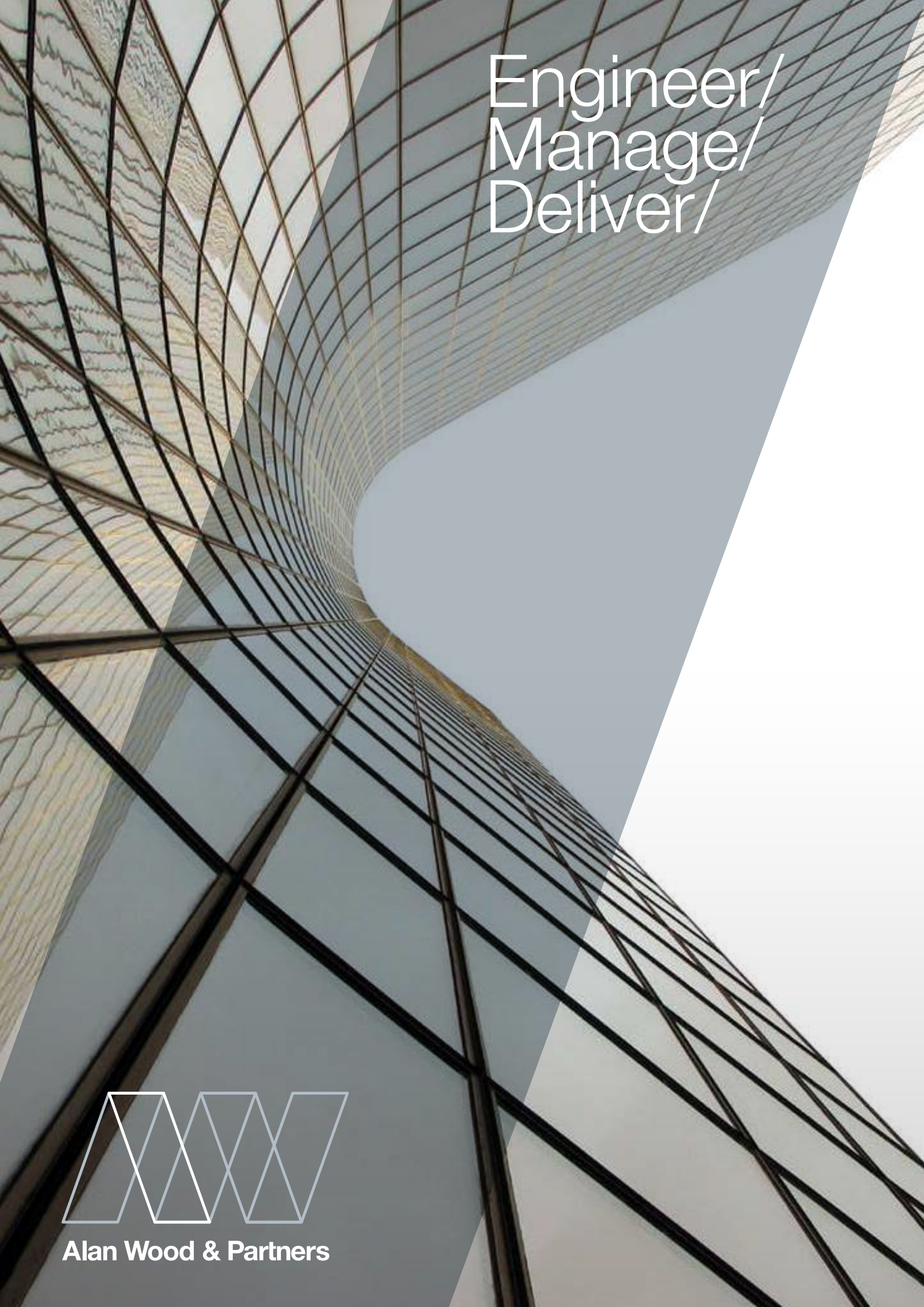


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FLOOD RISK ASSESSMENT FOR NEW BUILD FIRE STATION AT BROADWAY, BARNSLEY, S70 6RA

Prepared by: **Mark Jarvis**

Signed: .....
Date: 27nd August 2019

Approved by: **James Shores** *BEng (Hons) CEng MIStructE*
Office Director

Signed: .....
Date: 27nd August 2019

Issue	Revision	Revised by	Approved by	Revised Date

For the avoidance of doubt, the parties confirm that these conditions of engagement shall not and the parties do not intend that these conditions of engagement shall confer on any party any rights to enforce any term of this Agreement pursuant of the Contracts (Rights of third Parties) Act 1999.
The Appointment of Alan Wood & Partners shall be governed by and construed in all respects in accordance with the laws of England & Wales and each party submits to the exclusive jurisdiction of the Courts of England & Wales.

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1 INTRODUCTION

1.1 Background

Alan Wood and Partners were commissioned by Turner and Townsend Project Managers Limited to carry out a Flood Risk Assessment (FRA) for the Proposed Barnsley Fire Station, Broadway, Barnsley, S70 6RA.

1.2 Layout of Report

Section 1 introduces the FRA, explaining the layout of this FRA and provides an introduction to flood risk and the latest guidance on development and flood risk in England.

Section 2 introduces the site. The site description is based on knowledge of the site, and flood risk information which is publicly available. Further background information on flood risk has been sourced from the **Environment Agency, Yorkshire Water, Barnsley Metropolitan Borough Council, DEFRA, Danvm DC Drainage District, and the project team.**

Section 3 details the information gathered through the consultation periods (if applicable).

Section 4 details the development proposals and considers the proposals in relation to the current planning policy on development and flood risk in England (and what type of development is considered appropriate in different flood risk zones). National Planning Policy Framework (NPPF): and its associated Technical Guidance (Communities and Local Government, July 2018) is the current planning policy on flood risk in England, and an introduction to NPPF is provided below.

Section 5 considers the drainage arrangements for the proposed development. The drainage assessment is based on NPPF and outlines an indicative surface water & foul drainage strategy.

Section 6 considers the flood risk to the site, and the potential for the development proposals to impact on flood risk. The assessment of flood risk is based on the latest planning policy and uses all the information gathered as part of the FRA.

Section 7 provides Flood Mitigation Measures
Section 8 & 9 provide a summary and any recommendations for further work.

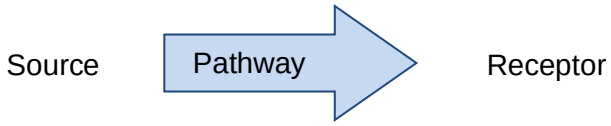
1.3 Flood Risk

Flood risk takes account of both the probability and the consequences of flooding.

Flood risk = probability of flooding x consequences of flooding

Probability is usually interpreted in terms of the return period, e.g. 1 in 100 and 1 in 200-year event, etc. In terms of probability, there is a 1 in 100 (1%) chance of one or more 1 in 100-year floods occurring in a given year. The consequences of flooding depend on how vulnerable a receptor is to flood.

The components of flood risk can be considered using a source-pathway-receptor model.



Sources constitute flood hazards, which are anything with the potential to cause harm through flooding (e.g. rainfall, extreme sea levels, river flows and canals). Pathways represent the mechanism by which the flood hazard would cause harm to a receptor (e.g. overtopping and failure of embankments and flood defences, inadequate drainage and inundation of floodplains). Receptors comprise of the people, property, infrastructure and ecosystems that could potentially be affected should a flood occur.

1.4 National Planning Policy Framework

1.4.1 General

NPPF and its associated Technical Guidance replaces Planning Policy Statement 25 and provides guidance on how to evaluate sites with respect to flood risk.

A summary of the requirements of NPPF is provided below.

1.4.2 Sources of Flooding

NPPF requires an assessment of flood risk to consider all forms of flooding and lists six forms of flooding that should be considered as part of a flood risk assessment. These forms of flooding are listed in Table 1, along with an explanation of each form of flooding.

Table 1: Forms of Flooding

Flooding from Rivers (Fluvial Flooding)
Watercourses flood when the amount of water in them exceeds the flow capacity of the river channel. Flooding can either develop gradually or rapidly, depending on the characteristics of the catchment. Land use, topography and the development can have a strong influence on flooding from rivers.
Flooding from the Sea (Tidal Flooding)
Flooding to low-lying land from the sea and tidal estuaries is caused by storm surges and high tides. Where tidal defences exist, they can be overtopped or breached during a severe storm, which may be more likely with climate change.
Flooding from Land (Pluvial Flooding)
Intense rainfall, often of short duration, that is unable to soak into the ground or enter drainage systems can run quickly off land and result in local flooding. In developed areas this flood water can be polluted with domestic sewage where foul sewers surcharge and overflow. Local topography and built form can have a strong influence on the direction and depth of flow. The design of development down to a micro-level can influence or exacerbate this. Overland flow paths should be considered in spatial planning for urban developments. Flooding can be exacerbated if development increases the percentage of impervious area.
Flooding from Groundwater
Groundwater flooding occurs when groundwater levels rise above ground levels (i.e. groundwater issues). Groundwater flooding is most likely to occur in low-lying areas underlain by permeable rocks (aquifers). Chalk is the most extensive source of groundwater flooding.
Flooding from Sewers
In urban areas, rainwater is frequently drained into sewers. Flooding can occur when sewers are overwhelmed by heavy rainfall and become blocked. Sewer flooding continues until the water drains away.
Flooding from Other Arterial Sources (i.e. reservoirs, canals, lakes and ponds)
Non-natural or artificial sources of flooding can include reservoirs, canals and lakes. Reservoir or canal flooding may occur as a result of the facility being overwhelmed and /or as a result of dam or bank failure.

1.4.3 Flood Zones

For river and sea flooding, NPPF uses four Flood Zones to characterise flood risk. These Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences, and are detailed in Table 2.

Table 2: Flood Zones

Flood Zone	Definition
1	Low probability (less than 1 in 1,000 annual probability of river or sea flooding in any year (<0.1%).
2	Medium probability (between 1 in 100 and 1 in 1,000 annual probability of river flooding (1%-0.1%) or between 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5%-0.1%) in any year).
3a	High probability (1 in 100 or greater annual probability of river flooding (>1%) in any year or 1 in 200 or greater annual probability of sea flooding (>0.5%) in any given year).
3b	This zone comprises land where water has flow or be stored in times of flood. Land which would flood with an annual probability of 1 in20 (5%) or is designed to flood in an extreme flood (0.1%) should provide a starting point for discussions to identify functional floodplain.

1.4.4 Vulnerability

NPPF classifies the vulnerability of developments to flooding into five categories. These categories are detailed in Table 3.

Table 3: Flood Risk Vulnerability Classification

Flood Risk Vulnerability Classification	Examples of Development Types
Essential Infrastructure	- Transport Infrastructure - Utility Infrastructure (e.g. water treatment works and wind turbines)
Water Compatible	- Flood Control Infrastructure - Water and Sewerage Infrastructure - Navigation Facilities - Water Based Recreation
Highly Vulnerable	- Emergency Services - Basement Dwellings

	- Mobile Home Parks
More Vulnerable	- Hospitals and other Health Services - Residential Establishments - Educational Establishments
Less Vulnerable	- Commercial Establishments (e.g. shops, restaurants and offices)

Based on the vulnerability of a development, NPPF states within what Flood Zones(s) the development is appropriate. The flood risk vulnerability and Flood Zone 'compatibility' of developments is summarised in Table 4.

Table 4: Flood Zone Compatibility

Flood Risk Vulnerability Classification		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone	1	✓	✓	✓	✓	✓
	2	✓	✓	Exception Test	✓	✓
	3a	Exception Test	✓	x	Exception Test	✓
	3b	Exception Test	✓	x	x	x

1.4.5 The Sequential Test, Exception Test and Sequential Approach

The Sequential Test is a risk-based test that should be applied at all stages of development and aims to steer new development to areas with the lowest probability of flooding (Zone 1). This is applied by the Local Planning Authority by means of a Strategic Flood Risk Assessment (SFRA).

The SFRA and NPPF may require the Exception Test to be applied to certain forms of new development. The test considers the vulnerability of the new development to flood risk and to be passed, must demonstrate that:

- There are sustainability benefits that outweigh the flood risk and;
- The new development is safe and does not increase flood risk elsewhere.

The Sequential Approach is also a risk-based approach to development. In a development site located in several Flood Zones or with other flood risks, the sequential approach directs the most vulnerable types of development towards areas of least risk within the site.

1.4.6 Climate Change

It is a planning requirement to account for climate change in the proposed design. The recommended allowances should be based on the most relevant guidance from the Environment Agency and the Lead Local Flood Authority.

1.4.7 Sustainable Drainage

The key planning objectives in NPPF are to appraise, manage and where possible, reduce flood risk. Sustainable Drainage Systems (SuDS) provide an effective way of achieving some of these objectives, and NPPF and Part H of the Building Regulations (DTLR 2002) direct developers towards the use of SuDS wherever possible.

