


Client: Flambeau Europlast Limited

Flood Risk Assessment and Drainage Strategy for the Proposed Development at The Land at Flambeau Europlast, Manston Road, Ramsgate, Kent

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Canterbury Office
Unit 6 & 7
Barham Business Park
Elham Valley Road
Barham
Canterbury
Kent
CT4 6DQ

London Office
Unit 52.11
Woolyard
52 Bermondsey Street
London
SE1 3UD

Tel 01227 833855
www.herringtonconsulting.co.uk

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Flood Risk Assessment and Drainage Strategy for the Proposed Development at Land at Flambeau Europlast, Manston Road, Ramsgate, Kent, CT12 6HW.

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			DW	

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1 Background and Scope of Appraisal

Flooding is a major issue in the United Kingdom. The impacts can be devastating in terms of the cost of repairs, replacement of damaged property and loss of business. The objectives of the Flood Risk Assessment (FRA) are therefore to establish the following:

- whether a proposed development is likely to be affected by current or future flooding from any source.
- whether the development will increase flood risk elsewhere within the floodplain.
- whether the measures proposed to address these effects and risks are appropriate.
- whether the site will pass Part B of the Exception Test (where applicable).

Herrington Consulting has been commissioned by Flambeau Europlast Ltd to prepare a Flood Risk Assessment (FRA) and Drainage Strategy for the proposed development at **Land at Flambeau Europlast, Manston Road, Ramsgate, Kent, CT12 6HW.**

This appraisal has been undertaken in accordance with the requirements of the National Planning Policy Framework (2023) and the National Planning Practice Guidance Suite (August 2022) that has been published by the Department for Communities and Local Government. The *Flood Risk and Coastal Change* planning practice guidance included within the Suite represents the most contemporary technical guidance on preparing FRAs. In addition, reference has also been made to Local Planning Policy.

To ensure that due account is taken of industry best practice, this FRA has been carried out in line with the CIRIA Report C624 ‘Development and flood risk - guidance for the construction industry’.

New development has the potential to increase the risk of flooding to neighbouring sites and properties through increased surface water runoff and as such, an assessment of the proposed site drainage can help to accurately quantify the runoff rates, flow pathways and the potential for infiltration at the site. This assessment considers the practicality of incorporating Sustainable Drainage Systems (SuDS) into the scheme design, with the aim of reducing the risk of flooding by actively managing surface water runoff.

This report has been prepared to accompany an outline planning application and has been prepared in accordance with the requirements of both national and local planning policy. To ensure that due account is taken of industry best practice, reference has also been made to CIRIA Report C753 ‘The SuDS Manual’ and any relevant local planning policy guidance. The surface water management strategy included within this report is not intended to constitute a detailed drainage design.

2 Development Description and Planning Context

2.1 Site Location and Existing Development

The site is located at OS coordinates 636309, 165551, off Manston Road in Ramsgate. The site covers an area of approximately 3.5 hectares and currently comprises an industrial factory building with office space. The location of the site in relation to the surrounding area is shown in Figure 2.1.

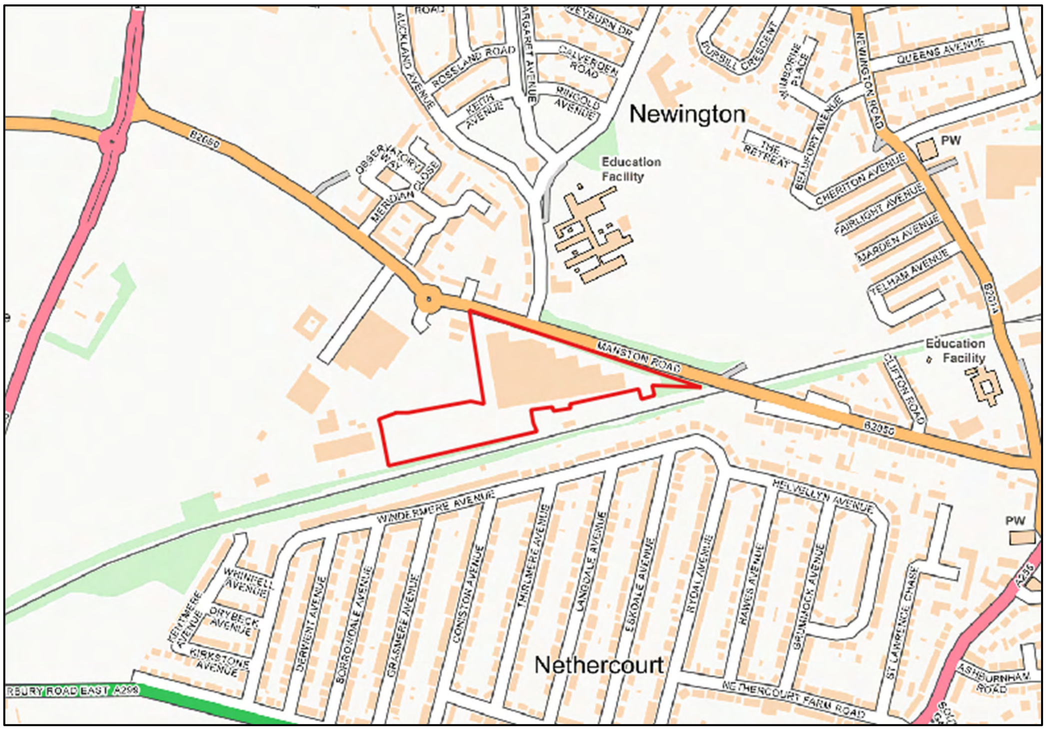


Figure 2.1 – Location map (contains Ordnance Survey data © Crown copyright and database right 2024).

The site plan included in Appendix A.1 of this report provides more detail in relation to the site location and layout.

2.2 Proposed Development

This report has been prepared to accompany an outline planning application for the demolition of the existing commercial building on site and the construction of 118no. residential units with associated landscaping, access roads and car parking (Figure 2.2).

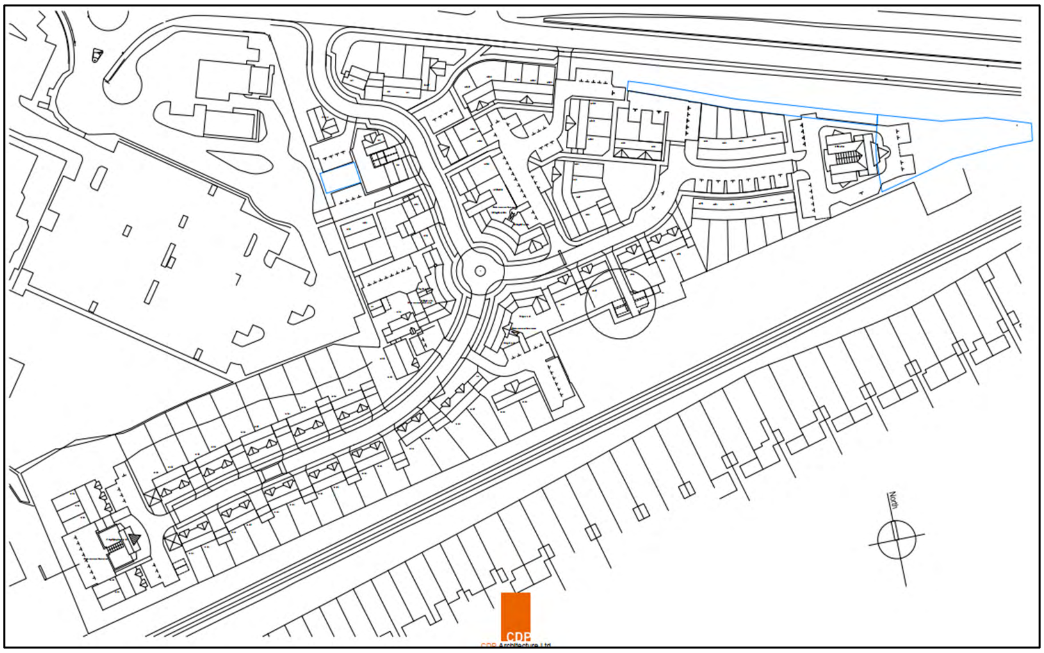


Figure 2.2 – Proposed site layout. The proposed flood storage areas on site are outlined in blue, to the east and west of the site.

Drawings of the proposed scheme are included in Appendix A.1 of this report.

2.3 Planning Policy and Context

When appraising the risk of flooding to a site, generally the starting point is the Environment Agency's (EA) 'Flood Map for Planning' (Figure 2.3). These maps and the associated information are intended for guidance and cannot provide details for individual properties. They do not take into account other considerations such as existing flood defences, alternative flooding mechanisms and detailed site-based surveys. They do, however, provide high level information on the type and likelihood of flood risk in any particular area of the country. The Flood Zones are classified as follows:

Zone 1 – *Low probability of flooding* – This zone is assessed as having less than a 1 in 1000 annual probability of river or sea flooding in any one year.

Zone 2 – *Medium probability of flooding* – This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding or between 1 in 200 and 1 in 1000 annual probability of sea flooding in any one year.

Zone 3a – *High probability of flooding* - This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding or 1 in 200 or greater annual probability of sea flooding in any one year.

Zone 3b – *The Functional Floodplain* – This zone comprises land where water has to flow or be stored in times of flood and can be defined as land which would flood during an event having an annual probability of 1 in 30 or greater. This zone can also represent areas that are designed to flood in an extreme event as part of a flood alleviation or flood storage scheme.

