Bellway Homes Ltd

FLOOD RISK ASSESSMENT

Land off Crown Quay Lane, Sittingbourne

DECEMBER 2019

CONFIDENTIAL

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REPORT (FIRST ISSUE) CONFIDENTIAL

PROJECT NO. 70049200

DATE: DECEMBER 2019

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QUALITY CONTROL

Issue/revision	First issue	Revision 1	Revision 2	Revision 3
Remarks				
Date	December 2019			
Prepared by	E. Stoykova PP			
Signature	dos Santos Gil, Joao (UKJPD002) Digitally signed by dos Santos Gil, Joao (UKJPD002) DN: cn=dos Santos Gil, Joao (UKJPD002), ou=Basingstoke (Mountbatten House), email=Joao.dosSantosGil@wsp.com Date: 2019.12.17 17:39:55			
Checked by	S. Webber and J. Dos Santos Gil			
Signature	dos Santos Gil, Joao (UKJPD002) Digitally signed by dos Santos Gil, Joao (UKJPD002) DN: cn=dos Santos Gil, Joao (UKJPD002), ou=Basingstoke (Mountbatten House), email=Joao.dosSantosGil@wsp.com Date: 2019.12.17 17:01:38			
Authorised by	C. Patmore			
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Project number	70049200			
Report number	49200-FRA-001			
File reference	\\uk.wspgroup.com\central data\Projects\700492xx\70049200 - Crown Quay Lane FRA - Site 3\02 WIP\EI EIA and flood risk\03 Document\FRA 2019\70049200-FRA-001.docx			

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EXECUTIVE SUMMARY

This Flood Risk Assessment has been prepared on behalf of Bellway Homes Limited as part of the supporting documentation for a detailed planning application of a Proposed Development at Land off Crown Quay Lane. Sittingbourne. It has been written in accordance with the guidelines set out in the National Planning Policy Framework and other relevant National and Local Policy and Guidance documents.

The Application Site is a brownfield site covering an area of approximately 2.08 hectares.

The Proposed Development comprises a detailed planning application for a residential-use development of up to 107 units.

The Proposed Development is classified as More Vulnerable and it is located within a combination of Flood Zone 1, 2 and 3. The Sequential and Exception test are considered satisfied f the Proposed Development has been allocated within the Local Plan and is part of the Area Action Plan as redevelopment of this derelict site is beneficial to the area.

Flood risks to and from the Site and the Proposed Development from all sources have been qualitatively assessed as the following prior to mitigation:

- Tidal – High
- Fluvial – Negligible
- Pluvial – Low to Medium
- Groundwater – Low
- Sewers and Drainage Infrastructure – Low
- Artificial Sources – Negligible

In accordance with the Area Action Plan and agreement of the Environment Agency, the site is to be raised to a level of 5.75m AOD with the finished floor levels of habitable rooms a minimum of 300mm above this to place the development above the long term predicted extreme tidal flood level.

The flood risk associated with tidal, pluvial, groundwater and sewer and drainage infrastructure will be mitigated by incorporating the surface water drainage strategy and by raising the ground to a suitable elevation as described in this document. The drainage of the development is in accordance with national and local policy and considers the effects of climate change in the future years. The development incorporates SuDS features to provide both surface water attenuation and water quality treatment. This will be incorporated into a new drainage network across the site and porous sub-base under the parking bays, prior to discharge to the Swale to the north of the site using the existing outfall. The outfall is to be redeveloped to bring it further south into the site to create a new head wall and a more natural outflow area allowing an increased inter-tidal area to be provided.

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1 INTRODUCTION

1.1 APPOINTMENT AND BRIEF

1.1.1. WSP was commissioned, by Bellway Homes Ltd, to produce a site-specific Flood Risk Assessment (FRA) and Surface Water Drainage Strategy (SWDS) to support the detailed planning application for a proposed residential development at Land off Crown Quay Lane, Sittingbourne (the Application Site).

1.1.2. The Application Site is part of a wider strategic residential development (the Allocation Site) which is included within Policy A9 of the Swale Borough Local Plan (2017) Policy A9 states the following:

LAND AT CROWN QUAY LANE, SITTINGBOURNE

Subject to securing high quality design and an appropriate mix, planning permission will be granted for a minimum of 650 dwellings, open space and habitat creation at Crown Quay Lane, Sittingbourne, as shown on the Proposals Map. Development proposals will:

1. *Accord with a Masterplan Development Brief (developed through stakeholder consultation, including the Borough Council and Swale Design Panel), which shall demonstrate a comprehensive approach to the bringing forward of the whole allocation:*
2. *Achieve high quality design befitting the prominent position of the site on Milton Creek and in important views;*
3. *Restore and enhance land on the creek frontage to provide open space and a creekside path to meet the needs of residents, mitigate flood risk (if required) and create creekside biodiversity habitats;*
4. *Incorporate an integrated landscape strategy that will create a strong landscaped framework of open spaces, habitat retention and creation and planting, including the use of tree lined streets within the development and at Crown Quay Lane and Eurolink Way;*
5. *Achieve pedestrian/cycle links to the town centre and pedestrian links to the Sittingbourne Retail Park, Milton Creek and its Country Park (via a landmark bridge);*
6. *Ensure that, through both on and off site measures, any significant adverse impacts on local wildlife sites are mitigated in accordance with Policy DM28. In the case of such impacts upon European designated sites, these will be mitigated in accordance with Policies CP7 and DM28, including a financial contribution towards the Strategic Access Management and Monitoring Strategy;*
7. *Undertake flood risk assessment in accordance with Policy DM21 to ensure that flood risk is not increased at adjacent sites and to bring forward proposal that create and utilise water features (inc. use of sustainable urban drainage) within the development;*
8. *Achieve a mix of housing in accordance with Policy CP3, including provision for affordable housing in accordance with Policy DM8;*
9. *Be accompanied by a Health Impact Assessment in accordance with Policy CP5. which shall also include an assessment of the impacts on residential areas from adjacent commercial uses;*
10. *Assess and respond to and mitigate impacts on any heritage assets;*
11. *Undertake a transport assessment and implement any highway and other transportation improvements arising from the proposed development;*
12. *Assess impacts upon and ensure that air quality objectives are not compromised; and,*

13. Provide infrastructure needs arising from the development, including those identified by the Local Plan Implementation and Delivery Schedule, in particular, health facilities.

