FLOOD RISK AND DRAINAGE SOLUTIONS LTD

NPPF Flood Risk Assessment

8 Ford Road, Ford, Arundel

Report No: 2024-026

Client: Consensus Ltd

Date: 13/05/2024

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Contract

This report describes work commissioned by The Leith Group on behalf of Consensus Ltd dated 17th April 2024 Chris Vose BSc of Flood Risk and Drainage Solutions Ltd carried out the work.

Disclaimer

This document has been prepared solely as a Flood Risk Assessment for Consensus Ltd. Flood Risk and Drainage Solutions Ltd accepts no responsibility or liability for any use that is made of this document other than by the Client for the purposes for which it was originally commissioned and prepared.

Executive Summary

Flood Risk and Drainage Solutions Ltd have been appointed by Consensus Ltd to provide a Flood Risk Assessment in support of a planning application for the development of 4No bungalows on land which is currently the east rear garden area of Waterbury House, 8 Ford Road, Ford in Arundel.

The development site is located within Flood Zone 3 and therefore has a high risk of fluvial/tidal flooding.

An initial assessment indicates that the primary flood risk at the proposed development is from the fluvial/tidal source the River Arun.

Consideration has also been given to the site flooding from secondary sources such as pluvial, groundwater; artificial water bodies; infrastructure failure and ponding.

The application site comprises of the existing Waterbury House care home facility with car parking to the west, garden area positioned to the east and south east of the existing building. Ford Road is positioned to the west of Waterbury House, access road for Willows Park to the north and east and railway line to the south.

The nearest watercourse to the application site is the River Arun located approximately 170m east of the site. The watercourse is considered to be a 'Main River' and therefore the Environment Agency have certain roles and responsibilities regarding management and maintenance.

Development proposals comprise of the erection of 4No terraced houses and associated off street parking on current garden area associated with Waterbury House.

Fluvial/Tidal Flooding

The Environment Agency have provided Asset Information associated with the Flood Data which identifies that the site does benefit from flood defences in the form of embankments along the west bank of the watercourse.

- Asset No1 – Embankment - 200-year SOP
- Asset No2 – Embankment - 200-year SOP
- Asset No3 – Embankment - 200-year SOP
- Asset No4 – Embankment - 50-year SOP
- Asset No6 – Embankment - 200-year SOP

The Environment Agency have provided onsite flood levels for the River Arun extracted from the Lower Tidal River Arun Strategy Study Model for the defended and undefended scenarios.

A review of the Environment Agency Flood Data during various tidal events associated with the River Arun concludes that only Node 5 will become affected during the worst-case fluvial event, the remainder of the site will not be affected.

Following a review of tidal flood information, only Node 5 will experience flooding during the undefended 1 in 200 year + climate change event..

During the defended 1 in 200 year + climate change event. Nodes 4 & 5 will experience flooding to a height of 4.09m AOD, the flood envelopes are expected to cover the eastern quarter of the site, the remainer of the site will be unaffected.

Surface Water and Foul Drainage

The preliminary drainage strategy could comprise of storage provided by a mixture of permeable paving within the car parking areas and on/offline storage for the roof and car parking contributing areas.

If following on-site percolation testing soakaways are found to be suitable, surface water flows from the site should discharge to ground with any additional storage provided within a geo-cell soakaway tank.

Failing the use of soakaways, it is recommended that surface water flows should be directed to public sewer, which is expected to be located within Ford Road, however this will require confirmation during the detailed design phase.

Flows to be restricted to no more than 2l/s by means of a vortex flow control chamber up to and including the 1 in 100 year + 50% climate change event.

Foul flows from the proposed development could connect into the public foul network which is expected to be located to the west of the site within Ford Road, this is to be confirmed during the detailed design phase.

Flood Mitigation Measures

Finished Floor Levels

It is proposed that finished floor levels should be elevated no less than the following

- 600mm above the 1 in 200 year + CC Tidal Flood level (4.09m AOD) = 4.690m AOD

Flood Resilience/Resistance

Flood resilience/resistance measures to be incorporated into the building set at 0.600m above finished floor levels, these are outlined below.

- Flood Resilience/Resistance Measures = 4.690 + 0.600 = 5.290m AOD

Flood Resilience/Resistance measures to be Incorporated into the development

- Careful consideration of materials: use low permeability materials to limit water penetration if dry proofing required.
- Avoid using timber frame and cavity walls. Consider applying a water-resistant coating.
- Avoid use of gypsum plaster if possible or apply plasterboards horizontally rather than vertically
- Avoid use of stud partition walls.
- Wall sockets to be raised to as high as is feasible and practicable in order to minimise damage if flood waters inundate the property.
- Any wood fixings on ground floor will be robust and/or protected by suitable coatings in order to minimise damage during a flood event.
- Storage of any materials or possessions that may be susceptible to flood damage should be stored or raised at a level 0.600m above finished floor levels to limit the damage caused in the event of a flood.
- Non-Return Valves fitted to prevent backflow of sewage which can occur during flood conditions.
- Avoid fitted carpets where possible.
- Locate electrical, gas and telephone equipment and systems as high as practically feasible

Environment Agency Flood Warnings

Due to the site being located within Flood Zone 3, it is advised that residents sign up to receive flood warnings.

It is essential that all persons evacuate the property immediately upon receipt of the Flood Warnings prior to the on-set of flooding, this is due to the main exit of the property being located within Flood Zone 3.

Evacuation Route

Upon receipt of an Environment Agency Flood Warnings persons should evacuate the site via the lowest risk route available as described below:

- All persons onsite should evacuate the properties via the north/west boundary prior to the on-set of actual flooding
- North along Ford for approximately 550m
- West along Tortington Road for approx. 200m into Flood Zone 1

Signage

In order to make residents and visitors aware of the potential risk of the site flooding, it is recommended that appropriate signage is incorporated within the site highlighting the proposed evacuation route, which should be adhered to upon receipt of the Environment agency Flood Warnings.

Personal Flood Plan

It is also recommended that residents create personal flood plans. This is a simple document that assists the occupant to prioritise actions required at the property before, during and following a flood event.

A copy of a Personal Flood Plan Template has been provided within the appendices of this report.

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Appendices

1.0 Introduction

1.1 Terms of Reference

Flood Risk and Drainage Solutions Ltd have been appointed by Consensus Ltd to provide a Flood Risk Assessment in support of a planning application for the development of 4No bungalows on land which is currently the east rear garden area of Waterbury House, 8 Ford Road, Ford in Arundel.

The development site is located within Flood Zone 3 and therefore has a high risk of fluvial/tidal flooding.

It is usual for the Environment Agency to raise an objection to development applications within the floodplain, or Zones 2 and 3 of the flood map, until the issue of flood risk has been properly evaluated. The Agency will also object to developments where the total site area is in excess of 1 Hectare until suitable consideration has been given to the management of surface water runoff.

1.2 Objectives

The objective of this assessment is to evaluate the following issues in regard to flood risk at the application site.

- Suitability of the proposed development in accordance with current planning policy.
- Identify the risk to both the proposed development and people from all forms of flooding.
- Provide a preliminary assessment of foul and surface water management.
- Increasing the risk of flooding elsewhere e.g. surface water flows and flood routing.
- Recommendation of appropriate measures to mitigate against flooding both within the proposed development, and neighbouring land and property.

1.3 Data Sources

This assessment is based on desk-top study of information from the following sources:

- National Planning Policy Framework (September 2023)
- Planning Practice Guidance at www.gov.uk
- Building Regulations Approved Document H
- Environment Agency Flood Mapping
- Arun Strategic Surface Water Management Strategy 2016
- Arun District Council Level 1 and Level 2 Strategic Flood Risk Assessment Final Report September 2016
- Strategic Flood Risk Assessment Arun District Volume 2 Technical Report February 2008
- British Geological Society – Historic Borehole Logs
- Cranfield University's Soilscape Viewer
- CIRIA C697 The SUDS Manual
- Chronology of British Hydrological Events (Dundee University)

2.0 Planning Policy Context

2.1 Approach to the Assessment

An initial assessment indicates that the primary flood risk at the proposed development is from the fluvial/tidal source the River Arun.

