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Client: Sunningdale House Developments Ltd

Flood Risk and SUDS Assessment for the Proposed Development at Land off Freemen's Way, Deal, Kent

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1 Scope of Appraisal

Herrington Consulting has been commissioned by **Sunningdale House Developments Ltd** to prepare a Flood Risk and Sustainable Drainage Assessment for the proposed development at **Land off Freemen's Way, Deal, Kent, CT14 9DH.**

A Flood Risk Assessment (FRA) appraises the risk of flooding to development at a site specific scale and recommends appropriate mitigation measures to reduce the impact of flooding to both the site and the surrounding area. New development has the potential to increase the risk of flooding to neighbouring sites and properties through increased surface water runoff and as such, an assessment of the proposed site drainage can help to accurately quantify the runoff rates, flow pathways and the potential for infiltration at the site. This assessment considers the practicality of incorporating Sustainable Drainage Systems (SuDS) into the scheme design, with the aim of reducing the risk of flooding by actively managing surface water runoff.

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

2 Background Information

2.1 Site Location and Existing Use

The site is located at OS coordinates 636755, 151397 off Freemen's Way in Deal and covers an area of approximately 3.4ha. 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 currently comprises a disused sports pitch which is still maintained.

2.2 Site Geology and Topography

Reference to the British Geological Survey (BGS) data identifies that the geology at the site comprises Seaford Chalk Formation bedrock.

Reference to aerial height data indicates that land levels at the site vary between 6.1m – 10.1m AODN, with a gradual fall towards the southeast.

2.3 Proposed Development

The development proposals comprise 78 residential dwellings, 186 parking spaces and the provision of a new grass football pitch.

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

Figure 2.2 – Proposed Development Plan

The important characteristics of the site that have the potential to influence the surface water drainage strategy are summarised in Table 2.1 below.

Site characteristic	Value
Total area of site	~3.38 ha
Current site condition	Greenfield
Infiltration coefficient	Negligible (based on soakage tests)
Current surface water discharge method	Assumed to drain via infiltration into the ground
Is there a watercourse within close proximity to site?	No
Proposed impermeable area	**14,870 m²**

Table 2.1 – Site characteristics affecting rainfall runoff

Based on the table above, it is evident that the development proposals will increase the total impermeable area across the site. As a result, the rate at which the surface water runoff is discharged from the site is likely to increase. Consequently, measures will need to be put in place to ensure that the impact of this additional surface water runoff is appropriately managed.

2.4 Planning Policy and Context

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 of 10 dwellings or more; or equivalent non-residential, or mixed development (as set out in Article 2(1) of the Town and Country Planning (Development Management Procedure) (England) Order 2010). It is, however, recognised that SuDS should be designed to ensure that the maintenance and operation requirements are economically proportionate.

In this instance, the proposed development is for the construction of 78 residential units with a total floor space greater than 1,000m². As a result, the proposals are classified as 'major' development and therefore, the NTSS will apply. Reference to the NTSS has therefore been made throughout the following sections of this report to ensure the principles of sustainable drainage are considered.

In addition to the NTSS, Kent County Council's (KCC) Drainage and Planning Policy Statement (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

2.5 Climate Change

The global climate is constantly changing, but it is widely recognised that we are now entering a period of accelerating change. Over the last few decades there have been numerous studies into the impact of potential futures changes in the climate 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. Consequently, the following section of this report takes into consideration the impacts of climate change and references the most contemporary guidance which is applicable to the development site.

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 climate change predictions which are 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 development that is the subject of this SWMS is classified as residential, and therefore a design life of 100 years has been assumed.

Potential Changes in Climate

The recommended allowances for increases in peak rainfall intensity were updated by the Environment Agency in February 2016 and are applicable nationally. These allowances, shown in Table 2.2 below, provides a range of values which correspond with the Central and Upper End percentiles (i.e. the 50^{th} and 90^{th} percentile respectively) over three-time epochs.

