LAND WEST OF RAYLEIGH
Environmental Statement
Appendix H
Flood Risk Assessment

08 / 2014

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01. 09. 2014
Support Services
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<tr>
<th>Rev</th>
<th>Date</th>
<th>Details</th>
<th>Prepared by</th>
<th>Reviewed by</th>
<th>Approved by</th>
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<td>2</td>
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<td>3</td>
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</table>
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INTRODUCTION

1.1 Background

1.1.1 A Flood Risk Assessment (FRA) was previously completed for the Proposed Development at Rawreth Lane, Rayleigh in April 2013. Since the completion of the FRA, changes in the site layout and updated sources of flood risk information have become available. The FRA has therefore been updated to include this information.

1.1.2 This FRA has been prepared for the Proposed Development of residential units, non-residential floor space, a school and a health centre at the Rawreth Lane site in Rayleigh, Essex. This FRA has been prepared in accordance with the National Planning Policy Framework (NPPF)\(^1\) and its accompanying Technical Guidance\(^2\). This FRA is based on the best available information from several sources.

1.1.3 The Environment Agency's Flood Map (Figure 1-1) shows the site to be in Flood Zones 1, 2 and 3 associated with the Rawreth Brook, a tributary of the River Crouch. Of the area to be developed, approximately 10% of the site area is within Flood Zone 2 and 3.

1.1.4 The site of the Proposed Development covers an area of 48.7 hectares (ha). Therefore as stated in paragraph 1-3 of the NPPF, a site-specific FRA is required due to the site being partially within Flood Zone 2 and 3, and being greater than 1ha in area.

![Detailed Flood Map centred on Rayleigh Created 22nd February 2013. Ref: CCE/2013/49727](image)

Figure 1-1 Environment Agency Flood Map (also shown in Appendix A)

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\(^1\) Communities and Local Government. (March 2012) National Planning Policy Framework.

\(^2\) Communities and Local Government. (March 2012) Technical Guidance to the National Planning Policy Framework.
1.2 Flood Risk Assessment Methodology

1.2.1 The aim of a FRA is to assess the risk of all forms of flooding to and from a development. URS’ approach to FRAs is based on the Source-Pathway-Receptor model.

1.2.2 The Source-Pathway-Receptor model firstly identifies the causes or ‘sources’ of flooding to and from a development. This identification is based on a review of available information such as mapping, local conditions and consideration of the effects of climate change. The nature and likely extent of flooding arising from any one source is considered, e.g. whether such flooding is likely to be localised or widespread.

1.2.3 As well as flooding from more obvious sources such as rivers and the sea, assessment of other flooding sources as defined by the NPPF is undertaken. This includes groundwater flooding, surface water flooding, sewer flooding and flooding from artificial sources.

1.2.4 The presence of a flood source does not always imply a risk. For example, the presence of a sewer does not necessarily increase the risk of flooding unless the sewer is local to the site and ground levels encourage surcharged flows to accumulate. The exposure pathway or ‘flooding mechanism’ determines whether there is a risk of exposure to a flood source. If a flooding mechanism is not present, then potential risk from the associated flood source is considered to be negligible.

1.2.5 If a flood source and flooding pathway are identified, then assessment of the flood risk to the receptor is determined by combining the probability of the flood event occurring with the severity of impact (or consequences) if the flood event were to occur. Receptors include any people or buildings which are connected to the source by a pathway.

1.2.6 The potential severity of the impact is determined through consideration of a combination of flood source type, flood mechanisms present, layout and design of the proposed receptor and vulnerability of the proposed receptor.

1.2.7 In summary, for a particular flood risk to exist, all the elements of the Source-Pathway-Receptor model must be present. Effective mitigation measures can be provided to reduce the magnitude of flood risk by removing one element of the model, such as a pathway. The incorporation of flood defence or flood resilience measures into building receptors and the provision of safe access and egress plans for users of a development are all strategies which, if utilised correctly, will reduce or remove the pathway element of flood risk.

1.3 Aims and Objectives

1.3.1 The aim of this report is to assess the flood risk associated with the Proposed Development at Rawreth Lane, Rayleigh. As stated in paragraph 9 of the NPPF technical guidance, a site specific FRA should aim to “... identify and assess the risk of all forms of flooding to and from the development and demonstrate how these flood risks will be managed so that the development remains safe throughout its lifetime, taking climate change into account.”

1.3.2 This has been achieved by:

- Considering the flood risks arising from the Proposed Development in addition to the risk of flooding to the site;
- Identifying and quantifying the vulnerability of the Proposed Development to flooding from different sources and identification of potential flood risk reduction measures;
- Assessing the remaining ‘residual’ risk after risk reduction measures have been taken into account and demonstrating that this is acceptable for the Proposed Development;
• Considering the vulnerability of potential users of the Proposed Development, taking into account the vulnerability classification of the development, and including arrangements for safe access.
2 SITE DESCRIPTION

2.1 The Existing Site

2.1.1 The Rawreth Lane site covers an area of 46.7 ha and is currently used as arable farmland. The approximate national grid reference for the centre of the site is TQ 79244 92418. The location of the site can be seen in Figure 2-1.

2.1.2 The site is located to the north west of the urban extent of Rayleigh, Essex. Rawreth Lane passes along the northern border of the site and London Road (A129) passes along the southern boundary. Further arable farmland is present to the west of the site.

2.1.3 To the east of the site lies the Rawreth Industrial Estate, with sections of residential areas to the north east (Laburnum Way) and south east (Cheapside West). Lower Barn Farm is located to the south of the site. Rawreth Hall is located to the north west of the site.

2.1.4 As can be seen in Figure 2-1, the site is divided by the Rawreth Brook. The Rawreth brook is classified as a main river and tributary of the River Crouch. This river flows from the south of Grosvenor Road (south east of the site) in a north westerly direction. To the west of the site, a main river channel draining from the south joins the Rawreth Brook. These channels are designated main rivers, therefore the Environment Agency have discretionary flood risk management, enforcements and maintenance powers on them. In addition there are several land drainage ditches that flow from the north and south of the site to the Rawreth Brook.

2.1.5 To the west of the site, there is an overflow channel from the Rawreth Brook that flows to the north, before entering a pond and flowing in a north westerly direction towards Rawreth. This overflow channel is located opposite the point of the confluence of the main river channel that drains from the south.

2.1.6 To the west of the site, a section of the Rawreth Brook is culverted as part of a crossing between the fields. These is located approximately 60m from the western boundary of the site. A drainage ditch, draining from the south of the site, join the Rawreth Brook at this point. The topographic survey identifies the culvert to have a diameter of 750 mm.

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A main river is defined by the environment agency as "Main rivers are watercourses shown on the statutory main river maps held by the Environment Agency, the Department of Environment, Food and Rural Affairs (in England) and the Welsh Assembly Government (in Wales). They can include any structure or appliance for controlling or regulating the flow of water into, in or out of the channel. The Environment Agency has permissive powers to carry out works of maintenance and improvement on these rivers. Our formal consent is required for works that affect a main river." (Environment Agency available online at http://www.geostore.com/environmen-t-agency/WebStore?xml=environment-agency/xml/dataLayers_MIR.xml)

FINAL REPORT
August 2014
Figure 2-1 Site Location
2.2 Proposed Development

2.2.1 The Land Use Parameter Plan for the Proposed Development is provided in Appendix C.

2.2.2 The Proposed Development covers an area of 46.7 ha. This comprises the construction of up to 500 residential properties (covering a total area of 15.11 ha). Using the channel of the Rawreth Brook as an indication of the centre of the site, the majority (78%) of the residential development, will be constructed in the north eastern part of the site. A smaller section (22%) of residential development will be in the south east of the site. Within the main development, land will also be used for the construction of non-residential floor space (0.38 ha), link road corridors (2.93 ha), public transport corridor (0.39 ha) and health centre (0.15 ha). In addition, a school and will be built within the north eastern part of the site covering an area of 1.12 ha, much of which will be the school playing field. In total, 20.08 ha of the site will be developed.

2.2.3 The total area of green space within the Proposed Development is approximately 26.62 ha. Semi-natural open space will be included within the development across the central river corridor section of the site, the western perimeter and between the residential blocks. This will cover an area of approximately 23.26 ha. In addition, there will be a central amenity green space of approximately 0.62 ha, 1.61 ha of sports pitches and attenuation basins covering approximately 1.11 ha.

2.2.4 The principal means of access to the Proposed Development will be from Rawreth Lane to the north of the site and London Road to the south of the site. The masterplan indicates that a primary road and pedestrian path will be developed to connect the northern and southern parts of the site.

