



**Land at Oldlands Farm,
Shripney Road,
Bognor Regis,
West Sussex**

**Flood Risk Assessment
and Drainage Strategy**

for

Bericote Properties Limited

June 2014

Hydrock Ref: R/14443/001



DOCUMENT CONTROL SHEET

Issued by: Hydrock Consultants Limited
St Baldred's Hall,
239 Ashley Road,
Hale,
Cheshire
WA15 9NE

Tel: 0161 233 0746
www.hydrock.com

Client: Bericote Properties Limited

Project: Oldlands Farm, Bognor Regis, West Sussex

Title: Flood Risk Assessment and Drainage Strategy

Status: Final

Date: 20th June 2014

Document Production Record

Issue Number:	2	Name	Signature
Prepared		Jon Hale <i>Senior Infrastructure Engineer</i>	
Checked		Eleanor Dale (BSc MSc) <i>Infrastructure Engineer</i>	
Approved		Paul Graveney (BEng CEng MICE) <i>Senior Civil Engineer</i>	

Document Revision Record

Issue number	Date	Revision Details	Issued to
1	20/06/2014	Final – for planning submission	Bericote Properties Limited / Quod
2	24/06/2014	Updated to clients comments	Bericote Properties Limited / Quod

Hydrock Consultants Limited has prepared this report in accordance with the instructions of the above named Client for their sole and specific use. Any third parties who may use the information contained herein do so at their own risk.



CONTENTS

Executive Summary	3
1.0 Introduction	5
2.0 Development Description and Location.....	6
2.1 Site Location	6
2.2 Existing Site Description	6
2.3 Development Proposals.....	7
3.0 Planning Policy and Consultation	9
3.1 Planning Policy Framework	9
3.2 Floodplain Compensation	9
3.3 Strategic Flood Risk Assessment (SFRA).....	10
3.4 Statutory Authority Correspondence	11
4.0 Definition of Flood Hazard	12
4.1 Sources of information	12
4.2 Flooding from Tidal Flood Risk.....	12
4.3 Flooding from the Land (Surface Water)	13
4.4 Flooding from Rivers (Fluvial).....	13
4.5 Flooding from Groundwater	14
4.6 Flooding from Sewers / Highway Drains	14
4.7 Flooding from Private On-Site Drainage.....	14
4.8 Flooding from Artificial Sources.....	14
5.0 Assessment of Flood Risk on Development Site (Probability)	15
5.1 Table 3: Flood Risk Summary	15
6.0 Drainage Strategy	16
6.1 Overview	16
6.2 External Consultation.....	16
6.3 Existing Surface Water Runoff.....	16
6.6 Surface Water Drainage Strategy.....	20
6.8 Foul Water Drainage Strategy and Proposals.....	22
7.0 Management Measures, Off Site Impacts and Residual Risk	23
7.1 Flood Risk Management Measures.....	23
7.2 Off Site Impacts	23
7.3 Residual Risk	24

APPENDICES

Appendix A – Architectural Site Plans

Appendix B – Topographical Survey

Appendix C – Statutory authority Correspondance

Appendix D – Southern Water Sewer Records

Appendix E – Hydrock Drawings

Appendix F – HYDROCK Hydraulic Calculations



Executive Summary

It should be highlighted from the outset of this FRA that the site already benefits from planning permission for a mixed-use development of up to 33,116 square metres (Arun District Council ref. BE/61/13). That application, which was approved on 19 March 2013, included a Flood Compensation Area and on-site attenuation ponds. The FRA which supported that scheme was found to be acceptable by the Environment Agency and Arun District Council, and sets clear precedent for the full planning permission now sought by Bericote Properties Limited. Moreover, whilst the application now being pursued is essentially an alternative development to the consented scheme in terms of the B1(c), B2 and B8 uses, the enabling development envisaged in Phase 1a of BE/61/13 can be implemented alongside Bericote's proposals.

