



UK Flood Risk
Flood Risk Consultants

Flood Risk Assessment

**Station Road, Ford,
West Sussex BN18 0BS**

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1. *Journal of the American Medical Association*, 1997; 277: 1033-1038.

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Executive Summary

UK Flood Risk Consultants has been commissioned to prepare this Flood Risk Assessment (FRA) in support of a proposal consisting of development of the site for storage located at Station Road, Ford, West Sussex BN18 0BS.

The main sources of information to undertake flood risk assessment are the flood maps and data of the Environment Agency and the previous flood studies by the Local Authority.

The proposed development is categorised as 'less vulnerable'.

The nearest main river from the site is the River Arun with the risk of combined and tidal flooding.

According to the information available from the SFRA and the Environment Agency, there were no records of flooding events at the site.

The Environment Agency's Flood Maps show that the site lies within the Flood Zone 3 (high probability flooding). The Environment Agency's flood risk map indicates that the risk of flooding to the site varies from 'medium' to 'high'.

According to the information available from the Environment Agency, the site benefits from the raised flood embankments on the East bank of the River Arun. The standard of protection is estimated between 1 in 75 year and 1 in 200 year.

The Environment Agency's modelling data indicated that under the undefended and defended conditions, the site is subject to fluvial flooding from the 1% AEP (1 in 100 year) plus Central and Higher Central CC events with the maximum flood depths of 0.52m and 0.72m respectively. This implies that the flood hazard to the people and the property is relatively high.

For the tidal flooding, under the undefended condition, the site is subject to flooding from the 0.5% AEP (1 in 200 year) and the 0.5% AEP (1 in 200 year) (2115) with the maximum flood depths of 0.76m and 2.12m respectively. This implies that the flood hazard to the people and the property is high. However, under the defended condition, the site is not subject to flooding from the 0.5% AEP (1 in 200 year). The site is, however, subject to flooding from the 0.5% AEP (1 in 200 year) (2115) with the maximum flood depths of 0.13m. This implies that the flood hazard to the people and the property is relatively low.

The overall risk of surface water flooding to the site is 'low'.



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The flood risk from other sources including underground water, sewer and reservoir is low.

As the site is located within a flood zone area, it will be necessary to make sure that the occupants are fully aware of the flood risk and flood warning and evacuation during an extreme event.

The occupants are advised to utilise the Environment Agency's Flood Warning Service available in the area.

The surface runoff will be improved by implementing appropriate SuDS measures. Permeable paving be implemented to improve the surface runoff.

The development will not give rise to backwater affects or divert water towards other properties.

This report demonstrates that the proposal will be safe, in terms of flood risk, for its design life and will not increase the flood risk elsewhere.

8.0	CONCLUSION
7.0	ASSESSMENT OF IMPACT ON FLOW OF FLOODWATER
6.0	MITIGATION MEASURES
5.0	ASSESSMENT OF FLOOD RISK
4.0	DEVELOPMENT AND FLOOD RISK POLICY
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APPENDIX B EXISTING SITE AND PROPOSED PLANS.....II
APPENDIX C ENVIRONMENT AGENCY'S DATA AND INFORMATION.....III

Abbreviations

Abbreviation	Description
mAOD	Metres Above Ordnance Datum
DEFRA	Department for Environment, Food, and Rural Affairs
EA	Environment Agency
FRA	Flood Risk Assessment
LLFA	Lead Local Flood Authority
NPPF	National Planning Policy Framework
SFRA	Strategic Flood Risk Assessment
PFRA	Preliminary Flood Risk Assessment
SuDS	Sustainable Drainage Systems



1.0 Background

UK Flood Risk Consultants has been commissioned to prepare this Flood Risk Assessment (FRA) in support of a proposal consisting of development of the site for storage located at Station Road, Ford, West Sussex BN18 0BS.

This FRA has been carried out in accordance with the requirements of the Revised National Planning Policy Framework (NPPF) published on 24 July 2018 and the Environment Agency's Flood Risk Assessment (FRA) Guidance Notes and the best practices in flood risk management.

The National Planning Policy Framework sets out planning policy in order to avoid inappropriate development in areas at risk of flooding by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere.

2.0 FRA Requirements and Objectives

The site-specific FRA should address the following:

- how flood risk affects the proposed development,
- whether the development type is appropriate for the proposed location,
- whether the site's flood risk is too great for the development,
- whether the proposed development will increase flood risk elsewhere,
- carry out the Sequential Test and the Exception Test where necessary,
- meet the additional flood resistance and resilience requirements where necessary.

