FLOOD RISK AND DRAINAGE ASSESSMENT FOR A PROPOSED RESIDENTIAL DEVELOPMENT ON LAND TO THE SOUTH OF BARROW ROAD, BARTON UPON HUMBER, NORTH LINCOLNSHIRE

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Alan Wood & Partners

Alan Wood & Partners

Issuing Office
341 Beverley Road
HULL
HU5 1LD

Telephone: 01482 442138

Email: eng@alanwood.co.uk
Website: www.alanwood.co.uk

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Prepared by: A Dunn

Signed: ……
Date: 13th February 2023

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

Signed: ……
Date: 13th February 2023

Issue	Revision	Revised by	Approved by	Revised Date
A	Minor amendments to text	AD	JAG	24.02.23
B	Additional ground investigation works undertaken	AD	JAG	23.03.23
C	Site layout amended, drainage outfall locations updated and hydraulic calculations updated	JP	JAG	21.08.23
D	Minor amendments to text to suit comments	ERD	JAG	24.08.23

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APPENDICES

1.0 INTRODUCTION

1.1 Background

1.1.1 Alan Wood & Partners were commissioned by Strata to prepare a Flood Risk and Drainage Assessment for a proposed residential development on land to the south of Barrow Road, Barton-Upon-Humber in support of an application for planning consent.

1.1.2 The site is served by a new roundabout and spine road, which will be designed and constructed to the requirements of the Local Highway Authority.

1.1.3 The site is proposed to be allocated for housing in the emerging Local Plan (Ref: H1P-13) and as part of the draft allocated, a new link road is to be constructed between the A1077 and Caistor Road, including a new roundabout. The new link road will serve the development and will be designed and constructed to the requirements of the Local Highway Authority.

1.1.4 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, July 2021) 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 considers the operation and maintenance requirements for the proposed development.

1.2.8 Section 8 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.

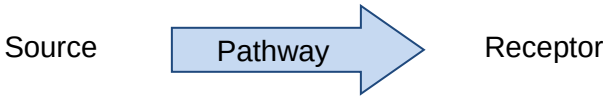
1.2.9 Section 9 of this report provides details of any recommendations for further work to mitigate against possible flooding.

1.2.10 Section 10 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. Flood risk = probability of flooding x consequences of flooding

1.3.2 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.



1.3.3 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 the NPPF is provided below.

1.4.2 Sources of Flooding

1.4.2.1 The 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.

Table 1: Forms of flooding

Flooding from Rivers (Fluvial Flooding)
Watercourses flood when the amount of water in them exceeds the flow capacity of the river channel. Flooding can either develop gradually or rapidly, depending on the characteristics of the catchment. Land use, topography and the development can have a strong influence on flooding from rivers.
Flooding from the Sea (Tidal Flooding)
Flooding to low-lying land from the sea and tidal estuaries is caused by storm surges and high tides. Where tidal defences exist, they can be overtopped or breached during a severe storm, which may be more likely with climate change.
Flooding from Land (Pluvial Flooding)
Intense rainfall, often of short duration, that is unable to soak into the ground or enter drainage systems can run quickly off land and result in local flooding. In developed areas this flood water can be polluted with domestic sewage where foul sewers surcharge and overflow. Local topography and built form can have a strong influence on the direction and depth of flow. The design of development down to a micro-level can influence or exacerbate this. Overland flow paths should be 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, the 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 There 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 (2015 Edition) direct developers towards the use of SuDS wherever possible.

2.0 EXISTING SITE DESCRIPTION

2.1 Location

2.1.1 The site occupies land to the south of Barrow Road on the eastern outskirts of Barton-Upon-Humber.

2.1.2 An aerial photograph is included in Figure 1 below, which identifies the location of the site.

Figure 1: Aerial Photograph

2.1.3 The Ordnance Survey grid reference for the centre of the site development is approximately 504230, 421605.

2.2 Site Description

2.2.1 The development site currently comprises an area of agricultural land extending to approximately 6.56 ha in area.

2.3 Surrounding Features

2.3.1 Barrow Road (A1077) forms the northern boundary of the site, beyond which lies a residential development an agricultural field and a local campsite, with a large manufacturing development lying to the north east.

2.3.2 To the east of the site lies an extensive area of agricultural land incorporating a number of farm buildings.

2.3.3 To the south of the site lies an extensive area of agricultural land.

2.3.4 To the west of the site lies an area of residential development with a secondary school beyond.

2.3.5 The River Humber lies approximately 2.2km to the north of the site.

2.3.6 The River Ancholme lies approximately 6.7km to the west of the site.

2.3.7 The River Trent lies approximately 17.5km to the west of the site.

2.3.8 The Beck and Barrow Haven lies approximately 2km to the east of the site

2.4 Topography

2.4.1 A topographic survey of the development site has been undertaken.

2.4.2 The survey has shown that the existing ground levels over the area of the development vary from approximately 21.79m to 35.26m OD(N), with the land generally sloping downwards from south to north.

2.4.3 Existing average road levels on Barrow Road to the north of the site are shown to vary from approximately 21.75m to 23.81m OD(N).

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

2.5 Ground Conditions

2.5.1 Soakaway testing has been undertaken in order to determine whether the underlying ground conditions are suitable for soakaways / infiltration methods to be used as the means for disposal of surface water run-off from the development.

2.5.2 The test report has shown that the ground conditions are not suitable for soakaways to be utilised.

2.5.3 A copy of the soakaway test report is included in Appendix B.

2.5.4 Deep infiltration tests were subsequently undertaken in order to check the suitability of the ground conditions at the design depth of the new drainage network.

2.5.5 The testing undertaken also demonstrates that the ground conditions are unsuitable for soakaways to be used as the means for disposal of surface water run-off the development.

2.5.6 A copy of these results is also included in Appendix B.

2.5.7 A desktop study of the British Geological Survey map shows that the local geology comprises superficial deposits of Till, Devensian – Diamicton. The underlying bedrock is shown to vary over the area of the site between Burnham Chalk Formation – Chalk and Welton Chalk Formation - Chalk

2.5.8 A study of the local groundwater maps show that the site overlays a Principal Aquifer and lies in an area where the groundwater vulnerability classification is ‘Medium-High’.

3.0 CONSULTATION

3.1 Consultation has taken place with Strata in order to obtain relevant information pertaining to the proposed development.

3.2 Consultation has taken place with the Environment Agency in order to obtain relevant information in respect of flood mapping, details of which are incorporated within this report.

3.3 Consultation has taken place with North Lincolnshire County Council in respect of surface water drainage in their role as Lead Local Flood Authority in the region in respect of SuDS guidance.

3.4 A copy of the email correspondence confirming the outcome of discussions undertaken with regard to SuDS requirements is appended to this report.

3.5 Consultation has been undertaken with Anglian Water Services in respect of the disposal of foul water and surface water drainage from the development.

3.6 A copy of the correspondence received from Anglian Water Services is appended to 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 construction of up to 173 residential dwellings
- New site access roads and footways
- Driveways and residential gardens
- Areas of public open space
- New electrical sub-station
- New service supplies serving the development

4.1.2 A copy of the layout drawing showing details of the proposed development is included in Appendix C. The site layout is centered around the first phase of the new link road which will bisect the site via a new four arm priority controlled roundabout. The link road and roundabout will be designed and constructed to the requirements of the LHA, albeit the detailed design has not been determined at the time of writing.

4.2 Flood Risk

4.2.1 In terms of flood risk vulnerability, the construction of buildings for residential use is classed as 'More Vulnerable' development, whilst the construction of the electrical sub-station is classed as 'Essential Infrastructure' (Table 3).

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

5.0 FOUL WATER DRAINAGE

5.1 Design Criteria

5.1.1 Based upon a development comprising 173 dwellings and with a peak flow rate of 4000 l/s per dwelling per day, in accordance with Sewerage Sector Guidance Appendix C – March 2020, the peak flow water flow from the development site would be 8 l/s (unfactored).

5.1.2 Assuming a peak flow rating of 6 is applied, this would result in a maximum discharge rate of approximately 48 l/s for design purposes.

5.2 Run-off Destination

5.2.1 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 Anglian Water Services.

5.2.2 Anglian Water Services have been consulted regarding the disposal of foul wastewater from the proposed development, and propose connection into their foul water sewers.

5.2.3 A copy of the pre-planning response from Anglian Water is included in Appendix D.

5.3 Outfall

5.3.1 At this stage of the development, the design work undertaken has shown that a gravity connection to the public sewer may be achievable.

5.3.2 The eastern parcel of development is proposed to outfall into existing public foul sewers further west under Barrow Road near the site frontage.

5.3.3 The western parcel of the proposed development is proposed to outfall separately, into the existing public foul sewers under Cornhill Drive, to the north-west of the site.

5.3.4 Both the proposed foul water outfalls end up flowing in the same public sewer further downstream.

5.3.5 A formal Section 106 Agreement with Anglian Water will be required for the connection to the public sewer.

5.3.6 Should it be found at the detailed design stage that a gravity connection to the public sewer cannot be achieved then a pumped outfall to the public sewer would be required.

5.4 Drawing

5.4.1 A drawing showing the foul water drainage strategy for the development is included within Appendix E.

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.

6.1.2 The surface water drainage strategy for the development is subject to agreement with the Local Highway Authority in respect of the layout and design of the roundabout and spine road serving the development.

6.2 Existing Site

6.2.1 From the aerial photograph included in Figure 2 below, it can be seen that the development area comprises an area of agricultural land which will consequently discharge at the greenfield run-off rate.

Figure 2: 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. Consideration should firstly be given to soakaway, infiltration, watercourse and sewer in that priority order.

6.3.2 The soakaway testing has shown that the underlying ground conditions are not suitable for soakaways to be utilised (see Section 2.5). Anglian Water Services have advised that as a last resort surface water run-off from the development can be discharged to the existing 225mm diameter public surface water in Falkland Way to the north of the development at a maximum discharge rate of 5 l/s.

6.3.3 It is therefore proposed that the surface water run-off from the development is discharged to this public sewer.

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 no property flooding or off site flooding from the critical 1 in 100 year storm event, with the additional allowance to account for climate change.

6.5 Climate Change

6.5.1 An additional allowance of 40% has been included in the preliminary surface water drainage design to account for the anticipated increase in peak rainfall due to climate change resulting from global warming in accordance with North Lincolnshire County Council SuDS Guidance.

6.6 Urban Creep

6.6.1 The project is a residential development and consequently an additional 10% allowance to the calculated impermeable roof areas will need to be included in the design to allow for urban creep.

6.7 Peak Flow Control

6.7.1 The impermeable area created by the new development has been calculated at approximately 2.734ha, based upon the layout drawing included in Appendix C.

6.7.2 The uncontrolled surface water run-off from the new development could be approximately 500l/s, based on BS EN 752 calculations, using a rainfall intensity of 50mm/hour. However, to meet the flood risk planning requirements, it is normally unacceptable to discharge flows freely from the proposed development site at an unrestricted rate.

6.7.3 Therefore, flows from the proposed development are normally limited to an agreed restricted run-off rate. For this development this will be based on 5l/s as permitted by Anglian Water Services. A separate flow controlled outfall will be provided for the roundabout and spine road highway works, as a separate phased works to the housing development.

6.7.4 It is anticipated that a gravity connection may be achievable into the Anglian Water public surface water sewers under/near the road junction of Barrow Road and Falkland Way.

6.7.5 Based upon the design criteria set out above, a hydraulic model study has been undertaken to assess the pipe sizes and the storage volumes which will need to be provided.

6.7.6 The pipe sizes required are shown to vary from 150mm diameter to 600mm in diameter.

6.7.7 Should it be found at the detailed design stage that a gravity connection to the public sewer cannot be achieved then a pumped outfall to the public sewer will be required.

6.7.8 On this basis, it would then become necessary to provide an adoptable pump station to the requirements of Anglian Water Services.

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

Table 5: Volume of Surface Water Storage Required

Storm Event	1 in 1 Probability Storm Event	1 in 30 Probability Storm Event	1 in 100 Probability Storm Event + 40%
Storage Volume Required	443m^3	1156m^3	2223m^3
Additional Storage Volume Required	Nil	713m^3	1067m^3

6.7.10 It is proposed that the full storage required to accommodate the 1 in 30 probability storm events will be contained within below ground storage tanks located in the northeast corner of the site, as shown on the drainage layout drawing.

6.7.11 It is proposed that the full storage required to accommodate the 1 in 100 probability storm events plus climate change will be contained within below ground storage tanks and a dry detention basin located in the north western area of the site, as shown on the drainage layout drawing.

6.7.12 A copy of the hydraulic model calculations is included in Appendix F.

6.8 Drawing

6.8.1 A drawing showing the proposed surface water drainage strategy for the development is included within Appendix E.

6.9 Volume Control

6.9.1 SuDS guidance advises that the run-off volume from the developed site for the 1 in 100 year 6-hour rainfall event should not exceed the greenfield run-off volume for the same event.

6.9.2 For this development the agreed discharge rate is equivalent to the greenfield run-off rate and is therefore compliant with this requirement.

6.10 Pollution Control

6.10.1 It is a requirement to ensure that the quality of any receiving body is not adversely affected by the development.

6.10.2 Investigations have revealed that the development site overlays a Principal Aquifer and lies within a Groundwater Vulnerability Zone classified as 'Medium – High'.

6.10.3 In order to minimise the risk of pollution to the final watercourse, clean roof water drainage should discharge directly into the sealed drainage network (i.e. not via gullies) and then directly towards the outfall.

6.10.4 Road drainage will be collected via trapped gullies and will also be discharged directly to the sealed drainage system.

6.10.5 On this basis, the risk of pollutants being discharged to the final receiving watercourse is extremely remote.

6.11 Designing for Exceedance

6.11.1 Flood risk from overland exceedance flows from the new surface water drainage network and from off-site sources should be mitigated to a large extent by the new surface water drainage system.

6.11.2 The ground floor construction level of the dwellings will be raised above external ground levels to shed water away from the dwellings.

6.11.3 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.

6.11.4 Any existing flood risk may reduce by the creation of a formal surface water drainage system but cannot be entirely removed.

6.11.5 Drawings showing the existing and anticipated overland surface water exceedance flood routing resulting from the development are included in Appendix G.

6.12 Highways Drainage

6.12.1 Any new drainage works will be to the required standards of the local Highway Authority.

6.12.2 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 via a formal Section 38 Agreement to the local Highway Authority.

6.13 SuDS Compliance

6.13.1 It is proposed that the development will incorporate permeable paving to the driveway areas which will incorporate attenuation storage prior to discharging to the drainage network.

6.13.2 SuDS features should be considered which would be subject to discussion and approval with the Lead Local Flood Authority (LLFA) at detailed design stage.

Such features could include:-

- The provision of rainwater harvesting
- The provision of permeable paving to reduce the velocity of the drainage discharge from impermeable areas into the drainage network
- The provision of geocellular/modular storage systems.
- The provision of bio-retention areas

6.13.3 Final details of SuDS components are to be agreed with the Lead Local Flood Authority at the detailed design stage.

6.13.4 A copy of the email correspondence summarising the discussions with the Lead Local Flood Authority regarding the SuDS requirements for the development is included in Appendix H.

6.13.5 The proposals therefore comply with policy CS19 which requires the use of SuDS, where practicable.

7.0 OPERATION AND MAINTENANCE

7.1 The drainage pipework is designed with self-cleansing gradients and consequently the network should require little or no maintenance.

7.2 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.

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.		

7.3 The final inspection chamber*(s)* prior to discharge to the storage tank and to the public sewer should be regularly inspected to ensure the system is free-flowing. See Table 7 below.

Table 7: Operation and Maintenance Requirements for Attenuation Storage Tank (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.		

7.4 Operation & maintenance requirements for the dry detention basin should be maintained as set out in Table 8 below.

Table 8: Operation and Maintenance Requirements for Detention Basins (Based on CIRIA C753 Table 22.1)

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly
	Cut grass – for spillways and access routes	Monthly (during growing season), or as required
	Cut grass – meadow grass in and around basin	Half yearly (spring – before nesting season, and autumn)
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly
	Inspect banksides, structures, pipework etc for evidence of physical damage	Monthly
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.	Monthly (for first year), then annually or as required
	Check any penstocks and other mechanical devices	Annually
	Tidy all dead growth before start of growing season	Annually
	Remove sediment from inlets, outlet and forebay	Annually (or as required)
	Manage wetland plants in outlet pool – where provided	Annually (as set out in Chapter 23)
Occasional maintenance	Reseed areas of poor vegetation growth	As required
	Prune and trim any trees and remove cuttings	Every 2 years, or as required
	Remove sediment from inlets, outlets, forebay and main basin when required	Every 5 years, or as required (likely to be minimal requirements where effective upstream source control is provided)
Remedial actions	Repair erosion or other damage by reseeding or re-turfing	As required
	Realignment of rip-rap	As required
	Repair/rehabilitation of inlets, outlets and overflows	As required
	Relevel uneven surfaces and reinstate design levels	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.

7.5 Operation & maintenance requirements for the vortex flow control should be maintained as set out in Table 8 below.

Table 9: Operation and Maintenance Requirements for 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

7.6 Operation and maintenance requirements of the drainage components, as listed above, should be undertaken in accordance with Chapter 32 of the CIRIA SuDS Manual, along with the relevant tables 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.

7.7 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).

7.8 The domestic drainage will remain the responsibility of the individual householders.

7.9 The main sewer network will be offered to Anglian Water Services for formal adoption under a Section 104 Agreement and therefore Anglian Water Services will be responsible for the operation, management and maintenance of the network in line with standard requirements and obligations. This will include underground pipes, manholes, and the surface water attenuation tanks.

