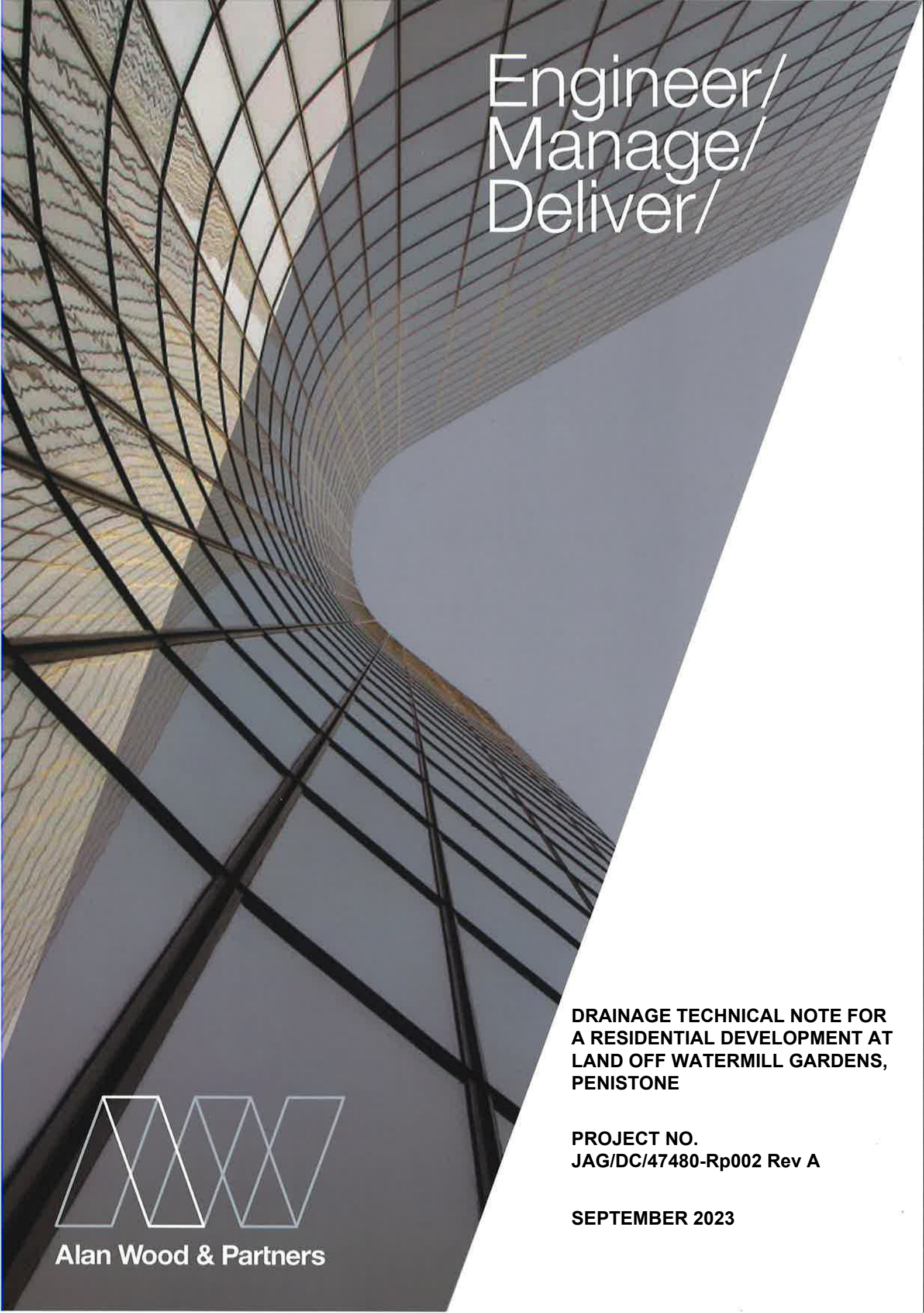

DRAINAGE TECHNICAL NOTE FOR A RESIDENTIAL DEVELOPMENT AT LAND OFF WATERMILL GARDENS, PENISTONE

PROJECT NO.
JAG/DC/47480-Rp002 Rev A

SEPTEMBER 2023

Alan Wood & Partners

Alan Wood & Partners

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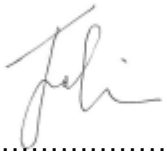
DRAINAGE TECHNICAL NOTE FOR RESIDENTIAL DEVELOPMENT AT LAND OFF WATERMILL GARDENS, PENISTONE

Prepared by: D Cook BSc (Hons)

Signed: ……

Date: 4th September 2023

Approved by: J Gibson, MEng (Hons), CEng, CWEM MCIWEM
Civil Engineering Director



Signed: ……

Date: 4th September 2023

Issue	Revision	Revised by	Approved by	Revised Date
A	Conclusion amended.	DC	JAG	05.09.23

TABLE OF CONTENTS

APPENDICES

1 INTRODUCTION

1.1 Alan Wood & Partners have been commissioned by Mulgrave Property Group Ltd to prepare a drainage technical note for the proposed residential development on land off Watermill Gardens, Penistone, South Yorkshire.

1.2 The site is located on land north of Watermill Gardens, as seen in Figure 1, north of the A628, to the north of the town of Penistone. The grid reference for the centre of the site is SE 24423 03866.

Figure 1: Location

1.3 The site has an area of 0.75ha and is entirely greenfield.

2 PROPOSED WORKS

2.1 It is proposed to develop the following:

- The construction of 17 residential dwellings,
- Domestic garages,
- Site access road and footpath,
- Driveways,
- Gardens,
- Public open space and
- Associated infrastructure.

2.2 A 'Flood Risk and Drainage Assessment' has been produced by Alan Wood and Partners, under reference JAG/AD/JF/47480-Rp001-Rev A, which outlines the flood risk and drainage strategy for the development. This technical note should be read in conjunction with this report.

2.3 As noted within the above assessment, it is intended for the drainage to be adopted by Yorkshire Water.

2.4 Requirement H3 of the Building Regulations establishes a preferred hierarchy for surface water disposal. Consideration should first be given to infiltration, watercourse, surface water sewer, and combined sewer in that priority order.

2.5 Local ground conditions do not permit the use of infiltration. The River Don is the nearest watercourse and is located 90m to the south through third-party land, therefore, a positive connection to this watercourse is unfeasible.

2.6 A Yorkshire Water adopted surface and foul water drainage network is located within the adjoining highway to the south, Watermill Gardens. It is proposed to connect to this system.

2.7 Refer to Appendix A for the Yorkshire Water Sewer Maps.

2.8 Technical drainage drawings for the adopted scheme identify a stub connection directed towards the proposed site to facilitate a connection.

2.9 Refer to Appendix B for the Technical Drainage Drawings.

2.10 It is proposed to collect and discharge surface water runoff into this system at a rate of 2.5l/s while containing the 1:100yr event +50%CC below ground.

2.11 In the pre-planning enquiry response from Yorkshire Water, it has been noted that the adoptable system within Watermill Gardens is at capacity and cannot accept additional flow.

2.12 Refer to Appendix C for the Yorkshire Water pre-planning enquiry.

2.13 Yorkshire Water was reconsulted to detail that alternative points of connection were not feasible and a connection into this sewer was the only possible point of connection.

2.14 Our request to connect to the system was directed to the Yorkshire Water Requisitions Team to discuss the scope and cost to accommodate the proposed connection.

2.15 Refer to Appendix D for the initial Yorkshire Water consultation response.

2.16 Yorkshire Water's Requisitions Team provided two options to progress the application; 1. Yorkshire Water would provide a cost to increase the discharge rate to accommodate our assessment. 2. The existing system could be modelled to demonstrate the proposed connection would not be at the detriment of the network.

2.17 Refer to Appendix E for the Yorkshire Water Requisition Team Correspondence.

2.18 This technical note will outline the methodology and results of modelling the existing system and the resulting effects of the proposed connection.

3 EXISTING MODEL

3.1 The existing system collects runoff from dwellings and the highway through a traditional drainage system. Runoff is brought to the south of the site where it is attenuated within oversized pipes and discharged into the River Don. Runoff is restricted through a HydroBrake flow control, discharging flow to 14l/s.

3.2 As Yorkshire Water could not supply the MicroDrainage Network model for the below adaptable system, the existing system has been modelled through the information provided on the technical drawings found within Appendix B.

3.3 The following parameters were adopted within the existing model.

Rainfall Parameters

M5 – 60 (mm)	= 19.000
Ratio R	= 0.350
Summer CV	= 0.750
Winter CV	= 0.840

Model Parameters

MADD Factor	= 0.000
Time of Entry (mins)	= 5.00
Max Rainfall (mm/hr)	= 50
PIMP (%)	= 100
Climate Change (%)	= 30

3.4 The model was run for the 1:1, 1:30, and 1:100 return periods. The model identifies surcharging within the 1:1 and 1:30 events and 5.7m³ of flooding within the 1:100 year event.

3.5 The presence of flooding is likely because the private drainage systems and any associated structures are not been identified, and thus cannot be modelled.

3.6 Further parameters and model results can be found in Appendix F.

3.7 This model will form the basis for establishing if the proposed connection will be at the detriment of the existing system. Any detriment will be assessed through any potential increase to above-ground flooding.

4 PROPOSED MODEL

4.1 As noted within section 2.0, it is proposed to discharge the proposed drainage into the existing Yorkshire Water system at a discharge rate of 2.5l/s.

4.2 Due to different model and climate change parameters, the proposed and existing system cannot be detailed within the same model. Consequently, to provide a conservative model of the impact on the existing system, a base flow of 2.5l/s has been added to the upstream of the system.

4.3 This will model the existing system with a constant flow of 2.5l/s entering the system throughout the duration of all storm events.

4.4 The results of this model indicate no flooding within the 1:1 and 1:30 year events and 13.1m³ of flooding during the 1:100 year event, an increase of 7.4m³.

4.5 Refer to Appendix G for model parameters and results.

4.6 Therefore, based on these models, the proposal to discharge into the existing system would cause an increase in flooding.

4.6.1 Further models have been undertaken to determine the scope of works to mitigate the detriment to the existing system.

4.6.2 Two possible solutions have been modelled to mitigate the detriment, increasing existing storage and changing the existing flow control unit.

4.7 Mitigation Option 1 – Additional Storage

4.7.1 An increase in storage of 5.4m³ has been modelled to the south of the site, adjacent to the oversized pipes.

4.7.2 This results in no flooding within the 1:1 and 1:30 year events and 5.6m³ of flooding within the 1:100 year event, a reduction of 0.1m³ to the existing system.

4.7.3 Therefore, no detriment to the system would occur and the proposal is deemed acceptable.

4.7.4 The additional storage may be formed through pipes, chambers, or cellular storage crates. The form of storage should be agreed with Yorkshire Water.

4.7.5 Refer to Appendix H for model parameters and results.

4.8 Mitigation Option 2 – Amended HydroBrake

4.8.1 Within this model, the downstream HydroBrake has been remodelled with different parameters; an increased discharge rate of 16.5l/s, an addition of 2.5l/s to the existing, and a deduced design head, a reduction to 1.9m.

4.8.2 This results in no flooding within the 1:1 and 1:30 year events and 5.6m³ of flooding within the 1:100 year event, a reduction of 0.1m³ to the existing system.

4.8.3 Therefore, no detriment to the system would occur and the proposal is deemed acceptable.

4.8.4 Refer to Appendix I for model parameters and results.

5 CONCLUSION

5.1 This note has been prepared with the purpose of analysing the effects of discharging runoff from a proposed residential development at a rate of 2.5l/s into the existing Yorkshire Water drainage system.

5.2 The existing Yorkshire Water system has been modelled through the information within the development technical drawings and Yorkshire Water sewerage records.

5.3 The model of the existing system produced a flooding volume of 5.7m³ during the 1:100 year event, likely due to unmodelled private drainage.

5.4 Providing a conservative analysis of the effects on the existing system, a base flow of 2.5l/s was modelled within the system, resulting in a flooding volume of 13.1m³ during the 1:100 year event, an increase of 7.4m³.

5.5 Consequently, based on the produced models, a restricted connection into the existing system with no further work would result in a detriment to the system. Two models have been produced to determine the extent of works required to mitigate the detriment to the existing system.

5.6 Firstly, a model incorporating 5.4m³ of additional storage within the system resulted in a reduction in flooding volume. Therefore, this approach is a possible solution to mitigate system detriment.

