REV	DESCRIPTION	BY	CHK	APR	DATE
-	-	-	-	-	-
-	-	-	-	-	-

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PURPOSE OF ISSUE	STATUS
SKETCH	S1

PROJECT
ALTHREY FARM

TITLE
SEWER DISTANCE

CLIENT
MR RETIEF JORDAAN

DRAWN BY	CHECKED BY	APPROVED BY
RH	MM	JP

DATE	SCALE (@ A3)	PROJECT NUMBER
25.06.2026	1:5000	95033

DRAWING NUMBER	REV
SK01	S01

info@jpstructural.co.uk

Appendix C – Percolation Tests

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Consulting Geotechnical Engineers

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Flintshire, CH5 2TB
Tel: 01244 952295

REF:GSL3470/AlthreyHallBarns/LR/01

Retief Jordaan,
Althrey Holdings Ltd,
Althrey Farm,
Overton Road,
Bangor-on-Dee, LL13 0DA

3rd March 2025

Dear Retief,

RE: ALTHREY HALL BARNS, BANGOR-ON-DEE – SOAKAWAY TESTING

1.0 Introduction

Althrey Holdings Ltd own a plot of land (Althrey Hall Barns) just south of Bangor-on-Dee Racecourse which has been granted permission for residential development.

They have appointed GroundSolve Ltd (GSL), to carry out soakaway testing at the site in relation to their proposed drainage plans to satisfy Wrexham Council requirements as the SuDS Approving Body (SAB).

2.0 Site Location and Description

The site is located immediately to the south off the B0569 (Bangor Road) in Bangor-on-Dee at National Grid Reference SJ378441 (E: 337898 , N:344191).

Drawings are presented in **Appendix A** with photograph survey of the site is included in **Appendix B**.

The main entrance to the site is off the B0569, with a main driveway leading into the existing property , with the access lane leading to the field at the rear of the property.

The site is bounded to the north and east by Bangor-on-Dee Racecourse, fields to the west and south by residential properties.

The latest British Geological Survey (BGS) 1:50,000 scale geological mapping indicates the site to be underlain by superficial river terrace deposits and/or alluvial deposits (associated with the River Dee). Bedrock is recorded as the Kinnerton Sandstone Formation.

3.0 Site Investigation

The site investigation was carried out on the 2nd March 2026 and comprised:

- Five machine excavated trial pits to a maximum depth of 2.50m
- Soakaway testing within the trial pits.

The trial pit locations were chosen based on the proposed locations of the soakaway and proposed drainage design.

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The depth of the trial pits was typically limited to 2.5m below ground level, this is due to the instability of the pits.

The trial pits were supervised and logged by a Geotechnical Engineer from GSL, in accordance with BS 5930:2015.

The trial pit logs and photographs are presented in **Appendix C**.

The soakaway test results are summarised and discussed in **Section 4.0** below, with the full results and calculations presented in **Appendix D**.

4.0 Ground Conditions

The trial pits revealed the ground conditions to vary across the site generally comprising made ground/topsoil on top of sandy gravelly clay overlying clayey sand and gravels and loamy sand (TP03 only).

The ground conditions for each trial pit is summarised in the table below.

Groundwater was encountered in four of the trial pits TP02 to TP05. During the fieldwork some seepages were encountered at shallow depth mainly in TP03, with most of the groundwater encountered generally recorded below 1.50mbgl.

The stratigraphy encountered is summarised in Table 4.1 below:

Table 4.1: General Stratigraphy

TP Ref No	Stratigraphy			
	Topsoil	Made Ground	Alluvium	River Terrace Deposits
TP01	-	0 – 1.00	1.00 – 2.50	-
TP02	-	0 – 0.30	0.30 – 2.40	-
TP03	0 – 0.30	0.30 – 0.40	0.40 – 2.30	-
TP04	0 – 0.10	-	0.10 – 2.50	-
TP05	0 – 0.30	-	0.30 – 1.80	-

- Not Encountered

The soakaway testing was carried out in accordance with BRE Digest 365, with the trial pits rapidly filled with water from a 2000-litre bowser, and the rate of fall monitored over a period of time.

A summary of the calculated infiltration rate for each test cycle is presented in Table 4.2:

Table 4.2: Soakaway Test Results

TP No	Test No	Depth (m)	Time (mins)	Fall in Water Level (m)	Infiltration Rate (m/sec)
TP02	1	2.40	150	0.00	N/A
TP03	1	2.30	210	0.22	N/A
TP05	1	1.80	180	0.06	N/A

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5.0 Conclusions

The ground investigation indicates that the site is underlain predominantly by low-permeability cohesive soils, including brown sandy gravelly clay, grey mottled clay, and gravelly clay. These materials are characteristically impermeable and do not provide the infiltration capacity required for soakaway systems to function effectively.

Although isolated sand and gravel layers were encountered, these were either thin, mixed with clay. Groundwater was also recorded at shallow depths in multiple locations, reducing the available unsaturated zone needed for soakaway storage and percolation.

Soakaway drainage is therefore considered unsuitable for this site, and alternative surface water management solutions should be adopted.

We trust this is satisfactory, should you have any queries please call Aaron Bell on 01244 661361.

Yours sincerely,

Aaron Bell

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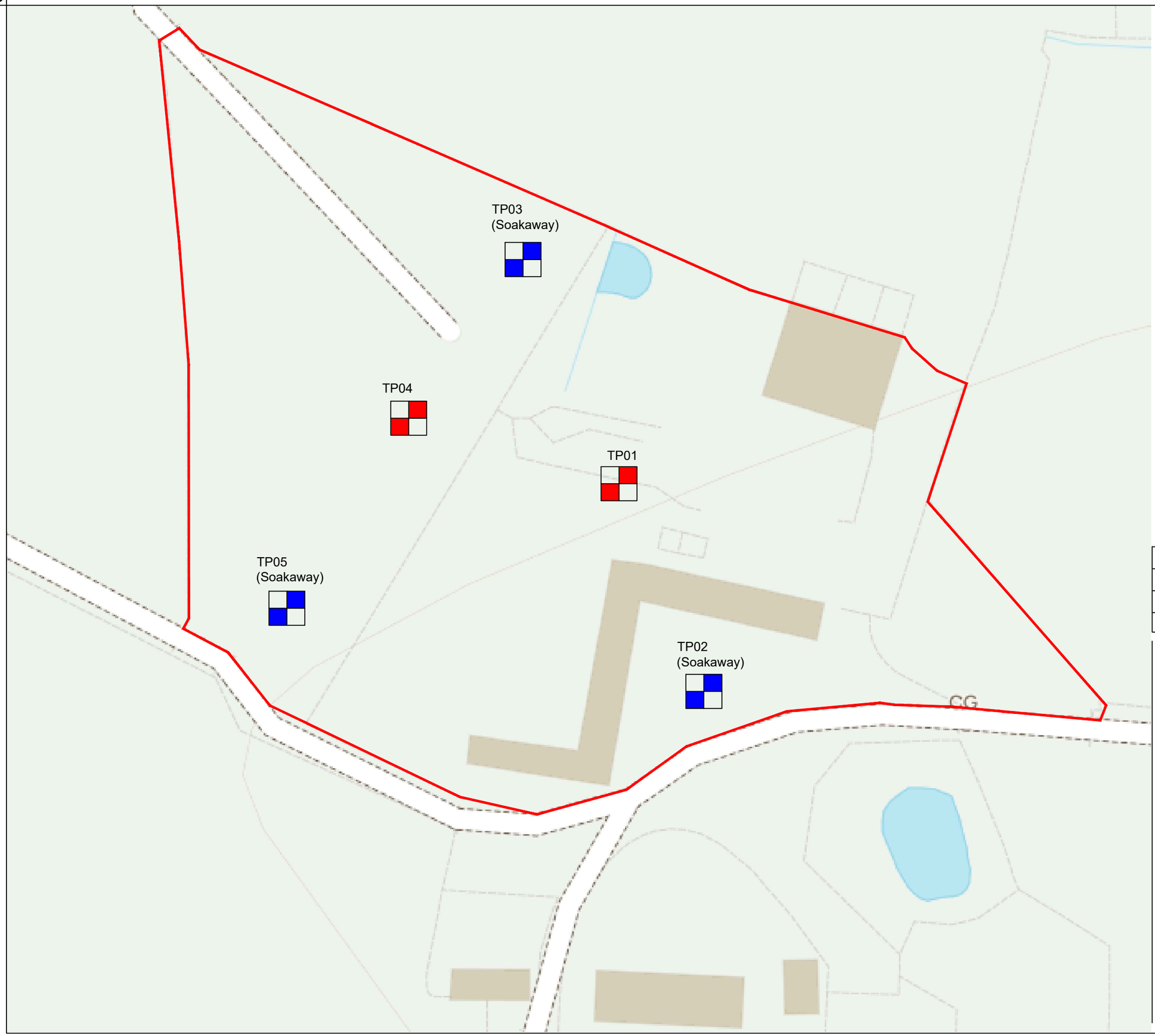
Appendix A

Drawings

A3



Legend

- Trial Pit Locations
- Trial Pit Soakaway Locations
- Site Extents

Revision	Description	Date
A	Original Drawing	05.03.26

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Job Title

Althrey Hall Barns
Bangor-on-Dee

Drawing Title

Existing Site Layout &
Exploratory Hole locations

Drawing Scale	Drawn By	Approved By
NTS	ALB	SF

Drawing Status	Date of Issue
Information	05.03.26

Drawing No	Revision
GSL3470-DR-001	A

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Appendix B

Site Photographs

Photo Descriptions

PHOTO NO.	DETAILS
1	Centre of site facing NW towards TP03
2	Western boundary of development
3	TP01 and renovation of existing buildings
4	Southern part of the site (TP02)

PHOTO 1

PHOTO 2

PHOTO 3

PHOTO 4

Photo Board- Site Photographs

Drawn:	Checked:	Authorised:
ALB	SF	SF
Date: 05.03.26	Date: 05.03.26	Date: 05.03.26

Client: Althrey Holdings Ltd

Project: GSL3470 Althrey Hall Barns, Bangor-on-Dee

GroundSolve Ltd

Unit 1, 85 Station Road,
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GroundSolve Ltd
Consulting Geotechnical Engineers

Document No : GSL_IMSR011
Rev No: 0
Issue date: 03/01/2025

Photo Descriptions

PHOTO NO.	DETAILS
5	TP02 Location
6	TP03 facing south
7	TP03 facing development site
8	TP03 Facing east

PHOTO 5

PHOTO 6

PHOTO 7

PHOTO 8

Photo Board- Site Photographs

Drawn:	Checked:	Authorised:
ALB	SF	SF
Date: 05.03.26	Date: 05.03.26	Date: 05.03.26

Client: Althrey Holdings Ltd

Project: GSL3470 Althrey Hall Barns, Bangor-on-Dee

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Appendix C

Exploratory Hole Logs

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Machine Dug Trial Pit Record

TP01

Project Name: Althrey Hall Barns	Client: Althrey Holdings Ltd	Date: 02/03/2026
Location: Bangor-on-Dee	Contractor: Althrey Holdings Ltd	Co-ords: E337890.000 N344202.000
Project No. : 3470	Crew Name:	Equipment: 3t Tracked excavatior

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP01	TP	20.00m AoD	AB	1:25	Sheet 1 of 1

Backfill/ Instal'n	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
								Dark brown sandy gravelly CLAY. Gravel is angular fine to coarse of mixed lithologies, brick and concrete. with frequent angular medium to large cobbles of brick and concrete and fragments of wood and metal.
					1.00	19.00		Brown sandy CLAY.
					1.50	18.50		Grey mottled brown sandy CLAY.
					2.00	18.00		Brown sandy CLAY.
					2.80	17.20		End of Trial Pit at 2.800m

1 2 3 4 5

Dimensions		Trench Support and Comment			Pumping Data		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Date	Rate	Remarks
1.60	0.60	Stable					

Remarks

1.Hole terminated due to target depth reached.
2. No groundwater encountered.

