



# Drainage Philosophy

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19T2197 – Housing Development, Robin Hood Farm,  
Brompton-on-Swale

Billingham George & Partners

Civil & Structural Engineers, Building Surveyors

Wellington House, Wellington Court, Preston Farm, Stockton-on-Tees, TS18 3TA

T: 01642 876 470 E: [consulting@bgp-teesside.co.uk](mailto:consulting@bgp-teesside.co.uk)  @BGPconsulting

## Drainage Philosophy

Project: Housing Development, Robin Hood Farm, Brompton-on-Swale

Client: Neil Pittaway

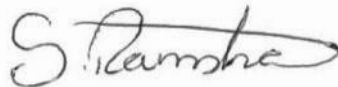
BGP Job No: 19T2197

### Document Checking:

Prepared By: J Ainscough – Technician



Checked By: S Ramshaw – Director



Issue	Date	Status	Checked for Issue
001	23/03/2020	Planning	SR
002	22/07/2020	Planning	SR
003	27/10/2020	Planning	SR

This document has been prepared solely as a Drainage Philosophy Report for Neil Pittaway regarding the proposed residential development on the land adjacent to Robin Hood Farm, Brompton-on-Swale, North Yorkshire. Billinghurst George & Partners accepts no responsibility or liability for any use that is made of this document other than by the Client for which it was originally commissioned and prepared.

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## 1. Executive Summary / Project Background

- 1.1. This Drainage Philosophy has been prepared to supplement the planning application for the existing Robin Hood Farm site that will involve the construction of 32no. residential properties and associated infrastructure within the same site. See Appendix A for the site location.
- 1.2. Yorkshire Water (YWL) records have been obtained and the SuDS Design Guidance available on the North Yorkshire County Council website has been referenced.
- 1.3. This report is a supplement to the flood risk assessment prepared by ID Civils Ltd ref: 4551/FRA01
- 1.4. A hierarchy for the appropriate disposal of surface water is included within Building Regulations Part H3 which states the following:

*"Rainwater from a system provided ... shall discharge to one of the following, listed in order of priority:*

  - 1) *An adequate soakaway or some other adequate infiltration system; or, where this is not reasonably practicable,*
  - 2) *A watercourse; or, where that is not reasonably practicable,*
  - 3) *A sewer."*
- 1.5. The following Drainage Philosophy addresses each element of the above hierarchy and details how the surface water and foul water will be discharged from site.
- 1.6. BGP have prepared this report based on the current information available and could be subject to change should new information become available.

## 2. Existing Site Information

### 2.1. Site Location

- 2.1.1 Site Name: Robin Hood Farm
- 2.1.2 Site Address: Robin Hood Farm, Gatherley Road, Brompton-on-Swale, Richmond, North Yorkshire, DL10 7JF
- 2.1.3 OS Grid Reference: 422439, 500370
- 2.1.4 National Grid Reference: NZ224003

### 2.2. Site Description

- 2.2.1 Site Area: 1.110 Ha
- 2.2.2 Existing Land Use: Residential/Agricultural
- 2.2.3 Proposed Land Use: Residential
- 2.2.4 Local Planning Authority: North Yorkshire County Council (NYCC)
- 2.2.5 Sewer Undertaker: Yorkshire Water (YWL)
- 2.2.6 The site is located on a parcel of land accessed off Gatherley Road, Brompton-on-Swale. The site currently comprises of Robin Hood Farm and the associated agricultural land.
- 2.2.7 The boundaries to the site consist of a tree/ hedge line which runs along the northern boundary with residential properties beyond, Caxton Close to the East, Stephenson Road to the South and Gatherley Road (A6136) to the West.

### 2.3. Site Levels

- 2.3.1 A topographical survey was carried out by David Brien Surveying Ltd in April 2016 and can be viewed in Appendix C.
- 2.3.2 The site falls quite steeply from a level of 75.5m AOD in the north east of the site adjacent to Caxton Close, to a level of 69.5m AOD to the south west of the site in the location of the existing farm buildings then towards the south to the junction between Gatherley Road and Stephenson Road

### 2.4. Existing Watercourses

- 2.4.1 There is a small watercourse 250m East of the site which runs southerly towards the River Swale.
- 2.4.2 The nearest named watercourse is the River Swale which is located approximately 1km to the South of the site. This river runs from West to East towards Catterick and ultimately connects into the River Ure.

- 2.4.3 The local unnamed watercourse connects into the River Swale approximately 1km to the South East of the Site.

## 2.5. Existing Public and Private Drainage

- 2.5.1 See Appendix D for locations of existing Yorkshire Water public drains. A 150mm diameter Yorkshire Water adopted surface water sewer runs north to south beneath Caxton Close located to the East of the site. A 150mm diameter Yorkshire Water foul water sewer runs north to south beneath the footpath adjacent to Gatherley Road (A6136).
- 2.5.2 Section 4.1 of this report provides a summary of how the existing drainage system discharges offsite to existing public sewers.

## 2.6. Existing Ground Conditions

- 2.6.1 A Phase 1 Desktop Study was carried out by iD Geo Environmental Engineers (4551-G-R001) in April 2016 with a Phase 2 Intrusive site investigation carried out by Solmek (S191209) in January 2020.
- 2.6.2 The Phase 2 Solmek report notes that the strata beneath the site was generally similar and consisted of between 300-600mm of topsoil that typically overlaid firm sandy slightly gravelly clays to a maximum depth of 5.2m below ground level.
- 2.6.3 Groundwater, where present, was encountered between 2.5 – 4.2m below ground level. Additionally, soakaway tests results show an infiltration rate of  $5.41 \times 10^{-6}$  m/s. (classified Unsuitable)

## 2.7. Existing Flood Risk Assessment

- 2.7.1 A site-specific flood risk assessment (June 2016) has been carried out by iD Civils and has been provided separately to support this planning application.
- 2.7.2 The report states that the site is within Flood Zone 1 and is at low risk of flooding from fluvial sources. The flooding from other sources has also been assessed and deemed to be LOW risk. Therefore, the proposed site is suitable for the proposed development category in accordance with the National Planning Policy Framework.

## 3. Proposed Site Details

### 3.1. Development Proposals

- 3.1.1. The proposals involve the construction of circa 32no. residential buildings and associated infrastructure on the former agricultural land adjacent to Robin Hood Farm.
- 3.1.2. This involves the provision of a new access to be created off Gatherley Road providing vehicular access to the site.
- 3.1.3. See appendix B for proposed site layout.

## 4. Proposed Surface Water Drainage

### 4.1. Existing Drainage Regime

- 4.1.1 See Appendix D for locations of existing Yorkshire Water public drains. A 150mm diameter Yorkshire Water adopted surface water sewer runs north to south beneath Caxton Close located to the East of the site. A 150mm diameter Yorkshire Water foul water sewer runs north to south beneath the footpath adjacent to Gatherley Road (A6136).
- 4.1.2 A CCTV sewer investigation of all existing drainage is proposed to be undertaken to confirm the diameter and condition of all existing drainage that is to be retained and any existing outfall sewers prior to the commencement of any works.
- 4.1.3 The existing agricultural fields fall steeply towards Gatherley road where any overland flows will be picked up via the existing road gullies.

### 4.2. Current Guidelines

- 4.2.1. In accordance with Building Regulations and the National Planning Policy Framework (NPPF) the disposal of surface water has been considered in the following order of priority; discharge to ground, where not reasonably practicable, a watercourse, or where not reasonably practicable a sewer.

