

LAND WEST OF B2132 BILSHAM ROAD, YAPTON

FLOOD RISK ASSESSMENT & DRAINAGE STRATEGY
ON BEHALF OF
GLEESON STRATEGIC LAND

Prepared by

Odyssey

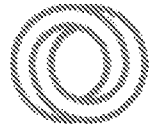
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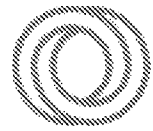


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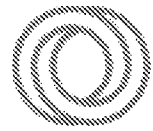


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1.0 INTRODUCTION

1.1 Odyssey has been commissioned by Gleeson Strategic Land to undertake a Flood Risk Assessment (FRA), incorporating a surface water and foul water drainage strategy to support a planning application for a proposed residential development in Yapton.

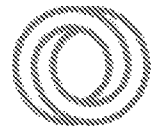
1.2 The land forms the eastern part of the emerging allocation site SD7 in the Arun Local Plan 2017-2031.

1.3 The proposed development comprises up to 250 dwellings and associated infrastructure and landscaping.

1.4 This report comprises the following elements:

- Review of existing legislation, policy and supporting documents in relation to flood risk, surface water and foul water;
- Review of all elements which may cause or increase the risk of flooding to the development and the local vicinity including fluvial, pluvial, groundwater, sewers and man-made infrastructure. The assessment also identifies and examines the residual flood risk to the proposed development and neighbouring property from these sources;
- Demonstration through the use of Sustainable Drainage Systems (SuDS) that the proposed development does not increase the potential for flooding through mitigation;
- A surface water and foul water drainage strategy, illustrating that the site can be drained effectively and in accordance with West Sussex County Council (WSCC), Arun District Council (ADC), Environment Agency (EA) and Southern Water Services Ltd (SWSL) requirements.

1.5 This FRA has been prepared in accordance with the requirements set out in the National Planning Policy Framework (NPPF) (Communities and Local Government, March 2012), Planning Practice Guidance (PPG) (Department for Communities and Local Government, updated April 2015), EA guidance, The SuDS Manual (CIRIA C753), the Non-Statutory Technical Standards for Sustainable Drainage, and SWSL requirements.



2.0 DEVELOPMENT PROPOSALS

2.1 The proposed development comprises up to 250 dwellings and associated infrastructure and landscaping. An outline application for the remainder of the emerging allocation is being drawn up alongside this application, using a jointly commissioned comprehensive masterplan.

2.2 A site location plan is shown in **Appendix A** and the indicative masterplan is presented in **Appendix B**.

2.3 Surface water runoff will be managed through the implementation of SuDS, in the form of attenuation basins. The surface water drainage strategy is discussed in detail in **Section 10** of this report.

2.4 A foul water drainage system for the development will be designed in accordance with Sewers for Adoption 7th Edition (SfA), the Building Regulations Part H, and SWSL requirements. The proposed foul water drainage will connect to the existing SWSL public foul sewer on Bilsham Road, subject to a Section 106 agreement with SWSL.



3.0 BASELINE CONDITIONS

3.1 *Sources of Information*

3.1.1 The baseline conditions for this site have been established using the following sources and references:

- Topographical Survey, Digital Terrain Surveys, April 2014;
- British Geological Survey (BGS) online mapping (data obtained in November 2017);
- Intrusive Ground Investigations, BRD Environmental, October 2017;
- EA mapping;
- SWSL asset location plans (data obtained in August 2017).

3.2 *Site Description*

3.2.1 The 11.6ha site is located in Yapton, within the Arun District of West Sussex. The site is bounded by existing residential development to the north, the B2132 Bilsham Road to the east, and agricultural fields to the south. The field to the west of the site forms part of the emerging allocation.

3.2.2 The approximate centre of the site is at Ordnance Survey (OS) Grid Reference 497553E, 102821N, and the nearest postcode is BN18 0LE.

3.2.3 The site currently comprises three fields of undeveloped farmland.

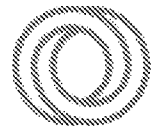
3.3 *Topography*

3.3.1 The topographical survey for the site was undertaken by Digital Terrain Surveys in April 2014. A level study of the site's topography shows that ground levels fall towards the route of the Main River. Levels at the site range from approximately 4.6m AOD to 6.7m AOD.

3.3.2 The topographical survey is provided in **Appendix C**.

3.4 *Geology*

3.4.1 BGS mapping indicates that the bedrock geology of the site consists of Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation - chalk.



3.4.2 The maps also show that there are superficial deposits at the site comprising river terrace deposits - sand, silt and clay.

3.4.3 BGS mapping is shown in **Appendix D**.

3.4.4 Intrusive ground investigations undertaken by BRD Environmental in October 2017 largely correspond with the BGS mapping. Topsoil and superficial deposits consisting of clay river terrace deposits were found site-wide. Chalk was encountered beneath these strata.

3.4.5 The ground investigation logs are shown in **Appendix E**.

3.5 ***Hydrology***

3.5.1 The Ryebank Rife is an EA designated Main River located within the site boundaries, and is culverted towards the south of the site. There is also a local network of ditches along the field boundaries within the western part of the site.

3.6 ***Hydrogeology***

3.6.1 According to the BGS hydrogeological mapping, the site is located within the White Chalk Subgroup, which is described as a highly productive aquifer.

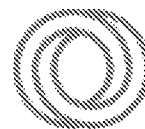
3.6.2 Groundwater mapping published by the EA indicates that the site is not situated within a groundwater Source Protection Zone. The bedrock at the site is designated as a 'Principal Aquifer'. The site is located within a 'Major Aquifer High' and 'Major Aquifer Intermediate' groundwater vulnerability zone. This information is shown within **Appendix F**.

3.6.3 Groundwater monitoring undertaken as part of the intrusive ground investigations in October 2017 found that groundwater levels ranged from 1.69m to 3.63m below the ground surface.