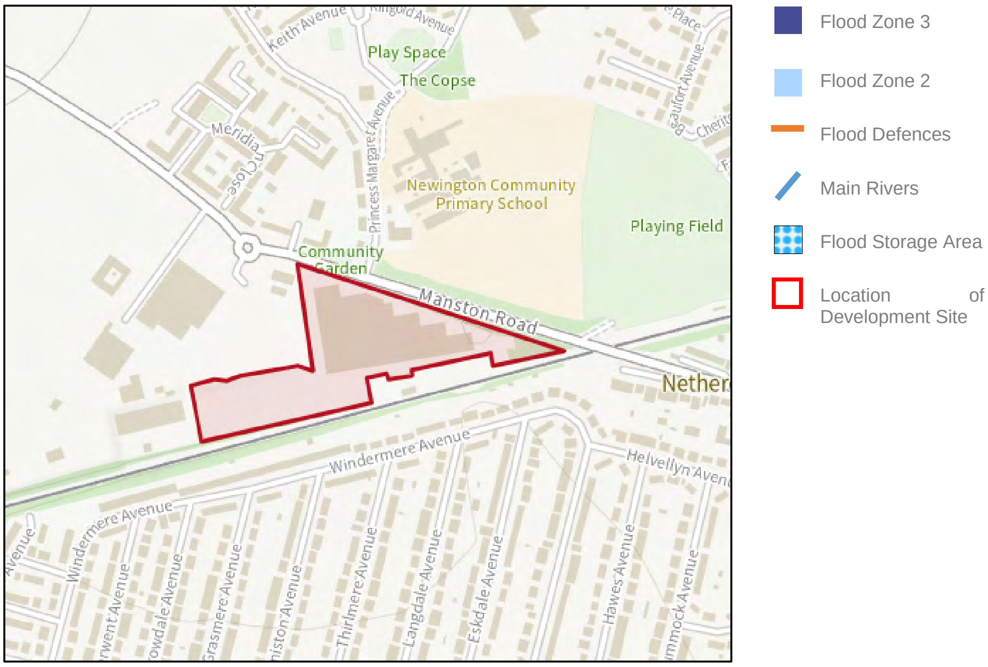


Figure 2.3 – EA's 'Flood Map for Planning' (© Environment Agency).

From Figure 2.3 it can be seen that the development site is located within an area considered to be Flood Zone 1, however the development site is over 1 hectare in size, therefore a site-specific FRA is required to be submitted alongside the planning application.

In addition to the above, the general requirement for all new development is to ensure that the runoff is managed sustainably, and that the development does not increase the risk of flooding at the site, or within the surrounding area. In the case of brownfield sites, drainage proposals are typically measured against the existing performance of the site, although it is preferable (where practicable) to provide runoff characteristics that are similar to greenfield behaviour.

The Non-statutory Technical Standards for SuDS (NTSS) specify criteria to ensure sustainable drainage is included within development classified as 'major development' as set out in Article 2(1) of the Town and Country Planning (Development Management Procedure) (England) Order 2010. It is, however, recognised that SuDS should be designed to ensure that the maintenance and operation requirements are economically proportionate.

In this instance, the proposed development is for the construction of 118no. residential units. As a result, the proposals are classified as 'major' development and therefore, the NTSS will apply. Reference to the NTSS has therefore been made throughout the following sections of this report to ensure the principles of sustainable drainage are considered.

In addition to the NTSS, Kent County Council's (KCC) Drainage and Planning Policy Statement (December 2019) also states that all major developments should undertake a Surface Water Management Strategy (SWMS) to provide evidence on how SuDS can be incorporated within the proposed development.

3 Definition of Flood Hazard

3.1 Site Specific Information

Information from a wide range of sources has been referenced to appraise the true risk of flooding at this location. This section summarises the additional information collected as part of this FRA.

Information contained within the SFRA – The Thanet District Council SFRA (2023) contains detailed mapping showing historic flood records for a wide range of sources. This document has been referenced as part of this site-specific FRA.

Site-specific pluvial modelling produced by Herrington Consulting Ltd (HCL) – HCL have undertaken detailed pluvial modelling of the development site. The modelling has been referenced throughout this report and a copy of the modelling report can be found in Appendix A.2.

Information on localised flooding contained within the SWMP – A Surface Water Management Plan (SWMP) is a study to understand the risk of flooding that arises from local surface water flooding, which is defined by the Flood and Water Management Act 2010 as flooding from surface runoff, groundwater, and ordinary watercourses. Such a document has been prepared for Thanet District Council (2013) and has therefore been referenced as part of this site-specific FRA.

Information provided by Southern Water – Southern Water has provided the results of an asset location search for the site. The response is included in Appendix A.3.

Site specific topographic surveys – Figure 3.1 provides a general overview of the land levels across the site, derived from aerial height data (LiDAR). However, a topographic survey has been undertaken for the site which provides more accurate land levels. The survey has been referenced throughout and a copy of this is included in Appendix A.1.

From the survey, it can be seen that the level of the site varies between 39.09m and 46.5m Above Ordnance Datum Newlyn (AODN). The ground levels across the site are relatively flat, with a lower lying area within the eastern corner. This lower lying area is adjacent to an embankment rising up towards Manston Road. To the south of the site a railway line runs parallel with the site, which is raised in comparison to the site atop a small embankment. This land where the railway is located falls towards the west of the site.

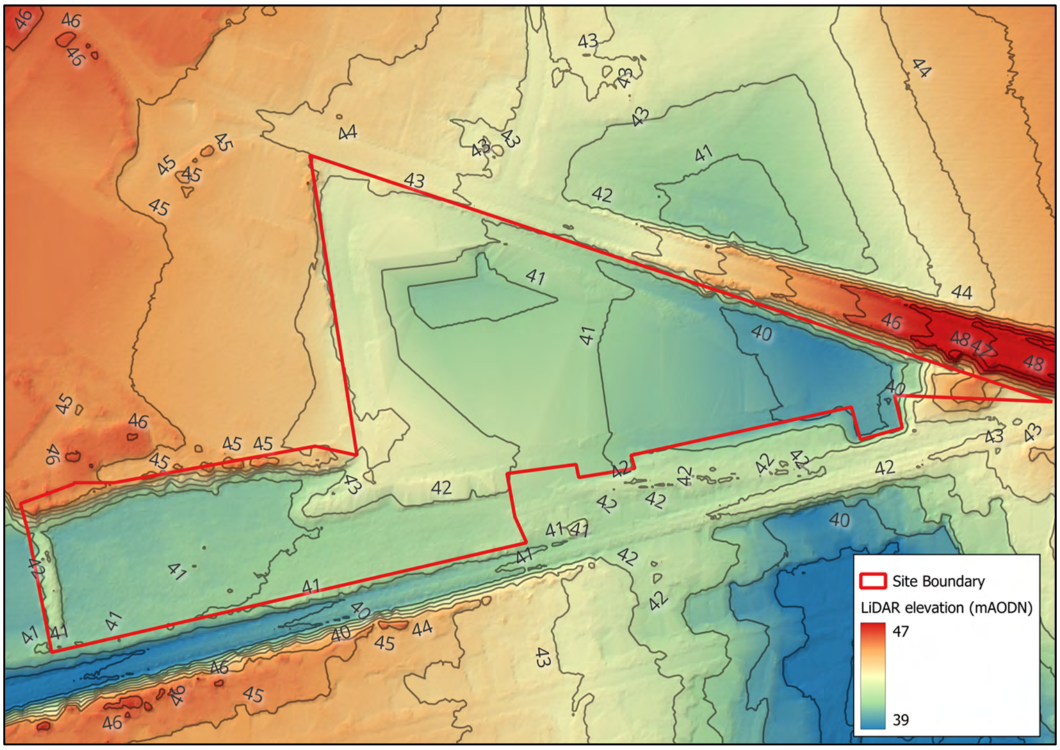


Figure 3.1 – Topography of the development site, derived from aerial height data (LiDAR) (© Environment Agency).

Geology – Reference to the British Geological Survey (BGS) map shows that the underlying solid geology in the location of the subject site is Margate Chalk Member (chalk). Overlying this are superficial deposits of Head (clay and silt). Site Investigations undertaken by EPS Ltd (Appendix A.4) confirms the presence of Margate Chalk Member and Head Deposits on site, in addition to the presence of Made Ground consisting of a mixture of clay and silt deposits.

Historic flooding – There have been a number of recorded flood event along Manston Road, being the result of blocked drains and gullies, however there are no previously recorded flood events that have occurred on the site itself.

3.2 Potential Sources of Flooding

The main sources of flooding have been assessed as part of this appraisal. The specific issues relating to each one and its impact on this development are discussed below. Table 3.1 at the end of this section summarises the risks associated with each of the sources of flooding.

Flooding from Surface Water – Surface water, or overland flooding, typically occurs in natural valley bottoms as normally dry areas become covered in flowing water and in low spots where water may pond. This mechanism of flooding can occur almost anywhere but is likely to be of particular concern in any topographical low spot, or where the pathway for runoff is restricted by terrain or man-made obstructions.

Reference to the EA's 'Flood Risk from Surface Water' mapping indicated that the area where the proposed development is located could be subject to surface water flooding. HCL has undertaken detailed pluvial modelling which has been used to appraise the risk of flooding for the proposed development site. Referencing this modelling, the risk of flooding from this source has been investigated further in Section 5.

Flooding from Rivers, Ordinary and Man-Made Watercourses (Fluvial) – Inspection of OS mapping identifies that there are no watercourses nearby and the site is not located within an area identified by the EA's 'Flood Map for Planning' as being at risk of flooding from a main river. Consequently, the risk of flooding from this source is considered to be *low.*

Flooding from the Sea – The site is located a significant distance inland and is elevated well above predicted extreme tide levels. Consequently, the risk of flooding from this source is considered to be *low*.

Flooding from Groundwater – Water levels below the ground rise during wet winter months, and fall again in the summer as water flows out into rivers. In very wet winters, rising water levels may lead to the flooding of normally dry land, as well as reactivating flow in 'bournes' (streams that only flow for part of the year).