2.3 Topography

2.3.1 A topographic survey of the site has been completed and can be seen in Appendix B. The general slope of the site is to the west. There is also a slope from the north and the south towards the centre of the site to where the river channel passes. The lowest point in the topography is therefore towards the west of the site along the river channel, where levels are at 7.8 meters above Ordnance Datum (mAOD) where the river channel exits the site.

2.3.2 The highest points are to the south east and the north east of the site, where the ground levels are at 15.6 mAOD and 27.6 mAOD respectively. Within the northern part of the site, there is a section with a steeper slope of approximately 1 in 20 that runs across the site from west to east.

2.3.3 From the east to the west of the site to be developed, following the channel of the river, the ground levels fall from 12.2 mAOD to 7.8 mAOD (this is a gradient of approximately 1:600).

2.4 Geology

2.4.1 The bedrock geology at the site is predominantly the London Clay Formation (clay, silt and sand). The central part of the site has superficial Head Deposits (comprised of sand and gravel) and Alluvium (within the proximity of the Rawreth Brook).

2.4.2 There are a number of shallow boreholes across the site. In the northern part of the site, there are two borehole records (TQ79SE2 and TQ79SE3) to the east of Rawreth Hall. These record the geology to be clay dominated. The groundwater levels are recorded to be at 6.71 m below ground level (approximately 13.3 mAOD) and 3.66 m below ground level (approximately 17.3 mAOD).

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2.4.3 A borehole record further to the south (TQ79SE13), and north of the river channel, records the presence of superficial Head Deposits and Alluvium. The clay is reached at a depth of 2.5 m below ground level (approximately 5.3 m AOD).

2.4.4 The top soil in the northern part of the site is a slowly permeable seasonally wet base rich and loamy and clayey soil. The top soil around the river channel and the southern part of the site is a loamy clayey soil with impeded drainage.

2.5 Hydrogeology

2.5.1 The Environment Agency groundwater maps (available online at: http://environment-agency.gov.uk) show the superficial deposits across the site to be classified as aquifers. The Alluvium is considered to be secondary A aquifers that are capable of supporting water supplies at local scales and can be important in forming base flows to rivers. The Head Deposits are classified as secondary undifferentiated aquifers due to the variable geology.

2.5.2 The northern part of the site, dominated by the London Clay, is classified as unproductive strata. That is, the clay has low permeability and will have negligible significance or water supply or river base flow.

2.5.3 The aquifers at the site are classed as minor with intermediate vulnerability. The site is not located within any groundwater source protection zones.

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3 PLANNING POLICY

3.1 National Planning Policy Framework

3.1.1 Section 10 of the National Planning Policy Framework (NPPF) and its associated Technical Guide provides current guidance for planning with respect to flood risk. Paragraph 103 of the NPPF outlines that all development proposals greater than 1 hectare in scale will require a site specific flood risk assessment to show that the development is appropriate and does not increase the risk of flooding elsewhere.

3.1.2 The NPPF considers the vulnerability of different forms of development to flooding. The vulnerability classifications are detailed in Table 2 of the Technical Guidance to the NPPF and have been reproduced in Table 3-1 below.

Table 3-1 NPPF flood risk vulnerability classification [abbreviated] (CLG, March 2012)

<table>
<thead>
<tr>
<th>Vulnerability Classification</th>
<th>Development Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Essential Infrastructure</td>
<td>• Essential transport infrastructure… which has to cross the area at risk; Wind turbines.</td>
</tr>
<tr>
<td></td>
<td>• Essential utility infrastructure which has to be located in a flood risk area for critical operational reasons</td>
</tr>
<tr>
<td>Highly Vulnerable</td>
<td>• Police stations, Ambulance stations and Fire stations and Command Centres and telecommunications installations required to be operational during flooding; Emergency dispersal points; Basement dwellings.</td>
</tr>
<tr>
<td></td>
<td>• Caravans, mobile homes and park homes intended for permanent residential use.</td>
</tr>
<tr>
<td></td>
<td>• Installations requiring hazardous substances consent.</td>
</tr>
<tr>
<td></td>
<td>• Hospitals; Residential institutions including care homes, children’s homes, social homes, prisons and hostels.</td>
</tr>
<tr>
<td></td>
<td>• Buildings used for: dwelling houses; student residences; drinking establishments; nightclubs; and hotels.</td>
</tr>
<tr>
<td></td>
<td>• Non-residential uses for health services, nurseries and educational establishments.</td>
</tr>
<tr>
<td></td>
<td>• Landfill and sites used for waste management facilities for hazardous waste.</td>
</tr>
<tr>
<td></td>
<td>• Sites used for holiday or short-let caravans/camping, subject to a specific warning and evacuation plan.</td>
</tr>
<tr>
<td>More Vulnerable</td>
<td>• Police, ambulance and fire stations which are not required to be operational during flooding.</td>
</tr>
<tr>
<td></td>
<td>• Buildings used for: shops; financial, professional and other services; restaurants and cafes; hot food takeaways; offices; general industry; storage and distribution; non-residential institutions not included in ‘more vulnerable’; and assembly and leisure.</td>
</tr>
<tr>
<td></td>
<td>• Land and buildings used for agriculture and forestry.</td>
</tr>
<tr>
<td></td>
<td>• Waste treatment (except landfill and hazardous waste facilities); Water treatment plants.</td>
</tr>
<tr>
<td></td>
<td>• Mines working and processing (except for sand and gravel working).</td>
</tr>
<tr>
<td>Less Vulnerable</td>
<td>• Flood control infrastructure; water/sewage transmission infrastructure and pumping stations.</td>
</tr>
<tr>
<td></td>
<td>• Sand and gravel workings; docks, marinas and wharves; navigation facilities; MOD defence installations.</td>
</tr>
<tr>
<td></td>
<td>• Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location; Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms.</td>
</tr>
<tr>
<td></td>
<td>• Water-based recreation (excluding sleeping accommodation): Lifeguard and coastguard stations.</td>
</tr>
<tr>
<td>Water-Compatible Development</td>
<td>• Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms.</td>
</tr>
<tr>
<td></td>
<td>• Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.</td>
</tr>
</tbody>
</table>

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1 DETR Circular 04/00, paragraph 18. Planning controls for Hazardous Substances. See www.communities.gov.uk/index.asp?id=1144377
3.1.3 As highlighted in Table 3-1, residential development, educational establishments and health services are classified as being 'more vulnerable' to flooding. Amenity space, such as the country park is classified as 'water compatible development'. Table 3 of the Technical Guidance for the NPPF presents a matrix which identifies the vulnerability classifications that are appropriate within each Flood Zone. This has been reproduced in Table 3-2.

<table>
<thead>
<tr>
<th>Flood Zone</th>
<th>Essential Infrastructure</th>
<th>Water Compatible</th>
<th>Highly Vulnerable</th>
<th>More Vulnerable</th>
<th>Less Vulnerable</th>
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<td></td>
<td>✓</td>
<td>✓</td>
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<tr>
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<td>×</td>
<td>Exception Test required</td>
<td>✓</td>
</tr>
<tr>
<td>3B</td>
<td></td>
<td></td>
<td>×</td>
<td>×</td>
<td>×</td>
</tr>
</tbody>
</table>

 ✓ – Development is appropriate  × – Development should not be permitted

3.1.4 As the Proposed Development of residential properties and the school are classified as ‘more vulnerable’, development within Flood Zones 1 and 2 would be acceptable. Development within Flood Zone 3a would be required to pass the Exceptions Test. More vulnerable development within Flood Zone 3b is not appropriate. The ‘water compatible development’ country park would be acceptable within all Flood Zones.

3.1.5 For all development, the NPPF requires that the developers seek opportunities to reduce the overall level of flood risk in the area and beyond through the site layout and appropriate application of Sustainable Drainage Systems (SuDS).

3.1.6 Based on the Technical Guidance to the NPPF, the potential effects of Climate Change will need to be accounted for. Peak rainfall intensities used in calculations to estimate site runoff should be increased by a value ranging from 5% to 30% to cover a period from 1990 to 2115 (See Table 3-3) depending on the proposed longevity of the development.

<table>
<thead>
<tr>
<th>Time frame</th>
<th>1990 to 2025</th>
<th>2025 to 2055</th>
<th>2055 to 2085</th>
<th>2085 to 2115</th>
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<tr>
<td>Peak Rainfall Intensity</td>
<td>+5%</td>
<td>+10%</td>
<td>+20%</td>
<td>+30%</td>
</tr>
</tbody>
</table>
3.2 Local Planning Policy: Rochford District Council Local Development Framework Core Strategy

3.2.1 Rochford District Council Local Development Framework: Core Strategy Adopted Version 2011\(^6\) forms the main document for Rochford District Councils Local Development Framework. The Local Development Framework has replaced the Rochford Local Plan. None of the policies relating to flooding or surface water management (NR11 and NR12) were saved when the Local Plan expired in 2009.

