

**FLOOD RISK ASSESSMENT
LAND TO THE NORTH OF WATER LANE
ANGMERING, WEST SUSSEX
RYDON HOMES & GLEESON STRATEGIC LAND
FRA-19495-16-140
FEBRUARY 2018**



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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 – Not Used

APPENDIX 4

- MicroDrainage Outputs

APPENDIX 5

- Indicative Drainage Strategy



EXECUTIVE SUMMARY

A Flood Risk Assessment was requested by Rydon Homes/Gleeson Strategic Land. 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	31.15 ha, gross site area (approximate).
Current/Previous Use	Undeveloped, agriculture/arable plus motor race track.
Proposed Use	525 dwellings plus 3ha of employment land.

FLOOD RISK ASSESSMENT	
Fluvial Flood Zone	Zone 1.
NPPF Vulnerability	'More Vulnerable' – residential, 'Less Vulnerable' – commercial.
Compatibility	Compatible – 'More Vulnerable' and 'Less 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.
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	There are no sewers on or near the site, this will need to be rectified by means of a means of a foul sewer requisition.
Groundwater	Further investigation required in relation to a British Geological Survey identified 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	Further investigation required in relation to a British Geological Survey identified potential Clearwater Flooding risk.



SECTION 1 INTRODUCTION

- 1.1 IDOM Merebrook Limited ('**Merebrook**') has been instructed by Rydon Homes and Gleeson Strategic Land, ('**Rydon/Gleeson**') to undertake a Flood Risk Assessment (FRA) in support of an anticipated planning application for residential housing to be submitted by Rydon/Gleeson for a site identified as Land to the North 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, Gleeson 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 north of Water Lane, to the east of the village of Angmering and is located at approximate National Grid Reference E 507660, N 105265 (TQ 076 052) and nearest post code BN16 4EW, site centred. The Site is bordered to the north by the A27 dual carriageway; to the east by undeveloped land including Ecclesden Common and Groom's Copse; to the south by Water Lane; and to the west by existing residential properties on Dapper's Lane.
- 2.1.2 A topographic survey of the site by MK Surveys Limited Ref 21351 and dated September 2015, (revised February 2016 and April 2017 for the additional parcels, Ref 23680), 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 north to south from a maximum elevation of approximately 44 m AOD near the A27 to approximately 15.0 m AOD adjacent to Water Lane, (13 m AOD on the south-western parcel), with an overall average gradient of approximately 1 in 25, although the site is both locally steeper and has slacker gradients in places. The Site comprises arable agricultural land and the Angmering Raceway and Oval Race Club in the north-eastern portion of the Site.
- 2.1.3 To the south of the Site, a small river 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.
- 2.1.4 Site location plans are included in **Appendix 1**.



2.2 SITE AREA

- 2.2.1 The total site area is approximately 31.15 ha, and the impermeable area is approximately 10.74 ha, all as measured in AutoCAD.

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 to the south 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. 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 lies entirely within Flood Zone 1 (Low Probability of flooding).
 - ii.* The southern boundary of the site is close to Flood Zone 3 along the old abandoned alignment of Water Lane near the junction with the A280.
 - iii.* There are flood defences shown on the southern edge of Flood Zone 3 near Avenals Farm.
 - iv.* 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:

2.4.1.1 Drift Geology

Over the northern portion of the site close to the A27 and over the southern portion of the site adjacent to Water Lane, Head – comprising Clay, Silt, Sand and Gravel. The site superficial geology is indicated to be absent over the central part of the site.



There is Alluvium – comprising Clay, Silt, Sand and Gravel associated with the Black Ditch to the south of the Site.

2.4.1.2 **Solid Geology**

London Clay Formation – comprising Clay, Silt and Sand.

2.5 **HYDROGEOLOGY**

2.5.1 The Environment Agency online groundwater mapping indicates the following:

- i.* No aquifer designation is shown.
- ii.* Over the central and northern portion of the site up to the A27 – Minor Aquifer Low groundwater vulnerability zone.
- iii.* Over the southern half of the site - Minor 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 are no groundwater abstraction licences within 1 km of the Site indicated on the Environment Agency online mapping.

SECTION 3 DESCRIPTION OF THE PROPOSED DEVELOPMENT

3.1 The proposed development is shown on the Illustrative Masterplan Layout on Drawing No 1911 P 103, and includes the following:

- i.* Predominantly residential with 525 dwellings spread across the main parcel and the smaller south-west parcel.
- ii.* Employment/commercial in the south-east of the main parcel adjacent to Water Lane/A280, housed in six buildings with associated vehicle access and car parking.
- iii.* Areas of landscaping and public open space (POS), play areas (LAPs, LEAPs and NEAPs) and SuDS attenuation basins.

3.2 The Illustrative Masterplan Layout, Drawing No 1911 P 103, is included in **Appendix 1**.



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.



4.3 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 lies entirely within Flood Zone 1, that is land assessed as having a less than 0.1% (1 in 1000) annual probability of river or sea flooding.

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**' and the commercial area, is considered to be '**Less Vulnerable**'.

4.5.4 Referring to Table 4.1, '**More Vulnerable**' and '**Less Vulnerable**' development is considered appropriate in Flood Zone 1.

4.5.5 Development of '**More Vulnerable**' uses is compatible with Flood Zone 1, and it is considered that the Sequential Test has been applied by virtue of the proposal to locate '**More Vulnerable**' uses in the areas of lowest risk, namely Flood Zone 1.

4.5.6 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-ENVIRONMENTAL ASSESSMENT/SI/DESK STUDY

5.1.1 Merebrook was commissioned by Rydon/Gleeson 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 North of Water Lane, Angmering*', referenced GEA-19495b-17-318 which 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:

5.1.3.1 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). The superficial drift deposits may be locally absent across the central part of the site. Bedrock geology comprises London Clay Formation (clay, silt and sand). 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.

5.1.3.2 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 southern section of the site.

The underlying bedrock geology of the London Clay is classified as an Unproductive Stratum.

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.

5.1.3.3 Surface Water/Hydrology

Four records of surface water features are located near the 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 to the south of the Site. It is considered that the risk of flooding from rivers is considered low on site. Flood defences are currently being utilised 25 m southwest of the southern Site boundary.

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



- 5.1.4 The GroundSure® 'Floodview' report referenced in paragraph 5.1.3 has assessed that the site (Oval Raceway site) lies within an area considered to be at significant risk of surface water flooding with the site predicted to flood in a 1 in 75 year rainfall event. However, no specific details are provided and the report recommends that a more detailed flood risk assessment be obtained. The main areas at risk of surface water flooding adjacent to the Site being in the area of Black Ditch and Water Lane, although these areas are outside of the Site. There are a few smaller 'at risk' areas within the Site associated with the Angmering Raceway and Oval Race Club, refer to the Environment Agency consultation in **Section 6**.