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GroundSolve Ltd — Machine Dug Trial Pit Record — TP02

Project Name: Althrey Hall Barns	Client: Althrey Holdings Ltd	Date: 02/03/2026
Location: Bangor-on-Dee	Contractor: Althrey Holdings Ltd	Co-ords: E337904.000 N344160.000
Project No. : 3470	Crew Name:	Equipment: 3t Tracked excavator

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP02	TP	22.00m AoD	AB	1:25	Sheet 1 of 1

Backfill/ Instal'n	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
					0.30	21.70		Brown sandy gravelly CLAY. Gravel is subangular to rounded fine to coarse of mixed lithologies brick and concrete with small to large angular cobbles of brick and concrete.
								Brown sandy gravelly CLAY. Gravel is subangular to rounded fine to coarse of mixed lithologies.
					1.20	20.80		Grey sandy slightly clayey GRAVEL. Gravel is subangular to rounded fine to coarse of mixed lithologies with frequent small to large subangular to rounded cobbles of mixed lithologies.
	▼				2.40	19.60		End of Trial Pit at 2.400m

1 2 3 4 5

Dimensions		Trench Support and Comment			Pumping Data		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Date	Rate	Remarks
1.40	0.60	Stable					

Remarks

1.Hole terminated due to target depth reached.
2. Strata wet from 1.40mbgl with noticeable groundwater at base of pit.

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GroundSolve Ltd — Machine Dug Trial Pit Record — TP03

Project Name: Althrey Hall Barns	Client: Althrey Holdings Ltd	Date: 02/03/2026
Location: Bangor-on-Dee	Contractor: Althrey Holdings Ltd	Co-ords: E337873.000 N344246.000
Project No. : 3470	Crew Name:	Equipment: 3t Tracked Excavator

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP03	TP	19.00m AoD	AB	1:25	Sheet 1 of 1

Backfill/ Instal'n	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
					0.30	18.70		Grass on top brown sandy gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mixed lithologies.
					0.40	18.60		Black slightly sandy GRAVEL. Gravel is angular fine to coarse of clinker.
								Brown sandy gravelly CLAY. Gravel is subangular to rounded fine to coarse of mixed lithologies.
					1.50	17.50		Brown loamy SAND.
					2.30	16.70		End of Trial Pit at 2.300m

1 2 3 4 5

Dimensions		Trench Support and Comment			Pumping Data		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Date	Rate	Remarks
1.60	0.60	Stable					

Remarks

1.Hole terminated due to target depth reached.
2. Groundwater encountered from 0.70mbgl.
3. Running sands encountered at base of pit.

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GroundSolve Ltd

Machine Dug Trial Pit Record

TP04

Project Name: Althrey Hall Barns	Client: Althrey Holdings Ltd	Date: 02/03/2026
Location: Bangor-on-Dee	Contractor: Althrey Holdings Ltd	Co-ords: E337852.000 N344211.000
Project No. : 3470	Crew Name:	Equipment: 3t Tracked Excavator

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP04	TP	20.00m AoD	AB	1:25	Sheet 1 of 1

Backfill/ Instal'n	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
					0.10	19.90		Dark brown sandy gravelly CLAY. Gravel is subangular to rounded fine to coarse of mixed lithologies.
					0.50	19.50		Brown sandy gravelly CLAY. Gravel is subangular to rounded fine to coarse of mixed lithologies with medium to large subangular to rounded cobbles of mixed lithologies.
					1.00	19.00		Reddish brown clayey SAND and GRAVEL. Gravel is subangular to rounded fine to coarse of mixed lithologies.
					2.50	17.50		Greyish brown clayey SAND and GRAVEL. Gravel is subangular to rounded fine to coarse of mixed lithologies with small to large subangular to rounded cobbles of mixed lithologies.
								End of Trial Pit at 2.500m

1 2 3 4 5

Dimensions		Trench Support and Comment			Pumping Data		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Date	Rate	Remarks
1.40	0.60	Stable					

Remarks

1.Hole terminated due to target depth reached.
2. Groundwater encountered from 1.60mbgl.

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GroundSolve Ltd — Machine Dug Trial Pit Record — TP05

Project Name: Althrey Hall Barns	Client: Althrey Holdings Ltd	Date: 02/03/2026
Location: Bangor-on-Dee	Contractor: Althrey Holdings Ltd	Co-ords: E337825.000 N344177.000
Project No. : 3470	Crew Name:	Equipment: 3t Tracked Excavator

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP05	TP	21.00m AoD	AB	1:25	Sheet 1 of 1

Backfill/ Instal'n	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
					0.30	20.70		Grass on top of dark brown sandy CLAY.
					1.00	20.00		Brown sandy gravelly CLAY. Gravel is subangular to rounded fine to coarse of mixed lithologies.
	▼				1.80	19.20		Grey mottled dark grey gravelly CLAY. Grave is subangular to rounded fine to coarse of mixed lithologies with small to large subangular to rounded cobbles of mixed lithologies.
								End of Trial Pit at 1.800m

1 2 3 4 5

Dimensions		Trench Support and Comment			Pumping Data		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Date	Rate	Remarks
1.20	0.60	Stable					

Remarks

1.Hole terminated due to target depth reached.
2. Groundwater encountered at 1.80mbgl.

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Appendix D

Soakaway Testing Results

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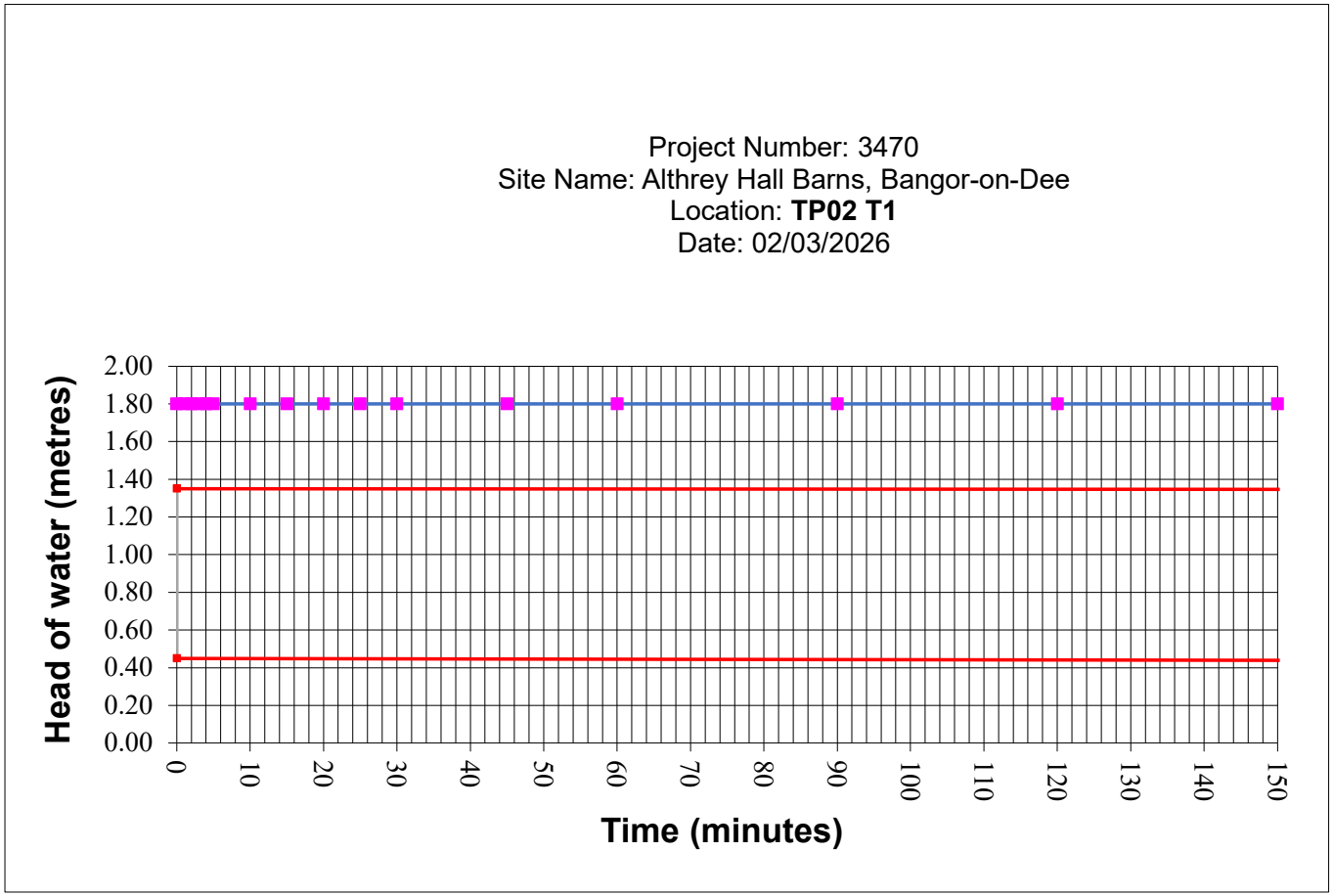
Time (Mins)	Depth of Water	Head of Water
0	0.60	1.80
1	0.60	1.80
2	0.60	1.80
3	0.60	1.80
4	0.60	1.80
5	0.60	1.80
10	0.60	1.80
15	0.60	1.80
20	0.60	1.80
25	0.60	1.80
30	0.60	1.80
45	0.60	1.80
60	0.60	1.80
90	0.60	1.80
120	0.60	1.80
150	0.60	1.80



Depth	Length	Width	Head at 75% Vol	Head at 25% Vol	Water depth(t=0)	Effective Area	Vp75-Vp25	Adjustment Factor *	t75	t25	Infiltration
(m)	(m)	(m)	(m)	(m)	(m)	Ap50 m2	Volume of water m3		(mins)	(mins)	rate m/s
2.40	1.40	0.60	1.350	0.45	1.80	4.440	0.756	1.00	-	-	N/A

* with gravel filter adjustment factor = 0.30, with no filter = 1.0

Note: The test failed to reach the 75 and 25% head.

