COAST
CONSULTING ENGINEERS

Jack Lawson Terrace
Wheatley Hill

Flood Risk Assessment
and Drainage Strategy

Issue Date:
02 February 2024

Report Number:
23066-FRADS 01

Client:
Gleeson Homes

Revision:
A

Contents

1. Introduction 1
2. Site location, Topographical Features and Proposals 3
3. Potential Sources of Flooding And Proposed Mitigation 8
4. Surface and Foul Water Disposal 12
5. Foul Water Disposal 15
6. References 16

Appendix A – Topographical Survey
Appendix B – Sewer Records and NWL correspondence
Appendix C – Architectural Layout
Appendix D – Extract from Phase 2 report
Appendix E – Proposed Drainage Layout and Calculations

Executive Summary

Site Location	The proposed development is located adjacent to Jack Lawson Terrace and Wheatley Terrace, Wheatley Hill, County Durham, DH6 3RD. The site boundary measures approximately 2.640 Ha and consists entirely of brownfield land. The site is split into two parcels (western (Area A) and eastern (Area B) parcels), within an existing housing estate. The two areas are irregular to rectangular in shape and comprise flat lying grassed public open space that were formerly occupied by housing and industrial units/depots. A topographical survey of the site has been undertaken and is included in appendix A.
Site Proposals	Site proposals currently identify the construction of a residential development and associated infrastructure.
Ground Conditions	A geoenvironmental appraisal report has been undertaken by Sirius Geotechnical Limited reference C9843/GAR (August 2023). The investigation has identified made ground, locally overlain by reworked topsoil, to depths typically ranging between 0.15m and 0.65m, but locally up to 2.4m BGL in the south west of the eastern parcel, overlying predominantly stiff and very stiff high strength slightly sandy slightly gravelly clay (glacial till). Limestone (dolostone) bedrock was encountered at shallow depth in some locations in the north and south of the site, at depths ranging from 1.25m to 2.8m BGL. In the central area of the site, bedrock was not encountered within exploratory holes and rockhead is anticipated to be in excess of circa 3m BGL. Groundwater was not encountered during the investigation. Please refer to Appendix D for further information.
Nearest Watercourse	The nearest watercourse is an unnamed watercourse located approximately 250m to the east of the site boundary, beyond third party land.
Nearest Surface Water Sewer	None within the vicinity of the site.
Nearest Combined Sewer	Within the site boundary.
Nearest Foul Water Sewer	None within the vicinity of the site.
Flood Zone	EA flood maps indicate that the development boundary is located entirely within an area classified as a Flood Zone 1.
Surface Water Flooding	Surface water flood risk mapping indicates that the development area lies almost entirely within an area classified as having a very low risk of surface water flooding. A small portion of the development at the northeastern extent of Area B is shown to be at low risk of flooding. The introduction of a positive surface water drainage system will mitigate against the issue and as such, the post development risk of flooding due to surface water can be considered very low.
Ground Water	The risk of flooding due to ground water rise can be considered as low throughout the site.
Surface Water Discharge Rate	Surface water should be restricted to 10.0litres/sec peak discharge for all events up to an including the 100-year event with a 45% allowance for climate change, providing betterment of up to 67% in comparison to the current regime.
SuDS	vortex flow control will be utilised to restrict flows to predevelopment greenfield rates. Private drives should discharge to permeable paving to assist with water quality treatment. Cellular storage and oversized pipes will be installed to store attenuated surface water flows.

The above summary should not be used in isolation and reference should be made the full report.

1. Introduction

Coast Consulting Engineers have been commissioned by Gleeson Homes to assess the flood risk associated with a proposed development at Jack Lawson Terrace, Wheatley Hill. This Flood Risk Assessment is reviewed in accordance with the National Planning Policy Framework (NPPF) for Development and Flood Risk. In conjunction with assessing the site for flood risk a proposed drainage strategy has been prepared.

This site-specific Flood Risk Assessment (FRA) has been undertaken to determine the risk of flooding to the proposed development from all sources in accordance with the National Planning Policy Framework (NPPF) and to assess the flood risk to others as a result of the development. The assessment will recommend how the risk can be managed in line with planning policy requirements.

One of the key aims of the National Planning Policy Framework (NPPF) is to ensure that flood risk is considered at all stages of the planning process to avoid inappropriate development in areas at risk of flooding and to direct development away from areas at highest risk. Where new development is necessary in such areas, the policy aims to make it safe without increasing flood risk elsewhere and where possible, reducing flood risk overall.

1.1 National Planning Policy Framework (NPPF)

The NPPF requires that:

> A site-specific flood risk assessment must demonstrate that the development will be safe for its lifetime taking account the vulnerability of its users, without increasing flood risk elsewhere, and where possible, will reduce flood risk overall.
>
> A site-specific flood risk assessment is required for proposals greater than 1 ha in size in a Flood Zone 1; all proposals for new development in Flood Zones 2 and 3, or in an area within Flood Zone 1 which has critical drainage problems (as identified in the Strategic Flood Risk Assessment).

The following definitions for flood zones are derived from NPPF:

FLOOD ZONE 1:

This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).

FLOOD ZONE 2:

This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% – 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% – 0.1%) in any year.

FLOOD ZONE 3:

This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.

In addition to the risk of flooding from rivers or sea, consideration must also be given to surface water flooding, flooding due to ground water and flooding from artificial sources such as sewer failure or overtopping of reservoirs.

2. Site location, Topographical Features and Proposals

2.1 Site Location

The proposed development is located adjacent to Jack Lawson Terrace and Wheatley Terrace, Wheatley Hill, County Durham, DH6 3RD. The site boundary measures approximately 2.640 Ha and consists entirely of brownfield land.

The site is split into two parcels (western (Area A) and eastern (Area B) parcels), within an existing housing estate. The two areas are irregular to rectangular in shape and comprise flat lying grassed public open space that were formerly occupied by housing and industrial units/depots.

The site location is indicated in Figure 2.11 below.

Figure 2.11 – Site Location

2.2 Existing Topography

A topographical survey of the site has been undertaken and is included in appendix A. Area A generally falls from the north to the south at a highest level of approximately 158.40m AOD at the north to a lowest level of approximately 155.00m AOD at the south. Area B generally falls from the south to the north at a highest level of approximately 160.70m AOD at the south to a lowest level of approximately 155.00m AOD at the north.

The surrounding area is developed as follows:

North: Residential units
East: Residential units
South: Residential units
West: Residential units

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

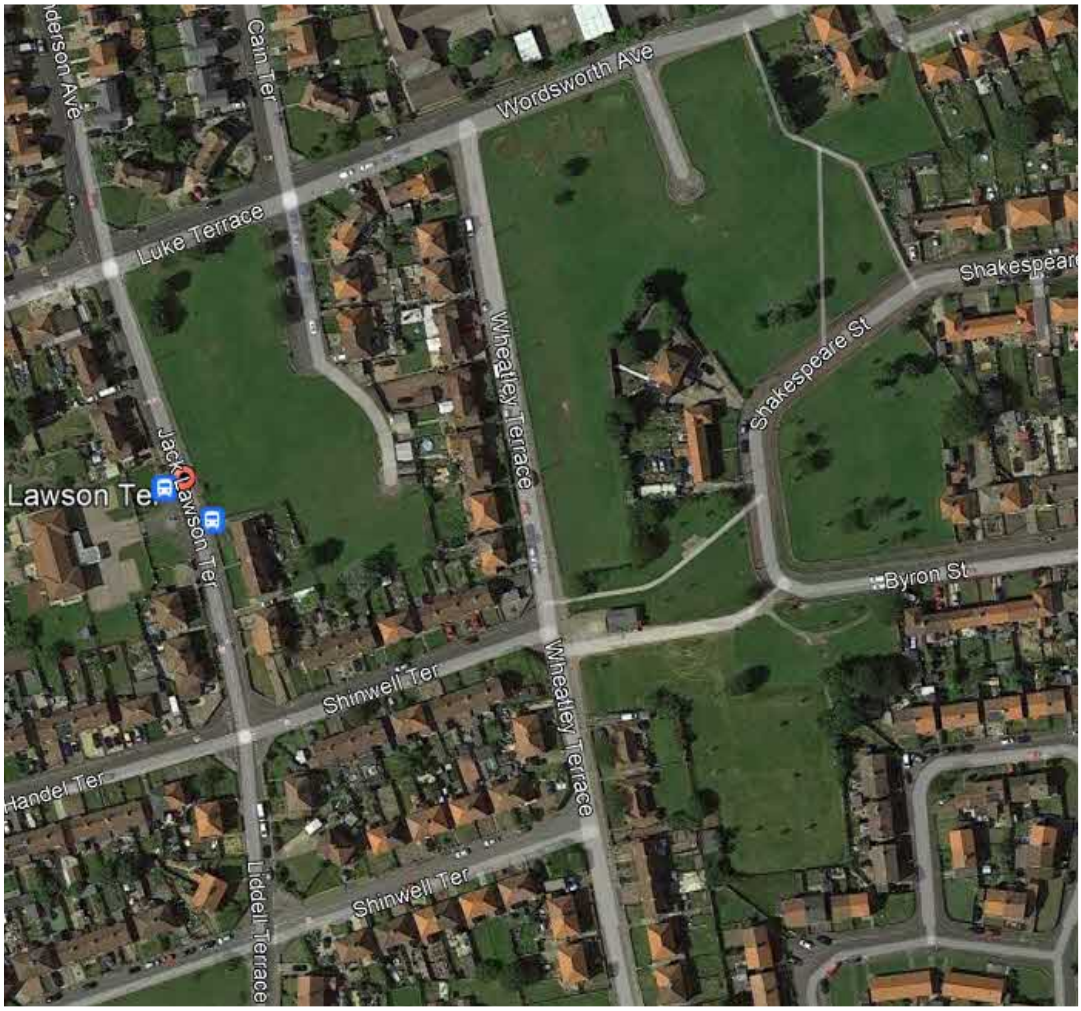


Figure 2.21 – Satellite image of existing site.

2.3 Existing sewers and watercourses

There are numerous existing combined sewers within the site boundary and the surrounding area, indicated on the NWL sewer records contained in figure 2.31 below.

There are no separate foul or surface water sewers located within the vicinity of the site.

The nearest watercourse is an unnamed watercourse located approximately 250m to the east of the site boundary, beyond third party land. Refer to figure 2.32 overleaf.

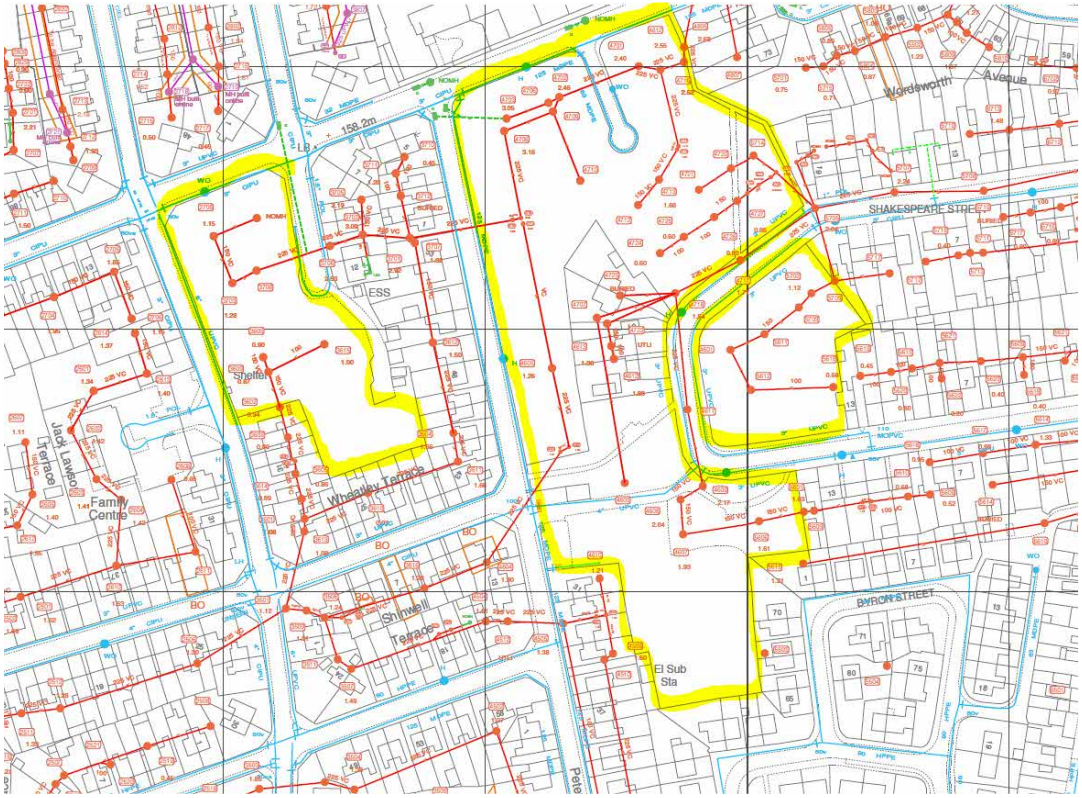


Figure 2.31 – Existing sewers.

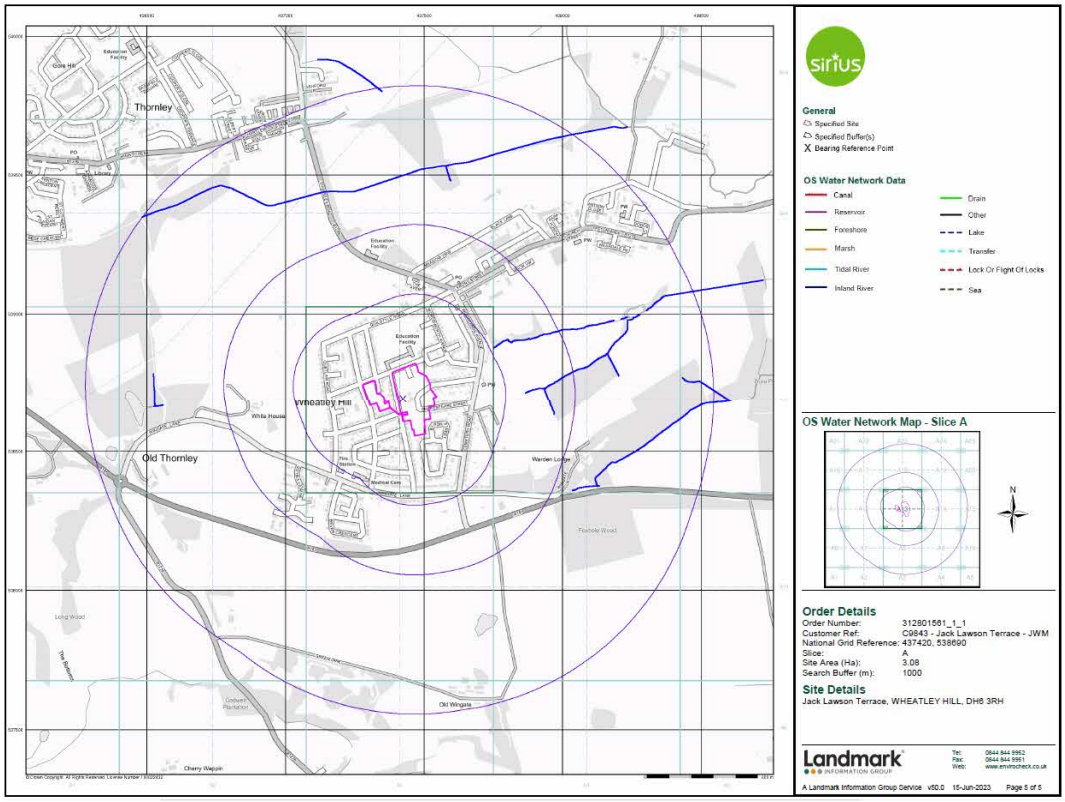


Figure 2.32 – Existing watercourses.

2.4 Ground conditions

A geoenvironmental appraisal report has been undertaken by Sirius Geotechnical Limited reference C9843/GAR (August 2023).

The investigation has identified made ground, locally overlain by reworked topsoil, to depths typically ranging between 0.15m and 0.65m, but locally up to 2.4m BGL in the south west of the eastern parcel, overlying predominantly stiff and very stiff high strength slightly sandy slightly gravelly clay (glacial till). Limestone (dolostone) bedrock was encountered at shallow depth in some locations in the north and south of the site, at depths ranging from 1.25m to 2.8m BGL. In the central area of the site, bedrock was not encountered within exploratory holes and rockhead is anticipated to be in excess of circa 3m BGL. Groundwater was not encountered during the investigation. Please refer to Appendix D for further information.

2.5 Development proposals

A copy of the proposed architectural site layout comprising of a residential development of approximately 78 units and associated infrastructure can be found in Appendix C and figure 2.51 below.

Figure 2.51 – Proposed architectural layout.

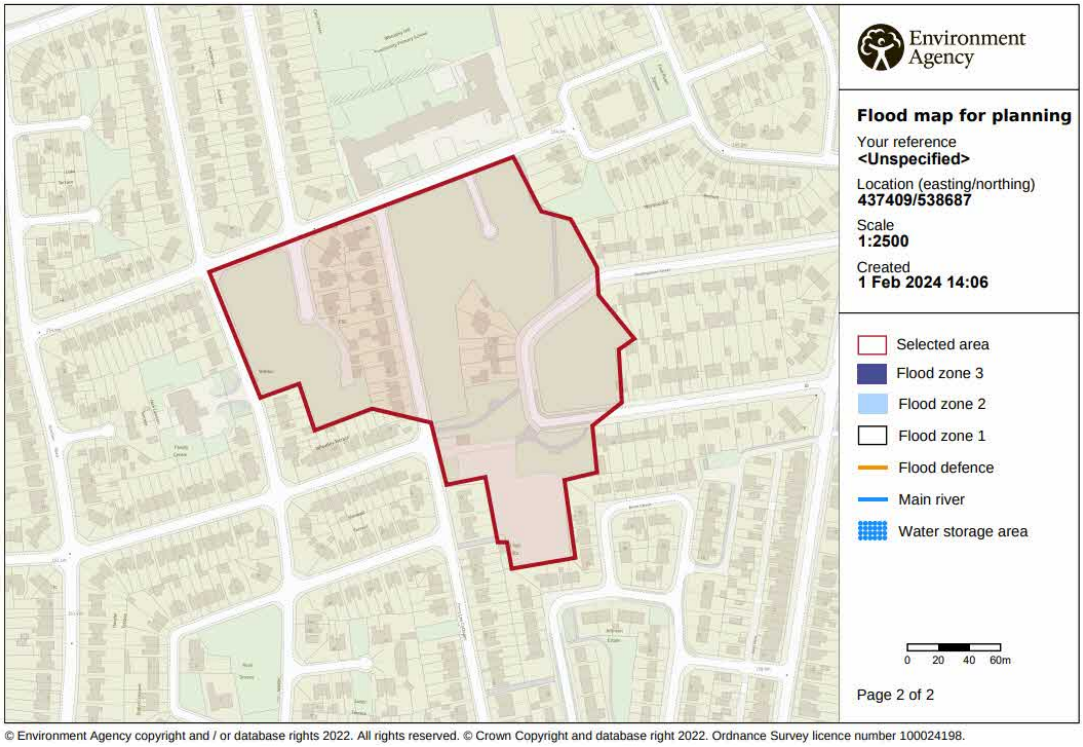
3. Potential Sources of Flooding And Proposed Mitigation

As required by the National Planning Policy Framework (NPPF) and Technical Guidance to the NPPF, each potential source of flooding needs to be considered; rivers and sea, land, groundwater, sewers and artificial sources (such as reservoirs and canals). Consideration also needs to be given to the flood risk vulnerability classification for this type of development.

3.1 Flood zone classification

Government flood maps have been acquired to help with this assessment. The flood maps indicate that the proposed development boundary is located entirely within an area classified as a Flood Zone 1.

Land located within a flood zone 1 is defined as having less than a 1 in 1,000 annual probability of flooding from rivers or the sea (low risk). Refer to the extract below which identifies the Flood Zones within and in proximity to the development site. The proposed residential units and access is not considered to be at risk of flooding from rivers or sea.



© Environment Agency copyright and / or database rights 2022. All rights reserved. © Crown Copyright and database right 2022. Ordnance Survey licence number 100024198.

Figure 3.11 – Flood zone map.

3.2 Flood Risk Vulnerability Classification

Table 2 of the Technical Guidance to the National Planning Policy Framework states the following with respect to flood risk vulnerability classification.

More vulnerable

Hospitals.

Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels.

Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels.

Non–residential uses for health services, nurseries and educational establishments.

Landfill and sites used for waste management facilities for hazardous waste.

Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan

Table 3 of the Technical Guidance to the National Planning Policy Framework states the following with respect to appropriate land uses:

Table 3: flood risk vulnerability and flood zone 'compaibility'

Flood Risk Vulnerability Classification (See Table 2)	Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	✓	Exception Test required	✓	✓
Zone 3a	Exception Test required	✓	x	Exception Test required	✓
Zone 3b functional floodplain	Exception Test required	✓	x	x	x

Key: ✓ Development is appropriate.
X Development should not be permitted.

An exception test will not be required in this instance as development is located outside of a flood zone 2 or flood zone 3.

3.3 Surface water flood risk

Surface water flood risk mapping indicates that the development area lies almost entirely within an area classified as having a very low risk of surface water flooding as is indicated in the figures below.

A small portion of the development at the north eastern extent of Area B is shown to be at low risk of flooding.

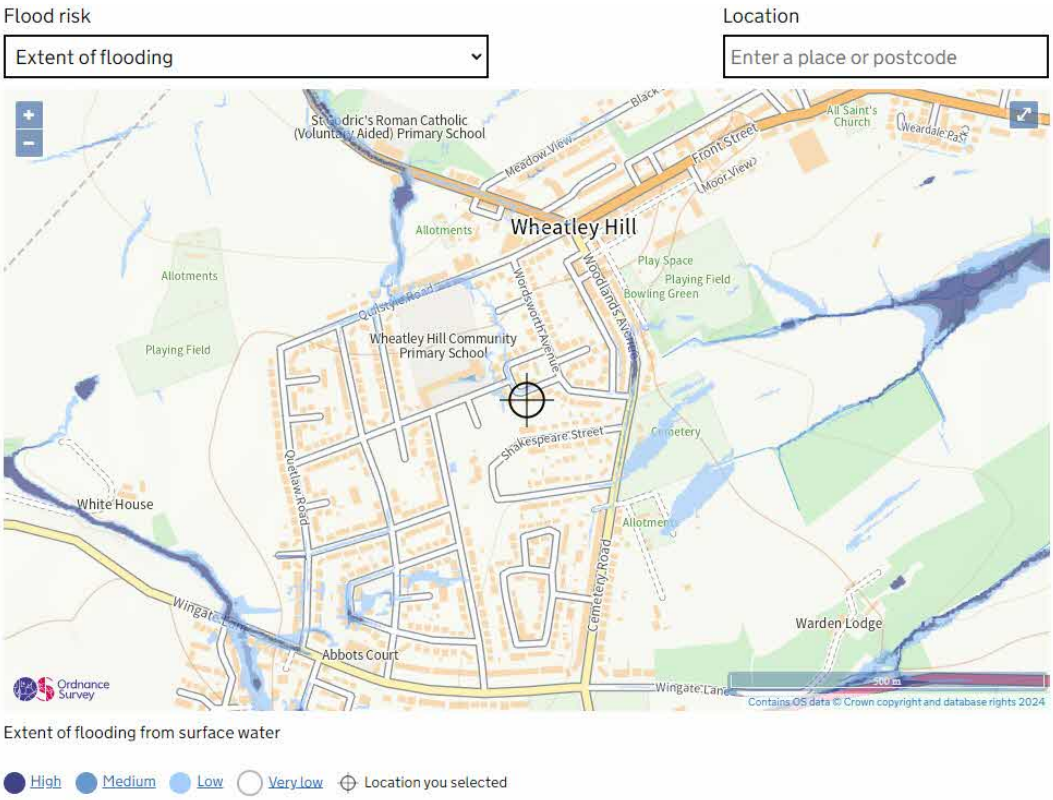


Figure 3.31 – Surface water risk.

The introduction of a positive surface water drainage system will mitigate against the issue and as such, the post development risk of flooding due to surface water can be considered very low.

3.4 Ground water flood risk

Flooding due to ground water occurs when the levels of water below the ground rise and emanate above finished ground level. This occurs more frequently when the site is underlain by a permeable strata. As noted earlier, the site is underlain by glacial clays with a low permeability.

The phase 2 assessment of ground conditions completed by Sirius Geotechnical Limited reference C9843/GAR states *"The investigation has identified predominantly stiff and very stiff high strength slightly sandy slightly gravelly clay (glacial till). Limestone (dolostone) bedrock, encountered at shallow depth in some locations in the north and south of the site, at depths ranging from 1.25m to 2.8m BGL. In the central area of the site, bedrock was not encountered within exploratory holes and rockhead is anticipated to be in excess of circa 3m BGL. Groundwater was not encountered during the investigation."*

Therefore, the risk of flooding due to ground water rise may be considered low throughout the site.

3.5 Reservoir flood risk

Artificial sources of flood risk such as man-made ponds or reservoirs can cause a potential risk of flooding. Reservoir flood risk mapping shows that there is no potential flooding of the site from reservoirs, therefore the risk of flooding due to this source can be deemed low.