1.1.3. The residential parcels of the Allocation Site cover a total area of approximately 15.8 hectares (ha) and are split into five development parcels:

- Parcel 1: 10.6 ha (Redrow Homes site);
- Parcel 2: 1.2 ha (Jewsons site);
- Parcel 3: 2.08 ha (Bellway Homes site – the Application Site);
- Parcel 4: 1.3 ha (Odds Timber site); and,
- Parcel 5: 0.7 ha (Persimmon Homes site).

1.1.4. This FRA has been prepared to present the flood risk management and drainage philosophy for Parcel 3 of the Allocation Site, refer to Figure No. 49200-LOC-001 in **Appendix A**. A plan delineating all the parcels is included Figure No. 49200-LOC-002 in **Appendix A**, and copies of the Masterplan for the Application Site (Drawing No. 051904-BEL-K-01) are provided in **Appendix B.1**.

1.2 AIM OF REPORT

1.2.1. The aim of this FRA is to update and assess the risk from flood sources to the Application Site, in accordance with the requirements of the NPPF, and identify those that may arise as a result of the Proposed Development. Where risks are identified, mitigation measures are proposed to manage the risks over the lifetime of the development (assumed to be 100 years for residential uses), accounting for the predicted effects of climate change. This includes the presentation of a Surface Water Drainage Strategy (SWDS) for the Application Site. Where appropriate, residual risks have been considered, and methods for managing the residual risks are outlined.

METHODOLOGY

1.2.2. In order to meet the aims of the report, a desk study and data research has been undertaken including a review of the following Policy documents:

- The National Planning Policy Framework (NPPF);
- The NPPF Flood Risk and Coastal Change Planning Practice Guidance (PPG);
- Development and Flood Risk – Guidance for the Construction Industry (C624), (CIRIA, 2004);
- Non-statutory technical standards for sustainable drainage systems, (DEFRA, 2015);
- The SuDS Manual (CIRIA C753), (CIRIA, 2015); and,
- Sittingbourne Local Policy Documents.

1.2.3. As well as the desk study element, consultation with regulatory bodies and third parties has been undertaken; copies of correspondence exchanged with these stakeholders are provided in Appendix C. The regulatory bodies and third parties consulted are listed below:

- The Environment Agency (**Appendix C.1**);
- Southern Water (**Appendix C.2**); and,
- Kent County Council as LLFA (**Appendix C.3**).

1.2.4. An assessment of flood risks to the Application Site from all sources considered under the NPPF, including fluvial, pluvial, groundwater, sewers and man-made infrastructure, has been undertaken. This has included:

- Determination of baseline flood risk profile for the Application Site;
- An assessment of the impact of the proposed developments on local flood risks;
- An assessment of the residual flood risk to the proposed development and neighbouring property from local flood sources;
- Estimation of surface water flows based on the current conditions at the Application Site and existing drainage systems; and,
- Estimation of post development surface water flows, based on the development proposals.

2 CLIMATE CHANGE

2.1 BACKGROUND INFORMATION

2.1.1. The Climate Change Adaptation Sub-Committee Progress Report 2014 identifies that increased flood risk is the greatest threat to the United Kingdom as a result of climate change. Models of the climate system suggest that floods, of the type experienced in England and Wales in Autumn 2000 and between December 2013 and February 2014, are becoming more likely as a consequence of increased concentrations of greenhouse gases in the atmosphere.

2.1.2. More frequent, short-duration, high intensity rainfall events and more frequent periods of long-duration rainfall are expected. Sea levels are also expected to continue to rise.

2.1.3. Environment Agency guidance - Flood Risk Assessments: Climate Change Allowances, issued in February 2016, and updated in February 2019, provide the latest information on expected changes in rainfall, river flows and sea level rise as a result of climate change.

2.1.4. This guidance was incorporated into the NPPF Technical Guidance[1] in February 2016, with an update in February 2017 and 2019, regarding further considerations and requirements for developments in Flood Zone 1.

2.1.5. A key change from the previous guidance is that the climate change allowances for peak river flows now are shown as variable on a regional basis. Allowances are also now based on percentiles, whereby a percentile is a measure used in statistics to describe the proportion of possible scenarios that fall below an allowance level (e.g. a 60% percentile means that the allowance has a 40% chance of not being exceeded).

2.1.6. Sea level allowances are similar to the previous guidance; they vary on a regional basis and for each epoch (from 1990 to 2115), as shown in Table 3 of the Environment Agency guidance[1].

2.1.7. For peak rainfall, the Environment Agency guidance provides an upper end and central allowance depending on the epoch; the guidance recommends assessing both the central and upper end allowances to understand the range of possible impacts. These allowances are detailed in Table 2 (Peak rainfall intensity allowance in small and urban catchments) of the Environment Agency guidance.

2.2 DEVELOPMENT LIFESPAN AND APPLICABLE ALLOWANCES

2.2.1. The typical lifespan for residential developments in terms of flood risk and coastal change is considered to be 100 years. Based on this typical lifespan, the contingency allowances for climate change, that are applicable to the Application Site, are presented in **Table 2-1**.

[1] https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

Table 2-1 - Climate Change Allowances applicable to the Application Site

Flood Source	Design Allowance	Sensitivity Testing
Rainfall	+ 20% (peak rainfall intensity)	+ 40% (peak rainfall intensity)
Sea Level Rise (East, East Midlands, London, South East)	1.21 m	Not stated
River Flows (South East River Basin District)	45%	105%

Note: The above allowances are based on the requirements for the South East, for the 2070 to 2115 epoch (in line with the 100-year lifespan of the Proposed Development), and for More Vulnerable (Residential) uses in Flood Zone 3.

2.2.2. The impacts of climate change on the Proposed Development are discussed in Section 5 and Section 6 of this FRA.

3 BACKGROUND

3.1 SITE LOCATION

3.1.1. The Application Site is located within the land to the west of the Eurolink Industrial Estate, in the centre of Sittingbourne, Kent. The Application Site is known as Crown Quay Lane and is located at the eastern edge of the industrial park.

3.1.2. The Ordnance Survey (OS) grid reference for the Application Site is 591150, 164250 and the nearest postcode is ME10 3JB. Refer to **Appendix A.1** for the Site Location Plan (Figure No. 49200-LOC-001).

