

5.0 Flood Risk Mitigation Measures

5.1 Introduction

5.1.1 The following sources of flooding were identified:

- Fluvial flooding (Hermitage Stream and Watercourse 1).
- Tidal flooding (Hermitage Stream/Solent).
- Groundwater flooding (below and above ground).
- Surface water flooding (overland flow pathways and ponding).
- Sewer flooding (surcharged flows from distribution mains).

5.2 Mitigation Measures

Fluvial/ Tidal Flooding

- Provide an 8m easement free from development along the side of Hermitage Stream. This easement would provide access for inspection and maintenance purposes, including vehicle access.
- Set the surface water outfall from the proposed development at an appropriate height, i.e. above the 1 in 100-year+51%CC modelled flood level (5.53m AOD).
- Set vulnerable electrical equipment a minimum of +150mm above the modelled 1 in 100-year 51%+CC flood level.
- The Site will not be permanently manned, and as such any persons on Site would be there for a short period of time. Implementation of measures such as flood alerts would give any onsite personnel enough time to leave the Site upon the issuing of a flood warning. A second means of access in an emergency can also be considered.
- Adoption of a surface water management strategy.
- Fit flapped outfalls to avoid surcharging in a flood event and allow surface water to still discharge.

Groundwater Flooding

- Set vulnerable electrical equipment above external levels as per above.
- Lined attenuation to prevent groundwater ingress.

Surface Water Flooding

- Sequentially develop the Site, limiting the built development outside the mapped extent of surface water flooding associated with overland flow pathways.
- Adoption of a surface water management strategy (see Section 6).
- Set vulnerable equipment above external levels as above.

Sewer Flooding

- Provide a development free easement (3m either side) of onsite Southern Water sewer assets, or re-direct around the Site boundary.

5.3 Summary of Flood Risk

5.3.1 Table 5.1 summarises the probability and level of risk, both with and without mitigation measures.

Table 5.1: Probability and Consequences of All Sources of Flooding

Flooding Source	Potential Source	Probability	Consequence & Impact Without Mitigation	Consequence & Impact with Mitigation
Fluvial	Hermitage Stream	Negligible for the Site and low along the southeastern boundary	Negligible for the Site and low along the southeastern boundary	Negligible
Tidal	Hermitage Stream/Solent	Negligible for most of the Site and low along the southeastern boundary	Negligible for most of the Site and low along the southeastern boundary	Negligible
Groundwater	Principal and Secondary A Aquifer	High for the entire Site	High for the entire Site	Negligible to Low
Surface Water	Poor permeability and Site topography	Negligible for most of the Site but low where there are overland flow pathways and ponding.	Negligible for most of the Site but low where there are overland flow pathways and ponding.	Negligible
Sewers and Mains	Distribution Mains	Negligible for most of the Site but low along identified assets	Negligible for most of the Site but low along identified assets	Negligible
Infrastructure Failure	None identified	Negligible	Negligible	Negligible

Key: Green - Negligible, Yellow - Low, Orange - Medium and Red - High; based on consequence and impact with mitigation from each flooding source.

5.4 Flood Guidance and Sequential Test

- 5.4.1 The proposal is for battery energy storage system (BESS) development. The PPG ID: 7 (not included in this report) classifies the proposed use as 'essential infrastructure'.
- 5.4.2 The Environment Agency Flood Zones and acceptable development types are listed in Table 5.2. All development types (including essential infrastructure uses) are acceptable in Flood Zone 1, 2, and 3 (low to high risk). However, as shown above the Site is not inundated during any return events and is therefore effectively within Flood Zone 1 in regard to fluvial flooding.
- 5.4.3 Subject to the above mitigation measures including locating the development outside of Flood Zone 2 and 3, in regard to tidal flooding, the Sequential Test would be passed and the Exception Test would not be required as indicated in Table 5.3.

Table 5.2: Environment Agency Flood Zones and Appropriate Land Use

Flood Zone	Probability	Explanation	Appropriate Land use
Zone 1	Low	Less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).	All development types generally acceptable.
Zone 2	Medium	Between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% - 0.1%) in any year.	Most development type are generally acceptable.
Zone 3a	High	A 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.	Some development types not acceptable.
Zone 3b	'Functional Floodplain'	Land where water must flow or be stored in times of flood. SFRAs should identify this zone (land which would flood with an annual probability of 1 in 30 (3.33%) or greater in any year or is designed to flood in an extreme (0.1% flood, or at another probability to be agreed between the LPA and the Environment Agency, including water conveyance routes).	Some development types not acceptable.

Note: The Flood Zones are the current best information on the extent of the extreme flood from rivers or the sea that would occur without the presence of flood defences, because these can be breached, overtopped and may not be in existence for the lifetime of the development. The identified risk of fluvial flooding is highlighted green.