### 4.3. Discharge to Ground

- 4.3.1. Discharge of the surface water to ground via infiltration is suited to sites which have ground conditions made up of gravel, sand or a mixture of the two. Sands and gravels permit rapid dispersion and infiltration of surface water which is necessary to ensure that overland flooding does not occur during intense rainfall periods.
- 2.6.4 The Phase 2 Solmek report (S191209 - January 2020) notes that the strata beneath the site was generally similar and consisted of between 300-600mm of topsoil that typically overlaid firm sandy slightly gravelly clays to a maximum depth of 5.2m below ground level.
- 2.6.5 Groundwater, where present, was encountered between 2.5 – 4.2m below ground level. Additionally, soakaway tests results show an infiltration rate of  $5.41 \times 10^{-6}$  m/s.
- 4.3.2. Based on the material encountered and the poor infiltration rate obtained from site, the discharge of surface water to ground is deemed unsuitable.



#### **4.4. Discharge to a Watercourse**

4.4.1. As noted in previous sections there is a small watercourse 250m East of the site which runs southerly towards to River Swale.

4.4.2. Due to the distance and the existing infrastructure, it is not deemed practical to discharge the surface water to a watercourse.

#### **4.5. Discharge to a Sewer**

4.5.1. It is not possible or practicable to discharge the surface water to either the ground via infiltration or to a nearby watercourse.

4.5.2. Therefore, as per the hierarchy within Building Regulations Part H3, it is deemed necessary to discharge the surface water to a nearby sewer.

4.5.3. The surface water will discharge to an existing Surface water sewer within Caxton Close in line with the hierarchy for separate foul and surface systems.

## 5. Surface Water Proposals

- 5.1.1. The proposals involve the construction of 32no. residential properties on the agricultural land adjacent to Robin Hood Farm. This development will involve the construction of associated infrastructure such as roads and drainage serving the properties.
- 5.1.2. Condition 16 of the planning conditions notes that the scheme must be carried out in accordance with the original FRA prepared by ID Civils. This notes a discharge rate 5l/s to the nearby surface water sewer of 5l/s or the culvert with 22l/s.
- 5.1.3. As it is unviable to reach the culverted watercourse located 250m East of the Site, the scheme has been designed on 5l/s to the nearby surface water sewer.
- 5.1.4. All new drainage is to be split into a separate foul and surface water system as per Building Regulations Part H. The surface water flows are to be directed towards the onsite attenuation tank located to the South West before being pumped to the discharge location beneath Caxton Close.
- 5.1.5. The surface water flows are to be restricted and attenuated to the West of the site. See BGP drawings RHF-BGP-01-ZZ-DR-C-01130\_P01 'Proposed Drainage Layout' within Appendix F.
- 5.1.6. The flow control device has been set at a 5l/s restriction to size the attenuation volumes to suit the constraints of the site such as depth from cover level to invert level, building lines, services, retaining walls and boundaries.
- 5.1.7. The surface water flows from the new properties, footpaths, roads and driveways are to be directed towards the large off-line Pre-cast Concrete attenuation tank within the main landscaped area to the west of the site near the access location. These flows are to be restricted to 5l/s via a flow control device, which will require approximately 290m<sup>3</sup> of attenuation storage to be provided by the off-line concrete tank.
- 5.1.8. This restricted 5 l/s flow is to be directed towards the proposed surface water pumping station located next to the attenuation tank. This in turn will pump the surface water flows to the east of the site where it will feed via gravity into the existing Yorkshire Water sewer located beneath Caxton Close.
- 5.1.9. The design of the surface water system accounts for the 1:100yr storm event plus an allowance of 40% climate change and 10% Urban creep.
- 5.1.10. The final attenuation volumes are to be determined during the detailed design.
- 5.1.11. A CCTV sewer investigation of all existing drainage is proposed to be undertaken to confirm the diameter and condition of all existing drainage that is to be retained and any existing outfall sewers prior to the commencement of any works.

## 5.2. Incorporation of SuDS Features

- 5.2.1. The site falls from a level of 75.5m AOD in the north east to a level of 69.5m AOD in the south west at an average gradient of 1:17 across the site. This steep fall across the site has required the creation of suitable plateaus in order to provide gradients which meet design requirements.
- 5.2.2. Therefore, the inclusion of natural grassed SuDS features such as swales, basins, or filter strips would not be appropriate for use as attenuation due to the steep falls across the site and the existing constraints. Although it may be possible to introduce small amenity features that will satisfy ecology requirements within the site, but not to be incorporated into the drainage strategy.

## 6. Proposed Foul Water Drainage

- 6.1. See Appendix F for the 'Proposed Drainage Layout'.
- 6.2. The proposed foul water that will serve the new residential properties will be drained via a new foul sewer network that will be separated from the surface water as per Building Regulations Part H. These foul sewers are to be directed and connected into the existing YWL sewer which runs beneath the footpath on Gatherley Road via a new manhole.
- 6.3. The foul water discharge rate and connection location is shown at the access of the new estate. this is subject to approval by Yorkshire Water and confirmation of existing invert level.

## 7. Conclusion

- 7.1. The proposals are to construct 32no. residential properties on the land adjacent to Robin Hood Farm, Brompton-on-Swale.
- 7.2. This involves creating a new junction on Gatherley Road to provide required infrastructure to access the proposed properties, including highways and drainage.
- 7.3. It is not possible or practicable to discharge the surface water to ground via infiltration.
- 7.4. It is not possible or practicable to discharge the surface water to a nearby watercourse.
- 7.5. Therefore, it is intended that the site drainage will discharge into the Yorkshire Water sewers surrounding the site, with the surface water being directed towards the existing manhole within Caxton Close to the East, and the foul water being directed towards the existing pipe beneath Gatherley Road to the West.
- 7.6. The proposed design of surface water has limited the discharge rate to 5l/s and the drainage network has been designed to cope with the 1:100yr +40% cc with an additional allowance of 10% for urban creep. This therefore protects both the proposed scheme and the offsite impact in line with government legislation.
- 7.7. A proposed drainage scheme has been recommended within Section 5 and Section 6 with a General Arrangement drawing included within Appendix F.
- 7.8. This statement has been prepared with reference to the information available at the time of writing.

