

FLOSH MEADOWS, CLEATOR

Drainage Strategy

Issue Date:

09 Dec 2021

Report Number:

1842-DS1

Client:

Lakeland Associates
(Cleator) Ltd

Revision:

C

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Executive Summary

Site Location	The site is located off A5086, Cleator, CA23 3EP (nearest) at NGR 301752E 514082N. The development footprint measures approximately 3.30 Ha, entirely greenfield.
Site Proposals	The site is proposed to be developed with residential units.
Ground Conditions	The site is located in an area underlain by drift deposits consisting of soft - stiff clays. Surface water cannot be discharged utilising infiltration techniques.
Nearest Watercourse	The River Ehen is located 300m to the south of the site boundary beyond third party land. It is not possible to make a direct connection to a water course to dispose of surface water.
Nearest water feature	Within the development site, an historic man-made culverted mill race flows from north to south and outfalls via a culvert below the public highway located to the south. The mill race conveys flows from agricultural land located to the north of the development site. The developer has no legal right to utilise the mill race for disposal of surface water. The legalities of this issue are covered in greater detail within section 5.0.
Nearest Surface Water Sewer.	Adjacent to proposed site entrance, discharging within 40m of the head of the run to a UU combined sewer at A5086. Another surface water sewer is located within Howthorne Fields to the south of Flish Meadows. Neither sewers are suitable for disposal of surface water. The reasons are covered in greater detail within section 3.0.
Nearest Combined Sewer	On site adjacent to southern boundary. Surface water should be discharged to the combined sewer at a restricted rate of 5.0 l/s, providing betterment of up to 95%.
Nearest Foul Water Sewer	Adjacent to proposed site entrance, discharging within 40m to a UU combined sewer at A5086
SUDS	Pipes, flow control, Swale.

The above summary should not be used in isolation and reference should be made the full report which provides a detailed assessment of the risks affecting the development.

1. Introduction

Coast Consulting Engineers have been commissioned by Lakeland Associates (Cleator) Ltd to produce a drainage strategy to accompany a planning application for a proposed development at Flish Meadows, Cleator. This Assessment is reviewed in accordance with the National Planning Policy Framework (NPPF) for Development and Flood Risk.

A flood risk assessment has previously been completed by RWO Associates reference RO/14016.200 Version 3, dated October 2017 and has subsequently been approved. As such, this report does not assess flood risk to the proposed development.

2.1 Site Location

The site location is indicated in Figure 2.1 below.

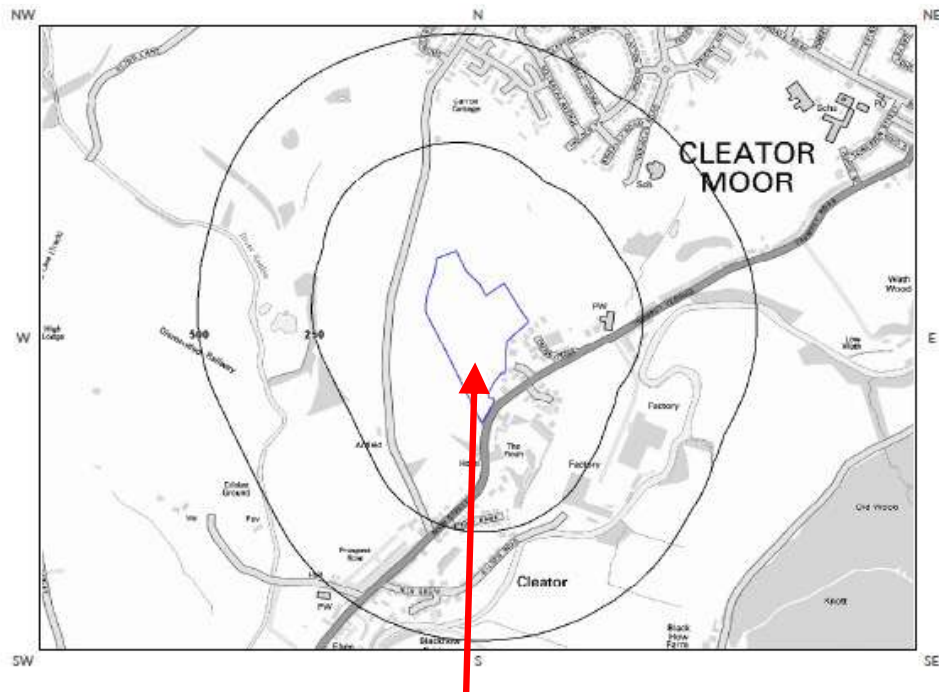


Figure 2.1 – Site Location

2.2 Existing Topography

A topographical survey of the site has been undertaken and is included in Appendix A. The development site generally falls in a southerly direction. Site levels range from approximately 67.50m AOD at the north to 63.00m AOD at the southern extents.

The surrounding area is developed as follows:

North: Agricultural Land
East: Agricultural Land and residential properties
South: Residential properties
West: Agricultural Land

Figure 2.21 below extracted from Google maps shows the existing site.



Figure 2.21 – Satellite image of the existing site.

2.3 Existing sewers and watercourses

A combined sewer is located within the development land, adjacent to the southern boundary line. Foul and surface water sewers are located within Flish Meadows, adjacent to the proposed site entrance. The surface water and foul sewers outfall into a combined sewer approximately 40m downstream of the head of each run. All sewers are owned and maintained by United Utilities Ltd (UU). Figure 2.31 below shows the location of the existing public sewers within the vicinity of the site.

Within the development site, an historic man-made culverted mill race flows from north to south and outfalls via a culvert below the public highway located to the south. The mill race conveys flows from agricultural land located to the north of the development site. Figure 2.32 overleaf shows the location of the natural watercourses within the vicinity of the site. Please also refer to Appendix C for further information on the existing drainage regime.

The River Ehen is located approximately 300m to the south of the site boundary, beyond third party land.

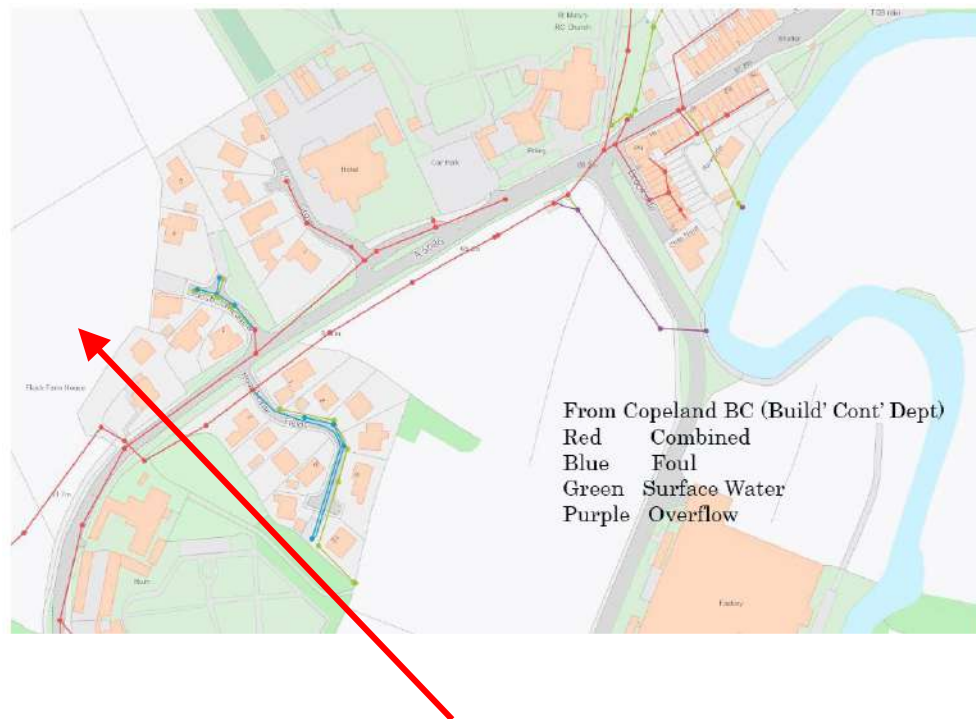


Figure 2.31 – sewers.

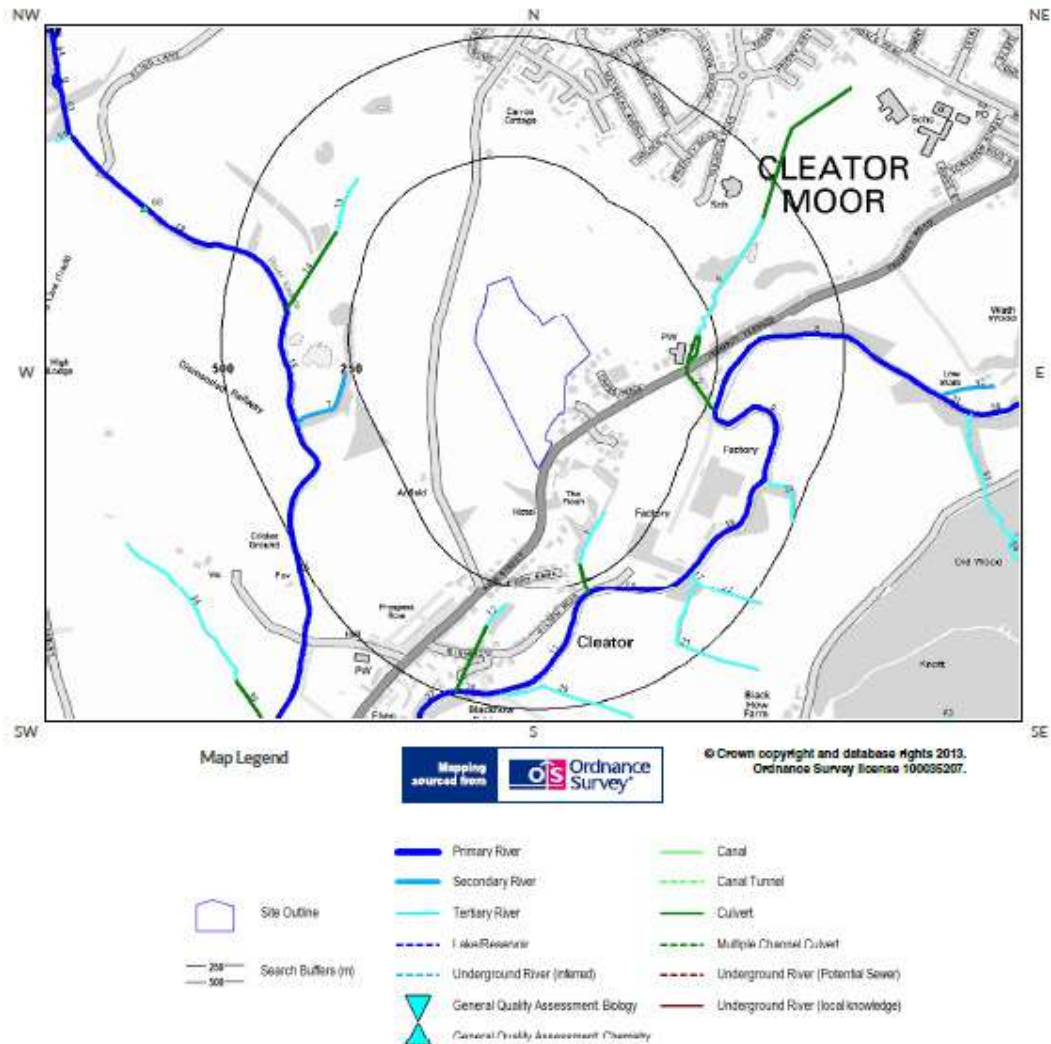


Figure 2.32 – watercourses.

2.4 Geology

A phase 2 intrusive investigation of ground conditions has been completed by Geo Environmental Engineering Ltd, reference 2018-3167 dated 09.08.2018. The report states that the site is underlain by varying ground conditions, largely comprising soft to stiff clays. Ground water was encountered across the site at depths of between 1.50m to 2.90m.

2.5 Development Proposals

The site is proposed to be developed with residential units. A copy of the proposed architectural site layout can be found in Appendix B.

