FLOOD RISK ASSESSMENT FOR PLANNING

AT

18 GRANNY LANE
LOWER HOPTON

FOR

MRS BURROWS

REPORT REF: MRB 3241

Engineering Geologists and Environmental Scientists

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MARCH 2016

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APPENDICES

QUALITY MANAGEMENT FOR REPORT

Project	16 Granny Lane, Lower Hopton, Mirfield		
Client	Mrs Burrows		
Date	March 2016		
Version	Issue 1		
Prepared by	Frances A Bennett	BSc, CGeol, FGS, FIMMM, C.WEM, MCIWEM, CEnv, AIEMA, MIEnvSci	Director Ashton Bennett Ltd
	Donna Metcalf	BEng	Director Flood Risk Consultancy
	David Emmott	BSc	Flood Risk Consultant

1. INTRODUCTION

This report describes the results of a Flood Risk Assessment for the development of two residential houses at 18 Granny Lane, Lower Hopton, Mirfield, WF14 8LA. The work was undertaken for Mallalieu Architects on behalf of their client Mrs Burrows and was carried out by the Ashton Bennett Consultancy of Holmfirth and the Flood Risk Consultancy of Burnley.

The purpose of this Report is to ascertain the potential for flooding on the site proposed for development.

The approach followed in this report is to initially undertake screening of the site and provide a full site characterisation including an assessment of available geological, hydrological, hydrogeological and topographic information and an assessment of Flood Risk for Planning.

The objective of the assessment is to evaluate the suitability of the proposed development in line with planning policy, to identify the risk to the proposed development and occupants from flooding, to identify the risk that the development may increase the flood risk elsewhere and to make recommendations for mitigating measures against flooding within the development and neighbouring land and property.

This report comprises the screening and flood risk assessment and was prepared by Frances A Bennett, Donna Metcalf and David Emmott.

2. THE SITE

2.1 Site Description

The site is located at number 18 Granny Lane in Lower Hopton, Mirfield near Huddersfield WF14 8LA.

The site area comprises the house and garden of 18 Granny Lane which is a private detached residential house and garden. The house is bordered on the west side by a

residential house and on the east side by Gregory Spring Lane with residential houses and gardens beyond. The site is bordered to the north by Granny Lane with woodland and the River Calder beyond, and is bounded to the south by further residential houses and gardens.

It is proposed to demolish the existing house and construct two houses on the site. All land on the site is relatively level at around 46.0m above OD.

Figure 1 Site Location Plan

The site lies at SE205190 and is 0.09 hectares in size. A Site Location Plan is presented as Figure 1 and a Site Plan Existing is presented as Figure 2 and a Site Plan Proposed as Figure 3.

A Geology Plan is presented as Figure 4. A Flooding from Rivers and Seas is presented as Figure 5. A Flooding from Surface Water is presented as Figure 6. Possible Flooding from Reservoirs is presented as Figure 7 and Groundwater Vulnerability Zone as Figure 8. Flood Warning Areas is presented as Figure 9.

The detailed Flood Risk Assessment is presented by The Flood Risk Consultancy in Appendix A. This should be read in full to understand all the recommendations.

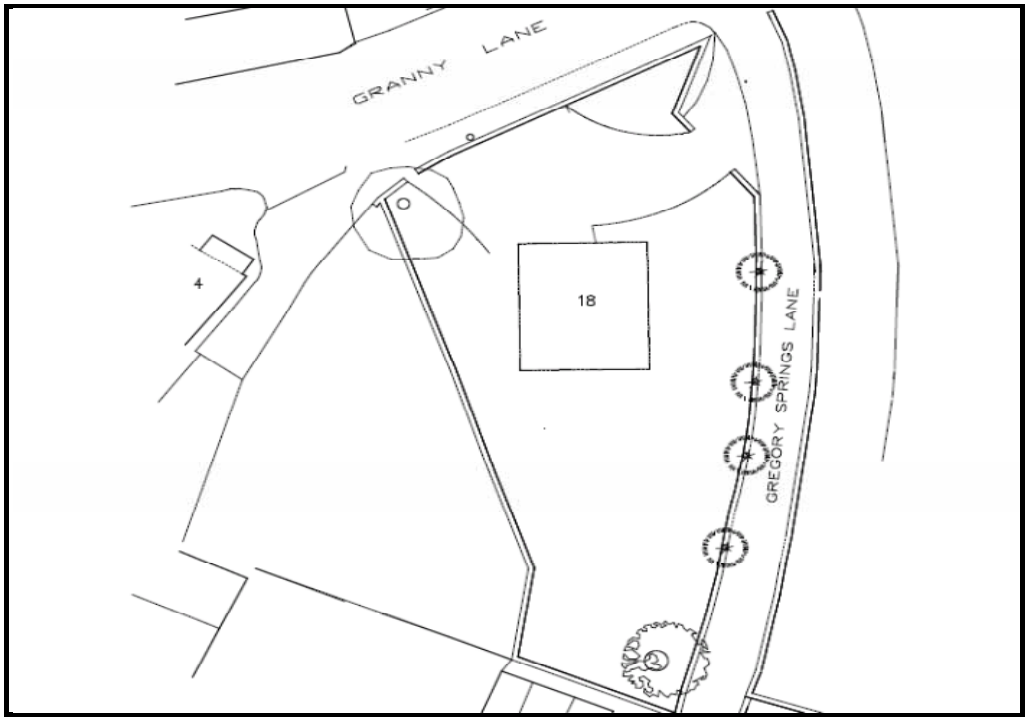

Figure 2 Site Plan Existing

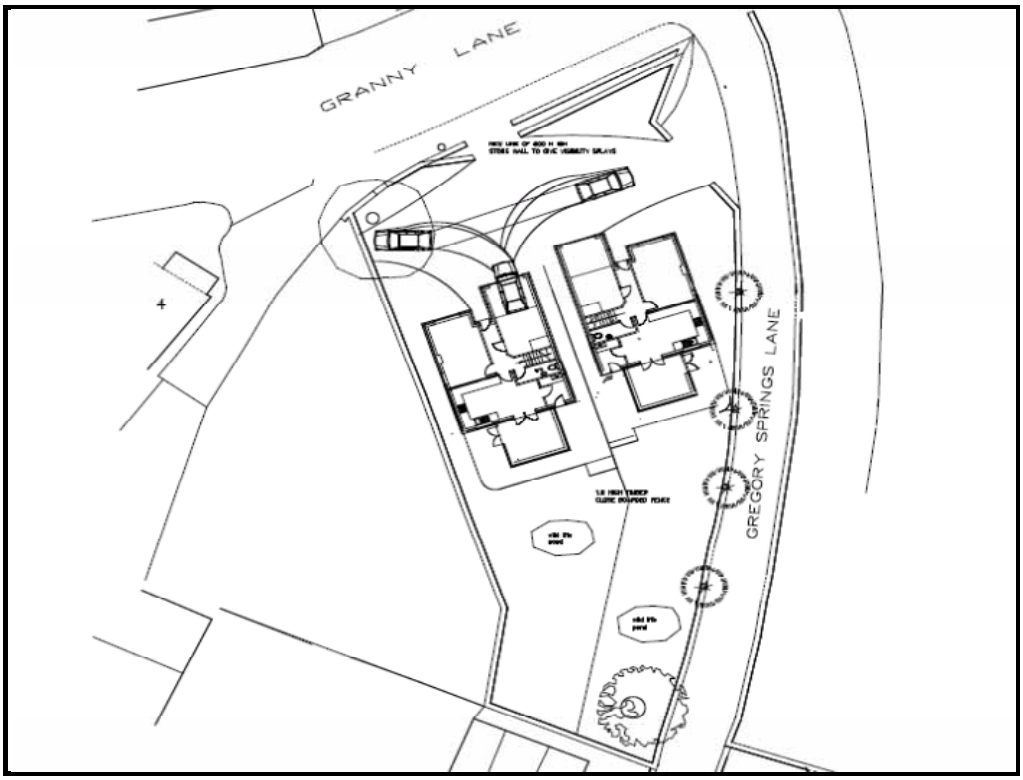

Figure 3 Site Plan Proposed

3. SITE GEOLOGY

The published 1:10,000 scale British Geological Survey (BGS) geological map of the area shows the site to be underlain by bedrock of the Pennine Coal Measures formation comprising sandstones and siltstones with mudstones and interbedded coal seams.

The bedrock is overlain by alluvial fan deposits of sands and gravels and immediately to the north by alluvial silts and clays deposited by the River Colne.

The alluvium is generally low strength and comprises clay, silt, peat and sand and may be partly water bearing. The alluvial fan deposits comprise sands and gravels and may also be water bearing. The underlying sandstone and siltstones are permeable strata and the mudstones are relatively impermeable.

Given the historical development of the site and surrounding areas, there may be made ground present on the site.

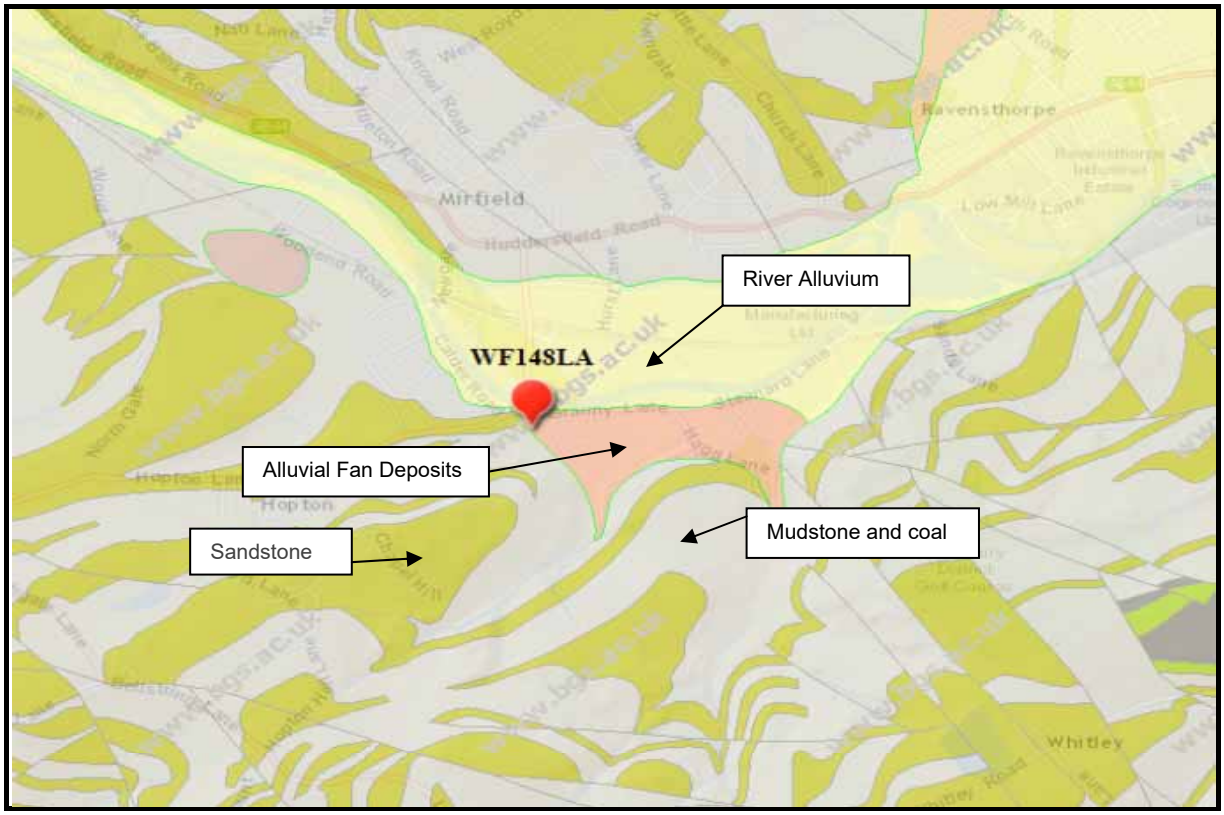

Figure 4 Geology Plan

No geological faults are shown to be present on the site although several pass in close proximity to the site.

A number of relevant available historic borehole logs have been obtained from the BGS which indicate the alluvium and the alluvial fan to be around 10m to 12m in thickness overlying the mudstone bedrock. Groundwater was encountered at 6.2m bgl in the alluvial strata.

4. HYDROLOGY

4.1 General

The River Calder flows west to east at 25m immediate north of the site. Valance Beck discharges into the River Calder to the east of the site near Hagg Lane and a further river flowing from Upper Hopton flows into the River Calder to the west of the site.

There are several possible flooding mechanisms which include flooding from rivers and seas, surface water, rainfall, reservoirs or canals and lakes.

4.2 Flood Risk From Rivers and Seas

The site is shown by the Environment Agency (EA) to lie on the boundary of an area at risk of flooding from the River Calder. The EA indicate a very low risk of flooding from the sea.

The Flood Zone maps produced by the Environment Agency provide an initial assessment of flood risk. The Flood Zones are divided into four categories of flood probability and do not take into account any flood defences. PPS25 defines the flood zones as:

Zone 1: Low Probability-This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).

Zone 2: Medium Probability-This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% to 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% to 0.1%) in any year.

Zone 3: High Probability- This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.

Zone 3B 'The Functional Floodplain' – This zone comprises land where water has to flow or be stored in times of flood.

The site lies partially within a Flood Zone 2, as shown on Figure 5, which is land assessed, ignoring the presence of flood defences indicating a low to medium risk of flooding.

The site benefits from flood defences as detailed on Figure 5.

4.3 Flooding from Surface Water and Rainfall

The risk of flooding from surface water is detailed in Figure 6 and indicates a very low risk. Rainfall is likely to follow the Valance Beck to the east, a small stream to the west of the site or the larger complex of streams to the north west of the site, all of which discharge into the River Calder.

Due to the lower lying land to the north, west and east of the site, rainfall discharging from the hills to the south is unlikely to flood the site.

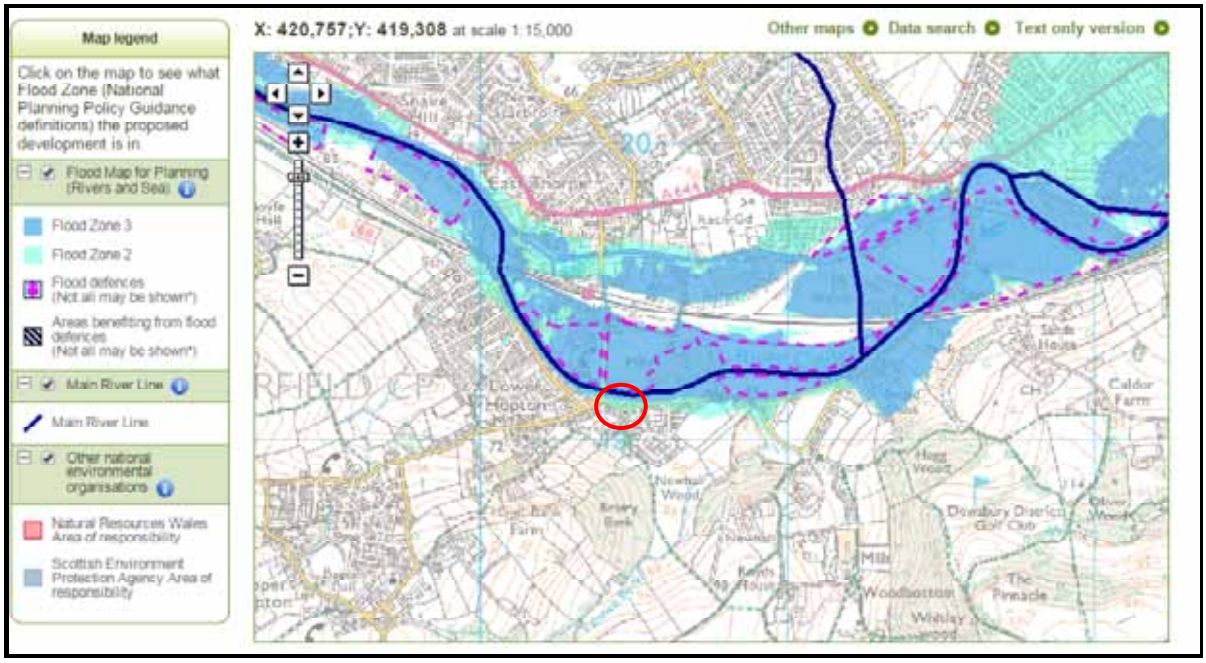

Figure 5 Flooding from Rivers and Seas

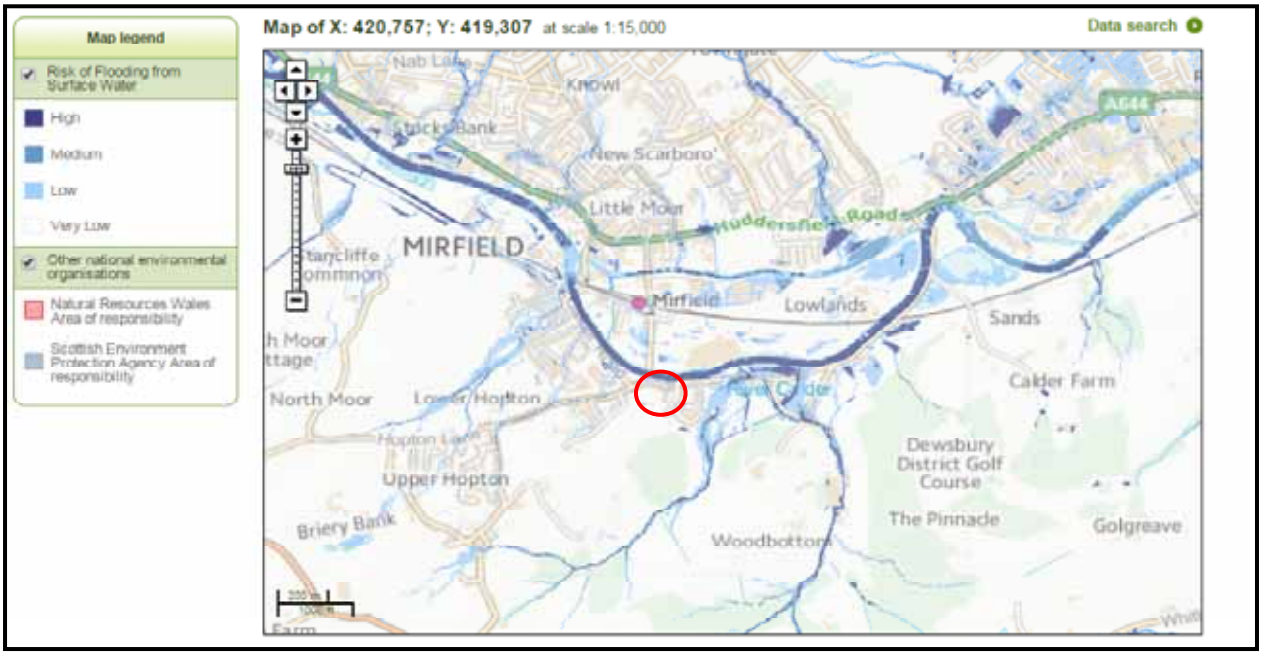

Figure 6 Flooding from Surface Water

4.4 Flood Risk From Reservoirs

The Environment Agency are the enforcement authority for the Reservoirs Act (1975) and all large reservoirs are inspected and monitored by reservoir panel engineers. The risk of flooding from reservoirs is therefore very low. The Environment Agency Reservoir Flood Risk Maps for large reservoirs (>25,000m3) for this area indicate the site is at very low risk of flooding from reservoirs.

Reservoir flooding is extremely unlikely to happen. There has been no loss of life in the UK from reservoir flooding since 1925. All large reservoirs must be inspected and supervised by reservoir panel engineers. As the enforcement authority for the Reservoirs Act 1975 in England, the Environment Agency ensure that reservoirs are inspected regularly and essential safety work is carried out.

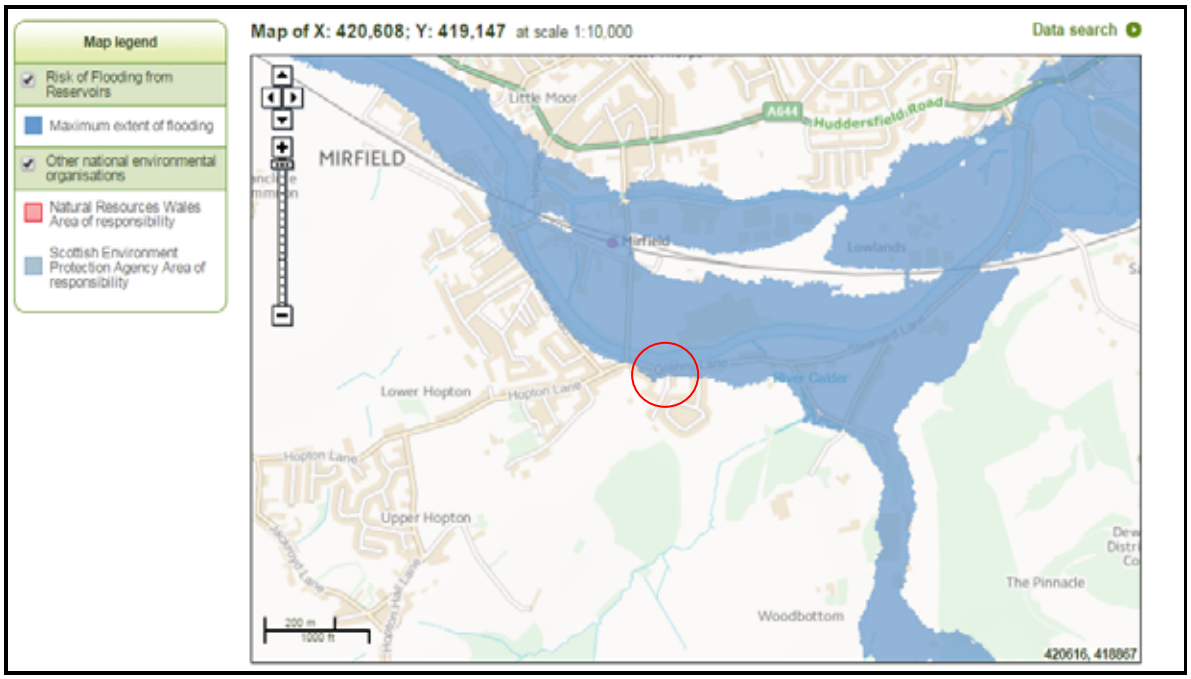

Figure 7 Possible Flooding from Reservoirs

The site lies just within the possible flood area from breach of a reservoir, but based on the above it is considered a very low risk.

4.5 Flood Risk From Canals, Lakes and Ponds.

The Calder and Hebble Navigation Canal is unlikely to detrimentally affect the site and there are no immediate lakes or ponds that are likely to flood the site.

5 HYDROGEOLOGY

5.1 General

The site lies on the minor aquifers of the alluvial deposits and the underlying Coal Measures. The alluvial deposits comprise silts ands and clays and are permeable in part and the alluvial fan deposits are generally more permeable comprising sands and gravels.

The underlying mudstone strata is generally impermeable and the interbedded sandstone and siltstone sequences in the Coal Measures are permeable minor aquifers.

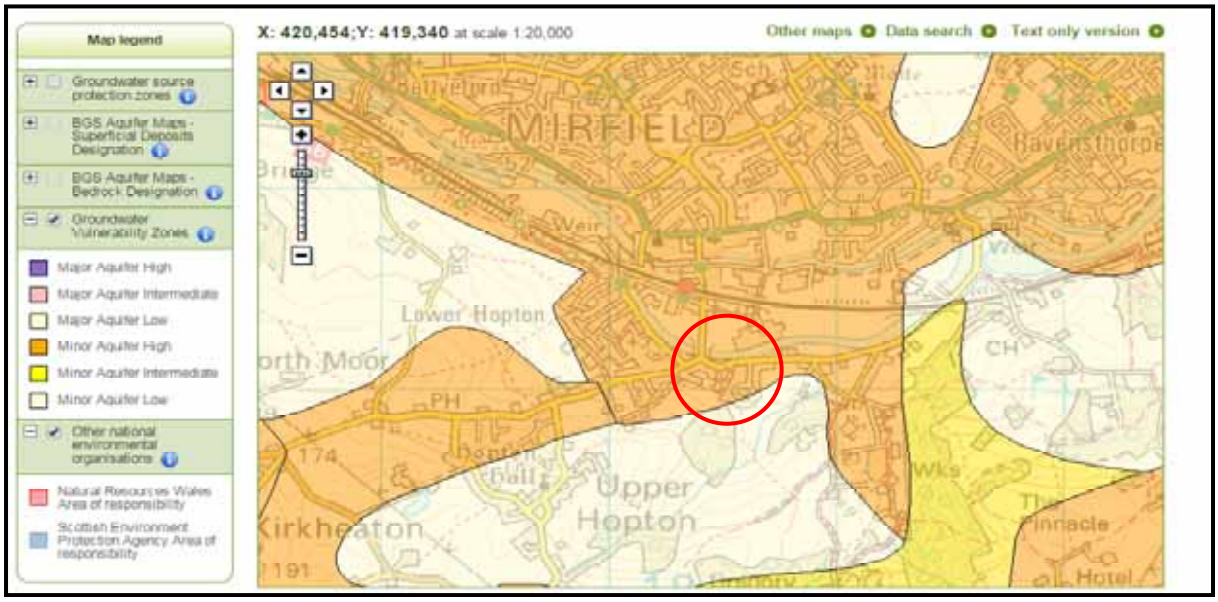

Figure 8 Groundwater Vulnerability Zone

5.2 Flood Risk From Groundwater

Flooding can occur from groundwater contained in the strata. Figure 8 indicates the site lies within a minor aquifer with high leaching potential. Minor or Secondary A aquifers are those which are permeable layers capable of supporting water supplies at a local rather than strategic scale and often forming an important source of base flow to rivers.

According to the BGS there are no groundwater flood susceptibility flood areas within 50m of the site. There is according to the BGS a negligible risk of groundwater flooding based on the underlying geology. Groundwater flooding occurs as a result of water rising up from an underlying aquifer or from water flowing from springs.

Kirklees have no records of flooding from groundwater and it is considered low risk.

5.3 Flood Warning Area

The site lies just within a Flood Warning Area as detailed on Figure 9 and outside the Flood Alert Area.