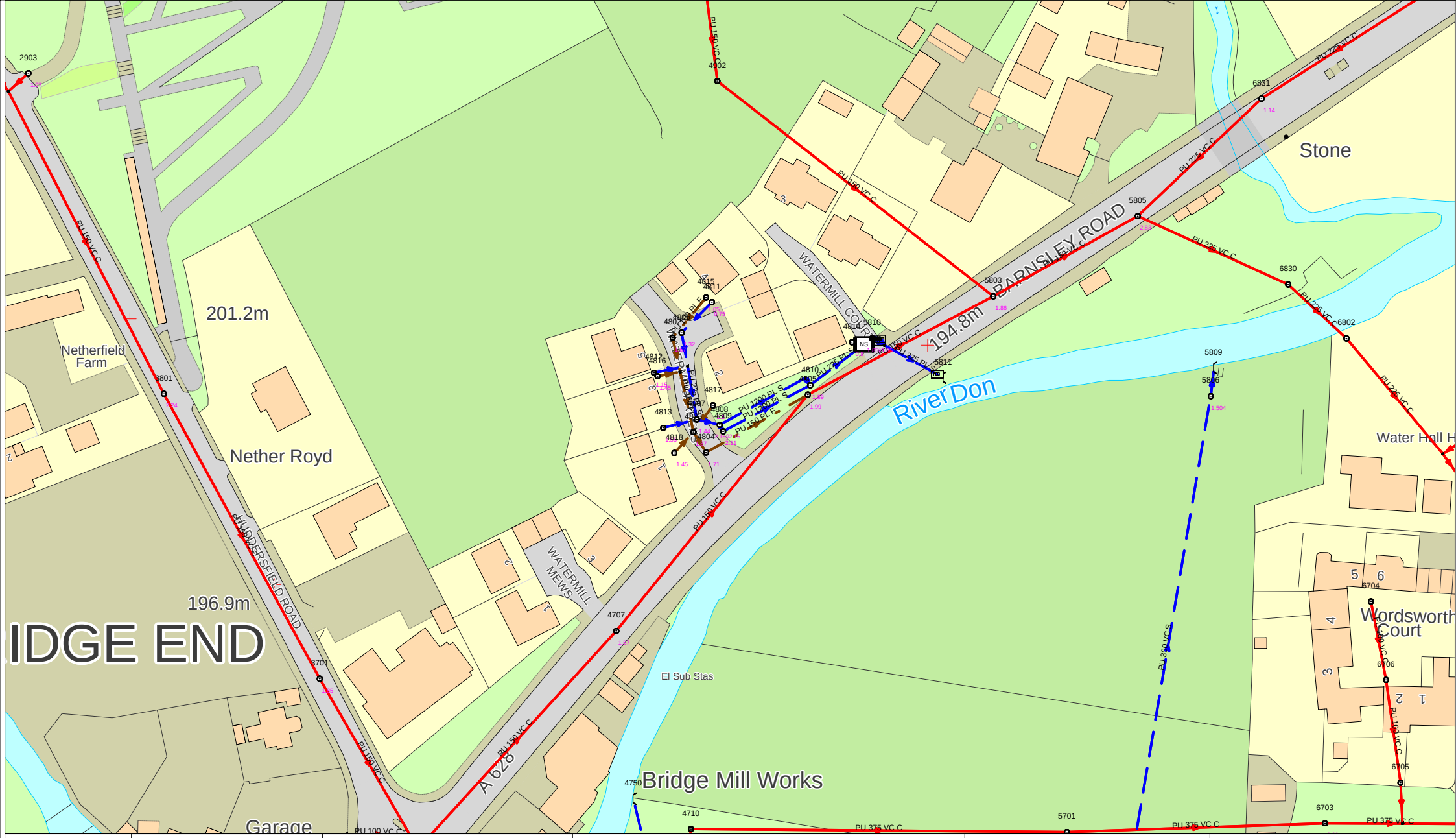
5.7 Secondly, a model with an amended HydroBrake flow control was produced with an increased design flow of 16.5l/s, an increase of 2.5l/s, resulting in a reduced flooding volume to the existing system. Therefore, this approach is a possible solution to mitigate system detriment.

5.8 It is the client's preference to adopt the latter solution, replacing the HydroBrake unit to accommodate the increased discharge rate. As noted within the Yorkshire Water consultation within Appendix E, this work can be undertaken as part of a major S185 application.

5.9 Any works need to be undertaken under Yorkshire Water approval and guidance.

APPENDIX A

Yorkshire Water Sewer Maps



424365 : 403759	Map Name : SE2403NW	Title	Partial Key
Yorkshire Water, PO Box 500, Halifax Road, Bradford BD6 2LZ Contact Name : C Cooke Contact Tel :		Notes	Foul Sewer = F Combined Sewer = C Surface Water Sewer = SW Trade Sewer = TD Partially Separate = PS
		(Ody) COPYRIGHT STATEMENTS: Reproduced by permission of Ordnance Survey on behalf of HMSO © Crown copyright and database 2014. All rights reserved Ordnance Survey Licence number 100022432	This plan is furnished as a general guide only and no warranty as to its correctness is given or implied. This plan must not be relied upon in the event of excavations or other works made in the vicinity of public sewers. No house or property connections are shown.
			Date Req : 10/07/2023, 14:58:01
			Date Gen : 10/07/2023, 14:58:07
			Source : Sewer Network Enquiry

UPN: Undefined Originator: C Cooke, ,

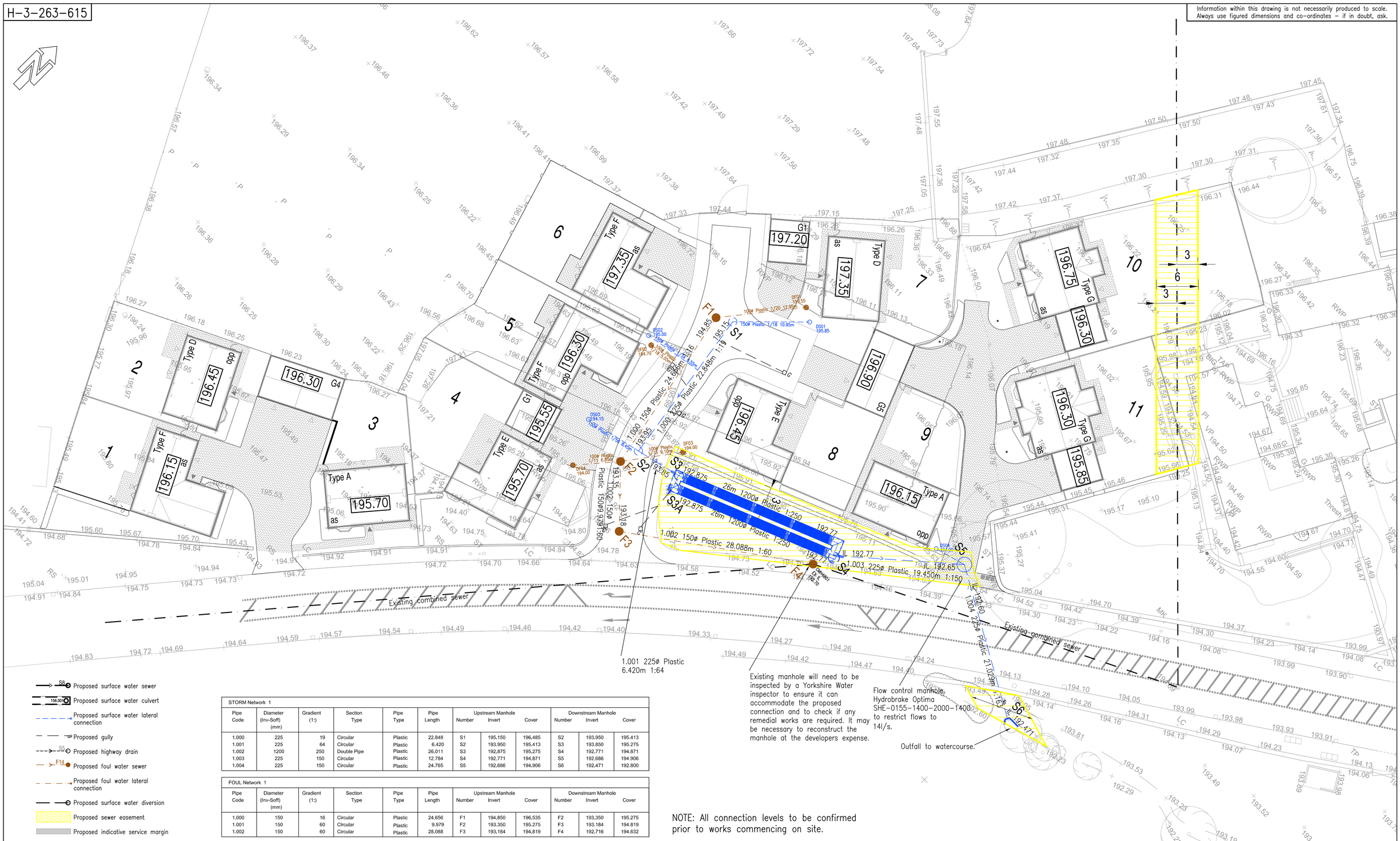
Alan Wood & Partners

APPENDIX B

Existing System Technical Drawing

H-3-263-615

Information within this drawing is not necessarily produced to scale. Always use figured dimensions and co-ordinates – if in doubt, ask.



NOTE: All connection levels to be confirmed prior to works commencing on site.

STORM Network 1

Pipe Code	Diameter (Inv-Soff) (mm)	Gradient (1:)	Section Type	Pipe Type	Pipe Length	Upstream Manhole Number	Upstream Manhole Invert	Upstream Manhole Cover	Downstream Manhole Number	Downstream Manhole Invert	Downstream Manhole Cover
1.000	225	19	Circular	Plastic	22.848	S1	195.150	196.485	S2	193.950	195.413
1.001	225	64	Circular	Plastic	6.420	S2	193.950	195.413	S3	193.850	195.275
1.002	1200	250	Double Pipe	Plastic	26.011	S3	192.875	195.275	S4	192.771	194.871
1.003	225	150	Circular	Plastic	12.784	S4	192.771	194.871	S5	192.686	194.906
1.004	225	150	Circular	Plastic	24.765	S5	192.686	194.906	S6	192.471	192.800

FOUL Network 1

Pipe Code	Diameter (Inv-Soff) (mm)	Gradient (1:)	Section Type	Pipe Type	Pipe Length	Upstream Manhole Number	Upstream Manhole Invert	Upstream Manhole Cover	Downstream Manhole Number	Downstream Manhole Invert	Downstream Manhole Cover
1.000	150	16	Circular	Plastic	24.656	F1	194.850	196.535	F2	193.350	195.275
1.001	150	60	Circular	Plastic	9.979	F2	193.350	195.275	F3	193.184	194.819
1.002	150	60	Circular	Plastic	28.088	F3	193.184	194.819	F4	192.716	194.632