3.2.2 The policies within the Core Strategy that relate to the flood risk of the Proposed Development are presented below.

**Policy ENV 3 – Flood Risk**

"The Council will direct development away from areas at risk of flooding by applying the sequential test and, where necessary, the exceptions test, as per PPS25 (sic). The vast majority of development will be accommodated within Flood Zone 1. However, considering the very limited supply of previously developed land in the District, proposed development on previously developed land within Flood Zone 3 will be permitted if it enables a contribution towards the District’s housing requirement that would otherwise require the reallocation of Green Belt land, provided that it passes the exceptions tests and is able to accommodate the necessary flood defence infrastructure.

The Council will continue to work with the Environment Agency to manage flood risk in a sustainable manner through capitalising on opportunities to make space for water wherever possible and through the continued provision of flood defences where necessary.\(^6\)

**Policy 4 – Sustainable Drainage Systems (SUDS)**

"All residential development over 10 units will be required to incorporate runoff control via SUDS to ensure runoff and infiltration rates do not increase the likelihood of flooding.

The requirement for SUDS will only be relaxed where there is conclusive evidence demonstrating that the system is not viable on a particular site.\(^6\)

3.3 Rochford District Council Local Development Framework Allocations Plan (Adopted February 2014)\(^7\)

3.3.1 The Rochford District Council Allocation Document, developed as part of the Local Development Framework, was adopted on the 25\(^{th}\) of February 2014.

3.3.2 Policy SER1 outlines the requirements of the allocated land associated with the Proposed Development. In relation to flood risk, the policy outlines the need to accommodate sustainable drainage systems as part of the development.

3.3.3 It is outlined that the 3.1 ha of the site associated within Flood Zone 2 and 3 should be set aside for public open space and natural/semi-natural greenspace.

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3.4 Rochford District Council Strategic Flood Risk Assessment (SFRA)\textsuperscript{10}

3.4.1 The Rochford District Council SFRA outlines the flood risk across the council area and the flood risk to specific development areas. The land north of London Road, Rayleigh (in which the Proposed Development lies), is one of these areas in which the following development control recommendations have been made:

"Sequential Approach: All future development should be steered towards Flood Zone 1 in accordance with the sequential approach. More vulnerable development, including residential, should be located within Flood Zone 1.

Finished Floor Levels: Detailed modelling may be required to more accurately determine the flood zones in this area and determine the flood level to inform development design.

Finished floor levels should be set 300mm above the 1 in 100 year flood level, including allowances for climate change for the lifetime of the development (100 years for residential development).

Floodplain Compensation: Any encroachment into Flood Zone 3a that results in loss of storage in the floodplain should be compensated for on a level for level and volume for volume basis.

Surface Water Management: Future development must make adequate provision for the sustainable management of surface water on the site. Due to the underlying geology, infiltration techniques are unlikely to be suitable and therefore attenuation techniques are recommended."

3.5 Sewers for Adoption – 6th Edition

3.5.1 Part 2.14 of Sewers for Adoption 6\textsuperscript{th} Edition\textsuperscript{11} states that, in order to be considered as adoptable by the sewerage undertaker, surface water sewers to be located within a highway corridor must be designed to feature a maximum on-line capacity of the 1.3% Annual Exceedance Probability (AEP) (1 in 30 year) return period runoff volume.

3.5.2 For a sewer to remain adoptable, any storage capacity above the 1.3% AEP (1 in 30 year) storm volume must be incorporated as an offline storage feature outside the online sewer network.


\textsuperscript{11} Water Research Centre (March 2006) Sewers for Adoption: 6\textsuperscript{th} Edition.
4 FLOOD RISK TO THE DEVELOPMENT

4.1.1 The NPPF requires the effects of all forms of flood risk to and from the development to be considered within an FRA. There should be demonstration of how these should be managed so that the development remains safe throughout its lifetime, taking into account climate change.

4.2 Tidal Flood Risk

4.2.1 Rochford is at risk of tidal flooding from the North Sea and the River Crouch estuary. The Environment Agency Flood Map (available online at: http://www.environment-agency.gov.uk) shows that the River Crouch is defended up to a 1% AEP (1 in 100 year) standard from tidal flooding.

4.2.2 The site itself is located 1.7 km inland and is not within the tidal flood extent of the River Crouch or the North Sea. The tidal extent associated with the River Crouch is shown within Figure 4-1 below.

Figure 4-1: Tidal Extent

4.2.3 In addition, breach modelling completed as part of the Rochford District Council SFRA, shows that for the breach scenario closest to the site (ROC07 at South Fambridge), flood extents are approximately 4.5 km from the site to the north east.

4.2.4 The flood risk from tidal sources is considered to be negligible.
4.3 Fluvial Flood Risk

4.3.1 Fluvial flooding results from large rainfall events in the upper reaches of the catchment causing flows in excess of the carrying capacity of watercourses. The site is predominately located within Flood Zone 1 (less than 0.1% AEP (1 in 1000 chance) of flooding occurring each year) with some areas within Flood Zone 2, (extreme flood event of up to a 1 in 1000 change of occurring each year) and Flood Zone 3 (1% AEP (1 in 100) or greater chance of flooding in each year from fluvial flooding).

4.3.2 As discussed in section 3.1, the NPPF states that more vulnerable development (such as residential development and schools) is suitable within Flood Zones 1 and 2, but is required to pass the Exceptions Test to be developed within Flood Zone 3. The Core Strategy however states a preference for avoiding development within Flood Zone 3 wherever possible.

4.3.3 The main source of fluvial flooding to the site is from the Rawreth Brook, a tributary of the River Crouch. The Rawreth Brook is a designated Main River that flows through the site from the south east to the north west. A channel from the south joins the Rawreth Brook to the west of the Proposed Development. In addition there are several land drains that drain from both the north and south towards the river channel.

4.3.4 The Rochford District Council SFRA states that the tributaries of the River Crouch, including the Rawreth Brook, are known to react rapidly to intense rainfall events. The report states that the Rawreth Brook has maintained channels that provide protection against the 1 in 50 year event (2% AEP).

4.3.5 Fluvial flooding for the Rawreth Brook was modelled in 2007 for a range of return period scenarios within the South Essex Flood Risk Study. The flood levels from this modelling have been supplied by the Environment Agency (Appendix A). To the east of the site, where the Rawreth Brook enters the site, the flood levels for the 1% AEP (1 in 100 year) event plus climate change are at 12.81 mAOD. The flood levels decrease along with the topography to the west of the site, where they are at 8.08 mAOD just beyond the crossing of Chelmsford Road.

4.3.6 Comparison of the modelled flood levels with the topographic survey confirm that there is potential for the flood waters to overtop the banks of the Rawreth Brook. For example at the very east of the site (cross section: BENF2_3210u), the 1% AEP (1 in 100 year) plus climate change flood levels are 12.81 mAOD whilst banks levels, according to the topographic survey, are at 12.07 mAOD to the north and 12.15 mAOD to the south.

4.3.7 The River Crouch is located approximately 1.6 km to the north of the site. The nearest available modelled flood levels for the River Crouch are at Battlesbridge, approximately 1.7 km north west of the site. The Environment Agency modelled flood levels for the Battlesbridge node for the 0.1% AEP (1 in 1000 year) undefended flood levels is 5.5 mAOD (Appendix A). The topographic survey of the site shows that the lowest elevation of the site to be in the west at a level of 7.8 mAOD; 2.3 m above the modelled 0.1% AEP (1 in 1000 year) flood level for the River Crouch.

4.3.8 The high water levels of the River Crouch appear to have minor impact on the water levels and discharge of the Rawreth Brook. Anecdotal evidence (photographs supplied by Countryside Properties (UK) Ltd.) showed that following a period of high flows within the River Crouch in February 2014, the water levels within the Rawreth Brook remained low and the drainage ditches remained clear.

4.3.9 As part of the site lies within Flood Zone 3 the flood risk is considered to be high. Section 5.2 discusses the impact of the development on the flood risk.
Access and Egress

4.3.10 The Proposed Development will be accessed via a road running from Rawreth Lane to the north and London Road to the south. The access road will pass through the site, crossing the Rawreth Brook. As there are access points to the north and south of the site, there is sufficient access should the Rawreth Brook flood above road levels.