2 EXISTING SITE DESCRIPTION

2.1 Location

The proposed development is located on Broadway and Keresforth Close, approximately 1.5km south west of Barnsley Town Centre.

The site is currently occupied by Barnsley Fire Station with a single point of access leading to the training yard, vehicle workshop, obsolete ambulance garage, drill tower and sub-station. Despite a small amount of soft landscaping around the car parking areas, the site would be considered as being predominantly hardstanding.

From a review of historical mapping the site as been predominantly fields and allotments.

The extents of previous hard surfacing can be seen from the aerial photograph and extend to an area of 0.56Ha.

A site location map and aerial photograph are shown within Figures 1 and 2

The Ordnance Survey grid reference for the centre of the site development is approximately 433201, 405634.



Figure 1: Site Location Plan



Figure 2: Aerial Photograph of Development Site

2.2 Surrounding Features

The area is predominantly residential, industrial and retail. The development is bounded by playing fields and sports pitches to the north, and housing estates to the east. Greenacre School is situated on the southern side of the site, separated by Broadway and there are further housing and industrial units to the west.

2.3 Ground Conditions

A Phase II Geo Environmental Site Assessment Report Ref. P18-00555 Rev 1 dated 13th August 2018, has been undertaken for the site by Met Consultancy Group. A review of the report shows that the development site was undeveloped agricultural land until the existing fire station buildings were developed by 1959. The site geology comprises of made ground to depths between 1 and 1.5m deep. Made ground comprises firm light brown sandy gravelly clay with gravels of fine to coarse of brick, ash, clinker, porcelain, glass, sandstone and mudstone. Superficial deposits comprising firm to stiff orangish brown mottled grey clay with

occasional mudstone and sandstone gravels were identified under the entire site from depths of between 1 and 1.5m with typical thicknesses between 0.3 and 1.7m. Bedrock was deepest in the eastern area of the site and was encountered at between 1.3 to 2.9m deep. Bedrock comprised weak to strong light grey mottled greyish brown mudstone and orange brown sandstone

The site is not in a radon affected area.

The bedrock is classed as a Secondary A aquifer.

There are no active licensed groundwater abstractions within 250m of the site, and it is not in a Source Protection Zone.

The site is in a nitrate vulnerable zone.

At this stage it is considered that the use of soakaways will be unsuitable.

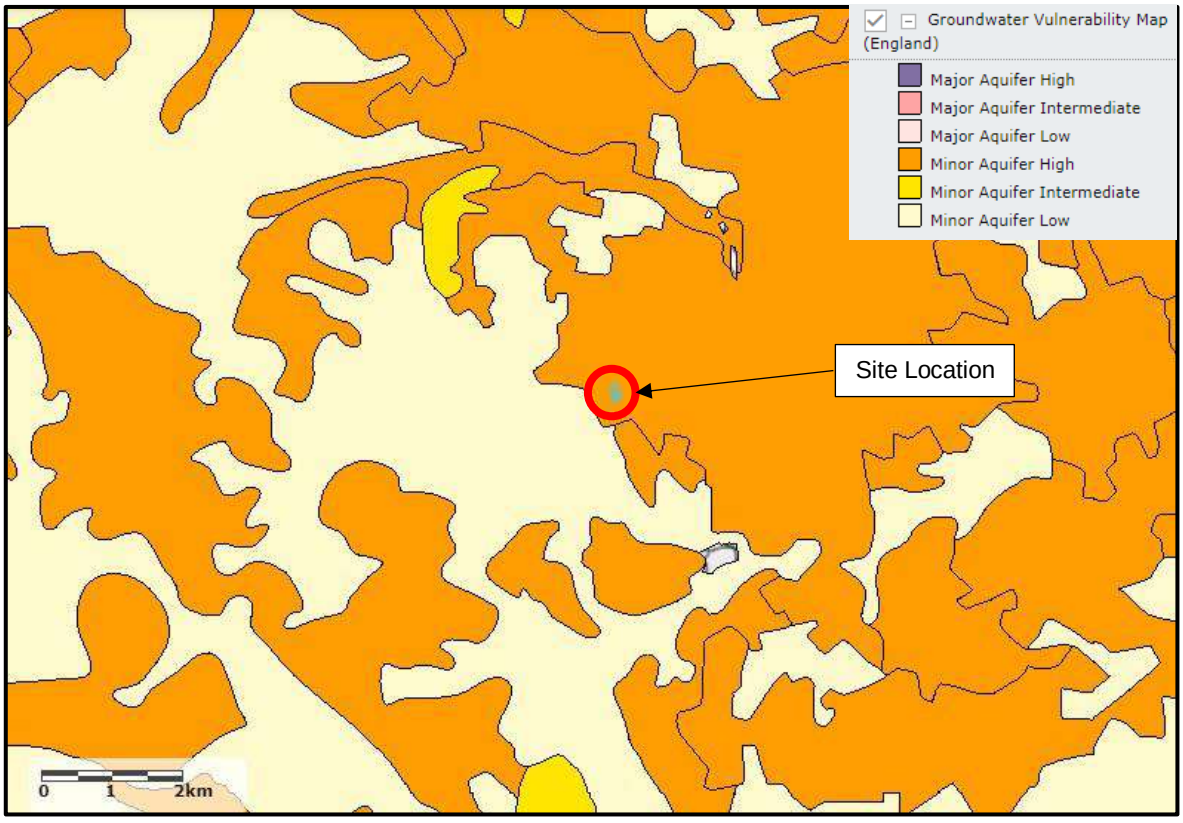


Figure 3: DEFRA map showing Ground Water Vulnerability Zones.

2.4 Water Features

There are no recorded water features in the immediate area.

2.5 Topography

A topographical survey has been undertaken for the development site and a copy is included in Appendix A.

The site area is approximately 0.81ha and is of a regular shape. There is one point of access and egress. Ground levels vary across the site from a high point of 152.0m to the south of the site, to 145.5m at the low point to the north east of the site. The survey also shows an embankment falling into the site from Broadway at a gradient of 1:6.

2.6 Drainage Features

There are no recorded public surface and foul water sewers recorded within the development site. There is a 525mm dia. surface water and a 225mm dia. foul water sewer within 5m of the north eastern boundary. The existing foul and surface water drains serving the existing fire station connect to these sewers.

2.7 Utilities

YW's response, included within Appendix B, shows public sewers running within the track to the north east of the development site.

3 CONSULTATION

Consultation has taken place with the design team in order to obtain information relating to the proposed development. Details of which, including an initial proposed site layout for the development, are included within Appendix C.

Consultation has also taken place with YW in the form of a pre-development enquiry. A copy of their response and recommendations for discharging surface & foul water from the development is included within Appendix B.

The Environment Agency have been consulted, and their response is included within Appendix D.

Danvm DC Drainage District have been consulted, and their response is included within Appendix E.

As part of the pre-application enquiry for the development, Barnsley Metropolitan Borough Council as the LLFA provided their advice on drainage and flood risk. Their response is included within Appendix F.

4 PROPOSED DEVELOPMENT

The proposed redevelopment consists generally of a one and two storey height commercial building for the use of South Yorkshire Fire and Rescue. There will also be a community building located within the site boundaries. Whilst the position of the building is known, there are at present no proposed plans available.

The development shall be constructed using a steel frame, with precast concrete floors. The roof structure will consist of a lightweight steel roof over the appliance bay and equipment areas, however over the functional/living accommodation the roof shall be precast concrete.

To proceed with the proposed development, the existing building on site will need to be demolished. The site layout utilises the existing roadway/driveway and minimal adjustments to these areas look to be required as the existing access and egress is to be maintained.

The proposed site layout for the development is included within Appendix C.
In terms of flood risk vulnerability, the development is classed as 'Highly Vulnerable'.
In terms of flood zone vulnerability and flood zone compatibility the development is appropriate.

5 DRAINAGE STRATEGY

5.1 Existing Surface Water

The proposal will be to provide a sustainable approach to the management of surface water within the site.

The site is occupied by Barnsley Fire Station with associated access roads and areas of car parking and is therefore classed as a Brownfield site. Records show surface & foul water sewers are not within the site. This is confirmed in Appendix B showing YW Services correspondence.

For brownfield developments, Yorkshire Water will accept a 30% reduction over the pre-development discharge rate. The run-off rate should never exceed the pre-development rate for the same event. Pre and Post Impermeable Areas are included in Appendix G.

Existing Impermeable Area = 0.55ha

Calculation

Discharge rate for a Brownfield Site:

Q = 2.781 x B x A x C

Where;

Q = existing run off rate (litres per second).

2.781 is a constant.

A = total impermeable area (hectares).

B = percentage impermeable.

C = rainfall rate (mm per hour).

Q = 2.781 x B x A x C

Q = 2.781 x 1 x 0.55 x 50mm.

Q = 77.5 litres per second

77.5 – 30% = **54.3 litres per second**.

5.2 Methods of Surface Water Disposal

Part H of the Building Regulations (2000) states a hierarchy of how surface water disposal should be managed. This is in the following order:

- Infiltration
- Watercourse
- Public sewer

5.3 Existing Water Courses

There is a watercourse within the vicinity of the site, please refer to section 2.4 water features for further information.

5.4 Infiltration Methods

Due to the nature of the ground conditions, outlined above, it is considered that soakaways/infiltration methods will not be a suitable means of disposal for surface water runoff from the development. Surface water will need to be taken to the local system subject to obtaining approvals and consents. Additionally, soakaways may result in potential instability of on site and neighbouring slopes and retaining walls.

5.5 Proposed Surface Water Drainage

The key planning objectives in NPPF are to appraise, manage and where possible, reduce flood risk. Sustainable Drainage Systems (SuDS) provide an effective way of achieving some of these objectives, and NPPF and Part H of the Building Regulations (DTLR 2002) direct developers towards the use of SuDS wherever possible. However, as noted above, direct infiltration to ground is not likely to be possible due to ground conditions.

The current design criteria required for the surface water drainage will need to be based upon a M100 storm event, with an appropriate allowance to account for climate change resulting from global warming.

In order to ensure the discharge of surface water from the development will not increase the risk of flooding to other properties, it will be necessary to attenuate the drainage by restricting the discharge to the agreed rate and providing storage as required.

Based upon the required design criteria, calculations have been undertaken to determine the volume of surface water storage. Outfall rate = 54.3 l/s, Impermeable Area = 0.54 Ha

A summary of the volumes is set out in Table 5 below.

Table 5: Volume of Surface Water Storage Required

Storm Event	1 Year Storm	30 Year Storm	100 Year Storm + 30%
Storage Volume Required	21.4m^3	53.8m^3	119.0m^3

The calculated storage volumes will be subject to detailed design and approval. The volumes shown are based on a singular structure connecting to the public sewer network, should multiple SuDS features be employed these volumes would need re-evaluating.

A copy of the calculations and layout are included in Appendix H.

There are 2 main impermeable areas utilising the SuDS feature;

The 2 areas are, the Fire Station, its associated footpaths/hardstanding's and car park areas. Surface water from the Fire Station roof will be collected using a siphonic system and pass directly to the proposed cellular storage structure. The hardstanding and car parking areas, and the carriageway will pass through a Class 1 Bypass Separator before passing through the storage structure.

To comply with current design criteria the surface water drainage system must not surcharge during a M1 storm event.

The drainage system must also contain the storage volume for the M30 storm event without flooding.

The additional volume required between the M30 and M100 plus climate change can be stored above ground provided it remains within the confines of the site without posing a risk of flooding.

Alternatively, this additional volume can be stored below ground in an appropriate storage tank.

5.6 Network

In order to convey surface water flow from the new development around the site, suitably sized pipes laid between inspection chambers and manholes will need to be constructed. The new network is proposed to connect to the public surface water sewer at locations to be agreed with YW's response in Appendix B.

Sustainable water management measures should be used to control the surface water runoff from the proposed development site, thereby managing the flood risk to the site and surrounding areas from surface water runoff. These measures will also improve the quality of water discharged from the Site.

5.7 Limitations

The information included in this report is subject to detailed design and co-ordination with the project team.

Any disused drains found on the site are to be either grubbed up and trenches backfilled with engineered stable material, or the system grouted and sealed to prevent future collapse and infestation.

A full hydraulic model of the proposed system has not been provided. At the detailed design stage, it is recommended that a detailed model is built, using the finished levels.

All works to the existing public sewer must be discussed in detail with YW to obtain all necessary approvals/permissions and easements.

5.8 Existing Foul Water Sewers

YW's response to the Pre-Development Enquiry, included within Appendix B, shows there is a public foul sewer outside of the site close to the north eastern boundary. This sewer has been suggested by YW as a possible location to discharge foul water drainage from the development site.

5.9 Proposed Foul Water Drainage

New foul water drainage is required to serve the development; based on the site area, Sewers for Adoption 7th Edition allowances, and 6 DWF's the estimated foul discharge rate = 0.6l/s. At this stage it is proposed to connect to the foul water sewer noted above.

