

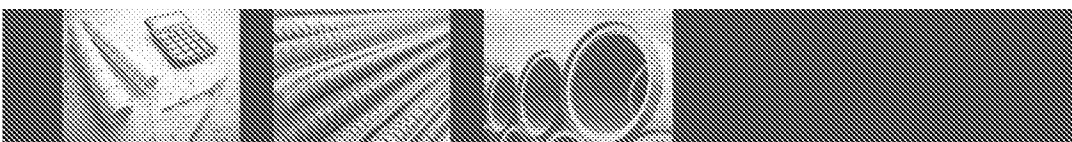
PROPOSED CHANGING FACILITY & SPORTS PITCH
LAND OFF CHARLES PURLEY WAY (A259)
FELPHAM
BOGNOR REGIS
WEST SUSSEX
PO22 8FW

FLOOD RISK ASSESSMENT & DEVELOPMENT DRAINAGE STRATEGY

BARRATT HOMES

JANUARY 2021

REF: SS/21/0045/5292



DOCUMENT CONTROL RECORD

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Appendices

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Appendix D – Pre / Post Development Runoff and Storage Calculations

References

Environment Agency Flood Map information © and database right www.environment_agency.gov.uk

Contains British Geological Survey materials © NERC (2018)

National Planning Policy Framework (Department for Communities and Local Government, March 2012)

PPG Flood risk and coastal change (Department for Communities and Local Government, March 2014)

West Sussex County Council Preliminary Flood Risk Assessment (PFRA) (WSCC, May 2011)

West Sussex County Council Strategic Flood Risk Assessment Volume II (SFRA) (Capita, January 2010)

1 Executive Summary

SITE INFORMATION	CLIENT	Barratt Homes
	SITE NAME	Felpham Changing Facility and Sports Pitch
	SITE LOCATION	SU 95412 01359 Land off Charles Purley Way (A259) Felpham, Bognor Regis West Sussex, PO22 8FW
	SITE AREA	2.33ha
	CURRENT LAND USE	Greenfield
	PROPOSED LAND USE	Changing Facilities and Sports Pitch (Class F2c)
	SITE GEOLOGY – Superficial	River Terrace Deposits – Sand, silt and clay.
	SITE GEOLOGY - Bedrock	Lewes Nodular Chalk; Seaford Chalk and Newhaven Chalk Formation - Chalk
	SOIL INFILTRATION RATE	Insufficient for infiltration SuDS - Clay
	GROUNDWATER LEVELS	Circa 0.6-1m Below Ground Level
	GROUNDWATER SPZ / AQUIFER	Not in a Source Protection Zone Bedrock: Principle, Superficial: Secondary A
	GROUND CONTAMINATION	None Encountered
FLOOD RISK	ENVIRONMENT AGENCY FLOOD ZONE	Flood Zone 1 – 2
	FLUVIAL (RIVERS & WATERCOURSES)	Medium Risk (1:100 – 1:1000 or 1% - 0.1%).
	PLUVIAL (SURFACE WATER)	High Risk (> 1:30 or 3.3%)
	GROUNDWATER	Not a risk
	EXISTING/PROPOSED SEWERS & MAINS	Not a risk
	ARTIFICIAL	Not a risk
	TIDAL	Not a risk
FOUL & SURFACE	PROPOSED SURFACE WATER STRATEGY	Gravity to watercourse
	PROPOSED SUDS TYPE	Attenuation Basin Swale
	EXISTING SW PEAK FLOW RATE	Greenfield QBar: 2.8l/s
	PROPOSED SW PEAK FLOW RATE	2.8 l/s
	FOUL WATER STRATEGY	Gravity to Southern Water Foul Sewer
	EXISTING FW PEAK FLOW RATE	N/A (0l/s)
	PROPOSED FW PEAK FLOW RATE	0.03l/s (420 l/unit/d) for 1 Unit
MISC	FURTHER INVESTIGATIONS	N/A

2 Introduction

2.1 Scope

Barratt Homes is seeking planning permission for the construction of sports pitches with associated parking and changing facility. The greenfield site occupies an area that lies to the northeast of Bognor Regis and west of the village of Flansham, West Sussex. The 23,275m² (2.33ha) site is located directly to the north of, and accompanies, the new Felpham development and lies south of the new Felpham bypass (A259). Refer to Appendix A for site layout.