4.3.11 In addition, the design of the access road (as shown in Appendix C) indicates that the road will be at a level of approximately 13.12 mAOD to the north and approximately 13.13 mAOD to the south of the river, excluding the raised level of the bridge. The modelled flood level of the Rawreth Brook at this point is 12.81 mAOD for the 1% AEP (1 in 100 year) plus climate change event, below the proposed road level.

Historic flooding

4.3.12 Data provided by the Environment Agency shows that there is a record of fluvial flooding along the Rawreth Brook from an event occurring in 1958 (Appendix A). The SFRA states that this event was a result of 76mm of rainfall that fell over 2 hours that lead to flooding of properties in Rawreth and the evacuation of a number of families. It can be seen that the flood extent from this event was greatest to the west of the site. To the east of the site, flooding is relatively contained within the channel of the Rawreth Brook.

4.3.13 The Environment Agency has confirmed that there have been no further fluvial flooding incidents along the Rawreth Brook at the site to date.

4.3.14 Gauged flow and stage records are available for the River Crouch at Wickford\textsuperscript{12} (TQ748933), 4.5km upstream from the site. The flow records indicate that the highest river levels recorded have been 2.38 m. This equates to a level of 6.471 mAOD (based on the site datum of 4.091 mAOD). The river reached a level of 2.35 m (6.441 mAOD) on the 24th of December 2013. Based on the site levels across the site described in paragraph 4.3.7 above, the site would not be expected to flood from the River Crouch.

Mitigation

4.3.15 Residential development will be constructed entirely within Flood Zone 1; therefore there will be a low flood risk to the development in this area. Part of the access road and bridge will be within Flood Zone 2, however as described within paragraph 4.3.11, the levels of the road are set above the 1% AEP (1 in 100 year) plus climate change flood levels.

4.3.16 Finished floor levels of the development should take into account the modelled flood levels of the Rawreth Brook. As suggested by the Rochford District Council SFRA in section 3.4, the finished floor levels should be raised to 300 mm above the 1% AEP (1 in 100 year) plus climate change flood level (ranging from 12.81 mAOD to 10.13 mAOD from the east to west of the Rawreth Brook across the site).

4.4 Surface Water / Overland Flow (Pluvial Flooding)

4.4.1 Overland flow results from rainfall that fails to infiltrate the surface and travels over the ground surface; this is exacerbated where the permeability of the ground is low due to the type of soil and geology (such as clayey soils) or urban development. Surface water flow is also promoted in areas of steep topography which can rapidly convey water that has failed to penetrate the surface.

4.4.2 The South Essex Surface Water Management Plan (SWMP)\textsuperscript{13} has undertaken strategic scale surface water modelling. The SWMP modelling results show that for the 1% AEP (1 in 100 year return period) storm, the site is subject to some surface water flooding. Within the lowest points of the site alongside the river channel, there is the potential for surface water flooding of up to 0.25 m. West of the site by Chelmsford Road, flood depths have been modelled to be greater (up to 1 m) as a result of the presence of the culvert passing below Chelmsford Road.

4.4.3 The flood hazard associated with the 1% AEP (1 in 100) year event has been modelled to be moderate (danger for some\textsuperscript{14}) across part of the site. Moderate hazard is shown to occur as a result of the steep slope north of the river, and the deep water associated with the flooding in front of the culvert. Elsewhere the hazard classification is lower at 'caution'.

4.4.4 The site itself is not located within a Critical Drainage Area (CDA). To the east of the site, the urban area of Rayleigh is within a CDA (ROC1) and to the north west of the site Watery Lane is a CDA (ROC2). Of importance to this site, are the surface water flow paths that flow within ROC1. The SWMP shows that these flow from across the urban extent of Rayleigh towards the west of the urban area (i.e. towards the site). The surface water flow paths tend towards the channel of the Rawreth Brook which then flows into the proposed site. Flows from the CDA ROC2 flow away from the site in a northerly direction.

4.4.5 Surface water generated by the site would follow the topography of the land and flow towards the channel of the Rawreth Brook. As described in paragraph 2.4.4, the soil across the site has limited infiltration potential, therefore in heavy rainfall events, surface water is likely to be generated more rapidly than in an area of permeable soils.

4.4.6 Analysis of the topography of the area suggests that surface water is likely to discharge towards the site from the Rayleigh Urban area to the west along the channel of the Rawreth Brook, and drainage ditches to the north of Grosvenor Road and the south of Victoria Road. Surface water entering the site from the Rayleigh urban area will largely be contained within the channel of the Rawreth Brook. The flood risk is therefore considered to be moderate prior to mitigation.

**Historic Flooding Incidents**

4.4.7 Consultation with Countryside Properties Ltd. and Essex County Council have confirmed a number of surface water flooding incidents have occurred within the vicinity of the site. This includes:

- 20th July 2014: Heavy rainfall across the area resulted in flooding at Salem Walk, Fairmead, Maine Crescent, Laburnum Way, Victoria Avenue and London Road;
- 30th January 2014: 1 property was recorded to flood at Parkhurst Drive;
- 24th August 2013: Extensive surface water flooding following heavy rainfall. Record of property flooding within the areas of Laburnum Way, Victoria Avenue, Salem Walks and Fairmead;
- 9th July 2013: flood at Laburnum Way;
- 3rd December 2012: Properties flooding at Laburnum Way; and,
- Pre 2010 (exact dates are unknown): Frequent flooding of Chelmsford Road and roundabout, thought to be due to runoff from surrounding areas.

\textsuperscript{13} Flood hazard based on the joint EA and Defra R&D Technical Report FD2320 (January 2006)

\textsuperscript{14} Flood hazard based on the joint EA and Defra R&D Technical Report FD2320 (January 2006)
4.4.8 The approximate location of these flooding incidents is shown in Figure 4-2 below.

4.4.9 Flooding at Salem Walk, Fairmead, Maine Crescent and Victoria Avenue is likely to be due to a combination of surface water runoff following heavy rainfall, coinciding within high flows within the river channel. Within the residential area, there is a network of drainage ditches and small watercourses that are thought to drain the area towards the Rawreth Brook. During heavy rainfall events, these channels are likely to become overwhelmed resulting in localised flooding. Details of the recent flooding on the 20th of July 2014, recorded by residents, indicates that in this instance, flooding was a result of a blocked sluice gate within the channel behind the properties.

4.4.10 Anecdotal evidence (discussions with Countryside Properties (UK) Ltd.) suggests that flooding in this area on the 24th of August 2013 may have been exacerbated by the infilling of drainage ditches associated with the new development to the west of Boston Avenue and south of Cheapside West.

4.4.11 In relation to the Proposed Development, surface water runoff and the resulting high river flows are likely to propagate downstream along the Rawreth Brook towards the site, potentially increasing the flood risk to the site.

4.4.12 Flooding recorded within the Parkhurst Drive and Laburnum Way is likely to be a result of intense rainfall overwhelming the drainage system within the area. At the junction of Laburnum Way and Rawreth Lane, there is a small drainage ditch which will have limited capacity for draining surface water runoff. The flooding recorded at Parkhurst Drive and Laburnum Way would be unlikely to affect the site, as there is an area of raised elevation between the flooding locations and the site.

4.4.13 In addition, Countryside Properties (UK) Ltd. are also aware of flooding having occurred along London Road, to the southwest of the site, on frequent occasions following heavy rainfall. This is thought to be due to runoff from the adjacent land to the south which comprises extensive hardstanding areas with little formal surface water drainage. This area is below the southern elevation of the site; therefore it is unlikely that surface water generated from this source would flow beyond London Road onto the site.

**Mitigation**

4.4.14 As described above, there is potential for surface water to run towards the site from the adjacent land, as well as surface water generated across the site. In order to mitigate the risk of surface water flooding to the site, the site layout should be considered so that surface water would follow flow paths and pond away from buildings.
Figure 4-2: Historic Surface Water Flooding Instances

Legend
- Site Boundary
- Main Rivers
- Ordinary Watercourses / Drainage Ditches
- Areas of Historic Flooding

Contains Ordnance Survey data © Crown copyright and database right 2014
4.5 Groundwater Flooding

4.5.1 Groundwater flooding occurs where groundwater levels rise above ground surface levels. Local geology has a major influence on where this type of flooding takes place; it is most likely to occur in low-lying areas underlain by permeable rocks (aquifers).

4.5.2 As discussed in section 2.4, the site is predominately underlain by Clay which is impermeable. The superficial deposits located around the centre and south of the site, support minor aquifers, which could potentially generate groundwater. This is reiterated in the SWMP that states the risk of groundwater flooding is higher in areas where Head Deposits or Alluvium are present at the surface.

