

Your Environment

SURFACE WATER DRAINAGE – SUPPLEMENTARY REPORT LAND TO THE REAR OF SUNNYSIDE BARN AND FLINT BARN, BARNHAM

For Manorwood Ltd

Your Environment
Head Office, Unit 2, Woodhorn Business Centre, Oving,
Chichester, Sussex, PO20 2BX
[REDACTED]

Report Number: YE4281, Date: May 2020

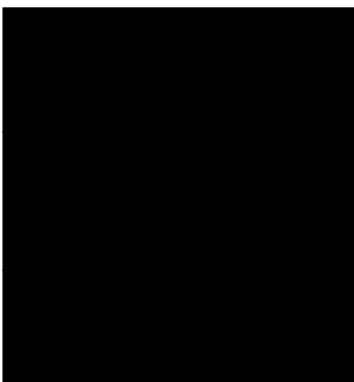
Paul Timmins
[REDACTED]

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	Name	Position	Signature	Date
Prepared by:	Paul Timmins	Drainage Consultant		May 2020
Reviewed by:	Mat Griffith	Geo Environmental Consultant		May 2020
Approved:	Colin Hiscock	Director		May 2020
For and on behalf of YourEnvironment				

Issue	Date	Description	Prepared	Reviewed	Approved
01	18/05/2020	For Issue to Arun DC	PT	MG	CH

1.0 Executive Summary

YourEnvironment (YE) was instructed by Manorwood Ltd to provide a Surface Water Drainage Report to describe the proposed drainage strategy for the proposed development within land to the rear of Sunnyside Barn and Flint Barn, Barnham. The strategy was deemed acceptable to the local planning authority, however more detailed design information is necessary in order to avoid the need for a pre commencement planning condition.

The purpose of this report is to provide the detailed drainage design information for the development to enable the application to be approved without the need for a pre commencement condition.

We trust this is sufficient for your requirements and should you have any questions please do not hesitate to contact the undersigned.

For *YourEnvironment*

Colin Hiscock

Director

2.0 Introduction

This report is to be read in conjunction with the Surface Water Drainage Report submitted in January 2020 as part of the planning application at the site.

This report seeks to provide detailed design information for the SuDS components proposed and also to provide further information relating to the drainage design, for example in relation to the groundwater identified at the site.

The consultation response from Sarah Burrows (Engineering Assistant at Arun DC Drainage team) during the planning stage is provided in Appendix A of this report. Within her email of the 18th March, Ms Burrows raises a number of issues which require clarification and recommends the wording for two planning conditions to be appended to the planning permission.

The applicant wishes to provide this detail prior to determination to avoid the need for a pre commencement condition.

The issues which require further information relate to the following and shall be assessed in turn below.

1. Further explanation regarding the groundwater levels encountered within the site.
2. The size of the orifices used to control runoff from the site.
3. Confirmation that the contributing area to the swale includes the area of the swale
4. Confirmation that all structures are 3m away from the pipe entering the existing watercourse passing through the site.
5. Confirmation that all buildings and fences are 3m away from the ditch bank
6. Improvements to the downstream headwall, pipe and culvert which drain runoff from the site currently.

The recommended conditions appended to the permission are as follows:

"Development shall not commence, other than works of site survey and investigation, until full details of the proposed surface water drainage scheme have been submitted to and approved in writing by the Local Planning Authority. The design should follow the hierarchy of preference for different types of surface water drainage disposal systems as set out in Approved Document H of the Building Regulations, and the recommendations of the SuDS Manual produced by CIRIA. No building / No part of the extended building shall be occupied until the complete surface water drainage system serving the property has been implemented in accordance with the agreed details and the details so agreed shall be maintained in good working order in perpetuity."

"The development shall not proceed until details have been submitted to and approved in writing by the Local Planning Authority for any proposals: to discharge flows to watercourses; or for the culverting, diversion, infilling or obstruction of any watercourse on or adjacent to the site. Any discharge to a watercourse must be at a rate no greater than the pre-development run-off values. No construction is permitted, which will restrict current and future land owners from undertaking their riparian maintenance responsibilities in respect to any watercourse or culvert on or adjacent to the site."

3.0 Issue 1 - Groundwater levels

An investigation of the groundwater levels at the site was undertaken on 21st March 2018. A screen shot of the data presented previously is provided below:

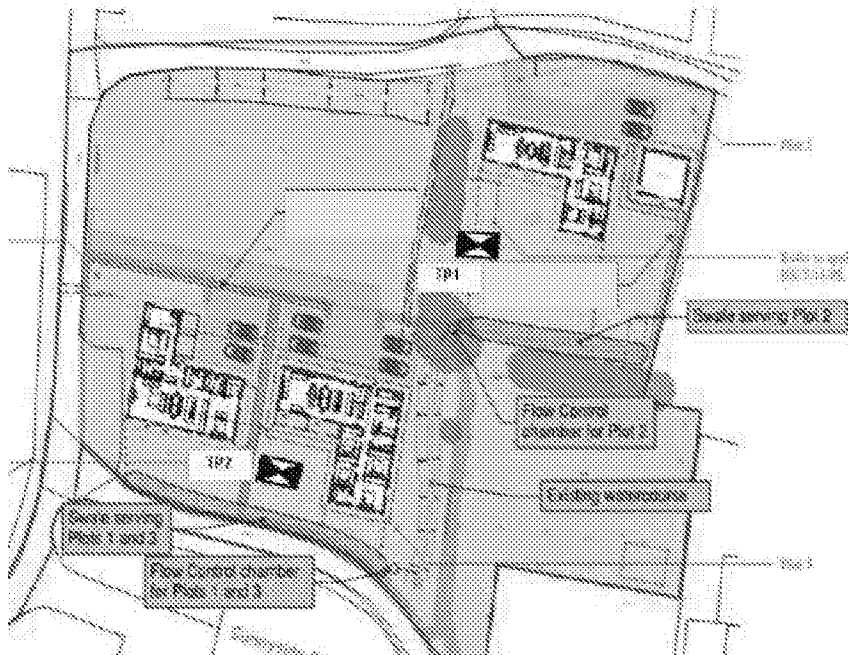
Trial pit observation												
Pit ID	Pit Name	Start Date	End Date	Current Date	Observation	Total Pit Length	Total Pit Width	Height	Flowing/Swelling	Flowing/Swelling	Flowing/Swelling	Flowing/Swelling
TP1	TP1	21.03.2018	21.03.2018	21.03.2018		2.00	0.50					
TP2	TP2	21.03.2018	21.03.2018	21.03.2018		2.00	0.50					

Arun DC made the following comment:

1. The groundwater level identified as part of the infiltration testing is unclear. The results state that each pit "filled 60cm within 20mins" from a starting point of 0.9mbgl and 0.7mbgl. On this basis we have read the results as peaking at 0.1mbgl in TP2. (Rather than both pits stabilising at 0.6mbgl). If this is the case the swales will require impermeable liners to avoid groundwater ingress, this will require the design to account for buoyancy. If the groundwater is in fact at 0.6mbgl then the applicant is advised to approach this department to discuss any further required monitoring and/or design options.

It is agreed that the data as presented could have been made more clear. During the excavation of the trial pit water ingress was noted at 0.9m bgl and was reported (verbally) to be perched groundwater which did not prevent the excavation from continuing to the target depth of 2.0m bgl. Once the excavation was complete water filled the excavation by 60cm (to 1.4mbgl) within 20mins. It is our contention that the design groundwater level is at 1.4m bgl (at TP1 and at TP2).

The Trial Pits were excavated in the positions shown below (not provided in the previous report). The ground levels at these locations are approx. 9.3m AOD for TP1 and approx. 9.1m AOD for TP2. Therefore, it may be stated that the groundwater level in TP1 has been measured at approx. 7.9m AOD at TP1 and at 7.7m AOD at TP2.



This would make sense as the watercourse which passes through the site has a bed level at between 8.2m AOD and 7.95m AOD. The lowest level being at the culvert which drains the site southwards. It would make sense that this watercourse prevents the groundwater from rising to the ground levels found across the site.

4.0 Issue 2 - Minimum orifice sizes for flow control devices

Arun DC commented as follows:

We do not accept orifices of less than 50mm as control devices due to the risk of blockage causing flooding upstream. On this basis the calculations will likely change with the inclusion of alternative flow control devices.

As an alternative, hydrobrakes have been incorporated into the detailed design which provide the necessary control to the discharge rates whilst maintaining an orifice size of at least 50mm.

5.0 Issue 3 - Contributing areas to the swales

Arun DC queried whether the contributing areas draining to the swales included the areas of the swales themselves. They did not.

The plan and table below identify the total areas draining to the swales which has been used in the updated hydraulic modelling (see Section 9).



Drained Area	Area (m ²)
Plot 1 - Access Road	67
Plot 1 - Parking area	91
Plot 1 - House	165
Plot 3 - Access Road	54
Plot 3 - Parking area	143
Plot 3 - House	179
Plot 1 + 3 Swale	175
Total Area draining to Plot 1 + 3 Swale	874
Plot 2 - Parking area	124
Plot 2 - House	145
Plot 2 - Garage	36
Plot 2 Swale	102
Total Area draining to Plot 2 Swale	407

6.0 Issue 4 - Contributing areas to the swales

4. A pipe is believed to enter the watercourse at the north end of it, all structures must be kept further than 3m from this.

The 3m offset from the north-end of the watercourse has been indicated on the latest layout plan. An extract of that plan is provided below and in full within Appendix B. The pipe that enters the north end of the watercourse is redundant and not connected to anything, it is approximately 6ft long and laid in the ground.

Nevertheless, all structures and fences are a minimum of 3m from the top of the ditch and swales

7.0 Issue 5 - Offset to top of bank to ditch

5. All buildings and fences must be minimum 3m from the top of the ditch bank.

The plan layout of the development has been adjusted in order to achieve this constraint. As above all structures and fences are a minimum of 3m from the top of the ditch and swales

8.0 Issue 6 - Downstream culvert

6. The downstream culvert (which the watercourse leads to) has known issues. The applicant will likely need to undertake offsite improvements to this to ensure it is fit for purpose. The same is likely to be applicable for the headwall and ditch onsite.

