PROPOSED DEVELOPMENT AT MILL RYTHE, HAYLING ISLAND, HAMPSHIRE

FLOOD RISK ASSESSMENT



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1.0 INTRODUCTION

It is currently proposed to redevelop part of the site at Mill Rythe Holiday Park to provide additional holiday use accommodation for guests. Due to its position in tidal Flood Zone 3, it is necessary to fully assess the flood risk. There is subsequently a requirement for a Flood Risk Assessment (FRA) to accompany any planning application for development at this site.

To fulfil this requirement Humberts Leisure has commissioned H2OK Systems Ltd. The objective of this appointment is to prepare a Flood Risk Assessment demonstrating compliance with Planning Policy Statement 25 'Development and Flood Risk', and standing advice for developments in Flood Zone 3.

Sequential Test and Exception test information has been produced and provided within the planning statement and submitted as part of the planning application. For the purposes of this FRA report it is considered that the sequential and exception tests are passed. This report will however provide details relating to Part C of the exception test.

The development proposals include the redevelopment of the open amenity space for the siting of 31 no. bases for static caravans. This development shall also include new access roads and planting. The static caravans will be for holiday usage only as agreed with the Local Planning Authority (LPA).

Caravans FFLs will be placed at 500mm above ground level. This is to ensure that the risk of flooding to the caravans is minimised.

The lifetime of the development is proposed to be 25 years. It is anticipate this will be agreed as part of the planning permission and as such the flood risks within this report are based upon a 25 year lifetime. For reference purposes details relating to longer lifetimes have also be made available.

2.0 SITE LOCATION AND DESCRIPTION

2.1 Site Location

Mill Rythe Holiday Park is located along the east coast of Hayling Island, just off Havant Road. The site is directly adjacent to the coastline in Chichester Harbour, along the Mill Rithe Estuary. The approximate Ordnance Survey Grid Reference for the site is SU 320 008. A site location plan showing the proposed development is included in **Appendix A**.

The development is to be located in the open field to the north of the holiday park's central facilities complex. Further to the north, beyond the proposed development boundary is a long ditch running directly adjacent to the sea defence bund. Beyond the holiday park site to the south is the Tournerbury Golf Course. The development site is roughly square in plan and covers an area of approximately 0.8 hectares.

With regard to topography the site is set at levels ranging from 1.48m AOD in the north-east corner up to a level 2.22m AOD in the south-west corner. The site is relatively flat with a slight slope down towards the north-east corner at a gradient of around 1 in 140.

2.2 Existing Usage

Presently the development site accommodates open amenity space and a small café building.

2.3 Proposed Usage

It is proposed to redevelop the open amenity space for the siting of 31 no. bases for static caravans. This development shall also include new access roads and planting. The static caravans will be for holiday usage only. The proposed lifetime of the development will be 25 years.

A plan showing the proposed site layout is included in **Appendix A**.

3.0 EXISTING HYDROLOGY

The development site is located within the 'Portsmouth and Langstone Harbours' sub-area outlined in the South East Hampshire Catchment Flood Management Plan (CFMP). The document states the following with regard to flood risk in this area:

"The main inland flood risk in this sub-area comes from surface water flooding where the urban drainage network is overwhelmed or unable to fully discharge into the sea. There is very little fluvial flood risk from the overtopping of river banks, it is important to note however that the greater risk in the sub-area is from tidal flooding considered by the North Solent Shoreline Management Plan."

South East Hampshire Catchment Flood Management Plan

During the 2000/2001 floods, it is reported that 114 no. properties were flooded within the sub-area, and 2,000 people were affected by the flooding of infrastructure. It is also estimated that this event was equivalent to the 2% Annual Exceedence Probability (AEP) event. Climate change is expected to be a key driver of flooding in the future, as sea-level rise will result in additional properties at risk.

At present no percolation tests have been conducted in the area, however a site visit has confirmed the low-lying coastal setting of the site.

Analysis of the EA's indicative flood map shows the subject site is located within the Flood Zone 3. An extract from the Environment Agency Interactive Flood Mapping is shown in **Figure 3.1** below.

