COAST
CONSULTING ENGINEERS

Hoyland

Barnsley, South Yorkshire

Flood Risk Assessment and Drainage Strategy

Issue Date:
28 November 2023

Report Number:
23085-01

Client:
Camstead Homes

Revision:
-

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Revision	Date	Comments	Prepared by	Checked by
-	28.11.23	Initial issue	PB	PL

Executive Summary

Site Location	The proposed 3.6Ha development is located on land to the north of the B6096 Wood Walk in the town of Hoyland, Barnsley, South Yorkshire. Barnsley town centre is located approximately 5.5km north-west of the site. National Grid Reference: SE 37366 01729 437366mE, 401729mN
Site Proposals	A residential development comprising of 83 properties with associated garages, gardens, and parking, with areas of public open space. Vehicular access to the development will be via a new junction on the B6096 Wood Walk on the site's southern boundary.
Ground Conditions	Approximately half of the site (centre and north) is underlain by the former Woodhead Farm Opencast Mine. Backfill has been found to be circa 26m deep. Natural ground outside of the opencast comprises of stiff clays and sandy gravel underlain by shallow sandstone and siltstone bedrock.
Nearest Watercourse	An unnamed watercourse approximately 90m from the site boundary located behind existing residential properties on Pepper Street to the south of the B6096 Wood Walk.
Nearest Surface Water Sewer	375mm diameter public surface water sewer in Wombwell Road to the south-west of the site.
Nearest Combined Sewer	225mm diameter public combined sewer in Wombwell Road to the south-west of the site.
Nearest Foul Water Sewer	None within vicinity of 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	Environment Agency surface water flood maps show that the majority site is classified as being at **very low risk** of surface water flooding. An area along the south-western boundary and a small area on the southern boundary are classified as being at **low risk** of surface water flooding to a depth of below 300mm.
Ground Water	The Geoenvironmental Appraisal report by Lithos Consulting states that "*no significant groundwater has been encountered*". Groundsure reports consider the risk of groundwater flooding to be 'negligible'. Based upon the information outlined above, the risk of flooding due to groundwater rise can be considered as **low** throughout the site.
Surface Water Discharge Rate	Surface water should be restricted to 3.5 litres/sec peak discharge for all events up to an including the 100-year event with a 40% allowance for climate change and 10% urban creep allowance providing betterment of up to 72% in comparison to the current regime.
SUDS	Detention basin Permeable paving Vortex flow control

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 Camstead Homes to assess the flood risk associated with a proposed development in Hoyland, Barnsley. 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 (2022) 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 3.6Ha development is located on land to the north of the B6096 Wood Walk in the town of Hoyland, Barnsley, South Yorkshire. Barnsley town centre is located approximately 5.5km north-west of the site.

National Grid Reference: SE 37366 01729

437366mE, 401729mN

Please refer to the site location plan shown below and in Appendix A.

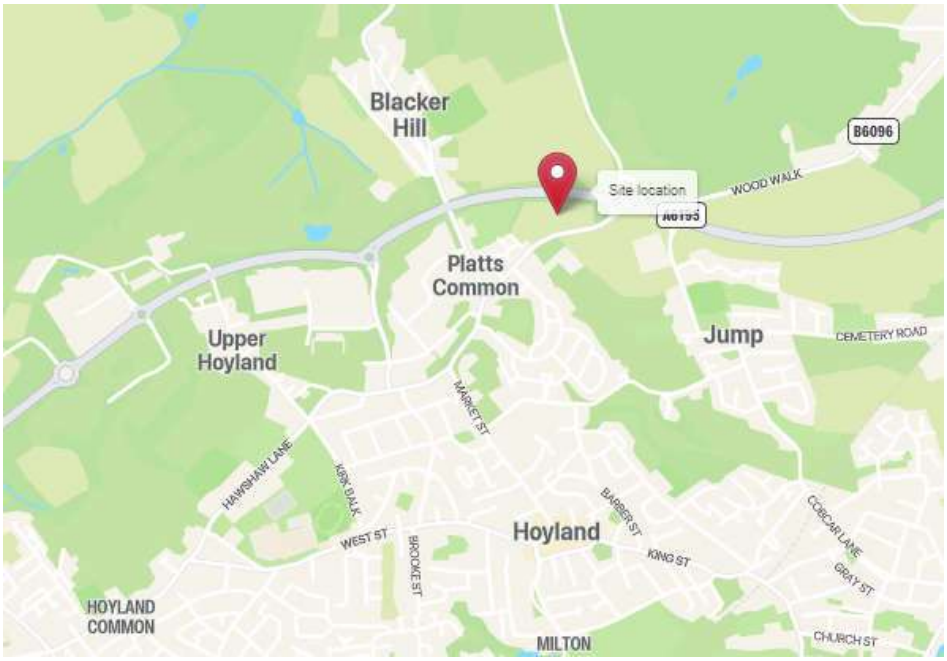


Figure 2.1 – Site location

2.2 Existing Site Description

The irregular shaped 3.6Ha site currently comprises of greenfield land with a wooded area in the east. Vehicular access is from the B6096 Wood Walk.

The site is bound by the A6195 Dearne Valley Parkway to the north, and by the B6096 Wood Walk to the south and east. An residential estate and further grassland are present beyond the tree-lined western boundary.

A topographical survey dated March 2020 by TriCAD Solutions Ltd shows that site levels fall from a central high point towards the south-west and eastern boundaries. Please refer to Appendix B.

2.3 Existing Watercourses

The Environment Agency's Statutory Main River Map shows that there are no Main Rivers within 1km of the site.

The closest watercourse is an unnamed watercourse approximately 90m from the site boundary located behind existing residential properties on Pepper Street to the south of the B6096 Wood Walk.

2.4 Existing Sewers and Drainage

Existing sewer records have been obtained from Yorkshire Water (YW). Sewer records show there are no public sewers located within the site boundary.

A 375mm diameter public surface water sewer is present in Wombwell Road to the south-west of the site.

A 225mm diameter public combined sewer is present in Wombwell Road to the south-west of the site.

A copy of the sewer records can be found in Appendix C.

2.5 Existing Ground Conditions

Lithos Consulting have produced a Geotechnical Appraisal report dated April 2023 which states that approximately half of the site (centre and north) is underlain by the former Woodhead Farm Opencast Mine. Backfill has been found to be circa 26m deep. Natural ground outside of the opencast comprises of stiff clays and sandy gravel underlain by shallow sandstone and siltstone bedrock.

2.6 Development Proposals

Architects' proposals show a residential development comprising of 83 properties with associated garages, gardens, and parking, with areas of public open space. Vehicular access to the development will be via a new junction on the B6096 Wood Walk on the site's southern boundary. Please refer to Appendix D.

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 Risk Vulnerability Classification

Environment Agency flood maps have been acquired to assist with this assessment. The flood maps indicate that the 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 river flooding (low risk). Refer to the extract below which identifies the Flood Zones within and in proximity to the development site. The site is not considered to be at risk of flooding from rivers or sea.