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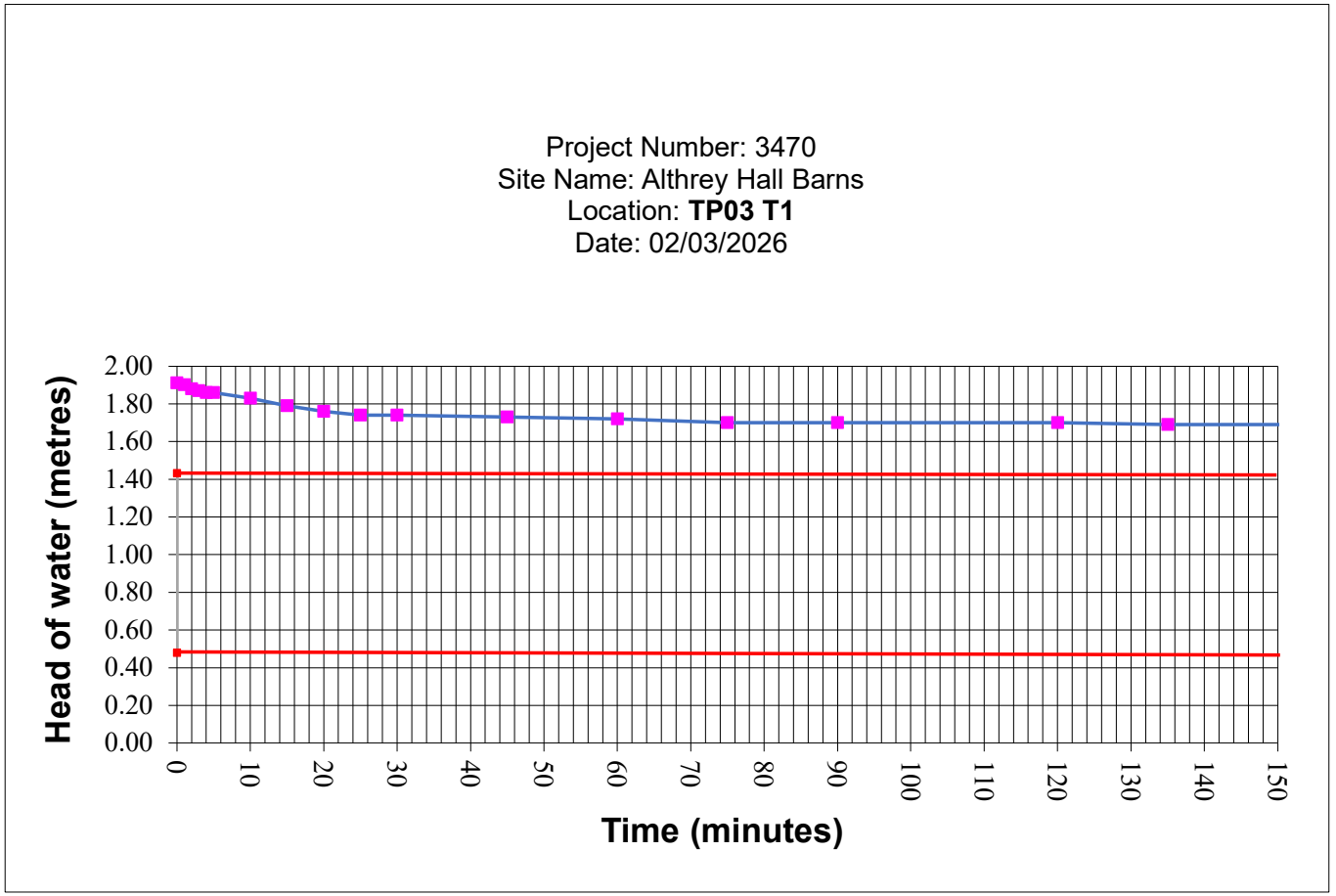
Time (Mins)	Depth of Water	Head of Water
0	0.39	1.91
1	0.40	1.90
2	0.42	1.88
3	0.43	1.87
4	0.44	1.86
5	0.44	1.86
10	0.47	1.83
15	0.51	1.79
20	0.54	1.76
25	0.56	1.74
30	0.56	1.74
45	0.57	1.73
60	0.58	1.72
75	0.60	1.70
90	0.60	1.70
120	0.60	1.70
135	0.61	1.69
155	0.61	1.69
180	0.61	1.69
210	0.61	1.69



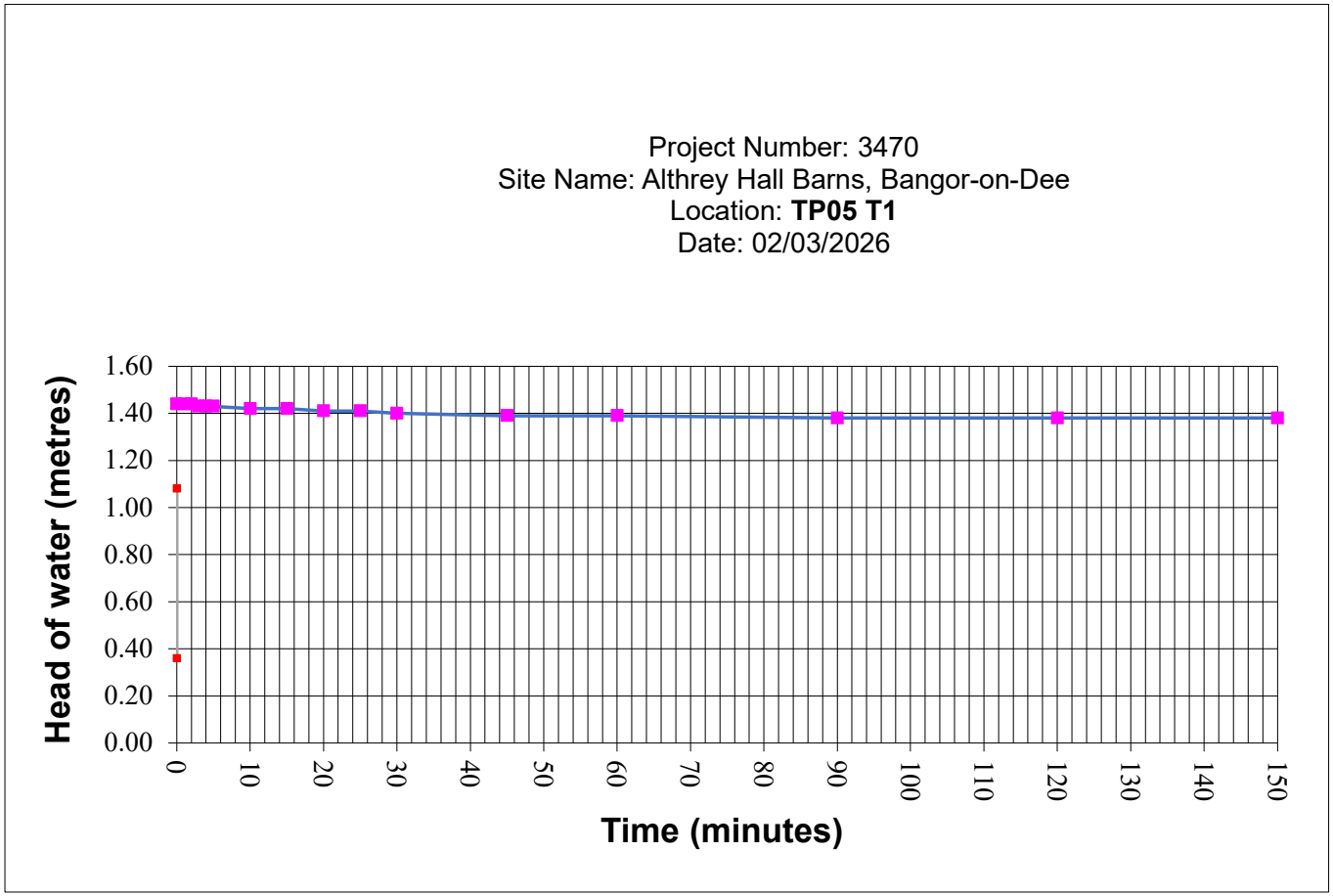
Depth	Length	Width	Head at 75% Vol	Head at 25% Vol	Water depth(t=0)	Effective Area	Vp75-Vp25	Adjustment Factor *	t75	t25	Infiltration
(m)	(m)	(m)	(m)	(m)	(m)	Ap50 m2	Volume of water m3		(mins)	(mins)	rate m/s
2.30	1.60	0.60	1.433	0.48	1.91	5.162	0.917	1.00	-	-	N/A

* with gravel filter adjustment factor = 0.30, with no filter = 1.0

Note: The test failed to reach the 75% and 25% head.

GroundSolve Ltd
Consulting Geotechnical Engineers

Time (Mins)	Depth of Water	Head of Water
0	0.36	1.44
1	0.36	1.44
2	0.36	1.44
3	0.37	1.43
4	0.37	1.43
5	0.37	1.43
10	0.38	1.42
15	0.38	1.42
20	0.39	1.41
25	0.39	1.41
30	0.40	1.40
45	0.41	1.39
60	0.41	1.39
90	0.42	1.38
120	0.42	1.38
150	0.42	1.38
180	0.42	1.38

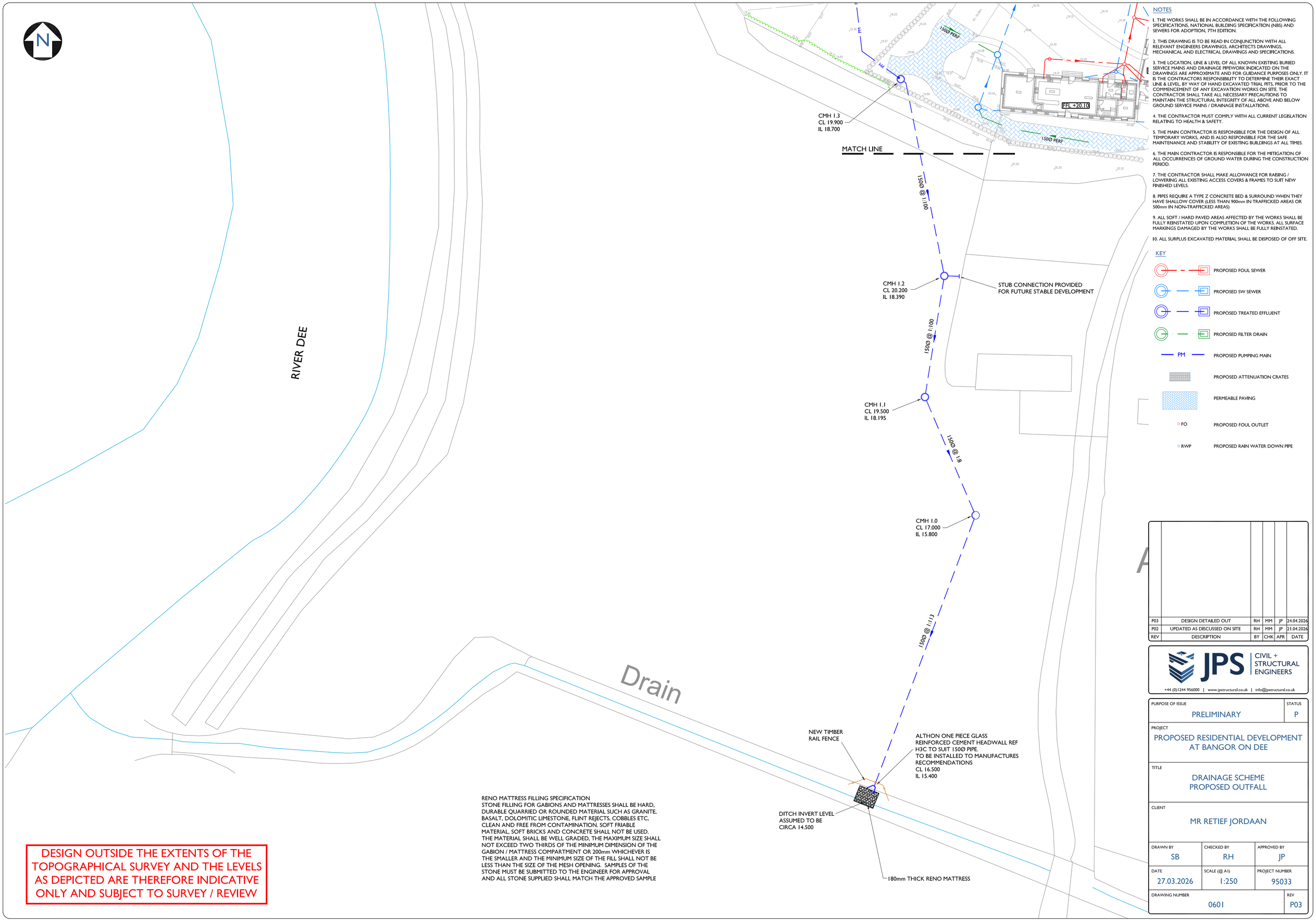


Depth	Length	Width	Head at 75% Vol	Head at 25% Vol	Water depth(t=0)	Effective Area	Vp75-Vp25	Adjustment Factor *	t75	t25	Infiltration
(m)	(m)	(m)	(m)	(m)	(m)	Ap50 m2	Volume of water m3		(mins)	(mins)	rate m/s
1.80	1.20	0.60	1.080	0.36	1.44	3.312	0.518	1.00	-	-	N/A

* with gravel filter adjustment factor = 0.30, with no filter = 1.0

Note: The test failed to reach the 75% and 25% head.