The objectives of this site-specific flood risk assessment are to establish:

- whether the proposed development is likely to be affected by current or future flooding from any source,
- whether it will increase flood risk elsewhere,
- whether the measures proposed to deal with these effects and risks are appropriate,



3.0 General Description of the Site and the Proposals

3.1. Description of the site

The proposal site is located at Station Road, Ford, West Sussex BN18 0BS approximately centred on the OS NGR 500282,104197 (**Appendix A Figure 1**). The site is located within the administrative boundary of Arun District Council, which is the Local Planning Authority.

Total site area is approximately 3.4 ha. Approximately 1.7 ha of the area is covered by soft landscaping.

The access to the site is via Station Road. The surrounding area consists of predominantly agricultural use (**Appendix A Figure 2**).

The nearest watercourse from the site is the River Arun with the risk of tidal flooding. The site topography has a slightly gentle slope from north to south with the general elevation varying from 1.73mAOD to 3.29mAOD. Further details about the existing site are provided in **Appendix B**.

3.2. Proposed Development

The proposal consists of development of the site for storage. Further details about the proposals have been provided in **Appendix B**.



4.0 Development and Flood Risk Policy

4.1. National Planning Policy Framework (NPPF)

The revised National Planning Policy Framework was published on 24 July 2018 and sets out the government's planning policies for England. The NPPF sets out planning and policies related to development planning and flood risk using a sequential characterisation of risk based on planning zones and the Environment Agency's Flood Maps. The aim of the flood risk assessment is to identify which Flood Zones the site is located in and vulnerability classification relevant to the proposed development, based on an assessment of current and future conditions.

4.2. Flood Zones

The Flood Zones refer to the probability of river and sea flooding which ignores the presence of defences. The national flood maps have been developed by the Environment Agency that shows the risk of tidal and/or fluvial flooding across England and Wales for different return period events. The Environment Agency's Flood Maps are the maps which have been developed using broad scale hydraulic modelling. It is therefore important to understand that the flood maps may not be very accurate at a site-specific level which may need further field observation and measurements. The Flood Zones do not take into account of the climate change impacts which must be considered in any flood risk assessment as required by the NPPF.

4.3. Sequential and Exception Tests

As set out in the NPPF, the overall aim of the Sequential Test should be to steer new development to Flood Zone 1 (Low Probability Flooding). Where there are no reasonably available sites in Flood Zone 1, the Local Authority should take into account the flood risk vulnerability of land uses and consider reasonably available sites in Flood Zone 2, applying the Exception Test if required. Where there are no reasonably available sites in Flood Zones 1 or 2, the suitability of sites in Flood Zone 3 should be considered, taking into account the flood risk vulnerability of land uses and applying the Exception Test if required.

As the proposal consists of change of use of existing land for storage, the Sequential Test will not be required.

The Exception Test, as set out in paragraph 102 of the Framework, is a method to demonstrate and help ensure that flood risk to people and property will be managed satisfactorily, while allowing necessary development to go ahead in situations where suitable sites at lower risk of flooding are not available. There are two requirements to meet for the Exception Tests. The proposed development will provide wider



sustainability benefits to the community that outweigh flood risk, and that it will be safe for its lifetime, without increasing flood risk elsewhere and where possible reduce flood risk overall.

4.4. Vulnerability of Use and Flood Risk Assessment

The site is located in Flood Zone 3 (high probability flooding). The proposed development is categorised as 'less vulnerable' (Table 2). The proposed development is therefore considered appropriate at this location (Table 3). It should be ensured that all types of flood risk are considered as part of the Flood Risk Assessment: *'A site-specific Flood Risk Assessment must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall'*.

This FRA aims to demonstrate that the proposal will remain safe for its lifetime and will not increase flood risk elsewhere.

4.5. NPPF Flood Zones

Table 1 below shows the NPPF Flood Zones and the requirements and policy aims in terms of undertaking site-specific flood risk assessment.