NOTES

1. All pipes shall be either:
   A - Vitrified clay to BS EN 295 with a minimum crushing strength as follow :-
   150 dia. - 40 kN/m
   225 dia. - 45 kN/m
   300 dia. - 72 kN/m
   B - PVC (certified to WIS 4-35-01)
   C - Class 120 concrete to BS 5911-1:2002/EN 1916.
2. All pipes should always connect soffit to soffit unless noted otherwise.
3. All sewers to have BSI kitemark status (certified to WIS 4-35-01 & BS EN 13476). Maximum pipe length to be 3m. Plastic channel sections in manholes are not acceptable, Clay channel sections shall be used.
4. Sewers to be laid in Class "S" bedding (150mm granular bed and surround). Where depth of cover to soffit is less than 1.2m in highways and verges (or less than 900mm in none vehicular access areas) then a reinforced 150mm concrete slab should be provided above granular bed and surround. Bedding and backfill material to conform to WIS 4-08-02 (Table 2) for PVC pipes.
5. Manhole covers shall have a clear opening of 600 and shall be class D400 to BS EN 124 with 150 deep frames in highways. Covers to have closed keyways and are to be bedded on steel shims with 1:3 mortar haunching.
6. Pipes entering manholes and road gullies shall have a flexible joint within 600 of the inside the manhole or gully joining with a short Rocker pipe.
7. The adoptable sewers should be a minimum of 1m and manholes 0.5m from kerb faces and service margins.
8. Sewers must have 5m clearance from trees and hedges (refer to Figure 2.3 page 33 in "Sewers For Adoption"6th Edition for restrictions on tree planting adjacent to sewers).
9. Filled ground must be filled and consolidated under the supervision and to the satisfaction of Yorkshire Water before any sewer works are carried out.
10. All insitu concrete to be designated mix FND2 to BS 8500-1 unless agreed otherwise.
11. The Invert levels at the proposed points of connection to existing public sewers shall be checked before any new drains are constructed. Any variation to the levels shown on the drawing shall be notified to Eastwood & Partners.
12. The chamber size of manholes with more than one connection in them may need to be increased by an increment to accommodate the connections and bends.
13. Cover levels are indicative only. Covers to be set to suit camber/gradient of existing and proposed roads.
14. Cover slabs must carry the BSI Kitemark or will be rejected by the Yorkshire Water Inspector. Where the clear opening of the Kitemarked product is different to that of the cover and frame, a load bearing slab should be fitted above the cover slab to bring the size down to 600x600, refer to CPSA Technical Bulletin issued autumn 2004 for Kitemarked cover slab opening sizes.
15. All surface water lateral sewers and drains to be 150Ø unless noted otherwise. All foul lateral sewers and drains to be 100Ø unless noted otherwise.
16. Yorkshire water policy is not to accept Type "C" brick manholes and 1050mmØ manhole rings. Instead use Type "B" manhole with 1200mmØ or 1500mmØ rings, with the opening sited over the channel where depth of cover to pipe soffit is 1-1.5m.
17. Manhole covers must have a clear opening of 600mm and shall be Class D400 to BS EN 124 with 150mm deep frames in highways.
18. All adoptable sewer works and material to be in accordance with Sewers for Adoption 6th Edition, the relevant British/European and Yorkshire Water standards/requirements/addendum to the Mechanical and Electrical specification and be kitemarked.
19. Yorkshire Water is not obliged to accept filterland drainage run off into the public sewer network or adoptable drainage system, either directly or indirectly. An alternative method of disposal of land drainage run off will therefore be required and you will have to liase with the Local Authority Land drainage section with regards land drainage run off.
20. Sulphate resisting cement (C20-DC2) and precast concrete products must be used or a laboratory report provided proving such precautions are not required.
21. Bedding and back fill material to conform to the requirements of Water Industry Specification 4-08-02 Table A2.

REV	DESCRIPTION	SIG	CHK	DATE
A	First Issue.			
C	Minor amendments to suit Yorkshire Water comments.	RJ	CH	28.10.16
D	Minor amendments to suit Yorkshire Water comments.	RJ	CH	08.11.16
E	Minor amendments to suit Yorkshire Water comments.	RJ	CH	15.11.16
F	Flow control manhole repositioned into access to Plots 9, 10 and 11.	RJ	CH	22.11.16
G	Flow control manhole repositioned further into access to Plots 9, 10 and 11.	RJ	CH	24.02.17
H	Site layout amended to suit latest Duchy Homes planning layout.	RJ	CH	10.03.17
J	Sewer easement amended to 3m.	RJ	CH	15.11.17

DUCHY HOMES

BARNSLEY ROAD, PENISTONE

ADOPTABLE DRAINAGE LAYOUT

Eastwood & Partners
CONSULTING ENGINEERS
St. Andrew's House
23 Kingfield Road
Sheffield
S11 9AS
Tel 0114 255 4554
Fax 0114 255 4330
mail@eastwoodandpartners.com
www.eastwoodandpartners.com

SCALE WHEN PLOTTED AT A1	DRAWING STATUS
1:250	APPROVAL

DRAWN	CHECKED	DATE	DRAWING NUMBER	REV
RJ	CH	02.02.16	38208/017	J

Alan Wood & Partners

APPENDIX C

Yorkshire Water Pre-Planning Enquiry

YorkshireWater

Mr H Dobson
Alan Wood & Partners
341 Beverley Road
Hull
HU5 1LD
harvey.dobson@alanwood.co.uk

Yorkshire Water Services
Developer Services
Pre-Development Team
PO BOX 52
Bradford
BD3 7AY

Tel: 0345 120 8482
Fax:

Email:
technical.sewerage@yorkshirewater.co.uk

For telephone enquiries ring:
Chris Roberts on 0345 120 8482

Your Ref:
Our Ref: Y010139

4th July 2022

Barnsley Road, Bridge Head, Penistone, S36 7AD – Pre-Planning Sewerage Enquiry U697790

Thank you for your recent enquiry. Our charge of £172.00 plus VAT will be added to your account with us, reference AWP054. You will receive an invoice for your account in due course.

Please find enclosed a complimentary extract from the Statutory Sewer Map which indicates the recorded position of the public sewers. Please note that as of October 2011 and the private to public sewer transfer, there are many uncharted Yorkshire Water assets currently not shown on our records. The following comments reflect our view, with regard to the public sewer network only, based on a 'desk top' study of the site and are valid for a maximum period of twelve months:

YorkshireWater

Development of the site should take place with separate systems for foul and surface water drainage. The separate systems should extend to the points of discharge to be agreed.

Foul Water

Foul water domestic waste can discharge to the 150 mm diameter public foul sewer recorded in Watermill Gardens, at a point to the south of the site.

Surface Water

The developer's attention is drawn to Requirement H3 of the Building Regulations 2010. This establishes a preferred hierarchy for surface water disposal. Consideration should firstly be given to discharge to soakaway, infiltration system and watercourse in that priority order.

Sustainable Drainage Systems (SuDS), for example the use of soakaways and/or permeable hardstanding etc, may be a suitable solution for surface water disposal appropriate in this situation. You are advised to seek comments on the suitability of SuDS in this instance from the appropriate authorities.

As the proposed site is currently undeveloped no surface water is known to have previously discharged to the public sewer network

As such, the local public sewer network does not have capacity to accept any surface water from the proposed site. If SuDS are not viable, the developer is advised to contact the Environment Agency/local Land Drainage Authority/Internal Drainage Board with a view to establishing a suitable watercourse for discharge.

It is understood that the River Don is located to the south of the site. This appears to be the obvious place for surface water disposal (if SuDS are not viable). Please note Yorkshire Water cannot provide plans of culverted watercourses or highway drains. To obtain plans please contact the Lead Local Flood Authority for more details.

Please note further restrictions on surface water disposal from the site may be imposed by other parties. You are strongly advised to seek advice/comments from the Environment Agency/Land Drainage Authority/Internal Drainage Board, with regard to surface water disposal from the site.

Other Observations

Any new connection to an existing public sewer will require the prior approval of Yorkshire Water. You may apply on line or obtain an application form from our website (www.yorkshirewater.com) or by telephoning 0345 120 84 82.

An off-site foul and surface water sewer may be required which may be provided by the developer and considered for Code for Adoption under Section 104 of the Water Industry Act 1991. Please telephone 0345 120 84 82 for advice on sewer adoptions. Alternatively, the developer may in certain circumstances be able to requisition off-site sewers under Section 98 of the Water Industry Act 1991 for which an application must be made in writing. For further information, please telephone 0345 120 84 82.

Prospectively adoptable sewers and pumping stations must be designed and constructed in accordance with the Code for Adoption 2021/22, pursuant to an agreement under Section 104 of the Water Industry Act 1991. We are happy to offer pre-development technical advice on any prospective sites that you would like to put forward for for adoption, prior to submission of your adoption application.

An application to enter into a Section 104 agreement must be made in writing prior to any works commencing on site. Please contact our Sewer Adoption, Diversion and Requisition (telephone 0345 120 84 82) or email technical.sewerage@yorkshirewater.co.uk or visit - https://www.yorkshirewater.com/developers/sewerage/sewer-adoptions/ for further information.

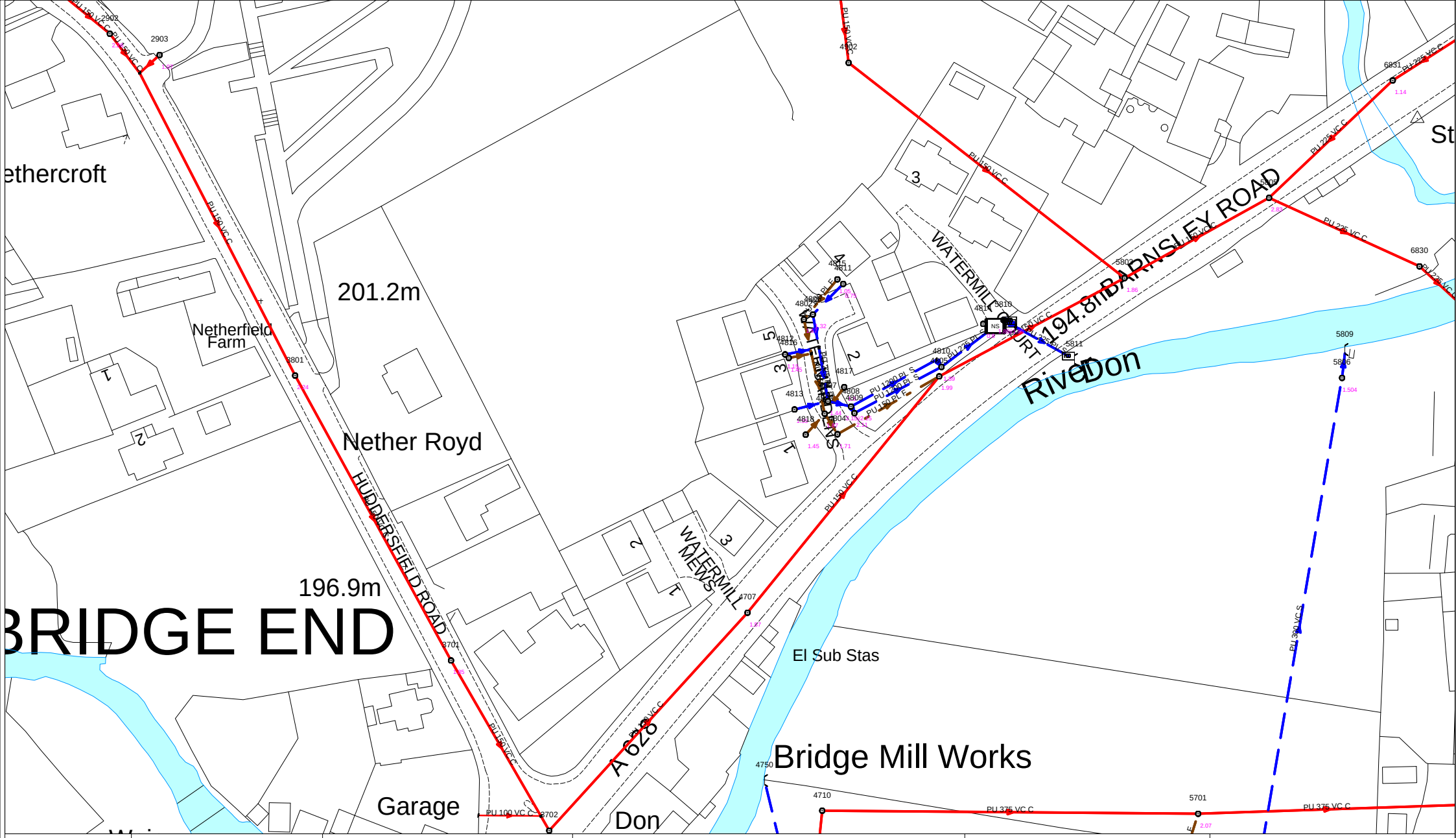
All the above comments are based upon the information and records available at the present time and is subject to formal planning approval agreement.

YorkshireWater

The information contained in this letter together with that shown on any extract from the Statutory Sewer Map that may be enclosed is believed to be correct and is supplied in good faith. Please note that capacity in the public sewer network is not reserved for specific future development. It is used up on a 'first come, first served' basis. You should visit the site and establish the line and level of any public sewers affecting your proposals before the commencement of any design work.

Yours sincerely

Chris Roberts
Development Services Technician



424262 : 403713	Map Name : SE2403NW	Title	Partial Key
		Notes	Foul Sewer = F Combined Sewer = C Surface Water Sewer = SW Trade Sewer = TD Partially Separate = PS
Yorkshire Water, PO Box 500, Halifax Road, Bradford BD6 2LZ Contact Name : YorMap Advisor C ROBERTS Contact Tel : 87 2582			Date Req : 04/07/2022, 11:28:48 Source : Sewer Network Enquiry

This plan is furnished as a general guide only and no warranty as to its correctness is given or implied. This plan must not be relied upon in the event of excavations or other works made in the vicinity of public sewers. No house or property connections are shown.

