

**FLOOD RISK ASSESSMENT
LAND TO THE SOUTH OF WATER LANE
ANGMERING, WEST SUSSEX
RYDON HOMES & GLEESON STRATEGIC LAND
FRA-19495-16-139
MAY 2017**



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APPENDIX 1

- Site Location Plan
- Existing Site Plan/Topographic Survey
- Proposed Layout Plan

APPENDIX 2

- Environment Agency Consultation
- Lead Local Flood Authority Consultation

APPENDIX 3

- Sewer Records
- Capacity Assessment

APPENDIX 4

- MicroDrainage Outputs

APPENDIX 5

- Indicative Drainage Strategy



EXECUTIVE SUMMARY

A Flood Risk Assessment was requested by Rydon. The purpose of this report is to present the findings of the assessment, which includes flood risk from all sources both to the site, and as a result of the development. Where flood risks are present, or where they cannot be clearly established, further actions or mitigations are outlined.

SITE DETAILS	
Approximate Site Area	9.023 ha, gross site area.
Current/Previous Use	Undeveloped, agriculture/arable.
Proposed Use	Residential, comprising up to 175 units.

FLOOD RISK ASSESSMENT	
Fluvial Flood Zone	Zone 1, excluding portion of the Site in Zone 3, landscaped.
NPPF Vulnerability	'More Vulnerable' – residential.
Compatibility	Compatible – 'More Vulnerable' development is appropriate in Flood Zone 1. Sequential Test applied, Exception Test is therefore not required.
Flood Risks to the Site	Low risk of flooding from all sources, including groundwater, subject to verification, excluding the part of the Site in Zone 3.
Flood Risk as a Result of the Development	Run-off from new impermeable areas and additional foul flows resulting in an increased risk of surface water, sewer and fluvial flooding, categorised as a high risk .

ACTIONS AND MITIGATIONS	
Off-site Surface Water	Managed by on-site surface water mitigations, see below.
On-site Surface Water and Fluvial	Reduce run-off from impermeable areas to greenfield rates. Attenuate using detention basins. Site drainage designed to 1% (1 in 100) AEP with 40% allowance for climate change.
Sewers and Drains	Foul requires off-site upgrading works. A new surface water sewer may be required for the Eastern Parcel (South).
Groundwater	Further investigation required in relation to potential Clearwater Flooding risk.
Water Management Infrastructure	There is no existing water management infrastructure on or near the site, (i.e., canals or reservoirs). The indicative drainage strategy for the site has highlighted the need for detention basins to manage surface water, however, the mitigations and actions described in this FRA mean that there should be no increased flood risk on site or to adjacent areas off site.
Further Investigation	Undertake groundwater monitoring to assess potential for infiltration on Eastern Parcel (South). If potential exists, then soakage testing will be undertaken to confirm permeability. The results of groundwater monitoring and soakage testing, if the latter is undertaken, will be reported separately.



SECTION 1 INTRODUCTION

- 1.1 IDOM Merebrook Limited (**'Merebrook'**) has been instructed by Rydon Homes and Gleeson Strategic Land, (**'Rydon'**) to undertake a Flood Risk Assessment (FRA) in support of an anticipated planning application for residential housing to be submitted by Rydon for a site identified as Land to the South of Water Lane, Angmering., in Arun District, West Sussex, (**the 'Site'**)
- 1.2 The purpose of this report is to present the results of a FRA undertaken on the Site proposals. The information does not purport to be a detailed design and a quantitative assessment cannot be undertaken at this time.
- 1.3 This report has been prepared for the sole purpose described above and no extended duty of care to any third party is implied or offered. Third parties making reference to this report should consult Rydon and Merebrook as to the extent to which findings may be appropriate for their use.

SECTION 2 DESCRIPTION OF THE PRE-DEVELOPMENT SITE

2.1 GENERAL

- 2.1.1 The development site is located in a rural area to the south of Water Lane, to the east of the village of Angmering and is located at approximate National Grid Reference E 507539, N 104557 (TQ 075 045) and nearest post code BN16 4EP, site centred. The Site is bordered to the north by Water Lane; to the east by the A280 Angmering By-Pass; to the south by existing residential properties on the eastern end of Angmering High Street; and to the west by three paddocks and Avenals Farm. A narrow corridor of land connects to the westernmost part of the Site, which comprises a smaller parcel of land beyond Avenals Farm and adjacent to Weavers Hill, hereafter the **'Western Parcel'**.
- 2.1.2 A topographic survey of the site by MK Surveys Limited Ref 21351 and dated September 2015, (revised February 2016), is included in **Appendix 1**. The topographic survey is stated to be to Ordnance Survey Datum Newlyn and Ordnance Survey National Grid. The Site falls from east to west; east to north-west and east to south-west from a maximum elevation of approximately 18 m AOD adjacent to the A280 to a minimum elevation of 13.0 m AOD at the top of the bank to an unnamed small river. Levels at the bottom of the bank to the river are typically 10 m AOD. Overall average gradients across the site are as follows:

East to west; approximately 1 in 120.

East to north-west; approximately 1 in 30, steepening toward the river.

East to south-west; approximately 1 in 135.
- 2.1.3 The Western Parcel has levels in the range 16.0 m AOD to 14.0 m AOD, falling to the west and north.



2.1.4 The Site (including the Western Parcel) comprises principally arable agricultural land with some undeveloped land in the north and west, with mature trees, scrub and hedgerows alongside the river which flows adjacent to Water Lane. Further downstream where the river passes through Angmering it is referred to as the Black Ditch, (also known locally as Patching Stream since it runs from Patching Pond north of the A27 – source; '*Angmering Neighbourhood Plan 2014 – 2029: 4.06*' page 11). The river is therefore referred to as the Black Ditch in this report.

2.1.5 A site location plan is included in **Appendix 1**.

2.2 SITE AREA

2.2.1 The total site area is approximately 9.023 ha, as measured in AutoCAD, this is comprised of the following:

- i.* Eastern Parcel (North) - 1.330 ha.
- ii.* Eastern Parcel (South) - 1.036 ha.
- iii.* Western Parcel - 0.586 ha.
- iv.* Green open space areas - 6.071 ha.
- v.* Total - 9.023 ha.

2.2.2 The total development area (excluding any areas of green open space) is 2.952 ha.

2.3 HYDROLOGY

2.3.1 A study of Ordnance Survey and Environment Agency online mapping indicates that that an unnamed small river which flows adjacent to Water Lane passes though the northern portion of the Site. As noted in paragraph 2.1.3, further downstream where the river passes through Angmering it is referred to as the Black Ditch.

2.3.2 The Angmering Neighbourhood Plan 2014 – 2029 also notes that the Black Ditch was routed via a culvert under the village centre in the nineteenth century and the former pond in the centre of the village through which the Black Ditch flowed was filled. The site of the pond is now the Green, which is planted with trees.

2.3.3 Two ponds are associated with the Black Ditch, one either side of the Avenals Farm access, i.e., upstream and downstream of the river crossing. The upstream pond falls within the Site. There are also ponds/wetlands features indicated in the triangle of land between the A280 Angmering By-Pass, the new junction between the by-pass and Water Lane and the old abandoned alignment of Water Lane. The river is culverted under the A280 and Water Lane in this area.

2.3.4 The Environment Agency online mapping indicates the following:

- i.* The Site has its northern portion within Flood Zone 3 (High Probability of flooding), associated with the Black Ditch, the flood zone extends up to and



includes sections of Water Lane on the northern side and on the southern side extends almost up to the edge of the arable agricultural land and to the northern edge of Avenals Farm.

- ii.* There are flood defences shown on the southern edge of Flood Zone 3 near Avenals Farm.
- iii.* The Black Ditch is enmained from the point where it exits from the culvert beneath the Water Lane and A280 junction.

2.3.5 There are no licenced surface water abstractions within 1 km of the Site identified on the Environment Agency online mapping

2.4 GEOLOGY

2.4.1 The inferred geology of the site, from the British Geological Survey 1:50,000 mapping, (via the Geology of Britain on-line viewer) is summarised as follows:

Drift Geology

Over the northern portion of the site close to Water Lane, Head – comprising Clay, Silt, Sand and Gravel, with linear tracts of Alluvium – comprising Clay, Silt, Sand and Gravel indicated in the area of the Black Ditch. Over the remainder of the southern portion of the site, River Terrace Deposits (undifferentiated) – comprising Sand, Silt and Clay.

Solid Geology

Over the north-east corner of the site near to the Water Lane and A280 junction, London Clay Formation – comprising Clay, Silt and Sand.

Over the remainder of the site from north to south, Lambeth Group – comprising Clay, Silt and Sand; Tarrant Chalk Member – comprising Chalk; Lewis Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, and Culver Chalk Formation.

2.5 HYDROGEOLOGY

2.5.1 The Environment Agency online groundwater mapping indicates the following:

- i.* No aquifer designation is shown. However, the Chalk present in the southern half of the site is likely to be the 'Principal Aquifer'.
- ii.* Over the north-east corner of the site near to the Water Lane and A280 junction - Minor Aquifer High groundwater vulnerability zone.
- iii.* Over the northern half of the site - Minor Aquifer Intermediate groundwater vulnerability zone.



- iv. Over the southern half of the site - Major Aquifer Intermediate groundwater vulnerability zone.
- 2.5.2 The Site does not lie within an Environment Agency designated groundwater source protection zone (SPZ).
- 2.5.3 There is one groundwater abstraction licence within 1 km of the Site indicated on the Environment Agency online mapping. This is at Hill Barn to the east of the site.

SECTION 3 DESCRIPTION OF THE PROPOSED DEVELOPMENT

- 3.1 The proposals are as shown on the Pro Vision Planning & Design '*Illustrative Masterplan*' referenced 1911/P 03 Rev C and dated June 2016, (included in **Appendix 1**), comprise 175 residential units with significant areas of landscaping and public open space.
- 3.2 Access to the Site is shown on the '*Illustrative Masterplan*' to be by means of a new bridge structure over the Black Ditch near to Avenals Farm.

SECTION 4 PLANNING FRAMEWORK

4.1 GENERAL

- 4.1.1 Flood Risk Assessment in England is assessed using the National Planning Policy Framework (NPPF), and '*Planning practice Guide – Flood Risk and Coastal Change*' produced by Communities and Local Government, in addition to the details set out in BS 8533:2011 '*Assessing and managing flood risk in development - Code of practice*'.
- 4.1.2 The NPPF provides guidance in relation to development and flooding. It provides a framework within which risks arising from both river and coastal flooding, and additional runoff from development in any location, can be assessed. Paragraph 100 in the NPPF outlines that inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere. This is achieved through applying the Sequential Test to development sites, as described below in **Section 4.2**.

4.2 THE SEQUENTIAL TEST

- 4.2.1 The Sequential Test is a decision making tool designed to direct development away from areas at high risk of flooding from rivers and the sea. The aim of the Sequential Test is to steer new development to areas with the lowest probability of flooding. Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower probability of flooding. In Table 1, Paragraph 065 of '*Planning Practice Guide – Flood Risk and Coastal Change*', land is divided into three basic zones:



- i.* Zone 1 (Low Probability) - land assessed as having a less than 0.1% (1 in 1000) annual probability of river or sea flooding;
 - ii.* Zone 2 (Medium Probability) - land assessed as having between a 1% (1 in 100) and 0.1% (1 in 1000) annual probability of river flooding; or between a 0.5% (1 in 200) and 0.1% (1 in 1,000) annual probability of sea flooding;
 - iii.* Zone 3a (High Probability) - land assessed as having a 1% (1 in 100) or greater annual probability of river flooding or a 0.5% (1 in 200) or greater annual probability of flooding from the sea;
 - iv.* Zone 3b (The Functional Floodplain) - land where water has to flow or be stored in times of flood.
- 4.2.2 The Sequential Test is not normally required for developments in Flood Zone 1 (Low Probability) and it is considered to have been 'applied' by virtue of the site being in the zone of lowest probability of flooding, unless there are flooding issues in the area of the development.
- 4.2.3 The Sequential Test is also not normally required for developments which are proposed on sites which have been 'allocated' by the local planning authority in their local plan and the development proposed is consistent with the land use allocation. For example, proposed residential development on land allocated for residential use. Where sites have been allocated the Sequential Test will have already been carried out by the local planning authority as part of the land allocation process.
- 4.2.4 However, if the site has not been allocated, it is likely that the Sequential Test will be required even if the site is in Flood Zone 1. It is recommended that checks are made with the local planning authority to establish if the site has been allocated and if so the site allocation reference in the local plan should be obtained and included in the planning application. If the local plan has not been adopted, the draft local plan should be checked.
- 4.3 **LAND USE AND DEVELOPMENT**
 - 4.3.1 Whilst it may sometimes not be possible to direct developments into low flood risk areas, particular flooding consequences may not be acceptable for certain land use types. Table 2, Paragraph 066 of '*Planning Practice Guide – Flood Risk and Coastal Change*' identifies the vulnerability of land uses to flooding by dividing land use into five distinct categories:
 - i.* Essential infrastructure
 - ii.* Highly vulnerable
 - iii.* More vulnerable
 - iv.* Less vulnerable



v. Water-compatible development

- 4.3.2 Table 3, Paragraph 067 of 'Planning Practice Guide – Flood Risk and Coastal Change' sets out the appropriateness of development, in terms of the compatibility of the Flood Zone classification and the flood risk vulnerability classification of a site, as shown in Table 4.1.

Flood risk vulnerability classification	Essential infrastructure	Water compatible	Highly vulnerable	More vulnerable	Less vulnerable
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	✓	Exception Test required	✓	✓
Zone 3a	Exception Test required	✓	✗	Exception Test required	✓
Zone 3b	Exception Test required	✓	✗	✗	✗
Key: ✓ Development is appropriate ✗ Development should not be permitted					

Table 4.1 Land use and flood risk vulnerability classification compatibility

4.4 **THE EXCEPTION TEST**

- 4.4.1 If, following application of the Sequential Test, it is not possible, consistent with wider sustainability objectives, for the development to be located in zones with a lower probability of flooding; the Exception Test can be applied if appropriate. For the Exception Test to be passed:

- i. it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a Strategic Flood Risk Assessment where one has been prepared; and
- ii. a site-specific flood risk assessment must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

- 4.4.2 Both elements of the test will have to be passed for development to be allocated or permitted.

4.5 **PLANNING POLICY & THE PROPOSED DEVELOPMENT SITE**

- 4.5.1 Based on the Environment Agency fluvial flood map as described further in **Sections 6.1 and 8.1** the Site has its northern portion within Flood Zone 3, that is land assessed as having a 1% (1 in 100) or greater annual probability of river flooding or a 0.5% (1 in 200) or greater annual probability of flooding from the sea. The majority of the Site, however, is within Flood Zone 1. The Illustrative Masterplan does not



show any development in the portion of the Site which lies in Flood Zone 3; this area is shown as being landscaped. If development were planned Flood Zone 3a the exception test would need to be passed; no development would be permitted in Flood Zone 3b – the functional floodplain.

- 4.5.2 The assessment in this section is therefore based on the premise that development will only be in Flood Zone 1.
- 4.5.3 With regards to the flood risk vulnerability classification, as described in **Section 4.3**, the proposed land use for the site, (residential housing), is considered to be **'More Vulnerable'**.
- 4.5.4 Referring to Table 4.1, **'More Vulnerable'** development is considered appropriate in Flood Zone 1.
- 4.5.5 Based upon the Sequential Test criteria, the Site is not considered to be at risk as a result of fluvial/tidal means, therefore the application of the Exception Test is not required for the Site.

SECTION 5 EXISTING REFERENCES AND/OR REPORTS

5.1 GEO-ENVIROMENTAL ASSESSMENT/SI/DESK STUDY

- 5.1.1 Merebrook was commissioned by Rydon to undertake a Phase 1 (Non-intrusive Investigation) and a Phase 2 (Preliminary Exploratory Investigation) and, *inter alia*, to advise on the geo-environmental implications for the redevelopment of the Site for the proposed end use.
- 5.1.2 The findings are presented in a report entitled '*Geo-environmental Assessment - Land to the South of Water Lane, Angmering*', referenced GEA-19495-16-306 Rev A and is being prepared in parallel with this FRA. Since both the geo-environmental assessment report and this FRA will be issued at the same time, it is recommended that the geo-environmental assessment report be referred to directly.
- 5.1.3 The geo-environmental assessment used GroundSure® reports commissioned by Merebrook in conjunction with other published information in order carry out the study. With respect to this FRA, the following aspects from the geo-environmental assessment and GroundSure® reports are reproduced and summarised as follows:

Geology & Ground Conditions

The published geological map indicates drift deposits to comprise Alluvium (clay, silt, sand and gravel), Head Deposits (clay, silt, sand and gravel), and River Terrace Deposits (sand, silt and clay). Bedrock geology comprises Lambeth Group (clay, silt and sand), Lewes Nodular Chalk Formation (chalk), and Tarrant Chalk Member (chalk) to the south. This is consistent with the inferred geology of the site, from the British Geological Survey 1:50,000 mapping, (via the Geology of Britain on-line viewer).



The intrusive investigation confirmed the published geology, the ground conditions encountered were variable in composition comprising clay, sand and gravel.

Groundwater/Hydrogeology

The superficial geology is classified as a Secondary Aquifer – Undifferentiated Layers associated with the Head deposits with a Secondary (A) Aquifer – Permeable Layers associated with the Alluvium and River Terrace Deposits within the northern section of the site.

A Secondary (A) Aquifer – Permeable Layers is associated with the Lambeth Group and a Principal Aquifer associated with the Chalk.

Three groundwater abstraction licences are noted with a 1 km radius of the Site. A single abstraction licence is still active which is 967 m east and is used for spray irrigation. The two historical groundwater abstraction licences no longer in use relate to horticultural watering.

The foregoing is consistent with the review and assessment in **Section 2.5**.