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 PFRA 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 south of the Site and based on the 1% AEP (1 in 100 year) event. This is within Flood Zone 3. Site levels range from approximately 44 m AOD near the A27 to approximately 15.0 m AOD adjacent to Water Lane. 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**.

In summary the lowest site levels of approximately 15.0 m AOD are higher than the highest modelled flood levels from the Environment Agency's 'Product 4' information, confirming that the Site is not at risk from fluvial flooding.

- 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 lies entirely within Flood Zone 1 (Low Probability of flooding), although the southern boundary is very close to Flood Zone 3 along the old abandoned alignment of Water Lane near the junction with the A280.
- 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 overall is indicated to be at very low risk of surface water flooding, some areas which are inferred to have hard surfacing, in particular the access to the Angmering Raceway and Oval Race Club and parts of the raceway are shown to be at low, medium and high risk, as is an area adjacent to Groom's Copse. This is likely to be as a result of little or no existing on-site drainage and significant run-off from these hard areas due to the 1 in 25 gradient of the site.

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 central and northern portion of the site up to the A27 – Minor Aquifer Low groundwater vulnerability zone.
 - ii.* Over the southern half of the site - Minor Aquifer Intermediate groundwater vulnerability zone.
- 6.1.10 There are no groundwater abstraction licences within 1 km of the Site indicated on the Environment Agency online mapping.

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.



6.3.2 The sewer records provided by Rydon show the following:

6.3.2.1 **Surface Water Sewers**

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

6.3.2.2 **Foul Water Sewers**

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

6.3.2.3 **Nearest Sewers**

There is a foul water sewer in Water Lane, the end of sewer run, the chamber reference is 2501, this is indicated to be a 150 mm diameter VC (vitrified clay) pipe with a chamber cover level of 7.35 m AOD and an invert level of 5.27 m AOD. This is located just beyond the junction of Water Lane and Dapper's Lane, at over 450 m from the nearest point on the Site, (main parcel).

The Site is isolated from the existing Section 104 sewer network (Sewer Catchment/Section 104 Area boundary) by double magenta lines.

6.3.2.4 **Capacity Assessment**

No capacity assessment has been sought from Southern Water, however, Merebrook is aware that at present Southern Water is unable to provide capacity assessments. Merebrook has recently received the following statements from Southern Water in relation to capacity assessment requests on other development sites:

'Southern Water has recently undertaken a review of their modelling criteria, processes and solutions for Level 2 capacity assessments. This review has indicated concerns with inconsistencies moving through the various processes. Southern Water are not satisfied that we are fully delivering a service that meets the expectations and needs of our Customers and hence the Foul and Surface Water Level 2 capacity assessments will not be available for the foreseeable future.'

and;

'Southern Water are currently developing a new process/application, which will aim to deliver a more comprehensive and robust solution in providing capacity for your proposed development site. This will appear on Southern Water's website on completion of the review process.'

Given that the nearest foul sewer is located over 450 m from the nearest point on the Site, (main parcel), and is only 150 mm in diameter, this is not only too remote but will be inadequate for the flows generated by the proposed 525 dwellings and commercial development. Therefore a new sewer will need to be requisitioned from Southern Water, (pursuant to Section 98 of the Water Industry Act 1991).

6.3.3 The provided Southern Water sewer records 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 Site is located in Flood Zone 1 that is land assessed as having a less than 0.1% (1 in 1000) annual probability of river or sea flooding. 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 to the south 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 The lowest site levels of approximately 13.0 m AOD are higher than the highest modelled flood levels from the Environment Agency's 'Product 4' information, confirming that the Site is not at risk from fluvial flooding.
- 8.1.4 Given the foregoing, the risk to the site from fluvial/tidal flooding is considered to be **low** and further action or mitigation is unlikely to be required.



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 north to south from a maximum elevation of approximately 44 m AOD to approximately 15.0 m AOD, (13 m AOD on the south-western parcel), with an overall average gradient of approximately 1 in 25. There will therefore be overland flow routes from north to south towards Water Lane. Where overland flow routes are not obstructed surface water should continue to flow southwards, however, obstructions or localised low spots will tend to cause ponding. Where surface water discharges from the site on to hard surfaces these too will be at risk from surface water flooding, in particular Water Lane.
- 8.2.3 A review of the Environment Agency online mapping indicates that overall the Site is at very low risk from surface water flooding. Some areas which are inferred to have hard surfacing, in particular the access to the Angmering Raceway and Oval Race Club and parts of the raceway are shown to be at low, medium and high risk, as is an area adjacent to Groom's Copse. This is likely to be as a result of little or no existing on-site drainage and significant run-off from these hard areas due to the 1 in 25 gradient of the site. This is consistent with the topographical analysis.
- 8.2.4 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.
- 8.2.5 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 overlying the London Clay Formation. The London Clay is classified as an Unproductive Stratum in relation to groundwater. The Head deposits are classified as a Secondary Aquifer – Undifferentiated, which may support localised groundwater.

The London Clay is unlikely to present a risk of groundwater flooding. The Head deposits at the highest elevation (adjacent to the A27) may potentially present a small risk in conjunction with the topography of the site; gradient at approximately 1 in 25 if perched groundwater drains from these deposits.

- 8.4.3 The Environment Agency groundwater map consulted online does not indicate that the Site is at risk from groundwater flooding.
- 8.4.4 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.
- 8.4.5 The GroundSure® reports, have identified that according to the British Geological Survey, 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 British Geological Survey has assigned a high confidence rating to this result. However, no specific details or location are provided. This will nevertheless require further investigation.
- 8.4.6 The risk to the undeveloped site from groundwater flooding is considered to be **low**, however, given the British Geological Survey 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	<u>Low</u>	Specific mitigation unlikely.	×
Surface water	<u>Low</u>	Specific mitigation unlikely	×
Sewers and drains	<u>Low</u>	Specific mitigation unlikely	×
Groundwater	<u>Low</u>	Further investigation required in relation to British Geological Survey reference to Clearwater Flooding risk.	✓
Failure of infrastructure	<u>Low</u>	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 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 mainly undeveloped agricultural land) means that impermeable areas and therefore run-off will increase.

9.1.2.2 Since the use of infiltration SuDS is unlikely to be viable given that the Site is situated on London Clay and as 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 where it is likely to be an ordinary watercourse.