The findings from the ground investigation on site (undertaken by EPS) outlines the geological strata on site being a combination of Made Ground, Head Deposits (clay and silt) and Margate Chalk Member (chalk). Whilst this underlying geology is typically permeable, the borehole investigations on site, carried out as part of the ground investigation, did not encounter groundwater within the 8m deep boreholes. In addition to this, inspection of BGS groundwater flood risk mapping data shows that the general area in which the development site lies is identified as being at low risk from groundwater flooding. Mapping on groundwater emergence provided as part of the Defra Groundwater Flood Scoping Study (May 2004) shows that no groundwater flooding events were recorded during the very wet periods of 2000/01 or 2002/03.

Taking the above information into account, the risk of flooding from groundwater on site is considered to be *low*.

Flooding from Sewers – In urban areas, rainwater is typically drained into surface water sewers or sewers containing both surface and wastewater known as "combined sewers". Flooding can result when the sewer is overwhelmed by heavy rainfall, becomes blocked, or has inadequate capacity; this will continue until the water drains away.

Inspection of the asset location mapping provided by Southern Water (Figure 3.1) identifies that the sewers in this area are foul gravity sewers and combined gravity sewers. In the very unlikely event that floodwater were to exit the sewers along Manston Road (e.g. due to a blockage or following an extreme rainfall event), floodwater has the potential to flow onto the site, similarly to the risk from surface water flows outlined in Section 5. However, as discussed later in this report, all of the residential units proposed as part of this scheme will be elevated above the access roads and flood storage areas, consequently any floodwater entering the site water will not be directed towards the proposed residential units, but instead be channelled within the roads or swales towards the flood storage areas away from the development. In addition to this the Thanet District Council SFRA identifies that there are no recorded incidents of flooding from sewers in this area. Considering the above, the risk of flooding from sewers is concluded to be *low*.

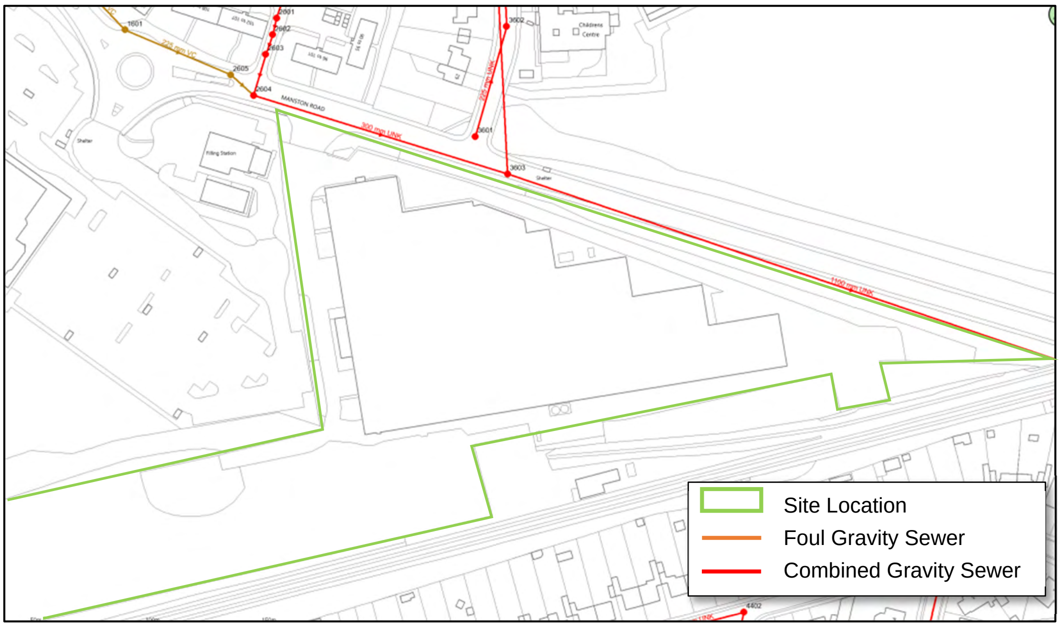


Figure 3.2 - Asset location mapping provided by Southern Water (a full scale copy can be found in Appendix A.3).

Flooding from Reservoirs, Canals and Other Artificial Sources – Non-natural or artificial sources of flooding can include reservoirs, canals, and lakes, where water is retained above natural ground level. In addition, operational and redundant industrial processes including mining, quarrying, and sand or gravel extraction, may also increase the depth of floodwater in areas adjacent to these features.

The potential effects of flood risk management infrastructure and other structures also needs to be considered. For example, reservoir or canal flooding may occur as a result of the facility being overwhelmed and/or as a result of dam or bank failure.

Inspection of the OS mapping for the area shows that there are no artificial sources of flooding within close proximity to the site. In addition, the EA's 'Flood Risk from Reservoirs' map shows that the site is not within an area considered to be at risk of flooding from reservoirs. Therefore, the risk of flooding from this source is considered to be *low.*

A summary of the overall risk of flooding from each source is provided in Table 3.1 below.

Source of Flooding	Initial Level of Risk	Appraisal method applied at the initial flood risk assessment stage
Surface Water	Low	EA's 'Flood Risk from Surface Water' map, and OS mapping
Rivers, Ordinary and Main Watercourses (fluvial)	Low	OS mapping and the EA's 'Flood Map for Planning'
Sea	Low	OS mapping and the EA's 'Flood Map for Planning'
Groundwater	Low	BGS groundwater flood hazard maps, Defra Groundwater Flood Scoping Study, site-specific geological data and OS mapping.
Sewers	Low	OS mapping, asset location data provided by Southern Water and the Thanet District Council SFRA
Artificial Sources	Low	OS mapping and EA's 'Flood Risk from Reservoirs' map

Table 3.1 – Summary of flood sources and risks.

3.3 Existing Flood Risk Management Measures

There are no formal flood defence structures that provide protection to the development site.

4 Climate Change

The global climate is constantly changing, but it is widely recognised that we are now entering a period of accelerating change. Over the last few decades there have been numerous studies into the impact of potential changes in the future and there is now an increasing body of scientific evidence which supports the fact that the global climate is changing as a result of human activity. Past, present, and future emissions of greenhouse gases are expected to cause significant global climate change during this century.

The nature of climate change at a regional level will vary: for the UK, projections of future climate change indicate that more frequent short-duration, high-intensity rainfall and more frequent periods of long-duration rainfall could be expected.

These effects will tend to increase the size of Flood Zones associated with rivers, and the amount of flooding experienced from other inland sources. The rise in sea level will change the frequency of occurrence of high water levels relative to today's sea levels. It will also increase the extent of the area at risk should sea defences fail. Changes in wave heights due to increased water depths, as well as possible changes in the frequency, duration and severity of storm events are also predicted.

4.1 Planning Horizon

To ensure that any recommended mitigation measures are sustainable and effective throughout the lifetime of the development, it is necessary to base the appraisal on the extreme flood level that is commensurate with the planning horizon for the proposed development. The NPPF and supporting Planning Practice Guidance Suite state that residential development (such as the proposed development) should be considered for a minimum of 100 years.

4.2 Potential Changes in Climate

Peak Rainfall Intensity

Recognising that the impact of climate change will vary across the UK, the allowances were updated in May 2022 to show the anticipated changes to peak rainfall across a series of management catchments. The proposed development site is located in the **Stour Management Catchment**, as defined by the 'Peak Rainfall Allowance' maps, hosted by the Department for Environment, Food and Rural Affairs. Guidance provided by the EA states that this mapping should be used for site-scale applications (e.g. drainage design), in small catchments (less than 5km^2), or urbanised drainage catchments. For large rural catchments, the peak river flow allowances should be used.

Detailed hydrological modelling has been undertaken (by HCL) as part of this FRA and this has included the appropriate climate change allowances, as set out below. The proposed development will also include a surface water management strategy and the Peak Rainfall Allowances for the

Stour Management Catchment should be applied to the hydraulic calculations undertaken as part of this.

For each Management Catchment, a range of climate change allowances are provided for two time epochs and for each epoch, there are two climate change allowances defined. These represent different levels of statistical confidence in the possible scenarios on which they are calculated. The two levels are as follows:

- Central: based on the 50th percentile
- Upper End: based on the 90th percentile

The EA has provided guidance regarding the application of the climate change allowances and how they should be applied in the planning process. The range of allowances for the Management Catchment in which the development site is located are shown in Table 4.1 below.

Management Catchment Name	Annual exceedance probability	Allowance Category	2050s	2070s
Stour	3.3 %	Central	20%	20%
		Upper End	40%	40%
	1 %	Central	20%	20%
		Upper End	45%	45%

Table 4.1 – Recommended peak rainfall intensity allowances for each epoch for the Stour Management Catchment.

For a development with a design life of 100 years the Upper End climate change allowance is recommended to assess whether:

- there is no increase in flood risk elsewhere, and;
- the development will be safe from surface water flooding.

From Table 4.1 above, it can be seen that the recommended climate change allowance for this site is a 45% increase in peak rainfall. Therefore, this increase has been applied to the hydraulic drainage model constructed to inform the surface water management strategy. Where this allowance has been applied the abbreviation "+45%cc" has been used.