3.2 Proposed Surface Water Drainage

In line with national standards, consideration has been given to the preferred hierarchy for disposal of surface water from the development, as contained in Part H of the Building Regulations. The hierarchy is as follows:

1. By infiltration
2. To watercourse
3. To sewer

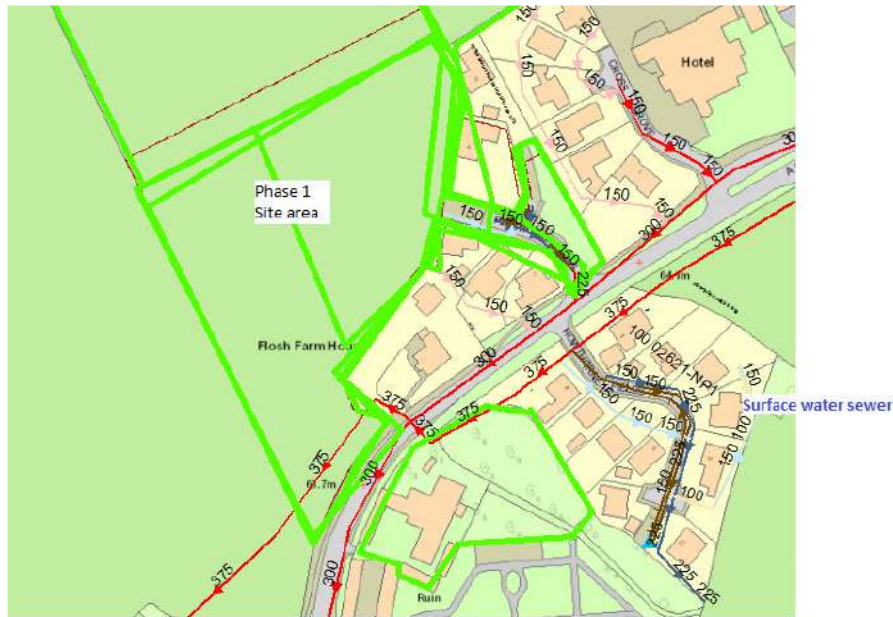
As noted earlier, superficial deposits comprise of soft - stiff clays with a low permeability. It is considered that utilisation of infiltration techniques will not be applicable for the proposed development.

Initially the developer intended to discharge the proposed surface water to the on-site mill race. Following completion of the initial design of the proposed surface water strategy, it was confirmed by the developers' legal representatives and United Utilities Ltd that the developer has no legal right to utilise the mill race for disposal of surface water. The legalities of this issue are covered in section 5.0.

The nearest watercourse to the development is located approximately 300m to the south of the site boundary, beyond third party land. As such, it will not be possible to make a direct connection to a watercourse.

As noted earlier, a surface water sewer is located adjacent to the site entrance at Flish Meadows. The sewer outfalls into a combined sewer approximately 40m downstream of the head of the run. The surface water sewer has limited capacity and was not suggested by United Utilities as an option for discharge of surface water.

Following discussions with United Utilities, two alternative options have been explored to discharge surface water to an existing United Utilities surface water sewer. The sewer is located within a public highway known as Howthorne Fields, opposite Flish Meadows. Due to the constraints of the existing highway levels and utilities/sewers, a gravity connection cannot be made to the Howthorne Fields sewers, as the proposed sewer will not achieve the necessary cover to soffit required by UU. Refer to Appendix E for options A and B.



Due to the issues noted above, it is proposed to discharge surface water to the adjacent combined sewer owned by United Utilities. United Utilities have confirmed a maximum discharge rate of 5 l/s for surface water to the combined sewer (refer to Appendix C).

3.3 SUDS Techniques

In line with National Planning Policy, SUDS techniques will be utilised as part of the design of the surface water network. The applicable techniques and the benefits that they bring to the development are outlined below.

- Flow control: A vortex flow control device will be utilised to restrict flows to the equivalent or betterment of existing site greenfield rate
- Surface water conveyance: Surface water will be conveyed through the development utilising below ground pipes.
- Surface water treatment: Attenuated surface water flows will be stored in a piped network.
- Surface water treatment: Surface water flows will be conveyed through swales prior to discharge to the watercourse.

3.4 SuDS Maintenance

Regular inspection and maintenance is key to the effective operation of SuDS features. Maintenance responsibility for SuDS features proposed as part of the development is to be placed with a responsible organisation and in this case a nominated management and maintenance company.

Removal of debris and any settled silt from SuDS features is the key maintenance requirement for the continued effective operation of the SuDS features. Most of the

maintenance activities can be undertaken as part of regular landscape maintenance activities.

3.5 Post Development Discharge Rate

Proposed surface water discharge rates will be limited from the development to the equivalent of the pre-development Qbar green field run off rate, for all storms up to and including 1 in 100 year return period rainfall event + 40% increase in rainfall intensity to account for the predicted effects of climate change.

In line with national and local standards the greenfield run off rate for 3.30 Ha of developed land has been calculated using the Institute of Hydrology (IH) Report 124 Flood Estimation for Small Catchments (1994) method, with flow rate linearly interpolated due to site being smaller than 50Ha. HR Wallingford Greenfield runoff rate estimation for sites tool, available at <https://www.uksuds.com> has been used to calculate Qbar run off rate at 32.02 l/sec. An assessment of the allowable discharge rate is outlined below in figure 4.1.

Greenfield runoff rates		
	Default	Edited
QBAR (l/s):	32.02	32.02
1 in 1 year (l/s):	27.85	27.85
1 in 30 years (l/s):	54.43	54.43
1 in 100 year (l/s):	66.59	66.59
1 in 200 years (l/s):	75.88	75.88

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

Figure 4.1 Greenfield run off rates.

Please refer to Appendix D for further information on green field run off rates.

Note – the ‘developed land’ includes for all phases of the proposed development.

The approved RWO Associates FRA and Drainage strategy stipulates a more stringent discharge rate of 5 l/s for all events up to and including the 100 year event, with a 40% allowance for climate change.

Following discussions with United Utilities, a discharge of rate of 5 l/s has been agreed to the adjacent surface water sewer. This provides significant betterment compared to the greenfield rate of discharge (32.02 l/s).

3.6 Surface Water Attenuation

Surface water will be restricted for all events up to and including the 100 year event with a 40% allowance for climate change and a 10% allowance for urban creep. Attenuated flows will be contained on site within a designated storage system. Please refer to the calculations and drainage strategy contained within Appendix E.

Note – the allowable discharge rate and drainage calculations include for all phases of the development.

By restricting the peak rate of discharge from the site Q_{bar} to the watercourse for all events up to and including the 100-year event, **the proposed development will provide betterment from the existing regime in line with the table below.**

Return period	greenfield rate	Proposed	Betterment
Q_{bar}	32.02 l/s	5.0 l/s	85%
30	54.43 l/s	5.0 l/s	91%
100	66.59 l/s	5.0 l/s	93%
100+40%	93.22 l/s	5.0 l/s	95%

4. Foul Water Disposal

4.1 Proposed Foul Drainage

It is proposed to discharge a portion of the foul water to the adjacent UU combined sewer and a portion to the existing foul sewer in Flosch Meadows, both via gravity connections.

5. Legal statement on the use of Mill Race for SW disposal, provided by Baines Wilson LLP

Annex 4

Re: Flish Meadows Drainage Strategy



I am asked to consider the ability of the current owner of the land known as Flish Meadows and registered at the Land Registry with title number CU185362 (the "Property") to discharge surface water from a new residential development (to be constructed) to an existing, on site, mill stream. The surface water will subsequently leave the Property and cross third party land in a number of separate ownerships to eventually discharge into the River Ehen.

The nature and description of the existing infrastructure is discussed at paragraph 2.3 of the Report and therefore I do not propose to repeat here.

Typically, the necessary rights would arise in one of 3 distinct ways:

- Option 1. By express rights.
- Option 2. By a right that has arisen by prescription.
- Option 3. As a result of riparian rights.

In summary (although discussed in greater detail below) I conclude as follows; the Owner does not benefit from an express right, a right by prescription to discharge in the manner the Owner desires has not been established and the Owner does not benefit from riparian rights.

Option 1

The most obvious, and from a legal perspective best, option would be an express right to enable the discharge. I have studied the registered title to the Property (title number CU185362) and such a right is not registered for the benefit of the Property. In addition the owner has confirmed they are unaware of any deeds, licences or other consents that may appertain to the proposed or existing discharge. It is therefore, concluded that no express rights can be evidenced and option 1 must, therefore, be disregarded.

Option 2

With regard to option 2, there are 3 alternative options under which a right by prescription may have arisen to consider; the common law, the fiction of lost modern grant and the rules under the Prescription Act 1832. In this instance I believe the pertinent method to consider is the fiction of lost modern grant.

For a prescriptive right to be substantiated under the doctrine of lost modern grant a number of 'hurdles' must be overcome. Paraphrasing those:

- a. The claimed right must have been in use (as of right) for a period in excess of 20 years (see *Tehidy Minerals Ltd v Norman* ([1971] 2 Q.B. 528 at 546);
- b. The dominant owner must have 'acquiesced' to the rights existence (*Liverpool Corp v Coghill* [1918] 1 Ch. 307).

I am informed by the owner that the current infrastructure, as existing, has been in situ for a significant period of time (and likely beyond 20 years). I take that as fact.

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For a right by prescription to exist it must be evidenced that the 'grantor' and 'grantee' are able to competently grant and receive the right (*Daniel v North (1809) 11 East 372*). To establish that a right has indeed arisen it would therefore be necessary to consider the ownership of all third party land-owners and determine whether, during the appropriate period, they had the adequate capacity for the easement to be granted. I have seen no evidence that the third party land owners have the necessary competency and therefore consider that the Owner would fail on this ground.

For the right by prescription to be established it must also be exercised 'as of right', quoting Gale on Easements at para 4-114

"As of right" requires one to look at the quality and character of the user and to ask whether the user is of a kind which would be enjoyed by a person having such a right. The user must be such as to convey the impression that such a right is asserted; it is not relevant to inquire into the subjective beliefs of the persons carrying on the user and, in particular, it is not necessary for such persons to show that they believed that they already possessed the right claimed. If a right is to be claimed by prescription, the persons claiming that right

"must by their conduct bring home to the landowner that a right is being asserted against him, so that the landowner has to choose between warning the trespassers off or eventually finding that they have established the asserted right against him".

I believe that this is a difficult 'hurdle' for the owner to overcome and suggest that the nature of the claimed prescriptive right is such that the dominant owner has not had the opportunity to acquiesce to the discharge as they are likely unaware that it exists. It is relevant to add that the burden of proving that the prescriptive easement exists is placed upon the party claiming it. Therefore, the Owner has again failed to establish that he has enjoyed the use of any existing water discharge (if any) as of right.

Whilst my conclusion is that a right by prescription is unlikely to be established, for the purpose of this exercise it is worth considering the position should the owner be able to do so.

A right established by prescription is necessarily bookended by its historic use (which gave rise to the right). The Owner proposes to significantly alter the Property by undertaking a residential development. This triggers the well-worn question as to whether that would give rise to an excessive use of the prescriptive easement established from historic use (notwithstanding that I do not consider one has been established).

The Court of Appeal considered this very point in *McAdams Homes Ltd v Robinson [2004] EWCA Civ 214; [2004] 3 E.G.L.R. 93*. The Court of Appeal held that the question of excessive user should be determined by asking two questions: first, whether the alteration in the dominant tenement involved a "radical change in character" or a "change in identity" and, secondly, whether the alteration would result in a substantial increase or alteration in the burden on the servient land.

It would seem clear from the *McAdams* case that the change from agricultural to residential as proposed will be a radical change in character. In determining whether the alteration would result in an alteration to the burden on the servient land, I am informed that currently surface water from the whole of the Property does not drain to the mill stream. It is a factual question as to whether attenuation features on site can mitigate any additional burden on the servient land. However, I also note that the prescriptive right can only benefit the land it currently

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benefits. To extend that to additional land would be, by definition, excessive and therefore fail.

In summary I do not believe that a right by prescription can be established. Furthermore, should the Owner successfully do so I believe the right would be contravened by utilising it for the benefit of a residential development on the Property. It is also sensible to comment that reliance on prescriptive rights is unacceptable to the current proposed funder of the scheme (this has been confirmed by their own independently instructed solicitor).

Option 3

In connection with riparian rights the following extract from para 6-01 of Gale on Easements is pertinent to quote;

"Rights in respect of water can be divided into natural rights and acquired rights. Watercourses can be divided into natural watercourses and artificial watercourses. It is possible to have natural rights in respect of natural watercourses but not in respect of artificial watercourses"

It is therefore essential to establish the nature and type of the watercourse that passes through the Property. I refer to the description given at paragraphs 2.3 of this report which clearly identifies this as a mill stream. That makes it clear that the watercourse was created to service a mill. The case of *Burrows v Lang [1901] 2 Ch. 502* provides confirmation that the Courts would consider a mill stream to be a temporary artificial watercourse. As such no riparian rights are conferred upon the Owner and any right may only be acquired by prescription (which we have established above is not viable).

I therefore conclude that the Owner does not have the benefit of riparian rights.

Finally, the Owners has asked that I consider the potential for the Land Drainage Acts to confer the appropriate rights upon him to enable the discharge to be used. The Land Drainage Acts give powers to the relevant authorities and not the landowner. I see no application of those 'Acts' to these circumstances.

28 May 2021

Baines Wilson LLP

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6. References

The following reference documents have been used in the preparation of this report.

- National Planning Policy Framework 2012.
- PPG 2014.
- Environment Agency online flood maps.
- Sewers for Adoption 6th Edition - WRC plc, April 2006.
- Building Regulations Document H 2010.
- Improving the Flood Performance of New Buildings – Defra.
- Rainfall runoff management for developments SC030219 – Defra.
- Susdrain.org
- The SuDS Manual CIRIA C753.