2.2

MJA Consulting has been appointed to provide a Flood Risk Assessment & Drainage Strategy suitable to submit as part of the planning application for the disposal of foul and surface water from the proposed development.

2.3 Report Structure

The National Planning Policy Framework (NPPF) and the Flood Risk and Coastal Planning Practice Guidance (PPG) is the current guidance on development and flood risk in England and Wales. The Flood Risk technical guidance for the National Planning Policy Framework requires a Flood Risk Assessment (FRA) to be carried out on sites over 1ha to consider all potential forms of flooding including that from river, sea, estuarial, land drainage, groundwater, overland flow, surface water run-off, sewer systems, and artificial water bodies (lakes, reservoirs, canals etc.) to both the development site and to offsite parties and land.

2.4

This report will take the structure of a 'Flood Risk Assessment' in accordance with the National Planning Policy Framework, the Flood Risk and Coastal Planning Practice Guidance, Environment Agency's Flood Risk Assessment Guidance and CIRIA Report 624 'Development and Flood Risk.

2.5

The objectives of this report are:

- To confirm whether the proposed development site is affected by current or anticipated future flooding from all sources for the lifetime of the site.
- To confirm that this development will not increase the risk of flooding to any offsite properties and land or increase the population within a floodplain.
- To undertake calculations to establish the foul and surface water runoff rates from the existing site and to assess the potential foul and surface water runoff from the proposed development.
- To detail a suitable strategy for the management of foul and surface water generated from the proposed development allowing for future climate change.
- To satisfy the approving planning authority that the most sustainable foul and surface water drainage solutions have been considered, in line with Environment Agency guidance, The Building Regulations (Document H 2002) and government legislation such as the Flood and Water Management Act 2010 (Defra) and The National Planning Policy Framework (NPPF & PPG).

3 The Development Site

Figure 1: Site location

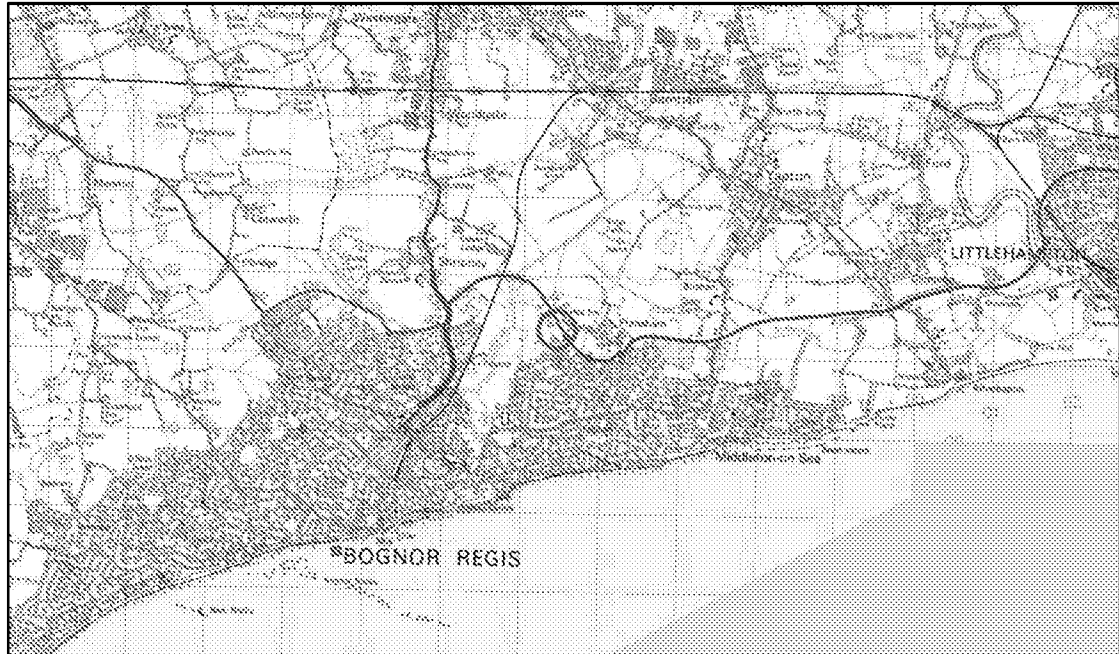


Image courtesy of: Bing Maps, 2021 Microsoft Corporation Image courtesy of Ordnance Survey