Report No: 19T2197 / DP

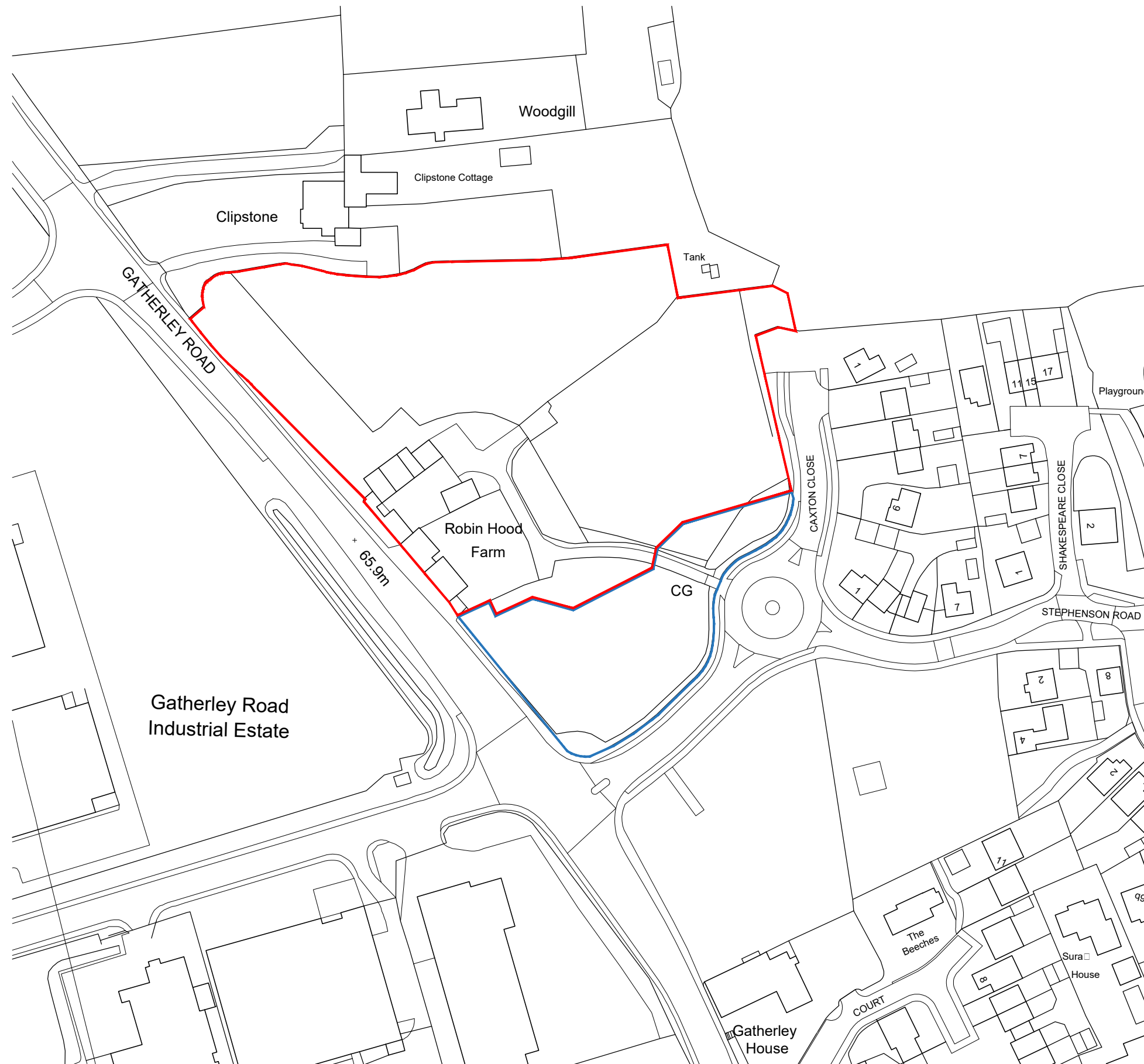
Report Title: Drainage Philosophy – 19T2197 – Housing Development, Robin Hood Farm, Brompton-on-Swale



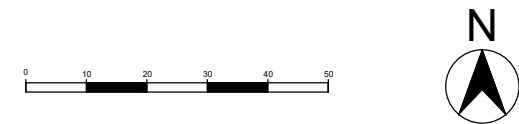
Appendix A  
Site Location Plan

"For the purposes of Planning Consent the following applies to any copy of this drawing made by the Local Authority:

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Rev A - : 2016.07.21 : CL : ACD : Site boundary amended as instructed by client.

**Issue Purpose: PLANNING APPLICATION**

P+HS Architects  
 84 Albion Street Leeds LS1 6AG  
 0113 2454332

The Old Station Station Road Stokesley TS9 7AB  
 01642 712684

Design Works William Street Gateshead NE10 0JP  
 0191 4692585



www.pandhs.co.uk

Client	Neil Pittaway	Issued From	Stokesley
Project	Land at Robin Hood Farm	Date	July 2016
Title	Site Location Plan	Scale	1:1250@A3
		Drawn	CL Auth ACD

Drawing Number	Revision	Do not scale from this drawing. Work to figured dimensions, and any discrepancy to be reported to the Architect.
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2752 - D - 00 - 01 - A

Stage Identification: Design - D Construction - C

Refer to larger scale drawings where available. © P+HS Architects Limited



## Appendix B

### Proposed Site Layout

Notes:

- Road and footpath surfaces are to meet architects specification.
- All works and materials to be in accordance with
    - North Yorkshire County Council current design standards
    - New Road and Streetworks Act. 1991
    - BGP Specifications
    - All applicable Building regulations
  - All levels are in metres to Ordnance Datum (m AOD).
  - The contractor is to check all dimensions and levels and report any discrepancies or omissions to the Engineer.
  - This drawing is to be read only in conjunction with BGP specification and drawings.
  - All concrete for foundation to kerb channels and edgings shall be Class Gen3 (BS 5328) unless shown otherwise.
  - All kerbs and channels shall be hydraulically pressed and comply in all respects with BS 7263 Part 1.
  - Kerbs and channels shall be laid true to line and level and shall not be backed until inspected and approved by the Engineer.
  - For softscape areas refer to Architects specification & details.

S.H.E.  
Do not excavate until all underground services have been identified and marked out. Refer to service providers drawings and to the utilities survey drawings. Unknown underground services may exist. Check for services by carrying out a scan with a cable avoidance tool. (CAT Scan)

Legend:

- ① Asphalt Concrete Highway
- ② Asphalt Concrete Footway
- ③ Private Paved Footway
- ④ Private Driveway
- Shared Surface
- Soft Landscaping

NB  
For Planning Only

Reference Drawings:

- RHF-BGP-01-ZZ-DR-C-01110 External Works GA
- RHF-BGP-01-ZZ-DR-C-01112 External Works Details
- RHF-BGP-01-ZZ-DR-C-01130 Drainage GA
- RHF-BGP-01-ZZ-DR-C-01131 Manhole Schedules
- RHF-BGP-01-ZZ-DR-C-01132 Drainage Details
- RHF-BGP-01-ZZ-DR-C-01900 Impermeable Areas Plan

Updated to suit revised site layout	JRA	P02	SR	22.07.2020
Issued for Planning	JRA	P01	SR	02.04.2020
AMENDMENT	BY	REV	CHK	DATE

Rev P = Preliminary T = Tender C = Construction LCI = Last Construction Issue

In instances where this drawing completes or partly completes a contract, Billingham George & Partners will consider that it's product has been validated, unless in a period not exceeding 90 working days, the client advises to the contrary.



**Billingham George & Partners**

CIVIL & STRUCTURAL ENGINEERS | BUILDING SURVEYORS  
1st Floor, Wellington House, Wellington Court, Stockton-on-Tees, TS18 3TA  
T 01642 876 470 @BGPconsulting E consulting@bgp-teeside.co.uk W www.bgp-consulting.co.uk

**Client**  
Neil Pittaway

**Project**  
Robin Hood Farm, Brompton-on-Swale

**Project No.**  
19T2197

**Drawing Title**  
External Works GA

Drawn	Date	Checked	Date	Size	Scale	Class.	Rev.
JRA	Jan 2020	SR	Jan 2020	A1	1:250	90.4	P02