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

Impacts of Climate Change on the Development Site

Potential increases in future rainfall need to be considered when designing surface water drainage systems. For this development, a design life of 100 years is assumed and therefore, an increase of 20% in peak rainfall intensity has been applied to the calculations used for the design rainfall event. Where this allowance has been applied the abbreviation *"+20%cc"* has been used.

To test the sensitivity of the proposed surface water drainage strategy to changes in peak rainfall intensity the Environment Agency recommend testing the drainage system under a higher climate change allowance of 40%. This has been considered further within the following sections of this report.

3 Potential Sources of Flooding

In determining whether the proposals for development are compliant with the NPPF, it is necessary to determine whether the development will be sustainable in terms of flood risk. Consequently, the main sources of flooding have been assessed and are discussed in Table 3.1 below.

Source of Flooding	Evidence
Risk of Flooding from Rivers	The Environment Agency's Flood Zone mapping shows the site is situated in Flood Zone 1 and is not at risk of flooding from a fluvial source. Consequently, the risk of flooding to the site from rivers is considered to be *low.*
Risk of Flooding from Sea/Estuaries	The site is located a significant distance inland and is elevated above predicted extreme tide levels. Consequently, the risk of flooding from this source is considered to be *low.*
Risk of Flooding from Ordinary and man-made watercourses	Inspection of OS mapping of the site and surrounding area reveals that there are no non-main rivers or artificial watercourses within close proximity to the site and therefore, the risk of flooding from this source is considered to be *low.*
Risk of Flooding from Overland flow	Inspection of the Environment Agency 'Flood Risk from Surface Water' mapping identifies that the majority of the site, including the proposed residential dwellings are shown to be at 'very low' risk of flooding from surface water. This is supported by the SFRA which shows the site has not been subject to historic surface water flooding in the past. The EA mapping does show a surface water flow path which runs through the south eastern half of the site, where the grass football pitch is proposed to be located. However, interrogation of aerial height data reveals there are no topographic depressions on site which would otherwise encourage surface water to pond. A detailed review of aerial height data reveals that land levels across the south eastern part of the site, where the surface water flow path has been identified, fall away to the northeast and therefore, during an extreme pluvial event, any surface water will flow away from the site in this direction. Notwithstanding this, it is recognised that the proposed residential dwellings are located away from this surface water flow path, in areas shown to be at very low risk of surface water flooding. Therefore, the risk of flooding to the proposed development from this source is considered to be *low.* In addition, the proposals for development will include a sustainable drainage system (SuDS) to ensure that surface water runoff is managed appropriately. These SuDS will reduce the risk of surface water flooding to the proposed development, whilst limiting the risk of flooding to the surrounding area. *Refer to Section 5.*
Risk of Flooding from Groundwater	Groundwater flooding is most likely to occur in low lying areas underlain by permeable rock (aquifers). The underlying geology in this area is Seaford Chalk Formation. Chalk formations can be susceptible to groundwater emergence as water passes through faults and discontinuities in the rock. However, land levels fall away from the site to the north and east towards the coastline. Therefore, it is this lower lying region away from the site where groundwater emergence is more likely to occur. This is supported by mapping provided as part of the Defra Groundwater Flood Scoping Study (May 2004), which shows that no groundwater flooding events were recorded near the site during the very wet periods of 2000/01 or 2002/03. The mapping also identifies that the site itself is not located within an area where groundwater emergence is predicted. Additionally, the SFRA shows that there are no historic records of groundwater flooding events at, or near the site in the past. Consequently, the risk of flooding from this source is considered to be *low.*