Figure 2: Development boundary



Image courtesy of: Google Maps, 2021 Microsoft Corporation

3.1 Site Location and Description

The application site is located at land west of Charles Purley Way (A259) Felpham, Bognor Regis, West Sussex. The irregular shaped parcel of land is centred on National Grid Reference SU 95412 01359 and comprises of previously arable fields in the east and Woodcote Garden Centre to the west.

3.2 Topography

A topographical survey of the site was undertaken by Siteline in May 2007 which indicates the site is relatively flat with levels ranging from 2.0mAOD to 4.0mAOD (metres above Ordnance Datum) and a general fall of 1/120 from north-east to south-west, towards the ditch. Refer to Appendix B for a Topographical Survey of the existing site.

3.3 Geology

Information published by the British Geological Society (BGS) indicates the underlying geology at the site as Lewes Nodular Chalk; Seaford Chalk, Newhaven Chalk, Culver Chalk and Portsdown Chalk Formation – Chalk, with superficial deposits of River Terrace Deposits – Sand, silt and clay.

- 3.4 Ground investigations were carried out by GEA as part of the wider Felpham development and local trial pits indicate the site is underlain by deposits of Clay and silt over Chalk at circa 3m below ground level.

3.5 Soil Permeability

Soil infiltration testing in accordance BRE 365 methodology has not been carried out across the site. The site is on clay with shallow groundwater and may be unsuitable for infiltration type SuDS.

3.6 Groundwater

Groundwater was encountered in the majority of the trial pits at depths of between 1.50 m and 3.00 m, with moderate to fast inflows noted from the more granular layers. Where trial pits were excavated within predominantly clay soils, groundwater has generally not been encountered other than as seepages at depths of below about 2.00 m. Groundwater monitoring standpipes were installed into a number of the previous boreholes and a limited programme of monitoring indicated a groundwater rest level at depths of 0.63 m and 1.00 m below ground level.

3.7 Hydrogeology

The Environment Agency's mapping website (<http://magic.defra.gov.uk/MagicMap.aspx>) has classified the site as not within or near a Source Protection Zone.

- 3.8 The bedrock Chalk formations are classified as a 'Principle' aquifer. These are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale.



3.9 The superficial deposits are classified as 'Secondary A' aquifers. These are layers of rock that are capable of supporting water supplies at a local rather than strategic scale, and in some cases are part of an important source of base flow to rivers.

3.10 Hydrology and Existing Site Drainage Characteristics

The existing site is undeveloped grassland, as such rainfall that lands on the site firstly infiltrates directly at source and into the underlying soils. It is likely the site has relatively poor surface water drainage with some overland flow due to the ditch.

3.11 There is an ordinary watercourse along the western boundary of the site which is connected to the main rivers, Lidsey Rife and Ryebank Rife, 500m away.

3.12 Ground Contamination

The available environment data does not indicate the presence of any significant sources of contamination risk on site and no visual or olfactory evidence of soil contamination was identified during a site walkover.

4 Flood Risk

- 4.1 The assessment of flood risk to the site requires that all potential forms of flooding are considered. In accordance with the Environment Agency's Flood Risk Assessment Guidance, NPPF, PPG and CIRIA Report 624, sources of flooding to be assessed include tidal, fluvial (rivers, streams and watercourses), pluvial (overland rainfall runoff), groundwater, artificial sources (canals and reservoirs) and existing / proposed sewerage and water mains infrastructure.