The GroundSure® reports indicate that the highest susceptibility to groundwater flooding is identified in the search area (*'within 50m of the boundary of the study site'*) based on the underlying geological conditions and is considered to be potential at the surface (Clearwater Flooding), the British Geological Survey has assigned a high confidence rating to this result. However, no specific details or location are provided.

Surface Water/Hydrology

Four records of surface water features are located on site, which are referenced as a Culvert and a Primary River, the name of which is undefined.

No surface water abstraction licences are located within a 1 km radius of the site.

Zone 2 and Zone 3 floodplains are associated with the watercourse which flows across the northern section of the Site. It is considered that the risk of flooding from rivers is considered low to high on site. Flood defences are currently being utilised on the Site.

The foregoing is consistent with the review and assessment in **Section 2.3**.

- 5.1.4 Rydon provided the results of a soakage investigation which was undertaken by Southern Testing/ST Consult for the westernmost section of land, (the Western Parcel), report entitled '*Soakage Test Report - Weavers Hill, Angmering*' referenced P0791 dated 4 June 2014. Six soakage tests were carried out across the parcel using the BRE 365 method; the report concluded good soakage capacity over the majority of the parcel with some variation, better results were obtained from the test pits excavated in the east of the parcel. The report summarised that the following rates could be considered:



- i.* TP1 – 1×10^{-5} m/s.
- ii.* TPs 2, 3 and 5 – 2.5×10^{-4} m/s.
- iii.* TP6 – 5×10^{-5} m/s.

5.2 STRATEGIC FLOOD RISK ASSESSMENT LEVEL 1

5.2.1 The Strategic Flood Risk Assessment Level 1 (SFRA-1) is intended to provide sufficient detail for the sequential test to be applied and is produced either by the local planning authority, or is commissioned by them from a flood consultancy to produce the SFRA. The SFRA-1 should have maps which show the entire area that the local planning authority covers, which should include:

- i.* Main rivers. (Environment Agency responsibility).
- ii.* Any other rivers and streams (ordinary watercourses - local planning authority responsibility).
- iii.* Development sites that have been allocated in the local plan and any under consideration for future allocation.
- iv.* Flood zones including the functional floodplain.

5.2.2 The SFRA-1 should include an assessment of the risk of flooding in the local planning authority area from all sources and should detail the following:

- i.* Areas at risk from other sources of flooding.
- ii.* Existing measures in use in the local planning authority area to manage flood risk (e.g., flood gates), including their effectiveness.
- iii.* Areas that are covered by flood warnings.
- iv.* Critical drainage areas as notified by the Environment Agency.
- v.* Areas that may need surface water management plans.
- vi.* Locations that may have an increased flood risk if there is additional development.

5.2.3 The SFRA-1 should contain advice for applicants carrying out site-specific flood risk assessments (such as this FRA) and should identify if there is anything specific they need to do to manage flood risk, e.g., sustainable urban drainage systems (SuDS). Site-specific flood risk assessments are required for developments which are more than 1 hectare.

5.2.4 The foregoing summary has been based on information provided on the DEFRA website.



- 5.2.5 A SFRA-1, dated February 2008, was produced by Capita Symonds (consulting engineers) on behalf of Arun District Council.
- 5.2.6 The SFRA has been reviewed and matters pertinent to the Site, the district and applicable policies are highlighted below.
- 5.2.7 In relation to Angmering and the Site, the following is of significance:

'Information on the drivers of groundwater flooding, recorded historic flood events and areas likely to experience groundwater flooding have been collated in the production of the SFRA. Much of Arun district has a high potential for groundwater flooding, due to the chalk geology. A large groundwater emergence zone (Defra, 2004) stretches across the southern half of the district, including the towns of Littlehampton and Angmering. Groundwater flooding is a known problem at Bersted, west of Bognor Regis.' (Page 112).

- 5.2.8 In relation to sustainable drainage systems (SuDS), the following is of significance:
- 5.2.9 *'It must be recognised however, that many of the typical approaches to SuDS will not work in low lying areas which suffer from high groundwater levels or seasonally waterlogged soils – as is the case in many parts of the Sussex coastal plain'* (Page 19). This would be applicable to source control infiltration SuDS techniques.

5.3 STRATEGIC FLOOD RISK ASSESSMENT LEVEL 2

- 5.3.1 The Strategic Flood Risk Assessment Level 2 (SFRA-2) is intended to provide sufficient detail for the exception test to be applied and is produced either by the local planning authority, or is commissioned by them from a flood consultancy to produce the SFRA. The SFRA-2 will follow up on any issues raised in the SFRA-1.
- 5.3.2 The SFRA-2 should assess existing flood defence infrastructure (e.g., flood barriers). The assessment should state where the flood defence infrastructure is located and what condition it is in, by reference to the organisations which operate and maintain the flood defence infrastructure, e.g., local authority or Internal Drainage Board (IDB).
- 5.3.3 The SFRA-2 should assess the risk of flood defence infrastructure failing during the lifetime of any developments, and should include an allowance for climate change as well as wave height and direction for assessments in coastal areas. Consideration should be given to the consequences of failed flood defences in the local planning authority area.
- 5.3.4 The SFRA-2 should identify anything specific which planning applicants need to do to meet the requirements of the exception test.
- 5.3.5 The foregoing summary has been based on information provided on the DEFRA website.



- 5.3.6 A SFRA-1&2, (combined Level 1 and 2), dated January 2010, was produced by Capita Symonds (consulting engineers) on behalf of West Sussex County Council.
- 5.3.7 The SFRA has been reviewed and one matter pertinent to the Site and Angmering is highlighted below.
- i.* Angmering is included in the EA's flood warning areas, reference code F5007; 'Lyminster and Angmering Village' (page 24). This is consistent with the EA's online flood warning map which delineates a corridor along Water Lane from its junction with Dapper's Lane through the village to Station Road and towards Ham Manor Golf Club.
- 5.3.8 The SFRA considers flooding from the following sources:
- i.* Rivers.
 - ii.* Sea.
 - iii.* Land.
 - iv.* Groundwater.
 - v.* Sewers.
 - vi.* Artificial sources.
- 5.3.9 The SFRA is in many respects very general and where key risk areas have been studied the analysis is based on a significant amount of hydraulic modelling; none of the identified key risk areas include Angmering.
- 5.4 **PRELIMINARY FLOOD RISK ASSESSMENT**
- 5.4.1 The Preliminary Flood Risk Assessment (PFRA) is produced either by the local planning authority, or is commissioned by them from a flood consultancy to produce the PFRA. PFRAs are intended as a high-level screening exercise to address local sources of flood risk, primarily from surface water runoff, groundwater and ordinary watercourses, which are the responsibility of the local planning authority (the Lead Local Flood Authority – LLFA).
- 5.4.2 A PFRA is an assessment of:
- i.* Floods that have taken place in the past.
 - ii.* Floods that could take place in the future.
- 5.4.3 The PFRA considers flooding from surface water runoff, groundwater and ordinary watercourses and is used to identify areas that are at risk of significant flooding, these areas are called flood risk areas. LLFAs are responsible for and prepare the PFRAs and identify the flood risk areas.



- 5.4.4 The foregoing summary has been based on information provided on the DEFRA website.
- 5.4.5 A PFRA, dated May 2011, was produced by West Sussex County Council. There are no specific references to the subject site, or Angmering in the PFRA, the PFRA focuses on areas of significant flood risk; areas of future flood risk; and past flood events with significant harmful consequences; none of which include the Site. Angmering is not included in any of the identified flood risk clusters.
- 5.4.6 Although the PFRA includes various supporting maps showing, *inter alia*, the following:
- i.* Recorded past flood events.
 - ii.* Surface water flood risk to settlements.
- 5.4.7 These are 'county wide' and are at too low a resolution to allow any meaningful interpretation with respect to the Site.
- 5.5 **SURFACE WATER MANAGEMENT PLAN**
- 5.5.1 A Surface Water Management Plan (SWMP) is defined by DEFRA in its SWMP technical guidance, which has been written for local authorities to assist them co-ordinate and lead local flood risk management activities, as a plan which outlines the preferred surface water management strategy in a given location, (DEFRA, March 2010, Surface Water Management Plan Technical Guidance).
- 5.5.2 The DEFRA technical guidance emphasises that SWMPs may not be required in all locations and that studies should be prioritised in areas considered to be at greatest risk of surface water flooding or where partnership working is essential to both understand and subsequently address surface water flooding issues.
- 5.5.3 There was no West Sussex County Council or Arun District Council Surface Water Management Plan (SWMP) available to download.
- 5.6 **CATCHMENT FLOOD MANAGEMENT PLAN**
- 5.6.1 Catchment Flood Management Plans (CFMPs) consider all types of inland flooding, from rivers, groundwater, surface water and tidal flooding. Shoreline management plans consider flooding from the sea.
- 5.6.2 CFMPs also include:
- i.* The likely impacts of climate change.
 - ii.* The effects of how land is used and managed.
 - iii.* How areas could be developed to meet present day needs without compromising the ability of future generations to meet their own needs.



- 5.6.3 CFMPs help the Environment Agency and their partners to understand the scale and extent of flooding now and to plan and agree the most effective way to manage flood risk in the future. This is achieved by setting policies for managing flood risk within the catchment.
- 5.6.4 CFMPs are used to inform planning and decision making by, *inter alia*, the Environment Agency, local authorities, internal drainage boards and transportation planners. CFMPs aim to promote more sustainable approaches to managing flood risk. CFMPs are grouped by river basin district.
- 5.6.5 The foregoing summary has been based on information provided on the DEFRA and Environment Agency websites.
- 5.6.6 A CFMP, dated December 2009, was produced by the Environment Agency for the Arun and Western Streams Catchment, which includes the area of the Site. The CFMP was downloaded from the Environment Agency website.
- 5.6.7 The CFMP describes the catchment as a landscape which varies from the hills and steep scarp slopes of the South Downs, to the gently rolling hills of the Low Weald and the wide Arun valley flood plain south of Pulborough. Flow characteristics of the rivers are reported to vary correspondingly, with fast flowing streams emerging from the High Weald area to the north, flowing into the low-lying coastal plain where the gradient is less and the river flows are much slower. The CFMP is stated to cover an area approximately 1,400 km² drained by the River Arun and its tributary the Rother.
- 5.6.8 Angmering is not specifically referenced in the CFMP, however, Angmering and the Site fall within Sub-area 7 – Lower River Arun and therefore Policy Option 5 is relevant to this sub-area; Policy Option 5 is described as:
- ‘Areas of moderate to high flood risk where we can generally take further action to reduce flood risk. This policy will tend to be applied to those areas where the case for further action to reduce flood risk is most compelling, for example where there are many people at high risk, or where changes in the environment have already increased risk. Taking further action to reduce risk will require additional appraisal to assess whether there are socially and environmentally sustainable, technically viable and economically justified options.’*
- 5.6.9 There are no details of historical flooding in the CFMP in relation to Angmering, the Site and surrounding areas. The main focus of Policy Option 5 appears to be in relation to the River Arun and associated flood defences. The CFMP highlights that in Sub-area 7 the number of properties at risk currently (i.e., 2009), is 742; this is predicted to increase to 1,099 by 2100.
- 5.6.10 There is no particular guidance on SuDS and SuDS are not highlighted within the Sub-area 7/Policy Option 5 review, although for other sub-areas the use of SuDS is highlighted as being ‘encouraged’.



- 5.6.11 In relation to Angmering and the Site the application of Policy Option 5 for the Lower River Arun sub-area is likely to translate into tight controls over runoff and requirements for on-site attenuation, storage and use of SuDS, given the CFMP's aims to 'take further action to reduce flood risk' and seeking to improve the flood risk in relation to the River Arun, of which the Black Ditch is a tributary.
- 5.7 **LOCAL FLOOD RISK MANAGEMENT STRATEGY**
- 5.7.1 A Local Flood Risk Management Strategy (LFRMS) is a requirement for all Lead Local Flood Authorities (LLFAs) to set out:
- i.* How local flood risks will be assessed and;
 - ii.* Objectives for managing local flooding.
- 5.7.2 The LFRMS should also set out the costs and benefits of the measures proposed to meet the objectives, who will deliver them and how they will be funded. Local flooding is defined as flooding that is caused by the following principal sources:
- i.* Surface water.
 - ii.* Groundwater.
 - iii.* Ordinary Watercourses.
- 5.7.3 The foregoing summary has been based on information provided on the DEFRA and Environment Agency websites.
- 5.7.4 A LFRMS, dated May 2014, was produced by West Sussex County Council.
- 5.7.5 The following general extracts from the LFRMS are of relevance:
- i.* Angmering is one of ten priority areas which West Sussex County Council has identified where risk management authorities will initially prioritise work. (page 10).
 - ii.* Angmering has 550 properties at risk from surface water flooding; 5 properties at risk from river and sea flooding; 60 properties at risk from combined sources. (Figure 6, page 31).
 - iii.* Angmering has high property numbers at risk from surface water flooding and from combined sources. (page 35).
- 5.7.6 Angmering is included in the schedule of 'wet spots' (Appendix B).



5.8 OTHER DOCUMENTS

- 5.8.1 A document entitled '*West Sussex County Council Report on June 2012 Flood Event*' dated November 2012, details the effects of an extreme rainfall event which led to widespread flooding across parts of West Sussex during 10, 11 and 12 June 2012. The report sets out 'what needs to be done' to resolve the identified problems.
- 5.8.2 In relation to Angmering, seven properties were affected in the village, one of which was in Water Lane.
- 5.8.3 Remedial works undertaken following the flooding have included, clearing of culverts, ordinary watercourses, gullies and drains.
- 5.8.4 The June 2012 flood event was reported in the Littlehampton Gazette, which reported that '*The centre of the village was completely under water after the Black Ditch burst its banks, flooding homes and businesses in Water Lane, Station Road, The Square and Arundel Road, as well as the village hall*'.

5.9 SUDS GUIDANCE

- 5.9.1 The principal SuDS guidance is provided in the Arun District Council SFRA-1 as detailed in **Section 5.2**.

SECTION 6 CONSULTATION RESPONSES: SUMMARY

6.1 ENVIRONMENT AGENCY

- 6.1.1 The Environment Agency were consulted regarding the site via an email and letter enquiry requesting a 'Product 4' for the site, dated 25 August 2015. The Environment Agency responded via two emails dated 27 August 2015, confirming that the request was being processed and 10 September 2015, requesting payment for the 'Product 4' information request. Merebrook paid the requested amount on 14 September 2015.
- 6.1.2 The Environment Agency provided the 'Product 4' information under cover of a letter dated 22 October 2015, the provide information includes the following:
- i.* Recorded Flood Outlines; these record that Water Lane has been subject to flooding through the centre of Angmering; this is based on a flood event that affected properties on the north side of Water Lane within Angmering in 1980. This also appears to be consistent with the historic flood outlines documented in **Section 5.8**.
 - ii.* Fluvial Flood Map; this is consistent with the online Fluvial Flood Map reviewed in paragraph 6.1.5.
 - iii.* Modelled Flood Levels; the flood levels and extents provided were taken from the 2010 Lower Tidal River Arun Flood Modelling study, the levels are



reported to represent undefended fluvial flood risk. The highest modelled flood level is 12.90 m AOD at node point 37i1_MN in the Black Ditch to the north of the Site and based on the 1% AEP (1 in 100 year) event. This is within Flood Zone 3. Site levels range from 18 m AOD adjacent to the A280 to a minimum elevation of 13.0 m AOD at the top of the bank to the Black Ditch. The proposed development is set at levels above 13 m AOD. The modelled flood level of 12.90 m AOD at node point 37i1_MN is considered to be anomalous, given that the upstream node point of 37_MN at 11.33 m AOD for the 1% AEP (1 in 100 year) event is 1.57 m lower. Further the modelled flood level of 11.78 m AOD for the 0.1% AEP (1 in 1000 year) event for the same upstream node point is also lower by 1.12 m.

- iv. Modelled Flood Outlines (2010 Lower Tidal River Arun Flood Modelling); these indicate that the Black Ditch and flood channel to the north of the Site are generally at risk from the 5% AEP (1 in 20 year) fluvial flood event. However, the outline appears to be constrained within the flood channel below site levels. Water Lane through the centre of Angmering is indicated to be generally at risk from the 1% AEP (1 in 100 year) fluvial flood event. This is shown to affect a number of properties and is generally consistent with historic flooding documented in paragraph 6.1.2 i. and **Section 5.8**.

- 6.1.3 Copies of correspondence with the Environment Agency, including the 'Product 4' information are included in **Appendix 2**. The 'Product 4' information reproduced in **Appendix 2** is included with the following required Environment Agency attribution statement:

"Contains Environment Agency information © Environment Agency and database right".

- 6.1.4 The Environment Agency's online mapping was consulted and the following is indicated:

Fluvial Flood Map

- 6.1.5 The Site has its northern portion within Flood Zone 3 (High Probability of flooding), associated with the Black Ditch, the flood zone extends up to and includes sections of Water Lane on the northern side and on the southern side extends almost up to the edge of the arable agricultural land and to the northern edge of Avenals Farm.
- 6.1.6 The Environment Agency's online flood warning map delineates a corridor along Water Lane from its junction with Dapper's Lane through the village to Station Road and towards Ham Manor Golf Club.

Surface Water Flood Map

- 6.1.7 There is a high risk of surface water flooding within the Flood Zone 3 'footprint' as shown on the Environment Agency fluvial flood map and as described in the preceding paragraphs.



- 6.1.8 The Site is overall indicated to be at very low risk of surface water flooding, there are some isolated areas at low risk and a small central area at high risk. The portion of the Site which lies in the Flood Zone 3 'footprint' is at medium and high risk of surface water flooding as noted in paragraph 6.1.7.