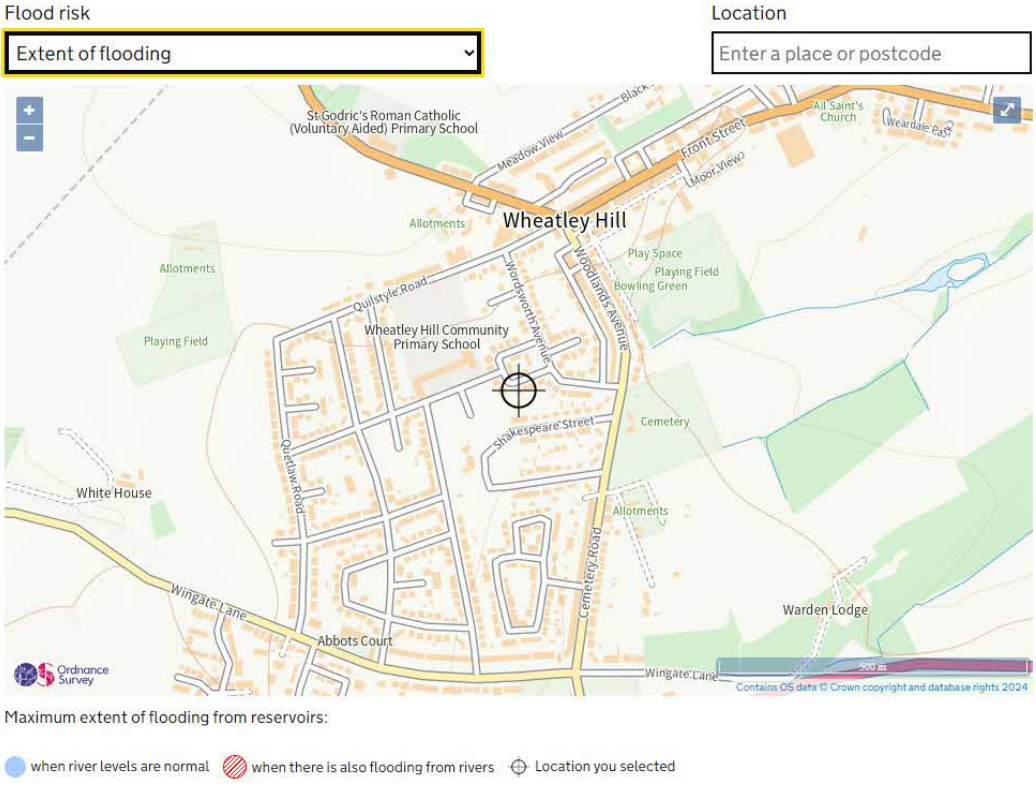


Figure 3.51 – Reservoir Flood Risk

4. Surface and Foul Water Disposal

Part H of the Building Regulations 2010 provides a recommended hierarchy for surface water disposal:

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

4.1 Infiltration

As noted earlier, the site is indicated to be underlain by drift deposits which comprise of stiff clays which are predominantly impermeable deposits and therefore unsuitable for the use of infiltration techniques for the disposal of surface water.

4.2 Watercourse

There are no watercourses located within the vicinity of the site. The nearest watercourse is an unnamed watercourse located approximately 250m to the east of the site beyond 3rd party land.

4.3 Sewer

Surface water should discharge to the existing combined sewers. A pre-planning submission has been made to NWL. Their full response is contained in Appendix B. An excerpt is shown below in figure 4.31.

- Surface Water Discharge

No surface water flow from the proposed development will be allowed to connect into the existing public sewerage system unless it is proven that the alternative options which are listed within Part H of the Building Regulations 2003 are not available:

Rainwater from a system provided pursuant to sub-paragraphs (1) or (2) shall discharge to one of the following, listed in order of priority –

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

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

(c) a sewer.

If the more sustainable options prove to be unfeasible, the flows can discharge as follows:
Site A = a restricted surface water flow of **3.5 l/sec** would be permitted to discharge into the **150/225mm** diameter **combined** public sewer to the rear of 28 Wheatley Terrace via manhole **3602.**
Site B = a restricted surface water flow of **10 l/sec** would be permitted to discharge into the **225mm** diameter **combined** public sewer to the front of 20 Burns Street via manhole **5705**. Any excess in flows must be attenuated on site.

Figure 4.31 – NWL response.

4.4 SuDS Techniques

In line with National Planning Policy, SuDS techniques are to be utilised as part of the design of the surface water network. As the development is an infill site, with no substantial areas of open space, the techniques available are limited. The applicable techniques and the benefits that they bring to the development are outlined below.

Source control: Vortex flow controls will be utilised to restrict flows to predevelopment greenfield rates. Attenuated flows will be stored in cellular storage systems and oversized pipes.

Source Control: Private driveways will be constructed with a permeable surfacing. Permeable surfaces can provide benefits such as reduced peak flows to the watercourse, reduced effects of pollution in run-off to the environment and can assist with the reduction of surface ponding.

4.5 Post development discharge rate

Proposed surface water discharge rates should be limited from the development to the equivalent to the predevelopment (Qbar) green field run off rate for all storms up to and including 1 in 100 year return period rainfall event + 45% increase in rainfall intensity to account for the predicted effects of climate change. To calculate the allowable discharge rate, it is necessary to first calculate the developable area. The developable area is defined as: The whole site area minus significant areas of public open space should be used.

Based upon the formula, the developable area for Site A is 0.527 Ha and Site B is 2.113 Ha respectively (2.640 Ha total).

In line with national and local standards the greenfield run off rate for the areas 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 2.5 l/s for Area A 10 l/s for Area B. An assessment of the allowable discharge rate is outlined below in figure 4.51.

The greenfield run-off rates supersede the allowable discharge rate for Area A, with a lesser figure of 2.5 l/s in comparison to NWL's allowable rate of 3.5 l/s. The allowable rate for Area B is in line with the NWL figures.

Greenfield runoff rates	Default	Edited
Q_{BAR} (l/s):	2.49	2.49
1 in 1 year (l/s):	2.14	2.14
1 in 30 years (l/s):	4.36	4.36
1 in 100 year (l/s):	5.18	5.18
1 in 200 years (l/s):	5.9	5.9

Greenfield runoff rates	Default	Edited
Q_{BAR} (l/s):	9.98	9.98
1 in 1 year (l/s):	8.59	8.59
1 in 30 years (l/s):	17.47	17.47
1 in 100 year (l/s):	20.77	20.77
1 in 200 years (l/s):	23.66	23.66

Figure 4.51 Greenfield run off rates.

4.6 Surface water attenuation

The allowable discharge rate from the entire site is 12.50 l/s. Surface water should be restricted for all events up to and including the 100-year event with a 45% allowance for climate change and a 10% allowance for urban creep. Attenuated flows should be contained on site within designated storage systems. Please refer to the detailed calculations and drainage strategy contained within Appendix E.

By restricting the peak rate of discharge from the site as set out above, 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	Existing	Proposed	Betterment
Qbar	12.50 l/s	12.50 l/s	0%
30	21.83 l/s	12.50 l/s	43%
100	25.95 l/s	12.50 l/s	52%
100+45%	37.62 l/s	12.50 l/s	67%

5. Foul Water Disposal

5.1 Proposed foul water drainage

The proposed foul water should discharge to the combined sewer, in line with NWL predevelopment response contained within Appendix B.

6. References

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

National Planning Policy Framework 2021.

Technical Guidance to the National Planning Policy Framework March 2021.

Environment Agency online flood maps.

Design and Construction Guidance - WRC plc.

Building Regulations Document H.

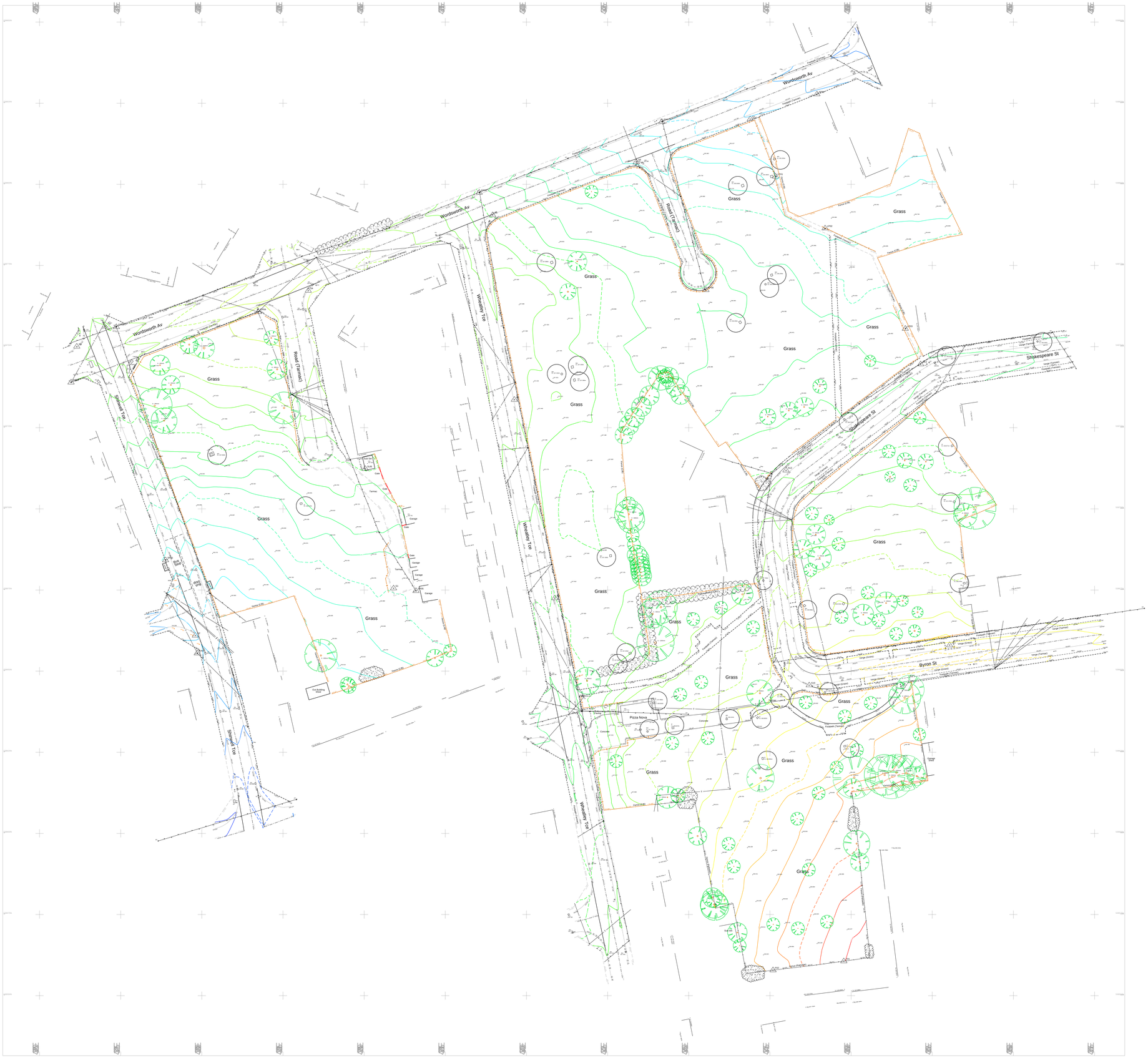
Improving the Flood Performance of New Buildings – Defra.

Rainfall runoff management for developments SC030219 – Defra.

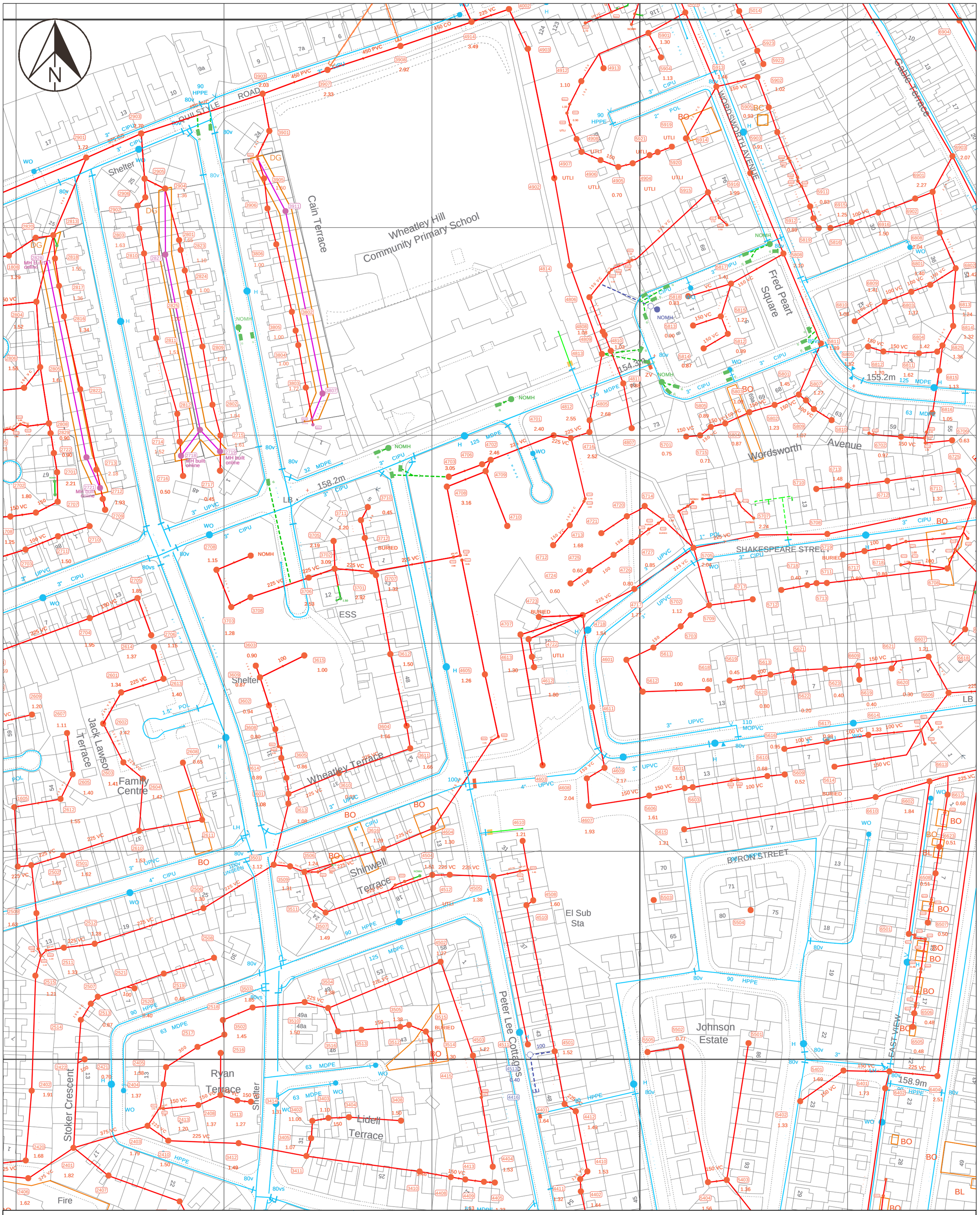
Susdrain.org

The SuDS Manual CIRIA C753.

Appendix A –
Topographical Survey


Wordsworth Av
Wordsworth Av
Wordsworth Av
Road (Tarmac)
Road (Tarmac)
Wrealthy Tce
Wrealthy Tce
Wrealthy Tce
Wrealthy Tce
Shirwell Tce
Shirwell Tce
Shakespeare St
Shakespeare St
Byron St
Grass
Grass
Grass

Appendix B –
Sewer Records and NWL correspondence



User : BOWMS
Date : 18/05/2023 13:58:12
Map Sheet : NZ3738NW
Title :
Centre Point : 437428,538718
Paper / Scale : A2@1:1250

The material contained on this plot has been reproduced from an Ordnance Survey map with permission of the controller of H.M.S.O. Crown Copyright Reserved. Licence No.100022480.
The information shown on this plan should be regarded as approximate and is intended for guidance only. No Liability of any kind whatsoever is accepted by Northumbrian Water, it's servants or agents for any omission. The actual position of any water mains or sewers shown on the plan must be established by taking trial holes in all cases. In the case of water mains Northumbrian Water must be given two working days notice of their intention to excavate trial holes. With effect from 1 October 2011, private lateral drains and sewers automatically transferred to Northumbrian Water under a scheme made by the Secretary of State pursuant to section 105A Water Industry Act 1991. These former private drains and sewers together with existing private connections may not be shown but their presence should be anticipated. WARNING...Where indicated on the plan there could be abandoned asbestos cement materials or shards of pipe. If excavating in the vicinity of these abandoned asbestos cement materials, the appropriate Health & Safety precautions should be taken. Northumbrian Water accepts no liability in respect of claims, costs, losses or other liabilities which arise as the result of the presence of the pipes or any failure to take adequate precautions. Emergency Telephone Number: 0345 717 1100

10 m

Northumbrian Water
Developer Services
Leat House
Pattinson Road
Washington
NE38 8LB

Direct Line: 07596315994
Email: developmentenquiries@nwl.co.uk
Our Ref: 306531

Tuesday, 30 May 2023

Gleeson Developments Ltd
6 Delta Bank Road
Metro Riverside Way
Gateshead
NE11 9DJ

Dear James,

Re: Pre-Planning Enquiry – Jack Lawson Terrace

Further to the Point of Connection Application for the above site, received May 19th 2023, we are now able to provide the following response.

We have based our response on the information in your application and accompanying correspondence. Therefore, should any of the information now be different, then you must ensure that you inform us of any changes as further Network Modelling may be required and our response may also change, leading to this response being invalid.

Northumbrian Water assesses the impact of the proposed development on our assets and assesses the capacity within our network's to accommodate and treat the anticipated flows arising from the development. We do not therefore offer comment on aspects of planning applications that are outside of our area of control.

Enclosed in this response is a scaled plan showing the approximate position of the water and sewerage networks within the vicinity of this site.

We have changed the way contractors and developers can access our assets.

Historically only our own staff and framework contractors could access our sewerage network. As of 1st January 2018, we are allowing third party contractors to access our sewer network on a site by site basis, subject to certain conditions.

Further information (including how to apply) is available from our web site - https://www.nwl.co.uk/services/developers/developer-sewerage-services/

Also enclosed is our extract showing locations within the approximate vicinity of this site that have, from our records, experienced flooding. This has been provided to demonstrate the known flood risks within the vicinity which have been considered as part of our assessment on this enquiry.

We have also carried out a review of your application and can confirm the following:

Sewerage and Sewage Treatment

Northumbrian Water would ask that you please separate the foul and surface water flows in accordance with Part H of the Building Regulations prior to the final connection to the public sewer.

All new connections to the public sewerage system must first be approved through the Section 106 of the Water Industry Act 1991 process prior to construction.

Should you decide to proceed with this development, a fully completed Sewer Connection application form will be required. These are available to download from the following link:

https://www.nwl.co.uk/services/developers/developer-sewerage-services/new-sewer-connections-s106/

Foul Water Discharge

The foul flows from the two sites can discharge without restriction as follows:
Site A (smaller portion to the west) into the 150/225mm diameter combined public sewer to the rear of 28 Wheatley Terrace via manhole 3602.
Site B (larger portion to the east) into the 225mm diameter combined public sewer to the front of 20 Burns Street via manhole 5705.

Surface Water Discharge

No surface water flow from the proposed development will be allowed to connect into the existing public sewerage system unless it is proven that the alternative options which are listed within Part H of the Building Regulations 2003 are not available:

Rainwater from a system provided pursuant to sub-paragraphs (1) or (2) shall discharge to one of the following, listed in order of priority –

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

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

(c) a sewer.

If the more sustainable options prove to be unfeasible, the flows can discharge as follows:
Site A = a restricted surface water flow of 3.5 l/sec would be permitted to discharge into the 150/225mm diameter combined public sewer to the rear of 28 Wheatley Terrace via manhole 3602.
Site B = a restricted surface water flow of 10 l/sec would be permitted to discharge into the 225mm diameter combined public sewer to the front of 20 Burns Street via manhole 5705. Any excess in flows must be attenuated on site.

For information

The Lead Local Flood Authority may require surface water flows to discharge at a different rate to that which has been agreed by Northumbrian Water. As the statutory consultee on flood risk and drainage matters, they have the authority to do so therefore, we suggest that you contact them to discuss this in further detail.

Written approval for all individual connections (direct or indirect) to the public sewerage system should be obtained through the Section 106 process, following completion of the detailed drainage design and before the commencement of any drainage works on site.

Protection of Existing Sewerage Assets

We wish to draw your attention to the existing sewers which pass through the site. These sewers could be diverted, protected or accommodated within your site layout with an appropriate easement.

Part H of the Building Regulations also details the reasons why Northumbrian Water does not permit buildings to be built over or near to its sewerage network:

Undue risk in the event of failure of the drain or sewer
Maintaining access
Protection of the drain or sewer during construction
Protection from settlement
Protection against piling

To discuss the diversion of this asset in further detail, please contact:

Steve O'Hair
07802 679008
steve.o'hair@nwl.co.uk

Sewage Treatment Capacity

The Sewage Treatment Works to which this development finally discharges to is Horden and these works are able to accept the additional flows.

Please note that this response is valid for 1 year only and you should resubmit your proposals should this period lapse prior to your development beginning.

Should you require any further assistance or information, then please do not hesitate to contact me at developmentenquiries@nwl.co.uk or alternatively on 07596315994, please quote our reference number above in any future correspondence.

Yours sincerely,

[redacted]

Laura Roberts
Technical Support Advisor
Developer Services

Appendix C –
Architectural Layout

JACK LAWSON TERRACE WHEATLEY HILL

sketch housing layout

..\..\..\..\Gleeson_Strapline_Master BIG.jpg

HOUSE TYPE SCHEDULE

Moy	2 bed bungalow	8
Greystones	2 bed semi-det	9
Glin	3 bed semi-det	15
Neale	3 bed semi-det	4
Limerick	3 bed detached	3
Strade	3 bed detached	3
Clifden	3 bed corner det	8
Milford	3 bed detached	11
Dalkey	4 bed detached	8
Blessington	4 bed detached	9
		78

* Denotes 67% M4(2) compliant house types: 57% Houses plus 10% Bungalows.

100% House types NDSS compliant.

Ⓐ Denotes proposed Affordable Housing plot.

Existing trees and hedgerow

Existing trees and hedgerow, dead, felled or to be removed

Public Right of Way №13

Gross Site Area = 6.56 Acres (2.65 Hectares)
Net Developable Area = 5.89 Acres (2.38 Hectares)

0 5m 10m 20m 50m

C 20.09.23 Red line corrected.
Plots 39-41 amended to suit. (DLM)

B 15.09.23 Survey info. added.
Red line amended to suit surveyed boundaries
Plots 78-81 amended to suit surveyed manhole position.
Amended as Gleeson Design Review comments:
Affordable Housing plots noted.
Plots 16-17 & 18-19 handed.
Type substitutions to Plots 21, 36, 71 & 73.
Plots 20-21 & 22 switched.
Plots 11 & 14 and Plots 32 & 55 switched.
Plots 13 & 14 switched. Twin garage added for Plots 12 & 13.
Plots 20-32 amended generally to facilitate Sales garage.
Show homes noted.
Garage added to Plot 52.
PROW №13 identified and noted.
Boundary to №13 Byron Street amended.
Easement for proposed foul sewer connection added.
General amendments to suit existing service positions.
Proposed car park by others added. (DLM)

A 10.02.23 Plots 47-49 omitted. (DLM)

revisions

1. Do not scale off drawing
2. All dimensions to be checked on site
3. Any discrepancy between drawn and specified information to be notified immediately
4. If in doubt - ASK

Layout based on Topographical Site Survey and OS information provided by client. Some existing tree and hedgerow are digitised from satelite imagery and are therefore indicative only. All external boundaries to be checked against the Land Registry title plan prior to commencement on site and any discrepancies to be notified to ACER Architectural Limited.

All materials, landscape details and boundary treatments are subject to approval by the Local Planning Authority.

..\..\..\..\Company Logos\ACER architectural LOGO.jpg

ACER architectural
Design & Planning Services

..\..\..\..\Company Logos\ACER david rushby

client
Gleeson

project
Land at
Jack Lawson Terrace
Wheatley Hill, Co. Durham

drawing title
SKETCH HOUSING LAYOUT

drg. no. 2215.03.01 rev C
scale 1:500 @ A1
date July 2022
drawn by DLM
checked by DLM

The Well Garden, Branton C
Great Ouseburn, North Yorks, YO26 9RT
Tel: 01423 579105
Email: Mail@ACERarchitectural.co.uk

© COPYRIGHT ACER ARCHITECTURAL LIMITED

Appendix D –
Extract from Phase 2 report

Executive Summary

Proposed Development	Sirius Geotechnical Ltd was commissioned by Gleeson Regeneration Ltd to undertake a geoenvironmental appraisal of two parcels of land at Jack Lawson Terrace, Wheatley Hill. It is understood that consideration is being given to development of the site with low-rise 1 to 3 storey residential houses/bungalows and associated infrastructure.
The Site	The site is split into two parcels (eastern and western parcels), with a combined area of approximately 2.7ha, nested within an existing housing estate. The two areas are irregular to rectangular in shape and comprise flat lying grassed public open space that were formerly occupied by housing and industrial units/depots.
Ground & Groundwater Conditions	The investigation has identified made ground, locally overlain by reworked topsoil, to depths typically ranging between 0.15m and 0.65m, but locally up to 2.4m bgl in the south west of the eastern parcel, overlying predominantly stiff and very stiff high strength slightly sandy slightly gravelly clay (glacial till). Limestone (dolostone) bedrock was encountered at shallow depth in some locations in the north and south of the site, at depths ranging from 1.25m to 2.8m bgl. In the central area of the site, bedrock was not encountered within exploratory holes and rockhead is anticipated to be in excess of circa 3m bgl. Groundwater was not encountered during the investigation.
Ground Stability	All soils should be assumed to be unstable in the short term within all excavations to any depth, and appropriate support should be provided to all excavations.
Foundations and Floor Slabs	Traditional shallow strip foundations are considered suitable across most of the site, placed at a minimum depth of 0.9m, although deepened locally to mitigate the effects of trees. Increased depths should be expected particularly around the site perimeter where trees are present. Some localised deepening of foundations may be required where made ground is potentially up to 2.4m thick below plot footprints. Ground bearing floor slabs may be suitable across most of the site, subject to made ground thicknesses on completion for example as a consequence of any site reprofiling, and where soils are affected by trees. Suspended floor slabs will be required where made ground thicknesses exceed 600mm.
Sulphate Class	Cohesive made ground: DS-1 and AC-2z Topsoil, granular made ground and natural superficial soils: DS-1 and AC-1
Contamination	Elevated concentrations of aromatic hydrocarbons (C16-C35 fractions) were detected towards the base of the made ground soils in the south west of the eastern parcel, in the vicinity of TP26. The most significant impacts were observed to be associated with gravel bedding surrounding a relict drain encountered in TP26E.
Asbestos	ACMs (chrysotile cement product fragments) and chrysotile and amosite asbestos fibres have been detected within shallow granular made ground soils, and locally on the ground surface.