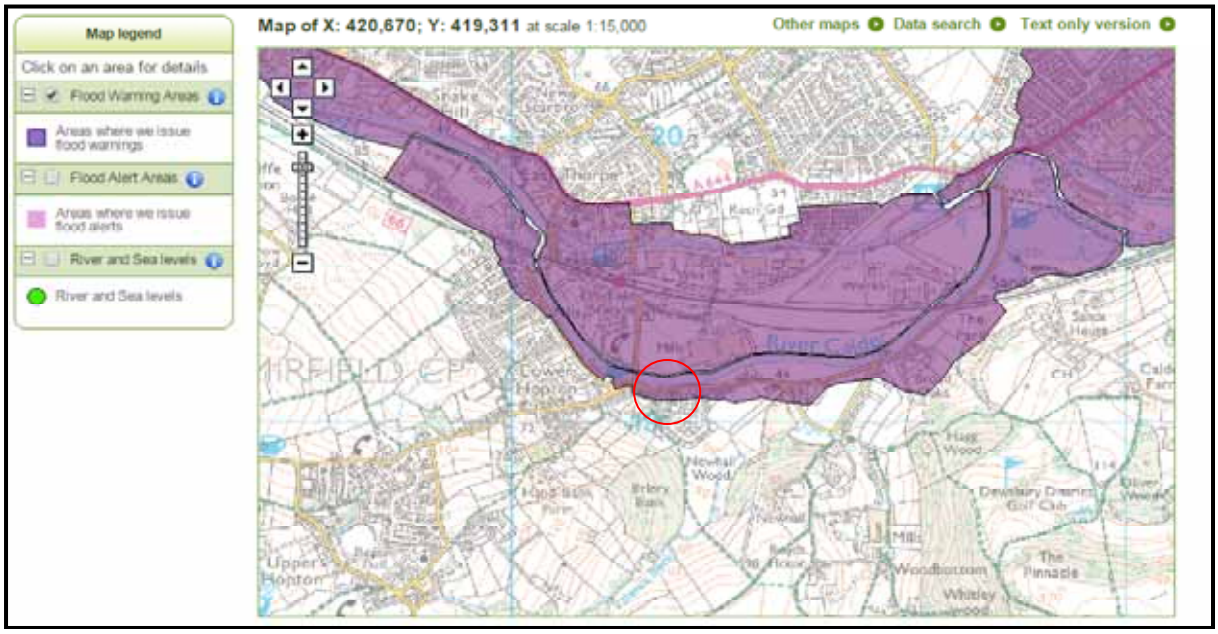

Figure 9 Flood Warning Areas

6. GEOLOGY, HYDROLOGY and HYDROGEOLOGY SETTING

With regard to the geology, hydrology and hydrogeology of the site, the report concludes that the site is immediately underlain by relatively permeable alluvial deposits overlying the relatively impermeable Coal Measures mudstone. The alluvial deposits and any sandstones underlying the mudstone are classified as Secondary A or minor aquifers.

Groundwater may be in the region of 6.0m bgl in this area and could be higher during and after heavy rainfall. Groundwater is unlikely to cause flooding to the property.

The site lies within a Zone 2 Flood Risk from the River Calder which flows west to east at 25m north of the site. The site lies within a flood risk from a breach of reservoirs although this is a very low risk. The site is unlikely to be flooded by surface water or from canals, lakes and ponds. The site may be flooded from blocked drains and sewers after heavy rainfall and this can be dealt with by ensuring drains are working adequately. The site lies within a Flood Warning Area but outside the Flood Alert Area.

7. CONCLUSIONS AND RECOMMENDATIONS

The detailed Flood Risk Assessment has been undertaken by Flood Risk Consultancy and their report 2016-006 is presented in full in Appendix A.

The geology indicates that a soakaway may not be feasible for discharge of surface water, although it should be considered following results of a soakaway test to BRE 365 design.

Other considerations for SUDS planning are presented in the detailed report.

Recommendations by the Flood Consultancy to date include :

1. A semipermeable paved area of 150m2 and 350mm sub base to attenuate the extra run off from the increase of 165m2 of impermeable hard standing.

2. Finished threshold levels to be 150mm above existing ground levels, ie 45.71m a OD.
3. Residents/occupants should register with the Environment Agency for Flood alerts.
4. Surface and foul water to be designed according to statutory requirements.
5. SUDS to be incorporated into final design to provide interception storage, attenuation and treatment of flows.
6. Surface water run off to be retained within the drainage system during a 1 in 1 year event, able to surcharge but not flood during a 1 in 30 year event and able to flood the ground surface but not enter the building on or off site during a 1 in 100 year plus climate change flood.

The Environment Agency has not been able to date to provide all the information to complete this Report, which is therefore a Draft Report. Once the information is obtained from the EA then the report will be updated.

8. GENERAL REMARKS

This report truly reflects the conditions found during the desk study and ground investigation. Whilst the desk study was undertaken in a professional manner taking due regard of additional information which became available as a result of ongoing research, the results portrayed only pertain to the information attained, and it is possible that other undetected information and undetected ground and gas conditions, undetected mining conditions and undetected contamination may exist. The desk study was only undertaken within the site boundaries and should not be used for interpretation purposes elsewhere. These conclusions are only a brief summary of the report, and it is recommended that the report is read in full to ensure that all recommendations have been understood.

Frances A Bennett
BSc, CGeol, FGS, FIMMM, C.WEM, MCIWEM, CEnv, AIEMA, MIEnvSci.

Appendix **A**

FLOOD RISK CONSULTANCY LIMITED

Level 2 Scoping Study Flood Risk & Drainage Impact Assessment

18 Granny Lane, Lower Hopton, Mirfield

Client: Mrs Burrows

Report No: 2016-006

Date: 10/03/2016

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APPRAISING, MANAGING & REDUCING FLOOD RISK

Document Control

Document Title: Flood Risk Assessment

Project Number: 2016-006

Revision	Date	Issued to	Status	Comments
/	10/03/2016	Mrs Burrows Frances A Bennett (Ashton Bennett)	Draft	

Contract

This report describes work commissioned by Frances A Bennett of Ashton Bennett on behalf of their client, Mrs Burrows, dated 22nd January 2016. David Emmott and Donna Metcalf of The Flood Risk Consultancy carried out the work.

Prepared by.....David Emmott (Flood Risk Consultant)

Reviewed by.....Donna Metcalf (Managing Director)

Approved by.....Donna Metcalf (Managing Director)

Disclaimer

This document has been prepared solely as a Flood Risk Assessment for Mrs Burrows. The Flood Risk Consultancy accepts no responsibility or liability for any use that is made of this document other than by the Client for the purposes for which it was originally commissioned and prepared.

Executive Summary

Flood Risk Consultancy Ltd have been commissioned to undertake a Flood Risk Assessment in accordance with National Planning Policy Framework to support a planning application for the demolition of an existing residential dwelling to create 2No new dwellings at 18 Granny Lane, Lower Hopton, Mirfield.

The proposed development site at Granny Lane, Lower Hopton covers a development area of 895m^2 (0.09 Hectares); and is shown to be partially located within Flood Zone 1 and 2 of the Environment Agency Flood Map.

The primary source of flood risk to the proposed development is identified to be from the River Calder; which is located approximately 23m north of the development site.

The River Calder is a tributary of the River Aire and predominantly flows in an easterly direction towards its confluence with the River Aire near Castleford.

Modelled flood data has been requested from the Environment Agency however at the time of writing the information has not been received. The Flood Risk Assessment will be amended following receipt of the Environment Agency data to quantify the fluvial flood risk to the development site.

An evaluation of secondary sources of flooding such as groundwater; artificial or man-made structures; pluvial or surface water sources, including ponding and infrastructure failure has been investigated and is deemed to present a low risk of flooding at the development site.

The existing site covers a total area of approximately 895m^2 and is comprised of the residential dwelling, associated hardstanding and garden areas. The site is considered to have an impermeable footprint of approximately 165m^2 which is 18% of the total site area. Following development the impermeable footprint will be increased to approximately 414m^2 which is 46% of the total site area.

Engineering judgement suggests that the site is positively drained via rainwater pipes and gullies with surface water likely to discharge via a combined sewer into the combined sewer within Granny Lane.

Existing surface water discharge rates have been determined using the modified rational method for the 1 in 2 year, 1 in 30 year and 1 in 100 year return periods and are as follows 0.6l/s, 1.8l/s and 2.7l/s respectively.

In accordance with the National Planning Policy Framework, surface water from the new development should be carefully managed; and Approved Document H of the current Building Regulations sets out a hierarchy for disposal of surface water from new development, in the following order of preference:

- Infiltration via soakaway or other infiltration device
- Watercourse
- Sewer

Desktop investigations suggest that infiltration methods at the development site could potentially be viable and as such it is recommended that percolation testing to BRE Digest 365 is undertaken to determine the infiltration rates at the development site.

If infiltration methods are not deemed to be viable then surface water should be discharged to the nearest watercourse. However due to the presence of 3rd party land it is recommended

that surface water is discharged into the surface water sewer located approximately 37m west of the development site.

A preliminary drainage plan has been produced which indicates that surface water from the development could be attenuated on site via the use of permeable paving within the shared driveway area with an area of 150m^2 and subbase depth of 350mm. However these values are indicative only and should be re-consulted at the detailed design stage of the project.

Contents

Figures

Tables

Appendices

1.0 Introduction

1.1 Terms of Reference

Flood Risk Consultancy Ltd has been appointed by Ashton Bennett on behalf of Mrs Burrows, to provide a Flood Risk and Drainage Impact Assessment in support of a planning application for the demolition of an existing residential dwelling and the creation of 2No residential developments within the site boundary.

The redline boundary of the development site covers an area approximating 895m^2 (0.09 Hectares) and is shown to be situated within Flood Zone 1 and 2 of the Environment Agency Flood Map.

Definitions of the different Flood Zones are provided within Section 2.2.2 of this report.

It is usual for the Environment Agency to raise an objection to development applications within the floodplain, or Zones 2 and 3 of the flood map until the issue of flood risk has been properly evaluated. The Agency will also object to developments where the total site area is in excess of 1 Hectare until suitable consideration has been given to surface water runoff.

1.2 Objectives

The objective of this assessment is to evaluate the following issues in regard to flood risk at the application site i.e. demolition of existing single residential dwelling with the development of 2No residential dwellings:

- Suitability of the proposed development in accordance with current planning policy.
- Identify the risk to both the proposed development and people from all forms of flooding.
- Provide a preliminary assessment of foul and surface water management.
- Increasing the risk of flooding elsewhere e.g. surface water flows; flood routing; and loss of floodplain storage.
- Recommendation of appropriate measures to mitigate against flooding both within the proposed development, and neighbouring land and property.

1.3 Data Sources

This assessment is based on desk-top study of information from the following sources:

- National Planning Policy Framework (2014)
- Planning Practice Guidance at www.gov.uk (March 2014)
- Building Regulations Approved Document H
- Environment Agency Flood Mapping
- Calder Valley Strategic Flood Risk Assessment (2008)
- Kirklees Council Preliminary Flood Risk Assessment (2009)
- Kirklees Council Surface Water Management Plan (2011)
- Kirklees Council Local Plan (2014)
- British Geological Society – Historic Borehole Logs
- Cranfield University's Soilscape Viewer
- CIRIA C697 The SUDS Manual
- MicroDrainage Windes

2.0 Planning Policy Context

2.1 Approach to the Assessment

The project is currently at the planning stage and consequently a detailed site specific flood risk assessment is required.

A Level 2 Scoping Study is designed to provide a qualitative appraisal of flood risk both within the application site and any potential impact that the development will have on flood risk elsewhere; and provide recommendations for mitigation measures which may be included within the design of the development to reduce the overall risk of flooding.

An initial assessment indicates that the primary flood risk at the proposed development is from fluvial sources i.e. River Calder.

Consideration has also been given to the site flooding from secondary sources such as pluvial, groundwater; artificial water bodies; infrastructure failure; overland flow and ponding.

2.2 National Planning Policy Framework (NPPF)

The requirements for undertaking site specific flood risk assessments are generally as set out in Guidance Point 10 from the Planning Practice Guide – Flood Risk & Coastal Change (www.gov.uk).

The information provided in the flood risk assessment should be credible and fit for purpose.

Site-specific flood risk assessments should always be proportionate to the degree of flood risk and make optimum use of information already available, including information in a Strategic Flood Risk Assessment for the area, and the interactive flood risk maps available on the Environment Agency's website.

A flood risk assessment should also be appropriate to the scale, nature and location of the development.

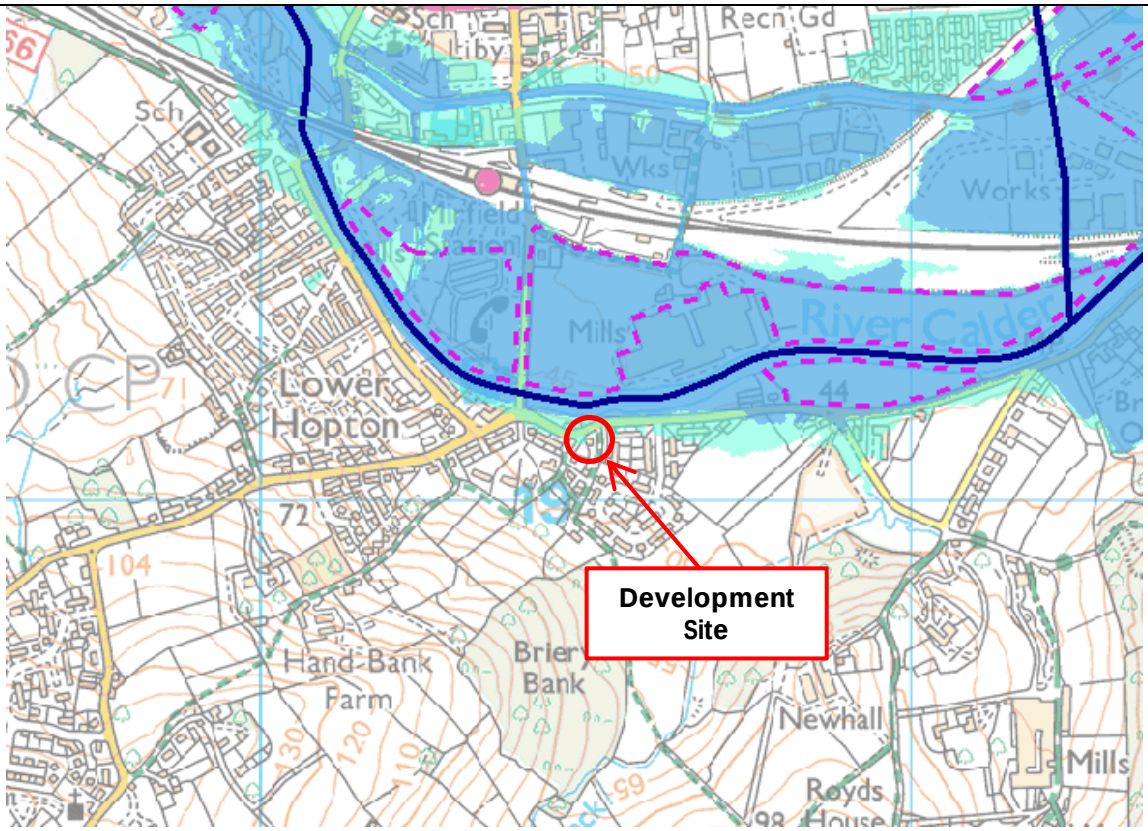
Changes to the NPPF in April 2015 made SUDS (Sustainable Drainage Systems) a material consideration while determining planning applications for major development with developers required to provide SUDS on major development where appropriate.

2.2.1 Sources of Flooding

- **Rivers (fluvial):** Flooding occurs when flow within river channels exceeds capacity; and the type of flood event experienced e.g. flash flooding; depends upon the characteristics of the river catchment.
- **The Sea (tidal):** Flooding at low lying coastline and tidal estuaries is caused by storm surges and high tides; with overtopping and breach failure of sea defences possible during extreme storm events.
- **Pluvial (surface flooding or overland flows):** Heavy rainfall, which is unable to soak away via infiltration or enter drainage systems can flow overland, resulting in localised flooding. Topography generally influences the direction and depth of flooding caused by this mechanism.
- **Groundwater:** Caused when ground water levels rise to the surface; and is most likely to occur in low lying areas underlain by aquifers.

- **Sewers and drains:** Generally occurs in more urban areas; where sewers and drains are overwhelmed by heavy rainfall or blocked pipes and gullies.
- **Artificial Sources (reservoirs, canals, lakes and ponds):** Reservoir and canal flooding may occur as a result of capacity exceedance or structural failure.

Figure 2.1: The Environment Agency Flood Map



Source: www.environment-agency.gov.uk

Key

- Flooding from rivers or sea without defences (Flood Zone 3)
- Extent of extreme flood (Flood Zone 2)
- Flood defences
- Areas benefiting from flood defences
- Main rivers
- COW Critical Ordinary Watercourse

2.2.2 Flood Zones

- **Flood Zone 1:** Low probability (less than 1 in 1000 year (<0.1% AEP) annual probability of river or sea flooding in any year).
- **Flood Zone 2:** Medium probability (between 1 in 100 year (1.0% AEP) and 1 in 1000 year (0.1% AEP) annual probability of river flooding; or between 1 in 200 year (0.2% AEP) and 1 in 1000 year (0.1% AEP) annual probability of sea flooding in any year).

- **Flood Zone 3a:** High probability (1 in 100 year (1.0% AEP) or greater annual probability of river flooding in any year or 1 in 200 year (0.5% AEP) or greater annual probability of sea flooding in any year).
- **Flood Zone 3b:** This zone comprises land where water has to flow or be stored in times of flood. Land which would flood with an annual probability of 1 in 20 (5% AEP), or is designed to flood in an extreme flood (0.1%) should provide a starting point for discussions to identify functional floodplain.

2.2.3 Vulnerability of Different Development Types

- **Essential Infrastructure:** Transport infrastructure (railways and motorways etc…); utility infrastructure (primary sub-stations, water treatment facilities; power stations; and wind turbines).
- **Water Compatible Development:** Flood control infrastructure; water and sewage infrastructure; navigation facilities.
- **Highly Vulnerable:** Emergency services; basement dwellings; mobile home parks; industrial or other facilities requiring hazardous substance consent.
- **More Vulnerable:** Hospitals; residential dwellings; educational facilities; landfill sites caravan and camping sites.
- **Less Vulnerable:** Commercial premises; emergency services not required during a flood; agricultural land.

2.2.4 Sequential & Exceptions Test

As set out in the National Planning Policy Framework, the aim of the Sequential Test is to steer new development to areas at the lowest probability of flooding.

The Flood Zones are the starting point for the sequential approach.

Table 1: Flood Risk Vulnerability and Flood Zone 'Compatibility'[1]

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

✓ Development is appropriate
× Development should not be permitted

The proposed development is for the demolition of an existing residential development and creation of 2No residential dwellings.

[1] Extracted from Table 3 of the Technical Guidance to the National Planning Policy Framework Document (March 2012)

The Environment Agency Flood Map shows the development site to be located within Flood Zones 1 and 2 with the proposed dwellings located within Flood Zone 1; as such it is considered that a Sequential Test is not required.

However more detailed review of modelled flood levels and site levels will be completed when Environment Agency data has been obtained with the flood zone classification of the buildings identified.

In accordance with Table 2 'Flood Risk Vulnerability Classification' of the Technical Guidance to the National Planning Policy Framework, residential developments are defined as 'More Vulnerable' and are classified as appropriate development within Flood Zone 1.

2.2.5 Climate Change

The National Planning Policy Framework (NPPF) sets out how the planning system should help minimise vulnerability and provide resilience to the impacts of climate change. Table 2 shows anticipated changes in extreme rainfall intensity in small and urban catchments.

For flood risk assessments and strategic flood risk assessments, both the central and upper end allowances should be assessed to understand the range of impact.

Residential development is usually designed with a lifetime approximating 100 years; and therefore 20% and 40% must be applied to peak rainfall intensities (see table 2).

Table 2: Peak rainfall intensity allowance in small and urban catchments'[2]

Applies across all of England	Total potential change anticipated for 2010 to 2039	Total potential change anticipated for 2040 to 2059	Total potential change anticipated for 2060 to 2115
Upper end	10%	20%	40%
Central	5%	10%	20%

2.2.6 Sustainable Urban Drainage Systems (SUDS)

The key planning objectives in the NPPF are to appraise, manage and where possible, reduce flood risk.

Sustainable Urban Drainage Systems (SUDS) are designed to reduce the potential impact of new and existing developments with respect to surface water drainage discharges, thereby providing a suitable way of achieving some of these objectives.

Furthermore the NPPF and Building Regulations Approved Document Part H direct developers towards the use of SUDS wherever possible.

The Flood and Water Management Act 2010 also reinforces the requirements for SUDS to be implemented where practicable.

Since 6th April 2015 local planning policies and decisions on planning applications relating to major development (developments of 10 dwellings or more; equivalent non-residential development or mixed development [as defined in Article 2(1) of the Town and Country Planning (Development Management Procedure) (England) Order 2010] will ensure that

[2] Extracted from Table 2 Guidance Flood Risk Assessments; climate change allowances (Available from: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances)

sustainable drainage systems (SUDS) for the management of surface water runoff are put in place unless demonstrated to be inappropriate.

Part H of the Building Regulations requires that surface water should be discharged from new development in accordance with the following hierarchy in order of preference:

- By infiltration to the ground via soakaway or other infiltration device
- To a watercourse
- To a public sewer

2.2.7 Local Planning Policy

The following policy has been taken from the Kirklees Draft Local Plan Strategy and Policies (November 2015):

11.2 Water Management

Policy DLP 28

Flood Risk

Proposals for development will need to demonstrate that development has been directed to areas at the lowest probability of flooding, following a sequential risk based approach. The whole Kirklees district should be the starting point for the sequential test with applicants required to provide justification where a smaller area of search is proposed. If following application of the sequential test, it is not possible for the development to be located in zones with a lower probability of flooding, it should also be demonstrated that a sequential approach has been applied within sites so that highly vulnerable and more vulnerable uses are directed towards the areas of lowest flood risk. Proposals will also need to demonstrate that the exception test is passed, where applicable, as set out in national planning policy.

Proposals within flood zone 3a(i) will be assessed in accordance with national policies relating to flood zone 3a but with all of the following additional restrictions:

a) no new highly vulnerable or more vulnerable uses will be permitted;
b) less vulnerable uses may only be permitted provided that the sequential test has been passed and;
c) where extensions are linked operationally to an existing business or, where redevelopment of a site provides buildings with the same or a smaller footprint;
d) all proposals will be expected to include flood mitigation measures to be identified through a site specific Flood Risk Assessment including consideration of the creation of additional sustainable flood storage areas;
e) development will not be permitted on any part of the site identified through a site specific Flood Risk Assessment as performing a functional floodplain role.

Proposals must be supported by an appropriate Flood Risk Assessment in line with national planning policy. This must take account of all sources of flooding set out in the Strategic Flood Risk Assessment and demonstrate that the proposal will be safe throughout the lifetime of the development (taking account of climate change). The proposal must also not increase flood risk elsewhere and where possible should reduce flood risk. Mitigation measures, where necessary, should be proposed.

Proposals involving building over existing culverts or the culverting or canalisation of water courses will not be permitted unless it can be demonstrated to be in the interests of public safety or to provide essential infrastructure and that there will be no detrimental effect on flood

risk and biodiversity. Where feasible, development proposals should incorporate re-opening of culverts, modification of canalised water courses and consideration of mitigation measures to achieve a more natural and maintainable state.

Policy DLP 29

Drainage

The presumption is that Sustainable Drainage Systems (SuDS) will be used to assist in achieving the following on each site:

a. for proposals on greenfield sites, typical greenfield run-off rates should not be exceeded;
b. for proposals on brownfield sites there should be a minimum 30% reduction in surface water run-off where previous positive surface water connections from the site can be proven. New connections will be subject to at least greenfield restrictions;
c. improvements in water quality;
d. ensure proposed open spaces within sites contribute towards sustainable drainage schemes.

Local conditions including the existence of critical drainage areas may require a lower run-off rate to be agreed to reflect volume control, local surface water risks, water course capacity and flood risk further downstream.

There will be a general presumption against pumping surface water. It must also be demonstrated that the surface water management solution is designed to meet requirements over the lifetime of the development including evidence that management and maintenance arrangements have been secured to cover that period. This includes ensuring proposals to store water meet national standards and latest best practice.

Flow paths accommodating water from outside the site or due to an exceedance event should be designed to avoid buildings and curtilages.

Development will only be permitted if it can be demonstrated that the water supply and waste water infrastructure required is available or can be co-ordinated to meet the demand generated by the new development.

3.0 Details of the Site

3.1 Site Details

Table 3: Development Location

Site Name:	18 Granny Lane, Lower Hopton
Purpose of Development:	Residential
Existing Land Use:	Residential
OS NGR:	SE 205190
Country:	England
County:	Yorkshire
Local Planning Authority:	Kirklees Metropolitan Borough Council
Internal Drainage Board:	Not Applicable
Other Authority (e.g. British Waterways/ Harbour Authority)	Not Applicable

Location Plan:

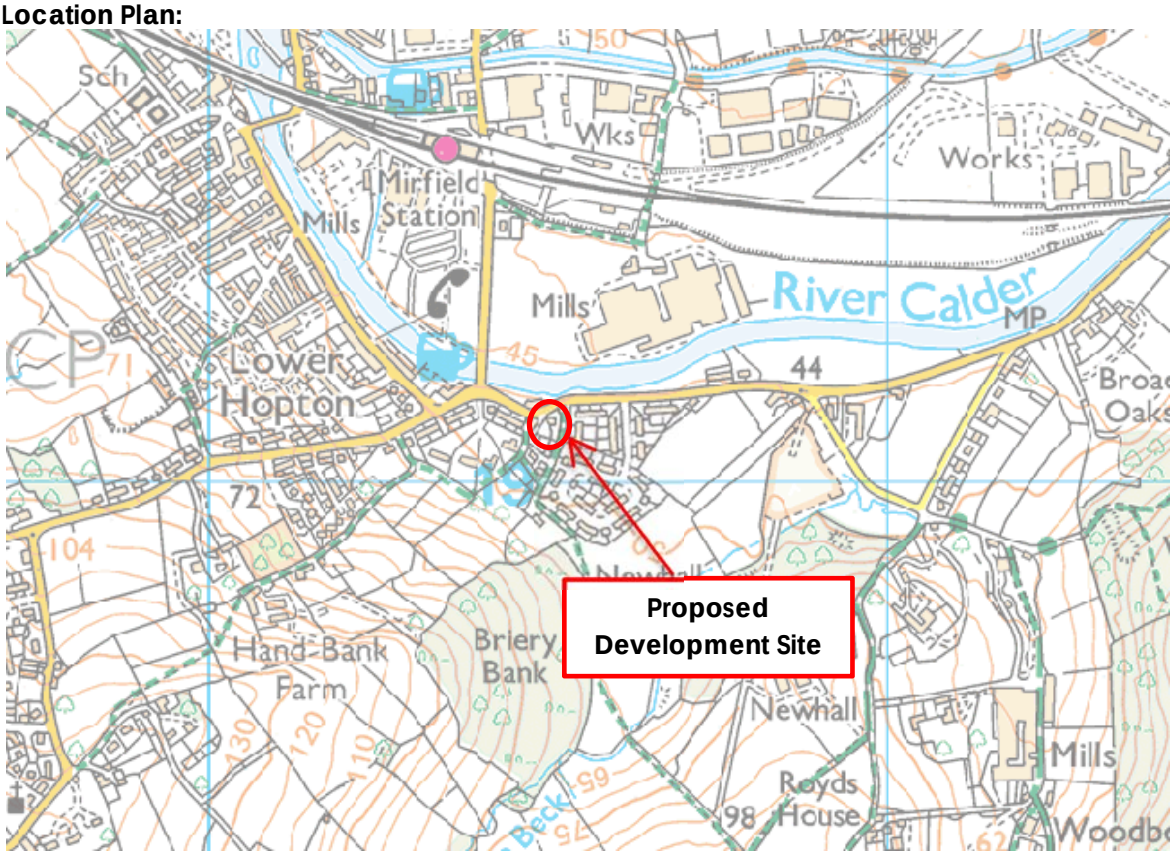


Image produced from the Ordnance Survey Get-a-map service.
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3.2 Site Description

The application site is comprised of an existing residential development and associated hardstanding and landscaped areas.

The proposed development site is located in the area of Lower Hopton within the metropolitan borough of Kirklees.