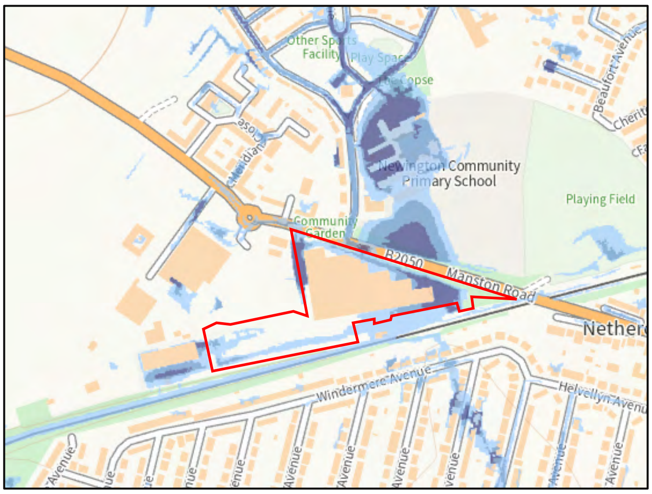
5 Probability and Consequence of Flooding

When appraising the risk of flooding to new development it is necessary to assess the impact of the 'design flood event'. Flood conditions can be predicted for a range of return periods, and these are expressed in either years or as a probability, i.e., the probability that the event will occur in any given year, or Annual Exceedance Probability (AEP). The design flood event is taken as the 1 in 100 year (1% AEP) event for pluvial flooding, including an appropriate allowance for climate change (refer to Section 4.2).

5.1 EA's 'Risk of Flooding from Surface Water' Mapping

It has been identified that the site could be affected by flooding from surface water based on the EA's 'Flood Risk from Surface Water' mapping (Figure 5.1). However, being a national scale map, the EA's surface water mapping is generalised and therefore does not account for certain site-specific variables, such as infiltration rates, site-specific topographic features and drainage networks.

Considering this, the EA's mapping can sometimes provide an unrealistic representation of surface water accumulation on site. Additionally, as part of this development the large scale commercial building on the existing site will be removed, therefore the site conditions will change drastically from the existing scenario in Figure 5.1 below. Considering this, HCL have undertaken detailed pluvial modelling of the site to provide a more accurate representation of the surface water accumulation on site during a design flood event (1 in 100 year event, including a 45% allowance for climate change) and this modelling has therefore been used to appraise the risk of flooding from surface water on site.



Probability of Flooding

High – Extent of flooding from surface water that has a 3.3% (1 in 30) or greater chance of happening each year.

Medium - Extent of flooding from surface water that has between a 3.3% (1 in 30) and 1% (1 in 100) chance of happening each year.

Low - Extent of flooding from surface water that has between a 1% (1 in 100) and 0.1% (1 in 1000) chance of happening each year.

Location of Development Site

Figure 5.1 – EA's 'Flood Risk from Surface Water' map (© Environment Agency).

5.2 Detailed Pluvial Modelling Undertaken by Herrington Consulting Ltd

HCL has undertaken detailed numerical flood modelling for the catchment within which the proposed development site is located and details of the parameters included within the site-specific model can be found within the modelling report in Appendix A.2.

The model takes account of site-specific information such as a topographic survey, CCTV survey, site investigations and the wider drainage network. It should be noted that this modelling does not include the proposed overflow into the public sewer network (outlined within Section 9 of this report), therefore the modelling provides a worst-case scenario.

Model outputs have been generated for a number of return period events and are discussed below in more detail.

The 1 in 30 year Flood Event – Functional Floodplain

The functional floodplain is defined by the NPPF as land where water has to flow or be stored in times of flood during events that have a probability of occurrence of 1 in 30 (3.33%) or greater in any one year.

From Figure 5.2 below, it can be seen that there is some localised surface water accumulation on site during this event under current day conditions, predominantly within the eastern corner of the site surrounding the existing commercial unit.

The proposed development includes the removal of the existing commercial building, significant reconfiguration and land raising works across the site. Therefore, when considering the proposed development scenario, the model outputs differ significantly, showing that the majority of floodwater is contained to the swale and flood storage areas onsite (Figure 5.2).

It is acknowledged that there are a number of small areas of accumulation within the gardens of the proposed residential units that will likely remain within these topographic low points on site, however, all of the residential units are located outside the extent of flooding and therefore not considered to be located within the functional floodplain.

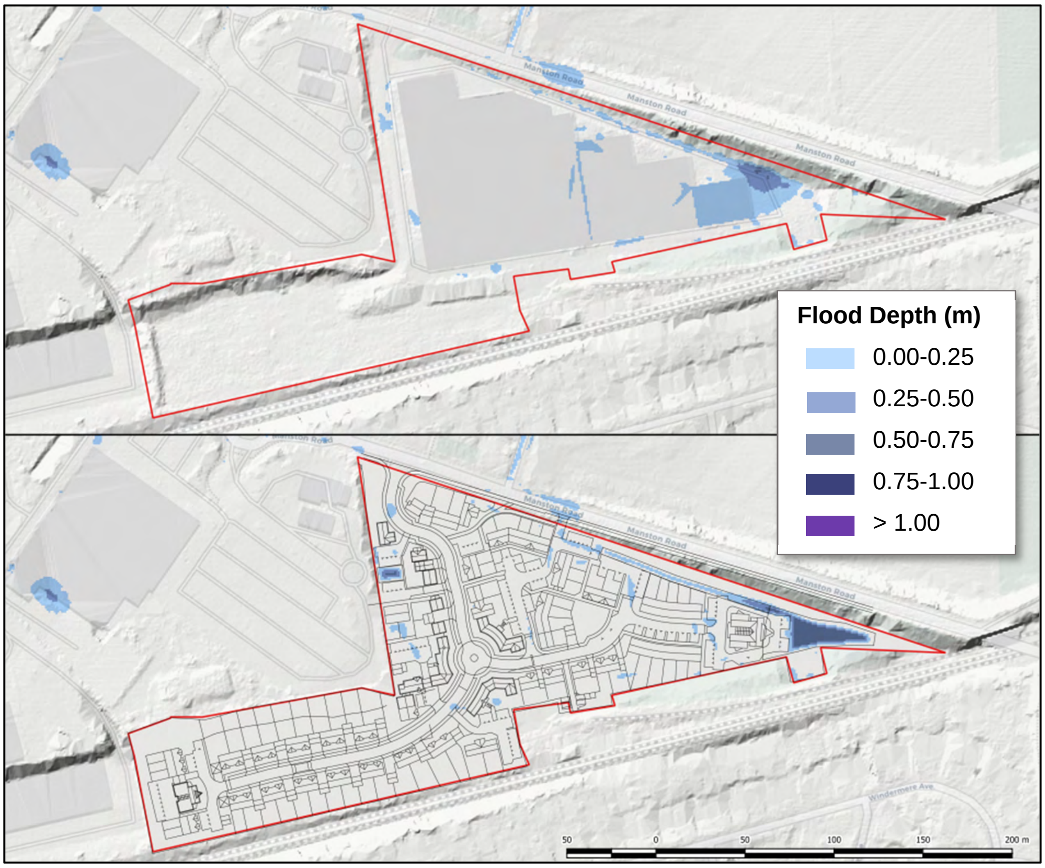


Figure 5.2 – Detailed pluvial modelling results produced by HCL for a 1 in 30 year (3.33% AEP) flood event. Baseline scenario represented in top image and proposed scenario below.

The Design Flood Event

The numerical flood model has also been run to show the extent of flooding during the design flood event. The modelling shows that during the baseline scenario, floodwater enters the building and the area around the north and east of the building is also subject to flooding.

As stated above, when considering the proposed scenario, it is key to note that the modelling does include site-specific features and the drainage network proposed onsite, but does not include the proposed overflow to the sewer network (discussed in section 9). Therefore, the modelling outputs show a worst case scenario whereby the drainage system is overwhelmed, water cannot discharge to the sewer through the overflow and as a result, backs up within the designated storage areas.

Considering the above, the modelling shows a surface water flow path from the north of the site flowing towards Manston Road. Surface water is shown to then flow across Manston Road onto the site in the centre of the northern boundary. At this point, floodwater is directed to the proposed swale feature and then further east into the lowered flood storage area.

The modelling shows that the area surrounding Unit F77-88 in the east of the site appears to be located within the flood storage area, however this element of the development is an overhanging balcony feature and is therefore elevated well above any flooding. The building itself is elevated above floodwater in the surrounding area. Additionally, the car parking to the east of this unit is strictly visitor parking and will be closed if a flood warning is in place (refer to section 7.2).

The output from the model also show some surface water accumulation in the northwest corner of the site, that will be directed into a swale feature on the western border and into another flood storage area. There are further small, localised areas of surface water accumulation within the garden areas of the proposed units which will likely remain within these topographic low points on site.

Whilst as identified above part of the site could be subject to flooding during this worst-case scenario, it can be seen that all of the proposed residential units on site outside the extent of flooding. This is in part due to the proposed mitigation measures, as discussed within the following section.