3.6.4 Soakage tests were also undertaken across the site, and the infiltration rates ranged from 1.86×10^{-6} m/s to 9.91×10^{-6} m/s. One test towards the centre of the site could not determine the infiltration rate, as the test pit would not reach half empty within 24 hours. The groundwater monitoring and soakage test records are included within **Appendix E**.

3.7 ***Existing Foul and Surface Water Drainage Regime***

3.7.1 According to maps provided SWSL, there is a surface water network along the northern part of the Main River route within the site boundary, upstream of the culvert.



3.7.2 It is anticipated that surface water runoff from the existing site currently infiltrates into the underlying strata, with any excess discharged towards the river and ditch networks on site due to the topography.

3.7.3 The SWSL mapping shows that there are no public foul sewers located within the site boundary. There is a public foul network serving the existing residential development to the north, and a 150mm diameter foul sewer flowing in a northern direction along the B2132 Bilsham Road to the east of the site. A copy of the SWSL sewer records is presented in **Appendix G**.

3.7.4 As the proposed development area is less than 50ha, the Institute of Hydrology (IoH) Report 124 Flood Estimation for Small Catchments (1994) method has been used to estimate the site greenfield peak flow rate, which is an approved methodology specified within the EA's Rainfall Runoff Management for Developments Report¹, using the parameters detailed in **Table 3.1** below.

Table 3.1: ICP SuDS Parameters

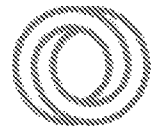
Parameter	Value	Unit
SAAR	747	mm
Soil Index	0.4	-
Region	7	-
Urban	0.000	-

3.7.5 **Table 3.2** summarises the estimated current greenfield discharge rates for the site. Calculations are provided in **Appendix H**.

Table 3.2: Existing Surface Water Discharge Rates

Return Period	Existing Greenfield Discharge Rates (l/s)	Existing Greenfield Discharge Rates (l/s/ha)
Q _{BAR}	43.0	3.7
Q1	36.5	3.1
Q30	97.3	8.3
Q100	137.0	11.7

¹ R Kellagher (2013) *Rainfall Runoff Management for Development Report SC030219*, Environment Agency, Bristol.



4.0 FLOOD RISK LEGISLATION AND POLICY REVIEW

Legislation

4.1 *Flood and Water Management Act 2010*

4.1.1 The Flood and Water Management Act 2010 (FWMA) received Royal Assent on 8th April 2010. The FWMA was introduced to enforce some of the key proposals set out within UK Government flood and water strategies along with the Government's response to Sir Michael Pitt's review of the summer 2007 floods.

4.1.2 Relevant to development sites, the FWMA is intended to encourage the uptake of SuDS by removing the automatic right to connect to sewers.

4.1.3 The development proposals will adhere to the FWMA through the provision of SuDS as a fundamental element of the surface water drainage system. Furthermore, Gleeson Strategic Land is committed to working with the relevant stakeholders, such as the EA and WSCC, in implementing the requirements of the FWMA where applicable.

4.2 *Flood Directive – The Flood Risk Regulations 2009*

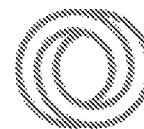
4.2.1 The Flood Risk Regulations 2009 came into force on 10th December 2009, transposing the European Floods Directive into domestic law. In essence the Regulations require the EA to prepare FRAs, maps and plans for sea, main river and reservoir flood risk and will require lead local flood authorities (unitary and county councils) to do the same for all other forms of flooding.

National Policy

4.3 *National Planning Policy Framework 2012*

4.3.1 The NPPF replaced all planning policy documents (including Planning Policy Statement 25: Development and Flood Risk) upon publication in March 2012.

4.3.2 The NPPF sets out the Government's planning policies for England and Wales, and how these policies should be applied. The technical guidance to the NPPF, the PPG, was published in March 2014 to accompany the NPPF. The PPG is an online document and provides additional guidance and links to relevant current detail documents.



4.3.3 Paragraph 100 of the NPPF states that *“inappropriate development in areas at risk of flooding should be avoided by directing development away from areas of highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere.”*

4.3.4 As stated in Paragraph 103 of the NPPF, when determining planning applications, local planning authorities should ensure flood risk is not increased elsewhere and only consider appropriate development in areas at risk of flooding where, following application of the Sequential Test (and if required, the Exception Test), it can be demonstrated that:

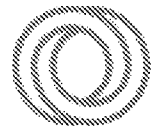
- Within the site, the most vulnerable development is located in areas of lowest flood risk unless there are overriding reasons to prefer a different location; and
- Development is appropriately flood resilient and resistant, including safe access and escape routes where required, and that any residual risk can be safely managed, including by emergency planning; and it gives priority to the use of SuDS.

4.3.5 All land in England and Wales is classified into three main Flood Zones which refer to the probability of river or sea flooding (ignoring the existence of defences). The PPG identifies and describes the EA Flood Zones as:

- Flood Zone 1: Low Probability, defined as land assessed as having less than 1 in 1,000 annual probability of river or sea flooding (<0.1%);
- Flood Zone 2: Medium Probability, defined as land assessed as having between 1 in 100 and 1 in 1,000 annual probability of river flooding (1% - 0.1%), or between 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% - 0.1%);
- Flood Zone 3a: High Probability, defined as land assessed as having a 1 in 100 or greater annual probability of river flooding ($\geq 1\%$), or a 1 in 200 or greater annual probability of sea flooding ($\geq 0.5\%$);
- Flood Zone 3b: The Functional Floodplain, defined as land where water has to flow or be stored in times of flood (as identified by local planning authorities in their Strategic Flood Risk Assessments).

4.3.6 In accordance with the NPPF, a site specific FRA is required for:

- Proposals of 1 hectare or greater in Flood Zone 1,
- All proposals for development in Flood Zones 2 and 3,



- An area within Flood Zone 1 which has critical drainage problems,
- Development or change of use to a more vulnerable class that may be subject to other sources of flooding.