The Client shall undertake to clear debris from the watercourse and at the trash screen as it flows into a pipe at the south end of the site.

A CCTV survey has identified a blockage at the north end of the pipe which shall be cleared as part of the development to allow water to pass freely

9.0 Detailed Drainage Design information

Drainage Layout

A Drainage Layout for the development is provided in Appendix B. An extract of that drawing is provided below:



Plot 1 and 3 Swale

This swale comprises the following technical details, which have been used for the hydraulic modelling.

Bed Length	32 m
Bed width	0.7m
Bed level at outlet	8.5m AOD
Min. top of slope level	9.3m AOD
Height to top of slope	0.8m
Side Slopes	1 in 3
Overall width	5.0m
Overall length	36.2m
Longitudinal gradient	1 in 200

Detailed Design drawings for this swale are provided in Appendix C.

Plot 1 and 3 Flow Control

The flow control device proposed to limit flows from the Plot 1 & Plot 3 swale is a Hydrobrake with a Design Flow of 1.1 l/s at a Design Head of 0.8m (it is noted that the specified Hydrobrake has a 52mm orifice, it had been recommended that orifices no smaller than 50mm are suitable).

The hydrobrake shall be installed within a 1200mm diameter concrete chamber and have its invert level set at 8.4m AOD. Construction details of the specified hydrobrake are provided within Appendix D.

Plot 2 swale

This swale comprises the following technical details, which have been used for the hydraulic modelling.

Bed Length	22 m
Bed width	0.5m
Bed level at outlet	8.6m AOD
Min. top of slope level	9.2m AOD
Height to top of slope	0.6m
Side Slopes	1 in 3
Overall width	4.1m
Overall length	25.6m
Longitudinal gradient	1 in 200

Detailed Design drawings for this swale are provided in Appendix C.

Plot 2 Flow Control

The flow control device proposed to limit flows from the Plot 2 swale is a Hydrobrake with a Design Flow of 1.0 l/s at a Design Head of 0.7m (it is noted that the specified Hydrobrake has a 51mm orifice, it had been recommended that orifices no smaller than 50mm are suitable).

The hydrobrake shall be installed within a 1200mm diameter concrete chamber and have its invert level set at 8.5m AOD.

Details of the specified hydrobrake are provided within Appendix D.

Headwalls

A headwall detail for incoming pipes into the swale and the outgoing pipes is provided in Appendix E. This detail is reproduced from the West Sussex CC suite of highways drawings.

Hydraulic Performance

Microdrainage outputs for both swales are provided in Appendix F.

Both fully contain the 1 in 100 year return period event of critical duration and discharge at no more than 1.1 l/s.

10.0 Limitations

YE have prepared this report with all reasonable skill, care and diligence. The work undertaken to provide the basis of this report comprised a study of available documented information from a variety of sources.

The opinions given in this report have been dictated by the finite data on which are they based and are relevant only to the purpose for which the report was commissioned.

Information reviewed should not be considered exhaustive and has accepted in good faith as providing true and representative data with respect to site conditions. Should additional information become available which may influence the opinion expressed in this report, YE reserves the right to review such information and, if warranted, to alter the opinions accordingly.

It should be noted that any risks identified in this report are perceived risks based on the information reviewed.

The recommendations contained in this report represent our professional opinions. These opinions were arrived at in accordance with currently accepted industry practices at this time and as such are not a guarantee that the study site is free of hazardous conditions.

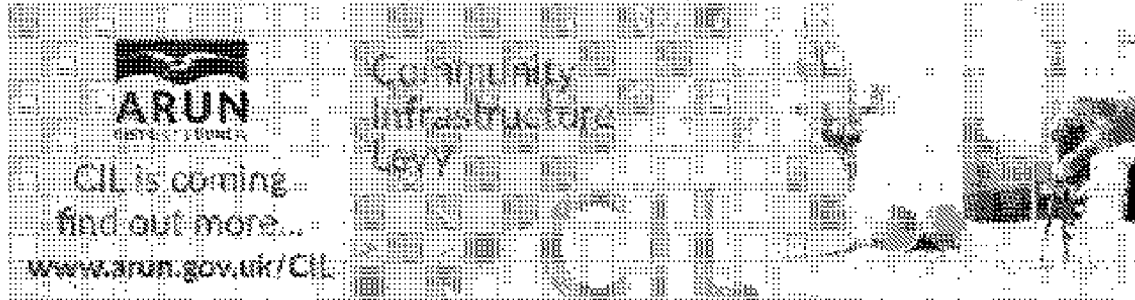
This report has been prepared solely for the use of the named client, and may not be relied upon by other parties without written consent from YE. YE disclaim any responsibility to the client and others in respect of any matters outside the agreed scope of the work

Appendix A - Arun DC e-mail dated 18th March 2020



Amanda Scholes | Receptionist, Department, Arun District Council | Location: Ground Floor, Arun Civic Centre, Maltravers Road, Littlehampton, BN17 5LF

Internal: 37736 | External: +44 (0) 1903 737500 ext 37736 | E-mail: amanda.scholes@arun.gov.uk



Visit Arun's web site at [Error! Hyperlink reference not valid.](http://www.arun.gov.uk/CIL)

Save the environment - think before you print

From: Sarah Burrow <Sarah.Burrow@arun.gov.uk>

Sent: 18 March 2020 12:39

To: Planning.Responses <Planning.Responses@arun.gov.uk>

Cc: Maria Tomalova <Maria.Tomalova@arun.gov.uk>

Subject: RE: Planning Consultation on: BN/5/20/PL

Engineers Comments Regarding Surface Water Drainage

The application is within the Lidsey Treatment Catchment, therefore surface water drainage design should be carefully considered.

The applicant has supplied a Surface Water Drainage Strategy as part of the application. The principle of the strategy; of attenuating surface water and discharging to the existing watercourse on the site is acceptable, however, this department will require further detail of the proposed scheme. We require a scaled drainage layout, including invert and cover levels and falls, control structures should be labelled with outflow rates, invert levels and design heads. In addition, the applicant should supply construction detail drawings of the proposed swales, conveyance channels, control structures, catch pits/silt traps and the outlets to the watercourse.

The following points have also been identified that require consideration:

1. The groundwater level identified as part of the infiltration testing is unclear. The results state that each pit "filled 60cm within 20mins" from a starting point of 0.9mgb/l and 0.7mgb/l. On this basis we have read the results as peaking at 0.1mgb/l in TP2. (Rather than both pits stabilising at 0.6mgb/l). If this is the case the swales will require impermeable liners to avoid groundwater ingress, this will require the design to account for buoyancy. If the groundwater is in fact at 0.6mgb/l then the applicant is advised to approach this department to discuss any further required monitoring and/or design options.
2. We do not accept orifices of less than 50mm as control devices due to the risk of blockage causing flooding upstream. On this basis the calculations will likely change with the inclusion of alternative flow control devices.

3. It is not mentioned within the discussion of the impermeable areas, but please ensure that the design accounts for rainwater falling directly onto the swales themselves (and runoff from surrounding areas).
4. A pipe is believed to enter the watercourse at the north end of it, all structures must be kept further than 3m from this.
5. All buildings and fences must be minimum 3m from the top of the ditch bank.
6. The downstream culvert (which the watercourse leads to) has known issues. The applicant will likely need to undertake offsite improvements to this to ensure it is fit for purpose. The same is likely to be applicable for the headwall and ditch onsite.

If you are minded to approve the scheme please apply the following conditions:

PCENG D2 (Modified to remove requirement for groundwater monitoring and infiltration testing – already completed)

"Development shall not commence, other than works of site survey and investigation, until full details of the proposed surface water drainage scheme have been submitted to and approved in writing by the Local Planning Authority. The design should follow the hierarchy of preference for different types of surface water drainage disposal systems as set out in Approved Document H of the Building Regulations, and the recommendations of the SuDS Manual produced by CIRIA. No building / No part of the extended building shall be occupied until the complete surface water drainage system serving the property has been implemented in accordance with the agreed details and the details so agreed shall be maintained in good working order in perpetuity."

Reason: To ensure that the proposed development is satisfactorily drained in accordance with policies W SP1, W DM1, W DM2 and W DM3 of the Arun Local Plan. This is required to be a pre-commencement condition because it is necessary to implement the surface water drainage system prior to commencing any building works.

PCENG D3

"The development shall not proceed until details have been submitted to and approved in writing by the Local Planning Authority for any proposals: to discharge flows to watercourses; or for the culverting, diversion, infilling or obstruction of any watercourse on or adjacent to the site. Any discharge to a watercourse must be at a rate no greater than the pre-development run-off values. No construction is permitted, which will restrict current and future land owners from undertaking their riparian maintenance responsibilities in respect to any watercourse or culvert on or adjacent to the site. "

Reason: To ensure that the proposed development is satisfactorily drained in accordance with policies W DM1, W DM2 and W DM3 of the Arun Local Plan. And to ensure that the duties and responsibilities, as required under the Land Drainage Act 1991, and amended by the Flood and Water Management Act 2010, can be fulfilled without additional impediment following the development completion. It is considered necessary for this to be a pre-commencement condition to protect existing watercourses prior to the construction commencing.

And the accompanying informative(s):

"Under Section 23 of the Land Drainage Act 1991 Land Drainage Consent must be sought from the Lead Local Flood Authority (West Sussex County Council), or its agent (Arun District Council land.drainage@arun.gov.uk), prior to starting any works (temporary or permanent) that affect the flow of water in an ordinary watercourse. Such works may include culverting, channel diversion, discharge of flows, connections, headwalls and the installation of trash screens.

The development layout must take account of any existing watercourses (open or culverted) to ensure that future access for maintenance is not restricted. No development is permitted within 3m of the bank of an ordinary watercourse, or 3m of a culverted ordinary watercourse."