9.1.2.3 The potential impact 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, 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 actions, mitigations and drainage strategy in **Section 10** are followed.
- 9.3.4 As there are no foul water sewers present on or near the site, the discharge of foul flows will require a new requisitioned foul water sewer, pursuant to Section 98 of the Water Industry Act 1991.
- 9.3.5 The nearest foul sewers to the site are some distance away (refer to **Section 6.3**), these are 150 mm diameter and will be of adequate capacity to service the new development, hence the requirement for a new requisitioned foul water sewer.
- 9.3.6 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 British Geological Survey 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, rather than by infiltration. It is considered that this may decrease the risk of groundwater flooding relative to the existing situation.

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.	x
	Foul water High	The discharge of foul flows will require a new	✓



Flood Risk	Summary of risk from the proposed development	Notes	* Further action or mitigation potential
		requisitioned foul water sewer.	
Groundwater	Low	Further action is required to verify groundwater levels and assess the risk from Clearwater Flooding.	✓ **
Failure of infrastructure	Low	Specific mitigation unlikely.	×

* 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 – low risk.
- ii.* Surface water – low risk.
- iii.* Sewers and drains – low risk.
- iv.* Groundwater – low risk.
- v.* Infrastructure failure – low risk.

10.3 GROUNDWATER FLOODING

10.3.1 Although an assessment of flood risk to the proposed development has indicated that there is a low risk from groundwater flooding, further investigation is required in relation to a British Geological Survey 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 absence of foul sewers on or near the site, which will require a sewer requisition for a new foul water sewer.

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 10.74 ha site (**Section 2**) using the ICP SuDS Mean Annual Flood method, the results of which are included in **Table 10.1**. Outputs from Microdrainage Source Control software are included in **Appendix 4**.

Design Event	Runoff (l/s)
Development mean annual peak flow (Q_{BAR})	39.1
100% (1 in 1) annual event probability (Q_{1yr})	33.3
3.33% annual event probability (Q_{30yr})	88.7
1% annual event probability (Q_{100yr})	124.8

Table 10.1 Greenfield Runoff Assessment

- 10.6.2 This equates to a mean annual Greenfield runoff rate per hectare at 3.7 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 nature of the geology (the Site is situated on London Clay) as discussed in **Section 2.4**, means that the Site is unlikely to be appropriate for infiltration.

- 10.8.3 Until the British Geological Survey identified risk of the site being potentially susceptibility to Clearwater Flooding has been further investigated and groundwater levels have been verified, the use of infiltration may be considered to contribute to an increased risk of groundwater flooding. Therefore, this means of disposal does not currently form part of the drainage strategy featured in **Appendix 5**.



10.9 DISPOSAL TO WATERCOURSE

- 10.9.1 Given the absence of surface water sewers in close proximity to the site and the potential to increase the risk of groundwater flooding by use of infiltration SuDS, it is considered preferable to discharge attenuated surface water into the Black Ditch where it is likely to be an ordinary watercourse, this therefore forms the basis of the drainage strategy featured in **Appendix 5**.
- 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 (Qbar), at 39.1 litres/second (**Section 10.6**), for all events up to and including the 1% (1 in 100) AEP as detailed in the Environment Agency 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 West Sussex County Council (as the LLFA) as the Black Ditch is likely to be an ordinary watercourse prior to the point where it exits from the culvert beneath the Water Lane and A280 junction, where it is main river and the responsibility of the Environment Agency.

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 For the evaluation, the site is considered as two distinct catchments; namely, the larger main body of the site and the smaller south-western catchment.
- 10.10.3 It is assumed that runoff is to be restricted to "greenfield rates"; namely, Qbar, for the site in its entirety. Due to practical constraints, the discharge rate from the south-western parcel will be increased over the Qbar rate with the corresponding reduction in the discharge from the main body of the site.
- 10.10.4 The receiving watercourse will be the same for both catchments and the discharge rate into that body of water will not exceed Qbar for full site. All Qbar/permissible discharge estimates are based upon the proposed impermeable areas only and do not include proposed green areas.
- 10.10.5 For the larger main body of the site, using the revised discharge rate, design calculations for the attenuation storage volumes were completed using the MicroDrainage Source Control Quick Storage Estimate tool, which indicates that storage volumes are required in the range 9,846 m³ to 14,048 m³, the output of which is included in **Appendix 4**.
- 10.10.6 As featured in the drainage strategy illustrated on drawing 19495 - Nth- 301- 001 and 002, for the main body of the site, attenuation is proposed by way of two detention basins, with flow controls to restrict flows, with the following storage volumes:



i. Northern Basin : 4,500 m³.

ii. Southern Basin : 8,285 m³.

iii. Total Storage : **12,785 m³**.

10.10.7 For the south-western catchment, using the revised discharge rate, design calculations for the attenuation storage volumes were completed using the MicroDrainage Source Control Quick Storage Estimate tool, which indicates that storage volumes are required in the range 278 m³ to 439 m³, the output of which is included in **Appendix 4**.

10.10.8 As featured in the drainage strategy illustrated on drawing 19495 - Nth- 301- 001 and 002, for the south-western parcel, attenuation is proposed by way of geo-cellular storage within private areas and a detention basin adjacent to the southern boundary of the site, with flow controls to restrict flows, with the following storage volumes:

i. Geo-cellular storage – 262 m³.

ii. Basin adjacent to the southern boundary – 85 m³.

iii. Total Storage - **347 m³**.

10.10.9 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*'.

10.10.10 The maximum outflow from the site in its entirety is detention basins is 39.1 litres/second, in line with the value 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.

10.10.11 In relation to water quality, SuDS guidance typically recommends a three-stage management treatment train comprising:

i. **Filtration**, using a variety of filtration media, for example: sands, gravels (e.g. permeable pavements, filter drains), soils (e.g. bio-retention), grasses and other surface vegetation (e.g. swales, detention basins) or aquatic vegetation (e.g. wetlands).

ii. **Detention**, by storing surface water runoff volumes in detention basins, by using outflow controls, meets hydraulic criteria but also allows filtering and sedimentation to take place, which contributes to water quality improvement.



- iii. Permanent Treatment Ponds*, ponds and wetlands are useful for polishing surface water runoff at the end of a management train and can be used to store large volumes of clean water.

10.10.12 Given the scale of the development comprising 525 residential dwellings, plus 3ha of employment land, it is proposed that all three treatment stages will be incorporated in the final design of the attenuation basins. The specifics of the how the treatment stages will be incorporated will be provided at a more advanced stage of the drainage design.

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 525 dwellings, plus the 3ha of employment land.

10.11.2 Moreover, given that there are no sewers (foul or surface water) present on or near the site, a sewer requisition, (pursuant to Section 98 of the Water Industry Act 1991), for a new foul water sewer will be required before the site can be developed.