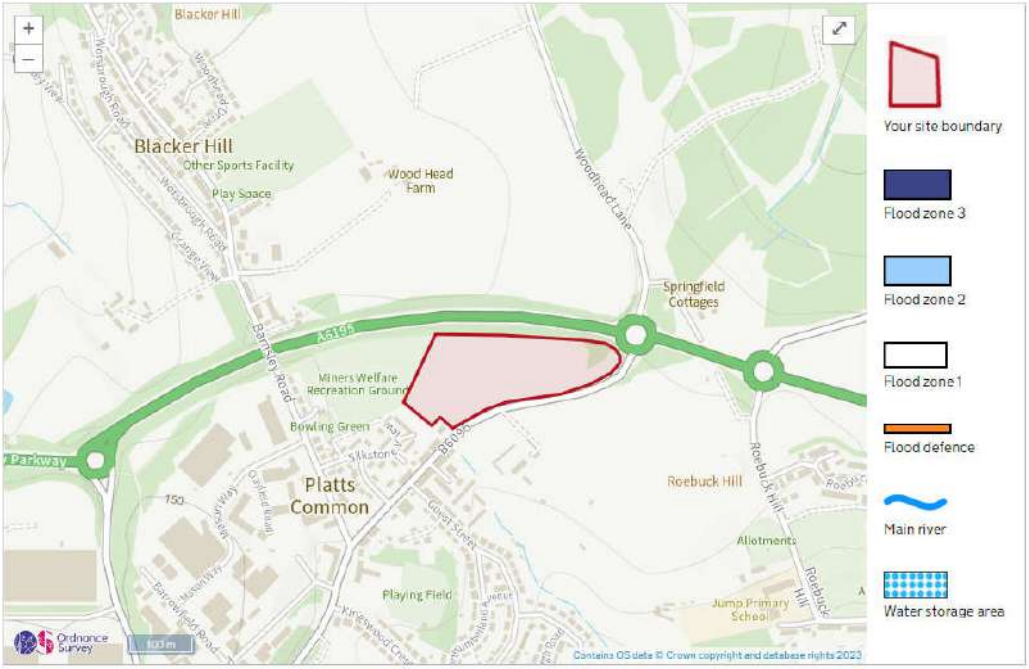


Figure 3.1 – Flood Zone Classification

3.2 Flood Risk Vulnerability Classification

Annex 3 of the National Planning Policy Framework (2022) 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

Environment Agency surface water flood maps show that the majority site is classified as being at **very low risk** of surface water flooding.

An area along the south-western boundary and a small area on the southern boundary are classified as being at **low risk** of surface water flooding to a depth of below 300mm. This is consistent with low areas on the topographic survey. Post development, regrading of existing levels and installation of a positive surface water drainage system will reduce or eliminate occurrences of standing water.

Finished floor levels should be raised locally to a minimum of 0.3m above the maximum water level of the proposed drainage features. In addition, proposed site levels should be designed to direct surface water away from dwelling entrances where possible.

Based upon the information outlined above, post development, the risk of surface water flooding to properties can be considered as **low** throughout the site.