4.2 History of Flooding

During the data collection process, it is important to consider the information which already exists for the site location with respect to flood risk. The main sources of data for flood risk and recorded incidents of flooding for this site has been the *West Sussex County Council Preliminary Flood Risk Assessment (PFRA) (WSCC, May 2011)* and the *West Sussex County Council Strategic Flood Risk Assessment Volume II (SFRA) (Capita, January 2010)*. Additional information has been obtained from The Environment Agency, British Society Chronology of Extreme Hydrological Events, local news and media outlets.

- 4.3 Within the SFRA/PRFA studies, consultation was carried out with all appropriate authorities and organisations including the Environment Agency, Southern Water, Arun District Council and local community stakeholders to identify known or perceived problem areas with respect to flooding.

- 4.4 With reference to the above, and in the context of the proposed development, there are no historic issues of flooding from the following potential sources including:

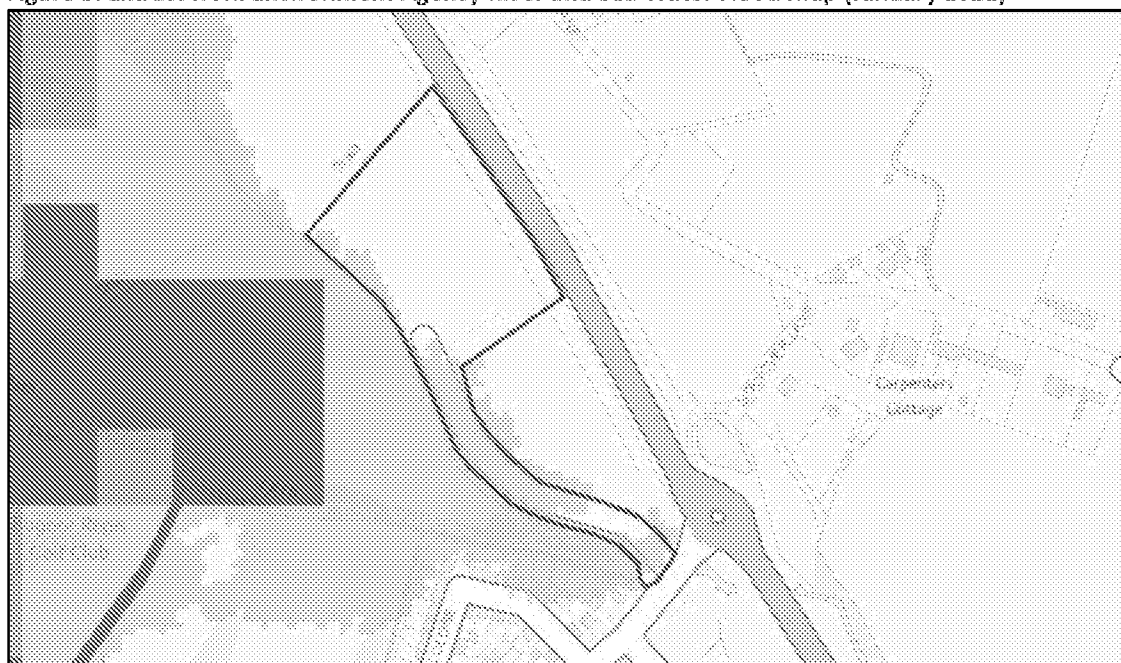
- Fluvial (Rivers and Sea).
- Tidal.
- Groundwater.
- Pluvial (Surface water runoff).
- Existing foul, storm and combined sewers or potable water main infrastructure.
- Artificial infrastructure.

4.5 Fluvial

The Environment Agency confirms that no incidents of flooding from main rivers or the ordinary watercourse have been recorded within the site boundary.

- 4.6 The Environment Agency (EA) is the principal flood risk management operating authority in England. The EA have carried out a national flood risk assessment (NaFRA) which assesses the probability of flooding to land from all main rivers in England. The results of this modelling are combined and calibrated against data from recorded flood events to produce the Environment Agency's Flood Zone Map (Figure 3).