10.11.3 Based on 'Sewers for Adoption' (WRC), the design flow for gravity sewers are as follows:

- i.* Residential developments should be 4000 litres/unit dwelling/per 24 hours. Based on 525 dwellings, this equates to 24.3 litres/second.
- ii.* Commercial/Industrial developments should be 0.75 litres/second per hectare where the proportion of normal industry (at 0.5 litres/second per hectare) and wet industry (at 1 litre/second per hectare) is unknown. Since the proposed use of the commercial development is unknown the precautionary 0.75 litres/second per hectare has been used. Based on the 3ha of employment land shown on the Illustrative Masterplan Layout on Drawing No 1911 P 103, this equates to 2.25 litres/second.

It is suggested that for informing the required capacity for a new foul sewer to be requisitioned from Southern Water, a combined residential/commercial foul flow of, approximately, 26.6 litres/second be used.

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 British Geological Survey in relation to groundwater flood susceptibility from Clearwater Flooding.

10.12.2 It is recommended that the British Geological Survey identified risk be investigated further by means of consultation with the British Geological Survey and other 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 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.

10.13.3 The 2016 guidance is presented and summarised in this section.

Peak River Flow Allowances

10.13.4 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.

10.13.5 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%
	Upper end	25%	50%	105%



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
South East	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%
	Higher central	15%	20%	25%
	Central	10%	15%	20%

Table 10.2 Peak River Flow Allowances by River Basin District

10.13.6 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.

10.13.7 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.

10.13.8 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

10.13.9 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



- 10.13.10 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

- 10.13.11 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.
- 10.13.12 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.
- 10.13.13 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:
- The north-west and north east of England is north of Flamborough Head.
 - The east, East Midlands, London and the south-east is south of Flamborough Head.
 - 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)

- 10.13.14 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

10.13.15 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

10.13.16 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

10.13.17 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

10.13.18 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.

10.13.19 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 development of 525 residential dwellings, plus 3ha of employment land.

10.15.3 The Site is located in Environment Agency Flood Zone 1, namely, areas with a low probability of flooding from main rivers.

10.15.4 The site is classed as having 'More Vulnerability' (residential housing) and 'Less Vulnerability' (commercial development), 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' and 'Less Vulnerable' uses is compatible with Flood Zone 1 and it is considered that the Sequential Test has been applied by virtue of the proposal to locate 'More Vulnerable' uses in the areas of lowest risk, namely Flood Zone 1. The Exception Test is therefore 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 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 foul 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 foul sewers on or near the site. The mitigations described in this FRA and the accompanying indicative drainage strategy will only be viable with the provision of a new off-site foul sewer, for which purpose a new foul sewer will need to be requisitioned from Southern Water, (pursuant to Section 98 of the Water Industry Act 1991).

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



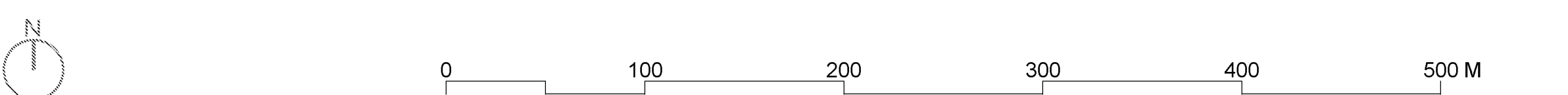
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Merebrook Consulting Limited AL 100048771



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Tel: +44(0)1773 826008 email: info@idommerebrook.co.uk

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

Amended border	02-10-2017			-
	SC	SJ	SJ	
Based on OS	20-08-2015			-
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Issue Details				
Job No.	19495	Dwg No.	001-003	Revision
Scale	NTS	Date	October 2017	Frame Dimensions mm (A4) 250x181
Drawn	SNC	Checked	SJ	Approved SJ



Site Location
Area 32.9 Hectares

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REV.	DATE	AMENDMENTS	DRAWN	CHECKED
A	12.09.16	Admission and added to plan		
B	13.09.17	Refine redraw		
C	13.09.17	Final plan confirmed		
D	07.02.17	Refine updated - Transport comments		
E	13.09.17	Issued for application		
F	08.01.18	Updated with A100 included		