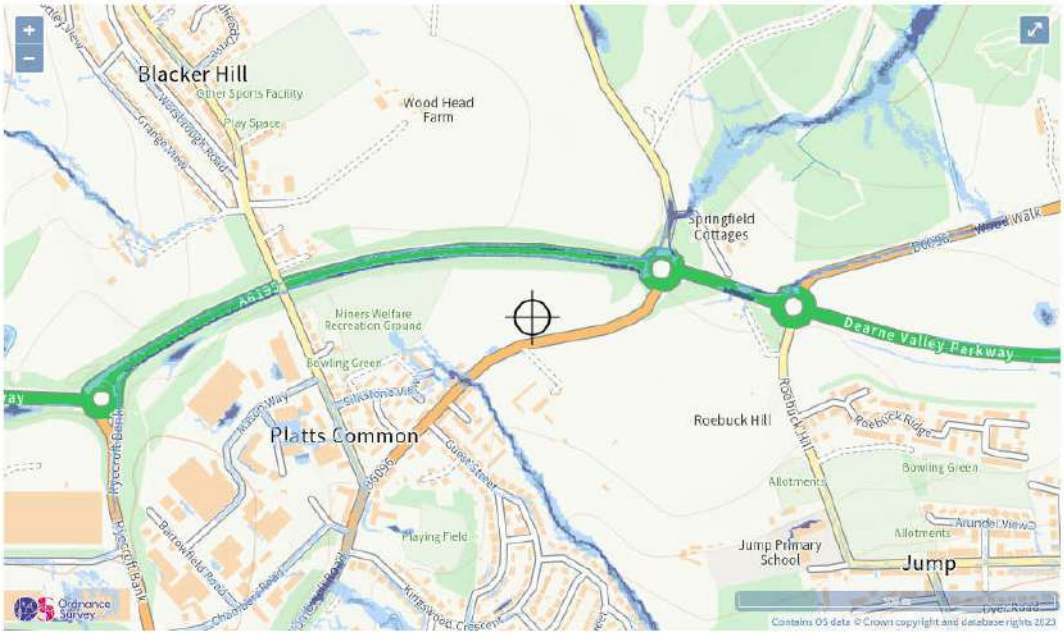


Figure 3.2 – Extent of 'High Risk' surface water flooding

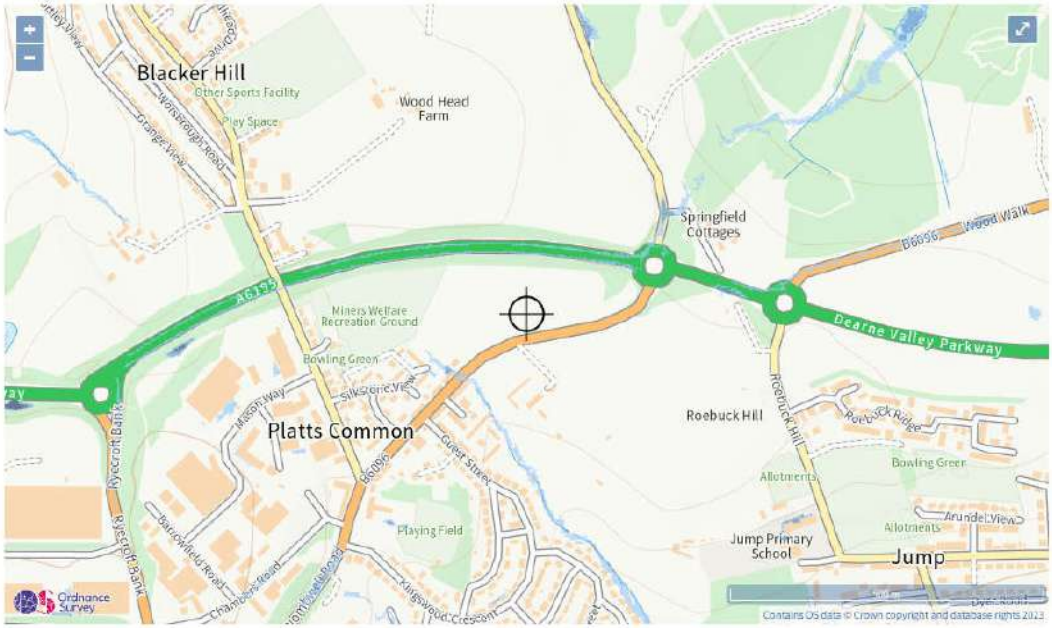


Figure 3.3 – Extent of 'Medium Risk' surface water flooding

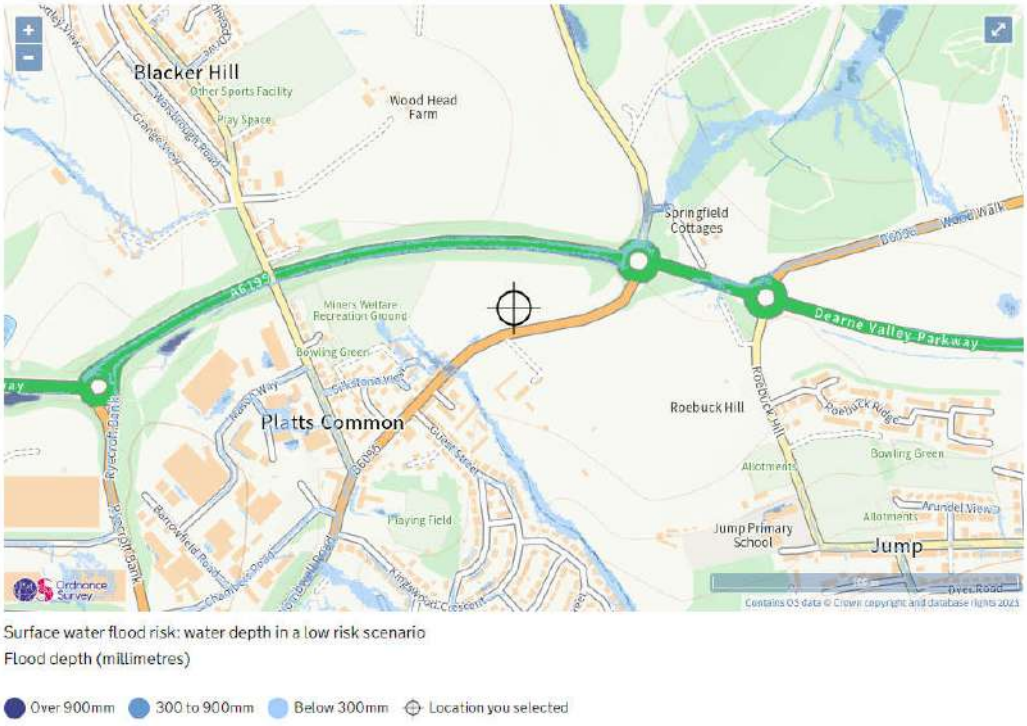


Figure 3.4 – Extent of 'Low Risk' surface water flooding

3.4 Groundwater 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 permeable strata.

The Geoenvironmental Appraisal report by Lithos Consulting states that "*no significant groundwater has been encountered*". In addition, Groundsure reports consider the risk of groundwater flooding to be 'negligible'. Based upon the information outlined above, the risk of flooding due to groundwater rise can be considered as **low** throughout the site.

3.5 Sewer Flood Risk

Sewer records show there are no public sewers located within the site boundary. Existing sewers in the B6096 Wombwell Road have cover levels considerably lower than the proposed development and local topography dictates that any flood flow paths would be away from the development. No flood risk has been identified therefore, the risk of sewer flooding can be deemed as **low**.

3.6 Reservoir Flood Risk

Artificial sources of flood risk such as man-made ponds or reservoirs can cause a potential risk of flooding. The flood map below 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.**

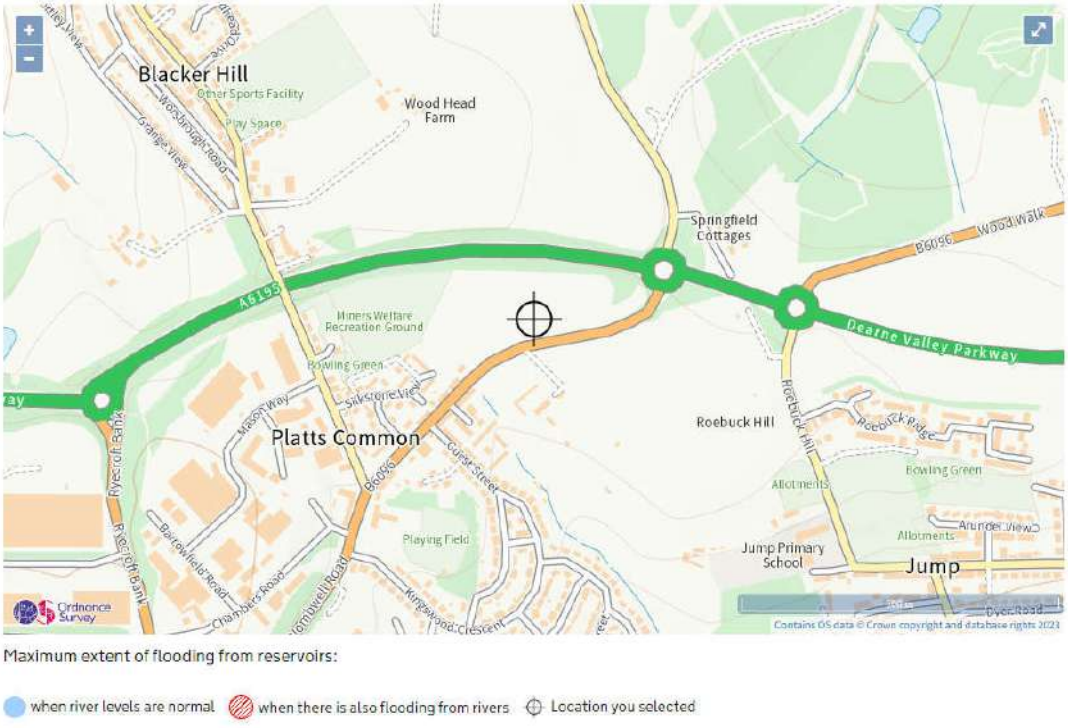


Figure 3.5 – Extent of reservoir flooding

The proposed development is considered appropriate within a Flood Zone 1 in line with the guidance contained within the National Planning Policy Framework for flooding.

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

The Geoenvironmental Appraisal by Lithos Consulting states that "*due to the presence of deep made ground, soakaways will not provide a suitable drainage solution for surface water run-off at the site*".

4.2 Watercourse

The Environment Agency's Statutory Main River Map shows that there are no Main Rivers within 1km of the site. The closest watercourse is an unnamed watercourse approximately 90m from the site boundary located behind existing residential properties on Pepper Street to the south of the B6096 Wood Walk. A new direct connection to the watercourse would require crossing third-party land and the B6096 Wood Walk and is therefore not considered to be practical.

4.3 Sewer

A 375mm diameter public surface water sewer is present in Wombwell Road to the south-west of the site and has been identified as a suitable point of discharge subject to Yorkshire Water approval. Yorkshire Water sewer plans suggest that the identified network in Wombwell Road discharges to the unnamed watercourse behind Pepper Street.

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. The applicable techniques and the benefits that they bring to the development are outlined below.

