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**FLOOD RISK AND DRAINAGE
ASSESSMENT FOR A
PROPOSED RESIDENTIAL
DEVELOPMENT AT
BARUGH GREEN ROAD,
BARNLEY,
SOUTH YORKSHIRE**

**PROJECT NO.
JAG/AD/JF/43733-Rp001**

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RESIDENTIAL DEVELOPMENT AT BARUGH GREEN ROAD, BARNSELY,
SOUTH YORKSHIRE**

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Signed:

Date: 27th March 2020

Approved by: J Gibson, MEng (Hons), CEng, CWEM MCIWEM
Civil Engineering Director



Signed:

Date: 27th March 2020

Issue	Revision	Revised by	Approved by	Revised Date
A	Amendments to Section 7.4	PLS	JAG	17.04.20
B	Amendment to discharge levels	CD	JAG	08.06.20
C	Updated Site Layout	PLS	CD	11.08.20

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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1.0 **INTRODUCTION**

1.1 **Background**

- 1.1.1 Alan Wood & Partners were commissioned by Countryside Properties to prepare a Flood Risk and Drainage Assessment for a proposed residential development on land at to the south of Barugh Green Road, Barnsley, South Yorkshire in support of an application for full planning consent.
- 1.1.2 A Flood Risk and Drainage Assessment (FRDA) for the proposed development is required to assess the development's risk from flooding and the suitability of the site in terms of drainage.

1.2 **Layout of Report**

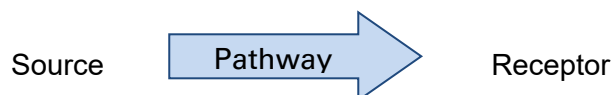
- 1.2.1 Section 1 provides an introduction to the FRDA, explains the layout of this FRDA and provides an introduction to flood risk and the latest guidance on development and flood risk in England.
- 1.2.2 Section 2 provides an introduction to the site. The site description is based upon a desktop study and information provided by the developer. In order to obtain further information on flood risk, consultation was undertaken with the Environment Agency.
- 1.2.3 Section 3 of this report details the information gathered through the consultation.
- 1.2.4 Section 4 of this report details the development proposals and considers the development 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, March 2012) is the current planning policy on flood risk in England, and an introduction to NPPF is provided below.
- 1.2.5 Section 5 considers the foul water drainage arrangements for the proposed development.

- 1.2.6 Section 6 considers the surface water drainage arrangements for the proposed development.
- 1.2.7 Section 7 of this report considers the flood risk to 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 utilises all the information gathered in the preparation of the report.
- 1.2.8 Section 8 of this report provides details of any recommendations for further work to mitigate against possible flooding.
- 1.2.9 Section 9 of this report provides a summary of the report.

1.3 Flood Risk

- 1.3.1 Flood risk takes account of both the probability and the consequences of flooding.
- 1.3.2 Flood risk = probability of flooding x consequences of flooding
- 1.3.3 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 depends on how vulnerable a receptor is to flooding.

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



- 1.3.4 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 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

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

1.4.1.2 A summary of the requirements of NPPF is provided below.

1.4.2 Sources of Flooding

1.4.2.1 NPPF requires an assessment to 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.

Table1: 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 taken into account 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 Artificial 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

- 1.4.3.1 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 to flow or be stored in times flood. Land which would flood with an annual probability of 1 in 20 (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

1.4.4.1 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	- Essential utility infrastructure including electricity generating power stations and grid and primary substations - Wind turbines
Highly Vulnerable	- Police stations, ambulance stations, fire stations, command centres and telecommunications installations required to be operational during flooding. - Emergency dispersal points. - Basement dwellings. - Caravans, mobile homes and park homes intended for permanent residential use.
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. - Sites used for holiday or short-let caravans and camping.
Less Vulnerable	- Building used for shops, financial, professional and other services, restaurants and cafes, hot foot takeaways, offices, general industry, storage and distribution, non-residential institutions not included in "more vulnerable" and assembly and leisure. - Land and buildings used for agriculture and forestry.
Water Compatible	- Docks, marinas and wharves. - Water based recreation (excluding sleeping accommodation). - Lifeguard and coastguard stations. - Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms.

1.4.4.2 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 risk vulnerability and 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

1.4.5.1 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 Assessment (SFRA).

1.4.5.2 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.

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

1.4.6 Climate Change

- 1.4.6.1 This 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

- 1.4.7.1 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.
- 1.4.7.2 The surface water drainage has been designed in accordance with current CIRIA C753 SuDS Manual guidelines.

2.0 EXISTING SITE DESCRIPTION

2.1 Location

- 2.1.1 The development site occupies land to the south of Barugh Green Road on the north western outskirts of Barnsley, South Yorkshire.
- 2.1.2 The Ordnance Survey grid reference for the centre of the site development is approximately 431820, 407820.
- 2.1.3 An aerial photograph and layout plan are included in Figures 1 and 2 below, which identify the location and layout of the development.

Figure 1: Aerial Photograph





Figure 2: Site Layout Plan

2.2 Site Description

- 2.2.1 The area of the development currently comprises agricultural land, extending to approximately 4.77 hectares.

2.3 Surrounding Features

- 2.3.1 Barugh Green Road bounds the site to the north, beyond which lie a number of light industrial and retail units.
- 2.3.2 To the east of the development site lies an existing residential development, with Claycliffe Avenue adjoining the site in the north.
- 2.3.3 To the south of the site is agricultural land extending southwards to the M1 Motorway.
- 2.3.4 To the west are agricultural fields extending to a large residential area of Barugh Green.
- 2.3.5 An existing horticultural nursery adjoins the north western corner of the site.

2.3.6 There is an open watercourse (Cawthorne Dike) situated approximately 1km to the north west of the development site, which enters the River Dearne 1km to the north of the site.

2.3.7 There are open ponds located approximately 3km to the east and approximately 1km to the north east of the site.

2.4 Topography

2.4.1 A topographic survey of the development site has been undertaken, which shows that the existing ground levels vary from approximately 78.87m to approximately 87.63m OD(N) across the site.

2.4.2 Existing carriageway levels on Barugh Green Road fronting the site are shown to vary from approximately 78.85m to approximately 81.53m OD(N).

2.4.3 Existing carriageway levels on Claycliffe Avenue adjoining the site are shown to vary from approximately 79.10m to approximately 80.51m OD(N).

2.4.4 A copy of the topographic survey drawing is included in Appendix A.

2.5 Ground Conditions

2.5.1 Ground investigation works have been carried out in relation to the proposed development.

2.5.2 The site lies on the footprint of a former opencast mine which has been backfilled to a significant depth.

2.5.3 An Exploratory Site Investigation was undertaken by Lithos Consulting (Job No 3407) whereby 7 trial pits and 3 trial trenches were excavated. A high water table level was observed in these excavations indicating possible perched water table not conducive to a soakaway solution.

2.5.4 A desktop study of the British Geological Survey map reveals the local geology comprises bedrock of Pennine Middle Coal Measures Formation – Mudstone, Siltstone and Sandstone with no superficial deposits.

2.5.5 A study of the groundwater maps show that the site overlays a Secondary A Aquifer, with the Groundwater Vulnerability classified as 'Medium'.

2.5.6 Local borehole records in the vicinity of the development show there is a shallow depth of sandy clay directly overlaying shale/mudstone.

2.5.7 On this basis, the local ground conditions are therefore considered to be unsuitable for soakaways/infiltration methods to be used as a means for disposal of the surface water run-off from the development.

3.0 CONSULTATION

- 3.1 The developer has been consulted in order to obtain relevant information pertaining to the proposed development.
- 3.2 Barnsley Metropolitan Borough Council have been consulted in respect of the disposal of surface water run-off from the development and the use of SuDS techniques, details of which are incorporated within this report.
- 3.4 Yorkshire Water (YWS) have been consulted in respect of the disposal of the disposal of foul wastewater from the development. Their pre-planning response is appended to this report.
- 3.5 The Environment Agency have been consulted in respect of flood mapping, details of which are incorporated within this report.

4.0 **PROPOSED DEVELOPMENT**

4.1 **The Development**

4.1.1 The proposed development comprises the construction of a new residential development to include the following:-

- The construction of up to 140 nr new residential dwellings
- Residential gardens
- The construction of a new site access road with enlarged access onto Barugh Green Road
- Car parking areas
- Areas of public open space
- New service supplies

4.1.2 A copy of the indicative site layout drawing of the proposed development is included in Appendix B.

4.2 **Flood Risk**

4.2.1 In terms of flood risk vulnerability, the construction of residential development is classed as 'More Vulnerable' development in terms of flood risk vulnerability (Table 3).

4.2.2 In terms of flood zone compatibility, 'More Vulnerable' development is considered to be 'appropriate' in Flood Zone 1 (Table 4).

5.0 FOUL WATER DRAINAGE

- 5.1 It is proposed that foul water domestic waste from the development will be discharged to the public sewer network, for which formal approval will be required from Yorkshire Water Services.
- 5.2 Yorkshire Water have been consulted in respect of this proposal. They have advised that foul waste water run-off from the development should discharge to the existing 600mm diameter public combined sewer recorded in Barugh Green Road at a point to the north of the site
- 5.3 A copy of their Pre-Planning Enquiry response is included in Appendix C.
- 5.4 Based upon a development of approximately 140 dwellings and with an average flow rate of 4000 litres per dwelling per day, in accordance with Sewers for Adoption 7th Edition (Clause B5.1), the peak foul water flow from the development site would be approximately 6.5 litres per second.
- 5.5 A separate foul sewer network will be designed and built to meet Building Regulations (private) and Sewers for Adoption (public) standards.
- 5.6 At this stage of the development, it is assumed that a gravity connection to the public sewer can be achieved.
- 5.7 It is envisaged that foul sewer pipe sizes will range from 100mm to 150mm in diameter. The preliminary design works which have been undertaken show that the pipe gradients will range from 1/10 to 1/100 to meet the required standards.
- 5.8 An indicative foul water drainage arrangement is shown on the Drainage Layout drawing included in Appendix D.

6.0 SURFACE WATER DRAINAGE

6.1 General

- 6.1.1 The surface water drainage has been designed in accordance with current CIRIA C753 SuDS Manual guidelines.

6.2 Existing Site

- 6.2.1 From the aerial photograph included in Figure 3 below, it can be seen that the development area currently comprises an area of agricultural land.



Figure 3: Aerial photograph

6.3 Run-off Destination

- 6.3.1 Requirement H3 of the Building Regulations establishes a preferred hierarchy for disposal of surface water disposal. Consideration should firstly be given to soakaway, infiltration, watercourse, surface water sewer and combined sewer in that priority order.

- 6.3.2 Ground investigations have shown that the underlying strata is not suitable for soakaways/infiltration trenches to be used due to the extensive depth of made and perched ground over the site.
- 6.3.3 The second preferred option would be to discharge the surface water run-off from the development to a watercourse.
- 6.3.4 Investigations have revealed that there is an open watercourse located along the northern boundary of the development into which the surface water run-off from the development could be discharged.
- 6.3.5 It is therefore proposed that the surface water run-off from the new development is discharged into this watercourse. Specifically there this a 600mm diameter pipe leading from a headwall at the lowest point along this ditch under Barugh Green rd. We will discharge to this headwall at an invert level of 76.43m.

6.4 Flood Risk

- 6.4.1 For new developments the current design criteria required for the surface water drainage will need to be based upon the critical 1 in 100 year storm event, with an additional allowance to account for climate change resulting from global warming. There should be no above ground flooding for the 1 in 30 year return period and with no flooding to the development or off-site flooding affecting other parties from the critical 1 in 100 year storm event, with an additional allowance to account for climate change.

6.5 Climate Change

- 6.5.1 An additional allowance of 30% to account for climate change has been included in the design of the surface water drainage network in accordance with Barnsley Metropolitan Borough Council SuDS guidelines.

6.6 Urban Creep

- 6.6.1 The project involves the construction of a residential development and consequently, it may be necessary to allow an additional 10% to the calculated impermeable areas for urban creep within the design. This was not allowed for in these drainage analysis calculations.

6.7 Peak Flow Control

- 6.7.1 We have calculated the impermeable area of the proposed development to be approximately 3.13 hectares based upon the appended layout drawing.
- 6.7.2 The remaining site area of approximately 1.57 hectares will remain permeable in the form of landscaping which will not require any positive drainage and will consequently discharge at greenfield run-off.
- 6.7.3 The uncontrolled surface water run-off from the new development could be approximately 424 litres per second, based on BS EN 752 calculations, using a rainfall intensity of 50mm/hour.
- 6.7.4 However, new developments are not permitted to discharge at an unrestricted rate and are normally limited to a “greenfield” discharge rate, which in this region has been determined at 20.9 litres per second, based upon the ICP SUDS calculated run-off rate. The Greenfield Runoff Rate Calculation is shown in Appendix H.
- 6.7.5 The impermeable area for design purposes will be 3.13 hectares and the permissible discharge rate for design purposes will remain at the greenfield runoff rate of 20.9 litres per second.
- 6.7.6 Preliminary design work shows that the surface water run-off from the site will be able to discharge by means of a gravity outfall.
- 6.7.7 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.
- 6.7.8 The design will need to be based upon the critical 100 year storm event with the required additional allowance of 30% to account for climate change.
- 6.7.9 Based upon the above design criteria storage, a hydraulic model study has been undertaken in order to assess the pipe sizes and gradients and the likely storage volumes required. The results of this analysis are shown in Appendix G.
- 6.7.10 A summary of the storage volumes required is set out in Table 5 below

Table 5: Volumes of surface water storage required

Storm Event	30 Year Storm	100 Year Storm +30%
Storage Volume Required	909 m ³	1667 m ³
Additional Storage Volume Required	Nil	758 m ³

- 6.7.11 The calculated storage volumes set out above will be subject to detailed design and approval.
- 6.7.12 The drainage system must contain the storage volume for the 1 year storm event below ground within the drainage system with no surcharging of manholes in order to prevent flooding.
- 6.7.13 The drainage system must also contain the storage volume for the 30 year storm event below ground within the drainage system.
- 6.7.14 The additional storage required to accommodate the 100-year storm event plus 30% climate change can be stored above ground provided it is retained on site such that it cannot flood other developments beyond the site.
- 6.7.15 Alternatively, it can be stored below ground within an adoptable storage tank which would form part of the Section 104 Agreement with the Water Authority.
- 6.7.16 A drainage layout drawing detailing the proposed drainage strategy is included in Appendix D, showing pipe sizes varying from 150mm to 600mm in diameter.