CLIENT:
**Rydon Group +
Gleeson Strategic Land**

PROJECT:
**Land North of Water Lane
Angmering**

DRAWING:
Site Location

DATE:
May 2016

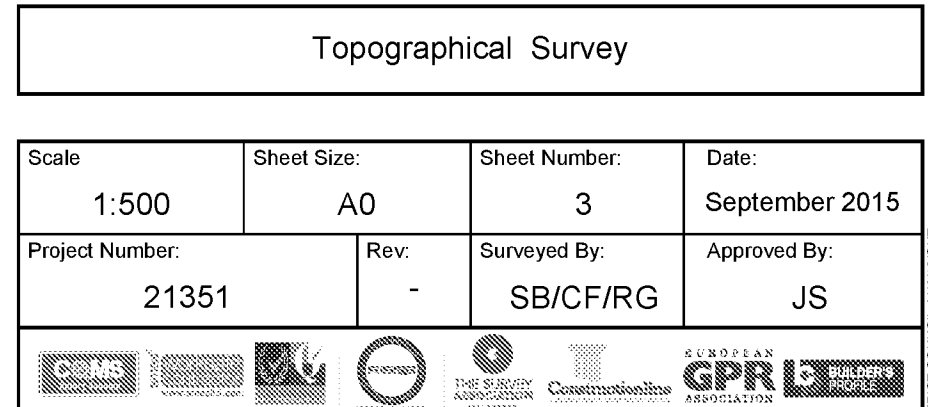
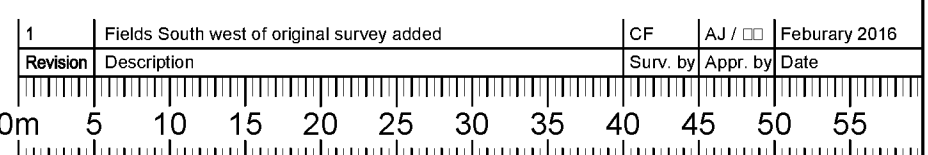
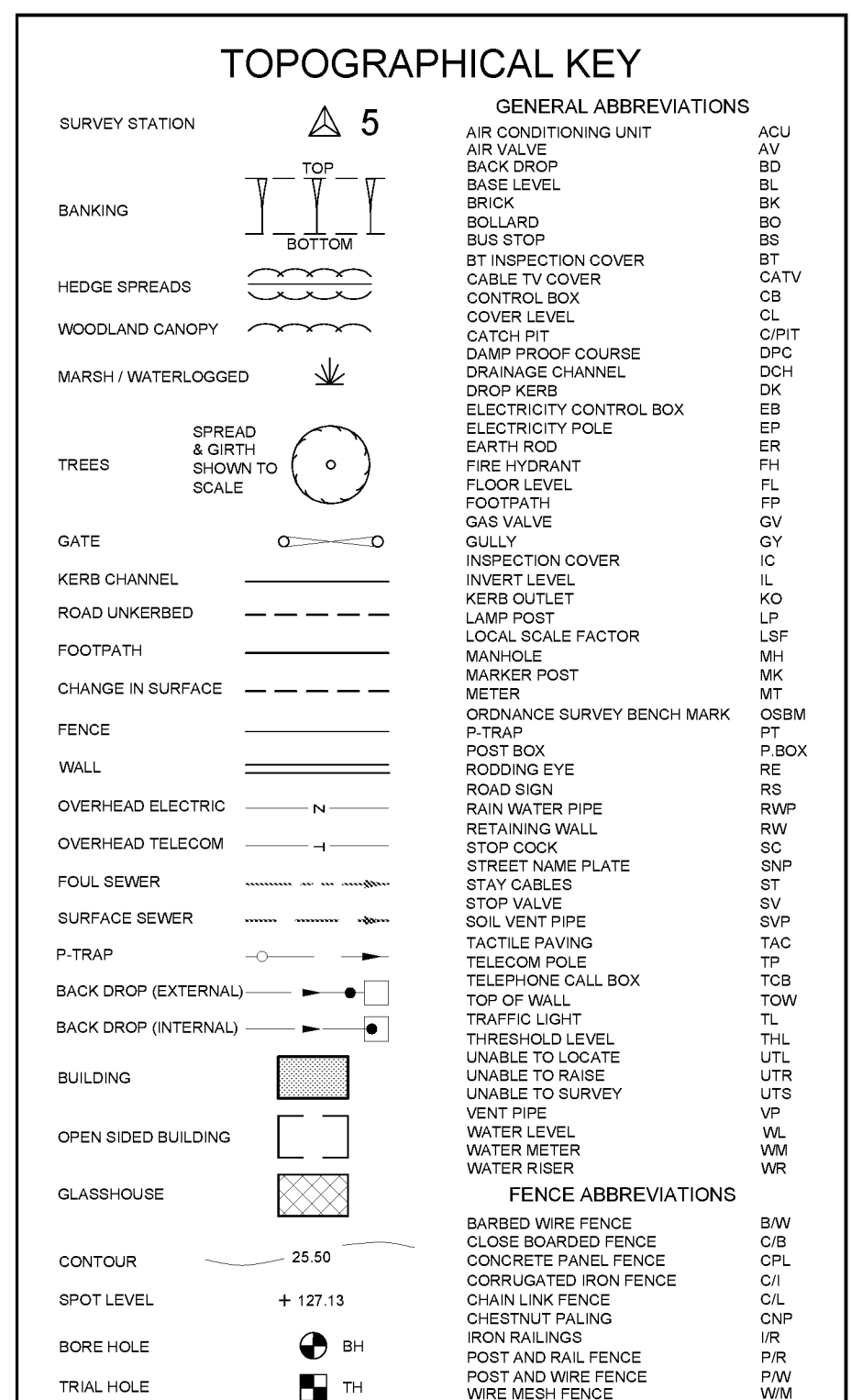
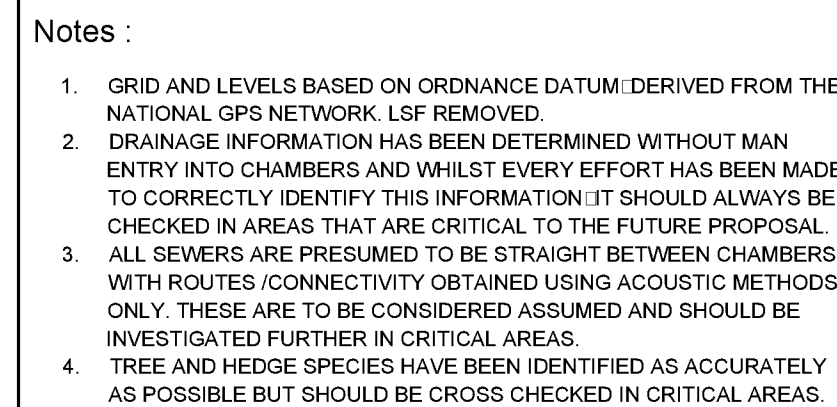
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PRELIMINARY P1

CLIENT:
Rydon Group
Gleeson Strategic Land

PROJECT:
Angmering,
Land North of Water Lane

SCALE: 1:1250 @ A1
DWG NO: 1911 P 103
REV: P1

REV.	DATE	AMENDMENTS	DRAWN	CHECKED
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APPENDIX 2

- Environment Agency Consultation
- Lead Local Flood Authority Consultation

25 August 2015

External Relations Team
Environment Agency

email: enquiries@environment-agency.gov.uk

Dear Sirs

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

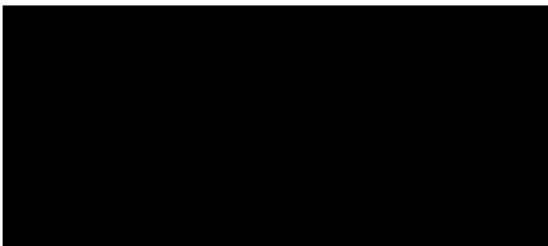
Our Client is pursuing the above development and we have been instructed to undertake a Flood Risk Assessment and are currently in the process of canvassing consultees.

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

Idom Merebrook Ltd East Mill, Bridgeton, Belper, Derbyshire, DE56 2UA
t +44 (0)1773 829 988 f +44 (0)1773 829 386 e consulting@merebrook.co.uk merebrook.co.uk idom.com
Registered in England No. 02740216 Registered office: Belper
offices London Kent Derby Cardiff Manchester Morey

From: Enquiries, Unit [REDACTED]
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

Tel 03708 506506

Regards

Paul Pinder

[REDACTED]