The intention is for the drainage to be a gravity system. However, the functionality of this proposed system will depend upon proposed levels and existing inverts of the public sewer network.

For this development, foul flows will be collected in a separate private system, which will be designed to meet the standards of the Building Regulations Part H with reference to Table 6.

Table 9: Minimum Gradient for Foul Sewers

Peak Flow (litres per second)	**Pipe Diameter** (mm)	**Minimum Gradient** (1 in …)	**Notes**
< 1	100	40	None
> 1	100	80	Minimum 1 WC
> 1	150	150	Minimum 5 WCs

6 FLOOD RISK ASSESSMENT

6.1 Flood Zone

A copy of the Environment Agency Flood Outline Map is included in Figure 4 below, which identifies whether the development site is located within Flood Zone 1, 2 or 3.

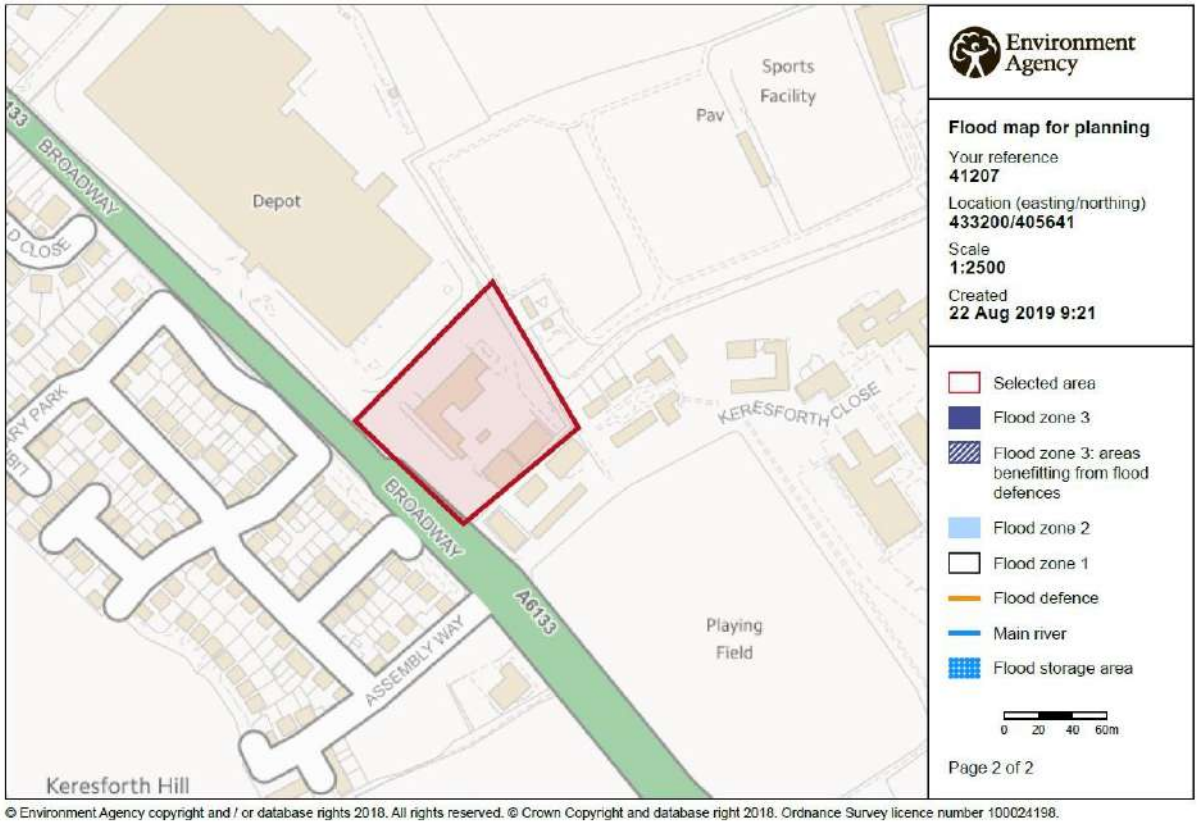


Figure 4: Environment Agency Flood Outline Map

As shown in Figure 4 the development is located within Flood Zone 1, an area considered to have a low probability of flooding, with less than 1 in 1000 annual probability of river or sea flooding (<0.1%).

6.2 Fluvial Flooding

Existing ground levels over the area of the development are in the region of 152.0 – 145.5m AOD. Detailed flood risk information, as shown in Figure 5 below from the Environment Agency, state that the flood risk to this site from rivers is less than 'very low'. This means that each year there is less than a 0.1% chance of flooding due 10to rivers.

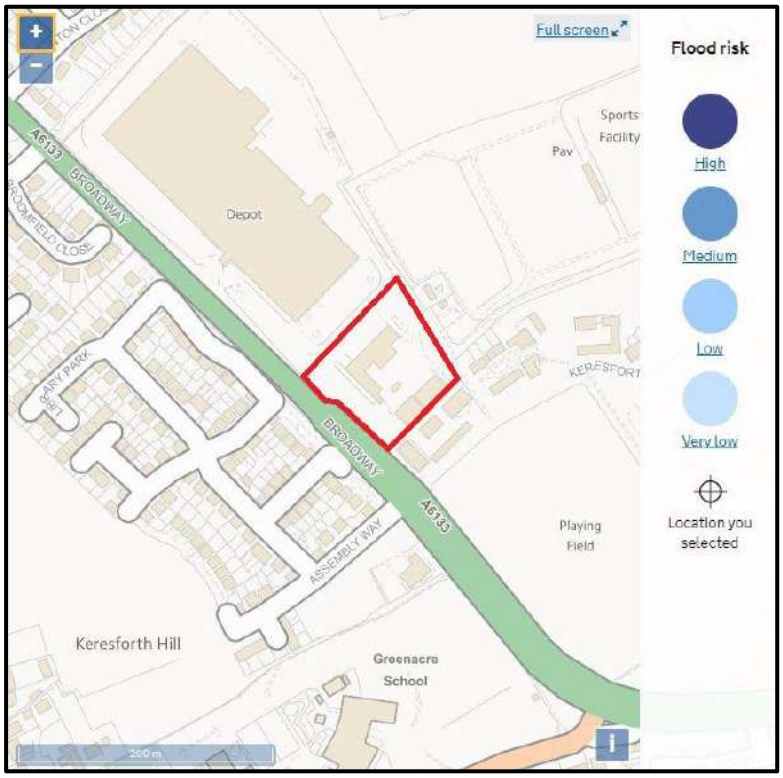


Figure 5: Extract from Environment Agency - Flood Risk Map for Rivers and the Sea

6.3 Tidal Flooding

Similar to fluvial flooding, the detailed flood risk information for this site from the Environment Agency states that the proposed development site is at 'very low' risk of flooding from the sea. This is shown in Figure 5 (above).

6.4 Groundwater Flooding

Groundwater flooding can occur when sub-surface levels are high and emerge above ground level.

There are no proposals to create any basements.

The project will not involve excessive deep excavation works beyond normal construction requirements and consequently the risk to the development from this potential flood source is considered to be low and acceptable.

6.5 Flood Risk from Surface Water

Extracts from the Environment Agency surface water flood risk and flood velocity maps are shown in Figures 6-8 below.

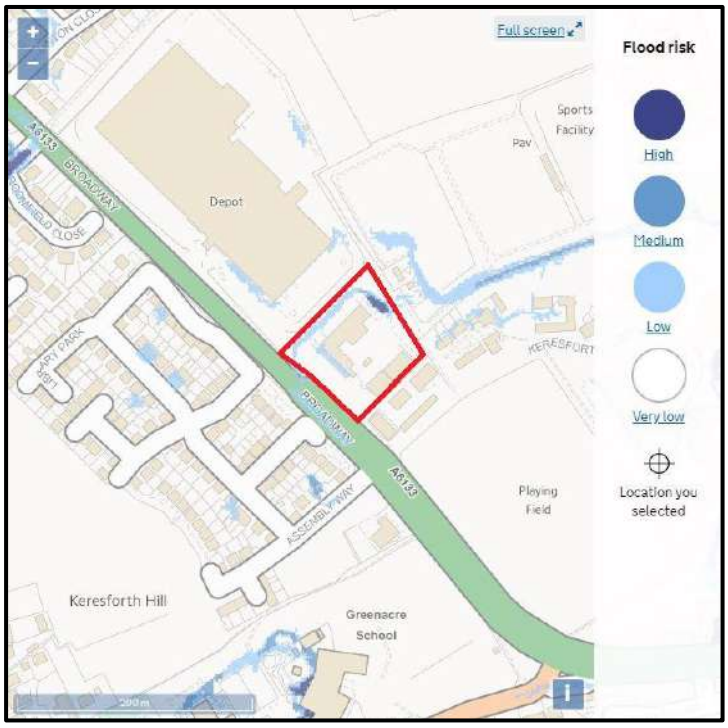


Figure 6: Environment Agency Surface Water Flood Risk Map

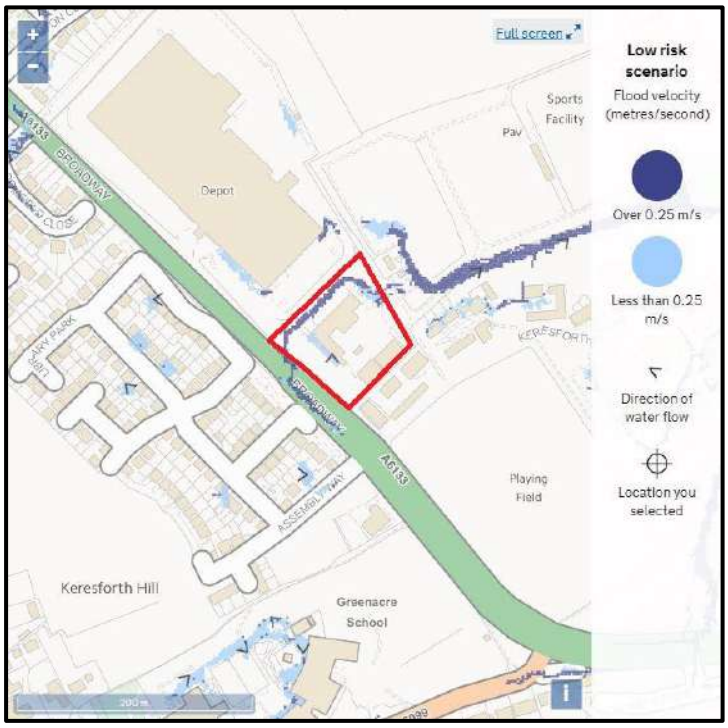


Figure 7: Environment Agency Surface Water Flood Velocities Map

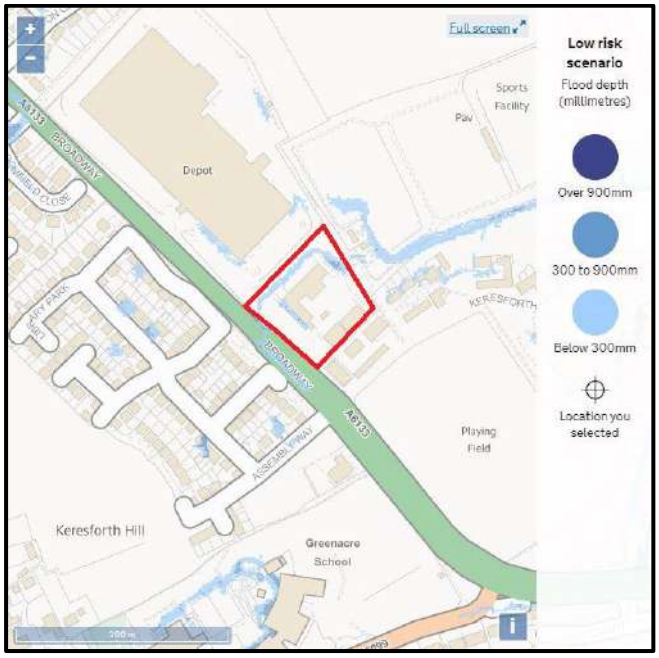


Figure 8: Environment Agency Surface Water Flood Depth Map

As shown in Figure 6, there is an area of surface water flooding on the north western boundary that is at risk of flooding and with a velocity greater than 0.25m/s. The surface flow pathway coincides with the current access road and is associated with potential flooding of a small area of Broadway.

The surface water flood risk will be managed by intercepting the flow as it enters the site and keeping the flow route along its existing path to the north eastern boundary. Proposed levels will be the same as existing therefore conveying the flow through the development on a similar route as at present.

6.6 Flood Risk from Existing Sewers

YW, through the pre-development enquiry, have not highlighted any flooding from the sewers in this area. The risk to the development from this potential flood source is low and acceptable. A copy of YW's response to the Pre-Development Enquiry is included within Appendix B, along with sewer record maps.