7.10 The proposed dry detention basin will be designed to only attenuate surface water runoff for storm events more than (but not including) 1 in 30 year, up to the 1 in 100 year plus climate change event. As the basin will not store water in the 1 in 30 year storm events, it will not be offered for adoption by Anglian Water, and shall be maintained by a private management company.

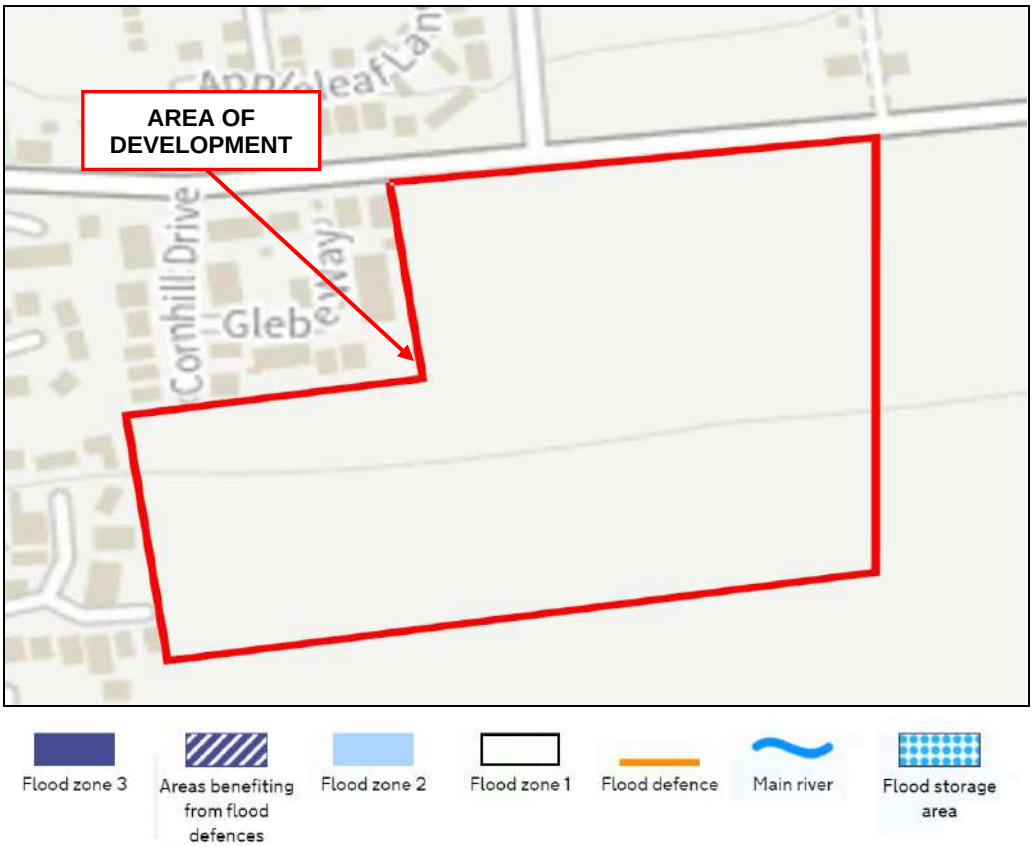
7.11 The highway drainage will form part of the Section 38 Agreement with the Highway Authority who will be responsible for future maintenance works.

8.0 FLOOD RISK ASSESSMENT

8.1 Flood Zone

8.1.1 A copy of the Environment Agency Flood Map for Planning is included in Figure 3 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 3: Environment Agency Flood map for planning dated February 2023



8.2 Fluvial Flooding

8.2.1 The River Ancholme lies approximately 6.7km to the west of the development.

8.2.2 The River Trent lies approximately 17.5km to the west of the development.

8.2.3 The Beck lies approximately 2km to the east of the development.

8.2.4 The site is considered to be sufficiently elevated and at a sufficient distance from these potential fluvial flood sources not to be at risk from a failure of the river defences during a flood situation.

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

8.3 Tidal Flooding

8.3.1 The development lies approximately 2.2km to the south of the River Humber.

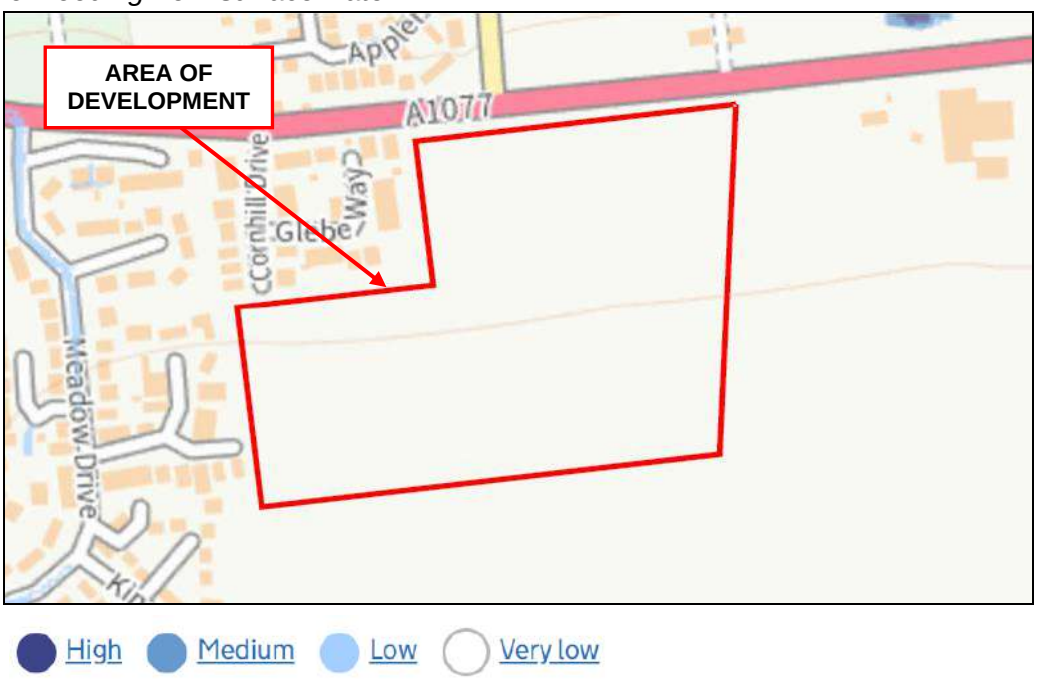
8.3.2 The site is considered to be sufficiently elevated and at a sufficient distance from this potential source of flooding not to be at risk from a failure of the river defences during a flood situation.

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

8.4 Surface Water Flooding

8.4.1 A copy of the Environment Agency map showing the extent of flooding from surface water is included in Figure 4 below.

Figure 4: Environment Agency map dated February 2023 showing the extent of flooding from surface water



8.4.2 The map shows that the development lies in an area which is considered to be at very low risk from surface water flooding.

8.4.3 On this basis, the risk of surface water flooding is therefore considered to be low and acceptable.

8.5 Flooding from Open Drainage Ditches

8.5.1 There are a number of open drainage ditches located in land to the north of Barrow Road, although there are no ditches present in the vicinity of the development site.

8.5.2 These drainage ditches are not shown to pose a risk of flooding to the site.

8.5.3 The risk of flooding from this potential flood source is therefore considered to be low and acceptable.

8.6 Groundwater Flooding

8.6.1 Groundwater flooding can occur when the sub-surface water levels are high and emerges above ground level.

8.6.2 The site is shown to overlay a Principal Aquifer and to lie in an area where the groundwater vulnerability classification is ‘Medium-High’.

8.6.3 It is not anticipated that the proposed development will involve deep excavation works and consequently the risk to the development from this potential flood source is considered to be low and acceptable.

8.7 Flood Risk from Existing Water Mains

8.7.1 There are likely to be existing water mains present in the adjacent highway and serving the adjacent residential developments.

8.7.2 There are no known issues with regard to the condition of any such water mains.

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

8.8 Flood Risk from Existing Drainage Services/Sewers

8.8.1 There are likely to be existing drainage services present in the adjacent highway and serving the adjacent residential developments.

8.8.2 There are no known issues with regard to the condition of any such drainage services.

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

8.9 Flood Risk from New Drainage Services

8.9.1 The drainage will be designed to the required standards and therefore the risk of flooding to the development or to other parties beyond the curtilage of the site will be adequately addressed.

8.9.2 The risk to the development from this potential source is therefore considered to be low and acceptable.

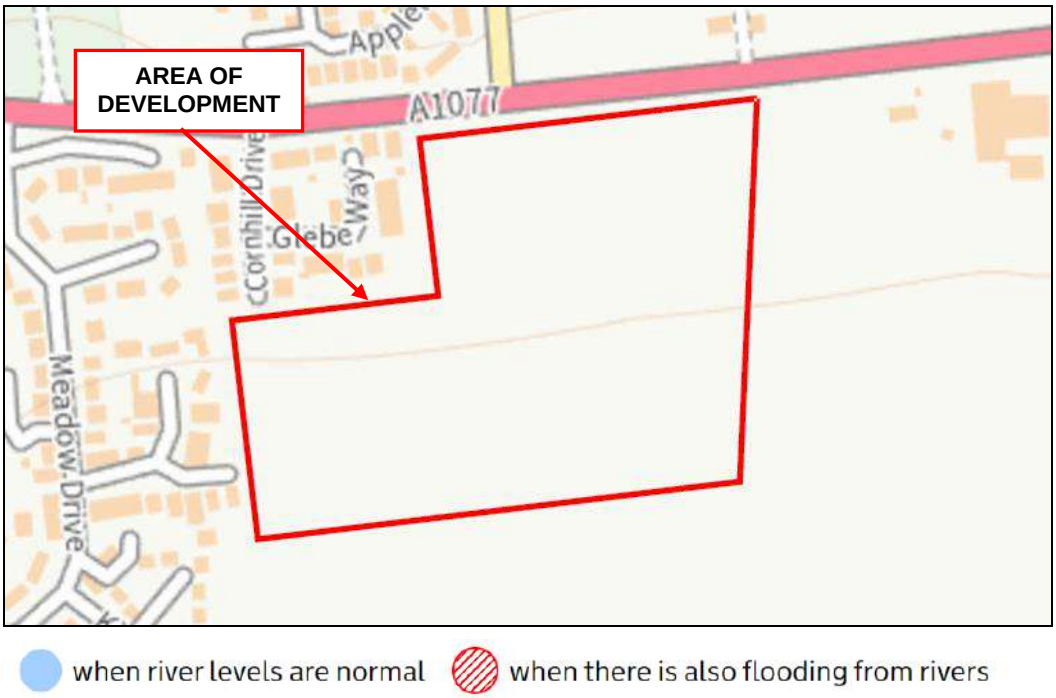
8.10 Flooding from Reservoirs, Canals and Other Artificial Sources

8.10.1 There are a number of small open lakes at the location of former clay pits along the southern bank of the River Humber at local nature reserves and leisure facilities.

8.10.2 Due to their scale these water features are not considered to pose any risk of flooding to the development should they overtop during an extreme rainfall event.

8.10.3 A copy of the map produced by the Environment Agency showing the extent of flooding from reservoirs is included in Figure 5 below.

Figure 5: Environment Agency map dated February 2023 showing the extent of flooding from reservoirs



8.10.4 The map shows that the development site is not considered to be at risk from reservoir flooding.

8.10.5 The risk to the development from reservoir flooding is considered to be low and acceptable.

8.10.6 The risk to the development from any such potential flood source is therefore considered to be low and acceptable.

9.0 FLOOD MITIGATION MEASURES

9.1 The development site is shown to lie within an area classified as 'low probability of flooding' on the maps produced by the Environment Agency.

9.2 The area of the development site is not shown to be at risk of flooding from overland surface water flooding on the maps produced by the Environment Agency.

9.3 On this basis, it is considered that the floor levels of the new residential dwellings can be constructed at traditional levels of construction, normally approximately 150mm above adjacent external ground level.

9.4 The surface water drainage for the development should be designed in accordance with Section 6 of this report to ensure the development does not create any risk of flooding from the new drainage services.

9.5 No other specific flood mitigation measures are considered necessary in respect of the proposed development.

10.0 SUMMARY

10.1 The report has been prepared to assess the flood risk and drainage implications for a proposed residential development on land to the south of Barrow Road, Barton-Upon-Humber, North Lincolnshire in support of an application for planning consent.

10.2 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 risk vulnerability (Table 3) which is considered to be appropriate development in this location in terms of flood zone compatibility (Table 4).

10.3 The surface water drainage for the development should be installed in accordance with Section 6 of this report to ensure the development does not increase the risk of flooding to other parties.

10.4 Overall, this report demonstrates that the flood risk to the site is reasonable and acceptable. The proposals therefore comply with Policy CS19 of the Core Strategy.

10.5 This report also demonstrates that the site can be suitably drained, with the development being designed to meet the required standards and guidelines of local planning policies.

10.6 It is proposed that the surface water run-off from the development will be discharged to the 225mm diameter public surface water sewer located in Falklands Way to the north of the proposed site at a maximum discharge rate of 5 l/s as advised by Anglian Water Services.

10.7 It is proposed that the foul water run-off from the western parcel of the development will be discharged to the existing foul water sewer located in Cornhill Drive to the northeast of the site, and the eastern parcel of the development to discharge to existing foul sewer located Barrow Road to the north of the site.

10.8 The private sewers will be designed and constructed to meet the requirements of the Building Regulations.

10.9 The adoptable sewer networks will be designed and constructed to meet the requirements of the local Water Authority (Anglian Water Services).

10.10 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
SITE SURVEY
BARROW ROAD
BARTON UPON HUMBER
DN18 6EY
S10328

Alan Wood & Partners

APPENDIX B

Soakaway Test Report

Our Ref: 0016/G
Your Ref: Barton Upon Humber
Date: 21st September 2022

Alan Wood and Partners
341 Beverley Road
Hull
HU5 1LD

Humberside Materials Laboratory LTD
Atherton Way, Brigg
North Lincs DN20 8AR
Tel & fax 01652 652753
Email: info@humbersidematerialslab.co.uk

Dear Sophie Williams
Barton Upon Humber, Soakaway testing

Further to your instruction soakaway testing to assess soil infiltration rates was undertaken at Barton Upon Humber during your site investigation. The soakaway testing included three trial pits (SA1, SA2 and SA3) to circa 1.4m below ground level as part of your site investigation. The trial pit locations were selected and recorded by you.

Trial pit SA1 (TP SA1) was excavated to 1.20m below ground level (bgl) with a width of 0.50m and a length of 1.90m. Water was introduced to the pit and monitored against time elapsed. An initial water level after filling was recorded at 0.90m bgl with an end depth after 180minutes of 0.90m bgl. With no drop in water level of its monitored period testing was ceased and this location was deemed unsuitable for soakaways.

Trial pit SA2 (TP SA2) was excavated to 1.40m below ground level (bgl) with a width of 0.50m and a length of 1.60m. Water was introduced to the pit and monitored against time elapsed. An initial water level after filling was recorded at 1.09m bgl with an end depth after 180minutes of 1.13m bgl. With no noticeable drop in water level of its monitored period testing was ceased and this location was deemed unsuitable for soakaways.

Trial pit SA3 (TP SA3) was excavated to 1.40m below ground level (bgl) with a width of 0.50m and a length of 1.35m. Water was introduced to the pit and monitored against time elapsed. An initial water level after filling was recorded at 0.90m bgl with an end depth after 180minutes of 0.98m bgl. With no noticeable drop in water level of its monitored period testing was ceased and this location was deemed unsuitable for soakaways.

All three trial pit (TP SA1 – SA3) locations have been deemed unsuitable for soakaways as no or negligible drop in water levels have been recorded throughout 180minutes of monitoring per pit. Available test data may deem this site as unsuitable for the inclusion of soakaways at the investigated depths. Site test data is enclosed.

If you require any further information, please contact the laboratory.

Yours Sincerely

D. Driver *Director*

Enclosed: *Test data*

Table 1: site test data from soakaway testing			
Time (minutes)	Depth to water from existing ground level (m)		
	SA1	SA2	SA3
0	0.90	1.09	0.90
0.5	0.90	1.09	0.90
1	0.90	1.09	0.90
2	0.90	1.10	0.90
5	0.90	1.10	0.91
10	0.90	1.10	0.91
15	-	1.10	0.94
30	0.90	1.12	0.95
45	0.90	-	0.96
60	0.90	1.12	0.97
75	-	-	0.98
90	0.90	1.125	0.98
105	-		0.98
120	0.90	1.13	0.98
180	0.90	1.13	0.98

MARCH 2023

Barrow Road, Barton Upon Humber Additional Soakaway Testing

PROJECT NO.
JMS/SR/BK/47697-TN001

Alan Wood & Partners

Alan Wood & Partners

Issuing Office
Hallamshire House
Meadow Court
Hayland Street
Sheffield
S9 1BY

Telephone: 01142 440077

Email: eng@alanwood.co.uk
Website: www.alanwood.co.uk

TECHNICAL NOTE – ADDITIONAL SOAKAWAY TESTING

For Strata Homes Yorkshire Limited.