3.2 SITE DESCRIPTION

3.2.1. The Application Site is identified as Parcel 3 on the wider Allocated Site in the area (refer to **Appendix A.2** for the Parcel boundaries)

3.2.2. The Application Site is bounded to the north by the tidal watercourse known as Swale. A tributary of the Swale is located adjacent to the east of the Application Site. To the west of the Application Site is Crown Quay Lane, and to the south is a timber merchant and storage area (Odds Timber - land identified as Parcel 4).

3.2.3. The Application Site is considered to be a brownfield site.

3.2.4. A topographic survey was completed by CADmap in September 2018; refer to **Appendix B.2** for full topographic survey drawings.

3.2.5. **Table 3-1** summarises the Application Site's general characteristics.

Table 3-1 – Application Site Characteristics

Characteristic	Description	
Area	Approximately 2.08 ha	
General Topography	The half of the Application Site (with elevations in excess of 8.00mAOD) relates to the material stockpiles associated with its previous use. The majority of the land is relatively flat, with elevations in the order of between 4.4mAOD to 4.8mAOD.	
Existing Surfacing	Brownfield, with some areas demolished to ground level (disused cement works) and three material stockpiles.	
Current Use	Mix of cleared brownfield land	
Boundaries	North	The Swale (Milton Creek)
	South	Commercial (timber merchant) – land identified as Parcel 4
	East	Tributary of the Swale

Characteristic	Description	
	West	Crown Quay Lane
Access	Existing access to the Application Site is via Crown Quay Lane	

3.3 GEOLOGY AND HYDROGEOLOGY

3.3.1. British Geological Survey (BGS) maps (available online at www.bgs.ac.uk and accessed in November 2019) indicate that the site is underlain by superficial deposits of mainly Alluvium and Beach and Tidal Flat Deposits. The bedrock deposits are formed of the Seaford Chalk (Chalk) and to the north-east corner, Thanet Formation (Sand Silt and Clay). Refer to **Appendix D** for figures showing British Geological Survey (Figures 49200-BGS-001 & 49200-BGS-002).

3.3.2. Site investigations were undertaken as part of a Phase 2 Contamination Report[2] in July 2017. The site investigation found that the Application Site is underlain by Made Ground of clay and sand, up to a maximum depth of 6.30m below ground level (bgl). The Made Ground was underlain by superficial deposits of Alluvium, to a maximum depth of 7.40m bgl, which in turn was underlain by the White Chalk Subgroup.

3.3.3. Groundwater monitoring at the site was undertaken as part of the site investigation. Groundwater was encountered at depths between 2.05m and 3.66m bgl in the Alluvium. Records indicate that groundwater levels vary up to 0.8m and this variation is directly related to tidal fluctuations. .

3.3.4. Environment Agency online resources (available online at magic.defra.gov.uk/MagicMap.aspx and accessed in November 2019) indicate that the Application Site is within a Zone 1[3] (Inner Protection Zone) Groundwater Source Protection Zone (SPZ). The northern-eastern part of the site is located within Zone 2[4] (Outer Protection) Groundwater SPZ. Refer to **Appendix D** for a map showing the locations of the Source Protection Zones (Figure 49200-SPZ-001).

3.3.5. It is understood that contamination is present at the site as a result of its historic industrial use. Discharge of surface water into the made ground of the site could increase the risk of contaminating the underlying Chalk and consequently the SPZ could be also affected. Infiltration to ground is therefore not considered to be suitable within the Application Site.

[2] Phase II Contamination Report, Leap Environmental Ltd., Report Reference LP1205/contam

[3] A Zone 1 source protection zone is defined as defined as areas where water takes 50-days travel time from any point below the water table to the abstraction source.

[4] A Zone 2 source protection zone is defined as areas where water takes 400-day travel time from a point below the water table to the abstraction source.

3.4 IDENTIFICATION OF EXISTING WATERBODIES

3.4.1. The Swale (also referred to as Milton Creek) is located immediately to the north of the Application Site and is a tidal watercourse. The Swale is classified as a Main River by the Environment Agency. A tributary of the Swale is located immediately to the east of Parcels 3, 4 and 5.

3.4.2. There are no other known watercourses in the vicinity of the Application Site.

3.5 EXISTING FLOOD DEFENCES

3.5.1. Environment Agency's flood defences are located along The Swale, to the north of the Application Site. From an inspection of the GIS data attributes[5], the defences are stated as being "*high ground; year of the built is 2019*". The design standard of protection varies from 5 years to 75 years along the northern boundary of the Site.

3.6 EXISTING SEWER AND DRAINAGE INFRASTRUCTURE

3.6.1. The Application Site is a served by public sewers along Crown Quay Lane. These assets are owned by Southern Water, as shown in **Appendix C.2**.

3.6.2. A 300mm diameter surface water sewer and a 225mm foul sewer convey flows from the north to the south along Crown Quay Lane. The surface water sewers discharge into the tributary of the Swale with the foul sewer discharging to a pumping station located off Crown Quay Lane to the south of Parcel 5. No other public sewers have been identified within the vicinity of the Site.

3.6.3. During the topographic survey in September 2018, a culvert was identified at the northern end of the Application Site. It discharges into the Swale. The surveyors could not determine the dimensions of the culverts as it was heavily silted. . A review of the Old maps website[6] indicates that the culvert was associated with a tributary of the Swale which was historically connected at the southern site boundary in the 1885 – 1895 period and discharged at the northern site boundary into Swale. The current site condition and the demolition of the site, suggests that this culver tis no longer functioning as drainage of the site.

3.7 HISTORIC FLOOD RECORDS

3.7.1. **Table 3-2** summarises the flood records obtained through liaison with the various stakeholders and third parties contacted in the production of this FRA.