Appendices

Appendix A



UTILITY KEY

LINE TYPES		
BT BELOW GROUND		WATER BELOW GROUND
BT ABOVE GROUND		WATER ABOVE GROUND
BT ASSUMED ROUTE		WATER ASSUMED ROUTE
CATV BELOW GROUND		UNION BELOW GROUND
CATV ABOVE GROUND		UNION ABOVE GROUND
CATV ASSUMED ROUTE		UPR BELOW GROUND
COMB BELOW GROUND		COMBINED WATER SEWER
COMB ABOVE GROUND		ASSUMED COMBINED WATER SEWER ROUTE
COMB ASSUMED ROUTE		SEWER SINKER
GAS BELOW GROUND		ASSUMED P-PIPE WATER SEWER ROUTE
GAS ABOVE GROUND		STORM WATER SEWER
GAS ASSUMED ROUTE		ASSUMED STORM WATER SEWER ROUTE
ELECTRIC BELOW GROUND		REINSTATEMENT
ELECTRIC ABOVE GROUND		SURVEY SCAFFOLD
ELECTRIC ASSUMED ROUTE		

[illegible]

NOTES

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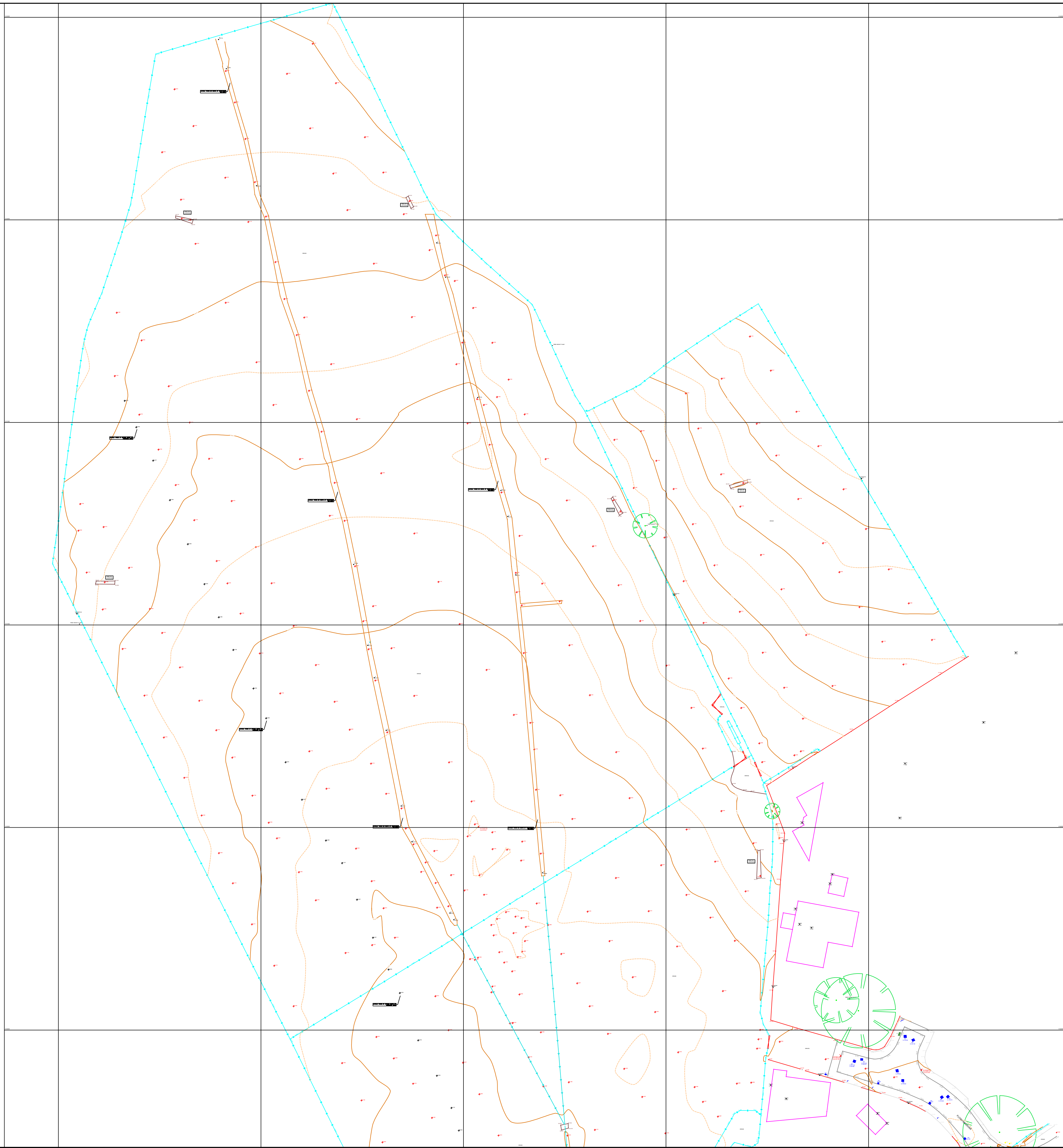


RICHARD MULHOLLAND

AND AT FLOSH MEADOWS
CLEATOR
CUMBRIA

TOPOGRAPHICAL SURVEY

PROJECT No.	SHEET No.	REV
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DISCLAIMER

Unless otherwise stated, all scenarios shown on this plan have been surveyed using approved detectors and the connections and orientations mentioned. First noticed, unless otherwise stated, is correct.

No guarantee is made that the information shown on this plan is a true and accurate reflection of all underground features or the contents of the property. It is not intended that the depth accuracy for the underground utilities should be $\pm 15\%$ of depth.

Utilities listed using GPR technology show depths approximately from ground level to the top of the utility. Utilities listed using other methods show depths approximately from the top of the utility to the bottom of the utility.

Electricity and gas are shown in red. Water is shown in blue. Sewerage is shown in green. The contents of the property, including pipes and drains, are shown in black. Underground features shown in grey are approximately the level of the level.

Where services are shown as 'Taken From Records' on the drawing we are not liable for any loss that may arise due to a lack of accuracy in that information.

Due to B7C's policy we are not permitted to take this inspection chamber cover off.

Reference should be made to the methodology used and as detailed within the latest edition of the Standards Procedures for Utility Location by the Institute of Non-Destructive Testing.

It is important to remember that all excavations are to be carried out in accordance with HSE V14 (Avoiding Danger from Underground Services).

Plan accuracies of the order of $\pm 10\%$ may be achieved but the figure will depend on the depth of the service below ground and the nature and position of the service in close proximity, separation may be possible. Scouring of free-standing pipes may be limited.

Existing recorded information showing underground services is not comprehensive and difficult to access. It should be regarded as only a guide to the location of services.

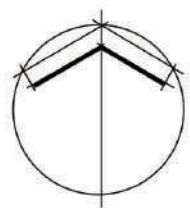
NOTES

C S A	SURVEY EXTENDED DRAINAGE SURVEYED INITIAL RELEASE	NP NP NP	NG NG NG
REV	AMENDMENT		DRAWN CHECKED

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TOPOGRAPHICAL SURVEY			
DRAWING TITLE			
1:500 @ A1	DATE 18.03.14	OSTN02	
APPROVED BY NP	PREPARED BY NP	CHECKED BY NG	
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Appendix B



0 50 100m
Scale ~ 1:1,250 at A3 page size.
Do not scale off this drawing.



Existing mature hedgerows provide substantial screening of consented and proposed development from Jacktrees Road. Additional planting up of small gaps as part of consented scheme provides further screening, creating a continuous band of trees between road and site.

New hedgerow along fenceline created as part of consented housing development to support landscape character objectives and to provide screening from Jacktrees Road. Additional planting to further increase screening of proposed housing.

Trees and hedges within proposed housing scheme to soften its appearance and create a green environment for residents.

Tree planting as part of consented scheme, supplemented by additional tree and hedge planting to create a green corridor.

Field access and turning head.

Shared surface

Tree and hedgerow planting within the site softens and frames new housing

Shared surfaces

Tree planting to frame proposed housing and soften rooflines.

New hedgerow to be planted as part of consented housing development, with further proposed tree planting alongside.

Cemetery Garden

Cross Grove

Flosch Meadows

Flosch Farm

A 5086

R 03	15/09/2017	further refinements to shared surface
R 02	12/09/2017	shared surface corrected
R 01	05.09.2017	minor changes to planting and notes
R 00	05.09.2017	original drawing
revision	date	notes

drawing number

01

drawing name

Illustrative layout

project

Housing at SR12A, Flosch Meadows

client

Mr and Mrs Mulholland
Flosch Farm, Cleator

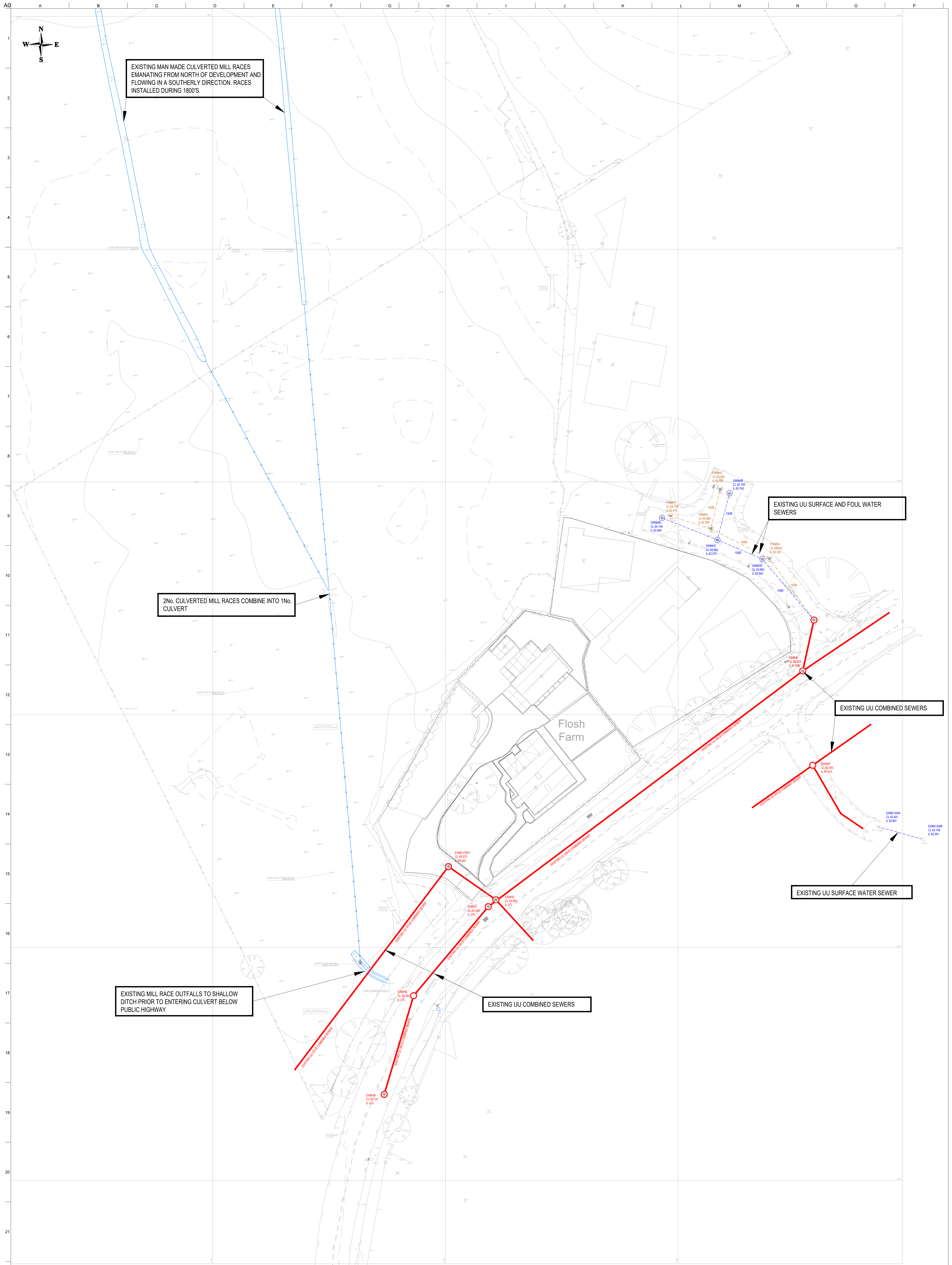
Key

- | | | | |
|--|---|--|---|
| | Existing vegetation | | Proposed houses (ridge lines shown) |
| | Planting included in consented housing development proposals | | Existing, consented and proposed access roads. |
| | Proposed planting | | Consented and proposed shared surfaces. |
| | Existing and consented houses and other buildings. (no ridge lines shown) | | No-build zone in consented housing development. |

produced for:
Lakeland Associates (Cleator) Ltd, The Flosch Farm House, Cleator, Cumbria. CA23 3DT
Directors: RW & E Mulholland. Registered in England and Wales no. 3184247. VAT no. 206997278
This illustration is based on a layout provided by Lakeland Associates (Cleator) Ltd.