Flood Risk

The proposal is for the construction of an industrial/warehouse development on land at Oldlands Farm, Bognor Regis, West Sussex. The scheme will consist of two buildings, service yards, car parks, landscaping, and an associated Flood Compensation Area (FCA) the need for which is outlined within this FRA.

This report has considered the flood risk posed to the site from a variety of flood risk sources, as defined by the National Planning Policy Framework (NPPF) and the West Sussex Local Flood Risk Management Strategy (LFRMS). The report has identified that the proposed development is currently located within Flood Zones 1, 2, and 3 and the Environment Agency's predicted 100 year fluvial flood level is 1.82m AOD. However, this has been increased to a level of 2.0m AOD to include climate change and this level is to be adopted as the minimum required floor level for the development. The designed finished floor level to the buildings is likely to be in the order of +3.0m AOD to allow for a balanced earthworks design between the proposed development and the flood compensation area on the land adjacent to the Bognor Northern Relief Road, and to achieve an enhanced level of flood protection for the end user.

The report has also found the site to be at low risk from tidal, surface water, sewer, groundwater flooding and artificial sources.

There is no residual flood risk from the development site to the surrounding district, due to the restriction imposed on allowable storm water peak flow rates from the development to Oldlands Farm drainage ditch. Therefore the development does not increase the risk of surface water flooding to other adjacent neighbourhoods. Out of chamber or gully flooding for the extreme 100 year plus climate change event may potentially occur within the development site and is classed as exceedance flows. Flood water from such events will be contained within the site in the lower lying external areas.



Drainage Strategy

The outline surface water drainage strategy is to control the surface water discharge from the new development and restrict peak flows to a maximum rate of greenfield runoff, to be agreed with the Environment Agency. The surface water drainage network has been designed to mimic the existing catchment division, with the majority of run-off being taken east towards the watercourse, adjacent to the Bognor to Chichester railway line. This then connects to an open ditch drain that runs east along the northern boundary of the site. The drainage ditch then culverts railway line, it ultimately discharges to the Lidsey Rife approximately 300m to the east of the development. The catchment boundary line is shown on the drainage strategy drawing C14443-101 contained within Appendix E.

The highway drainage for the proposed carriageway access will connect into the open drainage ditch to the north of the development and attenuated in oversized pipes.

Sustainable Drainage Systems (SuDS) in the form of Prevention, Source Control and Site Control methods will be considered and where appropriate incorporated. A drainage strategy assessment and outline strategy plan which corresponds with a full surface water hydraulic model accompanies this report.

Foul water generated by the development will be discharged by gravity to a pumping station located within the site. The station will then pump via a rising main to a point into the foul public sewer located in Shirpley Road, as indicated by Southern Water Sewer records.

The proposed pumping station and rising main to serve the development is being secured under a Section 98 off site sewer requisition with Southern Water. The design process for this is currently with Southern Water's consultants.

Summary

This report therefore demonstrates that the proposed scheme:

- Is at low risk from fluvial flooding but is partly in Flood Zone 2 and 3.
- Is not at risk from all other flood sources.
- Would be safe and flood resilient.
- Would not adversely increase flood risk elsewhere, as a result of the proposed development, through increase in surface water run-off.
- Incorporates a comprehensive and flood resilient drainage and SuDS strategy.
- Has an agreed foul discharge location.



1.0 INTRODUCTION

1.1 This report has been prepared by Hydrock Consultants Limited (Hydrock) on behalf of our Client, Bericote Properties Limited, in support of a full planning application to be submitted to Arun District Council for a proposed employment development on Land at Oldlands Farm, Shripney Road, Bognor Regis, West Sussex. A Site Location Plan and Site Layout Plan appear at Appendix A.