Table 5.3: Vulnerability and Flood Zone 'Compatibility' as Identified in Table 2 of PPG ID: 7

Flood Risk Vulnerability classification (see Table 1 of PPG ID: 7)	Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Zone 1	Yes	Yes	Yes	Yes	Yes
Zone 2	Yes	Yes	Exception test required	Yes	Yes
Zone 3a	Exception test required	Yes	No	Exception test required	Yes
Zone 3b 'Functional Floodplain'	Exception test required	Yes	No	No	No

Key: Yes: Development is appropriate, No: Development should not be permitted. The identified risk of fluvial flooding is highlighted green.

6.0 Site Drainage

6.1 Surface Water Drainage

- 6.1.1 Consideration of flood issues is not confined to the floodplain. This is recognised in the NPPF and associated guidance where all proposed development of 1ha or more in Flood Zone 1 and so outside the floodplain nevertheless requires an FRA. The alteration of natural surface water flow patterns through development can lead to problems elsewhere in a catchment, particularly flooding downstream, and the replacement of permeable vegetated areas by low-permeability roofs, roads and other paved surfaces will increase the speed, volume, and peak flow of surface water runoff. So, the NPPF and associated guidance require an FRA for all proposed development of 1ha or more outside the floodplain in Flood Zone 1.
- 6.1.2 A surface water management strategy for the development is proposed to manage and reduce the flood risk posed by surface water runoff from the Site. The developer will be required to ensure that any scheme for surface water management should build in enough capacity for the entire Site.
- 6.1.3 The surface water drainage arrangements for any development Site should be such that the volume and peak flow rates of surface water leaving a developed Site are no greater than the rates prior to the proposed development unless specific off-Site arrangements are made and result in the same net effect.
- 6.1.4 An assessment of the surface water runoff rates was undertaken to determine the surface water options and attenuation requirements for the Site.

6.2 Existing Drainage System

- 6.2.1 The land use is comprised of made ground and an is part of the wider Portsmouth Water Bedhampton WTW.
- 6.2.2 The Site is underlain by low permeable soils and high permeable bedrock. Drainage is predominantly via overland flow, following the topography of the Site to the topographic low points (Watercourse 1/Hermitage Stream) with a small amount of infiltration to bedrock, and throughflow to watercourse.

6.3 Developable and Impermeable Areas

- 6.3.1 An impermeable area of 0.657ha was measured from the 0.8ha developable area. The existing and proposed impermeable areas are summarised in Table 6.1 and a drawing is provided; SHF-3055-001-ENZ-XX-XX-DR-D-0002.
- 6.3.2 The proposed development will increase the impermeable surfaces and so increase the amount of runoff.
- 6.3.3 It must be noted that while there is a degree of made ground on the Site, with low permeability, the Site is not impermeable.

Table 6.1: Impermeable Area

Area	Existing Buildings and Hardstanding	Proposed Buildings and Hardstanding	Difference
Area (ha)	0	0.657	+0.657

Percentage of Total Site Area (%)	0	82.1	+82.1
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6.4 Greenfield Runoff Rates

- 6.4.1 An assessment of greenfield runoff rates was undertaken to determine the attenuation requirements for the proposed development.
- 6.4.2 The runoff rates were calculated using the HRWallingford UKSuDS online tool, with FEH method inputs (descriptors obtained from the FEH webservice¹⁹). This is a recommended methodology for Sites up to 50ha in area and the approach is in line with the current 'industry best practice' guidelines as outlined in the Interim Code of Practice for SuDS²⁰, and Environment Agency Report SC030219 - Rainfall runoff management for developments.
- 6.4.3 The following parameters were used in the runoff calculations:
- Impermeable Area: 0.657ha
 - Average Annual Rainfall (SAAR): 731mm/year
 - Region No.: 7
 - BFIHOST19: 0.597
- 6.4.4 BFIHOST was updated to BFIHOST19 (November 2019) since a number of issues were identified with BFIHOST, which including a tendency to underestimate BFI in clay-dominated catchments.
- 6.4.5 BFIHOST19 is the baseflow index developed using the Hydrology of Soil Types (HOST) classification and is the baseflow proportion of the flow on average. It is estimated based on the daily mean flow data. Baseflow comprises water entering the watercourse through shallow subsurface flow and groundwater flow (mechanisms other than direct surface runoff); hence permeable soils and geology tend to yield a higher baseflow.
- 6.4.6 The Soilsmap online soils map viewer and Geology of Britain online map viewer identified the following:
- Soils: loamy with naturally high groundwater
 - Superficial Deposits: Alluvium – clay, silt, sand, and gravel, and River Terrace Deposits – sand, silt, and clay.
 - Bedrock: Lewes Nodular Chalk, Seaford Chalk, Newhaven Chalk, Culvert Chalk, and Portsdown Chalk.
- 6.4.7 BFIHOST19 value assigned by the FEH webservice is considered to replicate on-site conditions.
- 6.4.8 Table 6.2 shows the calculated greenfield runoff rates. Runoff calculations are included in Appendix 8.