Consideration has also been given to the site flooding from secondary sources such as pluvial, groundwater; artificial water bodies; infrastructure failure and ponding.

The requirements for flood risk assessments are generally as set out in the 'Technical Guidance to the National Planning Policy Framework', updated in September 2023; and in more detail from the Environment Agency's 'Standing Advice on Flood Risk' available from https://www.gov.uk/government/publications/national-planning-policy-framework--3.

2.2 National Planning Policy Framework (NPPF)

The information provided in the flood risk assessment should be credible and fit for purpose.

Site-specific flood risk assessments should always be proportionate to the degree of flood risk and make optimum use of information already available, including information in a Strategic Flood Risk Assessment for the area, and the interactive flood risk maps available on the Environment Agency's website.

A flood risk assessment should also be appropriate to the scale, nature and location of the development.

2.2.1 Site Specific Flood Risk Assessment Checklist

The following checklist has been extracted from Flood Risk & Coastal Change Section available from www.gov.uk , updated in September 2023

1. Development site and location

Provide a description of the site you are proposing to develop, including, or making reference to, a location map which clearly indicates the development site.

A. Where is the development site located? (e.g. postal address or national grid reference)
B. What is the current use of the site? (e.g. undeveloped land, housing, shops, offices)
C. Which Flood Zone (for river or sea flooding) is the site within? (i.e. Flood Zone 1, Flood Zone 2, Flood Zone 3).

Check the Flood Map for Planning (Rivers and Sea) and the Strategic Flood Risk Assessment for the area available from the local planning authority.

2. Development proposals

Provide a general summary of the development proposals, including, or making reference to, an existing block plan and a proposed block plan, where appropriate.

A. What are the development proposal(s) for this site? Will this involve a change of use of the site and, if so, what will that change be?
B. In terms of vulnerability to flooding, what is the vulnerability classification of the proposed development?
C. What is the expected or estimated lifetime of the proposed development likely to be? (E.g. less than 20 years, 20-50 years, 50-100 years?).

3. Sequential test

For developments in flood zones 2 or 3 only.
(If the development site is wholly within flood zone 1, this section can be skipped - go to section 4).

Describe how the sequential test has been applied to the development (if required, and as set out in paragraphs 101-104 of the National Planning Policy Framework); and provide the evidence to demonstrate how the requirements of the test have been met.

See paragraph 033 of the NPPF guidance for further information. (It is recommended that the Developer or Agent contacts the LPA to confirm whether the sequential test should be applied and to ensure the appropriate level of information is provided).

A. What other locations with a lower risk of flooding have you considered for the proposed development?
B. If you have not considered any other locations, what are the reasons for this?

C. Explain why you consider the development cannot reasonably be located within an area with the lowest probability of flooding (flood zone 1); and, if your chosen site is within flood zone 3, explain why you consider the development cannot reasonably be located in flood zone 2.
D. As well as flood risk from rivers or the sea, have you taken account of the risk from any other sources of flooding in selecting the location for the development?

Exception test

Provide the evidence to support certain development proposals in flood zones 2 or 3 if, following application of the sequential test, it is appropriate to apply the exception test, as set out in paragraphs 102-104 of the National Planning Policy Framework.

It is advisable to contact the local planning authority to confirm whether the exception test needs to be applied and to ensure the appropriate level of information is provided.

A. Would the proposed development provide wider sustainability benefits to the community? If so, could these benefits be considered to outweigh the flood risk to and from the proposed development?

B. How can it be demonstrated that the proposed development will remain safe over its lifetime without increasing flood risk elsewhere?
C. Will it be possible to for the development to reduce flood risk overall (e.g. through the provision of improved drainage)?

4. Climate Change

How is flood risk at the site likely to be affected by climate change? (The local planning authority's Strategic Flood Risk Assessment should have taken this into account). Further advice on how to take account of the impacts of climate change in flood risk assessments is available from the Environment Agency.

5. Site specific flood risk

Describe the risk of flooding to and from the proposed development over its expected lifetime, including appropriate allowances for the impacts of climate change. It would be helpful to include any evidence, such as maps and level surveys of the site, flood datasets (e.g. flood levels, depths and/or velocities) and any other relevant data, which can be acquired through consultation with the Environment Agency, the lead local flood authority for the area, or any other relevant flood risk management authority. Alternatively, you may consider undertaking or commissioning your own assessment of flood risk, using methods such as computer flood modelling.

A. What is/ are the main source(s) of flood risk to the site? (E.g. tidal/sea, fluvial or rivers, surface water, groundwater, other?). You should consider the flood mapping available from the Environment Agency, the Strategic Flood Risk Assessment for the area, historic flooding records and any other relevant and available information.

B. What is the probability of the site flooding, taking account of the maps of flood risk available from the Environment Agency, the local planning authority's Strategic Flood Risk Assessment and any further flood risk information?
C. Are you aware of any other sources of flooding that may affect the site?
D. What is the expected depth and level for the design flood? See paragraph 055 of the NPPF guidance for information on what is meant by a "design flood". If possible, flood levels should be presented in metres above Ordnance Datum (i.e., the height above average sea level).
E. Are properties expected to flood internally in the design flood and to what depth? Internal flood depths should be provided in metres.
F. How will the development be made safe from flooding and the impacts of climate change, for its lifetime? Further information can be found in paragraphs 054 and 059 (including on the use of flood resilience and resistance measures) of the NPPF guidance.
G. How will you ensure that the development and any measures to protect the site from flooding will not cause any increase in flood risk off-site and elsewhere? Have you taken into account the impacts of climate change, over the expected lifetime of the development? (e.g. providing compensatory flood storage which has been agreed with the Environment Agency).
H. Are there any opportunities offered by the development to reduce the causes and impacts of flooding?

6. Surface water management*

Describe the existing and proposed surface water management arrangements at the site using sustainable drainage systems wherever appropriate, to ensure there is no increase in flood risk to others off-site.

A. What are the existing surface water drainage arrangements for the site?
B. If known, what (approximately) are the existing rates and volumes of surface water run-off generated by the site?
C. What are the proposals for managing and discharging surface water from the site, including any measures for restricting discharge rates? For major developments (e.g. of ten or more homes or major commercial developments), and for all developments in areas at risk of flooding, sustainable drainage systems should be used, unless demonstrated to be inappropriate.
D. How will you prevent run-off from the completed development causing an impact elsewhere?
E. Where applicable, what are the plans for the ongoing operation and/or maintenance of the surface water drainage systems?

7. Occupants and users of the development

Provide a summary of the numbers of future occupants and users of the new development; the likely future pattern of occupancy and use; and proposed measures for protecting more vulnerable people from flooding.

A. Will the development proposals increase the overall number of occupants and/or people using the building or land, compared with the current use? If this is the case, by approximately how many will the number(s) increase?
B. Will the proposals change the nature or times of occupation or use, such that it may affect the degree of flood risk to these people? If this is the case, describe the extent of the change.
C. Where appropriate, are you able to demonstrate how the occupants and users that may be more vulnerable to the impact of flooding (e.g., residents who will sleep in the building; people with health or mobility issues; etc.,) will be located primarily in the parts of the building and site that are at lowest risk of flooding? If not, are there any overriding reasons why this approach is not being followed?

8. Residual risk

Describe any residual risks that remain after the flood risk management and mitigation measures are implemented, and to explain how these risks can be managed to keep the users of the development safe over its lifetime.

A. What flood related risks will remain after the flood risk management and mitigation measures have been implemented?
B. How, and by whom, will these risks be managed over the lifetime of the development? (e.g., putting in place flood warning and evacuation plans).

9. Flood risk assessment credentials

Provide details of the author and date of the flood risk assessment.

A. Who has undertaken the flood risk assessment?
B. When was the flood risk assessment completed?

Other considerations

* Managing surface water

The site-specific flood risk assessment will need to show how surface water runoff generated by the developed site will be managed. In some cases, it may be advisable to detail the surface water management for the proposed development in a separate drainage strategy or plan. You may like to discuss this approach with the lead local flood authority.

Surface water drainage elements of major planning applications (e.g., of ten or more homes) are reviewed by the lead local flood authority for the area. As a result, there may be specific issues or local policies, for example the Local Flood Risk Management Strategy or Surface Water Management Plan, that will need to be considered when assessing and managing surface water matters.