1.2 The report has been commissioned to identify any flood related issues associated with the proposed development and any likely constraints that could be imposed. The following issues have been suggested by the Environment Agency (EA), Arun District Council (ADC), and Southern Water (SW) following detailed correspondence and are subsequently addressed within this report;

- Identify all available data relating to flood risk at the site.
- Review the historical application relevant to the site and the associated findings and conditions imposed.
- Determine whether the site is at risk from flooding from all sources, including but not exhaustive, from breach or overtopping of any existing flood defences, watercourse flooding, surface water flooding and/or groundwater flooding.
- If at risk from any source, devise appropriate measures to prevent flood risk whilst not compromising the flood risk elsewhere.
- Determine the current surface water drainage regime and assess any potential increase in surface water runoff as a result of the proposed development.
- Consider Sustainable Drainage Systems (SuDS) as an option for reducing surface water flood risk.
- Devise an appropriate surface water drainage strategy (and provide supporting calculations) to deal with any increase in surface water runoff and include an allowance for climate change.
- Consider the recommendations of the EA, Arun District Council and Southern Water.
- Consider the recommendations of the West Sussex Local Flood Risk Management Strategy (LFRMS).
- Prepare the Flood Risk Assessment and Foul & Surface Water Drainage Strategy report.
- Assess flood risk mitigation measures & off site impacts, and define any residual risks.

2.0 DEVELOPMENT DESCRIPTION AND LOCATION

2.1 Site Location

The site is referenced in Table 1, and a site location map is provided in Figure 1.

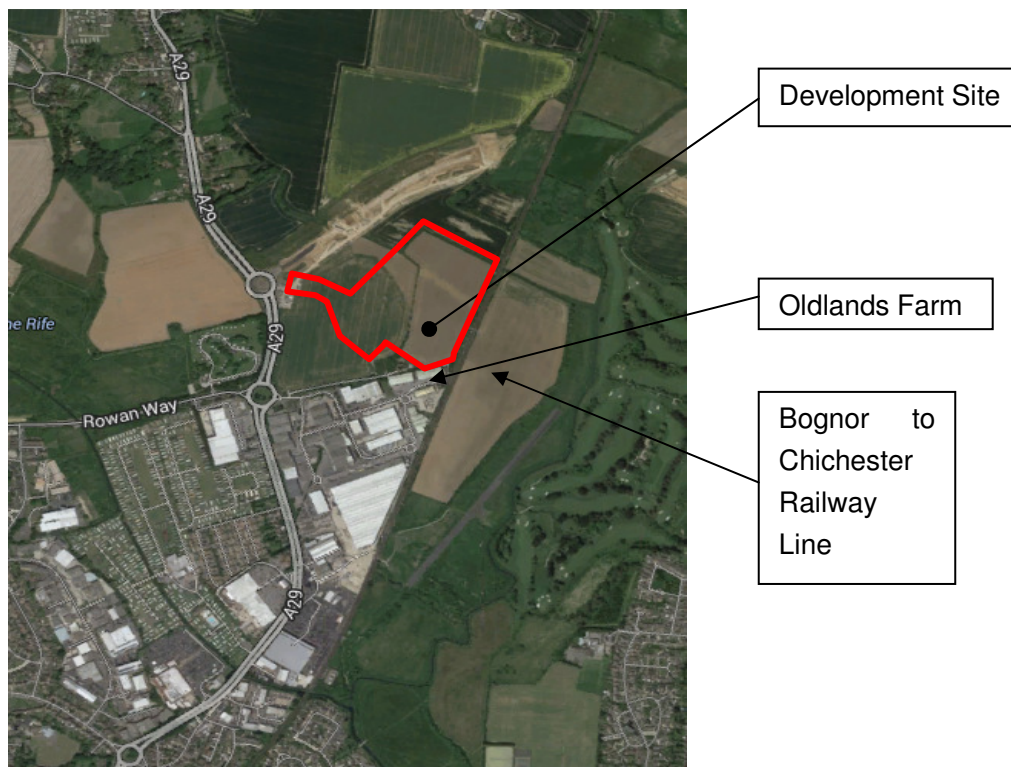
Table 1: Site Referencing Information

Item	Brief Description
Site name	Land at Oldlands Farm
Site address and location	Land at Oldlands Farm, Shripney Road, Bognor Regis, West Sussex, PO22 9QF
Council Area	Arun District Council
Grid Reference	OS: 494360E, 101662N
General Locality	The site is located to the northeast of Bognor Regis town centre, off the A29 Trunk Road, and lies between the Southern Cross Industrial estate and the Bognor Northern Relief Road, currently under construction.

