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Client: Folkestone & Hythe District Council

Flood Risk Assessment for the Proposed Development at Land adjacent to 'The Retreat', Lydd Road, Old Romney, Kent

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Contents Page

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1 Background and Scope

Herrington Consulting has been commissioned by Folkestone & Hythe District Council to prepare a Flood Risk Assessment (FRA) for **Land adjacent to 'The Retreat', Lydd Road, Old Romney, TN29 9SY** to support a proposed site allocation for Gypsy and Traveller accommodation within the Places and Policies Local Plan (PPLP).

The objectives of the Flood Risk Assessment (FRA) are 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 the second element of the Exception Test (where applicable).

This appraisal has been undertaken in accordance with the requirements of the National Planning Policy Framework (2019) and the National Planning Practice Guidance Suite (March 2014) that has been published by the Ministry of Housing, Communities & 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'

1.1 Site Location and Existing Use

The site is located at OS coordinates 603848, 124927, off Lydd Road in Old Romney, Kent. The site covers an area of approximately 1.5 hectares and is currently an undeveloped field. The location of the site in relation to the surrounding area is shown in Figure 2.1.

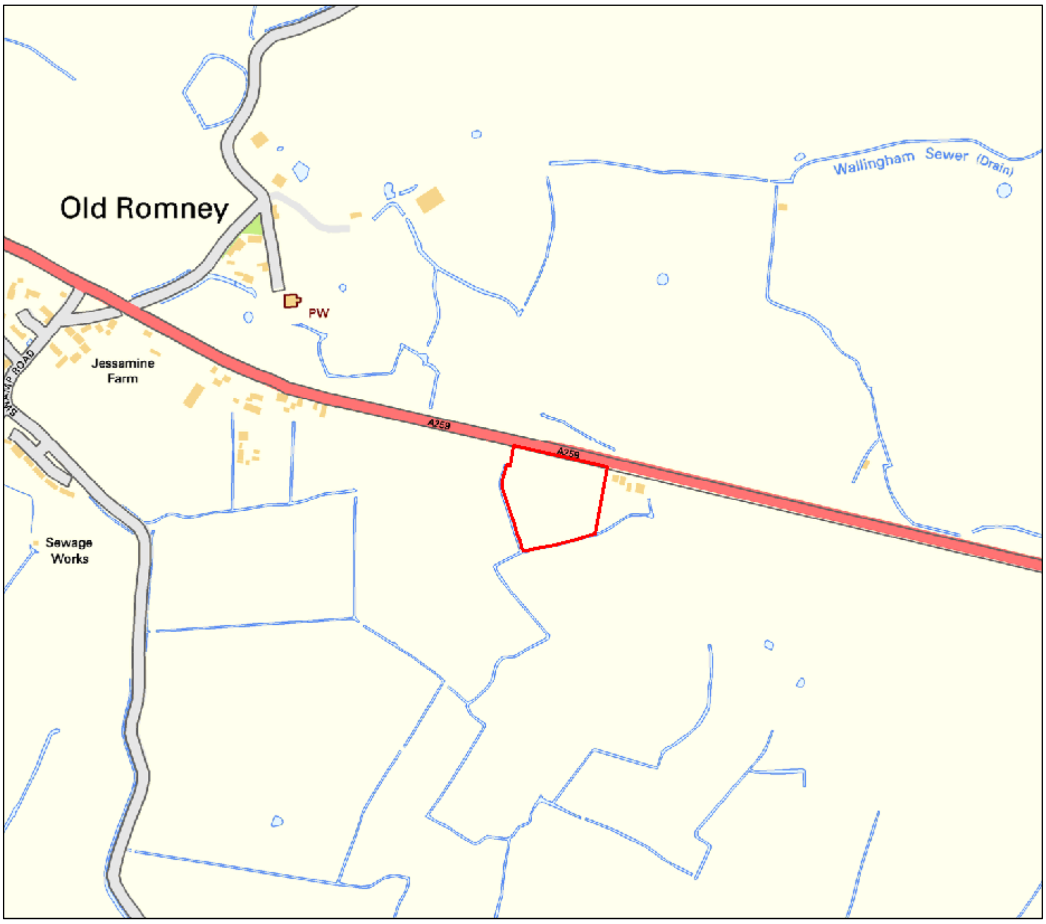


Figure 2.1 – Location map (Contains Ordnance Survey data © Crown copyright and database right 2019).

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

1.2 Planning Context and Development Proposals

The development site is proposed to be allocated for Gypsy and Traveller accommodation as part of the emerging Places and Policies Local Plan (PPLP) for the Folkestone & Hythe District. Draft Policy RM15 sets out the requirements for development and a copy of the policy can be found in Appendix A.1 of this report.

The proposed allocation at this site is to provide capacity for 4 pitches including amenity blocks, parking for static and touring caravans, visitor parking and storage. At this stage, the proposed site layout has not been confirmed. However, should the allocation be confirmed in the PPLP, this FRA can be used to provide information on the likelihood of flooding at the site, to enable a scheme to be designed which satisfies the flood risk requirements outlined in the NPPF.

2 Definition of Flood Hazard

2.1 Site Specific Information

In addition to the high level flood risk information shown in the Environment Agency (EA) flood zone maps, additional data from detailed studies and other information sources is referenced. This section summarises the additional information collected as part of this FRA.

Site specific flood level data provided by the EA – The EA has been contacted during the preparation of this assessment and a copy of their response is included in Appendix A.2.

Information contained within the SFRA – The Folkestone & Hythe District Council SFRA (2015) contains historic records of flooding from a wide range of sources. This document has 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 – A site-specific topographic survey has not been undertaken at this stage, however, inspection of aerial height data (LiDAR) records show that the land levels of the site vary between 1.8m and 3.7m Above Ordnance Datum Newlyn (AODN). The north of the development site forms part of the Rhee Wall and is elevated above the surrounding area. Land levels on site fall from the Rhee Wall towards the south as shown in Figure 2.1 below.

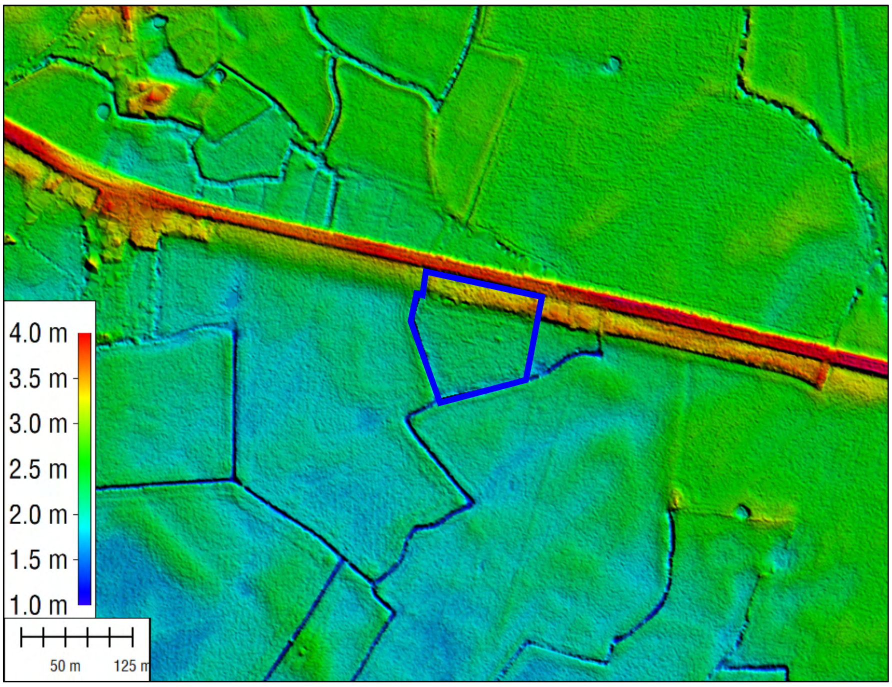


Figure 2.1 – Aerial height data showing the Rhee Wall in relation to the development site. Elevation shown in mAODN. Development site outlined in blue.

Site Photos – The site has been photographed as part of the topographic survey. A set of the photographs are referenced on the topographic survey drawing in Appendix A.1 and can be viewed/downloaded via the following link: https://photos.app.goo.gl/eKgbGrdSmGLupced9

Geology – Reference to the British Geological Survey map shows that the underlying solid geology in the location of the subject site is Hastings Beds (sandstone, siltstone and mudstone). Overlying this are superficial deposits of tidal flat deposits (clay and silt).

Historic flooding – Information provided as part of the Folkestone & Hythe SFRA (2015) identifies that there are no records of historic flooding at the proposed development allocation from any sources.

2.2 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 the proposed development allocation 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 the Sea – The location of the site is shown on the Environment Agency's flood zone map in Figure 2.2

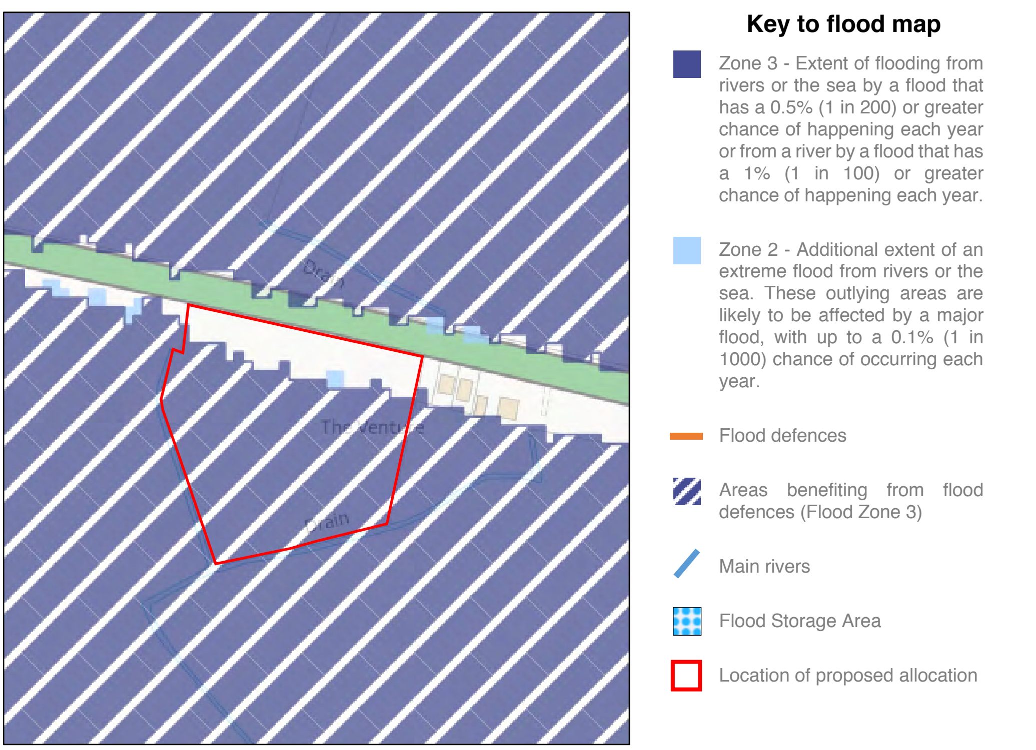


Figure 2.2 – Flood zone map showing the location of the proposed development allocation (© Environment Agency)

The above mapping shows the proposed development allocation is located within coastal Flood Zones 1, 2 and 3 and identifies that the site does benefit from existing flood defences that have been constructed in the last 5 years. The fact that the site lies partially within Flood Zone 3 means that the risk of flooding from this source is examined in more detail in this FRA.

Flooding from Rivers, Ordinary or Man-made Watercourses – 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. However, inspection of OS mapping reveals that there is a complex network of land drainage ditches to the south of the site. The main purpose of the drainage network is to reduce the groundwater level within the surrounding land, with pumps or tidal sluices being used to discharge flows to the sea.

Extreme rainfall, the failure of a pumping station or the tide-locking of the tidal outlet can prevent the system discharging, which may result in increased water levels in the network of drains and ditches. However, due to the large and relatively flat topography of the land that is drained, the consequence of such an event is likely to be water logging of the ground and shallow flooding in the lower-lying areas.

Land levels at the site are elevated approximately 0.5m above the lower-lying marshes to the south. Given the extensive area covered by the drainage network, and the difference in elevation, the water level within the drainage network is not expected to reach the elevation of site. Consequently, the risk of flooding from the ditches is considered to be low.

Flooding from Land (overland flow and surface water runoff) – 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 flooding mechanism 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.

Figure 2.3 below is an extract of the Environment Agency's 'Flood Risk from Surface Water' map which can be interrogated to identify whether the site is located in an area at risk of surface water flooding.