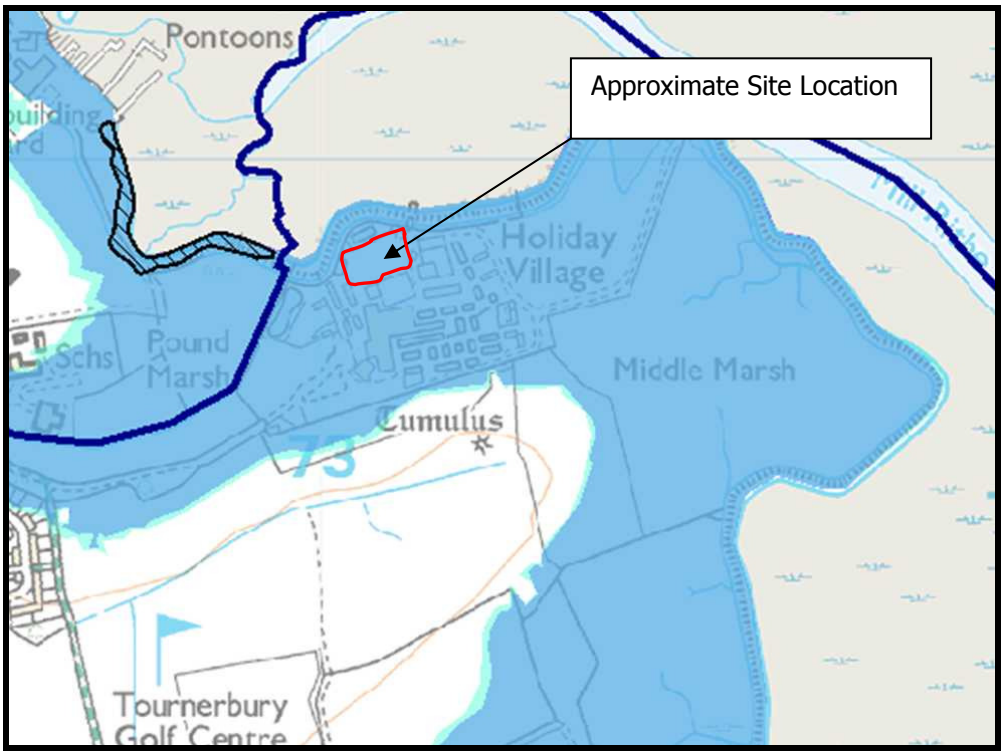


Figure 3.1 – Environment Agency Indicative Flood Mapping at subject site for fluvial flooding

4.0 FLOODING AND SURFACE WATER

A number of possible flooding mechanisms have been considered at the site, and are discussed further below.

4.1 Groundwater Flooding

Due to the low-lying nature of the site it is likely that the groundwater is close to the surface which could potentially influence the options for storage and management of flood water. The Cranfield University Soilscapes database demonstrates that the soil at the site to be 'loamy-clayey soils of coastal flats with naturally high groundwater'. This analysis is included in **Appendix B**.

Surface ponding of water was noted during a site visit in February 2011, although it cannot be confirmed whether this was groundwater or pluvial in origin. The bedrock geology at the site is expected to be the London Clay Formation which has a low permeability, as such it is thought that this ponding is more likely to be pluvial as water cannot easily infiltrate.

In consideration of the known tidal risks, flooding from groundwater is comparably insignificant and is not investigated further in this report.

4.2 Overland Sheet Flow

The site is located in a relatively low-lying and flat area with no significant area of catchment uphill. The golf-course to the south is slightly elevated above the holiday park; whilst this area could generate some overland sheet flow, it is considered that as it is entirely permeable, any flow would largely infiltrate before reaching the site. Any excess flow is unlikely, but if generated could be intercepted by existing holiday park surface water drainage infrastructure before reaching the development site. As such, it is concluded that overland sheet flow does not represent a flood risk to this site.

4.3 Fluvial (River) Flooding

Reference to the EA's indicative floodplain mapping (**Figure 3.1**) shows that the subject site is located within Flood Zone 3. The size of the tidal estuary adjacent to the site is such that any fluvial events would easily have capacity within the estuary. Therefore flooding at the site is not influenced by fluvial processes and will not be considered further.

4.4 Tidal Flooding

Reference to the EA's indicative floodplain mapping (**Figure 3.1**), indicates that the development site is within Flood Zone 3. The minimum elevation of the site is currently around 1.48m AOD. As such, the site may be at risk of tidal flooding and the potential for this will be considered further in **Section 5.0**.

4.5 Wave Overtopping

The Mill Rithe estuary is situated in a sheltered location within the equally sheltered Chichester Harbour. Any wave action influencing the site would therefore be as a result of wind-blown waves across the estuary. The potential for wind-blown waves shall be investigated further in **Sections 5.0 and 6.0**.

4.6 Flooding from Other Sources

Reference to the EA's reservoir flood mapping demonstrates that the site is highly unlikely to be at risk of flooding from a breach/failure of an impounded water body.