"Supplementary guidance notes regarding surface water drainage are located here <https://www.arun.gov.uk/surfacewater> on Arun District Councils website. A surface water drainage checklist is available on Arun District Councils website, this should be submitted with a Discharge of Conditions Application."

Kind Regards

Sarah Burrow
Engineering Assistant

From: Planning.Responses <Planning.Responses@arun.gov.uk>
Sent: 31 January 2020 14:34
To: Land Drainage [REDACTED]
Subject: Planning Consultation on: BN/5/20/PL

To: Engineers (Drainage)

NOTIFICATION FROM ARUN DISTRICT COUNCIL
Town & Country Planning Act 1990 (as amended)
Town and Country Planning (Development Management Procedure) (England) Order 2015
Planning Permission
APPLICATION NO: BN/5/20/PL
Registered: 30th January
2020
Site Address: Land north of Sunnyside Cottages Yapton Road Barnham PO22 0AZ
Grid Reference: 496475 104086
Description of Works: Removal of existing buildings and erection of three new build dwellings.
(Alternatives to BN/7/18/PL and BN/48/18/PL). This application is a Departure from the Development Plan

The Council have received the above application. I shall be pleased to receive any observations you may wish to make

[Click here to view the application details](#)

Should you have any comments to make, these should be sent by [replying to this email](#) by 05-MAR-20.

You can also monitor the progress of this application through the Council web site:
www.arun.gov.uk/planning

Please be aware that any comments you may make will be available on our website so please do not insert personal details or signatures on your reply.

In the absence of a reply within the period stated, I shall assume that you have no observations to make.

The application will be determined having regard to the development plan policies (if any are relevant) and other material considerations. The development plan can be accessed via the website as can the leaflet which deals with material planning considerations.

Should the application go to appeal the Planning Inspectorate will publish any comments made to the Council on their website: www.planningportal.gov.uk/planning/appeals/ but they will protect personal details.

The officer dealing with this application is Maria Tomalova who can be contacted on telephone number 01903 737510.

Regards
Planning Officer

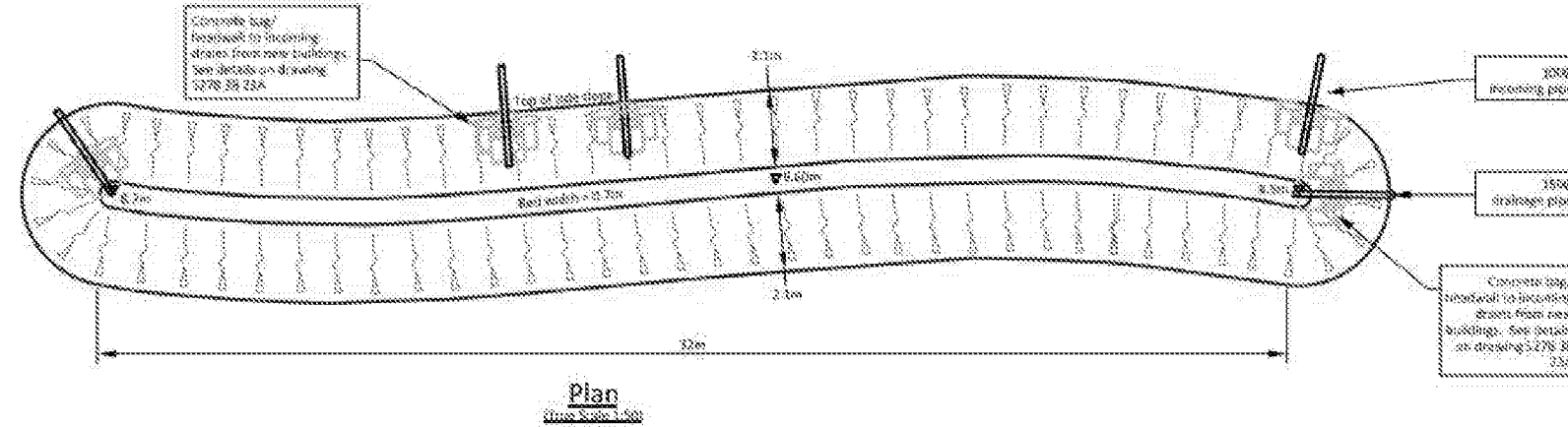
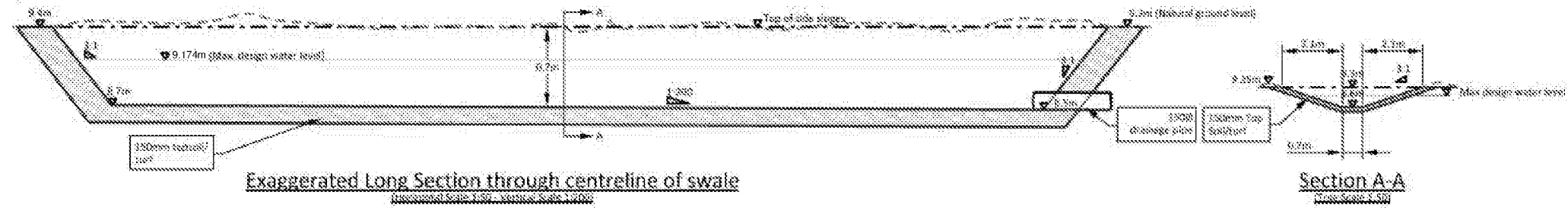
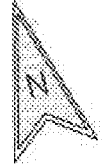
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Appendix B - Drainage layout plan

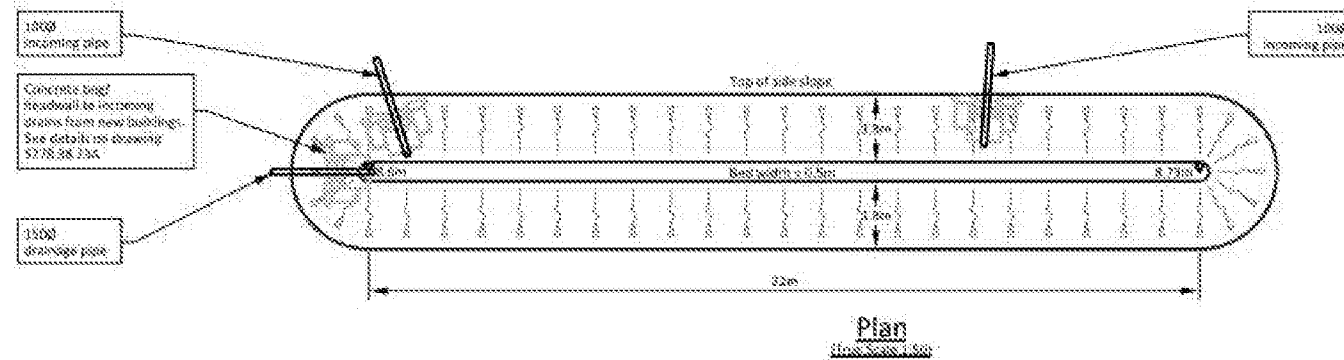
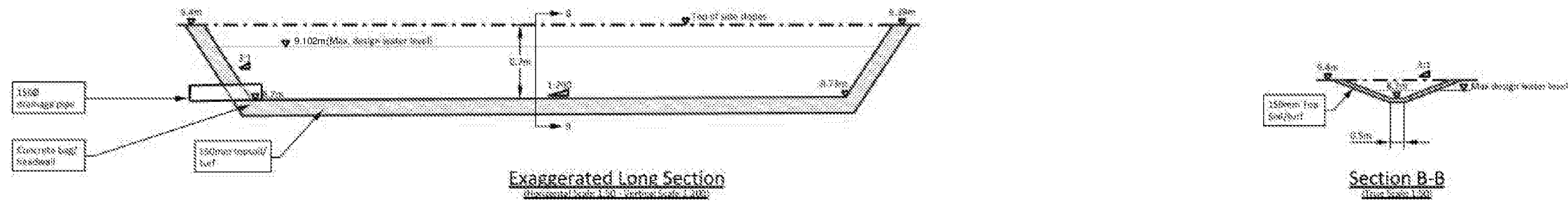
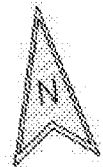


Appendix C - Detailed Design drawings





Swale adjacent to Plots 1 and 3



Swale adjacent to Plot 2

Swale Details

NOTES:

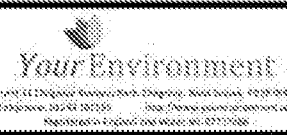
KEY:

SAFETY HEALTH AND ENVIRONMENTAL INFORMATION BOX

PROJECT	FLINT BARN BARNHAM
DESCRIPTION	CHURNAGE DESIGN
CLIENT	FLINT BARN BARNHAM
LOCATION	FLINT BARN BARNHAM
DATE	12/01/2021
BY	FLINT BARN BARNHAM
CHECKED	FLINT BARN BARNHAM
APPROVED	FLINT BARN BARNHAM

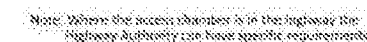
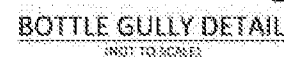
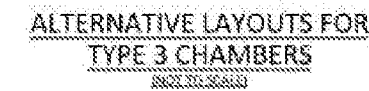
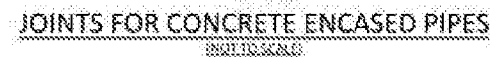
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APPROVED	FLINT BARN BARNHAM

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BY	FLINT BARN BARNHAM
CHECKED	FLINT BARN BARNHAM
APPROVED	FLINT BARN BARNHAM



FLB0102

PD1



INSPECTION CHAMBER
TYPE 3
(NOT TO SCALE)

[illegible]