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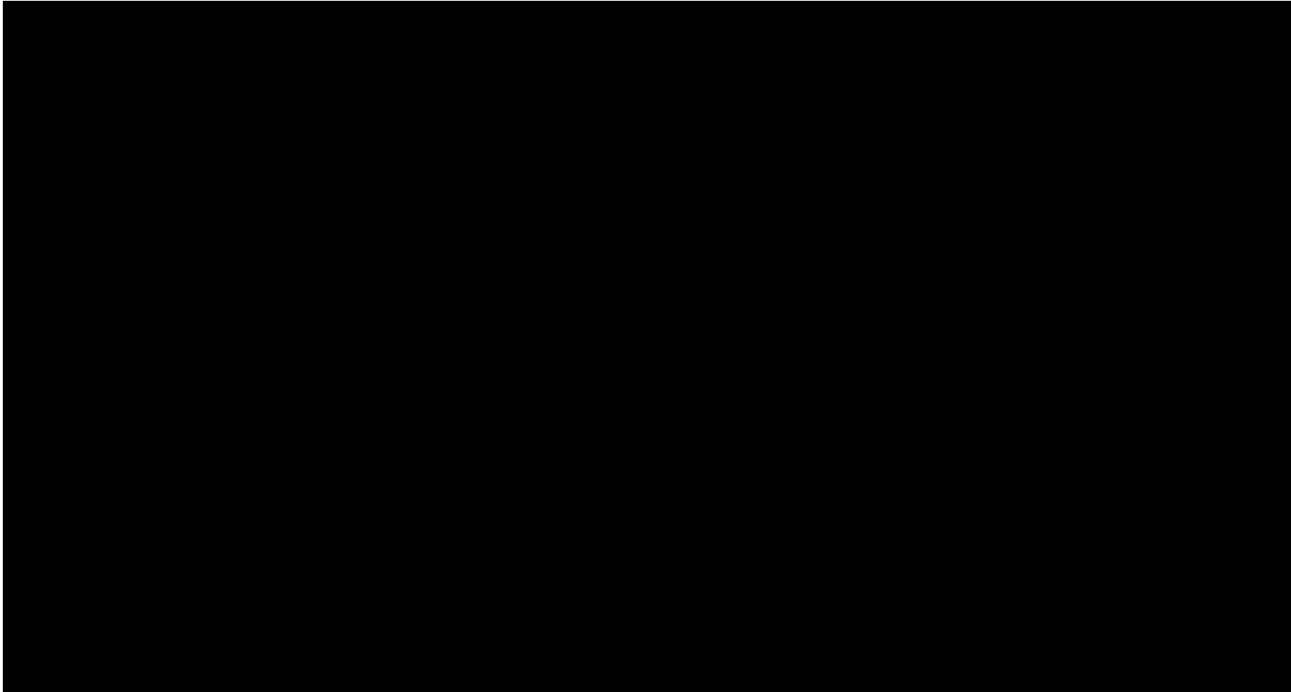
From: Gemma Jinks [REDACTED]
Sent: 25 August 2015 10:22
To: Enquiries, Unit
Subject: Flood Risk Assessment: Pre Planning Enquiry

Dear Sirs

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

Regards

Gemma Jinks



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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.

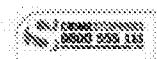
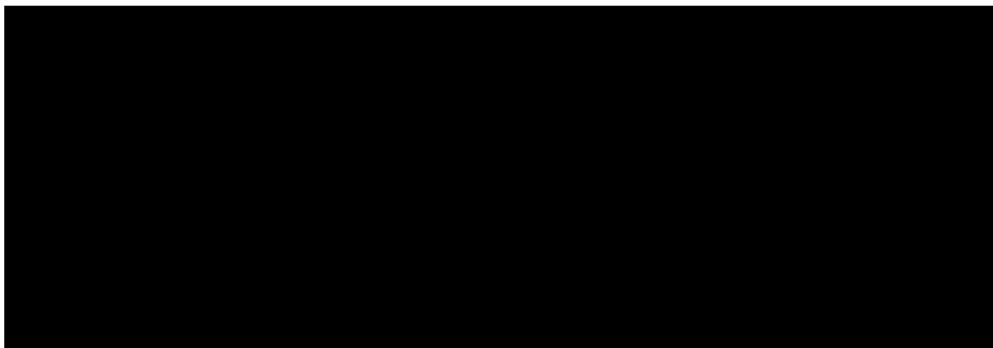
If I have not received your payment within 60 days of the date of this letter/email, I will assume that you no longer require the information.

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



Waste crime - see it, report it 0800 555 111

From: Gemma Jinks [REDACTED]
Sent: 25 August 2015 10:12
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

[REDACTED]

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www.merebrook.co.uk

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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

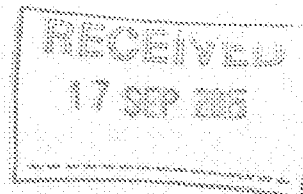
Gemma Jinks

[REDACTED]



APPENDIX 3

- Sewer Records
- Capacity Assessment – Not Used



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





APPENDIX 4 ▪ MicroDrainage Outputs

Idom Merebrook Ltd		Page 1
Suite 2B East Mill Belper Derbyshire DE56 2UA		
Date 30/10/2017 13:02 File SW QSE.srcx	Designed by rhopkinson Checked by	
XP Solutions		Source Control 2017.1

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.400
Area (ha)	10.740	Urban	0.000
SAAR (mm)	742	Region Number	Region 7

Results l/s

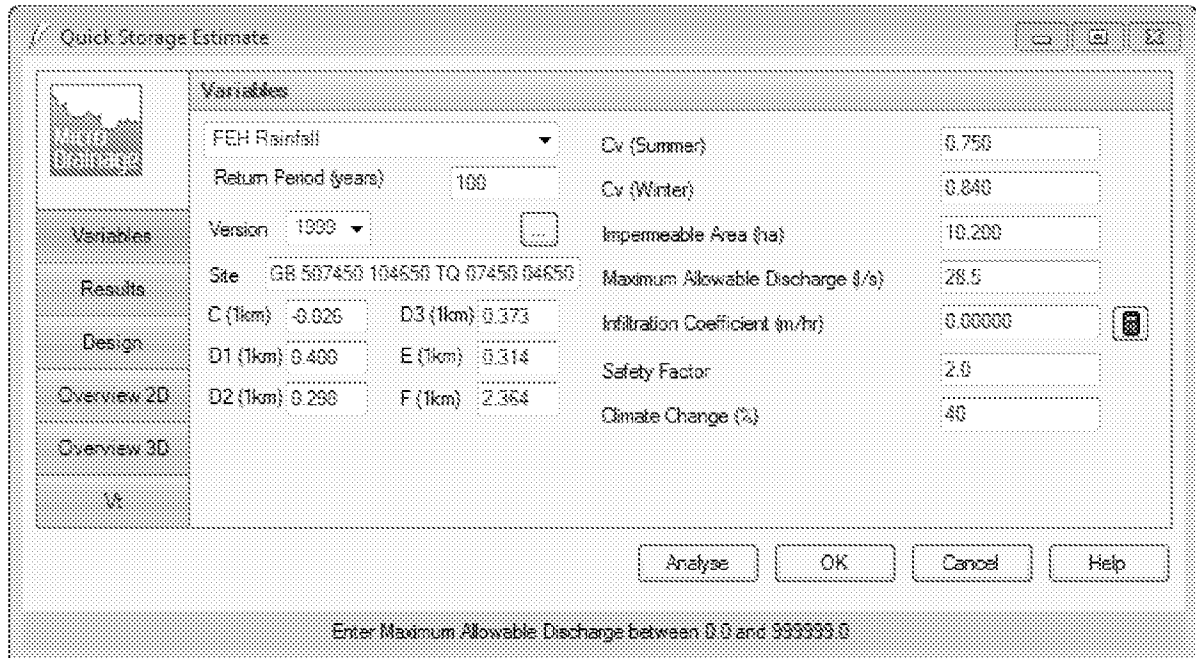
QBAR Rural	39.1
QBAR Urban	39.1
Q100 years	124.8
Q1 year	33.3
Q30 years	88.7
Q100 years	124.8

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19495: Land to The North of Water Lane, Angmering.