¹⁹ Centre for Ecology and Hydrology, Flood Estimation Handbook Web Service [<https://fehweb.ceh.ac.uk/>].

²⁰ Office of the Deputy Prime Minister, National SuDS Working Group (July 2004) Interim Code of Practice for Sustainable Drainage Systems [https://www.susdrain.org/files/resources/other-guidance/nswg_icop_for_suds_0704.pdf].

Table 6.2: Greenfield Runoff Rates

Annual Probability (Return Period, Years)	Greenfield Runoff (l/s)
QBAR	1.8
100% (1)	1.5
3.33% (30)	4.1
1% (100)	5.6
1% Plus Climate Change	8.12

Note: 45% climate change added. The 1 in 1-year, 30-year and 100-year annual probability events are of importance to the Water Companies and the Environment Agency when looking at sewage discharge and flood risk.

- 6.4.9 Consultation with the LLFA stated that discharge should be restricted to a minimal practicable rate of 2l/s and as such this rate has been carried forward for the remainder of the report.

6.5 Surface Water Management Strategy

Hierarchy of Discharge

- 6.5.1 In accordance with requirement H3 of the Building Regulations 2010²¹ rainwater runoff must discharge to one of the following, listed in order of priority:

- 1. An adequate soakaway or some other adequate infiltration system:** The use of infiltration-based SuDS is not feasible due to low infiltration potential into the clayey soils and geology, as well as the Sites use as a landfill and the presence of made-ground creating potential contamination into the high-water table, SPZ and Principal Aquifer below the Site.
- 2. A watercourse:** Hermitage Stream conveys flows southwest along the southeastern boundary of the Site.
- 3. A sewer:** There are no public surface water sewers located within the immediate vicinity of the Site.

- 6.5.2 The potential route to discharge surface water from the proposed development will be by outfall to Hermitage Stream.

6.6 Sustainable Drainage Options (SuDS)

Choice of SuDS Options

- 6.6.1 Sustainable water management measures should be used to control the surface water runoff from the proposed development Site, thereby managing the flood risk to the Site and surrounding areas from surface water runoff. These measures will also improve the quality of water discharged from the Site.
- 6.6.2 Current guidance promotes sustainable water management using SuDS. Options applicable to this Site are identified in Table 6.3.

²¹ Office of the Deputy Prime Minister, The Building Regulations 2010, amended 2021
[\[https://www.gov.uk/government/publications/drainage-and-waste-disposal-approved-document-h\]](https://www.gov.uk/government/publications/drainage-and-waste-disposal-approved-document-h)

Table 6.3: SuDS Options

Green roofs	Infiltration basins
Water butts	Detention basins
Permeable paving	Oversized pipes
Rainwater harvesting	Brown roofs
Filter strips	Swales
Wetland Areas	Cellular Storage

Note: SuDS appropriate to the development are highlighted green.

6.6.3 A hierarchy of SuDS techniques is identified²²:

- 1. Prevention** - the use of good Site design and housekeeping measures on individual Sites to prevent runoff and pollution (e.g. minimise areas of hard standing).
- 2. Source Control** - control of runoff at or very near its source (such as the use of rainwater harvesting).
- 3. Site Control** - management of water from several sub-catchments (including routing water from roofs and car parks to one/several large soakaways for the whole Site).
- 4. Regional Control** - management of runoff from several Sites, typically in a detention pond or wetland.

6.6.4 Using SuDS as opposed to conventional drainage systems provides several benefits by:

- Reducing peak flows to watercourses or sewers and potentially reducing the risk of flooding downstream.
- Reducing the volumes and frequency of water flowing directly to watercourses or sewers from developed Sites.
- Improving water quality over conventional surface water sewers by removing pollutants from diffuse pollutant sources.
- Reducing potable water demand through rainwater harvesting.
- Improving amenity through the provision of public open spaces and wildlife habitat.
- Replicating natural drainage patterns, including the recharge of groundwater so that base flows are maintained.

