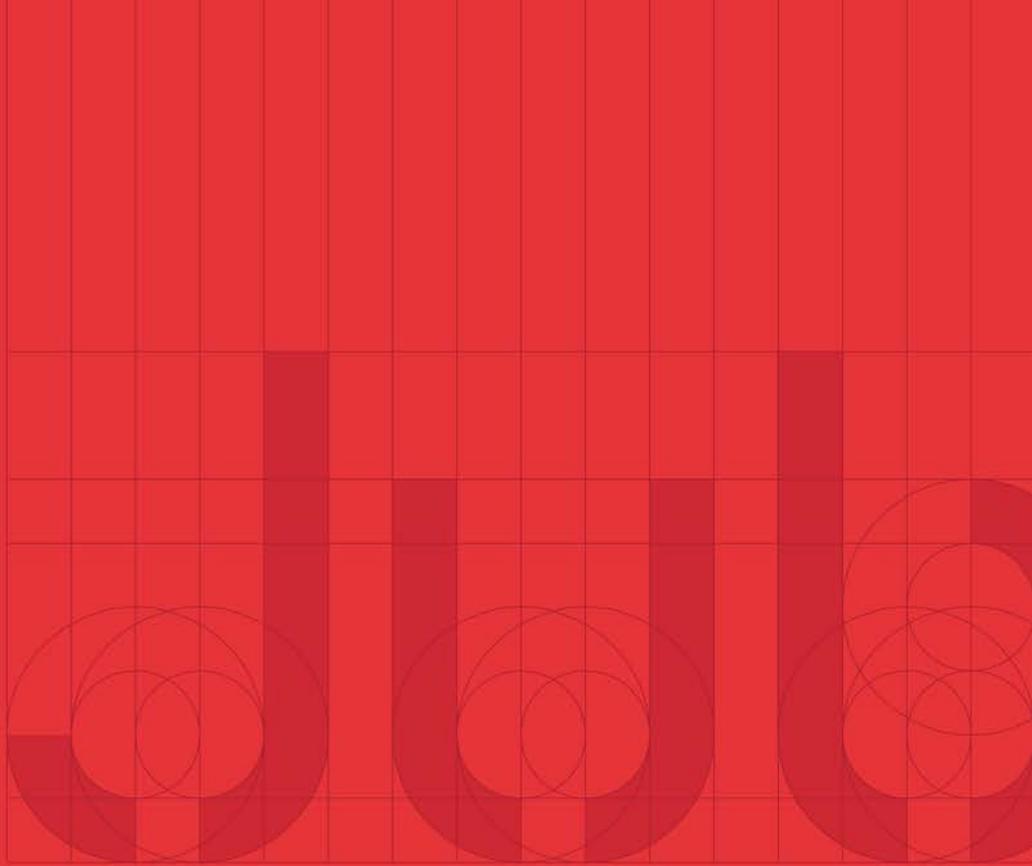


Flood Risk Assessment
and Drainage Strategy



Gotherington

Gloucestershire

The logo for Jubb Consulting Engineers Ltd. It consists of the word "Jubb" in a bold, white, sans-serif font. The letters are stylized, with the 'J' and 'b's having a unique, rounded appearance.

PREPARED BY:
Jubb Consulting Engineers Ltd.

FOR:
L&Q Estates

DATE:
October 2019

REFERENCE:
15163-FRA01-Rev6

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1 Project Information

1.1 Project Information

Client L&Q Estates

1.2 Project Details

Project Name Gotherington

Location Gloucestershire

Jubb Project Number 15163

1.3 Report Details

Version 6

Status Planning Issue

Date 04.10.19

1.4 Project Authorisation

ISSUE HISTORY:

Version	Date	Detail
1	15/04/16	DRAFT
2	04/07/16	Updated with latest site layout
3	14/0/16	Updated with latest site layout
4	25/07/16	Groundwater/geology update
5	24/09/19	Updated for revised layout
6	04/10/19	Updated Revised Layout

AUTHORISATION:

Prepared By	Approved By
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David Gwilliam	Rob Harrhy
Luke Evans	Rob Harrhy

2 Introduction

2.1 Instruction

2.1.1 Jubb has been appointed by L&Q Estates to complete a Flood Risk Assessment and Drainage Strategy for the proposed development of a site in Gotherington, Gloucestershire. This combined Flood Risk Assessment and Drainage Strategy has been prepared to support an outline planning application for the construction of a new housing development with associated infrastructure.