[5] Environment Agency (2019) Spatial Flood Defences Including Standardised Attributes https://data.gov.uk/dataset/6884fcc7-4204-4028-b2fb-5059ea159f1c/spatial-flood-defences-including-standardised-attributes

[6] https://www.old-maps.co.uk/#/Map/594533/164724/10/101322

Table 3-2 – Flood Records

Information Source	Flood records / details
Environment Agency	The Environment Agency has confirmed that they hold records of flooding of parts of Parcels 1, 2 and 3 following an event in February 1953 (refer to **Appendix C.1**).
Kent County Council	Historic flood records from Kent County Council have not been received. Response from Kent County Council is still awaited.
Southern Water	Southern Water has provided asset location plans for foul and surface water sewer networks for the Allocation Site, but no records of historical flooding (refer to Appendix C.2). Sewer flooding records from Southern Water are located in Appendix H of the Swale Borough Council Strategic Flood risk Assessment (SFRA) however none has been identified in the vicinity of the Site.
Swale Borough Council SFRA	The Swale Borough Council SFRA details historic flooding for all sources and details any history of significant flood events within Sittingbourne, particularly relating to tidal events on the Swale. There is a historic flood event in February 1953, where the tidal defences were overtopped, as well as sewer flooding incidents.

4 SEQUENTIAL AND EXCEPTION TESTS

4.1 NTRODUCTION

4.1.1. The purpose of the NPPF Sequential Test is to ensure that land use planning takes due regard of flood risks, and that areas at low or no risk of flooding are developed in preference to areas at higher risk.

4.2 SEQUENTIAL TEST

4.2.1. The area over which to apply the Sequential Test should be defined by local circumstances.

4.2.2. The Environment Agency Flood Map indicates that the majority of the Application Site is located partially within Flood Zone 3 as shown on the Environment Agency's mapping in **Appendix C.1**.

4.2.3. Within Table 2 (Flood Risk Vulnerability Classification) of the NPPF and Planning Practice Guidance (PPG) section related to Flood Risk and Coastal Change[7], the Proposed Development (residential) is classified as 'More Vulnerable'.

4.2.4. Table 3 (Flood Risk Vulnerability and Flood Zone Compatibility) of the NPPF and PPG section related to Flood Risk and Coastal Change, states that 'More Vulnerable' development will require the application of the Exception Test, after passing the Sequential Test.

4.2.5. Swale Borough Council have undertaken a Strategic Flood Risk Assessment as part of the preparation of the Local Plan which assesses the Applications Site (along with the adjacent developments) as part of Milton Creek Area Action Plan[8]. This document provides specific recommendations in relation to the Sequential and Exception test and SuDS Proposals.

4.2.6. The Sittingbourne Town Centre and Milton Creek Supplementary Planning Document (September 2010) has been adopted by Swale Borough Council as part of its local planning policy and is a material consideration in decision taking. This SPD includes the Application Site and has been produced by the Council to guide the regeneration and development of Sittingbourne Town Centre and the Milton Creek area.

4.2.7. The site is also allocated by the Swale Borough Local Plan (July 2017) for residential development under Policy A9. This states that:

> *"The northern and eastern parts of the site are at risk of flooding. The Environment Agency have agreed that land raising could take place to enable residential development to be above the 1:200 year flood risk level, taking into account climate change and freeboard." (para. 6.5.13, pg125).*

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[7] Department for Communities and Local Government, 2014, *Flood Risk and Coastal Change Planning Practice Guidance to the National Planning Policy Framework* – available at: http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/, accessed November 2015

8 Swale Borough Council, 2009, *Strategic Flood Risk Assessment for Local Development Framework – Level 1 and 2 Assessments,* Halcrow

4.2.8. It can therefore be considered that, based on the Swale Borough Council assessments and information from the Environment Agency, that the site passes the Sequential Test, subject to suitable mitigation.

4.3 EXCEPTION TEST

4.3.1. Although the Site passes the Sequential Test, the Exception Test will still need to be passed, the two aspects of the Exception Test are:

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

4.3.2. As part of the Exception testing, reference is made to the Swale Borough Strategic Housing Land Availability Assessment (SHLAA) (2014 -2015) Addendum June 2016 assesses the development quantum for the Allocation Site which includes the Applications Site.

4.3.3. This addendum to the SHLAA was produced by the Council in response to the Inspectors request to carry out a detailed analysis to establish whether there is a supply of sites in addition to those allocated within the Plan, capable of delivering an increased housing target. Crucially, the results of the SHLAA 2014-2015 Addendum recognised an increased yield was capable for the emerging policy allocation area of approximately 650 dwellings. This was an increase from 491 dwellings as previously set out within the SHLAA 2014 – 2015 and 2013 – 2014. This increased housing yield for the Site has arisen from investigation into the potential for land raising within the northern part of the allocation, reducing the land area that is subject to flood risk, thereby increasing the net developable area for residential use.

4.3.4. This document therefore provides further technical evidence to deal with the second aspect of the Exceptions test, as the first aspect has been considered as part of the wider determination of the Planning Application. The mitigation measures are discussed in further detail in the following sections.

5 OVERVIEW OF FLOOD RISK

5.1 INTRODUCTION

5.1.1. The following section provides an overview of flood risk to the Site, along with flood risk, to and from the Proposed Development. An assessment has been undertaken for each source that could affect the Proposed Development in accordance with the NPPF Flood Risk and Coastal Change Planning Practice Guidance (PPG).

5.1.2. Flood risks have been qualitatively assessed on the following basis:

- Negligible risk (e.g. coastal flood risk posed to inland areas);
- Very Low risk (e.g. Flood Zone 1 or <0.1% annual probability of flooding from surface water);
- Low risk (e.g. Flood Zone 2 or between 0.1% and 1.0% annual probability of flooding from surface water);
- Medium risk (e.g. Flood Zone 3a or between 1.0% and 3.3% annual probability of flooding from surface water); and
- High risk (e.g. Flood Zone 3b or 3.3% annual probability of flooding from surface water).

5.2 FLOODING FROM COASTAL AND TIDAL SOURCES

5.2.1. Tidal flooding occurs when sea levels rise above the level of the land or beyond the operational level of flood defences.

5.2.2. The Application Site is located within the predicted floodplain of the Swale, which is a tidal watercourse. The Environment Agency have provided a number of maps associated with the tidal flooding attributable to The Swale (**Appendix C.1**), which indicates that, in 2115, the 0.5% tidal flood level (1 in 200 year) at the Allocation Site is predicted to be around 5.75 mAOD.

5.2.3. The 5.75 mAOD flood level has been compared to the existing levels on-site using the topographic survey undertaken in September 2018 (refer to **Appendix B.2** for the Topographic Survey). The topographic survey shows that a significant portion of the site lies between 4.4mAOD to 4.8mAOD and therefore considered to be at risk of the long term tidal flooding.