2.2 Existing Site Description

2.2.1 Location Plan

Figure 1 General Location Plan





2.2.2 Area

The Development Site extends to approximately 15.87ha, this includes the Flood Compensation Area (FCA).

2.2.3 Boundaries and Surrounding Land

The development site is classed as agricultural fields, located off the A29 Trunk Road to the west and lies between the Southern Cross Industrial Estate to the south and the Bognor Northern Relief Road, currently under construction to the north. The Bognor to Chichester Railway Line is to the east of the proposed development.

2.2.4 Existing Land Use and Access

The site is currently open agricultural land used for arable crops. The existing site access is situated on the southern boundary, through Oldlands Farm, off Steyning Way. In March 2014, a hybrid application was approved, comprising full permission for the access road and flood compensation area, and outline permission for up to 33,316 square metres of a A1, B1, B2, B8 and sui generis car sales uses (ADC Ref: BE/61/13).

2.2.5 Elevation and Topography

A specific site topographical survey has been undertaken and indicates the ground generally falls from the A29 boundary easterly to the Oldlands Farm watercourse and the railway line. The site levels range from 4.00m AOD to 1.20m AOD at the watercourse.

The full topographical survey can be viewed in Appendix B.

2.3 **Development Proposals**

- 2.3.1 The proposed development is for the erection of 2no. detached industrial/distribution units (B1(c)/B2/B8) including access and servicing arrangements, car parking, landscaping and associated works, with a gross external area of circa 39,000m². Access to the site for both HGVs and staff cars will be directly from the new accessway off the A29 roundabout on the western boundary. The Site Layout Plan is included in Appendix A. The proposed finished floor level for the development will be set at a minimum level of +2.0m but to achieve a balanced earthworks design with an increased level of protection for the end user the designed floor level is likely to be in the order of +3.00m AOD.



2.3.2 Development Design Life

The generally accepted design life for a development such as the proposed commercial site for the assessment of flood risk is 50 years. This assessment therefore considers flood risk over the period 2014 to 2064.



3.0 PLANNING POLICY AND CONSULTATION

3.1 Planning Policy Framework

3.1.1 The flood maps provided by the Environment Agency locate the site is currently within Flood Zones 1, 2 and 3. Flood Zone 1 is land assessed as having a less than 1 in 1000 (<0.1%) annual probability of flooding, Zone 2 is land assessed in having between a 1 in 100 year and 1 in 1000 year annual probability of flooding, while Zone 3 is land assessed as having between a 1 in 100 year or greater annual probability of flooding from a river or stream in any year. As a requirement of the new NPPF (2012), the proposed development has to satisfy the requirements of the Sequential Test and where applicable the Exception Test.

3.1.2 Sequential Test:

Under the NPPF (2012), Zone 3 is defined as high probability flood risk. The proposed development is for industrial and warehousing uses which in line with table 2 is classified as 'Less Vulnerable'.

Placing both these criteria into Table 3 (Flood Risk Vulnerability and Flood Zone 'Compatibility'), Less Vulnerable development in Flood Zone 3 determines that 'Development is Appropriate'. Therefore the Exception test is not required, although this does not exempt the site from further consideration and it is the developer's intention to lift the site out of Flood Zone 2 and 3 and into Flood Zone 1, by designing the finished floor levels to a minimum of +2.0m AOD. To do this they intend to provide floodplain compensation within close vicinity to the proposed site.