Location	Originator	Volume	Level	Type	Role	Unique No.
RHF	BGP	01	ZZ	DR	C	01110

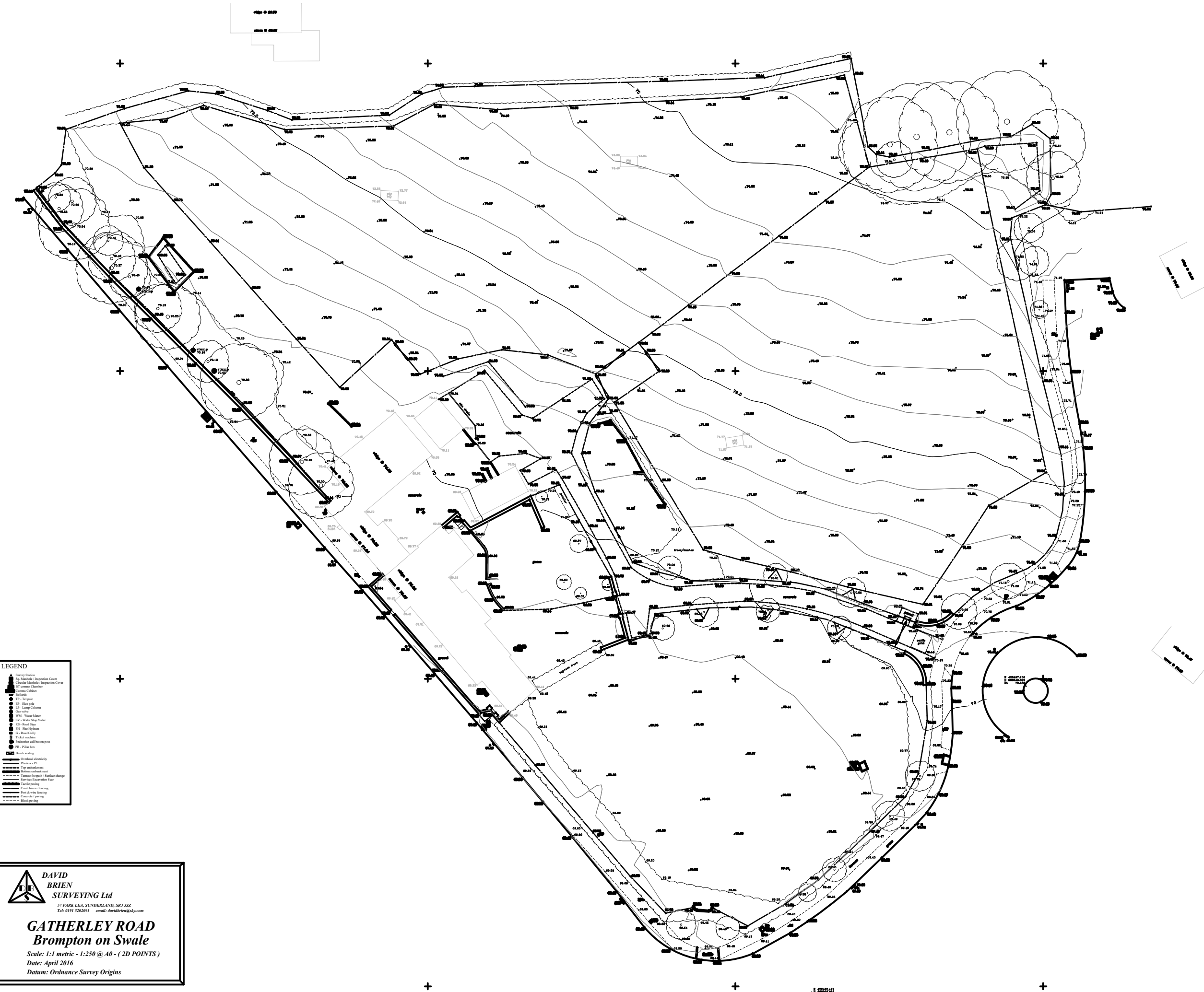
**File Reference**  
RHF-BGP-01-ZZ-DR-C-01110







Appendix C  
Topographical Survey



Symbol	Description
Survey Station	Survey Station
Machine Inspection Cover	Machine Inspection Cover
London Metrolink Inspection Cover	London Metrolink Inspection Cover
Concrete Chamber	Concrete Chamber
Manhole	Manhole
Utility Cabinet	Utility Cabinet
CP - Tall pole	CP - Tall pole
CP - 2m pole	CP - 2m pole
CP - Lamp Column	CP - Lamp Column
Water Meter	Water Meter
Water Stop Valve	Water Stop Valve
Road Sign	Road Sign
Road Boundary	Road Boundary
Road Gully	Road Gully
Electricity	Electricity
Electricity and water post	Electricity and water post
PO - Pole box	PO - Pole box
Overhead electricity	Overhead electricity
Pavers - PL	Pavers - PL
Turf embankment	Turf embankment
Drainage embankment	Drainage embankment
Level change	Level change
Level change	Level change
Services Excavation Line	Services Excavation Line
Fossil paving	Fossil paving
Crack barrier fencing	Crack barrier fencing
Pond & wet drainage	Pond & wet drainage
Concrete paving	Concrete paving
Block paving	Block paving

**DAVID BRIEN SURVEYING Ltd**  
57 PARK LEA, SUNDERLAND, SR1 3SZ  
Tel: 0191 5202091 email: davidbrien@sky.com

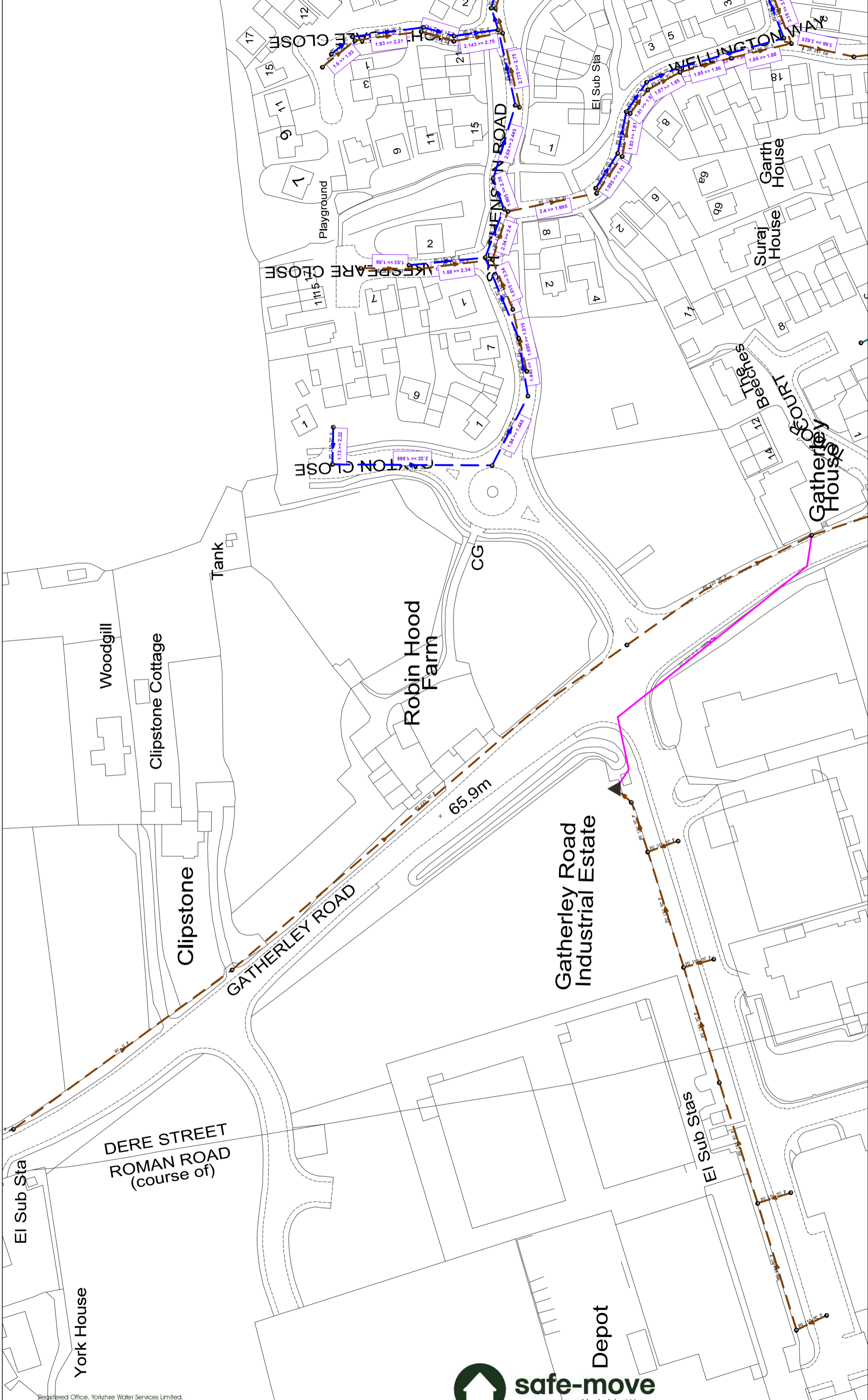
**GATHERLEY ROAD  
Brompton on Swale**

Scale: 1:1 metric - 1:250 @ A0 - ( 2D POINTS )  
Date: April 2016  
Datum: Ordnance Survey Origins



## Appendix D

### Yorkshire Water Records




This plan is furnished as a general guide only and its accuracy as to the location of any sewer is not guaranteed. The plan is not to be relied upon in the event of excavations or other works made in the vicinity of public sewers. No house or property connections are shown.