4.3.7 The site is larger than 1ha and mostly situated within Flood Zone 1, with a narrow area of land located within Flood Zone 2 and 3. The EA flood maps showed parts of the site as being located within Flood Zone 3 (high risk), but did not hold suitable flood levels for the area to inform this FRA. In July 2016, Odyssey Markides undertook hydraulic modelling to assess the flood risk associated with the Bilsham Ditch. The results were approved by the EA following a review, and the updated floodplain extents showed smaller Flood Zone 3 extents compared to the previous EA mapping. The EA correspondence and modelling report can be found in **Appendix F**.

4.3.8 A site specific FRA is required in accordance to the NPPF.

4.3.9 Greenfield sites would rely on natural drainage to convey or absorb rainfall. In general, development can reduce the permeability of the site if not well designed, increasing the volume and rate of water running off the site and potentially increasing flood risk to downstream areas.

4.4 ***Non-Statutory Technical Standards for Sustainable Drainage Systems 2015***

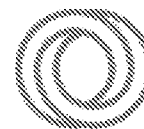
4.4.1 The Non-Statutory Technical Standards for Sustainable Drainage Systems was published by the Department for Environment, Food and Rural Affairs (DEFRA) in March 2015.

4.4.2 The standards are to be used in order to manage surface runoff in accordance with Schedule 3 of the FWMA.

4.4.3 The standards state that runoff destination should be considered in the following order of preference:

- Discharge into the ground (infiltration);
- Discharge to a surface water body;
- Discharge to a surface water sewer;
- Discharge to a combined sewer.

4.4.4 The document provides guidance on runoff destination, peak flow rate, volume and control of water quality and function.



4.4.5 The local planning authority may set local requirements for planning permission that have the effect of more stringent requirements than that of the standards.

4.5 ***The Water Industry Act 1991***

4.5.1 The Water Industry Act 1991 (WIA) (HMSO, 1991) was introduced to consolidate previous water supply and wastewater services enactments in the UK. Section 94 sets out the principal duties and standards of performance to sewerage undertakers which include the duty *'to provide, improve and extend such a system of public sewers (whether inside its area or elsewhere) and so to cleanse and maintain those sewers so as to ensure that the area is and continues to be effectually drained'*.

4.5.2 Relevant to new developments, Section 104 and Section 106 of the WIA provides the framework for the adoption of private sewers, subject to an agreement with the sewerage undertaker, who in this case is SWSL.

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

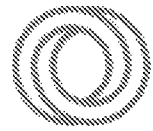
4.5.4 Section 106 allows the sewerage undertaker a 21 day notice period prior to the works being undertaken. During this time the application may be refused if the undertaker considers that the connection mode or condition of the connecting sewer does not satisfy the required standards. The undertaker cannot refuse the connection based on inadequate capacity.

4.6 ***Transfer of Private Sewers***

4.6.1 It should be noted that the Water Industry (Schemes for Adoption of Private Sewers) Regulations 2011 has transferred private sewers into the ownership of the statutory sewerage companies in England since October 2011. The government are also taking steps to stem the proliferation of newly built sewers in order to prevent the recurrence of existing ownership/maintenance problems in the future.

4.7 ***The Pitt Review***

4.7.1 In response to the severe flooding in the UK during the summer of 2007, the government commissioned an independent review on lessons to be learned. The Pitt Review was comprehensive and considered all stages of flooding – preparedness, response and recovery – as well as the coordination, responsibilities and legislation necessary to ensure the UK can advance in the area of flood risk management.



4.8 ***Sewers for Adoption 7th Edition***

4.8.1 The SfA places responsibility (in England and Wales) for existing and future private sewers and lateral drains that connect to the public sewer system to the water and sewerage companies.

4.8.2 The SfA will provide detailed guidance to support the Mandatory Build Standard whereby; it will be mandatory for new sewers and lateral drains (between the sewer and the serviced property boundary) to be adopted to public status by the sewerage undertaker.

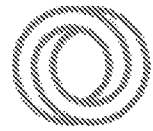
4.8.3 The guidance for foul sewer design in SfA states; *'The design of flows for gravity sewers for residential developments should be 4,000 litres / unit dwelling / per 24 hours.'*

4.9 ***Building Regulations***

4.9.1 Where drainage within a development is not to be adopted by the sewerage undertakers, the so-called private sewers will be required to meet the standards as set out in the Building Regulations 2015, Part H 'Drainage and Waste Disposal' guidance on the design of private sewers.

4.9.2 Specific guidance can be found within the following sections of the Building Regulations 2015, Part H 'Drainage and Waste Disposal':

- H1 – Foul water drainage
- H2 – Wastewater treatment systems and cesspools
- H3 – Rainwater drainage
- H4 – Building over sewers
- H5 – Separate systems of drainage
- H6 – Solid waste storage.



Local Policy

4.10 *Arun District Local Plan 2003 - saved policies*

4.10.1 The key aim of the plan is to apply the principles of sustainable development in assessing development proposals, addressing the balance between the need for development and the protection of resources.

4.10.2 Policy GEN 9 - Foul and Surface Water Drainage: planning permission for development which will materially increase foul and/or surface water discharges will be refused unless the Local Planning Authority is satisfied that either adequate drainage capacity exists or appropriate drainage capacity can be provided as part of the development. Consideration should also be given to the use of SuDS as alternatives to conventional drainage where appropriate.

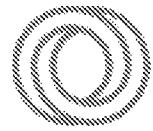
4.11 *Emerging Arun District Local Plan 2011-2031*

4.11.1 The plan will set out the strategic vision for the future of the District, and the objectives, policies and proposals for development to 2031 and beyond.