- Detention basin or ponds: An **online detention basin** will be installed to contain flows up to and including the 100 year event with a 40% allowance for climate change. Detention basins are effective in peak flow reduction, water quality treatment in the settlement of solids and have good amenity and ecological potential.
- Peak flow control: A **vortex flow control** will be utilised to restrict flows to no greater than pre-development greenfield runoff rates.
- Source Control: Private driveways will be of permeable construction. **Permeable driveways** 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

In accordance with Local Lead Flood Authority (LLFA) policy, post-development surface water peak discharge should be restricted to the equivalent greenfield runoff rate of discharge for the 1 in 1 year and 1 in 100-year rainfall events. The allowable rate of discharge for the development has been calculated using HR Wallingford 'Greenfield runoff estimation for site's'. The design of the drainage system should include a 40% allowance for climate change and an allowance for urban creep through a 10% increase in the impermeable area.

The minimum orifice size for a flow control should be no less than 75mm to prevent possible blockages to the system and this factor overrides the allowable discharge rate.

Please refer below to the table below and Appendix E from HR Wallingford's 'Greenfield runoff estimation for site's'.

Greenfield runoff rates	Default	Edited
Q_{BAR} (l/s):	6.11	6.11
1 in 1 year (l/s):	5.26	5.26
1 in 30 years (l/s):	10.7	10.7
1 in 100 year (l/s):	12.72	12.72
1 in 200 years (l/s):	14.49	14.49

The LLFA have confirmed that a rate of 1.7l/s/Ha (6.12 l/s for 3.6Ha) is acceptable. However it is understood that Yorkshire Water have agreed to a lower rate of 3.5l/s due to available capacity in the existing surface water sewer network therefore, the lower discharge rate will apply. By restricting the peak rate of discharge from the site to 3.5l/s for all rainfall events up to the 1 in 100 year return period with a 40% allowance for climate change, **the proposed development will provide betterment from the existing regime in line with the table below:**

Return Period	Existing	Proposed	Betterment
Qbar	6.11 l/s	3.5 l/s	43%
1	5.26 l/s	3.5 l/s	33%
30	10.7 l/s	3.5 l/s	67%
100	12.72 l/s	3.5 l/s	72%

4.6 Surface Water Attenuation

The proposed surface water drainage network will utilise an online detention basin to provide temporary storage for run-off from the proposed impermeable areas up to the 1 in 100 year rainfall event with an allowance of 40% for climate change and 10% increase in impermeable areas.

The required volume of surface water attenuation in the basin has been calculated to be 994m^3 based on a discharge rate of 3.5/s.

A detailed drainage strategy with associated calculations can be found in Appendix F.

4.7 Maintenance

The new foul and surface water sewers will be put forward for adoption by Yorkshire Water under a Section 104 agreement.

The developer will appoint a management company for the maintenance of the detention basin with rights for Yorkshire Water to discharge into the basin for perpetuity. Maintenance of the SuDS features should be carried out in accordance with CIRIA C753 The SuDS Manual.

4.8 Foul Water

Yorkshire Water has provided a Pre-Planning Sewerage Enquiry response which states that foul water domestic waste can discharge to the 225mm diameter public combined sewer recorded in Woodwalk, at a point to the south-west of the site.

5. References

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

- National Planning Policy Framework (2022)
- Technical Guidance to the National Planning Policy Framework
- Environment Agency online flood maps
- Design and Construction Guidance for foul and surface water sewers offered for adoption under the Code
- South Yorkshire Interim Local Guidance for Sustainable Drainage Systems (2015)
- Building Regulations Document H (2010)
- Improving the Flood Performance of New Buildings – Defra
- Rainfall runoff management for developments SC030219 – Defra
- Susdrain.org
- The Suds Manual CIRIA C753
- Non-statutory technical standards for sustainable drainage – LASOO
- British Geological Survey online maps
- LandIS by Cranfield University

Appendix A – Location Plan

A3



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Issue	Date	Description	By	Chkd	Appd
P1	28.11.23	Preliminary Issue	PB	PB	PL

COAST CONSULTING ENGINEERS
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0191 5977879

