



11.0 Water Environment

11.1 Introduction

11.1.1 This chapter assesses the likely significant effects of the Proposed Development with respect to flood risk and drainage. This chapter also describes the policy and legislative framework; the methods used to assess the effects; the baseline conditions currently existing at the site; the mitigation measures required to prevent, reduce or offset any significant negative effects; and the likely residual effects after these measures have been adopted.

11.2 Methodology and Scope

Policy Background

11.2.1 Policy CS15 of the Havant Borough Core Strategy addresses ‘flood and coastal erosion risk’. The development proposals adhere to this policy as it passes the sequential test and the Strategic Flood Risk Assessment states that the Site is not located in a flood risk area. The site-specific flood risk assessment (FRA) demonstrates that the development will be safe without increasing flood risk elsewhere. Sustainable Drainage Systems (SuDS) have been incorporated across the Site to manage surface water drainage.

Key Legislation

- 11.2.2 The Flood and Water Management Act (FWMA) encourages the use of SuDS on development sites by removing the automatic right to connect to sewers. The development proposals for the Site will adhere to the FWMA through the provision of SuDS as a fundamental component of the surface water drainage strategy.
- 11.2.3 The National Planning Policy Framework (NPPF) sets out the Government’s policies relating to planning and flood risk. The development proposals are compliant with Paragraph 163 of the NPPF, as they are supported by a site-specific FRA which demonstrates that within the Site, development is located in areas of lowest flood risk. The FRA also demonstrates that the development incorporates SuDS and that residual risk can be safely managed. The drainage strategy design takes account of advice from the Lead Local Flood Authority and will have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development.
- 11.2.4 The Building Regulations 2010 Part H ‘Drainage and Waste Disposal’ establishes a drainage hierarchy for surface water disposal, which encourages a SuDS approach. This hierarchy stipulates that surface water runoff not collected for reuse must be discharged to one or more of the following in order of priority:
- An adequate soakaway or some other adequate infiltration system; or, where that is not reasonably practicable,
 - A watercourse; or, where that is not reasonably practicable,
 - A sewer.
- 11.2.5 The method of surface water disposal from the site will be determined using the drainage hierarchy.

Scoping Assessment Stage

- 11.2.6 The Water Environment scoping assessment was submitted to Havant Borough Council (HBC) as part of the Environmental Impact Assessment Scoping Report in February 2018. The assessment set out the baseline conditions, mitigation within the design, and receptors to be considered during the construction and operational phases, in relation to hydrology and drainage.
- 11.2.7 Consultation responses were received from HBC and Natural England, who noted that the EIA should consider the impacts of the development on the water environment, as there is existing evidence of high levels of nitrogen and phosphorus in the water environment with eutrophication at some designated sites. Natural England recommend that a nutrient budget for the development is calculated. This point is addressed in section 11.7.
- 11.2.8 Environmental Health stated that the hydrogeological risks associated with foundations and structures should be low, although some chalk subsurface may be struck by foundation, drainage features, and other service-related construction. SuDS features may act as a vector for pollution and as an erosion/pathway creation risk. This point is addressed in section 11.5.
- 11.2.9 Southern Water noted that there is an existing foul sewer (and associated easement) crossing the site. An assessment is required to ascertain an appropriate point of connection to the foul and surface water sewerage network, and a formal application for this connection is also required. This point is addressed in section 11.5.

Assessment Methodology

11.2.10 Investigation into the hydrology and drainage on site and in the surrounding area has taken on different forms for various tasks, including completing an FRA and drainage strategy for the site. These are included in Appendix 11.1. A summary of these methodologies is presented in Table 11.1 below.