4.11.2 Policy W DM2 - Flood Risk: development in areas at risk from flooding, identified on the latest EA flood risk maps and the Council's Strategic Flood Risk Assessment, will only be permitted where all of the following criteria have been satisfied:

- a. The sequential test in accordance with the NPPF Technical Guidance has been met;
- b. A site specific FRA demonstrates that the development will be safe, including access and egress, without increasing flood risk elsewhere and reduce flood risk overall;
- c. The scheme identifies adaptation and mitigation measures;
- d. Appropriate flood warning and evacuation plans are in place; and
- e. New site drainage systems are designed to take account of events which exceed the normal design standard i.e. consideration of flood flow routing and utilising temporary storage areas.

The reports prepared as part of the criteria above must take into account contingency allowances, taking climate change into account as set out in the NPPF Technical Guidance.



In locations where strategic flood defence or resilient and resistant construction measures are necessary within the site itself, proposals will be required to demonstrate how measures have been incorporated as an intrinsic part of the scheme in a manner which is compatible with the Strategic Flood Risk Assessment.

All development proposals must take account of relevant Surface Water Management Plans, Catchment Flood Management Plans and related Flood Defence Plans and strategies such as the Lower Tidal River Arun Strategy. The council may require financial contributions from development on sites where measures to address flood risk or to improve the environmental quality of watercourses have been identified by these Plans and Strategies.

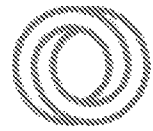
4.11.3 Policy W DM3 - Sustainable Urban Drainage Systems: to increase the levels of water capture and storage and improve water quality, all development must identify opportunities to incorporate a range of SuDS, appropriate to the size of the development, at an early stage of the design process.

Proposals for both major and minor development proposals must incorporate SuDS within the private areas of the development in order to provide source control features to the overall SuDS design. These features include:

- Green roofs
- Permeable driveways and parking
- Soakaways
- Water harvesting and storage features including water butts.

Proposals for major development must also integrate SuDS within public open spaces and roads, reflecting discussion with the appropriate bodies. SuDS must therefore be integrated into the overall design of a development and must:

- a. Contribute positively to the appearance of the area, integrating access to allow maintenance of existing watercourses and the system;
- b. Effectively manage water (including its quality);
- c. Accommodate and enhance biodiversity by making connections to existing Green Infrastructure assets;



- d. Provide amenity for local residents (ensuring a safe environment); and
- e. Retain the existing drainage network of the site and the wider area.

In order to ensure that SuDS discharge water from the development at the same or lesser rate, as prior to construction, developers must:

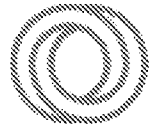
- f. Follow the hierarchy of preference for different types of surface water drainage disposal systems as set out in Approved Document H of the Building Regulations and the SuDS manual produced by CIRIA.
- g. Undertake up to six months groundwater monitoring within the winter period.
- h. Undertake winter percolation testing in accordance with BRE365.
- i. The proposed drainage system must be designed to ensure that there is no flooding on a 1 in 30 year storm event.
- j. The design must also take account of the 1 in 100 year storm event plus 30% allowance for climate change, on stored volumes, to ensure that there is no flooding of properties or the public highway or inundation of the foul sewerage system. Any excess flows must be contained within the site boundary, and within designated storage areas.

4.12 ***Yapton Neighbourhood Plan 2014-2029***

4.12.1 The Neighbourhood Plan establishes a vision for the future of Yapton parish, and sets out how that vision will be realised through planning and controlling land use and development change over the plan period 2014 to 2029.

4.12.2 Policy E11 - Minimising the impact of flooding from development: development proposals will be expected to:

- Be designed and constructed to minimise the overall level of flood risk within the parish; and
- Provide appropriate surface water drainage; and
- Open existing culverts where practicable.

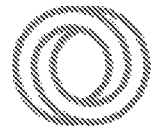


Development will not be permitted in flood attenuation areas where that development would reduce the ability of these areas to alleviate flooding.

Proposals that would create new culverts (unless essential to the provision of access to water systems) will not be permitted.

Proposals that would result in the loss of open watercourses will not be permitted.

Any new development must have adequate receiving surface water drainage, i.e. drains, culverts and definable water courses, under EA and Local Authority control.



5.0 THE SEQUENTIAL TEST AND THE EXCEPTION TEST

5.1 *The Sequential Test*

5.1.1 The EA Flood Zones are the starting point for the sequential approach promoted by the NPPF, and are shown on the EA flood mapping. The PPG identifies that the overall aim of the Sequential Test is to steer new development to Flood Zone 1 (NPPF, 2012).

5.1.2 As stated by the NPPF, development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with lower probability of flooding. The SFRA will provide the basis for applying this test (NPPF, 2012).

5.1.3 Following application of the Sequential Test, if it is not possible for the development to be located in zones with a lower probability of flooding (Flood Zone 1), proposed sites should take into account the flood risk vulnerability of land uses (Table 2, PPG) and consider reasonable sites in Flood Zone 2, and apply the Exception Test if required (Table 3, PPG). Only where there are no reasonably available sites in Flood Zones 1 and 2 should the suitability of sites in Flood Zone 3 be considered, taking into account the flood risk vulnerability of land uses and applying the Exception Test if required.

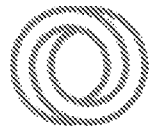
5.1.4 The vast majority of the development footprints are entirely situated within Flood Zone 1, with a small number of roads encroaching within the Flood Zone 2 area, which is deemed to be appropriate in accordance with the NPPF and PPG. The Sequential Test is therefore not required.