Appendix D - Hydrobrake details



Technical Specification

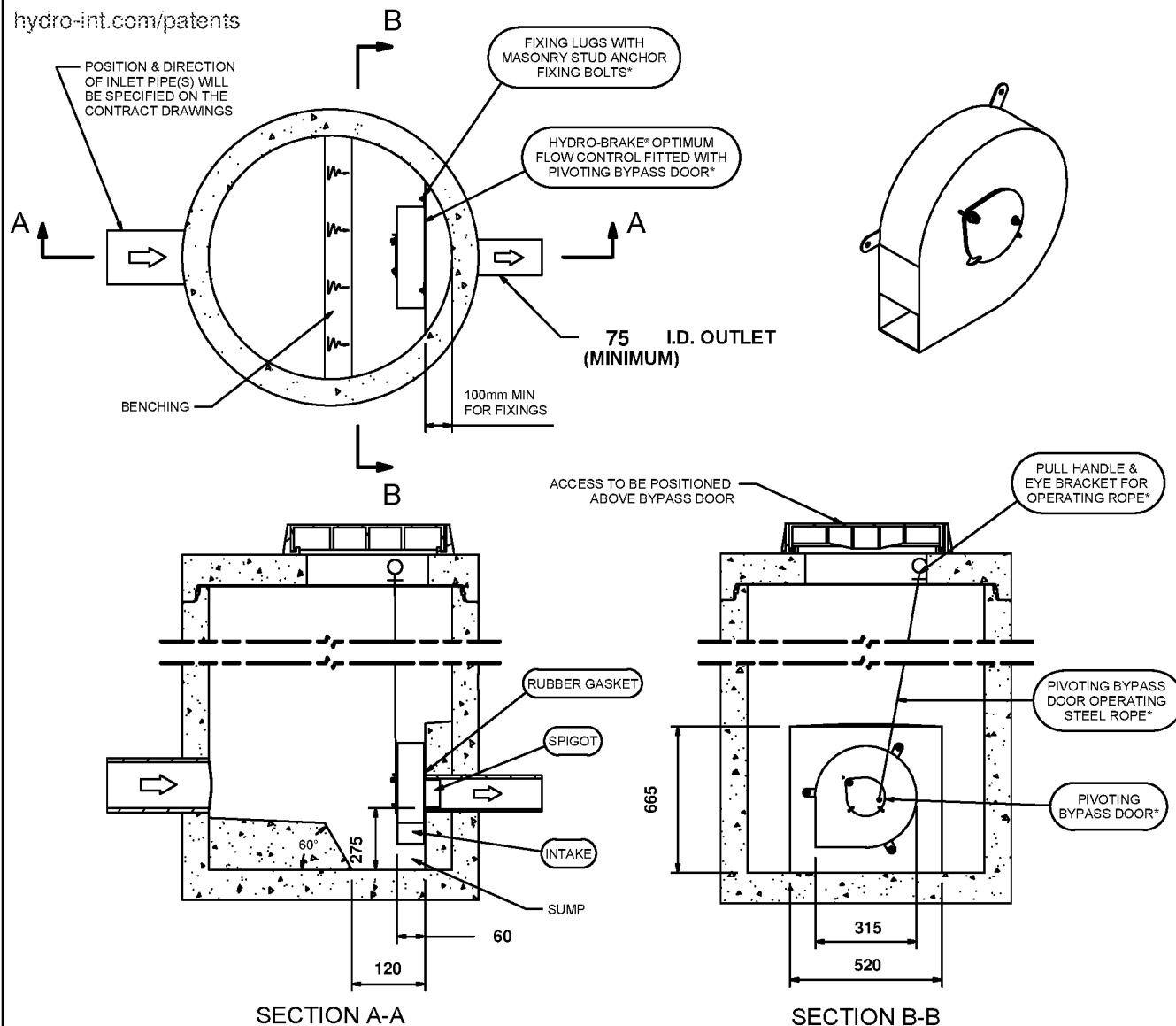
Control Point	Head (m)	Flow (l/s)
Primary Design	0.800	1.100
Flush-Flo™	0.229	1.046
Kick-Flo®	0.462	0.862
Mean Flow		0.939

Hydro-Brake® Optimum Flow Control including:

- 3 mm grade 304L stainless steel
- Integral stainless steel pivoting by-pass door allowing clear line of sight through to outlet, c/w stainless steel operating rope
- Beed blasted finish to maximise corrosion resistance
- Stainless steel fixings
- Rubber gasket to seal outlet



hydro-int.com/patents



IMPORTANT:

○ LIMIT OF HYDRO INTERNATIONAL SUPPLY

THE DEVICE WILL BE HANDED TO SUIT SITE CONDITIONS
FOR SITE SPECIFIC DETAILS AND MINIMUM CHAMBER SIZE REFER TO HYDRO INTERNATIONAL
ALL CIVIL AND INSTALLATION WORK BY OTHERS

* WHERE SUPPLIED

HYDRO-BRAKE® FLOW CONTROL & HYDRO-BRAKE® OPTIMUM FLOW CONTROL ARE REGISTERED TRADEMARKS FOR FLOW CONTROLS DESIGNED AND MANUFACTURED EXCLUSIVELY BY HYDRO INTERNATIONAL

THIS DESIGN LAYOUT IS FOR ILLUSTRATIVE PURPOSES ONLY. NOT TO SCALE.

DESIGN ADVICE



The head/flow characteristics of this SHE-0052-1100-0800-1100 Hydro-Brake® Optimum Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.
The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.

Hydro
International

DATE 5/13/2020 1:12 PM

SITE Flint Barn

DESIGNER Paul Timmins

REF Plot 1 & 3

SHE-0052-1100-0800-1100

Hydro-Brake® Optimum

© 2020 Hydro International Ltd, Shearwater House, Clevedon Hall Estate, Victoria Road, Clevedon, BS21 7RD. Tel: 01275 878371 Fax: 01275 874979 Web: www.hydro-int.com Email: enquiries@hydro-int.com

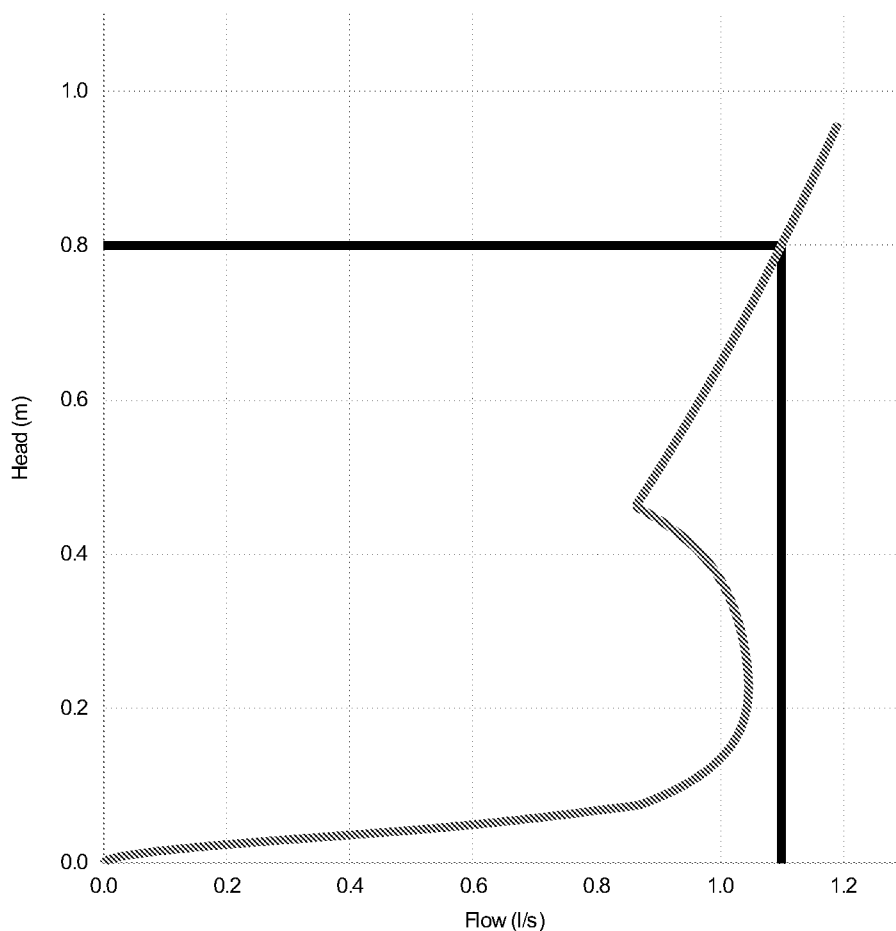
paul@timminsconsulting.co.uk

Technical Specification

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Primary Design	0.800	1.100
Flush-Flo	0.229	1.046
Kick-Flo®	0.462	0.862
Mean Flow		0.939



hydro-int.com/patents



Head (m)	Flow (l/s)
0.000	0.000
0.028	0.255
0.055	0.666
0.083	0.894
0.110	0.962
0.138	1.004
0.166	1.029
0.193	1.041
0.221	1.046
0.248	1.045
0.276	1.041
0.303	1.033
0.331	1.022
0.359	1.007
0.386	0.984
0.414	0.953
0.441	0.908
0.469	0.868
0.497	0.890
0.524	0.912
0.552	0.933
0.579	0.953
0.607	0.973
0.634	0.992
0.662	1.011
0.690	1.029
0.717	1.047
0.745	1.065
0.772	1.082
0.800	1.099

DESIGN ADVICE



The head/flow characteristics of this SHE-0052-1100-0800-1100 Hydro-Brake Optimum® Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.

The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.