It is advisable to contact the appropriate lead local flood authority prior to completing the surface water drainage section of the flood risk assessment, to ensure that the relevant matters are covered in sufficient detail.
Proximity to Main Rivers

If the development of the site involves any activity within specified distances of main rivers, a flood risk activity permit may be required in addition to planning permission.

For non-tidal main rivers, a flood risk activity permit may be required if the development of the site is within 8 metres of a river, flood defence structure or culvert.

For tidal main rivers, a flood risk activity permit may be required if the development of the site is within 16 metres of a river, flood defence structure or culvert.

Details on obtaining a Flood Risk Activity Permit are available from the Environment Agency.

2.2.2 Sources of Flooding

- Rivers (fluvial): Flooding occurs when flow within river channels exceeds capacity; and the type of flood event experienced e.g. flash flooding; depends upon the characteristics of the river catchment.
- The Sea (tidal): Flooding at low lying coastline and tidal estuaries is caused by storm surges and high tides; with overtopping and breach failure of sea defences possible during extreme storm events.
- Pluvial (surface flooding or overland flows): Heavy rainfall, which is unable to soak away via infiltration or enter drainage systems can flow overland, resulting in localised flooding. Topography generally influences the direction and depth of flooding caused by this mechanism.
- Groundwater: Caused when ground water levels rise to the surface; and is most likely to occur in low lying areas underlain by aquifers.
- Sewers and drains: Generally occurs in more urban areas; where sewers and drains are overwhelmed by heavy rainfall or blocked pipes and gullies.
- Artificial Sources (reservoirs, canals, lakes and ponds): Reservoir and canal flooding may occur as a result of capacity exceedance or structural failure.

Figure 2.1: The Environment Agency Flood Map

Source: www.gov.uk

2.2.3 Flood Zones

- **Flood Zone 1:** Low probability (less than 1 in 1000 year (<0.1% AEP) annual probability of river or sea flooding in any year.
- **Flood Zone 2:** Medium probability (between 1 in 100 year (1.0% AEP) and 1 in 1000 year (0.1% AEP) annual probability of river flooding; or between 1 in 200 year (0.2% AEP) and 1 in 1000 year (0.1% AEP) annual probability of sea flooding in any year).
- **Flood Zone 3a:** High probability (1 in 100 year (1.0% AEP) or greater annual probability of river flooding in any year or 1 in 200 year (0.5% AEP) or greater annual probability of sea flooding in any year).
- **Flood Zone 3b:** This zone comprises land where water has to flow or be stored in times of flood. Land which would flood with an annual probability of 1 in 20 (5% AEP), or is designed to flood in an extreme flood (0.1%) should provide a starting point for discussions to identify functional floodplain.

2.2.4 Vulnerability of Different Development Types

- **Essential Infrastructure:** Transport infrastructure (railways and motorways etc...); utility infrastructure (primary sub-stations, water treatment facilities; power stations; and wind turbines).
- **Water Compatible Development:** Flood control infrastructure; water and sewage infrastructure; navigation facilities.
- **Highly Vulnerable:** Emergency services; basement dwellings; mobile home parks; industrial or other facilities requiring hazardous substance consent.
- **More Vulnerable:** Hospitals; residential dwellings; educational facilities; landfill sites caravan and camping sites.
- **Less Vulnerable:** Commercial premises; emergency services not required during a flood; agricultural land.

2.2.5 Climate Change

The NPPF requires the application of climate change over the lifetime of a development. As of 27th May 2022, the Technical Guidance for NPPF has updated the climate change allowances based on river basin catchments. The climate change allowance for the Arun and Western Streams Management Catchment is tabulated below:

Table 1: Arun and Western Streams Management Catchment Climate Change Allowances[1]

Parameter	Allowance Category	2020's	2050's	2080's
Peak Rainfall Intensity	Upper	+ 27%	+ 36%	+ 64%
	Higher	+ 16%	+ 19%	+ 36%
	Central	+ 11%	+ 13%	+ 25%

Due to the proposed development being considered more vulnerable and located within Flood Zone 3 the central allowance of 25% should be applied to peak river flow to account for climate change as a minimum.

The Environment Agency have also provided climate change allowance for the tidal scenario based on the 1 in 200 year (up to the year 2110), which has been used when quantifying the tidal flood risk within Section 6 of this report.

[1] *Extracted from Tables 1-4 of the Technical Guidance for flood risk assessments: Climate change allowances Document (May 2022)*

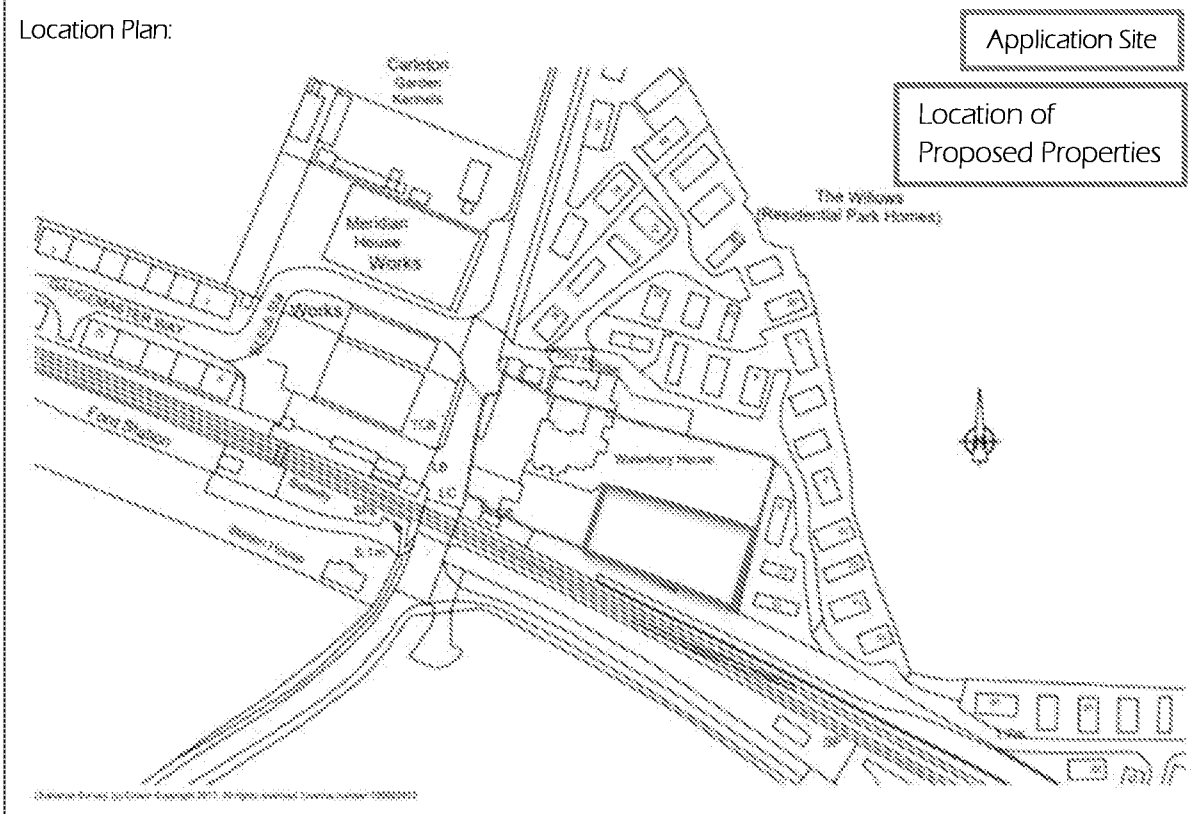
3.0 Details of the Site

3.1 Site Details

Table 2: Development Location

Site Name:	8 Ford Road, Ford, Arundel
Purpose of Development:	Residential
Existing Land Use:	Undeveloped Garden Area
OS NGR:	TQ0033404276
Country:	England
County:	West Sussex
Local Planning Authority:	Arun District Council
Lead Local Flood Authority	Arun District Council
Internal Drainage Board:	Not Applicable
Other Authority (e.g. British Waterways/ Harbour Authority)	Not Applicable