2.2 Brief

2.2.1 This Flood Risk Assessment is prepared in accordance with the requirements of the National Planning Policy Framework (NPPF) published by the Department of Communities and Local Government. Section 14 of the NPPF and the associated Planning Practice Guidance sets out the framework for planning decisions made by the local, regional and national government and the Environment Agency (EA). In order for planning authorities to make informed decisions on the development of sites in areas at risk of flood, NPPF requires the developer to carry out an assessment of flood risk.

2.2.2 This report addresses the requirements given in Section 14 of the NPPF and other issues which are deemed relevant to flood risk. These requirements include the following:

- Assessment of the magnitude and severity of flood risk to the site
- Assess suitability of site and development through the use of the Sequential Test & Exception Test (if required)
- Consider flood risk due to overtopping of existing flood defences
- Assess impact of proposed development on flood risk to adjacent developments
- Determine ability of existing and proposed drainage to accommodate development flows with respect to surface flooding
- Demonstrate that appropriate mitigation measures have been taken to prevent flooding
- Demonstrate that appropriate emergency situations have been considered e.g. overland flow paths, evacuation routes.

2.2.3 This report also considers the disposal of wastewater generated by the proposed development. Existing infrastructure will be reviewed to identify potential options for the disposal of foul and surface water run off. A strategy will be presented for the preferred option.

3 Existing Site

3.1 Location

- 3.1.1 The proposed site is located on existing greenfield land to the south of Aggs Lane and Lawrence's Meadow to the south west of the village of Gotherington, Gloucestershire. The existing site is approximately 6.3Ha in area, with a National Grid Reference (NGR) of 396149E, 229402N.
- 3.1.2 The site sits on the outskirts of the developed area of Gotherington with the surrounding land to the north and east of the site predominately residential areas, with land to the west and south predominately used for agricultural purposes.
- 3.1.3 The site boundaries to the north and east are formed by the property boundaries of the surrounding residential areas, a small section of grassland to the west and surrounding arable fields to the south.

A site location plan is attached in Appendix A.

3.2 Current Land Use

- 3.2.1 The existing site is currently used for agricultural purposes with public footpaths cutting across the northern part of the site.

3.3 Site Topography

- 3.3.1 A detailed topographical survey has been undertaken on the proposed site.
- 3.3.2 The survey shows there is a total fall of approximately 5m across the site. The high point of the site with a level of 61.61mAOD is located on the eastern boundary of the site. From this point site levels fall steadily across the whole site in a westerly direction, reaching a low point of 56.36AOD in the south west corner of the site.

A copy of the topographical survey is included in Appendix B.

3.4 Site Geology and Hydrogeology

- 3.4.1 The British Geological Survey (BGS) maps indicate that the site is underlain with Charmouth Mudstone Formation, with superficial deposits of Cheltenham sand and gravel.
- 3.4.2 The British Geological Survey (BGS) hydrogeology maps indicate that the site is underlain with rock from the Lias Group subgroup, these rocks are characterised as rocks with essentially no groundwater.
- 3.4.3 The Environment Agency groundwater source protection zones map show that the proposed site is not located within a groundwater protection zone.
- 3.4.4 A Groundsure Geosight assessment of the site has identified the site as lying within an area of very low to negligible potential for running sands, if the water table rises or if sandy strata is exposed to water. The Groundsure report states that no special actions or ground investigation is required to avoid problems due to running sand.