There are private sewers and pumping stations on the site. There is no known history of flooding from this source. However in the event of a tidal flood, there is likely to be a failure of sewerage infrastructure. Therefore measures should be taken to prevent 'backing-up' of any sewers serving the new development.

4.7 Flooding as a Result of Development

The development of the site will create impermeable surfaces in areas that are currently permeable. As a result, the rate at which water runs off these areas would increase. Due to this, it is important that surface water runoff from the development is managed appropriately.

In consideration of this, a suitable surface water drainage system should be installed and functional before the development is occupied.

4.8 Flooding as a Tidal Defence Breach

Due to the proximity of the site to the tidal defences the risk to the proposed development from a breach of the defences has been considered. This is explored further in Section 5.8 of this report.

5.0 TIDAL FLOODING

5.1 Extreme Tide Levels

The Extreme Water Level (EWL) associated with the 0.5% (1 in 200 year) Annual Exceedance Probability (AEP) event in 2010 for Chichester Harbour is **3.4m AOD**. The respective tidal information is included in **Appendix B** and summarised below**.**

Tide Return Period	Year 2010 level (m AOD)	Year 2055 level (m AOD)	Year 2085 level (m AOD)	Year 2115 level (m AOD)
1 in 1 year	2.8	3.1	3.5	3.9
1 in 5 year	3.0	3.3	3.7	4.1
1 in 10 year	3.1	3.4	3.8	4.2
1 in 25 year	3.2	3.5	3.9	4.3
1 in 50 year	3.3	3.6	4.0	4.4
1 in 100 year	3.3	3.6	4.0	4.4
1 in 200 year	3.4	3.7	4.1	4.5

Table 5.1: Predicted Still Water High Tide Levels for Chichester Harbour

5.2 Coastal Defences

Existing coastal defences protecting the site comprise a clay and rubble embankment. This is protected from erosion on the seaward side by concrete splash wall, concrete apron and hollow studded revetments. This sea-defence is in a functional condition and there are photos included in **Appendix D** along with a report formulated during the site visit. The report comments upon the condition of the defences and probability of failure.

The height of the embankment varies slightly around the boundary of the site, from 3.18m AOD to 3.60m AOD. As such there is a risk of flooding to the site from the direct overtopping by tidal water of the defence embankment in the vicinity of the site. The current crest level information can be found on the topographical survey included in **Appendix C**.

In addition to the topographic survey, cross-sections of these sea-defences are included, although it should be noted that these were drawn in 1999. Despite this, there have been no known changes made in this period.

Beyond the site to the east at a distance of 0.5km there is an embanked road acting as an additional flood defence, running perpendicular to the coastline, north to east. There is at least one culvert along its length which would serve to convey some flood water between the lower areas of land either side of it. Further to the east the coastal embankment has not been maintained and the coastal defences are in poor condition. However, considering the survey cross-sections from 1999 the elevation of this eastern embankment is higher than the embankment adjacent to the site.

At the time of the site visit on the 22nd February 2011, the water level in the estuary was higher than the level of the land at the site. This appears to be a regular situation and the MHWM is illustrated on the cross-sections of the sea-defences which are included in **Appendix C**.

Neither the Environment Agency nor Havant Borough Council claim ownership of the coastal defence bund at this site. As such, the ownership of the coastal defences is assumed to be private although the nature of this is unknown.

5.3 Environment Agency Modelling

The Environment Agency has produced a Tuflow model which has predicted the actual extents and depths of tidal flooding at the site in the events of various tidal flooding scenarios. This would take into account the tide level, defence crest level, site ground levels, and is likely to take tidal inundation time into account as well. The flood extents predicted in this model are lesser than those assumed through total tidal inundation of land below tide height. The model extract is included in **Appendix B**.

In the above mentioned modelling it is concluded that in a 3.7m AOD tide the development area would flood to a level of 2.1m AOD. This equates to a flood depth of up to 0.62m. The 3.7m AOD tide is equivalent to the present day 1 in 1000-year tidal flood level.

The model also predicts that in the 3.5m tide there would be no flooding experienced in the development area. The 3.5m is analogous to the present day 1 in 200 year tide.

There is no modelling information available for tidal levels above 3.7m AOD, and as such this model cannot be used to illustrate the effects of climate change.

5.4 Shoreline Management Plan

Hayling Island falls within the area covered by the North Solent Shoreline Management Plan. The site itself lies within policy unit 5AHI03 which stretches from Northney Farm (north of Mill Rythe Holiday Park) to Mengham in the south. The Shoreline Management Plan outlines the proposals for the maintenance of the current coastline and/or sea-defences. This area of Hayling Island has a policy to 'Hold the Line' which means that the protection offered by the existing coastal defences should be maintained or upgraded. It is noted though, that no public funding is available for this short stretch of coastline.