Outline Remedial Requirements	Remedial action is required for the potentially site wide asbestos impacted made ground soils and localised hydrocarbon impacted soils. Asbestos Impacted Soils: CAT B engineer to hand pick visible ACM fragments on ground surface. Excavation and removal of impacted soils off site to a suitable disposal facility; or Provision of a suitable cover soil system and geotextile membrane or hard dig layer where impacted soils remain within areas of gardens and landscaping. Hydrocarbon Impacted Soils: Excavation and removal of impacted soils off site to a suitable disposal facility and validation of surrounding and underlying soils.
Soakaway Testing	Based on the results of soakaway testing during the investigation, soakaway drainage is considered non-viable at the site within glacial till strata.
Ground Gas	Based on the ground gas conceptual site model, the site is considered to be representative of Characteristic Situation 1 (CS1) conditions. No gas protection measures are required for the construction of new dwellings or extensions. No radon protective measures are required.
Invasive and Protected Species	No evidence of any invasive or protected species was observed during the investigation, however it is recommended that the absence or otherwise of invasive species is confirmed by a qualified ecological consultant.

The executive summary is an overview of the key findings and conclusions of the report. There may be other information contained in the body of the report which puts into context the findings of the executive summary. No reliance should be placed on the executive summary in isolation, particularly when deriving design detail/abnormal costs.

Appendix E –
Proposed Drainage Layout and Calculations

Greenfield runoff ra estimation for sit

www.uksuds.com | Greenfield runoff

Calculated by:	Richard Hall
Site name:	Area A Wheatley Hill
Site location:	Durham

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:	54.74212° N
Longitude:	1.42204° W
Reference:	3060020414
Date:	Nov 27 2023 12:03

Runoff estimation approach

IH124

Site characteristics

Total site area (ha): 0.527

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):	687	687
Hydrological region:	3	3
Growth curve factor 1 year:	0.86	0.86
Growth curve factor 30 years:	175	175
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 ≤ 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):	2.49	2.49
1 in 1 year (l/s):	2.14	2.14
1 in 30 years (l/s):	4.36	4.36
1 in 100 year (l/s):	5.18	5.18
1 in 200 years (l/s):	5.9	5.9

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.

Greenfield runoff rate estimation for sit

www.uksuds.com | Greenfield runoff

Calculated by:	Richard Hall
Site name:	Area B Wheatley Hill
Site location:	Durham

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:	54.74212° N
Longitude:	1.42204° W
Reference:	3507662122
Date:	Nov 27 2023 12:04

Runoff estimation approach

IH124

Site characteristics

Total site area (ha): 2.1139

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):	687	687
Hydrological region:	3	3
Growth curve factor 1 year:	0.86	0.86
Growth curve factor 30 years:	1.75	1.75
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 ≤ 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):	9.98	9.98
1 in 1 year (l/s):	8.59	8.59
1 in 30 years (l/s):	17.47	17.47
1 in 100 year (l/s):	20.77	20.77
1 in 200 years (l/s):	23.66	23.66

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.

A1

Wheatley Terrace

Proposed Foul Sewer Connection

Telegraph pole to be relocated

Sub Sta

3703 CL:157.034 IL:155.754

3705 2.19

3706 2.53 IL:156.175

3708

3710 0.45

3711 1.20

3712

3701 2.92

3702 3.09

3707 1.32

3612 1.50

3615 1.00

3603 0.90

3602 0.94

3608 0.00

3607

3606 0.02

3605 0.86

3610

3604 1.66

3611 1.65

2708 1.15

NOM H

150Ø

100Ø

225Ø

Do not scale

© Coast Consulting Engineers Ltd.

Issue	Date	Description	By	Chkd	Appd
P1	02.02.24	Preliminary Issue	RH	RH	PL

COAST CONSULTING ENGINEERS
7 Silverton Court, Northumberland Business Park, NE23 7RY
0191 5977879

Client
GLEESON HOMES LTD

Job Title
JACK LAWSON TCE

Drawing Title
EXISTING SEWERS
SHEET 1

Scale at A1
1:250

Drawing Status
PRELIMINARY

Job No	Drawing No	Issue
23066	01	P1

A0

Car Park
by others

Electricity pole &
overhead cable
to be removed

Telegraph
pole to be
relocated

Ex. Sewer Easement

Proposed Sewer Diversion

PROW №13

NO ENTRY

NO EXIT

Wordsworth Av

SHAKESPEARE STR

Ex. Sewer Easement

Street sign &
electricity pole to
be relocated

Electricity pole to
be relocated

Ex. Fast
Food Outlet

Electricity pole &
overhead cable
to be removed

Proposed Sewer Diversion

BYRON STREE

Il Terrace

Sub Sta

Show Home

Show Home

Issue	Date	Description	By	Chkd	Appd
P1	02.02.24	Preliminary Issue	RH	RH	PL

COAST CONSULTING ENGINEERS
7 Silverton Court, Northumberland Business Park, NE23 7RY
0191 5977879

Client
GLEESON HOMES LTD

Job Title
JACK LAWSON TCE

Drawing Title
EXISTING SEWERS
SHEET 2

Scale at A0
1:250

Drawing Status
PRELIMINARY

Job No	Drawing No	Issue
23066	02	P1

© Coast Consulting Engineers Ltd.

A1

LEGEND:

- EXISTING SEWER TO REMAIN
- SEWER TO BE ABANDONED
- PROPOSED DIVERTED SEWER

Proposed Foul Sewer Connection

Telegraph pole to be relocated

Wheatley Terrace

Issue	Date	Description	By	Chkd	Appd
P1	02.02.24	Preliminary Issue	RH	RH	PL

COAST CONSULTING ENGINEERS

7 Silverton Court, Northumberland Business Park, NE23 7RY
0191 5977879

Client

GLEESON HOMES LTD

Job Title

JACK LAWSON TCE

Drawing Title

PROPOSED SEWER ABANDONMENT SHEET 1

Scale at A1

1:250

Drawing Status

PRELIMINARY

Job No	Drawing No	Issue
23066	03	P1

© Coast Consulting Engineers Ltd.

Do not scale

A0

Car Park
by others

Electricity pole &
overhead cable
to be removed

Wordsworth Av

PROW №13

Telegraph
pole to be
relocated

Ex. Sewer Easement

Show
Home

Street sign &
electricity pole to
be relocated

Ex. Sewer Easement

SHAKESPEARE STR

Electricity pole to
be relocated

Proposed Sewer Diversion

Ex. Fast
Food Outlet

Electricity pole &
overhead cable
to be removed

BYRON STREE

ll Terrace

Sub Sta

© Coast Consulting Engineers Ltd.

LEGEND:

- EXISTING SEWER TO REMAIN
- SEWER TO BE ABANDONED
- PROPOSED DIVERTED SEWER

Issue	Date	Description	By	Chkd	Appd
P1	02.02.24	Preliminary Issue	RH	RH	PL

COAST CONSULTING ENGINEERS

7 Silverton Court, Northumberland Business Park, NE23 7RY
0191 5977879

Client: GLEESON HOMES LTD

Job Title: JACK LAWSON TCE

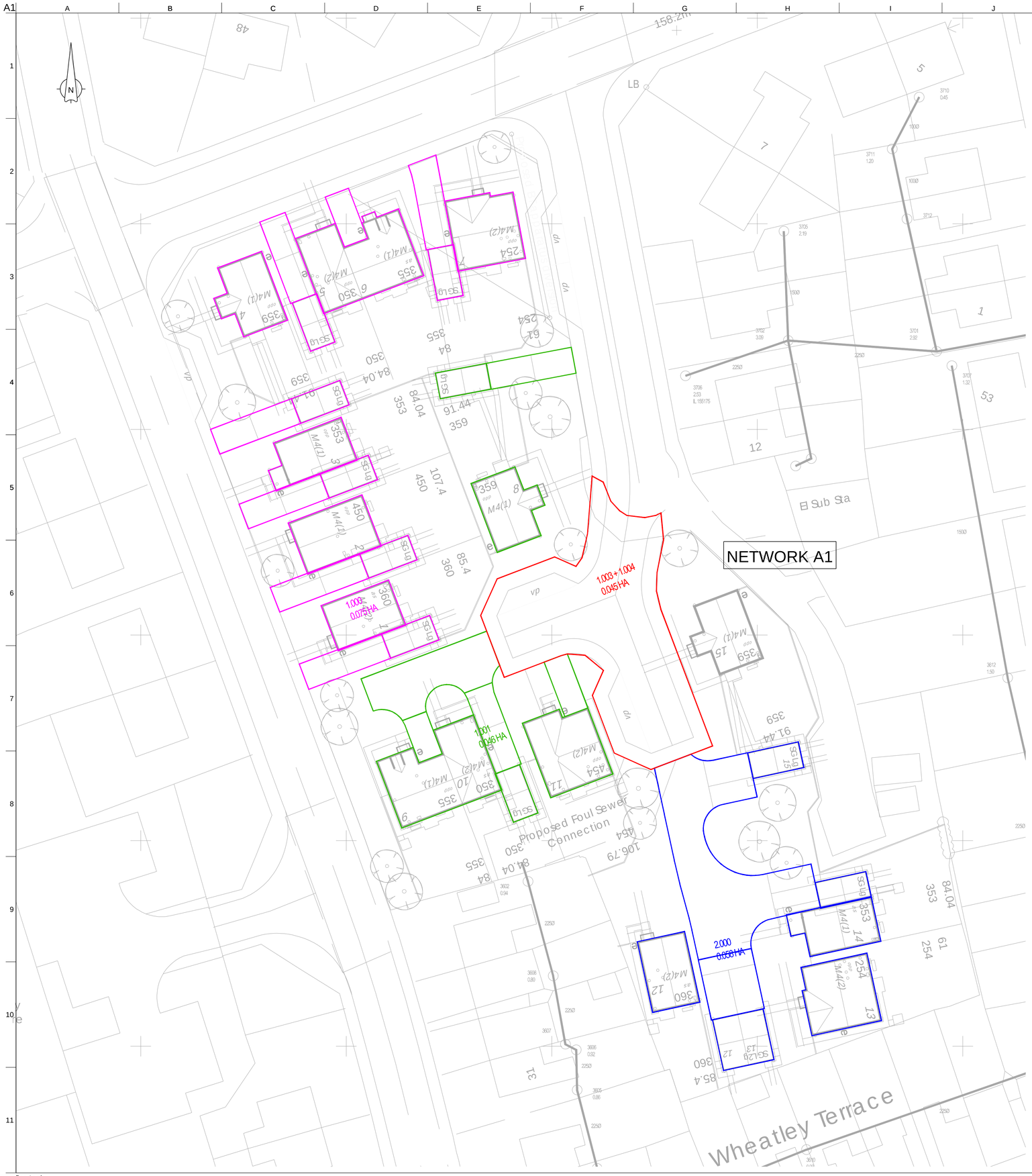
Drawing Title: PROPOSED SEWER ABANDONMENT SHEET 2

Scale at A0: 1:250

Drawing Status: **PRELIMINARY**

Job No	Drawing No	Issue
23066	04	P1

A1


NETWORK A1
1.003 + 1.004
0.045 HA
1.003
0.075 HA
1.001
0.046 HA
2.000
0.050 HA
Proposed Foul Sewer Connection
Wheatley Terrace
LB
48
158.2m
5
7
1
53
12
15
14
13
11
10
9
61
31
M4(1)
M4(2)
SCL19
SCL20
SCL21
SCL22
SCL23
SCL24
SCL25
SCL26
SCL27
SCL28
SCL29
SCL30
SCL31
SCL32
SCL33
SCL34
SCL35
SCL36
SCL37
SCL38
SCL39
SCL40
SCL41
SCL42
SCL43
SCL44
SCL45
SCL46
SCL47
SCL48
SCL49
SCL50
SCL51
SCL52
SCL53
SCL54
SCL55
SCL56
SCL57
SCL58

A0

NETWORK B3

NETWORK B4

NETWORK B2

NETWORK B5

NETWORK B5

NETWORK B6

Car Park by others

Electricity pole & overhead cable to be removed

Proposed Sewer Diversion

PROW №13

Ex. Sewer Easement

Telegraph pole to be relocated

Ex. Fast Food Outlet

Electricity pole & overhead cable to be removed

Street sign & electricity pole to be relocated

Electricity pole to be relocated

Proposed Sewer Diversion

Ex. Sewer Easement

Wordsworth A

SHAKESPEARE ST

BYRON STRE

Tinwell Terrace

Issue	Date	Description	By	Chkd	Appd
P1	02.02.24	Preliminary Issue	RH	RH	PL

COAST CONSULTING ENGINEERS

7 Silverton Court, Northumberland Business Park, NE23 7RY
0191 5977879

Client: GLEESON HOMES LTD

Job Title: JACK LAWSON TCE

Drawing Title: IMPERMEABLE AREAS SHEET 2

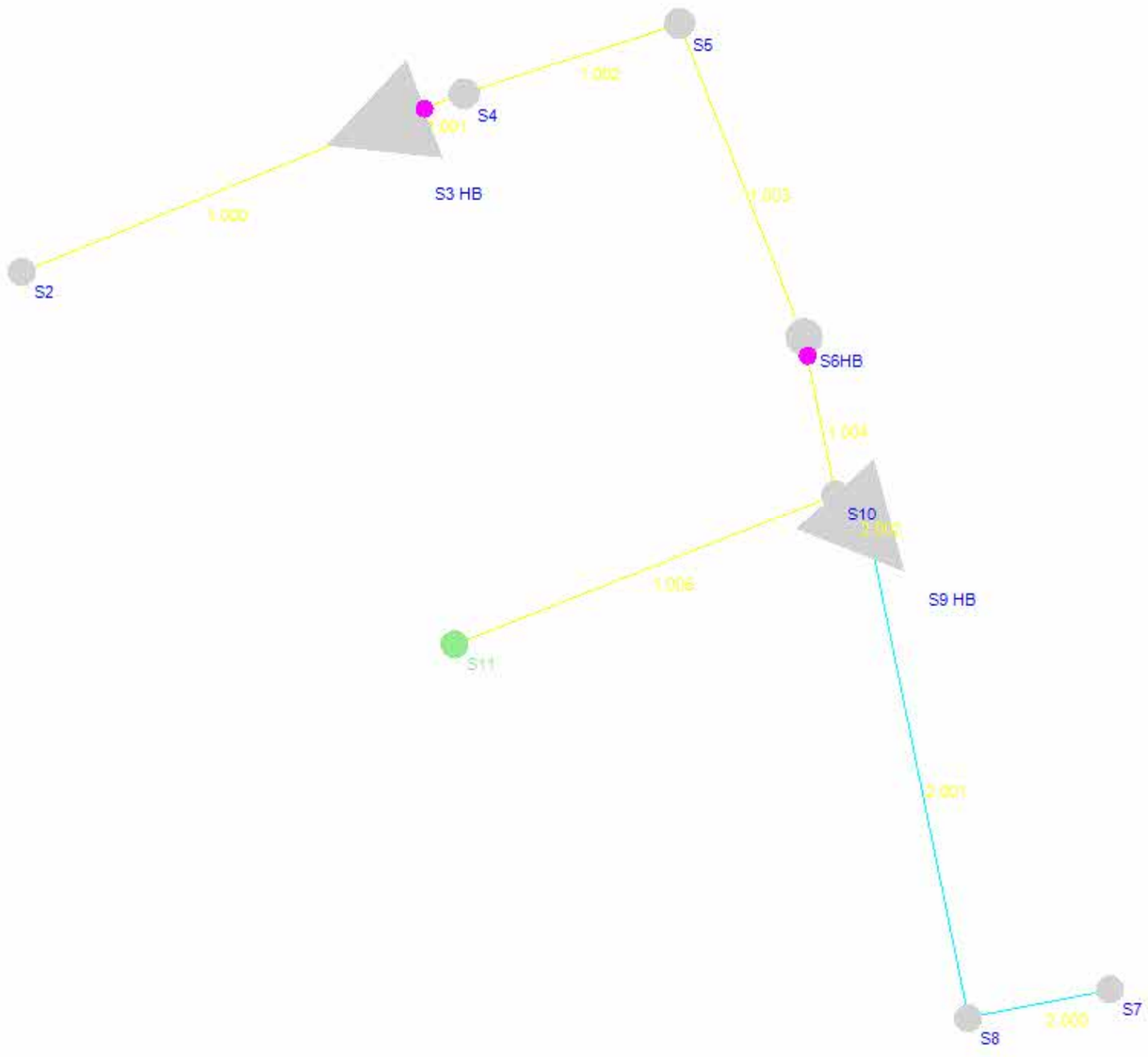
Scale at A0: 1:250

Drawing Status: **PRELIMINARY**

Job No	Drawing No	Issue
23066	06	P1

©Coast Consulting Engineers Ltd

Coast Consulting Engineers Ltd		Page 1
Suite 6, Vita House Fish Quay North Shields NE30 1JA		
Date 04/02/2024 11:47 File Area A1.mdx	Designed by rh Checked by	
Innovyze	Network 2020.1	



©1982-2020 Innovyze

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Surface Network 1

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	18.238	0.103	177.1	0.075	5.00	0.0	0.600	o	225	Pipe/Conduit	
1.001	4.480	0.026	172.3	0.046	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	10.815	0.036	300.4	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.003	16.062	0.036	446.2	0.022	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.004	7.640	0.051	149.8	0.023	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	6.914	0.046	150.3	0.058	5.00	0.0	0.600	o	225	Pipe/Conduit	
2.001	23.566	0.047	501.4	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.002	2.474	0.016	154.6	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.005	19.534	0.130	150.3	0.000	0.00	0.0	0.600	o	150	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	5.31	154.891	0.075	0.0	0.0	0.0	0.98	38.9	0.0
1.001	0.00	5.39	154.788	0.121	0.0	0.0	0.0	0.99	39.5	0.0
1.002	0.00	5.54	154.537	0.121	0.0	0.0	0.0	1.17	185.7	0.0
1.003	0.00	5.82	154.501	0.143	0.0	0.0	0.0	0.96	152.0	0.0
1.004	0.00	5.98	154.465	0.166	0.0	0.0	0.0	0.82	14.5	0.0
2.000	0.00	5.11	154.650	0.058	0.0	0.0	0.0	1.06	42.3	0.0
2.001	0.00	5.79	154.604	0.058	0.0	0.0	0.0	0.58	23.0	0.0
2.002	0.00	5.84	154.557	0.058	0.0	0.0	0.0	0.81	14.2	0.0
1.005	0.00	6.37	154.414	0.224	0.0	0.0	0.0	0.82	14.4	0.0

Free Flowing Outfall Details for Surface Network 1

Outfall Pipe Number	Outfall Name	C.Level (m)	I.Level (m)	Min I.Level (m)	D,L (mm)	W (mm)
1.005	S11	155.315	154.284	154.284	1350	0

©1982-2020 Innovyze

Simulation Criteria for Surface Network 1

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 Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	2
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)	17.000	Storm Duration (mins)	30
Ratio R	0.344		

©1982-2020 Innovyze

Online Controls for Surface Network 1

Hydro-Brake® Optimum Manhole: S3 HB, DS/PN: 1.001, Volume (m³): 5.2

Unit Reference	MD-SHE-0059-2000-1712-2000
Design Head (m)	1.712
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	59
Invert Level (m)	154.788
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.712	2.0
Flush-Flo™	0.261	1.4
Kick-Flo®	0.527	1.2
Mean Flow over Head Range	-	1.5

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	1.2	1.200	1.7	3.000	2.6	7.000	3.8
0.200	1.4	1.400	1.8	3.500	2.8	7.500	4.0
0.300	1.4	1.600	1.9	4.000	3.0	8.000	4.1
0.400	1.4	1.800	2.0	4.500	3.1	8.500	4.2
0.500	1.2	2.000	2.1	5.000	3.3	9.000	4.3
0.600	1.2	2.200	2.2	5.500	3.4	9.500	4.4
0.800	1.4	2.400	2.3	6.000	3.6		
1.000	1.6	2.600	2.4	6.500	3.7		

Hydro-Brake® Optimum Manhole: S6HB, DS/PN: 1.004, Volume (m³): 7.3

Unit Reference	MD-SHE-0049-1500-1955-1500
Design Head (m)	1.955
Design Flow (l/s)	1.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	49
Invert Level (m)	154.465
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

©1982-2020 Innovyze

Hydro-Brake® Optimum Manhole: S6HB, DS/PN: 1.004, Volume (m³): 7.3

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.955	1.5
Flush-Flo™	0.217	0.9
Kick-Flo®	0.438	0.8
Mean Flow over Head Range	-	1.1

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	0.8	1.200	1.2	3.000	1.8	7.000	2.7
0.200	0.9	1.400	1.3	3.500	2.0	7.500	2.8
0.300	0.9	1.600	1.4	4.000	2.1	8.000	2.9
0.400	0.8	1.800	1.4	4.500	2.2	8.500	2.9
0.500	0.8	2.000	1.5	5.000	2.3	9.000	3.0
0.600	0.9	2.200	1.6	5.500	2.4	9.500	3.1
0.800	1.0	2.400	1.6	6.000	2.5		
1.000	1.1	2.600	1.7	6.500	2.6		

Hydro-Brake® Optimum Manhole: S9 HB, DS/PN: 2.002, Volume (m³): 5.0

Unit Reference	MD-SHE-0041-1000-1630-1000
Design Head (m)	1.630
Design Flow (l/s)	1.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	41
Invert Level (m)	154.557
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.630	1.0
Flush-Flo™	0.181	0.6
Kick-Flo®	0.371	0.5
Mean Flow over Head Range	-	0.7

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	0.6	0.300	0.6	0.500	0.6	0.800	0.7
0.200	0.6	0.400	0.5	0.600	0.6	1.000	0.8

©1982-2020 Innovyze

Hydro-Brake® Optimum Manhole: S9 HB, DS/PN: 2.002, Volume (m³): 5.0

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
1.200	0.9	2.400	1.2	5.000	1.7	8.000	2.1
1.400	0.9	2.600	1.2	5.500	1.7	8.500	2.1
1.600	1.0	3.000	1.3	6.000	1.8	9.000	2.2
1.800	1.0	3.500	1.4	6.500	1.9	9.500	2.2
2.000	1.1	4.000	1.5	7.000	1.9		
2.200	1.1	4.500	1.6	7.500	2.0		

©1982-2020 Innovyze

Storage Structures for Surface Network 1

Cellular Storage Manhole: S3 HB, DS/PN: 1.001

Invert Level (m) 154.788 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	90.0	0.0	0.801	0.0	0.0
0.800	90.0	0.0			

Cellular Storage Manhole: S9 HB, DS/PN: 2.002

Invert Level (m) 154.557 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	58.5	0.0	0.401	0.0	0.0
0.400	58.5	0.0			

©1982-2020 Innovyze

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

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	2
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	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	17.300	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)	2
Climate Change (%)	0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S2	15 Winter	2	+0%					154.978
1.001	S3 HB	240 Winter	2	+0%					154.951
1.002	S4	360 Winter	2	+0%					154.905
1.003	S5	360 Winter	2	+0%					154.905
1.004	S6HB	360 Winter	2	+0%	2/15 Summer				154.905
2.000	S7	15 Winter	2	+0%					154.732
2.001	S8	15 Winter	2	+0%					154.705
2.002	S9 HB	240 Winter	2	+0%					154.664
1.005	S10	120 Summer	2	+0%					154.446

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S2	-0.138	0.000	0.31			10.9	OK	
1.001	S3 HB	-0.062	0.000	0.04		186	1.2	OK	
1.002	S4	-0.082	0.000	0.01			1.0	OK	
1.003	S5	-0.046	0.000	0.01			1.1	OK	
1.004	S6HB	0.290	0.000	0.07			0.9	SURCHARGED	

©1982-2020 Innovyze

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
2.000	S7	-0.143	0.000	0.28			8.5	OK	
2.001	S8	-0.124	0.000	0.41			8.5	OK	
2.002	S9 HB	-0.043	0.000	0.05		161	0.5	OK	
1.005	S10	-0.118	0.000	0.10			1.4	OK	

©1982-2020 Innovyze

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Surface Network 1

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	18.238	0.103	177.1	0.075	5.00	0.0	0.600	o	225	Pipe/Conduit	
1.001	4.480	0.026	172.3	0.046	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	10.815	0.036	300.4	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.003	16.062	0.036	446.2	0.022	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.004	7.640	0.051	149.8	0.023	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	6.914	0.046	150.3	0.058	5.00	0.0	0.600	o	225	Pipe/Conduit	
2.001	23.566	0.047	501.4	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.002	2.474	0.016	154.6	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.005	19.534	0.130	150.3	0.000	0.00	0.0	0.600	o	150	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	5.31	154.891	0.075	0.0	0.0	0.0	0.98	38.9	0.0
1.001	0.00	5.39	154.788	0.121	0.0	0.0	0.0	0.99	39.5	0.0
1.002	0.00	5.54	154.537	0.121	0.0	0.0	0.0	1.17	185.7	0.0
1.003	0.00	5.82	154.501	0.143	0.0	0.0	0.0	0.96	152.0	0.0
1.004	0.00	5.98	154.465	0.166	0.0	0.0	0.0	0.82	14.5	0.0
2.000	0.00	5.11	154.650	0.058	0.0	0.0	0.0	1.06	42.3	0.0
2.001	0.00	5.79	154.604	0.058	0.0	0.0	0.0	0.58	23.0	0.0
2.002	0.00	5.84	154.557	0.058	0.0	0.0	0.0	0.81	14.2	0.0
1.005	0.00	6.37	154.414	0.224	0.0	0.0	0.0	0.82	14.4	0.0

Free Flowing Outfall Details for Surface Network 1

Outfall Pipe Number	Outfall Name	C.Level (m)	I.Level (m)	Min I.Level (m)	D,L (mm)	W (mm)
1.005	S11	155.315	154.284	154.284	1350	0

©1982-2020 Innovyze

Simulation Criteria for Surface Network 1

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 Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	2
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)	17.000	Storm Duration (mins)	30
Ratio R	0.344		

©1982-2020 Innovyze

Online Controls for Surface Network 1

Hydro-Brake® Optimum Manhole: S3 HB, DS/PN: 1.001, Volume (m³): 5.2

Unit Reference	MD-SHE-0059-2000-1712-2000
Design Head (m)	1.712
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	59
Invert Level (m)	154.788
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.712	2.0
Flush-Flo™	0.261	1.4
Kick-Flo®	0.527	1.2
Mean Flow over Head Range	-	1.5

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	1.2	1.200	1.7	3.000	2.6	7.000	3.8
0.200	1.4	1.400	1.8	3.500	2.8	7.500	4.0
0.300	1.4	1.600	1.9	4.000	3.0	8.000	4.1
0.400	1.4	1.800	2.0	4.500	3.1	8.500	4.2
0.500	1.2	2.000	2.1	5.000	3.3	9.000	4.3
0.600	1.2	2.200	2.2	5.500	3.4	9.500	4.4
0.800	1.4	2.400	2.3	6.000	3.6		
1.000	1.6	2.600	2.4	6.500	3.7		