Source of Flooding	Evidence
Risk of Flooding from Sewers	Inspection of Southern Water asset location mapping identifies a foul sewer runs to the west of the site, before continuing away to the southeast, parallel to the site boundary. The absence of combined sewers in this location significantly reduces the risk of the sewers in this location surcharging. In the event that this sewer network was to become overwhelmed (i.e. as a result of a blockage), water is most likely to exit the sewer system away from the site, at the bottom of the network to the southeast. This is supported by the SFRA which shows the site has not been affected by recorded sewer flooding in the past. Notwithstanding this, in the unlikely event that water was to exit the sewer system adjacent to the site, there is the potential for shallow floodwater to flow across the south eastern half of the site, following the gradient of the land. However, inspection of the proposed scheme drawings identifies that no residential dwellings are proposed to be constructed in this area of the site. Consequently, taking the above into consideration the risk of flooding to the proposed development from sewers is considered to be *low*.
Risk of Flooding from Artificial Sources	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 Environment Agency's 'Flood Risk from Reservoirs' website shows that the site is not within an area considered to be at risk of flooding from reservoirs. Consequently, the risk of flooding is considered to be *low*.

Table 3.1 – Assessment of the risk of flooding from all sources.

From the analysis in Table 3.1, it can be seen that the area of proposed development is not exposed to any significant risks of flooding.

4 Existing Drainage

4.1 Existing Surface Water Drainage

The existing site is assumed to drain informally, with surface water running off the site into adjacent gardens and the public highway. Greenfield runoff rates for the part of the site which is to be developed have been calculated using the IH124 methodology and are outlined in Table 4.1 (below).

Return period (years)	Peak runoff from the existing site (l/s)
Qbar	1.83
Q1	0.47
Q30	5.54
Q100	5.95

Table 4.1 - Summary of peak runoff rated for the existing site.

Southern Water has provided sewer mapping for the site and surrounding area and an extract from this mapping is shown in Figure 4.1 below.

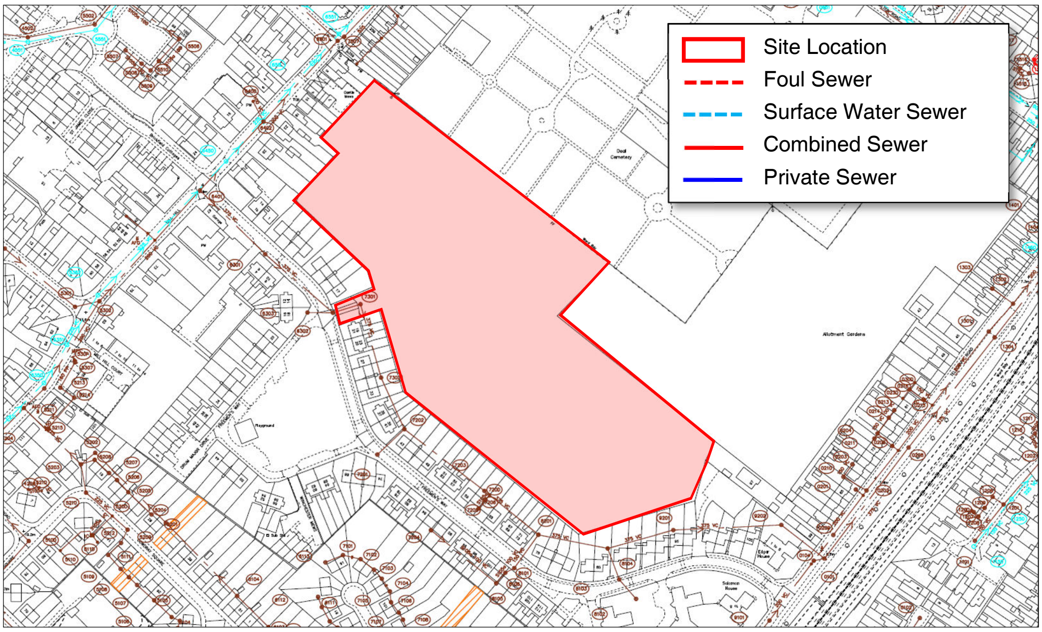

Figure 4.1 – Extract from Southern Water Asset Location mapping for the area around Freemen's Way.

From Figure 4.1 (above) it is evident that the sewers in this area are typically separated into dedicated surface water and foul water networks. The nearest surface water sewer to the site is located within Mill Hill.