6.8 Volume Control

- 6.8.1 SuDS guidelines advise that the run-off volume from the development site for the 1 in 100 year 6-hour rainfall event should not exceed the greenfield run-off volume for the same event.
- 6.8.2 The discharge rate has been based upon the greenfield run-off rate and consequently this requirement has been satisfied.

6.9 Pollution Control

- 6.9.1 It is a requirement to ensure that the quality of any receiving body is not adversely affected by the development.
- 6.9.2 Investigations have revealed that the development site Overlays a Secondary A Aquifer, with the Groundwater Vulnerability classed as 'Medium'.
- 6.9.3 In order to minimise the risk of pollution to the watercourse, clean roof water drainage should discharge directly into the sealed drainage network (i.e. not via gullies) and will then be stored below ground prior to discharge to the watercourse.
- 6.9.4 Silt traps should be provided on the outlets from any gullies or drainage channels, which should be maintained in accordance with Section 6.13 of this report.
- 6.9.5 On this basis, it is considered that the risk of pollution to the final receiving sewer/watercourse has been adequately addressed.

6.10 Water Quality

- 6.10.1 The water quality from the development via the surface water drainage system has been assessed in accordance with the simple index approach set out in Chapter 26 of the CIRIA SuDS Manual C753.
- 6.10.2 The output shows that the water quality from the roof areas and road areas will be of a suitable quality.
- 6.10.3 Copies of the matrix outputs from the assessment are included in Appendix E.

6.11 Designing for Exceedance

- 6.11.1 Overland flood risk from exceedance flows and from off-site sources will be mitigated to a large extent by the creation of the new surface water sewerage system as described above. Where possible proposed ground levels will be set to channel flows away from the proposed building. Furthermore, the ground floor construction level for the building will be raised by a minimum of 150mm above the finished ground level in order to provide additional clearance above any likely flooding.
- 6.11.2 The existing overland flow routes should generally be maintained within the final layout of the development site without increasing the flood risk to off-site parties.
- 6.11.3 Any existing flood risk may reduce by the creation of a formal surface water drainage system but cannot be entirely removed.
- 6.11.4 Drawings showing the existing and proposed overland surface water flood routing are included in Appendix F.

6.12 Highways Drainage

- 6.12.1 Highways drainage from the proposed adoptable roads on site will be collected by trapped gullies prior to discharge into the below ground drainage network. The highway drainage will be offered for adoption to the Local Authority, via a formal Section 38 Agreement.

6.13 Operation and Maintenance

- 6.13.1 All pipework within the new drainage system is designed with self-cleansing gradients and consequently there should be little or no maintenance required.
- 6.13.2 All road gullies or drainage channel systems serving areas of hardstanding will need to be regularly inspected to ensure the system remains operable see Table 6 below.
- 6.13.3 All inspection chambers should be regularly inspected to ensure the system is free-flowing. See operation and maintenance requirements in Table 6 below.

Table 6: Operation and Maintenance Requirements for Silt Traps/Trapped Gullies (Based on CIRIA C753 Table 14.2)

Maintenance schedule	Required action	Typical frequency
Routine maintenance	Remove litter and debris and inspect for sediment, oil and grease accumulation	6 monthly
	Change the filter media	As recommended by manufacturer
	Remove sediment, oil, grease and floatables	As necessary – indicated by system inspections or immediately following significant spill
Remedial actions	Replace malfunctioning parts or structures	As required
Monitoring	Inspect for evidence of poor operation	6 monthly
	Inspect filter media and establish appropriate replacement frequencies	6 monthly
	Inspect sediment accumulation rates and establish appropriate removal frequencies	Monthly during first half year of operation, then every 6 months
*During the first year of operation, inspections should be carried out at least monthly (and after significant storm events) to ensure that the system is functioning as designed and that no damage is evident.		

6.13.4 Any Hydro-Brake® vortex flow controls should be regularly inspected and maintained to ensure they remain operational. See Table 7 below.

Table 7: Operation and Maintenance Requirements for Hydro-Brake® Vortex Flow Control Device (Based on Manufacturer's recommendations)

Maintenance schedule	Required action	Typical frequency
Routine maintenance	Remove litter and debris and inspect for sediment, oil and grease accumulation	6 monthly
	Remove sediment, oil, grease and floatables	As necessary – indicated by system inspections or immediately following significant spill
Remedial actions	Replace malfunctioning parts or structures	As required
Monitoring	Inspect for evidence of poor operation	Monthly during the first three months, then every 6 months
	Inspect sediment accumulation rates and establish appropriate removal frequencies	Monthly during first half year of operation, then every 6 months

6.13.5 Operation and maintenance requirements for the storage tank are set out in Table 8 below.

**Table 8: Operation and Maintenance Requirements for Storage Tanks
 (Based on CIRIA C753 Table 21.3)**

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months, then annually
	Remove debris from the catchment surface (where it may cause risks to performance)	Monthly
	Remove sediment from pre-treatment structures.	Annually, or as required.
Remedial actions	Repair/rehabilitate inlets, outlet, overflows and vents	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually*
	Survey inside of tank for sediment build-up and remove if necessary	Every 5 years or as required*
*During the first year of operation, inspections should be carried out at least monthly (and after significant storm events) to ensure that the system is functioning as designed and that no damage is evident.		

6.13.6 The main sewer network will be offered to YWS for formal adoption under a Section 104 Agreement and therefore YWS will be responsible for the operation, management and maintenance of the network in line with standard requirements and obligations.

6.13.7 The highway drainage will form part of the Section 38 Agreement with the Highway Authority who will be responsible for future maintenance works.

6.13.8 Operation and maintenance requirements of the drainage components, as listed above, should be undertaken in accordance with Chapter 32 of the CIRIA SuDS Manual and any relevant manufacturer's recommendations. See also BS 8582:2013 Code of Practice for Surface Water Management for Development Sites Section 11 and Susdrain Fact Sheet on SuDS Maintenance and Adoption Options (England) dated September 2015.

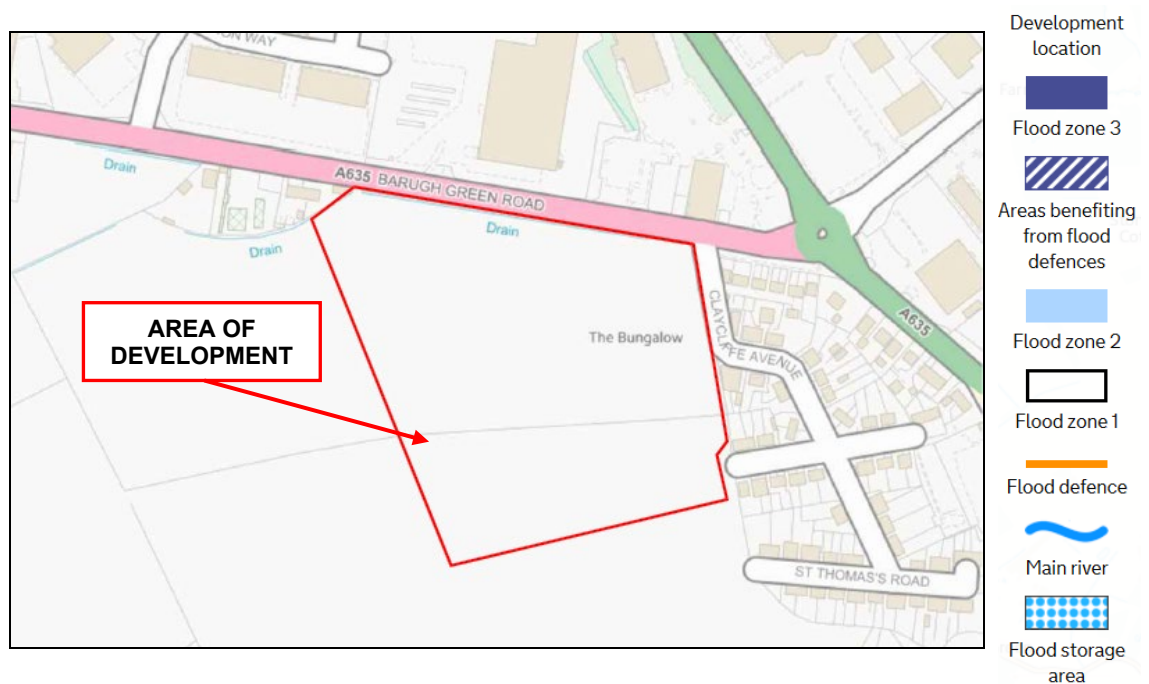
- 6.13.9 The personnel undertaking the maintenance should have appropriate experience of SuDS and drainage maintenance and should be capable of keeping sufficiently detailed records of any inspections. An example of a checklist for SuDS maintenance can be found within Appendix B of the CIRIA C753 SuDS Manual v2. If personnel do not have appropriate experience, then specific inspection visits may be necessary. During the first year of operations of SuDS, inspections should usually be carried out at monthly intervals (and after significant storm events).
- 6.13.10 The domestic drainage will remain the responsibility of the individual householders.

7.0 FLOOD RISK ASSESMENT

7.1 Flood Zone

- 7.1.1 A copy of the Environment Agency Flood Map for Planning is included in Figure 4 below, which identifies the development site to be located within an area designated as Flood Zone 1, (low probability of flooding), with a less than 1 in 1000 annual probability of flooding in any year.

Figure 4: Environment Agency flood map for planning dated March 2020



7.2 Fluvial Flooding

- 7.2.1 The site is located approximately 1km to the south of the River Dearne, which is the main potential source of flooding in the region.
- 7.2.2 The existing ground levels in proximity to the River Dearne are in the region of 52m OD(N), which is considerably lower than the ground levels over the area of the development site.
- 7.2.3 The risk to the development from fluvial flooding is therefore considered to be low and acceptable.

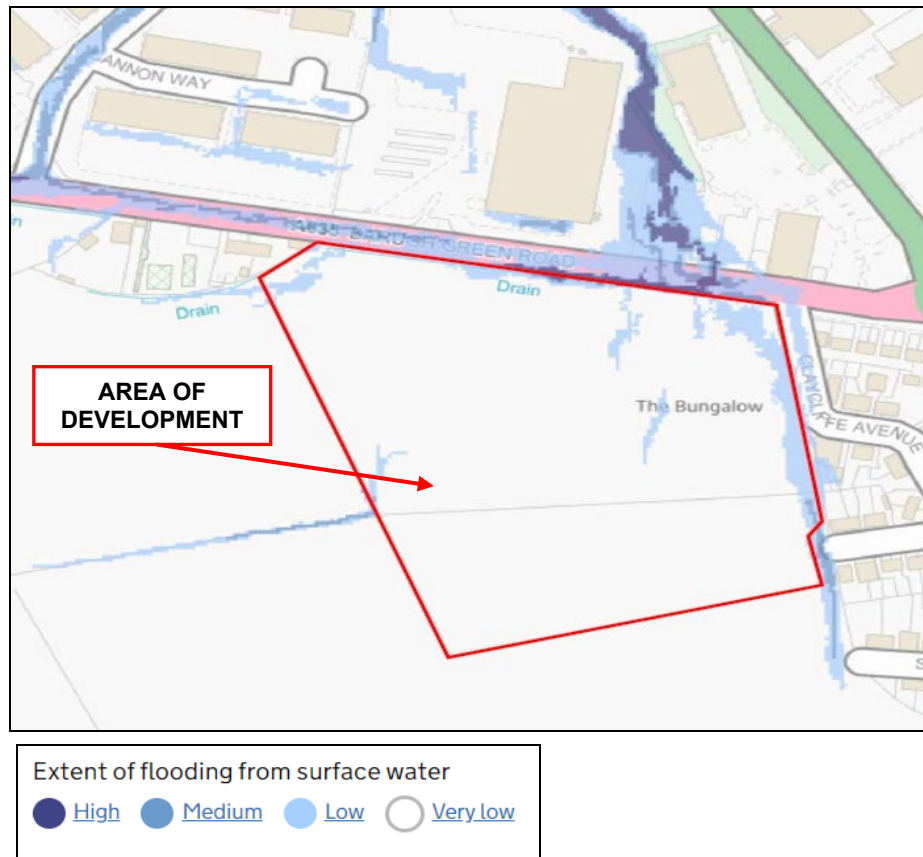
7.3 Flooding from Open Drainage Ditches

- 7.3.1 There is an open drainage ditch located along the northern boundary of the site which drains the surface water run-off from the agricultural field.
- 7.3.2 During periods of extreme rainfall, there is the potential risk that the ditch may overtop causing localised flooding.
- 7.3.3 However, as the site levels rise towards the south across the site, any such flooding would remain localised to the ditch.
- 7.3.4 This is reflected on the surface water flooding maps included in Section 7.4 below.
- 7.3.5 The entrance road will pass over this open ditch however the culvert will be sized appropriately to not increase the flood risk in this area.
- 7.3.6 We therefore consider the risk of flooding from this source to be low and acceptable.

7.4 Surface Water Flooding

- 7.4.1 A copy of the Environment Agency map showing the extent of flooding from surface water is included in Figure 5 below.