Groundwater

- 6.1.9 The groundwater map consulted online does not indicate that the Site is at risk from groundwater flooding. The Site does not lie within an Environment Agency designated groundwater source protection zone (SPZ). In terms of Environment Agency groundwater vulnerability zones, the following is indicated:
- i.* Over the north-east corner of the Site near to the Water Lane and A280 junction - Minor Aquifer High groundwater vulnerability zone.
 - ii.* Over the northern half of the Site - Minor Aquifer Intermediate groundwater vulnerability zone.
 - iii.* Over the southern half of the Site - Major Aquifer Intermediate groundwater vulnerability zone.
- 6.1.10 There is one groundwater abstraction licence within 1 km of the Site indicated on the Environment Agency online mapping. This is at Hill Barn to the east of the site.

Infrastructure

- 6.1.11 The Environment Agency online mapping does not indicate that the Site is at risk from flooding from reservoirs.

6.2 LEAD LOCAL FLOOD AUTHORITY

- 6.2.1 The Lead Local Flood Authority (LLFA) for the area, West Sussex County Council were consulted by email on 25 August 2015, in relation to the site, and any site specific flood history.
- 6.2.2 No response was ever received from the LLFA.
- 6.2.3 The West Sussex County Council Preliminary Flood Risk Assessment (PFRA), is reviewed in **Section 5**.
- 6.2.4 Copies of correspondence with the LLFA are included in **Appendix 2**.

6.3 STATUTORY DRAINAGE UNDERTAKER

- 6.3.1 Southern Water sewer records were provided by Rydon. Southern Water were contacted under cover of a letter dated 7 September 2015, and were requested to provide a capacity assessment on the existing sewer network. An initial response was received from Southern Water in a letter dated 16 September 2015, confirming receipt and that application was being processed.



- 6.3.2 The Southern Water capacity assessment was received on 6 November 2015, and included the following documents:
- i.* Covering letter.
 - ii.* Capacity assessment.
 - iii.* Foul sewer records.
- 6.3.3 The capacity assessment records that the proposal is to discharge foul flow from the Site to an existing foul manhole referenced TQ07045301 (chamber reference 5301) at the eastern end of High Street near the Spotted Cow public house and entrance to Tall Trees Bungalow. The capacity assessment concludes that there is inadequate capacity within the local foul sewerage network to accommodate the additional foul flows from the proposed development.
- 6.3.4 It is highlighted that the proposed development would increase flows to the local network and as a result existing properties and land may be subject to a greater risk of sewer flooding.
- 6.3.5 The capacity assessment details the upgrade works required in Table 1 and Figure 2 included within the assessment and highlights that Section 98 of the Water Industry Act 1991 provides the legal mechanism through which the appropriate infrastructure can be requested by the developer.
- 6.3.6 Table 1 and Figure 2 indicate that approximately 825 m of existing foul sewer would have to be upgraded/pipe diameters enlarged and an additional 110 m³ of storage provided at the Station Road Pumping Station.
- 6.3.7 No capacity assessment request was made for surface water.
- 6.3.8 The sewer records provided by Rydon show the following:

Surface Water Sewers

There are no surface water sewers present on or near the site.

Foul Water Sewers

There are no foul water sewers present on or near the site.

Nearest Sewers

The nearest foul sewer is at the eastern end of High Street, the end of sewer run chamber reference is 5301, this is indicated to be a 150 mm diameter VC (vitrified clay) pipe with a chamber cover level of 15.26 m AOD and an invert level of 12.83 m AOD. This sewer is approximately 50 m from the nearest point on the Site.

The nearest surface water sewer (300 mm diameter vitrified clay pipe) is within an existing residential estate to the south (Highdown Close); which is isolated from the



Site by approximately 420 m (from the nearest point on the Site). This is the only surface water sewer shown on the sewer record sheet.

The Site is isolated from the existing Section 104 sewer network (Sewer Catchment/Section 104 Area boundary) by double magenta lines, although these are not shown on the sewer records provided with the capacity assessment.

- 6.3.9 The provided Southern Water sewer records, correspondence and capacity assessment are included in **Appendix 3**.

SECTION 7 POTENTIAL SOURCES OF FLOODING

7.1 GENERAL

- 7.1.1 BS 8533: 2011 'Assessing and managing flood risk in development – Code of practice' details recommendation and guidance on the appropriate assessment and management of flood risk where development is proposed in the UK. It is intended to provide developers with practical assistance for dealing with flood risk in and around their development.

- 7.1.2 It outlines that an assessment should be made of flood risk both **to** the development site and **as a result of** the development site in relation to the following sources of flooding:

- i. Tidal and fluvial flooding – flooding from main rivers, ordinary watercourses and the sea.
- ii. Surface water flooding – flooding from overland flow due to rainfall.
- iii. Flooding from sewers and drains – flooding from surcharging of below ground drainage systems.
- iv. Groundwater flooding – flooding related to the water table, where ground water levels rise above surface levels.
- v. Flooding caused by the failure of infrastructure – flooding from reservoir, canal or land drainage infrastructure, usually as a result of catastrophic failure.

Sections 8 and 9 summarise the significant potential sources of flooding identified from a desk based appraisal. These potential sources have been used to inform further actions or mitigations, as described later in **Section 10**.

SECTION 8 ASSESSMENT OF FLOOD RISK TO THE DEVELOPMENT

8.1 FLUVIAL FLOOD RISK TO THE SITE

- 8.1.1 The majority of the Site is located in Flood Zone 1, however its northern portion is within Flood Zone 3. That is land assessed as having a 1% (1 in 100) or greater annual probability of river flooding or a 0.5% (1 in 200) or greater annual probability



of flooding from the sea This is confirmed by a review of the Environment Agency online fluvial flood mapping as discussed in **Section 6**.

8.1.2 The Black Ditch flows in the northern portion of the Site adjacent to Water Lane. The Black Ditch is likely to be an ordinary watercourse up to the point where it exits from the culvert beneath the Water Lane and A280 junction at which point it is enmained.

8.1.3 Given the foregoing, the risk to the site from fluvial/tidal flooding is considered to be **low** in Flood Zone 1 and further action or mitigation is unlikely to be required; **high** in Flood Zone 3, however, this is likely to be the functional floodplain and therefore no further action or mitigation is anticipated for the undeveloped site.

8.2 SURFACE WATER FLOOD RISK TO THE SITE

8.2.1 Surface water flooding is generally associated with either sloping land with poor permeability, or land that is topographically low relative to its surroundings, known as a 'low spot'.

8.2.2 Review of the local topography based on the provided topographic survey indicates that the Site falls from east to west; east to north-west and east to south-west from a maximum elevation of approximately 18 m AOD to a minimum elevation of 13.0 m AOD at the top of the bank to the Black Ditch. Overall average gradients across the site range from 1 in 30 to 1 in 135. In the north of the Site overland flow routes will tend to be to the north and west towards the Black Ditch into which it is likely that surface water will eventually drain. In the south of the site the more gentle gradients to the south and west will reduce the extent of overland flow and the underlying geology of River Terrace Deposits overlying Chalk may afford some infiltration.

8.2.3 The Western Parcel has levels in the range 16.0 m AOD to 14.0 m AOD, falling to the north and west, therefore overland flow routes will tend to be to the north and west towards undeveloped land to the north and Weavers Hill road to the west. The six soakage tests which were carried out across the parcel in 2014 by Southern Testing/ST Consult reported good soakage capacity. It is likely therefore that surface water will tend to infiltrate in this area rather than presenting a flood risk to the Site and adjacent areas.

8.2.4 A review of the Environment Agency online mapping indicates that overall the Site is at very low risk from surface water flooding. The portion of the Site which lies in the Flood Zone 3 'footprint' is at medium and high risk of surface water flooding, however this area is at a lower elevation relative to the remainder of the site and will be self-contained and unlikely to pose a risk to the remainder of the site.

8.2.5 There is no known history of surface water flooding on or in the vicinity of the Site. This may be due to events not having occurred, or may be due to instances not having any significant consequences based on the current land use.

8.2.6 The risk to the undeveloped site from surface water flooding is considered to be **low** and mitigation is not considered to be required.



8.3 FLOOD RISK TO THE SITE FROM SEWERS & DRAINS

- 8.3.1 As discussed in **Section 6**, there are no foul or surface water sewers present on or near the Site. There are no known instances of sewer flooding in the vicinity of the Site.
- 8.3.2 The risk to the undeveloped site from flooding from existing sewers and drains is considered to be **low**, and mitigation is not considered to be required.

8.4 GROUNDWATER FLOOD RISK TO THE SITE

- 8.4.1 Groundwater flooding occurs where groundwater levels rise above the ground surface level. Flooding can also occur due to seepage from higher ground where land is low-lying relative to its surroundings, or in locations where there is superficial clay geology with 'lenses' of sand which fill with water.

- 8.4.2 As described in **Section 2**, the underlying geology comprises:

Head deposits and River Terrace deposits overlying the London Clay Formation and the Lambeth Group in the north of the site; and River Terrace deposits overlying Chalk in the south of the site. The Head deposits are classified as a Secondary Aquifer – Undifferentiated, and the River Terrace deposits are classified as a Secondary (A) Aquifer; both of which may support localised groundwater. The Chalk is classified as the Principal Aquifer.

The Chalk may present a risk of groundwater flooding where unconfined and associated with sloping ground with seepage from higher ground or where groundwater levels rise above the ground surface level. However, the Chalk is confined by the overlying Head and River Terrace deposits, which although may support localised groundwater also contain clay and silt which will tend to reduce their overall permeability.

- 8.4.3 The gradients on the Site are relatively slack, therefore there is a low risk of groundwater seeping from higher ground.
- 8.4.4 The Environment Agency groundwater map consulted online does not indicate that the Site is at risk from groundwater flooding.
- 8.4.5 There is a risk from groundwater flooding in the Arun district as identified in the SFRA-1, but this is very general rather than site or area specific and related to the Chalk.
- 8.4.6 The GroundSure® reports, have identified that according to the BGS, the site has the highest susceptibility to groundwater flooding based on the underlying geological conditions and it is considered to be a potential at the surface (Clearwater Flooding), the BGS has assigned a high confidence rating to this result. However, no specific details or location are provided and the GroundSure® reports have not identified to which parcel this relates, or whether both parcels are at risk. This will nevertheless require further investigation.



8.4.7 The risk to the undeveloped site from groundwater flooding is considered to be **low**, however, given the BGS reference to the site having susceptibility to Clearwater Flooding, further investigation is considered to be required in order to assess this risk. This is discussed in **Section 10**.

8.5 FLOOD RISK FROM INFRASTRUCTURE FAILURE

8.5.1 There are no known canals in the vicinity of the site.

8.5.2 The Environment Agency mapping consulted online does not indicate that the site is at risk from reservoir flooding.

8.5.3 There are no known drainage ditches in close proximity to the site. The flood risk from main rivers and ordinary watercourses is discussed under the heading of fluvial flood risk, in **Section 8.1**.

8.5.4 The ponds associated with the Black Ditch (discussed in **Section 2.3**) are considered to be part of the fluvial flood risk discussed in **Section 8.1**.

8.5.5 The risk to the site from the failure of infrastructure is considered to be **low** and mitigation is not considered to be required.

8.6 SUMMARY OF FLOOD RISK TO THE DEVELOPMENT

Flood Risk	Summary of risk to the proposed development	Notes	* Further action or mitigation potential
Fluvial FZ1 FZ3	Low High	Specific mitigation unlikely. Specific mitigation unlikely, functional floodplain.	× ×
Surface water	Low	Specific mitigation unlikely	×
Sewers and drains	Low	Specific mitigation unlikely	×
Groundwater	Low	Further investigation required in relation to BGS reference to Clearwater Flooding risk.	✓
Failure of infrastructure	Low	Specific mitigation unlikely	×

* For proposed action(s) and/or mitigation refer to **Section 10**.



SECTION 9 ASSESSMENT OF FLOOD RISK FROM THE DEVELOPMENT

9.1 IMPACT ON FLUVIAL FLOODING

9.1.1 Loss of Floodplain

9.1.1.1 As discussed in **Section 4.5**, although part of the Site is located in Flood Zone 3, the Pro Vision Planning & Design '*Preliminary Illustrative Layout*' does not show any development in the portion of the Site which lies in Flood Zone 3; this area is shown as being landscaped. The remainder and majority of the Site is located in Flood Zone 1. The development is therefore not considered to have an impact on the fluvial floodplain of any main rivers.

9.1.1.2 The impact of the proposed development on the fluvial floodplain is expected to be **low** and it is not anticipated that mitigation will be required.

9.1.2 Increase in Fluvial Flows

9.1.2.1 The nature of the proposed development (residential housing replacing undeveloped agricultural land) means that impermeable areas and therefore run-off will increase.

9.1.2.2 Since the provided sewer records indicate that there are no sewers present on or near the site, it is likely to be preferable to discharge attenuated surface water into the Black Ditch for the majority of the Site. However, the soakage tests which were carried out on the Weavers Hill Parcel, which reported good soakage capacity, provides the potential for this parcel to use infiltration SuDS.

9.1.2.3 The potential impact of the majority of the development on fluvial flows is considered to be **high** and action or mitigation will be required. This is discussed in **Section 10**.

9.2 IMPACT ON SURFACE WATER FLOODING

9.2.1 The nature of the proposed development means that impermeable areas and therefore run-off will increase. If left unmanaged, this run-off is likely to dissipate to areas adjacent to the site via overland flow routes, increasing the risk of surface water flooding in other areas.

9.2.2 The impact of the proposed development on surface water is therefore considered to be **high** and further action or mitigation will be required. This is discussed in **Section 10**.

9.3 IMPACT ON SEWER FLOODING

9.3.1 As discussed in **Section 6**, there are no foul or surface water sewers present on or near the site.

9.3.2 New surface water drainage is proposed as part of the proposed development, which could introduce a source of flood risk to the site and surrounding areas via surcharging. However, surface water will be managed by means of attenuation and



storage on site, prior to discharge to the Black Ditch, and in the case of the Weavers Hill Parcel, by means of infiltration SuDS, this is described in the actions, mitigations and drainage strategy in **Section 10**.

9.3.3 The impact of the proposed development on surface water sewer flooding is therefore considered be **low** and action or mitigation is unlikely to be required provided the described in the actions, mitigations and drainage strategy in **Section 10** are followed.

9.3.4 The nearest foul sewer to the Site is approximately 50 m from the nearest point on the Site (refer to **Section 6.3**), this is 150 mm diameter and the Southern Water capacity assessment has indicated that this sewer and others downstream are of inadequate capacity to service the new development. The Southern Water capacity assessment has indicated that significant off-site reinforcement/upgrading works will be required to provide the required capacity.

9.3.5 The impact of the proposed development on foul water sewer flooding is therefore considered to be **high** and action or mitigation will be required as described in **Section 10**.

9.4 **IMPACT ON GROUNDWATER FLOODING**

9.4.1 As described in **Section 8.4**, the provided/available information suggests that the site has a high potential for flooding from groundwater, as there is a BGS reference to the site being susceptible to Clearwater Flooding, and further investigation is considered to be required in order to assess this risk.

9.4.2 An increase in the likelihood of groundwater flooding is generally related to changes in sub-surface flow paths as a result of underground structures, such as basements or sheet piling. Such structures are not expected to be proposed as part of the development.

9.4.3 It is noted that the anticipated means of disposal of surface water will be by means of attenuation and storage prior to discharge into the Black Ditch for the majority of the Site, rather than by infiltration. It is considered that this may decrease the risk of groundwater flooding relative to the existing situation. However, it is considered feasible that infiltration SuDS may be used on the Weavers Hill Parcel.

9.4.4 Provided that significant below-ground structures are not proposed, the impact of the development on groundwater flooding to adjacent areas is expected to be **low**. However further action is required to verify groundwater levels and assess the risk from Clearwater Flooding. This is discussed in **Section 10**.



9.5 IMPACT ON FLOOD RISK FROM INFRASTRUCTURE FAILURE

- 9.5.1 As discussed in Section 8.5.1 there are no canals in the vicinity of the site.
- 9.5.2 As discussed in Section 8.5.2 the site is not at risk from flooding from reservoirs.
- 9.5.3 As discussed in Section 8.5.3, there are no known drainage ditches in close proximity to the site.
- 9.5.4 As discussed in Section 8.5.4, the ponds associated with the Black Ditch are considered to be part of the fluvial flood risk, this is discussed in **Section 9.1**.
- 9.5.5 The impact of the proposed development on flood risk related to the failure of infrastructure is considered to be **low**, therefore mitigation is unlikely to be required.

9.6 SUMMARY OF FLOOD RISK FROM THE DEVELOPMENT

Flood Risk	Summary of risk from the proposed development	Notes	* Further action or mitigation potential
Fluvial	Loss of Floodplain - Low	Impact on fluvial floodplain considered unlikely.	x
	Increase in fluvial flows - High	Management of fluvial flows required.	✓
Surface water	High	Management of run-off required.	✓
Sewers and drains	Surface water Low	Proposed discharge of attenuated surface water to the Black Ditch and use of infiltration SuDS on the Weavers Hill Parcel.	x
	Foul water High	The discharge of foul flows will require off-site reinforcement/upgrading works as set out in the Southern Water capacity assessment.	✓
Groundwater	Low	Further action is required to verify groundwater levels and assess the risk from Clearwater Flooding.	✓ **
Failure of infrastructure	Low	Specific mitigation unlikely.	x

* For proposed action(s) and/or mitigation refer to **Section 10**.

** Subject to there being no significant below-ground structures (e.g., basements, sheet piling etc.) proposed as part of the development.