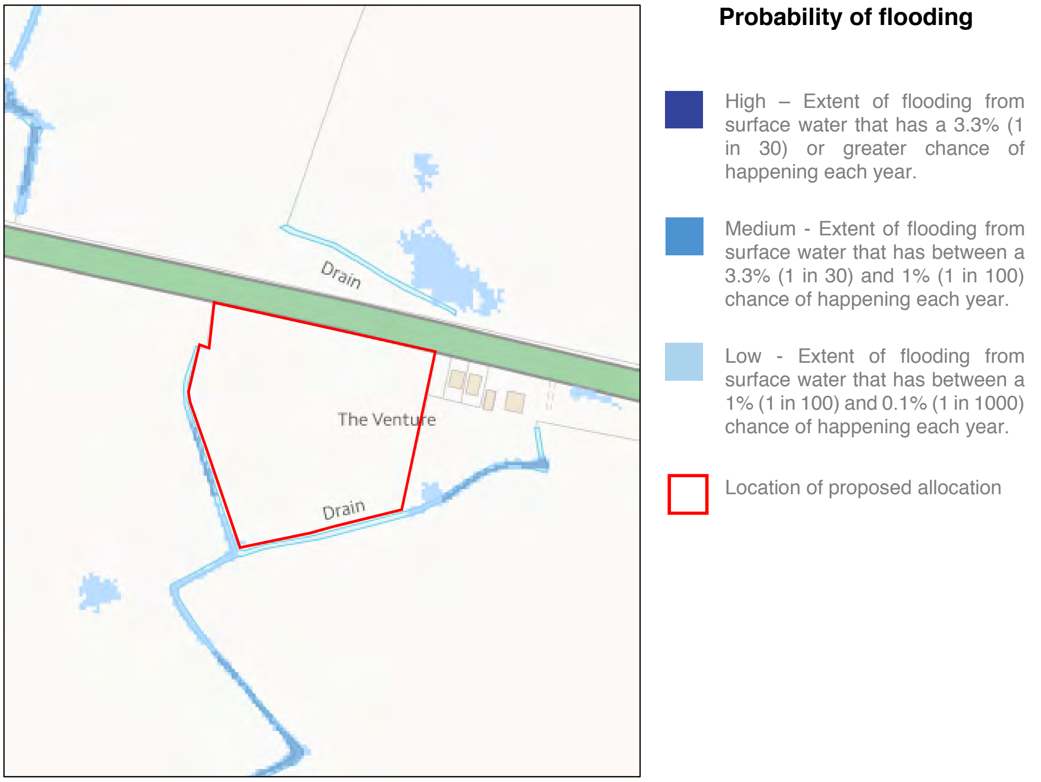


Figure 2.3 – Surface water flooding map showing the location of the proposed development allocation (© Environment Agency)

Figure 2.3 shows that the proposed development allocation is located within an area identified as being at 'very low' risk of flooding from surface water. This is supported by information contained within the Folkestone & Hythe SFRA (2015), which reveals that there are no records of flooding from surface water in the past. Consequently, it is concluded that the risk of flooding from this source is 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).

Groundwater flooding is most likely to occur in low-lying areas that are underlain by permeable rock (aquifers). The underlying geology in this area is Hasting Beds, with overlaying superficial Tidal Flat Deposits. This geological makeup is characteristically permeable and therefore can be susceptible to groundwater emergence.

OS mapping shows there is a complex network of drainage ditches to the south of the site. The main purpose of this drainage network is to artificially maintain reduced groundwater levels in the area and consequently, the risk of flooding from groundwater is directly linked to the risk of flooding from the drainage network which has been identified to be low. Furthermore, there are no records of flooding from groundwater at the site shown in the records outlined in the SFRA. It is concluded that the risk of flooding from groundwater is 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.

Information contained within the SFRA which shows that there are no known records of flooding from sewers in this area. In addition, correspondence with Southern Water has confirmed that there are no sewers in proximity to the proposed development site and consequently, the risk of flooding from this source is therefore considered to be low.

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, sand and 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' website 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
Rivers, ordinary and man-made watercourses	Low	OS mapping, the EA's 'Flood Map for Planning' and aerial height data
Sea/Estuaries	Appraised in Section 5	OS mapping and the EA's 'Flood Map for Planning'
Overland flow	Low	Environment Agency 'Flood Risk from Surface Water' map, and historic records contained within the Folkestone & Hythe SFRA

Groundwater	Low	Defra Groundwater Flood Scoping Study, aerial height data, OS mapping, and historic records in the SFRA
Sewers	Low	OS mapping, asset location data provided by Southern Water and historic sewer records contained within the SFRA
Artificial sources	Low	OS mapping and Environment Agency 'Flood Risk from Reservoirs' flood map

Table 2.1 – Summary of flood sources and risks.

2.3 Existing Flood Risk Management Measures

The shoreline of the District is approximately 41km long and much of this is defended to protect the lower-lying, rich and fertile land that forms part of the Romney, Walland and Denge Marshes. The land levels in these marsh areas are generally below the Mean High Water Springs (MHWS) level and consequently, without the protection of the existing sea defences much of this land would be permanently inundated.

In 2001, the Folkestone to Rye Coastal Defence Strategy Plan recognised the relatively low standard of protection and state of deterioration of the seawalls that protect the Dymchurch, St Mary's Bay and Littlestone frontages, recommending a phased scheme of improvement works.

The first scheme was at Littlestone-on-Sea, which is fronted by a concrete seawall backed by a strip of shingle backshore. In April 2003, work on the Littlestone to St Mary's Bay sea defence scheme started. This involved improvement works to the seawall itself and the importation of 240,000 cubic metres of shingle. The scheme is now complete and the area benefits from a 1 in 200 year standard of protection, although this can be reduced at times when beach levels are drawn down.

In 2005, work started on the improvement works to the Dymchurch seawall between the Redoubt and Martello Tower number 23 and this included placing a rock armour revetment along the lower apron of the seawall, improvements to the concrete upper section and raising the seawall crest. These works are now complete and provide a standard of protection of 1 in 200 years. Following these works the scheme was extended to meet the St. Mary's Bay defences, and comprise a concrete revetment and rear wave return wall. These works were completed in 2012.

In 2015, the Broomhill Sands Coastal defence scheme, located between Jury's Gap and Dungeness Power Station, was completed. The defences comprise an earth embankment, rock revetment and shingle beach (which is replenished on an annual basis). Combined this provides a 1 in 200 year standard of protection from flooding from the sea. These defence improvement works were not completed before the Folkestone & Hythe SFRA (2015) was published, and as such, the high standard of protection provided by the defences is not accurately represented within the modelling undertaken as part of the SFRA (referenced throughout this report).

3 Climate Change

When the impact of climate change is considered it is generally accepted that the standard of protection provided by current defences will reduce with time. 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 of the type responsible for the recent UK flooding 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.

3.1 Potential Changes in Climate

Extreme Sea Level

Global sea levels will continue to rise, depending on greenhouse gas emissions and the sensitivity of the climate system. The relative sea level rise in England also depends on the local vertical movement of the land, which is generally falling in the south-east and rising in the north and west. The accompanying Planning Practice Guidance Suite to the NPPF provides allowances for the regional rates of relative sea level rise and these are shown in Table 3.1.

Administrative Region	Net Sea Level Rise (mm/yr) Relative to 1990			
	1990 to 2025	2026 to 2055	2056 to 2085	2086 to 2115
East of England, East Midlands, London, SE England (south of Flamborough Head)	4.0	8.5	12.0	15.0
South West	3.5	8.0	11.5	14.5
NW England, NE England (north of Flamborough Head)	2.5	7.0	10.0	13.0

Table 3.1 – Recommended contingency allowances for net sea level rise

From these values it can be seen that the extreme flood level at the site will change with time and that this change is not linear. The 1 in 200 year flood level at the site has therefore been calculated for a number of steps between the current day and the year 2115 and these values are shown in Table 3.2 below.

Year	1 in 200 year extreme water level (m AODN)
Current day (year 2008)	4.75
2025	4.82
2055	5.07
2075	5.31
2085	5.43
2115	5.88

Table 3.2 – Climate change impacts on extreme sea levels.

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 should be considered for a minimum of 100 years, but that the lifetime of a non-residential development depends on the characteristics of the development. The proposed site allocation that is the subject of this FRA is classified as residential and therefore the extreme sea level is taken as 5.88m AODN.

Peak Rainfall Intensity

In addition to the impact of tidal flooding at the site, climatic changes will also impact on the way in which the proposed development affects the risk of flooding elsewhere. These impacts are primarily linked to the surface water discharge from the site; therefore, potential increases in future rainfall need to be taken into consideration when designing surface water drainage systems.

The recommended allowances for increases in peak rainfall intensity are applicable nationally. There is a range of values provided which correspond with the central and upper end percentiles (the 50th and 90th percentile respectively) over three time epochs. The recommended allowances are shown in Table 3.3 below.

Allowance Category (applicable nationwide)	**Total potential change anticipated for each epoch**		
	2015 to 2039	**2040 to 2069**	**2070 to 2115**
Upper End	+10%	+20%	+40%
Central	+5%	+10%	+20%

Table 3.3 – Recommended peak rainfall intensity allowance for small and urban catchments (1961 to 1990 baseline).

For more vulnerable development (i.e. residential) with a design life of 100 years, a 'Central' climate change allowance is typically recommended. Therefore, an increase of 20% in peak rainfall intensity has been applied to the calculations in the surface water management strategy (refer to Section 8).

All of the above recommended allowances for climate change should be used as a guideline and can be superseded if local evidence supports the use of other data or allowances. Additionally, in the instance where flood mitigation measures are not considered necessary at present, but will be required in the future to account for changes in the climate, a "managed adaptive approach" can be adopted. This approach would allow appropriate mitigation measures to be incorporated into the proposed development in the future to combat the impacts of climate change.

4 Probability and Consequence of Flooding

4.1 The Likelihood of Flooding

When appraising the risk of flooding to new development it is necessary to assess the impact of the 'design flood event' to establish depths, velocities and the rate of rise of floodwater under such conditions. 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 200 year (0.5% AEP) event for sea or tidal flooding, including an appropriate allowance for climate change (refer to Section 3.1).

4.2 Actual Risk of Flooding

The EA has undertaken modelling as part of the Romney Marsh Mapping Study 2017 and the study includes two modelled scenarios; 'undefended' and 'defended'. Section 2.3 of this report has identified that the site is currently protected by existing defence infrastructure and as such, it is evident that the 'undefended' scenario does not present a realistic representation of the actual risk of flooding.

The results of the defended scenario confirm that the site is protected from an extreme coastal event with a 1 in 200 year return period. However, the data provided for the defended scenario does not include an allowance for climate change, as required by the NPPF. Consequently, the coastal modelling from the Folkestone & Hythe District Council SFRA has been interrogated.

The SFRA modelling simulates the impact of wave overtopping during a 1 in 200 year event in the year 2115. The results show that the proposed development allocation remains unaffected under all of the modelled scenarios, and therefore the actual risk of flooding from the sea is considered to be low.

4.3 Residual Risk of Flooding

When assessing residual risk it is necessary to consider the impacts of a flood event that exceeds the design event, or in the case of areas that are already defended to an adequate standard, the impact of a failure of these defences.

As part of the SFRA modelling, 7 breach scenarios have been modelled and reference to the outputs shows that, when 100 years of climate change is taken into consideration, the lower part of the site could be affected by a breach at Broomhill Sands (Figure 4.1).