Appendix D – Drainage Proposals



NOTES

1. THE WORKS SHALL BE IN ACCORDANCE WITH THE FOLLOWING SPECIFICATIONS, NATIONAL BUILDING SPECIFICATION (NBS) AND SEWERS FOR ADOPTION, 7TH EDITION.

2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ENGINEERS DRAWINGS, ARCHITECTS DRAWINGS, MECHANICAL AND ELECTRICAL DRAWINGS AND SPECIFICATIONS.

3. THE LOCATION, LINE & LEVEL OF ALL KNOWN EXISTING BURIED SERVICE MAINS AND DRAINAGE PIPEWORK INDICATED ON THE DRAWINGS ARE APPROXIMATE AND FOR GUIDANCE PURPOSES ONLY. IT IS THE CONTRACTORS RESPONSIBILITY TO DETERMINE THEIR EXACT LINE & LEVEL, BY WAY OF HAND EXCAVATED TRIAL PITS, PRIOR TO THE COMMENCEMENT OF ANY EXCAVATION WORKS ON SITE. THE CONTRACTOR SHALL TAKE ALL NECESSARY PRECAUTIONS TO MAINTAIN THE STRUCTURAL INTEGRITY OF ALL ABOVE AND BELOW GROUND SERVICE MAINS / DRAINAGE INSTALLATIONS.

4. THE CONTRACTOR MUST COMPLY WITH ALL CURRENT LEGISLATION RELATING TO HEALTH & SAFETY.

5. THE MAIN CONTRACTOR IS RESPONSIBLE FOR THE DESIGN OF ALL TEMPORARY WORKS, AND IS ALSO RESPONSIBLE FOR THE SAFE MAINTENANCE AND STABILITY OF EXISTING BUILDINGS AT ALL TIMES.

6. THE MAIN CONTRACTOR IS RESPONSIBLE FOR THE MITIGATION OF ALL OCCURRENCES OF GROUND WATER DURING THE CONSTRUCTION PERIOD.

7. THE CONTRACTOR SHALL MAKE ALLOWANCE FOR RAISING / LOWERING ALL EXISTING ACCESS COVERS & FRAMES TO SUIT NEW FINISHED LEVELS.

8. PIPES REQUIRE A TYPE Z CONCRETE BED & SURROUND WHEN THEY HAVE SHALLOW COVER (LESS THAN 900mm IN TRAFFICKED AREAS OR 500mm IN NON-TRAFFICKED AREAS)

9. ALL SOFT / HARD PAVED AREAS AFFECTED BY THE WORKS SHALL BE FULLY REINSTATED UPON COMPLETION OF THE WORKS. ALL SURFACE MARKINGS DAMAGED BY THE WORKS SHALL BE FULLY REINSTATED.

10. ALL SURPLUS EXCAVATED MATERIAL SHALL BE DISPOSED OF OFF SITE.

KEY

- PROPOSED FOUL SEWER
- PROPOSED SW SEWER
- PROPOSED TREATED EFFLUENT
- PROPOSED FILTER DRAIN
- PM — PROPOSED PUMPING MAIN
- PROPOSED ATTENUATION CRATES
- PERMEABLE PAVING
- FO — PROPOSED FOUL OUTLET
- RWP — PROPOSED RAIN WATER DOWN PIPE

RENO MATTRESS FILLING SPECIFICATION
STONE FILLING FOR GABIONS AND MATTRESSES SHALL BE HARD, DURABLE QUARRIED OR ROUNDED MATERIAL SUCH AS GRANITE, BASALT, DOLOMITIC LIMESTONE, FLINT REJECTS, COBBLES ETC, CLEAN AND FREE FROM CONTAMINATION. SOFT FRIABLE MATERIAL, SOFT BRICKS AND CONCRETE SHALL NOT BE USED. THE MATERIAL SHALL BE WELL GRADED, THE MAXIMUM SIZE SHALL NOT EXCEED TWO THIRDS OF THE MINIMUM DIMENSION OF THE GABION / MATTRESS COMPARTMENT OR 200mm WHICHEVER IS THE SMALLER AND THE MINIMUM SIZE OF THE FILL SHALL NOT BE LESS THAN THE SIZE OF THE MESH OPENING. SAMPLES OF THE STONE MUST BE SUBMITTED TO THE ENGINEER FOR APPROVAL AND ALL STONE SUPPLIED SHALL MATCH THE APPROVED SAMPLE

DESIGN OUTSIDE THE EXTENTS OF THE TOPOGRAPHICAL SURVEY AND THE LEVELS AS DEPICTED ARE THEREFORE INDICATIVE ONLY AND SUBJECT TO SURVEY / REVIEW

REV	DESCRIPTION	BY	CHK	APR	DATE
P03	DESIGN DETAILED OUT	RH	MM	JP	24.04.2026
P02	UPDATED AS DISCUSSED ON SITE	RH	MM	JP	21.04.2026

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PURPOSE OF ISSUE: PRELIMINARY	STATUS: P
PROJECT: PROPOSED RESIDENTIAL DEVELOPMENT AT BANGOR ON DEE	
TITLE: DRAINAGE SCHEME PROPOSED OUTFALL	
CLIENT: MR RETIEF JORDAAN	
DRAWN BY: SB	CHECKED BY: RH / APPROVED BY: JP
DATE: 27.03.2026	SCALE (@ A1): 1:250 / PROJECT NUMBER: 95033
DRAWING NUMBER: 0601	REV: P03

PRIVATE PACKAGED PUMP STATION IN ACCORDANCE WITH BS EN 12050-1 REQUIRED TO PUMP A PEAK FLOW RATE OF 7.5 L/SEC. TWO No PUMPS TO BE INSTALLED IN DUTY / STAND BY ARRANGEMENT. PUMP STATION TO HAVE MINIMUM 200mm THICK C28/35 CONCRETE BASE & SURROUND.
CL 17.100
INCOMING PIPE IL 15.750
OUTGOING PIPE IL 16.300
BASE IL 15.000
(SUBJECT TO MANUFACTURER / SUPPLIER RECOMMENDATIONS / REQUIREMENTS)

CMH 1.4
CATCHPIT WITH DIP PIPE OUTLET
CL 17.350
IN 16.500
OUT 15.750
BASE 15.000

ALTHON ONE PIECE GLASS REINFORCED CEMENT HEADWALL REF H3C TO SUIT 150Ø PIPE.
TO BE INSTALLED TO MANUFACTURES RECOMMENDATIONS
CL 17.200
IL 16.800

ALTHON ONE PIECE GLASS REINFORCED CEMENT HEADWALL REF H3C TO SUIT 150Ø PIPE.
TO BE INSTALLED TO MANUFACTURES RECOMMENDATIONS
CL 18.200
IL 17.000

WEIR 16.900

REED BED

SWALE INLET
IL 16.900

KLARGESTER BE BIODISC + P
(INTEGRAL CHEMICAL DOSING UNIT)
DOMESTIC SEWAGE TREATMENT PLANT.
REQUIRES A CONCRETE BASE SLAB AND WILL BE FULLY ENCASED IN CONCRETE.
THIS UNIT WILL CATER UP TO A MAX. OF 35 PERSONS IN A RESIDENTIAL SITUATION
APPROX. DIMENSIONS 3340x2450Ø.
COVER LEVEL 18.150
INLET LEVEL 17.550
OUTLET LEVEL 17.050

RWP

150Ø @ 1:40

SMH 1.0
WITH FLOW CONTROL DEVICE TO LIMIT FORWARD FLOW TO 5 l/s @ 0.8m HEAD
CL 18.250
IL 17.100 (300Ø)
IL 17.100 (150Ø OUTLET)
IL 16.600 (SUMP BASE)

150Ø @ 1:28

SMH 2.0
CL 18.500
IL 17.700

RWP

CL 18.350
TOC 17.950
IL 17.150

FFL +19.32

FMH 1.0
CL 18.100
IL 17.560

SMH 1.1
(CATCHPIT WITH 300mm SUMP)
CL 18.700
IL 17.300
BASE 17.000

225Ø @ 1:198

100Ø @ 1:125

150Ø PERF

109m³ OF ATTENUATION CONSISTING OF AQUA CELL 'NG' STORAGE BLOCKS
35UNITS x 10 UNITS X 2 UNIT
(17.5m x 10m x 0.8m @ 95% VOID RATIO)
TO BE BACKFILLED & VENTED IN ACCORDANCE WITH MANUFACTURERS GUIDANCE & RECOMMENDATIONS TO CATER FOR THE 100 YEAR STORM EVENT WITH A 40% ALLOWANCE FOR CLIMATIC CHANGE