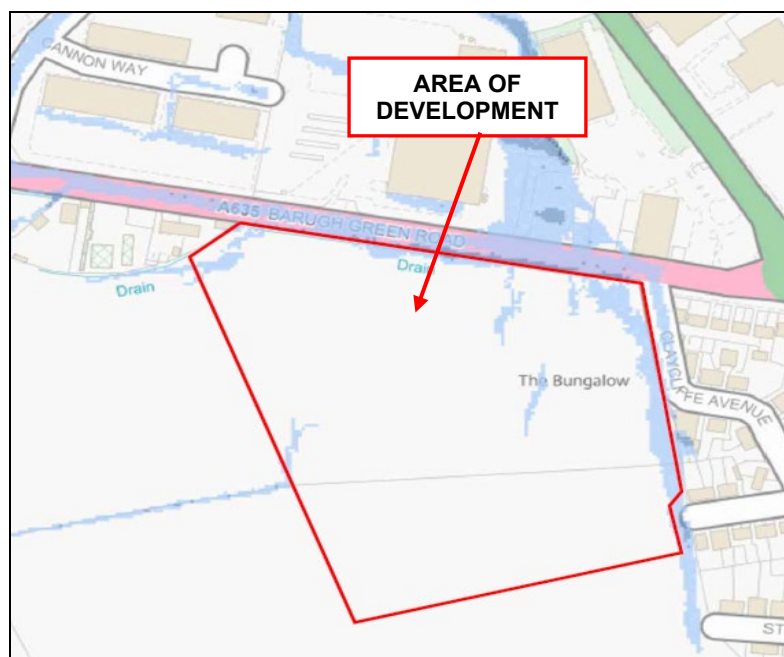
Figure 5: Environment Agency map dated March 2020 showing the extent of flooding from surface water



7.4.2 The map shows that areas along the northern and eastern boundaries of the site, as well as isolated pockets within the site, are prone to surface water flooding.

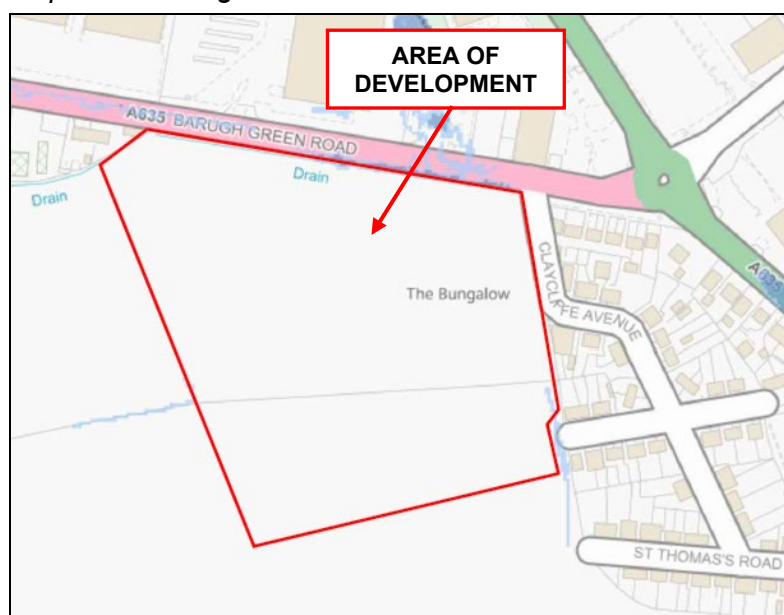
7.4.3 Copies of the maps produced by the Environment Agency showing the likely depth of surface water flooding are included in Figures 6, 7 and 8 below.

Figure 6: Environment Agency map dated March 2020 showing the likely depth of flooding from surface water – low risk



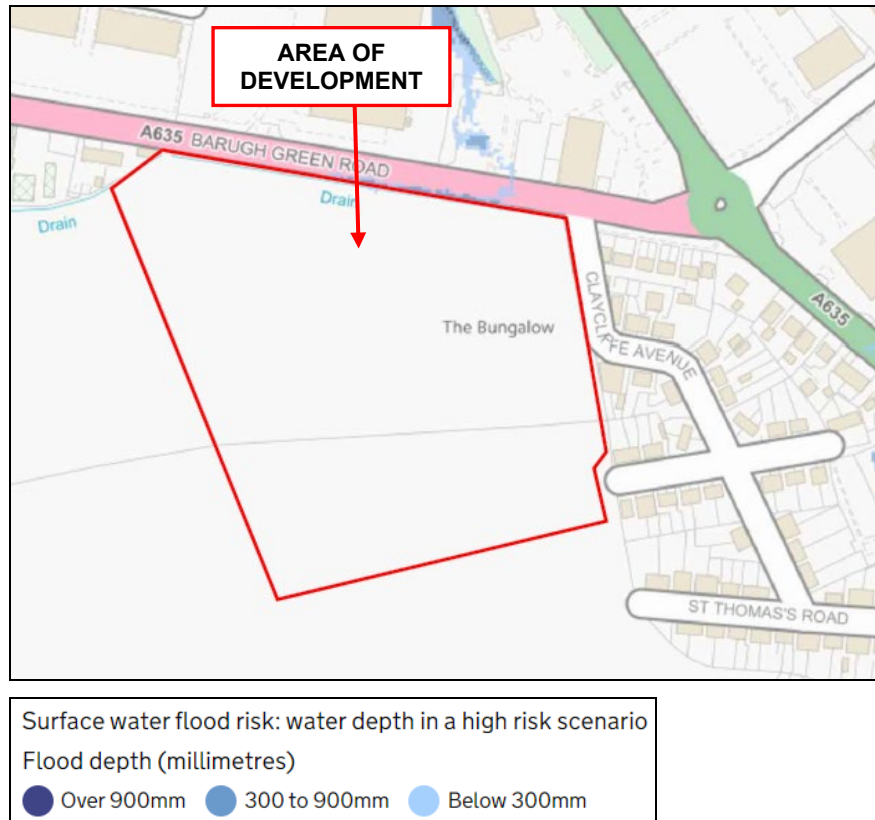
Surface water flood risk: water depth in a low risk scenario
 Flood depth (millimetres)
 ● Over 900mm ● 300 to 900mm ● Below 300mm

Figure 7: Environment Agency map dated March 2020 showing the likely depth of flooding from surface water – medium risk



Surface water flood risk: water depth in a medium risk scenario
 Flood depth (millimetres)
 ● Over 900mm ● 300 to 900mm ● Below 300mm

Figure 8: Environment Agency map dated March 2020 showing the likely depth of flooding from surface water – high risk



- 7.4.4 For a “low risk” scenario, the maps show that the likely depth of surface water flooding in the affected areas would be below 300mm.
- 7.4.5 For a “medium risk” scenario, the area shown to be affected is much reduced, with a small area in the south east corner, a small isolated pocket in the northern boundary and an isolated pocket on the western boundary shown to be prone to flooding to a depth below 300mm.
- 7.4.6 For a “high risk” scenario, the development site is not shown to be affected by surfaced water flooding.
- 7.4.7 Based on the maps, it is suggested that the eastern and northern boundaries of the site will experience surface water flooding in a low risk scenario. Given that the flood maps do not take account of existing road drainage, it is considered likely that the surface water flood risk to the north of the site is significantly reduced from that which is shown in Figure 6.

- 7.4.8 In the event of exceedance, it is predicted that water will flood out of gullies and follow a flow path to the northeast corner of the site. There will be no changes made to the boundary levels as part of the development, and as such the existing flow paths will be maintained.
- 7.4.9 Overland flooding will be accommodated for by raising finished floor levels and allowing water to collect at lower points within the site (designed as such).
- 7.4.10 As a result of the proposed development, the overall risk of surface water flooding to the site area and residential properties on the eastern boundary will be reduced. Surface water will be discharged from the site at a restricted rate and water storage will be provided within the site. The greenfield runoff rate for the existing undeveloped area is approximately 50.5 l/s, based on the 1:100 year flood event, which is greater than the proposed discharge rates of the development.
- 7.4.7 The risk of flooding to the development from this potential flood source is therefore considered to be low and acceptable.

7.5 Flood Risk from Existing Water Mains

- 7.5.1 There are likely be existing water mains present within the adjacent highways and serving the adjacent development sites.
- 7.5.2 There are no known issues with regard to the condition of any such water mains.
- 7.5.3 The risk of flooding to the development from this potential flood source is therefore considered to be low and acceptable.

7.6 Flood Risk from Existing Drainage Services

- 7.6.1 There are likely to be existing drainage services present within the adjacent highways and serving the adjacent development sites.
- 7.6.2 There are no known issues with regard to the condition or the capacity of any such drainage services.

- 7.6.3 The risk of flooding to the development from this potential flood source is therefore considered to be low and acceptable.

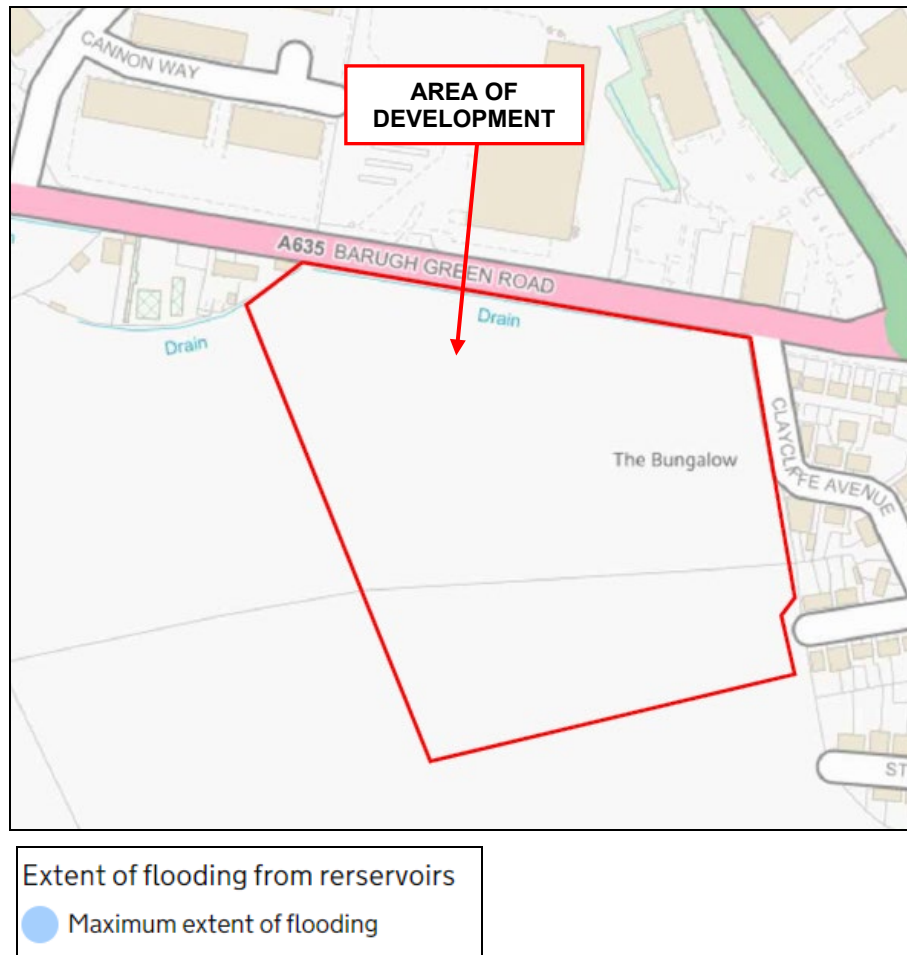
7.7 Groundwater Flooding

- 7.7.1 Groundwater flooding can occur when the sub-surface water levels are high and emerges above ground level.
- 7.7.2 There are no proposals to create any basements within the development.
- 7.7.3 The proposed development will not involve deep excavation works and consequently the risk to the development from this potential flood source is considered to be low and acceptable.

7.8 Flood Risk from Reservoirs, Canals and Other Artificial Sources

- 7.8.1 A study of the local area shows that there are no artificial water features in the local vicinity of the development, which could pose any risk of flooding.
- 7.8.2 A copy of the map produced by the Environment Agency showing the extent of flooding from reservoirs is included in Figure 9 below.

Figure 9: Environment Agency map dated March 2020 showing the extent of flooding from reservoirs



- 7.8.3 The map shows that the development site is not considered to be at risk from reservoir flooding.
- 7.8.4 The risk of flooding to the development from any such potential flood source is considered to be low and acceptable.