5.5 Flood Routing

The lowest point in the flood defence wall adjacent to the site is 57m east of the outdoor swimming pool. This point is the site's access to the defence wall and a concrete jetty into the water. The defence level here is 3.46m AOD. However, further east, at a distance of 459m from the outdoor swimming pool is the lowest point along this flood defence wall at 3.18m AOD. If water is to over-top the wall at this point it would flow directly into the deep ditch running parallel to the defence wall and then into the 'fishing lake', then flow out onto the open 3.4ha recreation field adjacent to the site.

5.6 Flood Inundation Time

Since tidal movements are predictable it is possible to estimate the time for which the coastal defences will be overtopped with water. During the present day 1 in 200-year event the lowest part of the defence will be overtopped for approximately 1 hour and 22 minutes. Calculations are included in **Appendix B**.

Using the rule of twelfths it has been calculated that in a 1 in 200-year plus climate change tide would be able to overtop the defence for 4 hours and 42 minutes.

It is thought that actual inundation time will be much greater, as it is possible that seawater will not be able to freely drain from the site once the tide level has dropped below 3.18m AOD; this is because of the presence of the sea-defences. The ditch which runs adjacent to the sea-defence would serve to convey water from the site and out to the Mill Rithe estuary through a culvert located 130m west of the development site. The capacity of this culvert will be the restricting factor in the subsidence of water levels from the site.

5.7 Wave Action

Wave action on its own is not significant enough to cause flooding; however it could raise the extreme tidal level beyond the predicted level.

Due to the site's relatively sheltered position on the estuary, wave action from open ocean swell would not affect the site. However in the event of a north-easterly wind, there may be sufficient fetch over open water in the estuary to generate wave heights which could contribute to flood risk at the site. The impact of combined wave/tide events is considered further in **Section 6.0** of this report.

5.8 Flooding as a result of tidal defence breach

The site is situated behind a tidal defence and during extreme tidal events the water level outside the defence is known to exceed the ground level on the proposed site. Under normal conditions the tidal defence will contain tidal floodwater, if however the defence was to suffer erosion or breach then rapid inundation of floodwater could impact upon the site.

In order to consider the risk of this further some basic breach analysis was conducted. This assessment used the guidance outlined in the EA Condition Assessment Manual (ref. 166_03_SD01) to classify the condition of the defences. From this assessment it was then possible to identify the probable location of a breach. This analysis was primarily concerned with the defences along the frontage associated with the Caravan Park. From this analysis a typical breach scenario was then assessed using a basic relationship between the volume of water weiring through the breach and the storage volume within the caravan park area.

The asset condition assessment of the defences along the frontage adjacent to the park identified that the along the majority of this length the defences are in a Good to Very Good condition. Consequently there is only a small chance that a breach would occur along this length.

The defences to the west of the holiday park are showing signs of deterioration and the condition is classified as Poor to Fair. Consequently there is a moderate chance that a breach along this section could occur if there is no intervention. If this section were to breach then flood waters would still not be able to affect the site as there is a bund running along the western boundary of the site which is in a Good condition. For more detail on the assessment of the defence condition refer to Appendix D.

As the condition of the defences protecting the development are in a Good to Very Good condition it is unlikely that a breach would occur that would affect the site. Notwithstanding this an analysis of the consequences of a breach of the defences protecting the development has been undertaken.

The breach scenario assessed in this analysis assumed a breach width of 4m and a depth of 1m. The water level was assumed to be at a maximum of 3.2m AOD which is equivalent to

the present day 1 in 25 extreme water level. This level was decided on as a water surface elevation in excess of this would overtop the low point of the defences which would flood the site regardless of whether there was a breach or not. The height of the defences was also assumed to correlate to the lowest point of the defences at 3.2m AOD.

A typical tidal curve for the area with a resolution of 10 minutes was derived based on tidal harmonics. This tidal curve was then raised so that the peak of the tide was equivalent to the desired extreme water surface elevation (3.2m AOD). The assessment assumed that a breach occurred at the peak of the tide and tidal waters then weir through the breach as the tide drops.

Using a simple weiring equation and based on the breach assumptions outlined above the volume of water flowing into the site during this breach event would be approximately 96,000m3.

The total area of the site is approximately 138,000m2. Assuming a flat site and that the volume of water weiring through the defences were to spread evenly across the site then this would equate to a flood depth of 0.7m. The western part of the site containing the pond and golf course/recreation area is roughly 0.75m lower than the developed area and covers 51,000m2. Therefore this area would store a volume of 38,250m3 of flood water prior to the developed area being affected. The developed area would then flood to a depth of approximately 0.4m.