FMH 1.1
CL 18.500
IL 17.640

FMH 2.0
CL 18.800
IL 17.775

STUB CONNECTION FOR BARN

SMH 6.0
(CATCHPIT WITH 300mm SUMP)
CL 18.600
IL 17.750
BASE 17.450

100Ø @ 1:125

225Ø @ 1:107

150Ø @ 1:110

SMH 1.2
CL 18.850
IL 17.400

100Ø @ 1:43

150Ø @ 1:29

RWP

SMH 3.0
(CATCHPIT WITH 300mm SUMP)
CL 19.200
IL 18.170
BASE 17.870

100Ø @ 1:66

150Ø @ 1:100

FMH 3.0
CL 19.000
IL 18.250

FMH 1.2
CL 19.000
IL 18.000

SMH 1.3
CL 18.900
IL 17.610

SMH 7.0
CL 19.200
IL 18.100

150Ø @ 1:32

150Ø @ 1:51

SMH 4.0
CL 19.300
IL 18.400

100Ø @ 1:73

150Ø @ 1:105

FMH 2.1
CL 19.300
IL 18.700

FMH 2.2
CL 19.300
IL 18.800

FFL +20.10

FFL +20.08

FFL +19.97

FFL +19.21

FMH 1.3
CL 19.050
IL 18.140

SMH 1.4
CL 19.100
IL 17.750

150Ø @ 1:100

100Ø @ 1:80

SMH 1.5
CL 19.000
IL 17.930

FMH 1.4
CL 19.100
IL 18.240

SMH 3.1
CL 19.700
IL 18.475

SMH 3.3
CL 19.650
IL 19.000

FMH 1.5
CL 19.150
IL 18.310

FFL +19.26

FMH 1.8
CL 19.300
IL 18.800

FMH 1.6
CL 19.300
IL 18.450

100Ø @ 1:76

SMH 3.2
CL 20.100
IL 18.580

SMH 5.0
(CATCHPIT WITH 300mm SUMP)
CL 20.100
IL 19.300
BASE 19.000

150Ø @ 1:82

SMH 8.0
CL 19.400
IL 18.100

FMH 1.7
CL 19.400
IL 18.565

SMH 1.6
(CATCHPIT WITH 300mm SUMP)
CL 19.100
IL 18.300
BASE 18.000

150Ø @ 1:10

SMH 3.4
CL 20.100
IL 19.450

CMH 1.3
CL 19.900
IL 18.700

SMH 1.7
(CATCHPIT WITH 300mm SUMP)
CL 20.100
IL 19.200
BASE 18.900

MATCH LINE

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REV	DESCRIPTION	BY	CHK	APR	DATE
P08	TREATMENT UNIT AMENDED	RH	MM	JP	25.06.2026
P07	UPDATED TO NRW RESPONSE	RH	MM	JP	18.06.2026
P06	TREATMENT TANK AMENDED	RH	MM	JP	27.05.2026
P05	DESIGN DETAILED OUT	RH	MM	JP	24.04.2026
P04	UPDATED AS DISCUSSED ON SITE	RH	MM	JP	21.04.2026
P03	OUTFALL UPDATED	RH	MM	JP	27.03.2026
P02	UPDATED TO LATEST LAYOUT	RH	MM	JP	26.03.2026

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PURPOSE OF ISSUE: PRELIMINARY
STATUS: P

PROJECT: PROPOSED RESIDENTIAL DEVELOPMENT AT BANGOR ON DEE

TITLE: DRAINAGE SCHEME PROPOSED LAYOUT

CLIENT: MR RETIEF JORDAAN

DRAWN BY	CHECKED BY	APPROVED BY
SB	RH	JP
DATE	SCALE (@ A1)	PROJECT NUMBER
19.03.2026	1:200	95033
DRAWING NUMBER		REV
0602		P08

Appendix E – Sewage Treatment Tank

Russell Hardy

From: Chris Quinn <chris.quinn@kingspan.com>
Sent: 24 June 2026 14:23
To: Russell Hardy
Subject: RE: PAN-032660 request for information Althrey Farm [Filed 24 Jun 2026 14:26]

Categories: Filed by Mail Manager

Hi Russell,

If a tighter effluent design is required we would probably need to change the plant from the Biotec 8 to our BE Biodisc + P (inc chemical dosing), which can achieve :

Phosphorous removal
Efficiency 95.4%
Effluent 0.3mg/l

Total Nitrogen removal
Efficiency 71.1%
Effluent 17.9mg/l

This option focus's more on Phos removal so the Nitrogen removal does reduce slightly from the Biotec 8.

Kind Regards
Chris

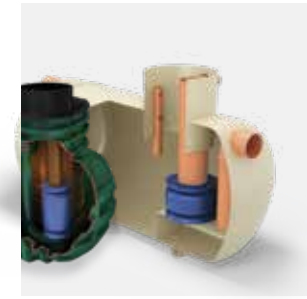
Chris Quinn
Technical Sales - Klargester

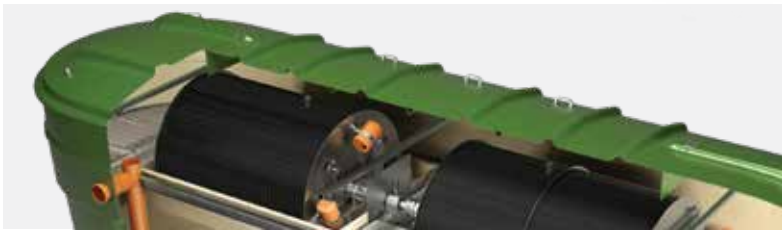
Klargester
Aylesbury | Buckinghamshire | HP22 5EW
T: +44 1296 633 033 | **M:** +44 7880 093 004
E: chris.quinn@kingspan.com
klargester.co.uk

Water Management Solutions

Klargester
Product Guide

The Klargester range of fully integrated wastewater management, surface water and rainwater harvesting solutions





kingspan.co.uk/klargester

Kingspan

Klargester BioDisc® Commercial Sewage Treatment Plant

Delivered as a single, packaged system, the Klargester BioDisc® RBC range (up to 300PE), offers low running costs due to its unique design and operational efficiencies.

Product Benefits

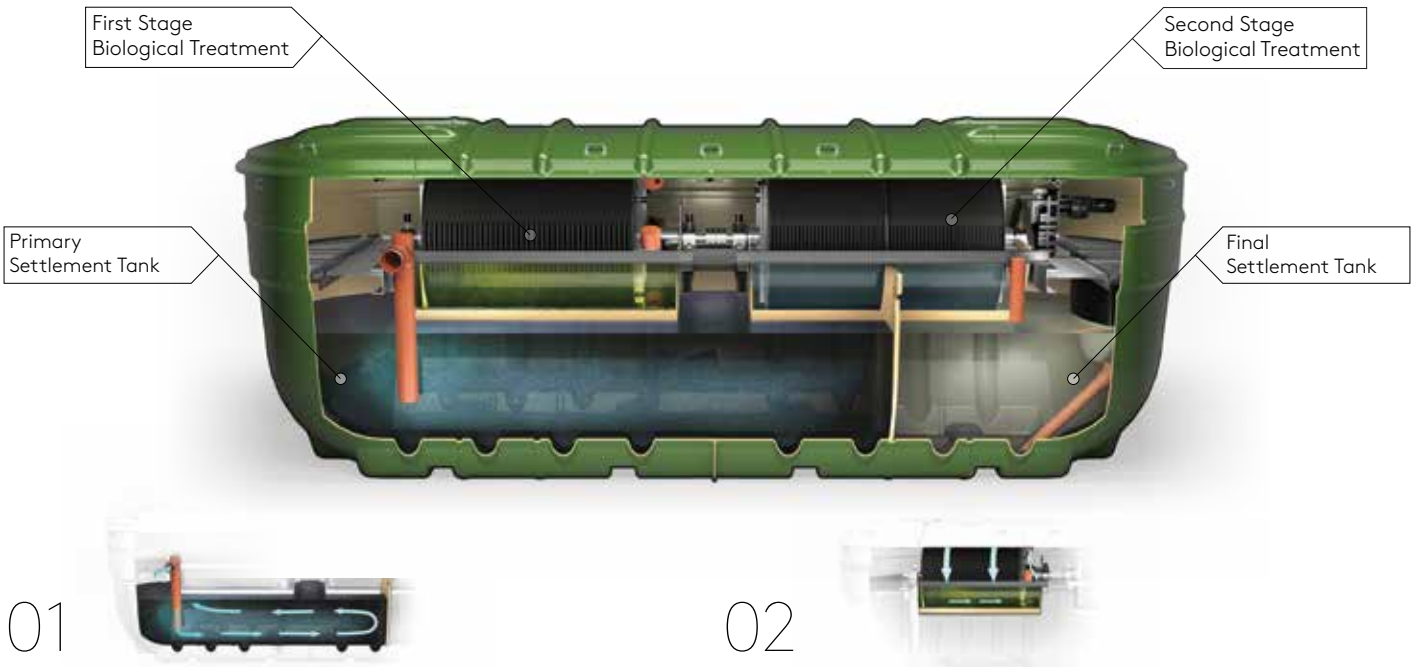
- Unique RBC technology.
- Tried and tested technology, offers robust and efficient water management treatment.
- Low running costs.
- Noise free.
- Fully removable lid for easy desludging.
- Fully packaged system, delivered direct on site.
- Bespoke technical support offered from our in-house technical teams.

Performance & Compliance

› Odour free – tested and fully approved in accordance with BSEN13725.

› Designed for applications selected in compliance with British Water Code of Practice Flows and Loads.

› 100% compliance with industry requirements across commercial sectors, including national and international regulations such as BS EN12255 and EN12566-3 (up to 50 PE).



01

Primary Settlement Tank

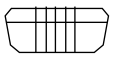
This is the initial stage of treatment and simply involves the retention of coarse solids present in raw sewage and wastewater for subsequent gradual breakdown. BioDisc® features one chamber to ensure efficient operation with a flow balancing facility.

02

First Stage Biological Treatment

The liquor and fine solids then flow into the first stage of Biological Treatment. A unique managed flow system ensures peak performance by smoothing variable loads.

Single Piece System



Technical Specifications

Model Reference	BD	BE	BF	BG	BH	BJ	BK	BL	BM	BN
Maximum Daily BOD (kg)	1.5	2.1	3	4.2	4.5	6	7.5	9	13.5	18
Maximum Daily Flow (m3)	5	7	10	14	15	20	25	30	45	60
Ø/Width (mm)	2450	2450	2450	2450	2450	2450	2450	2450	2450	2450
Length (mm)	3340	3340	4345	5235	7755	7755	7755	7755	10420	13100
Inlet Invert depth (mm)	600/1100	600/1100	600/1100	600/1100	600/1000	600/1000	600/1000	600/1000	600/1000	600/1000
Depth Below Inlet Invert (mm)	1820	1820	1820	1820	1790	1790	1790	1790	1790	1790
Outlet Invert Depth (mm)	1735	1735	1720	1720	1640	1640	1640	1640	1640	1640
Overall Height (mm)	2825/3325	2825/3325	2825/3325	2825/3325	2830/3230	2830/3230	2830/3230	2830/3230	2830/3230	2830/3230
Height to Rim of Cover (mm)	2485/2985	2485/2985	2485/2985	2485/2985	2490/2890	2490/2890	2490/2890	2490/2890	2490/2890	2490/2890
Empty Weight (kg)	1100/1200	1200/1300	1315/1465	1660/1810	3000/3020	3100/3120	3200/3220	3300/3320	4200/4250	5500/5650
Standard Power Supply	1 phase	1 phase	1 phase	1 phase	1 phase	1 phase	1 phase	1 phase	1 phase	1 phase
Motor Rating - 1 Phase (Watts)	75	75	120	180	250	250	370	370	550	2 x 370
Full Load Current 1 Phase (amps)	1.1	1.1	1.3	1.6	1.5	1.5	2.35	2.35	2.8	2 x 2.35
Optional Power Supply	3 phase	3 phase	3 phase	3 phase	3 phase	3 phase	3 phase	3 phase	3 phase	3 phase
Motor Rating - 3 Phase (Watts)	90	90	120	180	250	250	370	370	550	2 x 370
Full Load Current 3 Phase (amps)	0.38	0.38	0.42	0.63	0.88	0.88	1.35	1.35	2.8	2 x 1.35
Sludge Return Pump Rating (watts)	250	250	250	250	250	250	250	250	250	250

03

Second Stage Biological Treatment

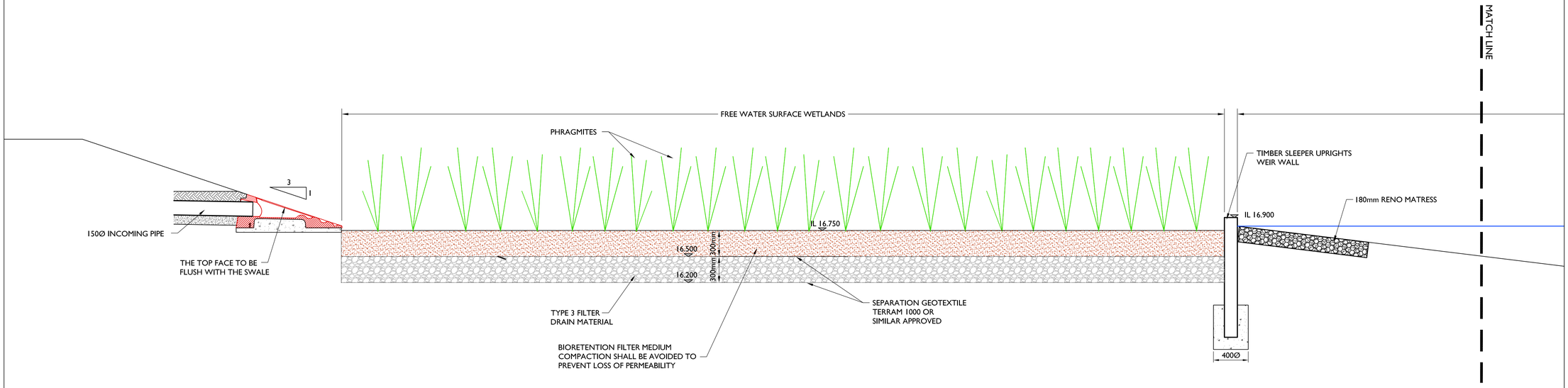
The liquor is then fed forward at a controlled rate into Biological Treatment stage 2 for further cleaning. This process ensures the whole media area available is utilised ensuring maximum efficiency.