Date Gen : 04/07/2022, 11:29:00

UPN: Undefined Originator: C ROBERTS, YorMap, 87 2582

Alan Wood & Partners

APPENDIX D

Yorkshire Water Consultation Response

Daniel Cook

From: Technical Sewerage <technical.sewerage@yorkshirewater.co.uk>
Sent: 07 July 2023 11:14
To: Daniel Cook
Subject: RE: U697790 - 47480 - Penistone Pre-Planning Enquiry

Hi Daniel,

The drainage and flow control were designed and agreed specifically for the Watermill Gardens site so I would not agree to your proposal but what you can do is approach our requisitions team and get a cost for them to assess and upgrade the system and flow control in Watermill Gardens to accommodate your additional 30 properties.

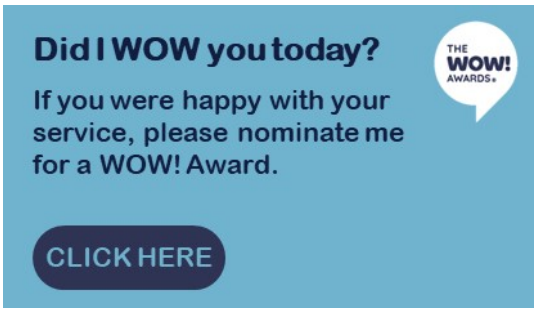
If you email Chris Cook and Hollie Hammond along with this email they will be able to advise on costs and timescales.

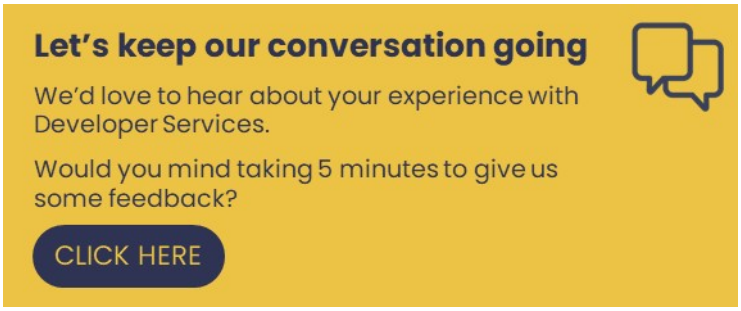
Kind Regards

YorkshireWater

Chris Roberts
Pre-Development Technician
Developer Services
Tel: 0345 1 20 84 82

*****Please note we have 10 working days to respond to email enquiries*****





From: Daniel Cook <daniel.cook@alanwood.co.uk>
Sent: 06 July 2023 11:31

To: Technical Sewerage <technical.sewerage@yorkshirewater.co.uk>
Subject: RE: U697790 - 47480 - Penistone Pre-Planning Enquiry

EXTERNAL SOURCE - THINK BEFORE YOU CLICK

Morning,

We received a pre-planning enquiry for the proposed residential development off Watermill Gardens, Penistone. The site plan and pre-planning enquiry are attached for reference.

Access to the site will be achieved through the recently developed residential development to the south. This drainage system serving the southern development has been adopted by Yorkshire Water, the adoptable drainage plan attached.

It is noted within the enquiry that this system does not have the capacity to accept additional flow and additional means of discharge should be sought.

The attached ground investigation notes shallow groundwater preventing percolation tests from being undertaken, therefore, infiltration as a means of discharge is not viable.

Due to the site being landlocked through third-party land, discharge to the southern watercourse is not considered viable either.

A connection to the Yorkshire Water system to the south is considered the most appropriate means of disposal. Additionally, the attached feasibility drainage plan of the southern drainage shows stub connections being provided on the northern chambers to facilitate a connection from this development.

On this basis, are you able to comment on the acceptability of a surface water connection into this system?

As the Yorkshire Water system is being restricted through a HydroBrake, it is accepted that further modelling may be required to demonstrate a connection will not imped this system.

I look forward to hearing back form you.

Alan Wood & Partners

Office locations:
Hull
Leeds
Lincoln
Scarborough
Sheffield
York

Regards
Daniel Cook
e: daniel.cook@alanwood.co.uk | **t:** 01482 442138
a: 341 Beverley Road | Hull | HU5 1LD
w: www.alanwood.co.uk

Want to know a bit more about Yorkshire Water? Our website is full of useful info, from how to apply for a water meter to planning your next walk at one of our beautiful reservoirs - it's all at yorkshirewater.com

Need to talk to us? For the best way to get in touch with us, go to yorkshirewater.com/contact

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Yorkshire Water Services Limited
Registered Office Western House, Halifax Road, Bradford, BD6 2SZ
Registered in England and Wales No 2366682

Alan Wood & Partners

APPENDIX E

Yorkshire Water Requisition Team Correspondence

Daniel Cook

From: Chris COOKE <Christopher.J.Cooke@yorkshirewater.co.uk>
Sent: 10 July 2023 11:51
To: Daniel Cook; Hollie Hammond
Subject: RE: U697790 - 47480 - Penistone Pre-Planning Enquiry
Attachments: final-s185_majorsewerdiversion-ywled-_23-24.pdf

Hi Daniel,

Thanks for your email.

I have discussed this with a few colleagues and from what I can see, you have two options to progress this:

- The first is we can look to provide you with a cost to upgrade the existing surface water system to suit the increase in discharge rate, as mentioned below. We would look to do this under a Major YW led Section 185. To provide a cost, we'd need to first undertake a feasibility study. An application form is attached if you wish to proceed with this.
- The second option is for you to model the existing downstream network & show the impact that the additional 2.5l/s from the new 17 plots has. If it can proved that no detriment to the network would occur, then a connection could be considered in principle. If detriment is shown, then you'll have no choice but to proceed with the first option.

I trust that this make sense, however if you wish to discuss, please don't hesitate to contact me.

Kind regards,

Chris

YorkshireWater

Chris Cooke
Sewer Diversion & Requisition Senior Engineer
Developer Services (Customer Experience)
07790 615043
yorkshirewater.com/developers

From: Daniel Cook <daniel.cook@alanwood.co.uk>
Sent: 10 July 2023 11:17
To: Chris COOKE <Christopher.J.Cooke@yorkshirewater.co.uk>; Hollie Hammond <Hollie.hansell@yorkshirewater.co.uk>
Cc: Technical Sewerage <technical.sewerage@yorkshirewater.co.uk>
Subject: RE: U697790 - 47480 - Penistone Pre-Planning Enquiry

Morning Chris & Hollie,

Hope this email finds you well.

Chris Roberts has directed me to the requisitions team to provide a cost to assess and upgrade the Yorkshire Water system and flow control within the Watermill Gardens development, Penistone, South Yorkshire. The adopted Yorkshire Water drainage is attached.

It is proposed to develop 17 additional plots to the north of the Watermill Gardens development, the proposal is attached. Due to failed percolation tests and a landlocked site, it is intended to discharge into this Yorkshire Water system. Please see attached email detailing the initial enquiry.

At present, I have produced a drainage plan and model which demonstrates the proposed development can achieve a gravity connection into this system with a reduced discharge rate of 2.5l/s. I expect the alterations of this system to be, in theory, limited to increase the discharge rate of the downstream HydroBrake by 2.5l/s.

Are you able to provide a cost to review this proposal and provide a scope and associated costs to make alterations to this system to permit a connection?

I look forward to hearing from you. Thanks

Alan Wood & Partners

Office locations:
Hull
Leeds
Lincoln
Scarborough
Sheffield
York

Regards
Daniel Cook
e: daniel.cook@alanwood.co.uk | **t:** 01482 442138
a: 341 Beverley Road | Hull | HU5 1LD
w: www.alanwood.co.uk

From: Technical Sewerage <technical.sewerage@yorkshirewater.co.uk>
Sent: Friday, July 7, 2023 12:57 PM
To: Daniel Cook <daniel.cook@alanwood.co.uk>
Cc: Chris COOKE <Christopher.J.Cooke@yorkshirewater.co.uk>
Subject: RE: U697790 - 47480 - Penistone Pre-Planning Enquiry

Hi Daniel,

Hollie.hansell@yorkshirewater.co.uk & christopher.j.cooke@yorkshirewater.co.uk

Regards

Chris

From: Daniel Cook <daniel.cook@alanwood.co.uk>
Sent: 07 July 2023 11:18
To: Technical Sewerage <technical.sewerage@yorkshirewater.co.uk>
Subject: RE: U697790 - 47480 - Penistone Pre-Planning Enquiry

Hi Chris,

Appreciate your quick response.

Are you able to provide me with Chris and Hollie's email address?

Alan Wood & Partners

Office locations:
Hull
Leeds
Lincoln
Scarborough
Sheffield
York

Regards
Daniel Cook
e: daniel.cook@alanwood.co.uk | **t:** 01482 442138
a: 341 Beverley Road | Hull | HU5 1LD
w: www.alanwood.co.uk

From: Technical Sewerage <technical.sewerage@yorkshirewater.co.uk>
Sent: Friday, July 7, 2023 11:14 AM
To: Daniel Cook <daniel.cook@alanwood.co.uk>
Subject: RE: U697790 - 47480 - Penistone Pre-Planning Enquiry

Hi Daniel,

The drainage and flow control were designed and agreed specifically for the Watermill Gardens site so I would not agree to your proposal but what you can do is approach our requisitions team and get a cost for them to assess and upgrade the system and flow control in Watermill Gardens to accommodate your additional 30 properties.

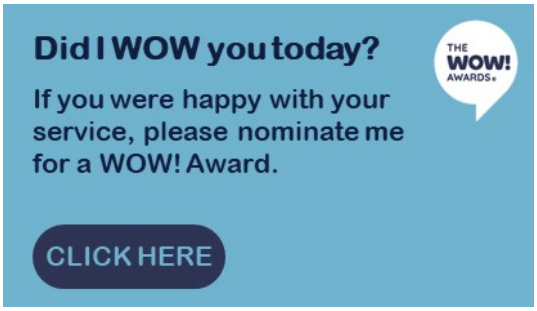
If you email Chris Cook and Hollie Hammond along with this email they will be able to advise on costs and timescales.

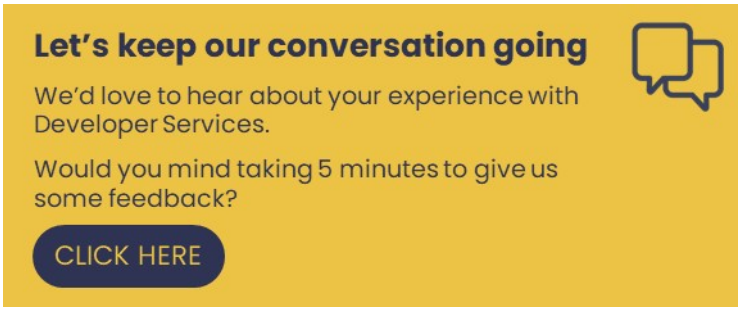
Kind Regards

YorkshireWater

Chris Roberts
Pre-Development Technician
Developer Services
Tel: 0345 1 20 84 82

*******Please note we have 10 working days to respond to email enquiries*******





From: Daniel Cook <daniel.cook@alanwood.co.uk>
Sent: 06 July 2023 11:31
To: Technical Sewerage <technical.sewerage@yorkshirewater.co.uk>
Subject: RE: U697790 - 47480 - Penistone Pre-Planning Enquiry

EXTERNAL SOURCE - THINK BEFORE YOU CLICK

Morning,

We received a pre-planning enquiry for the proposed residential development off Watermill Gardens, Penistone. The site plan and pre-planning enquiry are attached for reference.

Access to the site will be achieved through the recently developed residential development to the south. This drainage system serving the southern development has been adopted by Yorkshire Water, the adoptable drainage plan attached.

It is noted within the enquiry that this system does not have the capacity to accept additional flow and additional means of discharge should be sought.

The attached ground investigation notes shallow groundwater preventing percolation tests from being undertaken, therefore, infiltration as a means of discharge is not viable.

Due to the site being landlocked through third-party land, discharge to the southern watercourse is not considered viable either.

A connection to the Yorkshire Water system to the south is considered the most appropriate means of disposal. Additionally, the attached feasibility drainage plan of the southern drainage shows stub connections being provided on the northern chambers to facilitate a connection from this development.