3.2 Floodplain Compensation

3.2.1 As previously stated the proposed development currently lies partially within flood zones 2 and 3, with existing ground levels ranging from 0.2m AOD to 2.0m AOD. It is proposed to lift the area of the site located within zones 2 and 3 to a minimum of +2.0m AOD. Floodplain compensation will be provided by excavating adjacent land, to the north-west of the site which currently lies above the 2.0m AOD contour. The Environment Agency's predicted 100 year fluvial flood level is 1.82m AOD. However, this has been increased to a level of 2.0m AOD to include climate change and this level is to be adopted as the minimum required floor level for the development. The designed finished floor level to the buildings is likely to be in the order of +3.0m AOD to allow for a balanced earthworks design between the proposed development and the flood compensation area, and to achieve an enhanced level of flood protection for the end user.

3.2.2 The flood compensation has been designed in accordance with the Environment Agency policy and Appendix 3 of the CIRIA guide C624 entitled "Development and flood risk



guidance for the construction industry” where compensatory storage is provided on a “volume for volume” and “level for level” basis to ensure no loss of floodplain contours.

3.2.3 Floodplain compensation has been used on the Bognor Northern Relief Road (BNRR) where the road crosses Oldlands Farm Ditch. The location of this is adjacent to the northern boundary of the road and lies either side of the watercourse. The proposed floodplain compensation area is to the north of the new BNRR. Drawings are indicated within Appendix E.

3.2.4 Flood Compensation areas and volumes are calculated as follows:

Existing site area below 2.0m

Existing Ground Level (m AOD)	Total Area (m ²)
2.0m – 1.8m	62025
1.8m – 1.6m	57800
1.6m – 1.4m	53185
1.4m – 1.2m	41710
1.2m – 1.0m	13545
Total Area	= 228265m²

Flood compensation areas

Proposed Flood Area (m AOD)	Total Area (m ²)
2.0m – 1.8m	62313
1.8m – 1.6m	58296
1.6m – 1.4m	54338
1.4m – 1.2m	42208
1.2m – 1.0m	13958
Total Area	= 231113m²

3.3 Strategic Flood Risk Assessment (SFRA)

3.3.1 SFRA's assess the risk associated with all types of flooding and provide the information required to identify the amount of development permitted in an area, how drainage systems in the area should function and also how risks in vulnerable areas can be reduced and/or mitigated. The NPPF states that regional planning bodies (RPB's) or local planning authorities should prepare SFRA's in consultation with the EA.



3.3.2 In January 2010, West Sussex County Council, as Lead Local Flood Authority for the area, published their **Strategic Flood Risk Assessment of West Sussex** documents Volume 1 and 2. These documents perform the function of an SFRA, as described above, but also expand upon this to define a management strategy and guidance to deal with and mitigate the flood risks identified. The overarching aim of this strategy is to provide a robust local framework that employs a full range of complementary approaches towards managing and communicating the risks and consequences of flooding arising from surface runoff, groundwater and ordinary watercourses in West Sussex and the surrounding area.

3.3.3 A summary of the main elements from the LFRMS associated with the site is detailed below. The full report can be obtained from the West Sussex County Council website.

- The LFRMS provides a detailed understanding of flood risks across all areas of the county of West Sussex from all sources.
- Full sequential and exception tests to be carried out (where applicable).
- Development should be designed so there is no flooding to the development in a 1 in 30 year event and so there is no property flooding in a 1 in 100 year plus climate change event.
- Surface water management including the use of Sustainable Drainage Systems should be incorporated.
- No potential for groundwater flooding anticipated.
- No flooding incidences identified at the site.

3.4 Statutory Authority Correspondence

3.4.1 In compiling this report, liaison has taken place with the relevant authorities. Correspondence has been received from the Environment Agency and from Southern Water. Listed below is a summary, with the full responses located in Appendix C.

3.4.2 Environment Agency – Kelly Jaggard

- Site Located within Flood Zone 1, 2 and 3.
- Scale of development requires production of an FRA.
- The FRA should consider other aspects of flood risk for the proposed development and the potential impact on people and property within the catchment.

Southern Water

- At the time of writing, discussions have been held with Southern Water's Consultants Atkins, with regards to the Section 98 progress for this development, but to date



Hydrock have been unable to secure written confirmation of progress further to their letter dated 17th September 2013.