SuDS Maintenance

6.6.5 A geocellular tank will form the main attenuation feature within the development Site.

6.6.6 Maintenance of the SuDS features would be in line with the SuDS Manual (CIRIA C753, 2015), as detailed in Figure 6.1. It is standard for SuDS features within a new development to be maintained by a private maintenance company unless the council adopt it. If the maintenance company goes into administration, the Site will be contracted to a new maintenance company. Residents will pay a surcharge to the maintenance company and a number of them would be

²² CIRIA (2004) Report C609, Sustainable Drainage Systems – Hydraulic, Structural and Water Quality advice.

appointed to its board. This will ensure maintenance throughout the lifetime of the development.

- 6.6.7 Details of other SuDS features, and maintenance would be considered further at detailed design when a detailed layout has been produced. The level of detailed provided within this FRA should be sufficient at outline stage to demonstrate that SuDS would be deliverable.

Figure 6.1: Attenuation Storage Tanks Operation and Maintenance Requirements (Table 21.3 of the SuDS Manual)

TABLE 21.3 Operation and maintenance requirements for attenuation storage tanks		
Maintenance schedule	Required action	Typical frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then annually
	Remove debris from the catchment surface (where it may cause risks to performance)	Monthly
	For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae or other matter; remove and replace surface infiltration medium as necessary.	Annually
	Remove sediment from pre-treatment structures and/or internal forebays	Annually, or as required
Remedial actions	Repair/rehabilitate inlets, outlet, overflows and vents	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually
	Survey inside of tank for sediment build-up and remove if necessary	Every 5 years or as required

Drainage Design Summary

- 6.6.1 Surface water runoff would be directed to the drainage system through drainage gullies located around the perimeter of the buildings and through contouring of the hardstanding areas.
- 6.6.2 Landscaped areas should be incorporated into the layout where possible to allow a proportion of the rainfall to infiltrate into the soil substrate.
- 6.6.3 Surface water will be directed to an onsite attenuation tank.
- 6.6.4 An indicative surface water drainage layout is in Drawing SHF-3055-001-ENZ-XX-XX-DR-D-0001.

Attenuation Requirements

- 6.6.5 Attenuation storage is required to reduce the post-application surface water runoff from the Site to calculated greenfield runoff rates, up to and including the 1 in 100-year (+45%CC) rainfall event, assuming no infiltration losses.
- 6.6.6 The following input parameters were assumed in the calculations:
- Impermeable Area: 0.657ha (82%);
 - Cv (proportion of rainfall forming surface water runoff): 100% summer, 100% winter;
 - Infiltration losses: 0m/hour;
 - With outfall: 2l/s.
- 6.6.7 The attenuation volume for the 1 in 100-year event (plus climate change) is 646m³.

- 6.6.8 Attenuation calculations are included in Appendix 8. The calculated runoff rates and attenuation volumes will be reviewed at detailed design stage.

6.7 Exceedance Routes

- 6.7.1 The attenuation tanks will be designed with a capacity up to a 1 in 100-year (plus 45% climate change) event, based on the 2l/s restricted discharge rate. This provides a betterment (reduction) in runoff when compared to existing undeveloped conditions, where runoff is uncontrolled across all return periods.
- 6.7.2 A storm event in excess of this design standard would be extreme and would cause the attenuation tanks to overtop (with no sudden deluge) and would then shed overland following the topography into the centre, as per existing conditions (Drawing 007).
- 6.7.3 Finished floor levels of vulnerable equipment will be set above external levels, which will mitigate the residual risk of overtopping.

6.8 Firewater Considerations

- 6.8.1 The Site will be lined to prevent any contamination of water used for fire suppression into the groundwater system.
- 6.8.2 The tank will be fitted with a penstock which can be shut off in the event of a fire which will prevent contaminated water entering the watercourse.
- 6.8.3 Water tanks have been provided on Site to provide 228,000 litres of water on Site. This is the minimum recommended amount of 1,900 litres per minute for at least 2 hours²³.
- 6.8.4 The Battery Storage Units will be fitted with their own fire suppression systems providing further mitigation.

6.9 Water Quality

- 6.9.1 Water quality improvements are achieved by decreasing flow rates, which in turn traps silt, sediment, and pollutants before discharging to Hermitage Stream.
- 6.9.2 The online Simple Index Approach [SIA] Tool²⁴ has been used to demonstrate the effectiveness of the proposed strategy to manage surface water discharging to Hermitage Stream.
- 6.9.3 It must be noted that due to the sites previous use as a landfill, the land-use has been entered as waste-handling management site.
- 6.9.4 The use of a bioretention system with the possibility of gravel attenuation would provide a sufficient level of treatment. A copy of the calculations is included in Appendix 9, and a summary of the results are included in Table 6.4.

²³ <https://nfcc.org.uk/wp-content/uploads/2023/10/Grid-Scale-Battery-Energy-Storage-System-planning-Guidance-for-FRS.pdf>

²⁴ https://www.susdrain.org/resources/SuDS_Manual.html