SECTION 10 ACTIONS & MITIGATION

10.1 OVERVIEW

- 10.1.1 As discussed in **Sections 8 and 9**, further action and/or mitigation may be required in order to assess and manage any flood risks as a result of the development.
- 10.1.2 A sequential, risk-based approach to managing flood risk has been taken, as detailed in BS 8533:2011 'Assessing and managing flood risk in development – Code of practice', with mitigation stages in order of preference as follows:
- i.* Assessing and understanding the flood risk – achieving a sound understanding of risk, filling in gaps in understanding where practicable;
 - ii.* Avoiding the risk – Avoid building in areas of the site that are likely to be affected by flooding;
 - iii.* Substitution – allocating land uses within the site so that those most vulnerable to flooding are at lowest risk;
 - iv.* Control – incorporating flood risk management infrastructure such as barriers, water storage, surface and/or groundwater management, and safe overland flow pathways;
 - v.* Mitigation – where the risk of flooding cannot be avoided, the residual risks should be safely managed, by raising floor levels, or where appropriate, with the use of resistant/resilient building techniques to minimise the damage and disruption caused by flooding;
 - vi.* Public safety – public safety should be considered in all aspects of managing flood risk, and includes consideration of safe routes of access and egress, both within and outside of any proposed development, in addition to emergency planning.

10.2 FLOOD RISK TO THE PROPOSED DEVELOPMENT

- 10.2.1 An assessment of flood risk to the site has indicated the risk from the following sources as:
- i.* Fluvial; Flood Zone 1 – low risk.
 - ii.* Fluvial; Flood Zone 3 – high risk.
 - iii.* Surface water – low risk.
 - iv.* Sewers and drains – low risk.
 - v.* Groundwater – low risk.
 - vi.* Infrastructure failure – low risk.



- 10.2.2 In relation to fluvial flood risk from the portion of the Site which lies within Flood Zone 3, as this is likely to be the functional floodplain no further action or mitigation is anticipated for the undeveloped site. Mitigation is however required in order to manage the impact from the following:

10.3 **GROUNDWATER FLOODING**

- 10.3.1 There is a high risk from groundwater flooding, further investigation is required in relation to a BGS reference to Clearwater Flooding risk.

10.4 **FLOOD RISK FROM THE PROPOSED DEVELOPMENT**

- 10.4.1 An assessment of the impact of the development on flood risk elsewhere has indicated that the proposed development has the potential to impact flood risk in the vicinity of the site, as follows:

- i.* Increase in the risk of fluvial and surface water flooding.
- ii.* Increase in the risk of foul water sewer flooding due to the nearest foul sewer to the Site being of inadequate capacity to service the new development.

- 10.4.2 Mitigation is required in order to manage these impacts, as described below.

10.5 **SURFACE WATER MANAGEMENT**

- 10.5.1 Adequate surface water management is required for the proposed development in order to control the risk of flooding associated with an increase in the amount of surface water runoff which must be managed through collection, and storage in times of high flows.

- 10.5.2 In order to establish the likely attenuation requirements for the site, and to demonstrate adequate mitigation for the increase in runoff, the pre-development Greenfield runoff must be assessed.

10.6 **PRE-DEVELOPMENT GREENFIELD RUNOFF ASSESSMENT**

- 10.6.1 A Greenfield runoff assessment was completed for the 9.023 ha site (**Section 2**) using the ICP SuDS Mean Annual Flood method. Outputs from Microdrainage Source Control software are included in **Appendix 4**. Since there is a change in gradient and watershed between the northern and southern portions of the eastern part of the Site as described in **Section 2.1**, the Greenfield runoff assessment has been split between the two portions as follows:

- i.* Eastern Parcel (North) – 1.330 ha; the results of which are included in **Table 10.1**.
- ii.* Eastern Parcel (South) – 1.036 ha; the results of which are included in **Table 10.2**.

Note; the Western Parcel - 0.586 ha, is to use infiltration SuDS, refer **Section 10.8**.



Design Event	Runoff (l/s)
Development mean annual peak flow (Q_{BAR})	4.7
100% (1 in 1) annual event probability (Q_{1yr})	4.0
3.33% annual event probability (Q_{30yr})	10.8
1% annual event probability (Q_{100yr})	15.1

Table 10.1 Greenfield Runoff Assessment – Eastern Parcel (North)

- 10.6.2 This equates to a mean annual Greenfield runoff rate per hectare at 3.5 litres/second.

Design Event	Runoff (l/s)
Development mean annual peak flow (Q_{BAR})	3.7
100% (1 in 1) annual event probability (Q_{1yr})	3.1
3.33% annual event probability (Q_{30yr})	8.4
1% annual event probability (Q_{100yr})	11.8

Table 10.2 Greenfield Runoff Assessment – Eastern Parcel (South)

- 10.6.3 This equates to a mean annual Greenfield runoff rate per hectare at 3.6 litres/second.

10.7 METHOD OF DISPOSAL OF SURFACE WATER

- 10.7.1 Current national guidance including but not limited to Requirement H3 of the Building Regulations Approved Document H 'Drainage and Waste Disposal' (2000) indicates the following surface water management options should be considered (listed in order of preference):

- i. Disposal via on-site infiltration system (source control)
- ii. Disposal to off-site watercourse; or,
- iii. Disposal to off-site sewer.

- 10.7.2 An assessment the appropriateness of each of these solutions for the site is detailed below.

10.8 DISPOSAL BY INFILTRATION

- 10.8.1 As discussed in **Section 5** the SFRA-1 highlights the requirement for the incorporation of SuDS into surface water drainage.



- 10.8.2 The six soakage tests which were carried out across the Western Parcel in 2014 by Southern Testing/ST Consult reported good soakage capacity. The report summarised that the following rates could be considered:
- i.* TP1 – 1×10^{-5} m/s.
 - ii.* TPs 2, 3 and 5 – 2.5×10^{-4} m/s.
 - iii.* TP6 – 5×10^{-5} m/s.
- 10.8.3 The nature of the site geology as discussed in **Section 2.4**, means that:
- i.* The Western Parcel is likely to be appropriate for infiltration.
 - ii.* The Eastern Parcel (South) may be appropriate for infiltration, subject to further soakage testing to confirm permeability.
 - iii.* The Eastern Parcel (North) is unlikely to be appropriate for infiltration.
- 10.8.4 Given the foregoing, it is suggested that source control techniques may be incorporated through the use of infiltration SuDS/soakaways in the Western Parcel and Eastern Parcel (South). The potential location of these systems are included as part of the proposed drainage strategy for the site, as featured in **Appendix 5**
- 10.8.5 As part of any future intrusive site investigation and detailed drainage design, infiltration testing should be carried out on the Eastern Parcel (South) to confirm permeability, dependent on percolation and groundwater levels. Merebrook is to undertake groundwater monitoring in the first instance to assess whether there is potential for infiltration. If the results of the groundwater monitoring indicate potential for infiltration, then soakage testing will be undertaken to confirm permeability. The results of groundwater monitoring and soakage testing, if the latter is undertaken, will be reported separately.
- 10.8.6 The Site does not lie within an Environment Agency designated groundwater source protection zone (SPZ) and therefore SPZs are unlikely to be impacted by the use of infiltration SuDS/soakaways.
- 10.9 **DISPOSAL TO WATERCOURSE**
- 10.9.1 Given the proximity of the Black Ditch to the northern part of the site, it is likely to be preferable to discharge surface water into the watercourse system. This is the premise of the drainage strategy featured in **Appendix 5**, for the Eastern Parcel (North).
- 10.9.2 In order to adequately manage risk associated with an increase in the impermeable area on site, the discharge rate into the watercourse must be restricted to the value of the mean annual peak flow (Q_{bar}), at 4.7 litres/second (**Section 10.6**), for all events up to and including the 1% (1 in 100) AEP as detailed in EA Report SC030219



‘Rainfall runoff management for developments’ (2013). This requires attenuation of runoff volumes, as detailed in **Section 10.10**.

- 10.9.3 Consent to discharge will be required from the Environment Agency as the Black Ditch is main river from the point where it exits from the culvert beneath the Water Lane and A280 junction.

10.10 **SURFACE WATER ATTENUATION**

- 10.10.1 The SFRA-1 suggests that SuDS techniques should be designed to provide attenuation, or combined attenuation and infiltration.

- 10.10.2 As featured in the drainage strategy illustrated on drawing 19495-Sth-301-001, attenuation is proposed by way of two detention basins with the following storage volumes:

i. Northern Basin - 1519 m³.

ii. Southern Basin - 1188 m³.

iii. Total – 2707 m³.

- 10.10.3 Design calculations for the attenuation storage volume, was completed using the MicroDrainage Source Control Quick Storage Estimate tool, included in **Appendix 4**, demonstrate no flooding occurs up to the 1% (1 in 100) Annual Exceedance Probability with 40% allowance on inflows for climate change (**Section 10.13**). The climate change allowance is based on the Environment Agency’s guidance ‘*Flood risk assessments: climate change allowances, dated 19 February 2016*’.

- 10.10.4 The maximum outflow from the Northern Basin is 4.7 litres/second and from the Southern Basin is 3.7 litres/second, both in line with the values for Qbar detailed in **Section 10.6**. This demonstrates that the peak discharge rate for all events up to and including the 1% (1 in 100) Annual Exceedance Probability with 40% allowance on inflows for climate change (**Section 10.13**), will not exceed that of the existing site.

10.11 **IMPACT ON SEWERS AND DRAINS**

- 10.11.1 The nature of the proposed development means that residential foul flows will be generated from the 175 dwellings. Southern Water has confirmed that the foul sewer network does not have capacity to receive foul flows from the development. The Southern Water capacity assessment has indicated that significant off-site reinforcement/upgrading works will be required to provide the required capacity.

- 10.11.2 Based on ‘Sewers for Adoption’ (WRC), the design flow for gravity sewers for residential developments should be 4000 litres/unit dwelling/per 24 hours. Based on 175 dwellings, this equates to 8.1 litres/second. The Southern Water advised off-site reinforcement/upgrading works will therefore need to be undertaken in order to prevent an increased flood risk from foul sewers as a result of the development.



- 10.11.3 As noted in **Section 10.8**, Eastern Parcel (South) may be appropriate for infiltration SuDS, subject to further soakage testing to confirm permeability. However, if the results of infiltration testing are not favourable for the use of infiltration SuDS, a surface water sewer requisition will be required to take attenuated flows from the southern detention basin as described in **Section 10.10**. This is the premise of the drainage strategy featured in **Appendix 5**, for the Eastern Parcel (South).

10.12 GROUNDWATER FLOODING

- 10.12.1 As detailed in **Section 9.4**, the risk of groundwater flooding as a result of the development is thought to be low, however, further action is required to verify groundwater levels and assess a risk identified by the BGS in relation to groundwater flood susceptibility from Clearwater Flooding.
- 10.12.2 It is recommended that the BGS identified risk be investigated further by means of consultation with the BGS and others sources as appropriate
- 10.12.3 The results of on-site investigations should be assessed in order to further understand the level of risk. Where this risk is low, no further action is required, however if groundwater levels are found to be at, or near the surface, mitigation may be required, as described in **Section 10.1**.

10.13 CLIMATE CHANGE – FEBRUARY 2016 GUIDANCE

- 10.13.1 The frequency and intensity of rainfall is predicted to increase as a result of climate change. Allowance for how this will affect the development proposals will need to be factored into the design.
- 10.13.2 The Environment Agency's guidance 'Flood risk assessments: climate change allowances, 19 February 2016' supersedes⁽¹⁾ the earlier guidance produced in September 2013, which suggested that a 30% precautionary sensitivity range should be added to peak rainfall intensity and 20% added to peak river flows.

⁽¹⁾The 2016 guidance provides for temporary transitional arrangements that apply as of 19 February 2016, where development plans or proposals are well advanced based on the previous allowances, in these cases the Environment Agency will base its advice on the previous allowances. However, new developments will be required to follow the 2016 guidance. The transitional arrangements are expected to end on 1 September 2016, following which the new guidance will apply to all developments.

Peak River Flow Allowances

- 10.13.3 The 2016 guidance provides for peak river flow allowances to be assessed by river basin districts, flood zone and flood risk vulnerability classification (**Section 4.3**). Table 1 of the guidance provides a range of allowances based on percentiles to be applied (added) based on the flood zone and flood risk vulnerability classification for the site location and proposed land use respectively for each river basin district. The percentiles used are as follows:



- i. Central allowance, based on the 50th percentile.
- ii. Higher central allowance, based on the 70th percentile.
- iii. Upper end allowance, based on the 90th percentile.

10.13.4 Table 1 is reproduced as **Table 10.2** in this FRA. It is noted that the baseline to which the percentages in the table should be added is the 1961 to 1990 baseline.

River basin district	Allowance category	Total potential change anticipated for 2015 to 2039	Total potential change anticipated for 2040 to 2069	Total potential change anticipated for 2070 to 2115
Northumbria	Upper end	20%	30%	50%
	Higher central	15%	20%	25%
	Central	10%	15%	20%
Humber	Upper end	20%	30%	50%
	Higher central	15%	20%	30%
	Central	10%	15%	20%
Anglian	Upper end	25%	35%	65%
	Higher central	15%	20%	35%
	Central	10%	15%	25%
South East	Upper end	25%	50%	105%
	Higher central	15%	30%	45%
	Central	10%	20%	35%
Thames	Upper end	25%	35%	70%
	Higher central	15%	25%	35%
	Central	10%	15%	25%
South West	Upper end	25%	40%	85%
	Higher central	20%	30%	40%
	Central	10%	20%	30%
Severn	Upper end	25%	40%	70%
	Higher central	15%	25%	35%
	Central	10%	20%	25%
Dee	Upper end	20%	30%	45%
	Higher central	15%	20%	25%
	Central	10%	15%	20%
North West	Upper end	20%	35%	70%
	Higher central	20%	30%	35%
	Central	15%	25%	30%
Solway	Upper end	20%	30%	60%
	Higher central	15%	25%	30%
	Central	10%	20%	25%
Tweed	Upper end	20%	25%	45%



River basin district	Allowance category	Total potential change anticipated for 2015 to 2039	Total potential change anticipated for 2040 to 2069	Total potential change anticipated for 2070 to 2115
	Higher central	15%	20%	25%
	Central	10%	15%	20%

Table 10.2 Peak River Flow Allowances by River Basin District

10.13.5 The table should be read in conjunction with the flood zone and flood risk vulnerability classification for the site location within the relevant river basin district in order to determine the appropriate percentage allowance in the table to be added. The guidance is published with a set of river basin district maps in order to assist determining which river basin district a site may be located.

10.13.6 The flood zone, flood risk vulnerability classification and allowances to be added are reproduced below.

Flood Zone 2

Essential Infrastructure – use the higher central and upper end to assess a range of allowances.

Highly Vulnerable – use the higher central and upper end to assess a range of allowances.

More Vulnerable – use the central and higher central to assess a range of allowances.

Less Vulnerable – use the central allowance.

Water Compatible – use none of the allowances.

Flood Zone 3a

Essential Infrastructure – use the upper end allowance.

Highly Vulnerable – development should not be permitted.

More Vulnerable – use the higher central and upper end to assess a range of allowances.

Less Vulnerable – use the central and higher central to assess a range of allowances.

Water compatible – use the central allowance.

Flood Zone 3b (Functional Floodplain)

Essential Infrastructure – use the upper end allowance.

Highly Vulnerable – development should not be permitted.



More Vulnerable – development should not be permitted.

Less Vulnerable – development should not be permitted.

Water Compatible – use the central allowance.

10.13.7 The 2016 guidance notes that:

'If (exceptionally) development is considered appropriate when not in accordance with flood zone vulnerability categories, then it would be appropriate to use the upper end allowance.'

Peak Rainfall Intensity Allowances

10.13.8 The 2016 guidance provides for peak rainfall intensity allowances for central and upper end allowances only, which apply across all of England. These are set out in Table 2 of the guidance which is reproduced as **Table 10.3** in this FRA. It is noted that the baseline to which the percentages in the table should be added is the 1961 to 1990 baseline.

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%

Table 10.3 Peak Rainfall Intensity Allowances in Small & Urban Catchments

10.13.9 The guidance notes that flood risk assessments and strategic flood risk assessments should assess both the central and upper end allowances to understand the range of impact.

Sea Level Allowances

10.13.10 The 2016 guidance provides for a single regional allowance for each epoch or time frame for sea level rise in Table 3. Sea level rise is driven in part by climate change and in part by glacial isostatic re-adjustment resulting from the release of pressure after ice that covered large parts of northern Britain melted at the end of the last ice age. The northern part of the country is slowly rising and the southern part is slowly sinking. For this reason net sea level rise is less for the north-west and north-east than the rest of the country.

10.13.11 The Table 3 allowances are reproduced as **Table 10.4** in this FRA. It is noted that the baseline to which the percentages in the table should be added is the 1990 baseline.

10.13.12 The boundaries between the three regions used in Table 3 of the 2016 guidance is shown on the river basin district maps; these are as follows:

- i. The north-west and north east of England is north of Flamborough Head.



- ii. The east, East Midlands, London and the south-east is south of Flamborough Head.
- iii. The south-west of England is defined as the parts of the country to the west of a boundary between the Isle of Wight in the south to Weston-super-Mare in the north.

Area of England	1990 to 2025 (mm)	2026 to 2050 (mm)	2051 to 2080 (mm)	2081 to 2115 (mm)	Cumulative Rise 1990 to 2115
East, East Midlands, London, South-East	4 (140)	8.5 (212.5)	12 (360)	15 (525)	1.24 metres
South-West	3.5 (122.5)	8 (200)	11.5 (345)	14.5 (507.5)	1.18 metres
North-West, North-East	2.5 (87.5)	7 (175)	10 (300)	13 (455)	1.02 metres

Table 10.4 Sea Level Allowances for Each Epoch

(millimetres per year with cumulative sea level rise for each epoch in brackets)

10.13.13 The sea level is calculated by selecting an allowance for the appropriate geographical area for the location of the site and adding to the 1990 base sea level year. Either the cumulative total(s) for the relevant epoch(s) or parts thereof (if less than a full epoch) are added to the 1990 base sea level year. However, residential development with a life expectancy of 100 years will mean that the cumulative rise for the period 1990 to 2115 will be applied.

Offshore Wind Speed & Extreme Wave Height Allowances

10.13.14 Offshore wind speed and extreme wave height allowance is provided for in the 2016 guidance by means of percentage allowances to be added to the 1990 baseline as detailed in Table 4. Table 4 of the guidance is reproduced as **Table 10.5** in this FRA.