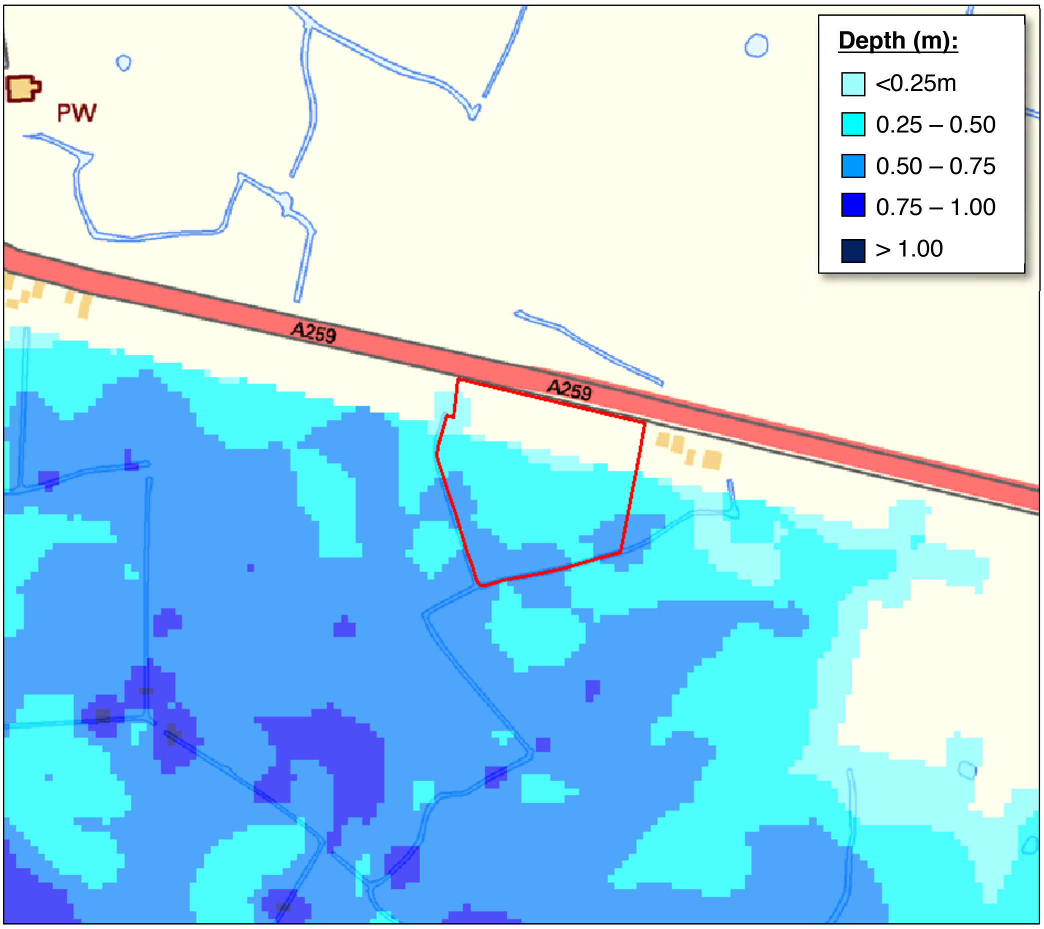


Figure 4.1 – Maximum predicted flood extent under a breach scenario at Broomhill Sands for the 1 in 200 year flood event including 100 years of climate change (i.e. future year 2115).

Under this scenario, the maximum predicted flood level is 2.58m AODN and the southern part of the proposed development allocation could be subject to flooding to a depth of 0.88m. The northern part of the site which is located on the Rhee Wall is shown to be remain dry.

It should be recognised that, since the publication of the SFRA, the defences at Broomhill Sands have been upgraded. As a result of these works, the likelihood of a breach forming within the defence has significantly reduced.

4.4 Velocities and Rate of Rise of Floodwater

The site is located over 1km from the sea defences and therefore there will be a residual delay between the defences breaching and the floodwater reaching the site. Interrogation of the SFRA results reveal that it will take in excess of 20 hours after the peak of the tide for floodwater to reach the proposed development allocation. Once water has reached the site, the rate of rise will be gradual.

Given that the volumes of water flowing through the breach are likely to be very large, the flow velocities in close proximity to the breach will be very high and are likely to cause structural damage.

However, these velocities will decrease with distance away from the breach. The flow velocities associated with floodwater at the proposed development allocation are not expected to exceed 0.2m/s.

5 Offsite Impacts

5.1 Access and Egress

The NPPF states that safe access and escape should be available to/from new developments located within areas at risk of flooding. The Practice Guidance 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.

It has been demonstrated that the site is currently defended up to a 1 in 200 year standard of protection and remains protected, even when 100 years of climate change are taken into consideration. It is only in the event of a breach of the defences that the lower part of the site could be flooded. Consequently, if pitches were to be located in the lower part of the site, then access/egress to/from the pitches could be affected.

Reference to the Practice Guidance shows that in circumstances where it is not possible to provide dry access, the flood hazard to people under the design flood conditions needs to be quantified. The modelling undertaken for the SFRA includes a series of hazard maps, delineating the maximum hazard rating following a breach. An extract is shown in Figure 5.1 below and the hazard classifications associated with these maps is shown in Table 5.1 below.

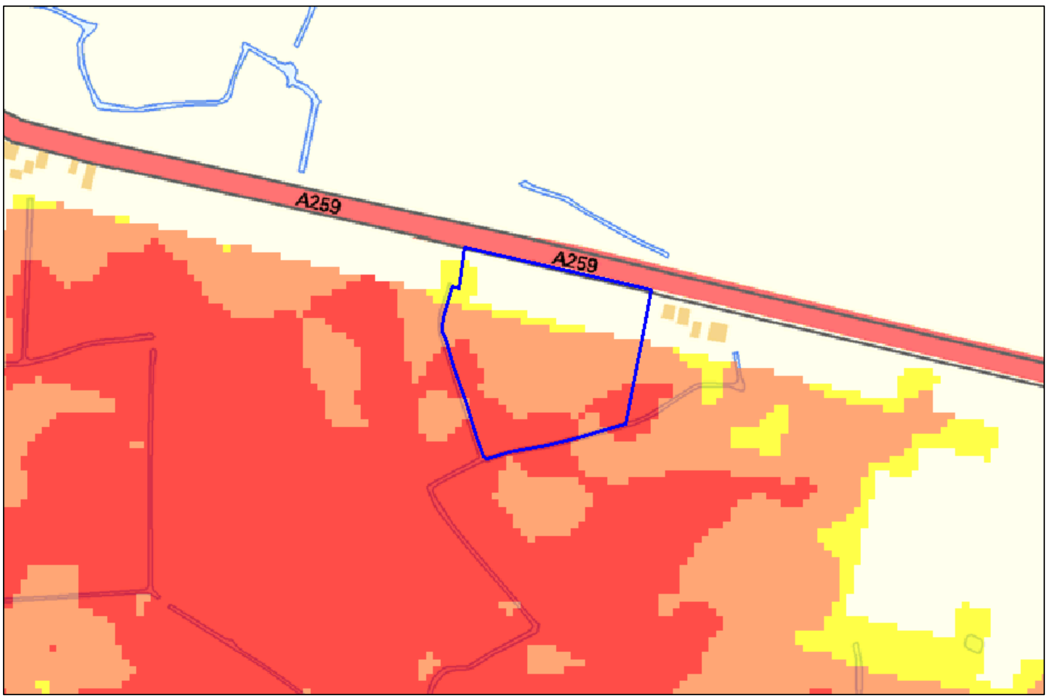


Figure 5.1 – Extract from the SFRA model results showing the hazard rating classification on site for a breach scenario for the 1 in 200 year return period, including 100 years of climate change. The proposed allocation site is outlined in blue.

Hazard Rating (HR)	Degree of flood hazard	Description
< 0.75	Low	Caution – shallow flowing water or deep standing water
0.75 to 1.25	Moderate	Dangerous for some, i.e. children – deep or fast flowing water
1.25 to 2.5	Significant	Dangerous for most people – deep fast flowing water
> 2.5	Extreme	Dangerous for all – extreme danger with deep and fast flowing water

Table 5.1 – Classification of Hazard Rating Thresholds.

From Figure 5.1, it can be seen that the hazard rating in the area affected by flooding ranges from 'significant' near to the drainage ditches, to 'low' adjacent to Rhee Wall. Safe dry egress from the site can be seen to be available along the A259. As such, it is recommended that users of the site refer to a flood warning and evacuation plan (FEP) to relocate to an area located outside of the predicted flood extents. The requirement for a FEP is discussed further in Section 6.4.

5.2 Displacement of Floodwater

Where development is proposed in tidal floodplains such as is the case here, it is generally accepted by the EA that raising the ground or building on the floodplain is unlikely to impact on maximum tidal levels. As such, the development will not increase the risk of flooding offsite.

5.3 Proximity to Watercourse

Under the Land Drainage Act 1991, as amended by the Flood and Water Management Act 2010, Lead Local Flood Authorities (LLFA) are responsible for the regulation of ordinary watercourses. The LLFA responsible for the watercourse adjacent to the proposed allocation site is Kent County Council (KCC). The Land Drainage Act requires that formal written consideration is sought for any works adjacent to, or within a watercourse that could affect in-channel flows.

KCC's Drainage and Planning Policy Statement recommends that ordinary watercourses "should be preferably retained as an open feature within a designated corridor, and ideally as public open space". It is therefore recommended that a 4m buffer is maintained from the toe of the bank of the drainage ditch.

5.4 Surface Water Management

The general requirement for all new development is to ensure that the runoff from the development is managed sustainably and that the drainage solution does not increase the risk of flooding at the site, or within the surrounding area.

For undeveloped greenfield sites, the impact of the proposed development will therefore require mitigation to ensure that the runoff from the site replicates the natural drainage characteristics of the pre-developed site.

Consequently, a surface water management strategy has been prepared to ensure that the risk of flooding is not increased onsite or offsite as a result of the proposals (refer to Section 7).

6 Management of Flood Risk

The following section appraises the opportunities to manage the risk of flooding to the proposed site allocation, using a range of flood mitigation measures. Only mitigation measures which are considered appropriate for the development proposals and can meet the requirements set out in the draft allocation policy RM15 have been considered.

6.1 Sequential Approach

The sequential approach to flood risk management can be adopted on a site-based scale and this can often be the most effective form of mitigation. For example, 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.

The 'less' vulnerable elements of the proposed development, such as the amenity blocks, visitor parking and storage facilities, could be located anywhere on-site. However, site allocation policy RM15 states that pitches are to be '*located away from the areas of highest flood risk'*. Permanent residential pitches are classified as having a 'highly vulnerable' use, and therefore should only be located within the highest part of the site, outside of the predicted extent of flooding from a breach.

6.2 Flood Resistance

Flood Resistance or 'dry proofing', involves the use of measures which reduce the risk of internal flooding by preventing floodwater ingress. This can be achieved by utilising flood resistant materials and construction techniques, or by simply raising the development above the flood level (i.e. through floor raising or land raising).

As set out in 6.1 (above), it is recommended that the permanent residential pitches are located outside of the predicted extent of flooding from a breach of the defences, and therefore would remain unaffected by flooding under the design event. As such, further mitigation has not been considered appropriate for these units.

With respect to the proposed amenity blocks and storage units, if these cannot be located outside the predicted extent of flooding, the finished floor level for the units should be situated above the flood level from a breach (i.e. 2.58mAODN). This could be achieved by either raising the internal finished floor level or undertaking land raising. However, in the event that there are constraints which prevent the building from being raised (i.e. access limitations), it may be possible to utilise flood resistant design to limit the ingress of floodwater as an alternative option.

Should any temporary residential pitches be proposed in the future, over and above the permanent pitches planned for in policy RM15, then caravans are expected to have floor levels which are elevated approximately 800mm above the ground. As such, it is recommended that these pitches are only located in the area where the depth of flooding is less than 0.5m, (refer to Figure 4.1) to ensure that there is sufficient freeboard between the predicted flood level from a breach and the internal floor level to prevent the ingress of floodwater.

6.3 Flood Resilience

Flood Resilience or 'wet proofing', accepts that internal flooding may occur, and seeks to accommodate this situation through careful internal design to limit damage. 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.

In line with the recommendations of this report, the permanent residential pitches are to be located outside of the predicted extent of flooding. Therefore, it is only the amenity building and storage units where flood resilience measures may be necessary, if these structures cannot be accommodated outside the predicted extent of flooding. These measures will help reduce the impact of a flood event.

Details of flood resilience measures can be found in the document 'Improving the Flood Performance of New Buildings; Flood Resilient Construction', which can be downloaded from the Communities and Local Government website.

6.4 Flood Warning and Evacuation

In the event of a breach of the defences, the lower part of the site could be flooded preventing safe dry access/egress to/from if pitches were to be located in the lowest part of the site, at the peak of the event. However, the higher part of the site to the north will remain unaffected and as such, there will be safe dry access/egress available to/from the site via the A259 (Lydd Road). Consequently, it is advised that occupants utilise the EA's early flood warning system to ensure early evacuation of the site via the A259 *prior* to the onset of flooding.

The occurrence of a breach is difficult to predict, but is typically associated with an extreme tidal storm surge event in the North Sea. Such an event is dependent on meteorological conditions that can be monitored reliably and therefore it is likely that a minimum of 12 hours warning could be given of a storm event. This forewarning can ensure that users of the site are aware of the potential for a breach to occur.

Following the occurrence of a breach, it has been shown that it is predicted to take in excess of 20 hours for floodwater to reach the site. Consequently, even if a forewarning is issued once the breach has occurred, there should be sufficient time available to ensure that users of the site can prepare themselves to evacuate to higher ground before floodwater reaches the site.

A Flood Warning and Evacuation Plan has therefore been prepared for the development, as required by the NPPG. The FEP should be used in conjunction with the EA's Flood Warning Service. Residents of the site can sign up to the EA's Flood Warning Service either by calling 0345 988 1188, or by visiting; https://www.gov.uk/sign-up-for-flood-warnings

7 Surface Water Management Strategy

7.1 Background and Policy

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 Flood and Water Management Act 2010 National Standards (Schedule 3 – paragraph 5) for design, construction, maintenance and operation of Sustainable Drainage Systems (SuDS), came into effect from 6 April 2015 and provides additional detail and requirements not initially covered by the NPPF and are Non-statutory Technical Standards for Sustainable Drainage Systems (NTSS).