Client
CAMSTEAD HOMES

Job Title
HOYLAND
BARNSLEY

Drawing Title
SITE LOCATION PLAN

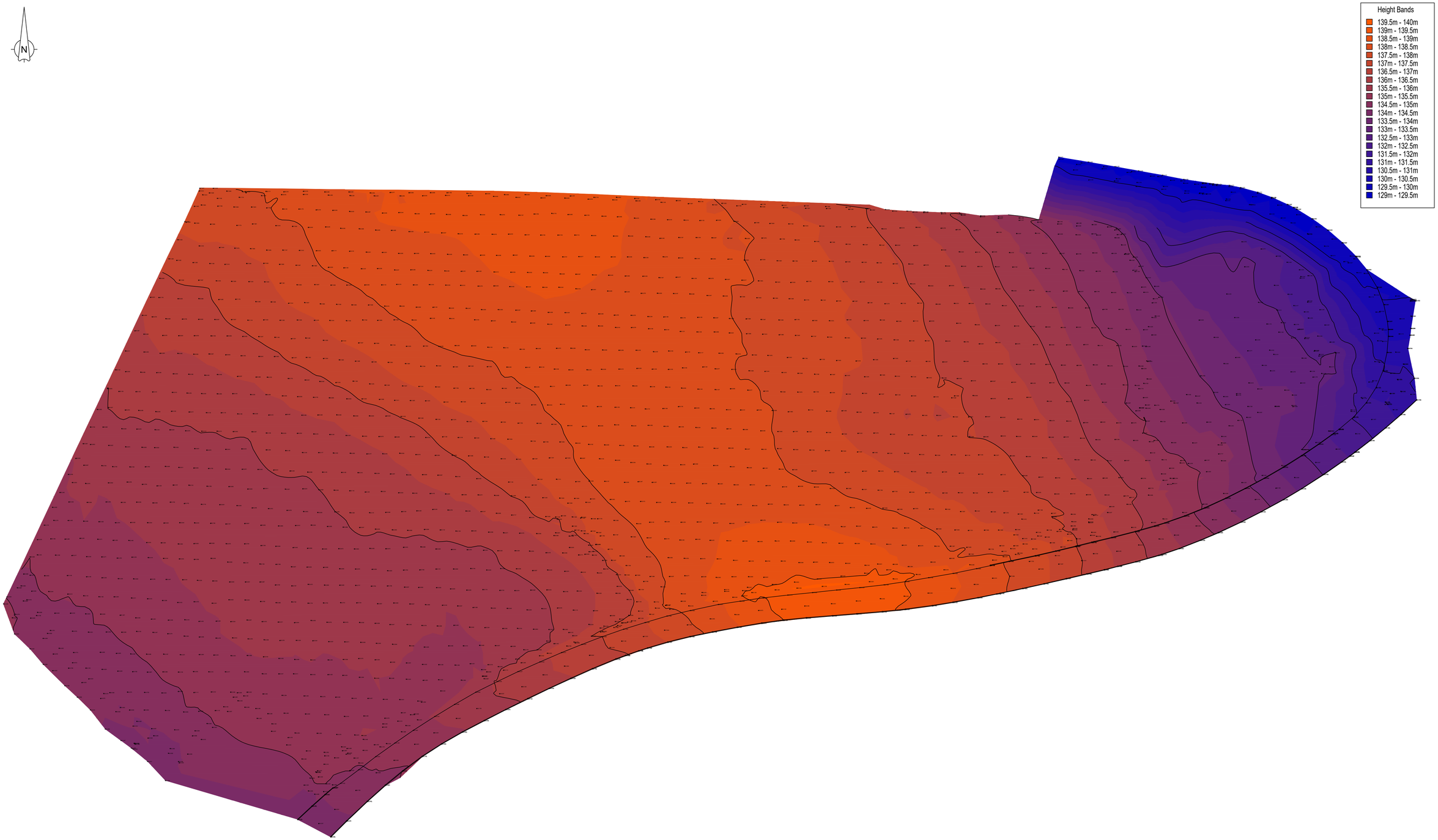
Scale at A3
NTS

Drawing Status
PRELIMINARY

Job No	Drawing No	Issue
23085		P1

Do not scale

Appendix B –
Topographic Survey


N
Height Bands
139.5m - 140m
139m - 139.5m
138.5m - 139m
138m - 138.5m
137.5m - 138m
137m - 137.5m
136.5m - 137m
136m - 136.5m
135.5m - 136m
135m - 135.5m
134.5m - 135m
134m - 134.5m
133.5m - 134m
133m - 133.5m
132.5m - 133m
132m - 132.5m
131.5m - 132m
131m - 131.5m
130.5m - 131m
130m - 130.5m
129.5m - 130m
129m - 129.5m

Appendix C –
Sewer Records

DEARNE VALLEY PARKWAY

WOMBWELL WOOD ROUNDABOUT

ABANDONED

ABANDONED

elfare Recreation Ground

Platts Common

139.3m

137.2m

WOOD WALK

Police Station House

134.6m

Issues

SILKSTONE VIEW

WOODLANDS

El Sub Sta

Shelter

WOMBWELL ROAD

PEPPER ST

Pepper Tree Court

437276 : 401638	Map Name : SE3701NW	Title	Partial Key Foul Sewer = F Combined Sewer = C Surface Water Sewer = SW Trade Sewer = TD Partially Separate = PS
Yorkshire Water, PO Box 500, Halifax Road, Bradford BD6 2LZ Contact Name : YorMap Advisor C ROBERTS Contact Tel : 87 2582		Notes	This plan is furnished as a general guide only and no warranty as to its correctness is given or implied. This plan must not be relied upon in the event of excavations or other works made in the vicinity of public sewers. No house or property connections are shown.
		(Ody) COPYRIGHT STATEMENTS: Reproduced by permission of Ordnance Survey on behalf of HMSO © Crown copyright and database 2014. All rights reserved Ordnance Survey Licence number 100022432	Date Req : 31/03/2020, 12:27:40 Source : Sewer Network Enquiry
			Date Gen : 31/03/2020, 12:29:09

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

Appendix D –
Development Proposals

YELCON CONSTRUCTION

CAMSTEAD HOMES

Scaled @ 1:500

0 10m 20m 50m

N

Notes:

This drawing, design and concept are copyright of STEN Architecture.

All Dimensions are to be verified on site before any work commences. If any discrepancies, errors or emissions are noted, these are to be reported to STEN Architecture immediately.

If any other drawings are referenced within this layout, please refer to the specific detailed drawing for design, materials and specific working practices.

DEARNE VALLEY PARKWAY

WOMBWELL WOOD ROUNDABOUT

Existing woodland

Open space

3m wide access track

Attenuation basin

WOOD WALK

WOMBWELL ROAD

Police Station House

134.6m

20m from proposed junction

PLANNING LAYOUT KEY:

Boundary treatments

- Masonary wall
- Acoustic fence
- Close boarded timber fence
- Estate Railings
- Knee height railing

General

- BCP — Bin collection point (bin collection day only)
- Indicative electric charging point.
- Affordable Dwelling
- Timber cycle store (If seperate store not shown, cycle storage to be provided within detached or integral garage of associated plot.
- Trees/Vegetation - Retained
- Trees/Vegetation - Removed
- Root protection area

Accommodation Schedule - Wood Walk, Hoyland

Private Dwellings						
Name	Floor Area Sq Ft	Beds	No.	Total	% Mix	% Beds
Beamsley	767	2	6	4602	8.0%	8.0%
Lilac	963	3	8	7704	10.7%	66.7%
Inglebrough	985	3	16	15760	21.3%	
Whernside	1029	3	4	4116	5.3%	
Malham	1108	3	10	11080	13.3%	
Aston	1145	3	8	9160	10.7%	
Bedale	1183	3	4	4732	5.3%	
Sandringham	1350	4	3	4050	4.0%	25.3%
Chevin	1360	4	4	5440	5.3%	
Winterley	1374	4	4	5496	5.3%	
Woodale	1378	4	6	8268	8.0%	
Buckden	1422	4	2	2844	2.7%	
Subtotal			75	83252	100.00%	

Private Dwellings						
Name	Floor Area Sq Ft	Beds	No.	Total	% Mix	% Beds
Eastern	690	2	3	2070	3.6%	9.6%
Kelham	734	2	3	2202	3.6%	
Beamsley	767	2	2	1534	2.4%	
Subtotal			8	5806	9.64%	

Grand total		
	83	89058
Average private house type		1073

	m2	hectares	acres	
Approx gross area	36057.00	3.61	8.91	
Usable open space	5348.00	0.53	1.32	
Woodland	2499.00	0.25	0.62	
Attenuation Basin	2906.00	0.29	0.72	
Total POS	10753.00	1.08	2.66	29.8%
Approx Private Nett Area	22889.00	2.29	5.66	
Coverage	Units P/H =	36.26	15745.48	

REV:	DESCRIPTION:	BY:	DATE:
C	Lilac, Inglebrough & Bedale sizes updated to suit latest house type design. Buckden house type name corrected within schedule. Roof designs to Chevin, Malham and Winterley updated.	TS	24.11.23
B	Whernside increased in depth to match planning drawing. Associated garages amended to suit.	TS	02.11.23
A	Minor amends to boundary treatment positions inline with boundary treatment plan.	TS	27.10.23

STEN ARCHITECTURE

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CLIENT: Camstead Homes
3 The Gateway North
Marsh Lane
Leeds LS9 8AX

SITE: Wood Walk
Hoyland

TITLE: Planning Layout

SCALE AT A1:	DATE:	DRAWN:	CHECKED:
1:500	26.10.23	TS	SL

PROJECT NO:	DRAWING NO:	REVISION:
2351	2351.01	C

Appendix E –
Greenfield Runoff Rates

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Paul Bye
Site name:	Hoyland
Site location:	Barnsley

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:	53.51083° N
Longitude:	1.43821° W
Reference:	3767813344
Date:	Nov 28 2023 09:31

Runoff estimation approach

IH124

Site characteristics

Total site area (ha): 3.6

Methodology

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

Soil characteristics

	Default	Edited
SOIL type:	2	2
HOST class:	N/A	N/A
SPR/SPRHOST:	0.3	0.3

Hydrological characteristics

	Default	Edited
SAAR (mm):	659	659
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):	6.11	6.11
1 in 1 year (l/s):	5.26	5.26
1 in 30 years (l/s):	10.7	10.7
1 in 100 year (l/s):	12.72	12.72
1 in 200 years (l/s):	14.49	14.49