Applies Around all the English Coast	1990 to 2050	2051 to 2115
Offshore wind speed allowance	+5%	+10%
Offshore wind speed sensitivity test	+10%	+10%
Extreme wave height allowance	+5%	+10%
Extreme wave height sensitivity test	+10%	+10%

Table 10.5 Offshore Wind Speed & Extreme Wave Height Allowances

10.13.15 The guidance notes that wave heights are predicted to change because of increased water depths resulting from climate change, as will the frequency, duration and severity of storms. Flood risk assessments should use the single allowance for each epoch for wind speed and wave height in Table 4 and the 10% sensitivity allowance to understand the range of impacts.



High++ Allowances for Peak River Flood Flow & Mean Sea Level

10.13.16 The guidance refers to 'high++ allowances', and that these will only apply to assessments for developments that are very sensitive to flood risk and with lifetimes beyond the end of the century. For example, infrastructure projects or developments that significantly change existing settlement patterns, including urban extensions and new settlements. The high++ allowances are provided in Table 3 of the Environment Agency document 'Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities', reference LIT_5707. The PDF document is undated, however, the document metadata indicates a 'create date' of 1 March 2016.

Application

10.13.17 The application of the climate change allowances in the assessment of flood risk as part of this FRA is undertaken as follows:

Inland Sites/No Coastal Exposure

- i.* Peak River Flow Allowances, and/or,
- ii.* Peak Rainfall Intensity Allowances, and in very sensitive flood risk areas,
- iii.* High++ Allowances for Peak River Flood Flow.

Sites With Coastal Exposure

- i.* Peak River Flow Allowances, and/or,
- ii.* Peak Rainfall Intensity Allowances, and
- iii.* Sea Level Allowances, and
- iv.* Offshore Wind Speed & Extreme Wave Height Allowances, and in very sensitive flood risk areas,
- v.* High++ Allowances for Peak River Flood Flow & Mean Sea Level.

10.13.18 The allowances used from this sub-section are referenced in the preceding sub-sections of **Section 10 – Actions & Mitigation**.

10.14 SCOPE

10.14.1 Given the outline nature of the development, the actions and mitigations detailed in the preceding sections are intended as guidance for the next stages of the development in relation to flood risk, and not as a definitive list of the requirements. These actions and mitigations should be developed as additional information becomes available.



10.15 **SUMMARY**

- 10.15.1 This FRA is intended as a qualitative study based upon a desk-based assessment, readily available information, and where applicable, responses from consultees.
- 10.15.2 The proposals comprise the construction of a residential development of 175 units.
- 10.15.3 The majority of the Site is located in Environment Agency Flood Zone 1, namely, areas with a low probability of flooding from main rivers. A portion of the Site is located in Flood Zone 3, however, it is not proposed to develop in Flood Zone 3, the area being set aside for landscaping.
- 10.15.4 The site is classed as having 'More Vulnerability' (residential housing) to flooding, as outlined in '*Planning practice Guide – Flood Risk and Coastal Change*', for the proposed land uses.
- 10.15.5 Development of 'More Vulnerable' uses is compatible with Flood Zone 1 and it is considered that the Sequential Test has been applied. The Exception Test is not required.
- 10.15.6 A review of relevant planning documents outline the guidance and recommendations in relation to the use of SuDS techniques and also highlights guidance relating to Greenfield run-off and climate change.
- 10.15.7 An assessment of flood risk to the development site highlighted that there is a low risk from all sources of flooding. However, the potential for groundwater flood susceptibility from Clearwater Flooding requires further investigation.
- 10.15.8 An assessment of flood risk as a result of the development suggests that an increase in the risk of fluvial flooding and could lead to an increased risk of surface water flooding and an increase in the risk of sewer flooding. Mitigations are proposed to manage runoff from the site to pre-development (Greenfield) rates, meaning that there will be no increase in volumes up to and including the 1% (1 in 100) annual exceedance probability event.
- 10.15.9 However, a significant obstacle to the development is the absence of any sewers on or near the site. The nearest foul sewer is approximately 50 m from the nearest point on the Site and this sewer and others downstream are of inadequate capacity to service the new development. The Southern Water capacity assessment has indicated that significant off-site reinforcement/upgrading works will be required.
- 10.15.10 The mitigations described in this FRA and the accompanying indicative drainage strategy will only be viable with the provision of the foul sewer network off-site reinforcement/upgrading works and possibly a new surface water sewer by means of a sewer requisition for the Eastern Parcel (South), which cannot drain by gravity to the Black Ditch.



10.16 **CONCLUSION**

- 10.16.1 The flood risk assessment highlights that there are some potential flood risks related to the site. However it is considered likely that risks and impacts can be managed to an appropriate level with the adoption of mitigation measures employed as part of the proposed development.



APPENDIX 1

- Site Location Plan
- Existing Site Plan/Topographic Survey
- Proposed Layout Plan



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Rydon Homes & Gleeson Strategic Land
Water Lane, Angmering
Land to the south of Water Lane

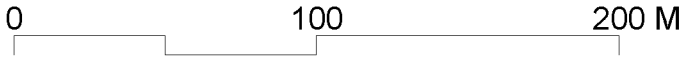
Site Boundary updated		31-10-2016	A
		RH	SJ
Based on OS		03-08-2015	-
		RH	SJ
Issue Details		Dwn	Chd
		App'd	
Job No.	Dwg No.	Revision	
19495	001-002	A	
Scale	Date	Frame Dimensions mm	
N.T.S.	August 2016	(A4) 250x181	
Drawn	Checked	Approved	
RH	SJ	SJ	

REV:	DATE:	AMENDMENTS:	DRAWN:	CHECKED:
#				
A	20.07.15	Redline updated		

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Location Plan

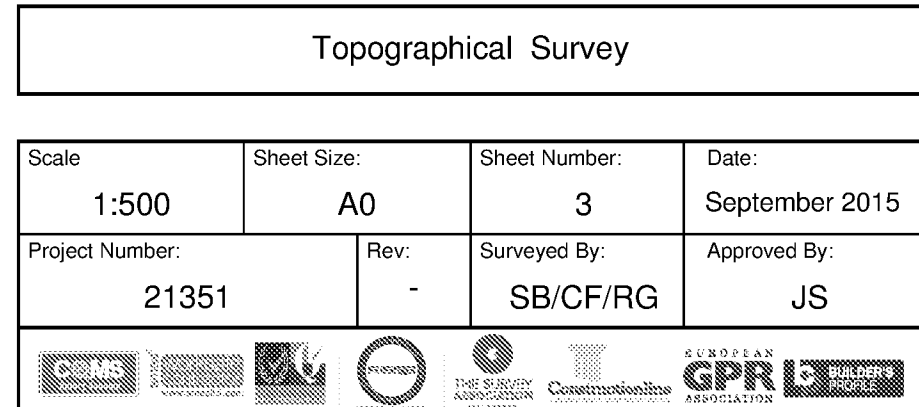
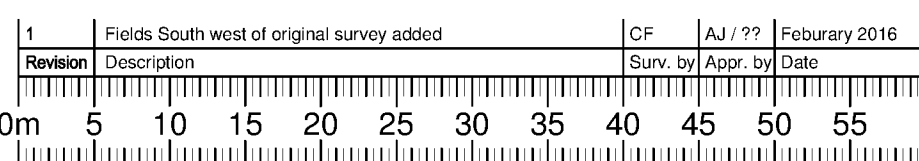
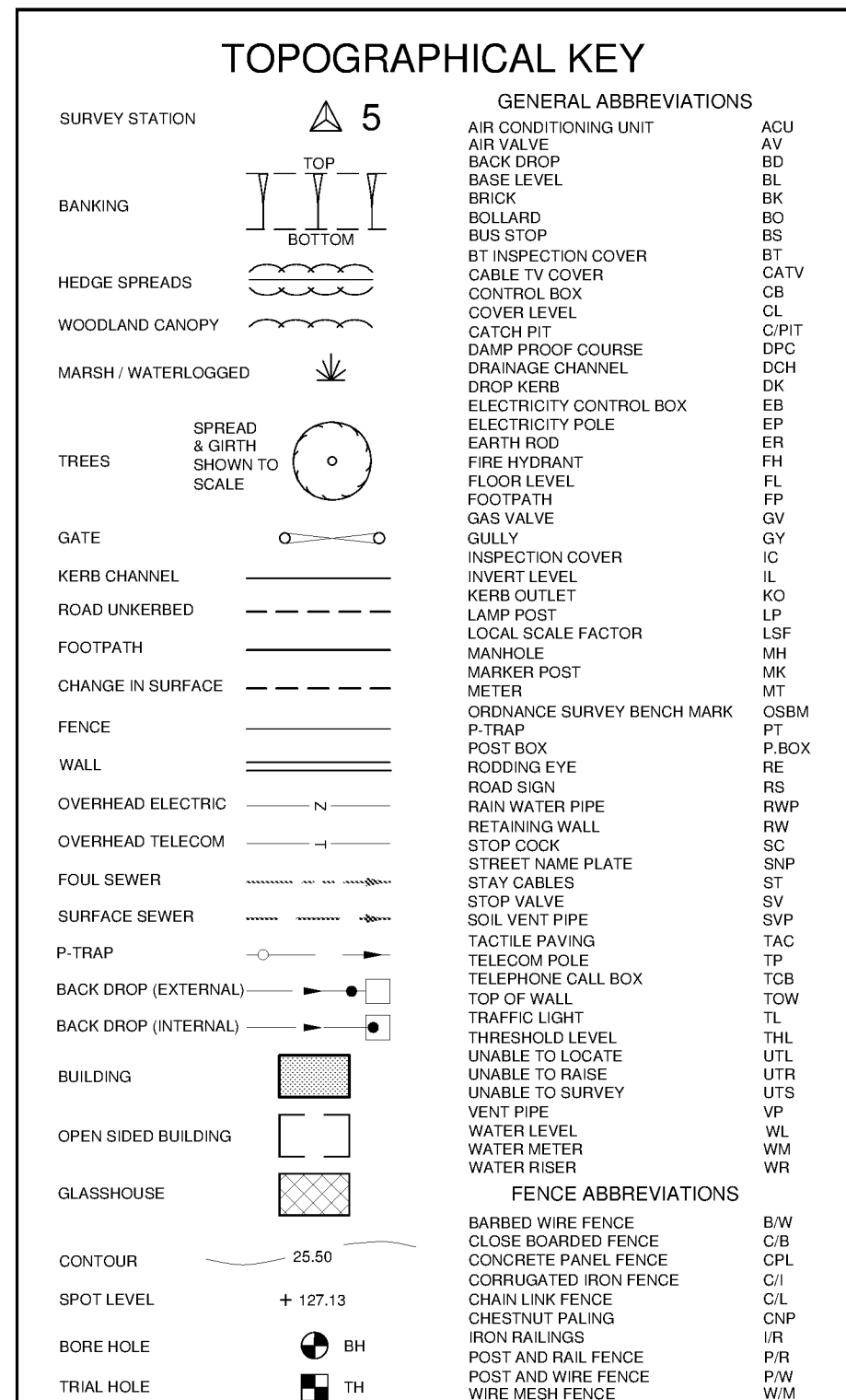
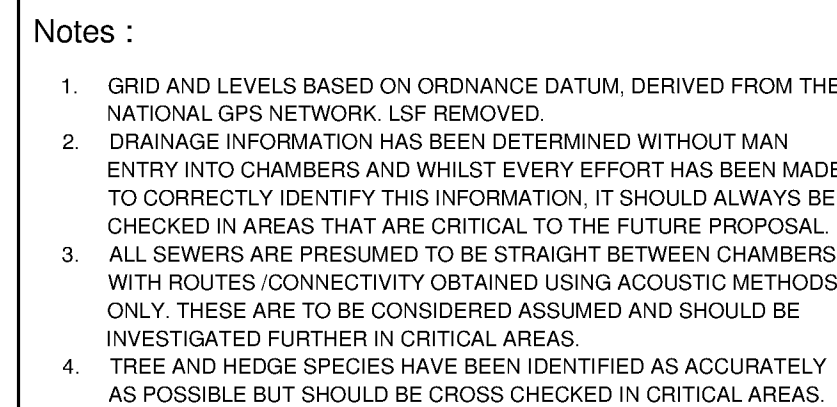
CLIENT:
Gleasons Strategic Land and Rydon Group
PROJECT:
Angmering Land adj. Water Lane

DRAWING:
Location Plan

SCALE: **1:2500@A3** DWG NO: **1911 P 01**

DATE: **March'16** REV: **A**







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Land South of Water Lane - Masterplan - For Illustrative Purposes Only

REV.	DATE	AMENDMENTS	DRAWN	CHECKED
A	19.07.16	Prepared for Pre-App consultation	DB	XX
B	23.09.16	Updated following Pre-App consultation		
C	20.10.16	Updates following Transport comments		

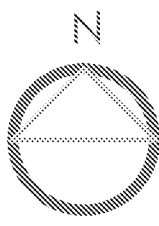
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KEY

- Site Boundary
- Existing Watercourse
- Existing Tree
- Proposed Tree
- Curtilage (gardens)
- Groundcover Planting/Hedgling
- New Screen Planting
- Existing Screen Planting
- SUDS Attenuation Area
- Open Space Used For Sustainable Drainage
- Local Equipped Area For Play 400m2 with 20m buffer on Village Green
- Local Area For Play 100m2 with 5m buffer
- New Bridge Access Road
- Primary Road, 5.5m wide 2m Footway
- Parking
- New Dwelling (Apartments)
- New Dwelling (Detached House, Garage)
- Listed Building
- Footway/Cycleway



CLIENT:
Gleasons Strategic Land and Rydon Group

PROJECT:
Angmering Land adj. Water Lane

DRAWING:
Illustrative Masterplan

SCALE: **1:1250 @ A1** DWG NO: **1911/P 03**

DATE: **June 16** REV: **C**



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APPENDIX 2

- Environment Agency Consultation
- Lead Local Flood Authority Consultation

25 August 2015

External Relations Team
Environment Agency

Dear Sirs

**WATER LANE, ANGMERING, BN16.
FLOOD RISK ASSESSMENT: PRE PLANNING ENQUIRY**

Our Client is pursuing the above development and we have been instructed to undertake a Flood Risk Assessment and are currently in the process of canvassing consultees.

We note from the flood map for planning that the site is located outside of the 0.1% AEP flood outline. Based on the site area being greater than 1 hectare, we intend to follow your Guidance Note 1 issued April 2012 in completion of the Flood Risk Assessment.

We would be grateful if you could advise whether this is considered appropriate for planning purposes by yourselves, and also whether there is any specific information or any issues related to the site, such as historical flooding events, IDB management areas, relevant catchment or flood management plans.

If you have any queries or if this site is known to you and you would like to discuss things on either a formal or informal basis please do not hesitate to telephone my colleague me on 01773 829988

Yours sincerely,

Gemma Jinks
For Idom Merebrook Ltd

Encs Site Location Plan

cc File

AN  GROUP COMPANY

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From: Enquiries, Unit [mailto:enquiries@environment-agency.gov.uk]
Sent: 27 August 2015 09:23
To: Gemma Jinks <gjinks@merebrook.co.uk>
Subject: 150827/PP02 FW: Flood Risk Assessment: Pre Planning Enquiry

Dear Gemma,

Thank you for your request for information.

I have passed your enquiry to our customer team for the relevant area and they will be in touch with you shortly.

The Freedom of Information Act and Environmental Information Regulations state that a public authority must respond to requests for information within 20 working days, but we aim to respond to all enquiries as quickly as we can.

You can find more information about our service commitment by clicking on the link below:

<https://www.gov.uk/government/publications/environment-agency-customer-service-commitment>

Should you wish to contact the customer team directly, please use the contact details below. Please quote your Enquiry Reference 150827/PP02 in any correspondence with us regarding this matter.

Customer and Engagement
Environment Planning & Engagement
Environment Agency
Solent and South Downs Area
Guildbourne House
Chatsworth Road
Worthing
West Sussex
BN11 1LD

Regards

Paul Pinder
Customer Service Advisor
National Customer Contact Centre - Part of National Operations Services

Environment Agency, Quadrant 2, 99 Parkway Avenue, Parkway Business Park, Sheffield, S9 4WF

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Click here:

From: Gemma Jinks [mailto:gjinks@merebrook.co.uk]
Sent: 25 August 2015 10:22
To: Enquiries, Unit
Subject: Flood Risk Assessment: Pre Planning Enquiry

Dear Sirs

Please find attached a letter for a Flood Risk assessment: Pre Planning Enquiry

Regards

Gemma Jinks
BEng (Hons), NEBOSH
IDOM Merebrook Limited
East Mill, Bridgefoot, Belper, Derbyshire, DE56 2UA
Offices: London Kent Derby Cardiff



IDOM Merebrook Ltd. East Mill, Bridgefoot, Belper, Derbyshire, DE56 2UA

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From: SSD Enquiries [REDACTED]
Sent: 10 September 2015 15:02
To: Gemma Jinks
Subject: 150910 SSD/7204 Flood risk assessment: Product 4 request
Attachments: 89_07_SD02 Standard Notice.pdf

Dear Gemma

Thank you for your request for information that was received on 25 August.

Before proceeding with this request, we will require a payment of £50 + VAT 662490134 (£60). This is not a charge for supplying the data, but a charge for the copyright licence which is set out in our Standard Notice. The Standard Notice explains how you may use the information you have asked for and will be sent to you at the same time that we send you your information.

Charging Summary

Copyright Licence Charge = £50 + VAT @ 20%

Total Charge = £60

If you wish to pay by credit or debit card please contact me on 01903 832064 and I will be pleased to take these details over the phone.

If you wish to make payment by cheque, please make your cheque payable to 'The Environment Agency' and send it to the address below.

Once we have received your payment, we will aim to respond to your enquiry within 20 working days in accordance with our Customer Charter.