On this basis, are you able to comment on the acceptability of a surface water connection into this system?

As the Yorkshire Water system is being restricted through a HydroBrake, it is accepted that further modelling may be required to demonstrate a connection will not imped this system.

I look forward to hearing back form you.

Alan Wood & Partners

Office locations:

Regards
Daniel Cook
e: daniel.cook@alanwood.co.uk | **t:** 01482 442138
a: 341 Beverley Road | Hull | HU5 1LD
w: www.alanwood.co.uk

Want to know a bit more about Yorkshire Water? Our website is full of useful info, from how to apply for a water meter to planning your next walk at one of our beautiful reservoirs - it's all at yorkshirewater.com

Need to talk to us? For the best way to get in touch with us, go to yorkshirewater.com/contact

Now the legal stuff! The information and any files sent as part of this email are confidential, possibly legally privileged and for the addressee's attention only. If you've wrongly received this email, please reply to it to let the sender know and delete it from your computer. Just to confirm, this email isn't a binding offer, acceptance, amendment, waiver or any agreement or obligation – unless this is clearly stated in the email.

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Alan Wood & Partners

APPENDIX F

MicroDrainage Model

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	PIMP (%)	100
M5-60 (mm)	19.000	Add Flow / Climate Change (%)	0
Ratio R	0.350	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.176	4-8	0.098

Total Area Contributing (ha) = 0.275

Total Pipe Volume (m³) = 59.983

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S10.000	10.895	0.700	15.6	0.060	5.00	0.0	0.600	o	150	Pipe/Conduit	
S10.001	8.517	0.600	14.2	0.028	0.00	0.0	0.600	o	225	Pipe/Conduit	
S11.000	8.343	0.450	18.5	0.025	5.00	0.0	0.600	o	150	Pipe/Conduit	
S10.002	14.141	0.700	20.2	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S10.000	48.37	5.07	195.850	0.060	0.0	0.0	0.0	2.57	45.4	7.9
S10.001	48.21	5.11	195.150	0.089	0.0	0.0	0.0	3.49	138.8	11.6
S11.000	48.41	5.06	195.000	0.025	0.0	0.0	0.0	2.35	41.5	3.3
S10.002	47.89	5.19	194.550	0.114	0.0	0.0	0.0	2.92	116.3	14.7

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S12.000	8.346	0.200	41.7	0.078	5.00	0.0	0.600	o	150	Pipe/Conduit	
S10.003	6.606	0.075	88.1	0.033	0.00	0.0	0.600	o	225	Pipe/Conduit	
S10.004	25.009	0.105	238.2	0.000	0.00	0.0	0.600	oo	1200	Double Pipe	
S10.005	18.408	0.120	153.4	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S13.000	4.598	1.350	3.4	0.050	5.00	0.0	0.600	o	150	Pipe/Conduit	
S10.006	23.882	0.129	185.1	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S12.000	48.29	5.09	194.150	0.078	0.0	0.0	0.0	1.56	27.6	10.2
S10.003	47.58	5.27	193.950	0.225	0.0	0.0	0.0	1.39	55.4	29.0
S10.004	46.93	5.44	192.875	0.225	0.0	0.0	0.0	2.42	5473.6	29.0
S10.005	45.88	5.73	192.770	0.225	0.0	0.0	0.0	1.05	41.9	29.0
S13.000	48.60	5.01	194.000	0.050	0.0	0.0	0.0	5.50	97.2	6.5
S10.006	44.47	6.15	192.600	0.275	0.0	0.0	0.0	0.96	38.1	33.1

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
10.000	User	-	100	0.010	0.010	0.010
	User	-	100	0.012	0.012	0.022
	User	-	100	0.016	0.016	0.037
	User	-	100	0.016	0.016	0.053
	User	-	100	0.007	0.007	0.060
10.001	User	-	100	0.019	0.019	0.019
	User	-	100	0.009	0.009	0.028
11.000	User	-	100	0.013	0.013	0.013
	User	-	100	0.012	0.012	0.025
10.002	-	-	100	0.000	0.000	0.000
12.000	User	-	100	0.010	0.010	0.010
	User	-	100	0.013	0.013	0.023
	User	-	100	0.010	0.010	0.033
	User	-	100	0.012	0.012	0.045
	User	-	100	0.007	0.007	0.052
	User	-	100	0.026	0.026	0.078
10.003	User	-	100	0.033	0.033	0.033
10.004	-	-	100	0.000	0.000	0.000
10.005	-	-	100	0.000	0.000	0.000
13.000	User	-	100	0.010	0.010	0.010
	User	-	100	0.033	0.033	0.044
	User	-	100	0.006	0.006	0.050
10.006	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.275	0.275	0.275

Network Classifications for Storm

PN	USMH Name	Pipe Dia (mm)	Min Cover Depth (m)	Max Cover Depth (m)	Pipe Type	MH Dia (mm)	MH Width (mm)	MH Ring Depth (m)	MH Type
S10.000	SS01	150	0.600	1.170	Unclassified	600	0	0.600	Unclassified
S10.001	SS02	225	1.095	1.225	Unclassified	1200	0	1.095	Unclassified
S11.000	SS03	150	1.000	1.300	Unclassified	600	0	1.000	Unclassified
S10.002	SJUNCTION	225	1.215	1.225	Unclassified				Junction
S12.000	SS05	150	1.190	2.750	Unclassified	600	0	2.750	Unclassified
S10.003	SS06	225	1.115	1.550	Unclassified	1200	0	1.115	Unclassified
S10.004	SS07	1200	0.690	1.575	Unclassified	1500	0	1.575	Unclassified
S10.005	SS08	225	1.575	1.665	Unclassified	1500	0	1.665	Unclassified
S13.000	SS09	150	0.650	1.650	Unclassified	600	0	0.650	Unclassified
S10.006	SS010	225	1.625	4.454	Unclassified	1800	0	1.625	Unclassified

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S10.006	S	197.150	192.471	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	0.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Storm Duration (mins)	30
Ratio R	0.350		

Online Controls for Storm

Hydro-Brake® Optimum Manhole: SS010, DS/PN: S10.006, Volume (m³): 5.4

Unit Reference	MD-SHE-0155-1400-2000-1400
Design Head (m)	2.000
Design Flow (l/s)	14.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	155
Invert Level (m)	192.600
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	14.0
Flush-Flo™	0.583	14.0
Kick-Flo®	1.216	11.1
Mean Flow over Head Range	-	12.2

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.6	1.200	11.3	3.000	17.0	7.000	25.5
0.200	11.7	1.400	11.8	3.500	18.3	7.500	26.3
0.300	13.0	1.600	12.6	4.000	19.5	8.000	27.1
0.400	13.6	1.800	13.3	4.500	20.6	8.500	27.9
0.500	13.9	2.000	14.0	5.000	21.7	9.000	28.7
0.600	14.0	2.200	14.6	5.500	22.7	9.500	29.5
0.800	13.7	2.400	15.3	6.000	23.6		
1.000	13.0	2.600	15.8	6.500	24.6		

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	0.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	ON
Analysis Timestep	Fine	Inertia Status	ON
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S10.000	SS01	15 Winter	1	+0%				
S10.001	SS02	15 Winter	1	+0%				
S11.000	SS03	15 Winter	1	+0%				
S10.002	SJUNCTION	15 Winter	1	+0%				
S12.000	SS05	15 Winter	1	+0%	30/15 Summer			
S10.003	SS06	15 Winter	1	+0%	30/15 Summer			
S10.004	SS07	15 Winter	1	+0%	100/30 Winter			
S10.005	SS08	15 Winter	1	+0%	1/15 Summer			
S13.000	SS09	15 Winter	1	+0%	100/30 Winter			
S10.006	SS010	15 Winter	1	+0%	1/15 Summer	100/30 Winter		

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S10.000	SS01	195.894	-0.106	0.000	0.19			7.6	OK
S10.001	SS02	195.197	-0.178	0.000	0.10			10.6	OK
S11.000	SS03	195.030	-0.120	0.000	0.09			3.2	OK

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S10.002	SJUNCTION	194.602	-0.173	0.000	0.12			13.6	OK*
S12.000	SS05	194.217	-0.083	0.000	0.41			9.9	OK
S10.003	SS06	194.091	-0.084	0.000	0.70			27.0	OK
S10.004	SS07	193.050	-1.025	0.000	0.01			26.3	OK
S10.005	SS08	193.050	0.055	0.000	0.35			13.3	SURCHARGED
S13.000	SS09	194.030	-0.120	0.000	0.09			6.3	OK
S10.006	SS010	193.029	0.204	0.000	0.39			13.7	SURCHARGED

PN	US/MH Name	Level Exceeded
S10.000	SS01	
S10.001	SS02	
S11.000	SS03	
S10.002	SJUNCTION	
S12.000	SS05	
S10.003	SS06	
S10.004	SS07	
S10.005	SS08	
S13.000	SS09	
S10.006	SS010	3

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	0.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	ON
Analysis Timestep	Fine	Inertia Status	ON
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S10.000	SS01	15 Winter	30	+0%				
S10.001	SS02	15 Winter	30	+0%				
S11.000	SS03	15 Winter	30	+0%				
S10.002	SJUNCTION	15 Winter	30	+0%				
S12.000	SS05	15 Winter	30	+0%	30/15 Summer			
S10.003	SS06	15 Winter	30	+0%	30/15 Summer			
S10.004	SS07	30 Winter	30	+0%	100/30 Winter			
S10.005	SS08	30 Winter	30	+0%	1/15 Summer			
S13.000	SS09	15 Winter	30	+0%	100/30 Winter			
S10.006	SS010	30 Winter	30	+0%	1/15 Summer	100/30 Winter		

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S10.000	SS01	195.922	-0.078	0.000	0.46			18.7	OK
S10.001	SS02	195.227	-0.148	0.000	0.26			27.9	OK
S11.000	SS03	195.047	-0.103	0.000	0.21			7.8	OK

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S10.002	SJUNCTION	194.636	-0.139	0.000	0.30			35.4	OK*
S12.000	SS05	194.553	0.253	0.000	1.00			24.0	SURCHARGED
S10.003	SS06	194.348	0.173	0.000	1.80			69.6	SURCHARGED
S10.004	SS07	193.490	-0.585	0.000	0.02			53.8	OK
S10.005	SS08	193.488	0.493	0.000	0.36			13.7	SURCHARGED
S13.000	SS09	194.047	-0.103	0.000	0.21			15.4	OK
S10.006	SS010	193.477	0.652	0.000	0.40			14.0	SURCHARGED

PN	US/MH Name	Level Exceeded
S10.000	SS01	
S10.001	SS02	
S11.000	SS03	
S10.002	SJUNCTION	
S12.000	SS05	
S10.003	SS06	
S10.004	SS07	
S10.005	SS08	
S13.000	SS09	
S10.006	SS010	3

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	0.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	ON
Analysis Timestep	Fine	Inertia Status	ON
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S10.000	SS01	15 Winter	100	+30%				
S10.001	SS02	15 Winter	100	+30%				
S11.000	SS03	15 Winter	100	+30%				
S10.002	SJUNCTION	15 Summer	100	+30%				
S12.000	SS05	15 Winter	100	+30%	30/15 Summer			
S10.003	SS06	15 Winter	100	+30%	30/15 Summer			
S10.004	SS07	60 Winter	100	+30%	100/30 Winter			
S10.005	SS08	60 Winter	100	+30%	1/15 Summer			
S13.000	SS09	60 Winter	100	+30%	100/30 Winter			
S10.006	SS010	60 Winter	100	+30%	1/15 Summer	100/30 Winter		

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S10.000	SS01	195.950	-0.050	0.000	0.77			31.5	OK
S10.001	SS02	195.254	-0.121	0.000	0.43			46.9	OK
S11.000	SS03	195.062	-0.088	0.000	0.36			13.1	OK

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S10.002	SJUNCTION	194.775	0.000	0.000	0.49			57.0	SURCHARGED*
S12.000	SS05	195.350	1.050	0.000	1.65			39.7	SURCHARGED
S10.003	SS06	194.775	0.600	0.000	2.99			115.3	SURCHARGED
S10.004	SS07	194.536	0.461	0.000	0.02			61.4	SURCHARGED
S10.005	SS08	194.535	1.540	0.000	0.64			24.2	FLOOD RISK
S13.000	SS09	194.462	0.312	0.000	0.19			14.1	SURCHARGED
S10.006	SS010	194.456	1.631	5.715	0.40			14.0	FLOOD