Eden Environment Ltd
www.edenenvironment.com

Appendix C



Richard Hall

From: Hunt, Timothy
Sent: 06 September 2021 16:07
To: Richard Hall
Subject: S104: Floss Meadows, Cleator Moor (Surface Water) 4200011332

Richard,

Under the circumstances we will accept a connection of surface water to the combined sewer to the south of the site at a rate not exceeding 5 l/s

This will mean that you will need to increase the storage volume of the storm tank slightly

Thanks Tim



Tim Hunt
Developer Services Engineer (North Area)
Developer Services & Metering
Customer Services
unitedutilities.com

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From: Richard Hall
Sent: 02 September 2021 15:59
To: Hunt, Timothy
Subject: Floss Meadows - Surface Water

EXTERNAL EMAIL This email originated outside of the organisation. Do not click links or open attachments unless you recognise the sender and know the content is safe.

Hi Tim,

Further to our conversation yesterday, please refer to the enclosed plans and summary below.

As discussed, there is a 'watercourse' running through the site. We had initially intended to discharge surface water from the development to the watercourse. This would have satisfied the planning hierarchy for disposal of surface water as the ground conditions are unsuitable for the use of infiltration techniques.

During the application for funding arrangements, it was discovered that the developer had no legal right to discharge to the 'watercourse', partly due to the fact that the watercourse is in fact man made and was constructed as a Mill Race, to feed a downstream mill wheel. This has been agreed as correct between legal teams representing the developer, Homes England, United Utilities and the Local Authority.

UU have previously confirmed that surface water can discharge to the existing sewer located within the extents of Howthorne Fields. Coast have reviewed various potential proposed routes for offsite drainage. The only route that appeared feasible is as shown on the enclosed plan. The route presents difficulties with buildability. Due to the

depths and locations of existing sewers and utility apparatus, the proposed sewer becomes very shallow with cover to pipes as shallow as 0.625m. Both UU and the LA highways have agreed that this solution is acceptable, providing that a protection slab is installed in particularly shallow locations. Coasts view is that this will present a maintenance issue for the highway authority as a shallow hard spot will be situated at a depth of 0.325m below finished ground level and it is highly likely that the flexible surfacing will crack above the slab, presenting an opportunity for ingress of surface water and spalling of the road surface in due course.

In addition to the issues above, the depth of the proposed sewers are likely to lead to clashes with existing gas, water and electricity mains. The proposed depth of 0.625m to soffit and 0.850m to underside of the proposed pipe will be situated within the zone of the existing utility services, which are typically 0.60m – 0.90m below finished ground level. Again this will cause significant issues with buildability and may make the proposals unfeasible. The enclosed plans identify the location of existing utilities. We have requested water and electricity plans to further demonstrate the issue.

We have discussed the use of a surface water pumping station with the LLFA and they deem pumping station to be lower in the planning hierarchy than a connection to a combined sewer.

We believe that the only available option to the developer is to form a connection to the existing combined sewer located within the developers land at the southern boundary. We would be grateful if you could review this e mail and information and advise us accordingly.

The LLFA are satisfied that a combined connection is satisfactory given the work completed to date and subject to confirmation from UU of its acceptability.

If you have any queries, please let me know.

Kind regards,

Richard Hall



Consulting Engineers

Civil : Structural : Geotechnical

E : rn@coastconsult.co.uk | www.coastconsult.co.uk

North East : 7 Silverton Court, Northumberland Business Park, NE23 7RY.

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Appendix D

Calculated by:	richard hall
Site name:	Flosh Meadows
Site location:	Cleator

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

Site Details

Latitude:	54.51164° N
Longitude:	3.51942° W
Reference:	2032601581
Date:	May 28 2021 13:23

Runoff estimation approach**Site characteristics**

Total site area (ha):	3.30
-----------------------	-----------------------------------

Methodology

Q _{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics

	Default	Edited
SAAR (mm):	1271	1271
Hydrological region:	10	10
Growth curve factor 1 year:	0.87	0.87
Growth curve factor 30 years:	1.7	1.7
Growth curve factor 100 years:	2.08	2.08
Growth curve factor 200 years:	2.37	2.37

Notes**(1) Is $Q_{BAR} < 2.0$ l/s/ha?**

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is $SPR/SPRHOST \leq 0.3$?

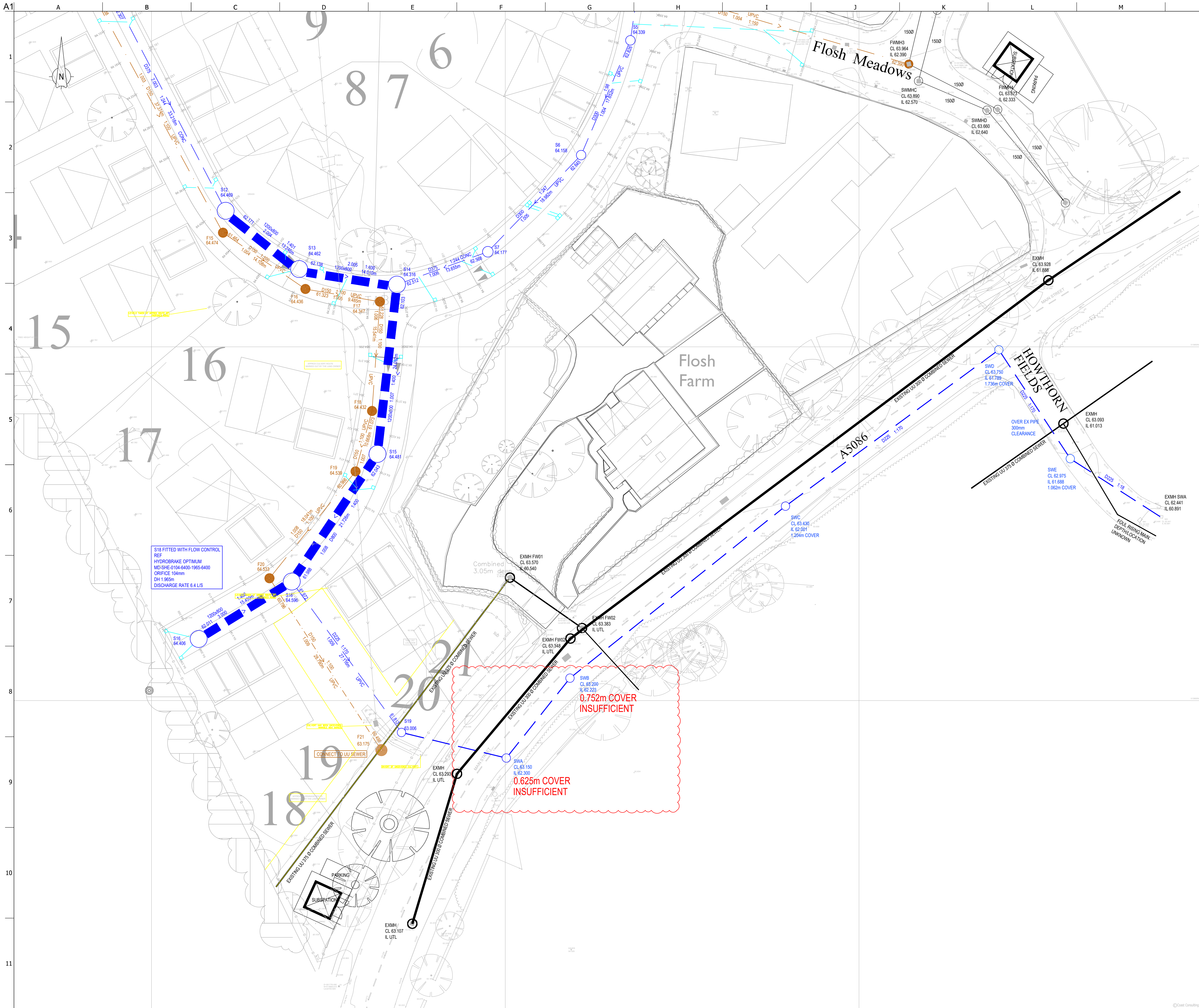
Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

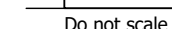
Greenfield runoff rates

	Default	Edited
Q _{BAR} (l/s):	32.02	32.02
1 in 1 year (l/s):	27.85	27.85
1 in 30 years (l/s):	54.43	54.43
1 in 100 year (l/s):	66.59	66.59
1 in 200 years (l/s):	75.88	75.88

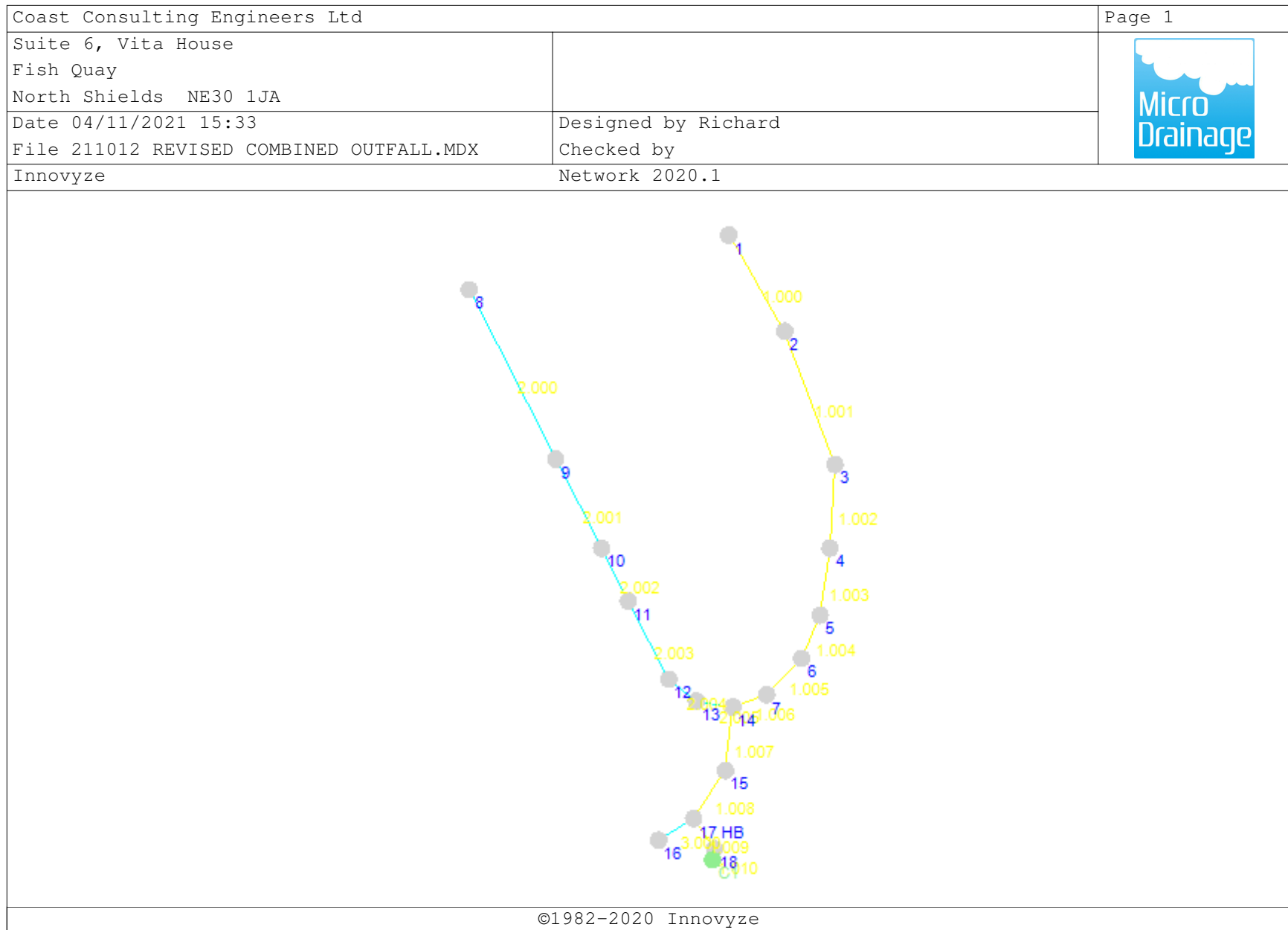
This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

Appendix E





IN ADDITION, ON SITE LEVELS WILL NEED TO BE RAISED TO ACHIEVE THE MINIMUM REQUIRED DEPTH OF COVER AS SET OUT BY UU GUIDANCE.