3.5 Existing Drainage

- 3.5.1 The existing local public foul and surface sewer network is owned and operated by Severn Trent Water Ltd.
- 3.5.2 There are no existing surface water sewers located within the proposed site boundary. However, there is a large network of public surface water sewers in the surrounding area which serve the nearby residential areas.
- 3.5.3 To the north of the site there is an existing 300mm diameter surface water sewer running within Malleson Road. This sewer runs from the east in a westerly direction throughout the length of Malleson Road before heading north into Woolstone Lane.
- 3.5.4 Two smaller 225mm diameter surface water networks run within Aggs Close and Ashmead Drive to the north east of the site. These sewers collect flows from the existing residential properties and convey flows to the main sewer run in Malleson Road.
- 3.5.5 There are existing foul water sewers located within the proposed site boundary and in the surrounding area serving the nearby residential areas.
- 3.5.6 Within the site boundary there is an existing 150mm diameter foul sewer which cuts across a small section of the site on the north eastern boundary.
- 3.5.7 In the surrounding area a large network of 150mm diameter foul sewers run throughout the residential streets of Gotherington. These sewers collect flows from the residential area of Gotherington and convey flows to the nearest sewerage treatment works located approximately 1.2km to the north west of the site.

A copy of the Severn Trent Water asset plans are included in Appendix C.

3.6 Local Watercourses

- 3.6.1 There are no existing watercourses located within the boundaries of the proposed site.
- 3.6.2 Beyond the site boundaries there are two local watercourses in the surrounding area to the north and south of the site.
- 3.6.3 To the north of the site the Tirlle Brook flows from the east in a westerly direction approximately 500m north of the proposed site. The Tirlle Brook is a designated main river by the Environment Agency.
- 3.6.4 To the south of the site the Dean Brook flows from the east in a westerly direction approximately 350m to the south of the site.

4 Flood Risk to the Existing Site

This section explores the primary sources of flooding to the site.

4.1 Tidal Flooding

4.1.1 The site is identified as lying outside of the fluvial and tidal flood risk zone according to the Environment Agency's published floodplain map (refer to Figure 1). This estimate of the extent of flooding is based on the absence or failure of all existing flood defences currently protecting the site.



Figure 1 – Extract from Environment Agency Flood Map

4.1.2 The EA floodplain map indicates that the level of flood risk to the site corresponds to a Flood Zone 1 – Low Probability in Table 1 of Planning Practice Guidance. This zone has less than a 1 in 1000 year annual probability of flooding.

4.1.3 The technical guidance states that all types of development are suitable for this flood zone.

4.2 Fluvial Flooding

4.2.1 As discussed in Section 2.6, there are two watercourses located within the surrounding area of the site. Tittle Brook located approximately 500m to the north of the site and Dean Brook located approximately 350m to the south.

- 4.2.2 Both of these watercourses are located at least 350m away from the site and are separated from the development by a large extent of agricultural land which existing levels show falls away from the site to the north and south.
- 4.2.3 There are no records of fluvial flooding within the proposed site and the Environment Agency Flood maps indicate that the site is outside of the fluvial flood zone.
- 4.2.4 Based on the factors discussed above the proposed site is not considered to be at risk of fluvial flooding.

4.3 Overland Flooding

- 4.3.1 The site is protected from overland flows from the surrounding area by the nearby developed area and local infrastructure. With the existing development areas of Gotherington including the residential areas off Malleson Road to the north and Cleeve Road to the east preventing overland flooding to the site.
- 4.3.2 The topographical profile of the area prevents overland flooding from the west and south of the site with the levels of the surrounding land falling away to the south west and away from the site.

4.4 Flooding from Sewers

- 4.4.1 The proposed site is not currently positively drained, however, there is a short length of existing Severn Trent Water sewers running through the site which serve the surrounding residential areas.
- 4.4.2 However, these sewers are owned, maintained and monitored by Severn Trent Water and have no previous incidents of flooding on record, so do not pose a flood threat to the site.