Hydro
International

DATE 13/05/2020 13:12

Site Flint Barn

DESIGNER Paul Timmins

Ref Plot 1 & 3

SHE-0052-1100-0800-1100

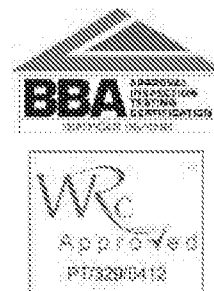
Hydro-Brake Optimum®

Technical Specification

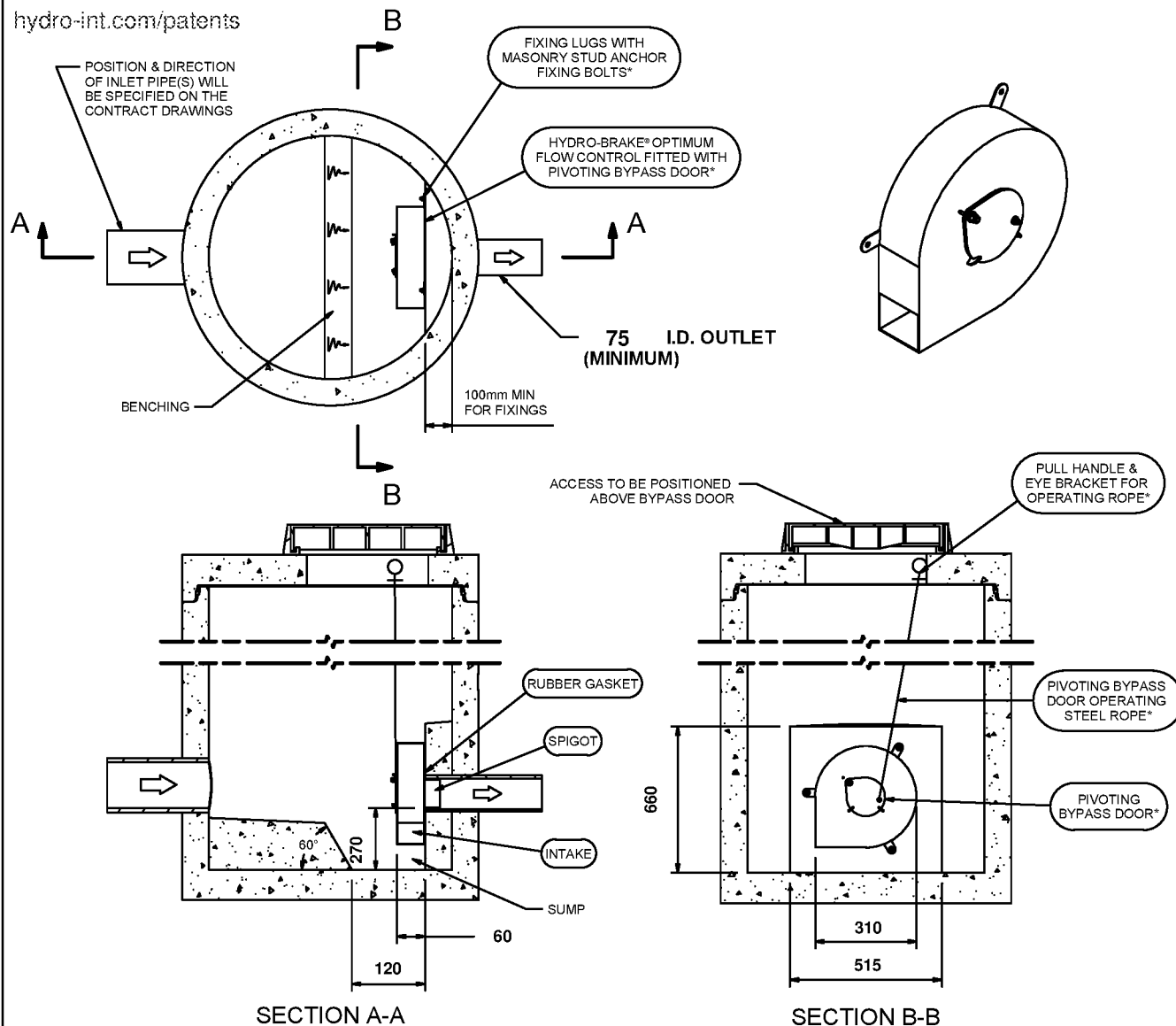
Control Point	Head (m)	Flow (l/s)
Primary Design	0.700	1.000
Flush-Flo™	0.222	0.996
Kick-Flo®	0.449	0.822
Mean Flow		0.880

Hydro-Brake® Optimum Flow Control including:

- 3 mm grade 304L stainless steel
- Integral stainless steel pivoting by-pass door allowing clear line of sight through to outlet, c/w stainless steel operating rope
- Beed blasted finish to maximise corrosion resistance
- Stainless steel fixings
- Rubber gasket to seal outlet



hydro-int.com/patents



IMPORTANT:

○ LIMIT OF HYDRO INTERNATIONAL SUPPLY

THE DEVICE WILL BE HANDED TO SUIT SITE CONDITIONS
FOR SITE SPECIFIC DETAILS AND MINIMUM CHAMBER SIZE REFER TO HYDRO INTERNATIONAL
ALL CIVIL AND INSTALLATION WORK BY OTHERS

* WHERE SUPPLIED

HYDRO-BRAKE® FLOW CONTROL & HYDRO-BRAKE® OPTIMUM FLOW CONTROL ARE REGISTERED TRADEMARKS FOR FLOW CONTROLS DESIGNED AND MANUFACTURED EXCLUSIVELY BY HYDRO INTERNATIONAL

THIS DESIGN LAYOUT IS FOR ILLUSTRATIVE PURPOSES ONLY. NOT TO SCALE.

DESIGN ADVICE



The head/flow characteristics of this SHE-0051-1000-0700-1000 Hydro-Brake® Optimum Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.
The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.

Hydro
International

DATE 5/13/2020 12:59 PM

SITE Flint Barn

DESIGNER Paul Timmins

REF Plot 2

SHE-0051-1000-0700-1000

Hydro-Brake® Optimum

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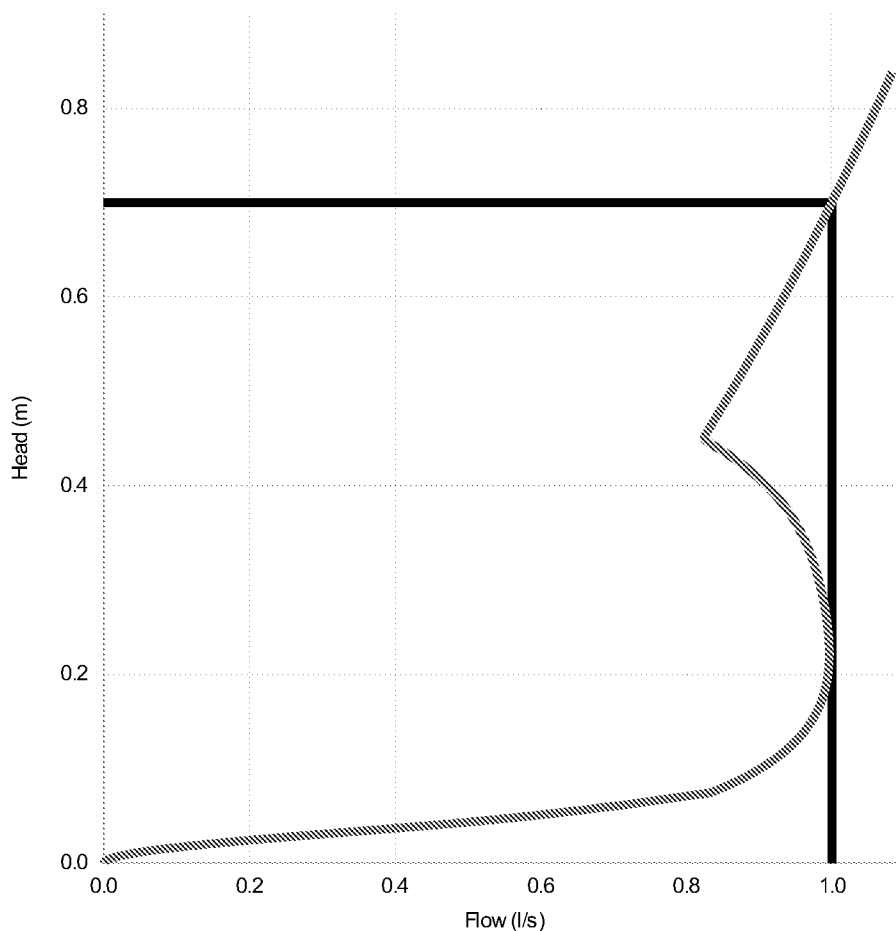
paul@timminsconsulting.co.uk

Technical Specification

Control Point	Head (m)	Flow (l/s)
Primary Design	0.700	1.000
Flush-Flo	0.222	0.996
Kick-Flo®	0.449	0.822
Mean Flow		0.880



hydro-int.com/patents



Head (m)	Flow (l/s)
0.000	0.000
0.024	0.199
0.048	0.565
0.072	0.814
0.097	0.894
0.121	0.939
0.145	0.967
0.169	0.984
0.193	0.993
0.217	0.996
0.241	0.995
0.266	0.991
0.290	0.985
0.314	0.977
0.338	0.965
0.362	0.949
0.386	0.927
0.410	0.896
0.434	0.854
0.459	0.830
0.483	0.849
0.507	0.867
0.531	0.885
0.555	0.902
0.579	0.920
0.603	0.936
0.628	0.953
0.652	0.969
0.676	0.984
0.700	1.000

DESIGN ADVICE



The head/flow characteristics of this SHE-0051-1000-0700-1000 Hydro-Brake Optimum® Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.

The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.