Table 4: Boundaries

North	The site is bound to the north by Granny Lane with a wooded area located to the north of Granny Lane and the River Calder located approximately 23m north of the development site. To the north of the River Calder there is a large area of grassland and industrial buildings known as Holme Bank Mills Industrial Units. Mirfield Railway Station is located approximately 380m north of the development site.
East	To the east of the site is a small road known as Gregory Springs Lane with residential properties located on the east of the Gregory Springs Lane. To the east of the residential properties on Gregory Springs Lane there are more residential properties with agricultural areas and woodland areas located to the east of the residential properties.
South	The south of the site is bound by residential properties with a woodland area located approximately 180m south of the site. A watercourse known as Valance Beck is located approximately 300m south east of the development site.
West	The west of the site is bound by residential properties with an agricultural area located to the west of the residential properties approximately 590m west of the site. The village of Kirkheaton is located approximately 2.1km west of the development site.

Figure 3.1: Aerial View of Proposal Site (Sept 2011)

Source: Google Earth

The nearest watercourse to the development site is the River Calder located approximately 23m north of the site.

Figure 3.2: Development Site Viewed from Granny Lane

Source: Google Street View

A topographical survey of the site has yet to be conducted however Lidar data indicates the site is relatively flat with a range from approximately 46.53mAOD in the south east of the site to 45.50mAOD in the north. It is considered the threshold level of the exiting bungalow is thought to be approximately 46.00mAOD.

An indicative map showing spot levels at strategic points using Lidar data is included within Appendix A of this report with the northern boundary of the site shown to range from 45.53mAOD to 45.50mAOD, the vehicular entrance has a level of 45.67mAOD, the front of the bungalow has a level of approximately 45.56mAOD and the south of the site has a level of 46.15mAOD in the south west and 46.53mAOD in the south east.

It is proposed that the existing vehicular access to the site will be retained following development.

3.3 Proposed Development Details

The proposed development plans are for the demolition of an existing residential development and erection of 2No detached dwellings.

The existing vehicular entrance from Gregory Springs Lane will be retained with a new vehicular access from Granny Lane to the north.

Current developments plans indicate that there will be two wild life ponds located in the rear gardens of each properties.

4.0 Historic Flooding

4.1 Internet Search

A search of flooding within the Lower Hopton and Mirfield areas of Kirklees results in an article within the Huddersfield Daily Examiner titled '*Shocking drone footage shows state of Mirfield's flood devastation'* from 28th December 2015 and states the following:

'The worst floods in memory swamped large parts of Mirfield and Lower Hopton on Saturday.

Surging water levels saw the River Calder burst its banks cutting off all four routes between the two neighbouring settlements.

Water engulfed homes and businesses that were still recovering from the floods earlier this month, including the Ship Pub at Steanard Lane.

OAPs in Calder Care Cottages were cut off, Lowlands allotments were under water and access to the train station was impossible without wading through several feet of water.

Figure 4.1: River Calder Flood Event December 2015 (Mirfield Allotments)

Source: Huddersfield Daily Examiner

A business park next to the train station was flooded and many homes close to the river bank were breached.

Residents of Lower and Upper Hopton were forced to drive into Colne Bridge or Grange Moor to get across to Mirfield.

The river level recorded in central Mirfield as the highest ever – 5.395m – 345mm above the previous record.'

It is noted that the Ship Pub is located approximately 1.3km north east of the development site with the business park and allotments located on the northern side of the River Calder north of the development site. From the article it is unclear whether the southern banks of the River Calder and the Granny Lane area of Little Hopton experienced flooding during this event.

4.2 Calderdale and Kirklees Metropolitan Borough Council SFRA (2008)

A Strategic Flood Risk Assessment (SFRA) was completed by JBA Consulting in 2008.

There are no historical flood incidents recorded within the JBA Consulting Strategic Flood Risk Assessment.

4.3 Preliminary Assessment Report for Kirklees (2009)

The Kirklees Preliminary Flood Risk Assessment was completed in 2009 by Kirklees Council. Section 4 of the report contains records of past flood events in the area.

Within *Table 1. Summary of Past Flooding* there are 2No historical flood events recorded for Mirfield. The flood events occurred in October 2000 described as a 2 week period of rain/surface water with 30 flooded properties and July 2002 with 40mm in 12 hours/surface water with more than 10 properties flooded.

It is noted that there is no further information in regards to the exact location of flooding during these events as such the direct impact on the proposed development site is unable to be quantified from these events.

4.4 Kirklees Surface Water Management Plan (2011)

The Kirklees Surface Water Management Plan was completed in 2011 by Kirklees Council. The report states the following:

'There has been recent significant local summer flooding in the summers of 2002, 2004, 2007 and January 2008.'

'The 2007 floods flooded up to an estimated 500 properties across the district and were described by many residents as the worst in living memory. The flooding was widespread across the district but hotspots occurred around Ravensthorpe, Liversedge, Cleckheaton, Chickenley, Mirfield, Milnsbridge, Brockholes, New Mill, Denby Dale, Scissett and Clayton West.'

It is noted that Mirfield is referenced as one of the hotspots within the SWMP during the 2007 floods however there is no reference to the Little Hopton area of Mirfield as such it is not considered that the development site was affected during the 2007 floods.

5.0 Initial Evaluation of Flood Risk

5.1 The Environment Agency Flood Map

The Environment Agency Flood Map illustrated within Figure 2.1, confirms that proposed development site is located within Flood Zone 1 and 2.

The definition for each of the flood zones highlighted above is provided for reference within Section 2.2.2 of this report.

Table 5: Possible Flooding Mechanisms

Source/Pathway	Significant?	Comment/Reason
Fluvial	Yes	River Calder located 23m north of the development site
Canal	No	Nearest Canal (Mirfield Cut) located approximately 530m north of the site
Tidal/Coastal	No	N/A
Reservoir	Yes	EA Map shows that the site is within reservoir flood extents
Pluvial (urban drainage)	No	Site is less than 1 Hectare in size; and is an extension to an existing building
Surface Water Flooding	No	EA Surface Water Flood Maps indicates the site is at very low risk of surface water flooding
Groundwater	Yes	EA Groundwater indicates site located on Secondary A aquifer
Overland flow	Yes	Surface water flow route identified within vicinity of the development site
Blockage	Yes	Bridge over River Calder located in the vicinity of the development site
Infrastructure failure	No	No culverted sections of the river near the site
Rainfall Ponding	Yes	Existing pond system where ponding could occur identified within the site

From the initial assessment it is concluded that the primary source of flood risk will be from fluvial sources i.e. River Calder.

Fluvial: River Calder

The nearest watercourse to the application site is the River Calder located approximately 23m north of the development site.

The source of the River Calder is located near Todmorden at Heald Moor and flows in an easterly direction for approximately 72km to its confluence with the River Aire near the town of Castleford.

The confluence of the River Calder and the River Aire is located approximately 23km east of the development site.

The River Calder is classified as 'Main River' and therefore flood management along the watercourse is the responsibility of the Environment Agency.

As the development is located within Flood Zone 1 and 2 the risk of fluvial flooding from this source is regarded as low to medium and needs to be assessed in more detail.

Fluvial: Valance Beck

Valance Beck is located approximately 300m south east of the development site and is a minor tributary to the River Calder. The source of Fish House Brook is located near Covey Clough Wood to the south west of the development site and flows in a north easterly direction across agricultural and woodland areas before discharging into the River Calder approximately 290m east of the development site.

The watercourse is classified as an 'Ordinary Watercourse' and is considered to have a relatively small catchment. Due to the small catchment and distance from the watercourse to the development site the risk of flooding from Valance Beck is considered to be low.

Reservoir Flooding

The Environment Agency Risk of Flooding from Reservoirs map indicates the proposed development is located within the maximum extent of flooding following a breach of a reservoir.

Figure 5.1: Environment Agency Risk of Flooding from Reservoirs Map

Source: Environment Agency

The reservoir which affects this area is known as Scammonden owned by Yorkshire Water Services.

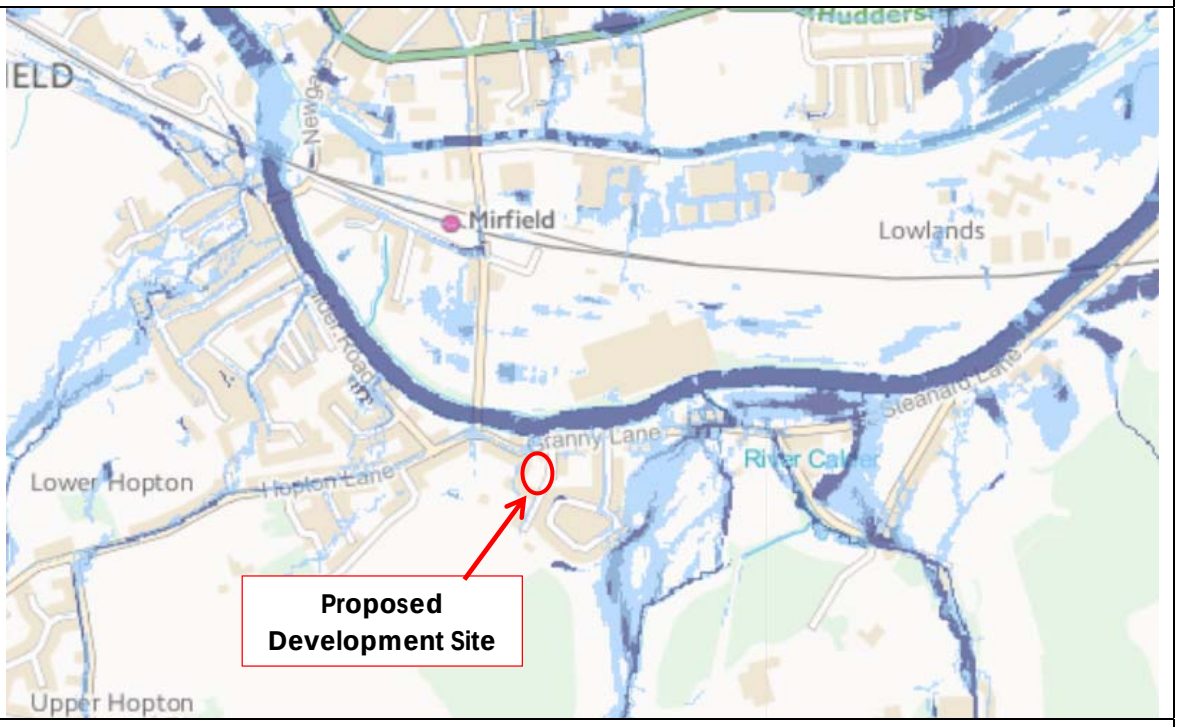
It is noted that reservoir flooding is extremely unlikely to happen. There has been no loss of life in the UK from reservoir flooding since 1925. As such the risk of flooding to the development site is considered to be low.

Pluvial: Surface Water Flooding

The Environment Agency's Flooding from Surface Water Map shows potential depths, velocities and direction of flow for low, medium and high probabilities of surface water flooding.

The Surface Water Flood Risk map is included within Figure 5.2 below.

Figure 5.2: Surface Water Flood Map



Source: www.environment-agency.gov.uk

Definitions of the high, medium and low probability events are included below:

Key

Very Low Probability – Very low probability means that each year, this area has a chance of flooding of less than 1 in 1000 (0.1%).

Low probability - Low probability means that each year, this area has a chance of flooding of between 1 in 1000 (0.1%) and 1 in 100 (1%).

Medium probability - Medium means that each year, this area has a chance of flooding of between 1 in 100 (1%) and 1 in 30 (3.3%).

High probability - High probability event means that each year, this area has a chance of flooding of greater than 1 in 30 (3.3%).

The surface water flood map indicates that the proposed development site has a very low probability of surface water flooding with an area of low probability shown to flow down the west of the development site and areas of low probability on Granny Lane to the north of the site.

As such it is considered that the risk of surface water flooding to the development site is considered to be very low.

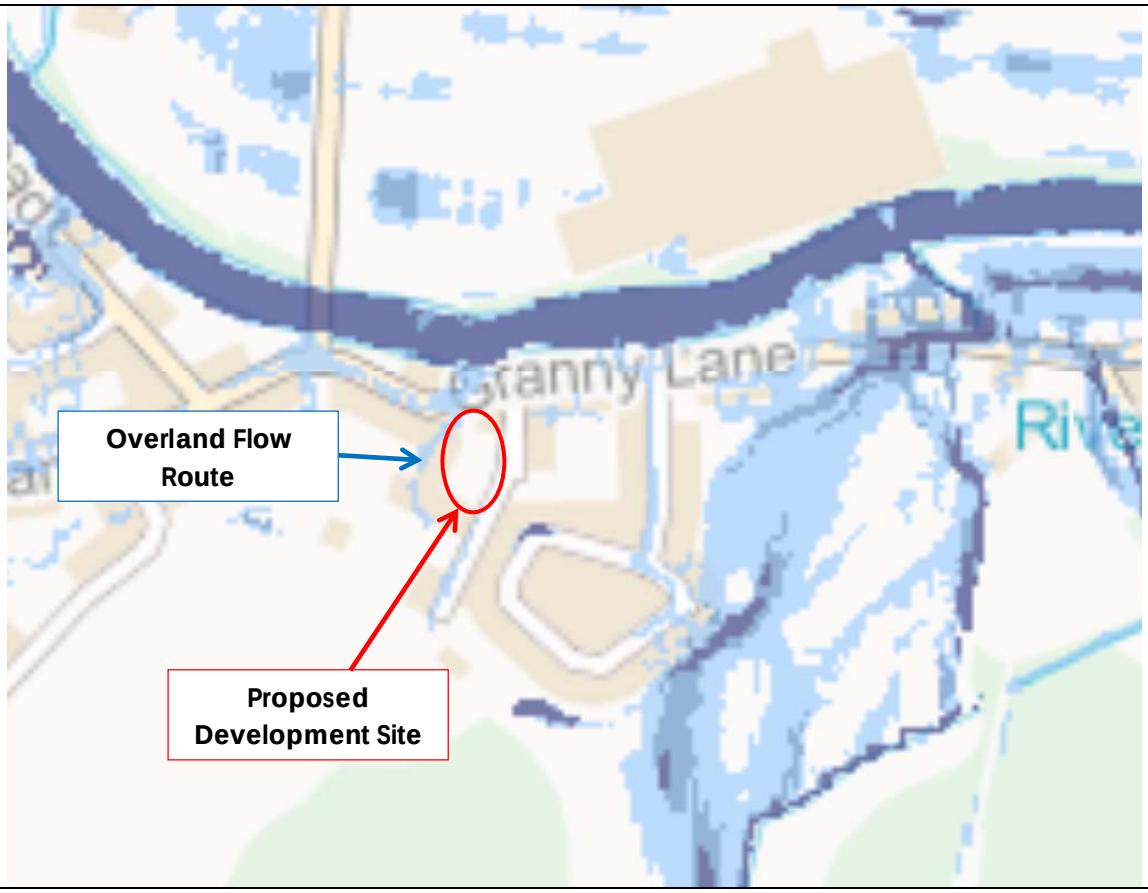
Pluvial: Overland Flow

Flooding from this source generally occurs when the infiltration capacity of land is exceeded and excess rainwater flows overland. Flooding from this source occurs as a result of an accumulation of water within topographic depressions and at areas where its flow route is impeded.

Severe rainfall events, steep slopes, soils, geology and land management all contribute to the effect and severity of flooding resulting from overland flow.

As mentioned previously there appears to be an overland flow route that flows towards the River Calder along the western boundary of the development site as shown below.

Figure 5.3: Surface Water Flood Map



Source: www.environment-agency.gov.uk

It is not considered that the development site would experience flooding from the overland flow route adjacent to the west of the site and as such in conclusion the risk from this source is low.

Groundwater

Groundwater flooding is caused by the emergence of water originating from underground. The water may emerge from either point or diffuse locations. The occurrence of groundwater flooding is usually very local.

There are no reports of specific groundwater flooding within the Kirklees Preliminary Flood Risk Assessment, Strategic Flood Risk Assessment or Surface Water Management Plan.

The Environment Agency's Groundwater Map shows that the site is not located within a Groundwater Source Protection Zone, with the site underlain by bedrock and superficial geology classified as a Secondary A Aquifer.

Secondary A aquifers are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.

Due to the lack of historic evidence of groundwater flooding within the Kirklees and Lower Hopton area and lack of basement areas within the development site the risk of groundwater flooding to the development site is considered to be low.

Blockage/Infrastructure Failure: Bridges

During flood conditions there is the potential for debris to enter open channel sections of watercourses, and be washed downstream.

An accumulation of debris at bridges and culverted sections of any watercourse may lead to blockages within structures located along the channel, causing flood water to backup.

Similarly should the existing bridges spanning a river fail, the capacity of the enclosed section of watercourse is likely to be greatly reduced, which again is likely to cause flood water to backup within the channel upstream form the existing bridge crossing.

As such, in regard to the River Calder it is considered likely that the extent of flooding within the local vicinity of the affected structure will be exacerbated in the event of severe blockage or structural collapse.

The nearest bridge downstream of the development site is a railway bridge located approximately 940m east of the development site with a road bridge from Steanard Lane located approximately 60m north east of the railway bridge.

Figure 5.4: Railway Bridge approximately 940m east of development site

Source: Google Street View

Figure 5.5: Road Bridge downstream of Railway Bridge

Source: Google Street View

The bridges over the River Calder in the vicinity of the development site are large span with large freeboards from the soffit of the bridges to the watercourse, additionally it is considered that the risk of structural collapse of the bridges are considered low due to their uses as a railway bridge and a road bridge.

As such the risk of infrastructure failure of the bridges in the vicinity of the development site is considered to be low.

It is noted that the River Calder is designated as 'Main River' and therefore the Environment Agency are responsible for managing flood risk along the watercourse.

An extract from the Environment Agency's routine maintenance programme for 2015-2016 within the vicinity of the development site indicates the following:

'*Channel maintenance is important as it provides unobstructed conveyance at all times.*'

Table 6: Environment Agency Maintenance Programme

Type of work we may carry out	When work will be carried out			
	Apr/May/Jun 2015	Jul/Aug/Sept 2015	Oct/Nov/Dec 2015	Jan/Feb/Mar 2016
Channels				
Raised Defences			Yes	Yes
Structures	Yes	Yes	Yes	Yes
Non FRM Assets				
Operation & Operability			Yes	Yes
MEICA Assets (Mechanical and Electrical, Instruments, Control and Automations)				

The Maintenance Schedule infers that the work carried out will involve:

- Maintain Channel
- Defence Repair
- Operational Inspection

6.0 Quantitative Flood Risk Assessment

6.1 National Planning Policy Framework

6.1.1 Site Specific Flood Risk Assessment Checklist

The following checklist has been extracted from Flood Risk & Coastal Change Section available from www.gov.uk , published in March 2014.

1. Development Description and Location

- What type of development is proposed (e.g., new development, an extension to existing development, a change of use etc.) and where will it be located?
- What is its flood risk vulnerability classification?
- Is the proposed development consistent with the Local Plan for the area? (Seek advice from the local planning authority if you are unsure about this).
- What evidence can be provided that the Sequential Test and where necessary the Exception Test has/have been applied in the selection of this site for this development type?
- Will your proposal increase overall the number of occupants and/or users of the building/land, or the nature or times of occupation or use, such that it may affect the degree of flood risk to these people? (Particularly relevant to minor developments (alterations & extensions) & changes of use).

2. Definition of the Flood Hazard

- What sources of flooding could affect the site?
- For each identified source, can you describe how flooding would occur, with reference to any historic records where these are available?
- What are the existing surface water drainage arrangements for the site?

3. Probability

- Which flood zone is the site within?
- If there is a Strategic Flood Risk Assessment covering this site (check with the local planning authority). Does this show the same or a different flood zone compared with the Environment Agency's flood map?
- What is the probability of the site flooding, taking account of the maps of flood risk from rivers and the sea and from surface water, on the Environment Agency's site, and the Strategic Flood Risk Assessment, and of any further flood risk information for the site?
- If known, what (approximately) are the existing rates and volumes of surface water run-off generated by the site?

4. Climate Change

- How is flood risk at the site likely to be affected by climate change? (The local planning authority's Strategic Flood Risk Assessment should have taken this into account. Further information on climate change and development and flood risk is available on the Environment Agency's website.

5. Detailed Development Proposals

- Where appropriate, are you able to demonstrate how land uses most sensitive to flood damage have been placed in areas within the site that are at least risk of flooding (including providing details of the development layout)?

6. Flood Risk Management Measures

- How will the site/building be protected from flooding, including the potential impacts of climate change, over the development's lifetime?

7. Off-site Impacts

- How will you ensure that your proposed development and the measures to protect your site from flooding will not increase flood risk elsewhere?
- How will you prevent run-off from the completed development causing an impact elsewhere?
- Are there any opportunities offered by the development to reduce flood risk elsewhere?

8. Residual Risks

- What flood-related risks will remain after you have implemented the measures to protect the site from flooding?
- How, and by whom, will these risks be managed over the lifetime of the development? (E.g., flood warning and evacuation procedures).

6.2 Fluvial: River Calder

6.2.1 General

The proposed development site is situated to the south of the River Calder and is designated by the Environment Agency flood map as being located within Flood Zone 1 and 2; the low and medium flood risk area.

The River Calder is classified as 'Main River' and is therefore flood management is the responsibility of the Environment Agency.

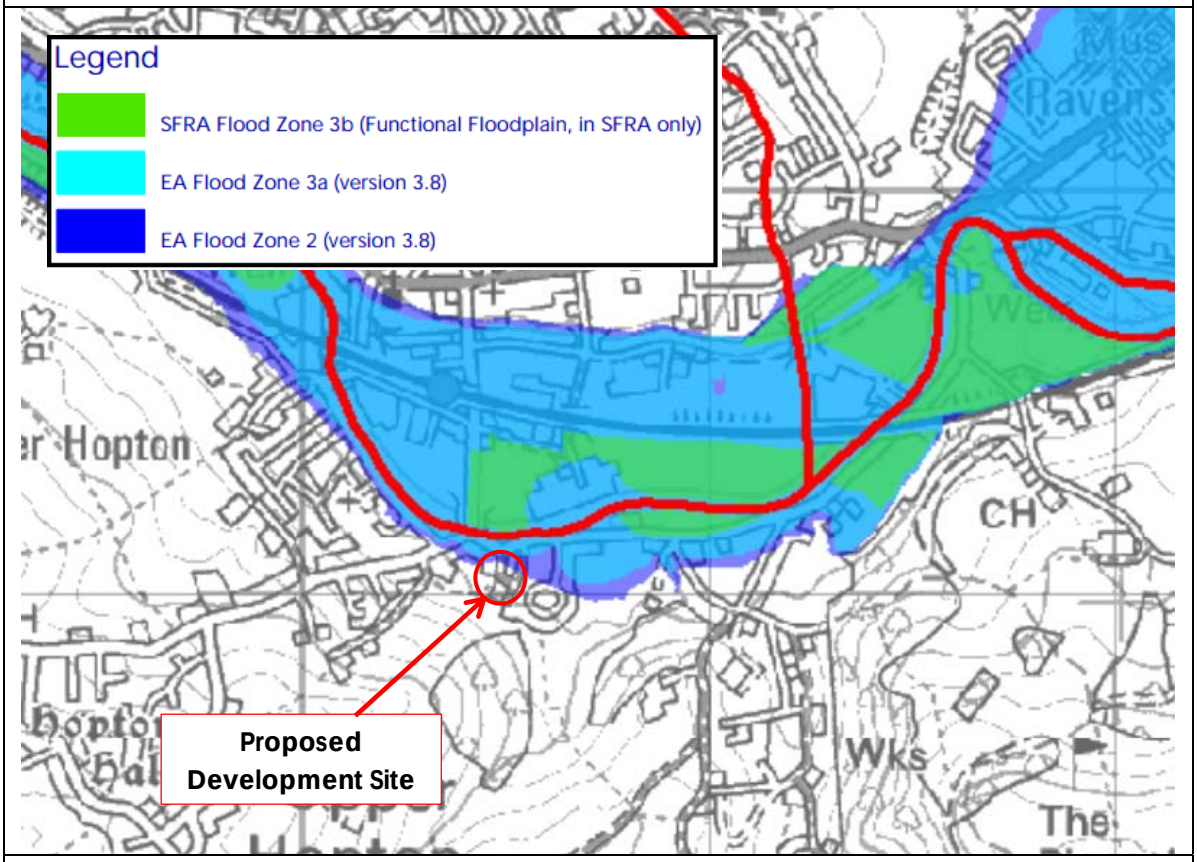
In order to suitably assess flood risk at the development site from this source; a comparison of flood levels for the watercourse against site levels is usually undertaken.

This will determine anticipated flood depths across the site; and help to assess suitable measures which may be incorporated into the development design to mitigate against flood risk.

6.2.2 SFRA Flood Map

The Granny Road site in Lower Hopton is shown in Figure A 2-1 of the Kirklees SFRA to be located within Flood Zone 1 and 2.

Figure 6.1: Flood Zone Map – Mirfield, Kirklees



Source: Kirklees SFRA

6.2.3 Fluvial Flood Defences

The Environment agency flood map for planning indicates there are flood defences in the vicinity of the development site, it is anticipated that the Environment Agency data will provide more information on the type and condition of the defences. As such further flood defence information will be added when available.

6.2.4 River Calder: Modelled Flood Levels

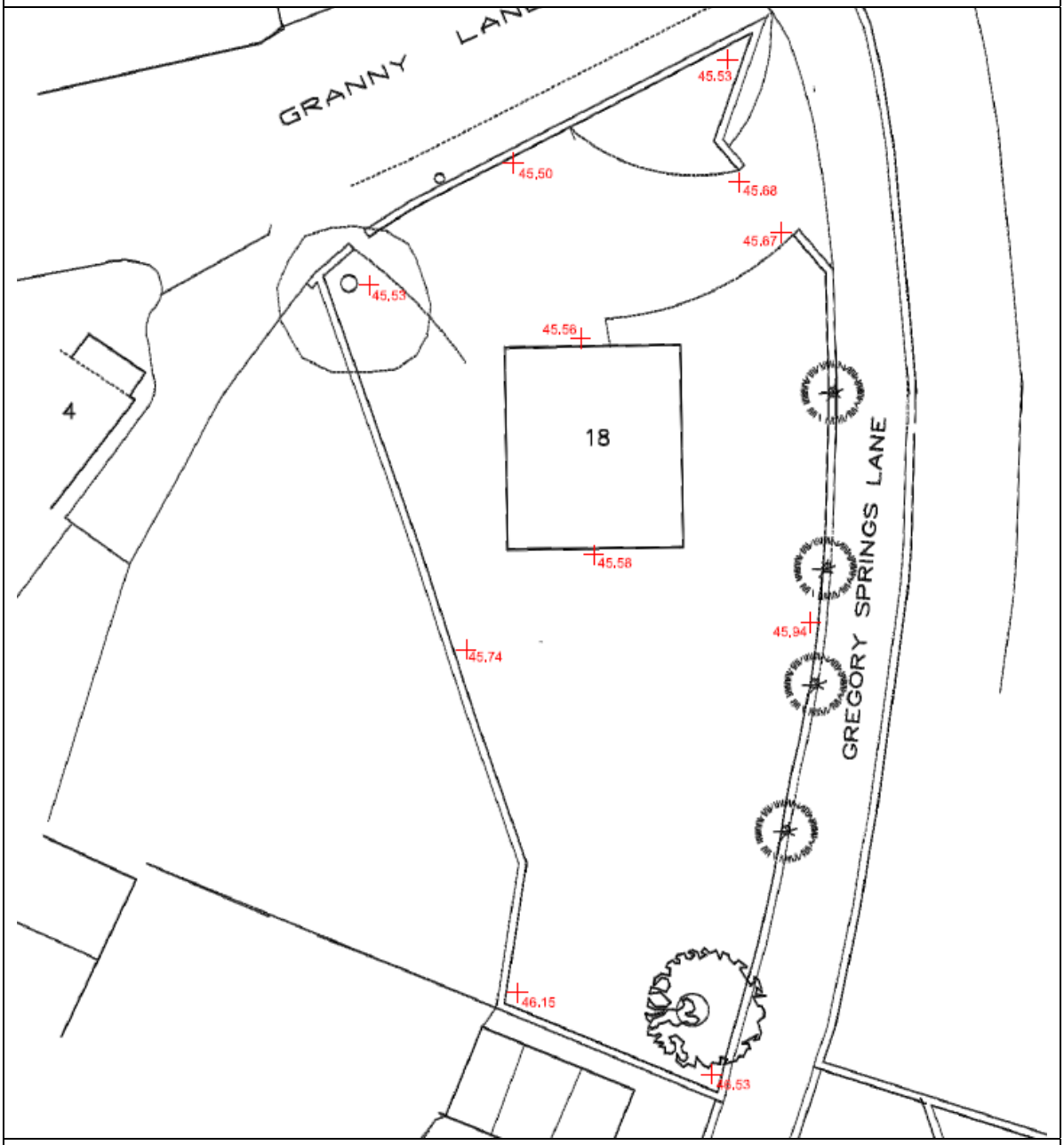
Modelled flood level data has been requested from the Environment Agency however this information has yet to be released. This section of the report will be amended following receipt of Environment Agency data with modelled flood levels compared against site levels to give an indication of the fluvial flood risk at the development site.