Table 1 - NPPF Flood Zones and Requirements (NPPF Technical Guidance Table 1)

Zone 1: Low Probability Flood Zone	This is defined as the land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).
Appropriate uses	All uses of land are appropriate in this zone.
FRA requirements	For development proposals on sites comprising 1 ha or above the vulnerability to flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off, should be incorporated in a FRA.
Policy aims	Developers and local authorities should seek opportunities to reduce the overall level of flood risk through the layout and form of the development, and



	the appropriate application of sustainable drainage techniques.
Zone 2: Medium Probability Flood Zone	This is defined as the land assessed as having 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.
Appropriate uses	The water-compatible, less vulnerable and more vulnerable uses of land and essential infrastructure in Table 2 are appropriate in this zone. Highly vulnerable uses in Table 2 are only appropriate in this zone if the Exception Test is passed.
FRA requirements	All proposals in this zone should be accompanied by a FRA.
Policy aims	Developers and local authorities should seek opportunities to reduce the overall level of flood risk through the layout and form of the development, and the appropriate application of sustainable drainage techniques.
Zone 3a: High Probability Flood Zone	This is defined as the land assessed as having 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.
Appropriate uses	The water-compatible and less vulnerable uses of land in Table 2 are appropriate in this zone. The highly vulnerable uses (Table 2) should not be permitted in this zone. The more vulnerable and essential infrastructure uses in Table 2 should only be permitted in this zone if the Exception Test is passed. All proposals in this zone should be accompanied by a FRA.
FRA requirements	
Policy aims	Developers and local authorities should seek opportunities to:



	❖ reduce the overall level of flood risk through the layout and form of the development and the appropriate application of sustainable drainage techniques; ❖ relocate existing development to land with a lower probability of flooding; ❖ create space for flooding to occur by allocating and safeguarding open space for flood storage.
Zone 3b: Functional Floodplain	This is the land where water has to flow or be stored in times of flood. This zone is generally defined as the land which would flood with an annual probability of 1 in 20 (5%AEP) or greater in any year. The Local Council may define the Functional Floodplain area with a different annual probability of event.
Appropriate uses	Only the water-compatible uses and the essential infrastructure listed in Table 2 that has to be there should be permitted. It should be designed and constructed to: ❖ remain operational and safe for users in times of flood; ❖ result in no net loss of floodplain storage; ❖ not impede water flows; ❖ not increase flood risk elsewhere.
FRA requirements	All proposals in this zone should be accompanied by a FRA.
Policy aims	In this zone, developers and local authorities should seek opportunities to: ❖ reduce the overall level of flood risk through the layout and form of the development and the appropriate application of sustainable drainage techniques; ❖ relocate existing development to land with a lower probability of flooding.



Table 2 - Flood Risk Vulnerability Classification (NPPF Technical Guidance Table 2)

Essential Infrastructure	Essential transport infrastructure and strategic utility infrastructure, including electricity generating power stations and grid and primary substations.
Highly Vulnerable	❖ Police stations, Ambulance stations and Fire stations and Command Centres and telecommunications installations and emergency dispersal points. ❖ Basement dwellings, caravans, mobile homes and park homes intended for permanent residential use. ❖ Installations requiring hazardous substances consent.
More Vulnerable	❖ Hospitals, residential institutions such as residential care homes, children's homes, ❖ Social services homes, prisons and hostels. ❖ Buildings used for: dwelling houses, student halls of residence, drinking establishments, nightclubs, hotels and sites used for holiday or short-let caravans and camping. ❖ Non-residential uses for health services, nurseries and education. ❖ Landfill and waste management facilities for hazardous waste.
Less Vulnerable	❖ Buildings used for shops, financial, professional and other services, restaurants and cafes, offices, industry, storage and distribution, and assembly and leisure. ❖ Land and buildings used for agriculture and forestry. ❖ Waste treatment (except landfill and hazardous waste facilities), minerals working and processing (except for sand and gravel). ❖ Water treatment plants and sewage treatment plants (if adequate pollution control measures are in place).



Water-compatible Development	❖ Flood control infrastructure, water transmission infrastructure and pumping stations. ❖ Sewage transmission infrastructure and pumping stations. ❖ Sand and gravel workings. ❖ Docks, marinas and wharves, navigation facilities. ❖ MOD defence installations. ❖ Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location ❖ Water-based recreation (excluding sleeping accommodation). ❖ Lifeguard and coastguard stations. ❖ Amenity open space, nature conservation and biodiversity, outdoor sports and recreation. ❖ Essential sleeping or residential accommodation for staff required by uses in this category, subject to a warning and evacuation plan.
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Table 3 - Flood Risk Vulnerability and Flood Zone 'compatibility'