5.2.4. In order to ensure that all habitable rooms for the future development are above the 0.5% AEP 2115 tidal flood level, ground levels will be raised on-site to be at least at this predicted level (i.e. 5.75 mAOD). Raising ground levels within a tidal floodplain does not require compensatory floodplain storage, due to the size of the flood source being considered, resulting in a nominal impact. These levels and the principle was accepted by the Environment Agency during the allocation of the Site and in subsequent site-specific discussions.

5.2.5. **Table 5-1** provides the safe design levels, agreed with the Environment Agency as part of an earlier study undertaken by Pinnacle Consulting Engineers in December 2015 (**Appendix C.4**), for different proposed uses within the adjacent site (Parcel 1). This criterion was also referenced as Section 6.2 in Planning Condition 26 of the approval (16/507877/FULL).

5.2.6. In addition to the external areas, the setting the minimum finished floor levels of all habitable rooms to 6.05 m AOD for living units and 6.35 m AOD for sleeping units within flat blocks, the Proposed Development will be safe for the predicted flood events attributable to a 0.5% AEP event up to 2115.

Table 5-1 – Safe Design Levels

Proposed Development	0.5% AEP 2115 flood level	Freeboard (Safety Factor)	Safe Design Level
External areas (access road, footpaths etc.)	5.75 m AOD	0.000 m	5.75 m AOD
Minimum Finished Floor Level of Living Units	5.75 m AOD	0.300 m	6.05 m AOD
Finished Floor Level of Sleeping Units	5.75 m AOD	0.600 m	6.35 m AOD

5.2.7. As a result of the above criteria, to achieve the required road levels, the existing ground level will need to be raised by more than 1m in parts. This is discussed further below.

5.3 FLOODING FROM FLUVIAL SOURCES

5.3.1. Fluvial flooding occurs when flows within watercourses exceed the capacity of the watercourse causing out of bank flows.

5.3.2. The Environment Agency's flood zone maps identify the Application Site as being partially within Flood Zone 3, and therefore at potential risk of tidal and/or fluvial flooding. In their correspondence, the Environment Agency indicate that the flood mapping relates to risk of tidal flooding (refer to **Appendix C.1**).

5.3.3. Based on the above, the risk of flooding from fluvial sources is considered negligible. Therefore, additional flood mitigation measures are not required.

5.4 FLOODING FROM PLUVIAL / OVERLAND FLOW SOURCES

5.4.1. During extreme storms the ground may become saturated and drains and sewers which carry away surface water may not be able to accommodate the overland flows that arise from such conditions, or may become blocked with debris. This may lead to surface water flooding.

5.4.2. The Environment Agency's Updated Flood Map for Surface Water indicates that the risk of pluvial flooding is Very Low. Areas at Very Low risk of surface water flooding have an annual probability of flooding of less than 0.1%. Refer to Figure No. 49200-EA-001 in **Appendix D**.

5.4.3. Isolated areas of the Site are shown to be subject to a risk of flooding of between 0.1% and 1.0% annual probability and are therefore considered to have a Low risk of surface water flooding. These are associated with existing depressions within the current site.

5.4.4. The Proposed Development will increase the impermeable surface area at the Site, potentially generating greater volumes and rates of surface water discharging from the Application Site.

5.4.5. The risk of pluvial / overland flooding is considered to be Moderate if the Application Site is developed without appropriate mitigation measures. It should be noted that, as stated in the Non-statutory technical guidance for sustainable drainage:

5.4.6. "*S1 Where the drainage system discharges to a surface water body that can accommodate uncontrolled surface water discharges without any impact on flood risk from that surface water body (e.g. the sea or a large estuary) the peak flow control standards (S2 and S3) and volume control technical standards (S4 and S6) need not apply*"

5.4.7. The Surface Water Drainage Strategy Described in Section 6 includes the proposed mitigation measures which would be implemented for the Application Site. Those would reduce the surface water flood risk from Moderate to Low.

5.5 FLOODING FROM GROUNDWATER SOURCES

5.5.1. Groundwater flooding occurs when the water table rises above the level of the ground. It is commonly associated with porous underlying geology, such as chalk, sands and gravels.

5.5.2. The BGS geology (refer to **Section 3.3** and Figures No. 49200-BGS-001 and 49200-BGS-001 in **Appendix D**) is composed of permeable material at the site with groundwater levels influenced by the tidal variation. Recorded groundwater levels are approximately 2-3m below existing ground level and Groundwater flooding is therefore not possible on site.

5.5.3. The risk of groundwater flooding to the Proposed Development is therefore considered to be Low.

5.5.4. No basements or underground car parks are proposed as part of the Proposed Development. As discussed in **Section 5.2**, ground raising is required to reduce the risk of flooding from tidal sources, thus increasing the relative depth of the existing groundwater.

5.5.5. Consequently, there is a negligible risk of groundwater rising above existing ground levels and it is considered that the risk of groundwater flooding impacting the Proposed Development is negligible.

FLOODING FROM SEWER AND DRAINAGE INFRASTRUCTURE SOURCES

5.5.6. Kent County Council (KCC) has been contacted for records of flooding at the Application Site (in their role as Lead Local Flood Authority - LLFA) however their response has not been received yet.

5.5.7. The Swale Borough Council SFRA details instances of sewer flooding attributable to Southern Water sewers in the highway.

5.5.8. The topographic survey undertaken in September 2018, confirmed the presence of parts of the historic culvert. The culvert however has been described as completely silted by the surveyors. No direct evidence or information is available on the culvert or of the existing of any upstream drainage connection to the culvert. Following the demolition of the site and the lack of surface drainage features, the culvert is unlikely to provide a positive drainage route for the site.

5.5.9. The risk of flooding associated with the culvert is considered to be low, due to its elevation relative to the site. The Proposed Development is to mitigate the ecological benefit that the culvert may offer by replacing and realigning it as well as opening up the northern end with a new head wall feature. Refer to Drawing No. 9200-DRN in **Appendix E.2** for more details on the proposed culvert re-alignment. No other existing sewers or drainage infrastructure has been identified within the site.

5.5.10. Therefore, the risk of the Proposed Development exacerbating the risk of flooding from sewer and drainage infrastructure to neighbouring property is very low as, any new flows generated by the Proposed Development, will be managed in accordance with the LLFA and national criteria.