Land near Barrow Road, Barton Upon Humber, DN18 6DB

Prepared By: **B. Kennerley** *BSc (Hons), MSc, GradCIWEM*

Signed: [redacted]……

Date: 8th March 2023

Approved By: **S. L. Roberts**, BEng (Hons) MSc CEnv MICE

Signed: [redacted]……

Date: 8th March 2023

Issue	Revision	Revised by	Approved by	Revised Date

1.0 INTRODUCTION

1.1.1 Alan Wood & Partners were appointed by Strata Homes Yorkshire Ltd. (the 'Client') to undertake deep borehole soakaways to supplement a previous Phase II intrusive investigation on the proposed development site at Barrow Road, Barton Upon Humber to assess the potential for disposing of surface water drainage via deep soakaways.

1.1.2 This report provides geotechnical information in relation to the proposed redevelopment of the site for a residential development, assuming that ground levels will remain similar to present. Interpretation and recommendations should not be assumed valid for adjacent areas of land, or for alternative land uses. Should the proposed site usage change, the recommendations and conclusions presented in this report may need to be re-assessed.

1.1.3 The findings and recommendations given in this report are based on fieldwork undertaken between the 22nd and 24th of February 2023, comprising the completion of three rotary cored boreholes to three depths of 3mbgl, 7mbgl and 10mbgl and at each depth in each borehole soakaway percolation tests were performed.

1.1.4 This report presents factual and interpretative geotechnical information relevant to the objectives of the investigation for the site end-use given above. The report has been prepared for the titled project and Alan Wood and Partners can accept no responsibility or liability for the consequences of the use of this document, wholly or in part, for any other purpose than that for which it was commissioned.

1.1.5 The conclusions and recommendations presented in this report are based on site-specific information obtained during the investigation. They should not necessarily be relied upon to represent site conditions at a substantially later date.

1.1.6 The findings and opinions provided in this report are given in good faith and are subject to the limitations and constraints imposed by the methods and information sources described. Professional judgement and experience are used to ensure that uncertainties are reduced to a level appropriate to the site conditions, the purpose of the investigation and the resources devoted to it by the Client.

1.1.7 Whilst every effort has been made to carry out an assessment that enables a realistic characterisation of the geotechnical parameters at the site, the possibility of significant spatial variation in actual ground and groundwater conditions existing between or beyond exploratory hole locations cannot be discounted. Where information or opinion is given this is for guidance only.

Further information, ground investigation, construction activities, change of site use or the passage of time may reveal conditions that were not indicated in the data and therefore could not have been considered in the preparation of this report. Where such information might impact upon stated opinions, Alan Wood and Partners cannot accept responsibility for conditions not encountered and reserves the right to modify or retract the opinions expressed in this report. Where opinions expressed are based on current available guidelines and legislation, no liability can be accepted by AWP for the effects of any future changes to such guidelines and legislation. New information of improved practices and changes in legislation may require reinterpretation of the report as a whole, or in part.

1.1.8 All ground investigation works and soil descriptions were undertaken in general accordance with BS EN ISO 14688-1 &Geotechnical Investigation and Testing – Identification and Classification of Soil9(2018), BS10175 (2011), BS 5930 (2015) and/or BS EN 1997-1:2004 (Part 1, General Rules) and BS EN 1997-2:2007 (Part 2, Ground Investigation and Testing).

2.0 SITE DETAILS AND DESCRIPTION

2.1 Introduction

2.1.1 The geo-environmental investigation of the site has been carried out in three phases. A Phase I preliminary assessment (desk-based study) has previously been completed by Alan Wood & Partners (Ref: JMS/SLR/SW/47697-Rp-001, dated 5th of October). A subsequent Phase II (intrusive) investigation has been completed by Alan Wood & Partners (Ref: JMS/SLR/SW/47697-Rp-001, dated 5th of October) and deep borehole soakaways, reported herein.

2.1.2 Shallow soakaway tests were carried out during the intrusive ground investigation and the report concluded that the use of soakaway drainage would be considered unsuitable for this site.

2.1.3 A subsequent day of deep soakaways has been completed by AWP on the basis of the findings of the previous report. The results of the recent intrusive soakaway investigation are presented in this technical note.

2.2 Site Location and Description

2.2.1 The site is located off Barrow Road, Barton Upon Humber, and is centred at national gird reference (NGR) 504209mE, 421598mN. A site location plan is shown appended on Figure 47697/001.

2.2.2 The site is currently an open field to the south of Barrow Road with residential development to the east and north and agricultural land to the south and west of the site.

2.2.3 Published geological mapping for the site indicates potential superficial deposits of Till, Devensian comprising of a mixture clay, sand and gravel. Bedrock is recorded as the Welton Chalk Formation to the north and Burnham Chalk Formation to the south.

2.2.4 The superficial soils below the site are designated as a Secondary (Undifferentiated) aquifer. The bedrock aquifer is designated as a Principal aquifer.

3.0 GROUND INVESTIGATION FIELDWORK

3.1 Ground Investigation Objectives

3.1.1 A ground investigation was carried out to identify the potential for soakaway drainage in relation to the proposed development work at the site. The scope of works consisted of advancing three trial pits (BH1-BH3) to three depths 3mbgl, 7mbgl and 10mbgl and performing one soakaway test in each of the boreholes at each of the depths.

3.1.2 The positions of the exploratory locations are limited to areas of the site, within the site boundary, that were accessible during the works. The positions of the exploratory holes are shown on the appended ground investigation plan, Figure 47697/003.

3.1.3 The following objectives of the ground investigation were therefore to:

- Confirm the lateral and vertical extent of any made ground soils, the nature of the underlying natural ground at selected positions across the area under investigation;
- Determine the depth to groundwater where possible and the stability of excavation;
- Undertake soakaway testing to determine the infiltration rate of the soil to aid potential soakaway design.

4.0 RESULTS OF THE INVESTIGATION

4.1 Ground Conditions Encountered

4.1.1 The ground conditions encountered are summarised in Table 1, while discussion about each one is given in the following paragraphs. A copy of the ground investigation logs is appended to this report.

4.1.2 The deep soakaways used open hole drilling to reach the 3m, 7m and 10mbgl resulting in no cores to be logged. Therefore, the ground conditions encountered in Table 1 have been taken from the Phase II Intrusive ground investigation report.

Table 1 - Summary of Encountered Ground Conditions

Lithology	Exploration Location	Approximate proven depth (m) to base from existing ground level	Approximate Thickness (m)	Approximate allowable bearing capacity (kN/m^2)
Topsoil	All locations	0.3 – 0.55	0.3 – 0.55	Nil
Sand	TP01, TP02, TP03, TP07, TP10, TP18, TP19, TP22, TP23,	0.35 – 1.05	0.20 – 0.95	100
Clay	CBR02, CBR03, CBR04, CBR05, CBR06, TP12, TP13, TP14, TP20	0.3 – 1.5	0.25 – 1.1	150
Sand containing weathered chalk	TP01, TP18 AND CBR04	0.80 – 1.90	0.10 – 1.10	150
Chalk Bedrock	All locations except TP12	Base not proven		150
Groundwater	Groundwater was encountered at approximately 6.2mbgl.			

*Base not proven.

4.1.3 **Topsoil**: Topsoil was encountered within all locations to a maximum depth of 0.60m bgl. This typically comprised sand with frequent rootlets.

4.1.4 **Natural Strata**: The underlying natural strata of the site comprised of a silty sand underlain by a firm clay.

4.1.5 **Bedrock**: The underlying bedrock is comprised of chalk.

4.1.6 **Groundwater**: Groundwater was encountered on the northern part of site at depths of around 6.2mbgl.

4.1.7 No visual or olfactory evidence of gross contamination, such as hydrocarbons, was recorded during the ground investigation.

Table 2 – Summary of Shallow Soakaway Testing

Location	Soakage Area Dimensions (average m^2)	Test Depth (m bgl)	Infiltration Rate (m/sec)
TP12 (SA1)	0.95	1.2	Unable to calculate infiltration rate as 25% effective depth not achieved
TP13 (SA2)	0.8	1.4	
TP18 (SA3)	0.675	1.4	

Table 3 – Summary of Deep Soakaway Testing

Location	Test Depth (m bgl)	Casing Depth (m bgl)	Starting Water Depth (m bgl)	Approximate water per test (litres)	Infiltration Rate (m/sec)
BH1	3	2.5	-	200	Unable to generate a head
BH1	7	3	-	200	Unable to generate a head
BH1	10	3	-	250	Unable to generate a head
BH2	3	1.5	-	200	Unable to generate a head
BH2	7	4.5	-	200	Unable to generate a head
BH2	10	4.5	5.1	250	$2.4x10^{-8}$
BH3	3	2.5	1.5	200	$4.4x10^{-7}$
BH3	7	2.5	1.8	200	$2.5x10^{-7}$
BH3	10	2.5	3.0	300	$1.9x10^{-7}$

5.0 GEOTECHNICAL ASSESSMENT

5.1 Drainage and Soakaways

5.1.1 In situ permeability testing was conducted between the 22nd and 24th of February 2023 by Dynamic Sampling Ltd.

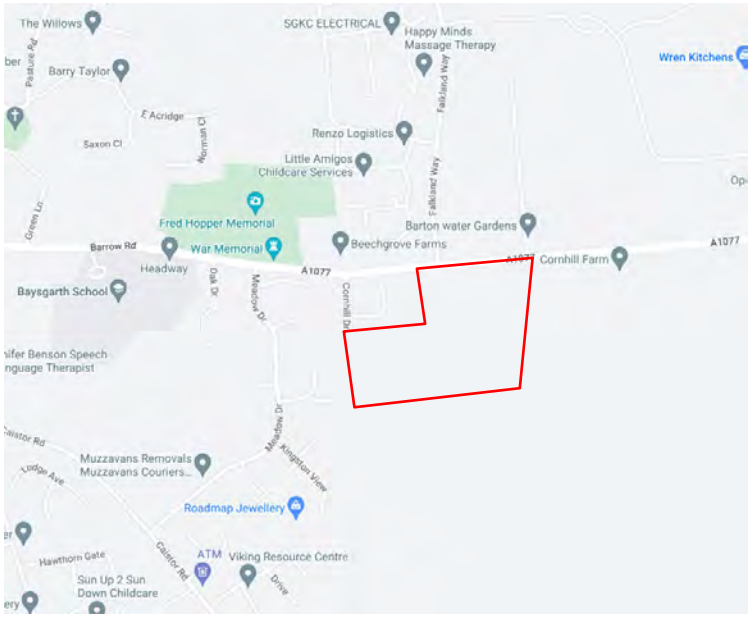
5.1.2 The soakaways were carried out at depths of 3m, 7m and 10mbgl in the bedrock. The bedrock to the south of the site is the Burnham Chalk Formation and to the north lies the Welton Chalk Formation.

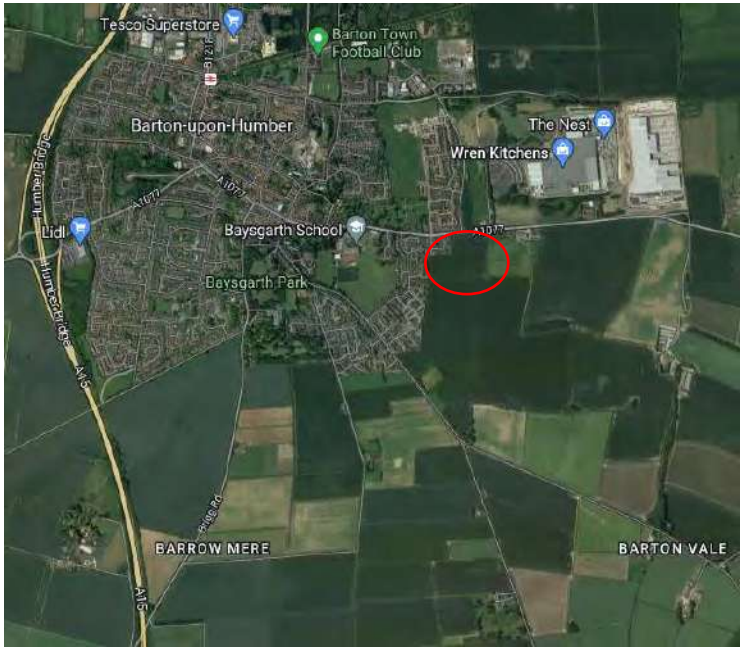
5.1.3 Based on the testing carried out on site it is unlikely that soakaway drainage will be suitable for use at the site given that insufficient infiltration of water was observed. A copy of the test results is appended to this document.

5.1.4 Alternative methods of disposal of surface water will need to be determined.

Alan Wood & Partners

FIGURES





Key

Site Location

Approximate Red Line Boundary

N

DO NOT SCALE

Alan Wood & Partners

Client. **Strata Homes Yorkshire Limited**		
Project. **Barrow Road, Barton Upon Humber**		
Drawing. **Site Location Plan**		
Date. **16.09.22**	Scale. **NTS**	
Drawn by. **SW**	Check by. **SLR**	Approved by. **SLR**
Status: **INFO**		
Job no. **47697**	Fig. no. **001**	Rev.

DO NOT SCALE

TP# Approximate Trial Pit Location

CBR# Approximate CBR Test Location

Alan Wood & Partners

Client.	**Strata Homes Yorkshire Ltd**		
Project.	**Barrow Road, Barton Upon Humber**		
Drawing.	**Exploratory Hole Location Plan**		
Date. **16.09.22**		Scale. **NTS**	
Drawn by. **SW**	Check by. **SLR**	Approved by. **SLR**	
Status:	**FOR INFORMATION**		
Job no. **47697**	Fig. no. **002**	Rev.	

DO NOT SCALE

Approximate Borehole Location

Alan Wood & Partners

Client.	**Strata Homes Yorkshire Ltd**		
Project.	**Barrow Road, Barton Upon Humber**		
Drawing.	**Bore Hole Soak Away Location Plan**		
Date. **20.2.23**		Scale. **NTS**	
Drawn by. **BK**	Check by. **SLR**	Approved by. **SLR**	
Status:	**FOR INFORMATION**		
Job no. **47697**	Fig. no. **003**	Rev.	

APPENDIX A

Falling Head Test

In-situ Infltration Testing - Falling Head Permeability Test Results
Barrow Road, Barton Upon Humber
47697

Alan Wood & Partners

Falling Head Test

Borehole	BH2	
Date of Test	22.2.23	
Borehole Depth	10.00	m
Casing Depth	4.50	m
Casing Diameter (D)	0.08	m
Water Level Below Surface	5.60	m
Water Depth	5.10	m
Height of casing above ground level	0.00	m
Approximate long term water table	10.00	m

General Approach (after BS 5930 : 1999)

$$k = \frac{A}{F\left(t_2 - t_1\right)} \log_e \frac{H_1}{H_2}$$

Where

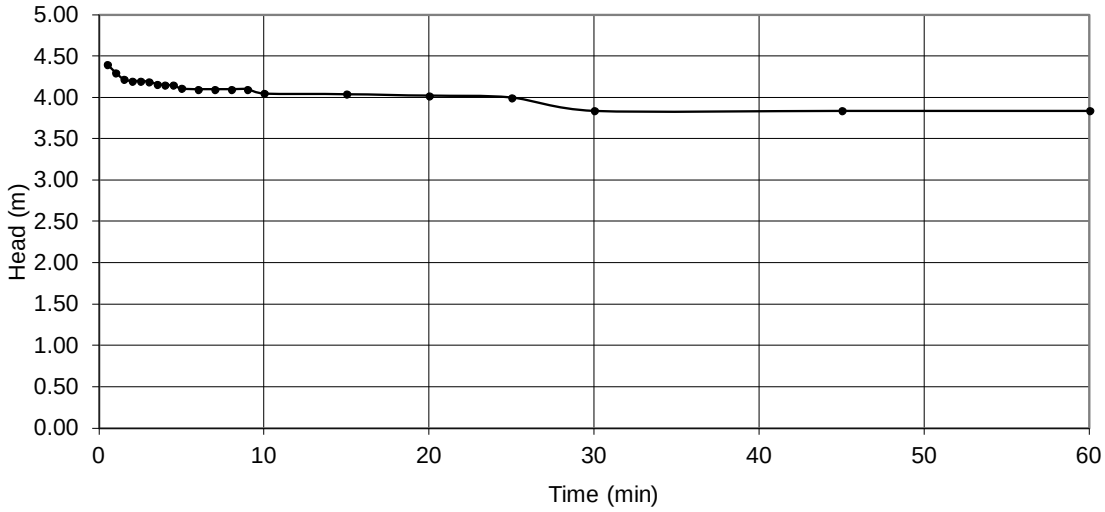
- k is the permeability of the soil
- F is the intake factor
- H_1 is the variable head measured at time t_1 after the commencement of the test
- H_2 is the variable head measured at time t_2 after the commencement of the test
- A is the cross sectional area of the borehole casing

Therefore

F =	8.59	
A =	0.005	m
H_1 =	4.40	m
H_2 =	3.84	m
t_1 =	0.5	min
t_2 =	60	min

k = 2.4E-08 m/s

Time (min)	Depth (m)	Head (m)
0.5	5.60	4.40
1	5.70	4.30
1.5	5.78	4.22
2	5.80	4.20
2.5	5.80	4.20
3	5.81	4.19
3.5	5.84	4.16
4	5.85	4.15
4.5	5.85	4.15
5	5.89	4.11
6	5.90	4.10
7	5.90	4.10
8	5.90	4.10
9	5.90	4.10
10	5.95	4.05
15	5.96	4.04
20	5.98	4.02
25	6.00	4.00
30	6.16	3.84
45	6.16	3.84
60	6.16	3.84



In-situ Infltration Testing - Falling Head Permeability Test Results
Barrow Road, Barton Upon Humber
47697