<b>Partial Key</b>	<b>Date Req :</b> 06/04/2016, 12:32:12
Foul Sewer = F	<b>Date Gen :</b> 06/04/2016, 12:32:13
Combined Sewer = C	<b>Source :</b> Sewer Network Enquiry
Surface Water Sewer = SW	
Trade Sewer = TD	
Partially Separate = PS	

<b>Title</b>	<b>Map Name :</b> NZ2200SW
<b>Notes</b>	Yorkshire Water, PO Box 500, Halifax Road, Bradford BD6 2LZ Contact Name : Ms H Webster Contact Tel :

422209 : 500237



Yorkshire Water  
PO Box 500,  
Halifax Road,  
Bradford BD6 2LZ  
Contact Name :  
Ms H Webster  
Contact Tel :

UPN: Undefined  
Originator: H Webster, Safe Move  
Date Gen : 06/04/2016, 12:32:13  
Date Req : 06/04/2016, 12:32:12  
Source : Sewer Network Enquiry



## Appendix E Proposed Drainage Layout

Notes

- All works to be carried out in accordance with:
  - "Sewers for Adoption" The contractor should note any changes regarding adoption of sewers and construction methods.
  - BS EN 752 "Drain and sewer system outside buildings"
  - Current Applicable Building regulations
  - BGP Specifications
- All levels shown are in metres and are relative to ordnance datum (m AOD).
- Connection to Yorkshire Water sewers are only to be carried out under an S108 agreement by YWA approved firm contractors unless agreed otherwise between both parties. (organised by main contractor)
- Invert levels of all existing chambers and connection points are to be confirmed and engineer advised prior to commencement of any Drainage Works.
- Where proposed sewers connect to existing sewers, the existing sewers must be checked for line, level and condition preferably by a CCTV survey
- Concrete bed and surround is required to all gully leads and to all pipes in highways hardstanding where cover to pipe  $\geq 1200$ mm
- All pipes to be either extra strength V.C. to BS 65 or PVC to BS 4660 or concrete pipes Class 120 to BS 5911
- All RWP & slab penetration locations are indicative and accurate positions should be taken from the Architects drawings. All slab penetrations to be roddable above ground level via access pipe
- Existing sewer positions are indicative and are not to be used in conjunction with design. Contractor to confirm location.
- All existing drainage to be cleaned and atted as part of the contract
- All RWP connections to be 1000 & Surface water sewers to be 1500 unless noted otherwise.
- All FW drains to be 1500 UNO unless noted otherwise.
- Contractor is responsible for positioning MIs so they do not compromise line or level of kerbing or other delineation at the juncture of two surface materials.
- Cover levels shown are indicative and may vary on site. The contractor should adjust levels to suit site conditions
- Other services are not shown on this drawing however their presence must be anticipated. The contractor is to confirm prior to commencing any works, the location and depth of all services that may affect the works the manufacturers literature and recommendations
- Route of proposed rising main is indicative only and subject to detailed design and Section 104 approval.

Legend:

- Existing Surface Water Drainage —
- Existing Foul Water Drainage —
- Proposed Surface Water Drainage —
- Proposed Foul Water Drainage —
- Rain Water Pipe — RWP
- Foul Pop up Location ● PP
- Rodding Eye ○ Re
- Backdrop ▭ bd
- Road Gully ▭ G
- Trapped Gully ▭ g
- Linear Drain ▭ LD
- PPIC Silt Trap ▭ ST

NB For Planning Only

Reference Drawings:

- RHF-BGP-01-ZZ-DR-C-01110 External Works GA
- RHF-BGP-01-ZZ-DR-C-01112 External Works Details
- RHF-BGP-01-ZZ-DR-C-01130 Drainage GA
- RHF-BGP-01-ZZ-DR-C-01131 Manhole Schedules
- RHF-BGP-01-ZZ-DR-C-01132 Drainage Details
- RHF-BGP-01-ZZ-DR-C-01900 Impermeable Areas Plan

Proposed Rising Main re-routed, drawing size changed to A0	JRA	P04	SR	15.09.2020
Updated to suit revised site layout	JRA	P03	SR	23.07.2020
Updated to suit revised site layout	JRA	P02	SR	22.07.2020
Issued for Planning	JRA	P01	SR	02.04.2020
AMENDMENT	BY	REV	CHK	DATE

Rev: P = Preliminary T = Tender C = Construction LD = Last Construction Issue  
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Billingham George & Partners

CIVIL & STRUCTURAL ENGINEERS | BUILDING SURVEYORS  
 1st Floor, Wellington House, Wellington Court, Stockton-on-Tees, TS16 3TA  
 T: 01642 876 470 E: info@bilinghamgeorge.co.uk W: www.bilinghamgeorge.co.uk

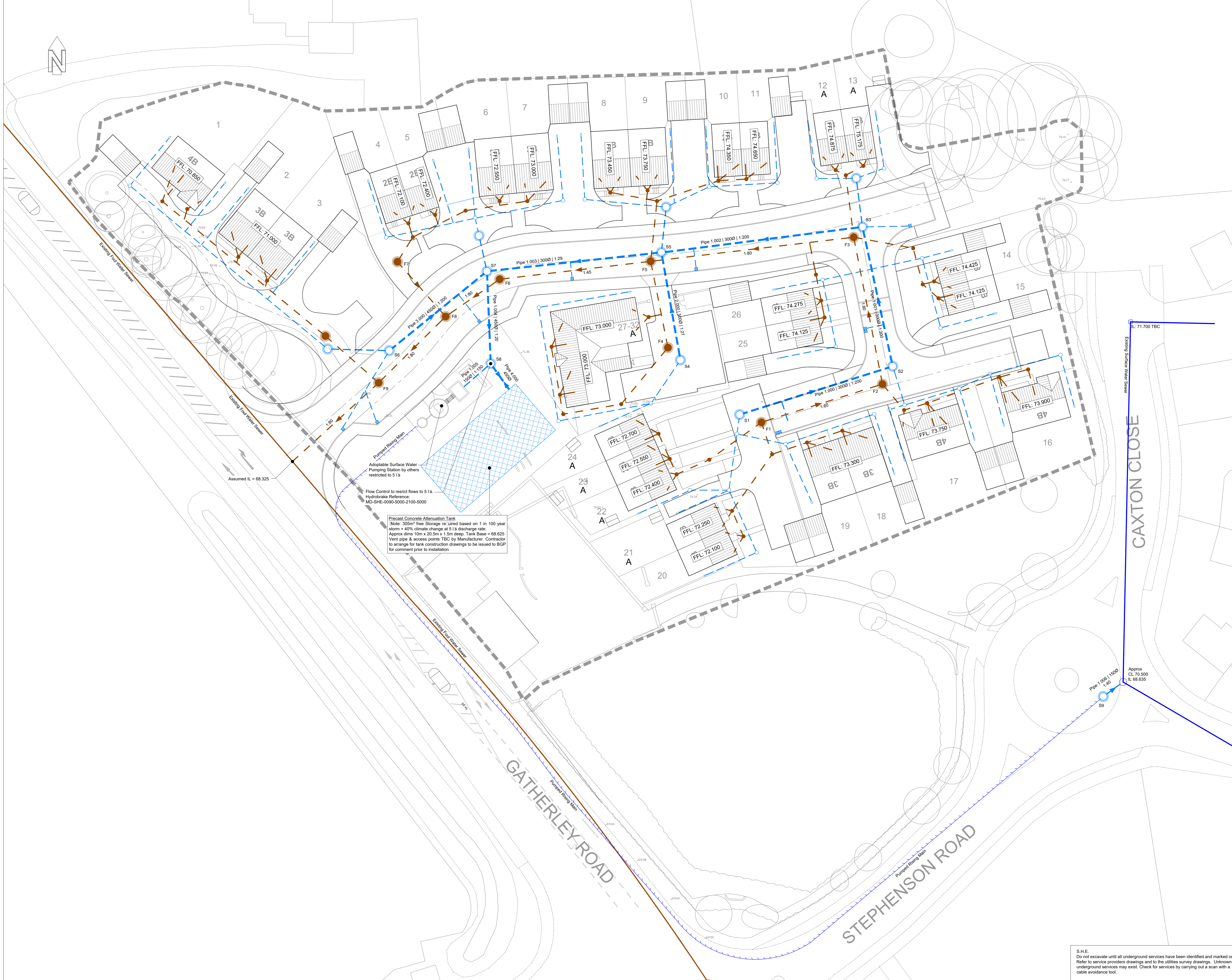
Client: Neil Pittaway  
 Project: Robin Hood Farm, Brompton-on-Swale  
 Project No.: 1972197