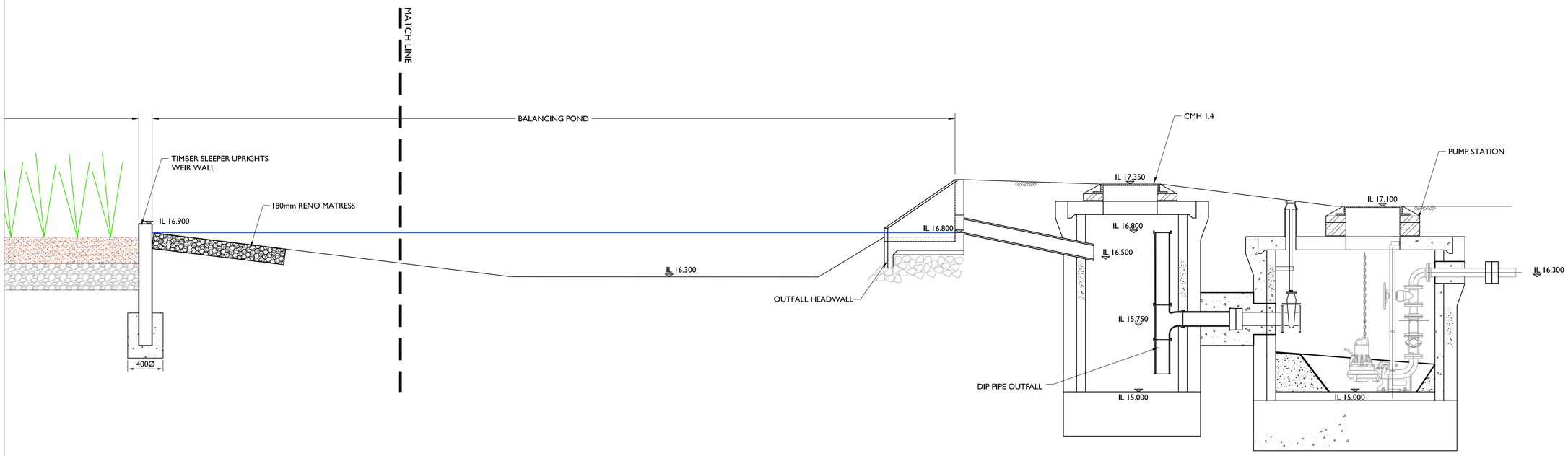
04

Final Settlement Tank

The surplus micro-organisms continuously slough off the discs and are carried forward to the final settlement where they settle out as a humus sludge, leaving a clear treated effluent to be discharged to ground or water course. The settled humus sludge is returned to the Primary Settlement Tank by the sludge return pump under timer control. The sludge return pump also removes any floating scum which helps to keep the final settlement tank working efficiently.

Appendix F – Free Water Surface Wetlands





NOTES

1. ALL LEVELS AS SHOWN ARE AS PER TOPOGRAPHICAL SURVEY.

2. CONSTRUCTION AND TESTING OF DRAINS AND SEWERS TO COMPLY WITH BS EN 1610. CONTRACTOR SHALL NOTE THAT TOLERANCES OF + OR - 5% OF THE PIPES INTERNAL DIAMETER MUST BE ACHIEVED UPTO A MAXIMUM OF 20mm

3. FOR MANHOLE CONSTRUCTION INFORMATION REFER TO STANDARD DETAILS DRAWINGS.

4. PRECAST MANHOLES SHALL COMPLY WITH BS EN 1917

5. POLYPROPYLENE CHAMBERS TO COMPLY WITH BS 7158.

6. BRICKWORK CHAMBERS WILL TO BE CONSTRUCTED FROM CLASS B ENGINEERING BRICKS COMPLYING WITH BS 3921. BRICKS SHALL ALSO BE FROST-RESISTANT CATEGORY F.

7. CLAY PIPES TO COMPLY TO BS EN 295

8. CONCRETE PIPES TO COMPLY TO BS EN 1916

9. TYPE OF PIPE "PERF" REFERS TO PERFORATED FILTER DRAINS TO COMPLY TO BS 4962.

10. PLASTIC PIPE ALTERNATIVES
IN NON-AGGRESSIVE SOIL CONDITIONS PLASTIC PIPE ALTERNATIVES WILL BE DEEMED ACCEPTABLE. IF THE CONTRACTOR INTENDS TO USE PLASTIC PIPEWORK IN ACCORDANCE WITH BS 4660 - THE FOLLOWING STANDARDS WILL BE REQUIRED:

DRAINAGE CONNECTIONS OF LESS THAN 150Ø SHALL BE SOLID WALL uPVC PIPES COMPLYING WITH BS EN 1401-1

PIPE SIZES 150-900Ø (TO BE USED IN FOUL OR COMBINED FLOW DRAINAGE SYSTEMS) SHALL BE THERMOPLASTIC STRUCTURED WALL PIPE COMPLYING WITH WIS 4-35-01

PIPE SIZES 150-900Ø (TO BE USED IN SURFACE WATER DRAINAGE SYSTEMS) SHALL BE THERMOPLASTIC STRUCTURED WALL PIPES WITH BBA & HAPAS ACCREDITATION.

THE CONTRACTOR SHALL SUBMIT DETAILS OF THE PROPOSED PLASTIC PRODUCTS FOR APPROVAL BY THE ENGINEER.

11. THE CONTRACTOR SHALL ALSO NOTE THAT CONNECTIONS TO PUBLIC SEWERS & MATERIALS USED IS SUBJECT TO AGREEMENT WITH THE ADOPTING AUTHORITY AND THE CONTRACTOR SHALL THEREFORE ASSUME THAT TRADITIONAL MATERIALS MUST BE USED UNLESS EXPRESSIVELY INFORMED OTHERWISE.

12. MOULDED PPIC BASES HAVE A CAST IN SLOPE OF 20mm ACROSS THE MAIN CHANNEL AND A STEP OF 75mm FROM THE MAIN CHANNEL TO INCOMING BRANCHES. WHERE PPIC MANHOLES ARE SHOWN, LEVELS HAVE BEEN CALCULATED TO REFLECT THE SLOPE / STEP AS NECESSARY.

13. MOULDED MINI PPIC BASES HAVE A CAST IN SLOPE OF 10mm ACROSS THE MAIN CHANNEL AND A STEP OF 35mm FROM THE MAIN CHANNEL TO INCOMING BRANCHES. WHERE MINI PPIC MANHOLES ARE SHOWN, LEVELS HAVE BEEN CALCULATED TO REFLECT THE SLOPE / STEP AS NECESSARY.

REV	DESCRIPTION	BY	CHK	APR	DATE
-	-	-	-	-	-

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PURPOSE OF ISSUE: PRELIMINARY	STATUS: P
PROJECT: PROPOSED RESIDENTIAL DEVELOPMENT AT BANGOR ON DEE	
TITLE: DRAINAGE SCHEME REED BED / POND DETAIL	
CLIENT: MR RETIEF JORDAAN	
DRAWN BY: SB	CHECKED BY: RH / APPROVED BY: JP
DATE: 18.06.2026	SCALE (@ A1): 1:25 / PROJECT NUMBER: 95033
DRAWING NUMBER: 0608	REV: P01

Free Water Surface Wetlands / Integrated Constructed Wetlands

TYPE: End of Pipe Solution

Brief Description

A constructed wetland which is characterised by a volume of water of 0.1- 0.3 metre deep with various types of aquatic and wetland plant used in combination with areas of open water.

Regulatory Requirement

Wetlands constructed for the primary purpose of water treatment will need an Environmental Permit. The type of Permit will depend on various circumstances. May need an Environmental Permit for:

· Waste

· Water discharge (surface and ground waters)

· Covering both waste and water discharge.

Planning permission may be required through the Local Authority.

Limitations / Concerns

Requires primary / secondary treatment. Potential mosquito habitat. Natural wetland should not be used for wastewater treatment. Health and safety concerns around algal blooms - restrict public access to cells.

Likely Stakeholders for Engagement

NRW	LPA	Water Companies
Env. NGOs		Landowners

Nutrient Removal Rate

Total Phosphorus	Up to 80%
Total Nitrogen	Up to 80%
Ammonia	80-90%
BOD5	~50%
COD	Up to 90%

Sizing models or regression equations used in wetland design should dictate the wetland area and hydraulic residence time necessary to achieve the required treatment target(s).

Wider Benefits

Water reuse	Carbon Sequestration
Aesthetic Value	Biomass Production
Flood mitigation	Temperature Regulation
Biodiversity	Recreation

Time to Effectiveness

Physical filtration aspect will immediately remove suspended sediment. Removal of nutrients / organic matter require biofilms and vegetation to become established. Research has shown wetlands providing tertiary treatment have no start up period.

Performance with Time

P and sediment removal due to filtration and plant uptake (for P) should be effective immediately. Management needs will be dependent on the type of treatment and design. Harvesting and disposal of plant material may be needed. The wetland will need stable conditions to prevent release of stored P.

Cost

Low		

Maintenance

Low		

Option to carry out vegetation offtake periodically in the long term. A comprehensive maintenance plan including sediment monitoring measures will need to be submitted as part of wetland design.

What is needed for Certainty

Design concepts within the Natural England Framework Approach for Responding to Wetland Mitigation Proposals represent best practice design for nutrient treatment wetlands. Reference must be made to NRW's policy and regulatory position on CWs when designing treatment wetlands

Full Description

A Free Water Surface Treatment Wetland is a constructed wetland which aims to utilize naturally occurring processes involving wetland soils, vegetation and microbes, in order to provide treatment. This type of wetland is characterised by a volume of water of 0.1- 0.3 metre deep with various types of aquatic and wetland plant used in combination with areas of open water. The structure of the various plants serves as physical substrate for biofilm while the plants themselves incorporate ammonia nitrogen and phosphorus.

These have a a very low energy usage as feed is generally achieved by gravity flow. To avoid losses to groundwater, free water surface treatment wetlands would need to be sealed systems.