The NTSS specify criteria to ensure sustainable drainage is included within developments greater than 1ha. It is, however, recognised that SuDS should be designed to ensure that the maintenance and operation requirements are economically proportionate.

In addition to the NTSS, Kent County Council's (KCC) Drainage and Planning Policy Statement (June 2017) also applies. Most notably this document states that in the absence of FEH rainfall data, a rainfall depth of 26.25mm for M5-60 event should be applied.

7.2 Surface Water Management Overview

The main characteristics of the proposed allocation that have the potential to influence surface water drainage are summarised in Table 7.1 below. As the site layout has not yet been designed, for the purposes of these calculations, it has been assumed that 50% of the site will be impermeable. The remaining 50% will be permeable. These assumed impermeable areas will need to be reassessed once a more detailed scheme design has been undertaken.

Site Characteristic	Value
Total area of site	1.5 ha
Impermeable area (existing)	0 m^2 (undeveloped)
Impermeable area (proposed)	~0.75 ha (50% of the total site area)
Unaltered / Retained areas (excluded from calculations)	~0.75 ha
Greenfield runoff rates (based on the IH124 methodology)	QBar = 2.28 l/s Q30 = 6.18 l/s Q100 = 8.57 l/s
Current surface water discharge method	Discharge into surrounding drainage ditches leading to the Romney Marsh Internal Drainage Board watercourses

Table 7.1 – Site characteristics affecting rainfall runoff.

Reference to the Table 7.1 above shows the proposed development will increase the percentage of impermeable area within the boundaries of the site. Consequently, this will increase the rate and volume of surface water runoff discharged from the site. It will therefore be necessary to provide mitigation measures to ensure the rate of runoff discharged from the site is not increased as a result of the proposed development.

Assuming the impermeable areas of the proposed development equate to 50% of the total site area, runoff rates have been calculated for a range of annual return probabilities including the 100 year return period event, with a 20% increase in rainfall intensity to account for future climatic changes. These values are summarised in Table 7.2 for a range of return periods.

Return period (years)	Peak runoff (l/s) Developed site
1	198.9
30	486.5
100	637.8
100 + 20%	765.3

Table 7.2 – Summary of peak runoff.

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

7.3 Existing Drainage

The existing site currently discharges surface water runoff informally to field drainage ditches located along the southern and western boundaries of the site. Figure 7.1 below indicates the position of the ditches relative to the site.

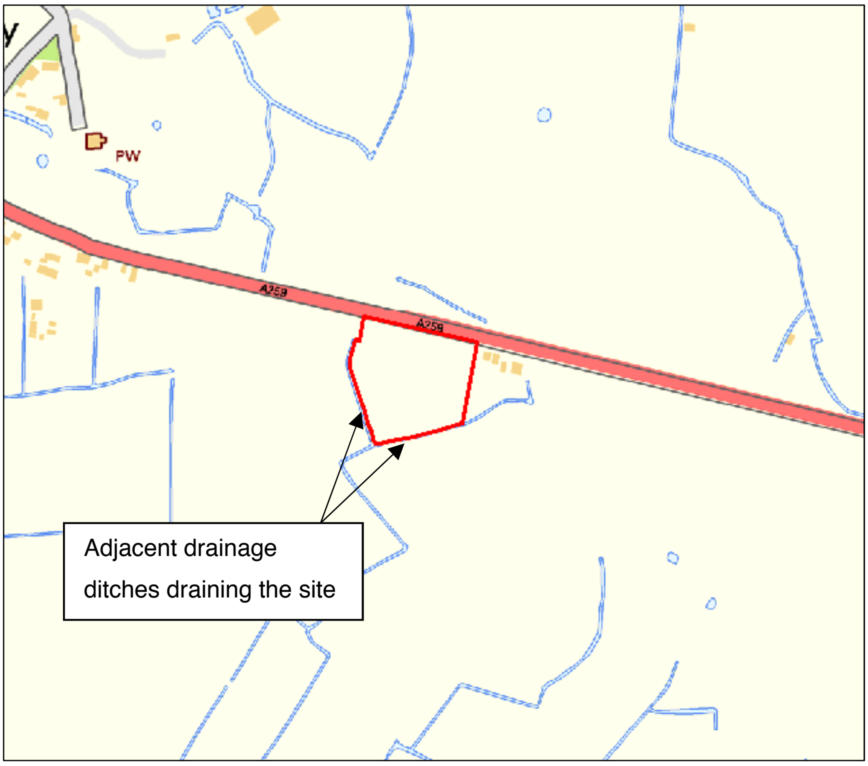


Figure 7.1 – Plan showing the adjacent drainage ditches to site.

Correspondence from Southern Water indicates that there are no public sewers located in close proximity to the site. Although, there may be the presence of private sewers within the area, it is unlikely that there are any located within the vicinity of the site.

Further investigation may be required as part of the detailed design to confirm the exact layout of the existing underground utilities and the potential to utilise any pre-existing connections.

7.4 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 of preference is for the runoff to be discharged into a **watercourse**. Only if neither of these options are possible, the water should be conducted into the **public sewer** system.

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 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 – Whilst site-specific ground investigations have not been carried out at this stage in the development process, the geology of the site predominantly comprises of sandstone, siltstone and mudstone with clay and silt superficial deposits. Typically soakage properties within this geology is considered to be poor and consequently, it has been assumed on this basis that infiltration will not be a suitable method for discharging surface water runoff from the site.

Discharge to Watercourses – Figure 7.1 (above) shows the location of an existing drainage ditches adjacent to the southern and western site boundaries. OS mapping for the area surrounding the site has been inspected and it is concluded that these ditches are likely to drain to the wider catchment. Due to the proximity of the ditches to the site, it is likely that a direct connection will be possible. Consequently, a connection to either watercourse is likely to be the most sustainable solution for draining surface water runoff from the proposed development.

Discharge to Public Sewer System – as an alternative preferred solution is available and there are no mapped public sewers within the vicinity, discharge into the public sewer will not be viable.

7.5 Constraints and Further Considerations

There are a number of potential constraints that should be considered as part of the drainage strategy. The key constraints that are relevant to this development are listed below:

- 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.
- If a new connection to the existing watercourse is needed, it will be necessary to obtain ordinary watercourse consent from the Lead Local Flood Authority before construction can commence. It may also be necessary to gain consent for the new connection from the Romney Marsh Internal Drainage Board who should be consulted as part of the connection proposals.

7.6 Sustainable Drainage Systems (SuDS)

Appropriately designed SuDS can be utilised such that they not only attenuate runoff but also provide a level of improvement to the quality of the water passed on to watercourses or into the groundwater table. This is known as source control and is a fundamental part of the SuDS philosophy.

A range of typical SuDS that can be used to improve the environmental impact of a development is listed in Table 7.3 below along with the relative benefits of each feature and the appropriateness for the subject site.

SuDS	Description	Constraints/Comments	Appropriate for site?
Rainwater harvesting systems	Collecting of rainwater and storing for reuse on site.	None	Yes
Green/Blue roofs	Provide landscaping and planting at roof level to reduce surface water runoff rates.	Not appropriate for the development type	No
Infiltration Systems	Allow water to percolate into the ground at a controlled rate via natural infiltration.	Poor soakage rates, unviable	No
Filter strips	Wide gently sloping densely planted areas promoting sedimentation and filtration.	For conveyance only (no infiltration)	Yes
Filter drains	Trenches infilled with stone/gravel providing attenuation, sedimentation and filtration.	For conveyance only (no infiltration)	Yes
Swales	Broad shallow channels that convey and store runoff and allow infiltration.	None	Yes
Bioretention systems / rain gardens	A shallow landscaped depression allowing runoff to pond temporarily on the surface.	None	Yes
Permeable pavements	Runoff is allowed to soak into structural paving and stored potentially being allowed to infiltrate.	For conveyance only (no infiltration)	Yes
Underground storage	Below ground storage which can be used to temporarily store storm water.	None	Yes
Detention basins	A landscaped depression for attenuation with a restricted runoff.	None	Yes
Ponds and wetlands	A permanent pool of water which can be used for attenuation and controlled outflows by water levels.	None	Yes

Table 7.3 – Potential use of SuDS at this site.

From Table 7.3 it can be seen that there are a number of SuDS elements which could potentially be suitable for use at this site. However, at this stage in the planning process it is envisaged that above ground storage will be used to store water and attenuate the rate at which surface water is discharged to the adjacent watercourse(s).

7.7 Proposed Surface Water Storage System

In accordance with the NTSS and local planning policy, it will be necessary to provide storm water attenuation on site to replicate, or reduce the current discharge rates. In order to achieve this, it will be necessary to install storage features at the lowest point of the site to avoid pumping. Calculations have been undertaken to determine the required storage volume for the site when discharging into the watercourse at QBar.

Parameter	Value
Assumed area draining to storage system	7,500m²
Infiltration rate	Negligible
M5-60 (FSR methodology)	26.25mm
Return Period	1:100yr +20%cc
Design Flow Restriction	2.3l/s
Volume of storage required	712m³

Table 7.4 – Estimated storage volume for the proposed development assuming 50% of the site is impermeable.

From the table above, it is evident that with the inclusion of a proposed storage system there is the potential to accommodate all of the surface water runoff from the site up to, and including, the design rainfall event. Furthermore, the rate at which water is discharged from the site can be reduced by using a flow control device, and therefore the principle of this type of SuDS system is likely to meet the planning requirements.

The typical geometry of a drainage basin would comprise a depth of 0.8m with 1:3 side slopes. This configuration would require an approximate area of 940m². Inspection of the proposed allocation plan suggests that there is sufficient space to incorporate a basin of this size within the curtilage of the site. Access to the basin for maintenance should also be considered, leaving adequate space around the top edge/perimeter of the basin. A single track access around the top of the basin, with a width of 4m, would enable a suitable access for an excavator/vehicles.

7.8 Foul Water Drainage

In general, there are two methods for draining foul effluent from proposed development sites. The preferred solution is a connection to the public sewer network, which is controlled by the sewerage undertaker. Nonetheless, if there are no sewers near to the development site, as is commonly the case in rural locations, then the use of package treatment systems or cesspits is permitted.

The Environment Agency's "Binding Rules" control the use of package treatment systems. For example, if the site boundary is located within 30m from an existing sewer (plus an additional 30 meters for every proposed unit), the EA will require the development to connect to the public sewer system. In this case, there are no sewers located in the surrounding areas and therefore, a new connection to the public sewer system is not considered a viable option. The use of alternative solutions for managing foul effluent at the site have therefore been explored.

For package treatment systems to be acceptable it will be necessary to meet the requirements of the Environment Agency and Lead Local Flood Authority. In this case the poor infiltration rates at the site will restrict the use of package treatment systems which discharge treated effluent to the ground, e.g. via a drainage mound. Nonetheless, *treated* effluent could still be drained to the existing watercourse.

It will be necessary to obtain an environmental permit from the Environment Agency before construction of the foul drainage system can commence. The foul drainage system will need to meet current British Standards, as well as any additional design requirements and water quality requirements specified by the EA.

Before any treated effluent can be discharged to the neighbouring watercourse, it will be necessary to obtain ordinary watercourse consent for the new connections.

Inspection of the proposed allocation site confirms that there is sufficient space within the site to accommodate package treatment systems and consequently, the use of package treatment systems is likely to provide a viable solution for this development.

8 The Sequential and Exception Test

8.1 The Sequential Test

Local Planning Authorities (LPA) are encouraged to take a risk-based approach to proposals for development in areas at risk of flooding through the application of the Sequential Test. The objectives of this test are to steer new development away from high risk areas towards those areas at lower risk of flooding. However, in some areas where developable land is in short supply there can be an overriding need to build in areas that are at risk of flooding. In such circumstances, the application of the Sequential Test is used to ensure that the lower risk sites are developed before the higher risk ones.

The National Planning Policy Framework (NPPF) requires the Sequential Test to be applied at all stages of the planning process and generally the starting point is the EA's flood zone maps. Reference to Figure 3.1 identifies that the site is partially located within Flood Zones 1, 2 and 3. This mapping, however, does not distinguish between high risk areas and the functional floodplain, i.e. Zones 3a and 3b. This is an important differentiation that needs to be made by the FRA because the NPPF states that [*ideally*] no development, other than essential transport and utilities infrastructure, should be located within the functional floodplain. From the analysis undertaken it has been demonstrated that the site is afforded a standard of protection of 1 in 200 years, and therefore located outside of the functional floodplain (i.e. it is classified as Flood Zone 3a).

The flood zone mapping and associated information has been summarised in Table 8.1 below.