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Date 12/10/2021 File 211012 REVISED COMBINED...	Designed by RH Checked by PL	
Innovyze	Network 2020.1	

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for 180518 SW1.SWS

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
1.000	41.957	0.420	99.9	0.049	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	53.639	1.516	35.4	0.083	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	31.512	0.770	40.9	0.096	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.003	25.483	0.255	100.0	0.104	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.004	17.652	0.177	100.0	0.035	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.005	18.982	0.077	245.0	0.028	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.006	13.655	0.192	71.1	0.029	0.00	0.0	0.600	o	375	Pipe/Conduit	
2.000	71.706	0.718	99.9	0.095	5.00	0.0	0.600	o	150	Pipe/Conduit	
2.001	37.730	0.314	120.2	0.195	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.002	22.253	0.091	245.0	0.078	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.003	33.218	0.136	245.0	0.065	0.00	0.0	0.600	o	375	Pipe/Conduit	
2.004	13.246	0.033	400.0	0.062	0.00	0.0	0.600	o	825	Pipe/Conduit	
2.005	14.105	0.035	400.0	0.042	0.00	0.0	0.600	o	825	Pipe/Conduit	
1.007	24.092	0.048	501.9	0.021	0.00	0.0	0.600	o	825	Pipe/Conduit	
1.008	21.726	0.041	529.9	0.029	0.00	0.0	0.600	o	825	Pipe/Conduit	
3.000	15.459	0.039	400.0	0.070	5.00	0.0	0.600	o	825	Pipe/Conduit	
1.009	13.858	0.082	170.0	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)
1.000	0.00	5.70	64.855	0.049	0.0	0.0	0.0	1.01	17.8	0.0
1.001	0.00	6.10	64.360	0.132	0.0	0.0	0.0	2.21	87.7	0.0
1.002	0.00	6.36	62.844	0.228	0.0	0.0	0.0	2.05	81.5	0.0
1.003	0.00	6.68	62.074	0.332	0.0	0.0	0.0	1.31	52.0	0.0
1.004	0.00	6.87	61.744	0.367	0.0	0.0	0.0	1.57	111.1	0.0
1.005	0.00	7.19	61.568	0.395	0.0	0.0	0.0	1.00	70.7	0.0
1.006	0.00	7.29	61.415	0.424	0.0	0.0	0.0	2.15	237.6	0.0
2.000	0.00	6.19	62.776	0.095	0.0	0.0	0.0	1.01	17.8	0.0
2.001	0.00	6.72	61.983	0.290	0.0	0.0	0.0	1.19	47.4	0.0
2.002	0.00	7.09	61.594	0.368	0.0	0.0	0.0	1.00	70.7	0.0
2.003	0.00	7.57	61.428	0.433	0.0	0.0	0.0	1.15	127.4	0.0
2.004	0.00	7.72	60.843	0.495	0.0	0.0	0.0	1.48	790.2	0.0
2.005	0.00	7.88	60.809	0.537	0.0	0.0	0.0	1.48	790.2	0.0
1.007	0.00	8.18	60.773	0.982	0.0	0.0	0.0	1.32	704.7	0.0
1.008	0.00	8.46	60.725	1.011	0.0	0.0	0.0	1.28	685.7	0.0
3.000	0.00	5.17	61.323	0.070	0.0	0.0	0.0	1.48	790.2	0.0
1.009	0.00	8.69	60.684	1.081	0.0	0.0	0.0	1.00	39.8	0.0

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STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for 180518 SW1.SWS

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
1.010	4.168	0.025	170.0	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)
1.010	0.00	8.76	60.603	1.081	0.0	0.0	0.0	1.00	39.8	0.0

Free Flowing Outfall Details for 180518 SW1.SWS

Outfall Pipe Number	Outfall C. Level Name	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.010	C1	63.006	60.578	60.578	1350

Simulation Criteria for 180518 SW1.SWS

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	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	13
Number of Online Controls	3	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)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Storm Duration (mins)	30
Ratio R	0.223		

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Online Controls for 180518 SW1.SWS

Hydro-Brake® Optimum Manhole: 3, DS/PN: 1.002, Volume (m³): 5.0

Unit Reference MD-SHE-0075-3400-2049-3400
Design Head (m) 2.049
Design Flow (l/s) 3.4
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 75
Invert Level (m) 62.844
Minimum Outlet Pipe Diameter (mm) 100
Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.049	3.4
Flush-Flo™	0.327	2.5
Kick-Flo®	0.667	2.0
Mean Flow over Head Range	-	2.6

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	2.0	1.200	2.7	3.000	4.1	7.000	6.0
0.200	2.4	1.400	2.8	3.500	4.4	7.500	6.2
0.300	2.5	1.600	3.0	4.000	4.6	8.000	6.4
0.400	2.5	1.800	3.2	4.500	4.9	8.500	6.6
0.500	2.4	2.000	3.4	5.000	5.2	9.000	6.8
0.600	2.3	2.200	3.5	5.500	5.4	9.500	7.0
0.800	2.2	2.400	3.7	6.000	5.6		
1.000	2.4	2.600	3.8	6.500	5.8		

Hydro-Brake® Optimum Manhole: 10, DS/PN: 2.002, Volume (m³): 3.8

Unit Reference MD-SHE-0075-3100-1610-3100
Design Head (m) 1.610
Design Flow (l/s) 3.1
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 75
Invert Level (m) 61.594
Minimum Outlet Pipe Diameter (mm) 100
Suggested Manhole Diameter (mm) 1200

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Suite 6, Vita House Fish Quay North Shields NE30 1JA		FLOSH MEADOWS CLEATOR																																																																										
Date 12/10/2021 File 211012 REVISED COMBINED...		Designed by RH Checked by PL																																																																										
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<u>Hydro-Brake® Optimum Manhole: 17 HB, DS/PN: 1.009, Volume (m³): 30.3</u>																																																																												
<table><tr><td>Unit Reference</td><td>MD-SHE-0089-5000-2299-5000</td></tr><tr><td>Design Head (m)</td><td>2.299</td></tr><tr><td>Design Flow (l/s)</td><td>5.0</td></tr><tr><td>Flush-Flo™</td><td>Calculated</td></tr><tr><td>Objective</td><td>Minimise upstream storage</td></tr><tr><td>Application</td><td>Surface</td></tr><tr><td>Sump Available</td><td>Yes</td></tr><tr><td>Diameter (mm)</td><td>89</td></tr><tr><td>Invert Level (m)</td><td>60.684</td></tr><tr><td>Minimum Outlet Pipe Diameter (mm)</td><td>150</td></tr><tr><td>Suggested Manhole Diameter (mm)</td><td>1200</td></tr></table>					Unit Reference	MD-SHE-0089-5000-2299-5000	Design Head (m)	2.299	Design Flow (l/s)	5.0	Flush-Flo™	Calculated	Objective	Minimise upstream storage	Application	Surface	Sump Available	Yes	Diameter (mm)	89	Invert Level (m)	60.684	Minimum Outlet Pipe Diameter (mm)	150	Suggested Manhole Diameter (mm)	1200																																																		
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<table><tr><th>Control Points</th><th>Head (m)</th><th>Flow (l/s)</th></tr><tr><td>Design Point (Calculated)</td><td>2.299</td><td>5.0</td></tr><tr><td>Flush-Flo™</td><td>0.384</td><td>3.8</td></tr><tr><td>Kick-Flo®</td><td>0.790</td><td>3.1</td></tr><tr><td>Mean Flow over Head Range</td><td>-</td><td>3.8</td></tr></table>					Control Points	Head (m)	Flow (l/s)	Design Point (Calculated)	2.299	5.0	Flush-Flo™	0.384	3.8	Kick-Flo®	0.790	3.1	Mean Flow over Head Range	-	3.8																																																									
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Mean Flow over Head Range	-	3.8																																																																										
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><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th></tr><tr><td>0.100</td><td>2.7</td><td>0.300</td><td>3.8</td><td>0.500</td><td>3.8</td><td>0.800</td><td>3.1</td></tr><tr><td>0.200</td><td>3.6</td><td>0.400</td><td>3.8</td><td>0.600</td><td>3.7</td><td>1.000</td><td>3.4</td></tr></table>					Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	0.100	2.7	0.300	3.8	0.500	3.8	0.800	3.1	0.200	3.6	0.400	3.8	0.600	3.7	1.000	3.4																																																
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Innovyze	Network 2020.1																																																																									
Storage Structures for 180518 SW1.SWS Cellular Storage Manhole: 1, DS/PN: 1.000 Invert Level (m) 63.655 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><thead><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr></thead><tbody><tr><td>0.000</td><td>51.8</td><td>0.0</td><td>0.521</td><td>0.0</td><td>0.0</td></tr><tr><td>0.520</td><td>51.8</td><td>0.0</td><td></td><td></td><td></td></tr></tbody></table> Cellular Storage Manhole: 2, DS/PN: 1.001 Invert Level (m) 64.360 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><thead><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr></thead><tbody><tr><td>0.000</td><td>207.0</td><td>0.0</td><td>0.521</td><td>0.0</td><td>0.0</td></tr><tr><td>0.520</td><td>207.0</td><td>0.0</td><td></td><td></td><td></td></tr></tbody></table> Cellular Storage Manhole: 4, DS/PN: 1.003 Invert Level (m) 62.074 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><thead><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr></thead><tbody><tr><td>0.000</td><td>129.5</td><td>0.0</td><td>0.521</td><td>0.0</td><td>0.0</td></tr><tr><td>0.520</td><td>129.5</td><td>0.0</td><td></td><td></td><td></td></tr></tbody></table> Cellular Storage Manhole: 6, DS/PN: 1.005 Invert Level (m) 61.568 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><thead><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr></thead><tbody><tr><td>0.000</td><td>25.9</td><td>0.0</td><td>0.521</td><td>0.0</td><td>0.0</td></tr><tr><td>0.520</td><td>25.9</td><td>0.0</td><td></td><td></td><td></td></tr></tbody></table> Cellular Storage Manhole: 7, DS/PN: 1.006 Invert Level (m) 61.415 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000			Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	51.8	0.0	0.521	0.0	0.0	0.520	51.8	0.0				Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	207.0	0.0	0.521	0.0	0.0	0.520	207.0	0.0				Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	129.5	0.0	0.521	0.0	0.0	0.520	129.5	0.0				Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	25.9	0.0	0.521	0.0	0.0	0.520	25.9	0.0			
Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)																																																																					
0.000	51.8	0.0	0.521	0.0	0.0																																																																					
0.520	51.8	0.0																																																																								
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0.000	207.0	0.0	0.521	0.0	0.0																																																																					
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0.000	129.5	0.0	0.521	0.0	0.0																																																																					
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<u>Cellular Storage Manhole: 7, DS/PN: 1.006</u> <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>25.9</td><td>0.0</td><td>0.521</td><td>0.0</td><td>0.0</td></tr><tr><td>0.520</td><td>25.9</td><td>0.0</td><td></td><td></td><td></td></tr></table> <u>Cellular Storage Manhole: 8, DS/PN: 2.000</u> Invert Level (m) 62.776 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>77.7</td><td>0.0</td><td>0.521</td><td>0.0</td><td>0.0</td></tr><tr><td>0.520</td><td>77.7</td><td>0.0</td><td></td><td></td><td></td></tr></table> <u>Cellular Storage Manhole: 9, DS/PN: 2.001</u> Invert Level (m) 61.983 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>388.5</td><td>0.0</td><td>0.521</td><td>0.0</td><td>0.0</td></tr><tr><td>0.520</td><td>388.5</td><td>0.0</td><td></td><td></td><td></td></tr></table> <u>Cellular Storage Manhole: 10, DS/PN: 2.002</u> Invert Level (m) 61.594 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>103.6</td><td>0.0</td><td>0.521</td><td>0.0</td><td>0.0</td></tr><tr><td>0.520</td><td>103.6</td><td>0.0</td><td></td><td></td><td></td></tr></table> <u>Cellular Storage Manhole: 11, DS/PN: 2.003</u> Invert Level (m) 61.428 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>181.4</td><td>0.0</td><td>0.521</td><td>0.0</td><td>0.0</td></tr><tr><td>0.520</td><td>181.4</td><td>0.0</td><td></td><td></td><td></td></tr></table>						Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	25.9	0.0	0.521	0.0	0.0	0.520	25.9	0.0				Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	77.7	0.0	0.521	0.0	0.0	0.520	77.7	0.0				Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	388.5	0.0	0.521	0.0	0.0	0.520	388.5	0.0				Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	103.6	0.0	0.521	0.0	0.0	0.520	103.6	0.0				Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	181.4	0.0	0.521	0.0	0.0	0.520	181.4	0.0			
Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)																																																																																										
0.000	25.9	0.0	0.521	0.0	0.0																																																																																										
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0.000	388.5	0.0	0.521	0.0	0.0																																																																																										
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Suite 6, Vita House Fish Quay North Shields NE30 1JA	FLOSH MEADOWS CLEATOR																																																																									
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Innovyze	Network 2020.1																																																																									
Cellular Storage Manhole: 12, DS/PN: 2.004 Invert Level (m) 60.868 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>129.5</td><td>0.0</td><td>0.521</td><td>0.0</td><td>0.0</td></tr><tr><td>0.520</td><td>129.5</td><td>0.0</td><td></td><td></td><td></td></tr></table> Cellular Storage Manhole: 15, DS/PN: 1.008 Invert Level (m) 60.783 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>25.9</td><td>0.0</td><td>0.521</td><td>0.0</td><td>0.0</td></tr><tr><td>0.520</td><td>25.9</td><td>0.0</td><td></td><td></td><td></td></tr></table> Cellular Storage Manhole: 16, DS/PN: 3.000 Invert Level (m) 61.323 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>51.8</td><td>0.0</td><td>0.521</td><td>0.0</td><td>0.0</td></tr><tr><td>0.520</td><td>51.8</td><td>0.0</td><td></td><td></td><td></td></tr></table> Cellular Storage Manhole: 17 HB, DS/PN: 1.009 Invert Level (m) 60.684 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>77.7</td><td>0.0</td><td>0.521</td><td>0.0</td><td>0.0</td></tr><tr><td>0.520</td><td>77.7</td><td>0.0</td><td></td><td></td><td></td></tr></table>			Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	129.5	0.0	0.521	0.0	0.0	0.520	129.5	0.0				Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	25.9	0.0	0.521	0.0	0.0	0.520	25.9	0.0				Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	51.8	0.0	0.521	0.0	0.0	0.520	51.8	0.0				Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	77.7	0.0	0.521	0.0	0.0	0.520	77.7	0.0			
Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)																																																																					
0.000	129.5	0.0	0.521	0.0	0.0																																																																					
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FLOSH MEADOWS
CLEATOR