Drawing Title: Proposed Drainage Philosophy

Drawn	Date	Checked	Date	Size	Scale	Class.	Rev.
JRA	Jan 2020	SR	Jan 2020	A0	1:200	S2	P04

Location	Originator	Volume	Level	Type	Role	Unique No.
RHF	BGP	01	ZZ	DR	C	01130

File Reference: RHF-BGP-01-ZZ-DR-C-01130



**Precast Concrete Attenuation Tank**  
 Note: 305m<sup>3</sup> free storage re-lined based on 1 in 100 year storm + 40% climate change at 5 l/s discharge rate. Approx dims 10m x 20.5m x 1.5m deep. Tank Base = 68.625  
 Vent pipe & access points TBC by Manufacturer. Contractor to arrange for tank construction drawings to be issued to BGP for comment prior to installation

Adoptable Surface Water Pumping Station by others restricted to 5 l/s  
 Flow Control to restrict flows to 5 l/s.  
 Hydraulic Reference: MD-SHE-0090-5000-2100-5000

S.H.E.  
 Do not excavate until all underground services have been identified and marked out. Refer to service providers drawings and to the utilities survey drawings. Unknown underground services may exist. Check for services by carrying out a scan with a cable avoidance tool.



## Appendix F

### Proposed Impermeable Areas Plan

Impermeable Areas:

	Pipe 1.000 Impermeable Area = 1225m <sup>2</sup> (0.1225ha) Impermeable Area +10% = 1348m <sup>2</sup> (0.1348ha)
	Pipe 1.001 Impermeable Area = 625m <sup>2</sup> (0.0625ha) Impermeable Area +10% = 688m <sup>2</sup> (0.0688ha)
	Pipe 1.002 Impermeable Area = 472m <sup>2</sup> (0.0472ha) Impermeable Area +10% = 520m <sup>2</sup> (0.0520ha)
	Pipe 1.003 Impermeable Area = 733m <sup>2</sup> (0.0733ha) Impermeable Area +10% = 807m <sup>2</sup> (0.0807ha)
	Pipe 1.004 Impermeable Area = 800m <sup>2</sup> (0.0800ha) Impermeable Area +10% = 880m <sup>2</sup> (0.0880ha)
	Pipe 2.000 Impermeable Area = 425m <sup>2</sup> (0.0425ha) Impermeable Area +10% = 468m <sup>2</sup> (0.0468ha)
	Pipe 3.000 Impermeable Area = 963m <sup>2</sup> (0.0963ha) Impermeable Area +10% = 1060m <sup>2</sup> (0.1060ha)

Totals  
Impermeable Area = 5074m<sup>2</sup> (0.5074ha)  
Impermeable Area +10% = 5581m<sup>2</sup> (0.5581ha)

NB  
For Planning Only

Reference Drawings:

- RHF-BGP-01-ZZ-DR-C-01110 External Works GA
- RHF-BGP-01-ZZ-DR-C-01112 External Works Details
- RHF-BGP-01-ZZ-DR-C-01130 Drainage GA
- RHF-BGP-01-ZZ-DR-C-01131 Manhole Schedules
- RHF-BGP-01-ZZ-DR-C-01132 Drainage Details
- RHF-BGP-01-ZZ-DR-C-01900 Impermeable Areas Plan

Updated to suit revised site layout	JRA	P02	SR	22.07.2020
Issued for Planning	JRA	P01	SR	02.04.2020
AMENDMENT	BY	REV	CHK	DATE

Rev P = Preliminary T = Tender C = Construction LCI = Last Construction Issue

In instances where this drawing completes or partly completes a contract, Billingham George & Partners will consider that it's product has been validated, unless in a period not exceeding 90 working days, the client advises to the contrary.



**Billingham George & Partners**

CIVIL & STRUCTURAL ENGINEERS | BUILDING SURVEYORS  
1st Floor, Wellington House, Wellington Court, Stockton-on-Tees, TS18 3TA  
T 01642 876 470 @BGPconsulting E consulting@bgp-teeside.co.uk W www.bgp-consulting.co.uk