8.0 FLOOD MITIGATION MEASURES

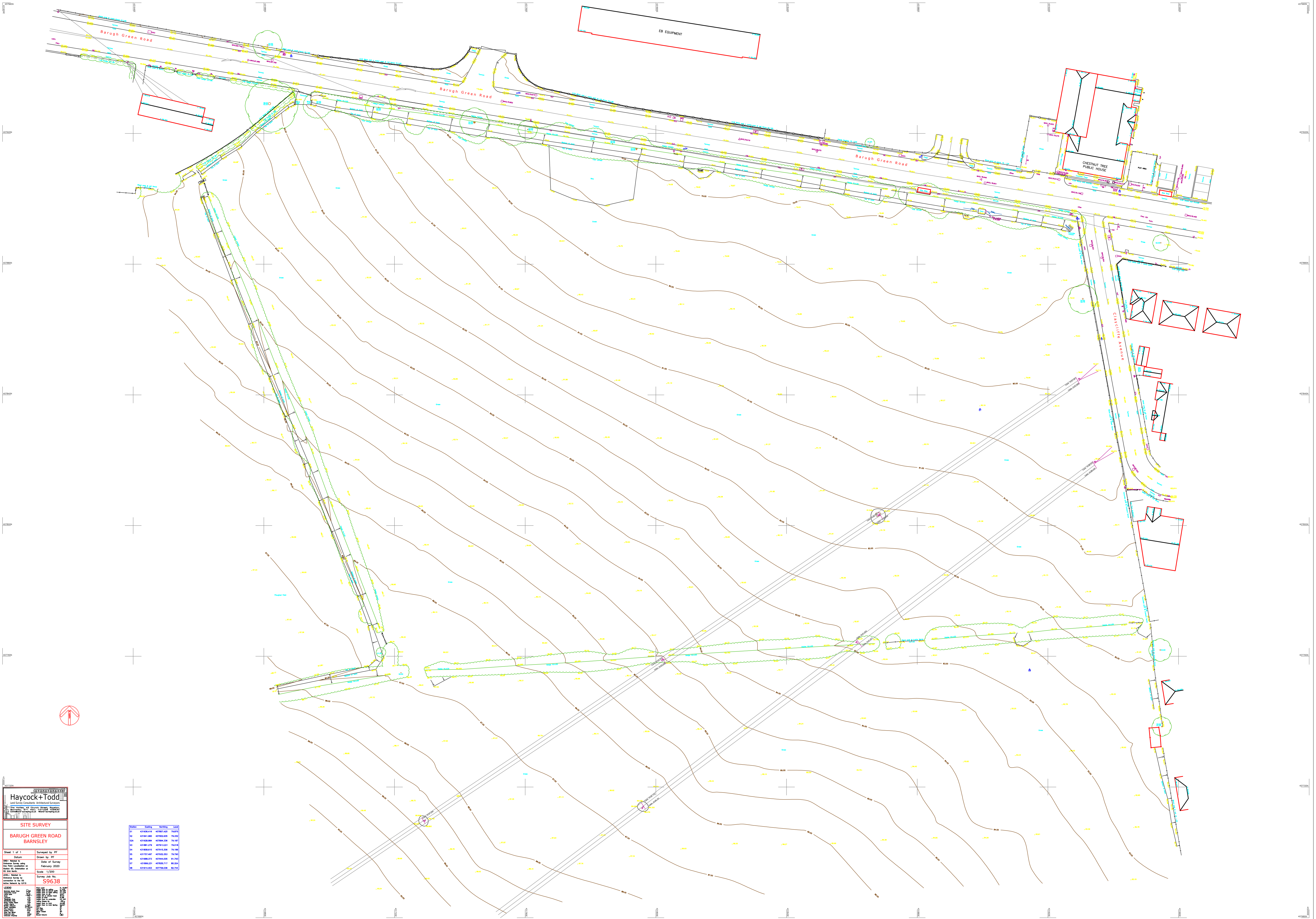
- 8.1 With the area of the new development site lying within Flood Zone 1 (low probability of flooding), there is no requirement to elevate the floor level of the buildings above traditional construction methods (normally 150mm above adjacent ground level).
- 8.2 As the development is not at risk from fluvial flooding, it is considered that there will be no requirement to incorporate any flood resilient construction measures within the design of the development.
- 8.3 Areas of the site are shown to be at minor risk from surface water flooding.
- 8.4 The finished ground levels over the full area of the development will be re-profiled to suit the new construction arrangement and any local depressions within the area of the development will be infilled. Developing the design to suit the required gradients and the introduction of the new drainage network should adequately address any localised risk of overland surface water flooding.
- 8.5 Finished external ground levels should also be designed to direct waters away from the buildings to ensure there is no localised risk of flooding to the buildings during an extreme rainfall event.
- 8.6 The surface water drainage should be designed in accordance with Section 6 of this report in order to ensure the development does not pose a risk of flooding to the new development or to other parties.
- 8.7 All approach roads to the development are shown to lie within Flood Zone 1 (low probability of flooding) and consequently safe access to and egress from the development should still be achievable should a flood situation arise.
- 8.8 The entrance road culvert over the open ditch will be sized sufficiently large enough to not become a restriction point for flooding in this area.
- 8.9 There should therefore be no requirements for evacuation of building occupants resulting from the development during an extreme flood event.
- 8.10 It is not considered that any other specific mitigation works will be required in respect of flood risk to the development.

9.0 SUMMARY

- 9.1 This report has been prepared to assess the flood risk and drainage implications for a proposed residential development to the south of Barugh Green Road, Barnsley, South Yorkshire.
- 9.2 The site falls in Flood Zone 1 (low probability of flooding) on the Environment Agency maps and the proposals are considered to be 'More Vulnerable' in terms of flood vulnerability (Table 3) which is compatible in Flood Zone 1 (Table 4).
- 9.3 No specific flood risk to the development has been identified in the preparation of this report, other than minor flood risk from overland surface water which will be addressed at the detailed design stage of the project.
- 9.4 Foul water will be discharged to the existing 600mm diameter public combined sewer recorded in Barugh Green Road at a point to the north of the site via a gravity outfall at an approximate rate of 6.5 litres per second. The sewers will be designed and constructed to meet the requirements of the Building Regulations.
- 9.5 Surface water will be discharged to the watercourse on the northern boundary of the site at the agreed discharge rate of 20.9 litres per second and any excess flows balanced on site. The sewers will be designed and constructed to meet the requirements of the Local Water Authority for the adoptable drainage and the requirement of the Building Regulations for the domestic drainage.
- 9.6 The report's supporting calculations and sketches provide a robust case for justifying the means of foul and surface water drainage and that the site can be suitably, safely and sustainably drained.
- 9.7 Overall, this report demonstrates that the foul and surface water drainage systems for the new development can be designed and constructed to meet local and national planning and drainage policies. Suitably worded Conditions can be applied to the grant of planning permission to control the delivery of the development in the usual manner.

APPENDIX A

Topographic Survey Drawing



Haycock+Todd
Land Survey Consultants, Architectural Surveyors
100, The Quadrant, 100, Queens Road, Brighton, BN1 3AB, England
Tel: 01273 593939 Fax: 01273 593940
Email: info@haycock-todd.co.uk Website: www.haycock-todd.co.uk

SITE SURVEY
BARUGH GREEN ROAD
BARNSELEY

Sheet 1 of 1 Surveyed by: RT
Client: Barnsley Council
Date of Survey: February 2005
Scale: 1:200
Survey: 200 10
S9638

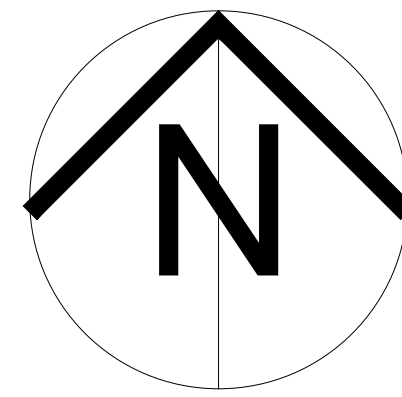
EDR:
Surveyed by: RT
Checked by: RT
Drawn by: RT
Reviewed by: RT
Date: 2005/02/25
Scale: 1:200
Project: Barugh Green Road
Drawing: S9638

Station	Easting	Northing	Level
1	43106.518	407861.000	76.275
2	43107.000	407862.000	76.280
3	43108.000	407863.000	76.285
4	43109.000	407864.000	76.290
5	43110.000	407865.000	76.295
6	43111.000	407866.000	76.300
7	43112.000	407867.000	76.305
8	43113.000	407868.000	76.310
9	43114.000	407869.000	76.315
10	43115.000	407870.000	76.320

APPENDIX B

Indicative Site Layout Drawing

SITE DATA	
TENURE	PFS & AFFORDABLE
PART Q BUILDING REGULATIONS / SECURED BY DESIGN	TBC POST PLANNING
PART M BUILDING REGULATIONS	TBC POST PLANNING
PART L BUILDING REGULATIONS	2013
CODE FOR SUSTAINABLE HOMES	NO REQUIREMENT
ACOUSTIC REQUIREMENTS	AWAITING REPORT - MEASURES TBC
OTHER	"



- | | |
|--|--|
| | EASEMENT |
| | 1800mm HIGH BRICK WALL, SEE NSD 9001 TYPE 1. |
| | 1800mm HIGH CLOSE BOARD FENCE, SEE NSD 9012 TYPE A (TIMBERS TO COMPLY WITH BS55989 WHERE NOTED). |
| | 2100mm HIGH CLOSE BOARD FENCE, SEE NSD 9012 TYPE A (TIMBERS TO COMPLY WITH BS55989 WHERE NOTED). |
| | 1100mm HIGH HOOPED TOP METAL RAILING, SEE NSD 9202. |
| | POST AND RAIL FENCE, SEE NSD 9105 (TIMBERS TO COMPLY WITH BS55989 WHERE NOTED). |
| | 1800mm HIGH CLOSE BOARDED GATE, SLAM TO LOCK WITH ACCESS KEY. GATES MARKED WITH AN * TO BE SLAM TO LOCK WITH COMMUNAL ACCESS KEY. UNDERPASS GATES TO BE METAL AS PER WORKING DRAWINGS. |
| | FRONT ENTRANCE DOOR, ALL DOORS TO HAVE FLUSH THRESHOLD. UNLESS NOTED OTHERWISE PROVIDED 1200 x 900mm LEVEL PLATFORM AT ENTRANCE TO DWELLING. |
| | PATIO / FRENCH DOORS |
| | GARAGE PERSONNEL DOORS |
| | GARAGE DOORS |
| | DENOTES PLOTS WITH GABLE WINDOWS OMITTED |
| | DENOTES PLOTS WITH WINDOWS REQUIRING ACOUSTIC GLAZING |
| | DENOTES PLOTS WITH FEATURE ROOF TILE BANDING. |

-  TREES TO BE RETAINED (REFER TO TREE SURVEY).
-  ROOT PROTECTION AREA (REFER TO TREE SURVEY FOR RADIUS).
-  TREES TO BE REMOVED (REFER TO TREE SURVEY).
-  MINESHAFT STANDOFF
-  INDICATIVE LANDSCAPING

BUILDING REGULATIONS

NO GLAZING EXCEEDING 1M² TO BE INCLUDED TO ELEVATIONS WITHIN 1M OF THE BOUNDARY.

NO TWO FACING BOILER FLUES ARE TO DISCHARGE
WITHIN 1.2M OF EACH OTHER.

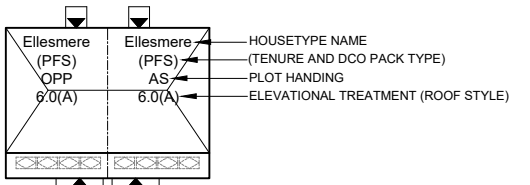
NOTES

- PATHS GENERALLY TO BE 900mm WIDE.
- PATIOS GENERALLY TO BE 2700 x 1800mm UNLESS INDICATED OTHERWISE.
- PAVING SLABS TO BE OFFSET 10mm WHERE FOOTPATH OR PATIO IS ADJACENT TO DWELLING.
- MOWING STRIP TO BE PROVIDED WHERE TURFED AREAS ABUT HOUSE, TO CONSIST OF 150mm WIDE GOLDEN (BUFF) STONE CHIPPINGS.
- GROUND LEVEL ADJACENT TO HOUSE TO BE 150mm BELOW S.L. UNLESS OTHERWISE NOTED.

MATERIAL REFERENCE

6.0 = BRICK
6.1 = BRICK / RENDER
6.2 = BRICK / TILE-HANGING

HOUSETYPE REFERENCE



D	05.08.20	ZE	Drawing Number updated from SKY004-PL-01, Schedule updated
C	27.07.20	ZE	Redrawn with new mix.
B	21.04.2020	LB	Footpath / cycle links added to POS areas.
A	20.04.2020	LB	AMENDMENTS FOLLOWING INTERVENTION COMMENTS; Various rear garden fences / walls adjusted to improve gardens. Various plot positions tweaked. Bin collection points added to shared drives. Shared drive widths reduced where possible. Post and rail fence added to POS areas.



COUNTRYSIDE
Places People Love

Countryside Properties (UK) Limited
Partnerships Yorkshire
Aeris, 3200 Century Way,
Thorpe Park, Leeds, LS15 8ZB
Tel: 01135 324500
www.countrysideproperties.com

site:

**Barugh Green Road
Barnsley**

title:

Planning Layout

scale: 1:500
@A1
date: 10.04.20

1:500
10.04.20

Drawing no:

SKPY-004-PL-PL-01

sheet no:

Sheet 1 of 1

vision:

D

Affordable Accomodation Schedule	Number	SQFT	Bed	Total SQFT	Mid	End	Det	Total
Arun	19	759	2	14421	5	14	0	19
Bourne	9	918	3	8262	1	8	0	9
Total	28			22683				28

Nett Area (Acres)	1.25
Coverage SQFT	18146.4
Density (Units Per Acre)	22.4

Open Market Accommodation Schedule	Number	SQFT	Bed	Total SQFT	Mid	End	Det	Total
Arun	20	759	2	15180	2	18	0	20
Holliswood	24	948	3	22652	0	24	0	24
Midford	4	986	4	3944	0	4	0	4
Rydal	7	1067	3	7479	0	7	0	7
Rydal FCT	12	1067	3	12804	0	7	5	12
Sankey	28	1073	3	30044	0	28	0	28
Southwick	8	1131	4	9048	0	5	3	8
Southwick SA	9	1131	4	10179	0	5	4	9
Total	112			111420				112

Nett Area (Acres)	7.22
Coverage	15432.13
Density (Units Per Acre)	15.5124

Totals	140
Gross Area (Acres)	11.79
POS Area (Acres)	2.07
Nett Area (Acres)	8.57
Coverage SQFT/Acre	15647.96
Density (Units Per Acre)	16.33606

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g:\yorkshire\barnsley\barugh green road\3.00_design info\3.03 architectural\tech\layouts\sky004-pl-01_barugh green planning layout_rev c.dwg

APPENDIX C

Yorkshire Water Services Pre-Plan Enquiry Response



YorkshireWater

Ms E Luckman
Alan Wood & Partners
341 Beverley Road
Hull
HU5 1LD

emma.luckman@alanwood.co.uk

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

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

Your Ref: HC03328/39
Our Ref: W002778

Email:
technical.sewerage@yorkshirewater.co.uk

For telephone enquiries ring:
Chris Roberts on 0345 120 8482

5th March 2020

Dear Ms Luckman,

Barugh Green, Yorkshire, S75 1JY - Pre-Planning Sewerage Enquiry T751508 (RESIDENTIAL)

Thank you for your recent enquiry. Our charge of £164.00 (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 can discharge to the 600 mm diameter public combined sewer recorded in Barugh Green Road, at a point to the north of the site.