They use a mix of aerobic reactions, anoxic reactions, and phytodegredation to achieve treatment

They are mainly used for tertiary treatment of wastewater at present, but have also been used for secondary treatment. Trials are underway using constructed wetlands for CSO treatment.

Useful Links

NE Framework Constructed Wetland Hub (arcgis.com)

Appendix G – Pond / Sediment Trap

Terrestrial Sediment Traps

TYPE: Nature-based Solution

Brief Description

Temporary or permanent barriers made of geotextiles or permeable materials that allow water through but trap sediment.

Regulatory Requirement

TBC

Planning permission / Ordinary Watercourse Consent may be required through the Local Authority.

Limitations / Concerns

The permeable geotextiles used for sediment fences can become blocked, which can cause water to back up behind a fence and then overtop it, resulting in a reduction in sediment deposition and P removal performance.

Likely Stakeholders for Engagement

NRW	LPA		
Env. NGOs		Landowners	

Nutrient Removal Rate

Total Phosphorus	<33%

Wider Benefits

Flood mitigation	
	Pollutant removal

Time to Effectiveness

Immediately upon installation.

Long term management required for any certainty of use.

Performance with Time

Sediment fences are primarily controlled by their location and will dictate how much surface water runoff passes through the fence, thus how much sediment will be trapped by it. Detention ponds will reduce in effectiveness once they are full. Sediment accumulation will also affect the storage capacity of a pond.

Cost

Low		

Sediment fences can be constructed cheaply and also moved to different locations once accumulated sediment has been removed.
Potential costs of long term maintenance

Maintenance

Low		

Sediment fences require little maintenance if left to be buried by accumulated sediment. For continued functionality, sediment can be removed once the fence is buried. A comprehensive maintenance plan including silt removal measures will need to be submitted as part of design.

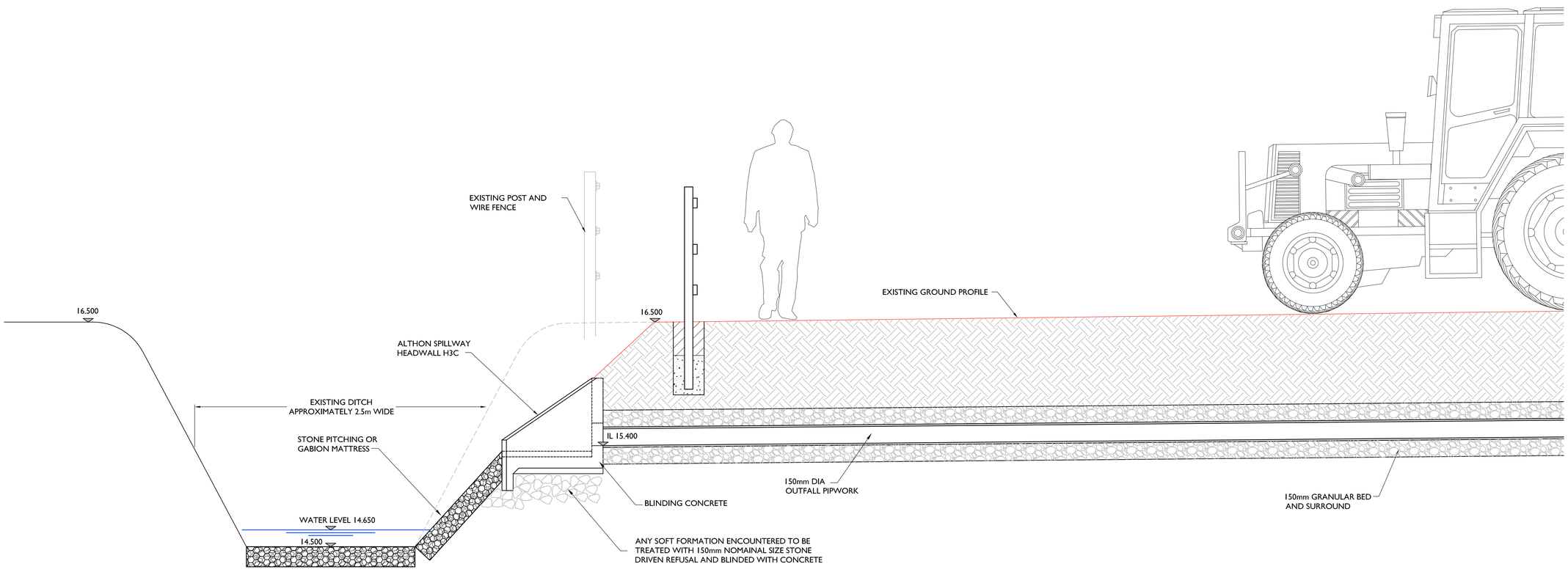
What is needed for Certainty

Full Description

Temporary or permanent barriers made of geotextiles or permeable materials that allow water through but trap sediment. Detention ponds are depressions that are filled by surface water runoff during rainfall events, forming ephemeral wetland features.
Sediment traps immobilise sediment and sediment-bound P by trapping sediment on surface water runoff pathways. A sediment trap is placed in an area where surface water flow pathways are known to occur and should be located in the right place, taking into account any field drainage issues. Sediment accumulates in the traps and is left to stabilise or is removed, thus immobilising and removing a source of P pollution to rivers.

Useful Links

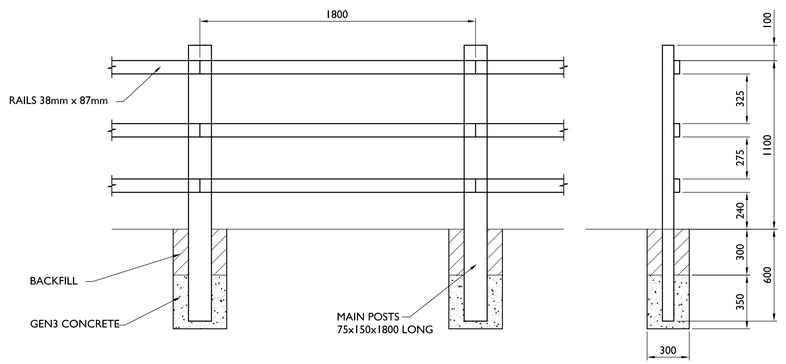
Appendix H – Ditch Outfall



SECTION THROUGH HEADWALL

SCALE 1:20

PHOTOGRAPH OF EXISTING WATERCOURSE



TIMBER POST & 3 RAIL FENCE

SCALE 1:20

NOTES

TIMBER POST AND 3 RAIL FENCES

1) B.S.1722 PART 7 TYPE SPR 11/3 APPLIES UNLESS OTHWISE STATED.

2) WHERE THE FENCE FORMS A BOUNDARY BETWEEN THE HIGHWAY AND PRIVATE PROPERTY, THE RAILS SHALL BE FIXED TO THE PRIVATE PROPERTY SIDE.

3) POSTS TO BE SUPPORTED BY RAMMED BACKFILL AND CONCRETE MIX GEN 3.

4) ALL DIMENSIONS ARE IN MILLIMETERS

NOTES

1. ALL LEVELS AS SHOWN ARE AS PER TOPOGRAPHICAL SURVEY.

2. CONSTRUCTION AND TESTING OF DRAINS AND SEWERS TO COMPLY WITH BS EN 1610. CONTRACTOR SHALL NOTE THAT TOLERANCES OF + OR - 5% OF THE PIPES INTERNAL DIAMETER MUST BE ACHIEVED UPTO A MAXIMUM OF 20mm

3. FOR MANHOLE CONSTRUCTION INFORMATION REFER TO STANDARD DETAILS DRAWINGS.

4. PRECAST MANHOLES SHALL COMPLY WITH BS EN 1917

5. POLYPROPYLENE CHAMBERS TO COMPLY WITH BS 7158.

6. BRICKWORK CHAMBERS WILL TO BE CONSTRUCTED FROM CLASS B ENGINEERING BRICKS COMPLYING WITH BS 3921. BRICKS SHALL ALSO BE FROST-RESISTANT CATEGORY F.

7. CLAY PIPES TO COMPLY TO BS EN 295

8. CONCRETE PIPES TO COMPLY TO BS EN 1916

9. TYPE OF PIPE "PERF" REFERS TO PERFORATED FILTER DRAINS TO COMPLY TO BS 4962.

10. PLASTIC PIPE ALTERNATIVES
IN NON-AGGRESSIVE SOIL CONDITIONS PLASTIC PIPE ALTERNATIVES WILL BE DEEMED ACCEPTABLE. IF THE CONTRACTOR INTENDS TO USE PLASTIC PIPEWORK IN ACCORDANCE WITH BS 4660 - THE FOLLOWING STANDARDS WILL BE REQUIRED:

DRAINAGE CONNECTIONS OF LESS THAN 150Ø SHALL BE SOLID WALL uPVC PIPES COMPLYING WITH BS EN 1401-1

PIPE SIZES 150-900Ø (TO BE USED IN FOUL OR COMBINED FLOW DRAINAGE SYSTEMS) SHALL BE THERMOPLASTIC STRUCTURED WALL PIPE COMPLYING WITH WIS 4-35-01

PIPE SIZES 150-900Ø (TO BE USED IN SURFACE WATER DRAINAGE SYSTEMS) SHALL BE THERMOPLASTIC STRUCTURED WALL PIPES WITH BBA & HAPAS ACCREDITATION.

THE CONTRACTOR SHALL SUBMIT DETAILS OF THE PROPOSED PLASTIC PRODUCTS FOR APPROVAL BY THE ENGINEER.

11. THE CONTRACTOR SHALL ALSO NOTE THAT CONNECTIONS TO PUBLIC SEWERS & MATERIALS USED IS SUBJECT TO AGREEMENT WITH THE ADOPTING AUTHORITY AND THE CONTRACTOR SHALL THEREFORE ASSUME THAT TRADITIONAL MATERIALS MUST BE USED UNLESS EXPRESSIVELY INFORMED OTHERWISE.