Table 11.1 Assessment Methodologies Undertaken on Campdown

		Assessment undertaken	Consultation source
Type of Methodology	Desktop study	Reviewing national and local policy documents	UK Government, Building Regulations, Havant Borough Council
		Reviewing flood risk data	Environment Agency
		Reviewing topographical data	Persimmon Homes
		Reviewing geological conditions and analysing site investigation results	British Geological Survey, RSK Environment
		Reviewing sewer maps	Southern Water



		Assessment undertaken	Consultation source
	Field study	Intrusive ground investigations including soakage testing to determine the suitability of infiltrating SuDS and determination of groundwater levels	RSK Environment
	Hydraulic modelling	Completing a hydraulic rainfall model of the catchments draining to the site to quantify the risk from overland flows and test the proposed mitigation measures to ensure flood risk is not exacerbated offsite	Environment Agency, Centre for Ecology & Hydrology
	Design Review	Seeking pre-application guidance on what information regarding flood risk and drainage needs to be included in the application	Hampshire County Council
	Report Writing	FRA and drainage strategy – culmination of methodologies and assessments listed above. A summary of existing site conditions, current levels of flood risk and existing drainage provisions, as well as discussion on the proposed drainage strategy and the rationale behind it. Appendices contain relevant supporting documentation.	Various

Receptor Sensitivity

11.2.11 The value of the receptor has been assessed based on professional judgement and a review of the key receptors as part of the initial review process and is set out within Table 11.2 below.

Table 11.2 Criteria for Assessing Receptor Sensitivity

Sensitivity	Criteria	Measures
Very High	Receptor has a high quality and rarity on	Water Framework Directive (WFD) Class 'High'.

Sensitivity	Criteria	Measures
	a national or regional scale	- Site protected/designated under EU or UK habitat legislation (e.g. Special Protection Area (SPA), Site of Special Scientific Interest (SSSI). - Flood Zone 3b (functional floodplain), land where water has to flow or be stored in times of flood, generally with a 1 in 20 or greater annual probability of flooding. - Source Protection Zone 1.
High	Receptor has a high quality on a local scale	- WFD Class 'Good'. - Main River >10m wide. - Flood Zone 3a (high probability), land having a 1 in 100 or greater annual probability of river flooding. - Source Protection Zone 2.
Medium	Receptor has a medium quality on a local scale	- WFD Class 'Moderate'. - Main river <10m wide. - Ordinary watercourse >5m wide. - Flood Zone 2 (medium probability), land having between a 1 in 100 and 1 in 1000 annual probability of river flooding. - Source Protection Zone 3.
Low	Receptor has a low quality and rarity on a local scale	- WFD Class 'Poor'. - Unclassified field drain which is likely to be <5m wide. - Flood Zone 1 (low probability), land having a less than 1 in 1000 annual probability of river flooding.

Effect Magnitude

11.2.12 The magnitude of the change on the local flood risk (i.e. increase in impermeable area), in terms of impact, is set out in Table 11.3 below.

Table 11.3 Magnitude of Effect

		Criteria	Definition
Magnitude	High	Results in major and lasting exacerbation of risk	Where the Proposed Development could be expected to have a very significant environmental effect (either adverse or beneficial) on existing levels of flood risk, groundwater contamination levels, sewerage capacity, as well as impact on residents living on site, and upstream and downstream of the site during the construction and operational phases
	Medium	Results in exacerbation of risk	Where the Proposed Development could be expected to have a noticeable environmental effect (either adverse or beneficial) on existing levels of flood risk, groundwater contamination levels, sewerage capacity, as well as impact



		Criteria	Definition
			on residents living on site, and upstream and downstream of the site during the construction and operational phases
	Low	Results in minor exacerbation of risk	Where the Proposed Development could be expected to result in a small, barely noticeable environmental effect (either adverse or beneficial) on existing levels of flood risk, groundwater contamination levels, sewerage capacity, as well as impact on residents living on site, and upstream and downstream of the site during the construction and operational phases
	Negligible	No impact to risk, or level of change not significant	Where no discernible environmental effect is expected (less than 30%, or 10% in sensitive areas) as a result of the proposed development on existing levels of flood risk, groundwater contamination levels, sewerage capacity, as well as impact on residents living on site, and upstream and downstream of the site during the construction and operational phases

Effect Significance

11.2.13 The '7-point scale' of significance criteria, compares the nature of an impact with its significance, and must be judged by detailed consideration of the characteristics of the impact against the sensitivity of the receptor. This scale is as follows and is set out in Table 11.4.