4.5.3 The topography of the site indicates that groundwater flooding would follow local topography, ie. towards the river channel.

4.5.4 As the site is in an area of predominantly impermeable geology, the quantities of groundwater generated are likely to be minimal. Should groundwater discharge, it would be within the channel of the river. The flood risk from this source is therefore considered to be low.

4.6 Sewer Flooding

4.6.1 Sewer flooding can occur as a result of blocked sewers or failed pumping stations. Appendix D shows plans of the Anglian Water sewer networks in and around the site.

4.6.2 The sewer systems within the site and the surrounding area are separate systems, that is, foul water and surface water are drained separately. It can be seen that there is a 675mm diameter public foul sewer that passes through the site that drains to the Rayleigh West Sewage Treatment Works. This flows from Rayleigh in a north westerly direction and exits the site just to the east of Rawreth Hall. There are several manholes located along the length of the sewer at approximately 90 m intervals. In addition there are smaller foul sewers that run along Rawreth Lane from the west and east to join the trunk sewer in Rawreth Lane. The Anglian Water sewer plans show the closest surface water sewers to be within the residential developments to the east of the site.

4.6.3 Providing that there are no misconnections to the foul sewer, the flows within the pipes will remain relatively constant and will not be affected by surface water resulting from rainfall events. In the unlikely event that the foul sewers exceed their capacity, there is the potential for the foul water to surcharge manholes and to flow, following the topography of the land, across the site towards the low point of the Rawreth Brook channel.

4.6.4 The SWMP indicates that there have been several DG5 records of sewer flooding within the Rayleigh Urban area in the last 10 years. There are no records associated with the site.

4.6.5 The flood risk to the site from this source is considered to be low.

4.7 Artificial Sources of Flooding

4.7.1 Artificial flood sources include raised channels such as canals or storage features such as ponds and reservoirs.
4.7.2 There are three ponds of varying size within the site boundary. The largest of these is to the north of the Rawreth Brook, in the centre of the site, with an approximate area of approximately 0.18 ha. The second two smaller ponds are to the south east and south west of the larger pond and north of the Rawreth Brook. The topographic survey shows the banks of the ponds to be at ground level and not elevated above the surrounding land. Two of the ponds are isolated from the watercourses and drainage channels within the site. The third smaller pond (to west) appears to have an inflow from a drainage channel draining from Rawreth Hall to the north and from the relief channel from the Rawreth Brook.

4.7.3 If the water within the ponds were to exceed the bank level, the water would flow towards the channel of the Rawreth Brook. The flood risk from this source is considered to be low.

4.8 **Summary of Flood Risk to the Development**

4.8.1 The flood risk to the development can be summarised as follows:

**Table 4-1 Summary of flood risk to the development**

<table>
<thead>
<tr>
<th>Type of Flooding</th>
<th>Source of Flooding</th>
<th>Flood risk to the development</th>
<th>Mitigation required?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tidal</td>
<td>River Crouch estuary</td>
<td>Negligible</td>
<td>No</td>
</tr>
<tr>
<td>Fluvial</td>
<td>Rawreth Brook</td>
<td>High</td>
<td>Yes – Development within Flood Zone 1 &amp; 2 only.</td>
</tr>
<tr>
<td></td>
<td>River Crouch</td>
<td>Low</td>
<td>No</td>
</tr>
<tr>
<td>Surface water</td>
<td>Runoff from surrounding land</td>
<td>Moderate</td>
<td>Yes – Site layout to manage overland flow routes.</td>
</tr>
<tr>
<td>Sewers</td>
<td>Surrounding public/private drainage systems</td>
<td>Low</td>
<td>No</td>
</tr>
<tr>
<td>Groundwater</td>
<td>Underlying geology and groundwater levels</td>
<td>Low</td>
<td>No</td>
</tr>
<tr>
<td>Artificial Sources</td>
<td>Ponds within the site</td>
<td>Low</td>
<td>No</td>
</tr>
</tbody>
</table>
5 FLOOD RISK FROM THE DEVELOPMENT

5.1.1 The NPPF advises that a FRA should consider all potential sources of flooding arising from development.

5.2 Fluvial Flooding

5.2.1 As the central section of the site is within Flood Zones 2 and 3, should development be undertaken within the extent of these flood zones, compensatory storage would be required to ensure there is no detrimental impact on floodplain storage. Where development will displace floodplain volume compensatory storage must be provided on a level for level and volume for volume basis.

5.2.2 To mitigate the risk to the Proposed Development from fluvial flood sources (Rawreth Brook) and to mitigate the risk of the Proposed Development exacerbating fluvial flood risk through floodplain volume displacement, all residential development will be located in Flood Zone 1 (i.e. outside of 0.1% AEP or 1 in 100 year floodplain). This is in keeping with the principles of the sequential approach advocated by the NPPF and the preferred approach outlined in local planning policy.

5.2.3 The Environment Agency modelled flood levels for the Rawreth Brook should be used to inform the finished floor levels of the buildings. It is recommended that buildings have a finished floor level of 300 mm above the flood levels for the 1% AEP (1 in 100 year return period) event including allowances for climate change (ranging from 12.81 mAOD to 12.13 mAOD across the site). This will ensure that in the event of flooding, water does not inundate properties.

5.2.4 The masterplan for the Proposed Development, presented in Appendix C, identifies the land located within Flood Zone 2 and 3 to be intended for the development of natural and semi-natural green space. The masterplan also identifies an access road to pass across the river to connect the northern and southern sections of the site. The construction of the bridge for the access road will need to be completed in such a way that any loss of volume of the floodplain is compensated for and that the 1% AEP (1 in 100 year) plus allowance for climate change flow is not impeded. Mitigation measures for bridge design are discussed below.

5.2.5 In addition it should be noted that under the terms of the Water Resources Act 1991, and the Land Drainage Bylaws 1981 works within 8 m of a main river (including works or structures in, under, over or within 8 m of the top of the bank), require the written consent of the Environment Agency.

Mitigation

5.2.6 The design of crossings of Rawreth Brook should consider potential flood events and the impact of the structure on water flows and quality. Consultation with the Environment Agency is recommended during the detailed design process. Formal consent will be required from the Environment Agency.

5.2.7 The following basic design requirements for crossings should be considered:
- Bridges are preferred to be a clear span structure.
- The bridge abutments should be set back (minimum of 1 m) from the top of the bank of the watercourse.
- The soffit level of the bridge should be set a minimum of 600 mm above the 1% (1 in 100 year) modelled fluvial flood levels including allowance for climate change.
• Open parapets/handrails may be appropriate to allow some flow over the deck in case the bridge opening becomes blocked or in an extreme flood event.

5.2.8 Development of culverts will require other specific design measures.

5.2.9 The location of residential development within Flood Zone 1 and the appropriate bridge design will mean the Proposed Development will have a negligible effect on the fluvial flood risk.

Opportunities for Development

5.2.10 As described in section 2.1.6, there is a section of the Rawth Brook that is culverted to the west of the site. The opportunity could be taken to de-culvert the selection and undertake river restoration work to restore the channel of the Rawth Brook as it passes through the site. This would not only provide benefits in increasing the flood storage capacity of the Rawth Brook within the site, but would offer opportunities for aesthetic, amenity and ecological space within the development.

5.3 Surface water flooding / overland flow

5.3.1 The NPPF highlights the ways in which construction of a development can exacerbate the risk of flooding by increasing surface water runoff. Enlargement of areas of impermeable surfaces across a site will promote rapid runoff to surface water sewers or watercourses rather than allowing percolation into the ground. The result can be to increase both total volume and peak water flow rates, thus contributing to flooding.

5.3.2 The Environment Agency aspires to reduce runoff rates from new developments as much as possible. The minimum requirement within the NPPF is to demonstrate that no increase in runoff will occur when comparing the existing and post development scenarios. As the site is currently undeveloped, surface water runoff from the proposed development will therefore need to be restricted to the greenfield runoff rate. This is discussed further in the paragraphs below.

5.3.3 As discussed in section 4.4.12, there are a number of historical incidents of flooding within the vicinity of the site. Based on the topography of the site, if the site were to be developed without any mitigation measures, Parkhurst Drive and Laburnum Way (and surrounding area) would potentially be a receptor of surface water runoff generated from the northern part of the site. Surface water runoff from the Proposed Development is not likely to influence flooding within Fairmead, Victoria Avenue and Main Crescent as the Proposed Development is downstream of these areas.