Hydro
International

DATE 13/05/2020 12:59

Site Flint Barn

DESIGNER Paul Timmins

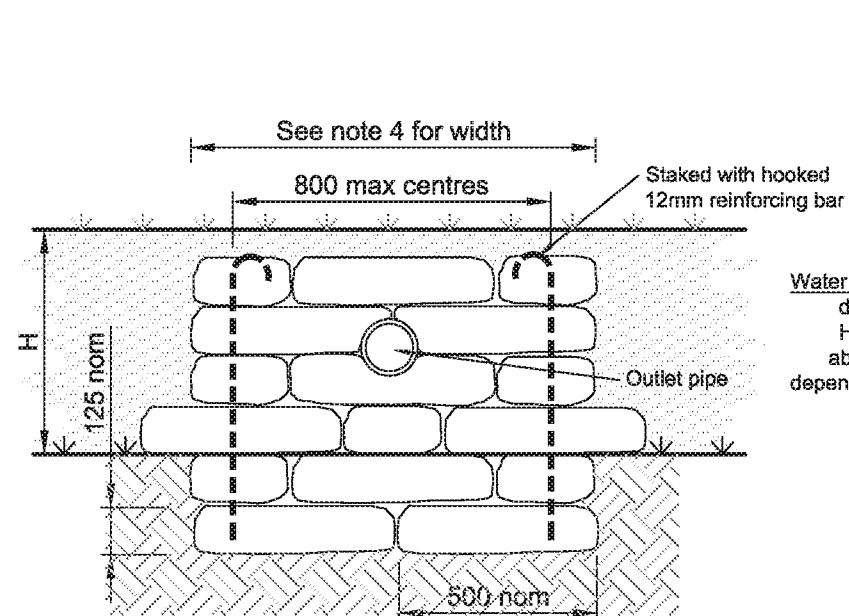
Ref Plot 2

SHE-0051-1000-0700-1000

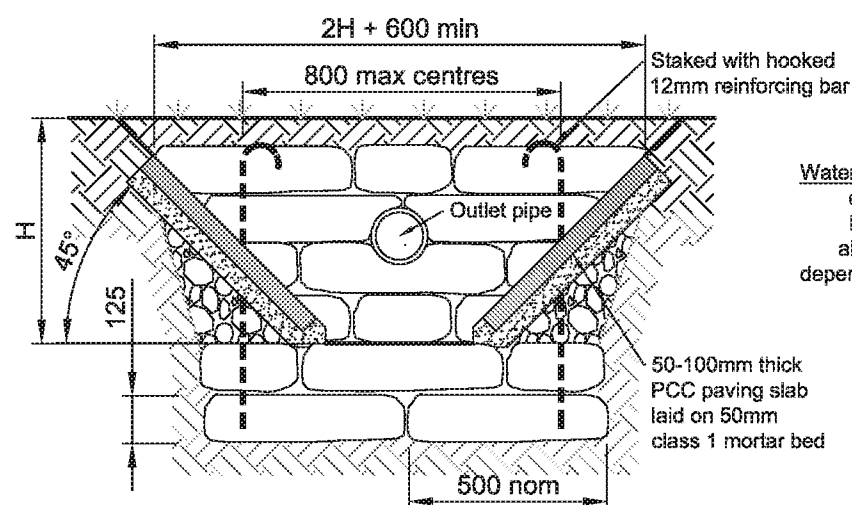
Hydro-Brake Optimum®

Appendix E - Headwall details



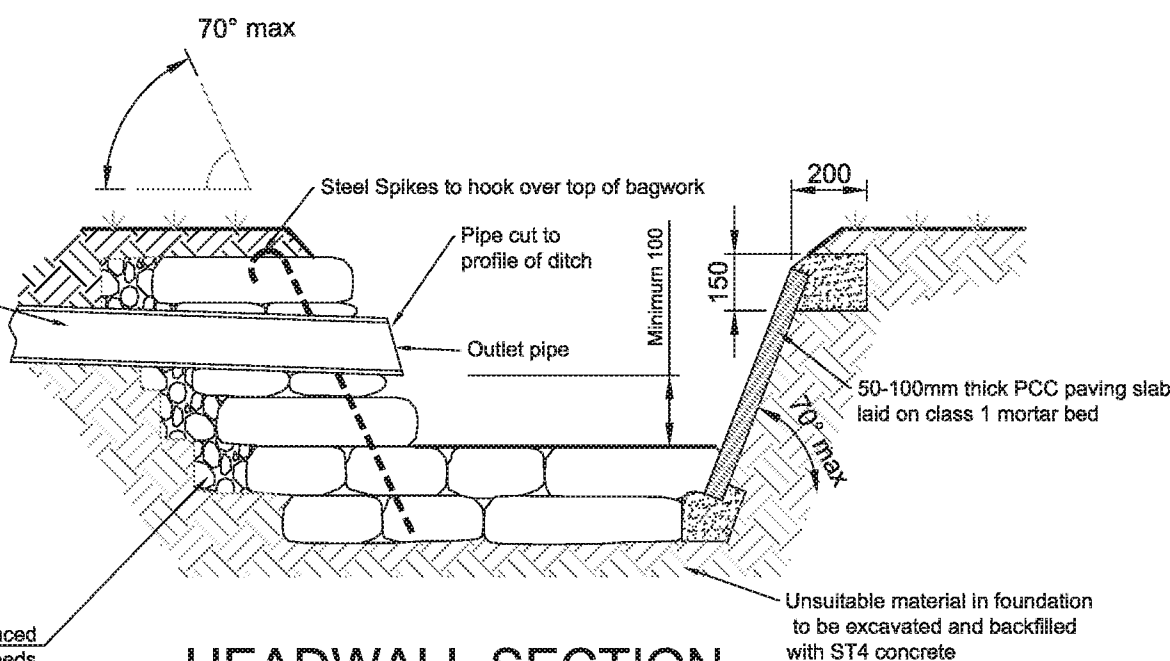


**ELEVATION OF HEADWALL
OUTFALL TO POND / SIDE OF DITCH**

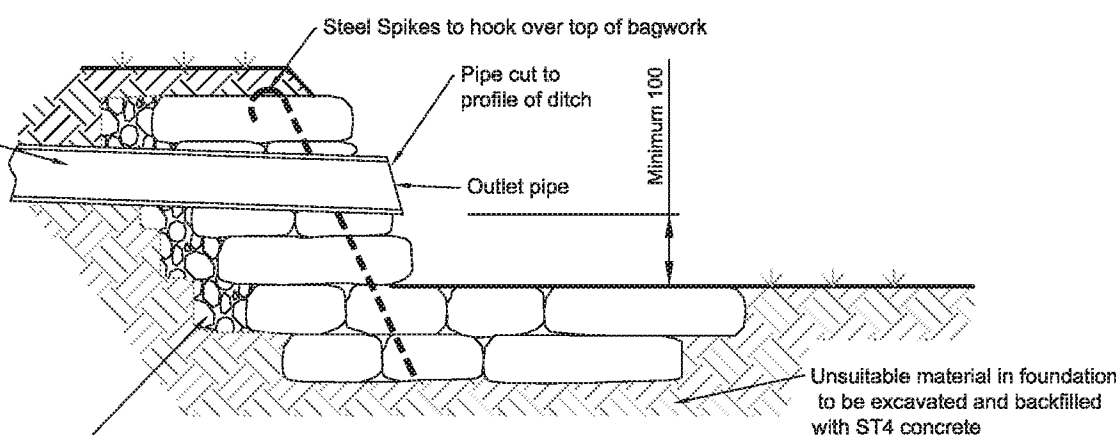


**ELEVATION OF HEADWALL
OUTFALL TO END OF DITCH**

Backfill behind bagwork to be placed and tamped as work proceeds



**HEADWALL SECTION
OUTFALL TO SIDE OF DITCH**



**HEADWALL SECTION
OUTFALL TO POND / END OF DITCH**

NOTES

1. Bags shall be of Hessian or Canvas and shall be of a size to provide a wall thickness of 500mm
2. Concrete bagwork shall be to Clause 519 and be three quarter filled with 25mm slump ST4 concrete immediately prior to placing with the ends sewn.
3. The bags shall be placed in a modified Flemish bond so as to 'break joint' with the mouths away from the surface and be tamped into position to form a rectangular block
4. Extent of outlet protection to be the greater of 1500mm or pipe diameter + 1200mm spanning the outlet pipe.
5. Headwall design may need to be adjusted to on site conditions following approval from WSCC Inspector
6. For vehicular crossings of ditches pipes shall be min 450mm diam and be set to invert of ditch. Ditch to be regraded to achieve satisfactory falls.
7. For $H > 600$ appropriate vehicular or pedestrian containment shall be installed.
8. The nearest edge of any carriageway shall be set back at least H from the base of the ditch
9. All exposed pipework to be certified UV stable.

A	Note 9 added	DL	HM	25.04.17
Rev	Revision details	Chkd	Appd	Date
Drawn:	DJL		For comment	
Chkd:	GM		For tender	
Appd:	AH	X	For construction	
Date:	SEPT 2013		As constructed	
File ref:				
IWP Ref:				

West Sussex County Council
Infrastructure Group
County Hall,
West Street
Chichester
West Sussex
PO19 1RH
(01243) 642105



Project Name

Section 278/38 Highway Agreement
Standard Details

Drawing Title

Headwall Detail for pipe sizes up to 600 diam
Concrete Bagwork



Original Drawing Size : A3

Scale : 1:20

Dimensions : mm

Drawing No.