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REV	DESCRIPTION	BY	CHK	APR	DATE
-	-	-	-	-	-

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PURPOSE OF ISSUE	STATUS
PRELIMINARY	P
PROJECT	
PROPOSED RESIDENTIAL DEVELOPMENT AT BANGOR ON DEE	
TITLE	
DRAINAGE SCHEME CROSS SECTIONS	
CLIENT	
MR RETIEF JORDAAN	
DRAWN BY / CHECKED BY / APPROVED BY	
SB / RH / JP	
DATE / SCALE (@ A1) / PROJECT NUMBER	
24.04.2026 / AS SHOWN / 95033	
DRAWING NUMBER	REV
0607	P01

Appendix I – Surface Water Calculations

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	40	Minimum Backdrop Height (m)	0.200
CV	0.750	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	4.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
S3.4	0.013	4.00	20.100	1200	61.477	8.345	0.650
S3.3	0.013	4.00	19.650	1200	67.793	39.257	0.650
S3.2	0.040	4.00	20.100	1200	104.067	31.790	1.470
S3.1	0.004	4.00	19.700	1200	105.934	41.930	1.175
S4.0	0.011	4.00	19.300	1200	81.801	48.201	0.900
S3.0	0.007	4.00	19.200	1200	79.160	59.663	1.030
ROAD 1	0.016	4.00	19.800		19.371	14.736	0.450
S1.7	0.003	4.00	20.100	1200	27.649	10.492	0.900
S1.6	0.030	4.00	19.100	1200	30.929	18.670	1.000
S1.5	0.007	4.00	19.000	1200	36.790	34.385	1.070
S8.0	0.008	4.00	19.400	1200	49.648	15.893	1.300
S1.4	0.007	4.00	19.100	1200	54.307	38.278	1.350
S7.0	0.003	4.00	19.200	1200	41.973	48.740	1.100
S1.3	0.006	4.00	18.900	1200	57.240	52.255	1.290
ROAD 2	0.039	4.00	18.800		43.640	65.090	0.850
S6.0			18.600	1200	46.668	69.290	1.000
S1.2			18.850	1200	59.920	65.468	1.450
ROAD 3	0.092	4.00	18.800		70.244	74.169	0.850
S1.1			18.700	1200	62.143	75.923	1.475
S2.0	0.043	4.00	18.500	1200	75.994	90.136	1.000
TANK			18.350		66.202	90.214	1.200
S1.0			18.250	1200	66.126	94.271	1.150
HW2			18.100	1200	65.928	100.952	1.100

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	S3.4	S3.3	31.551	0.600	19.450	19.000	0.450	70.1	150	4.44	50.0
1.001	S3.3	S3.2	37.035	0.600	19.000	18.630	0.370	100.0	150	5.05	50.0
1.002	S3.2	S3.1	10.310	0.600	18.630	18.525	0.105	98.2	150	5.22	50.0
1.003	S3.1	S3.0	32.114	0.600	18.525	18.170	0.355	90.5	150	5.73	50.0
2.000	S4.0	S3.0	11.762	0.600	18.400	18.170	0.230	51.1	150	4.14	50.0

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	1.202	21.2	2.5	0.500	0.500	0.013	0.0	34	0.802
1.001	1.005	17.8	4.9	0.500	1.320	0.026	0.0	54	0.863
1.002	1.014	17.9	12.5	1.320	1.025	0.066	0.0	92	1.095
1.003	1.057	18.7	13.3	1.025	0.880	0.070	0.0	93	1.145
2.000	1.410	24.9	2.1	0.750	0.880	0.011	0.0	30	0.863

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)
1.004	S3.0	S1.2	20.097	0.600	18.170	17.475	0.695	28.9	150	5.91	50.0
3.000	ROAD 1	S1.7	9.303	0.600	19.350	19.200	0.150	62.0	150	4.12	50.0
3.001	S1.7	S1.6	8.811	0.600	19.200	18.300	0.900	9.8	150	4.17	50.0
3.002	S1.6	S1.5	16.772	0.600	18.100	17.930	0.170	98.7	150	4.44	50.0
3.003	S1.5	S1.4	17.944	0.600	17.930	17.750	0.180	99.7	150	4.74	50.0
4.000	S8.0	S1.4	22.865	0.600	18.100	17.800	0.300	76.2	100	4.43	50.0
3.004	S1.4	S1.3	14.281	0.600	17.750	17.610	0.140	102.0	150	4.98	50.0
5.000	S7.0	S1.3	15.666	0.600	18.100	17.610	0.490	32.0	150	4.15	50.0
3.005	S1.3	S1.2	13.482	0.600	17.610	17.475	0.135	100.0	150	5.20	50.0
6.000	ROAD 2	S6.0	5.178	0.600	17.950	17.600	0.350	14.8	150	4.03	50.0
6.001	S6.0	S1.2	13.792	0.600	17.600	17.475	0.125	110.3	150	4.27	50.0
1.005	S1.2	S1.1	10.689	0.600	17.400	17.300	0.100	106.9	225	6.05	50.0
7.000	ROAD 3	S1.1	8.289	0.600	17.950	17.375	0.575	14.4	150	4.05	50.0
1.006	S1.1	TANK	14.856	0.600	17.225	17.150	0.075	198.1	300	6.27	50.0
8.000	S2.0	TANK	9.792	0.600	17.500	17.150	0.350	28.0	150	4.09	50.0
1.007	TANK	S1.0	4.058	0.600	17.150	17.100	0.050	81.2	300	6.31	50.0
1.008	S1.0	HW2	6.684	0.600	17.100	17.000	0.100	66.8	300	6.37	50.0

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)
1.004	1.879	33.2	16.7	0.880	1.225	0.088	0.0	75	1.882
3.000	1.279	22.6	3.0	0.300	0.750	0.016	0.0	37	0.895
3.001	3.239	57.2	3.6	0.750	0.650	0.019	0.0	25	1.816
3.002	1.011	17.9	9.3	0.850	0.920	0.049	0.0	77	1.023
3.003	1.006	17.8	10.6	0.920	1.200	0.056	0.0	83	1.050
4.000	0.882	6.9	1.5	1.200	1.200	0.008	0.0	32	0.704
3.004	0.995	17.6	13.5	1.200	1.140	0.071	0.0	99	1.095
5.000	1.786	31.6	0.6	0.950	1.140	0.003	0.0	14	0.673
3.005	1.005	17.8	15.2	1.140	1.225	0.080	0.0	107	1.126
6.000	2.632	46.5	7.4	0.700	0.850	0.039	0.0	40	1.927
6.001	0.956	16.9	7.4	0.850	1.225	0.039	0.0	69	0.925
1.005	1.264	50.3	39.3	1.225	1.175	0.207	0.0	150	1.394
7.000	2.667	47.1	17.5	0.700	1.175	0.092	0.0	63	2.468
1.006	1.113	78.7	56.7	1.175	0.900	0.299	0.0	189	1.208
8.000	1.911	33.8	8.2	0.850	1.050	0.043	0.0	50	1.577
1.007	1.746	123.4	64.9	0.900	0.850	0.342	0.0	154	1.767
1.008	1.926	136.1	64.9	0.850	0.800	0.342	0.0	146	1.902

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	0.750	Drain Down Time (mins)	240	Check Discharge Volume	x
Winter CV	0.840	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	40	0	0

Node S1.0 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Downstream Link	1.008	Sump Available	✓
Replaces Downstream Link	x	Product Number	CTL-SHE-0126-7500-1100-7500
Invert Level (m)	17.100	Min Outlet Diameter (m)	0.150
Design Depth (m)	1.100	Min Node Diameter (mm)	1200
Design Flow (l/s)	7.5		

Node TANK Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	17.150
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	176

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	175.0	175.0	0.800	175.0	212.5	0.801	0.0	212.5

Node ROAD 1 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	19.350	Slope (1:X)	68.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	0.400
Safety Factor	2.0	Width (m)	5.000	Inf Depth (m)	
Porosity	1.00	Length (m)	170.000		

Node ROAD 2 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	17.950	Slope (1:X)	76.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	0.400
Safety Factor	2.0	Width (m)	5.000	Inf Depth (m)	
Porosity	1.00	Length (m)	50.000		

Node ROAD 3 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	17.950	Slope (1:X)	50.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	0.400
Safety Factor	2.0	Width (m)	2.500	Inf Depth (m)	
Porosity	1.00	Length (m)	55.000		

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.73%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S3.4	12	19.659	0.209	8.0	0.3193	0.0000	SURCHARGED
15 minute winter	S3.3	12	19.634	0.634	16.0	0.9707	0.0000	FLOOD RISK
15 minute winter	S3.2	12	19.541	0.911	31.9	1.5257	0.0000	SURCHARGED
15 minute winter	S3.1	12	19.312	0.787	26.9	0.9438	0.0000	SURCHARGED
15 minute winter	S4.0	12	18.616	0.216	6.8	0.2970	0.0000	SURCHARGED
15 minute winter	S3.0	12	18.609	0.439	33.2	0.5565	0.0000	SURCHARGED
15 minute winter	ROAD 1	10	19.425	0.075	9.9	0.2151	0.0000	OK
15 minute winter	S1.7	11	19.247	0.047	11.8	0.0562	0.0000	OK
15 minute winter	S1.6	11	19.100	1.000	30.3	1.7310	0.5711	FLOOD
15 minute winter	S1.5	12	18.891	0.961	25.2	1.2128	0.0000	FLOOD RISK
15 minute winter	S8.0	13	18.657	0.557	4.9	0.6989	0.0000	SURCHARGED
15 minute winter	S1.4	13	18.619	0.869	26.9	1.0730	0.0000	SURCHARGED
15 minute winter	S7.0	13	18.292	0.192	3.3	0.2283	0.0000	SURCHARGED
15 minute winter	S1.3	13	18.293	0.683	28.1	0.8364	0.0000	SURCHARGED
180 minute winter	ROAD 2	172	18.182	0.232	5.7	6.4407	0.0000	SURCHARGED
180 minute winter	S6.0	172	18.182	0.582	5.7	0.6578	0.0000	SURCHARGED
180 minute winter	S1.2	172	18.181	0.781	29.2	0.8834	0.0000	SURCHARGED
15 minute winter	ROAD 3	11	18.224	0.274	56.8	2.3250	0.0000	SURCHARGED
180 minute winter	S1.1	172	18.180	0.955	41.3	1.0800	0.0000	SURCHARGED
180 minute winter	S2.0	172	18.180	0.680	6.3	1.3531	0.0000	SURCHARGED
180 minute winter	TANK	172	18.179	1.029	46.7	133.0831	0.0000	FLOOD RISK
180 minute winter	S1.0	172	18.179	1.079	11.9	1.2203	0.0000	FLOOD RISK
60 minute winter	HW2	262	17.047	0.047	7.5	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)
15 minute winter	S3.4	1.000	S3.3	8.0	0.759	0.376	0.5554	
15 minute winter	S3.3	1.001	S3.2	11.6	0.697	0.651	0.6520	
15 minute winter	S3.2	1.002	S3.1	24.7	1.406	1.381	0.1815	
15 minute winter	S3.1	1.003	S3.0	24.5	1.391	1.311	0.5654	
15 minute winter	S4.0	2.000	S3.0	6.6	0.611	0.266	0.2071	
15 minute winter	S3.0	1.004	S1.2	30.4	1.732	0.915	0.3538	
15 minute winter	ROAD 1	3.000	S1.7	9.9	1.476	0.436	0.0625	
15 minute winter	S1.7	3.001	S1.6	11.8	2.057	0.205	0.0983	
15 minute winter	S1.6	3.002	S1.5	20.9	1.186	1.168	0.2953	
15 minute winter	S1.5	3.003	S1.4	21.6	1.227	1.215	0.3159	
15 minute winter	S8.0	4.000	S1.4	3.8	0.616	0.551	0.1789	
15 minute winter	S1.4	3.004	S1.3	24.9	1.413	1.415	0.2514	
15 minute winter	S7.0	5.000	S1.3	2.5	0.305	0.078	0.2758	
15 minute winter	S1.3	3.005	S1.2	26.1	1.482	1.470	0.2373	
180 minute winter	ROAD 2	6.000	S6.0	5.7	1.173	0.122	0.0912	
180 minute winter	S6.0	6.001	S1.2	5.4	0.804	0.322	0.2428	
180 minute winter	S1.2	1.005	S1.1	28.2	1.132	0.561	0.4251	
15 minute winter	ROAD 3	7.000	S1.1	45.9	2.843	0.974	0.1459	
180 minute winter	S1.1	1.006	TANK	41.0	1.271	0.521	1.0461	
180 minute winter	S2.0	8.000	TANK	5.8	1.307	0.171	0.1724	
180 minute winter	TANK	1.007	S1.0	11.9	0.509	0.097	0.2858	
180 minute winter	S1.0	1.008	HW2	7.5	0.997	0.055	0.0502	159.5