Surface Water

The developer's attention is drawn to Requirement H3 of the Building Regulations 2000. This establishes a preferred hierarchy for surface water disposal. Consideration should firstly be given to discharge to soakaway, infiltration system and watercourse in that priority order.

Sustainable Drainage Systems (SuDS), for example the use of soakaways and/or permeable hardstanding etc, may be a suitable solution for surface water disposal appropriate in this situation. You are advised to seek comments on the suitability of SuDS in this instance from the appropriate authorities.

As the proposed site is currently undeveloped no surface water is known to have previously discharged to the public sewer network

As such, the local public sewer network does not have capacity to accept any surface water from the proposed site. If SuDS are not viable, the developer is advised to contact the Environment Agency/local Land Drainage Authority/Internal Drainage Board* with a view to establishing a suitable watercourse for discharge.



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.

Other Observations

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.

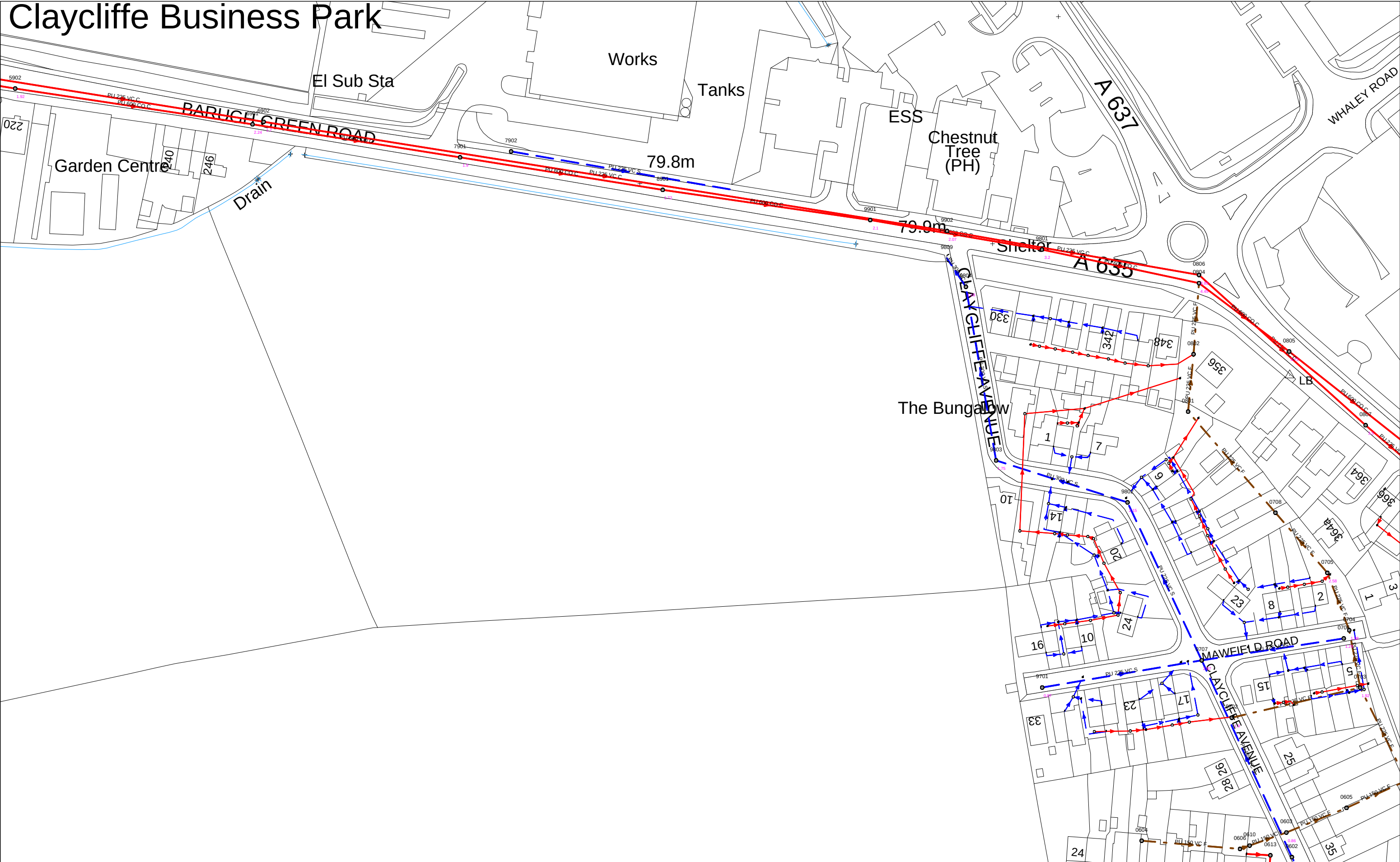
Prospectively adoptable sewers and pumping stations must be designed and constructed in accordance with the WRc publication "Sewers for Adoption - a design and construction guide for developers" 6th Edition as supplemented by Yorkshire Water's requirements, pursuant to an agreement under Section 104 of the Water Industry Act 1991. An application to enter into a Section 104 agreement must be made in writing prior to any works commencing on site. Please contact our Developer Services Team (telephone 0345 120 84 82) for further information.

All the above comments are based upon the information and records available at the present time and is subject to formal planning approval agreement. 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
Development Services Technician

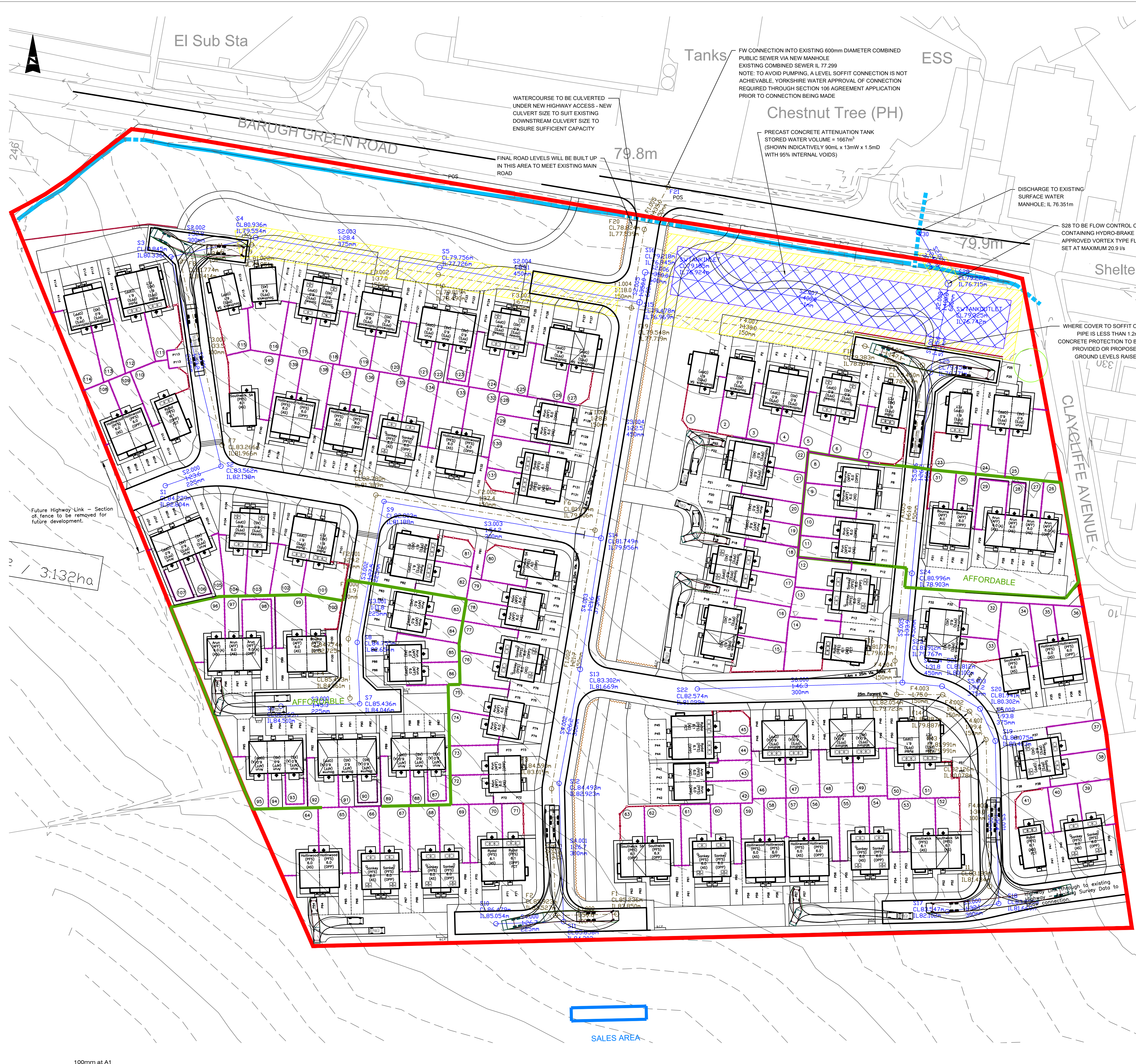
Claycliffe Business Park



	431673 : 407725	Map Name : SE3107NE	YorkshireWater	Yorkshire Water, PO Box 500, Halifax Road, Bradford BD6 2LZ Contact Name : YorMap Advisor C ROBERTS Contact Tel : 87 2582	Title	Partial Key Foul Sewer = F Combined Sewer = C Surface Water Sewer = SW Trade Sewer = TD Partially Separate = PS	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.
				Notes			
				(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 : 04/03/2020, 15:42:10	Date Gen : 04/03/2020, 15:42:39	
				Source : Sewer Network Enquiry			

APPENDIX D

Indicative Drainage Layout Drawings



KEY:

- PROPOSED SITE BOUNDARY
- PROPOSED FOUL WATER SEWER
- PROPOSED FOUL WATER MANHOLE
- PROPOSED SURFACE WATER SEWER
- PROPOSED SURFACE WATER MANHOLE
- PROPOSED SURFACE WATER ATTENUATION TANK
- PROPOSED SURFACE WATER RISING MAIN
- EXISTING PUBLIC COMBINED SEWER
- EXISTING WATERCOURSE (OPEN)
- EXISTING WATERCOURSE (CULVERTED)
- EXISTING GROUND MAJOR CONTOUR (2.5m INTERVALS)
- EXISTING GROUND MINOR CONTOUR (0.5m INTERVALS)
- EASEMENT FOR ADAPTABLE WORKS LOCATED OUTSIDE PUBLIC HIGHWAY (3m EITHER SIDE OF SEWER/STRUCTURE)

GENERAL NOTES:

G01. ALL WORKS SUBJECT TO SECTION 38, SECTION 60/278 AND SECTION 104 AGREEMENTS TO BE APPROVED BY THE RELEVANT AUTHORITY PRIOR TO COMMENCEMENT OF WORKS.

G02. ALL LEVELS ARE IN METRES AOD (ABOVE ORDNANCE DATUM) UNLESS NOTED OTHERWISE.

G03. ALL WORKS TO BE UNDERTAKEN IN COMPLIANCE WITH BS 8000 FOR WORKMANSHIP ON BUILDING SITES.

ABBREVIATIONS:

MH = MANHOLE
CL = COVER LEVEL
I = INVERT LEVEL
S/SW = SURFACE WATER
F/FW = FOUL WATER
SD = DEMARCATION CHAMBER
FD = FLOW CONTROL CHAMBER
CONC = CONCRETE
VC = VITRIFIED CLAY
FFL = FINISHED FLOOR LEVEL
DWG = DRAWING