5 Sustainable Drainage Assessment

5.1 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 most 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 – Soakage tests have been undertaken by others, which have come back inconclusive due to poor infiltration. Due to the poor infiltration rate, discharging surface water runoff via infiltration is not considered viable for the development.

Discharge to Watercourses – There are no watercourses located within close proximity to the site, which show onward connectivity to a main river, the sea, or any other large surface water body. As a result, there is no opportunity to discharge surface water runoff from the development to an existing watercourse.

Discharge to Public Sewer System – A more preferable solution for managing surface water runoff discharged from the development is unlikely to be available, and therefore it is likely that a connection to the public sewer system will be required. The nearest suitable connection point is the existing surface water sewer located approximately 100m away, within Mill Hill. At the detailed design stage, it will be necessary to requisition a new surface water drainage connection between the site and this sewer. The levels of the surface water sewer are unknown and therefore, a pump may be needed depending on the invert level of the public sewer. A CCTV survey is recommended at the detailed design stage to inform the levels of the public surface water sewer.

5.2 Proposed Surface Water Management Strategy

The drainage strategy set out below discusses each of the different elements of the proposed scheme, along with calculations that have been undertaken to demonstrate how the overall objectives can be achieved. This does not represent a detailed surface water drainage design; it is simply an assessment to demonstrate that the objectives and requirements of the NPPF can be met at the planning stage.

Water Butts

There is the opportunity to incorporate water butts within the communal garden area for external use, which will help to reduce the reliance on potable water supplies.

Typical house water butt options	Dimensions of a typical house water butt	Volume of storage provided (litres)
Type 1 (wall mounted – Small)	1.22m high x 0.46m x 0.23m	100
Type 2 (Standard house water butt)	0.9m high x 0.68m diameter	210
Type 3 (Large house water butt)	1.26m high x 1.24m x 0.8m	510
Type 4 (Column tank – Very large)	2.23m high x 1.28m diameter	2000

Table 5.1 – Estimated storage capacity of available water butts.

In this case the demand for potable water from each of the gardens is likely to be relatively small and as a result, standard house water butts (typical 200 - 210 litre units) are likely to be the most appropriate size for inclusion within the scheme.

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

Permeable Surfacing

Runoff from the hardstanding and roof areas across parts of the site, will be directed via underground pipes into a layer of open graded sub-base material, located beneath permeable surfacing. The sub-base will attenuate surface water before passing through a flow control and discharging into cellular storage. The overflow from water butts can also feed into this sub-surface storage.

Figure 5.1, illustrating the location of the SuDS can be found below.

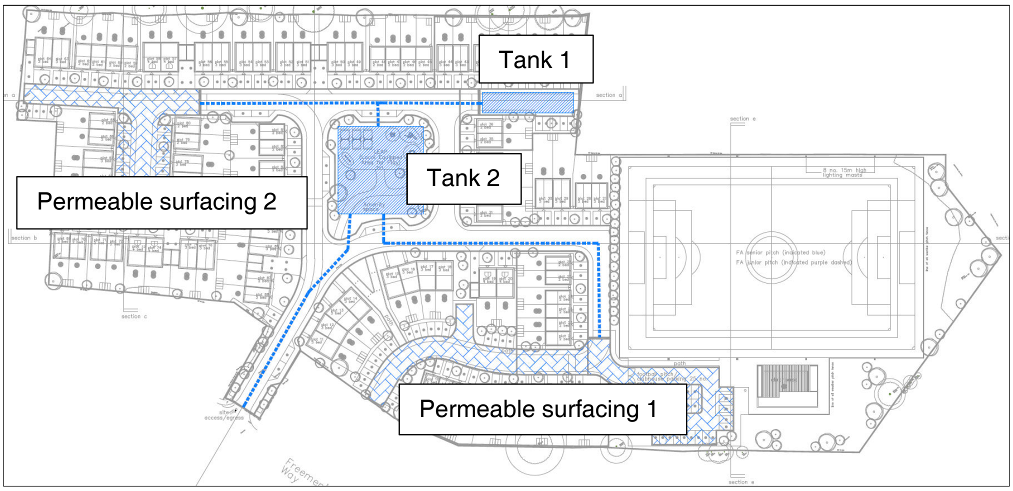

Figure 5.1 – Image showing location of SuDS

A summary of the Causeway Flow+ analysis for permeable surfacing is shown in Table 5.2 below.