Figure 3: Extract from Environment Agency River and Sea Water Flood Map (January 2021)



Contains Environment Agency information © Environment Agency 2021

Key:



Main Rivers

Dark Blue ■ (Flood Zone 3)

Shows the area that could be affected by flooding, either from rivers or the sea, if there were no flood defences. This area could be flooded: from the sea by a flood that has a 0.5% (1 in 200) or greater chance of happening each year, or from a river by a flood that has a 1% (1 in 100) or greater chance of happening each year.

Light Blue ■ (Flood Zone 2)

Shows the additional extent of an extreme flood from rivers or the sea.

These outlying areas are likely to be affected by a major flood, with up to a 0.1% (1 in 1000) chance of occurring each year.

These two colours show the extent of the natural floodplain if there were no flood defences or certain other manmade structures and channel improvements.

Clear ■ (Flood Zone 1)

Shows the area where flooding from rivers and the sea is very unlikely.

There is less than a 0.1% (1 in 1000) chance of flooding occurring each year.

- 4.7 The latest Environment Agency 'Flood Zone Map' (May 2020) indicates that much of the site is located within the lowest risk category - Flood Zone 1. 'Flood Zone 1' is land assessed as having a less than 1 in 1000 (<0.1%) annual probability of flooding from a main river in each year and is not within an area of recorded river flooding.
- 4.8 The access road is located within flood zone 2. 'Flood Zone 2' is land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% – 0.1%).
- 4.9 Lidsey Rife floodplain which lies adjacent to the Felpham Development was reviewed by the Environment Agency during the wider development design and was found to have a peak level of 2.0m AOD for the 1:100 year event. The flood level has no impact on this development site and all areas of the development have an unrestricted access and egress during periods of adjacent flooding.

4.10 The full background to the above is contained in WSP report 11010487, 487/Flood technical note of 23rd October 2003.

4.11 Tidal

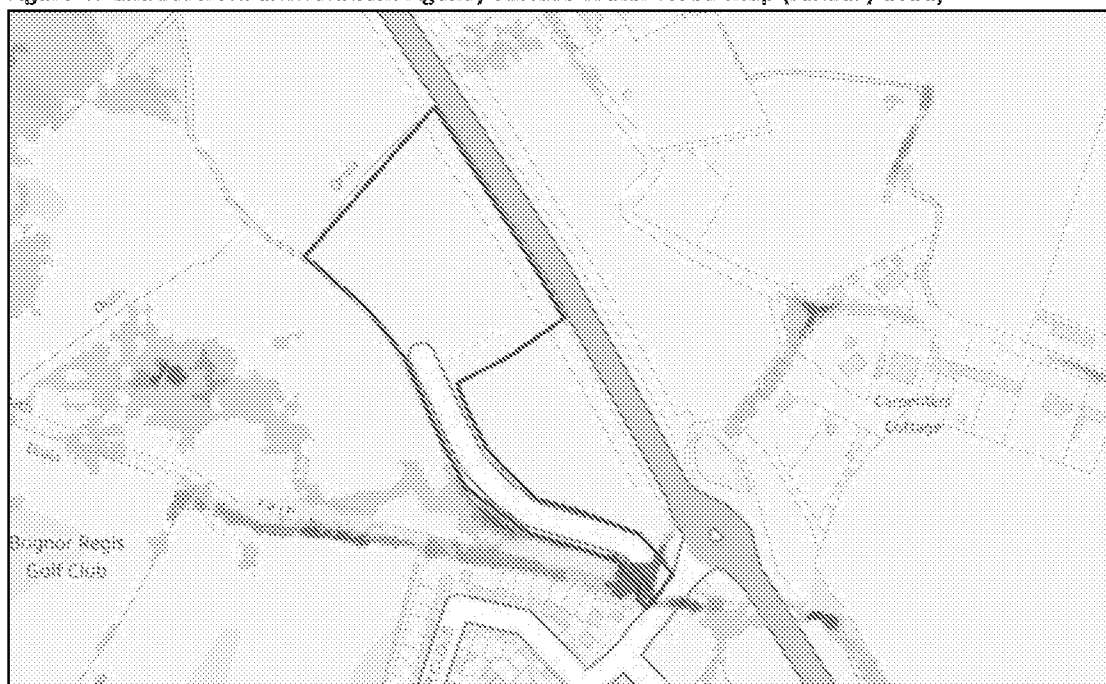
Felpham has a high risk of tidal flooding due to its proximity to the coast as confirmed by the SFRA, PFRA and the Environment Agency. This can affect the local river networks but the peak flood plain level in the rivers and ditch network does not affect the development site.