Vulnerability Classification (Refer Table 2)		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zones	Flood Zone 1	✓	✓	✓	✓	✓
	Flood Zone 2	✓	✓	Exception Test	✓	✓
	Flood Zone 3a	Exception Test	✓	*	Exception Test	✓
	Flood Zone 3b	Exception Test	✓	*	*	*

✓ Development is appropriate
* Development should not be permitted



5.0 Assessment of Flood Risk

5.1. History of Flooding

The Arun District Council's Strategic Flood Risk Assessment, SFRA (February 2008) has provided brief information about past flooding events in the area. The SFRA reported some past flooding incidents in the area, however, there were no records of any flooding event at the site. In addition, information on historic floods was obtained from the Environment Agency (**Appendix C**). The Environment Agency have confirmed that there were no records of flooding around the site,

Information on the past flooding event was also obtained from the landowner. They were not aware of any flooding issues at the site.

5.2. Risk of Fluvial/Tidal Flooding

The site is located in close proximity to the River Arun with the risk of combined fluvial and tidal flooding. The Environment Agency's Flood Map around the site is shown in **Appendix A Figure 3** which shows that the site lies within the Flood Zone 3 (high probability flooding). The Flood Zone 3 fluvial outline shows a 1 in 100 chance of flooding at a location in any one given year (i.e., a 1% annual probability of flooding). Similarly, the Flood Zone 3 tidal outline shows a 1 in 200 chance of flooding at a location in any one given year (i.e., a 0.5% annual probability of flooding).

According to the information available from the Environment Agency, the site benefits from the raised flood embankments on the East bank of the River Arun. The standard of protection is estimated between 1 in 75 year and 1 in 200 year

Figure 4 shows the Environment Agency's flood risk map which indicates that the risk of flooding to the site varies from 'medium' to 'high'.

5.2.1. Modelled Water Levels (Fluvial Flooding)

Information on modelled water levels was obtained from the Environment Agency (**Appendix C**). The site-specific modelled flood levels at the proposed development site have been taken from the Lower Tidal River Arun Strategy (LTRAS) which was completed by Atkins in 2010. The modelled flood extent maps for a range of events are shown in **Appendix C**. **Appendix C** also contains a 2D model node location map near the site. The map shows that the nearest model node from the site is 1.

The modelled water levels (Node 1) have been compared against the existing site levels. The estimated flood levels and flood depths are provide in **Table 4** and **Table**



5 for undefended and defended conditions respectively. The information on the site levels have been taken from the topographic map provided in **Appendix B**.

Table 4 and **Table 5** show that under the undefended and defended conditions, the site is subject to flooding from the 1% AEP (1 in 100 year) plus Central and Higher Central CC events with the maximum flood depths of 0.52m and 0.72m respectively. This implies that the flood hazard to the people and the property is relatively high.

Table 4 – Comparison of modelled water levels against the site level (Undefended condition)

Events	Modelled levels, mAOD	Max flood depth, m
5% AEP (1 in 20 year)	2.00	0.12
1% AEP (1 in 100 year)	2.10	0.21
*1% AEP (1 in 100 year) plus Central CC	2.40	0.52
*1% AEP (1 in 100 year) plus Higher Central CC	2.60	0.72
0.1 %AEP (1 in 1000 year)	2.44	0.56

*35% Central and 45% Higher Central change allowances applicable for this site, see Chapter 5.10.

Table 5 – Comparison of modelled water levels against the site level (Defended condition)

Events	Modelled levels, mAOD	Max flood depth, m
5% AEP (1 in 20 year)	2.00	0.12
1% AEP (1 in 100 year)	2.10	0.22
*1% AEP (1 in 100 year) plus Central CC	2.40	0.52
*1% AEP (1 in 100 year) plus Higher Central CC	2.60	0.72
0.1 %AEP (1 in 1000 year)	2.26	0.37

*35% Central and 45% Higher Central change allowances applicable for this site, see Chapter 5.10.



5.2.2. Modelled Water Levels (Tidal Flooding)

Information on modelled water levels was obtained from the Environment Agency (**Appendix C**). The site-specific modelled flood levels at the proposed development site have been taken from the tidal model was the Emsworth to Littlehampton coastal model completed by JBA Consulting in 2016. The modelled flood extent maps for a range of events are shown in **Appendix C**.

The modelled water levels (Node 1) have been compared against the existing site levels. The estimated flood levels and flood depths are provide in **Table 6** and **Table 7** for undefended and defended conditions respectively.