6.7 Flood Risk from Water Mains

The area is served by water mains in the adjacent public highways which are owned by the local Water Authority. There are no known issues about the condition of the water main. The risk to the development from this potential flood source is low and acceptable.

6.8 Flooding from Reservoirs, Canals and other Artificial Sources

Environment Agency Reservoir Flood Risk maps are provided in Figure 9 below.

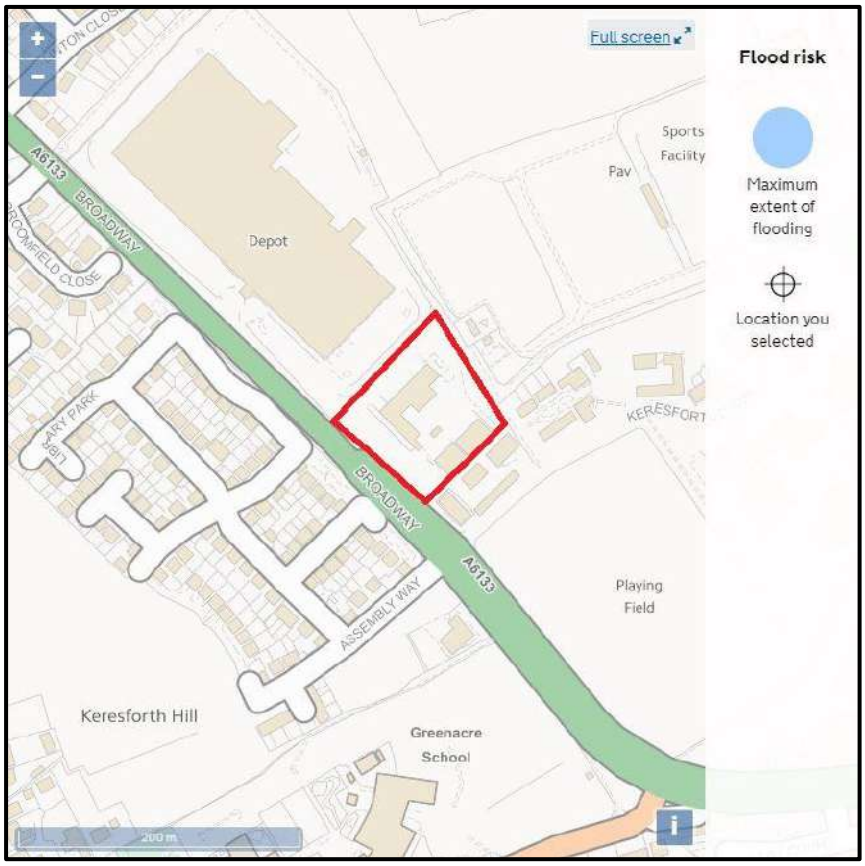


Figure 9: Environment Agency Reservoir Flood Risk Map

Investigations indicate that there are no structures in proximity to the development which are likely to pose any risk of flooding. The map shows that the development site is not considered to be at risk.

6.9 Flooding from Open Drainage Ditches

There are no open drainage ditches in the vicinity of the development site which could pose a risk of flooding.

6.10 Flooding from Proposed Sewers

There are new drainage works involved with the development. The network will be designed to the required standard as detailed in Section 5 of this report, in order to minimise the risk of flooding. The risk to the development from any such potential flood source is low and acceptable.

7 FLOOD MITIGATION MEASURES

With the site being in Flood Zone 1, low flood risk, it is considered that floor levels of the new buildings can be set at traditional levels, normally 150mm above finished ground level. The proposed Fire Station will have the same floor level as the existing building, 147.58m AOD. Existing levels in the area of the flow path are between 0.5 – 1.4m lower than the floor level. Proposed levels to new hardstanding areas will be set a minimum of 150mm lower than the floor level. This will reduce risk of flooding to the buildings.

The surface water drainage should be designed in accordance with Section 5 of this report to ensure the development does not pose a risk of flooding to other parties.

Surrounding hardstanding areas to the building are above any predicted flood levels and consequently safe access to and egress from the building will be achievable should a flood situation occur.

There should therefore be no requirements for evacuation of building occupants resulting from the development.

Proposed ground levels should be designed to direct water away from the buildings to ensure there is no localised risk from overland surface flows.

8 SUMMARY

The primary focus for flood risk assessment is to protect life, and then consideration should be given to buildings, contents, operation and re-use. As the scheme is progressed the design should consider exceedance and routing of flows away from the buildings.

The site falls in Flood Zone 1 and the proposals are 'Highly Vulnerable'.

The primary risk to the site is from overland surface water flooding during an extreme rainfall event.

Mitigation measures are proposed which we consider will reduce the risk from this event down to an acceptable level.

This report has considered other potential sources of flooding to the site, including groundwater, fluvial, existing sewers, water mains and other artificial sources.

No works are proposed which would suggest that flooding will be made worse on adjacent land as a result of the development.

Overall, this report demonstrates that the flood risk to the site is reasonable and acceptable providing the mitigation measures detailed within Section 7 are incorporated into the design.

9 RECOMMENDATIONS

The following actions are recommended for the development site:

The risk of surface water flooding should be addressed during the detailed design stage.

Proposed levels, along the flow path, to be the same as existing to enable the flow route to follow its existing path through the site.

The use of Sustainable Urban Drainage Systems should be investigated; however, it is noted that direct infiltration to ground is not likely to be possible due to ground conditions and space limitations.

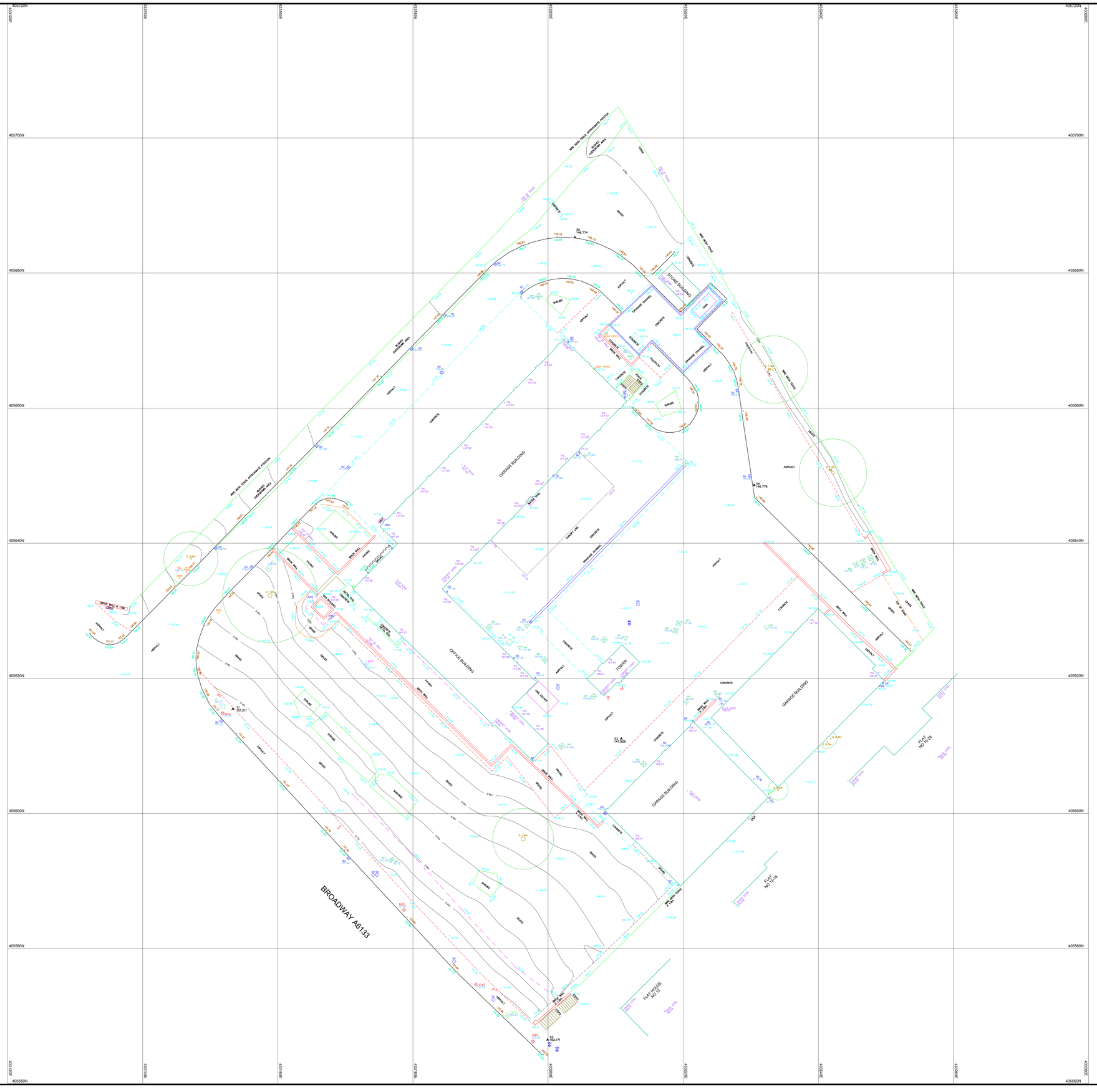
As noted in the YW correspondence, YW requires to see existing drainage layouts with pipe sizes, gradients and connection points. If a pre-demolition layout showing this information is not available, then a cctv/connectivity survey will be needed.

Confirm location and invert levels of storm and foul water connection point manholes to the north eastern boundary.

Alan Wood & Partners

APPENDIX A

Topographical Survey



Notes

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Direction of North

Grid : OS National Grid.
Using the OS GPS Network and applying OSTN02 transformation and then removing the scale factor for true distances with a one-step transformation centred on S5

Datum : OS Level Datum.
Using the OS GPS Network and applying OSGM02 National Geoid Model to obtain local area corrections.

Station Listing

Station	Easting	Northing	Level
S1	433153.353	405615.495	151.211
S2	433199.935	405566.516	152.171
S3	433210.847	405611.077	147.929
S4	433230.494	405648.612	146.776
S5	433203.968	405685.270	146.774

KEY

AIR VALVE	AV	KERB OUTLET	KO
BENCH MARK	BM	LAMP POST	LP
BIN	BIN	MANHOLE (CIRCULAR)	MH
BOLLARD	BOL	MANHOLE (RECTANGULAR)	MH
BORE HOLE	BH	MANHOLE (TRIANGULAR)	MH
BRITISH TELECOM COVER	BT	MARKER POST	MAR
BUS STOP	BUS	GULLY	GUL
CABLE TV COVER	CATV	RODDING EYE	RE
CABLE TV SUPPLY	CS	SIGN POST	SIGN
COLUMN	COL	TELECOM COVER	BT
DROPPED KERB	DK	TELEGRAPH POLE	TP
EARTHING POINT	ER	THRESHOLD LEVEL	THL
ELECTRICITY COVER	ELEC	TRAFFIC LIGHT	TL
ELECTRICITY POLE	EP	TRIAL PIT	PIT
FIRE HYDRANT	FH	WASH OUT	WO
GAS VALVE	GAS	WATER METER	WM
GATE	G	WATER STOP COCK	WC
INSPECTON COVER (CIRCULAR)	IC	WATER STOP VALVE	WV
INSPECTON COVER (RECTANGULAR)	IC		
JUNCTION BOX	JUNC		

COVER LEVEL	CL	CHAMBER BASE LEVEL	CHL
INVERT LEVEL	IL	WATER SURFACE LEVEL	WL
UNABLE TO RAISE	UTR	UNABLE TO MEASURE	UTM
GIRTH OF TREE TRUNK	G	DIAMETER OF TREE TRUNK	D
HEIGHT TO TOP OF TREE CANOPY	H	MULTI BOLE TREE	MB

Rev	Date	Drawn	Description	Check
-	--/--/----	--	--	--

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Southgate House
Pontefract Road
Stourton
Leeds
West Yorkshire
LS10 1SW
T: +44 [0] 1132 008 900
F: +44 [0] 1132 008 901
E: admin@metgeoenvironmental.com
W: www.metgeoenvironmental.com

Client
SOUTH YORKSHIRE FIRE & RESCUE

Site
BARNSLEY FIRE STATION
BROADWAY BARNSLEY S70 6RA

Title
TOPOGRAPHICAL SURVEY

Surveyed	MC,PF	Drawn	PF
Chk.	DA	Date	04/05/2018
Scale 1:200	Job No P18-00583	Sheet Size A0	Issue 01

DWG Ref

Project Number	Origin	Zone	Level	Desc	Role	Type	Sheet
P18-00583	MET	EXT	XX	TOP	G	M2	001

APPENDIX B

Pre-Development Enquiry Response from Yorkshire Water

YorkshireWater

Mr B Charles
Alan Wood & Partners
Unit B
Hayland Street
Meadowhall Road
Sheffield
S9 1BY

Yorkshire Water Services
Developer Services
Sewerage Technical Team
PO BOX 52
Bradford
BD3 7AY

Tel: 0345 120 8482
Fax: (01274) 372 834

Email:
technical.sewerage@yorkshirewater.co.uk

For telephone enquiries ring:
Chris Roberts on 0345 120 8482

Your Ref: AWP054
Our Ref: V002992

6th March 2019

Dear Mr Charles,

Proposed New Barnsley Fire Station For SYFR, 56 Broadway, Barnsley, S70 6RT - Pre-Planning Sewerage Enquiry - Fire Station - T323691

Thank you for your recent enquiry. Our charge of £158.93 (plus VAT) will be added to your account with us, reference AWP054. You will receive an invoice for your account in due course.