Hydro-Brake® Optimum Manhole: S6HB, DS/PN: 1.004, Volume (m³): 7.3

Unit Reference	MD-SHE-0049-1500-1955-1500
Design Head (m)	1.955
Design Flow (l/s)	1.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	49
Invert Level (m)	154.465
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

©1982-2020 Innovyze

Hydro-Brake® Optimum Manhole: S6HB, DS/PN: 1.004, Volume (m³): 7.3

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.955	1.5
Flush-Flo™	0.217	0.9
Kick-Flo®	0.438	0.8
Mean Flow over Head Range	-	1.1

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	0.8	1.200	1.2	3.000	1.8	7.000	2.7
0.200	0.9	1.400	1.3	3.500	2.0	7.500	2.8
0.300	0.9	1.600	1.4	4.000	2.1	8.000	2.9
0.400	0.8	1.800	1.4	4.500	2.2	8.500	2.9
0.500	0.8	2.000	1.5	5.000	2.3	9.000	3.0
0.600	0.9	2.200	1.6	5.500	2.4	9.500	3.1
0.800	1.0	2.400	1.6	6.000	2.5		
1.000	1.1	2.600	1.7	6.500	2.6		

Hydro-Brake® Optimum Manhole: S9 HB, DS/PN: 2.002, Volume (m³): 5.0

Unit Reference	MD-SHE-0041-1000-1630-1000
Design Head (m)	1.630
Design Flow (l/s)	1.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	41
Invert Level (m)	154.557
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.630	1.0
Flush-Flo™	0.181	0.6
Kick-Flo®	0.371	0.5
Mean Flow over Head Range	-	0.7

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	0.6	0.300	0.6	0.500	0.6	0.800	0.7
0.200	0.6	0.400	0.5	0.600	0.6	1.000	0.8

©1982-2020 Innovyze

Hydro-Brake® Optimum Manhole: S9 HB, DS/PN: 2.002, Volume (m³): 5.0

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
1.200	0.9	2.400	1.2	5.000	1.7	8.000	2.1
1.400	0.9	2.600	1.2	5.500	1.7	8.500	2.1
1.600	1.0	3.000	1.3	6.000	1.8	9.000	2.2
1.800	1.0	3.500	1.4	6.500	1.9	9.500	2.2
2.000	1.1	4.000	1.5	7.000	1.9		
2.200	1.1	4.500	1.6	7.500	2.0		

©1982-2020 Innovyze

Storage Structures for Surface Network 1

Cellular Storage Manhole: S3 HB, DS/PN: 1.001

Invert Level (m) 154.788 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	90.0	0.0	0.801	0.0	0.0
0.800	90.0	0.0			

Cellular Storage Manhole: S9 HB, DS/PN: 2.002

Invert Level (m) 154.557 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	58.5	0.0	0.401	0.0	0.0
0.400	58.5	0.0			

©1982-2020 Innovyze

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

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	2
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	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	17.300	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)	30
Climate Change (%)	0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S2	360 Winter	30	+0%	30/120 Winter				155.198
1.001	S3 HB	360 Winter	30	+0%	30/60 Summer				155.197
1.002	S4	180 Winter	30	+0%	30/30 Winter				155.160
1.003	S5	180 Winter	30	+0%	30/30 Winter				155.160
1.004	S6HB	180 Winter	30	+0%	30/15 Summer				155.160
2.000	S7	15 Winter	30	+0%					154.773
2.001	S8	240 Winter	30	+0%					154.772
2.002	S9 HB	240 Winter	30	+0%	30/60 Summer				154.770
1.005	S10	180 Winter	30	+0%					154.448

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S2	0.082	0.000	0.09			3.2	SURCHARGED	
1.001	S3 HB	0.184	0.000	0.04		417	1.2	SURCHARGED	
1.002	S4	0.173	0.000	0.01			0.9	SURCHARGED	
1.003	S5	0.209	0.000	0.01			1.1	SURCHARGED	
1.004	S6HB	0.545	0.000	0.08			0.9	SURCHARGED	

©1982-2020 Innovyze

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
2.000	S7	-0.102	0.000	0.53			16.0	OK	
2.001	S8	-0.057	0.000	0.16			3.3	OK	
2.002	S9 HB	0.063	0.000	0.06		236	0.6	SURCHARGED	
1.005	S10	-0.116	0.000	0.12			1.6	OK	

©1982-2020 Innovyze

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Surface Network 1

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	18.238	0.103	177.1	0.075	5.00	0.0	0.600	o	225	Pipe/Conduit	
1.001	4.480	0.026	172.3	0.046	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	10.815	0.036	300.4	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.003	16.062	0.036	446.2	0.022	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.004	7.640	0.051	149.8	0.023	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	6.914	0.046	150.3	0.058	5.00	0.0	0.600	o	225	Pipe/Conduit	
2.001	23.566	0.047	501.4	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.002	2.474	0.016	154.6	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.005	19.534	0.130	150.3	0.000	0.00	0.0	0.600	o	150	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	5.31	154.891	0.075	0.0	0.0	0.0	0.98	38.9	0.0
1.001	0.00	5.39	154.788	0.121	0.0	0.0	0.0	0.99	39.5	0.0
1.002	0.00	5.54	154.537	0.121	0.0	0.0	0.0	1.17	185.7	0.0
1.003	0.00	5.82	154.501	0.143	0.0	0.0	0.0	0.96	152.0	0.0
1.004	0.00	5.98	154.465	0.166	0.0	0.0	0.0	0.82	14.5	0.0
2.000	0.00	5.11	154.650	0.058	0.0	0.0	0.0	1.06	42.3	0.0
2.001	0.00	5.79	154.604	0.058	0.0	0.0	0.0	0.58	23.0	0.0
2.002	0.00	5.84	154.557	0.058	0.0	0.0	0.0	0.81	14.2	0.0
1.005	0.00	6.37	154.414	0.224	0.0	0.0	0.0	0.82	14.4	0.0

Free Flowing Outfall Details for Surface Network 1

Outfall Pipe Number	Outfall Name	C.Level (m)	I.Level (m)	Min I.Level (m)	D,L (mm)	W (mm)
1.005	S11	155.315	154.284	154.284	1350	0

©1982-2020 Innovyze

Simulation Criteria for Surface Network 1

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 Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	2
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)	17.000	Storm Duration (mins)	30
Ratio R	0.344		

©1982-2020 Innovyze

Online Controls for Surface Network 1

Hydro-Brake® Optimum Manhole: S3 HB, DS/PN: 1.001, Volume (m³): 5.2

Unit Reference	MD-SHE-0059-2000-1712-2000
Design Head (m)	1.712
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	59
Invert Level (m)	154.788
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.712	2.0
Flush-Flo™	0.261	1.4
Kick-Flo®	0.527	1.2
Mean Flow over Head Range	-	1.5

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	1.2	1.200	1.7	3.000	2.6	7.000	3.8
0.200	1.4	1.400	1.8	3.500	2.8	7.500	4.0
0.300	1.4	1.600	1.9	4.000	3.0	8.000	4.1
0.400	1.4	1.800	2.0	4.500	3.1	8.500	4.2
0.500	1.2	2.000	2.1	5.000	3.3	9.000	4.3
0.600	1.2	2.200	2.2	5.500	3.4	9.500	4.4
0.800	1.4	2.400	2.3	6.000	3.6		
1.000	1.6	2.600	2.4	6.500	3.7		

Hydro-Brake® Optimum Manhole: S6HB, DS/PN: 1.004, Volume (m³): 7.3

Unit Reference	MD-SHE-0049-1500-1955-1500
Design Head (m)	1.955
Design Flow (l/s)	1.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	49
Invert Level (m)	154.465
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

©1982-2020 Innovyze

Hydro-Brake® Optimum Manhole: S6HB, DS/PN: 1.004, Volume (m³): 7.3

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.955	1.5
Flush-Flo™	0.217	0.9
Kick-Flo®	0.438	0.8
Mean Flow over Head Range	-	1.1

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	0.8	1.200	1.2	3.000	1.8	7.000	2.7
0.200	0.9	1.400	1.3	3.500	2.0	7.500	2.8
0.300	0.9	1.600	1.4	4.000	2.1	8.000	2.9
0.400	0.8	1.800	1.4	4.500	2.2	8.500	2.9
0.500	0.8	2.000	1.5	5.000	2.3	9.000	3.0
0.600	0.9	2.200	1.6	5.500	2.4	9.500	3.1
0.800	1.0	2.400	1.6	6.000	2.5		
1.000	1.1	2.600	1.7	6.500	2.6		

Hydro-Brake® Optimum Manhole: S9 HB, DS/PN: 2.002, Volume (m³): 5.0

Unit Reference	MD-SHE-0041-1000-1630-1000
Design Head (m)	1.630
Design Flow (l/s)	1.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	41
Invert Level (m)	154.557
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.630	1.0
Flush-Flo™	0.181	0.6
Kick-Flo®	0.371	0.5
Mean Flow over Head Range	-	0.7

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	0.6	0.300	0.6	0.500	0.6	0.800	0.7
0.200	0.6	0.400	0.5	0.600	0.6	1.000	0.8

©1982-2020 Innovyze

Hydro-Brake® Optimum Manhole: S9 HB, DS/PN: 2.002, Volume (m³): 5.0

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
1.200	0.9	2.400	1.2	5.000	1.7	8.000	2.1
1.400	0.9	2.600	1.2	5.500	1.7	8.500	2.1
1.600	1.0	3.000	1.3	6.000	1.8	9.000	2.2
1.800	1.0	3.500	1.4	6.500	1.9	9.500	2.2
2.000	1.1	4.000	1.5	7.000	1.9		
2.200	1.1	4.500	1.6	7.500	2.0		

©1982-2020 Innovyze

Storage Structures for Surface Network 1

Cellular Storage Manhole: S3 HB, DS/PN: 1.001

Invert Level (m) 154.788 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	90.0	0.0	0.801	0.0	0.0
0.800	90.0	0.0			

Cellular Storage Manhole: S9 HB, DS/PN: 2.002

Invert Level (m) 154.557 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	58.5	0.0	0.401	0.0	0.0
0.400	58.5	0.0			

©1982-2020 Innovyze

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

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	2
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	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	17.300	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 (%)	45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S2	360 Winter	100	+45%	100/15 Summer				156.566
1.001	S3 HB	360 Winter	100	+45%	100/15 Summer				156.564
1.002	S4	360 Winter	100	+45%	100/15 Summer				156.411
1.003	S5	360 Winter	100	+45%	100/15 Summer				156.411
1.004	S6HB	360 Winter	100	+45%	100/15 Summer				156.410
2.000	S7	360 Winter	100	+45%	100/15 Summer				155.628
2.001	S8	360 Winter	100	+45%	100/15 Summer				155.627
2.002	S9 HB	360 Winter	100	+45%	100/15 Summer				155.625
1.005	S10	360 Winter	100	+45%					154.455

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S2	1.450	0.000	0.17			5.9	FLOOD RISK	
1.001	S3 HB	1.551	0.000	0.05		783	1.4	FLOOD RISK	
1.002	S4	1.424	0.000	0.01			1.3	FLOOD RISK	
1.003	S5	1.460	0.000	0.01			1.4	FLOOD RISK	
1.004	S6HB	1.795	0.000	0.12			1.5	FLOOD RISK	

©1982-2020 Innovyze

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	HalfDrain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
2.000	S7	0.753	0.000	0.15			4.6	SURCHARGED	
2.001	S8	0.798	0.000	0.22			4.5	FLOOD RISK	
2.002	S9 HB	0.918	0.000	0.08		475	0.8	SURCHARGED	
1.005	S10	-0.109	0.000	0.17			2.3	OK	

©1982-2020 Innovyze

Coast Consulting Engineers Ltd		Page 1
Suite 6, Vita House Fish Quay North Shields NE30 1JA		
Date 02/02/2024 14:29 File Area B2.mdx	Designed by rh Checked by	
Innovyze	Network 2020.1	

©1982-2020 Innovyze

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Surface Network 2

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	93.233	0.622	149.9	0.053	5.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	28.730	0.192	149.6	0.029	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	7.485	0.050	149.7	0.053	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	5.293	0.035	151.2	0.000	0.00	0.0	0.600	o	150	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	6.90	155.620	0.053	0.0	0.0	0.0	0.82	14.5	0.0
2.000	0.00	5.58	156.249	0.029	0.0	0.0	0.0	0.82	14.5	0.0
1.001	0.00	7.02	154.923	0.135	0.0	0.0	0.0	1.07	42.4	0.0
1.002	0.00	7.12	154.873	0.135	0.0	0.0	0.0	0.81	14.4	0.0

Free Flowing Outfall Details for Surface Network 2

Outfall Pipe Number	Outfall Name	C.Level (m)	I.Level (m)	Min I.Level (m)	D,L (mm)	W (mm)
1.002	4704	157.453	154.838	154.553	1200	0

Simulation Criteria for Surface Network 2

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 Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	1440
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

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

Synthetic Rainfall Details

©1982-2020 Innovyze

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)	17.700	Storm Duration (mins)	30
Ratio R	0.350		

©1982-2020 Innovyze

Online Controls for Surface Network 2

Hydro-Brake® Optimum Manhole: S12HB, DS/PN: 1.001, Volume (m³): 8.8

Unit Reference	MD-SHE-0037-1000-2648-1000
Design Head (m)	2.648
Design Flow (l/s)	1.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	37
Invert Level (m)	154.923
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.648	1.0	Kick-Flo®	0.330	0.4
Flush-Flo™	0.165	0.5	Mean Flow over Head Range	-	0.7

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	0.5	1.200	0.7	3.000	1.1	7.000	1.6
0.200	0.5	1.400	0.7	3.500	1.1	7.500	1.6
0.300	0.4	1.600	0.8	4.000	1.2	8.000	1.6
0.400	0.4	1.800	0.8	4.500	1.3	8.500	1.7
0.500	0.5	2.000	0.9	5.000	1.3	9.000	1.7
0.600	0.5	2.200	0.9	5.500	1.4	9.500	1.8
0.800	0.6	2.400	1.0	6.000	1.4		
1.000	0.6	2.600	1.0	6.500	1.5		

©1982-2020 Innovyze

Storage Structures for Surface Network 2

Cellular Storage Manhole: S12HB, DS/PN: 1.001

Invert Level (m) 154.923 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	60.0	0.0	1.201	0.0	0.0
1.200	60.0	0.0			

©1982-2020 Innovyze

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 2

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

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	17.200	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)	2
Climate Change (%)	0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S10	15 Winter	2	+0%					155.700
2.000	S11	15 Winter	2	+0%					156.306
1.001	S12HB	360 Winter	2	+0%	2/60 Winter				155.258
1.002	S13	120 Winter	2	+0%					154.892

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S10	-0.070	0.000	0.54			7.7	OK	
2.000	S11	-0.093	0.000	0.31			4.3	OK	
1.001	S12HB	0.110	0.000	0.01		391	0.5	SURCHARGED	
1.002	S13	-0.131	0.000	0.04			0.5	OK	

©1982-2020 Innovyze

Coast Consulting Engineers Ltd		Page 0
Suite 6, Vita House Fish Quay North Shields NE30 1JA	JACK LAWSON TCE AREA B2 30 YEAR	
Date 02/02/2024 File Area B2.mdx	Designed by RH Checked by PL	
Innovyze	Network 2020.1	

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Surface Network 2

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	93.233	0.622	149.9	0.053	5.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	28.730	0.192	149.6	0.029	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	7.485	0.050	149.7	0.053	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	5.293	0.035	151.2	0.000	0.00	0.0	0.600	o	150	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	6.90	155.620	0.053	0.0	0.0	0.0	0.82	14.5	0.0
2.000	0.00	5.58	156.249	0.029	0.0	0.0	0.0	0.82	14.5	0.0
1.001	0.00	7.02	154.923	0.135	0.0	0.0	0.0	1.07	42.4	0.0
1.002	0.00	7.12	154.873	0.135	0.0	0.0	0.0	0.81	14.4	0.0

Free Flowing Outfall Details for Surface Network 2

Outfall Pipe Number	Outfall Name	C.Level (m)	I.Level (m)	Min I.Level (m)	D,L (mm)	W (mm)
1.002	4704	157.453	154.838	154.553	1200	0

Simulation Criteria for Surface Network 2

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 Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	1440
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

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

Synthetic Rainfall Details

©1982-2020 Innovyze

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)	17.700	Storm Duration (mins)	30
Ratio R	0.350		

©1982-2020 Innovyze

Online Controls for Surface Network 2

Hydro-Brake® Optimum Manhole: S12HB, DS/PN: 1.001, Volume (m³): 8.8

Unit Reference	MD-SHE-0037-1000-2648-1000
Design Head (m)	2.648
Design Flow (l/s)	1.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	37
Invert Level (m)	154.923
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.648	1.0	Kick-Flo®	0.330	0.4
Flush-Flo™	0.165	0.5	Mean Flow over Head Range	-	0.7

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	0.5	1.200	0.7	3.000	1.1	7.000	1.6
0.200	0.5	1.400	0.7	3.500	1.1	7.500	1.6
0.300	0.4	1.600	0.8	4.000	1.2	8.000	1.6
0.400	0.4	1.800	0.8	4.500	1.3	8.500	1.7
0.500	0.5	2.000	0.9	5.000	1.3	9.000	1.7
0.600	0.5	2.200	0.9	5.500	1.4	9.500	1.8
0.800	0.6	2.400	1.0	6.000	1.4		
1.000	0.6	2.600	1.0	6.500	1.5		

©1982-2020 Innovyze

Storage Structures for Surface Network 2

Cellular Storage Manhole: S12HB, DS/PN: 1.001

Invert Level (m) 154.923 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	60.0	0.0	1.201	0.0	0.0
1.200	60.0	0.0			

©1982-2020 Innovyze

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 2

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

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	17.200	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)	30
Climate Change (%)	0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S10	15 Winter	30	+0%					155.750
2.000	S11	15 Winter	30	+0%					156.332
1.001	S12HB	360 Winter	30	+0%	30/15 Summer				155.596
1.002	S13	360 Winter	30	+0%					154.894

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S10	-0.020	0.000	0.94			13.4	OK	
2.000	S11	-0.067	0.000	0.58			8.1	OK	
1.001	S12HB	0.448	0.000	0.02		741	0.5	SURCHARGED	
1.002	S13	-0.129	0.000	0.05			0.5	OK	

©1982-2020 Innovyze

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Surface Network 2

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	93.233	0.622	149.9	0.053	5.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	28.730	0.192	149.6	0.029	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	7.485	0.050	149.7	0.053	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	5.293	0.035	151.2	0.000	0.00	0.0	0.600	o	150	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	6.90	155.620	0.053	0.0	0.0	0.0	0.82	14.5	0.0
2.000	0.00	5.58	156.249	0.029	0.0	0.0	0.0	0.82	14.5	0.0
1.001	0.00	7.02	154.923	0.135	0.0	0.0	0.0	1.07	42.4	0.0
1.002	0.00	7.12	154.873	0.135	0.0	0.0	0.0	0.81	14.4	0.0

Free Flowing Outfall Details for Surface Network 2

Outfall Pipe Number	Outfall Name	C.Level (m)	I.Level (m)	Min I.Level (m)	D,L (mm)	W (mm)
1.002	4704	157.453	154.838	154.553	1200	0

Simulation Criteria for Surface Network 2

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 Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	1440
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

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

Synthetic Rainfall Details

©1982-2020 Innovyze

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)	17.700	Storm Duration (mins)	30
Ratio R	0.350		

©1982-2020 Innovyze

Online Controls for Surface Network 2

Hydro-Brake® Optimum Manhole: S12HB, DS/PN: 1.001, Volume (m³): 8.8

Unit Reference	MD-SHE-0037-1000-2648-1000
Design Head (m)	2.648
Design Flow (l/s)	1.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	37
Invert Level (m)	154.923
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.648	1.0	Kick-Flo®	0.330	0.4
Flush-Flo™	0.165	0.5	Mean Flow over Head Range	-	0.7

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	0.5	1.200	0.7	3.000	1.1	7.000	1.6
0.200	0.5	1.400	0.7	3.500	1.1	7.500	1.6
0.300	0.4	1.600	0.8	4.000	1.2	8.000	1.6
0.400	0.4	1.800	0.8	4.500	1.3	8.500	1.7
0.500	0.5	2.000	0.9	5.000	1.3	9.000	1.7
0.600	0.5	2.200	0.9	5.500	1.4	9.500	1.8
0.800	0.6	2.400	1.0	6.000	1.4		
1.000	0.6	2.600	1.0	6.500	1.5		

©1982-2020 Innovyze

Storage Structures for Surface Network 2

Cellular Storage Manhole: S12HB, DS/PN: 1.001

Invert Level (m) 154.923 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	60.0	0.0	1.201	0.0	0.0
1.200	60.0	0.0			

©1982-2020 Innovyze

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 2

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

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	17.200	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

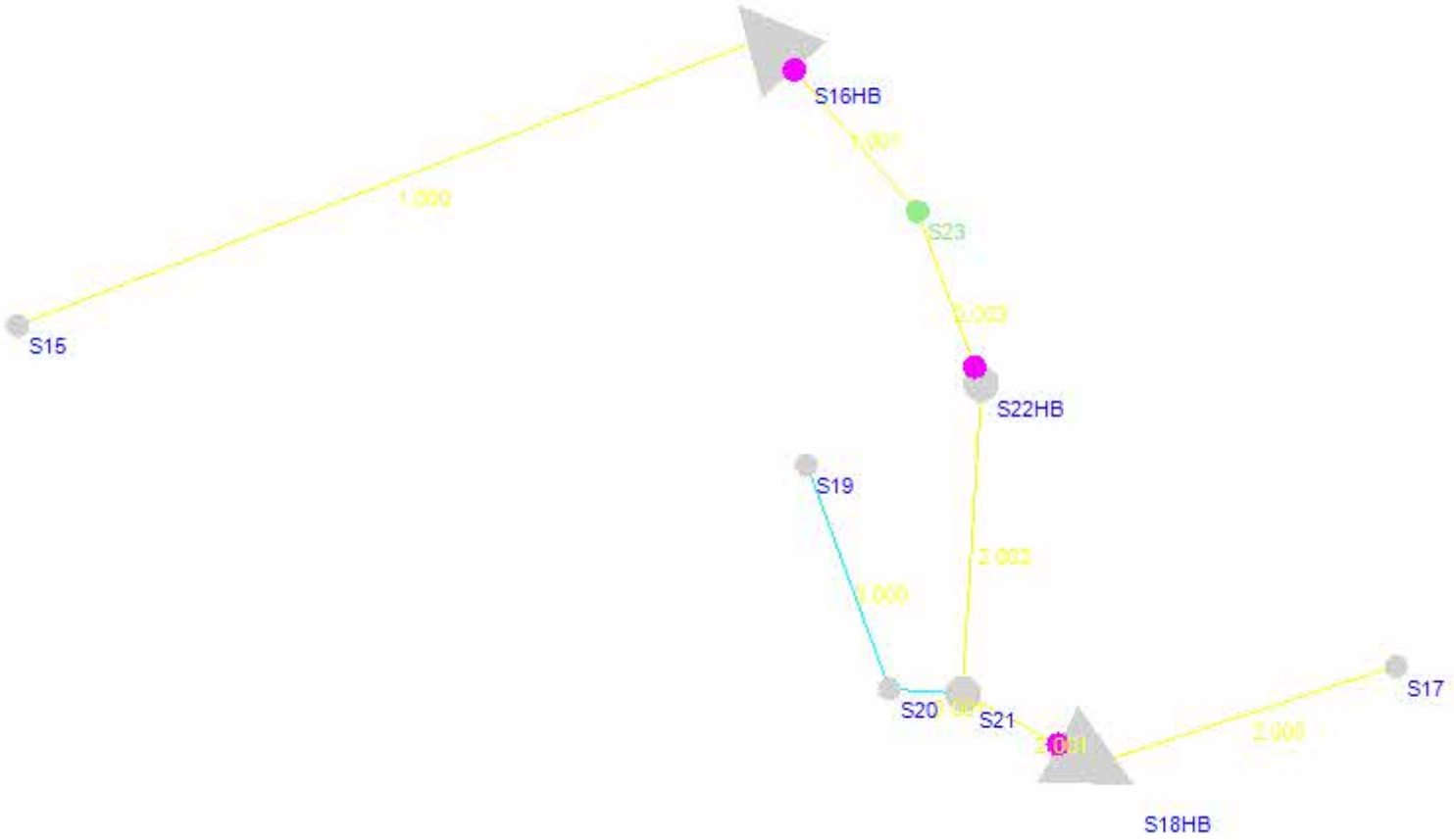
Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360
Return Period(s) (years)	100
Climate Change (%)	45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S10	360 Winter	100	+45%	100/15 Summer				157.048
2.000	S11	360 Winter	100	+45%	100/15 Winter				157.045
1.001	S12HB	360 Winter	100	+45%	100/15 Summer				157.044
1.002	S13	360 Winter	100	+45%					154.900

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S10	1.278	0.000	0.30			4.3	FLOOD RISK	
2.000	S11	0.646	0.000	0.17			2.4	SURCHARGED	
1.001	S12HB	1.896	0.000	0.03		1185	0.9	SURCHARGED	
1.002	S13	-0.123	0.000	0.08			0.9	OK	

©1982-2020 Innovyze

Coast Consulting Engineers Ltd		Page 1
Suite 6, Vita House Fish Quay North Shields NE30 1JA		
Date 02/02/2024 15:52 File Area B3.mdx	Designed by rh Checked by	
Innovyze	Network 2020.1	



©1982-2020 Innovyze

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Surface Network 3

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	46.625	1.875	24.9	0.024	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	13.401	0.800	16.8	0.024	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	18.375	0.123	149.4	0.042	5.00	0.0	0.600	o	150	Pipe/Conduit	
2.001	8.740	0.424	20.6	0.034	0.00	0.0	0.600	o	150	Pipe/Conduit	
3.000	13.833	0.092	150.4	0.033	5.00	0.0	0.600	o	150	Pipe/Conduit	
3.001	4.302	0.405	10.6	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.002	17.990	0.045	399.8	0.029	0.00	0.0	0.600	o	1050	Pipe/Conduit	
2.003	10.656	0.708	15.1	0.000	0.00	0.0	0.600	o	150	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	5.38	156.275	0.024	0.0	0.0	0.0	2.03	35.8	0.0
1.001	0.00	5.47	154.400	0.048	0.0	0.0	0.0	2.47	43.7	0.0
2.000	0.00	5.37	155.800	0.042	0.0	0.0	0.0	0.82	14.5	0.0
2.001	0.00	5.44	155.677	0.076	0.0	0.0	0.0	2.23	39.4	0.0
3.000	0.00	5.28	155.750	0.033	0.0	0.0	0.0	0.82	14.4	0.0
3.001	0.00	5.31	155.658	0.033	0.0	0.0	0.0	3.11	54.9	0.0
2.002	0.00	5.61	154.353	0.138	0.0	0.0	0.0	1.72	1487.0	0.0
2.003	0.00	5.68	154.308	0.138	0.0	0.0	0.0	2.61	46.1	0.0