4.12 Surface Water

The 'FMFSWF' (Flood Map for Surface Water Flooding) presented within the SFRA confirms that no incidents of flooding from surface water runoff have been recorded within the site boundary. Since the SFRA/PFRA reports were produced, no further evidence of surface water flooding at the site has been identified.

4.13 The Environment Agency's 'uFMFSW' (updated Flood Map for Surface Water) (Figure 4) is a theoretical assessment of potential overland flow paths, ground levels and drainage systems using information from West Sussex County Council as the LLFA to indicate areas that may be susceptible to surface water flooding.

Figure 4: Extract from Environment Agency Surface Water Flood Map (January 2021)



Contains Environment Agency information © Environment Agency 2021

Key:

-  High (Greater than 1:30(3.3%) chance of flooding)
-  Medium (Between 1:100(1%) and 1:30(3.3%) chance of flooding)
-  Low (Between 1:1000 (0.1%) and 1:100 (1%) chance of flooding)
-  Very Low (Less than 1:1000 (0.1%) chance of flooding)



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- 4.14 The latest Environment Agency 'Flood Zone Map' (May 2020) indicates that the existing site has a 'very low' (less than a 1:1000 or 0.1%) risk of flooding from surface water runoff.
- 4.15 There is an area of 'high' (greater than a 1:30 or 3.3%) risk of flooding over the site access associated with the ditch and culverts. This risk will be mitigated by the addition of an adjacent swale that runs parallel to the ditch which will store and reduce the amount of water reaching that area.
- 4.16 The implementation of a robust drainage scheme to collect, attenuate and convey the surface water runoff from the proposed development will mitigate any residual risk of surface water flooding to the site in its developed state.
- 4.17 Although the main site entrance is at 'high' risk of flooding, it is demonstrated that safe and dry access and egress at the site is achievable to a publicly accessible location outside the 1:100 year (plus climate change) flood event extent, via the foot path along Charles Purley Way, in accordance with DEFRA Report FD2320/TR2 - 'Flood Risk Assessment Guidance for New Developments'.
- 4.18 **Groundwater**
The PFRA, SFRA and the Environment Agency confirm that no recorded events of groundwater flooding have been identified at or within the vicinity of the site.
- 4.19 Groundwater was encountered is expected to be circa 1m below ground level as confirmed by the ground investigations.
- 4.20 **Artificial Sources**
With reference to the SFRA/PRFA there have been no recorded incidents of flooding to the site or surrounding areas from artificial sources.
- 4.21 There are no additional artificial sources of flooding, such as that from canals, reservoirs and sewage treatment works within a 1 km radius of the site.
- 4.22 **Overland Flood Flow / Exceedance**
The occurrence of overland flooding at the site due to an extreme rainfall event exceeding the design capacity of the drainage system and SuDS, or a failure of the associated flow controls have been considered both during the construction and operational phase of the development.
- 4.23 If SuDS or the piped drainage system becomes overwhelmed by exceptional rainfall then exceedance routes are proposed to protect people and property by providing unobstructed overland flow routes across the development.
- 4.24 Any residual risk of overland flooding to buildings is to be mitigated by the provision of raised property slab levels a minimum of 300mm above surrounding ground level.
- 4.25 The described protection measures ensure that properties both within the proposed development and any offsite parties and land will not be affected by overland runoff in the event of a reasonably extreme rainfall event exceeding the design storm or a failure or a blockage of the SuDS structures within the system.