As such it is considered that the depth of flooding within the developed area during this breach scenario would be approximately 0.4m. Therefore the strategy of raising the static homes 0.5m from the ground level would site the caravans above this flood level.

6.0 JOINT EVENTS

6.1 Combined Probability Analysis

In order to assess the combined probability of wave events and high tide events occurring at the same time, reference was made to the 'Joint Probability Report' issued by DEFRA and the EA. In particular, an example on page 35 of part 2 would appear to provide a good example of a comparable situation. Therefore analysis of the subject site was carried out in a similar way to that shown in the above mentioned example.

In the first instance, an elevation for tide levels for the site was obtained from the Environment Agency. This yielded the following results for Chichester Harbour. Following this, wave heights have been calculated using the method outlined in the Institute of Civil Engineers' Flood and Reservoir Safety Handbook 3rd edition.

Therefore, as included in **Table 6.1** the two variables have been allocated relative return periods generating the following combinations of Sea Level and Wave height conditions. These would simultaneously achieve a combined probability return period of 500 years. The Wave Height and Sea Level correlation coefficient for Portsmouth is 0.41, and therefore the two variables are 'well correlated' at the site. This is in accordance with the joint probability report.

Variable 1		**Variable 2**	
Sea Level (mAOD)		**Significant Wave Height (m)**	
Return Period	**Sea Level**	**Return Period**	**Wave Height**
0.2yr	-	500yr	0.511
1yr	**2.8**	**130yr**	**0.447**
5yr	3.0	26yr	0.409
10yr	**3.1**	**13yr**	**0.401**
20yr	3.1	6yr	0.366
50yr	3.3	2.6yr	0.345
100yr	**3.3**	**1.3yr**	**0.337**
200yr	**3.4**	**0.6yr**	**0.2**

Table 6.1 Joint Probability Analysis

The four cases outlined in bold in **Table 6.1** were combined yielding a final water surface elevation included in **Table 6.2**.

Sea Level Return Period	**Wave height Return Period**	**Maximum Water Surface Elevation**
1 Year	130 Year	3.02
10 Year	13 Year	3.30
100 Year	1.3 Year	3.47
200 Year	**0.6 Year**	**3.50**

Table 6.2 Showing Flood Levels for Various Joint Probability Scenarios.

From the above it can be seen that the low probability 200-year tide combined with the high probability wave event gives the worst-case flood level, as shown in bold font. From this analysis it can be seen that flood risk is directly related to the tidal situation and is not significantly influenced by wave action.

7.0 TIDAL FLOOD RISK SUMMARY

The site is situated adjacent to the tidal estuary known as 'Mill Rithe' in Chichester Harbour. The tidal effects of which are found to be the predominant flooding mechanism at Mill Rythe Holiday Park. The proposed development site is set at elevations between 1.48m AOD and 2.22m AOD.

For present day conditions, the Environment Agency have provided modelled tidal flood levels for the development site. In the 3.5m AOD tide equivalent to the 1 in 200-year tide there would be no flooding experienced in the development area.

In a 3.7m AOD tide, equivalent to the present day 1 in 1000-year tidal flood, the development area could flood to a level of 2.1m AOD.

To assess the flood depth on site in the climate change scenarios, the sea-defence only offers complete protection up to a tide level of 3.18m AOD.

The development proposals indicate that the lifetime of the proposed development would be 25 years. Taking a 25 year lifetime for the development and applying the recommended contingency allowance for sea level rise outlined within Table B.1 of PPS 25, a total of 145mm of sea level rise would be expected over the lifetime of the development.

If sea-level rise due to climate change is taken into consideration, by 2035 the flood level would increase to 3.55m AOD in a 1 in 200-year tide, and similarly would increase to 3.65m AOD in a 1 in 1000-year tide. The tables below summarise the flood levels and depth anticipated based upon EA modelled data and climate change allowances.

	Year 2010					
	1 in 200-year tide			1 in 1000-year tide		
Development Site (1.48m to 2.22mAOD)	Tide Level	Flood Level (EA Model)	Flood Depth	Tide Level	Flood Level (EA Model)	Flood Depth
	3.4m AOD	**No Flooding**	**None**	3.6m AOD	2.1m AOD	up to 0.62m

Table 7.1 Present Day Tidal Flood Levels

	Year 2035					
	1 in 200-year tide			1 in 1000-year tide		
Development Site (1.48m to 2.22mAOD)	Tide Level	Flood Level (EA Model)	Flood Depth	Tide Level	Flood Level (EA Model)	Flood Depth
	3.55m AOD	2.10m AOD	Up to 0.13m	3.75m AOD	Not known	Not Known

Table 7.2 Lifetime of Proposed Development Tidal Flood Levels

NB: In order to determine the flood depth on site during the 2035 event the EA flood modelling information for the flood level of 3.7m AOD was used to give a representative flood depth for the site during the 2035 1 in 200 year event. EA flood level information is shown in Appendix B.