5.2 *The Exception Test*

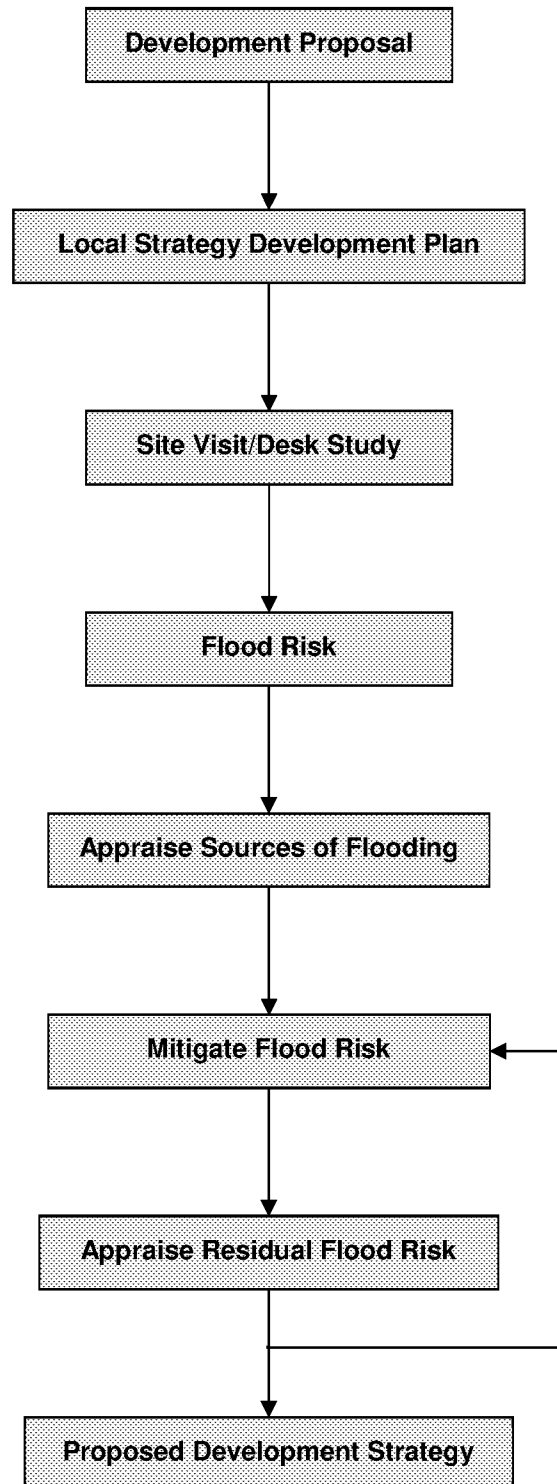
5.2.1 For the Exception Test to be passed, a development proposal:

- Must demonstrate that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA;
- The development should be on developable brownfield land or, if not, it must be demonstrated that there is no such alternative land available; and
- An FRA must demonstrate that the development will be safe for its lifetime, taking into account the vulnerability of its users, without increasing flood risk elsewhere, and where possible, reducing flood risk overall.

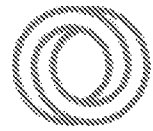
5.2.2 The vast majority of development footprint is situated within Flood Zone 1, and so the Exception Test is not required.



6.0 FLOOD RISK METHODOLOGY



6.1 The assessment methodology is based on the requirements of the NPPF.



7.0 APPRAISE KEY SOURCES OF FLOOD RISK

7.1 Introduction

7.1.1 In accordance with NPPF requirements, all forms of flooding must be considered within a site specific FRA. The following is a review of all types of flooding and an overview of their risks to the site, if any.

7.2 Flooding from Rivers (Fluvial)

7.2.1 Fluvial flooding is caused by high flows in rivers or streams exceeding the capacity of the river channel and spilling into the floodplain, or in some cases non-designated floodplain, which can occur after a period of heavy rainfall.

7.2.2 The EA's Flood Map for Planning (accessed November 2017) indicates that the vast majority of the site is located within Flood Zone 1: land having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%) in any given year. A narrow area of land is located within Flood Zone 2 (medium flood risk), associated with the route of the Bilsham Ditch which is classed as Main River by the Environment Agency.

7.2.3 Detailed hydraulic modelling of the Bilsham Ditch has been undertaken to refine the flood map at the site. This was carried out in collaboration with the Environment Agency and their letter of approval of the flood study can be found in **Appendix F**. All the proposed new homes will be located in Flood Zone 1.

7.2.4 Appendix H of the ADC Strategic Flood Risk Assessment (SFRA) Update 2016 shows that the site is not located within the extents of any historic fluvial flooding incidents, as shown in **Appendix I**.

7.3 Surface Water Flooding / Overland Flows (Pluvial)

7.3.1 Surface water flooding is caused by rainfall levels exceeding the natural infiltration properties of the surrounding soils. It occurs where there is a lack of a formalised drainage system, as a result of poorly designed or maintained sewer systems, or due to no natural method of drainage such as watercourses or ditches, or where soil infiltration rates are low. It often results in ponding of water at low points or backing up behind obstructions.

7.3.2 The EA's updated Flood Map for Surface Water (uFMfSW) shows that the vast majority of the site lies within an area at 'very low risk' of surface water flooding. This is an area which has a less than 1 in 1,000 annual probability of surface water flooding (<0.1%).



7.3.3 The mapping shows that there is a narrow strip of low surface water flood risk and a very small area of medium surface water flood risk, associated with the Main River at the site. The uFMfSW is shown in **Appendix F**.

7.3.4 The SFRA map shown in **Appendix I** shows that there are no records of surface water flooding at the site.

7.4 ***Groundwater Flooding***

7.4.1 Groundwater flooding is caused by the emergence of water originating from sub-surface permeable strata. A groundwater flood event results from a rise in groundwater level sufficient for the water table to intersect the ground surface and inundate low lying land. Periods of prolonged rainfall may also be a cause of groundwater flooding, with aquifers and soils becoming saturated.

7.4.2 According to the SFRA, the north west of the site is located in an area where the susceptibility to groundwater flooding is more than 25%, but less than 50%. For the majority of the site, the susceptibility is more than 50%, but less than 75%. The susceptibility to groundwater flooding map is shown within **Appendix I**.