Free Flowing Outfall Details for Surface Network 3

Outfall Pipe Number	Outfall Name	C.Level (m)	I.Level (m)	Min I.Level (m)	D,L (mm)	W (mm)
1.001	S23	156.900	153.600	153.600	1350	0

Free Flowing Outfall Details for Surface Network 3

Outfall Pipe Number	Outfall Name	C.Level (m)	I.Level (m)	Min I.Level (m)	D,L (mm)	W (mm)
2.003	S23	156.900	153.600	153.600	1350	0

©1982-2020 Innovyze

Simulation Criteria for Surface Network 3

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 Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	2
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)	17.000	Storm Duration (mins)	30
Ratio R	0.350		

©1982-2020 Innovyze

Online Controls for Surface Network 3

Hydro-Brake® Optimum Manhole: S16HB, DS/PN: 1.001, Volume (m³): 4.6

Unit Reference	MD-SHE-0042-1000-1500-1000
Design Head (m)	1.500
Design Flow (l/s)	1.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	42
Invert Level (m)	154.400
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	1.0
Flush-Flo™	0.186	0.7
Kick-Flo®	0.378	0.5
Mean Flow over Head Range	-	0.7

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	0.6	1.200	0.9	3.000	1.4	7.000	2.0
0.200	0.7	1.400	1.0	3.500	1.5	7.500	2.1
0.300	0.6	1.600	1.0	4.000	1.6	8.000	2.1
0.400	0.6	1.800	1.1	4.500	1.6	8.500	2.2
0.500	0.6	2.000	1.1	5.000	1.7	9.000	2.3
0.600	0.7	2.200	1.2	5.500	1.8	9.500	2.3
0.800	0.8	2.400	1.2	6.000	1.9		
1.000	0.8	2.600	1.3	6.500	1.9		

Hydro-Brake® Optimum Manhole: S18HB, DS/PN: 2.001, Volume (m³): 2.8

Unit Reference	MD-SHE-0051-1200-0998-1200
Design Head (m)	0.998
Design Flow (l/s)	1.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	51
Invert Level (m)	155.677
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

©1982-2020 Innovyze

Hydro-Brake® Optimum Manhole: S18HB, DS/PN: 2.001, Volume (m³): 2.8

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.998	1.2
Flush-Flo™	0.225	1.0
Kick-Flo®	0.458	0.8
Mean Flow over Head Range	-	1.0

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	0.9	1.200	1.3	3.000	2.0	7.000	2.9
0.200	1.0	1.400	1.4	3.500	2.1	7.500	3.0
0.300	1.0	1.600	1.5	4.000	2.2	8.000	3.1
0.400	1.0	1.800	1.6	4.500	2.4	8.500	3.2
0.500	0.9	2.000	1.6	5.000	2.5	9.000	3.3
0.600	1.0	2.200	1.7	5.500	2.6	9.500	3.4
0.800	1.1	2.400	1.8	6.000	2.7		
1.000	1.2	2.600	1.8	6.500	2.8		

Hydro-Brake® Optimum Manhole: S22HB, DS/PN: 2.003, Volume (m³): 20.5

Unit Reference	MD-SHE-0057-2000-1952-2000
Design Head (m)	1.952
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	57
Invert Level (m)	154.308
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.952	2.0
Flush-Flo™	0.250	1.3
Kick-Flo®	0.512	1.1
Mean Flow over Head Range	-	1.5

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	1.2	0.300	1.3	0.500	1.1	0.800	1.3
0.200	1.3	0.400	1.3	0.600	1.2	1.000	1.5

©1982-2020 Innovyze

Hydro-Brake® Optimum Manhole: S22HB, DS/PN: 2.003, Volume (m³): 20.5

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
1.200	1.6	2.400	2.2	5.000	3.1	8.000	3.8
1.400	1.7	2.600	2.3	5.500	3.2	8.500	3.9
1.600	1.8	3.000	2.4	6.000	3.4	9.000	4.1
1.800	1.9	3.500	2.6	6.500	3.5	9.500	4.2
2.000	2.0	4.000	2.8	7.000	3.6		
2.200	2.1	4.500	2.9	7.500	3.7		

©1982-2020 Innovyze

Storage Structures for Surface Network 3

Cellular Storage Manhole: S16HB, DS/PN: 1.001

Invert Level (m) 154.400 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	48.0	0.0	0.401	0.0	0.0
0.400	48.0	0.0			

Cellular Storage Manhole: S18HB, DS/PN: 2.001

Invert Level (m) 155.677 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	84.0	0.0	0.401	0.0	0.0
0.400	84.0	0.0			

©1982-2020 Innovyze

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 3

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	2
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	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	17.100	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)	2
Climate Change (%)	0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S15	15 Winter	2	+0%					156.307
1.001	S16HB	180 Winter	2	+0%					154.496
2.000	S17	15 Winter	2	+0%					155.871
2.001	S18HB	180 Winter	2	+0%					155.770
3.000	S19	15 Winter	2	+0%					155.813
3.001	S20	15 Winter	2	+0%					155.693
2.002	S21	120 Winter	2	+0%					154.686
2.003	S22HB	120 Winter	2	+0%	2/15 Summer				154.686

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	HalfDrain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S15	-0.118	0.000	0.10			3.4	OK	
1.001	S16HB	-0.054	0.000	0.02		101	0.6	OK	
2.000	S17	-0.079	0.000	0.45			6.1	OK	
2.001	S18HB	-0.057	0.000	0.03		116	0.9	OK	
3.000	S19	-0.087	0.000	0.36			4.8	OK	
3.001	S20	-0.115	0.000	0.12			4.8	OK	

©1982-2020 Innovyze

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 3

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
2.002	S21	-0.717	0.000	0.00			3.3	OK	
2.003	S22HB	0.228	0.000	0.03			1.3	SURCHARGED	

©1982-2020 Innovyze

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Surface Network 3

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	46.625	1.875	24.9	0.024	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	13.401	0.800	16.8	0.024	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	18.375	0.123	149.4	0.042	5.00	0.0	0.600	o	150	Pipe/Conduit	
2.001	8.740	0.424	20.6	0.034	0.00	0.0	0.600	o	150	Pipe/Conduit	
3.000	13.833	0.092	150.4	0.033	5.00	0.0	0.600	o	150	Pipe/Conduit	
3.001	4.302	0.405	10.6	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.002	17.990	0.045	399.8	0.029	0.00	0.0	0.600	o	1050	Pipe/Conduit	
2.003	10.656	0.708	15.1	0.000	0.00	0.0	0.600	o	150	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	5.38	156.275	0.024	0.0	0.0	0.0	2.03	35.8	0.0
1.001	0.00	5.47	154.400	0.048	0.0	0.0	0.0	2.47	43.7	0.0
2.000	0.00	5.37	155.800	0.042	0.0	0.0	0.0	0.82	14.5	0.0
2.001	0.00	5.44	155.677	0.076	0.0	0.0	0.0	2.23	39.4	0.0
3.000	0.00	5.28	155.750	0.033	0.0	0.0	0.0	0.82	14.4	0.0
3.001	0.00	5.31	155.658	0.033	0.0	0.0	0.0	3.11	54.9	0.0
2.002	0.00	5.61	154.353	0.138	0.0	0.0	0.0	1.72	1487.0	0.0
2.003	0.00	5.68	154.308	0.138	0.0	0.0	0.0	2.61	46.1	0.0

Free Flowing Outfall Details for Surface Network 3

Outfall Pipe Number	Outfall Name	C.Level (m)	I.Level (m)	Min I.Level (m)	D,L (mm)	W (mm)
1.001	S23	156.900	153.600	153.600	1350	0

Free Flowing Outfall Details for Surface Network 3

Outfall Pipe Number	Outfall Name	C.Level (m)	I.Level (m)	Min I.Level (m)	D,L (mm)	W (mm)
2.003	S23	156.900	153.600	153.600	1350	0

©1982-2020 Innovyze

Simulation Criteria for Surface Network 3

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 Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	2
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)	17.000	Storm Duration (mins)	30
Ratio R	0.350		

©1982-2020 Innovyze

Online Controls for Surface Network 3

Hydro-Brake® Optimum Manhole: S16HB, DS/PN: 1.001, Volume (m³): 4.6

Unit Reference	MD-SHE-0042-1000-1500-1000
Design Head (m)	1.500
Design Flow (l/s)	1.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	42
Invert Level (m)	154.400
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	1.0
Flush-Flo™	0.186	0.7
Kick-Flo®	0.378	0.5
Mean Flow over Head Range	-	0.7

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	0.6	1.200	0.9	3.000	1.4	7.000	2.0
0.200	0.7	1.400	1.0	3.500	1.5	7.500	2.1
0.300	0.6	1.600	1.0	4.000	1.6	8.000	2.1
0.400	0.6	1.800	1.1	4.500	1.6	8.500	2.2
0.500	0.6	2.000	1.1	5.000	1.7	9.000	2.3
0.600	0.7	2.200	1.2	5.500	1.8	9.500	2.3
0.800	0.8	2.400	1.2	6.000	1.9		
1.000	0.8	2.600	1.3	6.500	1.9		

Hydro-Brake® Optimum Manhole: S18HB, DS/PN: 2.001, Volume (m³): 2.8

Unit Reference	MD-SHE-0051-1200-0998-1200
Design Head (m)	0.998
Design Flow (l/s)	1.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	51
Invert Level (m)	155.677
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

©1982-2020 Innovyze

Hydro-Brake® Optimum Manhole: S18HB, DS/PN: 2.001, Volume (m³): 2.8

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.998	1.2
Flush-Flo™	0.225	1.0
Kick-Flo®	0.458	0.8
Mean Flow over Head Range	-	1.0

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	0.9	1.200	1.3	3.000	2.0	7.000	2.9
0.200	1.0	1.400	1.4	3.500	2.1	7.500	3.0
0.300	1.0	1.600	1.5	4.000	2.2	8.000	3.1
0.400	1.0	1.800	1.6	4.500	2.4	8.500	3.2
0.500	0.9	2.000	1.6	5.000	2.5	9.000	3.3
0.600	1.0	2.200	1.7	5.500	2.6	9.500	3.4
0.800	1.1	2.400	1.8	6.000	2.7		
1.000	1.2	2.600	1.8	6.500	2.8		

Hydro-Brake® Optimum Manhole: S22HB, DS/PN: 2.003, Volume (m³): 20.5

Unit Reference	MD-SHE-0057-2000-1952-2000
Design Head (m)	1.952
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	57
Invert Level (m)	154.308
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.952	2.0
Flush-Flo™	0.250	1.3
Kick-Flo®	0.512	1.1
Mean Flow over Head Range	-	1.5

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	1.2	0.300	1.3	0.500	1.1	0.800	1.3
0.200	1.3	0.400	1.3	0.600	1.2	1.000	1.5

©1982-2020 Innovyze

Hydro-Brake® Optimum Manhole: S22HB, DS/PN: 2.003, Volume (m³): 20.5

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
1.200	1.6	2.400	2.2	5.000	3.1	8.000	3.8
1.400	1.7	2.600	2.3	5.500	3.2	8.500	3.9
1.600	1.8	3.000	2.4	6.000	3.4	9.000	4.1
1.800	1.9	3.500	2.6	6.500	3.5	9.500	4.2
2.000	2.0	4.000	2.8	7.000	3.6		
2.200	2.1	4.500	2.9	7.500	3.7		

©1982-2020 Innovyze

Storage Structures for Surface Network 3

Cellular Storage Manhole: S16HB, DS/PN: 1.001

Invert Level (m) 154.400 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	48.0	0.0	0.401	0.0	0.0
0.400	48.0	0.0			

Cellular Storage Manhole: S18HB, DS/PN: 2.001

Invert Level (m) 155.677 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	84.0	0.0	0.401	0.0	0.0
0.400	84.0	0.0			

©1982-2020 Innovyze

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 3

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	2
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	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	17.100	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)	30
Climate Change (%)	0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S15	15 Winter	30	+0%					156.319
1.001	S16HB	180 Winter	30	+0%	30/30 Winter				154.608
2.000	S17	15 Winter	30	+0%					155.908
2.001	S18HB	240 Winter	30	+0%	30/60 Summer				155.872
3.000	S19	15 Winter	30	+0%					155.842
3.001	S20	15 Winter	30	+0%					155.707
2.002	S21	360 Winter	30	+0%					155.105
2.003	S22HB	360 Winter	30	+0%	30/15 Summer				155.105

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	HalfDrain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S15	-0.106	0.000	0.19			6.5	OK	
1.001	S16HB	0.058	0.000	0.02		159	0.7	SURCHARGED	
2.000	S17	-0.042	0.000	0.84			11.4	OK	
2.001	S18HB	0.045	0.000	0.03		184	1.0	SURCHARGED	
3.000	S19	-0.058	0.000	0.68			9.0	OK	
3.001	S20	-0.101	0.000	0.23			9.1	OK	

©1982-2020 Innovyze

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 3

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
2.002	S21	-0.298	0.000	0.00			3.3	OK	
2.003	S22HB	0.647	0.000	0.03			1.3	SURCHARGED	

©1982-2020 Innovyze

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Surface Network 3

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	46.625	1.875	24.9	0.024	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	13.401	0.800	16.8	0.024	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	18.375	0.123	149.4	0.042	5.00	0.0	0.600	o	150	Pipe/Conduit	
2.001	8.740	0.424	20.6	0.034	0.00	0.0	0.600	o	150	Pipe/Conduit	
3.000	13.833	0.092	150.4	0.033	5.00	0.0	0.600	o	150	Pipe/Conduit	
3.001	4.302	0.405	10.6	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.002	17.990	0.045	399.8	0.029	0.00	0.0	0.600	o	1050	Pipe/Conduit	
2.003	10.656	0.708	15.1	0.000	0.00	0.0	0.600	o	150	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	5.38	156.275	0.024	0.0	0.0	0.0	2.03	35.8	0.0
1.001	0.00	5.47	154.400	0.048	0.0	0.0	0.0	2.47	43.7	0.0
2.000	0.00	5.37	155.800	0.042	0.0	0.0	0.0	0.82	14.5	0.0
2.001	0.00	5.44	155.677	0.076	0.0	0.0	0.0	2.23	39.4	0.0
3.000	0.00	5.28	155.750	0.033	0.0	0.0	0.0	0.82	14.4	0.0
3.001	0.00	5.31	155.658	0.033	0.0	0.0	0.0	3.11	54.9	0.0
2.002	0.00	5.61	154.353	0.138	0.0	0.0	0.0	1.72	1487.0	0.0
2.003	0.00	5.68	154.308	0.138	0.0	0.0	0.0	2.61	46.1	0.0

Free Flowing Outfall Details for Surface Network 3

Outfall Pipe Number	Outfall Name	C.Level (m)	I.Level (m)	Min I.Level (m)	D,L (mm)	W (mm)
1.001	S23	156.900	153.600	153.600	1350	0

Free Flowing Outfall Details for Surface Network 3

Outfall Pipe Number	Outfall Name	C.Level (m)	I.Level (m)	Min I.Level (m)	D,L (mm)	W (mm)
2.003	S23	156.900	153.600	153.600	1350	0

©1982-2020 Innovyze

Simulation Criteria for Surface Network 3

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 Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	2
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)	17.000	Storm Duration (mins)	30
Ratio R	0.350		

©1982-2020 Innovyze

Online Controls for Surface Network 3

Hydro-Brake® Optimum Manhole: S16HB, DS/PN: 1.001, Volume (m³): 4.6

Unit Reference	MD-SHE-0042-1000-1500-1000
Design Head (m)	1.500
Design Flow (l/s)	1.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	42
Invert Level (m)	154.400
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	1.0
Flush-Flo™	0.186	0.7
Kick-Flo®	0.378	0.5
Mean Flow over Head Range	-	0.7

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	0.6	1.200	0.9	3.000	1.4	7.000	2.0
0.200	0.7	1.400	1.0	3.500	1.5	7.500	2.1
0.300	0.6	1.600	1.0	4.000	1.6	8.000	2.1
0.400	0.6	1.800	1.1	4.500	1.6	8.500	2.2
0.500	0.6	2.000	1.1	5.000	1.7	9.000	2.3
0.600	0.7	2.200	1.2	5.500	1.8	9.500	2.3
0.800	0.8	2.400	1.2	6.000	1.9		
1.000	0.8	2.600	1.3	6.500	1.9		

Hydro-Brake® Optimum Manhole: S18HB, DS/PN: 2.001, Volume (m³): 2.8

Unit Reference	MD-SHE-0051-1200-0998-1200
Design Head (m)	0.998
Design Flow (l/s)	1.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	51
Invert Level (m)	155.677
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

©1982-2020 Innovyze

Hydro-Brake® Optimum Manhole: S18HB, DS/PN: 2.001, Volume (m³): 2.8

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.998	1.2
Flush-Flo™	0.225	1.0
Kick-Flo®	0.458	0.8
Mean Flow over Head Range	-	1.0

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	0.9	1.200	1.3	3.000	2.0	7.000	2.9
0.200	1.0	1.400	1.4	3.500	2.1	7.500	3.0
0.300	1.0	1.600	1.5	4.000	2.2	8.000	3.1
0.400	1.0	1.800	1.6	4.500	2.4	8.500	3.2
0.500	0.9	2.000	1.6	5.000	2.5	9.000	3.3
0.600	1.0	2.200	1.7	5.500	2.6	9.500	3.4
0.800	1.1	2.400	1.8	6.000	2.7		
1.000	1.2	2.600	1.8	6.500	2.8		

Hydro-Brake® Optimum Manhole: S22HB, DS/PN: 2.003, Volume (m³): 20.5

Unit Reference	MD-SHE-0057-2000-1952-2000
Design Head (m)	1.952
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	57
Invert Level (m)	154.308
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.952	2.0
Flush-Flo™	0.250	1.3
Kick-Flo®	0.512	1.1
Mean Flow over Head Range	-	1.5

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	1.2	0.300	1.3	0.500	1.1	0.800	1.3
0.200	1.3	0.400	1.3	0.600	1.2	1.000	1.5

©1982-2020 Innovyze

Hydro-Brake® Optimum Manhole: S22HB, DS/PN: 2.003, Volume (m³): 20.5

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
1.200	1.6	2.400	2.2	5.000	3.1	8.000	3.8
1.400	1.7	2.600	2.3	5.500	3.2	8.500	3.9
1.600	1.8	3.000	2.4	6.000	3.4	9.000	4.1
1.800	1.9	3.500	2.6	6.500	3.5	9.500	4.2
2.000	2.0	4.000	2.8	7.000	3.6		
2.200	2.1	4.500	2.9	7.500	3.7		

©1982-2020 Innovyze

Storage Structures for Surface Network 3

Cellular Storage Manhole: S16HB, DS/PN: 1.001

Invert Level (m) 154.400 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	48.0	0.0	0.401	0.0	0.0
0.400	48.0	0.0			

Cellular Storage Manhole: S18HB, DS/PN: 2.001

Invert Level (m) 155.677 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	84.0	0.0	0.401	0.0	0.0
0.400	84.0	0.0			

©1982-2020 Innovyze

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 3

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	2
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	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	17.100	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 (%)	45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S15	15 Winter	100	+45%					156.337
1.001	S16HB	240 Winter	100	+45%	100/15 Summer				155.616
2.000	S17	240 Winter	100	+45%	100/15 Summer				156.616
2.001	S18HB	240 Winter	100	+45%	100/15 Summer				156.613
3.000	S19	240 Winter	100	+45%	100/15 Summer				156.215
3.001	S20	240 Winter	100	+45%	100/120 Winter				156.212
2.002	S21	240 Winter	100	+45%	100/60 Summer				156.211
2.003	S22HB	240 Winter	100	+45%	100/15 Summer				156.212

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	HalfDrain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S15	-0.088	0.000	0.35			12.2	OK	
1.001	S16HB	1.066	0.000	0.02		312	0.9	FLOOD RISK	
2.000	S17	0.666	0.000	0.33			4.5	FLOOD RISK	
2.001	S18HB	0.786	0.000	0.03		339	1.0	FLOOD RISK	
3.000	S19	0.315	0.000	0.28			3.7	SURCHARGED	
3.001	S20	0.404	0.000	0.09			3.7	SURCHARGED	

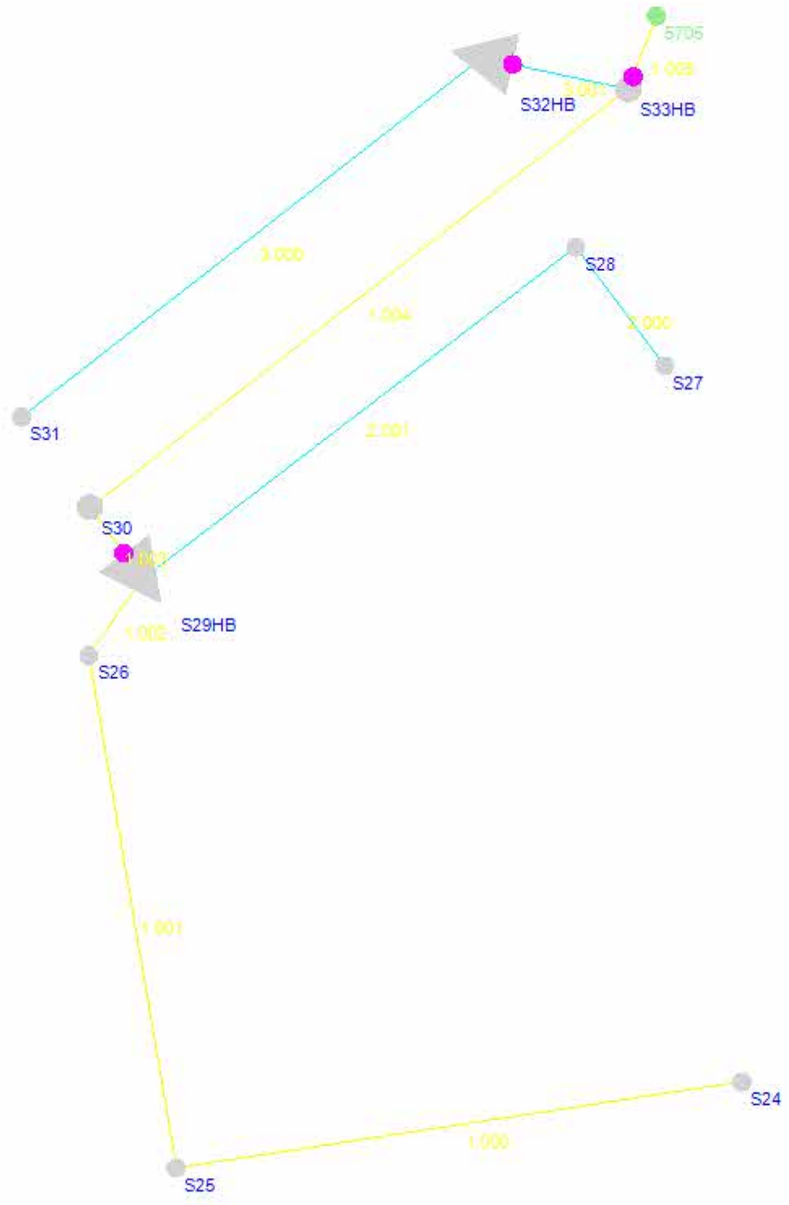
©1982-2020 Innovyze

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 3

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
2.002	S21	0.808	0.000	0.01			6.8	SURCHARGED	
2.003	S22HB	1.754	0.000	0.05			2.0	FLOOD RISK	

©1982-2020 Innovyze

Coast Consulting Engineers Ltd		Page 1
Suite 6, Vita House Fish Quay North Shields NE30 1JA		
Date 02/02/2024 17:14 File Area B4.mdx	Designed by rh Checked by	
Innovyze	Network 2020.1	



©1982-2020 Innovyze

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Surface Network 4

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	45.046	0.300	150.2	0.030	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	40.712	1.023	39.8	0.024	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	7.408	0.178	41.6	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	11.637	0.078	149.2	0.022	5.00	0.0	0.600	o	225	Pipe/Conduit	
2.001	42.851	0.286	149.8	0.037	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.003	6.993	0.183	38.2	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.004	53.550	0.107	500.5	0.000	0.00	0.0	0.600	o	1050	Pipe/Conduit	
3.000	45.848	0.306	149.8	0.035	5.00	0.0	0.600	o	150	Pipe/Conduit	
3.001	11.794	0.079	149.3	0.034	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.005	6.146	0.041	149.9	0.000	0.00	0.0	0.600	o	150	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	5.92	157.800	0.030	0.0	0.0	0.0	0.82	14.5	0.0
1.001	0.00	6.34	157.500	0.054	0.0	0.0	0.0	1.60	28.3	0.0
1.002	0.00	6.42	156.477	0.054	0.0	0.0	0.0	1.56	27.6	0.0
2.000	0.00	5.18	156.000	0.022	0.0	0.0	0.0	1.07	42.5	0.0
2.001	0.00	5.85	155.922	0.059	0.0	0.0	0.0	1.07	42.4	0.0
1.003	0.00	6.48	155.636	0.113	0.0	0.0	0.0	2.12	84.4	0.0
1.004	0.00	7.06	154.628	0.113	0.0	0.0	0.0	1.53	1327.9	0.0
3.000	0.00	5.93	156.100	0.035	0.0	0.0	0.0	0.82	14.5	0.0
3.001	0.00	6.17	155.794	0.069	0.0	0.0	0.0	0.82	14.5	0.0
1.005	0.00	7.18	154.521	0.182	0.0	0.0	0.0	0.82	14.5	0.0

Free Flowing Outfall Details for Surface Network 4

Outfall Pipe Number	Outfall Name	C.Level (m)	I.Level (m)	Min I.Level (m)	D,L (mm)	W (mm)
1.005	5705	156.503	154.480	154.480	1200	0