4.26 Proposed Site Drainage

A Flood Risk Assessment requires that an evaluation of all proposed artificial drainage systems and infrastructure within, or in close proximity to the site is carried out. In the context of this development, the following systems are to be installed which need to be assessed in terms of potential flooding through the capacity of the systems being exceeded or the structural, hydraulic, mechanical or operational failure of the system occurring during the lifetime of the development:

- Piped foul water sewers, manholes and potable water mains.
- SuDS for the temporary conveyance and attenuation of surface water.
- Foul water pumping station and associated rising main.

4.27 All adoptable foul and surface water drains, sewers and manholes will be designed and constructed to the with all private drainage constructed in accordance with the *Code for Adoption Design and Construction Guidance* and *The Building Regulations Part H, BS EN 752 or BS EN 12056-2* as appropriate, ensuring adequate design capacity and robust structural integrity for the lifetime of the development. This will not only prevent the risk of flooding to both the development and offsite parties, but will avoid the potential contamination of groundwater by preventing the ingress of groundwater into the pipework and egress of sewage into the underlying soils.

4.28 All SuDS within the drainage system will be sized to manage the runoff from the exceptionally rare 1 in 100 storm event (1% AEP), plus an additional 40% allowance for predicted future climate change effects (in accordance with EA recommendations up to the year 2115).

4.29 The new development as a whole must not create or exacerbate existing flood risk elsewhere and in particular to properties, land and highways downstream of the site. During the design of the proposed development careful consideration has been given to the most sustainable method of surface water disposal and strict controls have been imposed to limit the peak rate and volume of runoff generated from the developed site.

4.30 All surface water runoff from impermeable areas on the proposed development will be attenuated and safely disposed at a controlled rate to replicate the existing natural runoff regime for the undeveloped greenfield site. This will ensure that the risk of flooding to properties and land downstream of the site will not increase as a result of this proposed development.

4.31 Sequential Test

The flood risk technical guidance to the National Planning Policy Framework (NPPF) categorises sports facility developments as 'Less Vulnerable' within the risk classification. 'Less vulnerable' developments located within Flood Zone 1 are considered appropriate under the NPPF.

4.32 The NPPF guidance states that planning authorities should complete a risk based 'Sequential Test' at all stages of the planning process, to steer new development to areas with the lowest probability of flooding. Under the requirements of the 'Sequential Test' and as the proposed development is already located within Flood Zone 1 (lowest risk), there are no more suitable, developable and deliverable alternative sites, better located from a flood risk perspective which could accommodate the proposed development.

5 Existing and Proposed Site Runoff

- 5.1 This section aims to calculate the estimated peak rate and volume of surface water runoff from the existing site. These discharge figures are then used to establish the post-development constraints to inform the preliminary design of the site surface water drainage strategy.

5.2 Catchment Areas

The existing and proposed permeable and impermeable areas are listed in the table below.

Site Catchment	Impermeable	Permeable	Total
Existing Site Area	0 m ²	23,275 m ²	23,275 m ²
Proposed Site Area	8120 m ² **	15,155 m ²	23,275 m ²

** Although greenfield, 50% of the football field area has been included within the impermeable area figure.

- 5.3 This development represents an overall approximate increase of 8120m² in impermeable area post development.

5.4 Existing Surface Water Runoff Peak Runoff Rate & Volume (Greenfield)

An assessment of the estimated current greenfield runoff rate has been carried out using the Institute of Hydrology Report 124 (QBar) methodology.

Catchment: 0.812ha (F5R)

1 in 1 year	2.4 l/s
QBAR	2.8 l/s
1 in 30 year	6.4 l/s
1 in 100 year	9.0 l/s
Volume 100y 6hr	186.9 m ³

Refer to Appendix D for calculations

5.5 Post Development Surface Water Runoff Peak Runoff Rate & Volume

The procedure for surface water management in accordance within 'Rainfall runoff management for developments' (DEFRA/EA Report – SC030219 E, 2013) states; *"For the range of annual flow rate probabilities up to and including the 1% (1 in 100 year) annual exceedance probability event including an appropriate allowance for climate change, the post-developed rate of run-off into a watercourse, sewer, or other receiving water body, should be no greater than the existing pre-developed rate of run-off for the same event"*.