Mitigation - Surface water runoff rates

5.3.4 A detailed surface water drainage strategy for this site will be completed separately to the FRA. The surface water drainage for the site will be developed to accommodate surface water runoff for all rainfall events up to and including the 1% AEP + 30% Climate Change event.

5.3.5 The sections below outline the discharge rate and attenuation requirements needed to manage surface water from the site. Following the incorporation of the surface water drainage network and SuDS across the site, the risk of flooding from the development to the surrounding areas is considered to be low.

5.3.6 There will be a residual risk of surface water flooding to the site and downstream areas if the surface water drainage network and SuDS are not maintained correctly. It is therefore important that a maintenance program is developed and adopted.
5.3.7 The greenfield runoff rates for the site (the 20.08 ha that will be developed) have been determined using the MicroDrainage WinDES software (further details are provided in Appendix E). Table 5-1 outlines the greenfield runoff rates for the site for a range of return period events. These runoff rates will be used to determine the attenuation requirements for surface water runoff.

### Table 5-1 Greenfield runoff rates

<table>
<thead>
<tr>
<th>Return Period</th>
<th>Greenfield runoff (l/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100% AEP (1 in 1 year)</td>
<td>59.4</td>
</tr>
<tr>
<td>10% AEP (1 in 10 year)</td>
<td>113.3</td>
</tr>
<tr>
<td>3.3% AEP (1 in 30 year)</td>
<td>158.5</td>
</tr>
<tr>
<td>1% AEP (1 in 100 year)</td>
<td>223.1</td>
</tr>
<tr>
<td>1% AEP (1 in 100 year) + 30% Climate Change</td>
<td>296.7</td>
</tr>
</tbody>
</table>

5.3.8 The rate of surface water runoff from the Proposed Development will need to be restricted up to, and including, the 1% AEP (1 in 100 year) event plus 30% allowance for climate change.

**Surface water attenuation**

5.3.9 In order to achieve the greenfield runoff rates outlined above, surface water will need to be attenuated on site prior to discharge.

5.3.10 Based on the greenfield runoff rate, the following quick storage estimates have been conducted (Table 5-2). Quick storage estimates, provide a broad scale overview of the volume of storage required. These have been calculated based on an assumption of the final impermeable area of the site being 40%, 50% or 60% of the total site area that is to be developed. Further details of the WinDES Microdrainage outputs are shown in Appendix E. Calculations have been completed for the 1% AEP (1 in 100 year) rainfall event including a 30% allowance for climate change.

### Table 5-1: Quick Storage Estimate of Attenuation Requirements for the 1 % AEP plus Climate Change Event

<table>
<thead>
<tr>
<th>% Impermeable Area (ha)</th>
<th>Storage Requirement (m$^3$)</th>
<th>Runoff Rate (l/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>40% (8.0 ha)</td>
<td>2552 to 3789</td>
<td>296.7</td>
</tr>
<tr>
<td>50% (10.0 ha)</td>
<td>3430 to 5015</td>
<td>296.7</td>
</tr>
<tr>
<td>60% (12.0 ha)</td>
<td>4426 to 6289</td>
<td>296.7</td>
</tr>
</tbody>
</table>
5.3.11 As outlined in the land use parameter plan, it is proposed that the attenuation of surface water will be achieved through a series of attenuation basins located to the north and south of the river (as described in section 2.2).

Surface water discharge

5.3.12 Building Regulations Part H details that surface water should be discharged via soakaways or other infiltration systems where practicable. As the geology of the site is predominately impermeable clay, discharge via infiltration is not suitable. Therefore surface water should be discharged to the nearest watercourse, in this case, the Rawreth Brook following treatment and attenuation.

5.3.13 It should be noted that the Environment Agency is the authority responsible for the Rawreth Brook; therefore any discharge to the watercourse will require the written consent of the Environment Agency prior to discharge. Applications for discharge consents are covered under separate legislation to the Town and Country Planning Act. Therefore, achieving planning permissions does not guarantee the successful application for permission to discharge to the watercourse.

5.3.14 As described in paragraph 5.3.2, as the site is currently undeveloped, surface water will need to be discharged at the greenfield runoff rate.

Opportunities for Development

5.3.15 The Environment Agency’s preference is for surface water to be managed in above ground SuDS such as ponds, wetlands, swales or infiltration trenches within the landscape design of the site. Where possible, these should be aligned along the contours of the site to intercept overland flow. In addition, landscaped SuDS such as swales can be developed to enhance the aesthetics, amenity and biodiversity value of the area.

5.3.16 The additional use of permeable paving on roads and parking spaces would assist in reducing the total impermeable area.

5.4 Sewer Flooding

5.4.1 A Pre Planning Assessment Report for the Proposed Development completed by Anglian Water (Appendix D) states that it is acceptable to connect to the foul sewer that passes through the site. The report also states that the Rayleigh West Sewage Treatment Works has the capacity to treat the foul flows from the site.

5.4.2 The proposed connection will be at two points along the 675 mm public foul sewer at nodes 2501 and 3902. These are located to the western side of the area proposed for residential development, and to the north just before Rawreth Lane respectively.

5.5 Summary of flood risk from the development

5.5.1 The flood risk as a result of the proposed development can be summarised as follows:
<table>
<thead>
<tr>
<th>Flood Mechanism</th>
<th>Source of Flooding</th>
<th>Flood Risk as a result of the Proposed Development</th>
<th>Mitigation Required?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tidal</td>
<td>River Crouch estuary</td>
<td>Negligible - No loss of floodplain caused by development</td>
<td>No</td>
</tr>
<tr>
<td>Fluvial</td>
<td>Rawreth Brook</td>
<td>High - Potential loss of floodplain and impediment of flows.</td>
<td>Yes: Site layout and bridge design</td>
</tr>
<tr>
<td></td>
<td>River Crouch</td>
<td>No loss of floodplain caused by development</td>
<td>No</td>
</tr>
<tr>
<td>Surface water</td>
<td>Runoff to the surrounding land</td>
<td>Increase in impermeable areas and alteration of flow routes</td>
<td>Yes: Design of surface water drainage system</td>
</tr>
<tr>
<td>Sewers</td>
<td>Flow to the public/private drainage systems</td>
<td>Increase in flows to sewer system</td>
<td>No</td>
</tr>
<tr>
<td>Groundwater</td>
<td>Underlying geology and groundwater levels</td>
<td>No increase in groundwater levels</td>
<td>No</td>
</tr>
<tr>
<td>Artificial Sources</td>
<td>Ponds within the site</td>
<td>No impact on inflows to balancing pond</td>
<td>No</td>
</tr>
</tbody>
</table>
6 CONCLUSIONS AND RECOMMENDATIONS

6.1.1 The Proposed Development comprises of the construction of 500 residential units, non-
residential land use, transport routes, a school and health centre on previously undeveloped
land.

6.1.2 The assessment of flood risk to the development concludes that there is a low risk of flooding
from tidal, sewer, groundwater and artificial sources. There is a high risk of flooding from
surface water sources and a high to low risk of flooding for parts of the site, from fluvial
sources.

6.1.3 The Proposed Development is classified as more vulnerable. The residential, school and
healthcare components of the proposed development will be constructed entirely within Flood
Zone 1 away from the areas of high fluvial flood risk. This satisfies the sequential approach to
development as outlined in the NPPF.

6.1.4 The modelled flood levels for the Rawreth Brook should be used to ensure that finished floor
levels are set to 300 mm above the 100 year plus allowance for climate change flood level
(ranging from 12.81 mAOD to 12.13 mAOD across the site).

6.1.5 The site is currently greenfield land, in accordance with NPPF requirements, surface water
runoff from the site will need to be restricted to the greenfield runoff rate for the 1% AEP (1 in
100 year) rainfall event including allowance for climate change.

6.1.6 As the surface water runoff rates will need to be restricted to the greenfield runoff rate,
significant on site attenuation of surface water will be required. The onsite attenuation will
need to provide sufficient storage for surface water runoff from the site for events up to and
including the 1% AEP plus climate change event.

6.1.7 The discharge of surface water via infiltration measures is unlikely to be suitable due to
impermeable clay bedrock geology. Surface water will therefore need to be managed onsite
through appropriate storage and attenuation systems, designed to accommodate the
necessary storage prior to being discharged to the Rawreth Brook (providing discharge
consent is granted).

6.1.8 The assessment of the flood risk from the Proposed Development concludes that with
appropriately designed and managed surface water management measures (providing
sufficient attenuation and storage) and appropriate bridge construction, it is considered that
there is no increased flood risk to the surrounding area as a result of the development.
APPENDIX A – ENVIRONMENT AGENCY DATA
Ms D Skilton
danielle.skilton@urs.com

Dear Ms Skilton

Rawreth Lane, Rayleigh, Essex

Thank you for your enquiry which was received on 4 February, and subsequent payment of £60.