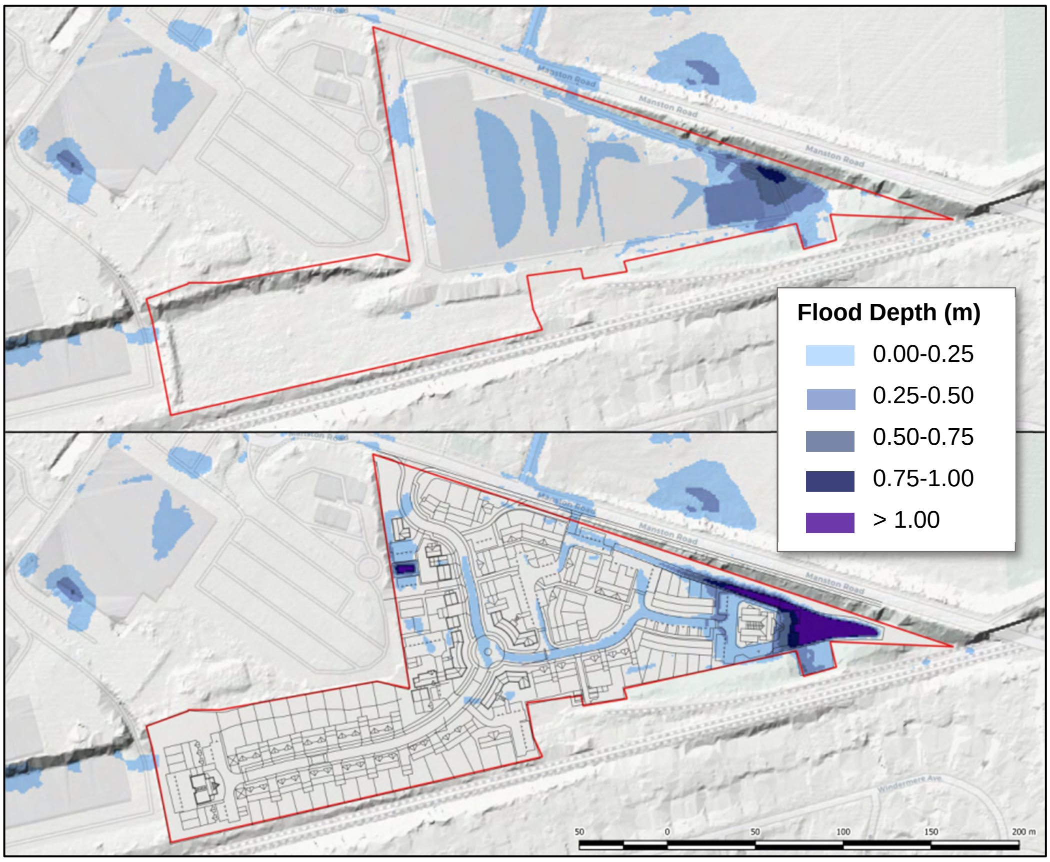


Figure 5.3 - Detailed pluvial modelling results produced by HCL for a 1 in 100 year (1% AEP) including a 45% allowance for climate change. Baseline scenario represented in top image and proposed scenario below.

6 Flood Mitigation Measures

The key objectives of flood risk mitigation are:

- to reduce the risk of the development being flooded.
- to ensure continued operation and safety during flood events.
- to ensure that the flood risk downstream of the site is not increased by increased runoff.
- to ensure that the development does not have an adverse impact on flood risk elsewhere.

The following section of this report examines ways in which the risk of flooding at the development site can be mitigated.

Mitigation Measure	Appropriate	Comment
Careful location of development within site boundaries (i.e., Sequential Approach)	✓	Refer to Section 6.1
Raising floor levels	✓	Refer to section 6.2
Land raising	✓	
Compensatory floodplain storage	✓	Refer to section 6.2 & Section 7.1
Flood resistance & resilience	✓	Refer to Section 6.3
Flood warning	✓	Refer to Section 6.4
Surface water management	✓	Refer to Section 8
Alterations/ improvements to channels and hydraulic structures	x	Not required
Flood defences	x	Not required

Table 6.1 – Appropriateness of mitigation measures.

6.1 Application of the Sequential Approach at a Local Scale

The sequential approach to flood risk management can also be adopted on a site based scale and this can often be the most effective form of mitigation. For example, on a large scheme this would mean locating the more vulnerable dwellings on the higher parts of the site and placing parking, recreational land or commercial buildings in the lower lying and higher risk areas.

As part of this assessment, it has been identified that the site could be subject to flooding from surface water, however it can be seen that the more vulnerable residential dwellings on site are located outside the extent of flooding during the design flood event. Therefore, it can be seen that this approach has been taken and the more vulnerable elements of the development have been located in the lowest risk area on site.

6.2 Raising Floor Levels and Land Raising

Floor Levels

At this outline stage, a ground model and unit floor levels have not been specified. However, it is recommended that all of the units are raised 300mm above the external ground level in the location of each plot (Figure 6.1). The detailed pluvial modelling undertaken by HCL has included this floor level raising within the model. In addition, units F1/F2, H89, H90 and H76 are recommended to be raised by a further 200mm above ground level (i.e. 500mm above external ground level) due to their proximity to an area predicted to flood. By ensuring the buildings are raised to this level, the proposed residential units will be elevated above the maximum predicted flood level during the design pluvial flood event.

Land Raising

As with the floor levels, land levels onsite have not been engineered at this outline stage of planning. It is recommended that two areas on site are lowered in order to provide a designated flood storage areas for surface water flowing onto the site from the surrounding area. Reference to Figure 2.1 below shows the two lowered areas, one on the eastern border of the site and another in the far west corner (outlined in blue), proposed for flood water storage.

These areas are connected to the surface water flow paths across the site, either within a designated indicative swale feature (on the northern border of the site, and a small swale feature connecting the eastern flood storage area to the north) or with surface water accumulation within the access roads on site flowing into these lowered areas (Figure 6.1). The access roads on site have been lowered by 125mm in comparison to the existing land levels on site within the flood modelling to ensure that surface water accumulation following an extreme weather event is channelled within the road network towards the lower lying flood storage areas, thereby ensuring the flood water is kept away from the residential units.

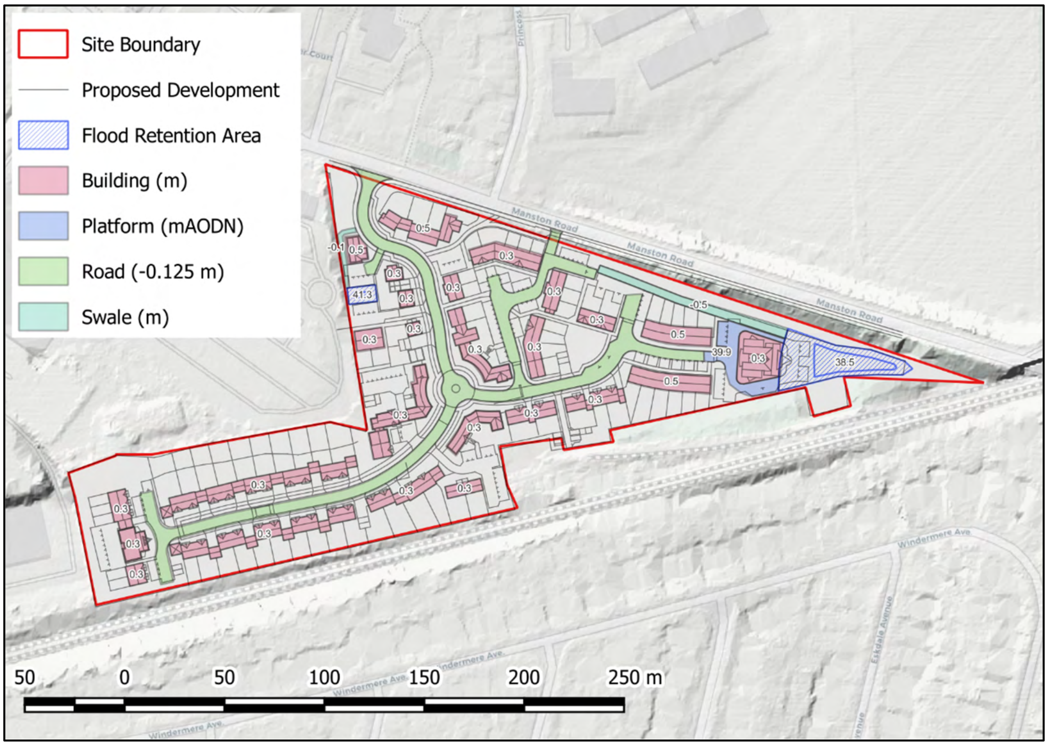


Figure 6.1 – Site plan showing the indicative land level alterations included within the flood model and outlining the location of the flood storage areas on site.

6.3 Flood Resistance and Resilience

During a flood event, floodwater can find its way into properties through a variety of routes including:

- Ingress around closed doorways.
- Ingress through airbricks and up through the ground floor.
- Backflow through overloaded sewers discharging inside the property through ground floor toilets and sinks.
- Seepage through the external walls.
- Seepage through the ground and up through the ground floor.
- Ingress around cable services through external walls.

Since flood management measures only manage the risk of flooding rather than eliminate it completely, flood resilience and resistance measures may need to be incorporated into the design of the buildings. The two possible alternatives are:

Flood Resistance or 'dry proofing', where flood water is prevented from entering the building. For example, using flood barriers across doorways and airbricks, or raising floor levels. These measures are considered appropriate for 'more vulnerable' development where recovery from internal flooding is not considered to be practical.

Flood Resilience or 'wet proofing', accepts that flood water will enter the building and allows for this situation through careful internal design for example raising electrical sockets and fitting tiled floors. The finishes and services are such that the building can quickly be returned to use after the flood. Such measures are generally only considered appropriate for some 'less vulnerable' uses and where the use of an existing building is to be changed and it can be demonstrated that no other measure is practicable.

It is proposed that a number of areas of the site are to be lowered to accommodate surface water flows on site (refer to section 6.2 above). Using this approach the pluvial modelling undertaken by HCL indicates that all of the residential units will be outside the extent of flooding during the design event. Nevertheless, as a precautionary measure, in the very unlikely event that surface water flooding on site exceeds the levels discussed within this report, it is recommended that flood resistance and resilience measures are considered for inclusion within the proposed dwellings.

Flood proofing measures which can be implemented to reduce the damage to buildings and property are becoming more common in areas that are subject to flooding. Typical examples of flood resilience measures which may be appropriate for the development site include (but are not limited to) the following:

- Raising floor slab level further.
- Bringing the electrical supply in at first floor.
- Placing boilers and meter cupboards on the first floor.
- Water-resistant plaster/tiles on the walls of the ground floor.
- Solid stone or concrete floors with no voids underneath.
- Covers for doors and airbricks.
- Non-return valves on new plumbing works.
- Avoidance of studwork partitions on the ground floor.