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Micro Drainage

Summary of Critical Results by Maximum Level (Rank 1) for 180518 SW1.SWS

Simulation Criteria

Areal Reduction Factor 1.000

Additional Flow - % of Total Flow 0.000

Hot Start (mins) 0

MADD Factor * 10m³/ha Storage 2.000

Hot Start Level (mm) 0

Inlet Coefficient 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 13

Number of Online Controls 3

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 0.220

Region England and Wales Cv (Summer) 0.750

M5-60 (mm) 18.600 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0

Analysis Timestep 2.5 Second Increment (Extended)

DTS Status OFF

DVD Status OFF

Inertia Status OFF

Profile(s) Summer and Winter

Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440

Return Period(s) (years) 2

Climate Change (%) 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	1440 Winter	2	+0%					64.129
1.001	2	180 Winter	2	+0%					64.413
1.002	3	60 Winter	2	+0%	2/15 Summer				64.449
1.003	4	60 Winter	2	+0%					62.138
1.004	5	60 Winter	2	+0%					61.811
1.005	6	60 Winter	2	+0%					61.659
1.006	7	1440 Winter	2	+0%					61.639
2.000	8	60 Summer	2	+0%					62.838
2.001	9	720 Winter	2	+0%					62.052
2.002	10	720 Winter	2	+0%	2/120 Winter				62.046
2.003	11	1440 Winter	2	+0%					61.641
2.004	12	1440 Winter	2	+0%					61.639
2.005	13	1440 Winter	2	+0%	2/1440 Winter				61.639
1.007	14	1440 Winter	2	+0%	2/1440 Winter				61.639
1.008	15	1440 Winter	2	+0%	2/960 Winter				61.639
3.000	16	1440 Winter	2	+0%					61.639
1.009	17	HB 1440 Winter	2	+0%	2/30 Summer				61.639
1.010	18	120 Winter	2	+0%					60.658

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Innovyze	Network 2020.1	

Summary of Critical Results by Maximum Level (Rank 1) for 180518 SW1.SWS

PN	US/MH Name	Surcharged		Flooded		Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
		Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)				
1.000	1	-0.876	0.000	0.00			0.0	OK	
1.001	2	-0.172	0.000	0.03		60	2.7	OK	
1.002	3	1.380	0.000	0.04			3.0	SURCHARGED	
1.003	4	-0.161	0.000	0.18			8.5	OK	
1.004	5	-0.233	0.000	0.11			10.6	OK	
1.005	6	-0.209	0.000	0.20		47	12.3	OK	
1.006	7	-0.151	0.000	0.03		349	5.3	OK	
2.000	8	-0.088	0.000	0.36		26	6.3	OK	
2.001	9	-0.156	0.000	0.13		234	5.9	OK	
2.002	10	0.152	0.000	0.04		415	2.6	SURCHARGED	
2.003	11	-0.162	0.000	0.03		345	3.5	OK	
2.004	12	-0.029	0.000	0.01		856	3.3	OK	
2.005	13	0.004	0.000	0.01			3.0	SURCHARGED	
1.007	14	0.041	0.000	0.01			6.5	SURCHARGED	
1.008	15	0.089	0.000	0.01		892	6.0	SURCHARGED	
3.000	16	-0.509	0.000	0.00		447	1.0	OK	
1.009	17 HB	0.730	0.000	0.11		1038	3.8	SURCHARGED	
1.010	18	-0.170	0.000	0.14			3.8	OK	

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STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for 180518 SW1.SWS

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
1.000	41.957	0.420	99.9	0.049	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	53.639	1.516	35.4	0.083	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	31.512	0.770	40.9	0.096	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.003	25.483	0.255	100.0	0.104	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.004	17.652	0.177	100.0	0.035	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.005	18.982	0.077	245.0	0.028	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.006	13.655	0.192	71.1	0.029	0.00	0.0	0.600	o	375	Pipe/Conduit	
2.000	71.706	0.718	99.9	0.095	5.00	0.0	0.600	o	150	Pipe/Conduit	
2.001	37.730	0.314	120.2	0.195	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.002	22.253	0.091	245.0	0.078	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.003	33.218	0.136	245.0	0.065	0.00	0.0	0.600	o	375	Pipe/Conduit	
2.004	13.246	0.033	400.0	0.062	0.00	0.0	0.600	o	825	Pipe/Conduit	
2.005	14.105	0.035	400.0	0.042	0.00	0.0	0.600	o	825	Pipe/Conduit	
1.007	24.092	0.048	501.9	0.021	0.00	0.0	0.600	o	825	Pipe/Conduit	
1.008	21.726	0.041	529.9	0.029	0.00	0.0	0.600	o	825	Pipe/Conduit	
3.000	15.459	0.039	400.0	0.070	5.00	0.0	0.600	o	825	Pipe/Conduit	
1.009	13.858	0.082	170.0	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)
1.000	0.00	5.70	64.855	0.049	0.0	0.0	0.0	1.01	17.8	0.0
1.001	0.00	6.10	64.360	0.132	0.0	0.0	0.0	2.21	87.7	0.0
1.002	0.00	6.36	62.844	0.228	0.0	0.0	0.0	2.05	81.5	0.0
1.003	0.00	6.68	62.074	0.332	0.0	0.0	0.0	1.31	52.0	0.0
1.004	0.00	6.87	61.744	0.367	0.0	0.0	0.0	1.57	111.1	0.0
1.005	0.00	7.19	61.568	0.395	0.0	0.0	0.0	1.00	70.7	0.0
1.006	0.00	7.29	61.415	0.424	0.0	0.0	0.0	2.15	237.6	0.0
2.000	0.00	6.19	62.776	0.095	0.0	0.0	0.0	1.01	17.8	0.0
2.001	0.00	6.72	61.983	0.290	0.0	0.0	0.0	1.19	47.4	0.0
2.002	0.00	7.09	61.594	0.368	0.0	0.0	0.0	1.00	70.7	0.0
2.003	0.00	7.57	61.428	0.433	0.0	0.0	0.0	1.15	127.4	0.0
2.004	0.00	7.72	60.843	0.495	0.0	0.0	0.0	1.48	790.2	0.0
2.005	0.00	7.88	60.809	0.537	0.0	0.0	0.0	1.48	790.2	0.0
1.007	0.00	8.18	60.773	0.982	0.0	0.0	0.0	1.32	704.7	0.0
1.008	0.00	8.46	60.725	1.011	0.0	0.0	0.0	1.28	685.7	0.0
3.000	0.00	5.17	61.323	0.070	0.0	0.0	0.0	1.48	790.2	0.0
1.009	0.00	8.69	60.684	1.081	0.0	0.0	0.0	1.00	39.8	0.0

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STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for 180518 SW1.SWS

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
1.010	4.168	0.025	170.0	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)
1.010	0.00	8.76	60.603	1.081	0.0	0.0	0.0	1.00	39.8	0.0

Free Flowing Outfall Details for 180518 SW1.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.010	C1	63.006	60.578	60.578	1350	0

Simulation Criteria for 180518 SW1.SWS

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	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	13
Number of Online Controls	3	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)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Storm Duration (mins)	30
Ratio R	0.223		

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Online Controls for 180518 SW1.SWS

Hydro-Brake® Optimum Manhole: 3, DS/PN: 1.002, Volume (m³): 5.0

Unit Reference MD-SHE-0075-3400-2049-3400
Design Head (m) 2.049
Design Flow (l/s) 3.4
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 75
Invert Level (m) 62.844
Minimum Outlet Pipe Diameter (mm) 100
Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.049	3.4
Flush-Flo™	0.327	2.5
Kick-Flo®	0.667	2.0
Mean Flow over Head Range	-	2.6

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	2.0	1.200	2.7	3.000	4.1	7.000	6.0
0.200	2.4	1.400	2.8	3.500	4.4	7.500	6.2
0.300	2.5	1.600	3.0	4.000	4.6	8.000	6.4
0.400	2.5	1.800	3.2	4.500	4.9	8.500	6.6
0.500	2.4	2.000	3.4	5.000	5.2	9.000	6.8
0.600	2.3	2.200	3.5	5.500	5.4	9.500	7.0
0.800	2.2	2.400	3.7	6.000	5.6		
1.000	2.4	2.600	3.8	6.500	5.8		

Hydro-Brake® Optimum Manhole: 10, DS/PN: 2.002, Volume (m³): 3.8

Unit Reference MD-SHE-0075-3100-1610-3100
Design Head (m) 1.610
Design Flow (l/s) 3.1
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 75
Invert Level (m) 61.594
Minimum Outlet Pipe Diameter (mm) 100
Suggested Manhole Diameter (mm) 1200

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Hydro-Brake® Optimum Manhole: 10, DS/PN: 2.002, Volume (m³): 3.8

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.610	3.1
Flush-Flo™	0.330	2.6
Kick-Flo®	0.672	2.1
Mean Flow over Head Range	-	2.5

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	2.1	1.200	2.7	3.000	4.1	7.000	6.1
0.200	2.5	1.400	2.9	3.500	4.4	7.500	6.3
0.300	2.6	1.600	3.1	4.000	4.7	8.000	6.5
0.400	2.6	1.800	3.3	4.500	5.0	8.500	6.7
0.500	2.5	2.000	3.4	5.000	5.2	9.000	6.9
0.600	2.3	2.200	3.6	5.500	5.5	9.500	7.1
0.800	2.2	2.400	3.7	6.000	5.7		
1.000	2.5	2.600	3.9	6.500	5.9		

Hydro-Brake® Optimum Manhole: 17 HB, DS/PN: 1.009, Volume (m³): 30.3

Unit Reference	MD-SHE-0089-5000-2299-5000
Design Head (m)	2.299
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	89
Invert Level (m)	60.684
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.299	5.0
Flush-Flo™	0.384	3.8
Kick-Flo®	0.790	3.1
Mean Flow over Head Range	-	3.8

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	2.7	0.300	3.8	0.500	3.8	0.800	3.1
0.200	3.6	0.400	3.8	0.600	3.7	1.000	3.4