Parameter	**Value (1:100yr+20%cc event)**	
SuDS	Permeable surfacing 1	Permeable surfacing
Area of permeable surfacing	~ 1,765 m^2	~1,445 m^2
Infiltration	Negligible	Negligible
Porosity	0.3	0.3
Sub-base depth	600 mm	600 mm
Flow restriction	Orifice plate (40mm diameter)	Orifice plate (40mm diameter)
Critical storm duration	960 minutes	960 minutes
Flooded Volume	0 m^3	0 m^3

Table 5.2 – Summary of permeable surfacing SuDS.

Cellular Storage

The surface water runoff from the remaining impermeable areas and the flow from the upstream SuDS can be discharged to the public sewer at an attenuated rate, via a cellular storage system. A vortex flow control device (Hydro-Brake or similar), can be used to restrict the outflow rate from the cellular storage tank thus minimising the peak rate at which runoff is discharged to the public sewer system. A summary of the Causeway Flow+ analysis for the cellular storage tanks are shown in Table 5.3 below.

Parameter	**Value (1:100yr+20%cc event)**	
SuDS	Tank 1	Tank 2
Storage Volume	~ 173 m^3	~ 912 m^3
Infiltration	Negligible	Negligible
Porosity	0.95	0.95
Tank depth	1.5m	1.0m
Flow restriction	Orifice plate (40mm diameter)	Vortex flow control (design head = 1.0 m, design flow = 1.0 l/s)
Peak discharge rate	4.3 l/s (to Tank 2)	0.9 l/s (to public sewer)
Critical storm duration	480 minutes	1,440 minutes
Flooded Volume	0 m^3	0 m^3

Table 5.3 – Summary of cellular storage.

From the table above it is evident that, with the inclusion of the proposed SuDS, there is the potential to accommodate all the surface water runoff from the site up to, and including, the design rainfall event. The peak discharge rate from the site during the design rainfall event is 0.9 l/s. This is considered as low as practicably possible and is likely to be acceptable to the LPA and Southern Water.

5.3 Indicative Drainage Layout Plan

Figure 5.1 below is an indicative drainage layout plan delineating how the proposed SuDS can be incorporated into the scheme proposals.

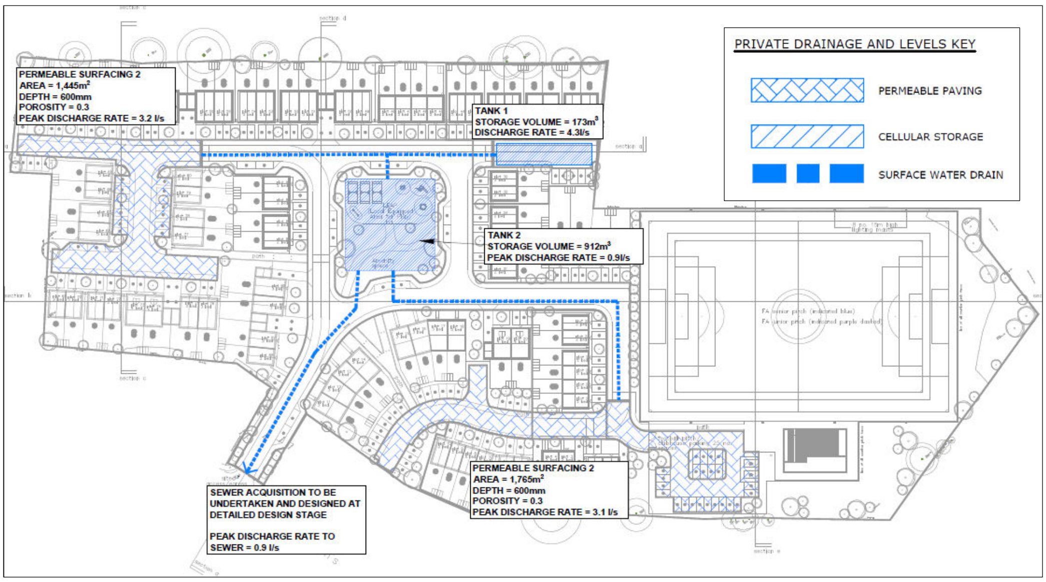

Figure 5.1 - Indicative drainage layout plan showing the proposed location of SuDS.