If I have not received your payment within 60 days of the date of this letter/email, I will assume that you no longer require the information.

If you have any queries regarding this email please contact me on the number below.

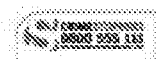
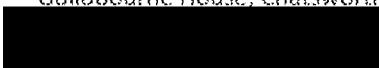
We are committed to providing a professional customer service. Please help us understand more about what is important to you by completing our [two-minute survey](#).

Kind regards

Hannah

Hannah Osborn
Customers and Engagement Officer
Customers & Engagement Team
Covering Sussex, Hampshire and the IoW (Solent & South Downs Area)

Guildbourne House, Chatsworth Road, Worthing, West Sussex, BN11 1LD



Waste crime - see it, report it



From: Gemma Jinks [REDACTED]
Sent: 25 August 2018 16:42
To: Enquiries, Unit
Subject: Ref: 150826/BLB52 Flood risk assessment: Product 4 request

**WATER LANE, ANGMERING, BN16
FLOOD RISK ASSESSMENT: PRODUCT 4 REQUEST**

Dear Sirs,

I am writing to request a Product 4 for the above site.

If you require any further information then please do not hesitate to contact me.

Kind Regards

Gemma Jinks
BEng (Hons), NEBOSH
IDOM Merebrook Limited
East Mill, Bridgefoot, Belper, Derbyshire, DE56 2UA
Offices: London Kent Derby Cardiff



IDOM Merebrook Ltd, East Mill, Bridgefoot, Belper, Derbyshire, DE56 2UA

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From: Gemma Jinks
Sent: 25 August 2015 10:52
To: [REDACTED]
Subject: 19495 - Proposed Development at Water Lane, Angmering, BN16 - Pre-planning enquiry

Good afternoon

Our client, Rydon Homes is currently preparing a detailed planning application for housing and commercial development, within approximately 60 acres, post code BN16

We are commissioned with preparing a Flood Risk Assessment and Drainage Strategy. We'd be grateful if you could provide any relevant information (advising on any charges where appropriate) as follows:

- Section 19 Flood Investigation Reports relevant to the site;
- Known ordinary watercourses in proximity to the site;
- Known surface water or groundwater flooding issues relevant to the site (with mapping where available);
- Guidance or advice documents on SuDS Policies (we note from your website that you are due to publish additional documents soon, we'd be grateful if you could advise on timescales for this);
- Information on specific documents (other than PFRA and SFRA) that may be relevant to the site, such as SWMPs, CMPs;
- LLFA standing advice on flood risk or SuDS.

With regards the proposed drainage strategy, we would be grateful if you could advise on the level of detail of information required in the supporting documents, for example the format of any drainage calculations and drawings (required scales etc).

Do not hesitate to contact me if you require any further information in order to process my request.

Kind regards

Gemma Jinks
BEng (Hons), NEBOSH
IDOM Merebrook Limited
East Mill, Bridgefoot, Belper, Derbyshire, DE56 2UA
Offices: London Kent Derby Cardiff



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Gemma Jinks
IDOM Merebrook
East Mill
Bridgefoot
Belper
Derbyshire
DE56 2UA

Our ref: SSD/7204

Your ref:

Date: 22/10/2014

Dear Gemma

Provision of Product 4 for Water Lane, Angmering BN16

Thank you for your request to use Environment Agency data. The information is attached.

If you have requested this information to help inform a development proposal, then you should note the detail in the attached advisory text on the use of Environment Agency Information for Flood Risk Assessments / Flood Consequence Assessments.

Supporting Information

This information is provided subject to the enclosed notice, which you should read.

Modelled Flood Levels

The flood levels and extents attached have been taken from the 2010 Lower Tidal River Arun Flood Modelling study. These levels represent undefended fluvial flood risk.

Flood Defences

There are no raised flood defences in this area.

Guildbourne House, Chatsworth Road, Worthing, West Sussex BN11 1LD



www.environment-agency.gov.uk

Flood History

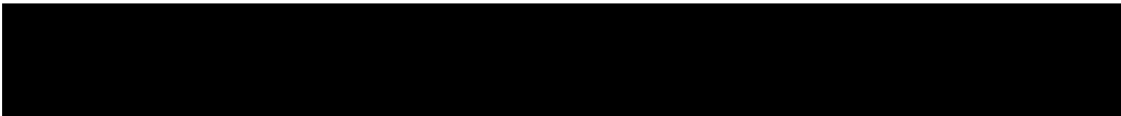
We have no records of previous flood events affecting this location. However, our records show that a flood event affected properties on the north side of Water Lane within Angmering in 1980. Please see the recorded event outline attached.

I would recommend contacting Arun District Council for a more comprehensive flood history check.

If you have any queries or would like to discuss the content of this letter further please don't hesitate to contact me.

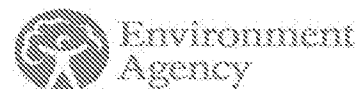
Yours faithfully

Jon Denman
FCRM Officer
Partnership and Strategic Overview Team – West Sussex



Enc. Detailed FRA/FCA Map, Flood Levels and extents
[Standard Notice]

Standard notice [not for use with Special Data, Personal Data or unlicensed 3rd party rights]



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- * internal use for any purpose, or offering a product or service based on the Information for indirect commercial advantage, by an organisation that is primarily engaged in trade, commerce or a profession.

Use of Environment Agency Information for Flood Risk / Flood Consequence Assessments

Important

If you have requested this information to help inform a development proposal, then we recommend that you undertake a formal pre-application enquiry using the form available from our website:-

<http://www.environment-agency.gov.uk/research/planning/33580.aspx>

Depending on the enquiry, we may also provide advice on other issues related to our responsibilities including flooding, waste, land contamination, water quality, biodiversity, navigation, pollution, water resources, foul drainage or Environmental Impact Assessment.

In **England**, you should refer to the Environment Agency's Flood Risk Standing Advice and PPS25 and its associated Practice Guide for information about what flood risk assessment is needed for new development in the different flood zones. These documents can be accessed via:

<http://www.environment-agency.gov.uk/research/planning/82587.aspx>

<http://www.communities.gov.uk/publications/planningandbuilding/pps25floodrisk>

<http://www.communities.gov.uk/publications/planningandbuilding/pps25practiceguide>

You should also consult the Strategic Flood Risk Assessment produced by your local planning authority.

In **Wales**, you should refer to TAN15 for information about what flood consequence assessment is needed for new development in the different flood zones

<http://new.wales.gov.uk/splash.jsessionid=8vIGTfGZthmB0t2vhp6hS1GcB1LXvZzB3Yiczf20Xn7LK3zk0nMkI981825250?orig=/topics/planning/policy/tans/tan15/>

You should also consult the Strategic Flood Consequence Assessment if one has been produced by your local planning authority.

In both **England and Wales** you should note that:

1. Information supplied by the Environment Agency may be used to assist in producing a Flood Risk / Consequence Assessment (FRA / FCA) where one is required, but does not constitute such an assessment on its own.
2. This information covers flood risk from main rivers and the sea, and you will need to consider other potential sources of flooding, such as

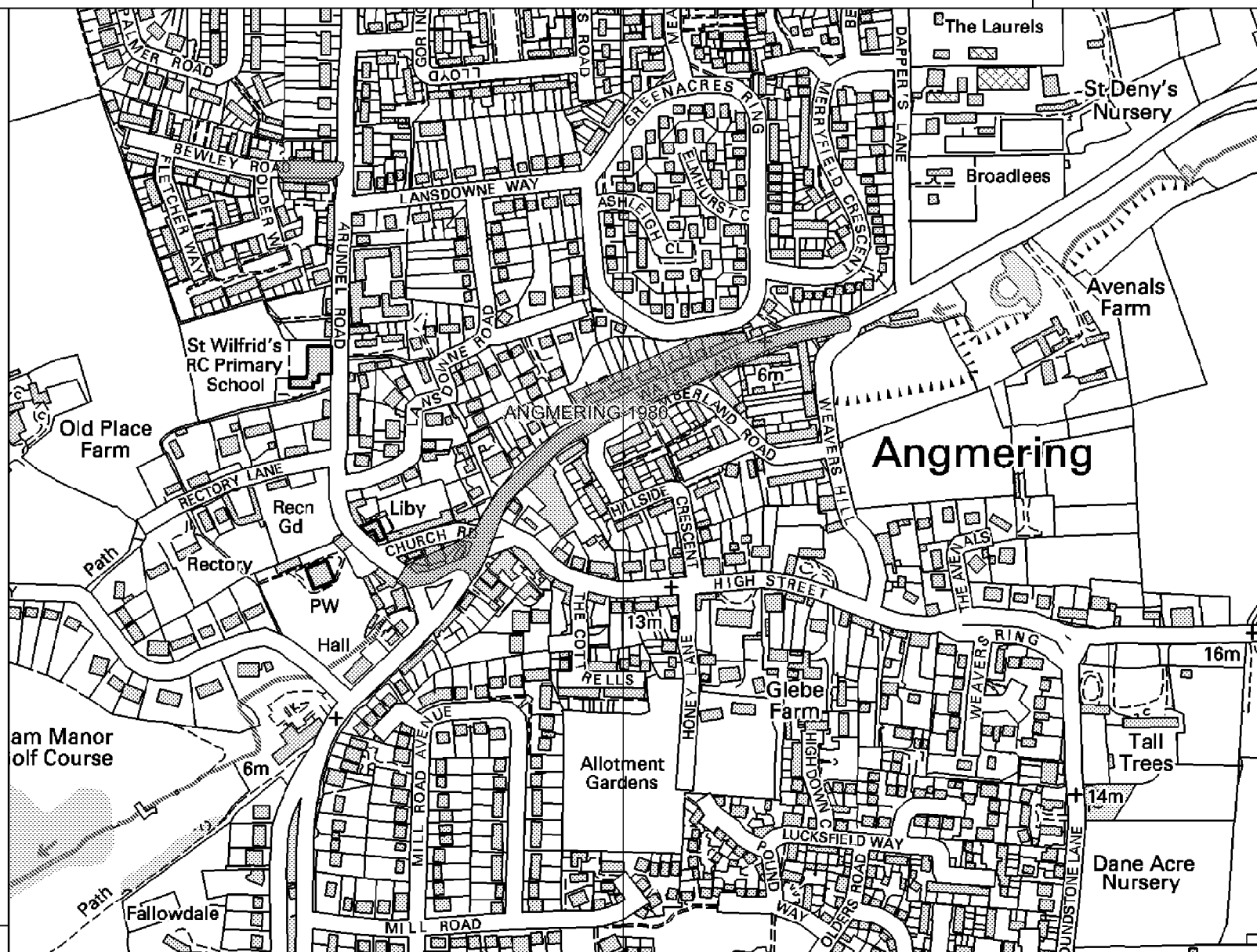
groundwater or overland runoff. The information produced by the local planning authority referred to above may assist here.

3. Where a planning application requires a FRA / FCA and this is not submitted or deficient, the Environment Agency may well raise an objection.
4. For more significant proposals in higher flood risk areas, we would be pleased to discuss details with you ahead of making any planning application, and you should also discuss the matter with your local planning authority.

Recorded Flood Outlines - Angmering

Legend

 Flood Event Outlines

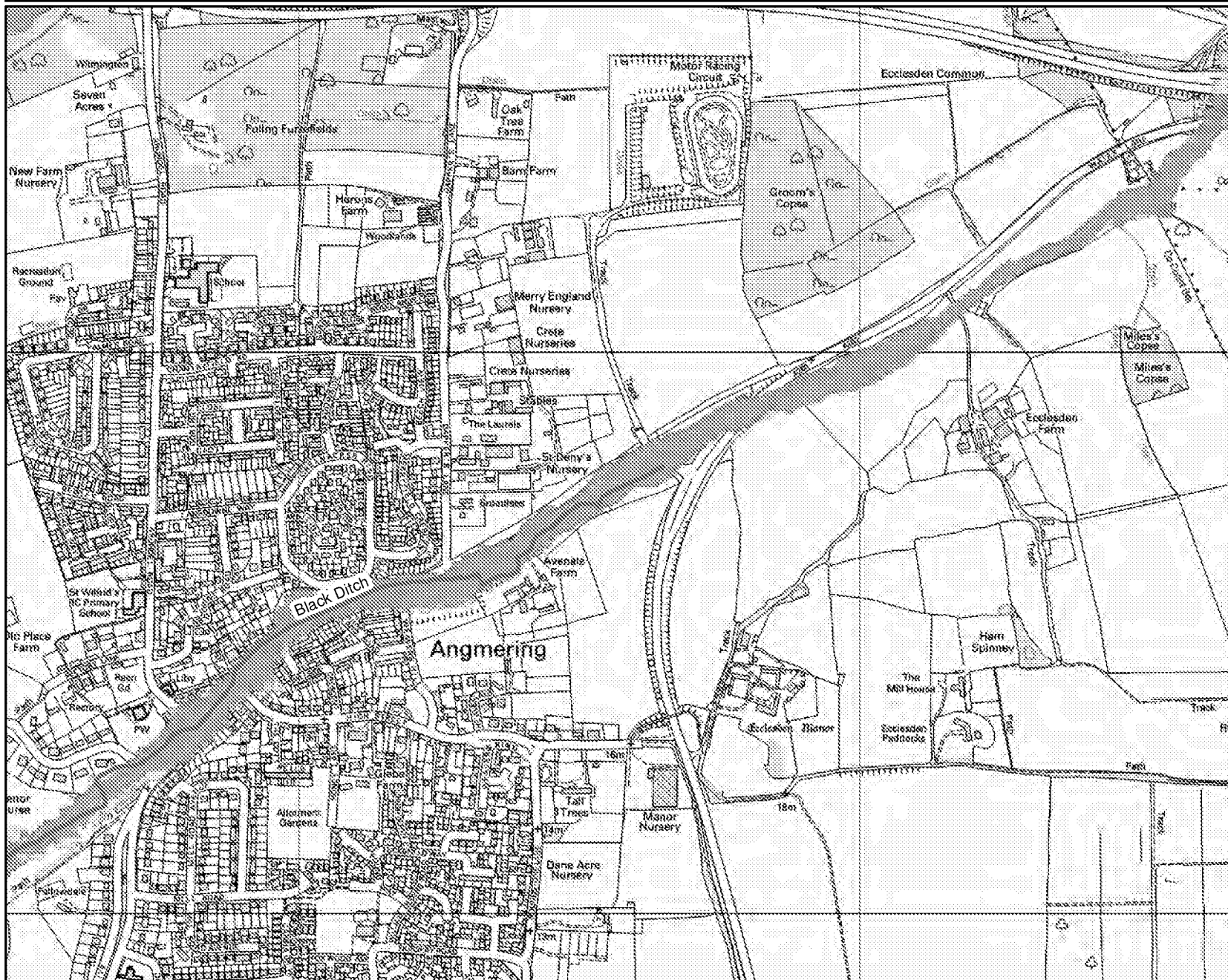


0 52 104 156 m.



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Flood Map for Planning Centered on Water Lane, Angmering - Created 22/10/2015 [Ref: SSD/7204]



Environment
Agency

Legend

- Main River
- Flood Zone 3
- Flood Zone 2

Flood Map Areas (assuming no defences)

Flood Zone 3

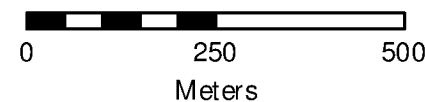
Shows the area that could be affected by flooding:
- from the sea with an 1 in 200 or greater chance of happening each year.
- or from a river with a 1 in 100 or greater chance of happening each year.

Flood Zone 2

Shows the extent of an extreme flood from rivers of the sea with up to a 1 in 1000 chance of occurring each year.