Location Plan:



Source: Consensus Healthcare

3.2 Site Description

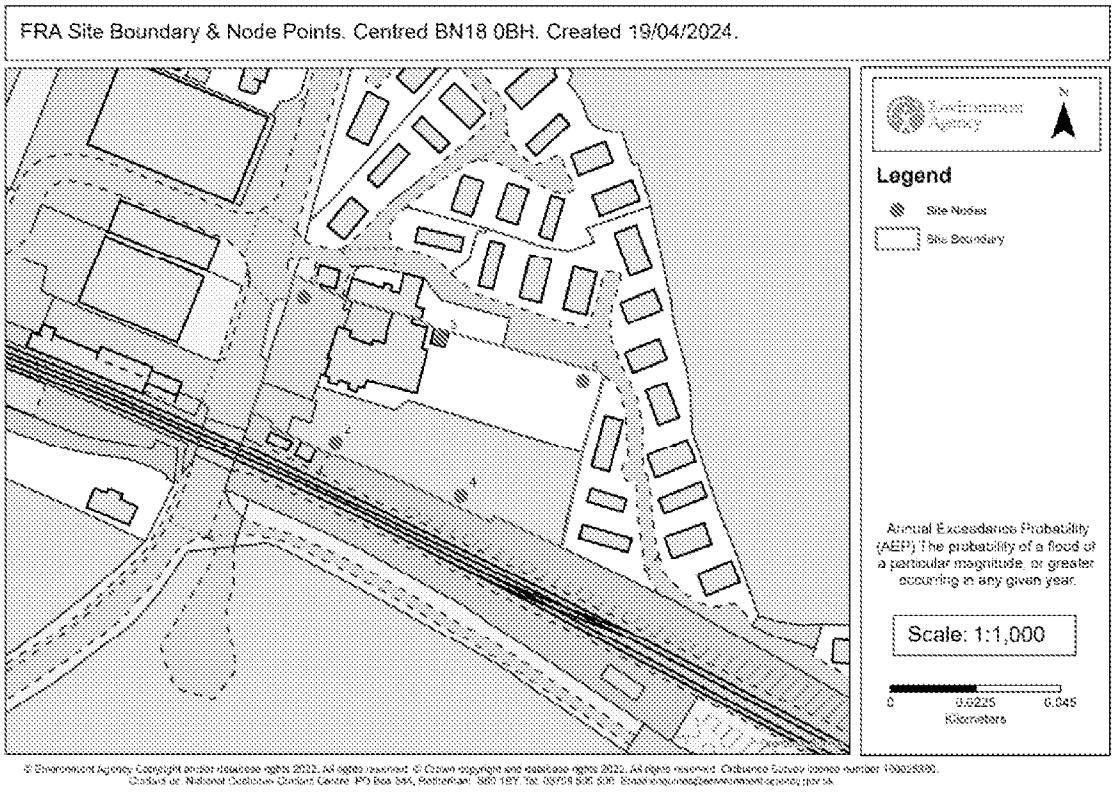
The application site comprises of the existing Waterbury House care home facility with car parking to the west, garden area positioned to the east and south east of the existing building. Ford Road is positioned to the west of Waterbury House, access road for Willows Park to the north and east and railway line to the south.

At the time of writing a topographical survey was not available, therefore LIDAR Data was ascertained to estimate onsite levels based on Flood Data Node Spot Levels, these are provided below for reference.

- Node 1 = 4.892m AOD
- Node 2 = 5.182m AOD
- Node 3 = 4.123m AOD

- Node 4 = 4.723m AOD (Nearest Spot Level to the Footprint of the Proposed Properties)
- Node 5 = 2.996m AOD

Figure 3.1: Spot Level Locations



Source: www.gov.uk

The nearest watercourse to the application site is the River Arun located approximately 170m east of the site. The watercourse is considered to be a 'Main River' and therefore the Environment Agency have certain roles and responsibilities regarding management and maintenance.

3.3 Proposed Development Details

Development proposals comprise of the erection of 4No terraced houses and associated off street parking on current garden area associated with Waterbury House.

4.0 Historic Flooding

4.1 Internet Search

An internet search for historic flooding within Arundel has numerous results most recently in 2014, however nothing was found online with regards to flooding within the vicinity of the application site.

4.2 Arundel Strategic Flood Risk Assessment 2008

Map H, Historic Flood Events does not identify the application site as having suffered flooding in the past.

4.3 Arundel Strategic Flood Risk Assessment 2016 Update

Map H (page 34 of 46), Historic Flood Events does not identify the application site as having suffered flooding in the past.

4.4 Environment Agency Historic Flooding

The Environment Agency state that they do not posses any historic flood information for this area.

5.0 Initial Evaluation of Flood Risk

5.1 The Environment Agency Flood Map

The Environment Agency Flood Map illustrated within Figure 2.1, confirms that the proposed development site is located within Flood Zone 3.

The definition for each of the flood zones highlighted above is provided for reference within Section 2.2.3 of this report.

5.2 Sources of Flooding

Table 3: Possible Flooding Mechanisms

Source/Pathway	Significant?	Comment/Reason
Fluvial	Yes	Flood Zone 3 River Arun
Canal	No	Not Applicable
Tidal/Coastal	Yes	Flood Zone 3 River Arun
Reservoir	No	EA Map shows that the site will not be affected by reservoir flooding.
Pluvial (urban drainage)	No	Site will require a new positive drainage strategy
Groundwater	No	Groundwater considered to have a risk of flooding >75%
Surface Water Flooding	No	Site is located within an area that has a very low risk surface water flooding.
Overland Flow	No	Site is located within an area that has a very low risk surface water flow route traversing through the site.
Blockage	No	Not Applicable
Infrastructure failure	No	Not Applicable
Rainfall Ponding	No	No known areas of ponding visible.

From the initial assessment it is concluded that the primary source of flood risk will be from the fluvial/tidal source the River Arun.

Fluvial/Tidal: River Arun

The nearest watercourse to the application site is the River Arun located approximately 170m east of the site. The watercourse is considered to be a tidally influenced 'Main River' and therefore the Environment Agency have certain roles and responsibilities regarding management and maintenance.

Due to the application site being located within Flood Zone 3 flooding from this mechanism requires further evaluation.

Groundwater Flooding

Compared with other sources, current understanding of the risks posed by groundwater flooding is limited and mapping of flood risk from groundwater sources is in its infancy. Under the Flood and Water Management Act (2010), LLFAs have powers to undertake risk management functions in relation to groundwater flood risk. Groundwater level monitoring records are available for areas on Major Aquifers.

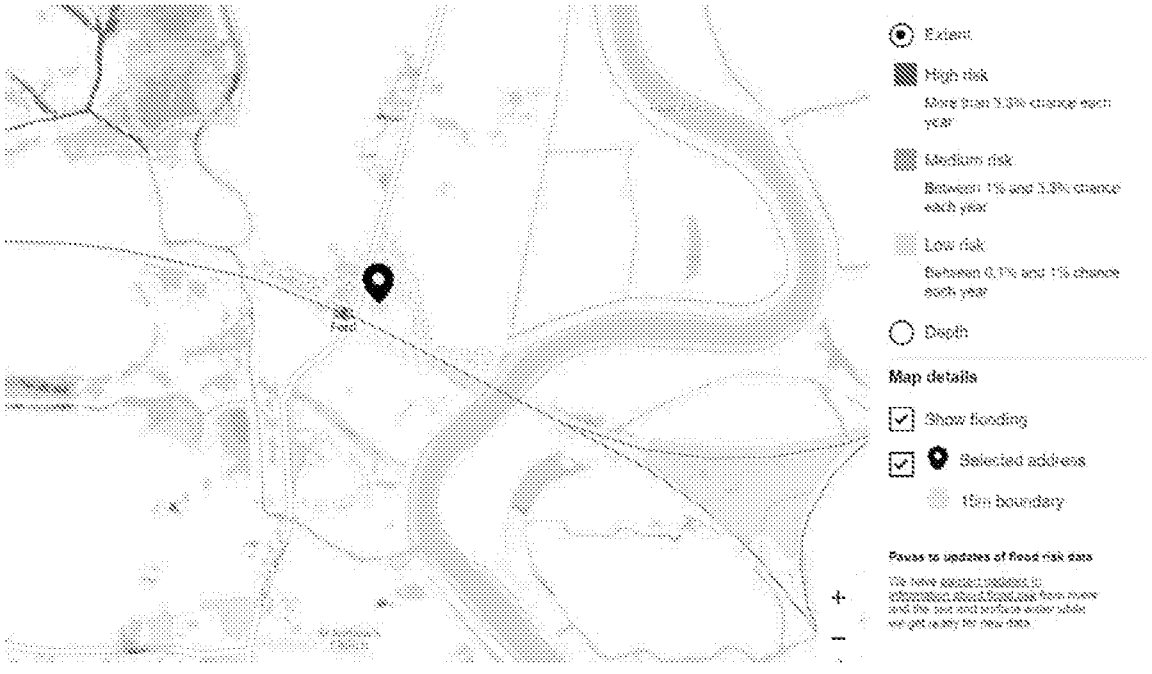
However, for low lying valley areas, which can be susceptible to groundwater flooding caused by a high water table in mudstones, clays and superficial alluvial deposits, very few records are available. Additionally, there is increased risk of groundwater flooding where long reaches of watercourse are culverted as a result of elevated groundwater levels not being able to naturally pass into watercourses and be conveyed to less susceptible areas.