4.5 Flooding from Groundwater

- 4.5.1 The British Geological Survey demonstrated the site is primarily underlain with Charmouth Mudstone formation with superficial deposits of Cheltenham sand and gravel.
- 4.5.2 From the BGS records Borehole tests carried out within the similar Mudstone formation in close proximity to the site area found that water was not discovered on average until a depth of between 1-1.5m below ground level.
- 4.5.3 This and the fact there are no records of flooding due to groundwater on the existing site indicates that groundwater does not pose a significant risk of flooding to the site.

4.6 Flooding from Artificial Sources

- 4.6.1 There are no artificial bodies of water located within or within close proximity to the site. Therefore the site is not considered that flooding from artificial sources poses a risk of flooding to the site.

5 Proposed Development

5.1 Development Description

5.1.1 The current proposals for the site include the construction of up to 50 dwellings and associated infrastructure.

A copy of the latest development proposals layout is included in Appendix D.

5.1.2 The housing aspect of the development will consist of private sales properties and a proportion of affordable housing.

5.1.3 A portion of the site will be retained as open green space, including informal and play public open space and ecological corridors.

5.1.4 A single site access will be provided from Ashmead Drive to the north east of the site.

5.2 Development Suitability

5.2.1 The NPPF aims to direct development to suitable areas with low probability of flooding. The Table below illustrates the acceptable classification of development within each flood zone.

Flood Risk Vulnerability Classification	Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone 1 (<1 in 1000)	✓	✓	✓	✓	✓
Flood Zone 2 (up to 1 in 1000)	✓	✓	Exception Test	✓	✓
Flood Zone 3a (1 in 100 fluvial) (1 in 200 tidal)	Exception Test	✓	X	Exception Test	✓
Flood Zone 3b (functional floodplain)	Exception Test	✓	X	X	X

5.2.2 The proposed development is considered to be classified as 'more vulnerable' development under Table 2 of the Planning Practice Guidance. As the site is in Flood Zone 1 it is deemed to be acceptable.

6 Development Drainage

6.1 Foul Water Drainage

- 6.1.1 A new foul water drainage network will be required to service the new development. The new network will collect and convey foul water discharge from the development to a connection point on the existing Severn Trent Water network. The proposed Drainage Strategy Plan is included in Appendix E.
- 6.1.2 Severn Trent Water have confirmed that the new foul network servicing the development can connect into the existing 150mm diameter foul network located within the north east corner of the site.
- 6.1.3 Due to the topography of the proposed site, it may be necessary to pump foul flows via a pump station to the connection points.
- 6.1.4 The existing site is not positively discharged, consequently the proposed development would increase flows to the public sewerage system.
- 6.1.5 Assuming the development will consist of approximately 50 dwellings. Sewers for Adoption 7th Edition recommends a peak flow rate of 4,000 l/day/unit dwelling for residential uses. On this basis an anticipated peak flow rate of 2.3 l/s will be generated by the housing usage with a dry weather flow of 0.4 l/s based on a peaking factor of 6.
- 6.1.6 The new foul sewerage network to service the site will be designed to accommodate the anticipated peak development flows without flooding.
- 6.1.7 If a pump station is require to service the site, emergency storage would be required to satisfy the requirements of Sewers for Adoption 7th Edition. Sewers for Adoption recommends a storage volume of 160 litres per dwellings for the residential areas.
- 6.1.8 Severn Trent Water have previously confirmed that the existing public sewerage network in the vicinity of the site currently has sufficient capacity to accommodate the additional flows from the new development. Capacity will need to be reconfirmed prior to commencement of development.

6.2 Surface Water Drainage

- 6.2.1 Current legislation and guidance requires developers to manage surface run off from new developments to mitigate flood risk to the site and surrounding area and also to provide a sustainable means of disposing of run off from impermeable areas of the site.
- 6.2.2 Off-site surface water discharge from the site must be managed to ensure that it does not exceed the predevelopment flow rate. Sustainable drainage systems should be utilised to attenuate flow and ensure that run off from the new hardstanding areas receives the appropriate level of treatment to improve water quality.
- 6.2.3 As there is currently no surface water sewerage servicing the site a new surface water sewer network will be constructed to collect and convey run off from the new impermeable areas. The possible discharge options for the proposed site include;
- Soakaway via an Infiltration Pond
 - Attenuation and discharge to the public sewerage system

The proposed drainage strategy drawing is included in Appendix E.