	Year 2115					
	1 in 200-year tide			1 in 1000-year tide		
Development Site (1.48m to 2.22mAOD)	Tide Level	Flood Level (EA Model)	Flood Depth	Tide Level	Flood Level (EA Model)	Flood Depth
	4.5m AOD	4.5m AOD	up to 3.02m	4.7m AOD	4.7m AOD	up to 3.22m

Table 7.3 Impact of Climate Change upon Tidal Flood Levels

The caravans are to be installed a minimum of 500mm above the existing ground levels. Therefore the minimum Finished Floor Level of the caravans would be 2.47m AOD. This would mean that the caravans have a minimum of 0.37m freeboard above the flood level. In addition if a breach scenario is considered the depth of flooding would be on average 0.4m at an approximate elevation of 2.4m AOD. Therefore even during a breach scenario the caravans would maintain a 0.07m freeboard.

8.0 PROPOSALS TO MINIMISE FLOOD RISK

Re-location of the development is not possible as the entire Mill Rythe Holiday Park is located within the same flood zone, and the ground levels are fairly similar across the site. Extending the accommodation outside the Holiday Park boundaries would not be viable. As such the measures below outline several options which would help reduce the overall level of flood risk.

- The holiday park should be connected to the EA's free flood warning system for the area. This will ensure prior warning of a possible flooding event and allow adequate time to prepare for flooding.
- Evacuation procedures should be issued for onsite staff, and guests. Due to tide predictability, it is possible to have a lengthy early warning period before flood water rises in order to evacuate. A flood management plan (discussed in more detail in **Section 9.0**) would outline the evacuation procedure.
- Vehicles could be used in evacuation prior to a flood event. Otherwise, vehicles should remain on site, and site users should be aware of damages to personal property that could occur.
- Whilst at risk of flooding, access and egress from the site should take place along the main access/egress route, and then south along Havant Road. This leads to an area at low risk of flooding, and the Church in Newtown could provide a suitable rally point.
- The effective crest level of the defences is set at approximately 3.18m AOD. The majority of the sea defence was a crest level in excess of 3.4m AOD. An 87m stretch of the defence is set below 3.4m AOD. It would be beneficial for this section of the defence to be raised in order to help improve the effective crest level of the defence. It is anticipated that raising the effective crest level of the defence will offer an improvement in terms of reducing flood risk to the development site over the proposed lifetime.
- A flood warning system could be installed along the flood defences in order to inform the site operator if the defences are close to being overtopped. A sensor would be located at the lowest point of the defence (3.18m AOD in the western-most corner of the site). An additional sensor could be located at the concrete jetty adjacent to the outdoor swimming pool. The triggering of either sensor should invoke a specific evacuation sequence.
- Static caravans should be securely anchored to the ground in order to prevent them floating on the flood waters and putting both site users and third parties at risk.

8.1 Access/Egress

The main access/egress route from the site is also under protection from the coastal defence embankment. During the present day 1 in 200 year and 1 in 1000 year flooding scenarios the site would have safe dry pedestrian access/egress away from the proposed development site. The maximum flood level modelled by the EA for the site is 2.10m AOD. Reference to the topographic survey indicates that a pedestrian access/egress route exists above the level of 2.10m AOD through the existing buildings on site exiting onto the access road to the south east. Vehicular access/egress would have to pass through a low point of 1.45m AOD in order to reach the development site. This would equate to a flood depth of 0.65m.

Over the proposed 25 year lifetime of the development safe dry access and egress would exist during the 1 in 200 year event. This assumes the sea defence remains during the flooding event and that tidal overtopping is the mechanism for flooding.

When taking into account sea level rise associated with 100 years of climate change the flood depth along the evacuation route could be up to 2.42m in a 1 in 200-year (plus climate change) flood. This would result in a Flood Hazard Rating of "Danger to All".

As such, evacuation must be undertaken prior to any flood event. Due to the predictability of tides, early warning should be available and plenty of time to evacuate all site users.

The above emergency access route should be as follows. Exit along the main holiday park entrance route-way, then onto Havant Road and continue to the south (left). A suitable rally point outside of the floodplain would be the Church in Newtown.