Due to the proposed development not comprising of basement dwellings or within a topographical depression, the risk of groundwater flooding affecting the development proposals is considered to be low.

Pluvial Flooding

The Environment Agency's Surface Water Flood Map identifies that the application site has a very low risk associated with pluvial (surface water) flooding.

Figure 5.1: Environment Agency Surface Water Flood Map



Source: www.gov.uk

- **Very low risk** means that each year this area has a chance of flooding of less than 0.1%. Flooding from surface water is difficult to predict as rainfall location and volume are difficult to forecast. In addition, local features can greatly affect the chance and severity of flooding.

Due to the application site being considered to have a very low risk of surface water flooding, no further evaluation is required.

6.0 Quantitative Flood Risk Assessment

6.1 Fluvial/Tidal: River Arun

6.1.1 Background

The application site is shown to be located within Flood Zone 3, which is considered to have a high risk of fluvial/tidal flooding.

Flood Zone 3a *High Probability – Land having a 1 in 100 or greater annual probability or river flooding; or Land having a 1 in 200 or greater annual probability or sea flooding.*

The nearest watercourse to the application site is the River Arun, located approximately 170m east of the south of the site, flowing in a southernly direction.

The River Arun is considered to be a 'Main River' therefore the Environment Agency have certain roles and responsibility it regards to maintenance and management of the watercourse.

6.1.2 Flood Defences

The Environment Agency have provided Asset Information associated with the Flood Data which identifies that the site does benefit from flood defences in the form of embankments along the west bank of the watercourse.

- Asset No1 – Embankment - 200-year SOP
- Asset No2 – Embankment - 200-year SOP
- Asset No3 – Embankment - 200-year SOP
- Asset No4 – Embankment - 50-year SOP
- Asset No6 – Embankment - 200-year SOP

6.1.3 Lower Tidal River Arun Strategy Study Environment Agency Modelled Flood Levels

The Environment Agency have provided onsite flood levels for the River Arun extracted from the Lower Tidal River Arun Strategy Study Model for the defended and undefended scenarios.

6.1.4 River Arun Fluvial Scenario

The Environment Agency On-site Flood levels identify that only Node 5 (located within the north east corner of the site) would be affected by fluvial flooding.

The flood depth and heights are provided below for reference:

Fluvial Undefended Scenario

- Node 5 Undefended Scenario 1 in 100 Year + Climate Change - Depth = 0.67m, Height = 3.30m AOD

Fluvial Defended Scenario

- Node 5 Defended Scenario 1 in 100 Year + Climate Change - Depth = 0.19m, Height = 2.38m AOD

Taking the above into consideration only the north east of the site will become flooded during both the defended and undefended 1 in 100 Year + Climate Change Flood Events. It is emphasised that the remainder of the site will be unaffected.

6.1.5 River Arun Fluvial Conclusion

A review of the Environment Agency Flood Data during various tidal events associated with the River Arun concludes that only Node 5 will become affected during the worst-case fluvial event, the remainder of the site will not be affected.

6.1.6 River Arun Tidal Scenario

The Environment Agency On-site Flood levels identify that only Nodes 4 & 5 (located within the north east corner of the site and the south east proportion of the site) would be affected by tidal flooding.

The flood depth and heights are provided below for reference for the worst-case event i.e. 1 in 200 year + 2110 Climate Change Defended and Undefended Events:

Tidal Undefended Scenario

- Node 4 Undefended Scenario 1 in 200 Year + 2110 (cc) - Depth = N/A, Height = N/A
- Node 5 Undefended Scenario 1 in 200 Year + 2110(cc) - Depth = 1.01m, Height = 3.65m AOD

Tidal Defended Scenario

- Node 4 Defended Scenario 1 in 200 Year + 2110 (cc) - Depth = 0.02, Height = 4.09m AOD
- Node 5 Defended Scenario 1 in 200 Year + 2110(cc) - Depth = 1.45m, Height = 4.09m AOD

6.1.7 River Arun Tidal Conclusion

Following a review of tidal flood information, only Node 5 will experience flooding during the undefended 1 in 200 year + climate change event..

During the defended 1 in 200 year + climate change event. Nodes 4 & 5 will experience flooding to a height of 4.09m AOD, the flood envelopes are expected to cover the eastern quarter of the site, the remainer of the site will be unaffected.

6.2 Surface Water Runoff

6.2.1 General

The application site comprises of undeveloped garden area associated with Waterbury House and is therefore not considered to be formally drained.

6.2.2 Existing On-site Drainage Regime

The existing site is not considered to be formally drained, surface water runoff infiltrates into the ground.

Engineering judgment suggest that the existing Waterbury House is formally drained, however at the time of writing it is not known if surface water discharges to ground, watercourse or public sewer.

- Total Site Area = 0.10Ha

6.2.1 Sewer Records

At the time of writing sewer records were not available, however engineering judgment suggests that the public sewer network is located to the west within Ford Road.

6.2.2 Surface Water Drainage Hierarchy

The hierarchy for disposal of surface water from new developments is outlined within the Building Regulations Approved Document H and specifies the following methods in order of preference:

- Infiltration via soakaway or other suitable infiltration device
- Discharge to watercourse
- Discharge to public surface water sewer
- Discharge to public combined sewer

Infiltration

A review of Soilscape Maps identifies that the underlying ground comprises of both *Freely draining slightly acid loamy soils* at the west of the site; and *Loamy and clayey soils of coastal flats with naturally high groundwater* at the east proportion.

Borehole logs taken from the BGS online service for the nearest borehole log which is approximately 200m west, shows that the underlying ground comprises of gravel.

Taking the above into consideration the use of soakaway methods is may be considered to be viable, following on-site percolation testing.

*Desktop ground conditions provided within the appendices.

Watercourse

The nearest watercourse to the application site is the River Arun located 170m east, which would require crossing third party land and is therefore not considered feasible to dispose of surface water

Sewer

If following on-site percolation testing it is found that the underlying ground is not considered suitable for the use of soakaways, it is recommended that surface water from the development is directed into public sewer, anticipated to be located within Ford Road.

6.2.3 Sustainable Urban Drainage Systems (SUDS)

SUDS act to reduce the impact of surface water runoff from the development by limiting runoff volumes and rates from leaving the site.

Undertaking an assessment using the SUDS Planner a number of different methods could be used within the development. A summary of the results is tabulated overleaf:

Table 4: SUDS Planner

SUDS Criteria	Rank 1	Rank 2	Rank 3
Hydrological	Green Roof	Permeable Paving	On/offline Storage
Land Use	Infiltration Trench/Soakaway	Bioretention Area	On/offline Storage
Site Features	Green Roof	Permeable Paving	Filtration Techniques
Community & Environment	Bioretention Area	Infiltration Trench/Soakaway	Stormwater Wetlands
Economics & Maintenance	Wet Ponds	Grassed Swales	Dry Detention
Total	Green Roof	Permeable Paving	On/offline Storage

1. Source Control

The inclusion of source control in SUDS schemes is one of the more important principles of SUDS design, and source control components should be upstream of any pond, wetland or other SUDS component.