7.5 ***Sewer Infrastructure Flooding***

7.5.1 Flooding can occur due to the failure of existing foul or surface water drainage infrastructure. If flows within the drainage system exceed the designed capacity or foreign matter causes blockages, overflow to the surface can occur, leading to flooding.

7.5.2 SWSL's records of historic flood incidents are included within the ADC SFRA. The database indicates that, as of February 2016, there have been 20 recorded sewer flood incidents within the BN18 0 postcode. However, as the data was provided at postcode area level, the exact location of these incidents cannot be determined from the information provided.

7.6 ***Flooding from Artificial Sources***

7.6.1 Flooding from artificial sources is that arising from the failure of man-made infrastructure, or human intervention that causes flooding.

7.6.2 The nearest reservoir is the Bilsham Farm Reservoir, located approximately 570m to the south west of the site. The site is not subject to flood risk from this reservoir.

7.6.3 The only canal within the Arun District SFRA area is the disused former Portsmouth to Arundel Canal located to the north west of the site, and therefore will not be a flood risk to the site.



8.0 FLOOD RISK MITIGATION MEASURES

8.1 *Mitigation against Flood Risk from the Proposed Development*

8.1.1 To mitigate against the risk from localised overland flooding from the proposed development, surface water runoff will be managed through the implementation of SuDS in the form of permeable paving, cellular storage tanks and detention basins.

8.1.2 The proposed development will alter the drainage regime of the site by increasing impermeable surface area and therefore increasing the rate, volume and potential contamination of surface runoff, it is necessary to provide mitigation measures to offset the potential impacts. It is proposed to manage the surface water runoff by utilising SuDS which will remove heavy metals, hydrocarbons, rubber dust, and silts prior to discharging into the river.

8.1.3 The proposed on-site drainage system will be designed to cater for the 1 in 30 year storm, providing attenuation to store flood waters on-site during flood events up to and including the 1 in 100 year plus 40% climate change rainfall event.

8.1.4 In order to manage the residual risk of blockage to all on-site drainage features, the developer, LLFA and/or adopting Sewerage Undertaker will ensure maintenance of their respective drainage system in line with the manufacturers' recommendations by the production of a Maintenance Management Plan. This will ensure that over the lifetime of the proposed development the drainage system will be maintained to ensure continuing functionality.

8.2 *Mitigation against Flood Risk to the Development*

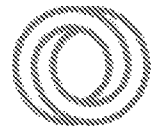
Fluvial Flooding

8.2.1 The site layout has been developed to avoid area located within Flood Zone 2; all dwellings will be located within Flood Zone 1. Some areas of road will encroach within the Flood Zone 2 area, however this is classed as 'essential infrastructure' within the PPG and is acceptable development within this Flood Zone. All proposed roads crossing the floodplain will be set 300mm above the 1 in 100 year plus climate change flood levels.

Surface Water Flooding

8.2.2 The site layout has been developed to avoid areas of surface water flooding; all dwellings will be located in areas at very low risk of surface water flooding.

8.2.3 As previously mentioned, a formalised surface water drainage system will be designed to accommodate storm water runoff for all events up to 1 in 100 year plus 40% climate change. Detailed information of the drainage strategy for the site is set out in **Section 10**.



Groundwater Flooding

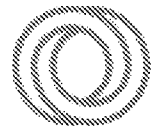
8.2.4 Finished floor levels will usually be set 150mm above existing levels, and ground levels manipulated in order to ensure that in the unlikely event of groundwater flooding occurring, flood flows will be conveyed away from the houses and discharged into the surface water drainage system.

8.3 *Contamination from Construction*

8.3.1 Contractors are to make reference to current legislation and EA guidelines in respect of construction pollution prevention. All procedures will be in effect to prevent pollution of the ground prior to, during, and post construction in order to maintain water quality.

8.3.2 All stocks of materials, oils and fuels are to be stored in a manner preventing spillage and seepage to the ground or drainage network. Wastewater will not be freely discharged to the ground or sewers. All hydrocarbons and chemical spillages will be thoroughly cleaned by excavation of the polluted ground and disposed of at a licensed waste depot.

8.3.3 The contractor would be required to report any pipework encountered during the construction works, trace the system to establish if it is live and maintain its operation whilst a diversion or protection to the system is established.



9.0 APPRAISAL OF RESIDUAL FLOOD RISK

9.1 Introduction

9.1.1 When undertaking an FRA it is essential to put into perspective any theoretical analysis with the reality of the physical system in place. It is impossible (both practically and economically) to design a system which will never fail. However, good design, controlled construction and regular maintenance can reduce the likelihood of failure during its design life.

9.1.2 The assessment has shown that the site offers low flood risk to users of the proposed residential development based on the following:

- There are no historic flood events recorded within the site boundaries;
- The proposals are for a residential scheme with all dwellings to be located in Flood Zone 1, and a small number of roads to be located within Flood Zone 2, which is deemed appropriate as per the recommendations of the NPPF;
- The proposed development will utilise SuDS techniques to provide treatment of surface water runoff, up to and including that arising from the 1 in 100 year plus 40% climate change storm;
- The foul drainage system will be designed in accordance with best practice.

9.1.3 All flood advice given is based on literature, mapping and historic records produced by the EA, ADC and SWSL.



10.0 PRELIMINARY SURFACE WATER DRAINAGE STRATEGY

10.1 *Surface Water Management Strategy Requirements*

10.1.1 Any surface water drainage strategy must demonstrate that the proposed development can be drained in a sustainable manner, commensurate with local and national policy. The NPPF requires that flood risk to land and property is not increased as a result of new development.

10.1.2 A fundamental principle of sustainable development in terms of flood defence is the reduction of surface water runoff from new developments. The Non-Statutory Technical Standards for Sustainable Drainage state that peak runoff rates should be limited to the greenfield runoff rates, and long term storage should be provided. Exceedance routes should be shown to not impact the safety of property.