A full copy of the drainage layout is located in Appendix A.3 of this report.

5.4 Management and Maintenance

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

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

- A description of the drainage scheme,
- A location plan showing all of the SuDS features and equipment such as flow control devices etc.
- Maintenance requirements for each element, including any manufacturer specific requirements
- An explanation of the consequences of not carrying out the specified maintenance
- Details of who will be responsible for the ongoing maintenance of the drainage system.

For the SuDS recommended by this assessment, the most obvious maintenance tasks will be the regular brushing and cleaning of the permeable surfacing and the desilting of chambers across the site to help prevent blockages in the drainage system. Appendix A.5 provides details on the typical maintenance requirements for each of the proposed SuDS. It is acknowledged that inspection and maintenance procedures are likely to be required at a higher frequency during the first few years following construction as each of the systems become established.

For developments such as this that rely to some extent on the ongoing inspection and maintenance of SuDS, it will be necessary to ensure that measures are in place to maintain the system for the lifetime of the development.

The management company responsible for maintaining the rest of the site will be tasked with the inspection and maintenance of the permeable paving system and pond. In addition, the regular inspection and desilting of the manholes will need to be carried out.

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

5.5 Sensitivity Testing and Residual Risk

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

The permeable surfacing system is hydraulically linked to the cellular storage via pipework, connecting the base of the sub-base material to the cellular storage. To minimise the risk of this pipework becoming blocked, an overflow pipe has been proposed at a higher level within the sub-base. If the lower pipework cannot discharge freely downstream, this high-level pipe will activate, allowing excess water to drain directly to the downstream SuDS. This reduces the risk of above ground flooding.

The surface water drainage system has been designed to accommodate the runoff generated under an extreme rainfall event with a 1 in 100 year return period, including a 20% allowance for climate change (to account for the impacts of climate change). Nonetheless, based on the EA's current climate change guidance, an Upper End climate change allowance of 40% has also been applied to account for any uncertainties associated with the predictions of future climate change, and to test the sensitivity of the proposed drainage system.

A summary of the Causeway Flow+ calculations is provided in Tables 5.4 and 5.5 below, which can be used to measure the performance of the proposed drainage system for a rainfall event with a 1 in 100 year return period, including a 40% allowance for climate change.

Parameter	**Value**	
SuDS	Permeable surfacing 1	Permeable surfacing 2
Critical storm duration	960 minutes	720 minutes
Freeboard	0mm (storage is surcharged)	0mm (storage is surcharged)
Flooded volume	0 m^3	0 m^3

Table 5.4 - Summary of the Causeway Flow+ analysis for the permeable surfacing, including a 40% allowance or climate change.

Parameter	**Value**	
SuDS	Tank 1	Tank 2
Critical storm duration	600 minutes	1,440 minutes
Freeboard	0mm (storage is surcharged)	185mm
Peak discharge rate	4.7 l/s (to downstream SuDS)	0.9 l/s (to public sewer)
Flooded volume	0 m^3	0 m^3

Table 5.5 - Summary of the Causeway Flow+ analysis for the cellular storage, including a 40% allowance or climate change.

The results presented in Tables 5.4 and 5.5 show that the proposed drainage system is unlikely to flood if the peak rainfall intensity is increased to 40%. This demonstrates that the risk of flooding to the internal ground floor of the buildings remains low. Additionally, if an exceedance diagram has been provided below in figure 5.2 below.