PN	US/MH Name	Level Exceeded
S10.000	SS01	
S10.001	SS02	
S11.000	SS03	
S10.002	SJUNCTION	
S12.000	SS05	
S10.003	SS06	
S10.004	SS07	
S10.005	SS08	
S13.000	SS09	
S10.006	SS010	3

Alan Wood & Partners

APPENDIX G

MicroDrainage Model and Base Flow

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	PIMP (%)	100
M5-60 (mm)	19.000	Add Flow / Climate Change (%)	0
Ratio R	0.350	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.176	4-8	0.098

Total Area Contributing (ha) = 0.275

Total Pipe Volume (m³) = 59.983

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S10.000	10.895	0.700	15.6	0.060	5.00	0.0	0.600	o	150	Pipe/Conduit	
S10.001	8.517	0.600	14.2	0.028	0.00	2.5	0.600	o	225	Pipe/Conduit	
S11.000	8.343	0.450	18.5	0.025	5.00	0.0	0.600	o	150	Pipe/Conduit	
S10.002	14.141	0.700	20.2	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S10.000	48.37	5.07	195.850	0.060	0.0	0.0	0.0	2.57	45.4	7.9
S10.001	48.21	5.11	195.150	0.089	2.5	0.0	0.0	3.49	138.8	14.1
S11.000	48.41	5.06	195.000	0.025	0.0	0.0	0.0	2.35	41.5	3.3
S10.002	47.89	5.19	194.550	0.114	2.5	0.0	0.0	2.92	116.3	17.2

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S12.000	8.346	0.200	41.7	0.078	5.00	0.0	0.600	o	150	Pipe/Conduit	
S10.003	6.606	0.075	88.1	0.033	0.00	0.0	0.600	o	225	Pipe/Conduit	
S10.004	25.009	0.105	238.2	0.000	0.00	0.0	0.600	oo	1200	Double Pipe	
S10.005	18.408	0.120	153.4	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S13.000	4.598	1.350	3.4	0.050	5.00	0.0	0.600	o	150	Pipe/Conduit	
S10.006	23.882	0.129	185.1	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S12.000	48.29	5.09	194.150	0.078	0.0	0.0	0.0	1.56	27.6	10.2
S10.003	47.58	5.27	193.950	0.225	2.5	0.0	0.0	1.39	55.4	31.5
S10.004	46.93	5.44	192.875	0.225	2.5	0.0	0.0	2.42	5473.6	31.5
S10.005	45.88	5.73	192.770	0.225	2.5	0.0	0.0	1.05	41.9	31.5
S13.000	48.60	5.01	194.000	0.050	0.0	0.0	0.0	5.50	97.2	6.5
S10.006	44.47	6.15	192.600	0.275	2.5	0.0	0.0	0.96	38.1	35.6

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
10.000	User	-	100	0.010	0.010	0.010
	User	-	100	0.012	0.012	0.022
	User	-	100	0.016	0.016	0.037
	User	-	100	0.016	0.016	0.053
	User	-	100	0.007	0.007	0.060
10.001	User	-	100	0.019	0.019	0.019
	User	-	100	0.009	0.009	0.028
11.000	User	-	100	0.013	0.013	0.013
	User	-	100	0.012	0.012	0.025
10.002	-	-	100	0.000	0.000	0.000
12.000	User	-	100	0.010	0.010	0.010
	User	-	100	0.013	0.013	0.023
	User	-	100	0.010	0.010	0.033
	User	-	100	0.012	0.012	0.045
	User	-	100	0.007	0.007	0.052
	User	-	100	0.026	0.026	0.078
10.003	User	-	100	0.033	0.033	0.033
10.004	-	-	100	0.000	0.000	0.000
10.005	-	-	100	0.000	0.000	0.000
13.000	User	-	100	0.010	0.010	0.010
	User	-	100	0.033	0.033	0.044
	User	-	100	0.006	0.006	0.050
10.006	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.275	0.275	0.275

Network Classifications for Storm

PN	USMH Name	Pipe Dia (mm)	Min Cover Depth (m)	Max Cover Depth (m)	Pipe Type	MH Dia (mm)	MH Width (mm)	MH Ring Depth (m)	MH Type
S10.000	SS01	150	0.600	1.170	Unclassified	600	0	0.600	Unclassified
S10.001	SS02	225	1.095	1.225	Unclassified	1200	0	1.095	Unclassified
S11.000	SS03	150	1.000	1.300	Unclassified	600	0	1.000	Unclassified
S10.002	SJUNCTION	225	1.215	1.225	Unclassified				Junction
S12.000	SS05	150	1.190	2.750	Unclassified	600	0	2.750	Unclassified
S10.003	SS06	225	1.115	1.550	Unclassified	1200	0	1.115	Unclassified
S10.004	SS07	1200	0.690	1.575	Unclassified	1500	0	1.575	Unclassified
S10.005	SS08	225	1.575	1.665	Unclassified	1500	0	1.665	Unclassified
S13.000	SS09	150	0.650	1.650	Unclassified	600	0	0.650	Unclassified
S10.006	SS010	225	1.625	4.454	Unclassified	1800	0	1.625	Unclassified

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S10.006	S	197.150	192.471	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	0.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Storm Duration (mins)	30
Ratio R	0.350		

Online Controls for Storm

Hydro-Brake® Optimum Manhole: SS010, DS/PN: S10.006, Volume (m³): 5.4

Unit Reference	MD-SHE-0155-1400-2000-1400
Design Head (m)	2.000
Design Flow (l/s)	14.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	155
Invert Level (m)	192.600
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	14.0
Flush-Flo™	0.583	14.0
Kick-Flo®	1.216	11.1
Mean Flow over Head Range	-	12.2

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.6	1.200	11.3	3.000	17.0	7.000	25.5
0.200	11.7	1.400	11.8	3.500	18.3	7.500	26.3
0.300	13.0	1.600	12.6	4.000	19.5	8.000	27.1
0.400	13.6	1.800	13.3	4.500	20.6	8.500	27.9
0.500	13.9	2.000	14.0	5.000	21.7	9.000	28.7
0.600	14.0	2.200	14.6	5.500	22.7	9.500	29.5
0.800	13.7	2.400	15.3	6.000	23.6		
1.000	13.0	2.600	15.8	6.500	24.6		

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	0.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	ON
Analysis Timestep	Fine	Inertia Status	ON
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S10.000	SS01	15 Winter	1	+0%				
S10.001	SS02	15 Winter	1	+0%				
S11.000	SS03	15 Winter	1	+0%				
S10.002	SJUNCTION	15 Winter	1	+0%				
S12.000	SS05	15 Winter	1	+0%	30/15 Summer			
S10.003	SS06	15 Winter	1	+0%	30/15 Summer			
S10.004	SS07	15 Winter	1	+0%	100/30 Summer			
S10.005	SS08	15 Winter	1	+0%	1/15 Summer			
S13.000	SS09	15 Winter	1	+0%	100/30 Winter			
S10.006	SS010	30 Winter	1	+0%	1/15 Summer	100/30 Winter		

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S10.000	SS01	195.894	-0.106	0.000	0.19			7.6	OK
S10.001	SS02	195.202	-0.173	0.000	0.12			13.1	OK
S11.000	SS03	195.030	-0.120	0.000	0.09			3.2	OK

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S10.002	SJUNCTION	194.606	-0.169	0.000	0.14			16.1	OK*
S12.000	SS05	194.217	-0.083	0.000	0.41			9.9	OK
S10.003	SS06	194.100	-0.075	0.000	0.77			29.5	OK
S10.004	SS07	193.084	-0.991	0.000	0.01			28.8	OK
S10.005	SS08	193.084	0.089	0.000	0.38			14.5	SURCHARGED
S13.000	SS09	194.030	-0.120	0.000	0.09			6.3	OK
S10.006	SS010	193.058	0.233	0.000	0.40			13.8	SURCHARGED

PN	US/MH Name	Level Exceeded
S10.000	SS01	
S10.001	SS02	
S11.000	SS03	
S10.002	SJUNCTION	
S12.000	SS05	
S10.003	SS06	
S10.004	SS07	
S10.005	SS08	
S13.000	SS09	
S10.006	SS010	5

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	0.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	ON
Analysis Timestep	Fine	Inertia Status	ON
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S10.000	SS01	15 Winter	30	+0%				
S10.001	SS02	15 Winter	30	+0%				
S11.000	SS03	15 Winter	30	+0%				
S10.002	SJUNCTION	15 Winter	30	+0%				
S12.000	SS05	15 Winter	30	+0%	30/15 Summer			
S10.003	SS06	15 Winter	30	+0%	30/15 Summer			
S10.004	SS07	30 Winter	30	+0%	100/30 Summer			
S10.005	SS08	30 Winter	30	+0%	1/15 Summer			
S13.000	SS09	15 Winter	30	+0%	100/30 Winter			
S10.006	SS010	60 Winter	30	+0%	1/15 Summer	100/30 Winter		

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S10.000	SS01	195.922	-0.078	0.000	0.46			18.7	OK
S10.001	SS02	195.231	-0.144	0.000	0.28			30.4	OK
S11.000	SS03	195.047	-0.103	0.000	0.21			7.8	OK

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S10.002	SJUNCTION	194.639	-0.136	0.000	0.33			37.9	OK*
S12.000	SS05	194.571	0.271	0.000	1.00			24.0	SURCHARGED
S10.003	SS06	194.366	0.191	0.000	1.87			72.1	SURCHARGED
S10.004	SS07	193.550	-0.525	0.000	0.02			56.3	OK
S10.005	SS08	193.548	0.553	0.000	0.37			13.8	SURCHARGED
S13.000	SS09	194.047	-0.103	0.000	0.21			15.4	OK
S10.006	SS010	193.551	0.726	0.000	0.40			14.0	SURCHARGED

PN	US/MH Name	Level Exceeded
S10.000	SS01	
S10.001	SS02	
S11.000	SS03	
S10.002	SJUNCTION	
S12.000	SS05	
S10.003	SS06	
S10.004	SS07	
S10.005	SS08	
S13.000	SS09	
S10.006	SS010	5

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	0.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	ON
Analysis Timestep	Fine	Inertia Status	ON
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S10.000	SS01	15 Winter	100	+30%				
S10.001	SS02	15 Winter	100	+30%				
S11.000	SS03	15 Winter	100	+30%				
S10.002	SJUNCTION	15 Summer	100	+30%				
S12.000	SS05	15 Winter	100	+30%	30/15	Summer		
S10.003	SS06	15 Winter	100	+30%	30/15	Summer		
S10.004	SS07	60 Winter	100	+30%	100/30	Summer		
S10.005	SS08	60 Winter	100	+30%	1/15	Summer		
S13.000	SS09	60 Winter	100	+30%	100/30	Winter		
S10.006	SS010	60 Winter	100	+30%	1/15	Summer	100/30	Winter

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S10.000	SS01	195.950	-0.050	0.000	0.77			31.5	OK
S10.001	SS02	195.257	-0.118	0.000	0.45			49.4	OK
S11.000	SS03	195.062	-0.088	0.000	0.36			13.1	OK

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S10.002	SJUNCTION	194.775	0.000	0.000	0.51			59.4	SURCHARGED*
S12.000	SS05	195.378	1.078	0.000	1.65			39.7	SURCHARGED
S10.003	SS06	194.803	0.628	0.000	3.05			117.7	SURCHARGED
S10.004	SS07	194.562	0.487	0.000	0.02			63.7	SURCHARGED
S10.005	SS08	194.562	1.567	0.000	0.89			33.4	FLOOD RISK
S13.000	SS09	194.475	0.325	0.000	0.19			14.1	SURCHARGED
S10.006	SS010	194.463	1.638	13.113	0.40			14.0	FLOOD

PN	US/MH Name	Level Exceeded
S10.000	SS01	
S10.001	SS02	
S11.000	SS03	
S10.002	SJUNCTION	
S12.000	SS05	
S10.003	SS06	
S10.004	SS07	
S10.005	SS08	
S13.000	SS09	
S10.006	SS010	5

Alan Wood & Partners

APPENDIX H

MicroDrainage Model and Additional Storage

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	PIMP (%)	100
M5-60 (mm)	19.000	Add Flow / Climate Change (%)	0
Ratio R	0.350	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.176	4-8	0.098