Source control can help provide interception storage which can handle and treat some of the more frequent but smaller, polluting events (at least 5mm).

Most source control components will be located within the private properties or highway areas. Their purpose is to manage rainfall close to where it falls, not allowing it to become a problem elsewhere.

The main types of source control include:

- Green roofs
- Rainwater harvesting
- Permeable paving
- Other permeable surfaces

Source control methods look to maximize permeability within a site to promote attenuation, treatment and infiltration, thereby reducing the need for off-site conveyance.

a) Green Roofs

Green roof solutions generally comprise of a multi-layered system that covers the roof of a building with vegetation cover, and/or landscaping over a drainage layer, designed to intercept and retain rainfall.

The incorporation of green roofs is to be decided by the architect/developers during the final design stage and is largely dependent on the final building design.

The likelihood of green roofs being utilised is considered to be low due to the increase in structural cost of the development.

b) Rainwater Harvesting

Rainwater harvesting provides a source of non-potable water, for purposes such as car washing; and landscaped area irrigation etc... and can be used for some industrial processes to reduce consumption of water from conventional supplies.

This SUDS solution, like green roof technology, is also designed to provide interception storage i.e. acts to reduce the volume of surface water leaving the proposed development; thereby helping to alleviate the current pressures on the receiving watercourse.

Rainwater harvesting can be installed at relatively low costs dependant on the chosen structure providing that the development site has scope.

c) Permeable Paving

Pervious surfaces can be either porous or permeable. The important distinction between the two is:

Porous surfacing is a surface that infiltrates water across the entire surface. Permeable surfacing is formed of material that is itself impervious to water but, by virtue of voids formed through the surface, allows infiltration through the pattern of voids.

Pervious surfaces provide a surface suitable for pedestrian and/or vehicular traffic, while allowing rainwater to infiltrate through the surface and into underlying layers.

The water can be temporarily stored before infiltration to the ground, reused, or discharged to a watercourse or other drainage system. Surfaces with an aggregate sub-base can provide good water quality treatment.

2. On/offline Storage

This is a traditional form of surface water attenuation and may be provided via online or offline structures such as oversized pipes; or shallow attenuation structures such as geo-cellular crate systems e.g. Hydro-International's Stormcell System or similar. These structures may be easily placed within either hardstanding or landscaped areas to provide ease of access for maintenance purposes.

6.2.4 Indicative Infiltration Rates

At the time of writing no infiltration testing had been undertaken, therefore in order to provide indicative attenuation volumes, indicative infiltration rates have been used based on CIRIA Guidance for ground comprising from the worst-case gravel figures outlined below:

- Worst Case CIRIA Gravel Indicative Infiltration Rate = 10^{-3}m/s = 36m/hr

6.2.5 Greenfield Runoff Rates

Greenfield runoff rates have been calculated using the redline boundary of the site, which has a total area of 0.10 Hectares.

- Qbar = 0.2l/s

*Greenfield Runoff Calculations provided as an appendix.

6.2.6 Restricted Discharge Rates

Normally, flows from the proposed development should not exceed existing runoff rates for the 1 in 2 year event i.e. QBar 1.6l/s, however this may cause siltation and blockage and therefore recommend a maximum discharge rate of 2l/s is applied.

- Proposed discharge rate = 2l/s

6.2.7 Indicative Attenuation Volumes

Indicative attenuation volumes have been calculated using the proposed impermeable area which accounts for 0.10Ha, for both scenarios i.e. soakaways and discharge to sewer.

Indicative Attenuation Volumes

- Soakaways = 1 in 100 year + 50% climate change event = $1m^3$- $15m^3$.
- Discharge to Sewer = 1 in 100 year + 50% climate change event = $59m^3$- $83m^3$.

6.2.8 Preliminary Drainage Strategy

The preliminary drainage strategy could comprise of storage provided by a mixture of permeable paving within the car parking areas and on/offline storage for the roof and car parking contributing areas.

If following on-site percolation testing soakaways are found to be suitable, surface water flows from the site should discharge to ground with any additional storage provided within a geo-cell soakaway tank.

Failing the use of soakaways, it is recommended that surface water flows should be directed to public sewer, which is expected to be located within Ford Road, however this will require confirmation during the detailed design phase.

Flows to be restricted to no more than 2l/s by means of a vortex flow control chamber up to and including the 1 in 100 year + 50% climate change event.

6.3 Foul

Foul flows from the proposed development could connect into the public foul network which is expected to be located to the west of the site within Ford Road, this is to be confirmed during the detailed design phase.

7.0 Mitigation Measures

7.1 Finished Floor Levels

It is proposed that finished floor levels should be elevated no less than the following

- 600mm above the 1 in 200 year + CC Flood level (4.09m AOD) = 4.690m AOD

7.2 Flood Resilience/Resistance

Flood resilience/resistance measures to be incorporated into the building set at 0.600m above finished floor levels, these are outlined in bold below.

- Flood Resilience/Resistance Measures = 4.690 + 0.600 = 5.290m AOD

Flood proofing is a technique by which buildings are designed to withstand the effects of flooding. There are two main categories of flood proofing, which are dry proofing and wet proofing.

Dry proofing methods are designed to keep water out of the building, and wet proofing methods are designed to improve the ability of the property to withstand effects of flooding once the water has entered the building.

In addition, fixtures and fittings should be built to withstand immersion in water or designed to be easily replaced.

Identified below are flood proofing measures which can be incorporated within the design for the proposed redevelopment works. Such measures are put forward in accordance with 'Development and Flood Risk Guidance for the Construction Industry' CIRIA C624.

It would be preferable to avoid external doors as this would remove a potential point of flood inflows. However, since free access and egress into the building will be required, flood resistant doors and/or the use of flood resistant stop logs or flood boards should be considered.

Full details of manufacturers or suppliers of flood protection equipment may be obtained from the Flood Protection Association (website: www.thefpa.org.uk).

Flood Resilience/Resistance measures to be Incorporated into the development

- Careful consideration of materials: use low permeability materials to limit water penetration if dry proofing required.
- Avoid using timber frame and cavity walls. Consider applying a water-resistant coating.
- Avoid use of gypsum plaster if possible or apply plasterboards horizontally rather than vertically
- Avoid use of stud partition walls.
- Wall sockets to be raised to as high as is feasible and practicable in order to minimise damage if flood waters inundate the property.
- Any wood fixings on ground floor will be robust and/or protected by suitable coatings in order to minimise damage during a flood event.
- Storage of any materials or possessions that may be susceptible to flood damage should be stored or raised at a level 0.600m above finished floor levels to limit the damage caused in the event of a flood.
- Non-Return Valves fitted to prevent backflow of sewage which can occur during flood conditions.
- Avoid fitted carpets where possible.
- Locate electrical, gas and telephone equipment and systems as high as practically feasible

7.3 Environment Agency Flood Warnings

Due to the site being located within Flood Zone 3, it is advised that residents sign up to receive flood warnings.

It is essential that all persons evacuate the property immediately upon receipt of the Flood Warnings prior to the on-set of flooding, this is due to the main exit of the property being located within Flood Zone 3.

The Flood Warning's Direct Service is a free service which enables the Environment Agency to send a direct message when flooding is expected and may affect the development. Flood warnings are designed to provide businesses/properties the time to prepare for flooding. Flood warnings can be sent by telephone, mobile, email SMS text message or fax.

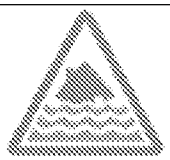
The Environment Agency also provides the **Floodline 0845 988 1188** service, where occupants can listen to recorded flood warning information for the area or speak to an operator for advice 24 hours a day.

Should a flood event reach the level where development is at risk of inundation, then the Environment Agency will issue a Severe Flood Warning.

Using the latest available technology, the Environment Agency is able to monitor rainfall, river levels and sea conditions 24 hours a day and use this information to forecast the possibility of flooding.

If flooding is forecast, they are able to issue warnings using a set of three different warning types.