Alan Wood & Partners

Falling Head Test

Borehole	BH3
Date of Test	23.2.23
Borehole Depth	3.00 m
Casing Depth	2.50 m
Casing Diameter (D)	0.08 m
Water Level Below Surface	2.00 m
Water Depth	1.00 m
Height of casing above ground level	0.00 m
Approximate long term water table	3.00 m

General Approach (after BS 5930 : 1999)

$$k = \frac{A}{F\left(t_2 - t_1\right)} \log_e \frac{H_1}{H_2}$$

Where

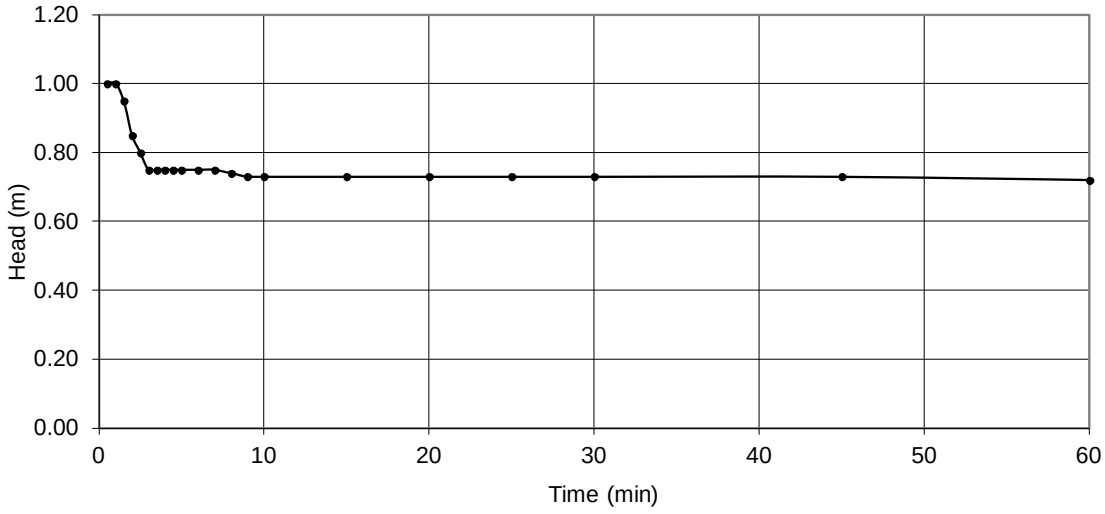
- k is the permeability of the soil
- F is the intake factor
- H_1 is the variable head measured at time t_1 after the commencement of the test
- H_2 is the variable head measured at time t_2 after the commencement of the test
- A is the cross sectional area of the borehole casing

Therefore

F =	1.13
A =	0.005 m
H_1 =	1.00 m
H_2 =	0.72 m
t_1 =	0.5 min
t_2 =	60 min

k = 4.4E-07 m/s

Time (min)	Depth (m)	Head (m)
0.5	2.00	1.00
1	2.00	1.00
1.5	2.05	0.95
2	2.15	0.85
2.5	2.20	0.80
3	2.25	0.75
3.5	2.25	0.75
4	2.25	0.75
4.5	2.25	0.75
5	2.25	0.75
6	2.25	0.75
7	2.25	0.75
8	2.26	0.74
9	2.27	0.73
10	2.27	0.73
15	2.27	0.73
20	2.27	0.73
25	2.27	0.73
30	2.27	0.73
45	2.27	0.73
60	2.28	0.72



In-situ Infltration Testing - Falling Head Permeability Test Results
Barrow Road, Barton Upon Humber
47697

Alan Wood & Partners

Falling Head Test

Borehole	BH3	
Date of Test	23.2.23	
Borehole Depth	7.00	m
Casing Depth	2.50	m
Casing Diameter (D)	0.08	m
Water Level Below Surface	2.30	m
Water Depth	1.80	m
Height of casing above ground level	0.00	m
Approximate long term water table	7.00	m

General Approach (after BS 5930 : 1999)

$$k = \frac{A}{F\left(t_2 - t_1\right)} \log_e \frac{H_1}{H_2}$$

Where

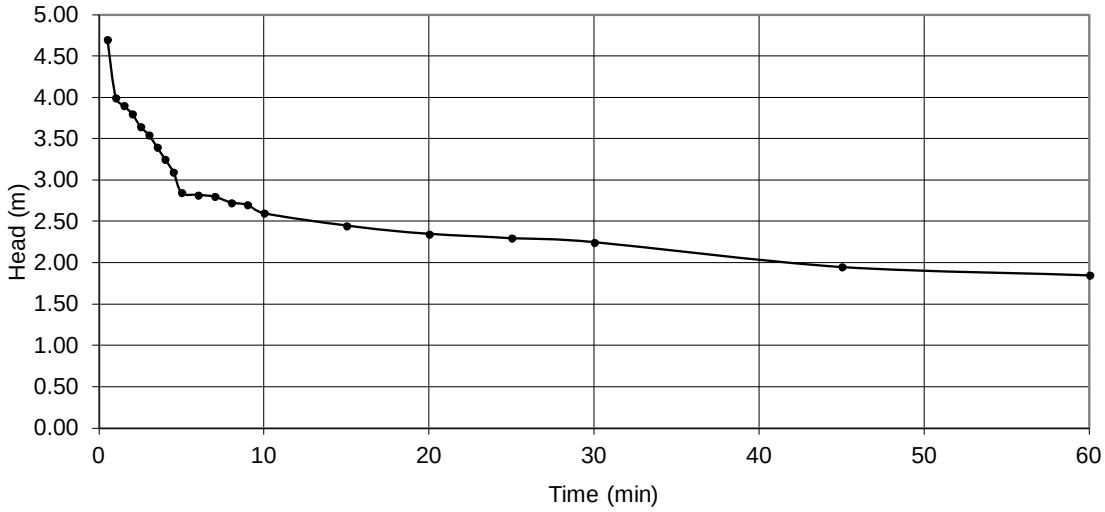
k	is the permeability of the soil
F	is the intake factor
H_1	is the variable head measured at time t_1 after the commencement of the test
H_2	is the variable head measured at time t_2 after the commencement of the test
A	is the cross sectional area of the borehole casing

Therefore

F =	5.69	
A =	0.005	m
H_1 =	4.70	m
H_2 =	1.85	m
t_1 =	0.5	min
t_2 =	60	min

k = 2.5E-07 m/s

Time (min)	Depth (m)	Head (m)
0.5	2.30	4.70
1	3.00	4.00
1.5	3.10	3.90
2	3.20	3.80
2.5	3.35	3.65
3	3.45	3.55
3.5	3.60	3.40
4	3.75	3.25
4.5	3.90	3.10
5	4.15	2.85
6	4.18	2.82
7	4.20	2.80
8	4.27	2.73
9	4.30	2.70
10	4.40	2.60
15	4.55	2.45
20	4.65	2.35
25	4.70	2.30
30	4.75	2.25
45	5.05	1.95
60	5.15	1.85



In-situ Infltration Testing - Falling Head Permeability Test Results
Barrow Road, Barton Upon Humber
47697

Alan Wood & Partners

Falling Head Test

Borehole	BH3	
Date of Test	23.2.23	
Borehole Depth	10.00	m
Casing Depth	2.50	m
Casing Diameter (D)	0.08	m
Water Level Below Surface	3.15	m
Water Depth	3.00	m
Height of casing above ground level	0.00	m
Approximate long term water table	10.00	m

General Approach (after BS 5930 : 1999)

$$k = \frac{A}{F\left(t_2 - t_1\right)} \log_e \frac{H_1}{H_2}$$

Where

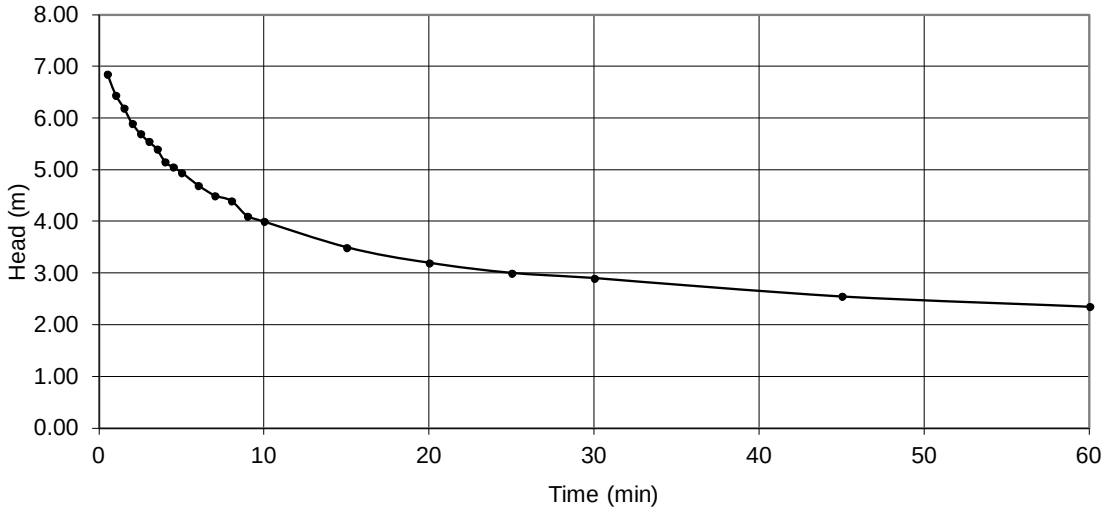
k	is the permeability of the soil
F	is the intake factor
H_1	is the variable head measured at time t_1 after the commencement of the test
H_2	is the variable head measured at time t_2 after the commencement of the test
A	is the cross sectional area of the borehole casing

Therefore

F =	8.59	
A =	0.005	m
H_1 =	6.85	m
H_2 =	2.35	m
t_1 =	0.5	min
t_2 =	60	min

k = 1.9E-07 m/s

Time (min)	Depth (m)	Head (m)
0.5	3.15	6.85
1	3.55	6.45
1.5	3.80	6.20
2	4.10	5.90
2.5	4.30	5.70
3	4.45	5.55
3.5	4.60	5.40
4	4.85	5.15
4.5	4.95	5.05
5	5.05	4.95
6	5.30	4.70
7	5.50	4.50
8	5.60	4.40
9	5.90	4.10
10	6.00	4.00
15	6.50	3.50
20	6.80	3.20
25	7.00	3.00
30	7.10	2.90
45	7.45	2.55
60	7.65	2.35



Alan Wood & Partners

Hull Office	**Leeds Office**	**Lincoln Office**
(Registered Office)	Suite 26	Unit H
341 Beverley Road	Brabazon House	The Quays
Hull	Turnberry Park	Burton Waters
HU5 1LD	Leeds LS27 7LE	Lincoln LN1 2XG
Telephone	**Telephone**	**Telephone**
01482.442138	0113.May5311098	01522.300210
Scarborough Office	**Sheffield Office**	**York Office**
Kingsley House	Hallamshire House	Omega 2
7 Pickering Road	Meadow Court	Monks Cross Drive
West Ayton	Hayland Street	York
Scarborough YO13 9JE	Sheffield S9 1BY	YO32 9GZ
Telephone	**Telephone**	Telephone
01723.865484	01142.440077	01904 611594
Email	**Website**	
eng@alanwood.co.uk	www.alanwood.co.uk	

Our Services

BIM Processes
Blast Design
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Road & Drainage Design
Site Investigations
Site Supervision
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Temporary Works
Topographic & Measured Surveys
Traffic Assessments

Quality Assurance Accreditation
ISO 9001 Registered firm
Certificate no. GB.02/07

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


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APPENDIX C

Layout Drawing

BARROW ROAD | BARTON UPON HUMBER

All work to be carried out in accordance with the requirements of the Building Regulations,Water Authority and the Construction (Design and Management) Regulations currently in force.

Do not scale from this drawing. Architect to be notified of any discrepancies.

Verify relevant dimensions on site before commencing work or preparing shop drawings. This drawing is copyright.

Rev	Date	Description	By	Checked
A	-	-	-	-
B	04.01.23	Layout revised plot numbers have increased to 169 from 168. Raised tables included, sales area relocated, sheds and paths moved to retain hedgerow.	AW	LA
C	17.01.23	Welcome centre relocated inside double garage. Private drive near plots 1-5 straightened and now includes turning head. Access added from front of plots to public highway. Plots 7 & 8 parking re-worked. Gates and paths re-worked across the site. Plots 12 & 13 mirrored. Eliminated paths and created shared ones where possible. 'Dead ' POS space worked into rear gardens where possible. Plots 36, 53, 128 & 135 parking moved towards front of plot. Roads rounded off to eliminate harsh corners. Drive rotated to be perpendicular to plots 135-138, bin collection added. Reworked plots 121-124. Mirrored plots 158-159 to have meter boxes to drives. Pedestrian link added to existing path near plot 52. Plots 29-32, 80-81, 42-45 pulled to align with build line. Low level hedging added along main spine road.	GF	LA
D	08.02.23	Layout revised following tracking comments. Visibility splays on bends and private drives have been included.	AW	GF
E	20.03.23	Layout revised following title boundary updated and ransom strip. Plots 53 and 54 rear boundary revised to offset from existing building. Plots 36-52 moved north.	AW	GF
F	16.06.23	Layout revised to updated drainage and link road.	AW	GF
G	02.08.23	Layout revised following updated roundabout and link road design.	AW	GF
H	04.08.23	Red line boundary revised to incorporate the roundabout. Bin collection points added to private drives.	AW	KM
I	15.08.23	Layout revised following forward visibility and tracking comments.	AW	KM

SITE LAYOUT KEY:

- 1800 HIGH SCREEN WALL — standard detail reference: SD10.EX.06 & 07 - refer to materials plan for brick/stone
- 1800 HIGH CLOSE BOARDED TIMBER FENCE — standard detail reference: SD10.EX.17
- 1200 HIGH CLOSE BOARDED TIMBER FENCE — standard detail reference: SD10.EX.153
- RED LINE APPLICATION BOUNDARY
- 900mm WIDE REAR ACCESS GATE
- 1800x2700 HARD STANDING AREA FOR REFUSE BINS
- SH — SHOW HOMES
- WC — WELCOME CENTRE
- WELCOME CENTRE VISITOR PARKING
- LOW LEVEL BOUNDARY HEDGING
- DENOTES TURF (PRIVATE)
- DENOTES TURF (PUBLIC) - turf areas to Public Open Spaces to be maintained by Management Company
- ELECTRIC VEHICLE CHARGING POINTS
- DENOTES 6'x4' TIMBER SHED - refer to specific detail for shed base
- DENOTES 900mm WIDE PATH - refer to specific detail for composition
- DENOTES SUB STATION - refer to services layout for details
- DENOTES LANDSCAPED BIN COLLECTION POINT — 900x900mm hard standing area per plot served. Refer to standard detail SD.10.113

PLEASE REFER TO LANDSCAPE DRAWINGS FOR ALL LANDSCAPE DETAILS

PLEASE REFER TO ENGINEERING DRAWINGS FOR ALL ENGINEERING DETAILS

ACCOMMODATION SCHEDULE

SITE NAME:
DRAWING NUMBER:

HOUSE TYPE	SALES NAME	NO	SQ.FT	TOTAL SQ.FT	SQ.M	TOTAL SQ.M	%	REGULATORY COMPLIANCE	BEDS	PEOPLE	STOREY	CONFIGURATION	LAND SEGMENT
OPEN MARKET - CORE (#MIY)													
2-300	205-M43 (WHEEL CHAIR USER BUNGALOW)	1	858	858	80	80	0.6%	M4/3 / NDSS	2	3	1	BUNGALOW	A
3-703	MALMO	46	998	45,908	93	4,265	26.6%	M4/2 / NDSS	3	4	2	SEMI-DETACHED/TERRACE	B
MY-PL-302	GENEVA	57	1,204	68,628	112	6,376	32.9%	M4/1 / NDSS	3	5	2.5	SEMI-DETACHED/TERRACE	B
MY PL 404	ROSAS (3 BED PLUS STUDY)	28	1,246	34,888	116	3,241	16.2%	M4/1 / NDSS	3	5	2.5	SEMI-DETACHED	B
S-301	BOLOGNA (CT) (3 BED PLUS STUDY)	7	1,235	8,645	115	803	4.0%	M4/1 / NDSS	3	5	2	DETACHED	B/C
S-102	OPORTO (3 BED PLUS STUDY)	24	1,345	32,280	125	2,999	13.9%	M4/1 / NDSS	3	6	2.5	SEMI-DETACHED /DETACHED	B/C
4-301	COPENHAGEN	10	1,350	13,500	125	1,254	5.8%	TBC	4	6	2	DETACHED	B/C
	OPEN MARKET TOTALS:	173		203,849		18,938	100.0%						
	TOTALS:	173		203,849		18,938	100.0%						

Area Gross:	6.56	Hectares
Area Gross:	16.210088	Acres
Non Developable/POS area	0.5	Hectares
Non Developable/POS area	1.235526	Acres
Developable area	6.06	Hectares
Developable area	14.974563	Acres
Density:	28.55	Units / Hectare
Density:	11.55	Units / Acre
Sq.ft/acre	13613.02	Sq.ft/acre
Sq. Metres/Hectare	3125.09	Sq. Metres/Hectare

M4/2 PERCENTAGE	M4/2 PLOT TOTAL
32.4%	56

M4/3 PERCENTAGE	M4/3 PLOT TOTAL
0.6%	1

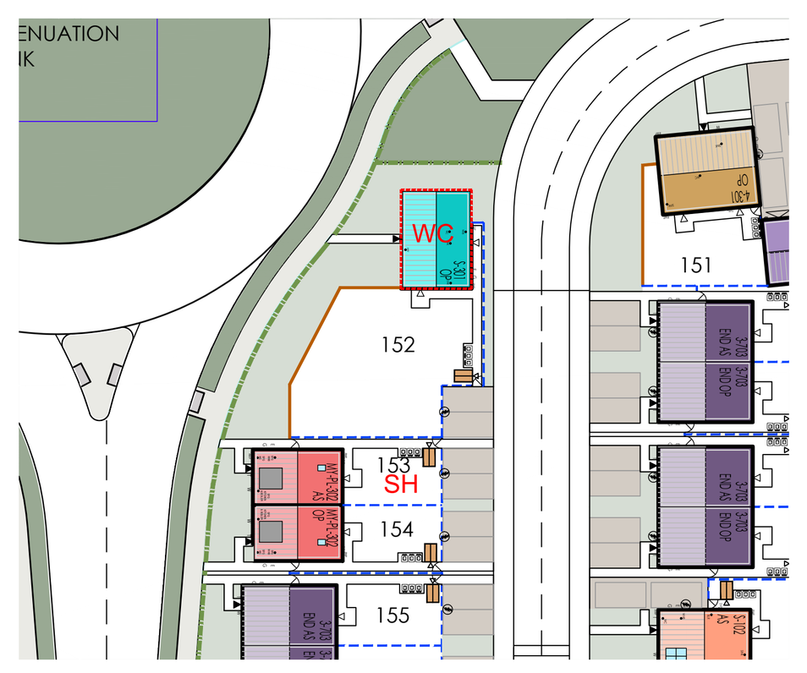
HOUSETYPE RANGE: MIY

SPECIFICATION TYPE: TBC

LAND CLUSTER: 3 (E. YORKS)

LAND SEGMENT: B

DRAWING STAGE: 3-PLANNING



SHOW HOME COMPLEX

LANDSCAPE SPEC: SILVER

strata

strata homes limited | quay point | lakeside | doncaster | DN4 5PL
t: 01302 308508 www.strata.co.uk

scale: 1:500 @ A0 drawn by: AW date: 19/12/2022

Project: Barrow Road, Barton upon Humber DN18 6DB

Drawing: Planning layout

Planning Ref: N/A

Drawing Number: 22-CL3-SEGB-BR-01-PL

Revision: I

Alan Wood & Partners

APPENDIX D

Anglian Water Pre-Planning Response

Pre-Planning Assessment Report

Barrow Road Barton-upon-Humber

InFlow Reference: PPE-0151737

Assessment Type: Used Water

Report published: 29/07/2022

Thank you for submitting a pre-planning enquiry.