4.0 DEFINITION OF FLOOD HAZARD

Flood risk to the proposed development site is considered from all sources of flooding, as defined by the NPPF (2012).

4.1 Sources of information

The NPPF (2012) requires the developer to consider the impact of runoff, generated by the proposed development onto the downstream catchment, and to assess the risk of runoff from the surrounding district impacting on the development's footprint. Further, the report is to consider flood risk from all other sources. This section defines the flood risk receptors and anticipated flood risk. Section 5 then discusses in further detail the probability of flooding and the likely impacts.

Table 2: Sources of information used in the identification of flood risk

Source of Information	Details
Environment Agency	Indicative Flood Map
Environment Agency	Pre-development enquiry response
Southern Water Sewer Records	Various Plans

4.2 Flooding from Tidal Flood Risk

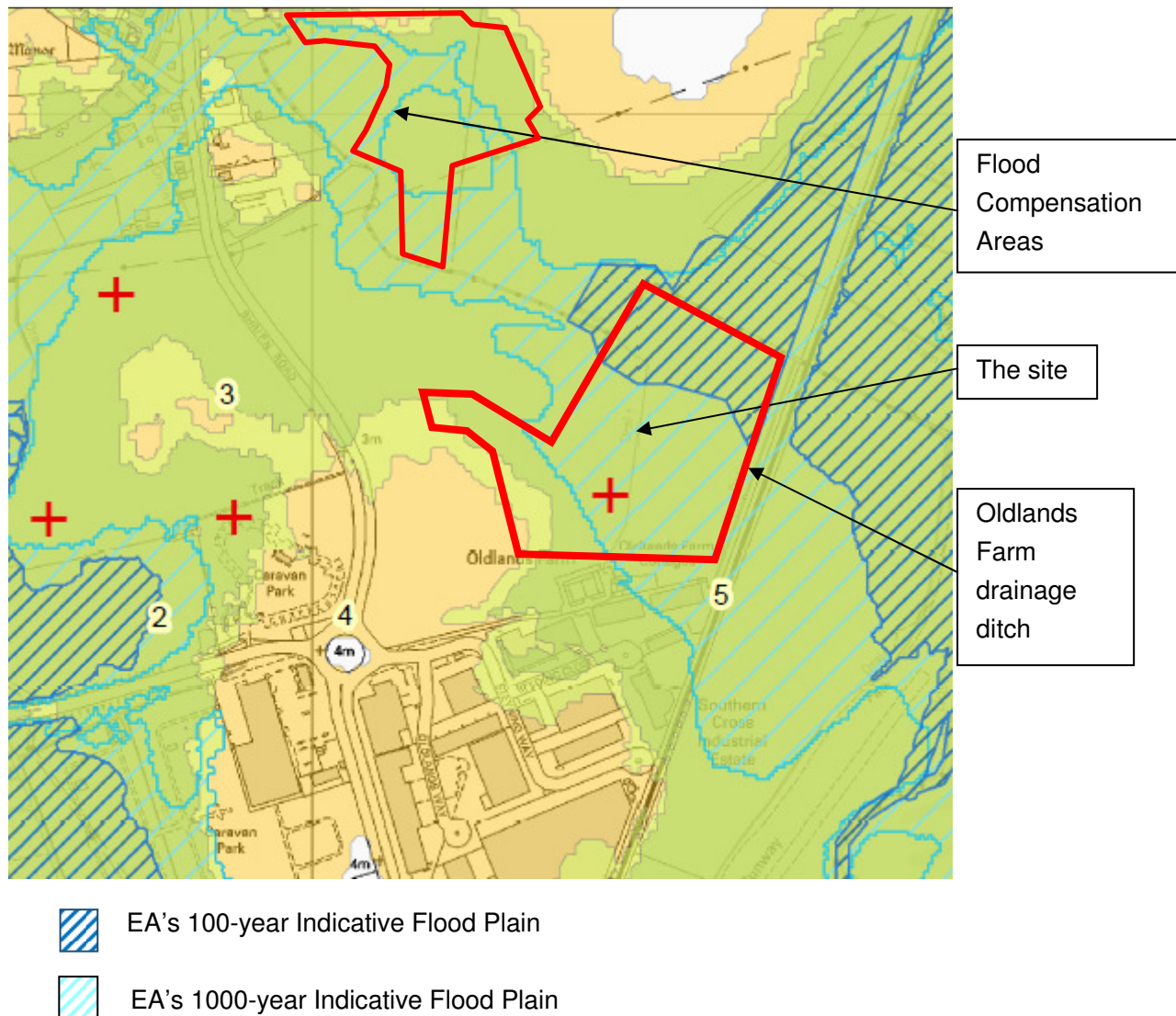
- 4.2.1 The tidal flood risk to the site is extremely low. Sea defences are well maintained and provide sufficient defence against the predicted 1:200 year tidal level. If a more extreme event or a localised breach occurs the risk to the site is minimal due to the distance to the sea defence.