S278/38/23

Rev

A

Appendix F - Microdrainage Outputs



KPT Properties			Page 1			
19 Lonsdale Avenue Hutton Essex CM13 1NH			Land to the rear of Sunnyside Barn and Flint Barn Barnham			
Date 15/05/2020 12:54 File Plotland3_Swale_HB_1%+40%_50mm orific...			Designed by Paul Checked by			
XP Solutions			Source Control 2020.1			
Summary of Results for 100 year Return Period (+40%)						
Half Drain Time : 390 minutes.						
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³) Status
15 min Summer	8.936	0.436	0.0	1.0	1.0	20.3 O K
30 min Summer	9.004	0.504	0.0	1.0	1.0	27.0 Flood Risk
60 min Summer	9.065	0.565	0.0	1.0	1.0	33.7 Flood Risk
120 min Summer	9.095	0.595	0.0	1.0	1.0	37.2 Flood Risk
180 min Summer	9.104	0.604	0.0	1.0	1.0	38.3 Flood Risk
240 min Summer	9.102	0.602	0.0	1.0	1.0	38.0 Flood Risk
360 min Summer	9.084	0.584	0.0	1.0	1.0	35.8 Flood Risk
480 min Summer	9.068	0.568	0.0	1.0	1.0	33.9 Flood Risk
600 min Summer	9.053	0.553	0.0	1.0	1.0	32.3 Flood Risk
720 min Summer	9.040	0.540	0.0	1.0	1.0	30.8 Flood Risk
960 min Summer	9.014	0.514	0.0	1.0	1.0	28.1 Flood Risk
1440 min Summer	8.966	0.466	0.0	1.0	1.0	23.2 O K
2160 min Summer	8.896	0.396	0.0	1.0	1.0	16.9 O K
2880 min Summer	8.815	0.315	0.0	1.0	1.0	10.8 O K
4320 min Summer	8.684	0.184	0.0	1.0	1.0	3.6 O K
5760 min Summer	8.589	0.089	0.0	1.0	1.0	0.7 O K
7200 min Summer	8.511	0.011	0.0	1.0	1.0	0.0 O K
8640 min Summer	8.500	0.000	0.0	0.9	0.9	0.0 O K
10080 min Summer	8.500	0.000	0.0	0.8	0.8	0.0 O K
15 min Winter	8.964	0.464	0.0	1.0	1.0	23.0 O K
30 min Winter	9.037	0.537	0.0	1.0	1.0	30.5 Flood Risk
60 min Winter	9.104	0.604	0.0	1.0	1.0	38.3 Flood Risk
120 min Winter	9.140	0.640	0.0	1.1	1.1	42.8 Flood Risk
180 min Winter	9.152	0.652	0.0	1.1	1.1	44.5 Flood Risk
240 min Winter	9.154	0.654	0.0	1.1	1.1	44.7 Flood Risk
360 min Winter	9.140	0.640	0.0	1.1	1.1	42.9 Flood Risk
480 min Winter	9.119	0.619	0.0	1.0	1.0	40.2 Flood Risk
600 min Winter	9.102	0.602	0.0	1.0	1.0	38.1 Flood Risk
720 min Winter	9.086	0.586	0.0	1.0	1.0	36.1 Flood Risk
960 min Winter	9.052	0.552	0.0	1.0	1.0	32.2 Flood Risk
1440 min Winter	8.984	0.484	0.0	1.0	1.0	24.9 O K
2160 min Winter	8.876	0.376	0.0	1.0	1.0	15.2 O K
2880 min Winter	8.736	0.236	0.0	1.0	1.0	6.0 O K
4320 min Winter	8.527	0.027	0.0	1.0	1.0	0.1 O K
5760 min Winter	8.500	0.000	0.0	0.8	0.8	0.0 O K
7200 min Winter	8.500	0.000	0.0	0.7	0.7	0.0 O K
8640 min Winter	8.500	0.000	0.0	0.6	0.6	0.0 O K
10080 min Winter	8.500	0.000	0.0	0.6	0.6	0.0 O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)		
15 min Summer	141.327	0.0	22.0	29		
30 min Summer	94.752	0.0	29.5	43		
60 min Summer	60.960	0.0	37.9	72		
120 min Summer	36.131	0.0	44.9	128		
180 min Summer	26.513	0.0	49.5	186		
240 min Summer	21.191	0.0	52.7	242		
360 min Summer	15.297	0.0	57.1	322		
480 min Summer	12.091	0.0	60.2	382		
600 min Summer	10.057	0.0	62.6	444		
720 min Summer	8.643	0.0	64.5	512		
960 min Summer	6.791	0.0	67.7	648		
1440 min Summer	4.841	0.0	72.3	920		
2160 min Summer	3.471	0.0	77.7	1320		
2880 min Summer	2.758	0.0	82.5	1676		
4320 min Summer	2.027	0.0	90.8	2336		
5760 min Summer	1.649	0.0	98.6	2952		
7200 min Summer	1.419	0.0	106.0	3624		
8640 min Summer	1.264	0.0	113.3	0		
10080 min Summer	1.152	0.0	120.5	0		
15 min Winter	141.327	0.0	24.6	29		
30 min Winter	94.752	0.0	33.0	43		
60 min Winter	60.960	0.0	42.4	72		
120 min Winter	36.131	0.0	50.4	126		
180 min Winter	26.513	0.0	55.5	184		
240 min Winter	21.191	0.0	59.1	240		
360 min Winter	15.297	0.0	64.0	348		
480 min Winter	12.091	0.0	67.4	410		
600 min Winter	10.057	0.0	70.1	474		
720 min Winter	8.643	0.0	72.3	550		
960 min Winter	6.791	0.0	75.7	702		
1440 min Winter	4.841	0.0	81.1	996		
2160 min Winter	3.471	0.0	87.1	1420		
2880 min Winter	2.758	0.0	92.3	1712		
4320 min Winter	2.027	0.0	101.7	2208		
5760 min Winter	1.649	0.0	110.4	0		
7200 min Winter	1.419	0.0	118.8	0		
8640 min Winter	1.264	0.0	126.9	0		
10080 min Winter	1.152	0.0	135.0	0		
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KPT Properties		Page 2
19 Lonsdale Avenue Hutton Essex CM13 1NH	Land to the rear of Sunnyside Barn and Flint Barn Barnham	
Date 15/05/2020 12:54 File Plotland3_Swale_HB_1%+40%_50mm orific...	Designed by Paul Checked by	
XP Solutions	Source Control 2020.1	
<		