6.2.5 LIDAR Data

Lidar data was obtained from the Environment Agency in order to give an indication of the general level of the development site and in the vicinity of the site.

The Lidar data shows that the development site is relatively flat with an average level of approximately 46.50mAOD. The Lidar data was then used to produce a map showing levels on the site at strategic points. The map is shown within the figure overleaf:

Figure 6.2: Site Levels using Lidar Data



Source: Lidar Data

6.3 Surface Water Runoff

6.3.1 General

The total area within the development boundary approximates 895m² (0.09 Hectares); and is currently comprised of hardstanding and grassed areas associated with the existing residential dwelling.

Proposals are for the demolition of the existing 18 Granny Lane dwelling to create 2No detached residential dwellings on the site with a shared driveway.

The impermeable area i.e. roof and hardstanding area of the existing site is considered to cover approximately 165m² comprised of 90m² of existing roof area and 150m² of gravelled driveway which has been considered to have 50% impermeability. As such the total impermeable area has been calculated to be 90m² + 75m² i.e. 18% of the total site area.

Following development the impermeable area of the development site is set to increase to approximately 414m² i.e. 46% of the total site area.

6.3.2 Existing Drainage Regime

Yorkshire Water Sewer Records show a combined sewer to the west of the development site running in a northerly direction towards a combined sewer within Granny Lane. The combined sewer within Granny Lane is a 450mm diameter vitrified clay pipe which continues east along Granny Lane.

The nearest surface water sewers to the development site is located approximately 37m west of the development site which discharges into the River Calder approximately 44m north west of the development site.

6.3.3 Existing Surface Water Runoff Calculations

In order to accurately estimate surface water flows from the existing brownfield development, it is considered good engineering practice to undertake hydraulic modelling of the surface water drainage system serving the existing site.

However detailed information regarding the private drainage system on site is not currently available.

As such, for calculation purposes it is surmised that surface water discharges into the combined sewer within Granny Lane.

Therefore utilising rainfall profiles obtained from the FEH CD-ROM (Version 3.0) and the Wallingford Procedure Modified Rational Method, the peak surface water flows for a range of probabilities has been calculated and is tabulated below. The calculation spreadsheets are provided for reference within Appendix D of this report.

Table 7: Existing Surface Water Runoff

Return Period	Peak Flow Rate Site (l/s)
1 in 2 year	0.6
1 in 30 year	1.8
1 in 100 year	2.7

Flows in excess of this must be attenuated within the boundary of the development prior to disposal.

6.3.4 Surface Water Drainage Hierarchy

The hierarchy for disposal of surface water from new developments is outlined within the building Regulations Approved Document H and specifies the following methods in order of preference:

- Infiltration via soakaway or other suitable infiltration device
- Discharge to watercourse
- Discharge to public sewer

6.3.5 Infiltration

A site investigation report for the proposed development site is not currently available.

In order to assess the potential for infiltration methods to dispose of surface water from the development, a desktop investigation of the general ground conditions within the local vicinity of the site has been undertaken.

Catchment wide data for the site was obtained from the FEH CD-ROM (v3.0), which indicates that, the SPRHOST (Standard Percentage Runoff) for the site has a value of 31.4%. This value is generally considered to represent ground conditions which are unsuitable for dissipation of surface water flows into the ground.

To further the investigation, a review of historical borehole logs taken from areas in the vicinity of the development site has been undertaken using the British Geological Society Borehole Records. The nearest borehole to the development site is located approximately 100m northwest labelled as Hopton River Bridge, Mirfield with the following information:

- Borehole SE21NW107 – Hopton River Bridge, Mirfield

Made ground:	0.00 - 2.9m below ground level
Sand/Sandy silt:	2.9 – 6.2m below ground level
Gravel and cobbles:	6.2 – 10.9m below ground level
Silty Clay:	10.9 – 11.3m below ground level
Coal:	11.3 – 11.4m below ground level
Mudstone:	11.4 – 11.85m below ground level

It is noted that groundwater was struck at 6.2m below ground level which settled at 6.0m.

Information from the National Soil Resource Institute: www.landis.org.uk/soilscapes details the development area as being situated on freely draining slightly acid loamy soils.

It is considered that discharge of surface water via infiltration could potentially be a viable solution for discharge for the development site. As such it is proposed that percolation testing to BRE Digest 365 standard is undertaken to determine if infiltration is a viable solution for discharge of surface water for the development site.

6.3.6 Watercourse

The nearest watercourse to the development site is located approximately 26m north of the development site at its nearest point.

In order to discharge surface water into the River Calder, it is considered that off-site works such as digging up Granny Lane highway and 3rd party land would be required. As such it is not considered a viable solution for the disposal of surface water.

6.3.7 Sewer

If, following percolation testing it is deemed that infiltration methods are not a viable solution for the development site then discharge to sewer is the next viable option.

The nearest surface water to the development site is located approximately 37m west of the development site. The surface water sewer discharges into the River Calder at a distance approximating 44m north west of the development site.

6.3.8 Surface Water Drainage Design Criteria

The following criteria for designing surface water drainage systems for new development have been extracted from the Joint DEFRA/EA R&D Technical Report 'Preliminary Rainfall Runoff Management for Developments' (SC030219) published in October 2013.

1. Discharge Rate

The Environment Agency normally require that, for the range of annual flow rate probabilities, up to and including the 1% annual probability (1 in 100 year event) the developed rate of runoff into a watercourse should be no greater than the undeveloped rate of runoff for the same event based on the calculation of QBAR or QMED and the use of FSSR growth curves.

Exceptions only apply where it is not practical to achieve this due to either constraints on the size of the hydraulic control unit, or excessive storage volumes. The purpose of this is to retain a natural flow regime in the receiving watercourse and not increase peak rates of flow for events of an annual probability greater than 1%. Three annual probabilities are used to define discharge compliance limits though the critical criteria are for the lowest and highest frequency events; 100% (1 year), 3.33% (30 year) and 1% (100 year).

2. 1 in 1 year Design Event

The 1 in 1 year event is the highest probability event to be specifically considered to ensure that flows to the watercourse are tightly controlled for frequent events to provide good morphological conditions.

3. 1 in 30 year Design Event

The 1 in 30 year event is of importance because of its linkage with the level of service requirement of Sewers for Adoption 6th Edition, which requires that surface water sewers should be capable of carrying the 1 in 30 year flows generated by a development within the system without causing flooding to any part of the site.

4. 1 in 100 year Design Event

The 1 in 100 year event has been selected since it represents the boundary between high and medium risks of fluvial flooding defined by the National Planning policy Framework (2012) and also recognises that it is not practicable to fully limit flows for the most extreme events. Also Sewers for Adoption 6th Edition recognises that, during extreme wet weather, the capacity of surface water sewers may be inadequate.

Sewers for Adoption 6th Edition requires that the site layout should be such that internal property flooding does not result, by demonstrating safe above ground flow paths.

The return period for this analysis is not specified, but it is recommended that 1% annual probability event (i.e. an event with a return period of 100 years) is used.

5. Flood Flows

Runoff up to the 1 in 100 year return period should preferably be managed within the site at designated temporary storage locations unless it can be shown to have no material impact by leaving the site in terms of nuisance or damage, or increase river flow during periods of fluvial flooding. Analysis for overland flood flows within the site will need to use appropriate duration events which may be different to critical events for designing surface water control storage structures.

6. Surface Water Runoff Volume

Theoretically the surface water runoff volume from a site should be limited to the greenfield runoff volume for all event frequencies.

However this is technically extremely difficult to achieve and therefore compliance to two criteria on runoff volume is required.

a. Interception: Where possible, infiltration or other techniques are to be used to try and achieve zero discharge to receiving waters for rainfall depths up to 5mm.

b. Additional Runoff Due to Development: The difference in runoff volume pre- and post-development for the 100 year 6 hour event, (the additional runoff generated) should be disposed of by way of infiltration, or if this is not feasible due to soil type, discharged from the site at flow rates below 2 l/s/ha, unless Point 9 (See below) is applicable to the development.

7. Climate Change

In accordance with Table 5 of the Technical Guidance for the NPPF (2012), a 20% increase to rainfall intensities should be applied for development with a lifetime up to 2085; and 30% for development with a prospective lifetime beyond this date.

Residential development is generally expected to have a design life of 100 years; and as such an additional 30% must be applied within the drainage design for the proposed development situated at Granny Lane, Lower Hopton.

8. Minimum Limit of Discharge Rate

A practicable minimum limit on the discharge rate from a flow attenuation device is often a compromise between attenuating to a satisfactorily low flow rate while keeping the risk of blockage to an acceptable level.

This limit is set to a minimum of 5l/s, using an appropriate vortex or other flow control device.

Where sedimentation could be an issue, the minimum size of orifice for controlling flow from an attenuation device should normally be 150mm laid at a gradient not flatter than 1 in 150, which meets the requirements of Sewers for Adoption 6th Edition.

6.3.9 Attenuation Requirements

Following development the impermeable area of the site will be increased to approximately 414m² which equates to 46% of the total site area.

Using the Quick Storage function of Microdrainage Windes, indicative surface water attenuation volumes for the 1 in 1 year, 1 in 30 year and 1 in 100 year events have been calculated, with the results tabulated below.

In addition 20% and 40% has been added to account for climate change over the lifetime of the development and the maximum discharge rate used is 5l/s in order to reduce the risk of blockage.

Table 8: Indicative Attenuation Volume: Proposed Development (0.041 Ha Imp.)

Return Period	Max Discharge Rate (l/s)	Indicative Attenuation Volume (m³)
1 in 1 year + 20% CC	5.0	0.0 – 1.5
1 in 1 year + 40% CC	5.0	0.0 – 2.0
1 in 30 year + 20% CC	5.0	2.4 – 7.0
1 in 30 year + 40% CC	5.0	3.6 – 8.9
1 in 100 year + 20% CC	5.0	4.6 – 11.0
1 in 100 year + 40% CC	5.0	6.3 – 13.0

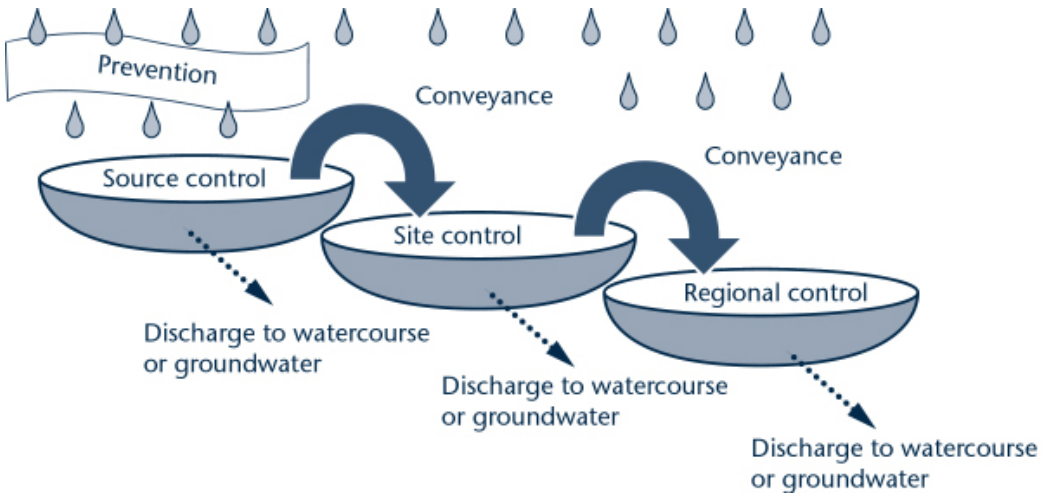
It is noted that the figures calculated above are indicative at this stage of the project, and must not be used for detailed design purposes.

6.3.10 Sustainable Urban Drainage Systems (SUDS)

In accordance with the Flood Water and Management Act 2010; there is a requirement to incorporate sustainable drainage systems i.e. SUDS into new development.

SUDS act to reduce the impact of surface water runoff from the development by limiting runoff volumes and rates from leaving the site.

Figure 6.3: Typical SUDS Train



Source: www.netregs.org.uk

Undertaking an assessment using the SUDS Planner Module within MicroDrainage Windes revealed that a number of different methods would be suitable for inclusion within the proposed drainage strategy for the development. A summary of the results is tabulated overleaf:

Table 9: SUDS Planner

SUDS Criteria	Rank 1	Rank 2	Rank 3
Hydrological	Pervious Pavements	Green Roofs	Infiltration Basin
Land Use	Online/Offline Storage	Wet Ponds	Stormwater Wetlands
Site Features	Pervious Pavements	Green Roofs	Online/Offline Storage
Community & Environment	Stormwater Wetlands	Wet Ponds	Bioretention Areas
Economics & Maintenance	Wet Ponds	Dry Detention	Green Roofs
Total	**Pervious Pavements**	**Wet Ponds**	**Online/Offline Storage**

It is noted that the precise combination of methods used will be dependent upon the site constraints identified at the final design stage.

A copy of the SUDS Planner is provided for reference within Appendix G.

1. Source Control

The inclusion of source control in SUDS schemes is one of the more important principles of SUDS design, and source control components should be upstream of any pond, wetland or other SUDS component.

Source control can help provide interception storage which can handle and treat some of the more frequent but smaller, polluting events (at least 5mm).

Most source control components will be located within the private properties or highway areas. Their purpose is to manage rainfall close to where it falls, not allowing it to become a problem elsewhere.

The main types of source control include:

- Green roofs
- Rainwater harvesting
- Permeable paving
- Other permeable surfaces

Source control methods look to maximize permeability within a site to promote attenuation, treatment and infiltration, thereby reducing the need for off-site conveyance.

a) Green Roofs

Green roof solutions generally comprise of a multi-layered system that covers the roof of a building with vegetation cover, and/or landscaping over a drainage layer.

They are designed to intercept and retain rainfall thereby reducing the volume and attenuating peak surface water flows.

Green roofs achieve this by increasing the amount of ground and vegetation cover on roofs, which increases storage, attenuation and evapotranspiration helping manage flows as well as providing other benefits like thermal comfort, and biodiversity etc…

b) Rainwater Harvesting

Rainwater harvesting provides a source of non-potable water, for purposes such as car washing; and landscaped area etc…

This SUDS solution, like green roof technology, is also designed to provide interception storage i.e. acts to reduce the volume of surface water leaving the proposed development; thereby helping to alleviate the current pressures on the receiving watercourse.

2. Permeable Paving

Pervious surfaces can be either porous or permeable. The important distinction between the two is:

Porous surfacing is a surface that infiltrates water across the entire surface. Permeable surfacing is formed of material that is itself impervious to water but, by virtue of voids formed through the surface, allows infiltration through the pattern of voids.

Pervious surfaces provide a surface suitable for pedestrian and/or vehicular traffic, while allowing rainwater to infiltrate through the surface and into underlying layers.

The water can be temporarily stored before infiltration to the ground, reused, or discharged to a watercourse or other drainage system. Surfaces with an aggregate sub-base can provide good water quality treatment.

3. Online/Offline Storage

Online/offline storage is a traditional form of surface water attenuation and may be provided via structures such as oversized pipes; or shallow attenuation structures such as geo-cellular crate systems e.g. Hydro-International's Stormcell System or similar. These structures may be easily placed within either hardstanding or landscaped areas to provide ease of access for maintenance purposes; and can be designed to facilitate infiltration.

6.3.11 Residual Flood Risk

The proposed drainage system should be designed such that attenuation will be provided to accommodate surface water runoff for storms with a return period of up to the 1 in 100 year plus climate change event incorporating an additional 30% to accommodate climate change over the lifetime of the development; in accordance with the Environment Agency's requirements.

Within the on-site drainage system however, the 1 in 100 year plus climate change event is allowed to flood at surface level within the development. However it is highlighted that the resulting flood water must be retained within the site; and will not be allowed to inundate property within the development; or migrate beyond the boundary of the site, thereby increasing flood risk elsewhere.

6.4 Outline Drainage Strategy

6.4.1 Preliminary Drainage Design

It is good engineering practice to design drainage systems in accordance with Sewers for Adoption 6th Edition; Building Regulations Approved Document H and other statutory requirements, as appropriate.

The impermeable area of the development site is set to increase from 165m² (19% of the total site area) to 414m² (46% of the total site area).

6.4.2 Layout

The purpose of this assessment is to demonstrate that a surface water drainage strategy is feasible for the development proposals and land available.

If it is deemed that infiltration via soakaway is not a viable option at the development site then the most appropriate point of connection is to connect to the surface water sewer within Granny Lane located approximately 37m west of the development site.

Flows into the surface water sewer will be restricted to the existing runoff rates or 5l/s whichever is the highest using a flow control; excess flows must be attenuated within the new drainage system prior to discharge into the channel.

A preliminary drainage layout has been devised for the development, which is provided for reference within Appendix I of this report.

The preliminary drainage plan indicates that permeable paving with a subbase of 350mm and area of 150m² within the shared driveway of the proposed dwellings could provide sufficient attenuation prior to discharge into the surface water sewer within Granny Lane.

It is noted however that the final decisions relating to surface water attenuation structures; permeable paving, rainwater harvesting and/or green roofs will be made during the detailed design stage.

6.4.3 Foul Drainage

Sewer records obtained from Yorkshire Water indicates the presence of a combined sewer located to the west of the development site near the north western corner of the site which flows in a northerly direction towards another combined sewer comprised of a 450mm diameter vitrified clay pipe which flows in an easterly direction within Granny Lane.

It is proposed that foul from the development site is discharged into the combined sewer located to the west of the development site via a new connection.

6.4.4 Maintenance

For drainage elements such as open attenuation structures or ponds, the Developer will maintain overall responsibility for inspection and maintenance, and as such it is recommended that a contract to undertake such works on a regular basis with a suitably qualified professional is set up and put into practice on completion of the project.

An indication of the level and schedule for maintenance of individual drainage assets which should be undertaken is provided below, however during the detailed design stage a

thorough Maintenance Plan should be constructed using guidance from CIRIA RP992 The SUDS Manual.

Permeable Paving

With permeable paving systems, the top 15-25mm of the voids has a tendency to self-seal with washed-in organic matter, muds and silts. This phenomenon obviously reduces the potential drainage capacity within the system.

It is estimated that a reduction in the potential drainage capacity of a permeable pavement to around 10%, however tests show the actual reduction does seem to stabilise in a period of 3-6 years to a value between 10% and 20%.

Regular jet-washing of the surface can be used to keep joints and voids clear, but it is an expensive and labour-intensive operation, so designs tend to assume that silting and reduction in capability will take place over time.

Porous systems may require periodic jetting or brushing to unclog blocked pores and so maintain system performance. The required frequency of jet-washing will be determined by local conditions. It has been shown that regular jetting can unclog around 80% of the original voids within the porous structure.

7.0 Mitigation Measures

7.1 Finished Development Levels

A review of the Environment Agency Flood Map for planning indicates that the proposed residential dwellings are located within Flood Zone 1. As such in accordance with building regulations it is proposed that the finished floor level of the dwellings are set 150mm above existing ground levels.

7.2 Access and Egress

In accordance with the requirements set out within the National Planning Policy Framework, it is essential to ensure that the route into and out of the application site will not present a danger to people during a flood event.

The Environment Agency Flood Map indicates that the access route into and out of the site is situated within Flood Zone 2 and as such is likely to remain dry during the 1 in 100 year plus climate change flood event and experience flooding during the 1 in 1000 year event.

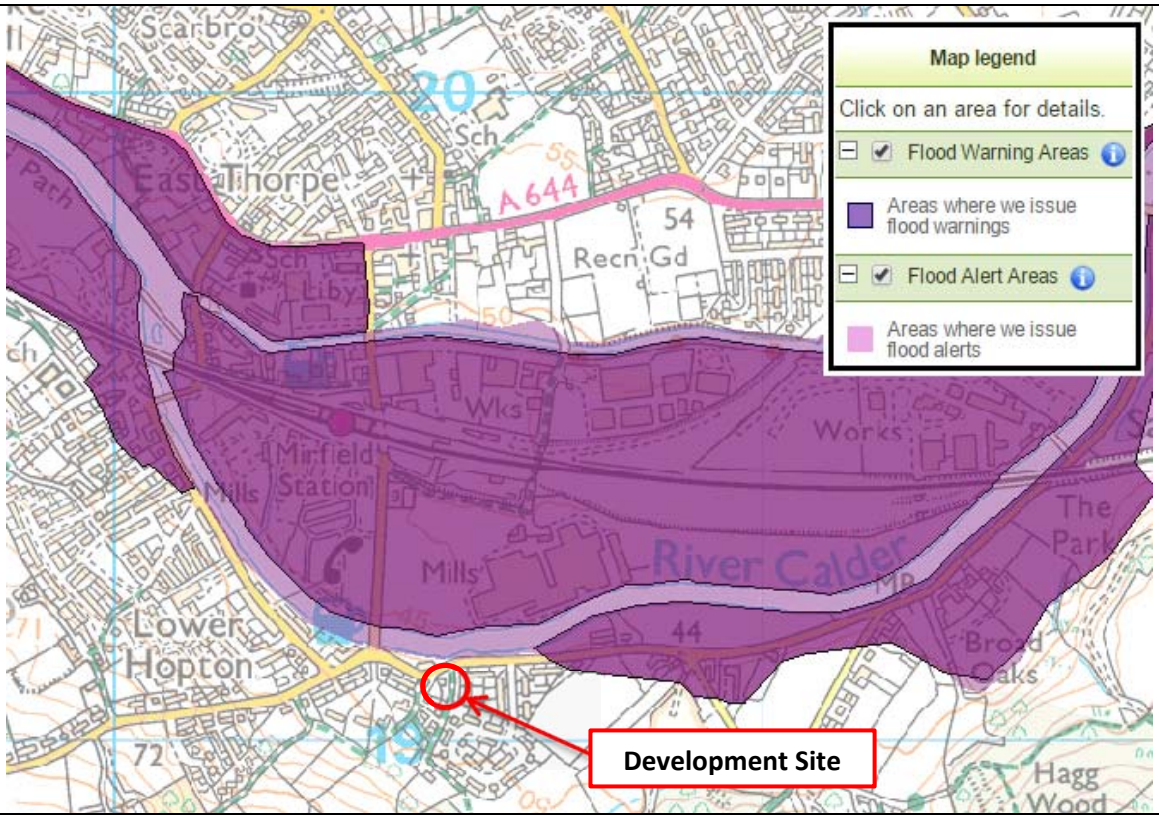
Consequently, it is anticipated that currently dry access and egress from the development site is available from the existing entrance/exit to the site from Granny Lane during the 1 in 100 year plus climate change event but not the extreme 1 in 1000 year event.

7.3 Flood Alerts

The development site at 18 Granny Lane, Lower Hopton is not located within the Environment Agency's flood alert area.

Due to the location of the site partially within Flood Zone 2, it is considered prudent that the residents of the proposed residential development register an interest to sign up to receive flood alerts.

Figure 7.1: Environment Agency Flood Alert Map



Source: www.environment-agency.co.uk

8.0 Conclusions & Recommendations

The proposed development at 18 Granny Lane, Lower Hopton comprises the demolition of existing residential building to create two new residential dwellings.

The Environment Agency Flood Map indicates that the proposed development site is located partially within Flood Zone 2, and as such is considered to have a low to medium flood risk from fluvial flooding.

The primary source of flood risk to the development site is identified to be from the River Calder which is located approximately 23m north of the development site at its nearest location.

Modelled flood data from the Environment Agency have not yet been received however following receipt of this information a detailed assessment of flood levels against site levels will be conducted to quantify the risk of flooding at the development site.

Existing runoff rates have been calculated using the Modified Rational Method for the 1 in 2 year, 1 in 30 year and 1 in 100 year return periods calculated flows are 0.6l/s, 1.8l/s and 2.7l/s respectively.

In accordance with the National Planning Policy Framework, surface water from the new development should be carefully managed; and Approved Document H of the current Building Regulations sets out a hierarchy for disposal of surface water from new development, in the following order of preference:

- Infiltration via soakaway or other infiltration device
- Watercourse
- Sewer

Investigations suggest that infiltration at the development site may be a viable solution for discharge of surface water and therefore it is recommended that during the detailed design stage, percolation tests are carried out in accordance with BRE Digest 365 to ascertain the suitability for soakaways and obtain design infiltration rates.

If infiltration at the development site is considered unviable then the next method to be investigated is discharge to watercourse. The nearest watercourse to the site is the River Calder located approximately 23m north of the development site however it is not considered that discharge to watercourse is a viable option due to the distances involved and the requirement to use 3rd party land.

As such it is considered that surface water from the development site is discharged into a surface water sewer located approximately 37m west of the development site.

The impermeable footprint of the development site will increase from a predevelopment area of approximately 165m^2 to a post development area of 448m^2.

Using the Quick Storage function of Microdrainage indicative attenuation volumes have been calculated for the 1 in 1 year plus climate change, 1 in 30 year plus climate change and 1 in 100 year plus climate change return periods using a discharge rate of 5l/s, the resulting volumes area 0.0 – 2.0m^3, 3.6 – 8.9m^3 and 6.3 – 13m^3 for the respective return periods.

The above volumes are indicative only at this stage of the development and it is recommended that the calculations are re-visited during the detailed design stage of the project to accommodate any changes to the development design and additional requirements made by the Statutory Consultees.

An evaluation of SUDS indicates that source control methods such as permeable paving or rainwater harvesting are suitable; along with wet ponds; for inclusion within the drainage strategy for the development site.

A preliminary drainage strategy has been developed with surface water from the development site directed towards permeable paving before discharging at restricted rates into the surface water sewer located approximately 37m west of the development site prior to discharge into the River Calder via an existing outfall.

Foul from the development site will be discharged either into the combined sewer which runs along the west of the development site or the combined sewer which runs along the course of Granny Lane.

It is proposed that permeable paving with a subbase depth of 350mm and area of 151m^2 would be sufficient to attenuate flows from the development site during the 1 in 100 year plus 30% climate change with a hydrobrake or similar orifice control device used to restrict the discharge rates to 5l/s.