Flood Zone (percentage of site within zone)		**Source of flooding**	**Benefiting from existing flood defences***
Zone 1	**~20%**	N/A	N/A
Zone 2	**<5%**	Sea/Estuaries	Yes
Zone 3a	**~75%**		
Zone 3b	**0%**		

(*) The flood zone maps only recognise defences constructed within the last 5 years

Table 8.1 – Flood zone classification.

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. As the site is proposed to be allocated within the PPLP, it is concluded that the Sequential Test has already been applied, and the development has met the requirements of the Sequential Test.

8.2 The Exception Test

According to the NPPF, where it has been demonstrated that the requirements of the Sequential Test can be met as part of the site allocation process, it is still necessary to consider the application of Exception Test.

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 8.2 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	✓ (shaded)	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	✓	✓ (shaded)	✓ (shaded)	×
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 8.2 – Flood risk vulnerability and flood zone compatibility.

From Table 8.2 it can be seen that the development site for permanent Gypsy and Traveller pitches as envisaged by policy RM15 is considered appropriate for its location and does not require the Exception Test to be applied. This does not include any future proposals for visitor or touring caravans as these do not form part of the draft policy allocation.

9 Conclusions and Recommendations

The key aim of this report is to determine whether the proposed allocation at Land adjacent to 'The Retreat', Lydd Road, Old Romney is sustainable in terms of flood risk, in accordance with the requirements set out in the NPPF.

This report appraises the risk of flooding from all sources of flooding and it has been identified the following measures and recommendations will be required to be incorporated into the scheme design:

- **All 'highly vulnerable' uses (i.e. permanent residential pitches) should be located within Flood Zone 1 (outside the predicted extent of flooding).** In accordance with the Flood Risk Vulnerability criteria specified in the NPPG, development classified as 'highly vulnerable' is not considered appropriate within Flood Zone 3. Consequently, it will be necessary to locate all residential pitches within Flood Zone 1.

- **An easement of 4m should be maintained from the toe of the bank of the drainage ditches.** This is to ensure that an appropriate buffer is maintained for access and biodiversity.

- **If any amenity buildings and storage units cannot be located outside the predicted extent of flooding, the floor level of these units should be raised to 2.58m AODN where possible, otherwise flood resistance measures should be proposed to limit the risk of internal flooding.** Whilst all efforts should be made to raise the floor level in order to prevent internal flooding, it is recognised that the opportunity for floor/land raising may be limited for this type of development (e.g. due to access). In which case, measures should be taken to design the building to be resistant to floodwater ingress.

- **Flood resilience measures should be incorporated into the design of the amenity and storage units.** This is recommended in accordance with best practice guidance for development in areas at risk of flooding in order to limit the impact of an exceedance event.

- **The owners of the site should sign up to the EA's Flood Warning Service and the FEP prepared as part of this report should be disseminated.** The Flood Warning Service will enable the owners to receive forewarning of a storm event and evacuate the site before floodwater reaches the site. The Flood Warning and Evacuation Plan should be used to inform residents and visitors of the site on how to safely evacuate the site and direct occupants to an area above the predicted flood level.

- **The proposed development should be designed to incorporate SuDS to control rate at which runoff is discharged from the development, ideally mimicking the greenfield runoff rates.**

- **Adequate space should be provided to incorporate surface water storage and a foul water packaged treatment plant.**

With the above measures in place, the proposals will meet the requirements of the NPPF and its Planning Practice Guidance. The proposals will therefore be acceptable and sustainable in terms of flood risk.

10 Appendices

Appendix A.1 – Drawings

Appendix A.2 – Environment Agency Flood Report

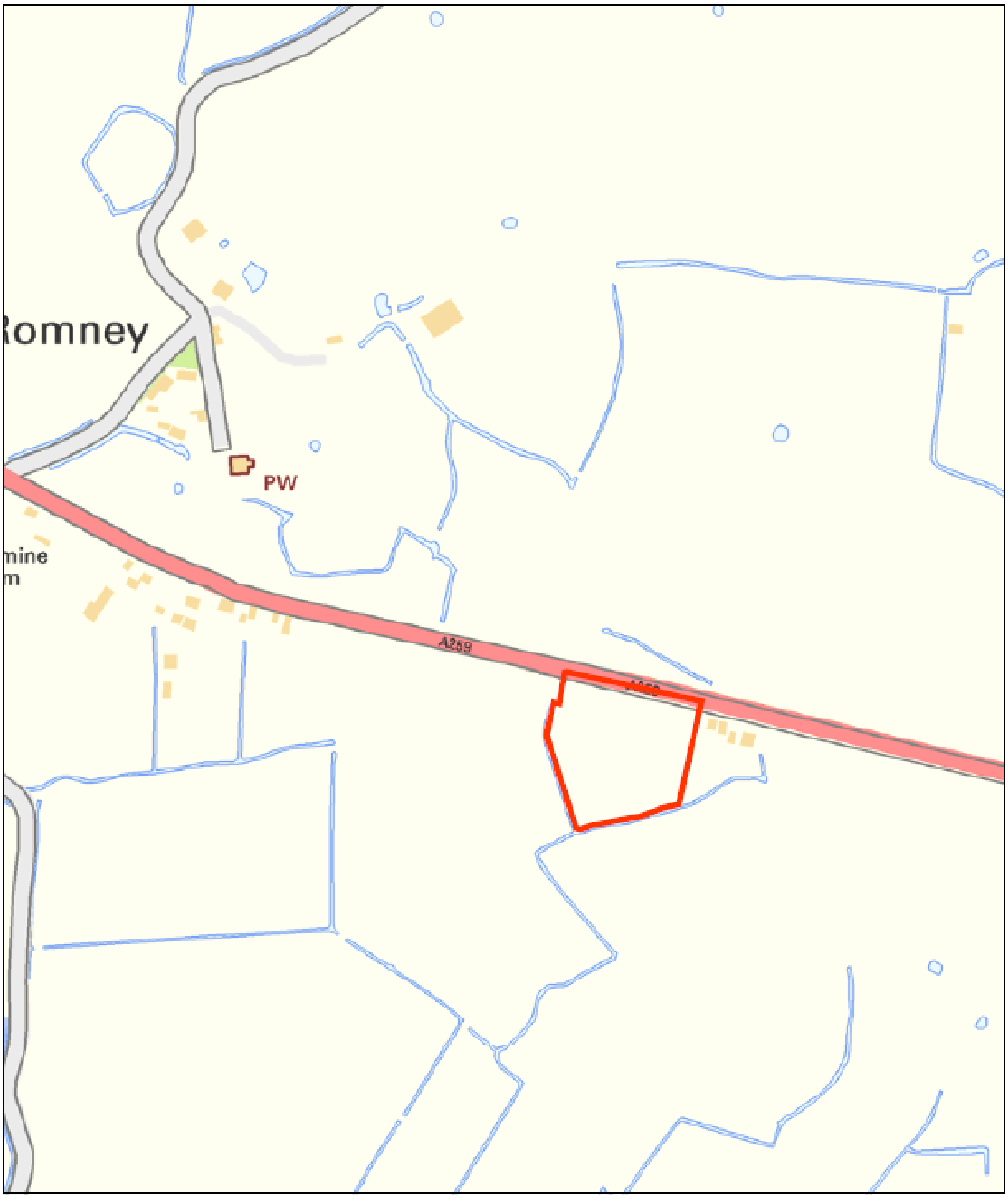
Appendix A.3 – Southern Water Response

Appendix A.4 – Surface Water Management Calculations

Appendix A.1 – Drawings

Appendix 2: Land adjacent to 'The Retreat', Lydd Road, Old Romney

Land adjacent to 'The Retreat', Old Romney

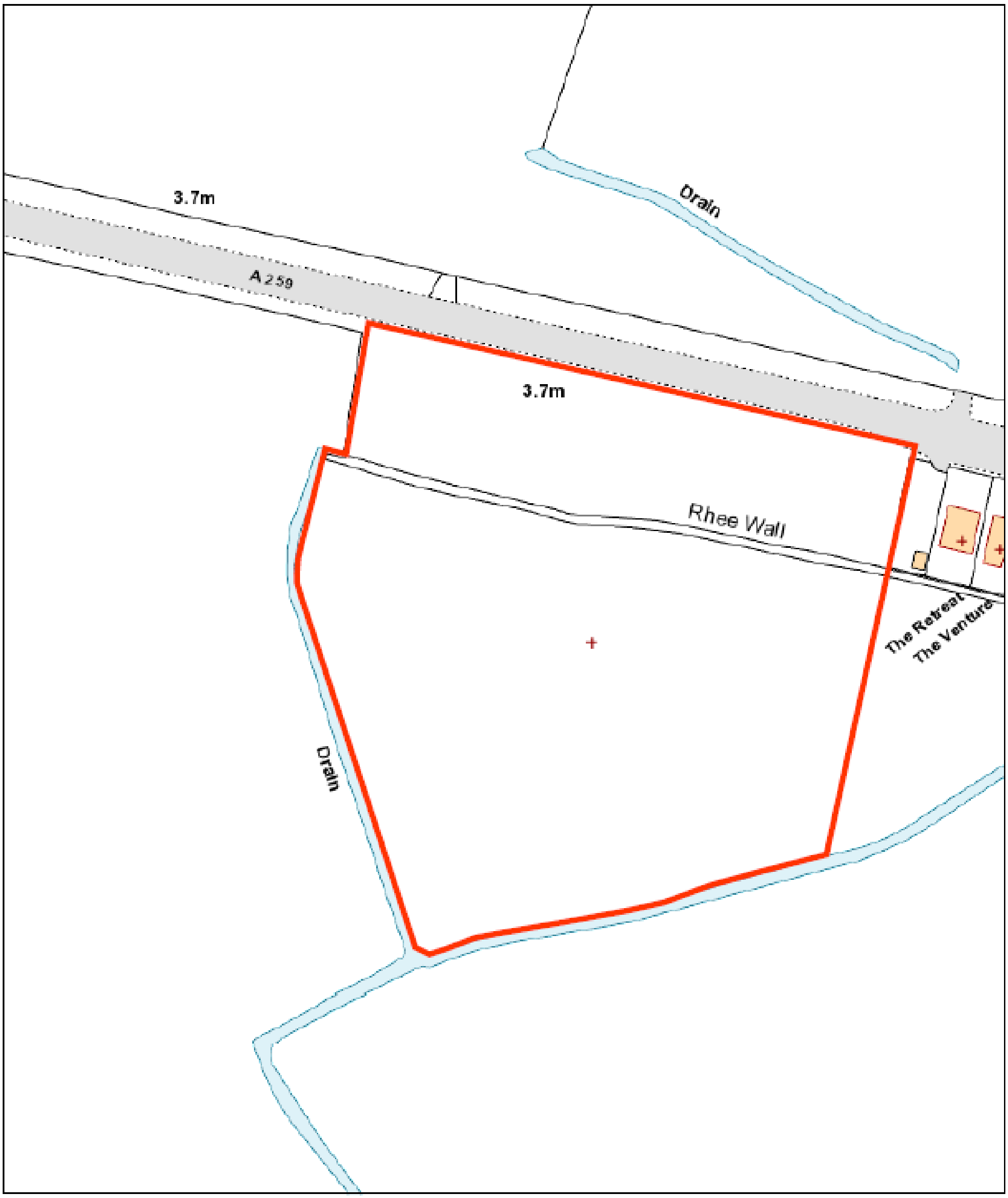


N

Drawn at
1: 5,000 on A4

0 25 50 100 150 200 250 Meters

Land adjacent to 'The Retreat', Old Romney



N

Drawn at
1: 1,250 on A4

0 5 10 20 30 40 50 Meters

Appendix 3: Draft Policy RM15: Land adjacent to 'The Retreat', Old Romney

<u>Policy RM15 – Land adjacent to 'The Retreat', Lydd Road, Old Romney</u>

Land adjacent to 'The Retreat', Old Romney is allocated for Gypsy and Traveller accommodation with capacity for 4 pitches comprising amenity blocks, parking for static and touring caravans, visitor parking; and storage.

Development proposals will be supported where

1. Vehicular access is from Lydd Road (A259) and appropriate space for turning and manoeuvring is provided within the site.
2. Pitches are sensitively sited and located away from the areas of highest flood risk.
3. A surface water drainage and foul sewerage disposal strategy is resolved to the satisfaction of the statutory authority;
4. A Phase 1 Habitat Survey is undertaken by a licensed ecologist to assess the presence of Protected Species on or near to the site. The drainage channels abutting the site should be assessed for their ecological importance and if appropriate mitigation measures introduced that maintain or improve water quality in accordance with CSD5 of the Core Strategy
5. Proposals (including any commercial activities) are compatible with and would not have an adverse impact on the amenity of neighbouring residents; and converse and enhance the natural environment in accordance with Policy NE2.
6. There is a landscaping scheme that retains the existing trees and hedgerows along the north, south and western boundaries; and where appropriate enhances the eastern boundary through additional planting.
7. Additional boundary treatments are compatible with the rural setting and wider landscape.
8. The archaeological potential of the land is properly considered and appropriate archaeological mitigation measures are put in place.
9. The development should be occupied by only those that fulfil the definition of a Gypsy or Traveller.