©1982-2020 Innovyze

Simulation Criteria for Surface Network 4

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 Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	2
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)	17.000	Storm Duration (mins)	30
Ratio R	0.350		

©1982-2020 Innovyze

Online Controls for Surface Network 4

Hydro-Brake® Optimum Manhole: S29HB, DS/PN: 1.003, Volume (m³): 3.7

Unit Reference	MD-SHE-0175-1500-1014-1500
Design Head (m)	1.014
Design Flow (l/s)	15.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	175
Invert Level (m)	155.636
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.014	15.0
Flush-Flo™	0.326	15.0
Kick-Flo®	0.712	12.7
Mean Flow over Head Range	-	12.8

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	6.2	1.200	16.2	3.000	25.2	7.000	37.8
0.200	14.4	1.400	17.5	3.500	27.1	7.500	39.1
0.300	15.0	1.600	18.6	4.000	28.9	8.000	40.4
0.400	14.9	1.800	19.7	4.500	30.6	8.500	41.6
0.500	14.6	2.000	20.7	5.000	32.2	9.000	42.7
0.600	14.1	2.200	21.7	5.500	33.7	9.500	43.9
0.800	13.4	2.400	22.6	6.000	35.1		
1.000	14.9	2.600	23.5	6.500	36.5		

Hydro-Brake® Optimum Manhole: S32HB, DS/PN: 3.001, Volume (m³): 3.5

Unit Reference	MD-SHE-0082-3000-1056-3000
Design Head (m)	1.056
Design Flow (l/s)	3.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	82
Invert Level (m)	155.794
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

©1982-2020 Innovyze

Hydro-Brake® Optimum Manhole: S32HB, DS/PN: 3.001, Volume (m³): 3.5

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.056	3.0
Flush-Flo™	0.318	3.0
Kick-Flo®	0.658	2.4
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	2.4	1.200	3.2	3.000	4.9	7.000	7.2
0.200	2.9	1.400	3.4	3.500	5.2	7.500	7.5
0.300	3.0	1.600	3.6	4.000	5.6	8.000	7.7
0.400	3.0	1.800	3.8	4.500	5.9	8.500	7.9
0.500	2.9	2.000	4.0	5.000	6.2	9.000	8.2
0.600	2.7	2.200	4.2	5.500	6.5	9.500	8.4
0.800	2.6	2.400	4.4	6.000	6.7		
1.000	2.9	2.600	4.5	6.500	7.0		

Hydro-Brake® Optimum Manhole: S33HB, DS/PN: 1.005, Volume (m³): 52.3

Unit Reference	MD-SHE-0063-2500-2181-2500
Design Head (m)	2.181
Design Flow (l/s)	2.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	63
Invert Level (m)	154.521
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.181	2.5
Flush-Flo™	0.274	1.7
Kick-Flo®	0.558	1.3
Mean Flow over Head Range	-	1.8

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	1.4	0.300	1.7	0.500	1.5	0.800	1.6
0.200	1.6	0.400	1.6	0.600	1.4	1.000	1.7

©1982-2020 Innovyze

Hydro-Brake® Optimum Manhole: S33HB, DS/PN: 1.005, Volume (m³): 52.3

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
1.200	1.9	2.400	2.6	5.000	3.7	8.000	4.6
1.400	2.0	2.600	2.7	5.500	3.8	8.500	4.7
1.600	2.2	3.000	2.9	6.000	4.0	9.000	4.8
1.800	2.3	3.500	3.1	6.500	4.1	9.500	5.0
2.000	2.4	4.000	3.3	7.000	4.3		
2.200	2.5	4.500	3.5	7.500	4.4		

©1982-2020 Innovyze

Storage Structures for Surface Network 4

Cellular Storage Manhole: S29HB, DS/PN: 1.003

Invert Level (m) 155.636 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	36.0	0.0	0.401	0.0	0.0
0.400	36.0	0.0			

Cellular Storage Manhole: S32HB, DS/PN: 3.001

Invert Level (m) 155.794 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	42.0	0.0	0.401	0.0	0.0
0.400	42.0	0.0			

©1982-2020 Innovyze

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 4

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	2
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	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	17.000	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)	2
Climate Change (%)	0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S24	15 Winter	2	+0%					157.857
1.001	S25	15 Winter	2	+0%					157.552
1.002	S26	15 Winter	2	+0%					156.533
2.000	S27	15 Winter	2	+0%					156.045
2.001	S28	15 Winter	2	+0%					155.989
1.003	S29HB	30 Winter	2	+0%					155.757
1.004	S30	120 Winter	2	+0%					154.956
3.000	S31	15 Winter	2	+0%					156.163
3.001	S32HB	60 Winter	2	+0%					155.895
1.005	S33HB	120 Winter	2	+0%	2/15 Summer				154.956

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S24	-0.093	0.000	0.30			4.2	OK	
1.001	S25	-0.098	0.000	0.25			7.0	OK	
1.002	S26	-0.094	0.000	0.29			7.0	OK	
2.000	S27	-0.180	0.000	0.09			3.2	OK	

©1982-2020 Innovyze

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 4

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
2.001	S28	-0.158	0.000	0.19			7.6	OK	
1.003	S29HB	-0.104	0.000	0.14		16	8.4	OK	
1.004	S30	-0.722	0.000	0.00			4.7	OK	
3.000	S31	-0.087	0.000	0.35			4.9	OK	
3.001	S32HB	-0.049	0.000	0.18		33	2.4	OK	
1.005	S33HB	0.285	0.000	0.14			1.7	SURCHARGED	

©1982-2020 Innovyze

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Surface Network 4

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	45.046	0.300	150.2	0.030	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	40.712	1.023	39.8	0.024	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	7.408	0.178	41.6	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	11.637	0.078	149.2	0.022	5.00	0.0	0.600	o	225	Pipe/Conduit	
2.001	42.851	0.286	149.8	0.037	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.003	6.993	0.183	38.2	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.004	53.550	0.107	500.5	0.000	0.00	0.0	0.600	o	1050	Pipe/Conduit	
3.000	45.848	0.306	149.8	0.035	5.00	0.0	0.600	o	150	Pipe/Conduit	
3.001	11.794	0.079	149.3	0.034	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.005	6.146	0.041	149.9	0.000	0.00	0.0	0.600	o	150	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	5.92	157.800	0.030	0.0	0.0	0.0	0.82	14.5	0.0
1.001	0.00	6.34	157.500	0.054	0.0	0.0	0.0	1.60	28.3	0.0
1.002	0.00	6.42	156.477	0.054	0.0	0.0	0.0	1.56	27.6	0.0
2.000	0.00	5.18	156.000	0.022	0.0	0.0	0.0	1.07	42.5	0.0
2.001	0.00	5.85	155.922	0.059	0.0	0.0	0.0	1.07	42.4	0.0
1.003	0.00	6.48	155.636	0.113	0.0	0.0	0.0	2.12	84.4	0.0
1.004	0.00	7.06	154.628	0.113	0.0	0.0	0.0	1.53	1327.9	0.0
3.000	0.00	5.93	156.100	0.035	0.0	0.0	0.0	0.82	14.5	0.0
3.001	0.00	6.17	155.794	0.069	0.0	0.0	0.0	0.82	14.5	0.0
1.005	0.00	7.18	154.521	0.182	0.0	0.0	0.0	0.82	14.5	0.0

Free Flowing Outfall Details for Surface Network 4

Outfall Pipe Number	Outfall Name	C.Level (m)	I.Level (m)	Min I.Level (m)	D,L (mm)	W (mm)
1.005	5705	156.503	154.480	154.480	1200	0

©1982-2020 Innovyze

Simulation Criteria for Surface Network 4

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 Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	2
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)	17.000	Storm Duration (mins)	30
Ratio R	0.350		

©1982-2020 Innovyze

Online Controls for Surface Network 4

Hydro-Brake® Optimum Manhole: S29HB, DS/PN: 1.003, Volume (m³): 3.7

Unit Reference	MD-SHE-0175-1500-1014-1500
Design Head (m)	1.014
Design Flow (l/s)	15.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	175
Invert Level (m)	155.636
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.014	15.0
Flush-Flo™	0.326	15.0
Kick-Flo®	0.712	12.7
Mean Flow over Head Range	-	12.8

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	6.2	1.200	16.2	3.000	25.2	7.000	37.8
0.200	14.4	1.400	17.5	3.500	27.1	7.500	39.1
0.300	15.0	1.600	18.6	4.000	28.9	8.000	40.4
0.400	14.9	1.800	19.7	4.500	30.6	8.500	41.6
0.500	14.6	2.000	20.7	5.000	32.2	9.000	42.7
0.600	14.1	2.200	21.7	5.500	33.7	9.500	43.9
0.800	13.4	2.400	22.6	6.000	35.1		
1.000	14.9	2.600	23.5	6.500	36.5		

Hydro-Brake® Optimum Manhole: S32HB, DS/PN: 3.001, Volume (m³): 3.5

Unit Reference	MD-SHE-0082-3000-1056-3000
Design Head (m)	1.056
Design Flow (l/s)	3.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	82
Invert Level (m)	155.794
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

©1982-2020 Innovyze

Hydro-Brake® Optimum Manhole: S32HB, DS/PN: 3.001, Volume (m³): 3.5

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.056	3.0
Flush-Flo™	0.318	3.0
Kick-Flo®	0.658	2.4
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	2.4	1.200	3.2	3.000	4.9	7.000	7.2
0.200	2.9	1.400	3.4	3.500	5.2	7.500	7.5
0.300	3.0	1.600	3.6	4.000	5.6	8.000	7.7
0.400	3.0	1.800	3.8	4.500	5.9	8.500	7.9
0.500	2.9	2.000	4.0	5.000	6.2	9.000	8.2
0.600	2.7	2.200	4.2	5.500	6.5	9.500	8.4
0.800	2.6	2.400	4.4	6.000	6.7		
1.000	2.9	2.600	4.5	6.500	7.0		

Hydro-Brake® Optimum Manhole: S33HB, DS/PN: 1.005, Volume (m³): 52.3

Unit Reference	MD-SHE-0063-2500-2181-2500
Design Head (m)	2.181
Design Flow (l/s)	2.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	63
Invert Level (m)	154.521
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.181	2.5
Flush-Flo™	0.274	1.7
Kick-Flo®	0.558	1.3
Mean Flow over Head Range	-	1.8

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	1.4	0.300	1.7	0.500	1.5	0.800	1.6
0.200	1.6	0.400	1.6	0.600	1.4	1.000	1.7

©1982-2020 Innovyze

Hydro-Brake® Optimum Manhole: S33HB, DS/PN: 1.005, Volume (m³): 52.3

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
1.200	1.9	2.400	2.6	5.000	3.7	8.000	4.6
1.400	2.0	2.600	2.7	5.500	3.8	8.500	4.7
1.600	2.2	3.000	2.9	6.000	4.0	9.000	4.8
1.800	2.3	3.500	3.1	6.500	4.1	9.500	5.0
2.000	2.4	4.000	3.3	7.000	4.3		
2.200	2.5	4.500	3.5	7.500	4.4		

©1982-2020 Innovyze

Storage Structures for Surface Network 4

Cellular Storage Manhole: S29HB, DS/PN: 1.003

Invert Level (m) 155.636 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	36.0	0.0	0.401	0.0	0.0
0.400	36.0	0.0			

Cellular Storage Manhole: S32HB, DS/PN: 3.001

Invert Level (m) 155.794 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	42.0	0.0	0.401	0.0	0.0
0.400	42.0	0.0			

©1982-2020 Innovyze

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 4

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	2
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	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	17.000	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)	30
Climate Change (%)	0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S24	15 Winter	30	+0%					157.883
1.001	S25	15 Winter	30	+0%					157.578
1.002	S26	15 Winter	30	+0%					156.561
2.000	S27	15 Winter	30	+0%					156.062
2.001	S28	15 Winter	30	+0%					156.024
1.003	S29HB	30 Winter	30	+0%					155.849
1.004	S30	240 Winter	30	+0%					155.367
3.000	S31	15 Winter	30	+0%					156.192
3.001	S32HB	60 Winter	30	+0%	30/15 Winter				156.003
1.005	S33HB	240 Winter	30	+0%	30/15 Summer				155.367

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	HalfDrain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S24	-0.067	0.000	0.56			7.9	OK	
1.001	S25	-0.072	0.000	0.52			14.2	OK	
1.002	S26	-0.066	0.000	0.60			14.3	OK	
2.000	S27	-0.163	0.000	0.17			6.0	OK	

©1982-2020 Innovyze

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 4

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	HalfDrain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
2.001	S28	-0.123	0.000	0.40			16.2	OK	
1.003	S29HB	-0.012	0.000	0.24		12	14.5	OK	
1.004	S30	-0.311	0.000	0.01			6.0	OK	
3.000	S31	-0.058	0.000	0.66			9.2	OK	
3.001	S32HB	0.059	0.000	0.22		40	2.9	SURCHARGED	
1.005	S33HB	0.696	0.000	0.14			1.7	SURCHARGED	

©1982-2020 Innovyze

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Surface Network 4

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	45.046	0.300	150.2	0.030	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	40.712	1.023	39.8	0.024	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	7.408	0.178	41.6	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	11.637	0.078	149.2	0.022	5.00	0.0	0.600	o	225	Pipe/Conduit	
2.001	42.851	0.286	149.8	0.037	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.003	6.993	0.183	38.2	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.004	53.550	0.107	500.5	0.000	0.00	0.0	0.600	o	1050	Pipe/Conduit	
3.000	45.848	0.306	149.8	0.035	5.00	0.0	0.600	o	150	Pipe/Conduit	
3.001	11.794	0.079	149.3	0.034	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.005	6.146	0.041	149.9	0.000	0.00	0.0	0.600	o	150	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	5.92	157.800	0.030	0.0	0.0	0.0	0.82	14.5	0.0
1.001	0.00	6.34	157.500	0.054	0.0	0.0	0.0	1.60	28.3	0.0
1.002	0.00	6.42	156.477	0.054	0.0	0.0	0.0	1.56	27.6	0.0
2.000	0.00	5.18	156.000	0.022	0.0	0.0	0.0	1.07	42.5	0.0
2.001	0.00	5.85	155.922	0.059	0.0	0.0	0.0	1.07	42.4	0.0
1.003	0.00	6.48	155.636	0.113	0.0	0.0	0.0	2.12	84.4	0.0
1.004	0.00	7.06	154.628	0.113	0.0	0.0	0.0	1.53	1327.9	0.0
3.000	0.00	5.93	156.100	0.035	0.0	0.0	0.0	0.82	14.5	0.0
3.001	0.00	6.17	155.794	0.069	0.0	0.0	0.0	0.82	14.5	0.0
1.005	0.00	7.18	154.521	0.182	0.0	0.0	0.0	0.82	14.5	0.0

Free Flowing Outfall Details for Surface Network 4

Outfall Pipe Number	Outfall Name	C.Level (m)	I.Level (m)	Min I.Level (m)	D,L (mm)	W (mm)
1.005	5705	156.503	154.480	154.480	1200	0

©1982-2020 Innovyze

Simulation Criteria for Surface Network 4

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 Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	2
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)	17.000	Storm Duration (mins)	30
Ratio R	0.350		

©1982-2020 Innovyze

Online Controls for Surface Network 4

Hydro-Brake® Optimum Manhole: S29HB, DS/PN: 1.003, Volume (m³): 3.7

Unit Reference	MD-SHE-0175-1500-1014-1500
Design Head (m)	1.014
Design Flow (l/s)	15.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	175
Invert Level (m)	155.636
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.014	15.0
Flush-Flo™	0.326	15.0
Kick-Flo®	0.712	12.7
Mean Flow over Head Range	-	12.8

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	6.2	1.200	16.2	3.000	25.2	7.000	37.8
0.200	14.4	1.400	17.5	3.500	27.1	7.500	39.1
0.300	15.0	1.600	18.6	4.000	28.9	8.000	40.4
0.400	14.9	1.800	19.7	4.500	30.6	8.500	41.6
0.500	14.6	2.000	20.7	5.000	32.2	9.000	42.7
0.600	14.1	2.200	21.7	5.500	33.7	9.500	43.9
0.800	13.4	2.400	22.6	6.000	35.1		
1.000	14.9	2.600	23.5	6.500	36.5		

Hydro-Brake® Optimum Manhole: S32HB, DS/PN: 3.001, Volume (m³): 3.5

Unit Reference	MD-SHE-0082-3000-1056-3000
Design Head (m)	1.056
Design Flow (l/s)	3.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	82
Invert Level (m)	155.794
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

©1982-2020 Innovyze

Hydro-Brake® Optimum Manhole: S32HB, DS/PN: 3.001, Volume (m³): 3.5

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.056	3.0
Flush-Flo™	0.318	3.0
Kick-Flo®	0.658	2.4
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	2.4	1.200	3.2	3.000	4.9	7.000	7.2
0.200	2.9	1.400	3.4	3.500	5.2	7.500	7.5
0.300	3.0	1.600	3.6	4.000	5.6	8.000	7.7
0.400	3.0	1.800	3.8	4.500	5.9	8.500	7.9
0.500	2.9	2.000	4.0	5.000	6.2	9.000	8.2
0.600	2.7	2.200	4.2	5.500	6.5	9.500	8.4
0.800	2.6	2.400	4.4	6.000	6.7		
1.000	2.9	2.600	4.5	6.500	7.0		

Hydro-Brake® Optimum Manhole: S33HB, DS/PN: 1.005, Volume (m³): 52.3

Unit Reference	MD-SHE-0063-2500-2181-2500
Design Head (m)	2.181
Design Flow (l/s)	2.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	63
Invert Level (m)	154.521
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.181	2.5
Flush-Flo™	0.274	1.7
Kick-Flo®	0.558	1.3
Mean Flow over Head Range	-	1.8

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	1.4	0.300	1.7	0.500	1.5	0.800	1.6
0.200	1.6	0.400	1.6	0.600	1.4	1.000	1.7

©1982-2020 Innovyze

Hydro-Brake® Optimum Manhole: S33HB, DS/PN: 1.005, Volume (m³): 52.3

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
1.200	1.9	2.400	2.6	5.000	3.7	8.000	4.6
1.400	2.0	2.600	2.7	5.500	3.8	8.500	4.7
1.600	2.2	3.000	2.9	6.000	4.0	9.000	4.8
1.800	2.3	3.500	3.1	6.500	4.1	9.500	5.0
2.000	2.4	4.000	3.3	7.000	4.3		
2.200	2.5	4.500	3.5	7.500	4.4		

©1982-2020 Innovyze

Storage Structures for Surface Network 4

Cellular Storage Manhole: S29HB, DS/PN: 1.003

Invert Level (m) 155.636 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	36.0	0.0	0.401	0.0	0.0
0.400	36.0	0.0			

Cellular Storage Manhole: S32HB, DS/PN: 3.001

Invert Level (m) 155.794 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	42.0	0.0	0.401	0.0	0.0
0.400	42.0	0.0			

©1982-2020 Innovyze

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 4

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	2
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	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	17.000	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 (%)	45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S24	15 Winter	100	+45%	100/15 Winter				157.967
1.001	S25	15 Winter	100	+45%					157.617
1.002	S26	15 Winter	100	+45%	100/15 Summer				156.650
2.000	S27	30 Winter	100	+45%	100/15 Winter				156.641
2.001	S28	30 Winter	100	+45%	100/15 Winter				156.636
1.003	S29HB	30 Winter	100	+45%	100/15 Summer				156.616
1.004	S30	360 Winter	100	+45%	100/60 Winter				156.185
3.000	S31	120 Winter	100	+45%	100/15 Summer				156.812
3.001	S32HB	120 Winter	100	+45%	100/15 Summer				156.800
1.005	S33HB	360 Winter	100	+45%	100/15 Summer				156.185

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	HalfDrain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S24	0.017	0.000	1.02			14.3	SURCHARGED	
1.001	S25	-0.033	0.000	0.94			25.9	OK	
1.002	S26	0.023	0.000	1.07			25.4	SURCHARGED	
2.000	S27	0.416	0.000	0.25			9.1	FLOOD RISK	

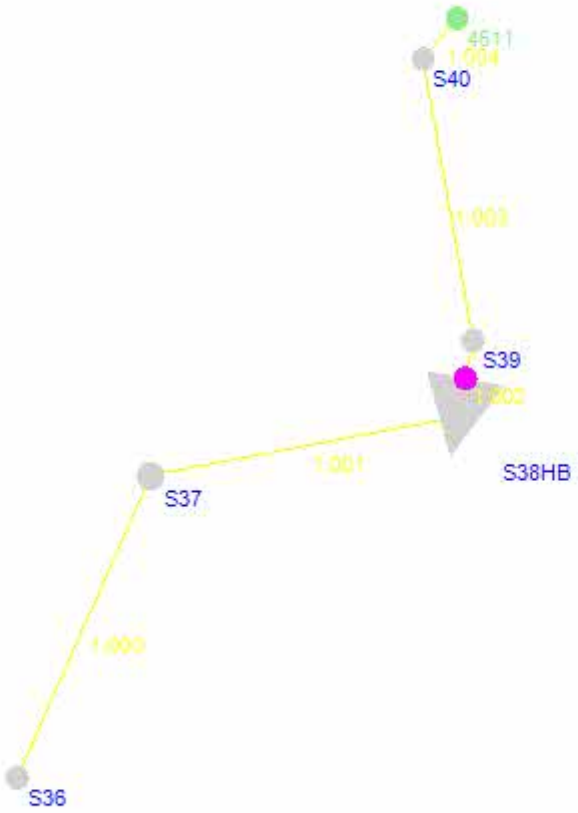
©1982-2020 Innovyze

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 4

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	HalfDrain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
2.001	S28	0.489	0.000	0.60			24.4	FLOOD RISK	
1.003	S29HB	0.755	0.000	0.25		21	14.9	SURCHARGED	
1.004	S30	0.507	0.000	0.01			8.5	SURCHARGED	
3.000	S31	0.562	0.000	0.45			6.3	FLOOD RISK	
3.001	S32HB	0.856	0.000	0.23		96	3.0	FLOOD RISK	
1.005	S33HB	1.514	0.000	0.18			2.2	SURCHARGED	

©1982-2020 Innovyze

Coast Consulting Engineers Ltd		Page 1
Suite 6, Vita House Fish Quay North Shields NE30 1JA		
Date 02/02/2024 17:38 File Area B5.mdx	Designed by rh Checked by	
Innovyze	Network 2020.1	



©1982-2020 Innovyze

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Surface Network 5

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	20.793	0.139	149.6	0.030	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	19.792	0.486	40.7	0.047	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	4.943	0.033	149.8	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.003	18.007	0.120	150.1	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.004	3.358	0.633	5.3	0.000	0.00	0.0	0.600	o	150	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	50.00	5.42	157.025	0.030	0.0	0.0	0.0	0.82	14.5	4.1
1.001	50.00	5.63	156.886	0.077	0.0	0.0	0.0	1.58	28.0	10.4
1.002	50.00	5.73	156.400	0.077	0.0	0.0	0.0	0.82	14.5	10.4
1.003	50.00	6.10	156.367	0.077	0.0	0.0	0.0	0.82	14.5	10.4
1.004	50.00	6.11	156.247	0.077	0.0	0.0	0.0	4.41	77.8	10.4

Free Flowing Outfall Details for Surface Network 5

Outfall Pipe Number	Outfall Name	C.Level (m)	I.Level (m)	Min I.Level (m)	D,L (mm)	W (mm)
1.004	4611	157.784	155.614	155.614	1200	0

Simulation Criteria for Surface Network 5

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 Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	17.100	Storm Duration (mins)	30
Ratio R	0.350		

©1982-2020 Innovyze

Online Controls for Surface Network 5

Hydro-Brake® Optimum Manhole: S38HB, DS/PN: 1.002, Volume (m³): 4.1

Unit Reference	MD-SHE-0042-1000-1500-1000
Design Head (m)	1.500
Design Flow (l/s)	1.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	42
Invert Level (m)	156.400
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	1.0
Flush-Flo™	0.186	0.7
Kick-Flo®	0.378	0.5
Mean Flow over Head Range	-	0.7

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	0.6	1.200	0.9	3.000	1.4	7.000	2.0
0.200	0.7	1.400	1.0	3.500	1.5	7.500	2.1
0.300	0.6	1.600	1.0	4.000	1.6	8.000	2.1
0.400	0.6	1.800	1.1	4.500	1.6	8.500	2.2
0.500	0.6	2.000	1.1	5.000	1.7	9.000	2.3
0.600	0.7	2.200	1.2	5.500	1.8	9.500	2.3
0.800	0.8	2.400	1.2	6.000	1.9		
1.000	0.8	2.600	1.3	6.500	1.9		

©1982-2020 Innovyze

Storage Structures for Surface Network 5

Cellular Storage Manhole: S38HB, DS/PN: 1.002

Invert Level (m) 156.400 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	84.0	0.0	0.401	0.0	0.0
0.400	84.0	0.0			

©1982-2020 Innovyze

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 5

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	1
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	17.000	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
Return Period(s) (years)	2
Climate Change (%)	0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S36	15 Winter	2	+0%					157.084
1.001	S37	15 Winter	2	+0%					156.951
1.002	S38HB	240 Winter	2	+0%					156.512
1.003	S39	240 Winter	2	+0%					156.387
1.004	S40	240 Winter	2	+0%					156.255

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S36	-0.091	0.000	0.32			4.3	OK	
1.001	S37	-0.085	0.000	0.38			10.1	OK	
1.002	S38HB	-0.038	0.000	0.05		197	0.6	OK	
1.003	S39	-0.130	0.000	0.04			0.6	OK	
1.004	S40	-0.142	0.000	0.01			0.6	OK	

©1982-2020 Innovyze

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Surface Network 5

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	20.793	0.139	149.6	0.030	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	19.792	0.486	40.7	0.047	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	4.943	0.033	149.8	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.003	18.007	0.120	150.1	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.004	3.358	0.633	5.3	0.000	0.00	0.0	0.600	o	150	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	50.00	5.42	157.025	0.030	0.0	0.0	0.0	0.82	14.5	4.1
1.001	50.00	5.63	156.886	0.077	0.0	0.0	0.0	1.58	28.0	10.4
1.002	50.00	5.73	156.400	0.077	0.0	0.0	0.0	0.82	14.5	10.4
1.003	50.00	6.10	156.367	0.077	0.0	0.0	0.0	0.82	14.5	10.4
1.004	50.00	6.11	156.247	0.077	0.0	0.0	0.0	4.41	77.8	10.4