- 6.2.4 British Geological Survey information shows the site is underlain with Charmouth Mudstone formation. This type of subgrade suggests ground conditions at the site are likely to provide a poor infiltration rate. Further site investigation is required to assess the suitability of the site for the use of an infiltration pond.
- 6.2.5 Due to the existing ground conditions discharge from the site via infiltration has been assessed using an assumed infiltration rate of 1×10^{-6} m/s. Assuming this rate of infiltration, an assessment of the 100 year event plus 40% climate change scenario requires an infiltration basin with a volume of 2755m³.
- 6.2.6 An accurate infiltration rate for the site is to be confirmed by onsite investigation and testing.
- 6.2.7 If an infiltration pond is not a suitable option as anticipated, the proposed solution is to discharge to the existing local public sewerage system to the north east of the site. This will require flows discharged from the site to be restricted to a predevelopment rate, which will be achieved by attenuating surface water flows onsite.
- 6.2.8 Surface water discharge from the site will be restricted to a rate of 5 litres per second per hectare as requested by Severn Trent Water.
- 6.2.9 Using the assumption that 65% of the proposed site will become an impermeable area. Restricting the discharge to the required rate will require 1160m³ of storage for the attenuation of flows for the 1 in 100 year event plus 40% climate change event.
- 6.2.10 Due to the gradient of the existing site if the most suitable option is to attenuate flows and discharge to the local public sewer network, surface water flows may require pumping from the proposed attenuation back up to the location of the existing public sewer to the north east of the site.

- 6.2.11 If a pump station is required to service the site emergency storage would be required to satisfy the requirements of Sewers for Adoption 7th Edition. Sewers for adoption recommends a storage volume of 125m³ should be provided per hectare of impermeable surface draining to the pump station.
- 6.2.12 Other external sources of information suggest that the existing groundwater levels could lie at approximately 1 – 1.5m below ground level. Detailed onsite ground investigation works are required in the locations of the proposed ponds to confirm the existing groundwater levels. If these site investigation works encounter groundwater at a shallow depth, there is sufficient room within the site to make the proposed attenuation or infiltration ponds larger and shallower, accommodating the depth of the groundwater.

6.3 Sustainable Drainage Systems & Water Quality

- 6.3.1 The surface water management should incorporate sustainable drainage techniques to restrict surface water discharge from the site and improve water quality of the run off. There are a wide range of techniques that can be applied including source control, online systems and outlet controls. Ciria have published a SuDS manual (C697) which details a number of systems along with guidance on their application and design.
- 6.3.2 The existing site subgrade suggests ground conditions may provide a poor infiltration rate. Discharging surface water from the new development is the preferred option, however, further onsite investigation is required to confirm an infiltration solution is achievable.
- 6.3.3 SuDS systems typically rely on either infiltration or attenuation to reduce peak flows and volume discharge and filtration systems to remove pollutants or solids from the effluent. As infiltration is unlikely to be possible, an attenuation solution is the most suitable method.
- 6.3.4 Detailed design will consider the use of swales, filter drains and source control features such as water butts to improve the treatment train.

7 Development Flood Risk & Mitigation

7.1 Tidal Flooding

7.1.1 The site is not at risk of tidal flooding and lies within Flood Zone 1 on the EA flood maps. The development proposals do not increase the flood risk from tidal sources. The proposed use increases the vulnerability class to 'more vulnerable' under the NPPF, however this is still acceptable for a low flood risk site.

7.2 Fluvial Flooding

7.2.1 The site is not at risk of fluvial flooding and lies within Flood Zone 1 on the EA flood maps. The development proposals do not increase the flood risk from fluvial sources. The proposed use increases the vulnerability class to 'more vulnerable' under the NPPF, however this is still acceptable for a low flood risk site.