This has been produced for Alan Wood & Partners.

Your reference number is **PPE-0151737**.

This report can be submitted as a drainage strategy for the development should it seek planning permission.

If you have any questions upon receipt of this report, you can submit a further question via InFlow. Alternatively, please contact the Planning & Capacity team on **07929 786 955** or email planningliaison@anglianwater.co.uk

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Section 1 - Proposed development

The response within this report has been based on the following information which was submitted as part of your application:

List of planned developments	
Type of development	**No. Of units**
Dwellings	172

The anticipated residential build rate is:

Year	Y1	Y2	Y3	Y4
Build rate	50	50	50	22

Development type: Greenfield

Planning application status: Pending Consideration

Site grid reference number: TA0419421607

The comments contained within this report relate to the public water mains and sewers indicated on our records.

Your attention is drawn to the disclaimer in the useful information section of this report.

Section 2 - Assets affected

Our records indicate that we have the following types of assets within or overlapping the boundary of your development site as listed in the table below.

Additionally, it is highly recommended that you carry out a thorough investigation of your proposed working area to establish whether any unmapped public or private sewers and lateral drains are in existence. We are unable to permit development either over or within the easement strip without our prior consent. The extent of the easement is provided in the table below.

Please be aware that the existing water mains/public sewers should be located in highway or open space and not in private gardens. This is to ensure available access for any future maintenance and repair, and this should be taken into consideration when planning your site layout.

Water and Used water easement information		
Asset type	Pipe size (mm)	Total easement required (m)
Water mains	146	4.50 m overall easement
Water mains	50	4.50 m overall easement

If it is not possible to avoid our assets then these may need to be diverted in accordance with Section 185 of the Water Industry Act (1991). You will need to make a formal application if you would like a diversion to be considered.

Due to the private sewer transfer in October 2011 many newly adopted public used water assets and their history are not indicated on our records. You also need to be aware that your development site may contain private water mains, drains or other assets not shown on our records. These are private assets and not the responsibility of Anglian Water but that of the landowner.

Section 3 - Water recycling services

In examining the used water system we assess the ability for your site to connect to the public sewerage network without causing a detriment to the operation of the system. We also assess the receiving water recycling centre and determine whether the water recycling centre can cope with the increased flow and effluent quality arising from your development.

Water recycling centre

The foul drainage from the proposed development is in the catchment of Barton On Humber Water Recycling Centre, which currently has capacity to treat the flows from your development site.

Anglian Water cannot reservecapacity and the available capacity at the water recycling centre can be reduced at any time due to growth, environmental and regulation driven changes.

Used water network

Our assessment has been based on development flows connecting to the nearest foul water sewer of the same size or greater pipe diameter to that required to drain the site. The infrastructure to convey foul water flows to the receiving sewerage network is assumed to be the responsibility of the developer. Conveyance to the connection point is considered as Onsite Work and includes all work carried out upstream from of the point of connection, including making the connection to our existing network. This connection point has been determined in reference to the calculated discharge flow and on this basis, a 150mm internal diameter pipe is required to drain the development site. The nearest practicable connection is to the 150mm diameter sewer at manhole 1701 in Barrow Road at National Grid Reference NGR TA0411621722. The cover level is 22.85 and the invert level is 21.65. Anglian water has assessed the impact of gravity flows from the planned development to the public foul sewerage network. We can confirm that this is acceptable as the foul sewerage system, at present, has available capacity for your site. Please note that Anglian Water will request a suitably worded condition at planning application stage to ensure this strategy is implemented to mitigate the risk of flooding.

It is assumed that the developer will provide the necessary infrastructure to convey flows from the site to the network. Consequently, this report does not include any costs for the conveyance of flows.

Surface water disposal

In principle, your proposed method of surface water disposal is acceptable to Anglian Water. It is our understanding that the evidence to confirm compliance with the surface water hierarchy is not available. Once the evidence has been confirmed, then a connection point may be made to manhole 2751 in Falkland Way at NGR TA0420721754 at a maximum rate of 5l/s. Our assessment has been based on development flows connecting to the nearest surface water sewer of the same size or greater pipe diameter. It is your responsibility to provide the evidence to confirm that all alternative methods of surface water disposal have been explored and these will be required before your connection can be agreed. This is subject to satisfactory evidence which shows the surface water management hierarchy as outlined in Building Regulations Part H has been explored. This would encompass the results from the site specific infiltration testing and/or confirmation that the flows cannot be discharged to a watercourse. Anglian Water's surface water policy follows the Surface Water hierarchy, outlined in Part H of the Building Regulations. Should your assumptions or evidence change then an alternative solution, connection point or flow rate may be required. You are therefore advised to update Anglian Water with the key supporting evidence at your earliest convenience.

As you may be aware, Anglian Water will consider the adoption of SuDs provided that they meet the criteria outline in our SuDs adoption manual. This can be found on our website. We will adopt features located in public open space that are designed and constructed, in conjunction with the Local Authority and Lead Local Flood Authority (LLFA), to the criteria within our SuDs adoption manual. Specifically, developers must be able to demonstrate:

1. Effective upstream source control,
2. Effective exceedance design, and
3. Effective maintenance schedule demonstrating than the assets can be maintained both now and in the future with adequate access.

If you wish to look at the adoption of any SuDs then an expression of interest form can be found on our website

Trade Effluent

We note that you do not have any trade effluent requirements. Should this be required in the future you will need our written formal consent. This is in accordance with Section 118 of the Water Industry Act (1991).

Used Water Budget Costs

Your development site will be required to pay an Infrastructure charge for each new property connecting to the public water and sewerage network that benefits from Full planning permission. The infrastructure charge replaces the zonal charge as previously identified.

You will be required to pay an infrastructure charge upon connection for each new plot on your development site. The infrastructure charge are types of charges set out in Section 146(2) of the Water Industry Act 1991.

The charge should be paid by anyone who wishes to build or develop a property and is payable upon request of connection.

• The Infrastructure Charge is based on the cost of any reinforcement and upgrades to our existing network ("Network Reinforcements"), whether designed to address strategic or local capacity issues. For more information on our Infrastructure Charge, please see the 'Useful Information' section of this report.

Infrastructure charges are raised on a standard basis of one charge per new connection (one for water and one for sewerage).

The Water Recycling Infrastructure charge for your dwellings is:

Infrastructure charge	Number of units	Total
£ 490	172	£84,280.00

Please note that you should also budget for infrastructure charges on non-household premises where applicable and these will be calculated according to the number and type of water fittings in the premises. This is called the "relevant multiplier" method of calculating the charge and the relevant multiplier will be applied to the figures set out in our 2022-23 Developer Charging Arrangements to arrive at the amount payable. Details of the relevant multiplier for each fitting can be found on our website.

Section 4 - Map of Proposed Point of Connection(s)

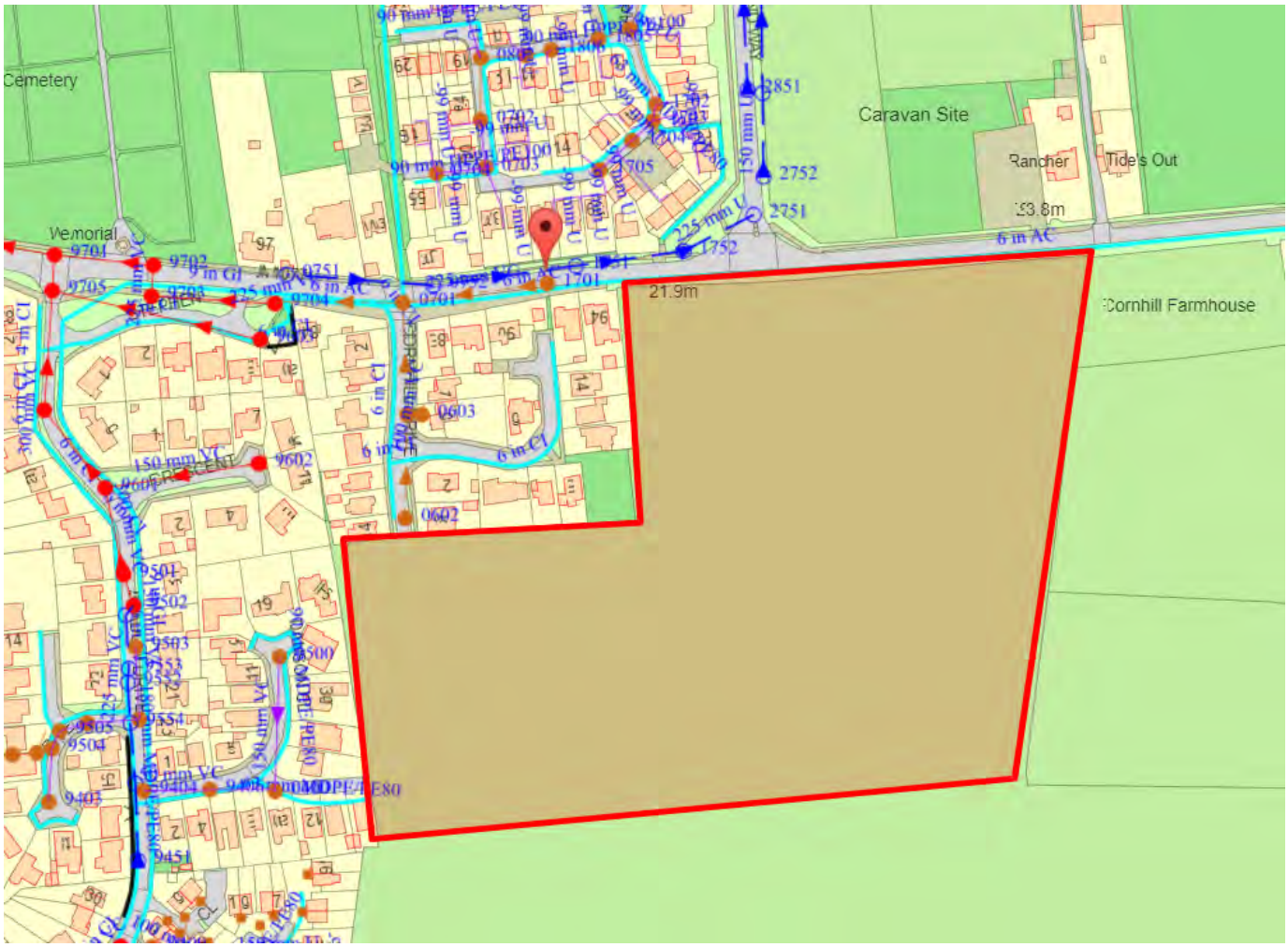


Figure 1: Showing your water recycling foul point of connection

Section 5 - Useful information

Water Industry Act – Key used water sections

Section 98:

This provides you with the right to requisition a new public sewer. The new public sewer can be constructed by Anglian Water on your behalf. Alternatively, you can construct the sewer yourself under section 30 of the Anglian Water Authority Act 1977.

Section 102:

This provides you with the right to have an existing sewerage asset vested by us. It is your responsibility to bring the infrastructure to an adoptable condition ahead of the asset being vested.

Section 104:

This provides you with the right to have a design technically vetted and an agreement reached that will see us adopt your assets following their satisfactory construction and connection to the public sewer.

Section 106:

This provides you with the right to have your constructed sewer connected to the public sewer.

Section 185

This provides you with the right to have a public sewerage asset diverted.

Details on how to make a formal application for a new sewer, new connection or diversion are available on our website or via our Development Services team on **0345 60 66 087**.

Sustainable drainage systems

Many existing urban drainage systems can cause problems of flooding, pollution or damage to the environment and are not resilient to climate change in the long term. .

Our preferred method of surface water disposal is through the use of Sustainable Drainage Systems or SuDS.

SuDS are a range of techniques that aim to mimic the way surface water drains in natural systems within urban areas. For more information on SuDS, please visit our website

We recommend that you contact the Local Authority and Lead Local Flood Authority (LLFA) for your site to discuss your application.

Private sewer transfers

Sewers and lateral drains connected to the public sewer on the 1 July 2011 transferred into Water Company ownership on the 1 October 2011. This follows the implementation of the Floods and Water Management Act (FWMA). This included sewers and lateral drains that were subject to an existing Section 104 Adoption Agreement and those that were not. There were exemptions and the main non-transferable assets were as follows:

Surface water sewers and lateral drains that do not discharge to the public sewer, e.g. those that discharged to a watercourse.

Foul sewers and lateral drains that discharged to a privately owned sewage treatment/collection facility.

Pumping stations and rising mains will transfer between 1 October 2011 and 1 October 2016.

The implementation of Section 42 of the FWMA will ensure that future private sewers will not be created. It is anticipated that all new sewer applications will need to have an approved section 104 application ahead of a section 106 connection.

It is anticipated that all new sewer applications will need to have an approved Section104 application ahead of a Section 106 connection

Encroachment

Anglian Water operates a risk based approach to development encroaching close to our used water infrastructure. We assess the issue of encroachment if you are planning to build within 400 metres of a water recycling centre or, within 15 metres to 100 metres of a pumping station. We have more information available on our website

Locating our assets

Maps detailing the location of our water and used water infrastructure including both underground assets and above ground assets such as pumping stations and recycling centres are available from digdat

All requests from members of the public or non-statutory bodies for maps showing the location of our assets will be subject to an appropriate administrative charge.

We have more information on our website

Charging arrangements

Our charging arrangements and summary for this year's water and used water connection and infrastructure charges can be found on our website

Section 6 - Disclaimer

The information provided in this report is based on data currently held by Anglian Water Services Limited ('Anglian Water') or provided by a third party. Accordingly, the information in this report is provided with no guarantee of accuracy, timeliness, completeness and is without indemnity or warranty of any kind (express or implied).

This report should not be considered in isolation and does not nullify the need for the enquirer to make additional appropriate searches, inspections and enquiries. Anglian Water supports the plan led approach to sustainable development that is set out in the National Planning Policy Framework ('NPPF') and any infrastructure needs identified in this report must be considered in the context of current, adopted and/or emerging local plans. Where local plans are absent, silent or have expired these needs should be considered against the definition of sustainability holistically as set out in the NPPF.

Whilst the information in this report is based on the presumption that proposed development obtains planning permission, nothing in this report confirms that planning permission will be granted or that Anglian Water will be bound to carry out the works/proposals contained within this report.