Table 5: Environment Agency Flood Warning Codes

Flood Warning Code	What it means	When it's used	What to do
 FLOOD ALERT	Flooding is possible. Be prepared.	2 hours – 2 days in advance of flooding.	• Be prepared to act on you flood plan • Prepare a flood kit • Monitor local water levels and the flood forecast of the EA website
 FLOOD WARNING	Flooding is expected. Immediate action is required.	½ hour – 1 day in advance of flooding.	• Move people to a safe place • Turn of gas, electricity and water supplies if safe to do so • Put flood protection equipment in place
 SEVERE FLOOD WARNING	Severe flooding. Danger to life.	When flooding poses a significant threat to life.	• Stay in a safe place with means of escape • Be ready to evacuate • Co-operate with the emergency services • Call 999 if you are in immediate danger
Warnings no longer in force	No further flooding is currently expected in your area	When river or sea conditions begin to return to normal	• Be careful as flood water may still be around for several days • If you have been flooded, ring your insurance company as soon as possible

How are Flood Warnings issued?

- **Direct to you** – receive warnings by phone, text, email or fax. Sign up for the Environment Agency's FREE Floodline Warnings Direct service via this website link: https://fwd.environment-agency.gov.uk/app/olr/register or by calling Floodline on **0845 988 1188**.
- **On the flood warnings website** – view up-to-date information about flood warnings in force, monitor the river or sea levels in your area and check out the latest flood risk forecast for your county.
- **By calling Floodline on 0845 988 1188** – you can listen to recorded information on the latest warnings and predictions or speak to an operator for more general information 24 hours a day. Environment Agency operators can also provide a quick dial number which gives you faster access to information for your area.
- **Through the media** – you may see or hear Environment Agency warnings on television and in radio broadcasts. You can also view the latest warnings on Digital Ceefax page 405.
- **Flood Wardens** – in some areas Flood Wardens are there to alert and support their local community when a flood warning is issued. Call Floodline on 0845 988 1188 to find out if this service is available in your area.
- **Sirens/loudhailers** – in some areas the Environment Agency uses loudhailer or siren systems to warn people that a flood warning has been issued. Call Floodline on 0845 988 1188 to find out if this type of service operates in your area.
- **Flood warning feeds** – Flood warning (RSS) feeds shows national and regional flood warnings in force and are updated every 15 minutes. The feeds contain a brief summary and link to the full information on the Environment Agency website.

7.4 Evacuation Route

It is recommended that persons on site are prepared to evacuate away from the property immediately via vehicle, if advised to do so by the EA Flood Warning Service, the emergency services and/or local authority, in the advance of the onset of any flooding.

Evacuation away from the site during fluvial flood events should be directed to an appropriate location within Flood Zone 1, to allow access to all major highway routes away from Flood Zones 2 and 3.

Upon receipt of an Environment Agency Flood Warnings persons should evacuate the site via the lowest risk route available as described below:

- All persons onsite should evacuate the building via the north/west boundary prior to the on-set of actual flooding
- North along Ford for approximately 550m
- West along Tortington Road for approx. 200m into Flood Zone 1

7.5 Signage

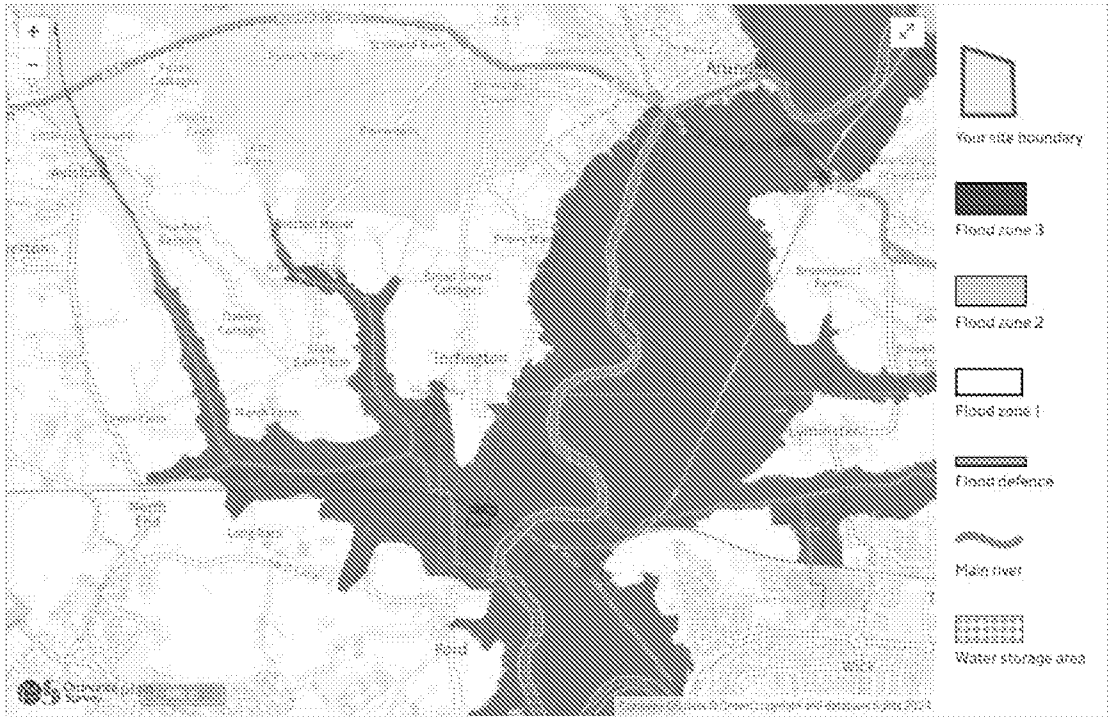
In order to make residents and visitors aware of the potential risk of the site flooding, it is recommended that appropriate signage is incorporated within the site highlighting the proposed evacuation route, which should be adhered to upon receipt of the Environment agency Flood Warnings.

7.6 Personal Flood Plan

It is also recommended that residents create personal flood plans. This is a simple document that assists the occupant to prioritise actions required at the property before, during and following a flood event.

A copy of a Personal Flood Plan Template has been provided within the appendices of this report.

Figure 7.1: Emergency Evacuation Route



Source: www.gov.uk

8.0 Conclusions & Recommendations

Fluvial/Tidal Flooding

The Environment Agency have provided Asset Information associated with the Flood Data which identifies that the site does benefit from flood defences in the form of embankments along the west bank of the watercourse.

- Asset No1 – Embankment - 200-year SOP
- Asset No2 – Embankment - 200-year SOP
- Asset No3 – Embankment - 200-year SOP
- Asset No4 – Embankment - 50-year SOP
- Asset No6 – Embankment - 200-year SOP

The Environment Agency have provided onsite flood levels for the River Arun extracted from the Lower Tidal River Arun Strategy Study Model for the defended and undefended scenarios.

A review of the Environment Agency Flood Data during various tidal events associated with the River Arun concludes that only Node 5 will become affected during the worst-case fluvial event, the remainder of the site will not be affected.

Following a review of tidal flood information, only Node 5 will experience flooding during the undefended 1 in 200 year + climate change event..

During the defended 1 in 200 year + climate change event. Nodes 4 & 5 will experience flooding to a height of 4.09m AOD, the flood envelopes are expected to cover the eastern quarter of the site, the remainer of the site will be unaffected.

Surface Water and Foul Drainage

The preliminary drainage strategy could comprise of storage provided by a mixture of permeable paving within the car parking areas and on/offline storage for the roof and car parking contributing areas.

If following on-site percolation testing soakaways are found to be suitable, surface water flows from the site should discharge to ground with any additional storage provided within a geo-cell soakaway tank.

Failing the use of soakaways, it is recommended that surface water flows should be directed to public sewer, which is expected to be located within Ford Road, however this will require confirmation during the detailed design phase.

Flows to be restricted to no more than 2l/s by means of a vortex flow control chamber up to and including the 1 in 100 year + 50% climate change event.

Foul flows from the proposed development could connect into the public foul network which is expected to be located to the west of the site within Ford Road, this is to be confirmed during the detailed design phase.