7.3 Overland Flooding

7.3.1 The proposed site is protected from overland flooding from the surrounding area by the nearby developed area, local infrastructure and the existing topographical profile of the area.

7.3.2 The development proposals will not have a significant impact on the flood risk of the proposed site or the surrounding area.

7.4 Groundwater Flooding

7.4.1 The site is not considered to be at risk from groundwater sources. Discharge of surface water via infiltration or attenuation is not expected to significantly alter the water table.

7.5 Flooding From Sewers

7.5.1 There is no current flood risk to the site from existing sewers.

7.5.2 A new surface sewer network will be constructed to service the site. The surface water sewers will be designed to prevent surface flooding in the 1 in 100 year return period storm event with an allowance for climate change.

7.5.3 The new foul sewer network serving the site will be designed to accommodate the anticipated peak flows with no flooding.

7.6 Flooding from Artificial Sources

7.6.1 As discussed in section 3.6.1 there is no risk to the site from artificial water bodies.

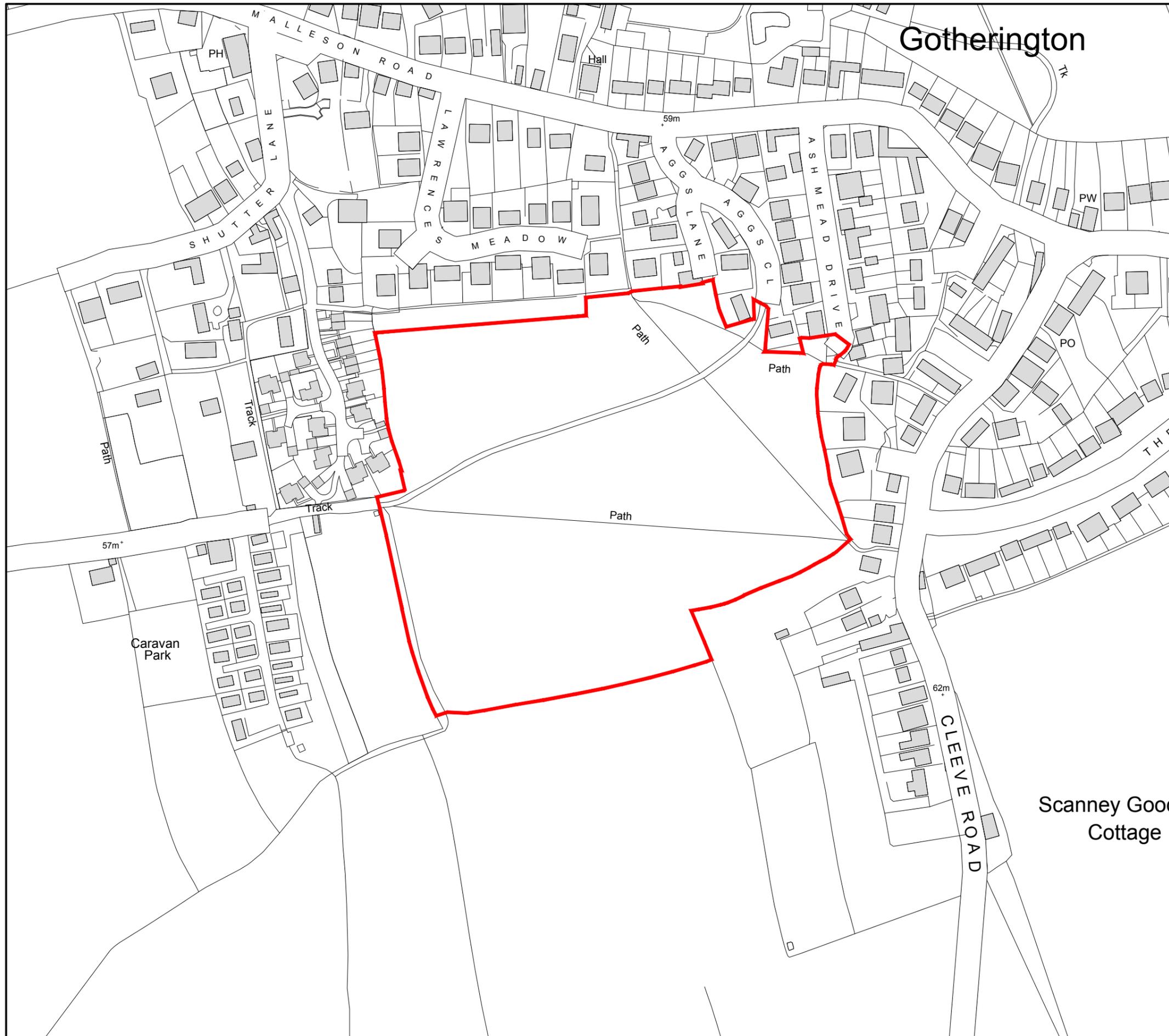
8 Conclusions

It is considered that this assessment represents a comprehensive and robust analysis of the flood impact of the development upon other adjacent properties and of existing flood mechanisms on the development itself. It demonstrates that the proposed development is sustainable in terms of flood risk, and can be summarised as follows:

Subject	Conclusions
Tidal & Fluvial Flood Risk	The development is located in Flood Zone 1 – low probability for tidal and fluvial flooding on the Environment Agency flood maps.
Flood Risk From Other Sources	No flood risk to the site from groundwater, sewers or artificial water bodies was identified.
Development Suitability	The development use is considered suitable for the site which lies within Flood Zone 1 – low probability under Table 3 of the Planning Practice Guidance.
Existing Drainage	<p>There is a small section of existing foul water sewer which is located within the proposed site boundary. The sewer cuts across the north eastern corner of the site, servicing the nearby residential area.</p> <p>There are no existing surface water sewers located within the site.</p>