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

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

Foul Water

Foul water domestic waste should discharge to the 225 mm diameter public foul/combined sewer recorded to the east of the site. Existing private foul drainage can be utilised if suitably sized.

Foul water from kitchens and/or food preparation areas of any restaurants and/or canteens etc. must pass through a fat and grease trap of adequate design before any discharge to the public sewer network.

Surface Water

In order to agree a surface water discharge I will need information on the surface water pipe that leaves site after manholes 5, 6, 7. I will need to know what size it is and the fall of the pipe from manhole 7 to the point it enters the public surface water sewer network. Additionally, it is imperative, that surface water run-off from areas of hardstanding used for training exercises and/or other similar areas likely to become contaminated by the use of foam and/or chemicals is not discharged to any public surface water sewer network. Surface water from such areas must pass through adequate interception and/or settlement facilities before discharge to the public foul or combined sewer network. A trade effluent consent - that may be conditional and, amongst other things, place a restriction on the rate of discharge to public sewer - may be required for such discharges. The developer is advised to contact Yorkshire Water's Industrial Waste Section (telephone 0345 1242424) about any such proposal.

YorkshireWater

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

Surface water run-off from communal parking (greater than 800 sq metres or more than 50 car parking spaces) and hardstanding must pass through an oil, petrol and grit interceptor/separator of adequate design before any discharge to the public sewer network. Roof water should not pass through the traditional 'stage' or full retention type of interceptor/separator. It is good drainage practice for any interceptor/separator to be located upstream of any on-site balancing, storage or other means of flow attenuation that may be required.

Surface water run-off from areas of vehicular parking and/or hardstanding etc. must pass through an oil, petrol and grit interceptor/separator of adequate design before any discharge to the public sewer network. Roof water should not pass through the traditional 'stage' or full retention type of interceptor/separator.

It is good drainage practice for any interceptor/separator and/or settlement facility to be located upstream of any on-site balancing, storage or other means of flow attenuation that may be required.

Other Observations

Under the provisions of section 111 of the Water Industry Act 1991 it is unlawful to pass into any public sewer (or into any drain or private sewer communicating with the public sewer network) any items likely to cause damage to the public sewer network interfere with the free flow of its contents or affect the treatment and disposal of its contents. Amongst other things this includes fat, oil, nappies, bandages, syringes, medicines, sanitary towels and incontinence pants. Contravention of the provisions of section 111 is a criminal offence.

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

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

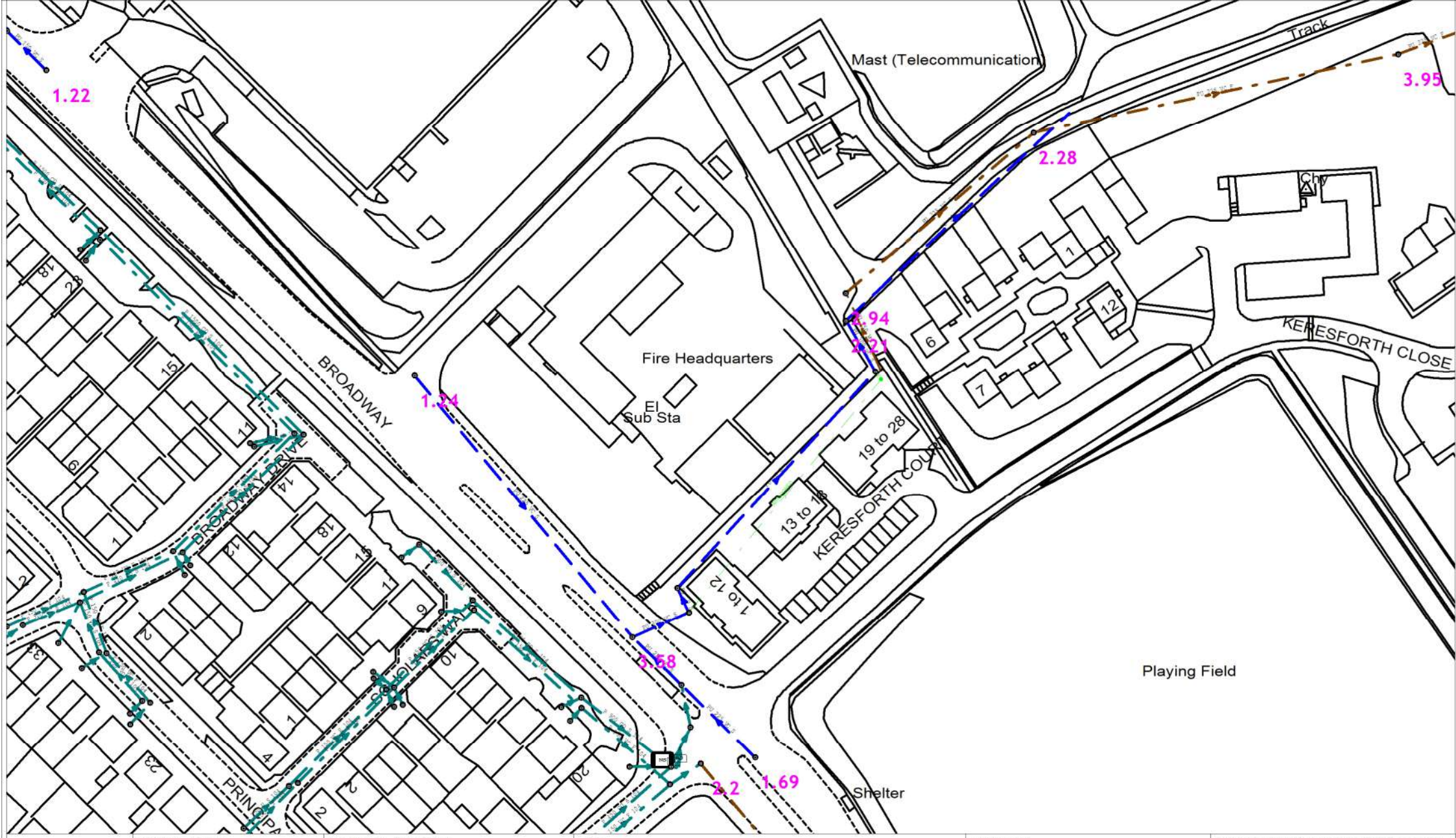
Yorkshire Water's Trade Effluent team must be consulted in respect of any proposed trade effluent discharge to the public sewer.

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

Yours sincerely

Chris Roberts
Sewerage Technician
Developer Services

YorkshireWater



433004 : 405489	Map Name : SE3305NW	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 : 08/03/2019, 09:09:47 Source : Sewer Network Enquiry
			Date Gen : 08/03/2019, 09:10:16

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

APPENDIX C

Proposed Site Layout

Radio Pylon



key plan

- Red Line Boundary
- Indicates proposed Secure Fence Line - Gates as Indicated.
- Indicates proposed Acoustic Timber Fence Line - Gates as Indicated.
- Indicative Line of Demolished Buildings

notes

1. This drawing is based on survey information dated 04/05/2018 and supplied by Met Geo Environmental.
2. The red line ownership boundary is assumed and is to be checked and confirmed by the client.
3. Vehicle tracking is indicative only - full vehicle tracking to be undertaken by Civil Engineer.

rev	description	drawn	checked	date
P07	Issued for Planning.	SB	GQ	20.08.19
P06	Draft issue for costing.	SB	GQ	24.07.19
P05	Record issue prior to actioning Client changes.	DRK	SB	12.07.19
P04	Updated as Stage 2A feedback.	DRK	SB	06.06.19
P03	Wash-doen Canopy Added.	SB	DH	01.03.19
P02	Updated to current GA Plans.	SB	FH	20.02.19
P01	First Issue	SB	DH	30.01.19

Bond Bryan Architects

The Church Studio Springvale Road Sheffield S10 1LP

t +44(0)114 266 2040 w www.bondbryan.com

e barnsley.syfs@bondbryan.co.uk

Barnsley Fire Station
Broadway A6133
Barnsley

South Yorkshire Fire and Rescue

PROPOSED SITE PLAN

bba project ref	scale(s)	original paper size
18-033	1:250	A1

name :

project	originator	volume	level	type	role	number
SYFRS	BBA	Z0	GF	DR	A	1003

status : **D5** suitability description : **SUITABLE FOR PLANNING**

revision : **P07** revision description : **PRELIMINARY**

This document is © Bond Bryan Architects Ltd. If in doubt ASK. Drawing measurements shall not be obtained by scaling. Verify all dimensions prior to construction. Immediately report any discrepancies on this document to the Architect. This document shall be read in conjunction with associated models, specifications and related consultant's documents.

APPENDIX D

Environment Agency Correspondence

APPENDIX E

Danvm DC Drainage District Correspondence

Mark Jarvis

From: Shire Group Planning <planning@shiregroup-idbs.gov.uk>
Sent: 22 July 2019 16:48
To: Mark Jarvis
Subject: RE: Barnsley Fire Station

Dear Mark

Thank you for your email.

The site falls outside the Danvm DC Drainage District and land drainage consents or agreement should be sought from Barnsley MBC in addition to Yorkshire Water.

If the culverted watercourse through Barnsley is riparian, then we would recommend that it is assessed / confirmed that any additional flow is acceptable and that the condition of the culverted watercourse is inspected. However, we suspect that the 'watercourse' referred to is Main River under the control of the Environment Agency; we encourage you to contact the EA direct for any additional Permits required for discharge into the system.

Kind regards,
For and on behalf of the Shire Group of Internal Drainage Boards,

Paul Jones BSc (Hons) MSc (Eng) GMICE
Engineer to the Board
Lead Water Level Management Engineer

Shire Group of IDBs

From: Mark Jarvis <Mark.Jarvis@alanwood.co.uk>
Sent: 02 July 2019 13:40
To: Shire Group Planning <planning@shiregroup-idbs.gov.uk>
Subject: Barnsley Fire Station

Dear Sir,

Please find attached the current layout for the proposed fire station off Broadway. We are part of the design team for the project.

One of our tasks is designing the foul and surface water drainage systems. The current fire station connects to public sewers near the eastern corner and flow down a track to the rear of the properties that front Keresforth Ct and Keresforth Cl. We have attached a plan for ease of reference. We are currently in discussions with YW to agree flow rates. YW have indicated that the sws connects to a public sewer that becomes a culverted watercourse, this flows through Barnsley town centre and eventually outfalls to the River Dearne at Darfield.

To assist with our design we would be grateful for your comments / recommendations etc.

We look forward to hearing from you.

Regards

Mark Jarvis

For and on behalf of Alan Wood & Partners
• SHEFFIELD • HULL • LEEDS • LINCOLN • LONDON • SCARBOROUGH • YORK •
• Hallamshire House • Meadow Court • Hayland Street • Sheffield • S9 1BY •

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www.shiregroup-idbs.gov.uk

APPENDIX F

Extract of LLFA Advice from Barnsley Metropolitan Borough Council

Mark Jarvis

From: Atkins , Wayne <WayneAtkins@barnsley.gov.uk>
Sent: 27 June 2019 15:00
To: Mark Jarvis
Subject: RE: Barnsley Fire Station

HI Mark,

I am happy to go with Yorkshire Water's recommendations providing there is no increase in flow from the site.

Cheers

Wayne Atkins
Principal Engineer – Drainage
Environment & Transport
Place Directorate
Barnsley Metropolitan Borough Council

Telephone: 01226 772182
E-mail: wayneatkins@barnsley.gov.uk

From: Mark Jarvis [mailto:Mark.Jarvis@alanwood.co.uk]
Sent: 26 June 2019 12:17
To: Atkins , Wayne
Cc: James Shores; Jenny Bulmer; Rebecca Thompson
Subject: Barnsley Fire Station

Hi Wayne,

Please find attached the current layout for the proposed fire station off Broadway. We are part of the design team for the project.

One of our tasks is designing the foul and surface water drainage systems. The current fire station connects to public sewers near the eastern corner and flow down a track to the rear of the properties that front Keresforth Ct and Keresforth Cl. We have attached a plan for ease of reference. We are currently in discussions with YW to agree a flow rates. YW have indicated that the sws connects too / becomes a culverted watercourse, that flows through Barnsley town centre and eventually outfalls to the River Dearne at Darfield.