Free Flowing Outfall Details for Surface Network 5

Outfall Pipe Number	Outfall Name	C.Level (m)	I.Level (m)	Min I.Level (m)	D,L (mm)	W (mm)
1.004	4611	157.784	155.614	155.614	1200	0

Simulation Criteria for Surface Network 5

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 Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	17.100	Storm Duration (mins)	30
Ratio R	0.350		

©1982-2020 Innovyze

Online Controls for Surface Network 5

Hydro-Brake® Optimum Manhole: S38HB, DS/PN: 1.002, Volume (m³): 4.1

Unit Reference	MD-SHE-0042-1000-1500-1000
Design Head (m)	1.500
Design Flow (l/s)	1.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	42
Invert Level (m)	156.400
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	1.0
Flush-Flo™	0.186	0.7
Kick-Flo®	0.378	0.5
Mean Flow over Head Range	-	0.7

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	0.6	1.200	0.9	3.000	1.4	7.000	2.0
0.200	0.7	1.400	1.0	3.500	1.5	7.500	2.1
0.300	0.6	1.600	1.0	4.000	1.6	8.000	2.1
0.400	0.6	1.800	1.1	4.500	1.6	8.500	2.2
0.500	0.6	2.000	1.1	5.000	1.7	9.000	2.3
0.600	0.7	2.200	1.2	5.500	1.8	9.500	2.3
0.800	0.8	2.400	1.2	6.000	1.9		
1.000	0.8	2.600	1.3	6.500	1.9		

©1982-2020 Innovyze

Storage Structures for Surface Network 5

Cellular Storage Manhole: S38HB, DS/PN: 1.002

Invert Level (m) 156.400 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	84.0	0.0	0.401	0.0	0.0
0.400	84.0	0.0			

©1982-2020 Innovyze

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 5

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	1
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	17.000	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
Return Period(s) (years)	30
Climate Change (%)	0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S36	15 Winter	30	+0%					157.110
1.001	S37	15 Winter	30	+0%					156.991
1.002	S38HB	240 Winter	30	+0%	30/30 Winter				156.634
1.003	S39	240 Summer	30	+0%					156.388
1.004	S40	120 Summer	30	+0%					156.256

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	HalfDrain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S36	-0.065	0.000	0.59			8.1	OK	
1.001	S37	-0.045	0.000	0.82			21.4	OK	
1.002	S38HB	0.084	0.000	0.06		266	0.7	SURCHARGED	
1.003	S39	-0.129	0.000	0.05			0.7	OK	
1.004	S40	-0.141	0.000	0.01			0.7	OK	

©1982-2020 Innovyze

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Surface Network 5

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	20.793	0.139	149.6	0.030	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	19.792	0.486	40.7	0.047	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	4.943	0.033	149.8	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.003	18.007	0.120	150.1	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.004	3.358	0.633	5.3	0.000	0.00	0.0	0.600	o	150	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	50.00	5.42	157.025	0.030	0.0	0.0	0.0	0.82	14.5	4.1
1.001	50.00	5.63	156.886	0.077	0.0	0.0	0.0	1.58	28.0	10.4
1.002	50.00	5.73	156.400	0.077	0.0	0.0	0.0	0.82	14.5	10.4
1.003	50.00	6.10	156.367	0.077	0.0	0.0	0.0	0.82	14.5	10.4
1.004	50.00	6.11	156.247	0.077	0.0	0.0	0.0	4.41	77.8	10.4

Free Flowing Outfall Details for Surface Network 5

Outfall Pipe Number	Outfall Name	C.Level (m)	I.Level (m)	Min I.Level (m)	D,L (mm)	W (mm)
1.004	4611	157.784	155.614	155.614	1200	0

Simulation Criteria for Surface Network 5

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 Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	17.100	Storm Duration (mins)	30
Ratio R	0.350		

©1982-2020 Innovyze

Online Controls for Surface Network 5

Hydro-Brake® Optimum Manhole: S38HB, DS/PN: 1.002, Volume (m³): 4.1

Unit Reference	MD-SHE-0042-1000-1500-1000
Design Head (m)	1.500
Design Flow (l/s)	1.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	42
Invert Level (m)	156.400
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	1.0
Flush-Flo™	0.186	0.7
Kick-Flo®	0.378	0.5
Mean Flow over Head Range	-	0.7

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	0.6	1.200	0.9	3.000	1.4	7.000	2.0
0.200	0.7	1.400	1.0	3.500	1.5	7.500	2.1
0.300	0.6	1.600	1.0	4.000	1.6	8.000	2.1
0.400	0.6	1.800	1.1	4.500	1.6	8.500	2.2
0.500	0.6	2.000	1.1	5.000	1.7	9.000	2.3
0.600	0.7	2.200	1.2	5.500	1.8	9.500	2.3
0.800	0.8	2.400	1.2	6.000	1.9		
1.000	0.8	2.600	1.3	6.500	1.9		

©1982-2020 Innovyze

Storage Structures for Surface Network 5

Cellular Storage Manhole: S38HB, DS/PN: 1.002

Invert Level (m) 156.400 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	84.0	0.0	0.401	0.0	0.0
0.400	84.0	0.0			

©1982-2020 Innovyze

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 5

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	1
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	17.000	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

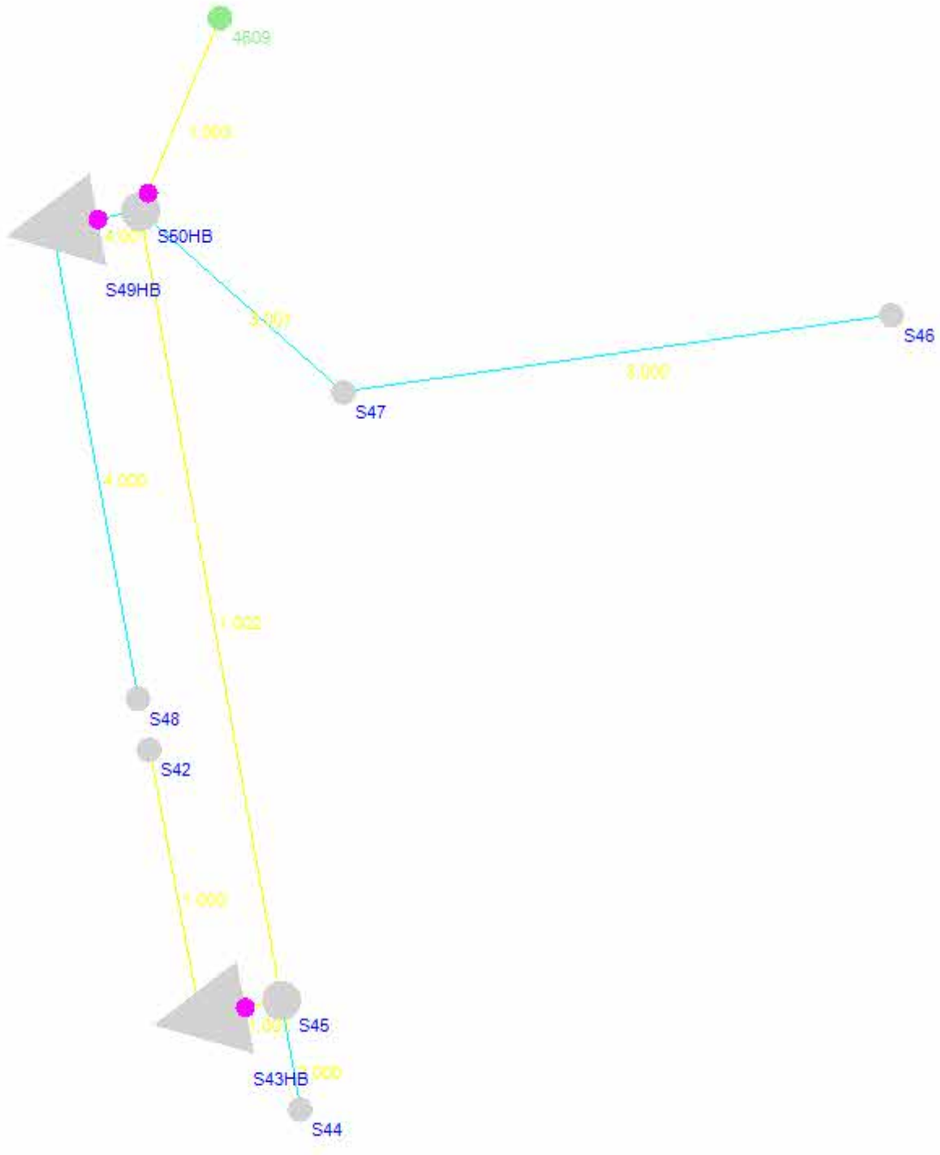
Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240
Return Period(s) (years)	100
Climate Change (%)	45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S36	240 Winter	100	+45%	100/15 Summer				157.723
1.001	S37	240 Winter	100	+45%	100/15 Summer				157.721
1.002	S38HB	240 Winter	100	+45%	100/15 Summer				157.717
1.003	S39	240 Winter	100	+45%					156.393
1.004	S40	240 Winter	100	+45%					156.260

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	HalfDrain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S36	0.548	0.000	0.24			3.3	SURCHARGED	
1.001	S37	0.685	0.000	0.32			8.5	FLOOD RISK	
1.002	S38HB	1.167	0.000	0.08		585	0.9	FLOOD RISK	
1.003	S39	-0.124	0.000	0.07			0.9	OK	
1.004	S40	-0.137	0.000	0.02			0.9	OK	

©1982-2020 Innovyze

Coast Consulting Engineers Ltd		Page 1
Suite 6, Vita House Fish Quay North Shields NE30 1JA		
Date 04/02/2024 10:07 File Area B6.mdx	Designed by rh Checked by	
Innovyze	Network 2020.1	



©1982-2020 Innovyze

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Surface Network 6

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	14.447	0.096	150.5	0.030	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	4.478	0.030	149.3	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	5.889	0.039	150.0	0.045	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	42.750	0.086	497.1	0.076	0.00	0.0	0.600	o	1350	Pipe/Conduit	
3.000	29.603	0.197	150.0	0.018	5.00	0.0	0.600	o	150	Pipe/Conduit	
3.001	14.500	0.097	150.0	0.018	0.00	0.0	0.600	o	150	Pipe/Conduit	
4.000	25.544	0.170	150.3	0.033	5.00	0.0	0.600	o	150	Pipe/Conduit	
4.001	4.823	0.032	150.7	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.003	11.138	0.074	150.5	0.000	0.00	0.0	0.600	o	150	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	5.29	158.600	0.030	0.0	0.0	0.0	0.82	14.4	0.0
1.001	0.00	5.39	158.504	0.030	0.0	0.0	0.0	0.82	14.5	0.0
2.000	0.00	5.12	158.750	0.045	0.0	0.0	0.0	0.82	14.5	0.0
1.002	0.00	5.78	156.502	0.151	0.0	0.0	0.0	1.80	2572.1	0.0
3.000	0.00	5.60	158.300	0.018	0.0	0.0	0.0	0.82	14.5	0.0
3.001	0.00	5.90	158.103	0.036	0.0	0.0	0.0	0.82	14.5	0.0
4.000	0.00	5.52	158.300	0.033	0.0	0.0	0.0	0.82	14.4	0.0
4.001	0.00	5.62	158.130	0.033	0.0	0.0	0.0	0.82	14.4	0.0
1.003	0.00	6.13	156.416	0.220	0.0	0.0	0.0	0.82	14.4	0.0

Free Flowing Outfall Details for Surface Network 6

Outfall Pipe Number	Outfall Name	C.Level (m)	I.Level (m)	Min I.Level (m)	D,L (mm)	W (mm)
1.003	4609	158.512	156.342	156.342	1350	0

©1982-2020 Innovyze

Simulation Criteria for Surface Network 6

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 Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	2
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)	17.200	Storm Duration (mins)	30
Ratio R	0.350		

©1982-2020 Innovyze

Online Controls for Surface Network 6

Hydro-Brake® Optimum Manhole: S43HB, DS/PN: 1.001, Volume (m³): 1.4

Unit Reference	MD-SHE-0106-5000-0996-5000
Design Head (m)	0.996
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	106
Invert Level (m)	158.504
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.996	5.0
Flush-Flo™	0.295	5.0
Kick-Flo®	0.638	4.1
Mean Flow over Head Range	-	4.3

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.6	1.200	5.5	3.000	8.4	7.000	12.5
0.200	4.9	1.400	5.9	3.500	9.0	7.500	12.9
0.300	5.0	1.600	6.2	4.000	9.6	8.000	13.4
0.400	4.9	1.800	6.6	4.500	10.1	8.500	13.7
0.500	4.8	2.000	6.9	5.000	10.7	9.000	14.1
0.600	4.4	2.200	7.2	5.500	11.2	9.500	14.5
0.800	4.5	2.400	7.5	6.000	11.6		
1.000	5.0	2.600	7.8	6.500	12.1		

Hydro-Brake® Optimum Manhole: S49HB, DS/PN: 4.001, Volume (m³): 2.0

Unit Reference	MD-SHE-0104-5000-1070-5000
Design Head (m)	1.070
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	104
Invert Level (m)	158.130
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

©1982-2020 Innovyze

Hydro-Brake® Optimum Manhole: S49HB, DS/PN: 4.001, Volume (m³): 2.0

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.070	5.0
Flush-Flo™	0.314	5.0
Kick-Flo®	0.674	4.0
Mean Flow over Head Range	-	4.4

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	3.5	1.200	5.3	3.000	8.1	7.000	12.1
0.200	4.8	1.400	5.7	3.500	8.7	7.500	12.5
0.300	5.0	1.600	6.0	4.000	9.3	8.000	12.9
0.400	5.0	1.800	6.4	4.500	9.8	8.500	13.3
0.500	4.8	2.000	6.7	5.000	10.3	9.000	13.7
0.600	4.5	2.200	7.0	5.500	10.8	9.500	14.0
0.800	4.4	2.400	7.3	6.000	11.3		
1.000	4.8	2.600	7.6	6.500	11.7		

Hydro-Brake® Optimum Manhole: S50HB, DS/PN: 1.003, Volume (m³): 67.9

Unit Reference	MD-SHE-0059-2500-2734-2500
Design Head (m)	2.734
Design Flow (l/s)	2.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	59
Invert Level (m)	156.416
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.734	2.5
Flush-Flo™	0.254	1.5
Kick-Flo®	0.528	1.2
Mean Flow over Head Range	-	1.8

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	1.3	0.300	1.5	0.500	1.3	0.800	1.4
0.200	1.5	0.400	1.4	0.600	1.3	1.000	1.6

©1982-2020 Innovyze

Hydro-Brake® Optimum Manhole: S50HB, DS/PN: 1.003, Volume (m³): 67.9

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
1.200	1.7	2.400	2.3	5.000	3.3	8.000	4.1
1.400	1.8	2.600	2.4	5.500	3.4	8.500	4.2
1.600	2.0	3.000	2.6	6.000	3.6	9.000	4.3
1.800	2.1	3.500	2.8	6.500	3.7	9.500	4.5
2.000	2.2	4.000	3.0	7.000	3.9		
2.200	2.3	4.500	3.1	7.500	4.0		

©1982-2020 Innovyze

Storage Structures for Surface Network 6

Cellular Storage Manhole: S43HB, DS/PN: 1.001

Invert Level (m) 158.504 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	36.0	0.0	0.401	0.0	0.0
0.400	36.0	0.0			

Cellular Storage Manhole: S49HB, DS/PN: 4.001

Invert Level (m) 158.130 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	36.0	0.0	0.401	0.0	0.0
0.400	36.0	0.0			

©1982-2020 Innovyze

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 6

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	2
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	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	17.000	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)	2
Climate Change (%)	0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S42	15 Winter	2	+0%					158.659
1.001	S43HB	60 Winter	2	+0%					158.555
2.000	S44	15 Winter	2	+0%					158.830
1.002	S45	180 Winter	2	+0%					157.017
3.000	S46	15 Winter	2	+0%					158.344
3.001	S47	15 Winter	2	+0%					158.164
4.000	S48	15 Winter	2	+0%					158.361
4.001	S49HB	60 Winter	2	+0%					158.185
1.003	S50HB	180 Winter	2	+0%	2/15 Summer				157.017

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S42	-0.091	0.000	0.32			4.3	OK	
1.001	S43HB	-0.099	0.000	0.12		34	1.3	OK	
2.000	S44	-0.070	0.000	0.54			6.5	OK	
1.002	S45	-0.835	0.000	0.00			4.8	OK	
3.000	S46	-0.106	0.000	0.19			2.6	OK	

©1982-2020 Innovyze

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 6

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
3.001	S47	-0.088	0.000	0.36			4.7	OK	
4.000	S48	-0.089	0.000	0.34			4.7	OK	
4.001	S49HB	-0.095	0.000	0.13		34	1.5	OK	
1.003	S50HB	0.451	0.000	0.11			1.5	SURCHARGED	

©1982-2020 Innovyze

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Surface Network 6

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	14.447	0.096	150.5	0.030	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	4.478	0.030	149.3	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	5.889	0.039	150.0	0.045	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	42.750	0.086	497.1	0.076	0.00	0.0	0.600	o	1350	Pipe/Conduit	
3.000	29.603	0.197	150.0	0.018	5.00	0.0	0.600	o	150	Pipe/Conduit	
3.001	14.500	0.097	150.0	0.018	0.00	0.0	0.600	o	150	Pipe/Conduit	
4.000	25.544	0.170	150.3	0.033	5.00	0.0	0.600	o	150	Pipe/Conduit	
4.001	4.823	0.032	150.7	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.003	11.138	0.074	150.5	0.000	0.00	0.0	0.600	o	150	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	5.29	158.600	0.030	0.0	0.0	0.0	0.82	14.4	0.0
1.001	0.00	5.39	158.504	0.030	0.0	0.0	0.0	0.82	14.5	0.0
2.000	0.00	5.12	158.750	0.045	0.0	0.0	0.0	0.82	14.5	0.0
1.002	0.00	5.78	156.502	0.151	0.0	0.0	0.0	1.80	2572.1	0.0
3.000	0.00	5.60	158.300	0.018	0.0	0.0	0.0	0.82	14.5	0.0
3.001	0.00	5.90	158.103	0.036	0.0	0.0	0.0	0.82	14.5	0.0
4.000	0.00	5.52	158.300	0.033	0.0	0.0	0.0	0.82	14.4	0.0
4.001	0.00	5.62	158.130	0.033	0.0	0.0	0.0	0.82	14.4	0.0
1.003	0.00	6.13	156.416	0.220	0.0	0.0	0.0	0.82	14.4	0.0

Free Flowing Outfall Details for Surface Network 6

Outfall Pipe Number	Outfall Name	C.Level (m)	I.Level (m)	Min I.Level (m)	D,L (mm)	W (mm)
1.003	4609	158.512	156.342	156.342	1350	0

©1982-2020 Innovyze

Simulation Criteria for Surface Network 6

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 Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	2
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)	17.200	Storm Duration (mins)	30
Ratio R	0.350		

©1982-2020 Innovyze

Online Controls for Surface Network 6

Hydro-Brake® Optimum Manhole: S43HB, DS/PN: 1.001, Volume (m³): 1.4

Unit Reference	MD-SHE-0106-5000-0996-5000
Design Head (m)	0.996
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	106
Invert Level (m)	158.504
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.996	5.0
Flush-Flo™	0.295	5.0
Kick-Flo®	0.638	4.1
Mean Flow over Head Range	-	4.3

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.6	1.200	5.5	3.000	8.4	7.000	12.5
0.200	4.9	1.400	5.9	3.500	9.0	7.500	12.9
0.300	5.0	1.600	6.2	4.000	9.6	8.000	13.4
0.400	4.9	1.800	6.6	4.500	10.1	8.500	13.7
0.500	4.8	2.000	6.9	5.000	10.7	9.000	14.1
0.600	4.4	2.200	7.2	5.500	11.2	9.500	14.5
0.800	4.5	2.400	7.5	6.000	11.6		
1.000	5.0	2.600	7.8	6.500	12.1		

Hydro-Brake® Optimum Manhole: S49HB, DS/PN: 4.001, Volume (m³): 2.0

Unit Reference	MD-SHE-0104-5000-1070-5000
Design Head (m)	1.070
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	104
Invert Level (m)	158.130
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

©1982-2020 Innovyze

Hydro-Brake® Optimum Manhole: S49HB, DS/PN: 4.001, Volume (m³): 2.0

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.070	5.0
Flush-Flo™	0.314	5.0
Kick-Flo®	0.674	4.0
Mean Flow over Head Range	-	4.4

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	3.5	1.200	5.3	3.000	8.1	7.000	12.1
0.200	4.8	1.400	5.7	3.500	8.7	7.500	12.5
0.300	5.0	1.600	6.0	4.000	9.3	8.000	12.9
0.400	5.0	1.800	6.4	4.500	9.8	8.500	13.3
0.500	4.8	2.000	6.7	5.000	10.3	9.000	13.7
0.600	4.5	2.200	7.0	5.500	10.8	9.500	14.0
0.800	4.4	2.400	7.3	6.000	11.3		
1.000	4.8	2.600	7.6	6.500	11.7		

Hydro-Brake® Optimum Manhole: S50HB, DS/PN: 1.003, Volume (m³): 67.9

Unit Reference	MD-SHE-0059-2500-2734-2500
Design Head (m)	2.734
Design Flow (l/s)	2.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	59
Invert Level (m)	156.416
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.734	2.5
Flush-Flo™	0.254	1.5
Kick-Flo®	0.528	1.2
Mean Flow over Head Range	-	1.8

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	1.3	0.300	1.5	0.500	1.3	0.800	1.4
0.200	1.5	0.400	1.4	0.600	1.3	1.000	1.6

©1982-2020 Innovyze

Hydro-Brake® Optimum Manhole: S50HB, DS/PN: 1.003, Volume (m³): 67.9

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
1.200	1.7	2.400	2.3	5.000	3.3	8.000	4.1
1.400	1.8	2.600	2.4	5.500	3.4	8.500	4.2
1.600	2.0	3.000	2.6	6.000	3.6	9.000	4.3
1.800	2.1	3.500	2.8	6.500	3.7	9.500	4.5
2.000	2.2	4.000	3.0	7.000	3.9		
2.200	2.3	4.500	3.1	7.500	4.0		

©1982-2020 Innovyze

Storage Structures for Surface Network 6

Cellular Storage Manhole: S43HB, DS/PN: 1.001

Invert Level (m) 158.504 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	36.0	0.0	0.401	0.0	0.0
0.400	36.0	0.0			

Cellular Storage Manhole: S49HB, DS/PN: 4.001

Invert Level (m) 158.130 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	36.0	0.0	0.401	0.0	0.0
0.400	36.0	0.0			

©1982-2020 Innovyze

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 6

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	2
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	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	17.000	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)	30
Climate Change (%)	0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S42	15 Winter	30	+0%					158.686
1.001	S43HB	30 Winter	30	+0%					158.589
2.000	S44	15 Winter	30	+0%					158.880
1.002	S45	240 Winter	30	+0%					157.512
3.000	S46	15 Winter	30	+0%					158.362
3.001	S47	15 Winter	30	+0%					158.200
4.000	S48	15 Winter	30	+0%					158.390
4.001	S49HB	30 Winter	30	+0%					158.223
1.003	S50HB	240 Winter	30	+0%	30/15 Summer				157.512

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S42	-0.064	0.000	0.61			8.1	OK	
1.001	S43HB	-0.065	0.000	0.27		22	3.0	OK	
2.000	S44	-0.020	0.000	1.00			12.0	OK	
1.002	S45	-0.340	0.000	0.00			7.8	OK	
3.000	S46	-0.088	0.000	0.35			4.8	OK	

©1982-2020 Innovyze

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 6

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	HalfDrain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
3.001	S47	-0.052	0.000	0.73			9.8	OK	
4.000	S48	-0.060	0.000	0.65			8.9	OK	
4.001	S49HB	-0.057	0.000	0.29		21	3.2	OK	
1.003	S50HB	0.946	0.000	0.13			1.6	SURCHARGED	

©1982-2020 Innovyze

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Surface Network 6

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	14.447	0.096	150.5	0.030	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	4.478	0.030	149.3	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	5.889	0.039	150.0	0.045	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	42.750	0.086	497.1	0.076	0.00	0.0	0.600	o	1350	Pipe/Conduit	
3.000	29.603	0.197	150.0	0.018	5.00	0.0	0.600	o	150	Pipe/Conduit	
3.001	14.500	0.097	150.0	0.018	0.00	0.0	0.600	o	150	Pipe/Conduit	
4.000	25.544	0.170	150.3	0.033	5.00	0.0	0.600	o	150	Pipe/Conduit	
4.001	4.823	0.032	150.7	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.003	11.138	0.074	150.5	0.000	0.00	0.0	0.600	o	150	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	5.29	158.600	0.030	0.0	0.0	0.0	0.82	14.4	0.0
1.001	0.00	5.39	158.504	0.030	0.0	0.0	0.0	0.82	14.5	0.0
2.000	0.00	5.12	158.750	0.045	0.0	0.0	0.0	0.82	14.5	0.0
1.002	0.00	5.78	156.502	0.151	0.0	0.0	0.0	1.80	2572.1	0.0
3.000	0.00	5.60	158.300	0.018	0.0	0.0	0.0	0.82	14.5	0.0
3.001	0.00	5.90	158.103	0.036	0.0	0.0	0.0	0.82	14.5	0.0
4.000	0.00	5.52	158.300	0.033	0.0	0.0	0.0	0.82	14.4	0.0
4.001	0.00	5.62	158.130	0.033	0.0	0.0	0.0	0.82	14.4	0.0
1.003	0.00	6.13	156.416	0.220	0.0	0.0	0.0	0.82	14.4	0.0

Free Flowing Outfall Details for Surface Network 6

Outfall Pipe Number	Outfall Name	C.Level (m)	I.Level (m)	Min I.Level (m)	D,L (mm)	W (mm)
1.003	4609	158.512	156.342	156.342	1350	0

©1982-2020 Innovyze

Simulation Criteria for Surface Network 6

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 Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	2
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)	17.200	Storm Duration (mins)	30
Ratio R	0.350		

©1982-2020 Innovyze

Online Controls for Surface Network 6

Hydro-Brake® Optimum Manhole: S43HB, DS/PN: 1.001, Volume (m³): 1.4

Unit Reference	MD-SHE-0106-5000-0996-5000
Design Head (m)	0.996
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	106
Invert Level (m)	158.504
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.996	5.0
Flush-Flo™	0.295	5.0
Kick-Flo®	0.638	4.1
Mean Flow over Head Range	-	4.3