Proposed Drainage	New surface and foul water sewer networks will be constructed to service the development. Surface water will discharge via infiltration or to the existing public sewer at a restricted rate of discharge. Foul water will discharge to the existing public foul sewer network.
Surface Water Management	Surface water will be disposed via an infiltration basin or by discharging to the existing public sewer if the further site investigation deems infiltration not suitable. A new on site sewer network will be designed to collect run off from hardstanding areas and convey it to the infiltration pond / attenuation feature.
Foul Water Disposal	The development will increase foul loadings from the site, increasing the peak discharge rate to 2.3 l/s. Severn Trent Water have confirmed that there is sufficient capacity in the public sewerage network to accommodate the site.
Tidal & Fluvial Flood Risk	The development is located in Flood Zone 1 – low probability for tidal and fluvial flooding on the Environment Agency flood maps.

Based on the findings of this report, it is considered that there are no grounds for objecting to the proposed development in terms of flood risk

Appendix A: Site Location Plan



The scaling of this drawing cannot be assured

Revision	Date	Drn	Ckd
B	21.11.16	K.D.	T.L.

Legend

 Site boundary
- 6.28Ha / 15.52Ac

Project
Gotherington



Drawing Title
Site Boundary Plan

Date	Scale	Drawn by	Check by
14.10.15	1:2500@A3	NB	TL
Project No	Drawing No	Revision	
25212	RG-M-00	B	



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Appendix B: Topographical Survey



Station Information:

Station	Easting (m)	Northing (m)	Level (m)
GH1	396359.968	229637.118	61.077
GH2	396285.512	229645.997	60.235
GH3	396189.131	229632.422	59.003
GH4	396306.399	229498.594	61.723
GH5	396219.850	229556.780	59.514

OS Note:
Some services may have been omitted due to parked vehicles. The Ordnance Survey site is to be used as a guide only.

OS Buildings Surveyed Buildings

This survey has been orientated to the Ordnance Survey (O.S.) National Grid (OSGB36) via Global Navigational Satellite Systems (GNSS) and the O.S. Active Network (OS AN).