Appendix A.2 – Environment Agency Flood Report

Product 4 (Detailed Flood Risk) for: Land adjacent to 'The Retreat', Lydd Road, Old Romney, Kent, TN19 9SG
Requested by: Herrington Consulting Ltd
Reference: KSL 137470 CM
Date: 14 August 2019

Contents

The information provided is based on the best data available as of the date of this letter.

You may feel it is appropriate to contact our office at regular intervals, to check whether any amendments/ improvements have been made to the data for this location. Should you contact us again, after a period of time, please quote the above reference in order to help us deal with your query.

Please refer to the Open Government Licence which explains the permitted use of this information.

Orchard House, Endeavour Park, London Road, Addington, West Malling, Kent, ME19 5SH.
Email: kslenquiries@environment-agency.gov.uk

Flood Map Confirmation

The Flood Map:

Our Flood Map shows the natural floodplain for areas at risk from fluvial and tidal flooding. The floodplain is specifically mapped ignoring the presence and effects of flood defences. Although flood defences reduce the risk of flooding they cannot completely remove that risk as they may be overtopped or breached during a flood event.

The Flood Map shows the probability of a flood of a particular magnitude, or greater, occurring in any given year. This is known as the Annual Exceedance Probability (AEP). Flood Zone 3 indicates areas of land having a 1 in 100 or greater annual probability (1% AEP) of flooding from rivers, or a 1 in 200 or greater annual probability (0.5% AEP) of flooding from the sea. Flood Zone 2 indicates areas of land having up to a 1 in 1000 annual probability (0.1% AEP) of flooding from rivers or the sea. The Flood Map also shows the location of some flood defences and the areas that benefit from them.

The Flood Map is intended to act as a guide to indicate the potential risk of flooding. When producing it we use the best data available to us at the time of completion, taking into account historic flooding and local knowledge. The Flood Map is updated on a quarterly basis to account for any amendments required. These amendments are then displayed on the internet at https://flood-map-for-planning.service.gov.uk/.

At this Site:

The Flood Map shows that this site lies within the outline of the 0.5% (Flood Zone 3) chance of flooding from the sea in any given year.

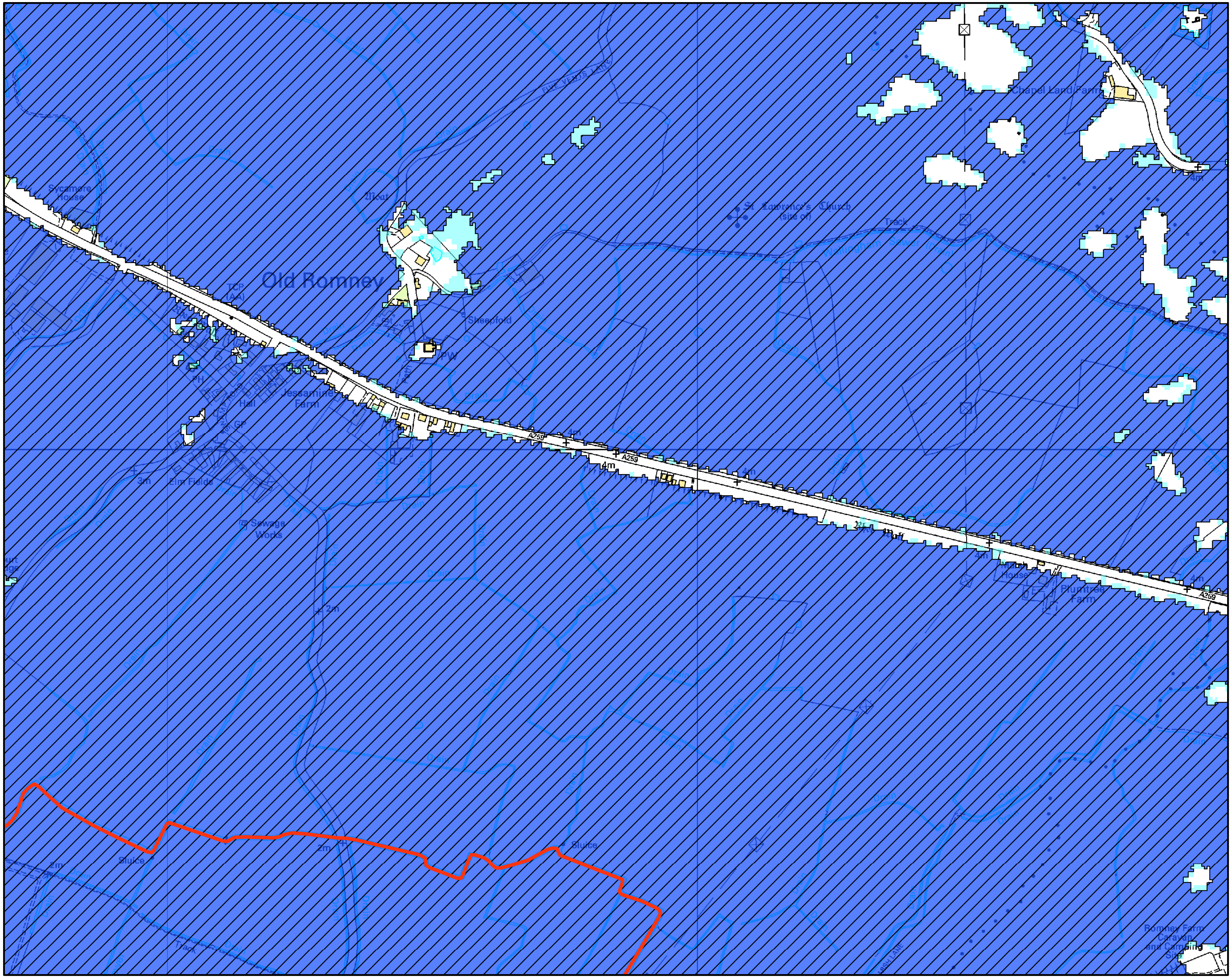
Enclosed is an extract of our Flood Map which shows this information for your area.

Method of production

The Flood Map at this location has been derived using detailed tidal modelling of Romney Marsh, completed by JBA Consulting in 2017.

Orchard House, Endeavour Park, London Road, Addington, West Malling, Kent, ME19 5SH.
Email: kslenquiries@environment-agency.gov.uk

Flood map centred on land adjacent to 'The Retreat', Lydd Road, Old Romney, Kent, TN19 9SG.
Created 14 August 2019 [Ref: KSL 137470 CM]



Environment Agency

N

Legend

- Main River
- Flood Defences
- Flood Storage Areas
- Areas Benefiting from Flood Defences
- 1% AEP Fluvial 0.5% AEP Tidal
- 0.1% AEP Flooding

Annual Exceedance Probability (AEP). The probability of a flood of a particular magnitude, or greater, occurring in any given year.

Scale 1:10,000

0 250 500
Metres

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Model Output Data

You have requested flood levels and/or depths for various return periods at this location.

A 2D TuFLOW model has been used to represent the floodplain as a grid. The flood water levels and/or depths have been calculated for each grid cell. The modelled flood levels/depths presented here are for the closest most appropriate model grid cells. Any additional information you may need to know about the modelling from which they are derived and/or any specific use or health warnings for their use are set out below.

A map showing the location of the points from which the data is taken is enclosed. Please refer to the Open Government Licence which explains the permitted use of this information.

Orchard House, Endeavour Park, London Road, Addington, West Malling, Kent, ME19 5SH.
Email: kslenquiries@environment-agency.gov.uk

Data points map centred on land adjacent to 'The Retreat', Lydd Road, Old Romney, Kent, TN19 9SG. Created 14 August 2019 [Ref: KSL 137470 CM].

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Table 1: Modelled tidal flood levels for Annual Exceedance Probability (AEP) events shown (mAOD).

Point ID	National Grid Reference		Modelled Tidal Flood Levels for Annual Exceedance Probability (AEP) events shown [metres AOD]										
			Undefended						Defended				
	Easting	Northing	0.5%	0.1%	0.5% + CC (2070)	0.1% + CC (2070)	0.5% + CC (2115)	0.1% + CC (2115)	20%	5%	1.33%	0.5%	0.1%
1	603808	124977	0.00	0.00	3.45	3.61	4.04	4.24	0.00	0.00	0.00	0.00	0.00
2	603837	124970	0.00	0.00	3.45	3.61	4.04	4.24	0.00	0.00	0.00	0.00	0.00
3	603869	124964	0.00	0.00	3.45	3.61	4.04	4.24	0.00	0.00	0.00	0.00	0.00
4	603904	124957	0.00	0.00	0.00	3.61	4.04	4.25	0.00	0.00	0.00	0.00	0.00
5	603788	124955	3.06	3.15	3.45	3.61	4.04	4.24	0.00	0.00	0.00	0.00	0.00
6	603816	124949	3.06	3.15	3.45	3.61	4.04	4.24	0.00	0.00	0.00	0.00	0.00
7	603848	124940	3.06	3.15	3.45	3.61	4.04	4.25	0.00	0.00	0.00	0.00	0.00
8	603881	124934	3.06	3.15	3.45	3.61	4.04	4.25	0.00	0.00	0.00	0.00	0.00
9	603913	124927	3.06	3.15	3.45	3.62	4.05	4.25	0.00	0.00	0.00	0.00	0.00
10	603798	124928	3.06	3.15	3.45	3.61	4.04	4.24	0.00	0.00	0.00	0.00	0.00
11	603828	124920	3.06	3.15	3.45	3.61	4.04	4.25	0.00	0.00	0.00	0.00	0.00
12	603864	124915	3.06	3.15	3.45	3.61	4.04	4.25	0.00	0.00	0.00	0.00	0.00
13	603897	124909	3.06	3.15	3.45	3.62	4.05	4.25	0.00	0.00	0.00	0.00	0.00
14	603807	124902	3.06	3.15	3.45	3.61	4.04	4.25	0.00	0.00	0.00	0.00	0.00
15	603843	124895	3.06	3.15	3.45	3.61	4.04	4.25	0.00	0.00	0.00	0.00	0.00
16	603878	124888	3.06	3.15	3.45	3.61	4.04	4.25	0.00	0.00	0.00	0.00	0.00
17	603822	124881	3.06	3.15	3.45	3.61	4.04	4.25	0.00	0.00	0.00	0.00	0.00
18	603857	124873	3.06	3.15	3.45	3.61	4.04	4.25	0.00	0.00	0.00	0.00	0.00
19	603813	124856	3.06	3.15	3.45	3.61	4.04	4.25	0.00	0.00	0.00	0.00	0.00
20	603836	124860	3.06	3.15	3.45	3.61	4.04	4.25	0.00	0.00	0.00	0.00	0.00
21	603899	124878	3.06	3.15	3.45	3.62	4.05	4.25	0.00	0.00	0.00	0.00	0.00

Data taken from the Romney Marsh Mapping Study, completed by JBA Consulting in 2017. Climate change (CC) data represents modelled levels and depths with an allowance for sea level rise for the years specified. Values of 0.00 indicate locations at which the selected points lie outside of a particular modelled flood extent. There are no health warnings or additional information for these levels/depths, or the model from which they were produced.