5.6 FLOODING FROM ARTIFICIAL SOURCES

DAM AND CANAL INFRASTRUCTURE

5.6.1. The Environment Agency's online map[9] indicates that the Application Site does not lie within the inundation area of any reservoirs.

5.6.2. There are no canals within 1km of the Site.

5.6.3. As the Site is not considered to be at risk of flooding from artificial sources, no mitigation measures will be required and the Proposed Development will not increase reservoir/ canal flood risk elsewhere.

5.7 SUMMARY OF FLOOD RISK

5.7.1. A summary of flood risk to the site is shown in **Table 5-2**.

Table 5-2 - Summary of Flood Risk to and from the Application Site / Proposed Development

Sources of flood risk	Baseline risk	Mitigation measure	NPPF Compliant
Coastal and Tidal	Flood Zone 3 (High)	Ground raising to above the 2115 0.5% AEP level.	Yes
Fluvial	Negligible Flood Zone 3 is associated with tidal flooding	No mitigation measures necessary.	Yes
Pluvial and Overland Flow	Low to Moderate	On-site surface water management strategy. Landscaping strategy/finished ground levels to provide dedicated pluvial flow routing.	Yes
Groundwater	Low Permeable BGS geology, potential for flooding.	Ground raising to manage tidal flooding, will also manage groundwater flooding	Yes

[9] https://flood-warning-information.service.gov.uk/long-term-flood-risk

Sources of flood risk	Baseline risk	Mitigation measure	NPPF Compliant
Sewer and Drainage Infrastructure	Low Local flooding due to blockage of gullies Culvert discharging to the Swale completely silted	 Dedicated on-site surface water management system. It is proposed to replace and realign the existing culvert. Regular Maintenance would be required.	Yes
Artificial Sources	Negligible No sources present	None.	Yes

6 SURFACE WATER DRAINAGE STRATEGY (SWMS)

6.1 EXISTING DRAINAGE REGIME

SURFACE WATER DRAINAGE REGINE

6.1.1. The Application Site is a brownfield site which has been historically used for cement production.

6.1.2. The existing drainage at the Application Site is a combination of free surface water runoff discharging into the estuary and infiltration to ground.

6.1.3. Topographic levels at the site (refer to **Appendix B.2**) indicate that surface water runoff flow towards the Swale and the tributary of the Swale located at the northern and eastern site boundary.

6.1.4. The BGS geology and the available site investigation data (refer to Section 3.3) indicate that the underlying geology mainly consists of permeable strata (made ground and alluvium deposits) and therefore part of the existing drainage on site is via ground infiltration.

6.1.5. It should be noted that site investigations (i.e. water and soil sampling) indicate that there are potential contaminants within the Made Ground deposits, mainly PAH and TPH. Promoting infiltration of surface water runoff into the soil as a drainage strategy is therefore unviable.

6.1.6. Southern Water sewer asset location plans indicate that a small portion of the western site might discharge to the Surface Water surface water sewer along Crown Quay Lane.

6.2 PROPOSED SURFACE WATER FLOW MANAGEMENT

PROPOSED CATCHMENTS AND DISCHARGE LOCATIONS

6.2.1. This proposed surface water drainage strategy seeks to demonstrate the Proposed Development can be drained in a sustainable manner, commensurate with local and national policy (NPPF).

6.2.2. Part H of the Building Regulations: Drainage and Waste Disposal establishes a hierarchy for surface water disposal, which encourages a SuDS approach. This hierarchy stipulates that surface water runoff not collected for reuse must be discharged to one or more of the following in order of priority:

- Ground (infiltration); or, where not reasonably practicable,
- Surface water body; or, where not reasonably practicable,
- Surface water sewer, highway drain, or another drainage system; or, where not reasonably practicable,
- Combined sewer.

6.2.3. As discussed above, disposing discharge of surface water into ground could increase the risk of mobilising contaminating that could enter groundwater and the underlying Chalk and consequently the SPZ could be also affected. Infiltration to ground is therefore not considered to be a suitable option within the Application Site.

6.2.4. The proposed SWDS also intends to replicate the natural water cycle at the site as much as practicable and therefore the preferred option is to discharge surface water into the a water body, in this case the tidal Swale, by connecting the drainage network to the existing outfall, at the northern edge of the site. The existing outfall is proposed to be relocated further south (into the site), by

building a new head wall. This will increase the natural outflow area, as the inter-tidal area will be enlarged. Refer to Drawing No. 9200-DRN-004 in **Appendix E.2** for the existing and proposed outfall locations.

6.2.5. The Application Site incorporates a maintenance easement at the top of the Swale banks which, along with the enlargement of the inter-tidal area at the outfall, would satisfy the biodiversity-net-gain requirement.

6.2.6. A small portion of the runoff from the proposed access road and the emergency entrance would drain towards the west and would join the surface water on Crown Quay Lane which is managed through the Southern Water Sewer as indicated on the Asset location plan in **Appendix C.2**. The levels of the connections to Crown Quay Lane are lower than the main site levels and hence separate connections are required.

6.2.7. The proposed surface water catchment and discharge locations are included in **Table 6-1** for reference.

Table 6-1 – Impermeable areas

Type of development	Impermeable areas (ha)	Discharge location
Housing	0.408	Outfall to the Swale at the northern edge of the site
Access roads, cul de sac and parking bays	0.511	Outfall to the Swale at the northern edge of the site
Access road ramp	0.025	Southern Water surface water sewer along Crown Quay Lane
TOTAL	**0.944**	**-**

DISCHARGE RATES

6.2.8. Kent County Council has confirmed that discharging at unrestricted rates is acceptable for the Application Site given the tidal nature of the Swale (in accordance with the Non-statutory technical guidance for sustainable drainage – S1). Refer to **Appendix C.3** for the correspondence with Kent County Council.

6.2.9. Surface water runoff generated along the ramp of the access road and the emergency entrance would flow towards Crown Quay Lane and eventually would be drained by highway gullies and conveyed into Southern Water surface water sewer along this road.