- Major beneficial;
- Moderate beneficial;
- Minor beneficial;
- Negligible;
- Minor adverse;
- Moderate adverse; and
- Major adverse.

Table 11.4 Matrix for Determining the Significance of Effects

		Sensitivity of Receptor			
		Very High	High	Medium	Low
Magnitude of Effect	High	Major	Major	Moderate	Minor
	Medium	Major	Moderate	Minor	Negligible

		Sensitivity of Receptor			
		Very High	High	Medium	Low
	Low	Moderate	Minor	Minor	Negligible
	Negligible	Minor	Negligible	Negligible	Negligible

11.2.14 An assessment is made later in the report regarding whether the impacts are short-term (construction related) or long-term (operational related), and how they can be dealt with.

11.2.15 Where appropriate, the significance of effect will be classified as being adverse/beneficial, direct/indirect or cumulative.

11.2.16 All effects classified as 'moderate' and above are considered to be significant.

Limitations of the Assessment

11.2.17 There are no significant limitations to the assessment.

11.3 Baseline Environment

Existing baseline

Topography

11.3.1 A study of the topography shows that levels fall towards the south east of the Site. Levels range from approximately 57.5m above ordnance datum (AOD) to 25.5m AOD. The topographical survey is included within the FRA in Appendix 11.1.

Hydrology

11.3.2 The nearest EA designated Main River is situated to the east of the Site, just beyond the A3(M) motorway. There is also an ordinary watercourse located to the south of the Site, which flows along part of the southern boundary.

Geology and Hydrogeology

11.3.3 British Geological Survey (BGS) online maps, accessed August 2019, indicate that the bedrock beneath the site comprises Wittering Formation – sand, silt and clay; London Clay Formation – clay, silt and sand; Bognor Sand Member – sand; and Lambeth Group – clay, silt and sand.

11.3.4 The mapping shows the presence of superficial deposits towards the south and south east of the site, formed of clay, silt, sand and gravel.

11.3.5 BGS records also show that the northern part of the site is located within the Bracklesham Group and Barton Group aquifer, described as a 'moderately productive aquifer'. The remaining area of the site sits on the Thames Group aquifer, described as 'rocks with essentially no groundwater'. BGS data is included in Appendix 11.1.



- 11.3.6 A site investigation was undertaken by RSK Environment in October 2016, and the intrusive investigations largely correspond with the BGS mapping, as topsoil, made ground, head deposits, Bognor Sand Member and Lambeth Group strata were encountered.
- 11.3.7 The results of the borehole soakage tests indicate that infiltration rates range from 5.37×10^{-6} m/s and 4.05×10^{-8} m/s.
- 11.3.8 During the site investigation, groundwater was encountered within two of the boreholes. A strike of 1.20 - 1.25m below ground level (bgl) was encountered to the north west of the site, and a strike of 2.00 – 2.50m bgl was encountered to the south west of the Site. Site investigation extracts are included within Appendix 11.1.

Existing Drainage Regime

- 11.3.9 According to Southern Water records, there are no public surface water sewers currently located within the site boundary, however there is existing Southern Water surface water infrastructure beyond the western site boundary.
- 11.3.10 It is anticipated that surface water runoff from the site currently infiltrates into the underlying strata, with any excess discharged to the watercourse to the south of the Site.
- 11.3.11 The Southern Water records show that a 375mm diameter public foul sewer crosses the site from west to east. These records are included in Appendix 11.1.