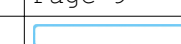
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<u>Hydro-Brake® Optimum Manhole: 17 HB, DS/PN: 1.009, Volume (m³): 30.3</u>							
Depth (m) Flow (l/s)		Depth (m) Flow (l/s)		Depth (m) Flow (l/s)		Depth (m) Flow (l/s)	
1.200	3.7	2.400	5.1	5.000	7.2	8.000	9.0
1.400	4.0	2.600	5.3	5.500	7.5	8.500	9.3
1.600	4.2	3.000	5.7	6.000	7.8	9.000	9.5
1.800	4.5	3.500	6.1	6.500	8.1	9.500	9.8
2.000	4.7	4.000	6.5	7.000	8.4		
2.200	4.9	4.500	6.8	7.500	8.7		
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Storage Structures for 180518 SW1.SWS Cellular Storage Manhole: 1, DS/PN: 1.000 Invert Level (m) 63.655 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>51.8</td><td>0.0</td><td>0.521</td><td>0.0</td><td>0.0</td></tr><tr><td>0.520</td><td>51.8</td><td>0.0</td><td></td><td></td><td></td></tr></table> Cellular Storage Manhole: 2, DS/PN: 1.001 Invert Level (m) 64.360 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>207.0</td><td>0.0</td><td>0.521</td><td>0.0</td><td>0.0</td></tr><tr><td>0.520</td><td>207.0</td><td>0.0</td><td></td><td></td><td></td></tr></table> Cellular Storage Manhole: 4, DS/PN: 1.003 Invert Level (m) 62.074 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>129.5</td><td>0.0</td><td>0.521</td><td>0.0</td><td>0.0</td></tr><tr><td>0.520</td><td>129.5</td><td>0.0</td><td></td><td></td><td></td></tr></table> Cellular Storage Manhole: 6, DS/PN: 1.005 Invert Level (m) 61.568 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>25.9</td><td>0.0</td><td>0.521</td><td>0.0</td><td>0.0</td></tr><tr><td>0.520</td><td>25.9</td><td>0.0</td><td></td><td></td><td></td></tr></table> Cellular Storage Manhole: 7, DS/PN: 1.006 Invert Level (m) 61.415 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000			Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	51.8	0.0	0.521	0.0	0.0	0.520	51.8	0.0				Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	207.0	0.0	0.521	0.0	0.0	0.520	207.0	0.0				Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	129.5	0.0	0.521	0.0	0.0	0.520	129.5	0.0				Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	25.9	0.0	0.521	0.0	0.0	0.520	25.9	0.0			
Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)																																																																					
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<u>Cellular Storage Manhole: 7, DS/PN: 1.006</u> <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>25.9</td><td>0.0</td><td>0.521</td><td>0.0</td><td>0.0</td></tr><tr><td>0.520</td><td>25.9</td><td>0.0</td><td></td><td></td><td></td></tr></table> <u>Cellular Storage Manhole: 8, DS/PN: 2.000</u> Invert Level (m) 62.776 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>77.7</td><td>0.0</td><td>0.521</td><td>0.0</td><td>0.0</td></tr><tr><td>0.520</td><td>77.7</td><td>0.0</td><td></td><td></td><td></td></tr></table> <u>Cellular Storage Manhole: 9, DS/PN: 2.001</u> Invert Level (m) 61.983 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>388.5</td><td>0.0</td><td>0.521</td><td>0.0</td><td>0.0</td></tr><tr><td>0.520</td><td>388.5</td><td>0.0</td><td></td><td></td><td></td></tr></table> <u>Cellular Storage Manhole: 10, DS/PN: 2.002</u> Invert Level (m) 61.594 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>103.6</td><td>0.0</td><td>0.521</td><td>0.0</td><td>0.0</td></tr><tr><td>0.520</td><td>103.6</td><td>0.0</td><td></td><td></td><td></td></tr></table> <u>Cellular Storage Manhole: 11, DS/PN: 2.003</u> Invert Level (m) 61.428 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>181.4</td><td>0.0</td><td>0.521</td><td>0.0</td><td>0.0</td></tr><tr><td>0.520</td><td>181.4</td><td>0.0</td><td></td><td></td><td></td></tr></table>						Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	25.9	0.0	0.521	0.0	0.0	0.520	25.9	0.0				Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	77.7	0.0	0.521	0.0	0.0	0.520	77.7	0.0				Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	388.5	0.0	0.521	0.0	0.0	0.520	388.5	0.0				Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	103.6	0.0	0.521	0.0	0.0	0.520	103.6	0.0				Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	181.4	0.0	0.521	0.0	0.0	0.520	181.4	0.0			
Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)																																																																																										
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0.000	77.7	0.0	0.521	0.0	0.0																																																																																										
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0.000	388.5	0.0	0.521	0.0	0.0																																																																																										
0.520	388.5	0.0																																																																																													
Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)																																																																																										
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0.000	181.4	0.0	0.521	0.0	0.0																																																																																										
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Innovyze	Network 2020.1																																																																									
Cellular Storage Manhole: 12, DS/PN: 2.004 Invert Level (m) 60.868 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>129.5</td><td>0.0</td><td>0.521</td><td>0.0</td><td>0.0</td></tr><tr><td>0.520</td><td>129.5</td><td>0.0</td><td></td><td></td><td></td></tr></table> Cellular Storage Manhole: 15, DS/PN: 1.008 Invert Level (m) 60.783 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>25.9</td><td>0.0</td><td>0.521</td><td>0.0</td><td>0.0</td></tr><tr><td>0.520</td><td>25.9</td><td>0.0</td><td></td><td></td><td></td></tr></table> Cellular Storage Manhole: 16, DS/PN: 3.000 Invert Level (m) 61.323 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>51.8</td><td>0.0</td><td>0.521</td><td>0.0</td><td>0.0</td></tr><tr><td>0.520</td><td>51.8</td><td>0.0</td><td></td><td></td><td></td></tr></table> Cellular Storage Manhole: 17 HB, DS/PN: 1.009 Invert Level (m) 60.684 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>77.7</td><td>0.0</td><td>0.521</td><td>0.0</td><td>0.0</td></tr><tr><td>0.520</td><td>77.7</td><td>0.0</td><td></td><td></td><td></td></tr></table>			Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	129.5	0.0	0.521	0.0	0.0	0.520	129.5	0.0				Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	25.9	0.0	0.521	0.0	0.0	0.520	25.9	0.0				Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	51.8	0.0	0.521	0.0	0.0	0.520	51.8	0.0				Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	77.7	0.0	0.521	0.0	0.0	0.520	77.7	0.0			
Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)																																																																					
0.000	129.5	0.0	0.521	0.0	0.0																																																																					
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Summary of Critical Results by Maximum Level (Rank 1) for 180518 SW1.SWS

PN	US/MH Name	Depth (m)	Surcharged Flooded		Flow / Overflow Cap. (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
			Volume (m³)	Flow					
1.000	1	-0.129	0.000	0.05			0.8	OK	
1.001	2	-0.050	0.000	0.04		138	3.0	OK	
1.002	3	1.615	0.000	0.04			3.2	FLOOD RISK	
1.003	4	-0.030	0.000	0.11		291	5.4	OK	
1.004	5	0.219	0.000	0.06			6.2	SURCHARGED	
1.005	6	0.393	0.000	0.11		988	6.8	SURCHARGED	
1.006	7	0.468	0.000	0.04		1451	7.4	SURCHARGED	
2.000	8	-0.049	0.000	0.78		15	13.7	OK	
2.001	9	0.084	0.000	0.12		488	5.6	SURCHARGED	
2.002	10	0.395	0.000	0.04		1074	2.6	SURCHARGED	
2.003	11	0.454	0.000	0.03		1445	4.0	SURCHARGED	
2.004	12	0.589	0.000	0.01			4.2	SURCHARGED	
2.005	13	0.622	0.000	0.01			3.7	SURCHARGED	
1.007	14	0.659	0.000	0.02			9.4	SURCHARGED	
1.008	15	0.707	0.000	0.02			8.6	SURCHARGED	
3.000	16	0.109	0.000	0.00		1653	1.5	SURCHARGED	

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Summary of Critical Results by Maximum Level (Rank 1) for 180518 SW1.SWS

US/MH		Return Climate		First (X)	First (Y)	First (Z)	Overflow	Water
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act. Level
								(m)
1.009	17 HB 1440	Winter	30	+0%	30/15 Summer			62.257
1.010	18 1440	Winter	30	+0%				60.661

US/MH		Surcharged	Flooded	Half Drain		Pipe	Level	
PN	Name	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Time (mins)	Flow (l/s)	Status Exceeded
1.009	17 HB	1.348	0.000	0.12			4.2	SURCHARGED
1.010	18	-0.167	0.000	0.15			4.2	OK

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STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for 180518 SW1.SWS

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
1.000	41.957	0.420	99.9	0.049	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	53.639	1.516	35.4	0.083	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	31.512	0.770	40.9	0.096	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.003	25.483	0.255	100.0	0.104	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.004	17.652	0.177	100.0	0.035	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.005	18.982	0.077	245.0	0.028	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.006	13.655	0.192	71.1	0.029	0.00	0.0	0.600	o	375	Pipe/Conduit	
2.000	71.706	0.718	99.9	0.095	5.00	0.0	0.600	o	150	Pipe/Conduit	
2.001	37.730	0.314	120.2	0.195	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.002	22.253	0.091	245.0	0.078	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.003	33.218	0.136	245.0	0.065	0.00	0.0	0.600	o	375	Pipe/Conduit	
2.004	13.246	0.033	400.0	0.062	0.00	0.0	0.600	o	825	Pipe/Conduit	
2.005	14.105	0.035	400.0	0.042	0.00	0.0	0.600	o	825	Pipe/Conduit	
1.007	24.092	0.048	501.9	0.021	0.00	0.0	0.600	o	825	Pipe/Conduit	
1.008	21.726	0.041	529.9	0.029	0.00	0.0	0.600	o	825	Pipe/Conduit	
3.000	15.459	0.039	400.0	0.070	5.00	0.0	0.600	o	825	Pipe/Conduit	
1.009	13.858	0.082	170.0	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)
1.000	0.00	5.70	64.855	0.049	0.0	0.0	0.0	1.01	17.8	0.0
1.001	0.00	6.10	64.360	0.132	0.0	0.0	0.0	2.21	87.7	0.0
1.002	0.00	6.36	62.844	0.228	0.0	0.0	0.0	2.05	81.5	0.0
1.003	0.00	6.68	62.074	0.332	0.0	0.0	0.0	1.31	52.0	0.0
1.004	0.00	6.87	61.744	0.367	0.0	0.0	0.0	1.57	111.1	0.0
1.005	0.00	7.19	61.568	0.395	0.0	0.0	0.0	1.00	70.7	0.0
1.006	0.00	7.29	61.415	0.424	0.0	0.0	0.0	2.15	237.6	0.0
2.000	0.00	6.19	62.776	0.095	0.0	0.0	0.0	1.01	17.8	0.0
2.001	0.00	6.72	61.983	0.290	0.0	0.0	0.0	1.19	47.4	0.0
2.002	0.00	7.09	61.594	0.368	0.0	0.0	0.0	1.00	70.7	0.0
2.003	0.00	7.57	61.428	0.433	0.0	0.0	0.0	1.15	127.4	0.0
2.004	0.00	7.72	60.843	0.495	0.0	0.0	0.0	1.48	790.2	0.0
2.005	0.00	7.88	60.809	0.537	0.0	0.0	0.0	1.48	790.2	0.0
1.007	0.00	8.18	60.773	0.982	0.0	0.0	0.0	1.32	704.7	0.0
1.008	0.00	8.46	60.725	1.011	0.0	0.0	0.0	1.28	685.7	0.0
3.000	0.00	5.17	61.323	0.070	0.0	0.0	0.0	1.48	790.2	0.0
1.009	0.00	8.69	60.684	1.081	0.0	0.0	0.0	1.00	39.8	0.0

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STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for 180518 SW1.SWS

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
1.010	4.168	0.025	170.0	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)
1.010	0.00	8.76	60.603	1.081	0.0	0.0	0.0	1.00	39.8	0.0

Free Flowing Outfall Details for 180518 SW1.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.010	C1	63.006	60.578	60.578	1350	0

Simulation Criteria for 180518 SW1.SWS

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	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	13
Number of Online Controls	3	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)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Storm Duration (mins)	30
Ratio R	0.223		

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Online Controls for 180518 SW1.SWS

Hydro-Brake® Optimum Manhole: 3, DS/PN: 1.002, Volume (m³): 5.0

Unit Reference MD-SHE-0075-3400-2049-3400
Design Head (m) 2.049
Design Flow (l/s) 3.4
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 75
Invert Level (m) 62.844
Minimum Outlet Pipe Diameter (mm) 100
Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.049	3.4
Flush-Flo™	0.327	2.5
Kick-Flo®	0.667	2.0
Mean Flow over Head Range	-	2.6

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	2.0	1.200	2.7	3.000	4.1	7.000	6.0
0.200	2.4	1.400	2.8	3.500	4.4	7.500	6.2
0.300	2.5	1.600	3.0	4.000	4.6	8.000	6.4
0.400	2.5	1.800	3.2	4.500	4.9	8.500	6.6
0.500	2.4	2.000	3.4	5.000	5.2	9.000	6.8
0.600	2.3	2.200	3.5	5.500	5.4	9.500	7.0
0.800	2.2	2.400	3.7	6.000	5.6		
1.000	2.4	2.600	3.8	6.500	5.8		

Hydro-Brake® Optimum Manhole: 10, DS/PN: 2.002, Volume (m³): 3.8

Unit Reference MD-SHE-0075-3100-1610-3100
Design Head (m) 1.610
Design Flow (l/s) 3.1
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 75
Invert Level (m) 61.594
Minimum Outlet Pipe Diameter (mm) 100
Suggested Manhole Diameter (mm) 1200