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

Appendix F –
Drainage Strategy


DEARNE VALLEY PARKWAY
WOMBWELL
ROUNDABO
Existing woodland
Open space
WOOD WALK
Police Station House
Shelter
Pepper Tree
Cop
134.6m
FFL138.100
FFL138.100
FFL137.900
FFL137.350
FFL137.350
FFL137.050
FFL136.675
FFL138.400
FFL138.550
FFL138.550
FFL139.000
FFL139.000
FFL138.250
FFL138.775
FFL138.700
FFL138.250
FFL138.250
FFL136.775
FFL136.650
FFL136.650
FFL136.650

Network Details

Manhole Schedule

Manhole	Catchment Area (ha)	Diameter (m)	Type	CL (m)	IL (m)	Depth To Soffit (m)	Easting (m)	Northing (m)
S1	0.162	1.350	Type C	136.250	134.450	1.500	437488.363	401738.238
S2	0.156	1.200	Type B	136.925	134.320	2.305	437462.285	401723.528
S3	0.123	1.200	Type B	138.890	136.500	2.240	437400.855	401688.876
S4	0.065	1.500	Type A	138.335	133.835	3.900	437424.038	401701.953
S5	0.000	1.500	Type A	138.250	133.775	3.875	437409.299	401728.083
S6	0.080	1.500	Type A	138.445	133.720	4.125	437397.309	401750.904
S7	0.063	1.500	Type A	138.535	133.695	4.240	437385.257	401754.197
S8	0.084	1.500	Type A	138.580	133.595	4.385	437339.620	401735.412
S9	0.100	1.500	Type A	138.505	133.565	4.340	437326.859	401733.423
S10	0.098	1.800	Type A	138.300	133.510	4.190	437306.869	401750.834
S11	0.049	1.500	Type A	137.800	133.445	3.755	437275.311	401751.183
S12	0.000	1.500	Type A	137.375	133.420	3.355	437267.070	401743.562
S13	0.118	1.500	Type B	136.715	133.385	2.730	437259.911	401728.333
S14	0.204	1.500	Type C	135.765	133.965	1.500	437308.972	401656.431
S15	0.047	1.200	Type B	135.990	133.840	1.850	437293.883	401680.925
S16	0.061	1.500	Type B	136.280	133.540	2.290	437269.894	401705.891
S17	0.000	1.800	Type B	135.860	133.335	1.925	437250.105	401707.476
Inlet	0.000	1.800	Type B	136.000	133.260	2.140	437229.334	401680.535
Outlet	0.000	0.000	Type B	136.000	132.900	2.500	437250.981	401661.632
S18 (C)	0.000	2.100	Type B	135.650	132.800	2.700	437278.516	401662.691
S19	0.000	1.200	Type A	135.955	132.585	3.220	437296.531	401673.783
S20	0.000	1.200	Type A	135.620	132.175	3.295	437317.822	401639.204
S21	0.000	1.200	Type B	134.685	131.820	2.715	437290.836	401616.767
ExSW MH	0.000	1.200	Type B	132.467	130.652	1.665	437248.166	401568.255

Pipe Schedule

Pipe Number	US Manhole	US IL (m)	DS Manhole	DS IL (m)	Diameter (m)	Length (m)	Gradient (1:x)	Roughness (mm)	US Depth To Soffit (m)	DS Depth To Soffit (m)
1.000	S1	134.450	S2	134.320	0.300	29.941	230.3	0.600	1.500	2.305
1.001	S2	134.320	S4	134.135	0.300	43.913	237.4	0.600	2.305	3.900
2.000	S3	136.500	S4	135.335	0.150	26.617	22.8	0.600	2.240	2.850
1.002	S4	133.835	S5	133.775	0.600	30.000	500.0	0.600	3.900	3.875
1.003	S5	133.775	S6	133.720	0.600	25.779	468.7	0.600	3.875	4.125
1.004	S6	133.720	S7	133.695	0.600	12.494	499.8	0.600	4.125	4.240
1.005	S7	133.695	S8	133.595	0.600	49.352	493.5	0.600	4.240	4.385
1.006	S8	133.595	S9	133.565	0.600	12.915	430.5	0.600	4.385	4.340
1.007	S9	133.565	S10	133.510	0.600	26.509	482.0	0.600	4.340	4.190
1.008	S10	133.510	S11	133.445	0.600	31.560	485.5	0.600	4.190	3.755
1.009	S11	133.445	S12	133.420	0.600	11.225	449.0	0.600	3.755	3.355
1.010	S12	133.420	S13	133.385	0.600	16.828	480.8	0.600	3.355	2.730
1.011	S13	133.385	S17	133.335	0.600	23.047	460.9	0.600	2.730	1.925
3.000	S14	133.965	S15	133.840	0.300	28.769	230.1	0.600	1.500	1.850
3.001	S15	133.840	S16	133.690	0.300	34.623	230.8	0.600	1.850	2.290
3.002	S16	133.540	S17	133.485	0.450	19.852	361.0	0.600	2.290	1.925
1.012	S17	133.335	Inlet	133.260	0.600	34.018	453.6	0.600	1.925	2.140
1.013	Inlet	133.260	Outlet	132.900	0.600	28.739	79.8	0.600	2.140	2.500
1.014	Outlet	132.900	S18 (C)	132.800	0.600	27.555	275.6	0.600	2.500	2.250
1.015	S18 (C)	132.800	S19	132.585	0.150	21.156	98.4	0.600	2.700	3.220
1.016	S19	132.585	S20	132.175	0.150	40.608	99.0	0.600	3.220	3.295
1.017	S20	132.175	S21	131.820	0.150	35.095	98.9	0.600	3.295	2.715
1.018	S21	131.820	ExSW MH	130.652	0.150	64.608	55.3	0.600	2.715	1.665

Outfall Details

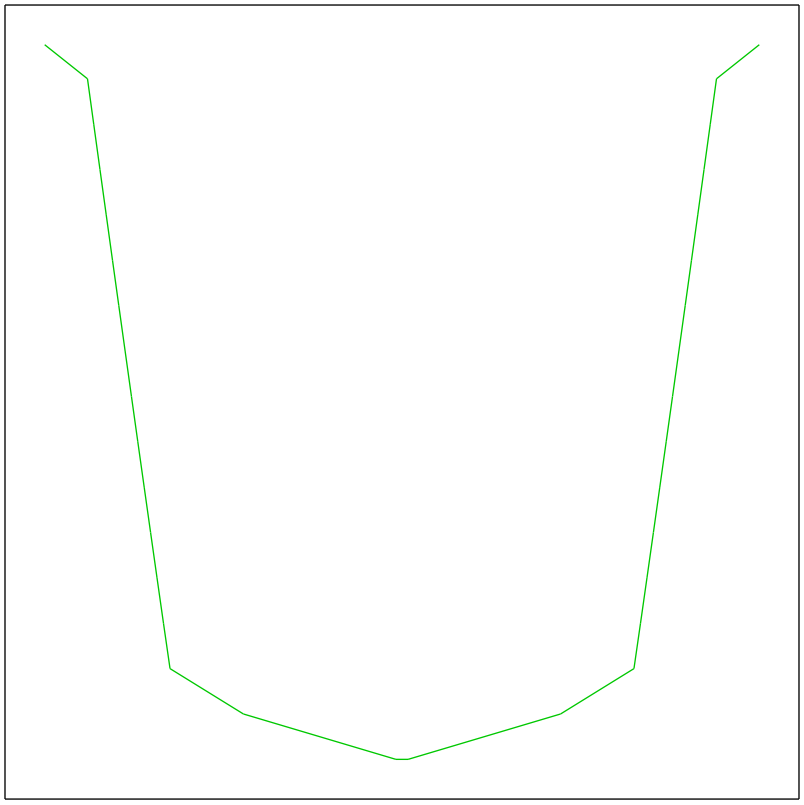
Outfall Manhole ExSW MH : Free Discharge