Table 6 and Table 7 show that under the undefended condition, the site is subject to flooding from the 0.5% AEP (1 in 200 year) and the 0.5% AEP (1 in 200 year) (2115) with the maximum flood depths of 0.76m and 2.12m respectively. This implies that the flood hazard to the people and the property is high. However, under the defended condition, the site is not subject to flooding from the 0.5% AEP (1 in 200 year). The site is, however, subject to flooding from the 0.5% AEP (1 in 200 year) (2115) with the maximum flood depths of 0.13m. This implies that the flood hazard to the people and the property is relatively low.

Table 6 – Comparison of modelled water levels against the site level (Undefended condition)

Events	Modelled levels, mAOD	Max flood depth, m
0.5% AEP (1 in 200 year)	2.68	0.76
0.5% AEP (1 in 200 year) (2070)	3.21	1.29
0.5% AEP (1 in 200 year) (2115)	4.04	2.12
0.1 %AEP (1 in 1000 year)	2.88	0.96



Table 7 – Comparison of modelled water levels against the site level (Defended condition)

Events	Modelled levels, mAOD	Max flood depth, m
0.5% AEP (1 in 200 year)	-	-
0.5% AEP (1 in 200 year) (2070)	-	-
0.5% AEP (1 in 200 year) (2115)	2.04	0.13
0.1 %AEP (1 in 1000 year)	-	-

5.3. Risk of Flooding From Artificial Water Bodies

There were no known flood risks from any artificial water bodies near the site.

5.4. Risk of Groundwater Flooding

In recent years groundwater has been recognised as a significant source of flooding in the UK. According to the British Geological Survey, groundwater flooding occurs when the water table in permeable rocks rises to enter basements/cellars or comes up above the ground surface. Groundwater flooding is not necessarily linked directly to a specific rainfall event and is generally of longer duration than other causes of flooding (possibly lasting for weeks or even months).

Evidence of historical groundwater flooding within the SFRA is very limited, however it is important to recognise that the risk of groundwater flooding is highly variable and heavily dependent upon local conditions at any particular time.

According to the information available from the landowner, there were no records of any groundwater flooding incidents around the site. Based on these evidences and information, it is reasonable to consider that the risk of groundwater flooding to the site is low.

5.5. Risk of Surface Water Flooding

The surface water flooding arises when the infiltration capacity of land or the drainage capacity of a local sewer network is exceeded and the excess rainwater flows



overland. The severity of surface water flooding depends on several factors such as the degree of saturation of the soil before the event, the permeability of soils and geology, hill slope steepness and the intensity of land use.

Information on the risk of surface water flooding is held by the Environment Agency. The Environment Agency's Surface Water Flood Risk Maps are provided in **Appendix A Figure 5 and Figure 6** which indicate that the risk of surface water flooding to the site is 'low'.

5.6. Risk of flooding from Reservoirs

The Environment Agency's reservoir flood map in **Appendix A Figure 7** indicated that the proposal site is located outside of the maximum extent of flooding from reservoir. According to the Environment Agency, the reservoir flooding is extremely unlikely to happen and reservoirs in the UK have an extremely good safety record; indeed there has been no loss of life in the UK from reservoir flooding since 1925. The Environment Agency is the enforcement authority for the Reservoirs Act 1975 in England and Wales. All large reservoirs must be inspected and supervised by reservoir panel engineers on a regular basis. It is therefore assumed that these reservoirs are regularly inspected and essential safety work is carried out. These reservoirs therefore present a managed residual risk.

5.7. Flood Risk from Sewers

Sewer flooding is often caused by excess surface water entering the drainage network causing sewers to surcharge. The SFRA has provided very limited information on sewer flooding within the area, however, there were no records of sewer flooding incidents at the site. It is important to note that previous sewer flood incidents or the lack thereof do not indicate the current or future risk to the site as upgrade work could have been carried out to alleviate any issues or conversely in areas that have not experienced sewer flooding incidents the local drainage infrastructure could deteriorate leading to future flooding.

According to the information obtained from the landowner, there were no records of sewer flooding incidents at the site in the past.

5.8. Impact of Climate Change

The Environment Agency released new climate change guidance for flood risk assessments on 19th February 2016 outlining the allowances for the impact of climate change on peak river flows, peak rainfall intensities, sea level rise, offshore wind speeds and extreme wave height. They are based on climate change projections and



different scenarios of carbon dioxide (CO₂) emissions to the atmosphere. There are different allowances for different epochs or periods of time over the next century.