To assist us with our design we would be grateful for your comments / recommendations etc.

We look forward to hearing from you.

Regards

Mark Jarvis

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• Hallamshire House • Meadow Court • Hayland Street • Sheffield • S9 1BY •

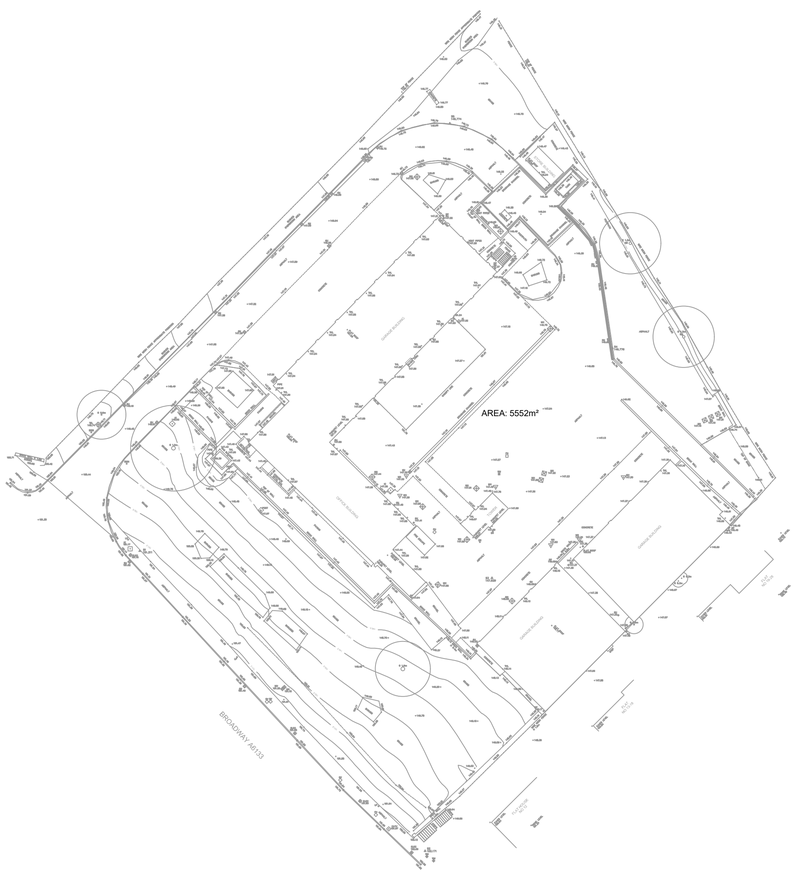
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APPENDIX G

Pre and Proposed Impermeable Areas



EXISTING IMPERMEABLE AREAS PLAN

SCALE 1:500



PROPOSED IMPERMEABLE AREAS PLAN

SCALE 1:500

NOTES:

1. THESE NOTES ARE INTENDED TO AUGMENT DRAWINGS AND SPECIFICATIONS. WHERE CONFLICT OF REQUIREMENTS EXIST THE ORDER OF PRECEDENCE SHALL BE AS SHOWN IN THE SPECIFICATION. OTHERWISE THE STRICTEST PROVISION SHALL GOVERN.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ENGINEERS AND ARCHITECTS DRAWINGS.
3. DRAWINGS NOT TO BE SCALED. ALL DIMENSIONS TO BE CHECKED ON SITE BY THE CONTRACTOR. ANY DISCREPANCIES TO BE NOTIFIED TO THE ENGINEER AND FURTHER INSTRUCTIONS OBTAINED BEFORE WORK IS COMMENCED.

GENERAL NOTES

4. **THIS DRAWING IS FOR INFORMATION ONLY.**

100mm at A1

Rev	Description	Date	By	Chk	App
A1	FIRST ISSUE	21.08.19	MJ	RT	JJS

Alan Wood & Partners

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London T. 02071 860761
Scarborough T. 01723 865484
York T. 01904 611594

Project: Barnsley Fire Station, Broadway, Barnsley, S70 6RA

Client: Turner and Townsend Project Management Ltd

Drawing: Existing and Proposed Impermeable Areas

Role: Civil Engineer

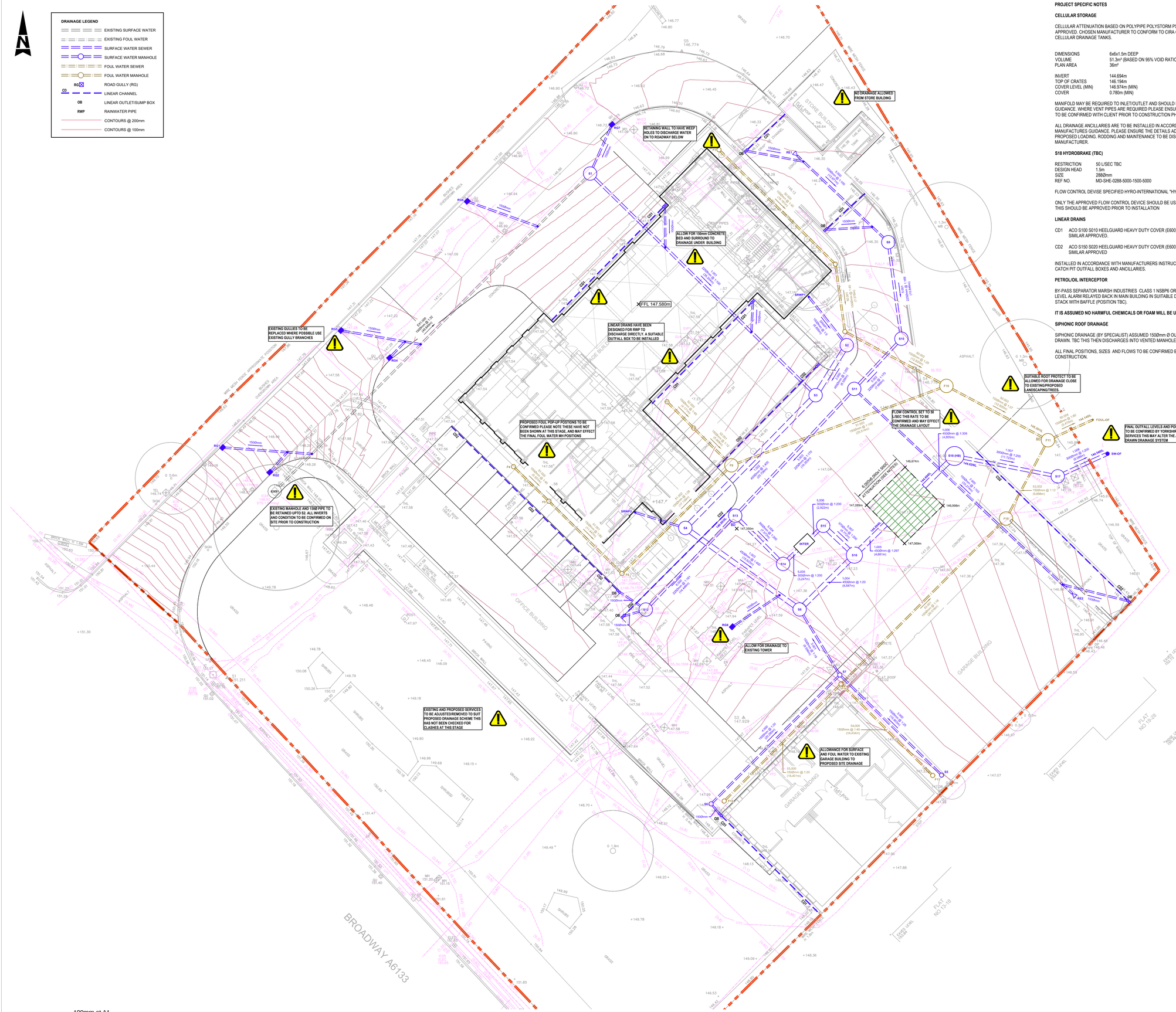
Drawing Status: FOR APPROVAL

Job. no. 41207 | Scale@ A1: 1:500 | Rev. A1

Project	Originator	Volume	Level	Type	Role	Number
FIRE	AWP	ZZ	00	DR	C	3110

APPENDIX G

Drainage Strategy and Microdrainage Calculations



PROJECT SPECIFIC NOTES

CELLULAR STORAGE

CELLULAR ATTENUATION BASED ON POLYPIPE POLYSTORM PSM1 (44tonne/ m²) UNITS OR SIMILAR APPROVED. CHOSEN MANUFACTURER TO CONFORM TO CIRA C680 STRUCTURAL DESIGN OF MODULAR CELLULAR DRAINAGE TANKS.

DIMENSIONS	6x6x1.5m DEEP
VOLUME	51.3m³ (BASED ON 95% VOID RATIO)
PLAN AREA	36m²
INVERT	144.694m
TOP OF CRATES	146.194m
COVER LEVEL (MIN)	146.974m (MIN)
COVER	0.780m (MIN)

MANIFOLD MAY BE REQUIRED TO INLET/OUTLET AND SHOULD REFER TO MANUFACTURER FOR GUIDANCE. WHERE VENT PIPES ARE REQUIRED PLEASE ENSURE THESE ARE DISCREET. PROPOSALS TO BE CONFIRMED WITH CLIENT PRIOR TO CONSTRUCTION PHASE.

ALL DRAINAGE ANCILLARIES ARE TO BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURES GUIDANCE. PLEASE ENSURE THE DETAILS ADOPTED ARE SUITABLE FOR THE PROPOSED LOADING. RODDING AND MAINTENANCE TO BE DISCUSSED WITH CELLULAR CRATE MANUFACTURER.

S18 HYDROBRAKE (TBC)

RESTRICTION	50 L/SEC TBC
DESIGN HEAD	1.5m
SIZE	280Ømm
REF NO.	MD-SHE-0288-5000-1500-5000

FLOW CONTROL DEVISE SPECIFIED HYRO-INTERNATIONAL "HYDRO-BRAKE OPTIMUM"

ONLY THE APPROVED FLOW CONTROL DEVICE SHOULD BE USED, IF ANOTHER MODEL IS PROPOSED THIS SHOULD BE APPROVED PRIOR TO INSTALLATION

LINEAR DRAINS

CD1 ACO S100 S010 HEELGUARD HEAVY DUTY COVER (E600) C/W SILT TRAP AND SUMP OR SIMILAR APPROVED.

CD2 ACO S150 S020 HEELGUARD HEAVY DUTY COVER (E600) C/W SILT TRAP AND SUMP OR SIMILAR APPROVED

INSTALLED IN ACCORDANCE WITH MANUFACTURERS INSTRUCTIONS COMPLETE WITH ALL NECESSARY CATCH PIT OUTFALL BOXES AND ANCILLARIES.

PETROL/OIL INTERCEPTOR

BY-PASS SEPARATOR MARSH INDUSTRIES CLASS 1 NSBP6 OR SIMILAR APPROVED. C/W WITH HIGH LEVEL ALARM RELAYED BACK IN MAIN BUILDING IN SUITABLE DUCTWORK. ALLOW FOR A 1000mm VENT STACK WITH BAFFLE (POSITION TBC).

IT IS ASSUMED NO HARMFUL CHEMICALS OR FOAM WILL BE USED IN THE DRILL YARD AREA.

SIPHONIC ROOF DRAINAGE

SIPHONIC DRAINAGE (BY SPECIALIST) ASSUMED 150Ømm Ø OUTLET PIPES FROM UNIT POSITIONED AS DRAWN. TBC THIS THEN DISCHARGES INTO VENTED MANHOLE WHICH BREAKS THE SIPHON.

ALL FINAL POSITIONS, SIZES AND FLOWS TO BE CONFIRMED BY SIPHONIC CONTRACTOR PRIOR TO CONSTRUCTION.

NOTES:

1. THESE NOTES ARE INTENDED TO AUGMENT DRAWINGS AND SPECIFICATIONS. WHERE CONFLICT OF REQUIREMENTS EXIST THE ORDER OF PRECEDENCE SHALL BE AS SHOWN IN THE SPECIFICATION. OTHERWISE THE STRICTEST PROVISION SHALL GOVERN.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ENGINEERS AND ARCHITECTS DRAWINGS.
3. DRAWINGS NOT TO BE SCALED. ALL DIMENSIONS TO BE CHECKED ON SITE BY THE CONTRACT OR. ANY DISCREPANCIES TO BE NOTIFIED TO THE ENGINEER AND FURTHER INSTRUCTIONS OBTAINED BEFORE WORK IS COMMENCED.