- NOTES:**
- 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.
 - THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ENGINEERS AND ARCHITECTS DRAWINGS.
 - 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.
 - THE STRUCTURE IS DESIGNED TO BE SELF-SUPPORTING AND STABLE AFTER THE BUILDING IS FULLY COMPLETED. IT IS THE CONTRACTORS SOLE RESPONSIBILITY TO DETERMINE THE ERECTION PROCEDURE AND SEQUENCE AND ENSURE THAT THE BUILDING AND ITS COMPONENTS ARE SAFE DURING ERECTION. THIS INCLUDES THE ADDITION OF WHATEVER TEMPORARY BRACING, GUYS OR TIE-DOWNS WHICH MAY BE NECESSARY. SUCH MATERIAL REMAINING THE PROPERTY OF THE CONTRACTOR ON COMPLETION AND FOR ENSURING THAT THE WORKS AND ANY ADJACENT PROPERTIES ARE SAFE IN THE TEMPORARY CONDITION.
- DRAINAGE NOTES:**
- D01. ALL ADAPTABLE SEWERS WORKS AND MATERIAL TO BE IN ACCORDANCE WITH 'SEWERS FOR ADOPTION' 6TH EDITION. THE RELEVANT BRITISH/EUROPEAN AND YORKSHIRE WATERS STANDARDS/REQUIREMENTS/ADDENDUMS AND KITEMARKED.
- D02. DRAINAGE SYSTEMS TO COMPLY WITH BS EN 476 AND BS EN 752.
- D03. ALL COMPONENTS USED IN DRAINAGE SYSTEMS TO COMPLY WITH THE FOLLOWING: BS EN 476:2011.
- D04. ALL DRAINAGE SYSTEMS AND COMPONENTS TO BE CONSTRUCTED AND TESTED TO THE FULL SATISFACTION OF THE RELEVANT ADOPTING AUTHORITY, AND IN ACCORDANCE WITH BS EN 1610.
- D05. 'VC' DENOTES VITRIFIED CLAY. VITRIFIED CLAY PIPES AND FITTINGS TO COMPLY WITH THE RELEVANT PROVISIONS OF BS EN 295:2013, 2:2012, 3:2012 AND BS 85 RESPECTIVELY AND BE KITEMARKED. ALL PIPES SHALL BE EXTRA STRENGTH TO BS 85 OR EQUIVALENT TO BS EN 295 PIPE CRUSHING STRENGTH.
- D06. WHERE COVER TO PIPE IS LESS THAN 1.2m TO GROUND LEVEL PIPE PROTECTION IS REQUIRED IN THE FORM OF A REINFORCED CONCRETE PROTECTION SLAB.
- D07. MANHOLE COVERS AND FRAMES SHALL COMPLY WITH THE RELEVANT PROVISIONS OF BS EN 124:2 TO 6:2015, BS EN 591:4:2004 AND BS 7903. MANHOLE COVERS AND FRAMES TO BE OF A NON-ROCKING DESIGN WITH CUSHION INSERTS AND KITEMARKED. LOAD CLASS D400 TO BE USED IN VEHICULAR TRAFFICKED AREAS. ALL COVERS TO BE BADGED 'FW' OR 'SW' AS APPROPRIATE. MANHOLE COVER SLABS AND ACCESS TO BE IN ACCORDANCE WITH THE BRITISH PRECAST DRAINAGE ASSOCIATION TECHNICAL GUIDE ISSUED JUNE 2019.
- D08. ROAD GULLY GRATES AND FRAMES SHALL COMPLY WITH THE RELEVANT PROVISIONS OF BS EN 124:2 TO 6:2015, BS EN 591:4:2004 AND BS 7903. TO BE OF A NON-ROCKING DESIGN WITH LEFT HANDED CAPTIVE HINGE ACCESS AND BE KITEMARKED. LOAD CLASS D400 TO BE USED IN VEHICULAR TRAFFICKED AREAS. WITH A 450mm GRATE AND FRAME. MINIMUM AREA OF WATERWAY TO BE 900mm².
- D09. NO MECHANICAL COMPACTION OF FILL MATERIAL WITHIN 300mm OF THE CROWN OF ANY PIPE.
- D10. MORTAR TO COMPLY WITH THE RELEVANT PROVISIONS OF BS EN 998-2:2016 AND PD 6678:2005.
- D11. COVER AND FRAME BEDDING MORTAR TO COMPLY WITH THE DESIGN MANUAL FOR ROADS AND BRIDGES VOLUME 4, SECTION 2, PART 5:14.10.000 CHAPTER 6, AND THE RELEVANT PROVISIONS OF THE MANUAL OF CONTRACT DOCUMENTS FOR HIGHWAYS WORKS VOLUMES 1 AND 2.
- D12. PRECAST CONCRETE MANHOLES TO BE IN ACCORDANCE WITH BS 5911:PART 200. PRECAST CONCRETE RINGS AND COVER SLABS TO BE JOINED WITH CEMENT MORTAR.
- D13. ALL CONCRETE PIPES TO BE CLASS 120 TO BS EN 1916/BS 5911-1:2002.
- D14. ALL CONCRETE MANHOLES TO BE IN ACCORDANCE WITH BS 1917/BS EN 5911-3:2010.
- D15. INSITU AND PRECAST CONCRETE UNITS SHALL HAVE SULPHATE RESISTING PORTLAND CEMENT TO BS 4027, UNLESS AGREED OTHERWISE WITH THE ADOPTING AUTHORITY.
- THE VERSIONS OF BRITISH STANDARDS AND OTHER PUBLICATIONS LISTED ABOVE ARE CURRENT AT THE TIME OF THE DRAWING ISSUE. HOWEVER IF THESE HAVE BEEN REVISED OR UPDATED THEN THE NEWER VERSIONS SHOULD BE USED. ANY DISCREPANCIES SHOULD BE NOTIFIED TO AWP IMMEDIATELY.

P4	UPDATED SITE LAYOUT	11.08.20	PLS	CD	-
P3	REVISED TO OMIT PUMP STATION	08.06.20	JP	CD	JAG
P2	LEVELS REVISED TO ALLOW DEEPER FOUL AROUND F11 TO F18	16.04.20	JP	CD	JAG
P1	FIRST ISSUE	08.04.20	JP	CD	JAG
Rev	Description	Date	By	Chk	App

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Project:	RESIDENTIAL DEVELOPMENT, BARUGH GREEN, BARNSELEY					
Client:	COUNTRYSIDE PROPERTIES					
Drawing:	PROPOSED DRAINAGE LAYOUT					
Role:	CIVIL ENGINEER					
Drawing Status:	FOR APPROVAL					
Job. no.	43733	Scale@ A1:	1:500	Rev.	P4	
Project	Originator	Volume	Level	Type	Role	Number
BAR - AWP - ZZ - XX - DR - C - 3001						

APPENDIX E

CIRIA SuDS Manual Quality Matrix Output

SIMPLE INDEX APPROACH: TOOL



HRW shall not be liable for any direct or indirect damage claim, loss, cost, expense or liability whatsoever arising out of the use or impossibility to use the tool, even when HRW has been informed of the possibility of this claim. The user hereby indemnifies HRW from and against any damage claim, loss, expense or liability resulting from any action taken against HRW that is related in any way to the use of the tool or any reliance made in respect of the output of such use by any person whatsoever. HRW does not guarantee that the tool's functions meet the requirements of any person, nor that the tool is free from errors.

1. The steps set out in the tool should be applied for each inflow or 'runoff area' (ie each impermeable surface area separately discharging to a SuDS component).
2. The supporting 'Design Conditions' stated by the tool must be fully considered and implemented in all cases.
3. The process that is automated in this tool is described in the SuDS Manual, Chapter 26 (Section 26.7)
3. Relevant design examples are included in the SuDS Manual Appendix C.
4. Each of the steps below are part of the process set out in the flowchart on Sheet 3.
5. Sheet 4 summarises the selections made below and indicates the acceptability of the proposed SuDS components.
6. Interception should be delivered for all upstream impermeable areas as part of the strategy for water quantity and quality control for the site. This is required in order to deliver both of the water quality criteria set out in Chapter 4 of the SuDS Manual

	DROP DOWN LIST	RELEVANT INPUTS NEED TO BE SELECTED FROM THESE LISTS, FOR EACH STEP
	USER ENTRY	USER ENTRY CELLS ARE ONLY REQUIRED WHERE INDICATED BY THE TOOL

STEP 1: Determine the Pollution Hazard Index for the runoff area discharging to the proposed SuDS scheme

This step requires the user to select the appropriate land use type for the area from which the runoff is occurring

If the land use varies across the 'runoff area', either:

- use the land use type with the highest Pollution Hazard Index

- apply the approach for each of the land use types to determine whether the proposed SuDS design is sufficient for all. If it is not, consider collecting more hazardous runoff separately and providing additional treatment.

If the generic land use types suggested are not applicable, select 'Other' and enter a description of the land use of the runoff area and agreed user defined indices in the row below the drop down lists.

Runoff Area Land Use Description	Hazard Level	Pollution Hazard Indices			DESIGN CONDITIONS
		Total Suspended Solids	Metals	Hydrocarbons	
Select land use type from the drop down list (or 'Other' if none applicable) → Commercial/Industrial roofing, inert materials	Very low	0.3	0.2	0.05	12
If the generic land use types in the drop down list above are not applicable, select 'Other' and enter a description of the land use of the runoff area and agreed user defined indices in this row:					
Landuse Pollution Hazard Index	Very low	0.3	0.2	0.05	

STEP 2A: Determine the Pollution Mitigation Index for the proposed SuDS components

This step requires the user to select the proposed SuDS components that will be used to treat runoff - before it is discharged to a receiving surface waterbody or downstream infiltration component

If the runoff is discharged directly to an infiltration component, without upstream treatment, select 'None' for each of the 3 SuDS components and move to Step 2B

This step should be applied to evaluate the water quality protection provided by proposed SuDS components for discharges to receiving surface waters or downstream infiltration components (note: in England and Wales this will include components that allow any amount of infiltration, however small, even where infiltration is not specifically accounted for in the design).

If you have fewer than 3 components, select 'None' for the components that are not required

If the proposed component is bespoke and/or a proprietary treatment product and not generically described by the suggested components, then 'Proprietary treatment system' or 'User defined indices' should be selected and a description of the component and agreed user defined indices should be entered in the rows below the drop down lists

SuDS Component Description	Total Suspended Solids	Pollution Mitigation Indices		DESIGN CONDITIONS
		Metals	Hydrocarbons	
Select SuDS Component 1 (i.e. the upstream SuDS component) from the drop down list: → Detention basin	0.5	0.5	0.6	123
Select SuDS Component 2 (i.e. the second SuDS component in a series) from the drop down list: → None	0	0	0	
Select SuDS Component 3 (i.e. the third SuDS component in a series) from the drop down list: → None	0	0	0	
If the proposed SuDS components are bespoke/proprietary and/or the generic indices above are not considered appropriate, select 'Proprietary treatment system' or 'User defined indices' and enter component descriptions and agreed user defined indices in these rows:				
Aggregated Surface Water Pollution Mitigation Index	0.5	0.5	0.6	

Note: If the total aggregated mitigation index is > 1 (which is not a realistic outcome), then the outcome is fixed at "<0.95". In this scenario, the proposed components are likely to have a very high mitigation potential for reducing pollutant levels in the runoff and should be sufficient for any proposed land use (note: where risk assessment is required, this outcome would need more detailed verification).

Is the runoff now discharged to an infiltration component?

Yes ? [Go to Step 2B](#)
No ? [Go to Step 2C](#)

STEP 2B: Determine the Pollution Mitigation Index for the proposed Groundwater Protection

This step requires the user to select the type of groundwater protection that is either part of the SuDS component or that lies between the component and the groundwater

This step should be applied where a SuDS component is specifically designed to infiltrate runoff (note: in England and Wales this will include components that allow any amount of infiltration, however small, even where infiltration is not specifically accounted for in the design).

'Groundwater protection' describes the proposed depth of soil or other material through which runoff will flow between the runoff surface and the underlying groundwater.

Where the discharge is to surface waters and risks to groundwater need not be considered, select 'None'

If the proposed groundwater protection is bespoke and/or a proprietary product and not generically described by the suggested measures, then a description of the protection and agreed user defined indices should be entered in the row below the drop down list

Groundwater Protection Description	Total Suspended Solids	Pollution Mitigation Indices		DESIGN CONDITIONS
		Metals	Hydrocarbons	
Select type of groundwater protection from the drop down list: → None	0	0	0	1234
If the proposed groundwater protection is bespoke/proprietary and/or the generic indices above are not considered appropriate, select 'Proprietary product' or 'User defined indices' and enter a description of the protection and agreed user defined indices in this row:				
Groundwater Protection Pollution Mitigation Index	0	0	0	

STEP 2C: Determine the Combined Pollution Mitigation Indices for the Runoff Area

This is an automatic step which combines the proposed SuDS Pollution Mitigation Indices with any Groundwater Protection Pollution Mitigation Indices

Combined Pollution Mitigation Indices	Total Suspended Solids	Metals	Hydrocarbons
Combined Pollution Mitigation Indices for the Runoff Area	0.5	0.5	0.6

Note: If the total aggregated mitigation index is > 1 (which is not a realistic outcome), then the outcome is fixed at "<0.95". In this scenario, the proposed components are likely to have a very high mitigation potential for reducing pollutant levels in the runoff and should be sufficient for any proposed land use (note: where risk assessment is required, this outcome would need more detailed verification).

STEP 2D: Determine Sufficiency of Pollution Mitigation Indices for Selected SuDS Components

This is an automatic step which compares the Combined Pollution Mitigation Indices with the Land Use Hazard Indices, to determine whether the proposed components are sufficient to manage each pollutant category type

When the combined mitigation index exceeds the land use pollution hazard index, then the proposed components are considered sufficient in providing pollution risk mitigation.

In England and Wales, where the discharge is to protected surface waters or groundwater, an additional treatment component (ie over and above that required for standard discharges), or other equivalent protection, is required that provides environmental protection in the event of an unexpected pollution event or poor system performance. Protected surface waters are those designated for drinking water abstraction. In England and Wales, protected groundwater resources are defined as 'Source Protection Zones'. In Northern Ireland, a more precautionary approach may be required and this should be checked with the environmental regulator or a site by site basis.

Sufficiency of Pollution Mitigation Indices	Total Suspended Solids	Metals	Hydrocarbons	1
Sufficient	Sufficient	Sufficient	Sufficient	

Reference to local planning documents should also be made to identify any additional protection required for sites due to habitat conservation (see Chapter 7 The SuDS design process). The implications of developments and/or other close proximity to an area with an environmental designation, such as a Site of Special Scientific Interest (SSSI), should be considered via consultation with relevant conservation bodies such as Natural England.

Note: In order to meet both Water Quality criteria set out in the SuDS Manual (Chapter 4), interception should be delivered for all impermeable areas wherever possible. Interception delivery and treatment may not be met by the same components, but interception requires separate evaluation.

SIMPLE INDEX APPROACH: TOOL



HRW shall not be liable for any direct or indirect damage claim, loss, cost, expense or liability howsoever arising out of the use or impossibility to use the tools, even when HRW has been informed of the possibility of the same. The user hereby indemnifies HRW from and against any damage claim, loss, expense or liability resulting from any action taken against HRW that is related in any way to the use of the tool or any reliance made in respect of the output of such use by any person whatsoever. HRW does not guarantee that the tool's functions meet the requirements of any person, nor that the tool is free from errors.