1:10,000 *

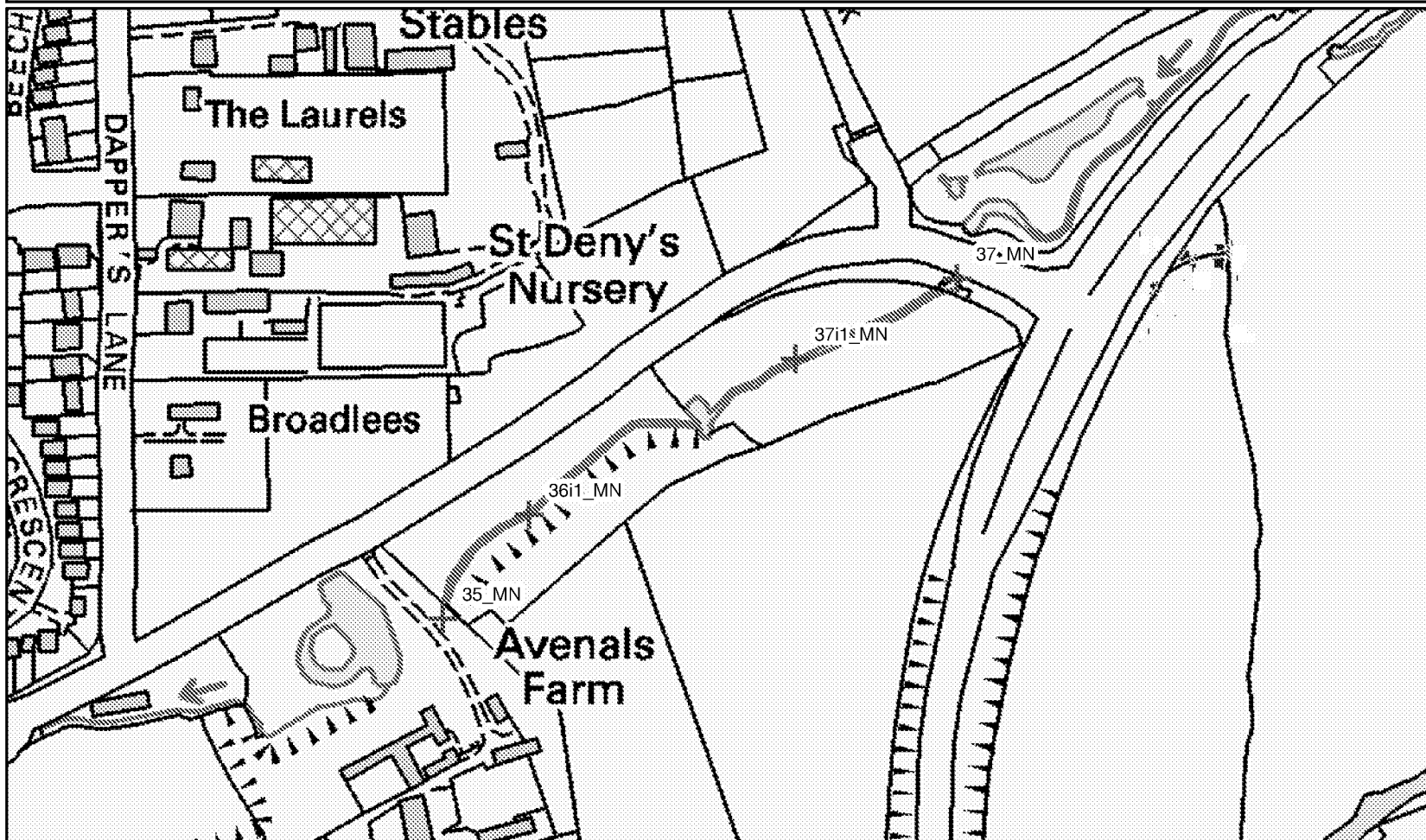
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**2010 LTRAS Modelled Levels Centered on Water Lane, Angmering -
Created 22/10/2015 [Ref: SSD/7204]**

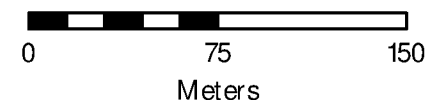


Legend

+ Node Point

Node Point	Easting	Northing	Fluvial levels taken from 2010 Infoworks model [mAOD]			
			UNDEFENDED			
			5% AEP [1in20yr]	1% AEP [1in100yr]	0.1% AEP [1in1000yr]	1% AEP [1in100yr] +CC 2115
37_MN	507,648	104,796	11.10	11.33	11.78	11.44
37i1_MN	507,573	104,757	10.65	12.90	11.15	10.99
36i1_MN	507,451	104,686	10.43	10.81	10.99	10.87
35_MN	507,410	104,639	10.41	10.80	10.98	10.86

1:3,000 *
*when printed at A4.



2010 LTRAS Modelled Extents Centered on Water Lane, Angmering - Created 22/10/2015 [Ref: SSD/7204]



Environment
Agency

Legend

-  5% [1in20] Fluvial
-  1% [1in100] Fluvial
-  1% [1in100] Fluvial+CC
-  0.1% [1in1000] Fluvial

Flood Map Areas (assuming no defences)

Flood Zone 3

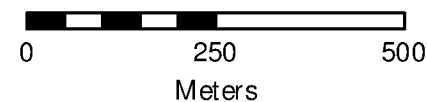
Shows the area that could be affected by flooding:
- from the sea with an 1 in 200 or greater chance of happening each year.
- or from a river with a 1 in 100 or greater chance of happening each year.

Flood Zone 2

Shows the extent of an extreme flood from rivers of the sea with up to a 1 in 1000 chance of occurring each year.

1:10,000 *

*when printed at A4.



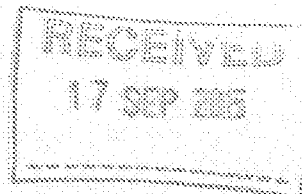
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APPENDIX 3

- Sewer Records
- Capacity Assessment



IDOM Merebrook Ltd
East Mill
Bridgefoot
Belper
Derbyshire
DE56 2VA

Developer Services
Southern Water
Sparrowgrove House
Sparrowgrove
Otterbourne
Hampshire
SO21 2SW



16 September 2015

Our Ref: CC-SUSS-00150

Level 2: Foul Water capacity check application for: Land to the North and East of Water Lane Angmering

Dear Ms Jinks,

Thank you for your capacity check application relating to the above development.

We will process your application and respond to you as quickly as we can.

Please quote the above reference number in all correspondence relating to this application.

Yours sincerely,

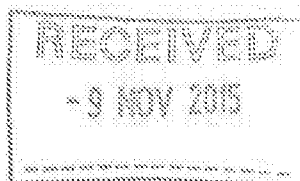


Developer Services

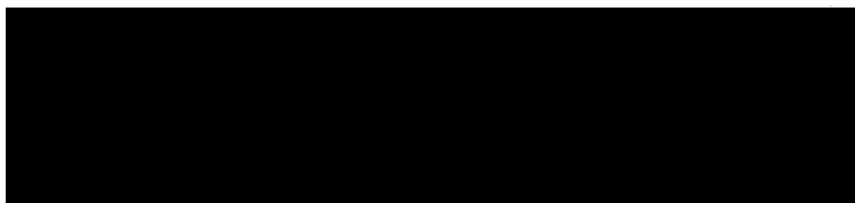




IDOM MEREBROOK LTD
East Mill
Bridge Foot
Belper
Derbyshire
DE56 2UA



Developer Services
Southern Water
Sparrowgrove House
Sparrowgrove
Otterbourne
Hampshire
SO21 2SW



Your Ref:

Our Ref:
CC-SUSS-00150

Date:
6th November 2015

F.A.O: Ms. Gemma Jinks,

Site: Land to the North and East of Water Lane, Angmering, BN16.

Dear Sirs,

Further to your recent application for a level 2 enquiry regarding the above development site.

FOUL WATER

Please find enclosed the report which details the extent of works required in order for your proposed development site to be accommodated within the local sewerage infrastructure. It should be noted that the report is only a hydraulic solution to provide capacity for the proposed development site. There are other options available to you / your client in discharging your proposed flows from the site such as making a connection application/requisition to a sewer at a point where capacity is currently available. Section 98 of the Water Industry Act 1991 provides a legal mechanism through which the appropriate infrastructure can be requested (by the developer) and provided to drain a specific location.

As you are aware the owner or occupier of the premises or private sewer or drain must give the sewerage undertaker notice of the proposed works. Upon receipt of the notice the undertaker may, within 21 days, refuse to allow him to make the connection if it considers that the mode of construction or the condition of the connecting sewer or drain either does not satisfy the standards reasonably required by the undertaker, or is such that the making of the communication would be prejudicial to its sewerage system.

The right of refusal is limited to these criteria alone and the undertaker cannot refuse to allow the connection on the grounds that the sewerage system is inadequate to take the extra liquid that the connection will discharge into it. This is a matter that should be dealt with at the planning stage.

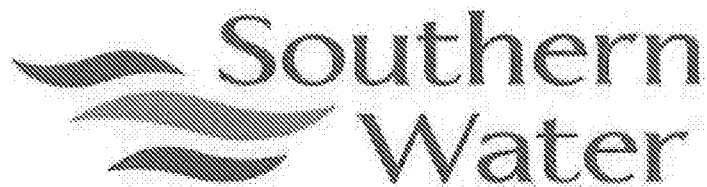
Yours faithfully



Developer Services

Please note: -

The information provided above does not grant approval for any designs/drawings submitted for the capacity analysis. The results quoted above are only valid for 12 months from the date of issue of this letter.



STUDY INTO THE OPTIONS FOR
FOUL DRAINAGE PROVISION AT
LAND TO THE NORTH AND EAST OF WATER LANE,
ANGMERING, BN16

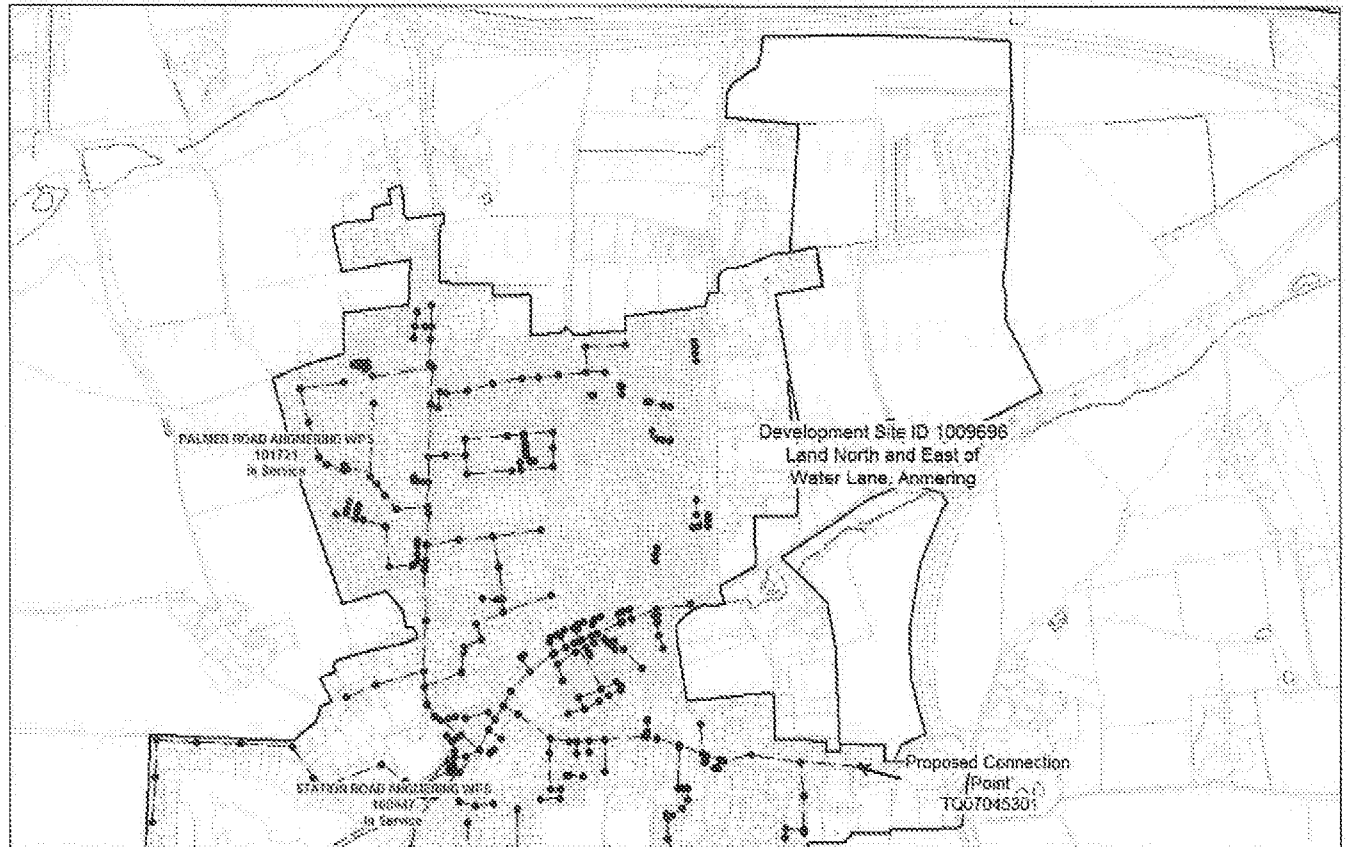
6th November 2015

REQUESTED:
IDOM MEREBROOK LTD

I. Development Details:

The proposal is to discharge foul flow from the proposed development site to the local foul sewerage systems at manhole reference TQ07045301 which is located at Tall Trees.

Figure 1 - Proposed Development



II. Results and Conclusions:

Foul Water:

There is currently inadequate capacity within the local foul sewerage network to accommodate the additional flows into manhole reference TQ07045301. The proposed development would increase flows to the local network and as a result existing properties and land may be subject to a greater risk of flooding. The upgrade works required are detailed in Table 1 and shown in Figure 2.

Section 98 of the Water Industry Act 1991 provides a legal mechanism through which the appropriate infrastructure can be requested (by the developer) and provided to drain a specific location.

Surface Water:

As a surface water capacity check has not been requested it is assumed that Surface Water will be disposed of by alternative means i.e. via soakaway or through local drainage watercourses, subject to approval from all interested parties.

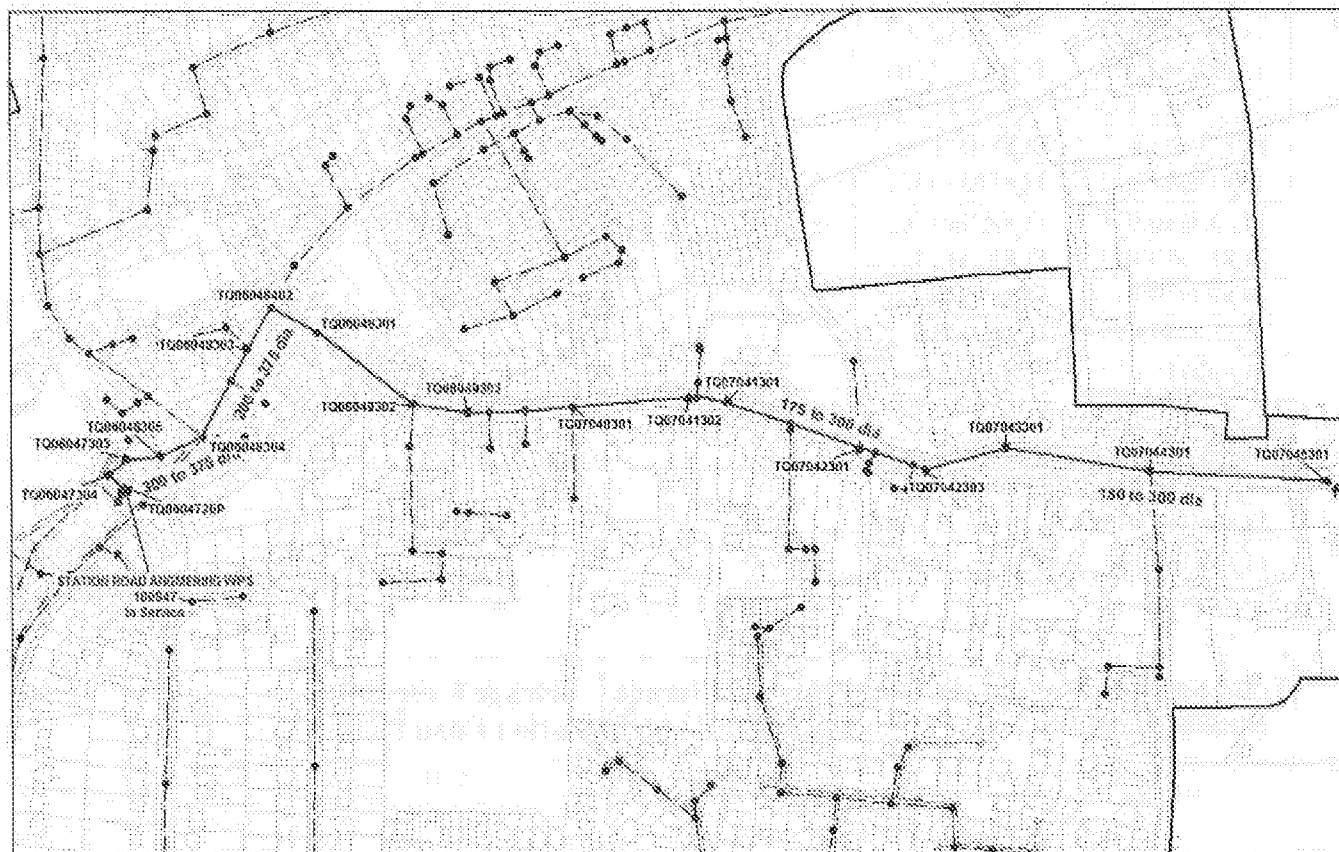
Figure 2- Proposed Improvements – Foul system

Table 1 Proposed Improvements Schedule (Sewers to be Upsized)

U/S Manhole	D/S Manhole	Sewer Diameter (mm)		Length (m)	Depth (m)
		Existing	Proposed		
TQ07045301	TQ07044301	150	300	109.2	2.60
TQ07044301	TQ07043301	150	300	90.3	2.49
TQ07043301	TQ07042303	175	300	51.5	2.30
TQ07042303	TQ07042301	175	300	41.9	2.41
TQ07042301	TQ07041301	175	300	87.6	2.62
TQ07041301	TQ07041302	175	300	23.1	2.94
TQ07041302	TQ07040301	175	300	72.5	3.07
TQ07040301	TQ06049303	175	300	41.7	2.80
TQ06049303	TQ06049302	175	300	34.5	2.42
TQ06049302	TQ06049301	175	300	73.6	1.81
TQ06049301	TQ06048402	175	300	32	2.29
TQ06048402	TQ06048303	200	375	28.8	2.97
TQ06048303	TQ06048304	200	375	61.4	2.73
TQ06048304	TQ06048305	300	375	28	3.02
TQ06048305	TQ06047303	300	375	21.1	3.57
TQ06047303	TQ06047304	300	375	14.2	3.88
TQ06047304	TQ0604720P	300	375	13.4	4.08

Total Existing Storage at Station Road PS (m ³)	Total Proposed Storage at Station Road PS (m ³)	Storage Increase at Station Road PS (m ³)
285	395	110

Before any connections are made, an application form needs to be completed and approved by Southern Water Services.

Please note: - The information provided above does not grant approval for any designs /drawings submitted for the capacity analysis. The results quoted above are only valid for 12 months from the date of issue of this letter.

SOUTHERN WATER



The positions of pipes shown on this plan are believed to be correct, but Southern Water Services Ltd accept no responsibility in the event of inaccuracy. The actual position should be determined on site.