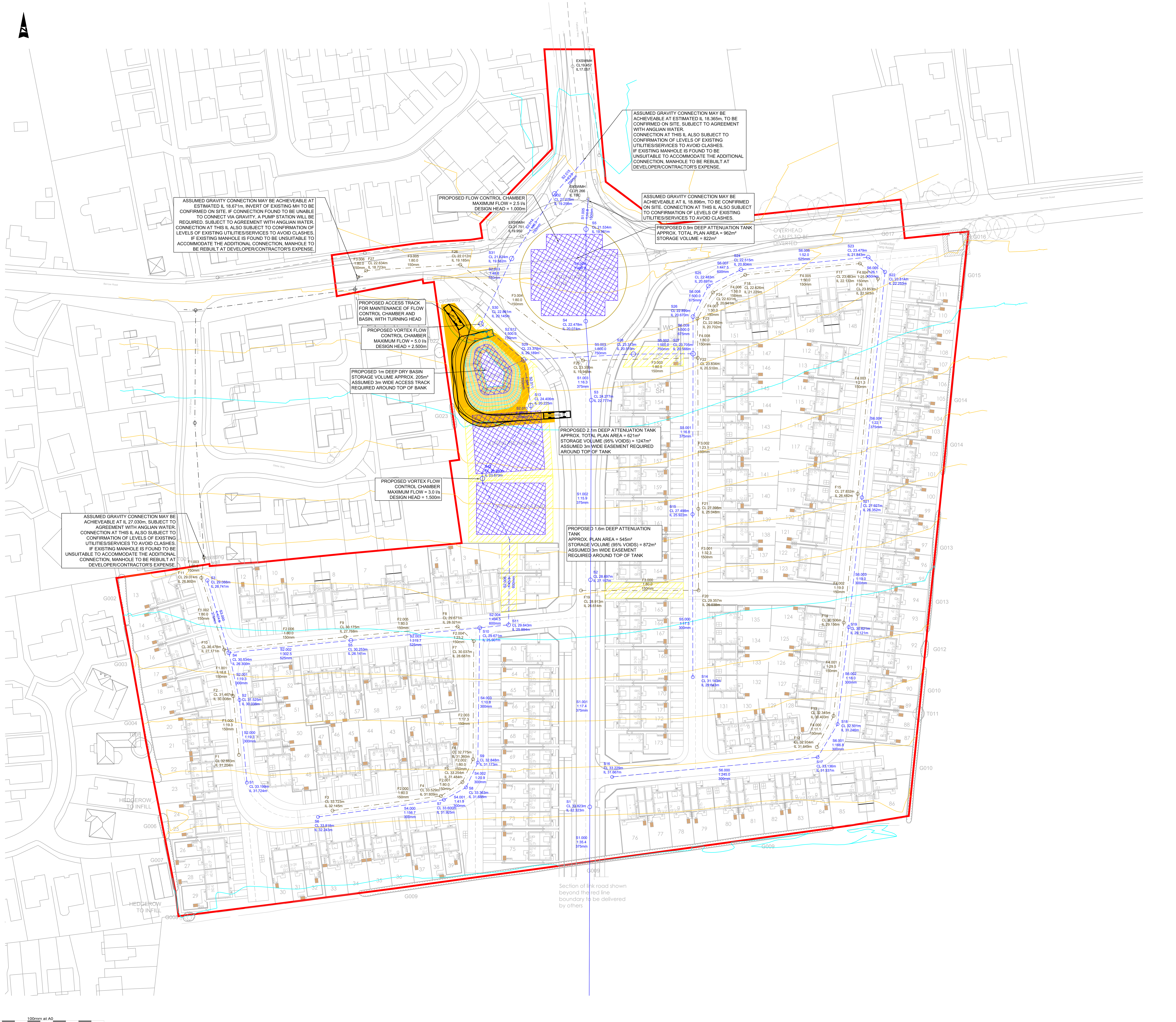
No liability whatsoever, including liability for negligence is accepted by Anglian Water or its partners, employees or agents, for any error or omission, or for the results obtained from the use of this report and/or its content.

Furthermore, in no event will any of those parties be liable to the applicant or any third party for any decision made or action taken as a result of reliance on this report.

This report is valid from the date issued and the enquirer is advised to resubmit their request for an up to date report should there be a delay in submitting any subsequent application for water supply/sewer connection(s). Our pre-planning reports are valid for 12 months, however please note Anglian Water cannot reserve capacity and available capacity in our network can be reduced at any time due to increased requirements from existing businesses and houses as well as from new housing and new commercial developments.

APPENDIX E

Strategic Drainage Drawing



HEALTH & SAFETY RISKS

IN ADDITION TO THE STANDARD HAZARDS AND RISKS NORMALLY ASSOCIATED WITH THE TYPE OF WORK DETAILED ON THIS DRAWING, PLEASE NOTE THE FOLLOWING RESIDUAL HEALTH AND SAFETY RISKS

CONSTRUCTION RISKS

CR 01 CARE TO BE TAKEN AROUND DEEP EXCAVATIONS. PLANT TO BE KEPT AT SAFE DISTANCE.

CR 02 EXISTING DRAINAGE AND SERVICE INFRASTRUCTURE NOT TO BE COMPROMISED. OVERHEAD POWER CABLES

CR 03 CONSTRUCTION ADJACENT LIVE TRAFFIC

CR 04 CARE TO BE TAKEN IN VICINITY OF OVERHEAD CABLES.

CR 04 CONTRACTOR TO TAKE MEASURES TO PROTECT HIS OPERATIVES WITH RESPECT TO THE PRESENCE OF POTENTIAL GAS IN SEWER TRENCHES AND MANHOLES THROUGH THE USE OF GAS MONITORING EQUIPMENT AND BREATHING APPARATUS AS REQUIRED.

CR 05 CONTRACTOR TO TAKE MEASURES TO PROTECT HIS OPERATIVES WITH RESPECT TO POTENTIAL UNKNOWN GROUND CONTAMINATION DURING EXCAVATION. CONTAMINATED MATERIAL TO BE REMOVED TO A LICENSED TIP.

IT IS ASSUMED THAT ALL WORKS WILL BE CARRIED OUT BY A COMPETENT CONTRACTOR WORKING IN ACCORDANCE WITH THE REQUIREMENTS DEFINED IN THE CDM REGULATIONS.

NOTES:

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

GENERAL NOTES:

G01. ALL WORKS SUBJECT TO SECTION 38, SECTION 62/278 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.

G04. ABBREVIATIONS:
MH = MANHOLE
CL = COVER LEVEL
IL = 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

SECTION 104 ADOPTION NOTES:

1. ALL ADOPTABLE SEWER WORKS AND MATERIAL TO BE IN ACCORDANCE WITH "CODE FOR ADOPTION", THE RELEVANT BRITISH/EUROPEAN AND THE ADOPTING WATER AUTHORITY'S STANDARDS/REQUIREMENTS/ADDENDUM TO THE MECHANICAL AND ELECTRICAL SPECIFICATION AND KITEMARKED.
2. MANHOLE COVERS SHALL/MUST HAVE A CLEAR OPENING OF 600mm AND SHALL BE CLASS D400 TO BS EN 124 WITH 150mm DEEP FRAMES IN HIGHWAYS.
3. FILLED GROUND MUST BE FILLED AND CONSOLIDATED UNDER THE SUPERVISION AND TO THE SATISFACTION OF THE ADOPTING WATER AUTHORITY BEFORE ANY SEWER WORKS ARE CARRIED OUT.
4. THE ADOPTING WATER AUTHORITY IS **NOT** OBLIGED TO ACCEPT FILTER DRAIN/LAND DRAINAGE RUN-OFF INTO THE PUBLIC SEWER NETWORK OR ADOPTABLE DRAINAGE SYSTEM (**DIRECTLY OR IN-DIRECTLY**). AN ALTERNATIVE METHOD OF DISPOSAL OF THE LAND DRAINAGE RUN-OFF WILL THEREFORE BE REQUIRED AND YOU WILL HAVE TO LIAISE WITH THE LOCAL AUTHORITY, LAND DRAINAGE SECTION REGARDING THE DISPOSAL OF THE FILTER DRAIN/LAND DRAINAGE RUN-OFF.
5. THE ADOPTABLE SEWERS SHOULD BE A MINIMUM OF 1m AND MANHOLES 0.5m FROM KERB FACES AND SERVICE MARGINS.
6. SEWERS MUST HAVE 5 METRES CLEARANCE FROM TREES AND HEDGES OR THE WIDTH OF THE CANOPY AT MATURE HEIGHT.
7. SEWERS TO BE LAID IN CLASS "S" BEDDING (**150mm GRANULAR BED AND SURROUND**). WHERE DEPTH OF COVER TO TOP OF THE SEWER IS LESS THAN 1.2m IN HIGHWAYS AND VERGES (**OR LESS THAN 900mm IN NONE VEHICULAR ACCESS AREAS**) THEN A CONCRETE SLAB SHOULD BE PROVIDE ABOVE GRANULAR BED AND SURROUND.
8. BEDDING AND BACKFILL MATERIAL TO CONFORM TO THE REQUIREMENT OF WATER INDUSTRY SPECIFICATION 4-08-02 (**TABLE A2**).
9. TYPE "C" BRICK MANHOLES AND 1050mm DIAMETER MANHOLE RINGS ARE NOT PREFERRED. INSTEAD, IT IS PREFERRED THAT YOU USE A TYPE "B" MANHOLE WITH 1200mm DIA OR 1500mm DIAMETER RINGS, WITH THE OPENING SITED OVER THE CHANNEL WHERE DEPTH OF COVER TO PIPE SOFFIT IS 1 - 1.5m.
10. ADOPTABLE PLASTIC SEWER PIPES TO BE BSI KITEMARKED (**CERTIFIED TO WIS 4-35-01** AND BS/EN13476). ADOPTABLE PLASTIC SEWER PIPES TO BE LAID IN MAXIMUM 3 METRE LENGTHS UNLESS THERE IS A SPECIFIC OPERATIONAL NEED TO LAY LONGER LENGTHS. PLASTIC CHANNEL SECTIONS IN MANHOLES ARE NOT ACCEPTABLE AND YORKSHIRE WATER WOULD REQUIRE CLAYWARE CHANNEL IN MANHOLES.
11. THE MINIMUM CRUSHING STRENGTH FOR CLAY PIPES SHOULD BE AS FOLLOWS: 100mm DIA. 40kN/m, 150mm DIA. 40kN/m, 225mm DIA. 45kN/m AND 300mm DIA. 72kN/m. THE MINIMUM CRUSHING STRENGTH FOR CONCRETE PIPES SHOULD BE - (CLASS 120 TO EN 1916/BS5911-1 2002). PLASTIC PIPES SHOULD CONFORM TO WIS 4-35-01 AND BS EN13476.
12. WHERE A B125 COVER AND FRAME HAS BEEN APPROVED, THIS **MUST NOT** BE COATED IN PLASTIC AND MUST HAVE LIFTING EYES SUITABLY SIZED TO ACCOMMODATE STANDARD LIFTING KEYS. SCREW DOWN COVERS ARE NOT ACCEPTABLE.
13. THERE MUST BE ENOUGH CLEARANCE AT CROSSOVERS TO ACCOMMODATE BEDDING TO BOTH PIPES, APPROX. 300mm: IF CROSSOVER IS NEAR THE ROCKER THEN THE CLEARANCE NEEDED MAY NEED TO BE INCREASED.

THE INFORMATION ON THIS DRAWING IS FOR APPROVAL PURPOSES ONLY. NO CONSTRUCTION WORKS ARE TO BE UNDERTAKEN UNTIL WRITTEN APPROVAL IS RECEIVED FROM THE ADOPTING WATER AUTHORITY

NOTES ON PROTECTION OF EXISTING WATER MAINS APPARATUS

1. ALL EXCAVATION WORKS NEAR TO EXISTING WATER MAINS APPARATUS SHOULD BE BY HAND DIGGING ONLY.
2. BACKFILLING WITH A SUITABLE MATERIAL TO A MINIMUM 300mm ABOVE EXISTING WATER MAINS APPARATUS IS REQUIRED.
3. WHERE SURFACE LEVELS ARE TO BE INCREASED OR DECREASED, ALL SURFACE BOXES MUST BE ADJUSTED AS PART OF THE SCHEME.
4. ADEQUATE SUPPORT MUST BE PROVIDED WHERE ANY WORKS PASS UNDER EXISTING WATER MAINS APPARATUS.
5. JOINTING CHAMBERS, LIGHTING COLUMNS AND OTHER STRUCTURES MUST BE INSTALLED IN SUCH A WAY THAT FUTURE REPAIR OR MAINTENANCE WORKS TO WATER MAINS APPARATUS WILL NOT BE HINDERED.
6. APPARATUS SUCH AS RAILINGS, SIGN POSTS, ETC. MUST NOT BE PLACED IN SUCH A WAY THAT THEY PREVENT ACCESS TO OR FULL OPERATION OF CONTROLLING VALVES, HYDRANTS OR SIMILAR APPARATUS. CHAMBER LIDS MUST NOT BE BURIED OR COVERED.
7. EXPLOSIVES SHALL NOT BE USED WITHIN 100 METRES OF ANY WATER MAINS APPARATUS OR INSTALLATIONS.
8. VIBRATING PLANT SHOULD NOT BE USED DIRECTLY OVER ANY APPARATUS.
9. UNDER NO CIRCUMSTANCES SHOULD TRUST BORING OR SIMILAR TRENCHLESS TECHNIQUES COMMENCE UNTIL THE ACTUAL POSITION OF WATER MAINS AND SERVICES ALONG THE PROPOSED ROUTE HAVE BEEN CONFIRMED BY TRIAL HOLES.
10. IMPACT PILING MUST NOT TAKE PLACE WITHIN 10m OF WATER MAINS APPARATUS. CORE DRILLING MUST NOT TAKE PLACE WITHIN 5m OF WATER MAINS APPARATUS.
11. ANY DAMAGE CAUSED OR OBSERVED TO WATER MAINS APPARATUS MUST BE IMMEDIATELY REPORTED TO THE RELEVANT AUTHORITIES.
12. SHOULD THE AUTHORITIES INCUR ANY COSTS AS A RESULT OF NON-COMPLIANCE WITH THE ABOVE, COSTS MAY BE RECHARGEABLE.

Rev	Description	Date	By	Chk	App
P3	SITE LAYOUT UPDATED	21.08.23	JP	JAG	JAG
P2	LAYOUT UPDATED	09.02.23	HD	AD	JAG
P1	FIRST ISSUE	01.02.23	JP	JAG	JAG

Alan Wood & Partners

Hull Office
341 Beverley Road
Hull
HU5 1LD

T. 01482 442138
www.alanwood.co.uk

Consulting Civil & Structural Engineers
Project Managers
Building Surveyors

Leeds T. 01135 311098
Lincoln T. 01522 300210
Scarborough T. 01723 865484
Sheffield T. 01142 440077
York T. 01904 611594

Project: Proposed Residential Development at Barrow Road, Barton Upon Humber

Client: Strata Homes Ltd

Drawing: Proposed Drainage Layout

Role: CIVIL ENGINEER

Drawing Status: FOR APPROVAL — Suitability Code: S3

Job. no. 47658 — Scale@ A0: 1:500 — Rev. P3

Project	Originator	Volume	Level	Type	Role	Number
BRBH	AWP	ZZ	XX	DR	C	3000

Alan Wood & Partners

APPENDIX F

Hydraulic Model Study

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Adoptable SW

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
S2.000	32.546	1.686	19.3	0.282	4.00	0.0	0.600		o	300	Pipe/Conduit	
S2.001	18.972	0.983	19.3	0.000	0.00	0.0	0.600		o	300	Pipe/Conduit	
S3.000	29.569	0.291	101.6	0.108	4.00	0.0	0.600		o	375	Pipe/Conduit	
S2.002	48.094	0.159	302.5	0.289	0.00	0.0	0.600		o	525	Pipe/Conduit	
S2.003	50.731	0.159	319.7	0.000	0.00	0.0	0.600		o	525	Pipe/Conduit	
S4.000	49.824	0.318	156.7	0.250	4.00	0.0	0.600		o	300	Pipe/Conduit	
S4.001	9.934	0.237	41.9	0.000	0.00	0.0	0.600		o	300	Pipe/Conduit	
S4.002	10.774	0.515	20.9	0.195	0.00	0.0	0.600		o	300	Pipe/Conduit	
S4.003	52.836	4.891	10.8	0.000	0.00	0.0	0.600		o	300	Pipe/Conduit	
S2.004	11.374	0.023	494.5	0.048	0.00	0.0	0.600		o	600	Pipe/Conduit	
S2.005	33.520	0.731	45.9	0.000	0.00	0.0	0.600		o	600	Pipe/Conduit	
S2.006	24.553	0.061	402.5	0.077	0.00	0.0		0.012	→_/		Pond/Tank	
S2.007	1.730	0.017	101.8	0.000	0.00	0.0	0.600		o	1650	Pipe/Conduit	
S2.008	1.977	0.020	98.9	0.000	0.00	0.0	0.600		o	1650	Pipe/Conduit	
S2.009	29.525	0.074	399.0	0.000	0.00	0.0		0.012	→_/		Pond/Tank	
S2.010	4.337	0.009	481.9	0.000	0.00	0.0	0.600		o	750	Pipe/Conduit	
S2.011	18.060	0.036	501.7	0.000	0.00	0.0	0.600		o	750	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	4.15	31.724	0.282	0.0	0.0	0.0	3.60	254.1	38.2
S2.001	50.00	4.24	30.038	0.282	0.0	0.0	0.0	3.60	254.1	38.2
S3.000	50.00	4.27	26.741	0.108	0.0	0.0	0.0	1.80	198.5	14.6
S2.002	50.00	4.90	26.300	0.678	0.0	0.0	0.0	1.28	277.7	91.9
S2.003	50.00	5.58	26.141	0.678	0.0	0.0	0.0	1.25	270.0	91.9
S4.000	50.00	4.66	32.243	0.250	0.0	0.0	0.0	1.25	88.6	33.8
S4.001	50.00	4.73	31.925	0.250	0.0	0.0	0.0	2.44	172.2	33.8
S4.002	50.00	4.78	31.688	0.445	0.0	0.0	0.0	3.45	244.1	60.2
S4.003	50.00	4.97	31.173	0.445	0.0	0.0	0.0	4.81	340.0	60.2
S2.004	50.00	5.75	25.907	1.171	0.0	0.0	0.0	1.09	307.7	158.6
S2.005	50.00	5.91	25.884	1.171	0.0	0.0	0.0	3.60	1018.6	158.6
S2.006	50.00	6.03	24.000	1.248	0.0	0.0	0.0	3.42	127245.9	169.1
S2.007	50.00	6.03	23.890	1.248	0.0	0.0	0.0	4.51	9637.9	169.1
S2.008	50.00	6.04	23.873	1.248	0.0	0.0	0.0	4.57	9779.4	169.1
S2.009	50.00	6.16	20.308	1.248	0.0	0.0	0.0	4.03	170493.5	169.1
S2.010	50.00	6.22	20.234	1.248	0.0	0.0	0.0	1.27	560.2	169.1
S2.011	50.00	6.46	20.225	1.248	0.0	0.0	0.0	1.24	548.9	169.1