Details of flood resilience and flood resistance construction techniques can be found in the document '*Improving the Flood Performance of New Buildings; Flood Resilient Construction*', which can be downloaded from www.gov.uk.

A Code of Practice (CoP) for Property Flood Resilience (PFR) has been put in place to provide a standardised approach for the delivery and management of PFR. Further information on the CoP and guidance on how to make a property more flood resilient can be accessed, and downloaded, from the Construction Industry Research and Information Association (CIRIA) Website:

https://www.ciria.org/Resources/Free_publications/CoP_for_PFR_resource.aspx

6.4 Flood Warning

The detailed pluvial modelling undertaken by HCL suggests that the site could also experience surface water flooding following an extreme weather event. Occupants of the dwellings and site managers are therefore recommended to monitor the Met Office's Weather Warnings to provide forewarning of weather conditions which could result in surface water flooding:

www.metoffice.gov.uk/weather/uk/uk_forecast_warnings.html

7 Offsite Impacts and Other Considerations

7.1 Displacement of Floodwater

The construction of new buildings within the floodplain has the potential to displace water and to increase the risk elsewhere by raising flood levels. A compensatory flood storage scheme can be used to mitigate this impact, ensuring the volume of water displaced is minimised.

This assessment has identified that the proposed development site could be subject to flooding from surface water and as such has the potential to displace flood water to the surrounding areas. However, as outlined previously within Section 6.2 of this report, indicative swales and two lowered flood storage areas have been proposed on site to accommodate for surface water which could accumulate on site following an extreme rainfall event. These features have been modelled as part of the detailed pluvial flood modelling undertaken by HCL to represent the risk of flooding to the proposed site during an extreme rainfall event (Figure 5.2) and this shows all of the surface water accumulation on site during the design flood event (1 in 100 year event, including an allowance for climate change) has been retained within the site boundary. Considering this, no floodwater will be displaced to the surrounding area during a flood event of this nature.

7.2 Public Safety and Access

The NPPF states that safe access and escape should be available to/from new developments located within areas at risk of flooding. The Practice Guide goes on to state that access routes should enable occupants to safely access and exit their dwellings during design flood conditions and that vehicular access should be available to allow the emergency services to safely reach the development.

This assessment has appraised the risk of flooding from all sources and it has been concluded that the risk of flooding is low, with the exception of the risk of flooding from surface water. Detailed pluvial modelling undertaken by HCL has identified that all of the proposed residential units will be located outside extent of flooding, however parts of the access roads on site could be subject to shallow flooding during this event.

The EA's guidance indicates that it is typically safe to access/egress a site by vehicle or foot within floodwater <250mm. Consequently, reference to Figure 5.3 indicates that safe access/egress to and from the site should be available for all units on the development site during the peak of an extreme rainfall event. Nevertheless, it is recommended that residents sign up to the Met Office Weather Warnings, which will provide a forewarning of extreme conditions which could result in surface water accumulation on site or in the surrounding area.

In addition to the above, the visitor car parking facilities to the east of units F77-F88 could be subject to over 1m of flooding during the peak of the design flood event. It is therefore recommended that this car park is closed for access to visitors during periods when a flood warning is in place.

7.3 Proximity to Watercourse

Under the Water Resources Act 1991 and Land Drainage Byelaws, any proposals for development in close proximity to a 'main river' would need to take into account the EA's requirement for an 8m buffer zone between the river bank and any permanent construction such as buildings or car parking etc.

The development site is located more than 8m from any watercourses and as such will not compromise any of the EA's maintenance or access requirements.

8 Existing Drainage

8.1 Existing Surface Water Drainage

The existing site drainage has been surveyed and this shows that surface water runoff from the majority of the hardstanding areas on site drains to the combined surface water sewer located in Manston Road. Furthermore, there is a gully in the southeast of the site that drains towards the south. A copy of the drainage survey is included within Appendix A.8.

Surface water runoff is discharged at an unrestricted rate from the existing site and this rate of discharge has been calculated for a range of rainfall events with varying return periods. These rates are outlined in Table 8.1 below. These hydrological calculations have been undertaken using the Modified Rational Method and synthetic rainfall data derived using the variables obtained from the Flood Estimation Handbook (FEH) online web service, in addition to information provided as part of the drainage survey. The drainage survey shows a 225mm outfall into the sewer, which is likely to limit the discharge rates from the development.

Return Period (years)	Peak runoff from the existing site (l/s)
2	138
30	138
100	138

Table 8.1 – Summary of peak runoff rates for the existing site.

Southern Water (SW) has provided sewer mapping as part of their asset location data for the site and surrounding area. An extract of this mapping is provided in Figure 3.2 above and shows the location of public sewers in close proximity to the site.

From Figure 3.2 above, it is evident that the sewers in this area are typically combined sewers. The nearest combined sewer to the site is located approximately 5m to the north of the site within Manston Road, where the drainage survey identifies an existing connection.

9 Sustainable Drainage Assessment

9.1 Site Characteristics

The important characteristics of the site, which have the potential to influence the surface water drainage strategy, are summarised in Table 9.1 Table 9.1 below.

Site Characteristic	Development Site	
Total area of site	~3.5 ha	
Current site condition	Developed (brownfield)	
Greenfield runoff rates (based on the FEH methodology)	1:1 yr = 1.97 l/s Qbar = 2.32 l/s 1:30 yr = 5.34 l/s 1:100 yr = 7.41 l/s	
Infiltration	Unavailable based upon site investigations	
Current surface water discharge method	Drains into combined public sewer network unattenuated	
Is there a watercourse nearby?	No	
Impermeable area	**Existing** **~ 20,000 m^2**	**Proposed** **~ 15,880 m^2**

Table 9.1 – *Site characteristics affecting rainfall runoff.*

Reference to the tables above shows the proposed development will decrease the percentage of impermeable area within the boundaries of the site and consequently, this will decrease the rate and volume of surface water runoff discharged from the site. Notwithstanding this, it is recognised that the impacts of climate change should be considered as part of any new development and it is for this reason, that it is recommended that SuDS are considered. The overall rate at which surface water runoff is discharged from the site should not increase over the lifetime of the development.

Furthermore, the potential use of SuDS within the proposed development will be considered to assess the practicality of better replicating greenfield behaviour, in accordance with Local Planning Policy, and S3 and S5 of the NTSS.

9.2 Opportunities to Discharge Surface Water Runoff

Part H of the Building Regulations summarises a hierarchy of options for discharging surface water runoff from developments. The preferred option is to **infiltrate** water into the ground, as this deals with the water at source and serves to replenish groundwater. If this option is not viable, the next option is for the runoff to be discharged into a **watercourse**. The water should only be conducted into the **public sewer** system if neither of the previous options are possible.

The following opportunities for managing the surface water runoff discharged from the development site are listed in order of preference:

Water Re-Use – Water re-use systems should ideally be considered to reduce the reliance on the demand for potable water. However, such systems can rarely manage 100% of the surface water runoff discharged from a development, as this requires the yield from the building and hardstanding area to balance perfectly with the demand from the proposed development. Consequently, whilst rainwater recycling systems can be considered for inclusion within the scheme, an alternative solution for attenuating storm water will still be required.

Infiltration – The soil and underlying geology at this location has been analysed using the British Geological Surveys mapping. The geology of the site is made up of Margate Chalk Formation with superficial deposits of Head (clay and silt). Site specific infiltration testing has been undertaken, and this shows that ground conditions comprise 'low' to 'very low' permeability. Therefore, the primary use of infiltration SuDS to manage surface water runoff is not considered suitable at this site. Notwithstanding this, it is recommended that the use of Type B SuDS is considered to partially manage surface water runoff from the proposed development. Based on the above, while Type B SuDS can be considered, an alternative primary method for managing surface water runoff will still be required.

Discharge to Watercourses – There are no watercourses located within close proximity to the site. As a result, there is no opportunity to discharge surface water runoff from the development to an existing watercourse.

Discharge to Public Sewer System – The remaining solution for draining surface water runoff from the proposed development is likely to be via the existing connection to the public sewer network. Providing the proposed discharge rate is equal to, or less than the existing discharge rate, it is likely this will be acceptable to the sewerage undertaker (SW).

9.3 Constraints and Further Considerations

The key constraints that are relevant to this development are listed below:

- There is limited open space to incorporate SuDS that require very large areas of land, such as wetlands and large infiltration basins.

- Due to the poor infiltration rate, it will not be possible to reduce or maintain the volume of surface water runoff discharged from the development site.

- Due to the gradient across the site, it may be necessary to incorporate check dams within the sub-base of any permeable paving system, or swales.

9.4 Proposed Surface Water Management Strategy

The drainage strategy set out below discusses each of the different elements of the proposed scheme, along with the results from a numerical drainage model constructed for the site, which can be used to demonstrate how the overall objectives can be achieved. This does not represent a detailed surface water drainage design; it is simply an assessment to demonstrate that the objectives and requirements of the NPPF and NTSS can be met at the planning stage.

For the purposes of the proposed surface water management strategy, the site has been sub-divided into two drainage catchments. The extent of these catchments can be seen in Figure 9.1 below.