Quick Storage Estimate

Main body of the site

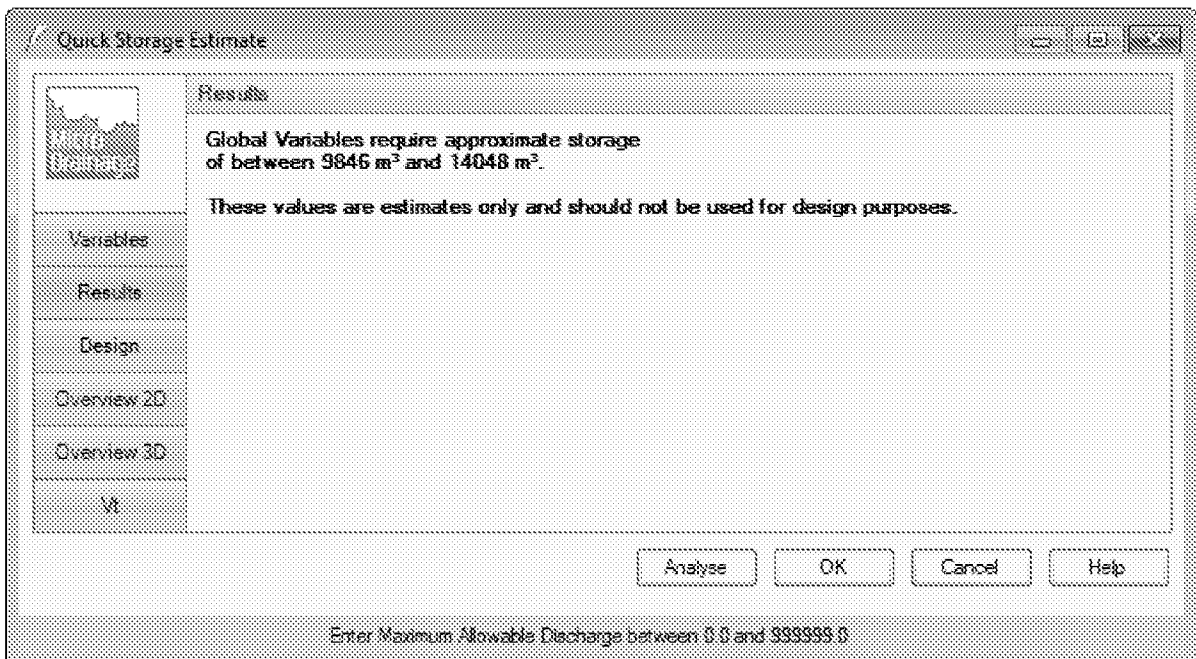


The screenshot shows the 'Quick Storage Estimate' software window with the 'Variables' tab selected. The window has a sidebar on the left with buttons for 'Variables', 'Results', 'Design', 'Overview 2D', 'Overview 3D', and 'Vt'. The main area contains various input fields for site and climate data.

Variable	Value
FEH Rainfall	[Dropdown]
Return Period (years)	100
Version	1000
Site	GB 587450 104650 TQ 67450 54650
C (1km)	-0.026
D1 (1km)	0.400
D2 (1km)	0.290
D3 (1km)	0.373
E (1km)	0.314
F (1km)	2.354
Cv (Summer)	0.750
Cv (Winter)	0.840
Impermeable Area (ha)	10.200
Maximum Allowable Discharge (l/s)	28.5
Infiltration Coefficient (m/hr)	0.00000
Safety Factor	2.0
Climate Change (%)	40

Buttons at the bottom: Analyse, OK, Cancel, Help.

Footer text: Enter Maximum Allowable Discharge between 0.0 and 999999.0



The screenshot shows the 'Quick Storage Estimate' software window with the 'Results' tab selected. The window displays the results of the storage estimate.

Results

Global Variables require approximate storage of between 9846 m³ and 14048 m³.

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

Buttons at the bottom: Analyse, OK, Cancel, Help.

Footer text: Enter Maximum Allowable Discharge between 0.0 and 999999.0

South-western part of the site

Quick Storage Estimate

Variables

FEH Rainfall

Return Period (years) 100

Version 1999

Site GB 507450 104650 TQ 07450 04650

C (1km) 0.026 D3 (1km) 0.373

D1 (1km) 0.400 E (1km) 0.314

D2 (1km) 0.200 F (1km) 2.364

Cv (Summer) 0.750

Cv (Winter) 0.840

Impermeable Area (ha) 0.540

Maximum Allowable Discharge (l/s) 10.6

Infiltration Coefficient (m/hr) 0.00000

Safety Factor 2.0

Climate Change (%) 40

Analyse OK Cancel Help

Enter Maximum Allowable Discharge between 0.0 and 999999.0

Quick Storage Estimate

Results

Global Variables require approximate storage of between 278 m³ and 439 m³.