GENERAL

4. ALL LEVELS ARE AOD (ABOVE ORDINANCE DATUM) UNO
5. REFER TO DRAWING No. 3101 FOR MANHOLE SCHEDULES.
6. REFER TO DRAWING No. 3105 FOR DRAINAGE DETAILS.
7. REFER TO DRAWING No. 4100 FOR PROPOSED SITE LEVELS.
8. REFER TO DRAWING No. 4105 FOR PROPOSED FINISHES AND KERBING DETAILS.
9. REFER TO DRAWING No. 4110 FOR PROPOSED HIGHWAY DETAILS.
10. REFER TO ARCHITECT DETAILS FOR SITE PLAN, FOUL/TRADE WASTE CONNECTIONS.

DRAINAGE

11. 100-225mmØ TO BE CLAY PIPES, HEPWORTH OR SIMILAR APPROVED.
12. 300mmØ & ABOVE TO BE OSMA TWINWALL OR SIMILAR APPROVED TO R12/346.
13. ALL STACKS, DOWNPIPES AND GULLIES TO BE RODDABLE.
14. BEDDING SURROUNDS:

UNDER BUILDING (ALL PIPES)	
LESS THAN 300mm GENERALLY	CLASS Z CLASS S
EXTERNAL UNDER ROADS (PLASTIC)	
LESS THAN 1200mm MORE THAN 1200mm	SEE SPECIFIC DETAIL CLASS S
EXTERNAL UNDER SOFT LANDSCAPING (PLASTIC)	
LESS THAN 600mm MORE THAN 600mm	CLASS Z CLASS S
NB ALL COVERS ARE BASED FROM FINISHED FORMATION LEVEL TO SOFFIT OF PIPE	

15. ALL PLASTIC PIPEWORK TO BE INSTALLED IN LENGTHS NO LONGER THAN 3.0m TO PREVENT IRREGULAR LEVELS IN THE INVERT OF THE PIPE.
16. WHERE SEWERS UNDER ROADS WITH LESS THAN 1.2M OF COVER OR TWO SEWERS CROSS TO HAVE 150mm (C20/30) FULL CONCRETE BED AND SURROUND.
17. PIPE DIAMETERS ARE TO BE 100mm OR AS SHOWN.
18. BRANCH CONNECTIONS TO ENTER ACCESS CHAMBERS AT HALF PIPE LEVEL.
19. EXTERNAL GULLIES TO BE TRAPPED AND FITTED WITH SILT BUCKETS. CONNECTIONS TO BE SURROUNDED IN 150mm (C20/30) UNTIL THE COVER TO THE CROWN OF THE PIPE IS LESS THAN 1.2m.
20. THE CONTRACTOR SHALL NOTIFY THE APPROPRIATE AUTHORITY OR THEIR AGENTS PRIOR TO COMMENCEMENT OF EACH STAGE OF WORK FOR THEIR REPRESENTATIVE TO CARRY OUT INSPECTIONS TO ENSURE COMPLIANCE WITH THEIR SPECIFICATION AND APPROVED DETAILS, IF ANY SUCH REQUESTS OR INSTRUCTIONS CAUSE CONFLICT WITH THE SPECIFICATION THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER.
21. MINIMUM FALLS:
SURFACE BRANCHES 1:100
FOUL BRANCHES 1:40
22. PIPE DIAMETERS 100mm MINIMUM OR AS SHOWN.
23. SEWERS MUST HAVE 5m CLEARANCE FROM TREES AND HEDGES, WHERE IT IS NOT POSSIBLE TO ACHIEVE THIS CLEARANCE, A CONCRETE BED AND SURROUND IS REQUIRED.
24. CHAMBER SIZE OF MANHOLES WITH MORE THAN ONE CONNECTION MAY NEED TO BE INCREASED AN INCREMENT TO ACCOMMODATE THE CONNECTIONS AND BENDS.
25. REFER TO ARCHITECT'S DRAWINGS FOR FURTHER DETAILS OF LANDSCAPING.
26. NEW CONNECTIONS TO PUBLIC SEWERS TO BE IN ACCORDANCE WITH SEWERS FOR ADOPTION 7TH EDITION, PROPOSALS TO BE SUBMITTED TO THE WATER AUTHORITY, IF A DIRECT CONNECTION TO EXISTING PUBLIC MANHOLE IS NOT ACHIEVABLE A SOFFIT CONNECTION MAYBE MORE SUITABLE PENDING CONFIRMATION FROM STATUTORY SUPPLIER, HIGHWAY AUTHORITY WILL ALSO NEED TO BE CONTACTED AS ROADWAY CONTROL MEASURES WILL NEEDED.
27. ALL INTERNAL MANHOLE WHERE SHOWN TO HAVE RECESSED STEEL DOUBLE SEAL COVERS. C/W/ PRESSURE PLATE TO WITHSTAND 1 BAR PRESSURE. TO CONFORM TO BSEN124-B12

MAINTENANCE NOTES

28. THERE WILL BE A REQUIREMENT FOR MAINTENANCE OPERATIONS TO BE PERFORMED ON THE BY-PASS SEPARATOR, ROAD GULLIES AND LINEAR DRAINAGE. THESE WORKS ARE TO BE CARRIED OUT BY SUITABLY EXPERIENCE PERSONNEL. A DETAILED METHOD STATEMENT SHOULD BE DEVELOPED BY THE CONTRACTOR AND DRAWN UP AT A APPROPRIATE TIME .

Rev	Description	Date	By	Chk	App
T1	FIRST ISSUE	21.08.19	JMc	MJ	RT

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Project: Barnsley Fire Station, Broadway, Barnsley, S70 6RA

Client: Turner and Townsend Project Management Ltd.

Drawing: External Works: Proposed Drainage

Role: Civil Engineer

Drawing Status: TENDER

Job. no. 41207 | Scale@ A1: 1:200 | Rev. T1

Project Originator Volume Level Type Role Number
FIRE - AWP - ZZ - 00 - DR - C - 3100

Summary of Results for 1 year Return Period

Half Drain Time : 10 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.176	0.176	0.0	25.3	25.3	18.4	O K
30 min Summer	0.195	0.195	0.0	29.8	29.8	20.4	O K
60 min Summer	0.198	0.198	0.0	30.6	30.6	20.7	O K
120 min Summer	0.182	0.182	0.0	26.8	26.8	19.0	O K
180 min Summer	0.167	0.167	0.0	23.2	23.2	17.5	O K
240 min Summer	0.156	0.156	0.0	20.5	20.5	16.3	O K
360 min Summer	0.139	0.139	0.0	16.8	16.8	14.5	O K
480 min Summer	0.127	0.127	0.0	14.3	14.3	13.3	O K
600 min Summer	0.119	0.119	0.0	12.7	12.7	12.4	O K
720 min Summer	0.112	0.112	0.0	11.4	11.4	11.7	O K
960 min Summer	0.102	0.102	0.0	9.6	9.6	10.7	O K
1440 min Summer	0.090	0.090	0.0	7.5	7.5	9.4	O K
2160 min Summer	0.078	0.078	0.0	5.8	5.8	8.2	O K
2880 min Summer	0.071	0.071	0.0	4.9	4.9	7.5	O K
4320 min Summer	0.062	0.062	0.0	3.8	3.8	6.5	O K
5760 min Summer	0.057	0.057	0.0	3.1	3.1	5.9	O K
7200 min Summer	0.053	0.053	0.0	2.7	2.7	5.5	O K
8640 min Summer	0.049	0.049	0.0	2.4	2.4	5.1	O K
10080 min Summer	0.047	0.047	0.0	2.2	2.2	4.9	O K
15 min Winter	0.190	0.190	0.0	28.7	28.7	19.9	O K
30 min Winter	0.205	0.205	0.0	32.3	32.3	21.4	O K
60 min Winter	0.197	0.197	0.0	30.3	30.3	20.5	O K
120 min Winter	0.170	0.170	0.0	23.8	23.8	17.7	O K
180 min Winter	0.151	0.151	0.0	19.5	19.5	15.8	O K
240 min Winter	0.138	0.138	0.0	16.7	16.7	14.4	O K
360 min Winter	0.121	0.121	0.0	13.1	13.1	12.6	O K
480 min Winter	0.110	0.110	0.0	11.0	11.0	11.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	28.172	0.0	28.4	16
30 min Summer	19.178	0.0	38.7	23
60 min Summer	12.800	0.0	51.8	38
120 min Summer	8.412	0.0	68.1	70
180 min Summer	6.562	0.0	79.7	100
240 min Summer	5.468	0.0	88.5	130
360 min Summer	4.212	0.0	102.3	190
480 min Summer	3.501	0.0	113.4	250
600 min Summer	3.033	0.0	122.8	310
720 min Summer	2.699	0.0	131.1	372
960 min Summer	2.245	0.0	145.4	492
1440 min Summer	1.728	0.0	167.9	736
2160 min Summer	1.332	0.0	194.2	1100
2880 min Summer	1.109	0.0	215.5	1468
4320 min Summer	0.853	0.0	248.5	2200
5760 min Summer	0.706	0.0	274.3	2920
7200 min Summer	0.610	0.0	296.3	3664
8640 min Summer	0.541	0.0	315.6	4392
10080 min Summer	0.487	0.0	331.3	5056
15 min Winter	28.172	0.0	31.8	16
30 min Winter	19.178	0.0	43.4	24
60 min Winter	12.800	0.0	58.0	40
120 min Winter	8.412	0.0	76.3	70
180 min Winter	6.562	0.0	89.2	100
240 min Winter	5.468	0.0	99.2	132
360 min Winter	4.212	0.0	114.6	192
480 min Winter	3.501	0.0	127.0	252

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Summary of Results for 1 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
600 min Winter	0.102	0.102	0.0	9.5	9.5	10.6	O K
720 min Winter	0.096	0.096	0.0	8.5	8.5	10.0	O K
960 min Winter	0.087	0.087	0.0	7.2	7.2	9.1	O K
1440 min Winter	0.076	0.076	0.0	5.5	5.5	7.9	O K
2160 min Winter	0.066	0.066	0.0	4.2	4.2	6.9	O K
2880 min Winter	0.060	0.060	0.0	3.5	3.5	6.3	O K
4320 min Winter	0.053	0.053	0.0	2.7	2.7	5.5	O K
5760 min Winter	0.048	0.048	0.0	2.2	2.2	5.0	O K
7200 min Winter	0.044	0.044	0.0	1.9	1.9	4.6	O K
8640 min Winter	0.042	0.042	0.0	1.7	1.7	4.3	O K
10080 min Winter	0.040	0.040	0.0	1.6	1.6	4.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
600 min Winter	3.033	0.0	137.5	312
720 min Winter	2.699	0.0	146.8	374
960 min Winter	2.245	0.0	162.9	494
1440 min Winter	1.728	0.0	188.0	738
2160 min Winter	1.332	0.0	217.5	1104
2880 min Winter	1.109	0.0	241.3	1468
4320 min Winter	0.853	0.0	278.3	2192
5760 min Winter	0.706	0.0	307.3	2840
7200 min Winter	0.610	0.0	331.9	3672
8640 min Winter	0.541	0.0	353.5	4384
10080 min Winter	0.487	0.0	371.1	5112

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.300	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.540

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.270	4	8	0.270

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Model Details

Storage is Online Cover Level (m) 2.200

Cellular Storage Structure

Invert Level (m)	0.000
Infiltration Coefficient Base (m/hr)	0.00000
Infiltration Coefficient Side (m/hr)	0.00000
Safety Factor	2.0
Porosity	0.95

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	110.0	195.0	1.201	0.0	239.7
1.200	110.0	239.7			

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0303-5430-1200-5430
Design Head (m)	1.200
Design Flow (l/s)	54.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	303
Invert Level (m)	0.000
Minimum Outlet Pipe Diameter (mm)	375
Suggested Manhole Diameter (mm)	2100

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	54.3
Flush-Flo™	0.478	54.3
Kick-Flo®	0.908	47.5
Mean Flow over Head Range	-	44.6

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	9.2	1.200	54.3	3.000	84.6	7.000	127.8
0.200	31.1	1.400	58.5	3.500	91.2	7.500	132.2
0.300	52.2	1.600	62.4	4.000	97.3	8.000	136.5
0.400	53.9	1.800	66.0	4.500	103.0	8.500	140.6
0.500	54.3	2.000	69.5	5.000	108.5	9.000	144.6
0.600	53.7	2.200	72.8	5.500	113.6	9.500	148.4
0.800	51.0	2.400	75.9	6.000	118.6		
1.000	49.7	2.600	78.9	6.500	123.3		

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Summary of Results for 30 year Return Period

Half Drain Time : 10 minutes.

	Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15	min Summer	0.398	0.398	0.0	53.9	53.9	41.6	O K
30	min Summer	0.465	0.465	0.0	54.3	54.3	48.6	O K
60	min Summer	0.462	0.462	0.0	54.3	54.3	48.3	O K
120	min Summer	0.368	0.368	0.0	53.6	53.6	38.5	O K
180	min Summer	0.296	0.296	0.0	52.1	52.1	31.0	O K
240	min Summer	0.262	0.262	0.0	45.7	45.7	27.4	O K
360	min Summer	0.223	0.223	0.0	36.7	36.7	23.3	O K
480	min Summer	0.198	0.198	0.0	30.7	30.7	20.7	O K
600	min Summer	0.182	0.182	0.0	26.7	26.7	19.0	O K
720	min Summer	0.169	0.169	0.0	23.7	23.7	17.7	O K
960	min Summer	0.151	0.151	0.0	19.4	19.4	15.8	O K
1440	min Summer	0.129	0.129	0.0	14.7	14.7	13.4	O K
2160	min Summer	0.110	0.110	0.0	11.0	11.0	11.4	O K
2880	min Summer	0.098	0.098	0.0	8.9	8.9	10.2	O K
4320	min Summer	0.084	0.084	0.0	6.6	6.6	8.7	O K
5760	min Summer	0.075	0.075	0.0	5.4	5.4	7.8	O K
7200	min Summer	0.069	0.069	0.0	4.5	4.5	7.2	O K
8640	min Summer	0.064	0.064	0.0	4.0	4.0	6.7	O K
10080	min Summer	0.061	0.061	0.0	3.6	3.6	6.3	O K
15	min Winter	0.450	0.450	0.0	54.2	54.2	47.0	O K
30	min Winter	0.515	0.515	0.0	54.3	54.3	53.8	O K
60	min Winter	0.470	0.470	0.0	54.3	54.3	49.1	O K
120	min Winter	0.316	0.316	0.0	52.6	52.6	33.0	O K
180	min Winter	0.255	0.255	0.0	44.1	44.1	26.6	O K
240	min Winter	0.224	0.224	0.0	37.0	37.0	23.4	O K
360	min Winter	0.188	0.188	0.0	28.2	28.2	19.7	O K
480	min Winter	0.167	0.167	0.0	23.2	23.2	17.5	O K

	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15	min Summer	68.992	0.0	69.7	16
30	min Summer	47.082	0.0	95.2	24
60	min Summer	30.811	0.0	124.7	40
120	min Summer	19.530	0.0	158.1	72
180	min Summer	14.749	0.0	179.1	100
240	min Summer	12.050	0.0	195.2	130
360	min Summer	9.053	0.0	219.9	190
480	min Summer	7.379	0.0	239.0	250
600	min Summer	6.291	0.0	254.7	310
720	min Summer	5.520	0.0	268.2	370
960	min Summer	4.488	0.0	290.7	492
1440	min Summer	3.346	0.0	325.1	734
2160	min Summer	2.490	0.0	363.0	1100
2880	min Summer	2.017	0.0	392.0	1460
4320	min Summer	1.499	0.0	436.9	2188
5760	min Summer	1.215	0.0	472.2	2896
7200	min Summer	1.032	0.0	501.6	3672
8640	min Summer	0.904	0.0	527.1	4304
10080	min Summer	0.808	0.0	549.8	5000
15	min Winter	68.992	0.0	78.1	17
30	min Winter	47.082	0.0	106.7	26
60	min Winter	30.811	0.0	139.7	42
120	min Winter	19.530	0.0	177.1	72
180	min Winter	14.749	0.0	200.6	100
240	min Winter	12.050	0.0	218.6	130
360	min Winter	9.053	0.0	246.3	190
480	min Winter	7.379	0.0	267.7	250

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Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
600 min Winter	0.153	0.153	0.0	19.9	19.9	16.0	O K
720 min Winter	0.142	0.142	0.0	17.5	17.5	14.8	O K
960 min Winter	0.127	0.127	0.0	14.3	14.3	13.2	O K
1440 min Winter	0.108	0.108	0.0	10.7	10.7	11.3	O K
2160 min Winter	0.092	0.092	0.0	7.9	7.9	9.6	O K
2880 min Winter	0.083	0.083	0.0	6.5	6.5	8.6	O K
4320 min Winter	0.071	0.071	0.0	4.8	4.8	7.4	O K
5760 min Winter	0.063	0.063	0.0	3.9	3.9	6.6	O K
7200 min Winter	0.058	0.058	0.0	3.3	3.3	6.1	O K
8640 min Winter	0.054	0.054	0.0	2.9	2.9	5.7	O K
10080 min Winter	0.051	0.051	0.0	2.6	2.6	5.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
600 min Winter	6.291	0.0	285.3	312
720 min Winter	5.520	0.0	300.4	372
960 min Winter	4.488	0.0	325.6	492
1440 min Winter	3.346	0.0	364.1	732
2160 min Winter	2.490	0.0	406.6	1088
2880 min Winter	2.017	0.0	439.1	1464
4320 min Winter	1.499	0.0	489.4	2156
5760 min Winter	1.215	0.0	528.9	2928
7200 min Winter	1.032	0.0	561.8	3672
8640 min Winter	0.904	0.0	590.4	4280
10080 min Winter	0.808	0.0	615.8	5024

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.300	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.540

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.270	4	8	0.270

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Model Details

Storage is Online Cover Level (m) 2.200

Cellular Storage Structure

Invert Level (m)	0.000
Infiltration Coefficient Base (m/hr)	0.00000
Infiltration Coefficient Side (m/hr)	0.00000
Safety Factor	2.0
Porosity	0.95

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	110.0	195.0	1.201	0.0	239.7
1.200	110.0	239.7			

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0303-5430-1200-5430
Design Head (m)	1.200
Design Flow (l/s)	54.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	303
Invert Level (m)	0.000
Minimum Outlet Pipe Diameter (mm)	375
Suggested Manhole Diameter (mm)	2100

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	54.3
Flush-Flo™	0.478	54.3
Kick-Flo®	0.908	47.5
Mean Flow over Head Range	-	44.6

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	9.2	1.200	54.3	3.000	84.6	7.000	127.8
0.200	31.1	1.400	58.5	3.500	91.2	7.500	132.2
0.300	52.2	1.600	62.4	4.000	97.3	8.000	136.5
0.400	53.9	1.800	66.0	4.500	103.0	8.500	140.6
0.500	54.3	2.000	69.5	5.000	108.5	9.000	144.6
0.600	53.7	2.200	72.8	5.500	113.6	9.500	148.4
0.800	51.0	2.400	75.9	6.000	118.6		
1.000	49.7	2.600	78.9	6.500	123.3		

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Summary of Results for 100 year Return Period (+30%)

Half Drain Time : 19 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.773	0.773	0.0	54.3	54.3	80.8	O K
30 min Summer	0.964	0.964	0.0	54.3	54.3	100.8	O K
60 min Summer	1.025	1.025	0.0	54.3	54.3	107.1	O K
120 min Summer	0.915	0.915	0.0	54.3	54.3	95.6	O K
180 min Summer	0.726	0.726	0.0	54.3	54.3	75.9	O K
240 min Summer	0.569	0.569	0.0	54.3	54.3	59.5	O K
360 min Summer	0.370	0.370	0.0	53.6	53.6	38.7	O K
480 min Summer	0.287	0.287	0.0	50.6	50.6	30.0	O K
600 min Summer	0.254	0.254	0.0	44.0	44.0	26.6	O K
720 min Summer	0.232	0.232	0.0	39.0	39.0	24.3	O K
960 min Summer	0.203	0.203	0.0	31.9	31.9	21.3	O K
1440 min Summer	0.170	0.170	0.0	23.8	23.8	17.7	O K
2160 min Summer	0.142	0.142	0.0	17.5	17.5	14.9	O K
2880 min Summer	0.126	0.126	0.0	14.2	14.2	13.2	O K
4320 min Summer	0.107	0.107	0.0	10.4	10.4	11.1	O K
5760 min Summer	0.095	0.095	0.0	8.3	8.3	9.9	O K
7200 min Summer	0.087	0.087	0.0	7.1	7.1	9.0	O K
8640 min Summer	0.081	0.081	0.0	6.2	6.2	8.4	O K
10080 min Summer	0.076	0.076	0.0	5.5	5.5	7.9	O K
15 min Winter	0.893	0.893	0.0	54.3	54.3	93.3	O K
30 min Winter	1.101	1.101	0.0	54.3	54.3	115.1	O K
60 min Winter	1.139	1.139	0.0	54.3	54.3	119.0	O K
120 min Winter	0.934	0.934	0.0	54.3	54.3	97.7	O K
180 min Winter	0.626	0.626	0.0	54.3	54.3	65.4	O K
240 min Winter	0.416	0.416	0.0	54.1	54.1	43.5	O K
360 min Winter	0.269	0.269	0.0	47.2	47.2	28.1	O K
480 min Winter	0.231	0.231	0.0	38.6	38.6	24.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	116.002	0.0	117.3	17
30 min Summer	79.998	0.0	161.9	27
60 min Summer	52.662	0.0	213.2	44
120 min Summer	33.322	0.0	269.9	78
180 min Summer	24.998	0.0	303.7	110
240 min Summer	20.313	0.0	329.0	138
360 min Summer	15.144	0.0	368.0	194
480 min Summer	12.271	0.0	397.5	250
600 min Summer	10.413	0.0	421.7	310
720 min Summer	9.099	0.0	442.1	370
960 min Summer	7.345	0.0	475.9	490
1440 min Summer	5.419	0.0	526.6	734
2160 min Summer	3.986	0.0	581.1	1100
2880 min Summer	3.200	0.0	622.1	1468
4320 min Summer	2.349	0.0	684.9	2172
5760 min Summer	1.888	0.0	734.1	2904
7200 min Summer	1.594	0.0	774.8	3592
8640 min Summer	1.389	0.0	810.2	4352
10080 min Summer	1.237	0.0	841.6	5016
15 min Winter	116.002	0.0	131.4	18
30 min Winter	79.998	0.0	181.3	29
60 min Winter	52.662	0.0	238.8	48
120 min Winter	33.322	0.0	302.3	84
180 min Winter	24.998	0.0	340.1	114
240 min Winter	20.313	0.0	368.5	140
360 min Winter	15.144	0.0	412.1	190
480 min Winter	12.271	0.0	445.2	250

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Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
600 min Winter	0.207	0.207	0.0	32.9	32.9	21.7	O K
720 min Winter	0.191	0.191	0.0	28.8	28.8	19.9	O K
960 min Winter	0.168	0.168	0.0	23.3	23.3	17.5	O K
1440 min Winter	0.141	0.141	0.0	17.3	17.3	14.7	O K
2160 min Winter	0.119	0.119	0.0	12.8	12.8	12.4	O K
2880 min Winter	0.106	0.106	0.0	10.2	10.2	11.0	O K
4320 min Winter	0.090	0.090	0.0	7.5	7.5	9.4	O K
5760 min Winter	0.080	0.080	0.0	6.0	6.0	8.3	O K
7200 min Winter	0.073	0.073	0.0	5.1	5.1	7.6	O K
8640 min Winter	0.068	0.068	0.0	4.5	4.5	7.1	O K
10080 min Winter	0.064	0.064	0.0	4.0	4.0	6.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
600 min Winter	10.413	0.0	472.3	312
720 min Winter	9.099	0.0	495.2	370
960 min Winter	7.345	0.0	533.0	492
1440 min Winter	5.419	0.0	589.8	734
2160 min Winter	3.986	0.0	650.9	1092
2880 min Winter	3.200	0.0	696.8	1456
4320 min Winter	2.349	0.0	767.1	2168
5760 min Winter	1.888	0.0	822.2	2928
7200 min Winter	1.594	0.0	867.8	3624
8640 min Winter	1.389	0.0	907.4	4392
10080 min Winter	1.237	0.0	942.6	5096

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.300	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 0.540

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.270	4	8	0.270

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Model Details

Storage is Online Cover Level (m) 2.200

Cellular Storage Structure

Invert Level (m)	0.000
Infiltration Coefficient Base (m/hr)	0.00000
Infiltration Coefficient Side (m/hr)	0.00000
Safety Factor	2.0
Porosity	0.95

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	110.0	195.0	1.201	0.0	239.7
1.200	110.0	239.7			

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0303-5430-1200-5430
Design Head (m)	1.200
Design Flow (l/s)	54.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	303
Invert Level (m)	0.000
Minimum Outlet Pipe Diameter (mm)	375
Suggested Manhole Diameter (mm)	2100

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	54.3
Flush-Flo™	0.478	54.3
Kick-Flo®	0.908	47.5
Mean Flow over Head Range	-	44.6

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	9.2	1.200	54.3	3.000	84.6	7.000	127.8
0.200	31.1	1.400	58.5	3.500	91.2	7.500	132.2
0.300	52.2	1.600	62.4	4.000	97.3	8.000	136.5
0.400	53.9	1.800	66.0	4.500	103.0	8.500	140.6
0.500	54.3	2.000	69.5	5.000	108.5	9.000	144.6
0.600	53.7	2.200	72.8	5.500	113.6	9.500	148.4
0.800	51.0	2.400	75.9	6.000	118.6		
1.000	49.7	2.600	78.9	6.500	123.3		

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