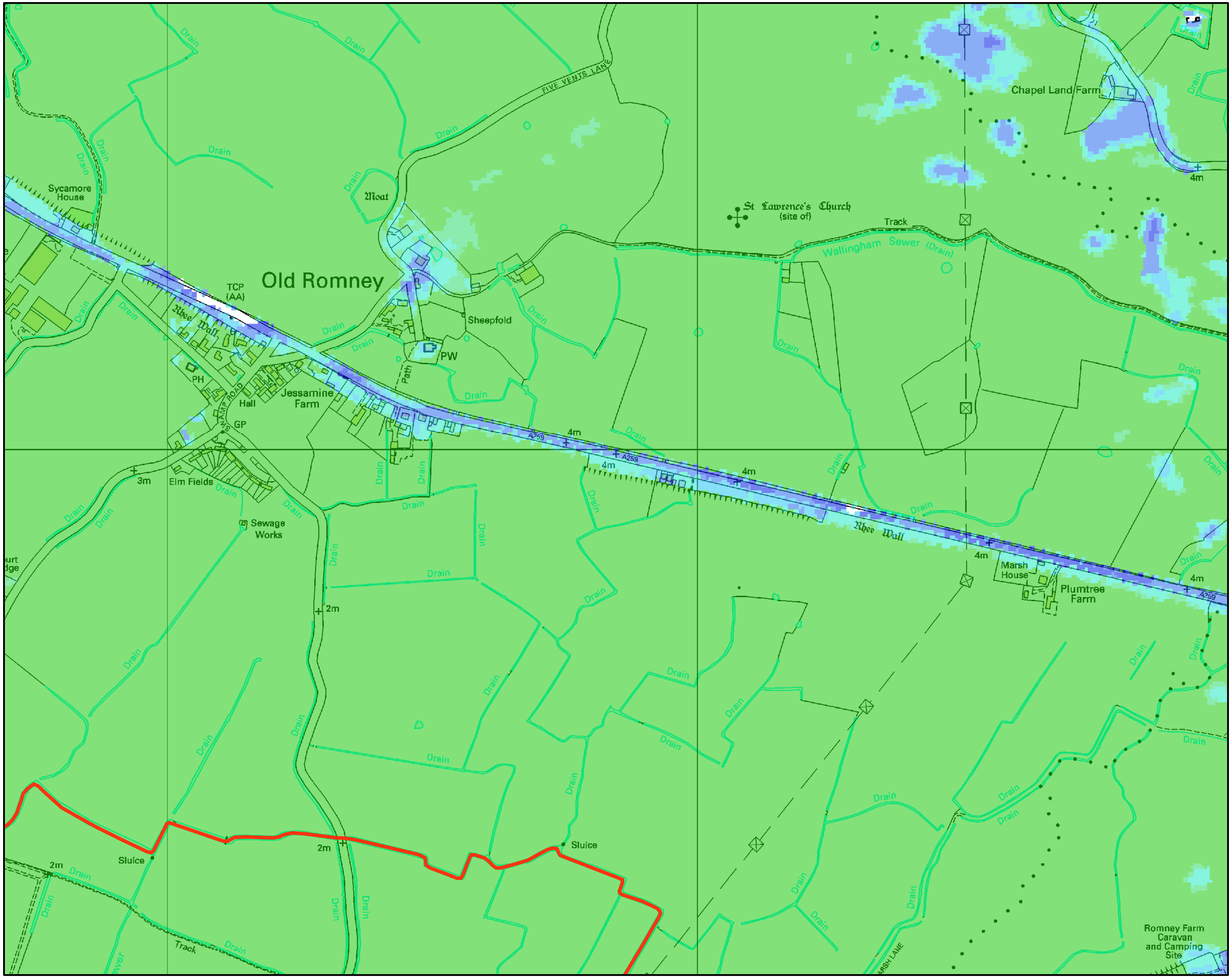
Orchard House, Endeavour Park, London Road, Addington, West Malling, Kent, ME19 5SH.
Email: kslenquiries@environment-agency.gov.uk

Table 2: Modelled tidal flood depths for Annual Exceedance Probability (AEP) events shown (m).

Point ID	National Grid Reference		Modelled Tidal Flood Depths for Annual Exceedance Probability (AEP) events shown (metres)										
			Undefended						Defended				
	Easting	Northing	0.5%	0.1%	0.5% + CC (2070)	0.1% + CC (2070)	0.5% + CC (2115)	0.1% + CC (2115)	20%	5%	1.33%	0.5%	0.1%
1	603808	124977	0.00	0.00	0.30	0.46	0.88	1.09	0.00	0.00	0.00	0.00	0.00
2	603837	124970	0.00	0.00	0.18	0.34	0.77	0.97	0.00	0.00	0.00	0.00	0.00
3	603869	124964	0.00	0.00	0.05	0.21	0.64	0.84	0.00	0.00	0.00	0.00	0.00
4	603904	124957	0.00	0.00	0.00	0.14	0.56	0.77	0.00	0.00	0.00	0.00	0.00
5	603788	124955	0.92	1.01	1.31	1.47	1.90	2.10	0.00	0.00	0.00	0.00	0.00
6	603816	124949	0.62	0.71	1.01	1.17	1.60	1.80	0.00	0.00	0.00	0.00	0.00
7	603848	124940	0.72	0.81	1.12	1.28	1.71	1.91	0.00	0.00	0.00	0.00	0.00
8	603881	124934	0.72	0.81	1.11	1.27	1.70	1.91	0.00	0.00	0.00	0.00	0.00
9	603913	124927	0.73	0.82	1.13	1.29	1.72	1.92	0.00	0.00	0.00	0.00	0.00
10	603798	124928	0.97	1.06	1.36	1.52	1.95	2.15	0.00	0.00	0.00	0.00	0.00
11	603828	124920	0.79	0.88	1.18	1.34	1.77	1.98	0.00	0.00	0.00	0.00	0.00
12	603864	124915	0.83	0.92	1.23	1.39	1.82	2.02	0.00	0.00	0.00	0.00	0.00
13	603897	124909	0.89	0.98	1.29	1.45	1.88	2.08	0.00	0.00	0.00	0.00	0.00
14	603807	124902	0.95	1.05	1.35	1.51	1.94	2.14	0.00	0.00	0.00	0.00	0.00
15	603843	124895	0.89	0.98	1.28	1.44	1.87	2.08	0.00	0.00	0.00	0.00	0.00
16	603878	124888	0.93	1.02	1.32	1.48	1.91	2.12	0.00	0.00	0.00	0.00	0.00
17	603822	124881	0.91	1.00	1.31	1.47	1.90	2.10	0.00	0.00	0.00	0.00	0.00
18	603857	124873	0.98	1.07	1.37	1.53	1.96	2.17	0.00	0.00	0.00	0.00	0.00
19	603813	124856	1.16	1.25	1.55	1.71	2.14	2.35	0.00	0.00	0.00	0.00	0.00
20	603836	124860	1.13	1.22	1.52	1.68	2.11	2.32	0.00	0.00	0.00	0.00	0.00
21	603899	124878	0.91	1.00	1.30	1.46	1.89	2.10	0.00	0.00	0.00	0.00	0.00

Data taken from the Romney Marsh Mapping Study, completed by JBA Consulting in 2017. Climate change (CC) data represents modelled levels and depths with an allowance for sea level rise for the years specified. Values of 0.00 indicate locations at which the selected points lie outside of a particular modelled flood extent. There are no health warnings or additional information for these levels/depths, or the model from which they were produced.

Undefended flood extents map centred on land adjacent to 'The Retreat', Lydd Road, Old Romney, Kent, TN19 9SG. Created 14 August 2019 [Ref: KSL 137470 CM].



N

Environment Agency

Legend

Main River

Undefended Tidal Flood Extents

- 0.5% AEP
- 0.1% AEP
- 0.5% AEP + CC (2070)
- 0.1% AEP + CC (2070)
- 0.5% AEP + CC (2115)
- 0.1% AEP + CC (2115)

Annual Exceedance Probability (AEP). The probability of a flood of a particular magnitude, or greater, occurring in any given year.

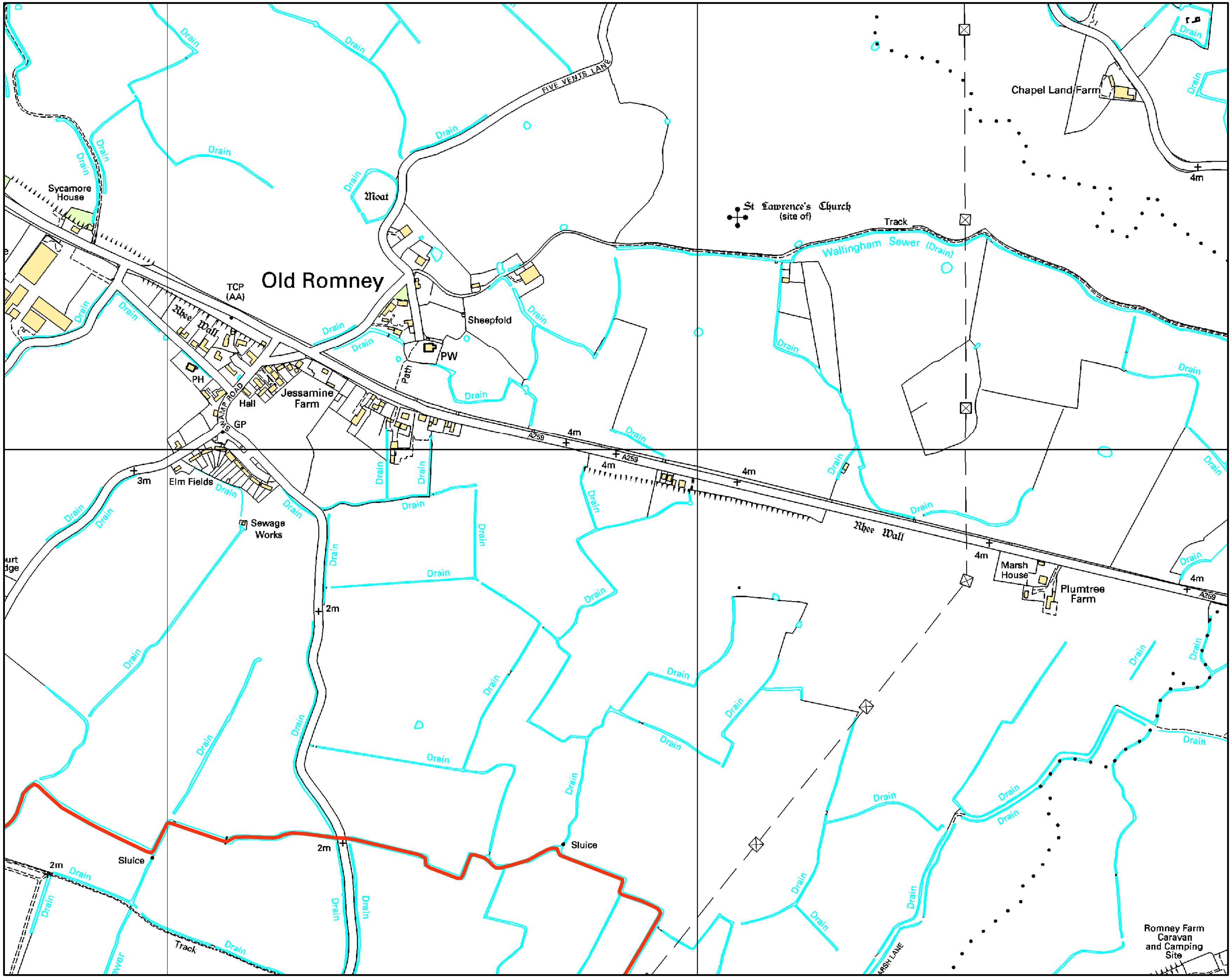
Climate Change (CC) extents based on modelled flood extents with an allowance for sea level rise, for the years specified.

Scale 1:10,000

0 250 500
Metres

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Defended flood extents map centred on land adjacent to 'The Retreat', Lydd Road, Old Romney, Kent, TN19 9SG. Created 14 August 2019 [Ref: KSL 137470 CM].



N

Legend

Main River

Defended Tidal Flood Extents

- 20% AEP
- 5% AEP
- 1.33% AEP
- 0.5% AEP
- 0.1% AEP

Annual Exceedance Probability (AEP). The probability of a flood of a particular magnitude, or greater, occurring in any given year.

Scale 1:10,000

0 250 500
Metres

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Defence Details

Due to the flat nature of Romney Marsh, much of which is below present day high tide level, flooding could regularly occur from many areas along the coast without properly maintained sea defences.

At present the defences around Romney Marsh provide a varying standard of protection from 5% (1 in 20) at Lydd Ranges, to in excess of 0.5% (1 in 200) at Greatstone dunes.

As part of the Folkestone to Cliff End Strategy, we have significant investment planned to improve the remaining sea defences on Romney Marsh to provide a 0.5% (1 in 200) standard of protection from a flood event occurring at any point along the coast by 2022.

Areas Benefiting from Flood Defences

This site is within an area benefiting from flood defences, as shown on the enclosed extract of our Flood Map. Areas benefiting from flood defences are defined as those areas which benefit from formal flood defences specifically in the event of flooding from rivers with a 1% (1 in 100) chance in any given year, or flooding from the sea with a 0.5% (1 in 200) chance in any given year.

If the defences were not there, these areas would be flooded. An area of land may benefit from the presence of a flood defence even if the defence has overtopped, if the presence of the defence means that the flood water does not extend as far as it would if the defence were not there.

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Email: kslenquiries@environment-agency.gov.uk

Historic Flood Data

We do not hold records of historic flood events from rivers and/or the sea affecting the area local to this site. However, please be aware that this does not necessarily mean that flooding has not occurred here in the past as our records are not comprehensive.

We would advise that you make further enquiries locally with specific reference to flooding at this location. You should consider contacting the relevant Local Planning Authority and/or water/sewerage undertaker for the area.