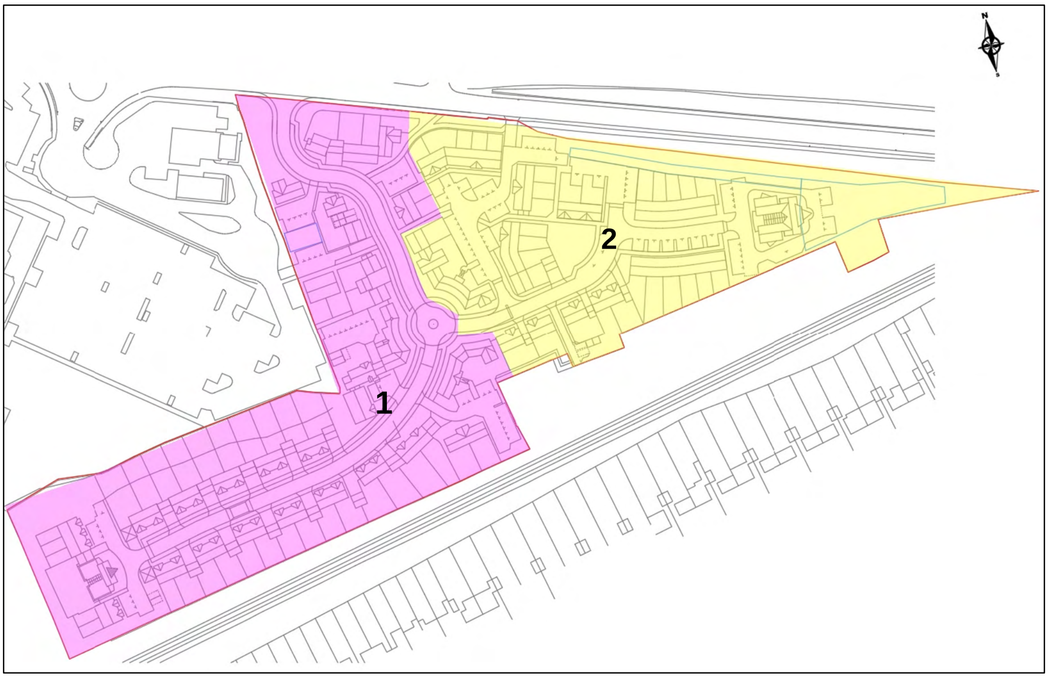


Figure 9.1 – Drainage sub-catchments.

Water Butts

To reduce the developments reliance on potable water supplies for external use, there is the potential to incorporate water butts within the gardens of each dwelling. Typical sizes and dimensions of water butts are outlined in Table 9.2 below.

Typical house water butt options	Dimensions of a typical house water butt	Volume of storage provided (litres)
Type 1 (wall mounted – small)	1.22m high x 0.46m x 0.23m	100
Type 2 (standard house water butt)	0.9m high x 0.68m diameter	210
Type 3 (large house water butt)	1.26m high x 1.24m x 0.8m	510
Type 4 (column tank – very large)	2.23m high x 1.28m diameter	2,000

Table 9.2 – *Estimated storage capacity of available water butts.*

In this case, the demand for potable water from each of the gardens is likely to be relatively small and as a result, small wall mounted water butts (typical 100 litre units) are likely to be the most appropriate size for inclusion within the scheme.

It is recognised that each of the water butts will need to overflow into the main drainage system for the site, to ensure that in the event the water butt is full prior to the onset of the design rainfall event, water can be discharged away from the properties without increasing the risk of flooding.

Permeable Surfacing

Runoff from the hardstanding areas across the site, in addition to overflow from the water butts, will be directed via underground pipes into a layer of open graded subbase material, located beneath permeable surfacing. While a detailed ground levels plan has not been provided at the time of this assessment, it is assumed that a small amount of land levelling will occur to enable the permeable surfacing system to drain via gravity. If however, there is a significant slope across the site, check-dams can be incorporated into the permeable surfacing system. Conversely, if it is not feasible to level the site sufficiently, it may be necessary to incorporate the use of a pump to drain any lower areas to the tanks. However, for this assessment, it is assumed that land levelling will enable the entire site to drain via gravity.

Runoff from the permeable surfacing system will subsequently be discharged into two geo-cellular storage tanks before being discharged to the public sewer at a restricted runoff rate. A summary of the Causeway Flow+ analysis for permeable surfacing is shown in Table 9.3Table 9.3 below.

Parameter	**Value (1:100yr+45%cc event)**	
SuDS	Permeable Surfacing 1	Permeable Surfacing 2
Total area draining to permeable surfacing, including overflow from other SuDS and a 10% allowance for urban creep	~ 10,490 m^2	~ 6975 m^2
Area of permeable surfacing	~ 5770 m^2	~ 3540 m^2
Infiltration	Not available	
Sub-base depth	900 mm	
Porosity	30 %	
Critical storm duration	4320 minutes	4320 minutes

Table 9.3 – *Summary of permeable surfacing SuDS.*

Geo-cellular Storage Tank

Surface water runoff stored within the permeable surfacing system will be discharged into two geo-cellular storage tanks located beneath the roads in the north of the site. The two geo-cellular tanks will provide additional storage for storm water before runoff is discharged to the public sewer system at a restricted rate. The rate at which runoff is permitted to exit the geo-cellular storage tanks will be restricted through the use of vortex flow control devices (Hydro-Brake or similar). The geo-cellular storage tanks can contain an overflow pipe that will direct water from the top of the tank directly into the public sewer system, in the event that the flow control devices fail or become blocked. Check valves should be specified to prevent backflow into the drainage system, should the public sewer system surcharge. Calculations have been undertaken to determine the depth and volume of the tank system required, and the results are summarised in Table 9.4 below.

Parameter	**Value (1:100yr+45%cc event)**	
SuDS	Geo-cellular storage tank 1	Geo-cellular storage tank 2
Total area draining to geo-cellular storage tank, including overflow from other SuDS and a 10% allowance for urban creep	~ 10,940 m^2 (Runoff from permeable surfacing 1)	~ 6975 m^2 (Runoff from permeable surfacing 2)
Area of tank	300 m^2	150 m^2
Infiltration	Not available	
Depth	1.8 m	1.8 m
Porosity	95 %	
Flow control device	Vortex flow control device (Hydro-Brake or similar)	
Limiting discharge rate	1.2 l/s	0.8 l/s
Critical storm duration	5760 minutes	5760 minutes
Overflow device	Pipe	

Table 9.4 – *Summary of geo-cellular storage tank SuDS.*

Runoff rates have been calculated for a range of annual return probabilities, including the 100-year return period event with a 45% increase in rainfall intensity, to account for future climatic changes. These values are summarised below in Table 9.5**Error! Reference source not found.**.

Return Period	**Existing Peak Discharge Rate**	**Proposed Peak Discharge Rate**	**Betterment**
1 in 2yr	138 l/s	1.5 l/s	98 %
1 in 30yr	138 l/s	1.7 l/s	98 %
1 in 100yr	138 l/s	1.8 l/s	98 %
1 in 100yr+45%cc	-	1.9 l/s	-

Table 9.5 - Summary of Causeway Flow+ analysis for the peak discharge rates for a range of return period events (+45%cc).

It is evident that with the inclusion of the proposed SuDS, there is the potential to accommodate all the surface water runoff from the site, up to and including, the design rainfall event. This assumes the rate at which water is discharged to the public sewer system will be attenuated to a rate that is no greater than 1.9 l/s.

9.5 Indicative Drainage Layout Plan

Figure 9.2 below is an indicative drainage layout plan delineating how the proposed SuDS can be incorporated into the scheme proposals.

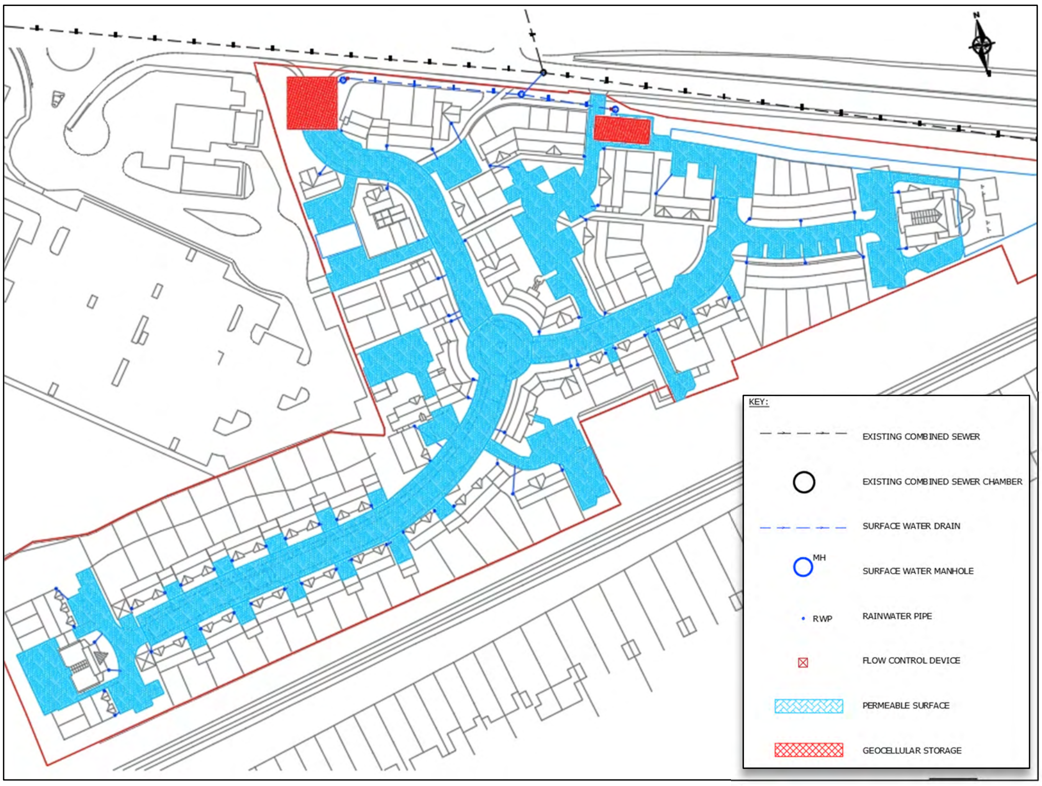


Figure 9.2 - Indicative drainage layout plan showing the proposed location of SuDS.