Environment Agency Flood Zones

- 4.2.4 Figure 3 locates the site on the Environment Agency's indicative flood plain map. It is clear from this that the red line boundary lies inside of the current statistical fluvial floodwater model footprint generated by any local watercourses i.e. probability of annual fluvial flooding of greater than 1 in 100 in any one year. It is proposed that the site levels will be raised, and so the levels the development will be located within an amended flood zone 1 (lowest Risk). Therefore the risk from fluvial flood water is diminished to acceptable levels.

4.2.4 The Environment Agency are currently revising peak flood levels for this area and results are expected in August 2014.

Figure 3 – The Environment Agency’s Indicative 100-year Flood Plain Map



4.3 Flooding from the Land (Surface Water)

4.3.1 The site is currently arable farming fields, and has a nominal fall from the A29 towards Oldlands Farm Ditch and the railway line on the eastern boundary. The A29 and Royal Oak Way North has an existing and effective highway drainage system with a drainage pond to the north of development. This poses no risk.

4.4 Flooding from Rivers (Fluvial)

4.4.1 Flows from the watercourse known as Oldlands Farm Ditch which runs along the northern boundary are the main cause of on-site flooding. The Environment Agency have



acknowledged that the catchment responds slowly and mirrors the flood levels on the Lindsey Rife.

- 4.4.2 As it is proposed to lift site levels out of the floodplain, the risk to the site from overland flooding now considered to be low.

4.5 Flooding from Groundwater

- 4.5.1 The Environmental Agency mapping indicates no risk of groundwater flooding.
- 4.5.2 The Environment Agency has confirmed there are no recorded incidents of groundwater flooding on this development site.

4.6 Flooding from Sewers / Highway Drains

- 4.6.1 The review of the Southern Water public sewer records would indicate there are no sewers within the development site. Public foul and surface water sewers are located to the west of the site within the A29 Trunk Road.
- 4.6.2 As these sewers and drains are located outside the site there is a low risk of flooding from exceedance failure or blockage. However, the risk is the same as that from new on site drainage and so as long as adequately maintained, the risk can be considered low.
- 4.6.3 Southern Water have confirmed no recorded incidents of flooding from public sewers within a 500m radius of the site.

4.7 Flooding from Private On-Site Drainage

- 4.7.1 The drainage strategy is discussed in greater detail later in this report. However, the design will be in line with current guidance with any overland flood flows from the extreme events identified to make sure they do not pose a risk to future occupiers.

4.8 Flooding from Artificial Sources

- 4.8.1 There are no identified artificial sources in close proximity to the site. Therefore the flood risk from artificial sources can be considered negligible.