A lower hazard evacuation route onto the higher ground to the south of Mill Rythe Holiday Park could be provided. This would utilise the Tournerbury Golf Course, and could provide a shorter and lower hazard evacuation route. This route would be subject to an agreement between the Holiday Park and the Golf Course, and the provision of a suitable pedestrian route across the existing boundary fence.

9.0 FLOOD MANAGEMENT PLAN

As part of the development it will be necessary to ensure that the residual flood risks at the development are adequately managed. Therefore the following will outline the principles of the Flood Management Plan to be included as part of the development.

9.1 Flood Defences

As part of the proposed development all caravans will be located at a minimum elevation of 500mm above the existing ground levels. As the likely depth of flooding on the site is in the region of 0.13 to 0.4m during a 1 in 100 year event or during a breach event respectively this will place the caravans above the level of flooding.

In addition the SMP highlights that a 'Hold the Line' policy is to be adopted along this frontage. Therefore the defences along this frontage will be maintained in line with Sea Level Rise. Regular inspection of the defences along the frontage associated with the park will also highlight any potential breach locations.

9.2 Warning Procedure

Tidal flooding is the overriding flood mechanism at the site. As such a robust warning system will be required. A tidal flood warning service is provided in this area by the EA.

All staff on the site will be required to subscribe to the Environment Agency's flood warning system. This system will deliver flood warnings for the site by e-mail, text message or by a recorded telephone message. The EA system operates as follows;



Flood Alert - Flooding is possible. Be prepared.



Flood Warning - Flooding is expected. Immediate action required



Severe Flood Warning - Severe flooding. Danger to life.

All Clear - Flood Watches or Warnings are no longer in force for this area.

As already stated, due to the predictable nature of tidal flooding, the EA flood warning system outlined above will provide more than enough time to allow any evacuation strategy to be implemented.

9.3 Evacuation Procedure

Evacuation of vehicles from the site will take place once the EA Flood Warning level has been reached. The responsibility for moving cars will rest with the car owners themselves.

As already stated the vehicular access/egress would be along the main holiday park entrance route-way, then onto Havant Road and continue to the south (left). A suitable rally point outside of the floodplain would be the Church in Newtown. This route would also prove suitable for pedestrian emergency access/egress.

In addition a lower hazard evacuation route onto the higher ground to the south of Mill Rythe Holiday Park has also been outlined. This would utilise the Tournerbury Golf Course, and could provide a shorter and lower hazard evacuation route for pedestrians. This route would be subject to an agreement between the Holiday Park and the Golf Course, and the provision of a suitable pedestrian route across the existing boundary fence.

9.4 Flood Warden

The Flood Warden will be an on site senior member of staff. The warden should be either a permanent on site member of staff or the responsibility should be split between shifts.

Training of the Flood Wardens will be arranged before the site is occupied in liaison with the Environment Agency. Training will be repeated every 3 years and will include:

- Inspection of the existing flood defences
- Actions to take at each flood warning.

The principal roles of the flood warden on the site are as follows:

- Inspect flood defences as necessary.
- Liase with statutory authorities over the maintenance of the defences as necessary.
- Inform other staff of the existence of a FRMP and ensure that they are updated on an annual basis on the flood protection measures and procedures.
- Keep a check on flood warnings and be ready to check that warnings have been received by the staff/residents.
- Co-ordinate with the emergency services.
- Assist with site evacuation where necessary.

The actions and priorities of the Flood Warden will be outlined during training. In summary they will be as follows in order of importance.

At times of no flood risk.

1. Check the condition of the existing defences and ensure that all emergency flood access/egress routes are not blocked.
2. Advise staff/residents of flood risk and ensure new site occupants understand flood warning and evacuation procedures and subscribe to EA warning system.

During a flood event.

1. Check that flood warnings have been received.
2. Assist with evacuation of persons/vehicles.
3. Assist emergency services if necessary.

9.5 The Role of Other Bodies

The response to a major flood event will involve a number of organisations working together at a local level, including the emergency services, the local authority, utilities companies and the Environment Agency. Other bodies which may play a major role in the response are communications media, voluntary organisations and the public.

The roles and responsibilities of these bodies are detailed in the Environment Agency report 'Flood Warning Service Strategy for England and Wales'. The roles of the main bodies in relation to a major event, as detailed in the report, are summarised as follows:

Police

- Co-ordination of the emergency services at a major flood event, as well as helping to save lives and protect property.
- Establish cordons where practicable to facilitate the work of the other emergency services in saving lives, protecting the public and caring for the vulnerable.