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Adoptable SW

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
S5.000	63.830	3.646	17.5	0.253	4.00	0.0	0.600		o	300	Pipe/Conduit	
S5.001	62.963	3.793	16.6	0.260	0.00	0.0	0.600		o	375	Pipe/Conduit	
S6.000	80.936	0.330	245.0	0.200	4.00	0.0	0.600		o	300	Pipe/Conduit	
S6.001	15.182	0.091	166.8	0.000	0.00	0.0	0.600		o	300	Pipe/Conduit	
S6.002	38.282	2.125	18.0	0.171	0.00	0.0	0.600		o	300	Pipe/Conduit	
S6.003	51.107	2.694	19.0	0.181	0.00	0.0	0.600		o	300	Pipe/Conduit	
S6.004	88.896	4.024	22.1	0.155	0.00	0.0	0.600		o	375	Pipe/Conduit	
S6.005	8.760	0.335	26.1	0.107	0.00	0.0	0.600		o	450	Pipe/Conduit	
S6.006	50.106	0.964	52.0	0.000	0.00	0.0	0.600		o	525	Pipe/Conduit	
S6.007	14.320	0.032	447.5	0.099	0.00	0.0	0.600		o	600	Pipe/Conduit	
S6.008	13.434	0.027	500.0	0.000	0.00	0.0	0.600		o	675	Pipe/Conduit	
S6.009	14.563	0.029	500.0	0.000	0.00	0.0	0.600		o	675	Pipe/Conduit	
S5.002	23.364	0.047	500.0	0.060	0.00	0.0	0.600		o	750	Pipe/Conduit	
S5.003	43.069	0.086	500.0	0.000	0.00	0.0	0.600		o	750	Pipe/Conduit	
S2.012	21.896	0.044	500.0	0.000	0.00	0.0	0.600		o	750	Pipe/Conduit	
S2.013	28.317	0.583	48.6	0.000	0.00	0.0	0.600		o	750	Pipe/Conduit	
S2.014	30.458	0.305	100.0	0.000	0.00	0.0	0.600		o	750	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)
S5.000	50.00	4.28	29.643	0.253	0.0	0.0	0.0	3.78	266.9	34.2
S5.001	50.00	4.52	25.922	0.513	0.0	0.0	0.0	4.47	493.3	69.5
S6.000	50.00	5.35	31.667	0.200	0.0	0.0	0.0	1.00	70.7	27.1
S6.001	50.00	5.56	31.337	0.200	0.0	0.0	0.0	1.21	85.8	27.1
S6.002	50.00	5.73	31.246	0.371	0.0	0.0	0.0	3.72	263.1	50.3
S6.003	50.00	5.96	29.121	0.552	0.0	0.0	0.0	3.63	256.3	74.7
S6.004	50.00	6.35	26.352	0.707	0.0	0.0	0.0	3.87	427.4	95.7
S6.005	50.00	6.38	22.253	0.813	0.0	0.0	0.0	3.99	634.3	110.1
S6.006	50.00	6.65	21.843	0.813	0.0	0.0	0.0	3.11	673.7	110.1
S6.007	50.00	6.86	20.804	0.913	0.0	0.0	0.0	1.14	323.6	123.6
S6.008	50.00	7.05	20.697	0.913	0.0	0.0	0.0	1.17	417.0	123.6
S6.009	50.00	7.26	20.670	0.913	0.0	0.0	0.0	1.17	417.0	123.6
S5.002	50.00	7.57	20.566	1.486	0.0	0.0	0.0	1.24	549.9	201.2
S5.003	50.00	8.15	20.519	1.486	0.0	0.0	0.0	1.24	549.9	201.2
S2.012	50.00	8.44	20.189	2.734	0.0	0.0	0.0	1.24	549.9	370.2
S2.013	50.00	8.56	20.145	2.734	0.0	0.0	0.0	4.02	1776.6	370.2
S2.014	50.00	8.74	19.562	2.734	0.0	0.0	0.0	2.80	1236.4	370.2

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Adoptable SW

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
S2.015	17.313	0.743	23.3	0.000	0.00	0.0	0.600		o	750	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)
S2.015	50.00	8.79	19.258	2.734	0.0	0.0	0.0	5.81	2567.6	370.2

Online Controls for Adoptable SW

Hydro-Brake® Optimum Manhole: S12, DS/PN: S2.008, Volume (m³): 8.2

Unit Reference	MD-SHE-0080-3400-1500-3400
Design Head (m)	1.500
Design Flow (l/s)	3.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	80
Invert Level (m)	23.873
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	3.4
Flush-Flo™	0.352	3.0
Kick-Flo®	0.720	2.4
Mean Flow over Head Range	-	2.8

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.3	1.200	3.1	3.000	4.7	7.000	7.0
0.200	2.9	1.400	3.3	3.500	5.0	7.500	7.2
0.300	3.0	1.600	3.5	4.000	5.4	8.000	7.4
0.400	3.0	1.800	3.7	4.500	5.7	8.500	7.7
0.500	3.0	2.000	3.9	5.000	6.0	9.000	7.9
0.600	2.8	2.200	4.1	5.500	6.2	9.500	8.1
0.800	2.5	2.400	4.2	6.000	6.5		
1.000	2.8	2.600	4.4	6.500	6.7		

Hydro-Brake® Optimum Manhole: S30, DS/PN: S2.013, Volume (m³): 15.8

Unit Reference	MD-SHE-0089-5000-2300-5000
Design Head (m)	2.300
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	89
Invert Level (m)	20.145
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Hydro-Brake® Optimum Manhole: S30, DS/PN: S2.013, Volume (m³): 15.8

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.300	5.0
Flush-Flo™	0.384	3.8
Kick-Flo®	0.790	3.1
Mean Flow over Head Range	-	3.8

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.7	1.200	3.7	3.000	5.7	7.000	8.4
0.200	3.6	1.400	4.0	3.500	6.1	7.500	8.7
0.300	3.8	1.600	4.2	4.000	6.5	8.000	9.0
0.400	3.8	1.800	4.5	4.500	6.8	8.500	9.3
0.500	3.8	2.000	4.7	5.000	7.2	9.000	9.5
0.600	3.7	2.200	4.9	5.500	7.5	9.500	9.8
0.800	3.1	2.400	5.1	6.000	7.8		
1.000	3.4	2.600	5.3	6.500	8.1		

Storage Structures for Adoptable SW

Tank or Pond Pipe: S2.006

Manning's N 0.012 Invert Level (m) 24.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	570.0	1.600	570.0	1.601	0.0

Tank or Pond Pipe: S2.009

Manning's N 0.012 Invert Level (m) 20.308

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	594.0	2.100	594.0	2.101	0.0

Tank or Pond Manhole: S30, DS/PN: S2.013

Invert Level (m) 21.850

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	82.0	1.000	221.0	1.001	0.0

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Adoptable SW

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 Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	3
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	18.800	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	100.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	OFF
Inertia Status	ON

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)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
S2.000	S1	15 Winter	1	+0%			
S2.001	S2	15 Winter	1	+0%			
S3.000	S3	15 Winter	1	+0%	100/15 Summer		
S2.002	S4	15 Winter	1	+0%	100/15 Summer		
S2.003	S5	15 Winter	1	+0%	30/15 Summer		
S4.000	S6	15 Winter	1	+0%	30/15 Summer		
S4.001	S7	15 Winter	1	+0%	100/15 Summer		
S4.002	S8	15 Winter	1	+0%	100/15 Summer		
S4.003	S9	15 Winter	1	+0%			
S2.004	S10	15 Winter	1	+0%	30/15 Summer		
S2.005	S11	15 Winter	1	+0%			
S2.006	SW TANK1 IN	480 Winter	1	+0%	100/960 Winter		
S2.007	SW TANK1 OUT	480 Winter	1	+0%	100/960 Winter		
S2.008	S12	480 Winter	1	+0%	100/120 Winter		
S2.009	SW TANK2 IN	2160 Winter	1	+0%	100/2880 Winter		
S2.010	SW TANK2 OUT	2160 Winter	1	+0%	30/180 Winter		
S2.011	S13	2160 Winter	1	+0%	30/15 Summer		

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Adoptable SW

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
S2.000	S1		31.806	-0.218	0.000	0.17			39.4
S2.001	S2		30.123	-0.215	0.000	0.18			39.4
S3.000	S3		26.815	-0.301	0.000	0.09			15.1
S2.002	S4		26.515	-0.310	0.000	0.34			84.2
S2.003	S5		26.384	-0.282	0.000	0.32			76.3
S4.000	S6		32.378	-0.165	0.000	0.41			34.0
S4.001	S7		32.033	-0.192	0.000	0.28			33.6
S4.002	S8		31.803	-0.185	0.000	0.31			55.3
S4.003	S9		31.257	-0.216	0.000	0.17			55.5
S2.004	S10		26.327	-0.181	0.000	0.82			128.9
S2.005	S11		26.041	-0.443	0.000	0.15			129.5
S2.006	SW TANK1 IN		24.260	-1.341	0.000	0.00			20.3
S2.007	SW TANK1 OUT		24.260	-1.280	0.000	0.00			7.7
S2.008	S12		24.342	-1.181	0.000	0.00			3.0
S2.009	SW TANK2 IN		20.747	-1.662	0.000	0.00			3.0
S2.010	SW TANK2 OUT		20.747	-0.237	0.000	0.04			12.7
S2.011	S13		20.747	-0.228	0.000	0.03			10.4

PN	US/MH Name	Status	Level Exceeded
S2.000	S1	OK	
S2.001	S2	OK	
S3.000	S3	OK	
S2.002	S4	OK	
S2.003	S5	OK	
S4.000	S6	OK	
S4.001	S7	OK	
S4.002	S8	OK	
S4.003	S9	OK	
S2.004	S10	OK	
S2.005	S11	OK	
S2.006	SW TANK1 IN	OK	
S2.007	SW TANK1 OUT	OK	
S2.008	S12	OK	
S2.009	SW TANK2 IN	OK	
S2.010	SW TANK2 OUT	OK	
S2.011	S13	OK	

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Adoptable SW

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S5.000	S14	15 Winter	1	+0%					29.717
S5.001	S15	15 Winter	1	+0%					26.015
S6.000	S16	15 Winter	1	+0%	100/15 Summer				31.800
S6.001	S17	15 Winter	1	+0%	100/15 Summer				31.459
S6.002	S18	15 Winter	1	+0%	100/15 Winter				31.331
S6.003	S19	15 Winter	1	+0%	100/15 Summer				29.225
S6.004	S21	15 Winter	1	+0%					26.464
S6.005	S22	15 Winter	1	+0%	100/15 Summer				22.414
S6.006	S23	15 Winter	1	+0%	100/15 Summer				21.978
S6.007	S24	15 Winter	1	+0%	30/15 Summer				21.120
S6.008	S25	15 Winter	1	+0%	30/15 Summer				21.030
S6.009	S26	15 Winter	1	+0%	30/15 Winter				20.989
S5.002	S27	15 Winter	1	+0%	30/720 Winter				20.914
S5.003	S28	15 Winter	1	+0%	30/600 Winter				20.873
S2.012	S29	15 Winter	1	+0%	30/15 Summer				20.825
S2.013	S30	15 Winter	1	+0%	30/15 Summer				20.825
S2.014	S31	960 Winter	1	+0%					19.578
S2.015	S32	960 Winter	1	+0%					19.267

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S5.000	S14	-0.226	0.000	0.14			35.3	OK	
S5.001	S15	-0.282	0.000	0.14			64.3	OK	
S6.000	S16	-0.167	0.000	0.37			25.4	OK	
S6.001	S17	-0.178	0.000	0.35			25.1	OK	
S6.002	S18	-0.215	0.000	0.18			43.5	OK	
S6.003	S19	-0.196	0.000	0.26			63.0	OK	
S6.004	S21	-0.263	0.000	0.19			79.2	OK	
S6.005	S22	-0.288	0.000	0.28			90.5	OK	
S6.006	S23	-0.389	0.000	0.15			90.1	OK	
S6.007	S24	-0.283	0.000	0.54			100.5	OK	
S6.008	S25	-0.342	0.000	0.46			98.5	OK	
S6.009	S26	-0.356	0.000	0.45			98.8	OK	
S5.002	S27	-0.401	0.000	0.39			150.7	OK	
S5.003	S28	-0.396	0.000	0.31			141.0	OK	
S2.012	S29	-0.114	0.000	0.08			29.2	OK	
S2.013	S30	-0.070	0.000	0.00			3.7	OK	
S2.014	S31	-0.735	0.000	0.00			3.7	OK	
S2.015	S32	-0.740	0.000	0.00			3.7	OK	

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

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 Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	3
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	18.800	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	100.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	OFF
Inertia Status	ON

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)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
S2.000	S1	15 Winter	30	+0%			
S2.001	S2	15 Winter	30	+0%			
S3.000	S3	15 Winter	30	+0%	100/15 Summer		
S2.002	S4	15 Winter	30	+0%	100/15 Summer		
S2.003	S5	15 Winter	30	+0%	30/15 Summer		
S4.000	S6	15 Winter	30	+0%	30/15 Summer		
S4.001	S7	15 Winter	30	+0%	100/15 Summer		
S4.002	S8	15 Winter	30	+0%	100/15 Summer		
S4.003	S9	15 Winter	30	+0%			
S2.004	S10	15 Winter	30	+0%	30/15 Summer		
S2.005	S11	15 Winter	30	+0%			
S2.006	SW TANK1 IN	960 Winter	30	+0%	100/960 Winter		
S2.007	SW TANK1 OUT	960 Winter	30	+0%	100/960 Winter		
S2.008	S12	960 Winter	30	+0%	100/120 Winter		
S2.009	SW TANK2 IN	5760 Winter	30	+0%	100/2880 Winter		
S2.010	SW TANK2 OUT	5760 Winter	30	+0%	30/180 Winter		
S2.011	S13	2160 Winter	30	+0%	30/15 Summer		

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

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
S2.000	S1		31.858	-0.166	0.000	0.42			96.6
S2.001	S2		30.176	-0.161	0.000	0.44			96.6
S3.000	S3		26.860	-0.256	0.000	0.21			36.9
S2.002	S4		26.797	-0.028	0.000	0.87			215.1
S2.003	S5		26.697	0.031	0.000	0.84			203.3
S4.000	S6		32.544	0.001	0.000	0.99			82.4
S4.001	S7		32.109	-0.116	0.000	0.68			83.0
S4.002	S8		31.899	-0.089	0.000	0.81			146.1
S4.003	S9		31.317	-0.156	0.000	0.45			144.7
S2.004	S10		26.583	0.075	0.000	2.24			351.3
S2.005	S11		26.153	-0.331	0.000	0.42			351.4
S2.006	SW TANK1 IN		24.766	-0.835	0.000	0.00			26.1
S2.007	SW TANK1 OUT		24.766	-0.774	0.000	0.01			27.2
S2.008	S12		24.921	-0.602	0.000	0.00			3.0
S2.009	SW TANK2 IN		21.462	-0.947	0.000	0.00			3.0
S2.010	SW TANK2 OUT		21.462	0.478	0.000	0.91			320.7
S2.011	S13		21.727	0.752	0.000	0.66			211.7

PN	US/MH Name	Status	Level Exceeded
S2.000	S1	OK	
S2.001	S2	OK	
S3.000	S3	OK	
S2.002	S4	OK	
S2.003	S5	SURCHARGED	
S4.000	S6	SURCHARGED	
S4.001	S7	OK	
S4.002	S8	OK	
S4.003	S9	OK	
S2.004	S10	SURCHARGED	
S2.005	S11	OK	
S2.006	SW TANK1 IN	OK	
S2.007	SW TANK1 OUT	OK	
S2.008	S12	OK	
S2.009	SW TANK2 IN	OK	
S2.010	SW TANK2 OUT	SURCHARGED	
S2.011	S13	SURCHARGED	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S5.000	S14	15 Winter	30	+0%					29.763
S5.001	S15	15 Winter	30	+0%					26.082
S6.000	S16	15 Winter	30	+0%	100/15 Summer				31.937
S6.001	S17	15 Winter	30	+0%	100/15 Summer				31.551
S6.002	S18	15 Winter	30	+0%	100/15 Winter				31.393
S6.003	S19	15 Winter	30	+0%	100/15 Summer				29.313
S6.004	S21	15 Winter	30	+0%					26.553
S6.005	S22	15 Winter	30	+0%	100/15 Summer				22.561
S6.006	S23	15 Winter	30	+0%	100/15 Summer				22.084
S6.007	S24	2160 Winter	30	+0%	30/15 Summer				21.660
S6.008	S25	2160 Winter	30	+0%	30/15 Summer				21.734
S6.009	S26	2160 Winter	30	+0%	30/15 Winter				21.771
S5.002	S27	2160 Winter	30	+0%	30/720 Winter				21.800
S5.003	S28	2160 Winter	30	+0%	30/600 Winter				21.823
S2.012	S29	2160 Winter	30	+0%	30/15 Summer				21.843
S2.013	S30	2160 Winter	30	+0%	30/15 Summer				21.855
S2.014	S31	5760 Winter	30	+0%					19.580
S2.015	S32	5760 Winter	30	+0%					19.269