5.0 **ASSESSMENT OF FLOOD RISK ON DEVELOPMENT SITE (PROBABILITY)**

5.1 **Table 3: Flood Risk Summary**

Source	Probability of Flood Risk	Impacts	Remarks / Mitigation
Fluvial	High	Low	The Development is partly Flood Zone 2 and 3, but the proposal is to raise the levels and provide flood compensation. Therefore the development is at low risk of flooding.
Surface (Overland Flood Flow)	Low	Low	No surrounding terrain or properties are considered to give rise to any significant degree of surface water runoff and subsequent flood flows
Sewers and drains	Low	Low	There are no public sewers within the development site. New drainage is to be designed to best practice guidance to reduce flood risk.
Groundwater	Low	Low	Site level are raised in relation to its locality and geotechnical report (see 6.4) does not indicate any risk from groundwater.
Artificial Sources	Low	Low	There are no artificial sources in close proximity.



6.0 **Drainage Strategy**

6.1 **Overview**

- 6.1.1 As part of this study Southern Water (SW), and the Environment Agency (EA) have been consulted.

6.2 **External Consultation**

Southern Water (SW)

- 6.2.1 As discussed in Section 4, the SW sewer records have been reviewed and confirm no public sewers are within the development site. SW were previously consulted in 2013 by another consultant with regard to a different (albeit similar in nature) development. At that time they responded in the form of a letter enclosed in Appendix C, which confirmed that the proposed foul sewer drainage will be accepted into the existing sewers through Section 98 of the Water Industry Act 1991.

Environment Agency

- 6.2.2 As mentioned in section 3.4.2, the EA have provided a response stating their requirements for this FRA with respect to the development surface water runoff and attenuation requirements.

6.3 **Existing Surface Water Runoff**

- 6.3.1 As described in previous sections the runoff currently drains primarily into the ground through the arable fields, or runs overland towards the eastern boundary, following the natural contours of the site.
- 6.3.2 For drainage design purposes, the proposed development is classed as being constructed on greenfield land. Therefore greenfield runoff rates should be applied. These can be found in Table 4 below and, as requested by the EA, the greenfield rate is based on the greenfield runoff for the Southern Region 7. See Appendix F for micro drainage calculations.

Table 4: Existing Surface Water Runoff

Total Area (ha)	Greenfield Runoff Rates for Respective Storm Events		
	QBar	30 Year	100 Year
9.745	35.3l/s	79.9l/s	112.5/s



6.4 Geology

- 6.4.1 The geotechnical data is based on the Hydrock ground investigation report ref. R/14459/001, dated June 2014. The site is underlain by Raised Marine Deposits in the east and River Terrace Deposits in the west. These superficial deposits overlie Undifferentiated Chalk deposits.

6.5 Sustainable Drainage Systems

6.5.1 SuDS Objectives:

Sustainable drainage, developed in line with the ideals of sustainable development is collectively referred to as Sustainable Drainage Systems (SuDS). At a particular site, these systems are designed to manage both the environmental risks resulting from the urban runoff and to contribute wherever possible to environmental enhancement. Therefore SuDS objectives are therefore to minimise the impacts from the development on the quantity and quality of the runoff and maximise amenity and biodiversity opportunities (CIRIA C697, 2007).

6.5.2 SuDS Design Themes

A strong design theme is essential if the maximum aesthetic benefits are to be gained from the SuDS approach. At a more local scale the SuDS should link with the individual plot structures, planting, public open space requirements and amenity areas, gaining multiple benefits from a limited area of land.

6.5.3 The SuDS Management Train

The 'Management Train Approach' should be central to the surface water drainage strategy of the proposed site. The main objective is treatment and control of runoff as near to the source as possible protecting downstream habitats and further enhancing the amenity value of the site. This concept uses a hierarchy of drainage techniques to incrementally reduce pollution, flow rates and volumes of storm water discharge from the site, and is as follows:

1. **Prevention** – The use of good site design and housekeeping measures to prevent runoff and pollution and includes the use of rainwater reuse / harvesting.
2. **Source Controls** – Control of runoff at source or as close to source as possible (e.g. soakaways, green roofs, pervious pavements).
3. **Site Control** – Management of water in a local area and can include below ground storage / attenuation, detention basins, large infiltration devices.
4. **Regional Control** – Management of water from a site or various sites and can include wetlands and balancing ponds.