1. The steps set out in the tool should be applied for each inflow or 'runoff area' (ie each impermeable surface area separately discharging to a SuDS component).
2. The supporting 'Design Conditions' stated by the tool must be fully considered and implemented in all cases.
3. The process that is automated in this tool is described in the SuDS Manual, Chapter 26 (Section 26.7)
3. Relevant design examples are included in the SuDS Manual Appendix C.
4. Each of the steps below are part of the process set out in the flowchart on Sheet 3.
5. Sheet 4 summarises the selections made below and indicates the acceptability of the proposed SuDS components.
6. Interception should be delivered for all upstream impermeable areas as part of the strategy for water quantity and quality control for the site. This is required in order to deliver both of the water quality criteria set out in Chapter 4 of the SuDS Manual

DROP DOWN LIST

RELEVANT INPUTS NEED TO BE SELECTED FROM THESE LISTS, FOR EACH STEP

USER ENTRY

USER ENTRY CELLS ARE ONLY REQUIRED WHERE INDICATED BY THE TOOL

STEP 1: Determine the Pollution Hazard Index for the runoff area discharging to the proposed SuDS scheme

This step requires the user to select the appropriate land use type for the area from which the runoff is occurring

If the land use varies across the 'runoff area', either:

- use the land use type with the highest Pollution Hazard Index
- apply the approach for each of the land use types to determine whether the proposed SuDS design is sufficient for all. If it is not, consider collecting more hazardous runoff separately and providing additional treatment.

If the generic land use types suggested are not applicable, select 'Other' and enter a description of the land use of the runoff area and agreed user defined indices in the row below the drop down lists.

Select land use type from the drop down list (or 'Other' if none applicable):

If the generic land use types in the drop down list above are not applicable, select 'Other' and enter a description of the land use of the runoff area and agreed user defined indices in this row:

Runoff Area Land Use Description

Low traffic roads (e.g. residential roads and general access roads, < 300 traffic movements/day)

Pollution Hazard

Low

Total Suspended Solids

0.5

Pollution Hazard Indices

Metals

0.4

Hydrocarbons

0.4

DESIGN CONDITIONS

1

2

Landuse Pollution Hazard Index

Low

0.5

0.4

0.4

STEP 2A: Determine the Pollution Mitigation Index for the proposed SuDS components

This step requires the user to select the proposed SuDS components that will be used to treat runoff - before it is discharged to a receiving surface waterbody or downstream infiltration component

If the runoff is discharged directly to an infiltration component, without upstream treatment, select 'None' for each of the 3 SuDS components and move to Step 2B

This step should be applied to evaluate the water quality protection provided by proposed SuDS components for discharges to receiving surface waters or downstream infiltration components (note: in England and Wales this will include components that allow any amount of infiltration, however small, even where infiltration is not specifically accounted for in the design).

If you have fewer than 3 components, select 'None' for the components that are not required

If the proposed component is bespoke and/or a proprietary treatment product and not generically described by the suggested components, then 'Proprietary treatment system' or 'User defined indices' should be selected and a description of the component and agreed user defined indices should be entered in the rows below the drop down lists

Select SuDS Component 1 (i.e. the upstream SuDS component) from the drop down list:

Select SuDS Component 2 (i.e. the second SuDS component in a series) from the drop down list:

Select SuDS Component 3 (i.e. the third SuDS component in a series) from the drop down list:

If the proposed SuDS components are bespoke/proprietary and/or the generic indices above are not considered appropriate, select 'Proprietary treatment system' or 'User defined indices' and enter component descriptions and agreed user defined indices in these rows:

SuDS Component Description

Swale

User defined indices

None

Catchpit Manhole/Trapped Gullies

SuDS Component 2

Total Suspended Solids

0.5

0

0.4

0.7

Pollution Mitigation Indices

Metals

0.6

0

0.2

0.7

Hydrocarbons

0.6

0

0.2

0.7

DESIGN CONDITIONS

1

2

3

SuDS components can only be assumed to deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters of the SuDS Manual. See also checklists in Appendix B

Detailed assessment of performance of designed component in reducing inflow concentrations of each pollutant type required as evidence of adopted indices. Enter indices approved by the environmental regulator in appropriate 'User Defined Indices' row below

Aggregated Surface Water Pollution Mitigation Index

0.7

0.7

0.7

Is the runoff now discharged to an infiltration component?

Yes ? [Go to Step 2B](#)

No ? [Go to Step 2C](#)

STEP 2B: Determine the Pollution Mitigation Index for the proposed Groundwater Protection

This step requires the user to select the type of groundwater protection that is either part of the SuDS component or that lies between the component and the groundwater

This step should be applied where a SuDS component is specifically designed to infiltrate runoff (note: in England and Wales this will include components that allow any amount of infiltration, however small, even where infiltration is not specifically accounted for in the design).

'Groundwater protection' describes the proposed depth of soil or other material through which runoff will flow between the runoff surface and the underlying groundwater.

Where the discharge is to surface waters and risks to groundwater need not be considered, select 'None'

If the proposed groundwater protection is bespoke and/or a proprietary product and not generically described by the suggested measures, then a description of the protection and agreed user defined indices should be entered in the row below the drop down list

Select type of groundwater protection from the drop down list:

If the proposed groundwater protection is bespoke/proprietary and/or the generic indices above are not considered appropriate, select 'Proprietary product' or 'User defined indices' and enter a description of the protection and agreed user defined indices in this row:

None

Total Suspended Solids

0

Pollution Mitigation Indices

Metals

0

Hydrocarbons

0

DESIGN CONDITIONS

1

2

3

4

Groundwater Protection Pollution Mitigation Index

0

0

0

STEP 2C: Determine the Combined Pollution Mitigation Indices for the Runoff Area

This is an automatic step which combines the proposed SuDS Pollution Mitigation Indices with any Groundwater Protection Pollution Mitigation Indices

Combined Pollution Mitigation Indices

Total Suspended Solids

0.7

Metals

0.7

Hydrocarbons

0.7

Combined Pollution Mitigation Indices for the Runoff Area

0.7

0.7

0.7

STEP 2D: Determine Sufficiency of Pollution Mitigation Indices for Selected SuDS Components

This is an automatic step which compares the Combined Pollution Mitigation Indices with the Land Use Hazard Indices, to determine whether the proposed components are sufficient to manage each pollutant category type

When the combined mitigation index exceeds the land use pollution hazard index, then the proposed components are considered sufficient in providing pollution risk mitigation.

In England and Wales, where the discharge is to protected surface waters or groundwater, an additional treatment component (ie over and above that required for standard discharges), or other equivalent protection, is required that provides environmental protection in the event of an unexpected pollution event or poor system performance. Protected surface waters are those designated for drinking water abstraction. In England and Wales, protected groundwater resources are defined as Source Protection Zone 1. In Northern Ireland, a more precautionary approach may be required and this should be checked with the environmental regulator on a site by site basis.

Sufficiency of Pollution Mitigation Indices

Total Suspended Solids

Sufficient

Metals

Sufficient

Hydrocarbons

Sufficient

DESIGN CONDITIONS

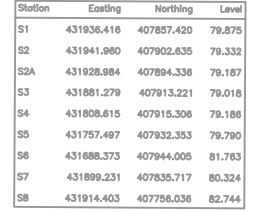
1

Reference to local planning documents should also be made to identify any additional protection required for sites due to habitat conservation (see Chapter 7 The SuDS design process). The implications of developments on or within close proximity to an area with an environmental designation, such as a Site of Special Scientific Interest (SSSI), should be considered via consultation with relevant conservation bodies such as Natural England

Note: In order to meet both Water Quality criteria set out in the SuDS Manual (Chapter 4), Interception should be delivered for all impermeable areas wherever possible. Interception delivery and treatment may be met by the same components, but Interception requires separate evaluation.

APPENDIX F

Surface Water Exceedance Flood Routing Drawings



Project	Originator	Volume	Level	Type	Role	Number
BAR - AWP - ZZ - XX - DR - C - 3002						

100mm at A1

APPENDIX G

Hydraulic Analysis Calculations

Alan Wood & Partners		Page 1
341 Beverley Road Hull, Yorkshire HU5 1LD	43733 Barugh Green Surface Water Drainage Hydraulic Calculations	
Date 08/06/2020	Designed by JP	
File Drawnet 2.7.MDX	Checked by CD	
Innovyze	Network 2020.1	

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Storm

- Indicates pipe length does not match coordinates
« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S2.000	15.743	0.666	23.6	0.101	1.00	0.0	0.600	o	225	Pipe/Conduit	
S2.001	57.359	1.727	33.2	0.101	0.00	0.0	0.600	o	225	Pipe/Conduit	
S2.002	23.175	0.707	32.8	0.101	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.003	49.703	1.753	28.4	0.101	0.00	0.0	0.600	o	375	Pipe/Conduit	
S2.004	54.106	0.607	89.1	0.101	0.00	0.0	0.600	o	450	Pipe/Conduit	
S3.000	21.009	0.464	45.3	0.101	1.00	0.0	0.600	o	225	Pipe/Conduit	
S3.001	16.392	1.392	11.8	0.101	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.002	38.233	1.392	27.5	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.003	58.680	1.082	54.2	0.101	0.00	0.0	0.600	o	300	Pipe/Conduit	
S4.000	18.042	0.677	26.7	0.101	1.00	0.0	0.600	o	225	Pipe/Conduit	
S4.001	36.886	1.379	26.7	0.202	0.00	0.0	0.600	o	300	Pipe/Conduit	
S4.002	30.934	1.179	26.2	0.101	0.00	0.0	0.600	o	300	Pipe/Conduit	
S4.003	35.378	1.637	21.6	0.202	0.00	0.0	0.600	o	375	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S2.000	50.00	1.10	82.804	0.101	0.0	0.0	0.0	2.70	107.5	13.7
S2.001	50.00	1.52	82.138	0.202	0.0	0.0	0.0	2.28	90.6	27.4
S2.002	50.00	1.66	80.336	0.303	0.0	0.0	0.0	2.76	194.8	41.0
S2.003	50.00	1.90	79.554	0.404	0.0	0.0	0.0	3.41	377.1	54.7
S2.004	50.00	2.32	77.726	0.505	0.0	0.0	0.0	2.15	342.6	68.4
S3.000	50.00	1.18	84.510	0.101	0.0	0.0	0.0	1.95	77.5	13.7
S3.001	50.00	1.25	84.046	0.202	0.0	0.0	0.0	3.83	152.4	27.4
S3.002	50.00	1.51	82.655	0.202	0.0	0.0	0.0	2.51	99.6	27.4
S3.003	50.00	1.96	81.188	0.303	0.0	0.0	0.0	2.14	151.2	41.0
S4.000	50.00	1.12	85.054	0.101	0.0	0.0	0.0	2.54	101.2	13.7
S4.001	50.00	1.32	84.302	0.303	0.0	0.0	0.0	3.05	215.7	41.0
S4.002	50.00	1.49	82.923	0.404	0.0	0.0	0.0	3.08	217.8	54.7
S4.003	50.00	1.64	81.669	0.606	0.0	0.0	0.0	3.91	432.1	82.1

Alan Wood & Partners		Page 2
341 Beverley Road Hull, Yorkshire HU5 1LD	43733 Barugh Green Surface Water Drainage Hydraulic Calculations	
Date 08/06/2020	Designed by JP	
File Drawnet 2.7.MDX	Checked by CD	
Innovyze	Network 2020.1	

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S3.004	63.717	2.837	22.5	0.202	0.00	0.0	0.600	o	450	Pipe/Conduit	
S2.005	8.141	0.023	350.0	0.101	0.00	0.0	0.600	o	600	Pipe/Conduit	
S2.006	7.531	0.022	350.0	0.101	0.00	0.0	0.600	o	600	Pipe/Conduit	
S2.007	90.000#	0.182	494.5	0.000	0.00	0.0	0.600	[]	-1	Pipe/Conduit	
S5.000	13.905	0.433	32.1	0.202	1.00	0.0	0.600	o	300	Pipe/Conduit	
S5.001	43.373	1.191	36.4	0.101	0.00	0.0	0.600	o	300	Pipe/Conduit	
S5.002	9.476	0.101	93.8	0.101	0.00	0.0	0.600	o	375	Pipe/Conduit	
S5.003	11.780	0.125	94.2	0.101	0.00	0.0	0.600	o	375	Pipe/Conduit	
S5.004	10.641	0.335	31.8	0.101	0.00	0.0	0.600	o	450	Pipe/Conduit	
S6.000	54.687	1.182	46.3	0.202	1.00	0.0	0.600	o	300	Pipe/Conduit	
S5.005	29.249	0.864	33.9	0.101	0.00	0.0	0.600	o	450	Pipe/Conduit	
S5.006	53.896	2.057	26.2	0.202	0.00	0.0	0.600	o	450	Pipe/Conduit	
S5.007	14.279	0.029	495.0	0.203	0.00	0.0	0.600	o	525	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E I.Area (ha)	E Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S3.004	50.00	2.21	79.956	1.111	0.0	0.0	0.0	4.30	684.6	150.4
S2.005	50.00	2.42	76.969	1.717	0.0	0.0	0.0	1.30	366.4	232.5
S2.006	50.00	2.52	76.946	1.818	0.0	0.0	0.0	1.30	366.4	246.2
S2.007	50.00	3.07	76.924	1.818	0.0	0.0	0.0	2.74	53504.3	246.2
S5.000	50.00	1.08	82.102	0.202	0.0	0.0	0.0	2.78	196.8	27.4
S5.001	50.00	1.36	81.669	0.303	0.0	0.0	0.0	2.61	184.8	41.0
S5.002	50.00	1.44	80.403	0.404	0.0	0.0	0.0	1.87	206.7	54.7
S5.003	50.00	1.55	80.302	0.505	0.0	0.0	0.0	1.87	206.2	68.4
S5.004	50.00	1.60	80.102	0.606	0.0	0.0	0.0	3.62	575.3	82.1
S6.000	50.00	1.39	81.099	0.202	0.0	0.0	0.0	2.32	163.8	27.4
S5.005	50.00	1.74	79.767	0.909	0.0	0.0	0.0	3.50	557.2	123.1
S5.006	50.00	1.96	78.903	1.111	0.0	0.0	0.0	3.98	633.7	150.4
S5.007	50.00	2.20	76.771	1.314	0.0	0.0	0.0	1.00	216.5	177.9

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STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S2.008	9.806	0.025	400.0	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S2.009	15.801	0.064	245.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S2.008	50.00	3.20	76.742	3.132	0.0	0.0	0.0	1.21	342.5«	424.1
S2.009	50.00	3.46	76.715	3.132	0.0	0.0	0.0	1.00	70.7«	424.1

Conduit Sections for Storm

NOTE: Diameters less than 66 refer to section numbers of hydraulic conduits. These conduits are marked by the symbols:- [] box culvert, \ / open channel, oo dual pipe, ooo triple pipe, O egg.