KPT Properties		Page 3																																																																																										
19 Lonsdale Avenue Hutton Essex CM13 1NH	Land to the rear of Sunnyside Barn and Flint Barn Barnham																																																																																											
Date 15/05/2020 12:54 File Plotland3_Swale_HB_1%+40%_50mm orific...	Designed by Paul Checked by																																																																																											
XP Solutions	Source Control 2020.1																																																																																											
Model Details Storage is Online Cover Level (m) 9.300 Swale Structure Infiltration Coefficient Base (m/hr) 0.00000Length (m) 32.0 Infiltration Coefficient Side (m/hr) 0.00000Side Slope (1:X) 3.0 Safety Factor 2.0Slope (1:X) 200.0 Porosity 1.00Cap Volume Depth (m) 0.000 Invert Level (m) 8.500Cap Infiltration Depth (m) 0.000 Base Width (m) 0.7 Hydro-Brake® Optimum Outflow Control Unit Reference MD-SHE-0052-1100-0800-1100Sump Available Yes Design Head (m) 0.800Diameter (mm) 52 Design Flow (l/s) 1.1Invert Level (m) 8.400 Flush-Flo™Calculated Minimum Outlet Pipe Diameter (mm) 75 Objective Minimise upstream storageSuggested Manhole Diameter (mm) 1200 Application Surface <table><tr><td>Control Points</td><td>Head (m)</td><td>Flow (l/s)</td><td>Control Points</td><td>Head (m)</td><td>Flow (l/s)</td></tr><tr><td>Design Point (Calculated)</td><td>0.800</td><td>1.1</td><td>Kick-Flo®</td><td>0.462</td><td>0.9</td></tr><tr><td>Flush-Flo™</td><td>0.229</td><td>1.0</td><td>Mean Flow over Head Range</td><td>-</td><td>0.9</td></tr></table> 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 <table><tr><td>Depth (m)</td><td>Flow (l/s)</td><td>Depth (m)</td><td>Flow (l/s)</td><td>Depth (m)</td><td>Flow (l/s)</td><td>Depth (m)</td><td>Flow (l/s)</td><td>Depth (m)</td><td>Flow (l/s)</td><td>Depth (m)</td><td>Flow (l/s)</td></tr><tr><td>0.100</td><td>0.9</td><td>0.600</td><td>1.0</td><td>1.600</td><td>1.5</td><td>2.600</td><td>1.9</td><td>5.000</td><td>2.5</td><td>7.500</td><td>3.1</td></tr><tr><td>0.200</td><td>1.0</td><td>0.800</td><td>1.1</td><td>1.800</td><td>1.6</td><td>3.000</td><td>2.0</td><td>5.500</td><td>2.6</td><td>8.000</td><td>3.2</td></tr><tr><td>0.300</td><td>1.0</td><td>1.000</td><td>1.2</td><td>2.000</td><td>1.7</td><td>3.500</td><td>2.1</td><td>6.000</td><td>2.8</td><td>8.500</td><td>3.2</td></tr><tr><td>0.400</td><td>1.0</td><td>1.200</td><td>1.3</td><td>2.200</td><td>1.7</td><td>4.000</td><td>2.3</td><td>6.500</td><td>2.9</td><td>9.000</td><td>3.3</td></tr><tr><td>0.500</td><td>0.9</td><td>1.400</td><td>1.4</td><td>2.400</td><td>1.8</td><td>4.500</td><td>2.4</td><td>7.000</td><td>3.0</td><td>9.500</td><td>3.4</td></tr></table>			Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)	Design Point (Calculated)	0.800	1.1	Kick-Flo®	0.462	0.9	Flush-Flo™	0.229	1.0	Mean Flow over Head Range	-	0.9	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	0.100	0.9	0.600	1.0	1.600	1.5	2.600	1.9	5.000	2.5	7.500	3.1	0.200	1.0	0.800	1.1	1.800	1.6	3.000	2.0	5.500	2.6	8.000	3.2	0.300	1.0	1.000	1.2	2.000	1.7	3.500	2.1	6.000	2.8	8.500	3.2	0.400	1.0	1.200	1.3	2.200	1.7	4.000	2.3	6.500	2.9	9.000	3.3	0.500	0.9	1.400	1.4	2.400	1.8	4.500	2.4	7.000	3.0	9.500	3.4
Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)																																																																																							
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0.100	0.9	0.600	1.0	1.600	1.5	2.600	1.9	5.000	2.5	7.500	3.1																																																																																	
0.200	1.0	0.800	1.1	1.800	1.6	3.000	2.0	5.500	2.6	8.000	3.2																																																																																	
0.300	1.0	1.000	1.2	2.000	1.7	3.500	2.1	6.000	2.8	8.500	3.2																																																																																	
0.400	1.0	1.200	1.3	2.200	1.7	4.000	2.3	6.500	2.9	9.000	3.3																																																																																	
0.500	0.9	1.400	1.4	2.400	1.8	4.500	2.4	7.000	3.0	9.500	3.4																																																																																	
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KPT Properties			Page 1				
19 Lonsdale Avenue Hutton Essex CM13 1NH			Land to the rear of Sunnyside Barn and Flint Barn Barnham				
Date 19/05/2020 10:15 File PLOT2_SWALE_HB_1%+40%_50MM ORIFICE.SRCX			Designed by Paul Checked by				
XP Solutions			Source Control 2020.1				
Summary of Results for 100 year Return Period (+40%)							
Half Drain Time : 169 minutes.							
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	8.956	0.356	0.0	1.0	1.0	9.3	Flood Risk
30 min Summer	9.010	0.410	0.0	1.0	1.0	12.3	Flood Risk
60 min Summer	9.054	0.454	0.0	1.0	1.0	15.0	Flood Risk
120 min Summer	9.061	0.461	0.0	1.0	1.0	15.4	Flood Risk
180 min Summer	9.052	0.452	0.0	1.0	1.0	14.8	Flood Risk
240 min Summer	9.042	0.442	0.0	1.0	1.0	14.2	Flood Risk
360 min Summer	9.022	0.422	0.0	1.0	1.0	13.0	Flood Risk
480 min Summer	9.001	0.401	0.0	1.0	1.0	11.8	Flood Risk
600 min Summer	8.980	0.380	0.0	1.0	1.0	10.6	Flood Risk
720 min Summer	8.958	0.358	0.0	1.0	1.0	9.4	Flood Risk
960 min Summer	8.906	0.306	0.0	1.0	1.0	7.0	Flood Risk
1440 min Summer	8.811	0.211	0.0	1.0	1.0	3.4	O K
2160 min Summer	8.700	0.100	0.0	1.0	1.0	0.7	O K
2880 min Summer	8.611	0.011	0.0	0.9	0.9	0.0	O K
4320 min Summer	8.600	0.000	0.0	0.7	0.7	0.0	O K
5760 min Summer	8.600	0.000	0.0	0.6	0.6	0.0	O K
7200 min Summer	8.600	0.000	0.0	0.5	0.5	0.0	O K
8640 min Summer	8.600	0.000	0.0	0.4	0.4	0.0	O K
10080 min Summer	8.600	0.000	0.0	0.4	0.4	0.0	O K
15 min Winter	8.980	0.380	0.0	1.0	1.0	10.6	Flood Risk
30 min Winter	9.040	0.440	0.0	1.0	1.0	14.1	Flood Risk
60 min Winter	9.089	0.489	0.0	1.0	1.0	17.3	Flood Risk
120 min Winter	9.102	0.502	0.0	1.0	1.0	18.2	Flood Risk
180 min Winter	9.096	0.496	0.0	1.0	1.0	17.7	Flood Risk
240 min Winter	9.082	0.482	0.0	1.0	1.0	16.8	Flood Risk
360 min Winter	9.057	0.457	0.0	1.0	1.0	15.2	Flood Risk
480 min Winter	9.030	0.430	0.0	1.0	1.0	13.4	Flood Risk
600 min Winter	9.000	0.400	0.0	1.0	1.0	11.7	Flood Risk
720 min Winter	8.967	0.367	0.0	1.0	1.0	9.9	Flood Risk
960 min Winter	8.886	0.286	0.0	1.0	1.0	6.1	O K
1440 min Winter	8.734	0.134	0.0	1.0	1.0	1.4	O K
2160 min Winter	8.600	0.000	0.0	0.8	0.8	0.0	O K
2880 min Winter	8.600	0.000	0.0	0.7	0.7	0.0	O K
4320 min Winter	8.600	0.000	0.0	0.5	0.5	0.0	O K
5760 min Winter	8.600	0.000	0.0	0.4	0.4	0.0	O K
7200 min Winter	8.600	0.000	0.0	0.3	0.3	0.0	O K
8640 min Winter	8.600	0.000	0.0	0.3	0.3	0.0	O K
10080 min Winter	8.600	0.000	0.0	0.3	0.3	0.0	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)			
15 min Summer	141.327	0.0	10.9	28			
30 min Summer	94.752	0.0	14.6	41			
60 min Summer	60.960	0.0	18.8	68			
120 min Summer	36.131	0.0	22.3	122			
180 min Summer	26.513	0.0	24.4	164			
240 min Summer	21.191	0.0	26.0	194			
360 min Summer	15.297	0.0	28.2	260			
480 min Summer	12.091	0.0	29.8	328			
600 min Summer	10.057	0.0	30.9	396			
720 min Summer	8.643	0.0	31.8	464			
960 min Summer	6.791	0.0	33.4	588			
1440 min Summer	4.841	0.0	35.7	816			
2160 min Summer	3.471	0.0	38.4	1136			
2880 min Summer	2.758	0.0	40.7	1468			
4320 min Summer	2.027	0.0	44.9	0			
5760 min Summer	1.649	0.0	48.7	0			
7200 min Summer	1.419	0.0	52.4	0			
8640 min Summer	1.264	0.0	56.0	0			
10080 min Summer	1.152	0.0	59.5	0			
15 min Winter	141.327	0.0	12.2	28			
30 min Winter	94.752	0.0	16.3	42			
60 min Winter	60.960	0.0	20.9	68			
120 min Winter	36.131	0.0	24.9	122			
180 min Winter	26.513	0.0	27.4	176			
240 min Winter	21.191	0.0	29.2	208			
360 min Winter	15.297	0.0	31.6	280			
480 min Winter	12.091	0.0	33.4	356			
600 min Winter	10.057	0.0	34.7	430			
720 min Winter	8.643	0.0	35.7	504			
960 min Winter	6.791	0.0	37.4	624			
1440 min Winter	4.841	0.0	40.0	822			
2160 min Winter	3.471	0.0	43.0	0			
2880 min Winter	2.758	0.0	45.6	0			
4320 min Winter	2.027	0.0	50.3	0			
5760 min Winter	1.649	0.0	54.5	0			
7200 min Winter	1.419	0.0	58.7	0			
8640 min Winter	1.264	0.0	62.7	0			
10080 min Winter	1.152	0.0	66.7	0			
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KPT Properties		Page 2																								
19 Lonsdale Avenue Hutton Essex CM13 1NH	Land to the rear of Sunnyside Barn and Flint Barn Barnham																									
Date 19/05/2020 10:15 File PLOT2_SWALE_HB_1%+40%_50MM ORIFICE.SRCX	Designed by Paul Checked by																									
XP Solutions	Source Control 2020.1																									
Rainfall Details Rainfall Model FEH Data Type Point Cv (Winter) 0.840 Return Period (years) 100 Summer Storms Yes Shortest Storm (mins) 15 FEH Rainfall Version 2013 Winter Storms Yes Longest Storm (mins) 10080 Site Location GB 496538 104129 Cv (Summer) 0.750 Climate Change % +40 Time Area Diagram Total Area (ha) 0.041 <table><tr><th>Time (mins)</th><th>Area</th><th>Time (mins)</th><th>Area</th><th>Time (mins)</th><th>Area</th><th>Time (mins)</th><th>Area</th></tr><tr><th>From: To: (ha)</th><th>From: To: (ha)</th><th>From: To: (ha)</th><th>From: To: (ha)</th><th>From: To: (ha)</th><th>From: To: (ha)</th><th>From: To: (ha)</th><th>From: To: (ha)</th></tr><tr><td>0 4 0.010</td><td>4 8 0.010</td><td>8 12 0.010</td><td>12 16 0.011</td><td></td><td></td><td></td><td></td></tr></table>			Time (mins)	Area	Time (mins)	Area	Time (mins)	Area	Time (mins)	Area	From: To: (ha)	From: To: (ha)	From: To: (ha)	From: To: (ha)	From: To: (ha)	From: To: (ha)	From: To: (ha)	From: To: (ha)	0 4 0.010	4 8 0.010	8 12 0.010	12 16 0.011				
Time (mins)	Area	Time (mins)	Area	Time (mins)	Area	Time (mins)	Area																			
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0 4 0.010	4 8 0.010	8 12 0.010	12 16 0.011																							
©1982-2020 Innovyze																										

KPT Properties		Page 3
19 Lonsdale Avenue Hutton Essex CM13 1NH	Land to the rear of Sunnyside Barn and Flint Barn Barnham	
Date 19/05/2020 10:15 File PLOT2_SWALE_HB_1%+40%_50MM ORIFICE.SRCX	Designed by Paul Checked by	
XP Solutions	Source Control 2020.1	

Model Details

Storage is Online Cover Level (m) 9.200

Swale Structure

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	22.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	3.0
Safety Factor	2.0	Slope (1:X)	200.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	8.600	Cap Infiltration Depth (m)	0.000
Base Width (m)	0.5		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0051-1000-0700-1000	Sump Available	Yes
Design Head (m)	0.700	Diameter (mm)	51
Design Flow (l/s)	1.0	Invert Level (m)	8.500
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	75
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	1.0	Kick-Flo®	0.449	0.8
Flush-Flo™	0.222	1.0	Mean Flow over Head Range	-	0.9

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)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.9	0.600	0.9	1.600	1.4	2.600	1.8	5.000	2.4	7.500	2.9
0.200	1.0	0.800	1.1	1.800	1.5	3.000	1.9	5.500	2.6	8.000	3.0
0.300	1.0	1.000	1.2	2.000	1.6	3.500	2.1	6.000	2.7	8.500	3.1
0.400	0.9	1.200	1.3	2.200	1.7	4.000	2.2	6.500	2.8	9.000	3.2
0.500	0.9	1.400	1.4	2.400	1.7	4.500	2.3	7.000	2.9	9.500	3.3