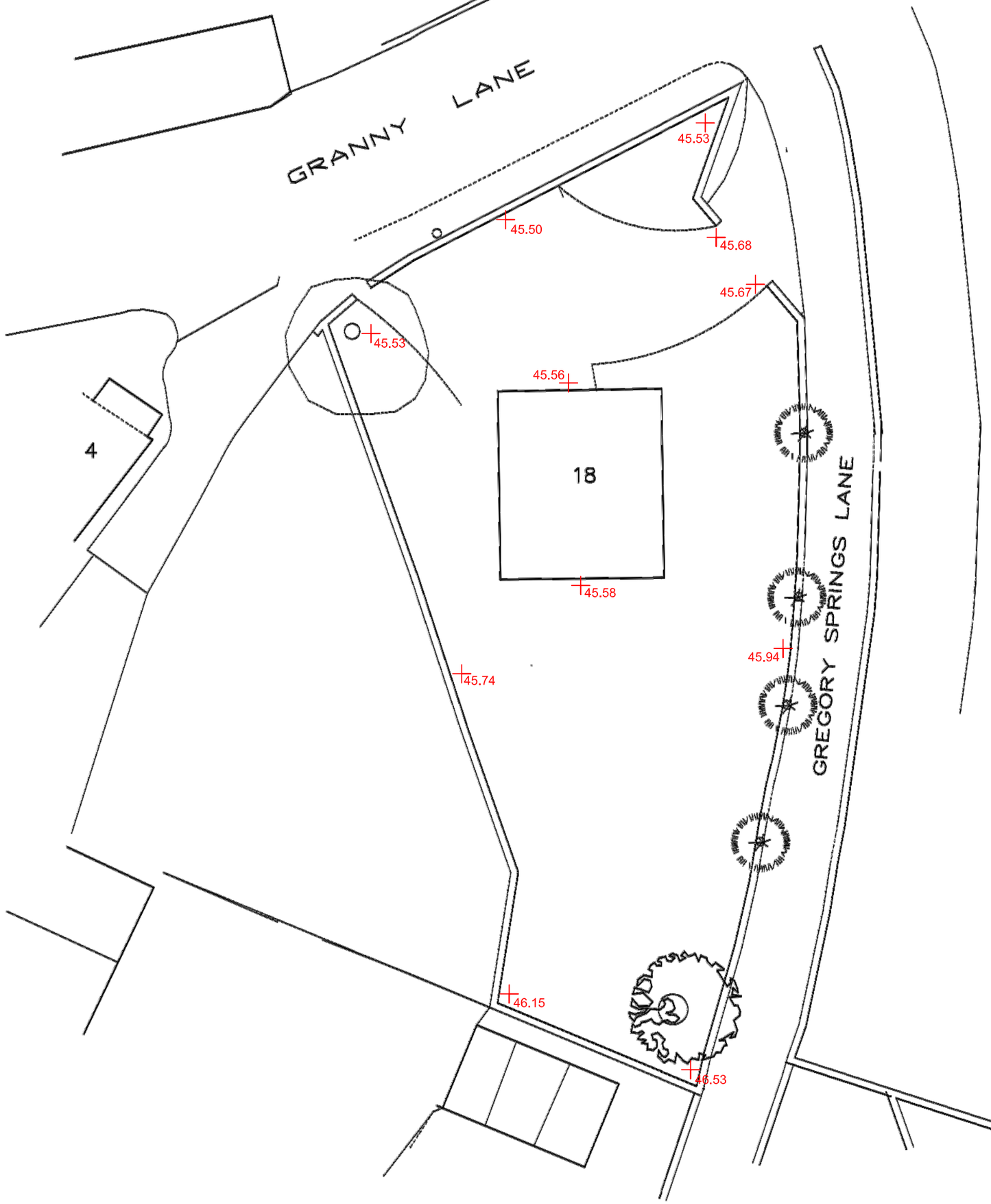
Secondary sources of flooding such as artificial water sources, overland flow, infrastructure failure, blockage and ponding have been investigated and are deemed to present a low risk of flooding at the proposed development site.

Recommended mitigation measures include:

- Finished threshold levels to be set 150mm above existing ground levels i.e. set to a level of approximately 45.71mAOD
- The residents/occupiers of the dwellings should register an interest in receiving Environment Agency Flood Alerts Direct Service.
- Surface water and foul drainage systems are to be designed in accordance with Building Regulations Approved Document H; Sewers for Adoption 6th Edition; the National Standards for SUDS (2011); CIRIA C753 The SUDS Manual; and any other statutory requirements.
- SUDS to be incorporated into the final drainage strategy for the development to provide interception storage, attenuation and treatment of flows.
- Surface water runoff to be retained within the drainage system during the 1 in 1 year event; able to surcharge but not flood during the 1 in 30 year event; and is able to flood the surface, but must not inundate buildings both on or off site during the 1 in 100 tear plus climate change event.

APPENDICES

Appendix A: - Site Level Survey



NORTH

MALLALIEU RCHITECTS

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EMLEY. HUDDERSFIELD. HD8 9SU.

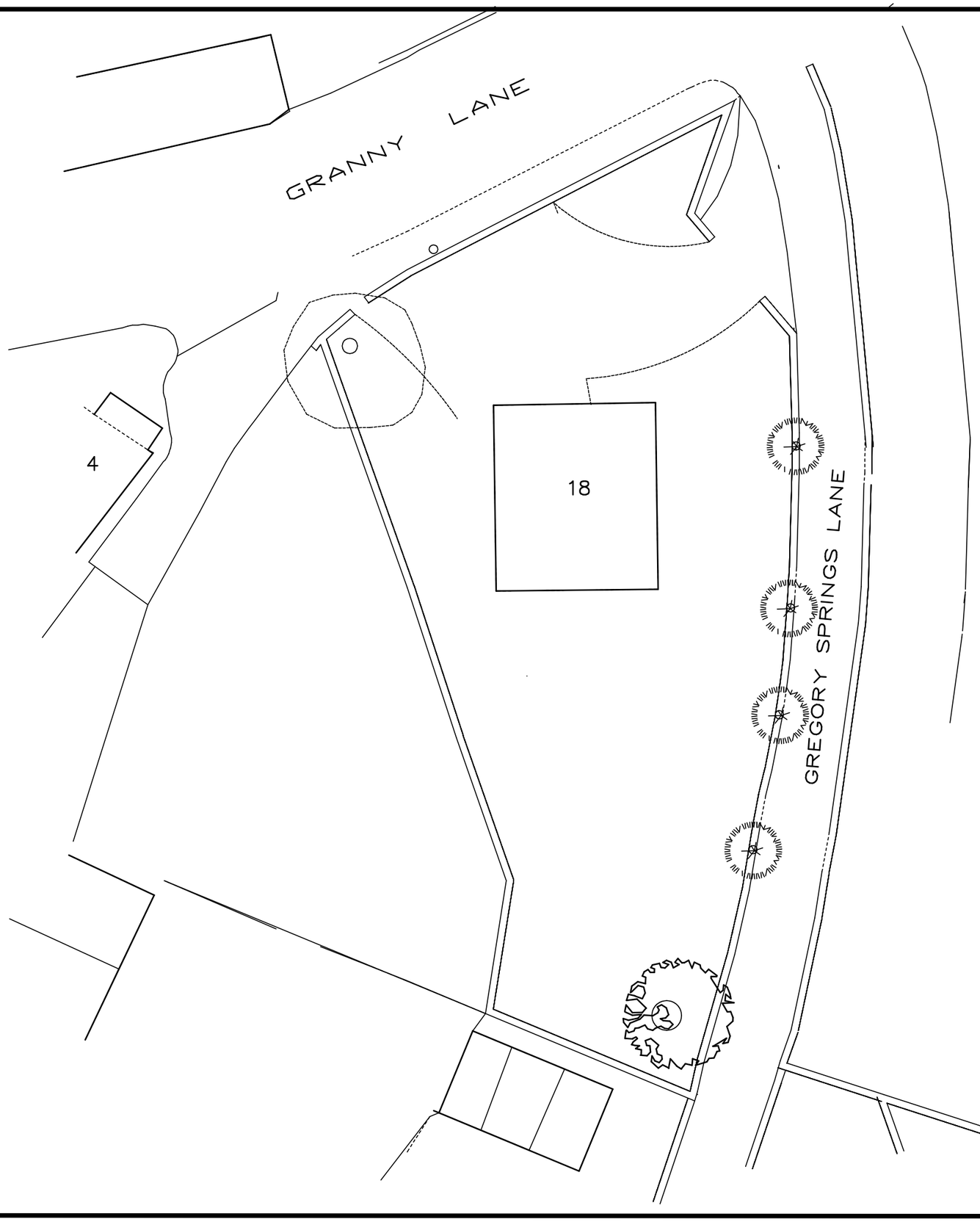
01924 848334
07971 041016

JOB TITLE
MRS BURROWS
18, GRANNY LANE,
LOWER HOPTON
MIRFIELD WF14 8LA

RESIDENTIAL DEVELOPMENT

DRAWING	NUMBER
SITE AS EXISTING	3080/1
SCALE	DATE
1: 250	DECEMBER 2015

Appendix B: - Existing and Proposed Development Plans



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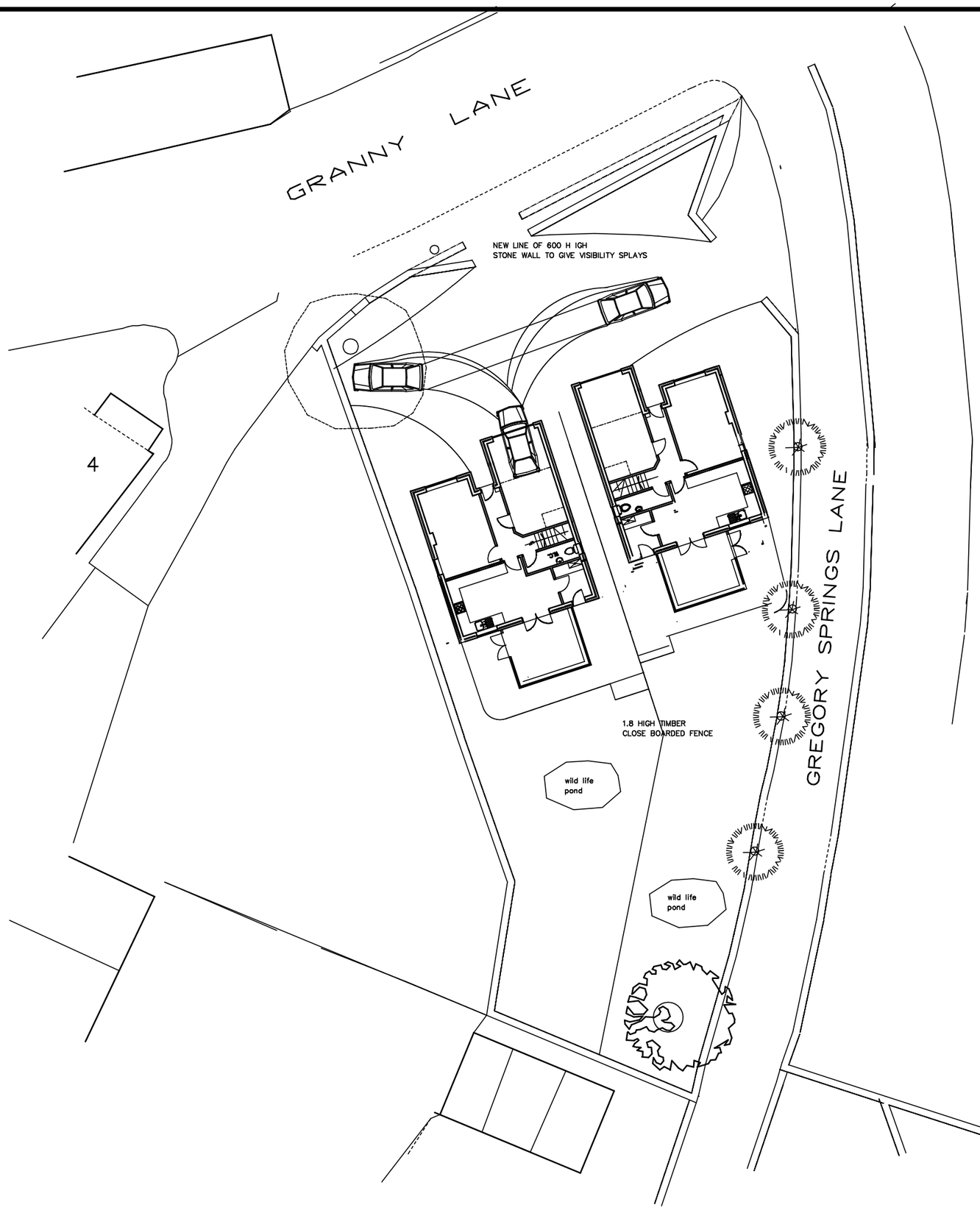
RESIDENTIAL DEVELOPMENT

DRAWING	NUMBER
SITE AS EXISTING	3080/1
SCALE: 1:250	DATE: DECEMBER 2015



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RESIDENTIAL DEVELOPMENT

DRAWING	NUMBER
SITE AS PROPOSED	3080/2
SCALE: 1:250	DATE: DECEMBER 2015

Appendix C: -Environment Agency Data

Appendix D: - Existing Discharge Rates – Modified Rational Method

Modified Rational Method

Length (m)	24	m
Area (ha)	0.017	Ha
Max Height	45.9	mAOD
Min Height	45.7	mAOD
DeltaH	0.2	
Slope (%)	0.83	
Te (mins)	11.94	mins
ARF	0.999	
SAAR	1174.000	mm
UCWI	124.8	mm
PIMP	100.0	%
SOIL	0.31	
Percentage Runoff PR	79.68	
DEEPSTOR	0.77	

Cv	0.796844
Cr	1.3

Peak 1 in 2 yr runoff	0.6	l/s

Return Period	flood	2	years
Pre Development	Rainfall	2	years

Rainfall Duration (hours)	Rainfall Duration (days)	Rainfall Depth (mm)	Effective Depth (mm)	Rainfall Intensity (mm/hr)	FLOW (l/s)	FLOW (l/s/ha)
0.199	0.008	2.71	2.808	13.623	0.647	39.232
0.250	0.010	3.36	3.481	13.440	0.639	38.704
0.500	0.021	5.72	5.925	11.440	0.544	32.945
0.750	0.031	7.44	7.707	9.920	0.471	28.568
1.000	0.042	8.84	9.157	8.840	0.420	25.457
1.250	0.052	10.05	10.411	8.040	0.382	23.154
1.500	0.063	11.11	11.509	7.407	0.352	21.330
1.750	0.073	12.08	12.514	6.903	0.328	19.879
2.000	0.083	12.96	13.425	6.480	0.308	18.661
2.250	0.094	13.78	14.275	6.124	0.291	17.637
2.500	0.104	14.55	15.072	5.820	0.277	16.760
2.750	0.115	15.27	15.818	5.553	0.264	15.991
3.000	0.125	15.96	16.533	5.320	0.253	15.321

Modified Rational Method

Length (m)	24	m
Area (ha)	0.017	Ha
Max Height	45.9	mAOD
Min Height	45.7	mAOD
DeltaH	0.2	
Slope (%)	0.83	
Te (mins)	11.94	mins
ARF	0.999	
SAAR	1174.000	mm
UCWI	124.8	mm
PIMP	100.0	%
SOIL	0.31	
Percentage Runoff PR	79.68	
DEEPSTOR	0.77	

Cv	0.796844
Cr	1.3

Peak 1 in 30 yr runoff	1.8	l/s

Return Period	flood	30	years
Pre Development	Rainfall	30	years

Rainfall Duration (hours)	Rainfall Duration (days)	Rainfall Depth (mm)	Effective Depth (mm)	Rainfall Intensity (mm/hr)	FLOW (l/s)	FLOW (l/s/ha)
0.199	0.008	7.7591	8.038	38.990	1.853	112.284
0.250	0.010	9.44	9.779	37.760	1.794	108.741
0.500	0.021	15.23	15.777	30.460	1.447	87.719
0.750	0.031	19.2	19.889	25.600	1.216	73.723
1.000	0.042	22.3	23.101	22.300	1.060	64.219
1.250	0.052	24.9	25.794	19.920	0.947	57.366
1.500	0.063	27.15	28.125	18.100	0.860	52.124
1.750	0.073	29.15	30.196	16.657	0.791	47.969
2.000	0.083	30.96	32.071	15.480	0.736	44.579
2.250	0.094	32.62	33.791	14.498	0.689	41.751
2.500	0.104	34.15	35.376	13.660	0.649	39.338
2.750	0.115	35.58	36.857	12.938	0.615	37.259
3.000	0.125	36.92	38.245	12.307	0.585	35.441

Modified Rational Method

Length (m)	24	m
Area (ha)	0.017	Ha
Max Height	45.9	mAOD
Min Height	45.7	mAOD
DeltaH	0.2	
Slope (%)	0.83	
Te (mins)	11.94	mins
ARF	0.999	
SAAR	1174.000	mm
UCWI	124.8	mm
PIMP	100.0	%
SOIL	0.31	
Percentage Runoff PR	79.68	
DEEPSTOR	0.77	
Cv	0.796844	
Cr	1.3	

Peak 1 in 100 yr runoff	2.7	l/s	

Return Period	flood	100	years
Pre Development	Rainfall	100	years

Rainfall Duration (hours)	Rainfall Duration (days)	Rainfall Depth (mm)	Effective Depth (mm)	Rainfall Intensity (mm/hr)	FLOW (l/s)	FLOW (l/s/ha)
0.199	0.008	11.8524	12.278	59.560	2.830	171.520
0.250	0.010	14.31	14.824	57.240	2.720	164.839
0.500	0.021	22.6	23.411	45.200	2.148	130.167
0.750	0.031	28.12	29.129	37.493	1.782	107.973
1.000	0.042	32.37	33.532	32.370	1.538	93.219
1.250	0.052	35.89	37.178	28.712	1.364	82.685
1.500	0.063	38.91	40.307	25.940	1.233	74.702
1.750	0.073	41.57	43.062	23.754	1.129	68.407
2.000	0.083	43.97	45.548	21.985	1.045	63.312
2.250	0.094	46.15	47.807	20.511	0.975	59.068
2.500	0.104	48.16	49.889	19.264	0.915	55.476
2.750	0.115	50.02	51.816	18.189	0.864	52.381
3.000	0.125	51.76	53.618	17.253	0.820	49.686

Appendix E: - Borehole Logs and Soilscapes Viewer

SE21NW107

LOCATION: HOPTON RIVER BRIDGE, MIRFIELD

BOREHOLE 4

Method Cable tool percussion 2041915

Date 22- 24.9.81

Casing 0.15m diameter to 10.8 metres.

Sheet 1 of 4

R.L. m A.O.D.	DEPTH m	SOIL DESCRIPTION	SAMPLING No.	SAMPLING Depth	TEST	RESULT
	G.L.					
	0.17	MADE GROUND comprising footpath construction				
	0.45	MADE GROUND comprising ash with some				
	0. 9	MADE GROUND comprising sandstone.				
		MADE GROUND comprising very loose slightly silty ashy sand with sandstone and mudstone fragments with traces of brick and coal.	B1	1.2-1.5		
			D2	1.5-1.95	N	3
			B3	2.0-2.6		
	2.9					
		Medium dense brown very silty fine SAND/sandy SILT with occasional sub-rounded and rounded gravel and cobbles.	B4	3.0-3.2		
			U5	3.35-3.8		
			D6	3.8		
			D7	3.8-4.25	N	12
		(Probably made ground)				
			B8	4.2-4.6		
			U9	4.65-5.1		
		Continued from 5.0 metres.				

SE29NW 107

LOCATION: HOPTON RIVER BRIDGE, MIRFIELD

BOREHOLE 4

Method

Date

Casing

Sheet 2 of 4

R.L. m A.O.D.	DEPTH m	SOIL DESCRIPTION	SAMPLING No.	SAMPLING Depth	TEST	RESULT
		Continued from 5.0 metres.				
		As above but becoming dense and clayey.	D10	5.15		
		(Probably made ground)	D11	5.2-5.65	N	50
	6.2	Dense brown slightly silty very sandy rounded GRAVEL and COBBLES with occasional boulders.				
			B12	7.0-7.5		
			D13	7.65-8.1	N	20
			B14	7.8-8.2		
			B15	8.5-8.8		
			D16	9.3-9.75	N	47
			B17	9.4-9.7		
		Continued from 10.0 metres.				

SE21NW 107

LOCATION: HOPTON RIVER BRIDGE, MIRFIELD

BOREHOLE 4

Method

Date

Casing

Sheet 3 of 4

R.L. m A.O.D.	DEPTH m	SOIL DESCRIPTION	SAMPLING No.	SAMPLING Depth	TEST	RESULT
		Continued from 10.0 metres.	B18	10.0–10.2		
		As above but less sandy	B19	10.5–10.8		
	10.9	Firm to stiff grey silty CLAY with fine mudstone gravel and traces of sand. Becoming stiff light grey friable very silty CLAY, tending to mudstone.	U20	10.9–11.35		
	11.3		D21	11.4		
	11.4	COAL	D22	11.4–11.85	N	102
		Extremely weak light grey MUDSTONE.				
	11.85					
		END OF BOREHOLE				

LOCATION: HOPTON RIVER BRIDGE, MIRFIELD

BOREHOLE 4

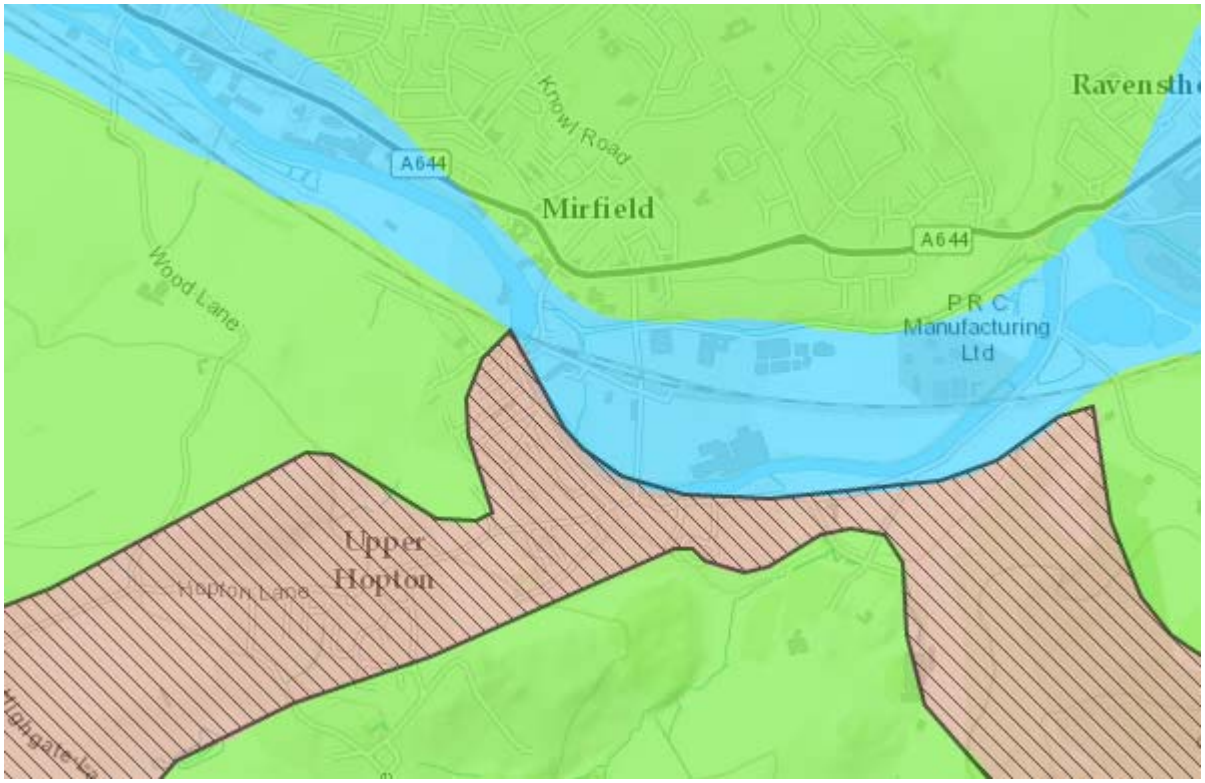
SE 21 NW 107

Sheet 4 of 4

WATER LEVEL OBSERVATIONS

Date	Time	Depth of Borehole m	Depth of Casing m	Depth to water m	Remarks
22.9.81		3.2	3.2	Dry	End of shift
23.9.81		3.2	3.2	Dry	Start of shift
"		6.2	4.6	6.2	Strike
"		10.2	10.0	6.0	End of shift
24.9.81		10.2	10.0	6.0	Start of shift

Soilscapes Viewer



Soilscape 6:
Freely draining slightly acid loamy soils

Texture:
Loamy

Coverage:
England: 15.5% Wales: 24.4%
England & Wales: 16.7%

Selected area:
371km^2

Drainage:
Freely draining

Fertility:
Low

Habitats:
Neutral and acid pastures and deciduous woodlands; acid communities such as bracken and gorse in the uplands