Following internal consultations, please now find attached the following:

- Flood map showing the Flood Zones (outlines) for the area of the site
- Historic flood map
- Modelled flood level location map
- Modelled flood level data

According to our records, this area falls within Flood Zone 2 and 3, Fluvial.

For your information, Flood Zone 1 shows a less than 0.1% annual probability of flooding.

The Flood Zone 2 outline shows a 1 in 1000 chance of flooding at a location in any one given year (i.e., a 0.1% annual probability of flooding).

The Flood Zone 3 fluvial outline shows a 1 in 100 chance of flooding at a location in any one given year (i.e., a 1% annual probability of flooding). The Flood Zone 3 tidal outline shows a 1 in 200 chance of flooding at a location in any one given year (i.e., a 0.5% annual probability of flooding).

The flood outlines show areas of potential flooding as a direct result of floodwater coming from a watercourse. No direct effects of surface runoff or surface flooding are included. The Flood Maps show areas at risk of flooding, and not the risk to individual properties. This is because we do not hold data on individual properties.

Examination of our historic flooding records shows that the general area of Rayleigh was flooded in 1958. Please note that these records show flooding to the land and do not necessarily indicate that properties within the historic flood events were flooded internally. It is also possible that the pattern of flooding in this area has changed and that this area would now flood under different circumstances.

Eastern Area - Iceni House
Cobham Road, Ipswich, Suffolk, IP3 9JD
General Enquiries: 03708 506506 Fax: 01473 724205
Weekday Daytime calls cost 8p plus up to 6p per minute from BT Weekend Unlimited.
Mobile and other providers' charges may vary
Email: enquiries@environment-agency.gov.uk
Website: www.environment-agency.gov.uk
There are no Environment Agency maintained defences in this area.

The purpose of the Flood Risk Assessment (FRA) is to demonstrate that any development will be safe and sustainable. The requirements and level of information required within a FRA depends on the development vulnerability and Flood Zone.

Further guidance on any development type within any of the Flood Zones can be found at the following website. Here you will find PDF documents detailing the information you will need to include in your Flood Risk Assessment. Just click on the relevant link for your proposal. [http://www.environment-agency.gov.uk/research/planning/93498.aspx](http://www.environment-agency.gov.uk/research/planning/93498.aspx)

Unfortunately we have no breach analysis for this site. However, this information maybe available from Rochford District Council’s SFRA.

If you would like to discuss the required content of the FRA in more detail, please email us at Corporate.Services@environment-agency.gov.uk.

Please see the attached notice for details of the permitted use of the information provided.

If you have any specific requirements because of dyslexia, visual or other physical impairment etc, we will be able to supply the data in an alternative format.

If we can be of any further assistance, please do contact the Corporate Services Team at the number below.

Yours sincerely,

Karen Hills
External Relations Officer

Corporate Services Team
01473 706720
Historic Flood Map centred on Rayleigh Created 22nd February 2013.
Ref: CCE/2013/49727

Legend
- Site
- 1958 Flood Outline

Scale 1:10,000

© Crown copyright and database rights 2012 Ordnance Survey 100024198
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<th>20% (1:5)</th>
<th>10% (1:16)</th>
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<th>5% (1:50) + CC</th>
<th>2% (1:150)</th>
<th>1% (1:100) + CC</th>
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<tbody>
<tr>
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<td>5.08</td>
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</tr>
</tbody>
</table>

CC = Climate Change

Source of information: Crouch and Reach Name Flood Risk Study (2011) by the Environment Agency.
Ms Danielle Skilton  
URS  
danielle.skilton@urs.com

Our ref  
CCE/2013/49939

Date  
19 March 2013

Dear Ms Skilton

Rawreth Lane, Rayleigh, Essex

Thank you for your enquiry of 28 February. Following internal consultations we are able to reply to your enquiry as below.

Please find attached to my email the modelled flood levels for Rawreth Brook along with the flood map. All the other information and advice is the same as that supplied under ref CCE/2013/49727.

Please see the attached notice for details of the permitted use of the information provided.

If you have any specific requirements because of dyslexia, visual or other physical impairment etc, we will be able to supply the data in an alternative format.

If we can be of any further assistance, please do contact the Corporate Services Team at the number below.

Yours sincerely

Mareth Bassett  
External Relations Officer

Corporate Services Team  
01473 706720
Fluvial flood levels (mAODN)

<table>
<thead>
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<th>Cross Section</th>
<th>10% (1:10)</th>
<th>5% (1:20)</th>
<th>2% (1:50)</th>
<th>1.3% (1:75)</th>
<th>1% (1:100)</th>
<th>1% (1:100) +CC</th>
<th>0.1% (1:1000)</th>
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<td>6.79</td>
<td>6.91</td>
<td>7.04</td>
<td>7.08</td>
<td>7.10</td>
<td>7.13</td>
<td>7.25</td>
</tr>
</tbody>
</table>

CC = Climate Change

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Contact: enquiries@environment-agency.gov.uk 03708 506506
Pre Planning Assessment Report

Land South of Rawreth Lane, RAYLEIGH
URS Infrastructure & Environmental Limited

Reference Number: 0409/SP56(001)

Anglian Water Services contact:
Anna Lansdown
Growth Planning Advisor
Thorpe Wood House
Thorpe Wood
Peterborough
PE3 6WT

Telephone Number: 01733 414690
Please use the above reference number in all communications
YOUR DEVELOPMENT SITE: Land South of Rawreth Lane, Rayleigh

The information provided within this report has been generated based on the following information provided in your application form:

- The grid reference for the site is TQ79329291.
- The site currently does not have planning permission and is located on a Greenfield site.
- The development site will contain 550 dwellings and 1 school across 110 Hectares.
- The anticipated residential build rate is:

<table>
<thead>
<tr>
<th>Year</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
</tr>
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<tr>
<td>Build rate</td>
<td>50</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>50</td>
</tr>
</tbody>
</table>

The comments contained within this report relate to the public water mains and sewers indicated on our records. Your attention is drawn to the disclaimer in the useful information section of this report.

Due to the recent adoption of private sewers in October 2011 many newly adopted public wastewater assets and their history are not indicated on our records. You also need to be aware that your development site may contain private water mains, drains or other assets not shown on our records. These are private assets and not the responsibility of Anglian Water but that of the landowner.

**ASSETS AFFECTED**

Our records indicate that we have public foul sewers within the boundary of your development site. Additionally, it is highly recommended that you carry out a thorough investigation of your proposed working area to establish whether any unmapped public or private sewers and lateral drains are in existence.

We are unable to permit development either over or within the easement strip without prior consent. The extent of the easement is provided in the table below. Please be aware that the existing underground assets should be located in highway or open space and not in private gardens. This is to ensure available access for any future maintenance and repair. This should be taken into consideration when planning your site layout.

<table>
<thead>
<tr>
<th>Wastewater Easement Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sewer Size (mm)</td>
</tr>
<tr>
<td>675</td>
</tr>
<tr>
<td>200</td>
</tr>
</tbody>
</table>

If it is not possible to avoid our assets then the sewer may need to be diverted in accordance with Section 185 of the Water Industry Act (1991). We have a duty to divert our sewerage infrastructure if requested to do so although this would be at your expense. You will need to make a formal application if you would like a diversion to be considered. A copy of the section 185 diversion application form can be found at www.anglianwater.co.uk /developers
Our records indicate that there is also a foul sewer which runs close to your site boundary and our statutory easement appears to overlap into your development site. This easement will need to be taken into consideration when designing your layout. The general guidance is a 3 metre easement which will be required either side of 150 millimetre sewer.

**WASTEWATER SERVICES**

In examining the wastewater system we assess the ability for your site to connect to the public sewerage network without causing a detriment to the operation of the system. We also assess the receiving sewage works and determine whether the sewage works can cope with the increased flow and influent quality arising from your development.

**Wastewater Treatment**
The foul drainage from this development is in the catchment of Rayleigh West Sewage Treatment Works, which has capacity to treat the flows from your development site. Anglian Water cannot reserve capacity at this sewage works and you are recommended to formally apply for a connection at your earliest convenience. Please note that capacity at the sewage works can be reduced at any time due to increased requirements from existing businesses and houses, from new housing and new commercial developments as well as from environmental and regulation driven changes.