10.1.3 The Non-Statutory Technical Standards for Sustainable Drainage and Part H of the Building Regulations: Drainage and Waste Disposal establish a hierarchy for surface water disposal, which also encourages a SuDS approach. This hierarchy stipulates that surface water runoff not collected for reuse must be discharged to one or more of the following in order of priority:

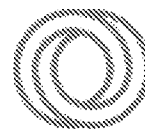
1. Discharge into the ground (infiltration); or, where not reasonably practicable;
2. Discharge to a surface water body; or, where not reasonably practicable;
3. Discharge to a surface water sewer, highway drain, or another drainage system; or, where not reasonably practicable;
4. Discharge to a combined sewer.

10.1.4 The peak runoff rates and volumes leaving the site must not be greater than those currently discharged during the following events:

- 1:1 year rainfall event;
- 1:30 year rainfall event;
- 1:100 year rainfall event; and
- 1:100 year plus climate change.

10.2 Proposed Surface Water Drainage Strategy

10.2.1 The proposed surface water management strategy described below is outlined in Drawing 14-111/103 in **Appendix H**.



10.2.2 The results of the soakage testing indicate that the ground conditions at the site may not be suitable for infiltration. In accordance with the above drainage hierarchy, it is proposed that surface water runoff will discharge to the river located to the south of the site.

10.2.3 Storm water will therefore be attenuated on site and released gradually. The attenuation storage will be achieved by utilising attenuation basins prior to controlled discharge to the river.

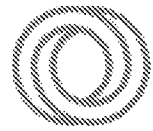
10.2.4 The SuDS features shown on the proposed drainage strategy have been sized to attenuate flows for all rainfall events up to the 1 in 100 year event plus climate change (+40%) whilst restricting discharge rates to less than Q_{BAR} , as shown in **Table 10.1**. This therefore negated the requirement to provide Long Term Storage for the site. The Micro Drainage Calculations are presented in **Appendix H**.

Table 10.1: Existing and Proposed Surface Water Discharge Rates

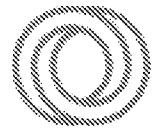
Return Period	Existing Greenfield Discharge Rates (l/s)	Proposed Discharge Rates (l/s/ha)
Q_{BAR}	43.0	41.0
Q1	36.5	36.5
Q30	97.3	41.0
Q100	137.0	41.0
Q100 + 40% CC	-	41.0

10.2.5 The proposed development is residential. The maximum pollution hazard index for the site as per the SuDS Manual (C753) is 0.5. The attenuation basins can treat runoff with pollution indices of 0.5 and 0.6; water quality treatment is therefore provided.

10.2.6 The onsite drainage system maintenance will be carried out by a private recognised management company through the implementation of an approved maintenance management plan, to minimise the residual risk of drainage system blockage. **Table 10.2** details the maintenance requirements for the SuDS features at the site.

**Table 10.2: Maintenance of SuDS Features**

SuDS Feature	Maintenance Requirement
Attenuation basin	Monthly maintenance, including removal of litter and debris; cutting grass for spillways and access; managing other vegetation and removing nuisance plants; inspecting inlets, outlets and overflows for blockages and clear if required. Annual maintenance also includes tidying dead growth, removing sediments from inlets and outlets, checking mechanical devices, and repairing erosion or other damage by replanting.



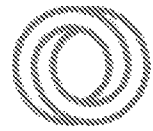
11.0 PRELIMINARY FOUL DRAINAGE STRATEGY

11.1 SWSL are the governing water authority for the area. Any proposed connections or changes to the existing discharge rates must be approved by SWSL prior to commencement of any construction works. A copy of the SWSL records is presented in **Appendix G**.

11.2 For the western parcel of the site, it is proposed to collect and discharge foul flows by gravity to the eastern parcel. Flows in the southern area of the western parcel will drain by gravity to the south eastern corner and will then be pumped in a northern direction to allow flows to discharge to the eastern parcel. All foul flows will then drain by gravity to the south west of the parcel, and will then be pumped in a south-eastern direction into the public foul sewer on Bilsham Road. It is envisaged that the foul flows will then be conveyed to either Lidsey or Ford Wastewater Treatment Works on the recommendation of SWSL. The new connection from the site must be approved by SWSL under a Section 106 agreement. The foul drainage strategy is also shown in Drawing 14-111/103 in **Appendix H**.

11.3 The hydraulic design for the discharge rate for the foul wastewater design has been calculated in accordance with Sewers for Adoption 7th Edition which states design flow rates for dwellings should be 4000l/day. The total foul discharge rate for the proposed development of up to 250 residential units, in accordance with SfA, equates to 11.6 l/s.

11.4 The results of the foul capacity check for the site have not yet been received; however discussions are ongoing with SWSL.



12.0 SUMMARY AND CONCLUSIONS

12.1 Odyssey has been commissioned by Gleeson Strategic Land to undertake an FRA, incorporating a surface water and foul water drainage strategy to support a planning application for proposed residential development in Yapton, West Sussex.

12.2 The EA flood mapping shows that the vast majority of the site lies within Flood Zone 1, an area with a low probability of flooding. A narrow area of land is located within Flood Zone 2. However, the site layout has been developed to ensure that all dwellings are located within Flood Zone 1. There are no records of historic flooding within the site boundaries.

12.3 The results of the soakage testing indicate that infiltrating SuDS features may not be suitable for the site. It is proposed that surface water will be discharged to the river to the south of the site, via a number of attenuation basins.

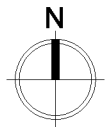
12.4 The SuDS features shown on the proposed drainage strategy have been sized to attenuate flows for all rainfall events up to the 1 in 100 year event plus climate change (40%).

12.5 It is proposed to pump foul flows from the site into the public foul sewer on Bilsham Road. Section 106 applications will be made in accordance with the Water Industries Act with SWSL.