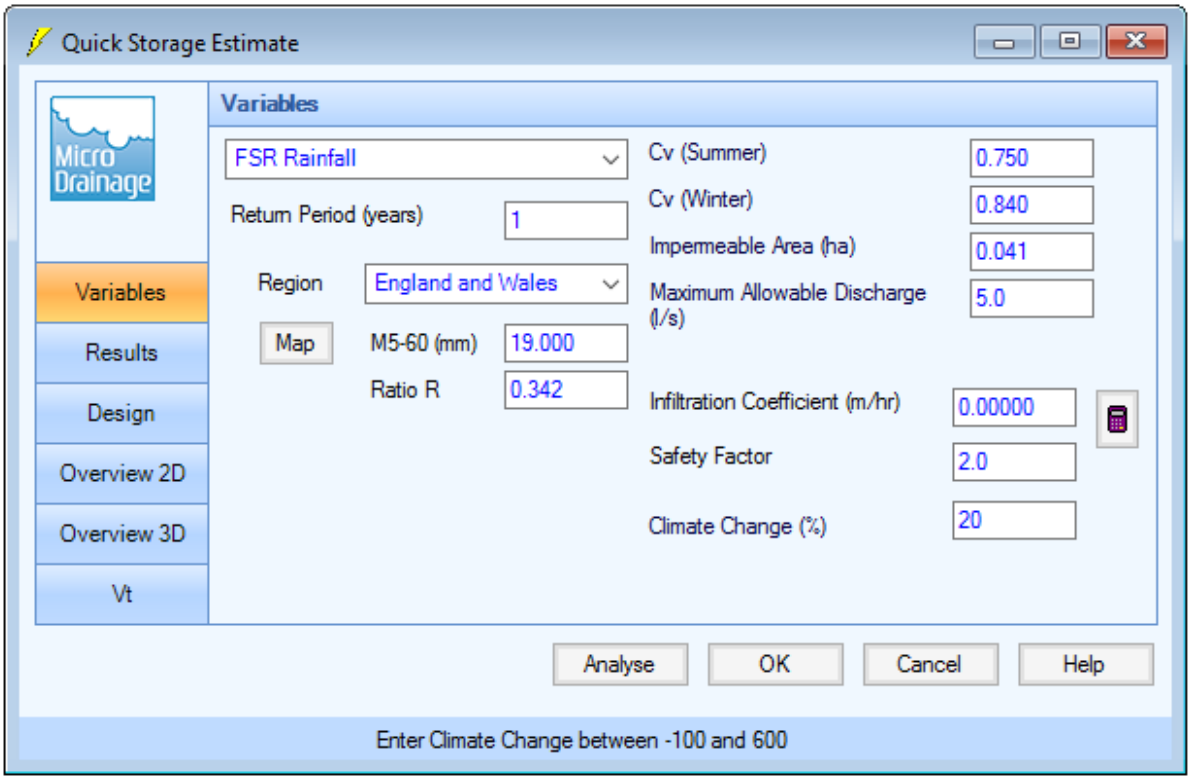
Landcover:
Arable and grassland

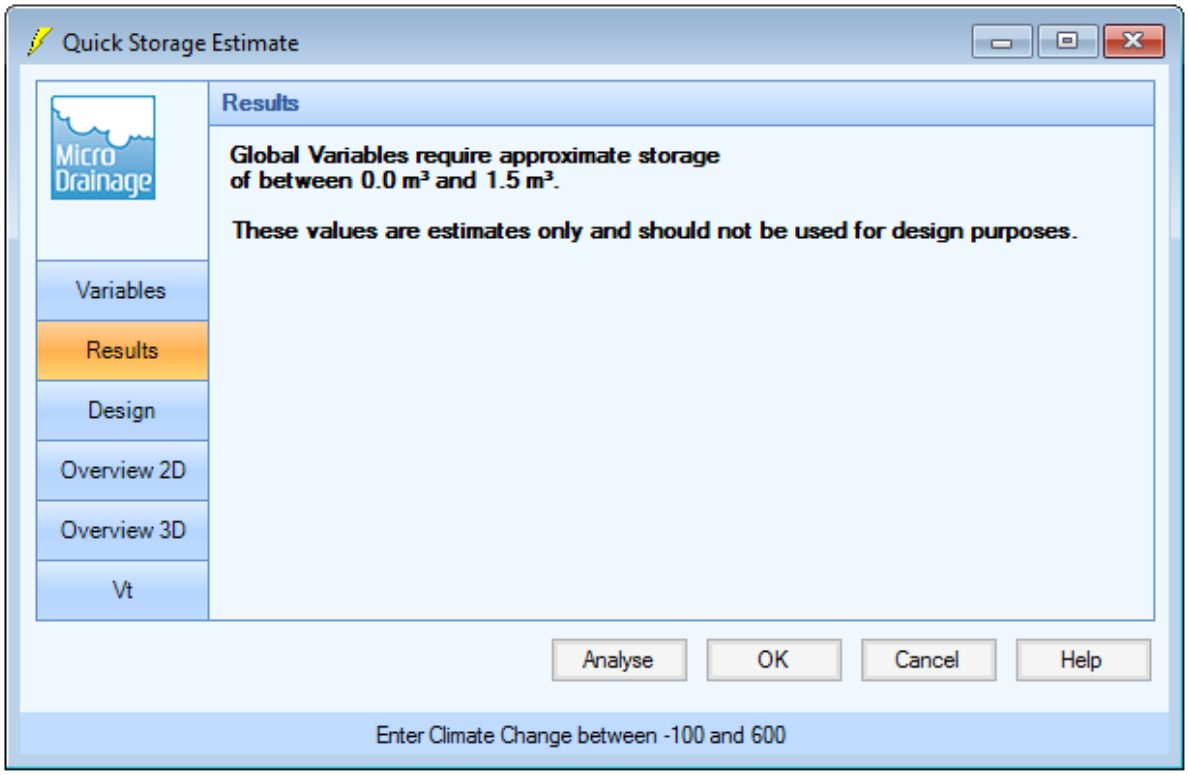
Carbon:
Low

Appendix F: - Indicative Attenuation Requirements

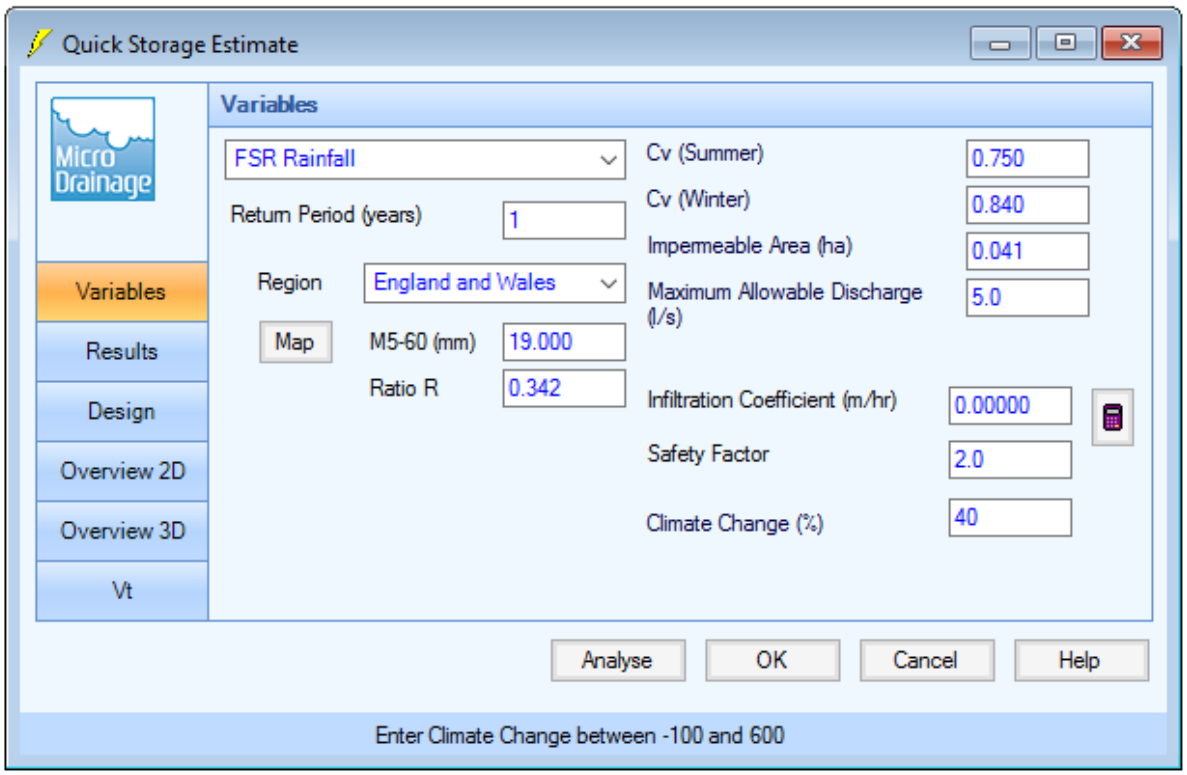
Indicative Attenuation Requirements

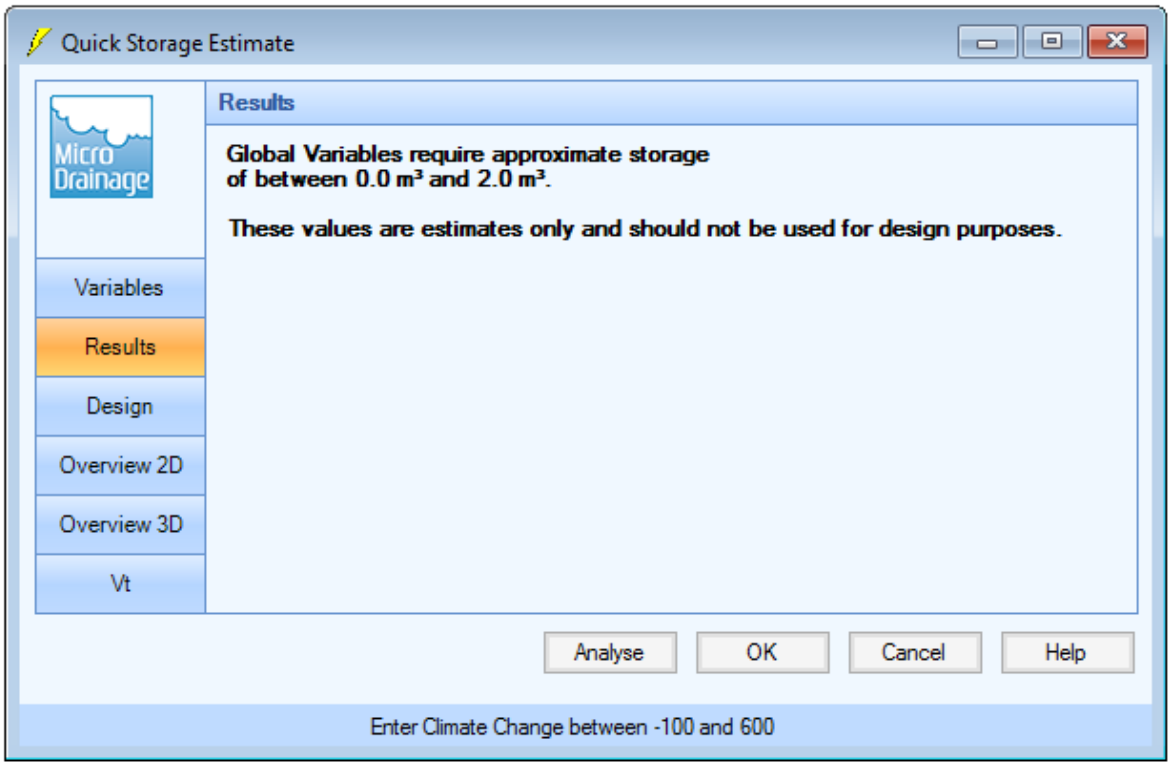
1 in 1 year + 20% Climate Change



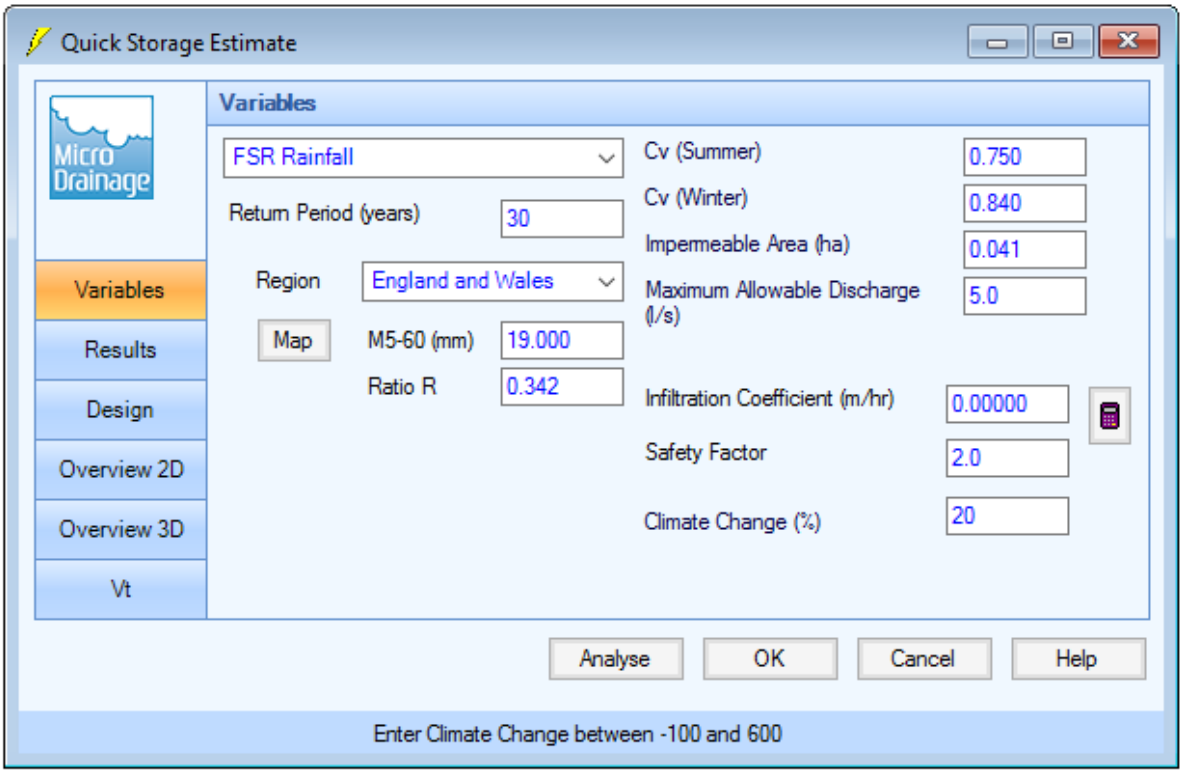


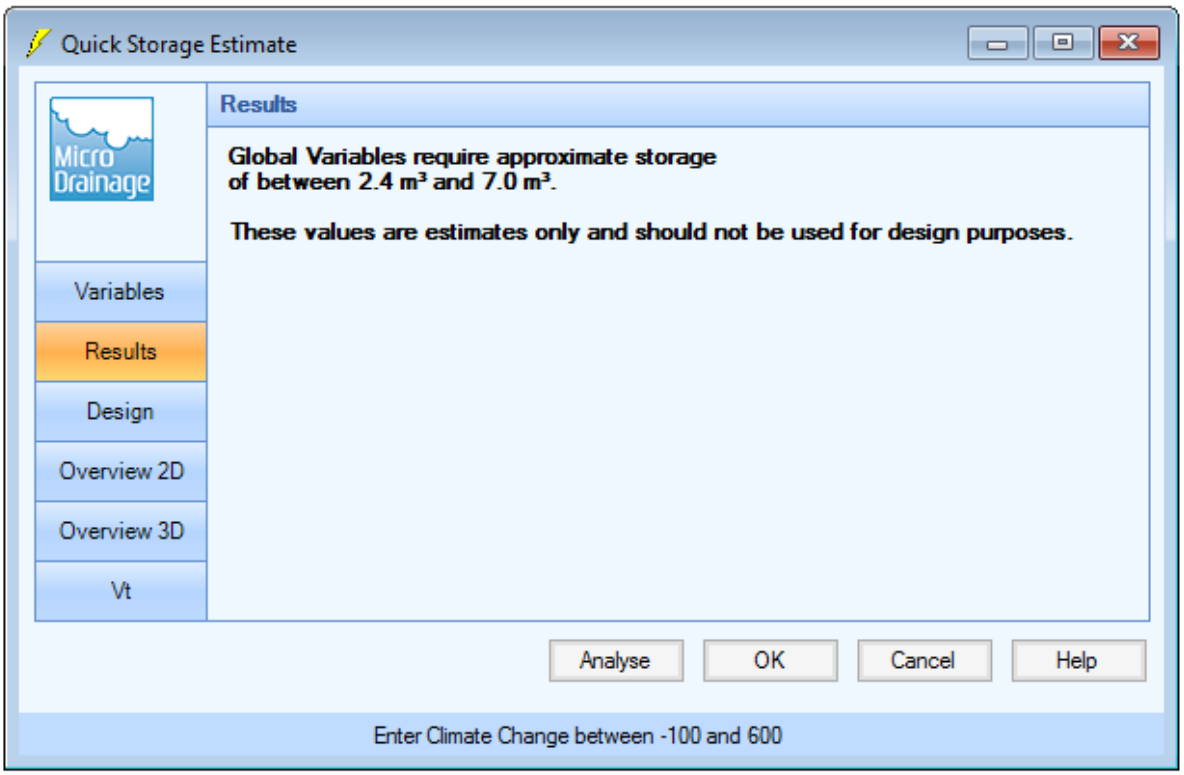
1 in 1 year + 40% Climate Change



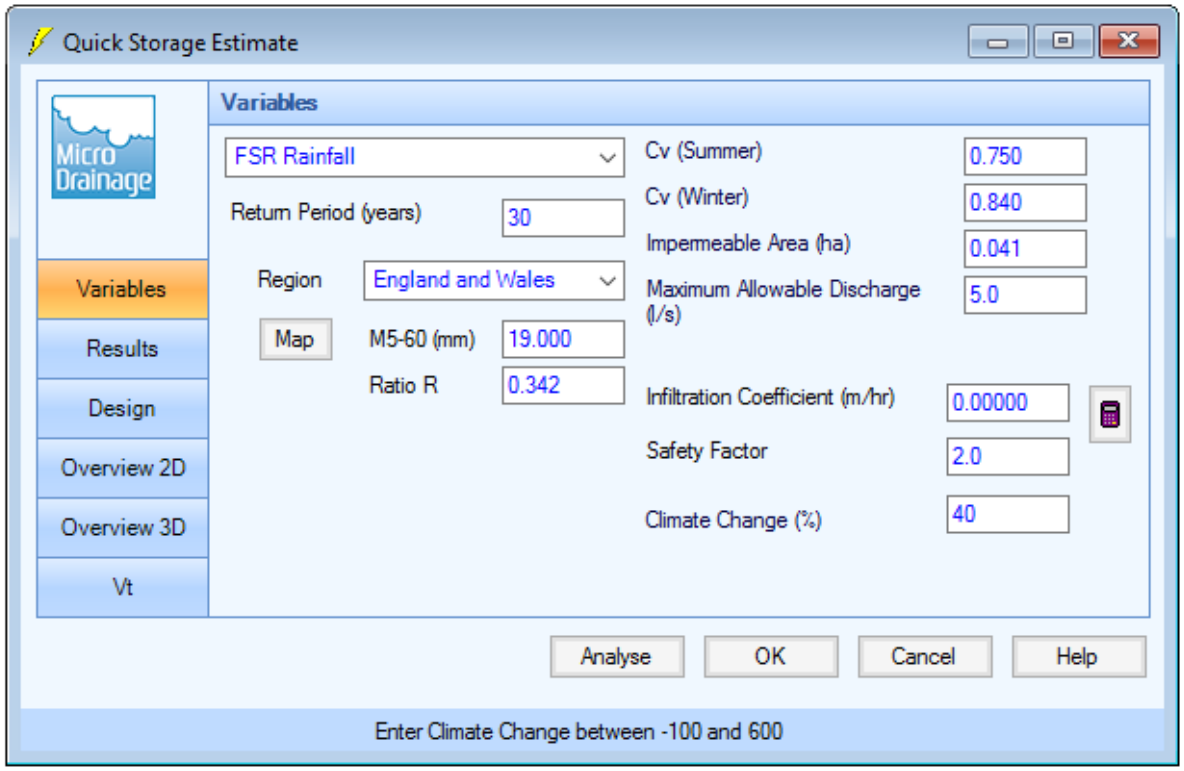


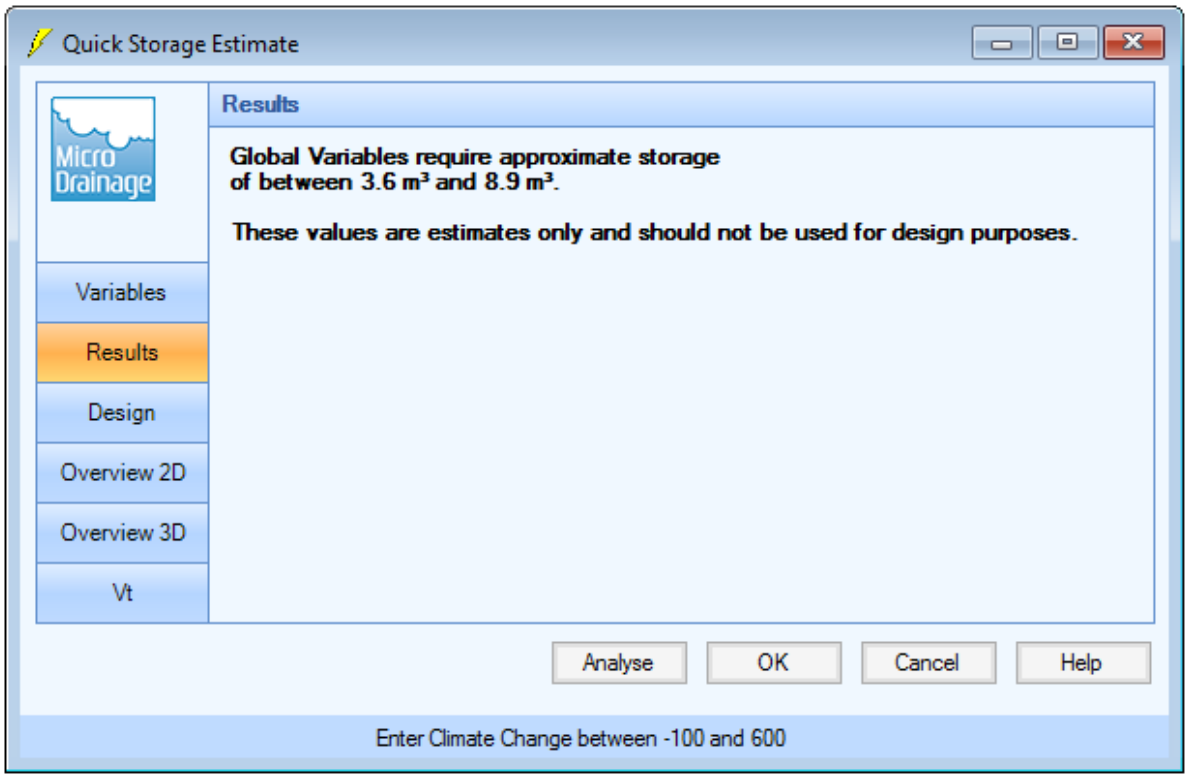
1 in 30 year + 20% Climate Change



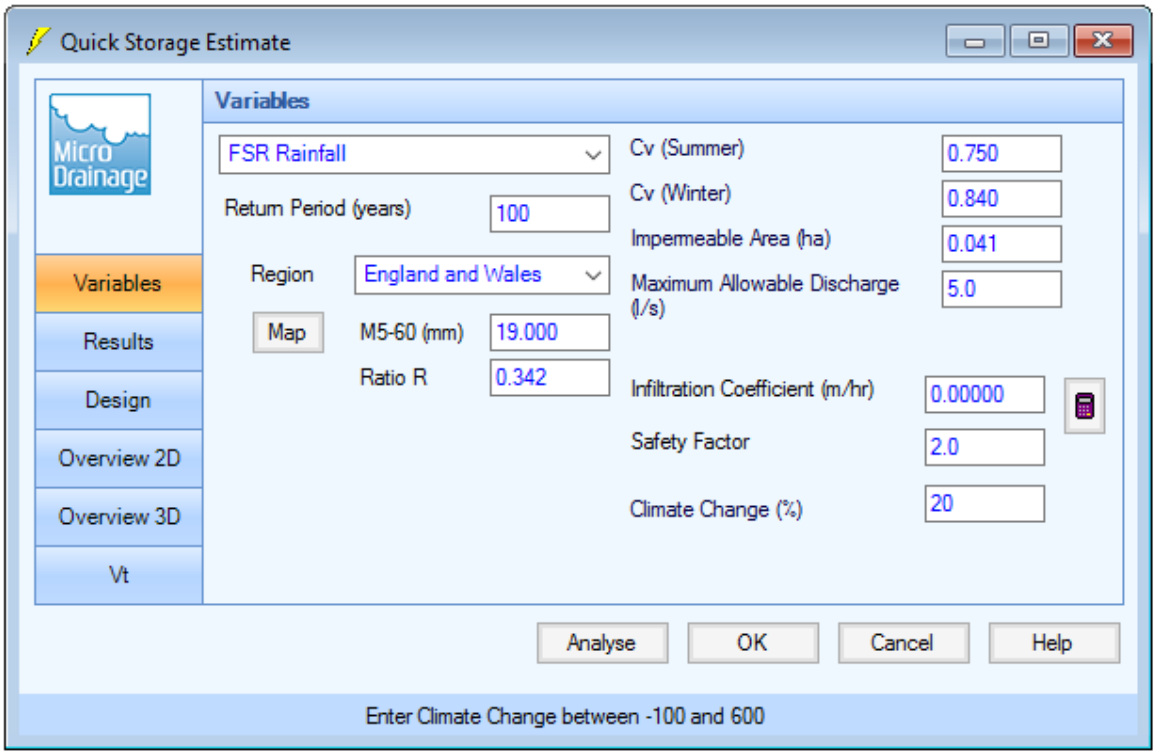


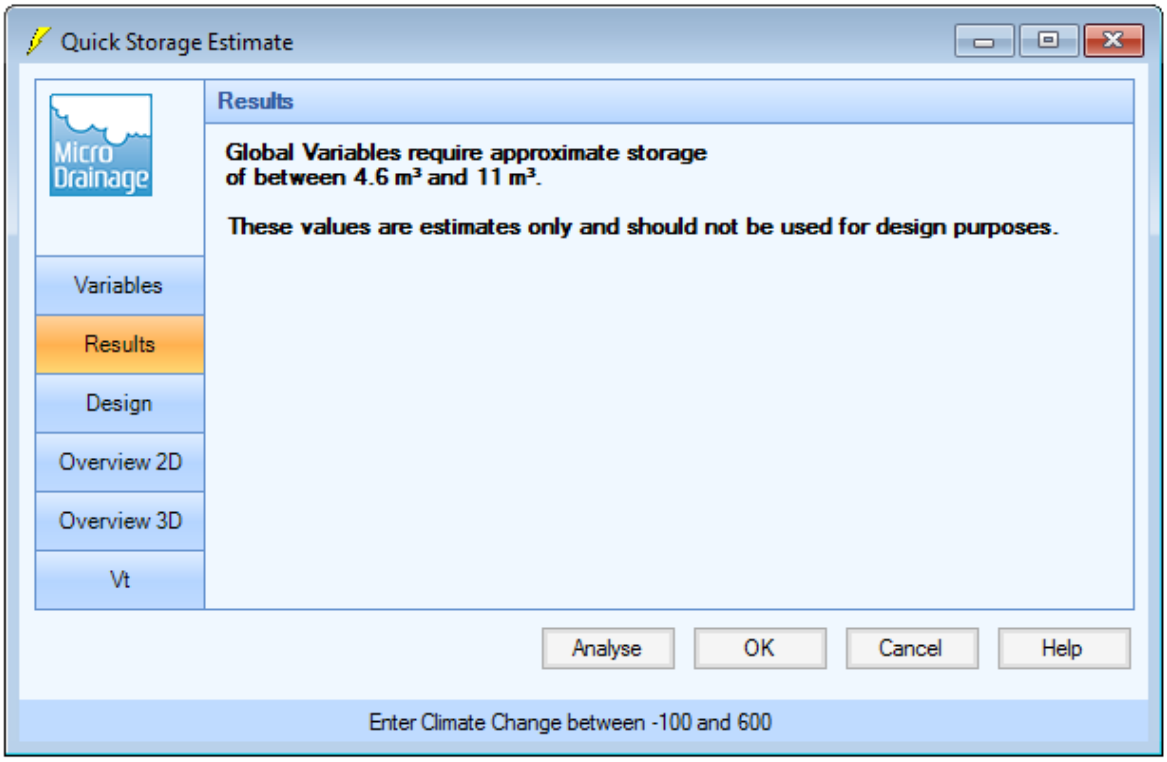
1 in 30 year + 40% Climate Change



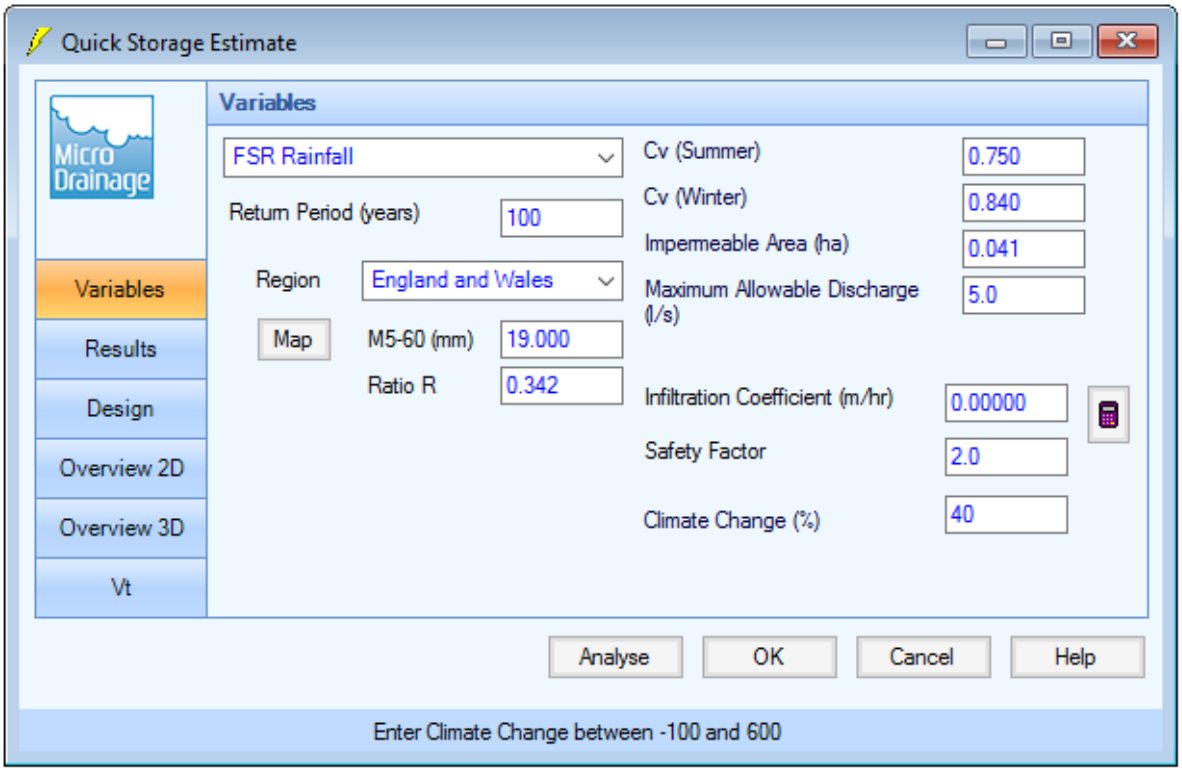


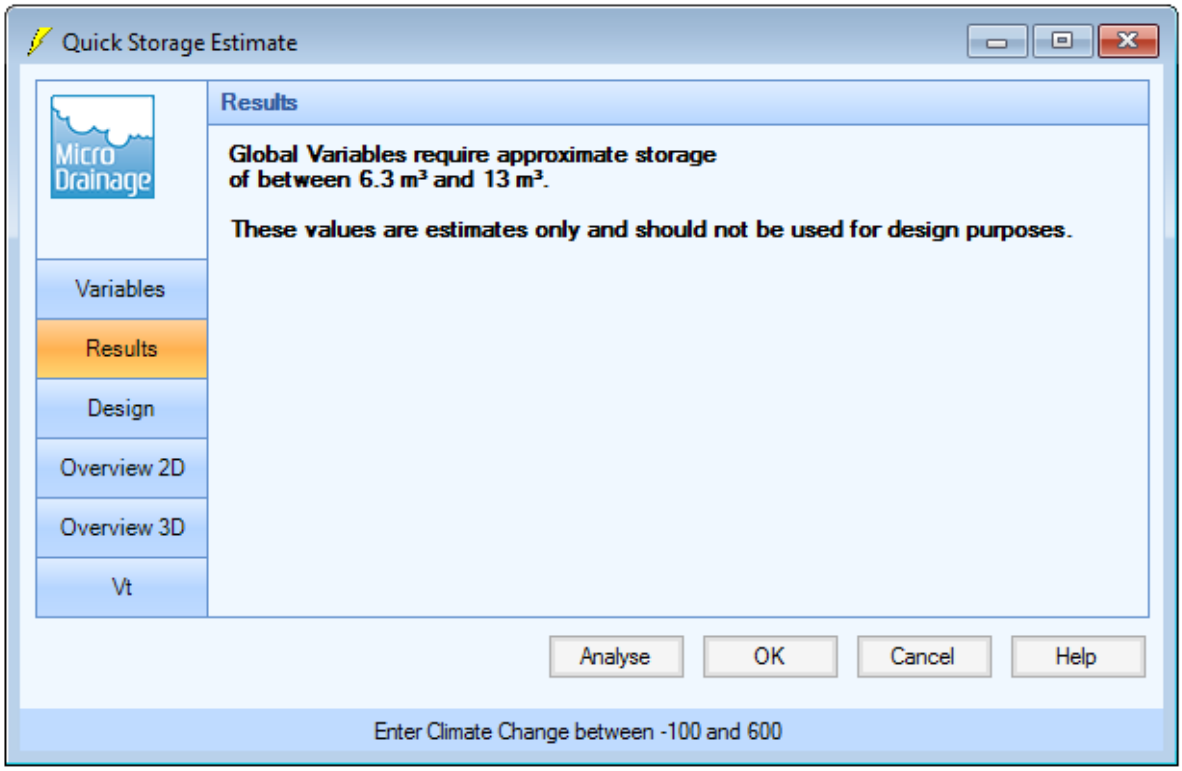
1 in 100 year + 20% Climate Change





1 in 100 year + 40% Climate Change





Appendix G: -SUDS Planner

SUDS Planner

Results

	Quick Rank View	Hydrological	Land Use	Site Features	Total	Community and Environment	Economics and Maintenance
Pervious Pavements	(1, 8, 5)	18 (1st)	9 (7th)	20 (1st)	47 (1st)	18 (8th)	22 (5th)
Green Roofs	(5, 5, 2)	17 (2nd)	7 (13th)	20 (1st)	44 (5th)	20 (5th)	24 (2nd)
Bioretention Area	(10, 3, 11)	11 (11th)	11 (5th)	12 (7th)	34 (10th)	23 (3rd)	18 (11th)
Filtration Techniques	(12, 8, 13)	10 (12th)	9 (7th)	12 (7th)	31 (12th)	18 (8th)	14 (13th)
Grassed Filter Strip	(13, 4, 2)	8 (13th)	8 (11th)	11 (11th)	27 (13th)	22 (4th)	24 (2nd)
Grassed Swales	(9, 6, 5)	15 (5th)	9 (7th)	11 (11th)	35 (9th)	19 (6th)	22 (5th)
Infiltration Trench / Soakaway	(7, 10, 8)	16 (3rd)	11 (5th)	12 (7th)	39 (7th)	17 (10th)	20 (8th)
Filter Drains	(11, 10, 11)	14 (7th)	8 (11th)	10 (13th)	32 (11th)	17 (10th)	18 (11th)
Infiltration Basin	(8, 13, 8)	16 (3rd)	9 (7th)	12 (7th)	37 (8th)	15 (13th)	20 (8th)
Dry Detention	(5, 10, 2)	13 (9th)	12 (2nd)	19 (4th)	44 (5th)	17 (10th)	24 (2nd)
Wet Ponds	(2, 2, 1)	15 (5th)	12 (2nd)	19 (4th)	46 (2nd)	28 (2nd)	26 (1st)
Stormwater Wetlands	(3, 1, 5)	14 (7th)	12 (2nd)	19 (4th)	45 (3rd)	30 (1st)	22 (5th)
Online / Offline Storage	(3, 6, 8)	12 (10th)	13 (1st)	20 (1st)	45 (3rd)	19 (6th)	20 (8th)

Appendix H: - Yorkshire Water Sewer Plans

YORKSHIRE WATER
PROTECTION OF MAINS AND SERVICES

1. The position of Yorkshire Water Services Ltd (YWS) apparatus shown on the existing mains record drawing(s) indicates the ***general*** position and nature of our apparatus and the accuracy of this information cannot be guaranteed. Any damage to YWS apparatus as a result of your works may have serious consequences and you will be held responsible for all costs incurred. Prior to commencing major works, the exact location of apparatus must be determined on site, if necessary by excavating trial holes. The actual position of such apparatus and that of service pipes which have not been indicated must be established on site by contacting the Customer Helpline on 0845 124 24 24 for both water and sewerage.

2. The public sewer and water network is lawfully retained in its existing position and the sewerage and water undertaker is entitled to have it remain so without any disturbance. The provisions of section 159 of the Water Industry Act 1991 provides that the undertaker may "inspect, maintain, adjust, repair or alter" the network. Those rights are given to enable the undertaker to perform its statutory duties. Any development of the land or any other action that unacceptably hindered the exercise of those rights would be unlawful. The provisions contained in Section 185 of the Water Industry Act 1991 state that where it is reasonable to do so, a person may require the water supply undertaker to alter or remove a pipe where it is necessary to enable that person to carry out a proposed change of use of the land. The provisions contained in Section 185 also require the person making the request to pay the full cost of carrying out the necessary works.

3. Ground levels over existing YWS apparatus are to be maintained. Sewers in highways will ***generally*** be laid to give 1200mm of cover from finished ground level working to kerb races, other permanent identification of the limits of the road or to an agreed line and level. Substantial increases or decreases to this 1200mm depth of cover will result in the sewer being re-laid at your expense. Water mains and services will ***generally*** be laid with a minimum of 750mm depth of cover however some mains and services usually those installed over 50 years ago may have less ground cover.

4. If surface levels are to be decreased / increased significantly the effects on existing water supply apparatus will be carefully considered and if any alterations are necessary, the costs of the alterations will be recharged to you in full. Outlets on fire hydrants must be no more than 300mm below the new levels and all surface boxes must be adjusted as part of the scheme.

5. To enable future repair works to be carried out without hindrance; any pipe, cable, duct, etc. installed parallel to a water main or service pipe should not be installed directly over or within 300mm of a water main or service pipe or 1000mm of a waste water asset. Where a pipe, cable, duct, etc. crosses a main or service it should preferably cross perpendicular or at an angle of no less than 45° and with a minimum clearance of 150mm. These requirements apply to activities within an existing highway and are relevant to the installation of pipes, cables, ducts, etc. up to and including 250mm in diameter *(see illustration below).* Necessary protection measures for installations greater than 250mm in diameter and/or in private land will need to be agreed on an individual basis. Installations within a new development site must comply with the National Joint Utilities Group publication Volume 2: NJUG Guidelines On The Positioning Of Underground Utilities Apparatus For New Development Sites.

6. All excavation works near to YW apparatus should be by hand digging only.

7. Backfilling with a suitable material to a minimum 300mm above YW apparatus is required.

8. Adequate support must be provided where any works pass under YW apparatus.

9. Jointing chambers, lighting columns and other structures must be installed in such a way that future repair or maintenance works to YW apparatus will not be hindered.

10. 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. YWS surface boxes must not be covered or buried. Any adjustment, alteration or replacement of manhole covers must be agreed on site prior to the commencement of the works with a YWS Inspector who may be contacted via our Call Centre on 0845 124 24 24.

11. Explosives shall not be used within 100 metres of any Yorkshire Water Services apparatus or installations.

12. Vibrating plant should not be used directly over any apparatus. Movement or operation by vehicles or heavy plant is not to be permitted in the immediate vicinity of YWS plant or apparatus unless there has been prior consultation and, if necessary, adequate protection provided without cost to YWS.

13. ***Under no circumstances*** should thrust boring or similar trenchless techniques commence until the actual position of the Company's mains/services along the proposed route have been confirmed by trial holes.

14. Any alterations to the highway should be notified following the procedures outlined in the New Road and Street Works Act 1991 Code of Practice; Measures Necessary Where Apparatus Is Affected By Major Works (Diversionary Works).