A true OSG36 coordinate has been established near to the site centre via a transformation using the OSTN02 & OSMD02 transformation models.

The survey has been correlated to this point and a further one or more OSGB36 points established to create a true O.S. bearing for angle orientation.

No scale factor has been applied to the survey therefore the coordinates shown are arbitrary & not true O.S. Coordinates which have a scale factor applied.

Please refer to Survey Station Table to enable establishment of the on-site grid and datum.

Legend:

Symbol	Description	Symbol	Description
...

Rev	Date	Description	Drawn	IG	Appr

greenhatch group

- Topographical Surveys
- Site Engineering
- Utility / CCTV Surveys
- Measured Building Surveys
- 3D Laser Scanning
- Revit & BIM Models

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CLIENT
JJ Gallagher Ltd

PROJECT
Aggs Close, Gotherington, Gloucestershire

TITLE
Topographical Survey

SCALE A1@ 1:1000	DATE 02.06.16
DRAWN LB	QUALITY REF E1317

Level datum: See note
GH3 orientation: See note
Job number: 23857
Drawing No: 23857_T
Rev: 0

Comments
This plan should only be used for its original purpose. Greenhatch Group accepts no responsibility for this plan if supplied to any party other than the original client.

All dimensions should be checked on site prior to design and construction.

Drainage information (where applicable) has been visually inspected from the surface and therefore should be treated as approximate only.

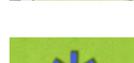
Notes:

Appendix C: Severn Trent Water Asset Plan

Appendix D: Proposed Site Layout



The scaling of this drawing cannot be assured
 Revision _____ Date _____ Drn _____ Ckd _____

-  Site boundary
- 6.28Ha / 15.52Ac
-  Building
-  Garage
-  Main Road
-  Side Street
-  Lane / Private Drive
-  Footpath
-  Locally Equipped Area of Play (LEAP)
-  Multi-Use Games Area (MUGA)
-  Multi-Purpose Community Area

Project
Gotherington

Drawing Title
Illustrative Site Layout

Date
 03.10.19

Scale
 1:1,250@A2

Project No
 25212

Drawn by
 MS

Check by
 LH

Revision
 A

0 10 20 30 40 50m

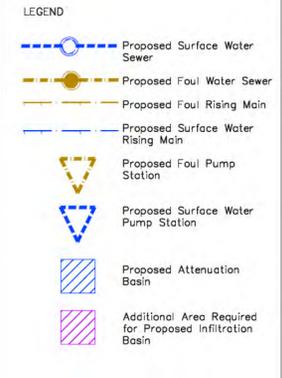


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Appendix E: Proposed Drainage Strategy



- Notes:**
1. Existing services locations taken from a combination of survey data and asset plans. Contractor to confirm location of impacted services onsite.
 2. Location of infiltration basin, attenuation basin, pump stations and new onsite sewer layout to be confirmed once a detailed masterplan has been produced.
 3. Infiltration basin sized on an assumed infiltration rate of 1 x 10⁻⁶ m/s, site investigation required to confirm infiltration rate.
 4. Infiltration attenuation basin sized on the 100 year event + 40% climate change.
 5. For attenuation scenario flows to existing public sewer restricted to a rate of 5 l/s per hectare as requested by Severn Trent Water.
 6. Foul Water easement of 2.5m either side of sewer centre-line as confirmed with Severn Trent Water.

Rev	Date	Description	By	Apvd
P5	04/10/19	Updated with latest layout	LE	DG
P4	20/09/19	Updated with latest layout	LE	DG
P3	04/07/18	Updated with latest layout	LE	DG
P2	20/06/16	Pond position amended	DG	DG
P1	15/04/16	Preliminary issue	LE	DG

PROJECT:
GOTHERINGTON

TITLE:
INDICATIVE DRAINAGE STRATEGY

CLIENT:
L&Q ESTATES

SCALE@A1:
1:1000

PROJECT REF:
15163

DRAWING No: 500 **REV:** P5

Revision Referencing
P = Preliminary A = Approval T = Tender C = Construction