The range of allowances in **Table 8** below is based on percentiles. A percentile is a measure used in statistics to describe the proportion of possible scenarios that fall below an allowance level. The 50th percentile is the point at which half of the possible scenarios for peak flows fall below it and half fall above it. The central allowance is based on the 50th percentile, higher central is based on the 70th percentile and the upper end is based on the 90th percentile.

Table 8 - Peak river flow allowances by river basin district (use 1961 to 1990 baseline)

River basin district	Allowance category	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Northumbria	Upper end	20%	30%	50%
	Higher central	15%	20%	25%
	Central	10%	15%	20%
Humber	Upper end	20%	30%	50%
	Higher central	15%	20%	30%
	Central	10%	15%	20%
Anglian	Upper end	25%	35%	65%
	Higher central	15%	20%	35%
	Central	10%	15%	25%
South East	Upper end	25%	50%	105%
	Higher central	15%	30%	45%
	Central	10%	20%	35%
Thames	Upper end	25%	35%	70%
	Higher central	15%	25%	35%
	Central	10%	15%	25%



South West	Upper end	25%	40%	85%
	Higher central	20%	30%	40%
	Central	10%	20%	30%
Severn	Upper end	25%	40%	70%
	Higher central	15%	25%	35%
	Central	10%	20%	25%
Dee	Upper end	20%	30%	45%
	Higher central	15%	20%	25%
	Central	10%	15%	20%
North West	Upper end	20%	35%	70%
	Higher central	20%	30%	35%
	Central	15%	25%	30%
Solway	Upper end	20%	30%	60%
	Higher central	15%	25%	30%
	Central	10%	20%	25%
Tweed	Upper end	20%	25%	45%
	Higher central	15%	20%	25%
	Central	10%	15%	20%

Using peak river flow allowances for flood risk assessments

The guideline suggests to consider the flood zone and the appropriate flood risk vulnerability classification to decide which allowances applies to the development or plan.

In flood zone 2

Essential infrastructure – use the higher central and upper end to assess a range of allowances



Highly vulnerable – use the higher central and upper end to assess a range of allowances

More vulnerable – use the central and higher central to assess a range of allowances

Less vulnerable – use the central allowance

Water compatible – use none of the allowances

In flood zone 3a

Essential infrastructure – use the upper end allowance

Highly vulnerable – development should not be permitted

More vulnerable – use the higher central and upper end to assess a range of allowances

Less vulnerable – use the central and higher central to assess a range of allowances

Water compatible – use the central allowance

In flood zone 3b

Essential infrastructure – use the upper end allowance

Highly vulnerable – development should not be permitted

More vulnerable – development should not be permitted

Less vulnerable – development should not be permitted

Water compatible – use the central allowance

Assessment of Climate Change Impact for the Site

The site is located within the South East River Basin District. As the proposed development is categorised as 'less vulnerable' and the site is located in Flood Zone 3 (high probability flooding), the guideline recommends to use the Central and Higher Central CC allowances for assessing the impact of climate change. The Central and Higher Central CC allowances for the South East River Basin District are 35% & 45% respectively for the period between 2070 and 2115. These allowances are greater than that currently used and incorporated into the Environment Agency's existing Fluvial Flood Model Levels where allowance of 20% was used.



Information on the modelled floodwaters was obtained from the Environment Agency (**Appendix B**). However, no information was available on the design flows and water levels that takes into account of climate change. Therefore, a stage-discharge curve could not be developed in order to estimate the water levels corresponding to the new climate change allowances. Therefore, an assessment has been done by considering a precautionary allowance for potential climate change impacts on peak design flood levels. A precautionary allowance of 300mm and 500mm have been considered for this site.

The most representative model node for the site is 1 (**Appendix C**). The estimated CC flood depths for the undefended and defended conditions are presented in **Table 6** below. These flood depths have been used for assessing the fluvial flood risk to the site in **Chapter 5.2.1** above.

Table 9 – Estimation of fluvial flood depths for climate change (Undefended, Defended)

Events	Flood Depth, m	CC Allowance (m)	Flood Depths for CC, mAOD
1% AEP	0.22	-	-
*1% AEP plus Higher Central	-	0.30	0.52
*1% AEP plus Upper End	-	0.50	0.72



6.0 Mitigation Measures

6.1. Flood Warning and Evacuation

As the site is located within a flood zone area, it will be necessary to make sure that the occupants are fully aware of the flood risk and flood warning and evacuation during an extreme event.