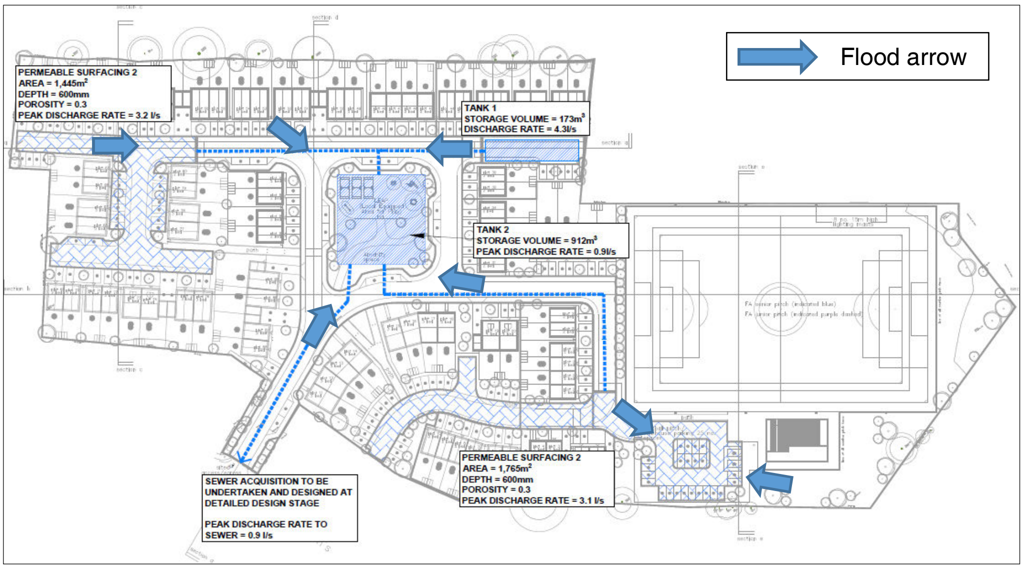

Figure 5.2 – Exceedance diagram.

Figure 5.2 illustrates that ponding would occur within the amenity space above attenuation tank 2. Surface water would be stored here and within the kerbs of the surrounding road to provide at least 125mm of storage if a standard HB2 kerb is used within this area. Additionally, the car park adjacent to the football pitch could be used to store surface water during an exceedance event if standard kerbs are to be used.

6 Conclusions and Recommendations

The overarching objective of this report is to appraise the proposals for the development at Freemen's Way, Deal to ensure that the risk of flooding to the occupants of the proposed residential units is acceptable and that the risk of flooding offsite will not increase as a result of the development proposals. This report has therefore been prepared to appraise the risk of flooding from all sources and to provide a sustainable solution for managing the surface water runoff discharged from the development site, in accordance with the NPPF and local planning policy.

As part of this assessment, the risk of flooding has been considered for a wide range of sources and it has been identified that the risk of flooding to the proposed development is low. Notwithstanding this, in order to minimise the impact that the building could have with respect to an increase is surface water runoff, the opportunities for managing surface water at the site have been further analysed.

It is concluded that the most viable solution for managing the surface water runoff discharged from the proposed development will be via the public surface water sewer located on Mill Hill. It is recommended that a CCTV survey is undertaken on the existing sewer and Southern Water is consulted to agree a proposed new connection.

In order to discharge the surface water runoff from the site to the public sewer various SuDS have been proposed, including; cellular storage and permeable surfacing. These SuDS will be used to attenuate surface water runoff prior to discharging to the public sewer at a rate no greater than 0.9l/s.

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

In conclusion, it is evident that the development is at low risk of flooding and a sustainable solution for managing the surface water runoff discharged from the proposed development at Freemen's Way is available. Consequently, the proposals will meet the requirements of the NPPF and local planning policy.

7 Appendices

Appendix A.1 – Drawings

Appendix A.2 – Southern Water Asset Location Data

Appendix A.3 – Indicative Drainage Layout Plan

Appendix A.4 – Surface Water Management Calculations

Appendix A.5 – Maintenance Schedules