Existing Flood Risk

- 11.3.12 According to the EA Flood Map for Planning, the entire site is situated in Flood Zone 1 for fluvial flooding, classified as 'land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding'.
- 11.3.13 The EA Long Term Flood Risk Map indicates that the majority of the Site lies within an area at 'very low risk' of surface water (pluvial) flooding. This is an area which has a less than 1 in 1,000 annual probability of surface water flooding.
- 11.3.14 The mapping shows a surface water flow route across the north west and south west of the Site, originating offsite. The flow route has low, medium and high-risk areas of surface water flooding.
- 11.3.15 EA mapping is included in Appendix 11.1.

Future baseline

- 11.3.16 Hydraulic modelling was undertaken to determine the risk from overland flows to the site, and the model was used to predict fluvial flood levels for the 1 in 100 year plus 40% climate change scenario. The baseline model results show that the overland flood routes will flow through the north west and south west of the Site, and into the watercourse along the southern site boundary. These results are included in Appendix 11.1.
- 11.3.17 If the proposed development were not to proceed, it is envisaged that none of the other baseline conditions discussed above would change unless further external factors changed, as they are all pre-existing and would not be expected to develop or evolve should there be no development on Site.

11.4 Mitigation within the Submitted Design

Construction

- 11.4.1 To ensure that the drainage will be suitable from the offset, the proposed SuDS features for relevant catchments will be designed to full storage capacity from the beginning of construction.
- 11.4.2 To eradicate the possibility of water quality being negatively impacted by construction runoff, sediment removal facilities shall be provided on site to treat surface water before it is discharged offsite.
- 11.4.3 A Construction Environmental Management Plan (CEMP) will outline how all construction activities will be managed and will include the management of surface water runoff during site preparation and construction to minimise the potential impacts on the environment.

Operation

- 11.4.1 Measures have been effectively implemented to mitigate against the risk of flooding to and from the Proposed Development. The proposed drainage strategy for the Site is presented in Appendix 11.1.
- 11.4.2 Surface water runoff generated by the development will be managed through the use of SuDS. The use of infiltrating SuDS at the Site is not practicable due to the poor infiltration rates achieved during the site investigation. In accordance with the drainage hierarchy, it is proposed that surface water runoff will drain to lined ponds/wetlands and lined cellular storage tanks. Flows will be discharged to the watercourse to the south of the Site at less than Q_{BAR} .
- 11.4.3 All surface water attenuation systems will be designed to accommodate the 1 in 100 year plus 40% climate change rainfall event. The drainage system will be maintained in line with the manufacturers' recommendations by the production of a maintenance and management plan.
- 11.4.4 In the case of a severe flood event that exceeds the flood management design standard, levels across the site will be manipulated in order to ensure that in an extreme rainfall event, flows will be contained within the highways and conveyed away from the houses. Flows will temporarily be stored within the low-lying areas and open spaces. The risk of property flooding and risks to health and safety will be minimised.
- 11.4.5 As previously mentioned, there is a surface water flow route across the north west and south west of the Site. The north west spur of the flow route has been considered within the Site layout and will be accommodated within the highway areas. It is proposed that a diversion channel in the form of a swale will redirect the south west spur of the flow route so as to not impact the development. The layout to the south west of the Site has been designed so that development is located outside of the diversion channel route. These proposals do not increase flood risk offsite.
- 11.4.6 A foul water drainage system for the development will be designed in accordance with Sewers for Adoption 8th Edition, the Building Regulations Part H and to Southern Water requirements. It is proposed to divert the existing foul sewer which currently crosses the site, so that it can be incorporated within the highways of the Proposed Development. The proposed foul water drainage will connect to the existing Southern Water public foul sewer located to the east of the Site, and a formal application will be made to confirm this. If capacity does not exist within the network to accommodate flows from the Site, Southern Water's charging arrangements will remove the constraints imposed on new development due to lack of capacity within existing foul infrastructure.



11.5 Likely Significant Environmental Effects of the Scheme

- 11.5.1 The flood risk in the area will be affected by the development. However, through the correct design of adequate drainage features, it is anticipated that this risk can be reduced instead of increased. The assessment of effects is split into construction and operational phases.