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O.S. REF: TQ0704SE

Scale: 1:1250

Sewer Plot

WARNING: BAC pipes are constructed of Bonded Asbestos Cement
ARUN DISTRICT COUNCIL A99/170/UT
WARNING: Unknown (UNK) materials may include Bonded Asbestos Cement



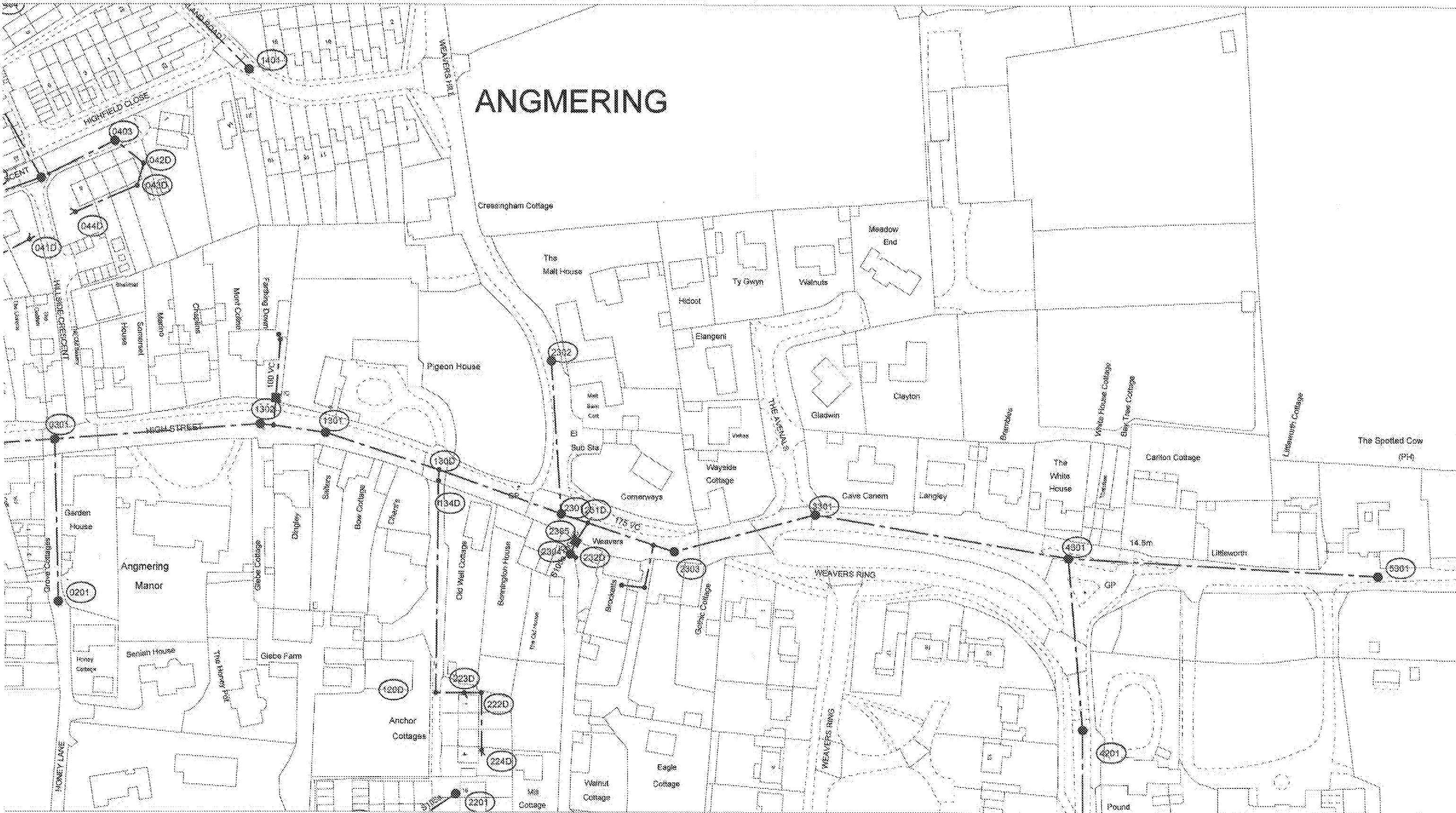
Printed By: sierrob

Date: 29-10-2015

Southern Water MapGuide Browser

Requested By:
Sewer Record Extract

Southern Water



ANGMERING

The positions of pipes shown on this plan are believed to be correct, but Southern Water Services Ltd accept no responsibility in the event of inaccuracy. The actual positions should be determined on site.

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O.S. REF. TQ0704SW

Scale: 1:1250

Sewer Plot

WARNING: BAC pipes are constructed of Bonded Asbestos Cement
WARNING: Unknown (UNK) materials may include Bonded Asbestos Cement



Printed By: sierrob
Southern Water MapGuide Browser
Requested By:
Sewer Record Extract

Date: 29-10-201



SOUTHERN WATER



The positions of pipes shown on this plan are believed to be correct, but Southern Water Services Ltd accept no responsibility in the event of inaccuracy. The actual positions should be determined on site.

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O.S. REF: TQ0604SE

Scale: 1:1250

Sewer Plot

WARNING: BAC pipes are constructed of Bonded Asbestos Cement

WARNING: Unknown (1886) materials may include Bonded Asbestos Cement



Printed By: sierrob
Southern Water MapGuide Browser

Requested By:
Sewer Record Extract

Date: 29-10-2011

**Southern
Water**



APPENDIX 4 ▪ MicroDrainage Outputs

Idom Merebrook Ltd		Page 1
Suite 2B East Mill Belper Derbyshire DE56 2UA		
Date 01/11/2016 12:18 File Angmering rl.srcx	Designed by rhopkinson Checked by	
XP Solutions Source Control 2016.1		

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.400
Area (ha)	1.330	Urban	0.000
SAAR (mm)	729	Region Number	Region 7

Results l/s

QBAR Rural	4.7
QBAR Urban	4.7
Q100 years	15.1
Q1 year	4.0
Q30 years	10.8
Q100 years	15.1

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Idom Merebrook Ltd		Page 1
Suite 2B East Mill Belper Derbyshire DE56 2UA		
Date 01/11/2016 12:19 File Angmering rl.srcx	Designed by rhopkinson Checked by	
XP Solutions		Source Control 2016.1

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.400
Area (ha)	1.036	Urban	0.000
SAAR (mm)	729	Region Number	Region 7

Results l/s

QBAR Rural	3.7
QBAR Urban	3.7
Q100 years	11.8
Q1 year	3.1
Q30 years	8.4
Q100 years	11.8

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19495: Angmering Quick Storage Estimates r1

01-11-2016

Land to the south of Water Lane (Northern Catchment)

The screenshot shows the 'Quick Storage Estimate' software window with the 'Variables' tab selected. The interface includes a sidebar with navigation buttons: Variables, Results, Design, Overview 2D, Overview 3D, and Vt. The main area contains input fields for various parameters. At the bottom, there are buttons for 'Analyse', 'OK', 'Cancel', and 'Help', along with a status bar indicating 'Enter Area between 0.000 and 333.333'.

Variables	
FEH Rainfall	Cv (Summer) 0.750
Return Period (years) 100	Cv (Winter) 0.840
Site Location	Impervious Area (ha) 1.330
GB 507500 104650 TQ 07500 0465	Maximum Allowable Discharge (l/s) 4.7
C (1km) 0.026	D3 (1km) 0.369
D1 (1km) 0.338	E (1km) 0.314
D2 (1km) 0.311	F (1km) 2.364
	Infiltration Coefficient (m/hr) 0.00000
	Safety Factor 2.0
	Climate Change (%) 40

The screenshot shows the 'Quick Storage Estimate' software window with the 'Results' tab selected. The main area displays a message about global variables and storage requirements. At the bottom, there are buttons for 'Analyse', 'OK', 'Cancel', and 'Help', along with a status bar indicating 'Enter Area between 0.000 and 333.333'.

Global Variables require approximate storage of between 1219 m³ and 1712 m³.

These values are estimates only and should not be used for design purposes.

19495: Angmering Quick Storage Estimates r1

01-11-2016

Land to the south of Water Lane (Southern Catchment)

The screenshot shows the 'Quick Storage Estimate' software window with the 'Variables' tab selected. The interface includes a sidebar with navigation options: Variables, Results, Design, Overview 2D, Overview 3D, and VI. The main area contains input fields for various parameters. A status bar at the bottom indicates 'Enter Area between 0.000 and 999.999'.

Variables	
FEH Rainfall	Cv (Summer) 0.750
Return Period (years) 100	Cv (Winter) 0.840
Site Location GB 507500 104650 TQ 07500 0465	Impermeable Area (ha) 1.036
C (1km) 0.626 D3 (1km) 0.369	Maximum Allowable Discharge (l/s) 3.7
D1 (1km) 0.358 E (1km) 0.314	Infiltration Coefficient (m/hr) 0.00000
D2 (1km) 0.311 F (1km) 2.364	Safety Factor 2.0
	Climate Change (%) 40

Buttons: Analyse, OK, Cancel, Help

Enter Area between 0.000 and 999.999

The screenshot shows the 'Quick Storage Estimate' software window with the 'Results' tab selected. The main area displays a message about global variables and storage estimates. The sidebar and status bar are identical to the previous screenshot.

Results

Global Variables require approximate storage of between 948 m³ and 1329 m³.

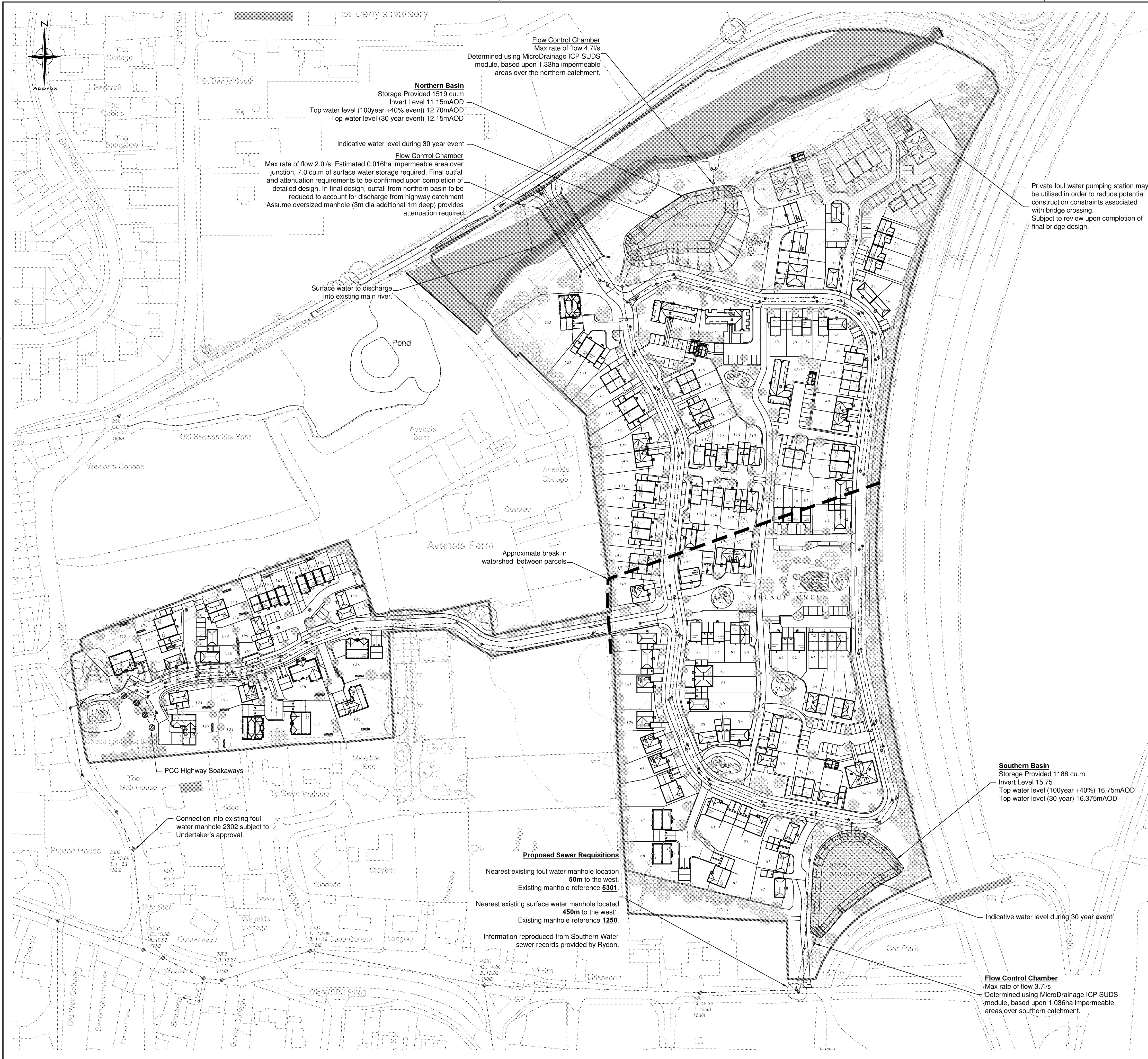
These values are estimates only and should not be used for design purposes.

Buttons: Analyse, OK, Cancel, Help

Enter Area between 0.000 and 999.999



APPENDIX 5 ▪ Indicative Drainage Strategy



- Notes
- The purpose of this drawing is to illustrate a notional surface and foul water drainage strategy. It does not purport to be a design for construction. Detailed hydraulic modelling has not been undertaken in the preparation of this strategy.
 - MicroDrainage Rural Runoff Estimation (ICP SUDS) and Quick Storage Design modules have been used to estimate existing runoff and the volume of attenuation required for the proposed development.
 - The Surface Water Drainage Strategy is outlined below:
 - The land south of Water Lane is considered to be two distinct catchments; namely, an eastern and western catchment. The eastern has been further subdivided in to two sub-catchments.
 - In order to accommodate the natural break in watershed it is assumed that the 100 year +40% storm is the reference event for this part of the site.
 - The western catchment is to be served by soakaways - see note 5.
 - The Flood Estimation Handbook (FEH) inputs have been used when estimating attenuation requirements.
 - It is assumed that runoff is to be restricted to "greenfield rates", namely, 0.4.
 - Drained area/contributing catchments have been measured in AutoCAD based upon the planning layout 1911 P03-A (layered) received 03-03-2016 and are summarised as follows:

Eastern Catchment (north)	
Impermeable area	1.33ha
Eastern Catchment (south)	
Impermeable area	1.036ha
Western Catchment	
Impermeable area	0.586ha
 - The strategy depicts attenuation being provided by detention basins. During detailed design it may be possible to reduce the basin provision by introducing the use of modular storage cells (eg serving individual plots).
 - It is assumed the existing levels will be indicative of proposed ground levels.
 - Basin shapes and locations are indicative. Batters terminate at existing levels.
 - The following summarises parcel estimates:

Eastern Catchment (north)	
Drained area	13300 sq m
Qbar	4.7 l/s
Attenuation	1465 cu m
Eastern Catchment (south)	
Drained area	10360 sq m
Qbar	3.7 l/s
Attenuation	1138 cu m
Western Catchment	
Drained area	5860 sq m
SERVED BY SOAKAWAYS	
- The western parcel soakaway strategy is summarised below:
 - Southern Testing has investigated the parcel. See Report P0791. An average infiltration rate of 3.58 x 10⁻⁴ m/s was determined. This supports the use of soakaways.
 - Surface water from highways is to discharge into traditional shallow PCC soakaways via a segregated Highway Drain.
 - Surface water from private areas (plots, driveways, etc) will use a combination of gravel filled soakaways and PCC soakaways for disposal. For outline design purposes private soakaways have been sized on the basis of approximately 200 sq m per soakaway (i.e typical area of a large detached dwelling) to ensure that suitable provision can be achieved.
 - BRE365 methodology has been for guidance when estimating soakaway sizes using 1 in 100 year + 40% for Climate Change design storm.
 - All soakaways to a be minimum of 5m away from a structure and/or another soakaway.
 - The Foul Water Drainage Strategy is summarised below for the eastern parcel (north):
 - Pipework generally following the watershed direction of the existing landform.
 - The site outfall is located at the low point of the site; into Water Lane.
 - Nearest existing foul water manhole located 450-500m to the west. Existing manhole reference 2501
 - The Foul Water Drainage Strategy is summarised below for the eastern parcel (south):
 - Pipework generally following the watershed direction of the existing landform.
 - The site outfall is located at the low point of the site; into High Street.
 - Nearest existing foul water manhole location 50m to the west. Existing manhole reference 5301.
 - The Foul Water Drainage Strategy is summarised below for the western parcel:
 - Pipework generally following the watershed direction of the existing landform.
 - The site outfall is located to the south west of the site in Weavers Hill.
 - All connections (capacity, invert and suitability) into public sewers to be confirmed by the Undertaker.
 - The Undertaker's/Regulators have been consulted in respect of the available capacity within the adjacent drainage systems. Refer to Flood Risk Assessment, referenced FRA-19495-16-139, for a summary of the response.

Legend

- Indicative site boundary
- Existing topographic survey information shown in GREY. Reproduced from MK Surveys Drawing ref: 21351
- BLACK Proposed development typically shown in BLACK Planning layout referenced 1911 P03-A
- Existing surface water sewer inferred from Southern Water sewer records
- Existing foul water sewer inferred from Southern Water sewer records
- Proposed outline adoptable surface water drainage
- Proposed outline adoptable foul water drainage
- Proposed private PCC soakaway
- Proposed private gravel filled trench soakaway
- 1000 year (0.1% AEP) flood risk envelope: 2010 Inflowworks fluvial levels supplied by EA superimposed on to detailed topographic survey.
- Foul pumping station may be required to serve low lying plots

Planning layout updated (1911 P 03revC)	01-11-2016	A
Northern pond increased in size	RH KN KN	
First issue	05-08-2016	-
Issue Details	RH PRD KN	
Client	Dwn Cld App'd	

Rydon Homes & Gleeson Strategic Land

Water Lane, Angmering

Land to the south of Water Lane
Outline Drainage Strategy

Job No.	Dwg No.	Revision
19495	Sth-301-001	A
Scale	Date	Frame Dimensions mm
1:1000	August 2016	(A1) 791 x 544
Drawn	Checked	Approved
RH	PRD	KN

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