Coast Consulting Engineers Ltd			Page 3																																																																									
Suite 6, Vita House Fish Quay North Shields NE30 1JA		FLOSH MEADOWS CLEATOR																																																																										
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<u>Hydro-Brake® Optimum Manhole: 10, DS/PN: 2.002, Volume (m³): 3.8</u>																																																																												
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<u>Hydro-Brake® Optimum Manhole: 17 HB, DS/PN: 1.009, Volume (m³): 30.3</u>							
Depth (m) Flow (l/s)		Depth (m) Flow (l/s)		Depth (m) Flow (l/s)		Depth (m) Flow (l/s)	
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1.400	4.0	2.600	5.3	5.500	7.5	8.500	9.3
1.600	4.2	3.000	5.7	6.000	7.8	9.000	9.5
1.800	4.5	3.500	6.1	6.500	8.1	9.500	9.8
2.000	4.7	4.000	6.5	7.000	8.4		
2.200	4.9	4.500	6.8	7.500	8.7		
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Storage Structures for 180518 SW1.SWS Cellular Storage Manhole: 1, DS/PN: 1.000 Invert Level (m) 63.655 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>51.8</td><td>0.0</td><td>0.521</td><td>0.0</td><td>0.0</td></tr><tr><td>0.520</td><td>51.8</td><td>0.0</td><td></td><td></td><td></td></tr></table> Cellular Storage Manhole: 2, DS/PN: 1.001 Invert Level (m) 64.360 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>207.0</td><td>0.0</td><td>0.521</td><td>0.0</td><td>0.0</td></tr><tr><td>0.520</td><td>207.0</td><td>0.0</td><td></td><td></td><td></td></tr></table> Cellular Storage Manhole: 4, DS/PN: 1.003 Invert Level (m) 62.074 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>129.5</td><td>0.0</td><td>0.521</td><td>0.0</td><td>0.0</td></tr><tr><td>0.520</td><td>129.5</td><td>0.0</td><td></td><td></td><td></td></tr></table> Cellular Storage Manhole: 6, DS/PN: 1.005 Invert Level (m) 61.568 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>25.9</td><td>0.0</td><td>0.521</td><td>0.0</td><td>0.0</td></tr><tr><td>0.520</td><td>25.9</td><td>0.0</td><td></td><td></td><td></td></tr></table> Cellular Storage Manhole: 7, DS/PN: 1.006 Invert Level (m) 61.415 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000			Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	51.8	0.0	0.521	0.0	0.0	0.520	51.8	0.0				Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	207.0	0.0	0.521	0.0	0.0	0.520	207.0	0.0				Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	129.5	0.0	0.521	0.0	0.0	0.520	129.5	0.0				Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	25.9	0.0	0.521	0.0	0.0	0.520	25.9	0.0			
Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)																																																																					
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<u>Cellular Storage Manhole: 7, DS/PN: 1.006</u> <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>25.9</td><td>0.0</td><td>0.521</td><td>0.0</td><td>0.0</td></tr><tr><td>0.520</td><td>25.9</td><td>0.0</td><td></td><td></td><td></td></tr></table> <u>Cellular Storage Manhole: 8, DS/PN: 2.000</u> Invert Level (m) 62.776 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>77.7</td><td>0.0</td><td>0.521</td><td>0.0</td><td>0.0</td></tr><tr><td>0.520</td><td>77.7</td><td>0.0</td><td></td><td></td><td></td></tr></table> <u>Cellular Storage Manhole: 9, DS/PN: 2.001</u> Invert Level (m) 61.983 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>388.5</td><td>0.0</td><td>0.521</td><td>0.0</td><td>0.0</td></tr><tr><td>0.520</td><td>388.5</td><td>0.0</td><td></td><td></td><td></td></tr></table> <u>Cellular Storage Manhole: 10, DS/PN: 2.002</u> Invert Level (m) 61.594 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>103.6</td><td>0.0</td><td>0.521</td><td>0.0</td><td>0.0</td></tr><tr><td>0.520</td><td>103.6</td><td>0.0</td><td></td><td></td><td></td></tr></table> <u>Cellular Storage Manhole: 11, DS/PN: 2.003</u> Invert Level (m) 61.428 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>181.4</td><td>0.0</td><td>0.521</td><td>0.0</td><td>0.0</td></tr><tr><td>0.520</td><td>181.4</td><td>0.0</td><td></td><td></td><td></td></tr></table>						Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	25.9	0.0	0.521	0.0	0.0	0.520	25.9	0.0				Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	77.7	0.0	0.521	0.0	0.0	0.520	77.7	0.0				Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	388.5	0.0	0.521	0.0	0.0	0.520	388.5	0.0				Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	103.6	0.0	0.521	0.0	0.0	0.520	103.6	0.0				Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	181.4	0.0	0.521	0.0	0.0	0.520	181.4	0.0			
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Cellular Storage Manhole: 12, DS/PN: 2.004 Invert Level (m) 60.868 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>129.5</td><td>0.0</td><td>0.521</td><td>0.0</td><td>0.0</td></tr><tr><td>0.520</td><td>129.5</td><td>0.0</td><td></td><td></td><td></td></tr></table> Cellular Storage Manhole: 15, DS/PN: 1.008 Invert Level (m) 60.783 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>25.9</td><td>0.0</td><td>0.521</td><td>0.0</td><td>0.0</td></tr><tr><td>0.520</td><td>25.9</td><td>0.0</td><td></td><td></td><td></td></tr></table> Cellular Storage Manhole: 16, DS/PN: 3.000 Invert Level (m) 61.323 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>51.8</td><td>0.0</td><td>0.521</td><td>0.0</td><td>0.0</td></tr><tr><td>0.520</td><td>51.8</td><td>0.0</td><td></td><td></td><td></td></tr></table> Cellular Storage Manhole: 17 HB, DS/PN: 1.009 Invert Level (m) 60.684 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>77.7</td><td>0.0</td><td>0.521</td><td>0.0</td><td>0.0</td></tr><tr><td>0.520</td><td>77.7</td><td>0.0</td><td></td><td></td><td></td></tr></table>			Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	129.5	0.0	0.521	0.0	0.0	0.520	129.5	0.0				Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	25.9	0.0	0.521	0.0	0.0	0.520	25.9	0.0				Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	51.8	0.0	0.521	0.0	0.0	0.520	51.8	0.0				Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	77.7	0.0	0.521	0.0	0.0	0.520	77.7	0.0			
Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)																																																																					
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Date 12/10/2021 File 211012 REVISED COMBINED...		Designed by RH Checked by PL						
Innovyze		Network 2020.1						
Summary of Critical Results by Maximum Level (Rank 1) for 180518 SW1.SWS								
Simulation Criteria								
Areal Reduction Factor		1.000	Additional Flow - % of Total Flow 0.000					
Hot Start (mins)		0	MADD Factor * 10m³/ha Storage 2.000					
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 13					
Number of Online Controls		3	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 0.220					
Region England and Wales		Cv (Summer)	0.750					
M5-60 (mm)		18.600	Cv (Winter) 0.840					
Margin for Flood Risk Warning (mm)			300.0					
Analysis Timestep		2.5	Second Increment (Extended)					
DTS Status			OFF					
DVD Status			OFF					
Inertia Status			OFF					
Profile(s)			Summer and Winter					
Duration(s) (mins)		15, 30, 60, 120, 180, 240, 360						
Return Period(s) (years)			100					
Climate Change (%)			40					
WARNING: Half Drain Time has not been calculated as the structure is too full.								
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.000	1	240 Winter	100	+40%				
1.001	2	360 Winter	100	+40%	100/60 Summer			
1.002	3	15 Winter	100	+40%	100/15 Summer	100/15 Summer		
1.003	4	360 Winter	100	+40%	100/240 Winter			
1.004	5	360 Winter	100	+40%	100/180 Winter			
1.005	6	360 Winter	100	+40%	100/180 Summer			
1.006	7	360 Winter	100	+40%	100/120 Winter			
2.000	8	360 Winter	100	+40%	100/15 Winter			
2.001	9	360 Winter	100	+40%	100/60 Winter			
2.002	10	360 Winter	100	+40%	100/15 Summer			
2.003	11	360 Winter	100	+40%	100/120 Winter	100/360 Winter		
2.004	12	360 Winter	100	+40%	100/120 Summer			
2.005	13	360 Winter	100	+40%	100/120 Summer			
1.007	14	360 Winter	100	+40%	100/120 Summer			
1.008	15	360 Winter	100	+40%	100/60 Winter			
3.000	16	360 Winter	100	+40%	100/180 Winter			
1.009	17	HB 360 Winter	100	+40%	100/15 Summer			
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Summary of Critical Results by Maximum Level (Rank 1) for 180518 SW1.SWS

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Overflow Cap. (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.000	1	64.905	-0.100	0.000	0.23		4.0	OK
1.001	2	64.872	0.287	0.000	0.04	283	3.2	SURCHARGED
1.002	3	64.894	1.825	0.727	0.04		3.4	FLOOD
1.003	4	63.005	0.706	0.000	0.28		13.6	SURCHARGED
1.004	5	62.996	0.952	0.000	0.18		17.1	SURCHARGED
1.005	6	62.992	1.125	0.000	0.32		19.8	SURCHARGED
1.006	7	62.988	1.198	0.000	0.12		21.3	SURCHARGED
2.000	8	63.085	0.159	0.000	0.55	187	9.5	SURCHARGED
2.001	9	63.095	0.887	0.000	0.34		15.2	SURCHARGED
2.002	10	63.092	1.198	0.000	0.04		2.6	FLOOD RISK
2.003	11	62.984	1.180	0.622	0.07		7.9	FLOOD
2.004	12	62.986	1.318	0.000	0.02		9.0	FLOOD RISK
2.005	13	62.986	1.352	0.000	0.02		8.4	FLOOD RISK
1.007	14	62.986	1.388	0.000	0.05		23.2	SURCHARGED
1.008	15	62.986	1.436	0.000	0.04		18.7	SURCHARGED
3.000	16	62.986	0.838	0.000	0.01		5.8	SURCHARGED
1.009 17	HB	62.986	2.077	0.000	0.14		5.0	SURCHARGED

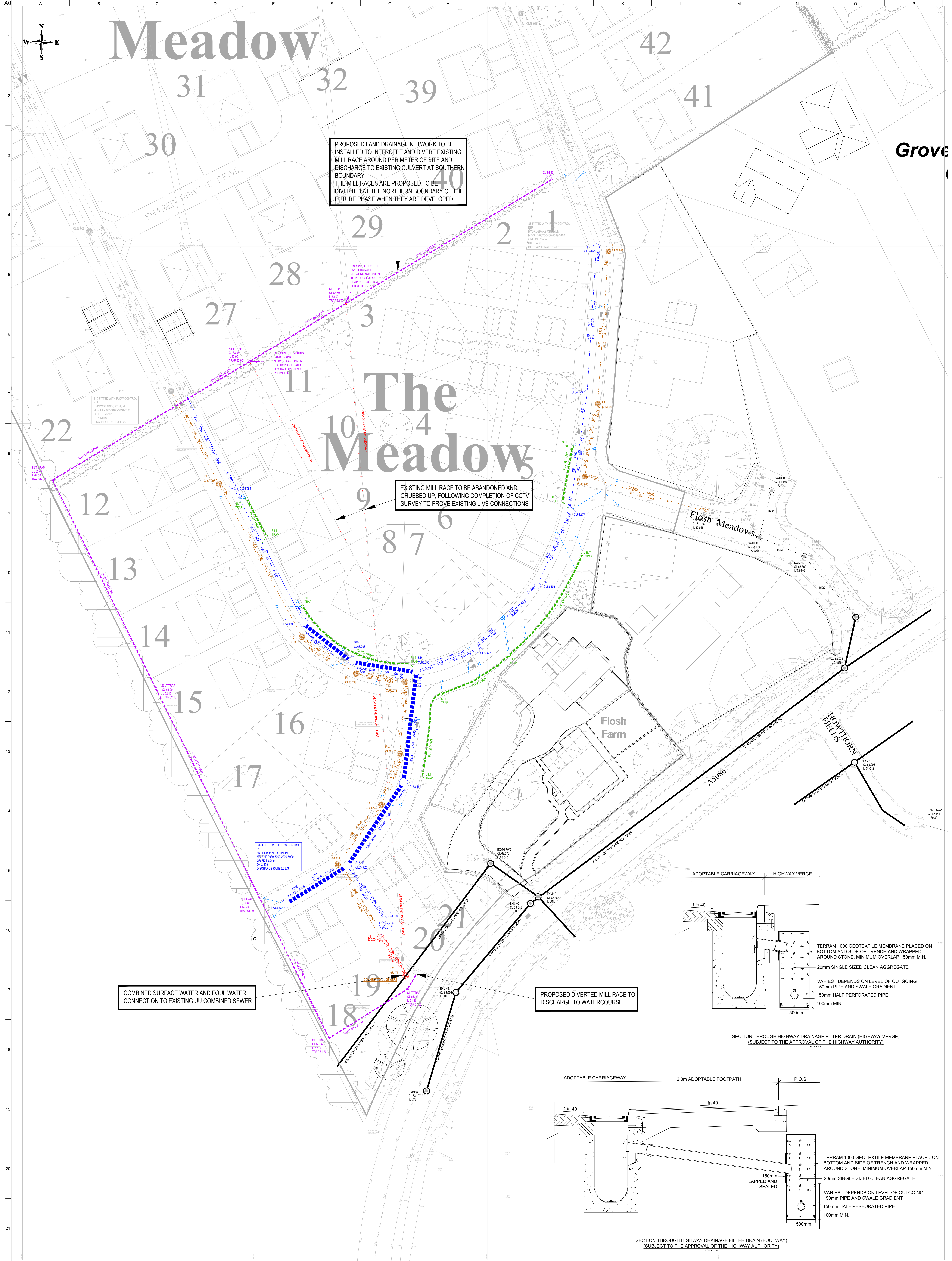
PN	US/MH Name	Level Exceeded
1.000	1	
1.001	2	
1.002	3	3
1.003	4	
1.004	5	
1.005	6	
1.006	7	
2.000	8	
2.001	9	
2.002	10	
2.003	11	1
2.004	12	
2.005	13	
1.007	14	
1.008	15	
3.000	16	
1.009 17	HB	

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Summary of Critical Results by Maximum Level (Rank 1) for 180518 SW1.SWS

	US/MH		Return Climate	First (X)	First (Y)	First (Z)	Overflow	Water
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act. Level
								(m)
1.010	18 360	Winter	100	+40%				60.667

	US/MH	Depth	Volume	Flow / Overflow	Time	Pipe		Level
PN	Name	(m)	(m ³)	Cap. (l/s)	(mins)	Flow (l/s)	Status	Exceeded
1.010	18	-0.161	0.000	0.18		5.0	OK	





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