Please be aware that flooding can come from different sources. Examples of these are:
- from rivers or the sea
- surface water (i.e. rainwater flowing over or accumulating on the ground before it is able to enter rivers or the drainage system)
- overflowing or backing up of sewer or drainage systems which have been overwhelmed
- groundwater rising up from underground aquifers

Currently the Environment Agency can only supply flood risk data relating to the chance of flooding from rivers or the sea. However you should be aware that in recent years, there has been an increase in flood damage caused by surface water flooding or drainage systems that have been overwhelmed.

Additional Information

Information Warning - OS background mapping

Planning advice and guidance

The Environment Agency are keen to work with partners to enable development which is resilient to flooding for its lifetime and provides wider benefits to communities. If you have requested this information to help inform a development proposal, then we recommend engaging with us as early as possible by using the pre-application form available from our website:
https://www.gov.uk/government/publications/pre-planning-application-enquiry-form-preliminary-opinion

Complete the form in the link and email back to kslplanning@environment-agency.gov.uk.

We recognise the value of early engagement in development planning decisions. This allows complex issues to be discussed, innovative solutions to be developed that both enables new development and protects existing communities. Such engagement can often avoid delays in the planning process following planning application submission, by reaching agreements up-front. We offer a charged pre-application advice service for applicants who wish to discuss a development proposal.

We can also provide a preliminary opinion for free which will identify environmental constraints related to our responsibilities including flooding, waste, land contamination, water quality, biodiversity, navigation, pollution, water resources, foul drainage or Environmental Impact Assessment.

Orchard House, Endeavour Park, London Road, Addington, West Malling, Kent, ME19 5SH.
Email: kslenquiries@environment-agency.gov.uk

Flood Risk Assessments Guidance

Flood risk standing advice for applicants

In preparing your planning application submission, you should refer to the Environment Agency's Flood Risk Standing Advice and the Planning Practice Guidance for information about what flood risk assessment is needed for new development in the different Flood Zones. This information can be accessed via:

https://www.gov.uk/flood-risk-assessment-standing-advice

http://planningguidance.planningportal.gov.uk/

https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications

https://www.gov.uk/guidance/flood-risk-and-coastal-change

You should also consult the Strategic Flood Risk Assessment and flood risk local plan policies produced by your local planning authority.

You should note that:

1. Information supplied by the Environment Agency may be used to assist in producing a Flood Risk Assessment where one is required, but does not constitute such an assessment on its own.
2. This information covers flood risk from main rivers and the sea, and you will need to consider other potential sources of flooding, such as groundwater or overland runoff. You should discuss surface water management with your Lead Local Flood Authority.
3. Where a planning application requires a FRA and this is not submitted or deficient, the Environment Agency may well raise an objection due to insufficient information.

Orchard House, Endeavour Park, London Road, Addington, West Malling, Kent, ME19 5SH.
Email: kslenquiries@environment-agency.gov.uk

Surface Water

We have provided two national Surface Water maps, under our Strategic Overview for flooding, to your Lead Local Flood Authority who are responsible for local flood risk (i.e. surface runoff, ground water and ordinary watercourse), which alongside their existing local information will help them in determining what best represents surface water flood risk in your area.

Your Lead Local Flood Authority have reviewed these and determined what it believes best represents surface water flood risk. You should therefore contact this authority so they can provide you with the most up to date information about surface water flood risk in your area.

You may also wish to consider contacting the appropriate relevant Local Planning Authority and/or water/sewerage undertaker for the area. They may be able to provide some knowledge on the risk of flooding from other sources. We are working with these organisations to improve knowledge and understanding of surface water flooding.

Orchard House, Endeavour Park, London Road, Addington, West Malling, Kent, ME19 5SH.
Email: kslenquiries@environment-agency.gov.uk

Appendix A.3 – Southern Water Response

Southern Water

Herrington Consulting Ltd
Unit 6
Barham Business Park
Canterbury
Kent
CT4 6DQ

Your ref	EG/2454
Our ref	347249
Date	12 August 2019
Contact	searches@southernwater.co.uk Tel 0845 272 0845 0330 303 0276 Fax 01634 844514

Attention: Herrington Consulting

Dear Customer

Re: **Provision of public sewer and/or water main record extract**

Location: **Land adjacent to The Retreat, Lydd Road, Old Romney, TN29 9SG**

Thank you for your request for the provision of extracts of our sewer and/or water main records.

According to our records,Southern Water currently has neither sewers nor water mains in the vicinity of the above location. As a consequence of this, we will be refunding your credit card payment that accompanied this request.

Customers should be aware that there are areas within our region in which there are neither sewers nor water mains. However, it should not be relied upon as indicating that further infrastructure does not exist and may subsequently be found following site investigation. Therefore actual positions of infrastructure should be determined on site.

Should you require any further assistance regarding this matter, please contact the LandSearch team.

Yours faithfully

LandSearch

Appendix A.4 – Surface Water Management Calculations

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
E_MH1	0.750	4.00	10.000	2025	100.000	100.000	1.725
E_MH2			10.000	2400	110.000	100.000	2.125
P_MH1	0.750	4.00	10.000	1500	100.000	50.000	1.275
P_MH2			9.900	1500	110.000	50.000	1.275
P_OF1			9.800	1500	120.000	50.000	1.275

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
E_Link	10.000	25.0	1500	Circular_Default Sewer Type	10.000	8.275	0.225	10.000	7.875	0.625
P_Link	10.000	100.0	675	Circular_Default Sewer Type	10.000	8.725	0.600	9.900	8.625	0.600
P_Link2	10.000	100.0	675	Circular_Default Sewer Type	9.900	8.625	0.600	9.800	8.525	0.600

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
E_Link	E_MH1	2025	Manhole	Adoptable	E_MH2	2400	Manhole	Adoptable
P_Link	P_MH1	1500	Manhole	Adoptable	P_MH2	1500	Manhole	Adoptable
P_Link2	P_MH2	1500	Manhole	Adoptable	P_OF1	1500	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
E_MH1	100.000	100.000	10.000	1.725	2025	0	E_Link	8.275	1500
E_MH2	110.000	100.000	10.000	2.125	2400	1	E_Link	7.875	1500
P_MH1	100.000	50.000	10.000	1.275	1500	0	P_Link	8.725	675
P_MH2	110.000	50.000	9.900	1.275	1500	1	P_Link	8.625	675
						0	P_Link2	8.625	675
P_OF1	120.000	50.000	9.800	1.275	1500	1	P_Link2	8.525	675

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	26.250	Drain Down Time (mins)	240
Ratio-R	0.400	Additional Storage (m³/ha)	20.0
Summer CV	1.000	Check Discharge Rate(s)	x
Winter CV	1.000	Check Discharge Volume	x

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
1	20	0	0
30	0	0	0
30	20	0	0
100	0	0	0
100	20	0	0
100	40	0	0

Node P_MH2 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	8.625	Product Number	CTL-SHE-0072-2300-1000-2300
Design Depth (m)	1.000	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	2.3	Min Node Diameter (mm)	1200

Node P_MH2 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	8.900
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	711.0	0.0	1.000	711.0	0.0

Results for 1 year Critical Storm Duration. Lowest mass balance: 97.36%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	E_MH1	10	8.411	0.136	198.8	1.6147	0.0000	OK
15 minute summer	E_MH2	10	7.991	0.116	199.2	0.0000	0.0000	OK
600 minute winter	P_MH1	585	9.138	0.413	17.7	5.5939	0.0000	OK
600 minute winter	P_MH2	585	9.138	0.513	17.6	170.7553	0.0000	OK
15 minute summer	P_OF1	1	8.525	0.000	2.3	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	E_MH1	E_Link	E_MH2	199.2	2.836	0.013	0.7039	77.6
15 minute summer	P_MH1	P_Link	P_MH2	197.8	1.261	0.211	1.7323	
15 minute summer	P_MH2	Hydro-Brake®	P_OF1	2.3				34.7

Results for 1 year +20% CC Critical Storm Duration. Lowest mass balance: 97.36%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	E_MH1	10	8.425	0.150	238.8	1.7842	0.0000	OK
15 minute summer	E_MH2	10	8.002	0.127	239.0	0.0000	0.0000	OK
720 minute winter	P_MH1	705	9.211	0.486	18.7	6.5760	0.0000	OK
720 minute winter	P_MH2	705	9.211	0.586	18.3	222.4873	0.0000	OK
15 minute summer	P_OF1	1	8.525	0.000	2.3	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	E_MH1	E_Link	E_MH2	239.0	2.964	0.016	0.8088	93.0
15 minute summer	P_MH1	P_Link	P_MH2	237.0	1.409	0.253	1.8533	
15 minute summer	P_MH2	Hydro-Brake®	P_OF1	2.3				34.6

Results for 30 year Critical Storm Duration. Lowest mass balance: 97.36%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m^3)	Flood (m^3)	Status
15 minute summer	E_MH1	10	8.499	0.224	486.7	2.6699	0.0000	OK
15 minute summer	E_MH2	10	8.052	0.177	487.1	0.0000	0.0000	OK
960 minute winter	P_MH1	945	9.510	0.785	24.9	10.6248	0.0000	SURCHARGED
960 minute winter	P_MH2	945	9.510	0.885	34.5	435.7457	0.0000	SURCHARGED
15 minute summer	P_OF1	1	8.525	0.000	2.3	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m^3)	Discharge Vol (m^3)
15 minute summer	E_MH1	E_Link	E_MH2	487.1	3.489	0.032	1.4031	189.6
15 minute summer	P_MH1	P_Link	P_MH2	481.5	2.133	0.513	2.6694	
15 minute summer	P_MH2	Hydro-Brake®	P_OF1	2.3				33.2

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 97.36%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	E_MH1	10	8.524	0.249	584.2	2.9708	0.0000	OK
15 minute summer	E_MH2	10	8.068	0.193	584.6	0.0000	0.0000	OK
960 minute winter	P_MH1	945	9.663	0.938	29.9	12.6987	0.0000	SURCHARGED
960 minute winter	P_MH2	945	9.663	1.038	39.4	544.9839	0.0000	FLOOD RISK
15 minute summer	P_OF1	1	8.525	0.000	2.3	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	E_MH1	E_Link	E_MH2	584.6	3.627	0.039	1.6195	227.4
15 minute summer	P_MH1	P_Link	P_MH2	577.7	2.299	0.616	3.0063	
960 minute winter	P_MH2	Hydro-Brake®	P_OF1	2.3				158.7

Results for 100 year Critical Storm Duration. Lowest mass balance: 97.36%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	E_MH1	10	8.538	0.263	637.9	3.1296	0.0000	OK
15 minute summer	E_MH2	10	8.077	0.202	638.0	0.0000	0.0000	OK
960 minute winter	P_MH1	945	9.702	0.977	31.2	13.2207	0.0000	FLOOD RISK
960 minute winter	P_MH2	945	9.701	1.076	59.1	571.7663	0.0000	FLOOD RISK
15 minute summer	P_OF1	1	8.525	0.000	2.3	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	E_MH1	E_Link	E_MH2	638.0	3.698	0.042	1.7350	248.1
15 minute summer	P_MH1	P_Link	P_MH2	630.4	2.405	0.672	3.1426	
960 minute winter	P_MH2	Hydro-Brake®	P_OF1	2.4				160.2

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 97.36%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	E_MH1	9	8.567	0.292	764.9	3.4854	0.0000	OK
15 minute summer	E_MH2	10	8.095	0.220	765.6	0.0000	0.0000	OK
1440 minute winter	P_MH1	1410	9.898	1.173	26.9	15.8706	0.0000	FLOOD RISK
1440 minute winter	P_MH2	1410	9.898	1.273	26.4	712.0518	0.0000	FLOOD RISK
15 minute summer	P_OF1	1	8.525	0.000	2.3	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	E_MH1	E_Link	E_MH2	765.6	3.842	0.050	2.0044	297.8
15 minute summer	P_MH1	P_Link	P_MH2	753.3	2.587	0.803	3.4277	
1440 minute winter	P_MH2	Hydro-Brake®	P_OF1	2.6				231.7

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 97.36%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	E_MH1	9	8.596	0.321	892.5	3.8232	0.0000	OK
15 minute summer	E_MH2	10	8.112	0.237	893.2	0.0000	0.0000	OK
1440 minute winter	P_MH1	960	9.908	1.183	31.4	16.0077	0.0000	FLOOD RISK
1440 minute summer	P_MH2	930	9.900	1.275	83.2	713.6084	364.4847	FLOOD
15 minute summer	P_OF1	1	8.525	0.000	2.3	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	E_MH1	E_Link	E_MH2	893.2	3.965	0.059	2.2659	347.3
15 minute summer	P_MH1	P_Link	P_MH2	864.8	2.746	0.922	3.5560	
360 minute summer	P_MH2	Hydro-Brake®	P_OF1	2.6				85.8