REQUIRED STORAGE VOLUMES

6.2.10. The SWMS for the Proposed Development has been designed to manage the critical duration 1% AEP rainfall event, with an additional 40% climate change allowance. Attenuation is not required as the site discharges to a tidal watercourse. However, high tides have the potential to “tide-lock” the outfalls causing water to back up the proposed surface water network. In order to minimise this

effect, the drainage network was set as high as possible and has been assessed in relation to the "tide locking effect".

6.2.11. Permeable paving at car park bays will limit/control any potential surface flooding that could occur. A flap valve should also be installed at the outfall to prevent tidal waters from filling the proposed network, prior to any rainfall event. The design outfall invert level has been calculated at 3.280mAOD which is approximately 400mm above the Mean Spring Tide Level at this location (2.900mAOD) thus enabling a fee discharge for the majority of rainfall and tidal event combinations.

6.2.12. A detailed drainage network was designed for the Application Site via the Network module of MicroDrainage. The MicroDrainage model demonstrates that flooding does not occur on site for the up to the 100 year return period, including a 40% climate change allowance. For the MicroDrainage results refer to **Table 6-3** and **Appendix E.3**.

Table 6-2 – MicroDrainage summary results for normal drainage conditions, i.e. unrestricted discharge to the Swale

Return period (Years)	Max. discharge rate (l/s)	Max. level (mAOD)	Flood volume (m3)
1	195	4.630	0
30	403	4.980	0
100	619	5.008	0

6.2.13. The drainage network has been tested for tidal lock conditions based on the Environment Agency's tidal modelling results for the 200-year event (2115 scenario); refer to **Appendix C.1** for Environment Agency's data and correspondence. Results from the MicroDrainage model are summarised in **Table 6-3** below and presented in **Appendix E.3**.

6.2.14. The tidal water level for the 1 in 200 year (2115) is estimated at 5.750 mAOD whilst the site outfall has been modelled at 3.280mAOD and the drainage results indicate that controlled flooding would occur at the site. Approximately 365m^3 were estimated to flood the site during the 30-year event including a 40% climate change allowance. Approximately 310m^3 would occur along the northern edge of the site and would run-off directly into the Swale based on the proposed final levels (refer to Drawing No. 9200-EWK-004 in **Appendix E.1**). The remaining flood volume (55 m^3) would be contained within the porous sub-base storage located under the car park bays within the development (considering a 500mm depth layer of granular material and a 30% void ratio).

Table 6-3 – Microdrainage summary results for the tide-locking conditions at the outfall using the 1 in 200 year return period (2115 year scenario).

Return period (Years)	Max. discharge rate (l/s)	Max. level at outfall (mAOD)	Total flood volume (m^3)	Flood contained within permeable paving (m^3)
1	2.5	5.750	300	0.02
30	31	5.750	365	55
100	57	5.750	510	80

PROPOSED DRAINAGE NETWORK AND SUDS FEATURES

6.2.15. A piped surface water sewer network will serve the residential development, directing flows to the north into the re-aligned culvert under the Site, which then discharges to the Swale via an outfall at unrestricted rates.

6.2.16. In accordance with the national and local standards, the proposed drainage network incorporates SuDS features such as porous sub-surface under the proposed parking bays which will act as additional surface water attenuation storage as well as water quality treatment prior to discharging into the swale. The drainage proposals also include the use of oil interceptors, to remove any hydro-carbon contaminants in the run-off generated on the road surfaces.

6.2.17. Drawing No. 9200-DRN-001 in **Appendix E.2** shows the proposed drainage network general arrangement, including the location of SuDS features and oil interceptor.

6.2.18. The design of the surface water drainage network is based on the following assumptions, which are mainly associated with the uncertainties of the existing culvert at the Site:

- An indicative location of the alignment of the existing culvert has been assumed and shown on Drawing No. 9200-DRN-001 in **Appendix E.2**.
- Capacity and culvert dimensions of the outfall would need to be confirmed. For the drainage strategy, the proposed outfall is 750mm in diameter, with an invert level set at 3.280mAOD.
- Based on historic mapping, it has been assumed that the existing culvert is associated with a tributary of the Swale and given the current condition of the culvert (i.e. non-functioning and silted-up), off-site drainage connections into the culvert are unlikely.
- The small portion of the access road which would drain to the Southern Water sewer along Crown Quay Lane was not modelled.

EXCEEDANCE FLOW ROUTES

6.2.19. The development proposals include rising the ground levels above 5.75m AOD. This provides an opportunity to shape the ground to fall away from the housing properties. Final levels at the Proposed Development are indicated on Drawing No. 9200-EWK-004 in **Appendix E.1** for reference.

6.2.20. The final ground levels have been designed in accordance with the agreed minimum elevations for the dwelling (refer to **Section 5.2** and **Table 5-1**).

- Finished Floor Levels for houses to be at least 6.05mAOD (i.e. 300mm above the EA's 200-year flood level from the sea)
- Finished Floor Levels for flats to be at least 6.35mAOD (i.e. 600mm above the EA's 200-year flood level from the sea)
- Finished levels for external areas where access is required to be at least 5.75mAOD
- Note that the mean spring high level (2.900mAOD) is not believed to pose a threat to the drainage network, as it is considerably lower than the invert level at the outfall (3.280mAOD).
- Access ramps to have gradients no steeper than 1 in 20.

- Re-development of the headwall located in the northern part (outfall location) which includes bringing the headwall approximately 7.5m to the south to provide a beach feature to provide biodiversity net gain. The minimum of 5m maintenance easement at the top level would be also met.

6.2.21. The Proposed Development has been designed considering the exceedance routes for the tidal locking scenario. The potential impact of the tidal locked scenario would be mitigated by designing the finished ground levels to slope away from the houses and by providing additional storage through porous sub-base under parking bays where required.

6.3 PROPOSED WATER QUALITY MANAGEMENT

6.3.1. Table 26.2 of the CIRIA C753 SuDS Manual identifies that the pollution hazard level associated with the land uses within the development as being 'low'.

6.3.2. On a scale from 0 – 1, 'residential roofs and car parks' are deemed to have the following pollution hazard indices:

Table 6-4 - Pollution Hazard Assessment for Flows going to Surface Water

	Total Suspended Solids	Metals	Hydrocarbons
Residential roofs and car parks'	0.5	0.4	0.4

6.3.3. The SuDS Manual confirms that in England and Wales, where the principal destination of runoff is to a surface waterbody, then the surface water indices should be used (Table 26.3 of SuDS Manual). The pollution mitigation assessment is described in **Table 6-** below.