Flow Control Details

Pond Structure at Manhole Outlet

Pond Invert (m)	Max Depth (m)	Volume To Water Level (m3)	Water Level (m)	Freeboard (m)	Infil Base (m/hr)	Infil Side (m/hr)	Safety Factor
132.900	3.100	994.303	133.900	0.575	0.00000000	0.00000000	2.00

Pond Depth/Area Diagram at Outlet

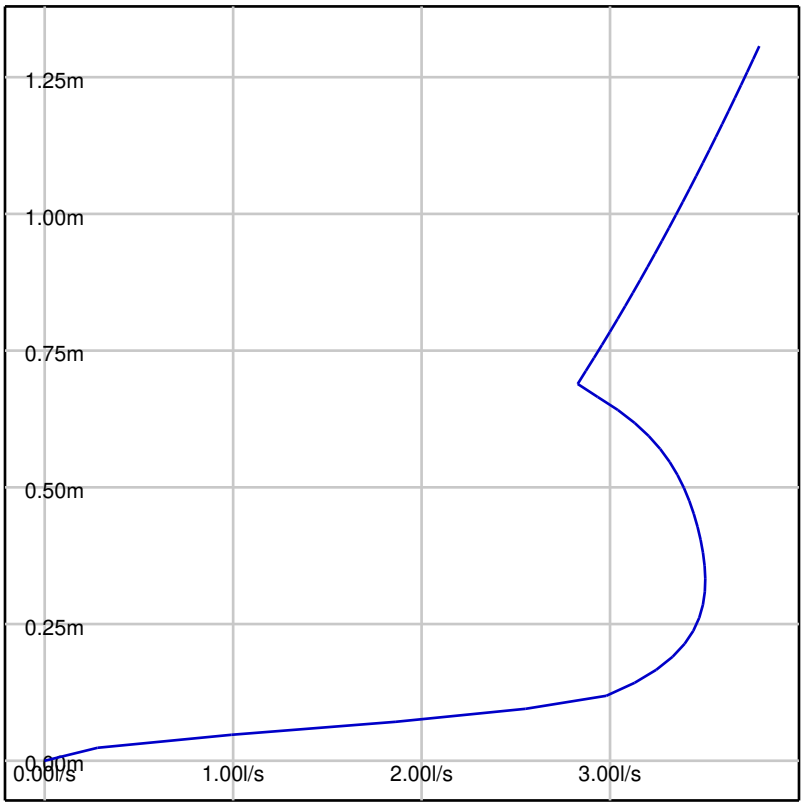


Controls within Manhole S18 (C)

Hydro-Brake® Optimum Control at Manhole S18 (C)

Model Ref	Design Depth (m)	Design Flow (l/s)	Depth Above Invert (m)	FF Head (m)	FF Flow (l/s)	KF Head (m)	KF Flow (l/s)
SHE-0087-3500-1100-3500 ID:528417	1.100	3.500	0.000	0.330	3.506	0.686	2.821

Hydro-Brake® Optimum Control at S18 (C)



Simulation Settings

FSR: M5-60=19.00, R=0.36, Locale=England and Wales

Summer (Cv: 0.75), Winter (Cv: 0.84)

Global Time of Entry: 5.0 mins

Durations (mins): 15, 30, 60, 120, 180, 240, 360

Return Periods (yrs) + Climate Change: (1, +0%), (100, +40%)

Simulated Rainfall Events

Storm	Average Intensity (mm/hr)	Runoff Continuity %	Flow Continuity %	Storm	Average Intensity (mm/hr)	Runoff Continuity %	Flow Continuity %
1Yr 15Min Winter	33.575	0.00	-0.23	100Yr +40% 15Min Summer	125.869	0.00	-0.01
1Yr 15Min Summer	33.575	0.00	-0.34	100Yr +40% 15Min Winter	125.869	0.00	0.08
1Yr 30Min Winter	21.657	0.00	-0.26	100Yr +40% 30Min Summer	84.215	0.00	0.04
1Yr 30Min Summer	21.657	0.00	-0.27	100Yr +40% 30Min Winter	84.215	0.00	0.07
1Yr 60Min Winter	13.523	0.00	-0.21	100Yr +40% 60Min Summer	53.779	0.00	0.11
1Yr 60Min Summer	13.523	0.00	-0.23	100Yr +40% 60Min Winter	53.779	0.00	0.21
1Yr 120Min Summer	8.320	0.00	-0.18	100Yr +40% 120Min Summer	33.180	0.00	0.22
1Yr 120Min Winter	8.320	0.00	-0.16	100Yr +40% 120Min Winter	33.180	0.00	0.30
1Yr 180Min Summer	6.253	0.00	-0.16	100Yr +40% 180Min Summer	24.659	0.00	0.27
1Yr 180Min Winter	6.253	0.00	-0.14	100Yr +40% 180Min Winter	24.659	0.00	0.32
1Yr 240Min Summer	5.110	0.00	-0.14	100Yr +40% 240Min Summer	19.841	0.00	0.27
1Yr 240Min Winter	5.110	0.00	-0.13	100Yr +40% 240Min Winter	19.841	0.00	0.33
1Yr 360Min Winter	3.844	0.00	-0.11	100Yr +40% 360Min Winter	14.545	0.00	0.33
1Yr 360Min Summer	3.844	0.00	-0.12	100Yr +40% 360Min Summer	14.545	0.00	0.28

Simulation Results

Return Period Yrs: 1.0

Climate Change %: 0

Manholes

Manhole	Critical Storm	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Flood (m3)	Status
S1	15 min Winter	8	134.566	0.116	24.174		OK
S2	15 min Winter	9	134.491	0.171	45.173		OK
S3	15 min Winter	8	136.574	0.074	18.354		OK
S4	15 min Winter	9	134.030	0.195	73.050		OK
S5	15 min Winter	9	133.972	0.197	73.566		OK
S6	15 min Winter	9	133.934	0.214	84.201		OK
S7	15 min Winter	10	133.914	0.219	89.643		OK
S8	15 min Winter	10	133.834	0.239	101.777		OK
S9	15 min Winter	10	133.816	0.251	114.151		OK
S10	15 min Winter	10	133.771	0.261	125.749		OK
S11	15 min Winter	10	133.712	0.267	130.769		OK
S12	15 min Winter	11	133.691	0.271	128.933		OK
S13	15 min Winter	11	133.665	0.280	140.630		OK
S14	15 min Winter	8	134.098	0.133	30.441		OK
S15	15 min Winter	9	133.988	0.148	35.845		OK
S16	15 min Winter	9	133.693	0.153	45.436		OK
S17	15 min Winter	11	133.620	0.285	177.267		OK
Inlet	15 min Winter	11	133.462	0.202	176.660		OK
Outlet	360 min Winter	350	133.215	0.315	3.588		OK
S18 (C)	360 min Winter	341	133.221	0.421	4.422		Surcharged
S19	360 min Summer	369	132.630	0.045	3.505		OK
S20	360 min Summer	368	132.221	0.046	3.505		OK
S21	360 min Summer	370	131.859	0.039	3.505		OK
ExSW MH	360 min Summer	370	130.691	0.039	3.505		Outfall