12.6 This FRA has demonstrated that the proposed development is fully compliant with the requirements of the NPPF. Issues relating to flood risk and drainage do not represent an obstruction to the development and therefore should not hinder an approval for planning permission of the proposed development.

APPENDIX A

Site Location Plan



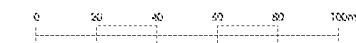
Site
**LAND AT BILSHAM ROAD,
YAPTON**

Drawing
Site location plan

Date
07.11.17

Scale
1:2500@A3

Drawing ref:
1244G.01



KEY

 Site boundary



APPENDIX B

Proposed Site Layout

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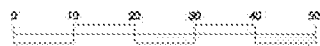
Site
**LAND AT BILSHAM ROAD,
YAPTON**

Drawing
Illustrative detailed masterplan

Date
14.11.17

Scale
1:1250@A1

Drawing ref:
1244G.03



- KEY**
- Site boundary
 - Existing trees retained
 - Existing hedgerows retained
 - Proposed planting
 - SuDS feature
 - Existing Public Right of Way retained
 - Potential location for pumping station + 15m offset
 - Affordable housing unit
 - Visitor parking space

APPENDIX C

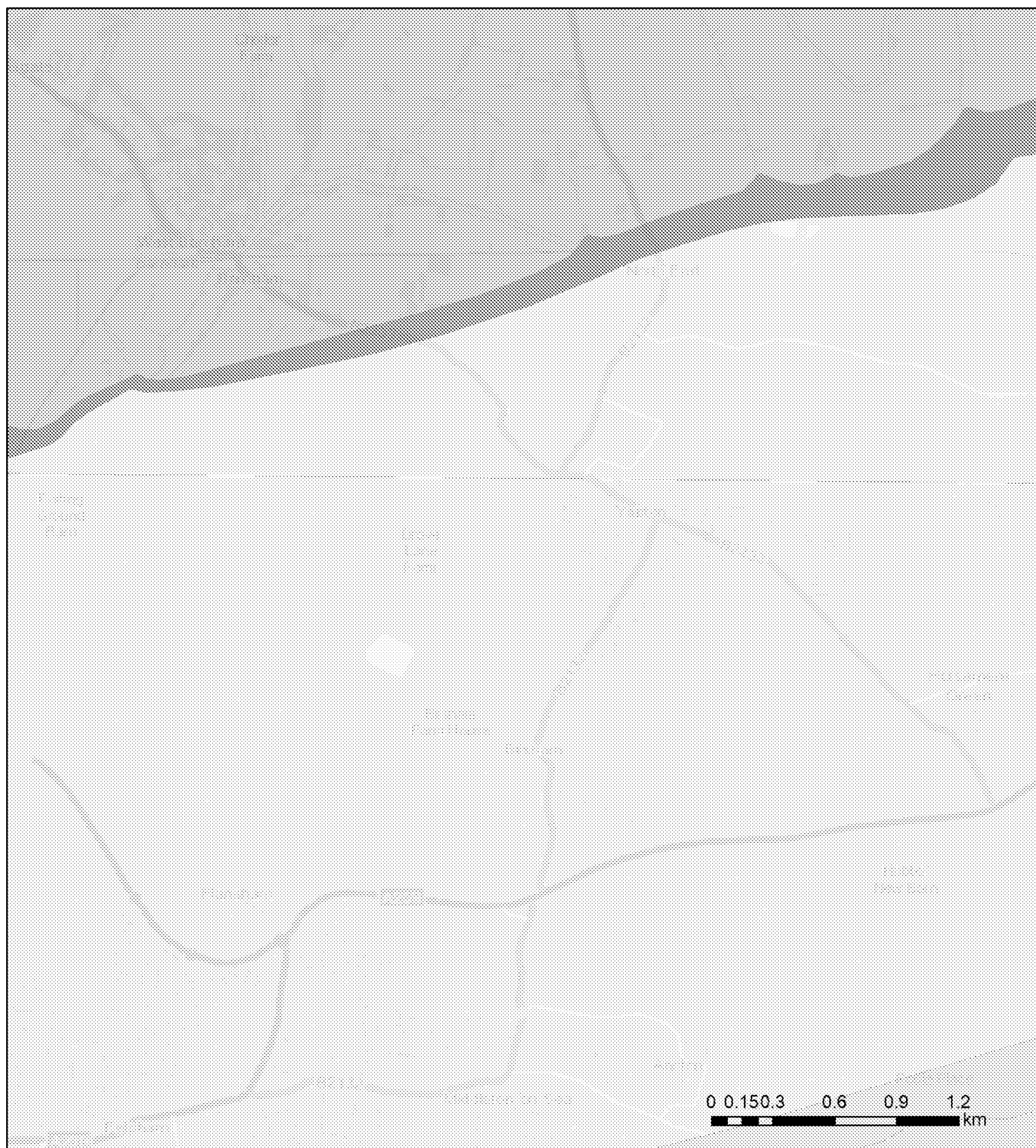
Topographical Survey

[illegible]

APPENDIX D

British Geological Survey (BGS) Data

**GEOINDEX
ONSHORE**



GeoIndex Onshore Data Sources: NERC, Natural England, English Heritage and Ordnance Survey

Map Key

Bedrock geology 1:50,000 scale

-  LONDON CLAY FORMATION - CLAY, SILT AND SAND
-  SEAFORD CHALK FORMATION - CHALK
-  LEWES NODULAR CHALK FORMATION, SEAFORD CHALK FORMATION, NEWHAVEN CHALK FORMATION, CULVER CHALK FORMATION AND PORTSDOWN CHALK FORMATION (UNDIFFERENTIATED) - CHALK
-  NEW PIT CHALK FORMATION - CHALK
-  LAMBETH GROUP - CLAY, SILT AND SAND
-  NEWHAVEN CHALK FORMATION - CHALK