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.6	1.200	5.5	3.000	8.4	7.000	12.5
0.200	4.9	1.400	5.9	3.500	9.0	7.500	12.9
0.300	5.0	1.600	6.2	4.000	9.6	8.000	13.4
0.400	4.9	1.800	6.6	4.500	10.1	8.500	13.7
0.500	4.8	2.000	6.9	5.000	10.7	9.000	14.1
0.600	4.4	2.200	7.2	5.500	11.2	9.500	14.5
0.800	4.5	2.400	7.5	6.000	11.6		
1.000	5.0	2.600	7.8	6.500	12.1		

Hydro-Brake® Optimum Manhole: S49HB, DS/PN: 4.001, Volume (m³): 2.0

Unit Reference	MD-SHE-0104-5000-1070-5000
Design Head (m)	1.070
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	104
Invert Level (m)	158.130
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

©1982-2020 Innovyze

Hydro-Brake® Optimum Manhole: S49HB, DS/PN: 4.001, Volume (m³): 2.0

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.070	5.0
Flush-Flo™	0.314	5.0
Kick-Flo®	0.674	4.0
Mean Flow over Head Range	-	4.4

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	3.5	1.200	5.3	3.000	8.1	7.000	12.1
0.200	4.8	1.400	5.7	3.500	8.7	7.500	12.5
0.300	5.0	1.600	6.0	4.000	9.3	8.000	12.9
0.400	5.0	1.800	6.4	4.500	9.8	8.500	13.3
0.500	4.8	2.000	6.7	5.000	10.3	9.000	13.7
0.600	4.5	2.200	7.0	5.500	10.8	9.500	14.0
0.800	4.4	2.400	7.3	6.000	11.3		
1.000	4.8	2.600	7.6	6.500	11.7		

Hydro-Brake® Optimum Manhole: S50HB, DS/PN: 1.003, Volume (m³): 67.9

Unit Reference	MD-SHE-0059-2500-2734-2500
Design Head (m)	2.734
Design Flow (l/s)	2.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	59
Invert Level (m)	156.416
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.734	2.5
Flush-Flo™	0.254	1.5
Kick-Flo®	0.528	1.2
Mean Flow over Head Range	-	1.8

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	1.3	0.300	1.5	0.500	1.3	0.800	1.4
0.200	1.5	0.400	1.4	0.600	1.3	1.000	1.6

©1982-2020 Innovyze

Hydro-Brake® Optimum Manhole: S50HB, DS/PN: 1.003, Volume (m³): 67.9

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
1.200	1.7	2.400	2.3	5.000	3.3	8.000	4.1
1.400	1.8	2.600	2.4	5.500	3.4	8.500	4.2
1.600	2.0	3.000	2.6	6.000	3.6	9.000	4.3
1.800	2.1	3.500	2.8	6.500	3.7	9.500	4.5
2.000	2.2	4.000	3.0	7.000	3.9		
2.200	2.3	4.500	3.1	7.500	4.0		

©1982-2020 Innovyze

Storage Structures for Surface Network 6

Cellular Storage Manhole: S43HB, DS/PN: 1.001

Invert Level (m) 158.504 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	36.0	0.0	0.401	0.0	0.0
0.400	36.0	0.0			

Cellular Storage Manhole: S49HB, DS/PN: 4.001

Invert Level (m) 158.130 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	36.0	0.0	0.401	0.0	0.0
0.400	36.0	0.0			

©1982-2020 Innovyze

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 6

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	2
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	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	17.000	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 (%)	45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S42	360 Winter	100	+45%	100/15 Summer				159.069
1.001	S43HB	360 Winter	100	+45%	100/30 Winter				159.067
2.000	S44	360 Winter	100	+45%	100/15 Summer				159.059
1.002	S45	360 Winter	100	+45%	100/60 Summer				159.058
3.000	S46	360 Winter	100	+45%	100/60 Winter				159.061
3.001	S47	360 Winter	100	+45%	100/15 Summer				159.060
4.000	S48	360 Winter	100	+45%	100/15 Summer				159.071
4.001	S49HB	360 Winter	100	+45%	100/15 Winter				159.069
1.003	S50HB	360 Winter	100	+45%	100/15 Summer				159.058

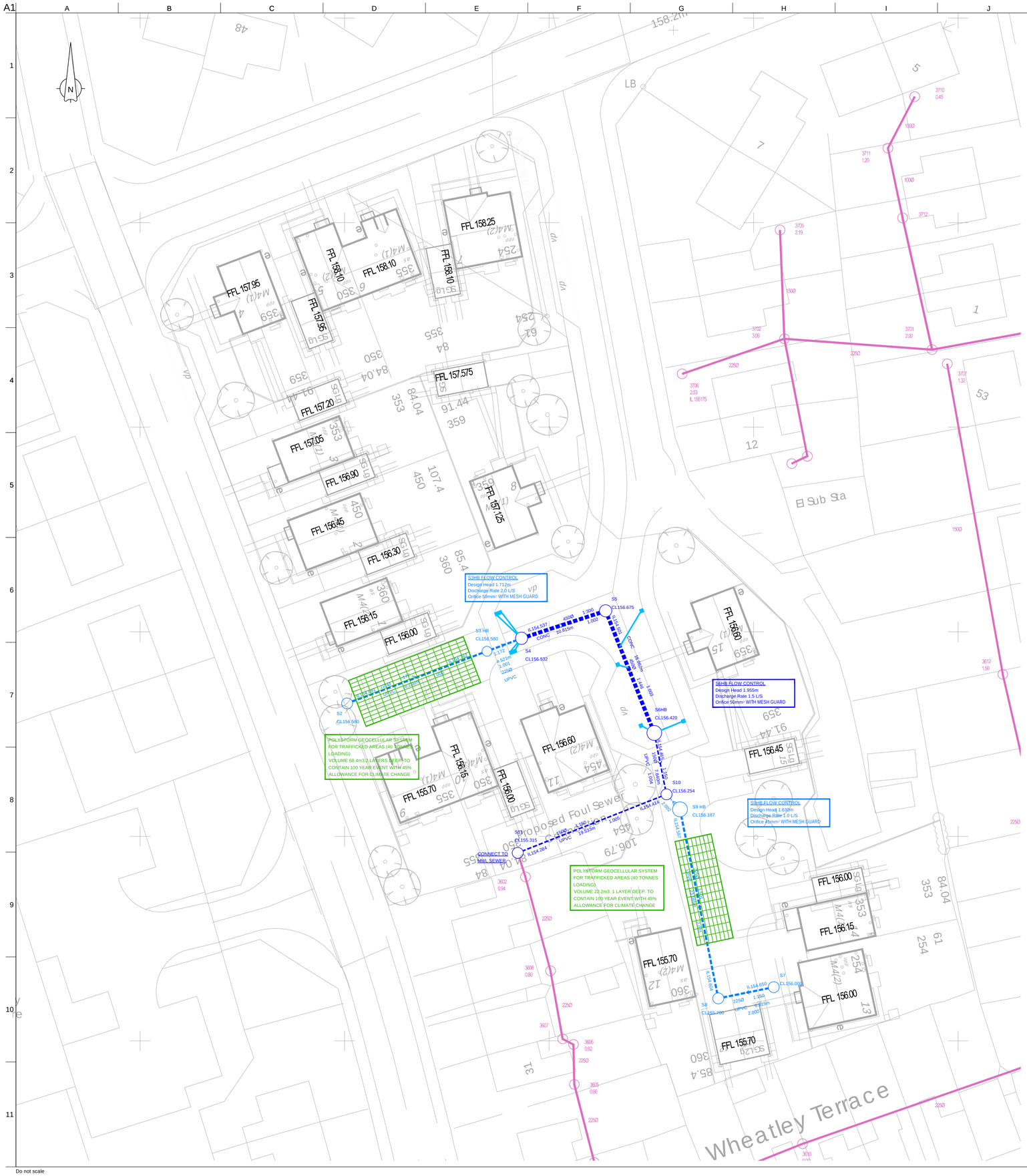
PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S42	0.319	0.000	0.18			2.5	SURCHARGED	
1.001	S43HB	0.413	0.000	0.22		119	2.4	SURCHARGED	
2.000	S44	0.159	0.000	0.31			3.7	SURCHARGED	
1.002	S45	1.206	0.000	0.01			11.0	SURCHARGED	
3.000	S46	0.611	0.000	0.11			1.5	FLOOD RISK	

©1982-2020 Innovyze

Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 6

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	HalfDrain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
3.001	S47	0.807	0.000	0.22			2.9	FLOOD RISK	
4.000	S48	0.621	0.000	0.20			2.7	FLOOD RISK	
4.001	S49HB	0.789	0.000	0.23		267	2.6	FLOOD RISK	
1.003	S50HB	2.492	0.000	0.19			2.5	FLOOD RISK	

©1982-2020 Innovyze



Highways

1. All excavations below adopted highways to be backfilled with Type 1 and compacted in layers not exceeding 150mm.
2. Highway Authority to be contacted as soon as Contractor is on site to enable early discussions with the Clerk of Works.

General Drainage

3. Manhole/inspespectionchamber covers in traffficked areas to be loading type D400 and B125 in non-traffficked areas.
4. All gullies to be trapped as shown on the details drawings.

Adopted Drainage

5. Position and levels of existing manholes and sewers are to be checked on site as soon as possible and preferably before site activities commence.
6. The sewer connection is to be carried out by an NWL Approved Contractor.
7. This drawing is to be read in conjunction with the drainage details drawings.
8. For proposed adopted drainage pipes with less than 900mm cover in areas not subjected to vehicular loading and less than 1200mm in vehicular loading areas to be concrete protected.
9. Adopted drainage is to comply with 'Design and Construction Guidance'.
10. Pipe surround to be granular type 's' unless noted otherwise.

Private Drainage

11. Private drainage is to comply with all statutory requirements and accord with BS EN 752 and Building Regulations Approved Document H.
12. Pipe bedding should granular unless noted otherwise and the granular material to be to BSBB2 Pt 2 and to Building Regulations Part H.
13. Pipe sizes to be 100mm u.n.o..
14. For drainage pipes to be cast in concrete to have rocker pipes either side of concrete.

PRIVATE DRAINAGE NOTES

PRIVATE DRAINAGE TO BE 110mm DIA. (UNLESS OTHERWISE NOTED) PVC-U PIPES WITH GRP OR PVC-U INSPECTION CHAMBERS. SYSTEM DESIGN & CONSTRUCTION TO CONFORM WITH MANUFACTURER'S INSTRUCTIONS & "GOOD PRACTICE GUIDE".

SURFACE WATER DRAINAGE

IL53.850	RODDING EYE WITH INVERT LEVEL.
IL53.850	INSPECTION CHAMBER. 475mmØ. NON MAN ENTRY WITH INVERT LEVEL
	PRIVATE PVC-U 100mmØ (UNLESS OTHERWISE NOTED) DRAINAGE PIPE
IL53.850	CONNECTION CHAMBER. 475mmØ. NON MAN ENTRY WITH INVERT LEVEL
	CELLULAR STORAGE UNITS
	ADOPTED SURFACE WATER PIPE
	ADOPTED SURFACE WATER MANHOLE
	HIGHWAY GULLY AND LEAD

ALL DRIVEWAYS TO BE CONSTRUCTED WITH A PERMEABLE SURFACING AND UNDERDRAIN TO COLLECT SURFACE WATER AND CONVEY TO DOWNSTREAM NETWORKS

Issue	Date	Description	By	Chkd	Appd
P1	02.02.24	Preliminary Issue	RH	RH	PL

COAST CONSULTING ENGINEERS
7 Silverton Court, Northumberland Business Park, NE23 7RY
0191 5977879

Client

GLEESON HOMES LTD

Job Title

JACK LAWSON TCE

Drawing Title

PROPOSED DRAINAGE
SHEET 1

Scale at A1

1:250

Drawing Status

PRELIMINARY

Job No	Drawing No	Issue
23066	11	P1

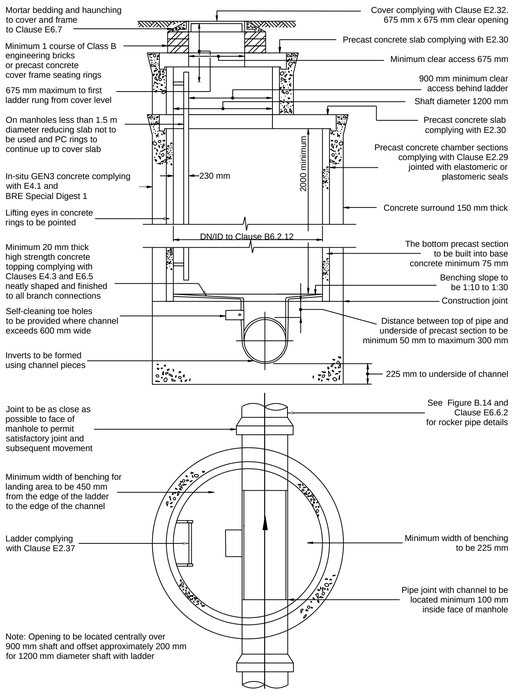
©Coast Consulting Engineers Ltd.

Do not scale

A1

FIGURE B4
TYPICAL MANHOLE DETAIL - TYPE A1

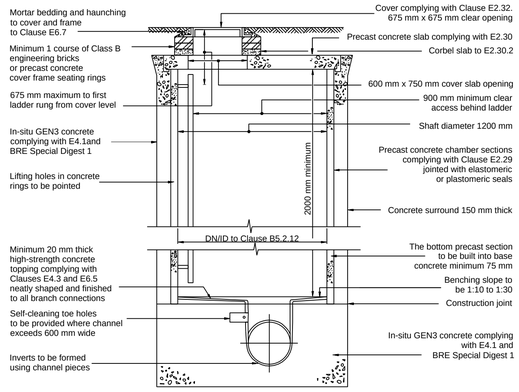
Depth from cover level to soffit of pipe 3 m to 6 m with ladder and reducing slab
Rigid material construction with concrete surround

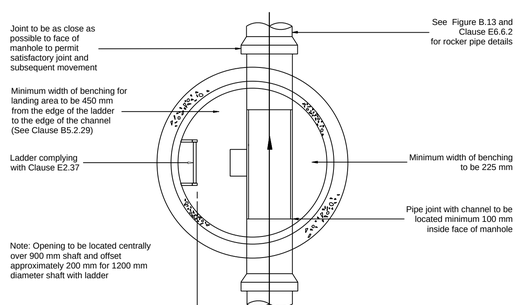


Note: Opening to be located centrally over 900 mm shaft and offset approximately 200 mm for 1200 mm diameter shaft with ladder

FIGURE B.7
TYPICAL MANHOLE DETAIL - TYPE A2

Depth from cover level to soffit of pipe 3 m to 6 m with ladder
Alternative rigid material construction with concrete surround

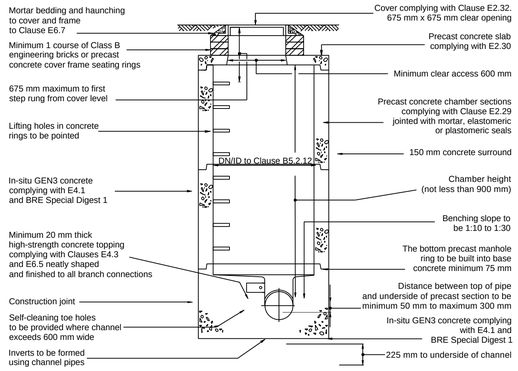




Note: Opening to be located centrally over 900 mm shaft and offset approximately 200 mm for 1200 mm diameter shaft with ladder

FIGURE B.10
TYPICAL MANHOLE DETAIL - TYPE B

Depth from cover level to soffit of pipe 1.5 m to 3.0 m
Alternative Rigid material construction with concrete surround



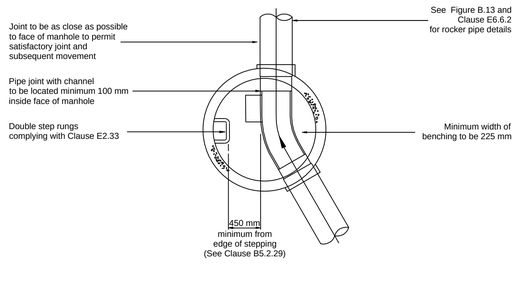
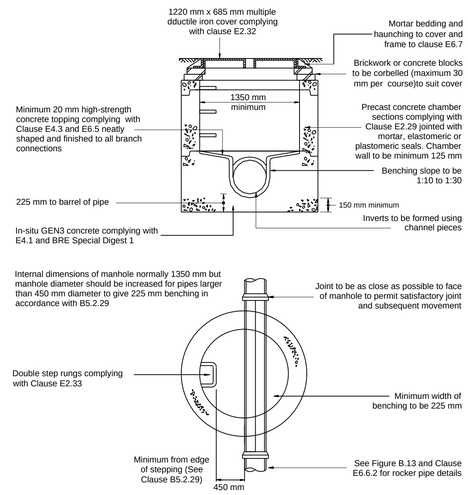


FIGURE B.15
TYPICAL MANHOLE DETAIL - TYPE C

Depth from cover level to soffit of pipe less than 1.5 m Maximum pipe size 450 mm diameter Rigid material construction



Note: The use of precast concrete chamber units to E2.29 with 150 mm GEN3 in-situ concrete complying with E4.1 and BRE Special Digest 1 in place of brickwork construction is permitted.

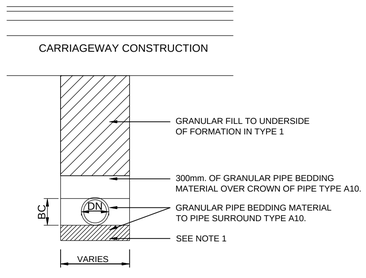
CLASS S BEDDING

1. TO BE USED EVERYWHERE WHEN THE DEPTH OF COVER TO THE PIPE EXCEEDS 1200mm

   THIS DIMENSION TO BE 1/6 Bc OR 100mm WHICHEVER IS THE GREATER, OR IN THE CASE OF ROCK,OR WHERE IRREGULAR HARD SPOTS MAY OCCUR, THE DIMENSION IS TO BE 1/4 Bc OR 200mm WHICHEVER IS THE GREATER, BUT IN ANY CASE NOT LESS THAN 50mm UNDER THE SOCKETS.

2. SELECTED BACKFILL IS TO BE FREE FROM VEGETABLE MATTER, RUBBISH AND FROZEN SOIL, AND IS TO EXCLUDE STONES AND LUMPS RETAINED ON A 40mm SIEVE, HAND COMPACTED IN LAYERS NOT EXCEEDING 150mm.

3. WHERE PIPELINES RUN UNDER PAVED/TRAFFICKED AREAS, BACKFILL TO THE TRENCH TO BE D.O.T. TYPE 1 SUB-BASE, CONSOLIDATED IN 150mm LAYERS UP TO THE UNDERSIDE OF THE PAVEMENT CONSTRUCTION.



BEDDING CLASS S.

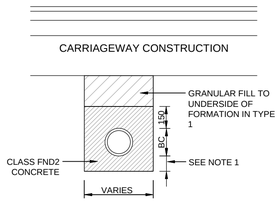
CLASS X BEDDING

1. (FND2 CONCRETE SURROUND)
   TO BE USED EVERYWHERE WHEN THE DEPTH OF COVER TO THE PIPE IS LESS THAN 1200mm AND ALL GULLY LEADS.

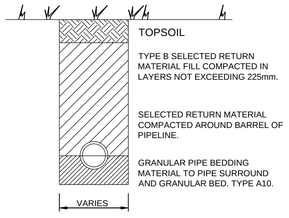
2. THIS DIMENSION TO BE 1/6 Bc OR 100mm WHICHEVER IS THE GREATER, OR IN THE CASE OF ROCK, OR WHERE IRREGULAR HARD SPOTS MAY OCCUR, THE DIMENSION IS TO BE 1/4 Bc OR 200mm WHICHEVER IS THE GREATER, BUT IN ANY CASE NOT LESS THAN 50mm UNDER THE SOCKETS.

3. PIPELINE FLEXIBILITY IS TO BE RETAINED BY INTERRUPTING THE CONCRETE SURROUND OVER ITS FUL CROSS-SECTION AT INTERVALS NOT EXCEEDING 8m BY A COMPRESSIBLE FILLER WHICH IS TO COINCIDE WITH PIPE JOINTS.

   WHERE PIPELINES RUN UNDER PAVED/TRAFFICKED AREAS, BACKFILL TO THE TRENCH TO BE D.O.T. TYPE 1 SUB-BASE, CONSOLIDATED IN 150mm LAYERS UP TO THE UNDERSIDE OF THE PAVEMENT CONSTRUCTION.



BEDDING CLASS X.



BEDDING CLASS B.

Issue	Date	Description	By	Chkd	Appd
P1	02.02.24	Preliminary Issue	RH	RH	PL

COAST CONSULTING ENGINEERS
7 Silverton Court, Northumberland Business Park, NE23 7RY
0191 5977879

Client
GLEESON HOMES

Job Title
JACK LAWSON TCE
WHEATLEY HILL

Drawing Title
DRAINAGE CONSTRUCTION DETAILS
SHEET 1

Scale at A1

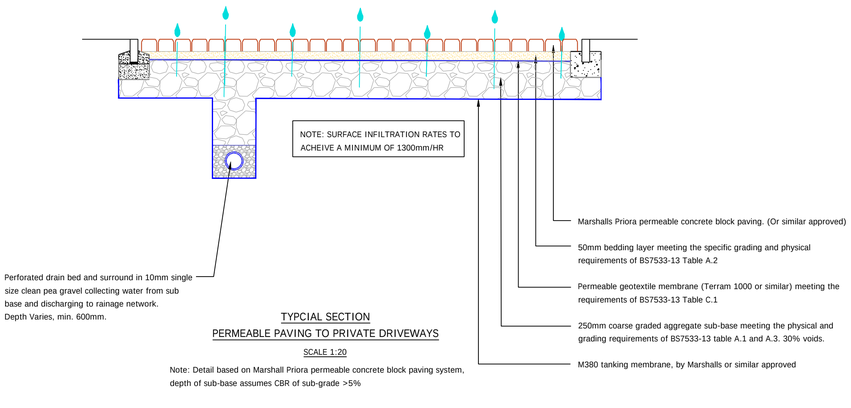
Drawing Status
PRELIMINARY

Job No	Drawing No	Issue
22090	41	P1

© Coast Consulting Engineers Ltd.

Do not scale

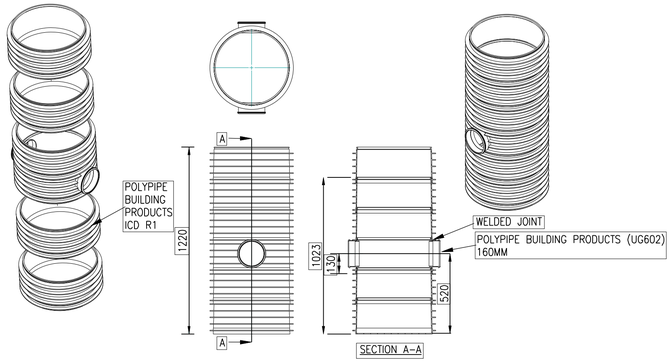
TYPICAL PLAN
PERMEABLE PAVING TO PRIVATE DRIVEWAYS
SCALE 1:20



TYPCIAL SECTION
PERMEABLE PAVING TO PRIVATE DRIVEWAYS
SCALE 1:20

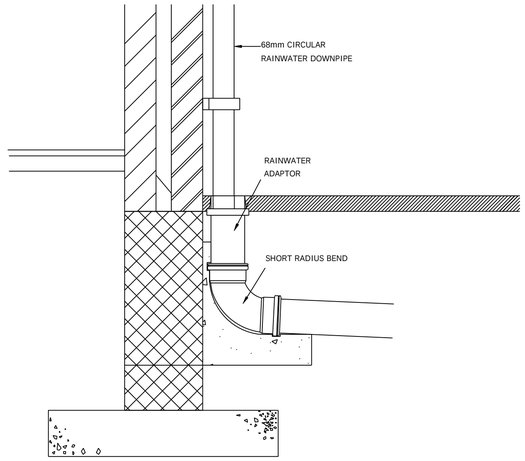
Note: Detail based on Marshall Priora permeable concrete block paving system, depth of sub-base assumes CBR of sub-grade >5%

NOTE: THE BASIC SILT TRAP CONSISTS OF A INLET / OUTLET PEICE WHICH IS MADE UP OF TWO ICDR1 RISERS WELDED TOGETHER WITH TWO AXIALLY ALLIGNED 160 COUPLERS FORMING THE INLET AND OUTLET RESPECTIVLY. THE BASE UNIT IS PRODUCED BY WELDING A POLYPROPYLENE BASE ON TO A ICDR1. THE REMAINDER OF THE CHAMBERS HEIGHT IS CREATED WITH PLAIN ICDR1 RISER PEICES PLACED ABOVE OR BELOW THE INLET/OUTLET PEICE.

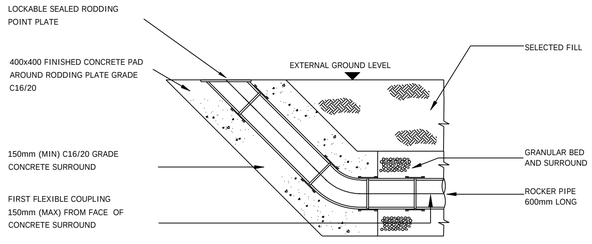


BASIC SILT TRAP DETAIL

NOTE:
ALL SURFACE WATER FIRST OFF MANHOLES TO BE SILT TRAPS



RWP DIRECT CONNECTION
MAXIMUM DEPTH 600mm



EXTERNAL RODDING POINT

©Coast Consulting Engineers Ltd.

Issue	Date	Description	By	Chkd	Appd
P1	02.02.24	Preliminary Issue	RH	RH	PL

COAST CONSULTING ENGINEERS
7 Silverton Court, Northumberland Business Park, NE23 7RY
0191 5977879

Client: GLEESON HOMES

Job Title: JACK LAWSON TCE WHEATLEY HILL

Drawing Title: DRAINAGE CONSTRUCTION DETAILS SHEET 2

Scale at A1

Drawing Status: **PRELIMINARY**

Job No	Drawing No	Issue
22090	42	P1

Do not scale

COAST
CONSULTING ENGINEERS

Civil

Structural

Geotechnical

www.coastconsult.co.uk
admin@coastconsult.co.uk