- 5.6 The National Planning Policy Framework requires that consideration is given to the effect of climate change on the surface water flows generated by any new development. Table 2 of the NPPF - Flood Risk Assessments: Climate Change Allowances – Detailed Guidance (Feb 2016), specifies that an assessment of a 40% increase in rainfall intensity allowance is made when calculating post development runoff rates for developments.



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- 5.7 The additional volume of runoff generated from a site should also be limited to the greenfield runoff volume where possible. Where infiltration cannot be utilised to dispose of the additional volume; *“The limiting discharge for any return period up to the 1% AEP (1 in 100 year) event including climate change, shall not be greater than the mean annual peak rate of runoff for the greenfield site – QBar or 2 l/s/ha, whichever is the greatest”*.
- 5.8 As a result of this development and the increase in impermeable areas, the peak rate and volume of surface water that could potentially runoff the proposed site if not effectively managed, could be greater than in its current undeveloped state.

6 Surface Water Drainage Strategy

- 6.1 The National Planning Policy Framework (NPPF) requires that developments do not exacerbate flood risks both to the development site and to offsite parties and land, which means there is a need to control surface water drainage and overland runoff to ensure there are no increases in peak rates and volumes of runoff as a result of the development.
- 6.2 Environment Agency guidance and government legislation such as the Flood and Water Management Act (Defra 2010) requires surface water drainage strategies for new developments to be in accordance with the ideals of 'sustainable development' via the provision of Sustainable Drainage Systems (SuDS).
- 6.3 SuDS are more sustainable than conventional drainage methods because they can mitigate many of the adverse effects of urban stormwater runoff on the environment. This can be achieved through reducing peak runoff rates and volumes to sewer networks and watercourses, reducing the risk of downstream flooding.
- 6.4 The Building Regulations Document H (2015) details the appropriate hierarchy of potential methods for disposing of surface water from a development:
1. A soakaway or some other adequate infiltration system, or where that is not practicable;
 2. A watercourse, or where that is not possible;
 3. A sewer.
- 6.5 Low soil permeability rates for the clay combined with high groundwater levels mean that infiltration as a method for disposing the surface water runoff generated from the proposed development is unsuitable.
- 6.6 Therefore, it is proposed to discharge all surface water runoff generated from the proposed development's hard standing areas including roofs, parking areas and roads to the watercourse at the site entrance.
- 6.7 The football pitch will be drained via perforated pipes to an attenuation basin then swale. All roads and parking areas will be impermeable macadam and drain via ACO channels and gullies to a swale.
- 6.8 Storage will be provided onsite in the form of a swale and an attenuation basin to manage the sized to store the 1:100year (1% AEP) storm event, plus an extra allowance of 40% for the predicted potential increase in peak rainfall up to 2115.
- 6.9 The total storage required onsite to manage the 1:100 year +40% storm event will be 366m³.
- 6.10 Any exceedance overflow will overtop the basin and swale system and will flow to the ditch, adjacent to the site, at rate far lower than the predevelopment greenfield run off for a large return period storm.
- 6.11 All flows leaving the site will be controlled to 2.8l/s for all storm events up to the 1:100 year +40% before outfalling to the adjacent ditch. This provides greenfield runoff rates for the site.



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- 6.12 All drains and manholes/inspection chambers will be designed and constructed in accordance with the Building Regulations Part H and BS EN 752, ensuring adequate capacity and robust structural integrity for the lifetime of the development. This will ensure that no polluted discharge from the drainage system to ground will take place.



7 Foul Water Drainage Strategy

- 7.1 All foul water flows generated from the development will discharge to a foul package pump station within the site boundary which will pump flows to a manhole within Bay Bridge Crescent.
- 7.2 The predicted peak foul sewer discharge from the changing room unit based on the Code for Adoption Design and Construction Guidance of 420 l/unit/day will be 0.03 l/s.
- 7.3 Southern Water will confirm that there is adequate capacity for the proposed development flows to ensure that it will have a 'no detriment' impact on the local foul sewer system and does not create an increase in flood risk.