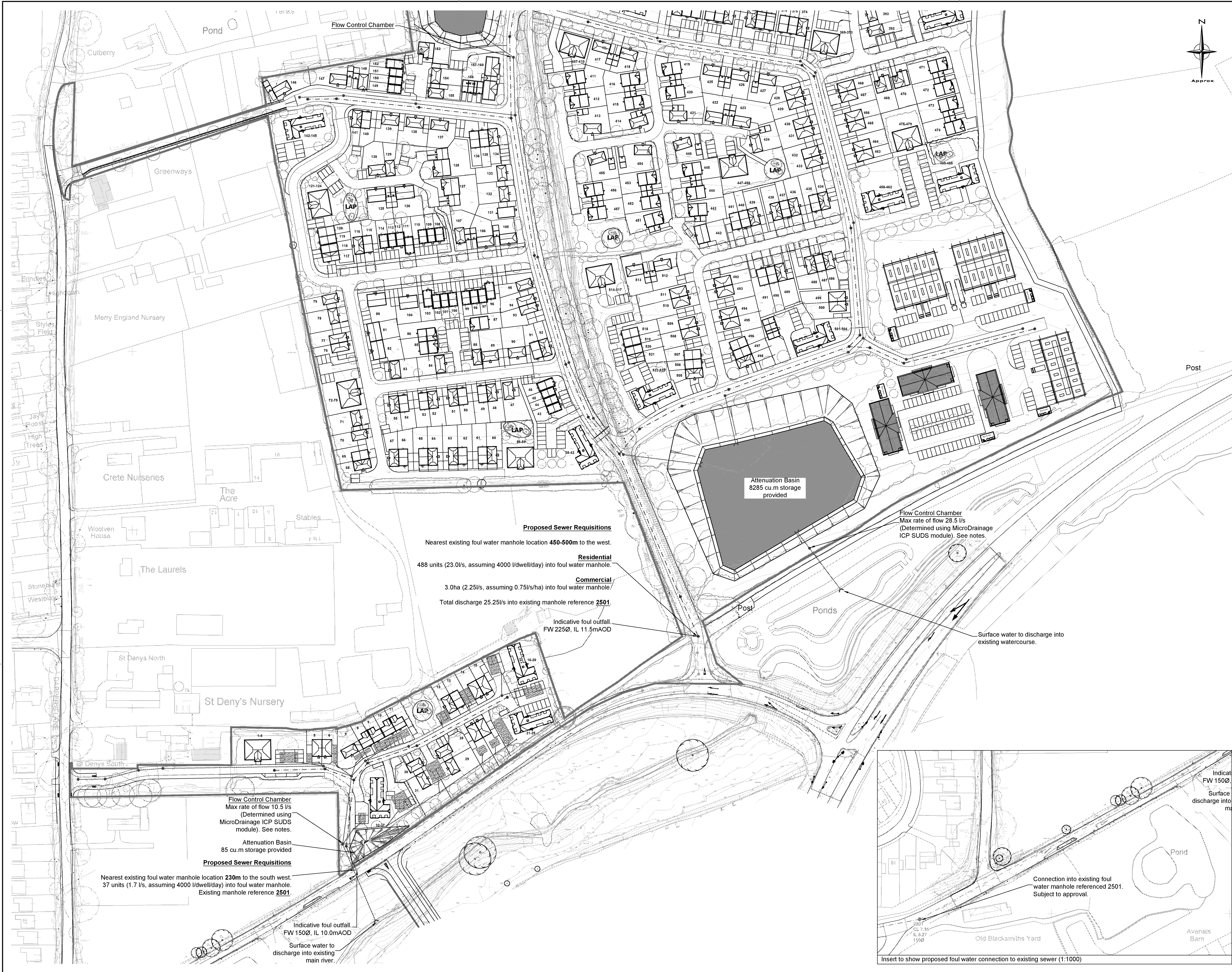
These values are estimates only and should not be used for design purposes.

Analyse OK Cancel Help

Enter Maximum Allowable Discharge between 0.0 and 999999.0



APPENDIX 5 ▪ Indicative Drainage Strategy



Legend

Indicative site boundary

Existing topographic survey information shown in GREY. Reproduced from MK Surveys Drawing ref. 21351

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 outline foul water sewer requisition

Proposed indicative geo-cellular storage

Notes

1. 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.

2. Detailed hydraulic modelling has not been undertaken in the preparation of this strategy.

3. 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.

4. The Surface Water Drainage Strategy is outlined below:

4.1. The site is considered to be two distinct catchments; namely, the larger main body of the site and the smaller south-western catchment.

4.2. It is assumed that the 100 year + 40% storm is the reference event for both catchments.

4.3. The Flood Estimation Handbook (FEH) inputs have been used when estimating attenuation requirements.

4.4. It is assumed that runoff is to be restricted to "greenfield rates", namely, Qbar, for the site in its entirety. Due to practical constraints the discharge rate from the south western parcel will be increased over the Qbar rate with the corresponding reduction in the discharge from the main body of the site.

4.5. The receiving watercourse will be the same for both catchments and the discharge rate into that body of water will not exceed Qbar for full site. All Qbar/permissible discharge estimates are based upon the proposed impermeable areas only and do not include proposed green areas.

4.6. Drained area/contributing catchments have been measured in AutoCAD and are outlined below.

4.7. 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 (e.g. serving individual plots).

4.8. It is assumed the existing levels will be indicative of proposed ground levels.

4.9. Basin shapes and locations are indicative and are subject to design following preparation of detailed planning layout and proposed levels.

4.10. The following summarises parcel estimates:

Main body of site

Drained area102000 sq.m

Qbar27.5 l/s

Revised discharge rate28.5 l/s

Attenuation required9845 - 14048 cu.m

Attenuation provided12785 cu.m

South-western parcel

Drained area5400 sq.m

Qbar2 l/s

Revised Discharge Rate10.5 l/s

Attenuation required278 - 439 cu.m

Attenuation provided347 cu.m

5. In respect of individual parcels the surface water drainage strategy has been developed as two distinct systems:

5.1. Main body of site:

5.1.1. Attenuation provided by two basins that are linked via the proposed strategic network with flows balanced between the two. Final discharge limited to 28.5 l/s.

5.2. South-western parcel:

5.2.1. Attenuation provided by at-source storage within private areas, it is anticipated the geo-cellular storage will be used with individual controls restricting flow into the strategic system.

5.2.2. Prior to final discharge at 10.5 l/s, attenuation by basin.

6. The Foul Water Drainage Strategy is summarised below for both catchments:

6.1. Pipework generally following the watershed direction of the existing landform.

6.2. The site outfall is located at the low point of the site, into Water Lane.

6.3. Nearest existing foul water manhole reference 2501.

6.4. The proposed sewer requisition route shown is indicative and is subject to detailed design and a Section 98 application.

7. The Undertaker/Regulators have been consulted in respect of the available capacity within the adjacent drainage systems. Formal responses are awaited.

Sheet 1

Sheet 2

Insert

Details of discharge rates added	16-01-2018	A
	SNC RH PRD	
Based on Drawing reference:	05-10-2015	-
	RH PRD KN	
Issue Details	Dwn Chd App'd	
Client	Rydon Homes & Gleeson Strategic Land	

Project

Land to the North of Water Lane, Angmering

Dwg Title

Outline Drainage Strategy Sheet 2

Job No.	Dwg No.	Revision
19495	Nth-301-002	A

Scale	Date	Frame Dimensions rrm
1:1000	October 2017	(A1) 791 x 544

Drawn	Checked	Approved
RH	PRD	KN

London

Kent

Derby

Cardiff

Manchester

dom

merebrook

Unit 18B, Bridgepark, Solihull, Birmingham, England, B37 7YU

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ARUN DISTRICT COUNCIL A/018/OUT



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