A full-scale copy of this layout is located in Appendix A.6 of this report.

9.6 Management and Maintenance

In order for any surface water drainage system to operate as originally designed, it is necessary to ensure that it is adequately maintained throughout its lifetime. Therefore, over the lifetime of a development there is a possibility that the performance of the system could be reduced or could fail if it is not correctly maintained. This is even more important when SuDS form a part of the surface water management system, as these require a more onerous maintenance regime than a typical piped network.

The key requirements of any management regime are routine inspection and maintenance. When the development is taken forward to the detailed design stage, an 'owner's manual' will need to be prepared. This should include:

- A description of the drainage scheme.
- A location plan showing all of the SuDS features and equipment, such as flow control devices etc.

- Maintenance requirements for each element, including any manufacturer-specific requirements.
- An explanation of the consequences of not carrying out the specified maintenance.
- Details of who will be responsible for the ongoing maintenance of the drainage system.

For the SuDS recommended by this assessment, the most obvious maintenance tasks will be desilting the geo-cellular storage tanks and brushing the permeable surfacing. General maintenance schedules have been included within the appendices of this report, which demonstrate the maintenance requirements of the proposed SuDS. For developments such as this, that to some extent rely on the ongoing inspection and maintenance of SuDS, it will be necessary to ensure that measures are in place to maintain the system for the lifetime of the development. For this site, it is likely that the management company responsible for the inspection and maintenance for the site, will be tasked with the maintenance of the drainage system.

For some elements of the drainage system, including the flow control devices, it may be necessary to use specialist contractors or have the original manufacturer inspect the features. If this is the case, the management company will need to make allowances for these inspections and works to be carried out.

It is recognised that the SuDS located within the surface water flow paths will likely require more intensive maintenance than would typically be expected for SuDS not subject to overland flows. These additional requirements should be considered as part of a maintenance and management strategy for the development.

For the SuDS located within the private garden areas, it is likely that maintenance will be the responsibility of the individual property owners/occupants. In this case, maintenance tasks are likely to include desilting the water butts.

Further details of the maintenance and management strategy should be confirmed, following the completion of a detailed drainage design for the development.

9.7 Sensitivity Testing and Residual Risk

When considering residual risk, it is necessary to consider the impact of a flood event that exceeds the design event, or the implications if the proposed drainage system was to become blocked.

For the water butts, there is the potential for a small amount of localised flooding to occur if the overflows from these features were to become blocked. Given the small catchment area draining to each of these features, the volume of floodwater will be relatively small, and it is unlikely to present a risk to the properties or occupants.

To minimise the risk of the uncontrolled discharge of floodwater from geo-cellular storage tanks, an overflow pipe has been incorporated into the design of these drainage features. If the primary flow control device becomes blocked, this pipe will be used to bypass the flow control device, allowing excess water to drain directly to the public sewer system.

It is acknowledged that under the design rainfall event, parts of the access roads are shown to be subject to flooding, and to ensure that the proposed dwellings remain dry, the proposed access roads are to be lowered 125mm below existing ground level. Therefore, any surface water flowing overland, would be contained within the access roads, and be picked up by the permeable surfacing system until the extreme rainfall conditions subside.

It is further recognised that the development proposals will decrease the impermeable area on site and that the drainage proposals will incorporate a significant volume of storage for storm water that is not currently provided on the existing site. Therefore, based on the analysis above it is concluded that the proposed drainage system outlined within this strategy will not result in an increased risk of flooding to properties at the site or within the surrounding area when compared to the existing situation.

10 The Sequential and Exception Tests

10.1 The Sequential Test

The NPPF states that the Local Planning Authority (LPA) should apply the sequential approach as part of the identification of land for development in areas at risk from flooding. The overarching objective of the Sequential Test is to ensure that lower risk sites are developed before sites in higher risk areas. When applying the Sequential Test, it is also necessary to ensure that the subject site is compared to only those sites that are available for development and are similar in size.

The proposed development is located within Flood Zone 1, therefore is considered to be an area with a less than 1 in 1000 year risk of flooding from rivers and the sea. Additionally, this assessment has concluded that the risk of flooding from all other sources is *low*, taking into account the inclusion of the various flood risk mitigation measures outlined in Section 7 of this report. Consequently, this development cannot be located within an area considered to be at a lower risk of flooding and therefore meets the requirements of the Sequential Test.

10.2 The Exception Test

According to the NPPF, if it is not possible, consistent with wider sustainability objectives, for the development to be located in areas at lower risk, the Exception Test may have to be applied. The application of the Exception Test will depend on the type and nature of the development, in line with the Flood Risk vulnerability classification set out in the NPPG. This has been summarised in Table 10.1 below.

Flood Risk Vulnerability Classification	Zone 1	Zone 2	Zone 3a	Zone 3b
Essential Infrastructure – Essential transport infrastructure, strategic utility infrastructure, including electricity generating power stations.	✓	✓	e	e
High Vulnerability – Emergency services, basement dwellings, caravans and mobile homes intended for permanent residential use.	✓	e	×	×
More Vulnerable – Hospitals, residential care homes, buildings used for dwelling houses, halls of residence, pubs, hotels, non-residential uses for health services, nurseries and education.	✓	✓	e	×
Less Vulnerable – Shops, offices, restaurants, general industry, agriculture, sewerage treatment plants.	✓	✓	✓	×
Water Compatible Development – Flood control infrastructure, sewerage infrastructure, docks, marinas, ship building, water-based recreation etc.	✓	✓	✓	✓

Key :

✓ Development is appropriate

× Development should not be permitted

e Exception Test required

Shaded cell represents the classification of this development

Table 10.1 - Flood risk vulnerability and flood zone incompatibility.

From Table 10.1 above it can be seen that the development falls into a classification that does not require the Exception Test to be applied.

11 Conclusions and Recommendations

The overarching objective of this report is to appraise the risk of flooding at the Land at Flambeau Europlast, Ramsgate, to ensure that the proposals for development are acceptable and that any risk of flooding to the occupants of the proposed residential units is appropriately mitigated. In addition, the NPPF also requires the risk of flooding offsite to be managed, to prevent any increase in flood risk as a result of the development proposals. This report has therefore been prepared to appraise the risk of flooding from all sources and to provide a sustainable solution for managing the surface water runoff discharged from the development site, in accordance with the NPPF and local planning policy.

The proposed development is located within Flood Zone 1 and when taking into consideration the proposed mitigation measures, the proposed units have been shown to be at *low* risk of flooding from all sources. Consequently, the development cannot be located within an area at lower risk of flooding and the requirements of the Sequential Test have been met. Furthermore, the development falls into a classification that does not require the Exception Test.

The risk of flooding has therefore been considered across a wide range of sources and it is only the risk of surface water flooding that has been shown to have any bearing on the development. However, when this risk is examined in detail, it has been demonstrated that with the following mitigation measures, the development will be safe and will not increase flood risk elsewhere. Therefore the following mitigation measures have been recommended:

- **The proposed residential units should be raised above the exterior ground levels.** It is recommended that all of the proposed residential units are raised by 300mm above the ground level and specifically units F1/F2, H89, H90 and H76 should be raised by a further 200mm. This will ensure that all of the units are raised above the design flood level on site.

- **Land raising to accommodate swales and flood storage areas on site.** In accordance with the detailed pluvial modelling undertaken by HCL, it is recommended that two areas of the site (to the east and west of the site as outlined within Figure 6.2) are lowered to form swale features connected to flood storage areas. Combining this approach with lowering the levels of the access roads ensures that any surface water flowing across the site is channelled within the road and swale areas towards the lowered flood storage areas, ensuring that the residential units remain outside the extent of flooding following an extreme rainfall event.

- **Site managers and residents should sign up to the Met Office Weather Warnings**. Whilst it should be acknowledged that safe access/egress to and from the site should be available, even following an extreme weather event, it is recommended that owners and residents sign up to the Met Office Weather Warnings which could provide a forewarning for when extreme weather could result in surface water accumulation within the access roads on site.

Furthermore, this FRA has demonstrated that the development will not increase flood risk elsewhere and by incorporating appropriate mitigation measures and SuDS features within the design of the surface water drainage system, it will be possible to limit the impact with respect to surface water runoff.

In order to restrict the rate at which surface water runoff is discharged offsite, various SuDS have been proposed, including water butts, geo-cellular storage tanks, and permeable surfacing. These SuDS will be used to store water onsite, before it is discharged to the public sewer system. Vortex flow control devices have been specified to attenuate the rate at which surface water runoff is discharged from the site, limiting the rate to a maximum of 1.9 l/s, in line with the calculated greenfield runoff rates for the site, in accordance with the NTSS.

Details of the typical maintenance and management requirements for each element of the drainage system have been provided to ensure that the proposed drainage solution can be maintained and will continue to operate over the lifetime of the development. It is, however, recommended that an “owner’s manual” containing additional product specific maintenance requirements is produced as part of the detailed design for the site.

In conclusion, following the recommendations of this report, the occupants of the development will be safe and the development will not increase the risk of flooding elsewhere. Consequently, it has been demonstrated that the development will meet the requirements of the NPPF.

12 Appendices

Appendix A.1 – Drawings

Appendix A.2 - Site-specific pluvial modelling produced by Herrington Consulting Ltd

Appendix A.3 – Southern Water Asset Location Data

Appendix A.4 – Site Investigation Report undertaken by EPS

Appendix A.5 – Surface Water Management Calculations

Appendix A.6 – Indicative Drainage Layout

Appendix A.7– Maintenance Schedules

Appendix A.8 – Drainage Survey