15. You will be held responsible for any damage or loss to YWS apparatus during and after completion of work, caused by yourselves, your servant or agent. Any damage caused or observed to YWS plant or apparatus should be immediately reported to YWS. Should YW incur any costs as a result of non-compliance with the above, all costs will be rechargeable in full.

16. You should ensure that nothing is done on the site to prejudice the safety or operation of YWS employees, plant or apparatus.

17. In accordance with the New Roads and Street Works Act 1991, Chapter 22, Part 3, Section 80. The location of any identified YW asset "*which is not marked, or is wrongly marked, on the records made available* " should be communicated back to Yorkshire Water. The location of the apparatus should be identified on copies of the supplied plans which should be returned to Yorkshire Water (Asset Records Team) with photographic supporting evidence where possible.

18. The Government has decided that responsibility for private sewers serving two or more properties and lateral drains (the section of pipe beyond the boundary of a single property, connecting it to the public sewer) will be transferred to the water companies on Oct 1 2011. Private pumping stations will also transfer during the period 1 October 2011 – 1 Oct 2016. Records of these assets may not yet be shown on the existing mains record drawing(s). If you encounter any of these assets you must inform Yorkshire Water Services Ltd (YWS).

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20. This information is for guidance only and the position and depth of any YW apparatus is approximate only. Likewise, the nature and condition of any YW apparatus cannot be guaranteed. YW has no responsibility for recording the locations of privately owned apparatus. As of 1 October 2011, there may be some lateral drains and/or public sewers which are not documented on YW records but may still be present. For the avoidance of doubt, this information is not a substitute for appropriate professional and/or legal advice. YW accepts no responsibility for any inaccuracy or omissions in this information. The actual position of YW apparatus must be determined on site by excavating trail holes by hand. YW requires a minimum of two working days' written notice of the intention to excavate any trial holes before any excavation can be undertaken. If there are any queries in this respect please contact Yorkshire Water on 0845 124 24 24.

Sewer Legend


Combined Sewer


S24 Combined Sewer


Surface Water Sewer


S24 Surface Water Sewer


Foul Sewer


S24 Foul Sewer


Section 104 Sewer

Public Rising Main


Pumping Station


Abandoned Sewer

Public Sewage
Treatment Works


Syphon Sewer &
Vacuum Sewer

\+ Property Identifier

Water Legend

Water Main 4" and below

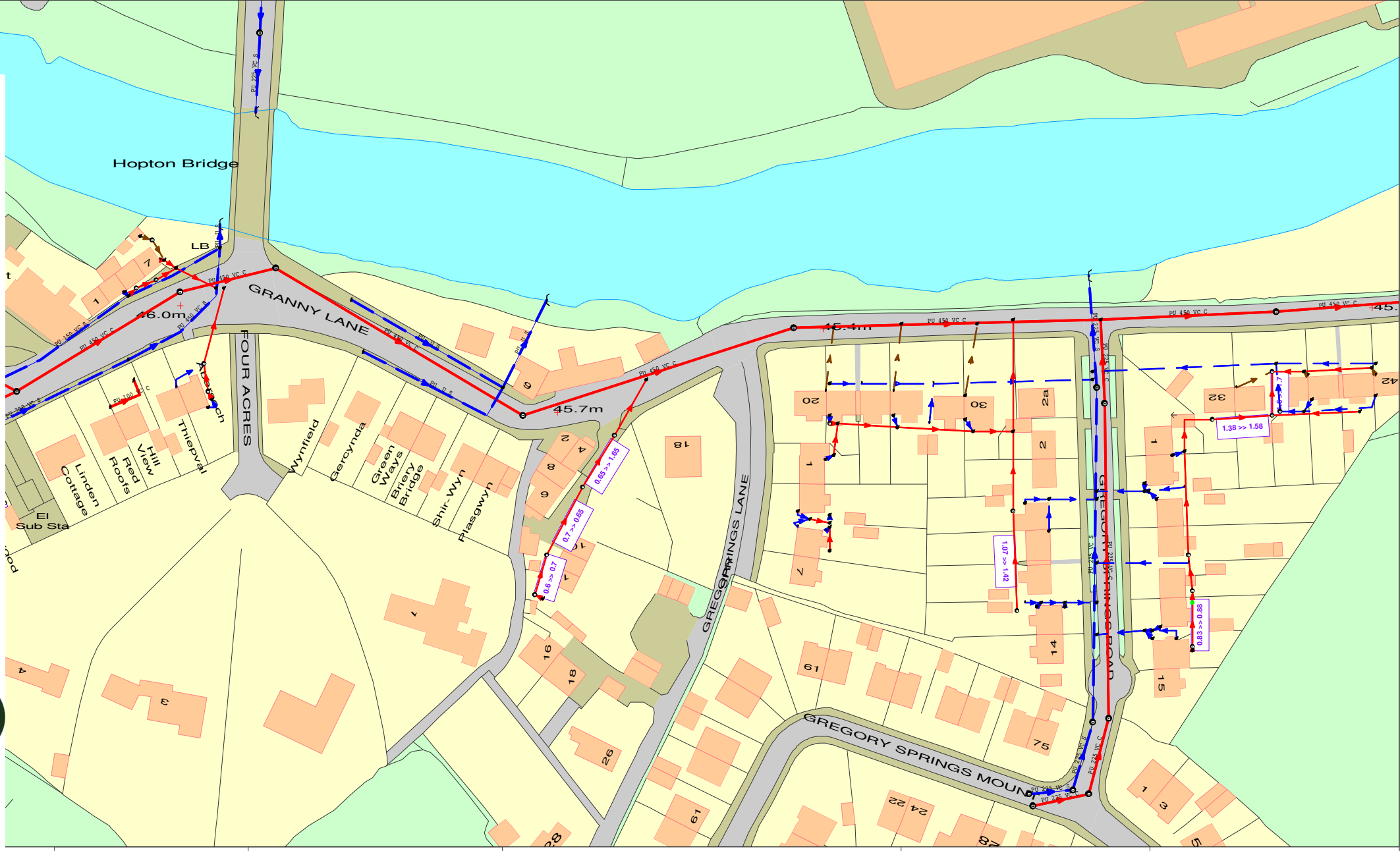
Water Main 4" and above

Raw Water Main

Private Water Main


Fire Hydrant


Pumping Station



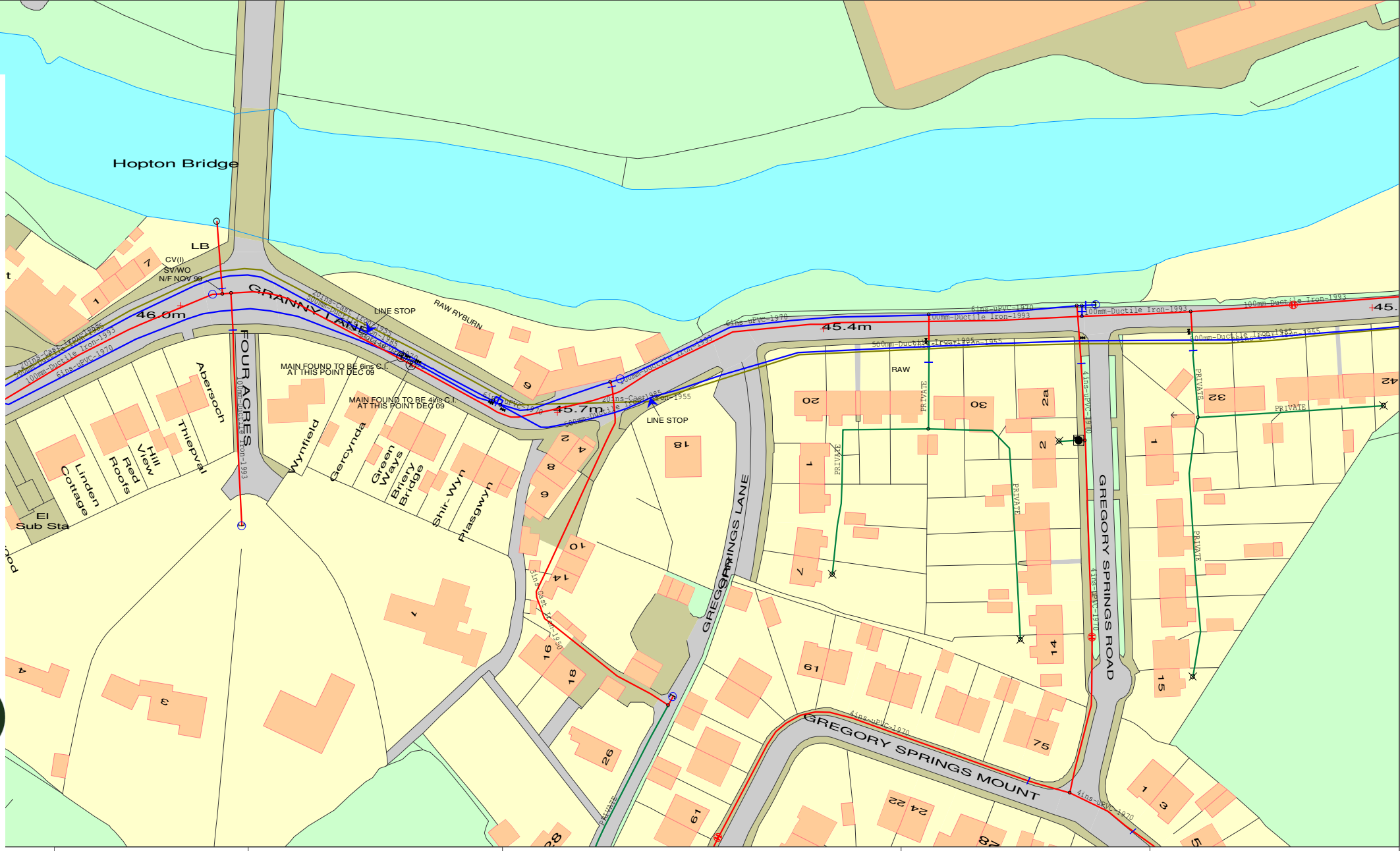
safe-move
A part of YorkshireWater

420284 : 418975	Map Name : SE2018NW	Title	Partial Key
Yorkshire Water, PO Box 500, Halifax Road, Bradford BD6 2LZ Contact Name : Search Advisor L MULLOCK Contact Tel : 75 4506		Notes	Foul Sewer = F Combined Sewer = C Surface Water Sewer = SW Trade Sewer = TD Partially Separate = PS
		(Ody) COPYRIGHT STATEMENTS: Reproduced by permission of Ordnance Survey on behalf of HMSO © Crown copyright and database 2014. All rights reserved Ordnance Survey Licence number 100022432	Date Req : 28/01/2016, 09:44:39
			Source : Sewer Network Enquiry

This plan is furnished as a general guide only and no warranty as to its correctness is given or implied. This plan must not be relied upon in the event of excavations or other works made in the vicinity of public sewers. No house or property connections are shown.

Date Gen : 28/01/2016, 09:44:40

UPN: Undefined Originator: L MULLOCK, Safe-Move, 75 4506

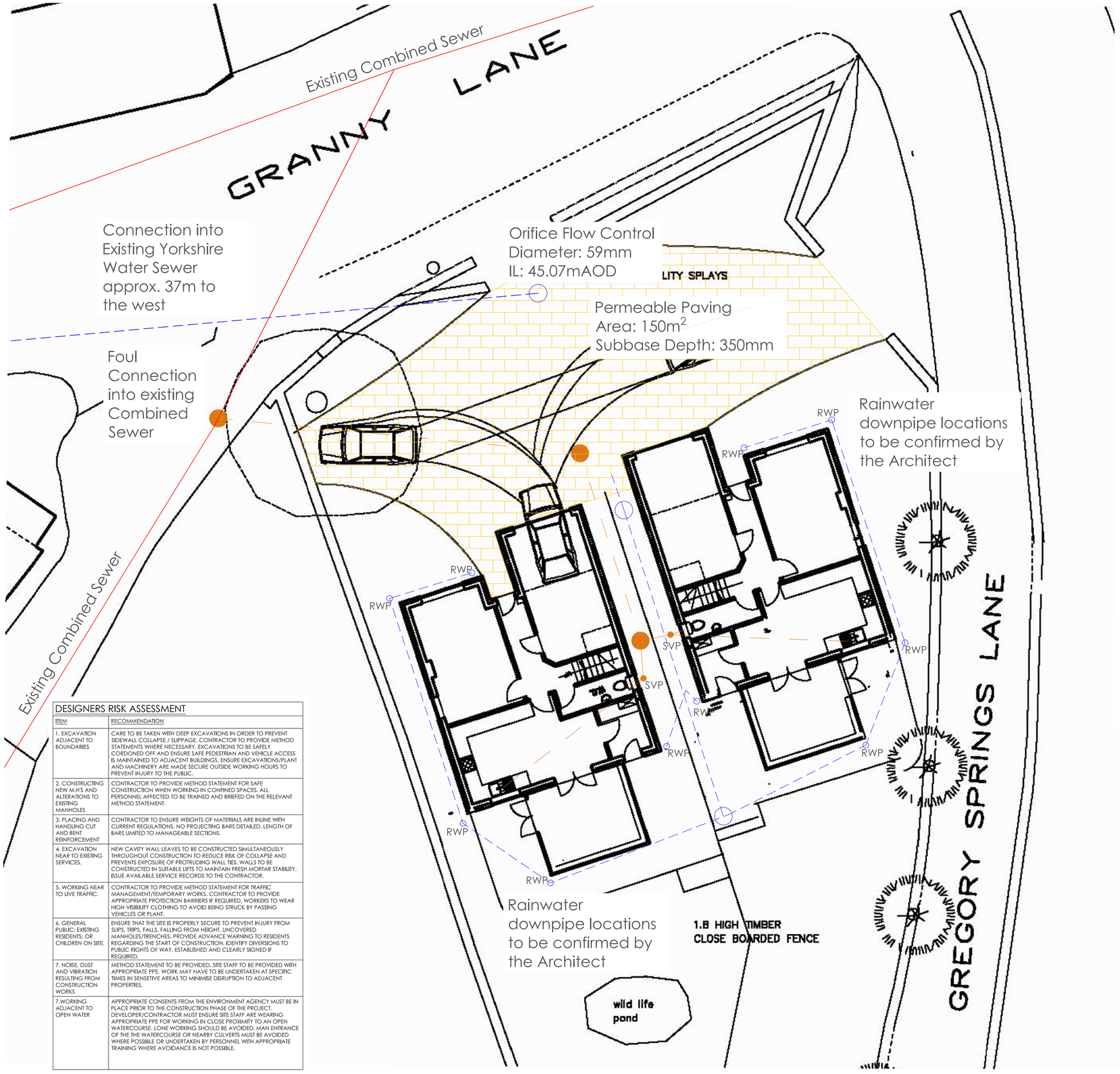


safe-move
A part of YorkshireWater

420284 : 418975	Map Name : SE2018NW	Title	Partial Key Water mains up to 4" in diameter Water mains over 4" in diameter Raw water mains Private water mains
YorkshireWater Yorkshire Water, PO Box 500, Halifax Road, Bradford BD6 2LZ Contact Name : Search Advisor L MULLOCK Contact Tel : 75 4506		Notes	The position and depths of apparatus shown on this plan are approximate only. The exact positions and depths should be obtained by excavation trial holes.
		(Ody) COPYRIGHT STATEMENTS: Reproduced by permission of Ordnance Survey on behalf of HMSO © Crown copyright and database 2014. All rights reserved Ordnance Survey Licence number 100022432	Scale : 1:1250 Drg No : Maris No : Date Req : 28/01/2016, 09:45:00 Date Gen : 28/01/2016, 09:45:01 Source : Water Network Enquiry

UPN: Undefined Originator: L MULLOCK, Safe-Move, 75 4506

Appendix I: - Preliminary Drainage Plan and Calculations



DESIGNERS RISK ASSESSMENT

ITEM	RECOMMENDATION
1. EXCAVATION ADJACENT TO BOUNDARIES	CARE TO BE TAKEN WITH DEEP EXCAVATIONS IN ORDER TO PREVENT SIDEWALL COLLAPSE / SLIPPAGE. CONTRACTOR TO PROVIDE METHOD STATEMENTS WHERE NECESSARY. EXCAVATIONS TO BE SAFELY CORDONED OFF AND ENSURE SAFE PEDESTRIAN AND VEHICLE ACCESS IS MAINTAINED TO ADJACENT BUILDINGS. ENSURE EXCAVATIONS/PLANT AND MACHINERY ARE MADE SECURE OUTSIDE WORKING HOURS TO PREVENT INJURY TO THE PUBLIC.
2. CONSTRUCTING NEW M.H'S AND ALTERATIONS TO EXISTING MANHOLES	CONTRACTOR TO PROVIDE METHOD STATEMENT FOR SAFE CONSTRUCTION WHEN WORKING IN CONFINED SPACES. ALL PERSONNEL AFFECTED TO BE TRAINED AND BRIEFED ON THE RELEVANT METHOD STATEMENT.
3. PLACING AND HANDLING CUT AND BENT REINFORCEMENT	CONTRACTOR TO ENSURE WEIGHTS OF MATERIALS ARE INLINE WITH CURRENT REGULATIONS. NO PROJECTING BARS DETAILED. LENGTH OF BARS LIMITED TO MANAGEABLE SECTIONS.
4. EXCAVATION NEAR TO EXISTING SERVICES.	NEW CAVITY WALL LEAVES TO BE CONSTRUCTED SIMULTANEOUSLY THROUGHOUT CONSTRUCTION TO REDUCE RISK OF COLLAPSE AND PREVENTS EXPOSURE OF PROTRUDING WALL TIES. WALLS TO BE CONSTRUCTED IN SUITABLE LIFTS TO MAINTAIN FRESH MORTAR STABILITY. ISSUE AVAILABLE SERVICE RECORDS TO THE CONTRACTOR.
5. WORKING NEAR TO LIVE TRAFFIC.	CONTRACTOR TO PROVIDE METHOD STATEMENT FOR TRAFFIC MANAGEMENT/TEMPORARY WORKS. CONTRACTOR TO PROVIDE APPROPRIATE PROTECTION BARRIERS IF REQUIRED. WORKERS TO WEAR HIGH VISIBILITY CLOTHING TO AVOID BEING STRUCK BY PASSING VEHICLES OR PLANT.
6. GENERAL PUBLIC; EXISTING RESIDENTS; OR CHILDREN ON SITE.	ENSURE THAT THE SITE IS PROPERLY SECURE TO PREVENT INJURY FROM SLIPS, TRIPS, FALLS, FALLING FROM HEIGHT, UNCOVERED MANHOLES/TRENCHES. PROVIDE ADVANCE WARNING TO RESIDENTS REGARDING THE START OF CONSTRUCTION. IDENTIFY DIVERSIONS TO PUBLIC RIGHTS OF WAY, ESTABLISHED AND CLEARLY SIGNED IF REQUIRED.
7. NOISE, DUST AND VIBRATION RESULTING FROM CONSTRUCTION WORKS	METHOD STATEMENT TO BE PROVIDED. SITE STAFF TO BE PROVIDED WITH APPROPRIATE PPE. WORK MAY HAVE TO BE UNDERTAKEN AT SPECIFIC TIMES IN SENSETIVE AREAS TO MINIMISE DISRUPTION TO ADJACENT PROPERTIES.
7.WORKING ADJACENT TO OPEN WATER	APPROPRIATE CONSENTS FROM THE ENVIRONMENT AGENCY MUST BE IN PLACE PRIOR TO THE CONSTRUCTION PHASE OF THE PROJECT. DEVELOPER/CONTRACTOR MUST ENSURE SITE STAFF ARE WEARING APPROPRIATE PPE FOR WORKING IN CLOSE PROXIMITY TO AN OPEN WATERCOURSE. LONE WORKING SHOULD BE AVOIDED. MAN ENTRANCE OF THE THE WATERCOURSE OR NEARBY CULVERTS MUST BE AVOIDED WHERE POSSIBLE OR UNDERTAKEN BY PERSONNEL WITH APPROPRIATE TRAINING WHERE AVOIDANCE IS NOT POSSIBLE.