Total Area Contributing (ha) = 0.275

Total Pipe Volume (m³) = 60.292

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S10.000	10.895	0.700	15.6	0.060	5.00	0.0	0.600	o	150	Pipe/Conduit	
S10.001	8.517	0.600	14.2	0.028	0.00	2.5	0.600	o	225	Pipe/Conduit	
S11.000	8.343	0.450	18.5	0.025	5.00	0.0	0.600	o	150	Pipe/Conduit	
S10.002	14.141	0.700	20.2	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S10.000	48.37	5.07	195.850	0.060	0.0	0.0	0.0	2.57	45.4	7.9
S10.001	48.21	5.11	195.150	0.089	2.5	0.0	0.0	3.49	138.8	14.1
S11.000	48.41	5.06	195.000	0.025	0.0	0.0	0.0	2.35	41.5	3.3
S10.002	47.89	5.19	194.550	0.114	2.5	0.0	0.0	2.92	116.3	17.2

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S12.000	8.346	0.200	41.7	0.078	5.00	0.0	0.600	o	150	Pipe/Conduit	
S10.003	6.606	0.075	88.1	0.033	0.00	0.0	0.600	o	225	Pipe/Conduit	
S10.004	25.009	0.105	238.2	0.000	0.00	0.0	0.600	oo	1200	Double Pipe	
S13.000	1.945	0.033	58.9	0.000	5.00	0.0	0.600	o	450	Pipe/Conduit	
S10.005	18.408	0.120	153.4	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S14.000	4.598	1.350	3.4	0.050	5.00	0.0	0.600	o	150	Pipe/Conduit	
S10.006	23.882	0.129	185.1	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S12.000	48.29	5.09	194.150	0.078	0.0	0.0	0.0	1.56	27.6	10.2
S10.003	47.58	5.27	193.950	0.225	2.5	0.0	0.0	1.39	55.4	31.5
S10.004	46.93	5.44	192.875	0.225	2.5	0.0	0.0	2.42	5473.6	31.5
S13.000	48.60	5.01	192.820	0.000	0.0	0.0	0.0	2.65	421.8	0.0
S10.005	45.88	5.73	192.770	0.225	2.5	0.0	0.0	1.05	41.9	31.5
S14.000	48.60	5.01	194.000	0.050	0.0	0.0	0.0	5.50	97.2	6.5
S10.006	44.47	6.15	192.600	0.275	2.5	0.0	0.0	0.96	38.1	35.6

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
10.000	User	-	100	0.010	0.010	0.010
	User	-	100	0.012	0.012	0.022
	User	-	100	0.016	0.016	0.037
	User	-	100	0.016	0.016	0.053
	User	-	100	0.007	0.007	0.060
10.001	User	-	100	0.019	0.019	0.019
	User	-	100	0.009	0.009	0.028
11.000	User	-	100	0.013	0.013	0.013
	User	-	100	0.012	0.012	0.025
10.002	-	-	100	0.000	0.000	0.000
12.000	User	-	100	0.010	0.010	0.010
	User	-	100	0.013	0.013	0.023
	User	-	100	0.010	0.010	0.033
	User	-	100	0.012	0.012	0.045
	User	-	100	0.007	0.007	0.052
	User	-	100	0.026	0.026	0.078
10.003	User	-	100	0.033	0.033	0.033
10.004	-	-	100	0.000	0.000	0.000
13.000	-	-	100	0.000	0.000	0.000
10.005	-	-	100	0.000	0.000	0.000
14.000	User	-	100	0.010	0.010	0.010
	User	-	100	0.033	0.033	0.044
	User	-	100	0.006	0.006	0.050
10.006	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.275	0.275	0.275

Network Classifications for Storm

PN	USMH Name	Pipe Dia (mm)	Min Cover Depth (m)	Max Cover Depth (m)	Pipe Type	MH Dia (mm)	MH Width (mm)	MH Ring Depth (m)	MH Type
S10.000	SS01	150	0.600	1.170	Unclassified	600	0	0.600	Unclassified
S10.001	SS02	225	1.095	1.225	Unclassified	1200	0	1.095	Unclassified
S11.000	SS03	150	1.000	1.300	Unclassified	600	0	1.000	Unclassified
S10.002	SJUNCTION	225	1.215	1.225	Unclassified				Junction
S12.000	SS05	150	1.190	2.750	Unclassified	600	0	2.750	Unclassified
S10.003	SS06	225	1.115	1.550	Unclassified	1200	0	1.115	Unclassified
S10.004	SS07	1200	0.690	1.575	Unclassified	1500	0	1.575	Unclassified
S13.000	SOffline Proposed Storage	450	1.390	1.423	Unclassified	1350	0	1.390	Unclassified
S10.005	SS08	225	1.575	1.665	Unclassified	1500	0	1.665	Unclassified
S14.000	SS09	150	0.650	1.650	Unclassified	600	0	0.650	Unclassified
S10.006	SS010	225	1.625	4.454	Unclassified	1800	0	1.625	Unclassified

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S10.006	S	197.150	192.471	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	0.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Storm Duration (mins)	30
Ratio R	0.350		

Online Controls for Storm

Hydro-Brake® Optimum Manhole: SS010, DS/PN: S10.006, Volume (m³): 5.4

Unit Reference	MD-SHE-0155-1400-2000-1400
Design Head (m)	2.000
Design Flow (l/s)	14.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	155
Invert Level (m)	192.600
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	14.0
Flush-Flo™	0.583	14.0
Kick-Flo®	1.216	11.1
Mean Flow over Head Range	-	12.2

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.6	1.200	11.3	3.000	17.0	7.000	25.5
0.200	11.7	1.400	11.8	3.500	18.3	7.500	26.3
0.300	13.0	1.600	12.6	4.000	19.5	8.000	27.1
0.400	13.6	1.800	13.3	4.500	20.6	8.500	27.9
0.500	13.9	2.000	14.0	5.000	21.7	9.000	28.7
0.600	14.0	2.200	14.6	5.500	22.7	9.500	29.5
0.800	13.7	2.400	15.3	6.000	23.6		
1.000	13.0	2.600	15.8	6.500	24.6		

Storage Structures for Storm

Tank or Pond Manhole: SOffline Proposed Storage, DS/PN: S13.000

Invert Level (m) 192.820

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	4.5	1.200	4.5	1.201	0.0	1.840	0.0

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	0.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	ON
Analysis Timestep	Fine	Inertia Status	ON
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood
S10.000	SS01	15 Winter	1	+0%		
S10.001	SS02	15 Winter	1	+0%		
S11.000	SS03	15 Winter	1	+0%		
S10.002	SJUNCTION	15 Winter	1	+0%		
S12.000	SS05	15 Winter	1	+0%	30/15 Summer	
S10.003	SS06	15 Winter	1	+0%	30/15 Summer	
S10.004	SS07	15 Winter	1	+0%	100/30 Winter	
S13.000	SOffline Proposed Storage	15 Winter	1	+0%	30/15 Summer	
S10.005	SS08	15 Winter	1	+0%	1/15 Summer	
S14.000	SS09	15 Winter	1	+0%	100/30 Winter	
S10.006	SS010	30 Winter	1	+0%	1/15 Summer	100/60 Winter

PN	US/MH Name	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
S10.000	SS01			195.894	-0.106	0.000	0.19
S10.001	SS02			195.202	-0.173	0.000	0.12

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.
S11.000	SS03			195.030	-0.120	0.000	0.09
S10.002	SJUNCTION			194.606	-0.169	0.000	0.14
S12.000	SS05			194.217	-0.083	0.000	0.41
S10.003	SS06			194.100	-0.075	0.000	0.77
S10.004	SS07			193.051	-1.024	0.000	0.01
S13.000	SOffline Proposed Storage			193.051	-0.219	0.000	0.01
S10.005	SS08			193.051	0.056	0.000	0.38
S14.000	SS09			194.030	-0.120	0.000	0.09
S10.006	SS010			193.027	0.202	0.000	0.39

PN	US/MH Name	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S10.000	SS01			7.6	OK	
S10.001	SS02			13.1	OK	
S11.000	SS03			3.2	OK	
S10.002	SJUNCTION			16.1	OK*	
S12.000	SS05			9.9	OK	
S10.003	SS06			29.5	OK	
S10.004	SS07			29.1	OK	
S13.000	SOffline Proposed Storage			2.3	OK	
S10.005	SS08			14.4	SURCHARGED	
S14.000	SS09			6.3	OK	
S10.006	SS010			13.7	SURCHARGED	2

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	0.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	ON
Analysis Timestep	Fine	Inertia Status	ON
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood
S10.000	SS01	15 Winter	30	+0%		
S10.001	SS02	15 Winter	30	+0%		
S11.000	SS03	15 Winter	30	+0%		
S10.002	SJUNCTION	15 Winter	30	+0%		
S12.000	SS05	15 Winter	30	+0%	30/15 Summer	
S10.003	SS06	15 Winter	30	+0%	30/15 Summer	
S10.004	SS07	60 Winter	30	+0%	100/30 Winter	
S13.000	SOffline Proposed Storage	60 Winter	30	+0%	30/15 Summer	
S10.005	SS08	60 Winter	30	+0%	1/15 Summer	
S14.000	SS09	15 Winter	30	+0%	100/30 Winter	
S10.006	SS010	60 Winter	30	+0%	1/15 Summer	100/60 Winter

PN	US/MH Name	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
S10.000	SS01			195.922	-0.078	0.000	0.46
S10.001	SS02			195.231	-0.144	0.000	0.28

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.
S11.000	SS03			195.047	-0.103	0.000	0.21
S10.002	SJUNCTION			194.639	-0.136	0.000	0.33
S12.000	SS05			194.571	0.271	0.000	1.00
S10.003	SS06			194.366	0.191	0.000	1.87
S10.004	SS07			193.483	-0.592	0.000	0.01
S13.000	SOffline Proposed Storage			193.482	0.212	0.000	0.01
S10.005	SS08			193.482	0.487	0.000	0.37
S14.000	SS09			194.047	-0.103	0.000	0.21
S10.006	SS010			193.477	0.652	0.000	0.40

PN	US/MH Name	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S10.000	SS01			18.7	OK	
S10.001	SS02			30.4	OK	
S11.000	SS03			7.8	OK	
S10.002	SJUNCTION			37.9	OK*	
S12.000	SS05			24.0	SURCHARGED	
S10.003	SS06			72.1	SURCHARGED	
S10.004	SS07			38.4	OK	
S13.000	SOffline Proposed Storage			2.2	SURCHARGED	
S10.005	SS08			14.1	SURCHARGED	
S14.000	SS09			15.4	OK	
S10.006	SS010			14.0	SURCHARGED	2

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	0.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	ON
Analysis Timestep	Fine	Inertia Status	ON
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood
S10.000	SS01	15 Winter	100	+30%		
S10.001	SS02	15 Winter	100	+30%		
S11.000	SS03	15 Winter	100	+30%		
S10.002	SJUNCTION	15 Summer	100	+30%		
S12.000	SS05	15 Winter	100	+30%	30/15 Summer	
S10.003	SS06	15 Winter	100	+30%	30/15 Summer	
S10.004	SS07	60 Winter	100	+30%	100/30 Winter	
S13.000	SOffline Proposed Storage	60 Winter	100	+30%	30/15 Summer	
S10.005	SS08	60 Winter	100	+30%	1/15 Summer	
S14.000	SS09	60 Winter	100	+30%	100/30 Winter	
S10.006	SS010	60 Winter	100	+30%	1/15 Summer	100/60 Winter

PN	US/MH Name	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
S10.000	SS01			195.950	-0.050	0.000	0.77
S10.001	SS02			195.257	-0.118	0.000	0.45

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.
S11.000	SS03			195.062	-0.088	0.000	0.36
S10.002	SJUNCTION			194.775	0.000	0.000	0.51
S12.000	SS05			195.378	1.078	0.000	1.65
S10.003	SS06			194.803	0.628	0.000	3.05
S10.004	SS07			194.522	0.447	0.000	0.02
S13.000	SOffline Proposed Storage			194.522	1.252	0.000	0.01
S10.005	SS08			194.522	1.527	0.000	0.58
S14.000	SS09			194.463	0.313	0.000	0.19
S10.006	SS010			194.456	1.631	5.552	0.40

PN	US/MH Name	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S10.000	SS01			31.5	OK	
S10.001	SS02			49.4	OK	
S11.000	SS03			13.1	OK	
S10.002	SJUNCTION			59.4	SURCHARGED*	
S12.000	SS05			39.7	SURCHARGED	
S10.003	SS06			117.7	SURCHARGED	
S10.004	SS07			64.1	SURCHARGED	
S13.000	SOffline Proposed Storage			1.8	FLOOD RISK	
S10.005	SS08			21.8	FLOOD RISK	
S14.000	SS09			14.1	SURCHARGED	
S10.006	SS010			14.0	FLOOD	2