Conduits

Pipe No.	Critical Storm	Peak (mins)	US Manhole	DS Manhole	Flow Depth (m)	Velocity (m/s)	Flow (l/s)	Flow / Capacity	Status
1.000	15 min Winter	8	S1	S2	0.142	0.719	23.777	0.327	OK
1.001	15 min Winter	9	S2	S4	0.169	1.130	46.335	0.646	OK
2.000	15 min Winter	8	S3	S4	0.074	2.104	18.122	0.485	OK
1.002	15 min Winter	9	S4	S5	0.196	0.916	73.566	0.241	OK
1.003	15 min Winter	9	S5	S6	0.206	0.850	72.932	0.231	OK
1.004	15 min Winter	9	S6	S7	0.216	0.902	82.771	0.271	OK
1.005	15 min Winter	10	S7	S8	0.229	0.927	91.923	0.299	OK
1.006	15 min Winter	10	S8	S9	0.245	0.944	102.420	0.311	OK
1.007	15 min Winter	10	S9	S10	0.256	0.993	114.252	0.367	OK
1.008	15 min Winter	10	S10	S11	0.264	1.044	125.020	0.403	OK
1.009	15 min Winter	10	S11	S12	0.269	1.057	129.517	0.401	OK
1.010	15 min Winter	11	S12	S13	0.276	1.025	129.954	0.417	OK
1.011	15 min Winter	11	S13	S17	0.282	1.086	141.844	0.446	OK
3.000	15 min Winter	8	S14	S15	0.139	0.933	30.022	0.412	OK
3.001	15 min Winter	9	S15	S16	0.148	1.063	36.843	0.507	OK
3.002	15 min Winter	9	S16	S17	0.150	0.989	45.701	0.270	OK
1.012	15 min Winter	11	S17	Inlet	0.243	1.640	176.660	0.550	OK
1.013	15 min Winter	11	Inlet	Outlet	0.165	2.903	183.415	0.238	OK
1.014	360 min Winter	350	Outlet	S18 (C)	0.363	0.001	0.211	0.001	OK
1.015	360 min Winter	341	S18 (C)	S19	0.045	0.791	3.496	0.196	OK
1.016	360 min Summer	369	S19	S20	0.045	0.777	3.505	0.197	OK
1.017	360 min Summer	368	S20	S21	0.042	0.858	3.505	0.197	OK
1.018	360 min Summer	370	S21	ExSW MH	0.039	0.973	3.505	0.147	OK

Return Period Yrs: 100.0
Climate Change %: 40

Manholes

Manhole	Critical Storm	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Flood (m3)	Status
S1	15 min Winter	9	135.382	0.932	85.253		Surcharged
S2	15 min Winter	9	135.227	0.907	164.334		Surcharged
S3	15 min Winter	10	138.006	1.506	53.686		Surcharged
S4	15 min Winter	10	134.413	0.578	240.015		OK
S5	15 min Winter	10	134.383	0.608	235.745		Surcharged
S6	15 min Winter	11	134.351	0.631	259.544		Surcharged
S7	15 min Winter	11	134.336	0.641	285.615		Surcharged
S8	15 min Winter	11	134.257	0.662	320.361		Surcharged
S9	15 min Winter	11	134.231	0.666	359.807		Surcharged
S10	15 min Winter	11	134.165	0.655	396.715		Surcharged
S11	15 min Winter	10	134.068	0.623	403.509		Surcharged
S12	15 min Winter	10	134.032	0.612	403.581		Surcharged
S13	15 min Winter	10	133.980	0.595	455.313		OK
S14	15 min Winter	9	134.660	0.695	107.356		Surcharged
S15	15 min Winter	9	134.406	0.566	132.267		Surcharged
S16	15 min Winter	9	133.927	0.387	162.909		OK
S17	15 min Winter	10	133.891	0.556	611.235		OK
Inlet	360 min Winter	359	133.823	0.563	2.603		OK
Outlet	360 min Winter	358	133.823	0.923	3.281		Surcharged
S18 (C)	360 min Winter	362	133.827	1.027	2.453		Surcharged
S19	15 min Winter	8	132.631	0.046	3.375		OK
S20	15 min Winter	10	132.222	0.047	3.485		OK
S21	360 min Summer	148	131.859	0.039	3.504		OK
ExSW MH	360 min Summer	148	130.691	0.039	3.504		Outfall

Conduits

Pipe No.	Critical Storm	Peak (mins)	US Manhole	DS Manhole	Flow Depth (m)	Velocity (m/s)	Flow (l/s)	Flow / Capacity	Status
1.000	15 min Winter	9	S1	S2	0.300	1.163	82.239	1.129	Surcharged
1.001	15 min Winter	9	S2	S4	0.292	2.232	156.453	2.182	OK
2.000	15 min Winter	10	S3	S4	0.150	3.128	55.283	1.479	Surcharged
1.002	15 min Winter	10	S4	S5	0.589	0.837	235.745	0.772	OK
1.003	15 min Winter	10	S5	S6	0.600	0.786	222.296	0.704	Surcharged
1.004	15 min Winter	11	S6	S7	0.600	0.935	264.420	0.865	Surcharged
1.005	15 min Winter	11	S7	S8	0.600	1.033	292.101	0.950	Surcharged
1.006	15 min Winter	11	S8	S9	0.600	1.154	326.163	0.990	Surcharged
1.007	15 min Winter	11	S9	S10	0.600	1.286	363.744	1.169	Surcharged
1.008	15 min Winter	11	S10	S11	0.600	1.419	401.258	1.294	Surcharged
1.009	15 min Winter	10	S11	S12	0.600	1.427	403.581	1.251	Surcharged
1.010	15 min Winter	10	S12	S13	0.597	1.430	403.809	1.296	OK
1.011	15 min Winter	10	S13	S17	0.575	1.635	455.788	1.432	OK
3.000	15 min Winter	9	S14	S15	0.300	1.521	107.533	1.476	Surcharged
3.001	15 min Winter	9	S15	S16	0.286	1.884	130.808	1.798	OK
3.002	15 min Winter	9	S16	S17	0.395	1.095	161.764	0.957	OK
1.012	15 min Winter	10	S17	Inlet	0.473	2.565	613.352	1.911	OK
1.013	360 min Winter	359	Inlet	Outlet	0.582	0.009	2.627	0.003	OK
1.014	360 min Winter	358	Outlet	S18 (C)	0.600	0.001	0.392	0.001	Surcharged
1.015	360 min Winter	362	S18 (C)	S19	0.044	0.779	3.319	0.186	OK
1.016	15 min Winter	8	S19	S20	0.042	0.855	3.435	0.193	OK
1.017	15 min Winter	10	S20	S21	0.041	0.891	3.528	0.198	OK
1.018	360 min Summer	148	S21	ExSW MH	0.039	0.973	3.504	0.146	OK


COAST
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