**Client**  
Neil Pittaway

**Project**  
Robin Hood Farm, Brompton-on-Swale

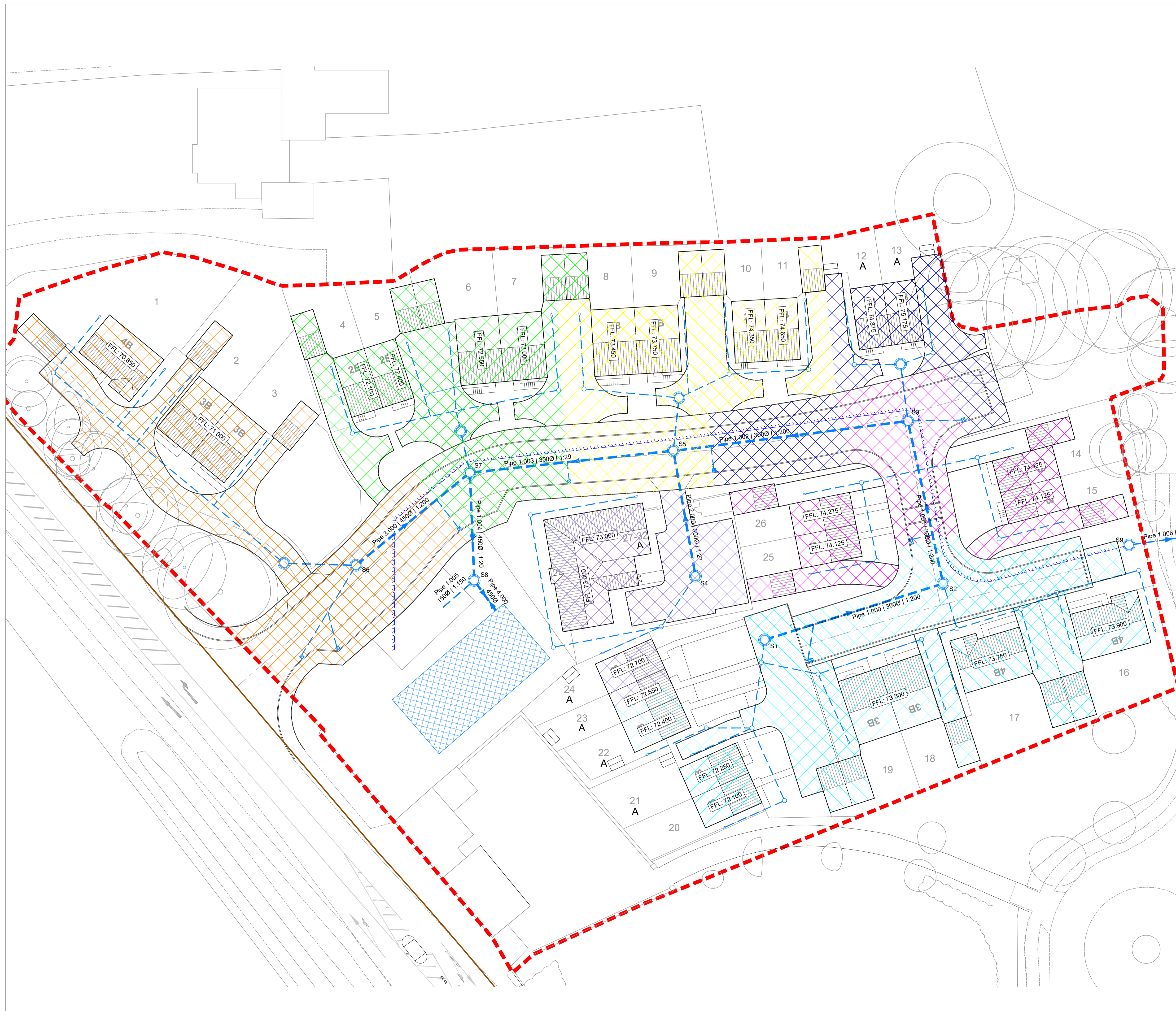
**Project No.**  
19T2197

**Drawing Title**  
Impermeable Areas Plan

Drawn	Date	Checked	Date	Size	Scale	Class.	Rev.
JRA	Jan 2020	SR	Jan 2020	A1	1:250	52	P02

Location	Originator	Volume	Level	Type	Role	Unique No.
RHF	BGP	01	ZZ	DR	C	01900

**File Reference**  
RHF-BGP-01-ZZ-DR-C-01900







## Appendix G

### MicroDrainage Calculations

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	18.000	Add Flow / Climate Change (%)	0
Ratio R	0.358	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm








Time (mins)	Area (ha)		Time (mins)	Area (ha)
0-4	0.450		4-8	0.127

Total Area Contributing (ha) = 0.577

Total Pipe Volume (m³) = 16.158

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section	Type	Auto Design
1.000	26.172	0.131	199.8	0.135	4.00	0.0	0.600	o	300	Pipe/Conduit		
1.001	23.261	0.116	200.5	0.069	0.00	0.0	0.600	o	300	Pipe/Conduit		
1.002	33.053	0.165	200.3	0.052	0.00	0.0	0.600	o	300	Pipe/Conduit		
2.000	17.825	0.662	26.9	0.046	4.00	0.0	0.600	o	300	Pipe/Conduit		
1.003	28.618	0.996	28.7	0.081	0.00	0.0	0.600	o	300	Pipe/Conduit		
3.000	20.533	0.103	199.3	0.106	4.00	0.0	0.600	o	450	Pipe/Conduit		
1.004	15.074	0.742	20.3	0.088	0.00	0.0	0.600	o	450	Pipe/Conduit		

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	4.39	70.750	0.135	0.0	0.0	0.0	1.11	78.4	18.3
1.001	50.00	4.74	70.619	0.204	0.0	0.0	0.0	1.11	78.2	27.6
1.002	50.00	5.24	70.503	0.256	0.0	0.0	0.0	1.11	78.3	34.7
2.000	50.00	4.10	71.000	0.046	0.0	0.0	0.0	3.04	215.0	6.2
1.003	50.00	5.40	70.338	0.383	0.0	0.0	0.0	2.94	208.1	51.9
3.000	50.00	4.24	69.445	0.106	0.0	0.0	0.0	1.44	228.4	14.4
1.004	50.00	5.46	69.342	0.577	0.0	0.0	0.0	4.53	719.9	78.1

58 Design Works

William St, Felling

Gateshead, NE10 0JP

Surface Water

Robin Hood Farm

Brompton-on-Swale

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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
4.000	5.000	0.025	200.0	0.000	4.00	0.0	0.600	o	450	Pipe/Conduit	🔒
1.005	14.739	0.100	147.4	0.000	0.00	0.0	0.600	o	225	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)
4.000	50.00	4.06	68.625	0.000	0.0	0.0	0.0	1.43	228.1	0.0
1.005	50.00	5.69	68.600	0.577	0.0	0.0	0.0	1.07	42.7«	78.1

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	Pipe Out		Pipes In		Backdrop (mm)	
					PN	Invert Level (m)	Diameter (mm)	PN		Invert Level (m)
S1	72.250	1.500	Open Manhole	1200	1.000	70.750	300			
S2	73.411	2.792	Open Manhole	1200	1.001	70.619	300	1.000	70.619	300
S3	74.554	4.051	Open Manhole	1200	1.002	70.503	300	1.001	70.503	300
S4	72.500	1.500	Open Manhole	1200	2.000	71.000	300			
S5	73.356	3.018	Open Manhole	1200	1.003	70.338	300	1.002	70.338	300
								2.000	70.338	300
S6	70.945	1.500	Open Manhole	1350	3.000	69.445	450			
S7	71.942	2.600	Open Manhole	1500	1.004	69.342	450	1.003	69.342	300
								3.000	69.342	450
Tank	70.725	2.100	Open Manhole	1200	4.000	68.625	450			
S8	70.725	2.125	Open Manhole	1800	1.005	68.600	225	1.004	68.600	450
								4.000	68.600	450
Pumping Station	70.500	2.000	Open Manhole	1200		OUTFALL		1.005	68.500	225

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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	300	S1	72.250	70.750	1.200	Open Manhole	1200
1.001	o	300	S2	73.411	70.619	2.492	Open Manhole	1200
1.002	o	300	S3	74.554	70.503	3.751	Open Manhole	1200
2.000	o	300	S4	72.500	71.000	1.200	Open Manhole	1200
1.003	o	300	S5	73.356	70.338	2.718	Open Manhole	1200
3.000	o	450	S6	70.945	69.445	1.050	Open Manhole	1350
1.004	o	450	S7	71.942	69.342	2.150	Open Manhole	1500
4.000	o	450	Tank	70.725	68.625	1.650	Open Manhole	1200
1.005	o	225	S8	70.725	68.600	1.900	Open Manhole	1800

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	26.172	199.8	S2	73.411	70.619	2.492	Open Manhole	1200
1.001	23.261	200.5	S3	74.554	70.503	3.751	Open Manhole	1200
1.002	33.053	200.3	S5	73.356	70.338	2.718	Open Manhole	1200
2.000	17.825	26.9	S5	73.356	70.338	2.718	Open Manhole	1200
1.003	28.618	28.7	S7	71.942	69.342	2.300	Open Manhole	1500
3.000	20.533	199.3	S7	71.942	69.342	2.150	Open Manhole	1500
1.004	15.074	20.3	S8	70.725	68.600	1.675	Open Manhole	1800
4.000	5.000	200.0	S8	70.725	68.600	1.675	Open Manhole	1800
1.005	14.739	147.4	Pumping Station	70.500	68.500	1.775	Open Manhole	1200

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### Network Classifications for Storm

PN	USMH Name	Pipe Dia (mm)	Min Cover Depth (m)	Max Cover Depth (m)	Pipe Type	MH Dia (mm)	MH Width (mm)	MH Ring Depth (m)	MH Type
1.000	S1	300	1.200	2.492	Unclassified	1200	0	1.200	Unclassified
1.001	S2	300	2.492	3.751	Unclassified	1200	0	2.492	Unclassified
1.002	S3	300	2.718	3.751	Unclassified	1200	0	3.751	Unclassified
2.000	S4	300	1.200	2.718	Unclassified	1200	0	1.200	Unclassified
1.003	S5	300	2.300	2.718	Unclassified	1200	0	2.718	Unclassified
3.000	S6	450	1.050	2.150	Unclassified	1350	0	1.050	Unclassified
1.004	S7	450	1.675	2.150	Unclassified	1500	0	2.150	Unclassified
4.000	Tank	450	1.650	1.675	Unclassified	1200	0	1.650	Unclassified
1.005	S8	225	1.775	1.900	Unclassified	1800	0	1.900	Unclassified

### Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.005	Pumping Station	70.500	68.500	68.500	1200	0

### Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m <sup>3</sup> /ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

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

### Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Storm Duration (mins)	30
Ratio R	0.358		

Online Controls for Storm

Hydro-Brake® Optimum Manhole: S8, DS/PN: 1.005, Volume (m³): 8.1

Unit Reference	MD-SHE-0090-5000-2100-5000
Design Head (m)	2.100
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	90
Invert Level (m)	68.600
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.100	5.0	Kick-Flo®	0.808	3.2
Flush-Flo™	0.397	4.0	Mean Flow over Head Range	-	3.9

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)	Depth (m)	Flow (l/s)
0.100	2.8	0.800	3.3	2.000	4.9	4.000	6.8	7.000	8.8
0.200	3.7	1.000	3.5	2.200	5.1	4.500	7.1	7.500	9.1
0.300	4.0	1.200	3.8	2.400	5.3	5.000	7.5	8.000	9.4
0.400	4.0	1.400	4.1	2.600	5.5	5.500	7.8	8.500	9.6
0.500	4.0	1.600	4.4	3.000	5.9	6.000	8.2	9.000	9.9
0.600	3.9	1.800	4.6	3.500	6.3	6.500	8.5	9.500	10.2

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Storage Structures for Storm

Tank or Pond Manhole: Tank, DS/PN: 4.000

Invert Level (m) 68.625

Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )
0.000	205.0	1.500	205.0	1.501	0.0





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

Simulation Criteria

Areal Reduction Factor 1.000    Additional Flow - % of Total Flow 0.000  
 Hot Start (mins) 0    MADD Factor \* 10m³/ha Storage 2.000  
 Hot Start Level (mm) 0    Inlet Coeffiecient 0.800  
 Manhole Headloss Coeff (Global) 0.500    Flow per Person per Day (l/per/day) 0.000  
 Foul Sewage per hectare (l/s) 0.000

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

Synthetic Rainfall Details

Rainfall Model    FSR M5-60 (mm) 18.300 Cv (Summer) 0.750  
 Region England and Wales    Ratio R 0.354 Cv (Winter) 0.840

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

Profile(s)    Summer and Winter  
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440  
 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	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	S1	15 Winter	1	+0%	100/15 Summer				70.851	-0.199	0.000
1.001	S2	15 Winter	1	+0%	100/15 Summer				70.742	-0.177	0.000
1.002	S3	15 Winter	1	+0%	100/15 Summer				70.636	-0.167	0.000
2.000	S4	15 Winter	1	+0%					71.035	-0.265	0.000
1.003	S5	15 Winter	1	+0%					70.434	-0.204	0.000
3.000	S6	15 Winter	1	+0%	100/120 Winter				69.527	-0.368	0.000
1.004	S7	15 Winter	1	+0%	100/120 Winter				69.450	-0.342	0.000
4.000	Tank	240 Winter	1	+0%	30/30 Winter				68.850	-0.225	0.000
1.005	S8	15 Winter	1	+0%	1/15 Summer				69.011	0.186	0.000

PN	US/MH Name	Flow / Cap. (l/s)	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S1	0.25		17.5	OK	
1.001	S2	0.35		24.3	OK	
1.002	S3	0.40		28.8	OK	
2.000	S4	0.03		6.0	OK	
1.003	S5	0.22		42.0	OK	
3.000	S6	0.08		13.8	OK	
1.004	S7	0.13		63.8	OK	
4.000	Tank	0.03		3.8	OK	
1.005	S8	0.11		4.0	SURCHARGED	



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

Simulation Criteria

Areal Reduction Factor 1.000    Additional Flow - % of Total Flow 0.000  
 Hot Start (mins) 0    MADD Factor \* 10m³/ha Storage 2.000  
 Hot Start Level (mm) 0    Inlet Coefficient 0.800  
 Manhole Headloss Coeff (Global) 0.500    Flow per Person per Day (l/per/day) 0.000  
 Foul Sewage per hectare (l/s) 0.000

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

Synthetic Rainfall Details

Rainfall Model    FSR M5-60 (mm) 18.300 Cv (Summer) 0.750  
 Region England and Wales    Ratio R 0.354 Cv (Winter) 0.840

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

Profile(s)    Summer and Winter  
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440  
 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	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	S1	15 Winter	30	+0%	100/15 Summer				70.925	-0.125	0.000
1.001	S2	15 Winter	30	+0%	100/15 Summer				70.875	-0.044	0.000
1.002	S3	15 Winter	30	+0%	100/15 Summer				70.798	-0.005	0.000
2.000	S4	15 Winter	30	+0%					71.056	-0.244	0.000
1.003	S5	15 Winter	30	+0%					70.504	-0.134	0.000
3.000	S6	15 Winter	30	+0%	100/120 Winter				69.583	-0.312	0.000
1.004	S7	15 Winter	30	+0%	100/120 Winter				69.527	-0.265	0.000
4.000	Tank	240 Winter	30	+0%	30/30 Winter				69.356	0.281	0.000
1.005	S8	240 Winter	30	+0%	1/15 Summer				69.356	0.531	0.000

PN	US/MH Name	Flow / Cap. (l/s)	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S1	0.61		42.7	OK	
1.001	S2	0.87		60.3	OK	
1.002	S3	1.00		71.6	OK	
2.000	S4	0.08		14.7	OK	
1.003	S5	0.57		108.0	OK	
3.000	S6	0.19		33.7	OK	
1.004	S7	0.34		166.1	OK	
4.000	Tank	0.03		4.0	SURCHARGED	
1.005	S8	0.11		4.0	SURCHARGED	

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

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000  
 Hot Start (mins) 0 MADD Factor \* 10m³/ha Storage 2.000  
 Hot Start Level (mm) 0 Inlet Coeffiecient 0.800  
 Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000  
 Foul Sewage per hectare (l/s) 0.000

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

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.300 Cv (Summer) 0.750  
 Region England and Wales Ratio R 0.354 Cv (Winter) 0.840

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

Profile(s) Summer and Winter  
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440  
 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	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	S1	15 Winter	100	+40%	100/15 Summer				71.583	0.533	0.000
1.001	S2	15 Winter	100	+40%	100/15 Summer				71.448	0.529	0.000
1.002	S3	15 Winter	100	+40%	100/15 Summer				71.177	0.374	0.000
2.000	S4	15 Winter	100	+40%					71.075	-0.225	0.000
1.003	S5	480 Winter	100	+40%					70.628	-0.010	0.000
3.000	S6	480 Winter	100	+40%	100/120 Winter				70.624	0.729	0.000
1.004	S7	480 Winter	100	+40%	100/120 Winter				70.624	0.832	0.000
4.000	Tank	480 Winter	100	+40%	30/30 Winter				70.622	1.547	0.000
1.005	S8	480 Winter	100	+40%	1/15 Summer				70.622	1.797	0.000

PN	US/MH Name	Flow / Cap. (l/s)	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S1	0.99		69.5	SURCHARGED	
1.001	S2	1.50		104.3	SURCHARGED	
1.002	S3	1.78		127.8	SURCHARGED	
2.000	S4	0.14		26.6	OK	
1.003	S5	0.14		25.7	OK	
3.000	S6	0.04		7.1	SURCHARGED	
1.004	S7	0.08		38.3	SURCHARGED	
4.000	Tank	0.04		4.6	FLOOD RISK	
1.005	S8	0.13		4.9	FLOOD RISK	