6.1.1. Flood Warnings Direct

The occupants are advised to utilise the Environment Agency's Flood Warnings Direct which is a free flood warning service called Floodline Warnings Direct (FWD). This service generally gives an advance notice of when flooding is likely to happen and time to prepare for a flood event. Property owners on the proposed development site will be able to sign up to FWD online using the following contact details (Table 10):

Table 10: Contacts for flood warning services

Methods	Remarks
Online	https://fwd.environment-agency.gov.uk/app/olr/register
Telephone	0345 988 1188

6.1.2. Flood Warning Service

The Flood Warning Service is provided by the Environment Agency across England and Wales in areas at risk of flooding from rivers or the sea. This is provided using up to date rainfall, river level and sea condition monitoring 24 hours a day to forecast the possibility of flooding. If flooding is forecast, the Environment Agency will issue warnings using a set of three different warning types (Table 11). Many areas of England are covered by the full four stages of the Environment Agency's Flood Warning Service. The site is located in an area covered by the Flood Alert Services (Appendix A Figure 8). The Environment Agency's Flood Warning target lead time; the time between a flood warning being issued and the onset of flooding is approximately two hours. Providing the Environment Agency can meet their target Flood Warning lead time, the occupants of the proposed development will have two hours to ensure that property is relocated to minimise risk and evacuation to safe locations can be carried out.



Site and Regional Control Infiltration/detention basins/ balancing ponds/ wetlands/underground storage/swales/retention ponds,	Balancing pond/storage will not be feasible due to limited space available.	No
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Based on the general assessment of the potential SuDS measures above, it is proposed that permeable paving will be implemented in order to improve the surface runoff from the site. The general layout of the proposed SuDS is shown in **Appendix B**. The landowners will be fully responsible for the repair and management of the SuDS throughout the lifetime of the proposed development.

7.0 Assessment of Impact on flow of floodwater

The proposed development consists of development of the site for storage. There are no any buildings planned for the site. These means there will be increase in the displaced floodwater as a result of the proposed development. In order to ensure that the proposed development will not increase flood risk elsewhere it is proposed to use of appropriate measures such as permeable paving. The development will not give rise to backwater affects or divert water towards other properties.

8.0 Conclusion

The proposal consists of development of the site for storage located at Station Road, Ford, West Sussex BN18 0BS.

The proposed development is categorised as 'less vulnerable'.

The nearest main river from the site is the River Arun with the risk of combined and tidal flooding.

According to the information available from the SFRA and the Environment Agency, there were no records of flooding events at the site.

The Environment Agency's Flood Maps show that the site lies within the Flood Zone 3 (high probability flooding). The Environment Agency's flood risk map indicates that the risk of flooding to the site varies from 'medium' to 'high'.

According to the information available from the Environment Agency, the site benefits from the raised flood embankments on the East bank of the River Arun. The standard of protection is estimated between 1 in 75 year and 1 in 200 year

Sohan Ghimire
UK Flood Risk
18 St Nicholas Road
Plumstead
London
SE18 1HJ

Our ref: SSD112624
Your ref:
Date: 29/01/2019

Dear Sohan Ghimire,

Enquiry Regarding Product 4 for Flood Risk Assessment for Station Road, Ford, BN18 0BS

Thank you for your enquiry which was received on 05 January 2019.

We respond to requests under the Freedom of Information Act 2000 and Environmental Information Regulations 2004. The information is attached.

The information on Flood Zones in the area relating to this address is as follows:

The site is in an area located within Flood Zone 3 as shown on our Flood Map for Planning (Rivers and Sea).

Note - This information relates to the area that the above named property is in and is not specific to the property itself as it is influenced by factors such as the height of door steps, air bricks or the height of surrounding walls. We do not have access to this information and is not currently used in our flood modelling.

Flood Zone definitions can be found at www.gov.uk/guidance/flood-risk-and-coastal-change#Table-1-Flood-Zones

Please note that according to Arun Strategic Flood Risk Assessment (2016) the site is partially within Flood Zone 3b (functional flood plain, defined as the defended case 1 in 20-year annual probability - 5% Annual Exceedance Probability - event).

As stated in Table 1 (Flood Zones) of the Planning Policy Guidance (PPG) to the National Planning Policy Framework (NPPF) this zone comprises land where water has to flow or be stored in times of flood. According to Table 3 (Flood Risk Vulnerability) of the PPG, only Essential Infrastructure and Water Compatible uses are permitted in this zone, and only if the Exception Test has been passed.