Construction Phase Effects

- 11.5.2 It is likely that the construction phase will generate additional surface water flows compared to the existing discharge from the Site. These additional flows would generate an impact if this is not controlled to existing runoff rates. As previously mentioned, the SuDS features will be implemented at the beginning of the construction phase to ensure there are adequate drainage provisions at all times on site, and that flood risk is not exacerbated on or offsite. The impact magnitude is expected to be negligible as existing site conditions will maintain the current scenario. The impact is also temporary and reversible. The sensitivity of the receiving ordinary watercourse is low (Flood Zone 1) however the catchment ultimately drains to the Solent which has a WFD status of 'moderate' and its sensitivity is medium. The resulting significance of construction surface water runoff is **negligible** and not significant.
- 11.5.3 During the construction phase, surface water runoff may become polluted with suspended solids and contaminants from mobilised sediment, oils, chemicals and building materials. The CEMP will set out the site-specific measures which will be undertaken to prevent polluted runoff from being discharged offsite. This is temporary and the impact magnitude of this is negligible, as water quality of the flows leaving the site will be maintained and prevent any adverse effects within the catchment downstream. The sensitivity of the Solent is medium, and the significance of this is therefore **negligible** and not significant.

Operational Phase Effects

- 11.5.4 The pluvial flood route to the north of the Site will be accommodated within the highways and therefore will not be impeded by the development. The diversion channel will also redirect the existing pluvial flood route to the south west of the Site to ensure that the development is not located within an area at risk of flooding. Hydraulic modelling undertaken by Odyssey shows that flood risk is not increased on or offsite in the post-development scenario.
- 11.5.5 The proposed drainage strategy incorporates SuDS features which will store the increased volumes of surface water runoff generated by the Proposed Development. The surface water drainage system has been designed to include 10% additional impermeable roof area to mitigate the impacts of future urban creep across the Site. The SuDS features will release flows at Q_{BAR} rates to mimic the existing drainage regime at the site. Flows draining offsite will be maintained and flood risk will not be increased downstream; the impact magnitude of this is negligible. This impact is long-term as it is anticipated that the operational phase of the development will be permanent and irreversible. The sensitivity of the receiving ordinary watercourse is low, and the sensitivity of the Solent into which it drains is medium. The significance of this is **negligible** and not significant.
- 11.5.6 The ponds/wetlands and cellular storage tanks will be lined to ensure the capacity of the SuDS features is not compromised, and to prevent the ingress of groundwater. Lining the attenuation features will also protect the groundwater by preventing infiltration and any associated pollutants. The impact magnitude of this is negligible as there should be no change in groundwater quality. The sensitivity of the groundwater is very high (Source Protection Zone 1). The significance of this is expected to be **minor adverse** and not considered to be significant.

- 11.5.7 The proposed drainage strategy will provide adequate pollution treatment, in accordance with CIRIA C753 The SuDS Manual. The impact magnitude of this is negligible, as the SuDS features, and proprietary treatment systems will reduce sediments and contaminants generated by the Proposed Development and maintain the quality of water discharging offsite. The sensitivity of the receptors is medium, and the significance of this is **negligible** and not significant.

- 11.5.8 The surface water drainage strategy incorporates ponds/wetlands which will offer ecological, aesthetic and amenity opportunities. The impact magnitude of this is low, as this offers a small noticeable environmental effect for residents and a reduction in nitrates entering the Solent. The significance of this is **minor beneficial** and not considered to be significant.

11.6 Additional Mitigation, Compensation and Enhancement Measures

- 11.6.1 There is a possibility that measures will be required to mitigate the adverse water quality impacts, e.g. eutrophication, arising from new development on several designated sites in the Solent. Natural England recommends that a nutrient budget for the development is calculated and that the proposals achieve nutrient neutrality.
- 11.6.2 The Client is currently exploring options to filter nitrates from surface water at the Site. One option is the incorporation of reed beds, and discussions will progress with the Council and Natural England to establish appropriate mitigation measures.