Fire Service

- Saving life and rescuing trapped persons.
- Provide monitoring procedures in respect of health and safety of those persons operating within an established cordon.
- Carry out essential damage control measures, including pumping out flood water and salvage work.
- Assist other relevant agencies, particularly the local authority, to minimise the effects of major flooding on the community.

Local Authority

- Emergency care, if necessary, including feeding, accommodation and welfare.
- Emergency transport for people, equipment and material such as sandbags, and if necessary evacuation.
- Information services for liaison with the media on the local authority response and for information to the public and to relatives of evacuees.
- Flood alleviation – for flood prevention, such as the issuing of sandbags at their discretion and clearing blocked culverts, for dealing with flooded roads and diversions and for other assistance to the public such as drying-out facilities.
- Emergency environmental health advice for action relating to environmental problems caused by flooding.

- Co-ordination of the voluntary response.

Environment Agency

- Responsibility for maintenance and operation of flood defences. Checking defences and undertaking essential repairs and maintenance as required.
- Monitor water levels, assessing the risk and advising the emergency services and local authority.
- Monitor and clear blockages of culverts and breaches of defences.
- Support police and local authority by providing materials, equipment and manpower as far as resources and other duties permit.

Utility Companies

- In the event of a flood, will secure their services and equipment to ensure continuity of supply.
- Repair services disrupted by flood.
- Provide alternative means of supply during service disruption if life and health risks are identified.

10.0 AFFECT ON ADJACENT SITES

With the implementation of suitable surface water drainage systems there should be no impact on adjacent and downstream sites as a result of the proposed development.

The proposed development would not affect flood routing or floodplain storage volume as the flooding mechanism is tidal.

11.0 RESIDUAL RISKS AFTER DEVELOPMENT

Tidal levels over and above 3.18m AOD have the potential to cause flooding at the site. The proposed mitigation measures aim to manage this risk. In addition the principles outlined in the **Section 9.0** show how the residual risks associated with a flood event can be effectively managed.

The Shoreline Management Plan policy states that these sea-defences should be maintained or upgraded for the next 100-years, although public funding is not available. This should ensure that the site is protected from lower order events. The ownership of the sea defence is expected to be private, as neither the Environment Agency nor Havant Borough Council claim ownership.

12.0 CONCLUSIONS AND RECOMMENDATIONS

This study has confirmed that the site is currently located within tidal Flood Zone 3. PPS 25 Table D.3 demonstrates that this 'More Vulnerable' development could be acceptable at this site subject to the Sequential Test, Exception Test and a suitable Flood Warning and Evacuation Plan.

The development site is set at elevations between 1.48m AOD and 2.22m AOD. For the present day flood, the Environment Agency give modelled tidal flood levels for the development site. In a 3.7m AOD tide the development area would flood to a level of 2.1m AOD, this tidal flood is equivalent to the present day 1 in 1000-year tidal flood. In the 3.5m AOD tide there would be no flooding experienced in the development area due to existing defences, this flood level is equivalent to the present day 1 in 200-year tidal flood.

Over the proposed lifetime of the development (25 years) the site would remain free from flooding during the 1 in 200 year tidal event as EA modelled flood level indicate that during a 3.7m AOD flood the site would flood to a level 2.10m AOD. This would flood a small portion of the proposed development site. However, as the caravans are to be located a minimum of 500mm above the existing ground levels they would be above the level of flooding.

A simplistic assessment of a breach scenario in the defences protecting the site has been conducted. This shows that if the defences were to fail at any point the probable depth of flooding would be in the region of 0.4m. Again, due to the caravans being elevated 0.5m above existing ground levels, they would remain free from flooding in this scenario.

Once an extreme flood event has inundated the site, the flood levels would be slow to recede below the level of 3.18m AOD as water could be trapped by the sea defences.

Over the proposed 25 year lifetime of the development safe dry pedestrian access and egress would exist during the 1 in 200 year event. This assumes the sea defence remains in place during the flooding event and that tidal overtopping is the mechanism for flooding.

A site specific Flood Warning and Site Evacuation Plan should be provided and made available to all site users. The basis for this plan is outlined in this report however further elaboration on the key concepts should be made.

The draft shoreline management plan indicates a future 'Hold the Line' policy for the protective sea-defence around the site. This policy is to continue for at least 100 years, and therefore considering the lifetime of the proposed development, the level of protection from tidal flooding should not decrease. However it is not clear at this time if any plans are in place to maintain/improve these defences.

Any increase in surface water runoff as a result of the proposed development should be managed with a suitable surface water drainage system. This would ensure that there is no increase in flood risk as a result of the development.