Table 6-5 - Pollution Mitigation Assessment for Flows going to Surface Water

	Total Suspended Solids	Metals	Hydrocarbons
Porous Sub-base*	0.7	0.6	0.7

* Porous Sub-base is considered to provide the same level of treatment as the Permeable Paving

6.3.4. As the proposed mitigation indices exceed the hazard indices, the Proposed Development would not have a negative impact on water quality in the receiving waterbody.

6.3.5. In addition, an oil interceptor is to be provided at the downstream end of the network, prior to discharge of runoff into the Swale. This feature will remove hydro-carbon contaminants from highway drainage, which did not previously percolate through the permeable paving porous material.

6.3.6. Refer to Drawing No. 9200-DRN-001 in **Appendix E.2** for the location of the oil interceptor and parking bays with porous sub-base.

6.4 MAINTENANCE AND ADOPTION

6.4.1. Regular inspection and maintenance are required to ensure the effective long-term operation of SuDS; these requirements are detailed in the SuDS Manual CIRIA 753. However, for the property drainage features as well as for the oil interceptor, maintenance should be undertaken in accordance with the manufacturer's specification.

6.4.2. The general maintenance obligations associated with the porous sub-base are included in Table 20.15 Operation and maintenance requirements for pervious pavements in the SuDS Manual (2015) C753. It should be noted that regular maintenance of the surface overlaying the sub-base would not be required for the pervious sub-base.

6.4.3. The drainage system will be constructed to an adoptable standard, and discussion with potential adoption authorities would be undertaken post planning, to determine the most appropriate method of long-term maintenance. It is understood that currently the preferred option for the maintenance of the different drainage elements would be through a private management company allowing the open space, drainage and river frontage to be managed by a single entity. However, this would be confirmed post planning.

7 INDICATIVE FOUL DRAINAGE STRATEGY

7.1 EXISTING FOUL NETWORK

7.1.1. A 225mm foul drainage sewer is present along the Crown Quay Lane as shown on the Southern Water Asset plans in **Appendix C.2**. The existing foul sewer flows south, towards a foul pumping station adjacent to Crown Quay Lane, located approximately 165m to the south of the Application Site. From this point, the flows are conveyed to the east via a foul rising main.

7.1.2. No other foul sewers are known to be present at the site.

7.2 SOUTHERN WATER FOUL CAPACITY CHECK

7.2.1. Southern Water has confirmed that there is currently adequate capacity to accommodate foul flows from the proposed development. Refer to **Appendix C.2** for the correspondence with Southern Water.

7.3 PROPOSED FOUL DRAINAGE NETWORK

7.3.1. The proposed foul drainage network has been designed using the MicroDrainage software with the Network module. The proposed drainage network is shown on Drawing No. 9200-DRN-001 in **Appendix E.2**.

7.3.2. The design of the foul drainage for the Proposed Development is summarised in the bullet points below:

- The proposed foul drainage network will be connected to the 225mm Southern Water foul sewer along Crown Quay Lane;
- The proposed foul network will connect at two locations to the existing Southern Water foul sewer; and,
- The diameter of the proposed foul network pipes is 150mm within the Application Site.

8 FLOOD RISK MANAGEMENT MEASURES

8.1 SAFE ACCESS AND EGRESS

8.1.1. Access and egress to the development would be via Crown Quay Lane which is varies but is approximately 5.2 mOAD at the Proposed Development access crossing. Crown Quay Lane is topographically lower than 5.75mAOD which is the minimum proposed ground elevation within the Site and the predicted Environment Agency's flood level for the 1 in 200 plus climate change.

8.1.2. The site is located within the Environment Agency flood warning scheme area Kent, South London and East Sussex The main flood risk is via tidal flood and this will have advance warning via the notifications. Each resident will be made aware of the available flood warning information services.

8.1.3. A Flood Warning and Evacuation Plan would therefore be required to demonstrate what actions site users will take before, during and after a flood event to ensure their safety. The plan would also show that the development will not impact on the ability of the local authority and the emergency services to safeguard the current population.

9 CONCLUSIONS

9.1.1. This FRA has been prepared as part of the supporting documentation for a detailed planning application of a Proposed Development at Crown Quay Lane, Sittingbourne.

9.1.2. The Site is a brownfield site covering an area of approximately 2.08 hectares.

9.1.3. The Proposed Development comprises a detailed planning application for a residential-use development of up to 107 units.

9.1.4. The Application site is located within Flood Zone 1, 2 and 3; the development use is classified as More Vulnerable in accordance with the NPPF. The required sequential and exception tests for this type of developments within flood zone 3 are satisfied based on the allocation of the site within the Swale Local Plan.

9.1.5. Although the Allocation Site is located partially within Flood Zone 3, this has been determined as being from tidal flooding. Consequently, land raising is proposed to lift the appropriate areas of Proposed Development plateau out of the area of risk of flooding, this will not increase the risk of flooding to others..

9.1.6. The flood risk to and from the Proposed Development from fluvial and artificial sources is negligible).

9.1.7. The surface water drainage strategy for the Proposed Development comprises the discharge to the north of surface water runoff to the tidal watercourse, the Swale, via the existing outfall.

9.1.8. The Proposed Development has been designed considering the exceedance routes for the tidal locking scenario. The potential residual impact of the tidal-locking scenario would be mitigated by designing the finished ground levels to slope away from the houses and by providing additional storage through porous sub-base under parking bays where required.

9.1.9. The surface water drainage network incorporates SuDS such as porous paving which, along with an oil interceptor, would provide sufficient water treatment of the runoff generated at the development prior to discharging into the Swale.

9.1.10. The Application Site incorporates a maintenance easement from the top of bank from the Swale which along with the increase natural area at the outfall would satisfy the requirements associated with the local biodiversity providing biodiversity net gain.

9.1.11. An indicative foul drainage network has been developed to demonstrate that the foul drainage is feasible for the Proposed Development and will connect to a Southern Water foul sewer located along Crown Quay Lane. Southern Water has confirmed that the existing foul sewer has sufficient capacity to accommodate the flows from the Proposed Development.

9.1.12. Based on the evidence presented in this FRA, the Proposed Development is considered suitable from flood risk and drainage perspective.