Flood Defences

Raised flood embankments on the East bank of the River Arun offer protection from the River Arun. The standard of protection is estimated between 1in75yr and 1in200yr. Please refer to the Lower Tidal River Arun Strategy for more information.

2009 Dodge

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Information

The site is an area located between one of the old
wooded areas and the new road.
The site is located on the north side of the road.

Considerazioni di base sul "no person's business" e sul "no one's business".

the 1990s and 2000s, the number of people who have been convicted of a crime has increased significantly. This is due to a number of factors, including the fact that the justice system has become more efficient, and the fact that there have been a number of high-profile cases that have led to increased public concern about crime.

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Sgt. Eric J. Smith

Estimated net loss \$153C

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UK Flood Risk
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Model Information

The model used for fluvial flood risk was the Lower Tidal River Arun Strategy (LTRAS) which was completed by Atkins in 2010. The tidal model was the Emsworth to Littlehampton coastal model completed by JBA Consulting in 2016.

Flood History

We hold no record of previous flooding events affecting this site.

Please note our records are not comprehensive and may not include all events. I recommend contacting the Lead Local Flood Authority, **West Sussex County Council** or the Local Authority, **Arun District Council** for a more comprehensive flood history check.

FRA advisory text

Name	Product 4
Description	Detailed Flood Risk Assessment Map for Station Road, Ford, BN18 0BS.
Licence	<u>Open Government Licence</u>
Information Warnings	Climate Change allowances for this model only show the superseded 20% increase in flows. The current allowances should be checked here: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances .
Information Warming - OS background mapping	<i>The mapping of features provided as a background in this product is © Ordnance Survey. It is provided to give context to this product. The Open Government Licence does not apply to this background mapping. You are granted a non-exclusive, royalty free, revocable licence solely to view the Licensed Data for non-commercial purposes for the period during which the Environment Agency makes it available. You are not permitted to copy, sub-license, distribute, sell or otherwise make available the Licensed Data to third parties in any form. Third party rights to enforce the terms of this licence shall be reserved to OS.</i>
Attribution	Contains Environment Agency information © Environment Agency and/or database rights. Contains Ordnance Survey data © Crown copyright 2018 Ordnance Survey 100024198.

Data Available Online

Many of our flood datasets are available online:

- Flood Map For Planning (Flood Zone 2, Flood Zone 3, Flood Storage Areas, Flood Defences, Areas Benefiting from Defences)
- Risk of Flooding from Rivers and Sea
- Historic Flood Map
- Current Flood Warnings

Model Information
The model used for fluvial flood risk was the Lower Tidal River Arun Strategy (LTRAS) which was completed by Atkins in 2010. The tidal model was the Emsworth to Littlehampton coastal model completed by JBA Consulting in 2016.

Flood History
We hold no record of previous flooding events affecting this site.
Please note our records are not comprehensive and may not include all events. I recommend contacting the Lead Local Flood Authority, West Sussex County Council or the Local Authority, Arun District Council for a more comprehensive flood history check.

FRA advisory text

Name	Description	Product 4
Warrington	Warrington	BN18 0BS
Information	Information	Open Government Licence
Warning - OS	Warning - OS	Climate Change allowances for this model only show the superseded 50% increase in flows. The current allowances should be checked here: https://www.gov.uk/government/uploads/system/uploads/attachmentatachment/361111/ClimateChangeAllowances.pdf
Background mapping	Background mapping	The mapping of features provided as a background in this product is © Ordnance Survey. It is provided to give context to this product. The Open Government Licence does not apply to this background mapping. You are granted a non-exclusive, royalty free, revocable licence solely to view the Licensed Data for non-commercial purposes for the period during which the Environment Agency makes it available. You are not permitted to copy, sub-license, distribute, or otherwise make available the Licensed Data to third parties in any form. Third party rights to enforce the terms of this licence shall be reserved to OS.
Attribution	Attribution	Contains Ordnance Survey data © Crown copyright 2018. Contains Environment Agency information © Environment Agency and/or database rights.

Data Available Online

Many of our flood datasets are available online.
 • Flood Maps For Planning (Flood Zone 2, Flood Zone 3, Flood Storage Areas, Flood Defence Areas, Flood Risk from Defence)

• Risk of Flooding from Rivers and Sea

• Historic Flood Maps

• Current Flood Warnings