**Foul Sewerage Network**
As per your request we have assessed a gravity solution to your preferred connection points. We can confirm that this is acceptable as the foul sewerage system, at present, has available capacity for your site. The connection point will be multiple connections within the 675 millimetre public foul sewer to suit the site layout. The requested connection points at manholes 2501 located at NGR TQ7923792543 and 3902 located at NGR TQ7931992975 are acceptable.

As per your correspondence dated 12 March 2013 in relation to missing manhole details, I can confirm that a technician will contact you directly to clarify this information with you.

**Surface Water Disposal**
The proposed method of surface water disposal is not relevant to Anglian Water; we suggest that you contact the future SuDS Approving Body for the area, the Environment Agency, the Internal Drainage Board.

**Wastewater Budget Costs**
It has been assumed that the onsite foul network will be provided under a section 104 Water Industry Act application. It is recommended that you also budget for both infrastructure charges and connection costs. The 2012/13 charges are:

<table>
<thead>
<tr>
<th>Infrastructure Charge</th>
<th>£328.00 per connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>S104 Supervision and inspection costs</td>
<td>2.5% of estimated construction costs</td>
</tr>
<tr>
<td>S104 Surety costs</td>
<td>10% of estimated construction costs</td>
</tr>
</tbody>
</table>
Map of proposed connection points

Figure 1: Showing your foul water point of connection at manhole 2501 with a Cover Level of 14.17m & and Invert Level of 10.78m.
Figure 2: Showing your foul water point of connection at manhole 3902.
USEFUL INFORMATION

Sustainable Drainage Systems: Many existing urban drainage systems can cause problems of flooding, pollution or damage to the environment and are resilient to climate change in the long term. Therefore our preferred method of surface water disposal is through the use of Sustainable Drainage Systems (SuDS). SuDS are a range of techniques that aim to mimic the way surface water drains in natural systems within urban areas. For more information on SuDS, please visit our website at http://anglianwater.co.uk/developers/sewer-connection/suds.aspx. We also recommend that you contact the future SuDS Approving Body (SAB) for the area to discuss your application.

Water Industry Act – Key Wastewater Sections:
- Section 98: This provides you with the right to requisition a new public sewer. The new public sewer can be constructed by Anglian Water on your behalf. Alternatively, you can construct the sewer yourself under section 30 of the Anglian Water Authority Act 1977.
- Section 102: This provides you with the right to have an existing seworage asset vested by us. It is your responsibility to bring the infrastructure to an adoptable condition ahead of the asset being vested.
- Section 104: This provides you with the right to have a design technically vetted and an agreement reached that will see us adopt your assets following their satisfactory construction and connection to the public sewer.
- Section 106: This provides you with the right to have your constructed sewer connected to the public sewer.
- Section 185: This provides you with the right to have a public seworage asset diverted.

Details on how to make a formal application for a new sewer, new connection or diversion are available on our website at www.anglianwater.co.uk/developers/application-form or via our Developer Services team on 08457 60 66 087.

Private Sewer Transfers: Sewers and lateral drains connected to the public sewer on the 1 July 2011 transferred into Water Company ownership on the 1 October 2011. This follows the implementation of the Floods and Water Management Act (FWMA). This included sewers and lateral drains that were subject to an existing Section 104 Adoption Agreement and those that were not. There were exemptions and the main non-transferable assets were as follows:

- Surface water sewers and lateral drains that did not discharge to the public sewer, e.g. those that discharged to a watercourse.
- Foul sewers and lateral drains that discharged to a privately owned sewage treatment/collection facility.
- Pumping stations and rising mains will transfer between 1 October 2011 and 1 October 2016.

The implementation of Section 42 of the FWMA will ensure that future private sewers will not be created. It is anticipated that all new sewer applications will need to have an approved section 104 application ahead of a section 106 connection.
Encroachment: Anglian Water operates a risk based approach to development encroaching close to our wastewater infrastructure. We assess the issue of encroachment if you are planning to build within 400 metres of a Sewage Treatment Works or, within 15 metres to 100 metres of a pumping station. We have more information available on our website at http://anglianwater.co.uk/developers/encroachment.aspx

Water Industry Act – Key Water Sections:
- Section 41: This provides you with the right to requisition a new water main to connect your site to the public water network.
- Section 45: This provides you with a right to have a connection from a building or part of a building to the public water main.
- Section 51A: This provides you with the right to provide the water main or service connection yourselves and for us to vest them into our company.
- Section 185: This provides you with the right to have a public water asset diverted. Details on how to make an application and the s185 form is available on our website at www.anglianwater.co.uk/developers/application-forms or via our Developer Services team on 08457 60 66 087.

Details on how to make a formal application for a new water main, new connection or diversion are available on our website at www.anglianwater.co.uk/developers/application-form or via our Developer Services team on 08457 60 66 087.

If you have any other queries on your rights to requisition or connect your housing to the public water and wastewater infrastructure then please contact our developer services team at: Developer Services, Anglian Water, PO Box 495, Huntingdon, PE29 6YY or Tel: 0845 60 66 087 or Email: developerservices@anglianwater.co.uk

Self Lay of Water Mains: A list of accredited Self Lay Organisations can be found at www.lloydssregister.co.uk/schemes/WIRS/providers-list.aspx.

Water pressure and flow rate: The water pressure and consistency that we must meet for your site is laid out in the Water Industry Act (1991). This states that we must supply a flow rate of 9 litres per second at a pressure of 10 metres of head to the external stop tap. If your water pressure requirements exceed this then you will need to provide and maintain any booster requirements to the development site.

Locating our assets: Maps detailing the location of our water and wastewater infrastructure including both underground assets and above ground assets such as pumping stations and treatment works are available from www.digdat.co.uk. All requests from members of the public or non-statutory bodies for maps showing the location of our assets will be subject to an appropriate administrative charge. We have more information on our website at: www.anglianwater.co.uk/developers/our-assets/

Summary of charges: A summary of this year’s water and wastewater connection and infrastructure charges can be found at www.anglianwater.co.uk/developers/charges/
Disclaimer: The information provided within this report is based on the best data currently recorded, recorded within the last 12 months or provided by a third party. The position must be regarded as approximate. If there is further development in the area or for other reasons the position may change.

The accuracy of this report is therefore not guaranteed and does not obviate the need to make additional appropriate searches, inspections and enquiries. You are advised therefore to renew your enquiry should there be a delay in submitting your application for water supply/sewer connection to re-confirm the situation.

Any cost calculations provided within the report are estimated only and may be subject to change.

No liability whatsoever including liability for negligence is accepted by Anglian Water Services Limited for any error or inaccuracy or omission including the failure to accurately record or record at all, the location of any water main, discharge pipe, sewer, or drain or disposal main or any item of apparatus.

Contacting us: If you have any comments or suggestions based on the information provided in this report then please feel free to contact me on 01733 414690.
APPENDIX E - WINDES MICRODRAINAGE CALCULATIONS

WinDES rural runoff calculator using ICP SUDS methodology:

<table>
<thead>
<tr>
<th>Region</th>
<th>QBAR (l/s)</th>
<th>Q (10 yrs) (l/s)</th>
<th>Q (1 yrs) (l/s)</th>
<th>Q (30 yrs) (l/s)</th>
<th>Q (100 yrs) (l/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Region 1</td>
<td>69.9</td>
<td>101.1</td>
<td>59.4</td>
<td>132.1</td>
<td>173.4</td>
</tr>
<tr>
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<td>99.3</td>
<td>60.8</td>
<td>132.7</td>
<td>183.9</td>
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<td>101.4</td>
<td>60.1</td>
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<td>68.8</td>
<td>168.0</td>
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<td>113.3</td>
<td>59.4</td>
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<td>54.5</td>
<td>133.3</td>
<td>165.2</td>
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<tr>
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<td>99.3</td>
<td>61.5</td>
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<td>152.5</td>
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<td>96.5</td>
<td>60.8</td>
<td>118.6</td>
<td>145.5</td>
</tr>
</tbody>
</table>

Enter Return Period between 1 and 1000
WinDES quick storage estimates: Assuming a 40% impermeable area (8.0ha impermeable of the 20.08ha being developed) for the 1 in 100 year including a 30% allowance for climate change.
WinDES quick storage estimates: Assuming a 50% impermeable area (10.0ha impermeable of the 20.08ha being developed) for the 1 in 100 year including a 30% allowance for climate change.

Global Variables require approximate storage of between 3430 m$^3$ and 5015 m$^3$.

These values are estimates only and should not be used for design purposes.
WinDES quick storage estimates: Assuming a 60% impermeable area (12.0ha impermeable of the 20.08ha being developed) for the 1 in 100 year including a 30% allowance for climate change.