Section numbers < 0 are taken from user conduit table

Section Number	Conduit Type	Major Dimn. (mm)	Minor Dimn. (mm)	Side Slope (Deg)	Corner Splay (mm)	4*Hyd Radius (m)	XSect Area (m ²)
-1	[]	13000	1500	90.0		2.690	19.500

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: S28, DS/PN: S2.009, Volume (m³): 8.9

Unit Reference MD-SHE-0192-2090-1725-2090
Design Head (m) 1.725
Design Flow (l/s) 20.9
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 192
Invert Level (m) 76.715
Minimum Outlet Pipe Diameter (mm) 225
Suggested Manhole Diameter (mm) 1800

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.725	20.9	Kick-Flo®	1.092	16.8
Flush-Flo™	0.507	20.8	Mean Flow over Head Range	-	18.1

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	6.7	1.200	17.6	3.000	27.2	7.000	40.9
0.200	17.7	1.400	18.9	3.500	29.3	7.500	42.3
0.300	19.8	1.600	20.1	4.000	31.2	8.000	43.6
0.400	20.6	1.800	21.3	4.500	33.1	8.500	44.9
0.500	20.8	2.000	22.4	5.000	34.8	9.000	46.2
0.600	20.7	2.200	23.4	5.500	36.4	9.500	47.4
0.800	20.0	2.400	24.4	6.000	38.0		
1.000	18.4	2.600	25.4	6.500	39.5		

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
 Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 0.000
 Hot Start Level (mm) 0 Inlet Coefficient 0.800
 Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
 Foul Sewage per hectare (l/s) 0.000

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

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.351
 Region England and Wales Cv (Summer) 0.750
 M5-60 (mm) 19.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
 Analysis Timestep 2.5 Second Increment (Extended)
 DTS Status ON
 DVD Status OFF
 Inertia Status OFF

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720,
 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640,
 10080
 Return Period(s) (years) 30, 100
 Climate Change (%) 0, 30

										Water
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.		Level (m)
S2.000	S1	15 Summer	30	+0%	100/15 Summer					82.922
S2.001	S2	15 Summer	30	+0%	100/15 Summer					82.305
S2.002	S3	15 Summer	30	+0%						80.505
S2.003	S4	15 Winter	30	+0%	100/15 Summer					79.716
S2.004	S6	15 Winter	30	+0%	30/15 Summer					78.324
S3.000	S7	15 Summer	30	+0%	100/15 Summer					84.653
S3.001	S8	15 Summer	30	+0%	100/15 Summer					84.169
S3.002	S8	15 Summer	30	+0%	100/15 Summer					82.814
S3.003	S9	15 Summer	30	+0%	100/15 Summer					81.382
S4.000	S10	15 Summer	30	+0%						85.175
S4.001	S11	15 Summer	30	+0%						84.458
S4.002	S12	15 Winter	30	+0%	100/15 Summer					83.105

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

PN	US/MH Name	Surcharged		Flooded		Half Drain		Pipe	Status	Level Exceeded
		Depth (m)	Volume (m ³)	Flow / Cap.	Overflow (l/s)	Time (mins)	Flow (l/s)			
S2.000	S1	-0.107	0.000	0.50			47.9		OK	
S2.001	S2	-0.058	0.000	0.84			73.6		OK	
S2.002	S3	-0.131	0.000	0.62			107.0		OK	
S2.003	S4	-0.213	0.000	0.38			133.9		OK	
S2.004	S6	0.148	0.000	0.51			159.8	SURCHARGED		
S3.000	S7	-0.082	0.000	0.68			47.7		OK	
S3.001	S8	-0.102	0.000	0.54			72.4		OK	
S3.002	S8	-0.066	0.000	0.79			74.9		OK	
S3.003	S9	-0.106	0.000	0.73			104.7		OK	
S4.000	S10	-0.104	0.000	0.53			47.9		OK	
S4.001	S11	-0.144	0.000	0.52			104.5		OK	
S4.002	S12	-0.118	0.000	0.67			133.8		OK	

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Innovyze		Network 2020.1

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S4.003	S13	15 Winter	30	+0%	100/15 Summer			
S3.004	S14	15 Summer	30	+0%	100/15 Summer			
S2.005	S15	15 Winter	30	+0%	30/15 Summer			
S2.006	S16	15 Summer	30	+0%	30/15 Summer			
S2.007	SWTANK2INLET	360 Winter	30	+0%				
S5.000	S17	15 Summer	30	+0%	100/15 Summer			
S5.001	S18	15 Summer	30	+0%	100/15 Summer			
S5.002	S19	15 Summer	30	+0%	30/15 Summer			
S5.003	S20	15 Summer	30	+0%	30/15 Summer			
S5.004	S21	15 Summer	30	+0%	100/15 Summer			
S6.000	S22	15 Summer	30	+0%	100/15 Summer			
S5.005	S23	15 Summer	30	+0%	100/15 Summer			
S5.006	S24	15 Summer	30	+0%	100/15 Summer			
S5.007	S25	360 Winter	30	+0%	30/15 Summer			
S2.008	SWTANK2OUTLET	360 Winter	30	+0%	30/30 Winter			
S2.009	S28	180 Winter	30	+0%	30/15 Summer			

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S4.003	S13	81.861	-0.183	0.000	0.51			199.2	OK
S3.004	S14	80.205	-0.201	0.000	0.58			369.9	OK
S2.005	S15	78.158	0.589	0.000	2.73			546.4	SURCHARGED
S2.006	S16	77.846	0.300	0.000	2.95			575.3	SURCHARGED
S2.007	SWTANK2INLET	77.651	-0.773	0.000	0.00			84.9	OK*
S5.000	S17	82.275	-0.127	0.000	0.59			95.9	OK
S5.001	S18	81.864	-0.105	0.000	0.67			115.0	OK
S5.002	S19	80.866	0.088	0.000	1.19			147.8	SURCHARGED
S5.003	S20	80.739	0.062	0.000	1.27			176.4	SURCHARGED
S5.004	S21	80.372	-0.180	0.000	0.64			209.9	OK
S6.000	S22	81.277	-0.122	0.000	0.56			87.5	OK
S5.005	S23	80.039	-0.178	0.000	0.64			306.5	OK
S5.006	S24	79.174	-0.179	0.000	0.65			375.5	OK
S5.007	S25	77.653	0.357	0.000	0.51			62.1	SURCHARGED
S2.008	SWTANK2OUTLET	77.651	0.309	0.000	0.23			66.8	SURCHARGED*
S2.009	S28	77.987	0.972	0.000	0.35			20.8	SURCHARGED

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

PN	US/MH Name	Level Exceeded
S4.003		S13
S3.004		S14
S2.005		S15
S2.006		S16
S2.007	SWTANK2INLET	
S5.000		S17
S5.001		S18
S5.002		S19
S5.003		S20
S5.004		S21
S6.000		S22
S5.005		S23
S5.006		S24
S5.007		S25
S2.008	SWTANK2OUTLET	
S2.009		S28



Micro
Drainage

for Storm

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	0.000
Hot Start Level (mm)	0	Inlet Coefficient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Online Controls 1 Number of Storage Structures 0 Number of Real Time Controls 0

Rainfall Model	FSR	Ratio R	0.351
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.000	Cv (Winter)	0.840

Analysis Timestep 2.5 Second Increment (Extended)

Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080

Water Level									Water
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Level (m)
S2.000	S1	15 Summer	100	+30%	100/15 Summer				83.446
S2.001	S2	15 Summer	100	+30%	100/15 Summer				83.228
S2.002	S3	15 Winter	100	+30%					80.571
S2.003	S4	15 Winter	100	+30%	100/15 Summer				79.988
S2.004	S6	15 Winter	100	+30%	30/15 Summer				79.386
S3.000	S7	15 Summer	100	+30%	100/15 Summer				84.971
S3.001	S8	15 Summer	100	+30%	100/15 Summer				84.473
S3.002	S8	15 Summer	100	+30%	100/15 Summer				83.657
S3.003	S9	15 Summer	100	+30%	100/15 Summer				82.206
S4.000	S10	15 Summer	100	+30%					85.225
S4.001	S11	15 Summer	100	+30%					84.556
S4.002	S12	15 Summer	100	+30%	100/15 Summer				83.577

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

PN	US/MH Name	Surcharged		Flooded		Half Drain		Pipe	Status	Level Exceeded
		Depth (m)	Volume (m ³)	Flow / Cap.	Overflow (l/s)	Time (mins)	Flow (l/s)	Flow		
S2.000	S1	0.417	0.000	0.77			73.1		SURCHARGED	
S2.001	S2	0.865	0.000	1.21			105.9		SURCHARGED	
S2.002	S3	-0.065	0.000	0.93			159.9		OK	
S2.003	S4	0.059	0.000	0.59			204.7		SURCHARGED	
S2.004	S6	1.210	0.000	0.80			250.0		SURCHARGED	
S3.000	S7	0.236	0.000	1.05			74.3		SURCHARGED	
S3.001	S8	0.202	0.000	0.85			114.5		SURCHARGED	
S3.002	S8	0.777	0.000	1.14			107.2		SURCHARGED	
S3.003	S9	0.718	0.000	1.01			144.9		SURCHARGED	
S4.000	S10	-0.054	0.000	0.89			80.5		OK	
S4.001	S11	-0.046	0.000	0.88			174.6		OK	
S4.002	S12	0.354	0.000	1.12			222.1		SURCHARGED	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S4.003	S13	15 Winter	100	+30%	100/15 Summer			
S3.004	S14	15 Winter	100	+30%	100/15 Summer			
S2.005	S15	15 Winter	100	+30%	30/15 Summer			
S2.006	S16	480 Winter	100	+30%	30/15 Summer			
S2.007	SWTANK2INLET	720 Winter	100	+30%				
S5.000	S17	15 Summer	100	+30%	100/15 Summer			
S5.001	S18	15 Summer	100	+30%	100/15 Summer			
S5.002	S19	15 Summer	100	+30%	30/15 Summer			
S5.003	S20	15 Summer	100	+30%	30/15 Summer			
S5.004	S21	15 Winter	100	+30%	100/15 Summer			
S6.000	S22	15 Summer	100	+30%	100/15 Summer			
S5.005	S23	15 Winter	100	+30%	100/15 Summer			
S5.006	S24	15 Summer	100	+30%	100/15 Summer			
S5.007	S25	480 Winter	100	+30%	30/15 Summer			
S2.008	SWTANK2OUTLET	720 Winter	100	+30%	30/30 Winter			
S2.009	S28	480 Winter	100	+30%	30/15 Summer			

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S4.003	S13	82.176	0.132	0.000	0.83			321.2	SURCHARGED
S3.004	S14	81.110	0.704	0.000	0.86			546.5	SURCHARGED
S2.005	S15	79.003	1.434	0.000	4.21			841.2	SURCHARGED
S2.006	S16	78.507	0.962	0.000	0.59			114.3	SURCHARGED
S2.007	SWTANK2INLET	78.424	0.000	0.000	0.00			83.8	SURCHARGED*
S5.000	S17	82.905	0.503	0.000	0.90			147.4	SURCHARGED
S5.001	S18	82.587	0.618	0.000	1.03			177.6	SURCHARGED
S5.002	S19	81.554	0.776	0.000	1.70			212.0	SURCHARGED
S5.003	S20	81.297	0.620	0.000	1.89			261.5	SURCHARGED
S5.004	S21	80.859	0.307	0.000	0.94			307.4	SURCHARGED
S6.000	S22	81.618	0.219	0.000	0.90			139.8	SURCHARGED
S5.005	S23	80.556	0.339	0.000	0.93			445.1	SURCHARGED
S5.006	S24	79.822	0.469	0.000	0.94			544.0	SURCHARGED
S5.007	S25	78.509	1.213	0.000	0.69			84.1	SURCHARGED
S2.008	SWTANK2OUTLET	78.242	0.900	0.000	0.24			69.9	SURCHARGED*
S2.009	S28	78.823	1.808	0.000	0.35			20.9	SURCHARGED

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

PN	US/MH Name	Level Exceeded
S4.003		S13
S3.004		S14
S2.005		S15
S2.006		S16
S2.007	SWTANK2INLET	
S5.000		S17
S5.001		S18
S5.002		S19
S5.003		S20
S5.004		S21
S6.000		S22
S5.005		S23
S5.006		S24
S5.007		S25
S2.008	SWTANK2OUTLET	
S2.009		S28

APPENDIX H

Greenfield Runoff Calculation

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Omega 2 Monks Cross Drive York YO32 9GZ		
Date 03/04/2020 12:55 File IH124 RATE.SRCX	Designed by Eluckman Checked by	
Innovyze		Source Control 2018.1
<u>ICP SUDS Mean Annual Flood</u> Input Return Period (years) 1 SAAR (mm) 790 Urban 0.000 Area (ha) 4.800 Soil 0.450 Region Number Region 3 Results 1/s QBAR Rural 24.3 QBAR Urban 24.3 Q1 year 20.9 Q1 year 20.9 Q30 years 42.7 Q100 years 50.5		
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Planning Applications
Project Managers
Renewable Energy
Risk Assessments & Remediation
Road & Drainage Design
Site Investigations
Site Supervision
Structural Engineering
Sulphate Attack Specialists
Temporary Works
Topographic & Measured Surveys
Traffic Assessments

Quality Assurance Accreditation

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Certificate no. GB.02/07

Environmental Accreditation

ISO 14001 Registered firm
Certificate no. GB.09/277b



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