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4. ALL DIMENSIONS ARE SHOWN IN MILLIMETRES UNLESS OTHERWISE STATED.
5. NO DIMENSIONS TO BE SCALED FROM THIS DRAWING.
6. UN-ADOPTED FW & SW DRAINAGE IS TO BE CONSTRUCTED IN ACCORDANCE WITH CURRENT BUILDING REGULATIONS, INCLUDING APPROVED DOCUMENT H (UPDATED 2015); BS EN 752:2008 AND OTHER RELEVANT STANDARDS AND AGREEMENT CERTIFICATES.
7. ALL ADOPTABLE DRAINAGE TO COMPLY WITH THE REQUIREMENTS OF YORKSHIRE WATER AND SEWERS FOR ADOPTION (7TH EDITION), UNLESS OTHERWISE SPECIFIED.
8. THE LOCATION AND LEVELS OF EXISTING DRAINAGE PIPES AND CULVERTS MUST BE CHECKED ON-SITE PRIOR TO CONSTRUCTION.
9. ALL EXISTING SERVICES TO BE LOCATED PRIOR TO THE COMMENCEMENT OF ANY DRAINAGE WORKS, AND WHERE NECESSARY PROTECTION OR DIVERSIONS ARE TO BE UNDERTAKEN TO AVOID CONFLICT WITH THE PROPOSED WORKS.
10. DRAINS ARE TO BE CONSTRUCTED USING FLEXIBLY JOINTED VITRIFIED CLAY PIPES TO BS 65 (1991) AND BS EN 295 (2012/2013); OR UPVC BUILDING DRAINAGE SYSTEM PIPEWORK TO BS 4660 (2000), BS EN 13598-1 (2010) & BS EN 1401-1 (2009); BEDDED & BACKFILLED IN ACCORDANCE WITH THE MANUFACTURERS INSTRUCTIONS.
11. BACKFILLING OF DRAIN TRENCHES ADJACENT TO DWELLINGS OR OTHER STRUCTURES TO BE IN ACCORDANCE WITH BS EN 1610 (1998).
12. ACCESS FITTINGS & INSPECTION CHAMBERS <1.2m DEEP ARE TO BE CLAYWARE OR PRE-FORMED POLYPROPYLENE AS APPROPRIATE TO THE NUMBER OF CONNECTIONS. POLYPROPYLENE CHAMBERS CAN BE USED UP TO 3.0m DEEP BUT REQUIRE A MAX 350mm DIAMETER REDUCED COVER TO PREVENT MAN ENTRY. INSPECTION CHAMBER SIZES ARE TO BE CONSTRUCTED IN ACCORDANCE WITH BS EN 752 (2008).
13. MANHOLE CHAMBERS ARE TO BE OF PRECAST CONCRETE CONSTRUCTION WITH 150mm INSITU CONCRETE SURROUND WITH A CLEAR OPENING OF 600mm.
14. COVER LEVELS INDICATED ON THE DRAWING OR WITHIN THE MANHOLE SCHEDULE ARE NOMINAL AND MAY BE ADJUSTED TO SUIT FINISHED LEVELS AS NECESSARY. INSPECTION CHAMBER COVERS SHOULD BE GRADE A15 FOR PEDESTRIAN AREAS ONLY; B125 FOR AREAS WITH OCCASIONAL VEHICLE ACCESS; AND D400 WITHIN THE PUBLIC HIGHWAY.
15. WHERE DRAINS PASS THROUGH FOUNDATIONS OR OTHER RIGID STRUCTURES, A LINTEL OR SLEEVE IS TO BE USED & PROVISION FOR FLEXIBILITY IS TO MADE WITH ROCKER PIPES.
16. ANY EXISTING LAND DRAINS SEVERED BY SITE OPERATIONS SHOULD BE DIVERTED AROUND ANY PROPERTIES/BUILDINGS AND RECONNECTED TO THE EXISTING LAND DRAINAGE SYSTEM VIA A SILT TRAP.
17. GULLIES SITUATED IN AREAS ACCESSIBLE TO WHEELED VEHICLES ARE TO BE OF A SUITABLE CONSTRUCTION (e.g. CPM GROUP CONCRETE GULLY POTS TO BS 5911:6 (2010) OR HEPWORTH CODE RGR3 GULLY POT, WITH INSITU CONCRETE BED AND SURROUND, FITTED WITH DRAINAGE CASTINGS CODE TD651 GRATING AND FRAME TO BS EN 124).
18. DRAINS WITHIN AREAS OF MADE GROUND TO BE CONSTRUCTED BY FIRST MAKING UP THE AREA TO APPROXIMATE FINISHED LEVEL AND THEN EXCAVATING THROUGH THE FILL MATERIAL INTO UNDISTURBED GROUND. THE DRAIN TRENCH IS THEN TO BE BACKFILLED TO FORMATION LEVEL USING SUITABLE GRANULAR FILL MATERIAL, WELL COMPACTED IN LAYERS NOT EXCEEDING 225mm.
19. CONCRETE PROTECTION TO PIPES WHERE DEPTH OF PIPE FROM GROUND LEVEL TO BARREL IS <0.35m WITHIN NON-TRAFFICKED AREAS; <0.5m WITHIN DOMESTIC DRIVEWAYS; <0.9m PARKING AREAS; AND <1.2m WITHIN THE PUBLIC HIGHWAY , OTHERWISE SEWERS TO BE LAID IN CLASS S BEDDING (150mm GRANULAR BED & SURROUND).
20. SEWERS MUST HAVE 5m CLEARANCE FROM TREES AND HEDGES.
21. BEDDING AND BACKFILL TO CONFORM TO THE REQUIREMENT OF THE WATER INDUSTRY SPECIFICATION 4-08-02 (TABLE A2).
22. THE CHAMBER SIZE OF MANHOLES WITH MORE THAN ONE CONNECTION MAY NEED TO BE INCREASED AN INCREMENT TO ACCOMMODATE THE CONNECTIONS AND BENDS.
23. THE POSITIONS OF SVP'S, STUB-STACKS, WC OUTLETS AND RAINWATER DOWNPIPES ARE TO BE ACCURATELY LOCATED FROM THE ARCHITECTS DRAWINGS.
24. CATCHPIT CHAMBERS ARE REQUIRED TO HAVE A MINIMUM 300mm SUMP.

KEY

- PROPOSED STORM WATER MANHOLE/INSPECTION CHAMBER
- PROPOSED STORM WATER DRAIN RUN
- RWP — RAINWATER PIPE
- EXISTING COMBINED SEWER
- PROPOSED FOUL MANHOLE/INSPECTION CHAMBER
- PROPOSED FOUL DRAIN RUN
- SVP — SOIL VENT PIPE
- Permeable Paving

REVISION	COMMENT	DATE	BY
..	..	..	..

FLOOD RISK CONSULTANCY LTD
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Elm Street Business Park
Burnley, BB10 1PD
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APPRAISING, MANAGING & REDUCING FLOOD RISK

CLIENT:	Mrs Burrows
PROJECT:	Residential Dwellings 18 Granny Lane, Lower Hopton
DRAWING TITLE:	Preliminary Drainage Design
DRAWING REFERENCE:	2016-006-01
DATE:	22.02.16
DRAWN BY:	DE
SCALE:	
SIZE:	A1
REVISION:	/

Summary of Results for 1 year Return Period (+40%)

Half Drain Time : 28 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	45.120	0.050	0.0	0.8	0.8	2.2	O K
30 min Summer	45.132	0.062	0.0	1.1	1.1	2.8	O K
60 min Summer	45.143	0.073	0.0	1.4	1.4	3.3	O K
120 min Summer	45.148	0.078	0.0	1.5	1.5	3.5	O K
180 min Summer	45.148	0.078	0.0	1.5	1.5	3.5	O K
240 min Summer	45.146	0.076	0.0	1.5	1.5	3.4	O K
360 min Summer	45.141	0.071	0.0	1.3	1.3	3.2	O K
480 min Summer	45.136	0.066	0.0	1.2	1.2	2.9	O K
600 min Summer	45.132	0.062	0.0	1.1	1.1	2.8	O K
720 min Summer	45.128	0.058	0.0	1.0	1.0	2.6	O K
960 min Summer	45.123	0.053	0.0	0.8	0.8	2.4	O K
1440 min Summer	45.116	0.046	0.0	0.7	0.7	2.1	O K
2160 min Summer	45.109	0.039	0.0	0.5	0.5	1.7	O K
2880 min Summer	45.105	0.035	0.0	0.5	0.5	1.6	O K
4320 min Summer	45.101	0.031	0.0	0.3	0.3	1.4	O K
5760 min Summer	45.099	0.029	0.0	0.3	0.3	1.3	O K
7200 min Summer	45.097	0.027	0.0	0.2	0.2	1.2	O K
8640 min Summer	45.095	0.025	0.0	0.2	0.2	1.1	O K
10080 min Summer	45.093	0.023	0.0	0.2	0.2	1.0	O K
15 min Winter	45.127	0.057	0.0	0.9	0.9	2.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	38.979	0.0	2.5	17
30 min Summer	25.969	0.0	3.6	26
60 min Summer	16.918	0.0	4.9	42
120 min Summer	10.829	0.0	6.5	74
180 min Summer	8.310	0.0	7.6	106
240 min Summer	6.882	0.0	8.5	138
360 min Summer	5.234	0.0	9.7	198
480 min Summer	4.301	0.0	10.7	260
600 min Summer	3.694	0.0	11.5	320
720 min Summer	3.262	0.0	12.2	382
960 min Summer	2.682	0.0	13.4	502
1440 min Summer	2.037	0.0	15.3	750
2160 min Summer	1.544	0.0	17.3	1104
2880 min Summer	1.269	0.0	18.9	1468
4320 min Summer	0.964	0.0	21.3	2204
5760 min Summer	0.794	0.0	23.2	2936
7200 min Summer	0.682	0.0	24.6	3648
8640 min Summer	0.601	0.0	25.7	4376
10080 min Summer	0.540	0.0	26.7	5088
15 min Winter	38.979	0.0	2.9	16

Summary of Results for 1 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	45.140	0.070	0.0	1.3	1.3	3.2	O K
60 min Winter	45.150	0.080	0.0	1.6	1.6	3.6	O K
120 min Winter	45.151	0.081	0.0	1.6	1.6	3.6	O K
180 min Winter	45.148	0.078	0.0	1.5	1.5	3.5	O K
240 min Winter	45.143	0.073	0.0	1.4	1.4	3.3	O K
360 min Winter	45.136	0.066	0.0	1.2	1.2	2.9	O K
480 min Winter	45.130	0.060	0.0	1.0	1.0	2.7	O K
600 min Winter	45.125	0.055	0.0	0.9	0.9	2.5	O K
720 min Winter	45.122	0.052	0.0	0.8	0.8	2.3	O K
960 min Winter	45.116	0.046	0.0	0.7	0.7	2.1	O K
1440 min Winter	45.109	0.039	0.0	0.5	0.5	1.7	O K
2160 min Winter	45.103	0.033	0.0	0.4	0.4	1.5	O K
2880 min Winter	45.100	0.030	0.0	0.3	0.3	1.3	O K
4320 min Winter	45.097	0.027	0.0	0.3	0.3	1.2	O K
5760 min Winter	45.094	0.024	0.0	0.2	0.2	1.1	O K
7200 min Winter	45.092	0.022	0.0	0.2	0.2	1.0	O K
8640 min Winter	45.091	0.021	0.0	0.2	0.2	0.9	O K
10080 min Winter	45.090	0.020	0.0	0.1	0.1	0.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	25.969	0.0	4.1	27
60 min Winter	16.918	0.0	5.6	44
120 min Winter	10.829	0.0	7.4	78
180 min Winter	8.310	0.0	8.6	112
240 min Winter	6.882	0.0	9.6	144
360 min Winter	5.234	0.0	11.0	204
480 min Winter	4.301	0.0	12.1	266
600 min Winter	3.694	0.0	13.0	328
720 min Winter	3.262	0.0	13.8	390
960 min Winter	2.682	0.0	15.2	514
1440 min Winter	2.037	0.0	17.2	752
2160 min Winter	1.544	0.0	19.6	1096
2880 min Winter	1.269	0.0	21.4	1468
4320 min Winter	0.964	0.0	24.1	2236
5760 min Winter	0.794	0.0	26.3	2944
7200 min Winter	0.682	0.0	27.9	3712
8640 min Winter	0.601	0.0	29.3	4384
10080 min Winter	0.540	0.0	30.4	5152

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.340	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.045

Time (mins) From:	To:	Area (ha)
0	4	0.045

Model Details

Storage is Online Cover Level (m) 45.550

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	21.5
Membrane Percolation (mm/hr)	1000	Length (m)	7.0
Max Percolation (l/s)	41.8	Slope (1:X)	8200.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	45.070	Cap Volume Depth (m)	0.000

Orifice Outflow Control

Diameter (m) 0.059 Discharge Coefficient 0.600 Invert Level (m) 45.070

Summary of Results for 30 year Return Period (+40%)

Half Drain Time : 37 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	45.207	0.137	0.0	2.4	2.4	6.1	O K
30 min Summer	45.238	0.168	0.0	2.7	2.7	7.6	O K
60 min Summer	45.260	0.190	0.0	2.9	2.9	8.5	Flood Risk
120 min Summer	45.264	0.194	0.0	2.9	2.9	8.7	Flood Risk
180 min Summer	45.255	0.185	0.0	2.9	2.9	8.3	Flood Risk
240 min Summer	45.242	0.172	0.0	2.7	2.7	7.7	O K
360 min Summer	45.219	0.149	0.0	2.5	2.5	6.7	O K
480 min Summer	45.200	0.130	0.0	2.3	2.3	5.9	O K
600 min Summer	45.186	0.116	0.0	2.1	2.1	5.2	O K
720 min Summer	45.175	0.105	0.0	2.0	2.0	4.7	O K
960 min Summer	45.159	0.089	0.0	1.8	1.8	4.0	O K
1440 min Summer	45.143	0.073	0.0	1.4	1.4	3.3	O K
2160 min Summer	45.131	0.061	0.0	1.1	1.1	2.7	O K
2880 min Summer	45.124	0.054	0.0	0.9	0.9	2.4	O K
4320 min Summer	45.115	0.045	0.0	0.6	0.6	2.0	O K
5760 min Summer	45.109	0.039	0.0	0.5	0.5	1.7	O K
7200 min Summer	45.105	0.035	0.0	0.4	0.4	1.5	O K
8640 min Summer	45.102	0.032	0.0	0.4	0.4	1.4	O K
10080 min Summer	45.101	0.031	0.0	0.3	0.3	1.4	O K
15 min Winter	45.226	0.156	0.0	2.6	2.6	7.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	95.431	0.0	7.3	16
30 min Summer	63.836	0.0	10.0	26
60 min Summer	40.933	0.0	13.0	44
120 min Summer	25.482	0.0	16.4	78
180 min Summer	19.091	0.0	18.5	110
240 min Summer	15.473	0.0	20.1	142
360 min Summer	11.486	0.0	22.4	204
480 min Summer	9.290	0.0	24.2	266
600 min Summer	7.875	0.0	25.6	326
720 min Summer	6.878	0.0	26.9	384
960 min Summer	5.550	0.0	28.9	502
1440 min Summer	4.097	0.0	32.0	738
2160 min Summer	3.020	0.0	35.3	1104
2880 min Summer	2.430	0.0	37.7	1468
4320 min Summer	1.787	0.0	41.3	2204
5760 min Summer	1.435	0.0	43.9	2928
7200 min Summer	1.211	0.0	46.0	3624
8640 min Summer	1.055	0.0	47.8	4400
10080 min Summer	0.938	0.0	49.3	5104
15 min Winter	95.431	0.0	8.2	16

Summary of Results for 30 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	45.261	0.191	0.0	2.9	2.9	8.6	Flood Risk
60 min Winter	45.281	0.211	0.0	3.1	3.1	9.5	Flood Risk
120 min Winter	45.276	0.206	0.0	3.1	3.1	9.3	Flood Risk
180 min Winter	45.257	0.187	0.0	2.9	2.9	8.4	Flood Risk
240 min Winter	45.238	0.168	0.0	2.7	2.7	7.6	O K
360 min Winter	45.206	0.136	0.0	2.4	2.4	6.1	O K
480 min Winter	45.183	0.113	0.0	2.1	2.1	5.1	O K
600 min Winter	45.167	0.097	0.0	1.9	1.9	4.4	O K
720 min Winter	45.156	0.086	0.0	1.7	1.7	3.9	O K
960 min Winter	45.144	0.074	0.0	1.4	1.4	3.3	O K
1440 min Winter	45.131	0.061	0.0	1.1	1.1	2.7	O K
2160 min Winter	45.121	0.051	0.0	0.8	0.8	2.3	O K
2880 min Winter	45.115	0.045	0.0	0.6	0.6	2.0	O K
4320 min Winter	45.106	0.036	0.0	0.5	0.5	1.6	O K
5760 min Winter	45.102	0.032	0.0	0.4	0.4	1.4	O K
7200 min Winter	45.100	0.030	0.0	0.3	0.3	1.3	O K
8640 min Winter	45.098	0.028	0.0	0.3	0.3	1.2	O K
10080 min Winter	45.097	0.027	0.0	0.2	0.2	1.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	63.836	0.0	11.3	28
60 min Winter	40.933	0.0	14.7	46
120 min Winter	25.482	0.0	18.5	82
180 min Winter	19.091	0.0	20.8	118
240 min Winter	15.473	0.0	22.6	150
360 min Winter	11.486	0.0	25.2	212
480 min Winter	9.290	0.0	27.2	274
600 min Winter	7.875	0.0	28.8	332
720 min Winter	6.878	0.0	30.2	386
960 min Winter	5.550	0.0	32.5	504
1440 min Winter	4.097	0.0	35.9	750
2160 min Winter	3.020	0.0	39.7	1100
2880 min Winter	2.430	0.0	42.4	1468
4320 min Winter	1.787	0.0	46.5	2200
5760 min Winter	1.435	0.0	49.5	2992
7200 min Winter	1.211	0.0	51.9	3616
8640 min Winter	1.055	0.0	54.0	4368
10080 min Winter	0.938	0.0	55.7	5080

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.340	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.045

Time (mins) From:	To:	Area (ha)
0	4	0.045

Model Details

Storage is Online Cover Level (m) 45.550

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	21.5
Membrane Percolation (mm/hr)	1000	Length (m)	7.0
Max Percolation (l/s)	41.8	Slope (1:X)	8200.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	45.070	Cap Volume Depth (m)	0.000

Orifice Outflow Control

Diameter (m) 0.059 Discharge Coefficient 0.600 Invert Level (m) 45.070

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 43 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	45.252	0.182	0.0	2.8	2.8	8.2	Flood Risk
30 min Summer	45.297	0.227	0.0	3.2	3.2	10.2	Flood Risk
60 min Summer	45.327	0.257	0.0	3.5	3.5	11.6	Flood Risk
120 min Summer	45.334	0.264	0.0	3.5	3.5	11.9	Flood Risk
180 min Summer	45.321	0.251	0.0	3.4	3.4	11.3	Flood Risk
240 min Summer	45.304	0.234	0.0	3.3	3.3	10.5	Flood Risk
360 min Summer	45.271	0.201	0.0	3.0	3.0	9.1	Flood Risk
480 min Summer	45.245	0.175	0.0	2.8	2.8	7.9	O K
600 min Summer	45.225	0.155	0.0	2.6	2.6	7.0	O K
720 min Summer	45.209	0.139	0.0	2.4	2.4	6.2	O K
960 min Summer	45.185	0.115	0.0	2.1	2.1	5.2	O K
1440 min Summer	45.157	0.087	0.0	1.7	1.7	3.9	O K
2160 min Summer	45.141	0.071	0.0	1.3	1.3	3.2	O K
2880 min Summer	45.132	0.062	0.0	1.1	1.1	2.8	O K
4320 min Summer	45.121	0.051	0.0	0.8	0.8	2.3	O K
5760 min Summer	45.114	0.044	0.0	0.6	0.6	2.0	O K
7200 min Summer	45.109	0.039	0.0	0.5	0.5	1.7	O K
8640 min Summer	45.106	0.036	0.0	0.5	0.5	1.6	O K
10080 min Summer	45.103	0.033	0.0	0.4	0.4	1.5	O K
15 min Winter	45.277	0.207	0.0	3.1	3.1	9.3	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	123.374	0.0	9.6	16
30 min Summer	83.353	0.0	13.3	27
60 min Summer	53.779	0.0	17.4	44
120 min Summer	33.499	0.0	21.8	78
180 min Summer	25.011	0.0	24.5	112
240 min Summer	20.175	0.0	26.4	144
360 min Summer	14.874	0.0	29.2	208
480 min Summer	11.973	0.0	31.4	268
600 min Summer	10.110	0.0	33.2	330
720 min Summer	8.799	0.0	34.7	390
960 min Summer	7.062	0.0	37.1	510
1440 min Summer	5.169	0.0	40.6	738
2160 min Summer	3.775	0.0	44.4	1104
2880 min Summer	3.016	0.0	47.2	1468
4320 min Summer	2.194	0.0	51.2	2200
5760 min Summer	1.748	0.0	54.1	2936
7200 min Summer	1.466	0.0	56.4	3672
8640 min Summer	1.271	0.0	58.3	4400
10080 min Summer	1.126	0.0	59.9	5136
15 min Winter	123.374	0.0	10.9	16

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	45.328	0.258	0.0	3.5	3.5	11.6	Flood Risk
60 min Winter	45.357	0.287	0.0	3.7	3.7	13.0	Flood Risk
120 min Winter	45.354	0.284	0.0	3.7	3.7	12.8	Flood Risk
180 min Winter	45.330	0.260	0.0	3.5	3.5	11.7	Flood Risk
240 min Winter	45.303	0.233	0.0	3.3	3.3	10.5	Flood Risk
360 min Winter	45.258	0.188	0.0	2.9	2.9	8.5	Flood Risk
480 min Winter	45.226	0.156	0.0	2.6	2.6	7.0	O K
600 min Winter	45.201	0.131	0.0	2.3	2.3	5.9	O K
720 min Winter	45.184	0.114	0.0	2.1	2.1	5.1	O K
960 min Winter	45.160	0.090	0.0	1.8	1.8	4.0	O K
1440 min Winter	45.142	0.072	0.0	1.4	1.4	3.2	O K
2160 min Winter	45.129	0.059	0.0	1.0	1.0	2.6	O K
2880 min Winter	45.121	0.051	0.0	0.8	0.8	2.3	O K
4320 min Winter	45.112	0.042	0.0	0.6	0.6	1.9	O K
5760 min Winter	45.106	0.036	0.0	0.5	0.5	1.6	O K
7200 min Winter	45.102	0.032	0.0	0.4	0.4	1.4	O K
8640 min Winter	45.100	0.030	0.0	0.3	0.3	1.4	O K
10080 min Winter	45.099	0.029	0.0	0.3	0.3	1.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	83.353	0.0	15.0	29
60 min Winter	53.779	0.0	19.6	46
120 min Winter	33.499	0.0	24.5	84
180 min Winter	25.011	0.0	27.5	120
240 min Winter	20.175	0.0	29.7	152
360 min Winter	14.874	0.0	32.9	218
480 min Winter	11.973	0.0	35.3	278
600 min Winter	10.110	0.0	37.3	338
720 min Winter	8.799	0.0	38.9	398
960 min Winter	7.062	0.0	41.6	512
1440 min Winter	5.169	0.0	45.7	746
2160 min Winter	3.775	0.0	49.9	1116
2880 min Winter	3.016	0.0	53.1	1468
4320 min Winter	2.194	0.0	57.6	2196
5760 min Winter	1.748	0.0	60.9	2944
7200 min Winter	1.466	0.0	63.5	3672
8640 min Winter	1.271	0.0	65.7	4408
10080 min Winter	1.126	0.0	67.6	5144

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.340	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.045

Time (mins) From:	To:	Area (ha)
0	4	0.045

Model Details

Storage is Online Cover Level (m) 45.550

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	21.5
Membrane Percolation (mm/hr)	1000	Length (m)	7.0
Max Percolation (l/s)	41.8	Slope (1:X)	8200.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	45.070	Cap Volume Depth (m)	0.000

Orifice Outflow Control

Diameter (m) 0.059 Discharge Coefficient 0.600 Invert Level (m) 45.070