11.7 Assessment Summary and Likely Significant Residual Environmental Effects

- 11.7.1 Residual risks are those remaining after mitigation actions have been taken.
- 11.7.2 One residual risk is the blockage of the surface water drainage system. To minimise this risk, the onsite drainage system maintenance will be carried out by a private recognised management company through the implementation of an approved maintenance and management plan for the lifetime of the development.

Climate change

- 11.7.3 The SuDS features have been sized to attenuate flows up to the 1 in 100 year plus 40% climate change storm event.
- 11.7.4 The post-development hydraulic model shows that the proposed mitigation measures will not impede the overland flood routes upstream and downstream of the site, and the site will be protected from the overland flood routes without increasing the risk offsite for the 1 in 100 year plus climate change event.



Table 11.5 Assessment Summary and Residual Environmental Effects (Water Resources and Flood Risk)

Summary description of the identified impact	Sensitivity of Receptor	Impact Magnitude	Significance and Nature of Effect	Additional Mitigation	Residual Impact Magnitude	Residual Significance and Nature of Effect	Confidence Level
Construction							
Increase in surface water runoff	Medium	Negligible	Negligible	None required	Negligible	Negligible	High
Pollution (CEMP to set out site-specific mitigation measures)	Medium	Negligible	Negligible	None required	Negligible	Negligible	High
Operation							
Increase in surface water runoff	Medium	Negligible	Negligible	None required	Negligible	Negligible	High
Groundwater impacts	Very high	Negligible	Minor adverse	None required	Negligible	Minor adverse	High
Pollution and water quality	Medium	Negligible	Negligible	None required	Negligible	Negligible	High
Pond/wetland features (amenity/biodiversity/nitrates)	Medium	Low	Minor beneficial	None required	Low	Minor beneficial	High



Table 11.6 Means by which Additional Mitigation Measure may be Secured (Water Resources and Flood Risk)

Identified Effect where additional mitigation (Not design mitigation) has been identified	Type of mitigation measures (avoidance, reduction, compensation, enhancement)	Means by which mitigation measure may be secured
Operation		
Nutrient neutrality	Reduction and enhancement	Reed beds (other options are currently being explored)

11.8 References

11.8.1 British Geological Society (2019) Geoindex Onshore <http://mapapps2.bgs.ac.uk/geoindex/home.html> (28th August 2019).

11.8.2 CIRIA (2015) The SuDS Manual (C753).

11.8.3 Environment Agency (2019) Long Term Flood Risk Information <https://flood-warning-information.service.gov.uk/long-term-flood-risk/map> (5th September 2019).

11.8.4 Havant Borough Council (2011) Havant Borough Core Strategy.

11.8.5 HM Government (2015) The Building Regulations 2010 Approved Document H (Drainage and Waste Disposal).

11.8.6 Ministry of Housing, Communities & Local Government (2019) National Planning Policy Framework.

11.8.7 The Stationery Office (2010) Flood and Water Management Act 2010.

11.9 Glossary

Term	Definition
Lead Local Flood Authority	County councils and unitary authorities which are responsible for developing, maintaining and applying a strategy for local flood risk management in their areas and maintaining a register of flood risk assets. They also have a lead responsibility for managing the risk of flooding from surface water, groundwater and ordinary watercourses.
Nutrient neutrality	A means of ensuring that development does not add to existing nutrient burdens and this provides certainty that the whole of the development is deliverable in line with the requirements of the Conservation of Habitats and Species Regulations 2017.

Q_{BAR}	The peak rate of flow from a catchment for the mean annual flood. This flow rate is used to provide a measure of the greenfield runoff performance of a site in its natural state to enable flow rate criteria to be set for post development surface water discharges.
Sustainable Drainage Systems (SuDS)	These mimic natural drainage patterns to manage rainfall and surface water runoff close to the source.