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APPENDIX I

MicroDrainage Model and Amended HydroBrake

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	PIMP (%)	100
M5-60 (mm)	19.000	Add Flow / Climate Change (%)	0
Ratio R	0.350	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.176	4-8	0.098

Total Area Contributing (ha) = 0.275

Total Pipe Volume (m³) = 59.983

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S10.000	10.895	0.700	15.6	0.060	5.00	0.0	0.600	o	150	Pipe/Conduit	
S10.001	8.517	0.600	14.2	0.028	0.00	2.5	0.600	o	225	Pipe/Conduit	
S11.000	8.343	0.450	18.5	0.025	5.00	0.0	0.600	o	150	Pipe/Conduit	
S10.002	14.141	0.700	20.2	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S10.000	48.37	5.07	195.850	0.060	0.0	0.0	0.0	2.57	45.4	7.9
S10.001	48.21	5.11	195.150	0.089	2.5	0.0	0.0	3.49	138.8	14.1
S11.000	48.41	5.06	195.000	0.025	0.0	0.0	0.0	2.35	41.5	3.3
S10.002	47.89	5.19	194.550	0.114	2.5	0.0	0.0	2.92	116.3	17.2

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S12.000	8.346	0.200	41.7	0.078	5.00	0.0	0.600	o	150	Pipe/Conduit	
S10.003	6.606	0.075	88.1	0.033	0.00	0.0	0.600	o	225	Pipe/Conduit	
S10.004	25.009	0.105	238.2	0.000	0.00	0.0	0.600	oo	1200	Double Pipe	
S10.005	18.408	0.120	153.4	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S13.000	4.598	1.350	3.4	0.050	5.00	0.0	0.600	o	150	Pipe/Conduit	
S10.006	23.882	0.129	185.1	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S12.000	48.29	5.09	194.150	0.078	0.0	0.0	0.0	1.56	27.6	10.2
S10.003	47.58	5.27	193.950	0.225	2.5	0.0	0.0	1.39	55.4	31.5
S10.004	46.93	5.44	192.875	0.225	2.5	0.0	0.0	2.42	5473.6	31.5
S10.005	45.88	5.73	192.770	0.225	2.5	0.0	0.0	1.05	41.9	31.5
S13.000	48.60	5.01	194.000	0.050	0.0	0.0	0.0	5.50	97.2	6.5
S10.006	44.47	6.15	192.600	0.275	2.5	0.0	0.0	0.96	38.1	35.6

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
10.000	User	-	100	0.010	0.010	0.010
	User	-	100	0.012	0.012	0.022
	User	-	100	0.016	0.016	0.037
	User	-	100	0.016	0.016	0.053
	User	-	100	0.007	0.007	0.060
10.001	User	-	100	0.019	0.019	0.019
	User	-	100	0.009	0.009	0.028
11.000	User	-	100	0.013	0.013	0.013
	User	-	100	0.012	0.012	0.025
10.002	-	-	100	0.000	0.000	0.000
12.000	User	-	100	0.010	0.010	0.010
	User	-	100	0.013	0.013	0.023
	User	-	100	0.010	0.010	0.033
	User	-	100	0.012	0.012	0.045
	User	-	100	0.007	0.007	0.052
	User	-	100	0.026	0.026	0.078
10.003	User	-	100	0.033	0.033	0.033
10.004	-	-	100	0.000	0.000	0.000
10.005	-	-	100	0.000	0.000	0.000
13.000	User	-	100	0.010	0.010	0.010
	User	-	100	0.033	0.033	0.044
	User	-	100	0.006	0.006	0.050
10.006	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.275	0.275	0.275

Network Classifications for Storm

PN	USMH Name	Pipe Dia (mm)	Min Cover Depth (m)	Max Cover Depth (m)	Pipe Type	MH Dia (mm)	MH Width (mm)	MH Ring Depth (m)	MH Type
S10.000	SS01	150	0.600	1.170	Unclassified	600	0	0.600	Unclassified
S10.001	SS02	225	1.095	1.225	Unclassified	1200	0	1.095	Unclassified
S11.000	SS03	150	1.000	1.300	Unclassified	600	0	1.000	Unclassified
S10.002	SJUNCTION	225	1.215	1.225	Unclassified				Junction
S12.000	SS05	150	1.190	2.750	Unclassified	600	0	2.750	Unclassified
S10.003	SS06	225	1.115	1.550	Unclassified	1200	0	1.115	Unclassified
S10.004	SS07	1200	0.690	1.575	Unclassified	1500	0	1.575	Unclassified
S10.005	SS08	225	1.575	1.665	Unclassified	1500	0	1.665	Unclassified
S13.000	SS09	150	0.650	1.650	Unclassified	600	0	0.650	Unclassified
S10.006	SS010	225	1.625	4.454	Unclassified	1800	0	1.625	Unclassified

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S10.006	S	197.150	192.471	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	0.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Storm Duration (mins)	30
Ratio R	0.350		

Online Controls for Storm

Hydro-Brake® Optimum Manhole: SS010, DS/PN: S10.006, Volume (m³): 5.4

Unit Reference	MD-SHE-0170-1650-1850-1650
Design Head (m)	1.850
Design Flow (l/s)	16.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	170
Invert Level (m)	192.600
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.850	16.4
Flush-Flo™	0.541	16.4
Kick-Flo®	1.146	13.1
Mean Flow over Head Range	-	14.3

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	6.0	1.200	13.4	3.000	20.7	7.000	31.1
0.200	14.0	1.400	14.4	3.500	22.3	7.500	32.1
0.300	15.5	1.600	15.3	4.000	23.7	8.000	33.2
0.400	16.2	1.800	16.2	4.500	25.1	8.500	34.1
0.500	16.4	2.000	17.1	5.000	26.4	9.000	35.1
0.600	16.4	2.200	17.8	5.500	27.7	9.500	36.0
0.800	16.0	2.400	18.6	6.000	28.9		
1.000	14.9	2.600	19.3	6.500	30.0		

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	0.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	ON
Analysis Timestep	Fine	Inertia Status	ON
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S10.000	SS01	15 Winter	1	+0%				
S10.001	SS02	15 Winter	1	+0%				
S11.000	SS03	15 Winter	1	+0%				
S10.002	SJUNCTION	15 Winter	1	+0%				
S12.000	SS05	15 Winter	1	+0%	30/15 Summer			
S10.003	SS06	15 Winter	1	+0%	30/15 Summer			
S10.004	SS07	15 Winter	1	+0%	100/30 Winter			
S10.005	SS08	15 Winter	1	+0%	1/15 Summer			
S13.000	SS09	15 Winter	1	+0%	100/30 Winter			
S10.006	SS010	15 Winter	1	+0%	1/15 Summer	100/30 Winter		

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S10.000	SS01	195.894	-0.106	0.000	0.19			7.6	OK
S10.001	SS02	195.202	-0.173	0.000	0.12			13.1	OK
S11.000	SS03	195.030	-0.120	0.000	0.09			3.2	OK

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S10.002	SJUNCTION	194.606	-0.169	0.000	0.14			16.1	OK*
S12.000	SS05	194.217	-0.083	0.000	0.41			9.9	OK
S10.003	SS06	194.100	-0.075	0.000	0.77			29.5	OK
S10.004	SS07	193.055	-1.020	0.000	0.01			28.8	OK
S10.005	SS08	193.054	0.059	0.000	0.41			15.4	SURCHARGED
S13.000	SS09	194.030	-0.120	0.000	0.09			6.3	OK
S10.006	SS010	193.028	0.203	0.000	0.46			16.3	SURCHARGED

PN	US/MH Name	Level Exceeded
S10.000	SS01	
S10.001	SS02	
S11.000	SS03	
S10.002	SJUNCTION	
S12.000	SS05	
S10.003	SS06	
S10.004	SS07	
S10.005	SS08	
S13.000	SS09	
S10.006	SS010	3

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	0.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	ON
Analysis Timestep	Fine	Inertia Status	ON
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S10.000	SS01	15 Winter	30	+0%				
S10.001	SS02	15 Winter	30	+0%				
S11.000	SS03	15 Winter	30	+0%				
S10.002	SJUNCTION	15 Winter	30	+0%				
S12.000	SS05	15 Winter	30	+0%	30/15 Summer			
S10.003	SS06	15 Winter	30	+0%	30/15 Summer			
S10.004	SS07	30 Winter	30	+0%	100/30 Winter			
S10.005	SS08	30 Winter	30	+0%	1/15 Summer			
S13.000	SS09	15 Winter	30	+0%	100/30 Winter			
S10.006	SS010	30 Winter	30	+0%	1/15 Summer	100/30 Winter		

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S10.000	SS01	195.922	-0.078	0.000	0.46			18.7	OK
S10.001	SS02	195.231	-0.144	0.000	0.28			30.4	OK
S11.000	SS03	195.047	-0.103	0.000	0.21			7.8	OK

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S10.002	SJUNCTION	194.639	-0.136	0.000	0.33			37.9	OK*
S12.000	SS05	194.571	0.271	0.000	1.00			24.0	SURCHARGED
S10.003	SS06	194.366	0.191	0.000	1.87			72.1	SURCHARGED
S10.004	SS07	193.496	-0.579	0.000	0.02			56.3	OK
S10.005	SS08	193.494	0.499	0.000	0.42			15.9	SURCHARGED
S13.000	SS09	194.047	-0.103	0.000	0.21			15.4	OK
S10.006	SS010	193.473	0.648	0.000	0.47			16.4	SURCHARGED

PN	US/MH Name	Level Exceeded
S10.000	SS01	
S10.001	SS02	
S11.000	SS03	
S10.002	SJUNCTION	
S12.000	SS05	
S10.003	SS06	
S10.004	SS07	
S10.005	SS08	
S13.000	SS09	
S10.006	SS010	3

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	0.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	ON
Analysis Timestep	Fine	Inertia Status	ON
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S10.000	SS01	15 Winter	100	+30%				
S10.001	SS02	15 Winter	100	+30%				
S11.000	SS03	15 Winter	100	+30%				
S10.002	SJUNCTION	15 Summer	100	+30%				
S12.000	SS05	15 Winter	100	+30%	30/15 Summer			
S10.003	SS06	15 Winter	100	+30%	30/15 Summer			
S10.004	SS07	60 Winter	100	+30%	100/30 Winter			
S10.005	SS08	60 Winter	100	+30%	1/15 Summer			
S13.000	SS09	60 Winter	100	+30%	100/30 Winter			
S10.006	SS010	60 Winter	100	+30%	1/15 Summer	100/30 Winter		

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S10.000	SS01	195.950	-0.050	0.000	0.77			31.5	OK
S10.001	SS02	195.257	-0.118	0.000	0.45			49.4	OK
S11.000	SS03	195.062	-0.088	0.000	0.36			13.1	OK

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S10.002	SJUNCTION	194.775	0.000	0.000	0.51			59.4	SURCHARGED*
S12.000	SS05	195.378	1.078	0.000	1.65			39.7	SURCHARGED
S10.003	SS06	194.803	0.628	0.000	3.05			117.7	SURCHARGED
S10.004	SS07	194.546	0.471	0.000	0.02			63.9	SURCHARGED
S10.005	SS08	194.545	1.550	0.000	0.71			26.7	FLOOD RISK
S13.000	SS09	194.464	0.314	0.000	0.19			14.1	SURCHARGED
S10.006	SS010	194.456	1.631	5.608	0.47			16.5	FLOOD

PN	US/MH Name	Level Exceeded
S10.000	SS01	
S10.001	SS02	
S11.000	SS03	
S10.002	SJUNCTION	
S12.000	SS05	
S10.003	SS06	
S10.004	SS07	
S10.005	SS08	
S13.000	SS09	
S10.006	SS010	3

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Project Managers
Renewable Energy
Risk Assessments & Remediation
Road & Drainage Design
Site Investigations
Site Supervision
Structural Engineering
Sulphate Attack Specialists
Temporary Works
Topographic & Measured Surveys
Traffic Assessments

Quality Assurance Accreditation
ISO 9001 Registered firm
Certificate no. GB.02/07

Environmental Accreditation
ISO 14001Registered firm Certificate no.
GB.09/277b


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