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S5.000	S14	-0.180	0.000	0.34			86.5	OK	
S5.001	S15	-0.215	0.000	0.38			175.7	OK	
S6.000	S16	-0.030	0.000	0.92			62.4	OK	
S6.001	S17	-0.085	0.000	0.85			61.0	OK	
S6.002	S18	-0.153	0.000	0.46			112.2	OK	
S6.003	S19	-0.107	0.000	0.71			172.3	OK	
S6.004	S21	-0.174	0.000	0.54			220.2	OK	
S6.005	S22	-0.142	0.000	0.78			253.7	OK	
S6.006	S23	-0.284	0.000	0.43			256.5	OK	
S6.007	S24	0.257	0.000	0.38			70.4	SURCHARGED	
S6.008	S25	0.362	0.000	0.45			94.9	SURCHARGED	
S6.009	S26	0.427	0.000	0.41			88.6	SURCHARGED	
S5.002	S27	0.484	0.000	0.16			60.5	SURCHARGED	
S5.003	S28	0.555	0.000	0.10			44.9	SURCHARGED	
S2.012	S29	0.904	0.000	0.15			55.2	SURCHARGED	
S2.013	S30	0.960	0.000	0.00			4.0	SURCHARGED	
S2.014	S31	-0.732	0.000	0.00			3.9	OK	
S2.015	S32	-0.739	0.000	0.00			4.0	OK	

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

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 Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	3
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	18.800	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	100.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	OFF
Inertia Status	ON

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)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
S2.000	S1	15 Winter	100	+40%			
S2.001	S2	15 Winter	100	+40%			
S3.000	S3	15 Winter	100	+40%	100/15 Summer		
S2.002	S4	15 Winter	100	+40%	100/15 Summer		
S2.003	S5	15 Winter	100	+40%	30/15 Summer		
S4.000	S6	15 Winter	100	+40%	30/15 Summer		
S4.001	S7	15 Winter	100	+40%	100/15 Summer		
S4.002	S8	15 Winter	100	+40%	100/15 Summer		
S4.003	S9	15 Winter	100	+40%			
S2.004	S10	15 Winter	100	+40%	30/15 Summer		
S2.005	S11	15 Winter	100	+40%			
S2.006	SW TANK1 IN	1440 Winter	100	+40%	100/960 Winter		
S2.007	SW TANK1 OUT	1440 Winter	100	+40%	100/960 Winter		
S2.008	S12	1440 Winter	100	+40%	100/120 Winter		
S2.009	SW TANK2 IN	2880 Winter	100	+40%	100/2880 Winter		
S2.010	SW TANK2 OUT	2880 Winter	100	+40%	30/180 Winter		
S2.011	S13	2880 Winter	100	+40%	30/15 Summer		

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

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
S2.000	S1		31.919	-0.105	0.000	0.75			175.1
S2.001	S2		30.241	-0.097	0.000	0.80			175.2
S3.000	S3		27.786	0.670	0.000	0.35			61.1
S2.002	S4		27.743	0.918	0.000	1.59			392.4
S2.003	S5		27.302	0.636	0.000	1.56			377.3
S4.000	S6		33.795	1.252	0.000	1.69			141.0
S4.001	S7		32.840	0.615	0.000	1.17			142.5
S4.002	S8		32.531	0.543	0.000	1.39			249.9
S4.003	S9		31.375	-0.098	0.000	0.78			249.6
S2.004	S10		26.886	0.379	0.000	4.12			646.1
S2.005	S11		26.285	-0.199	0.000	0.77			648.5
S2.006	SW TANK1 IN		25.658	0.057	0.000	0.00			33.9
S2.007	SW TANK1 OUT		25.658	0.118	0.000	0.03			58.6
S2.008	S12		25.753	0.230	0.000	0.00			3.6
S2.009	SW TANK2 IN		22.418	0.009	0.000	0.00			3.4
S2.010	SW TANK2 OUT		22.418	1.434	0.000	1.00			349.8
S2.011	S13		22.418	1.443	0.000	0.72			231.3

PN	US/MH Name	Status	Level Exceeded
S2.000	S1	OK	
S2.001	S2	OK	
S3.000	S3	SURCHARGED	
S2.002	S4	SURCHARGED	
S2.003	S5	SURCHARGED	
S4.000	S6	FLOOD RISK	
S4.001	S7	SURCHARGED	
S4.002	S8	SURCHARGED	
S4.003	S9	OK	
S2.004	S10	SURCHARGED	
S2.005	S11	OK	
S2.006	SW TANK1 IN	SURCHARGED	
S2.007	SW TANK1 OUT	SURCHARGED	
S2.008	S12	SURCHARGED	
S2.009	SW TANK2 IN	SURCHARGED	
S2.010	SW TANK2 OUT	SURCHARGED	
S2.011	S13	SURCHARGED	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S5.000	S14	15 Winter	100	+40%					29.814
S5.001	S15	15 Winter	100	+40%					26.151
S6.000	S16	15 Winter	100	+40%	100/15 Summer				32.766
S6.001	S17	15 Winter	100	+40%	100/15 Summer				31.760
S6.002	S18	15 Winter	100	+40%	100/15 Winter				31.594
S6.003	S19	15 Winter	100	+40%	100/15 Summer				30.407
S6.004	S21	15 Winter	100	+40%					26.633
S6.005	S22	15 Winter	100	+40%	100/15 Summer				23.091
S6.006	S23	15 Winter	100	+40%	100/15 Summer				22.642
S6.007	S24	2880 Winter	100	+40%	30/15 Summer				22.417
S6.008	S25	2880 Winter	100	+40%	30/15 Summer				22.417
S6.009	S26	2880 Winter	100	+40%	30/15 Winter				22.417
S5.002	S27	2880 Winter	100	+40%	30/720 Winter				22.417
S5.003	S28	2880 Winter	100	+40%	30/600 Winter				22.417
S2.012	S29	2880 Winter	100	+40%	30/15 Summer				22.417
S2.013	S30	2880 Winter	100	+40%	30/15 Summer				22.417
S2.014	S31	2880 Winter	100	+40%					19.583
S2.015	S32	2880 Winter	100	+40%					19.271

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S5.000	S14	-0.129	0.000	0.62			156.9	OK	
S5.001	S15	-0.146	0.000	0.69			318.5	OK	
S6.000	S16	0.799	0.000	1.64			111.6	SURCHARGED	
S6.001	S17	0.123	0.000	1.49			107.5	SURCHARGED	
S6.002	S18	0.049	0.000	0.77			187.5	SURCHARGED	
S6.003	S19	0.986	0.000	1.16			280.7	SURCHARGED	
S6.004	S21	-0.093	0.000	0.90			365.7	OK	
S6.005	S22	0.388	0.000	1.29			421.3	SURCHARGED	
S6.006	S23	0.275	0.000	0.69			413.7	SURCHARGED	
S6.007	S24	1.013	0.000	0.58			107.8	FLOOD RISK	
S6.008	S25	1.045	0.000	0.55			117.0	FLOOD RISK	
S6.009	S26	1.072	0.000	0.49			106.1	SURCHARGED	
S5.002	S27	1.102	0.000	0.22			84.1	SURCHARGED	
S5.003	S28	1.148	0.000	0.16			73.8	SURCHARGED	
S2.012	S29	1.478	0.000	0.21			79.8	SURCHARGED	
S2.013	S30	1.521	0.000	0.00			5.0	SURCHARGED	
S2.014	S31	-0.730	0.000	0.01			5.0	OK	
S2.015	S32	-0.737	0.000	0.00			5.0	OK	

APPENDIX G

Surface Water Exceedance Flood Routing Drawings

NOTES:

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

KEY

= EXISTING SURFACE WATER EXCEEDANCE FLOW PATH ROUTE

Rev	Description	Date	By	Chk	App
P2	UPDATED ACCORDING TO LATEST SITE PLAN	01.02.23	CRH	JP	JAG
P1	FIRST ISSUE	01.08.22	HD	AD	--

Alan Wood & Partners

Hull Office
341 Beverley Road
Hull
HU5 1LD

T. 01482 442138
www.alanwood.co.uk

Consulting Civil & Structural Engineers
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Leeds T. 01135 311098
Lincoln T. 01522 300210
Scarborough T. 01723 865484
Sheffield T. 01142 440077
York T. 01904 611594

Project: Proposed Development at Barrow Road, Barton Upon Humber

Client: Strata Homes Ltd

Drawing: Existing SW Exceedance Flood Routing

Role: Civils

Drawing Status: FOR APPROVAL

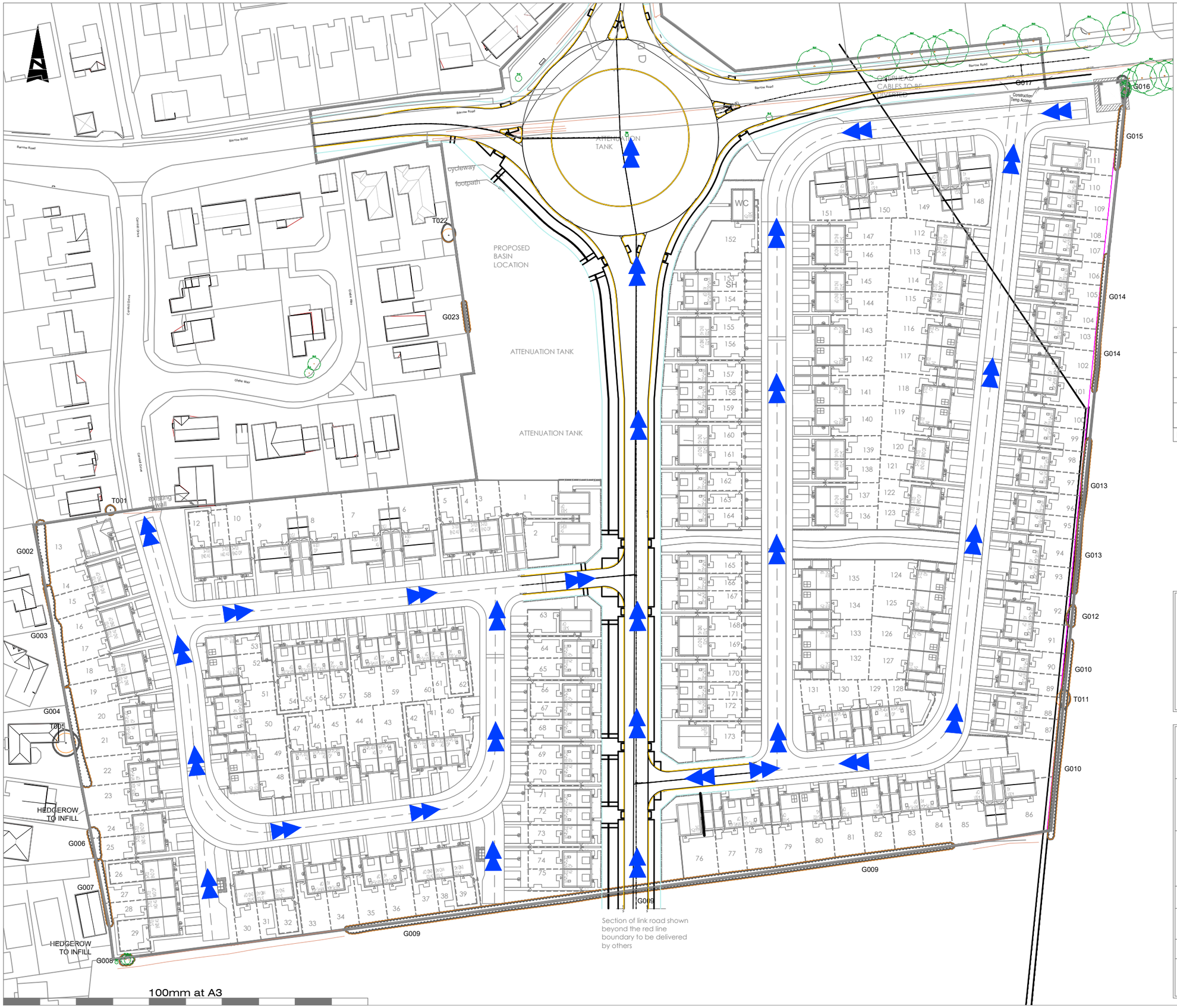
Suitability code: -

Job. no. 47658

Scale@ A3: N.T.S

Rev. P2

Project Originator Volume Level Type Role Number
BRBH - AWP - ZZ - XX - DR - C - 3300



NOTES:

1. THESE NOTES ARE INTENDED TO AUGMENT DRAWINGS AND SPECIFICATIONS. WHERE CONFLICT OF REQUIREMENTS EXIST THE ORDER OF PRECEDENCE SHALL BE AS SHOWN IN THE SPECIFICATION. OTHERWISE THE STRICTEST PROVISION SHALL GOVERN.
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KEY

= PROPOSED SURFACE WATER EXCEEDANCE FLOW PATH ROUTE

Rev	Description	Date	By	Chk	App
P4	REVISED TO SUIT SITE PLAN UPDATE	21.08.23	ERD	JP	JAG
P3	SITE PLAN UPDATED	09.02.23	HD	AD	JAG
P2	UPDATED ACCORDING TO LATEST SITE PLAN	01.02.23	CRH	JP	JAG
P1	FIRST ISSUE	01.08.22	HD	AD	--

Alan Wood & Partners

Hull Office
341 Beverley Road
Hull
HU5 1LD

T. 01482 442138
www.alanwood.co.uk

Consulting Civil & Structural Engineers
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York T. 01904 611594

Project: Proposed Development at Barrow Road, Barton Upon Humber

Client: Strata Homes Ltd

Drawing: Proposed SW Exceedance Flood Routing

Role: Civils

Drawing Status: FOR APPROVAL

Suitability code: -

Job. no. 47658 | Scale@ A3: N.T.S | Rev. P4

Project Originator Volume Level Type Role Number
BRBH - AWP - ZZ - XX - DR - C - 3301

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APPENDIX H

Correspondence with the Lead Local Flood Authority

From:	James Gibson
To:	Billy Green; Kate Mills
Cc:	"Claire Linley"; Andrew Bradley; Emma Lancaster; Jacob Padley; Alan Dunn
Subject:	Barrow Road, Barton : Drainage Principles
Date:	18 October 2022 10:08:00
Attachments:	1275_001.pdf image001.gif image002.png image003.png image004.png image005.png

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Billy, Kate,

Thank you both for your time yesterday morning; as promised please find attached our preliminary SuDS sketch and notes from the discussions:

- Infiltration tests have been undertaken and the water did not soakaway
- There are no watercourses to discharge to
- Surface water must therefore discharge to the closest surface water sewer
- Anglian Water's pre-development enquiry confirms that we can discharge to the nearest surface water sewer on Barrow Road at 5l/s, subject to the discharge hierarchy
- The site falls from around 35mAOD to 22mAOD south to north
- Over-sized pipe storage in the estate roads, swale storage and permeable paving storage is grossly inefficient and disproportionate given the site falls and the available developable space
- Land outside the red-line boundary is controlled by others so we can not use it to construct other SuDS
- There is a need for a link road and new roundabout that bisects the stie and provides access to land further south; this limits the available developable space further
- We have considered larger, open SuDS, but because of the site constraints, the line road, the falls and the available space, the use of SuDS to serve all roads and hardstanding areas is not achievable
- However, we have identified the areas on the sketch as potentially appropriate for filter trench locations, subject to the spine road drainage being able to be contained in the 2m verges, between the kerb and the footpath
    - This needs to be co-ordinated with the Link Road design team
    - The overall link road roundabout's drainage also needs to be co-ordinated with the scheme
- The filter trenches will treat and convey flow to the outfall,
- A basin will be used to balance excess flows, located at the lowest part of the site
- The basin will either be maintained by AWS or by a private management company to the Ciria requirements, subject to the design standards
- The AWS sewers in Barrow Road are at the head of the system and are shallow (<1.2m) therefore pumping flows from our development is likely
- We will review the topography of the surrounding land and consider overland flows from the south

I trust that this is a fair record of our discussions and that we can proceed with the detailed Flood Risk and Drainage Assessment on this principles above and attached.

Regards
James Gibson | **Director** | **MEng (Hons), CEng, C.WEM, MCIWEM**
e: james.gibson@alanwood.co.uk | **t:** 01482 442138
a: 341 Beverley Road | Hull | HU5 1LD
w: www.alanwood.co.uk

Office locations:
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341 Beverley Road	Pullan Way	The Quays
Hull	Leeds	Burton Waters
HU5 1LD	LS27 0BZ	Lincoln LN1 2XG
Telephone	**Telephone**	**Telephone**
01482.442138	0113. 5311098	01522.300210
Scarborough Office	**Sheffield Office**	**York Office**
Kingsley House	Hallamshire House	Omega 2
7 Pickering Road	Meadow Court	Monks Cross Drive
West Ayton	Hayland Street	York
Scarborough YO13 9JE	Sheffield S9 1BY	YO32 9GZ
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