Flood Mitigation Measures

Finished Floor Levels

It is proposed that finished floor levels should be elevated no less than the following

- 600mm above the 1 in 200 year + CC Tidal Flood level (4.09m AOD) = 4.690m AOD

Flood Resilience/Resistance

Flood resilience/resistance measures to be incorporated into the building set at 0.600m above finished floor levels, these are outlined below.

- Flood Resilience/Resistance Measures = 4.690 + 0.600 = 5.290m AOD

Flood Resilience/Resistance measures to be Incorporated into the development

- Careful consideration of materials: use low permeability materials to limit water penetration if dry proofing required.
- Avoid using timber frame and cavity walls. Consider applying a water-resistant coating.
- Avoid use of gypsum plaster if possible or apply plasterboards horizontally rather than vertically
- Avoid use of stud partition walls.
- Wall sockets to be raised to as high as is feasible and practicable in order to minimise damage if flood waters inundate the property.
- Any wood fixings on ground floor will be robust and/or protected by suitable coatings in order to minimise damage during a flood event.
- Storage of any materials or possessions that may be susceptible to flood damage should be stored or raised at a level 0.600m above finished floor levels to limit the damage caused in the event of a flood.
- Non-Return Valves fitted to prevent backflow of sewage which can occur during flood conditions.
- Avoid fitted carpets where possible.
- Locate electrical, gas and telephone equipment and systems as high as practically feasible

Environment Agency Flood Warnings

Due to the site being located within Flood Zone 3, it is advised that residents sign up to receive flood warnings.

It is essential that all persons evacuate the property immediately upon receipt of the Flood Warnings prior to the on-set of flooding, this is due to the main exit of the property being located within Flood Zone 3.

Evacuation Route

Upon receipt of an Environment Agency Flood Warnings persons should evacuate the site via the lowest risk route available as described below:

- All persons onsite should evacuate the properties via the north/west boundary prior to the on-set of actual flooding
- North along Ford for approximately 550m
- West along Tortington Road for approx. 200m into Flood Zone 1

Personal Flood Plan

It is also recommended that residents create personal flood plans. This is a simple document that assists the occupant to prioritise actions required at the property before, during and following a flood event.

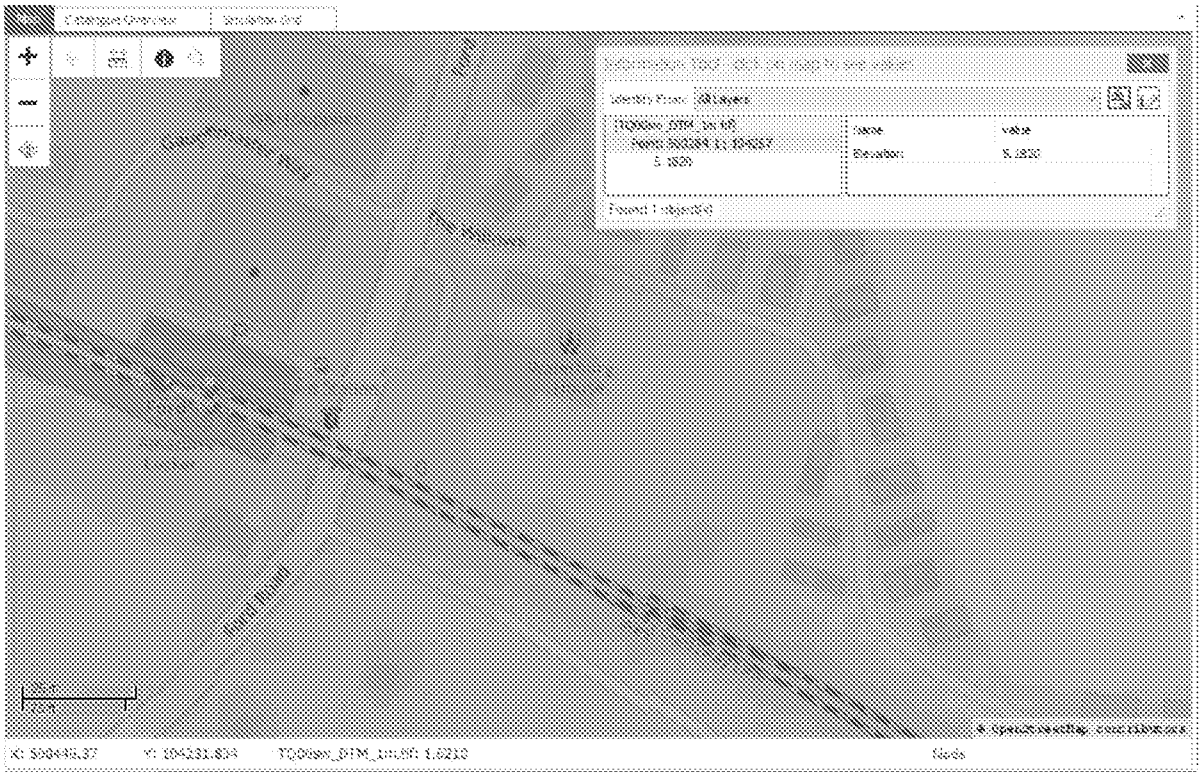
A copy of a Personal Flood Plan Template has been provided within the appendices of this report.

APPENDICES

Appendix A: - LIDAR Data

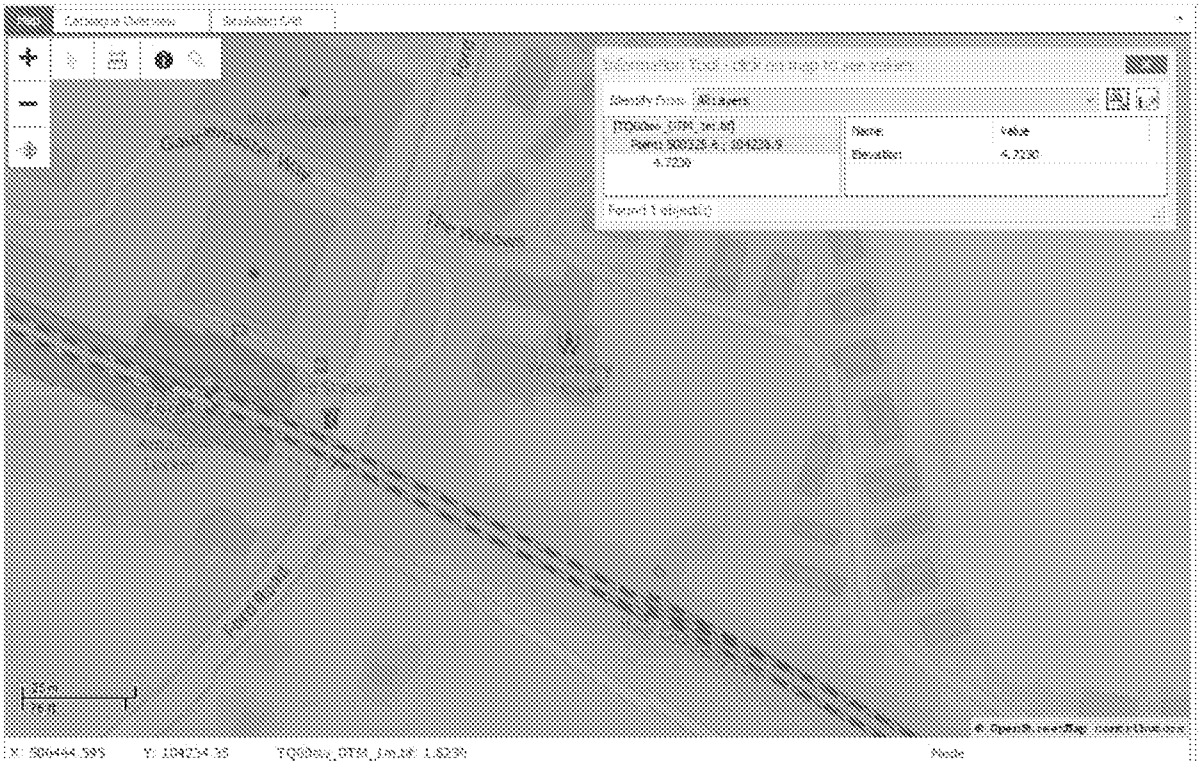
NODE 1 = 4.892

NODE 2 = 5.182

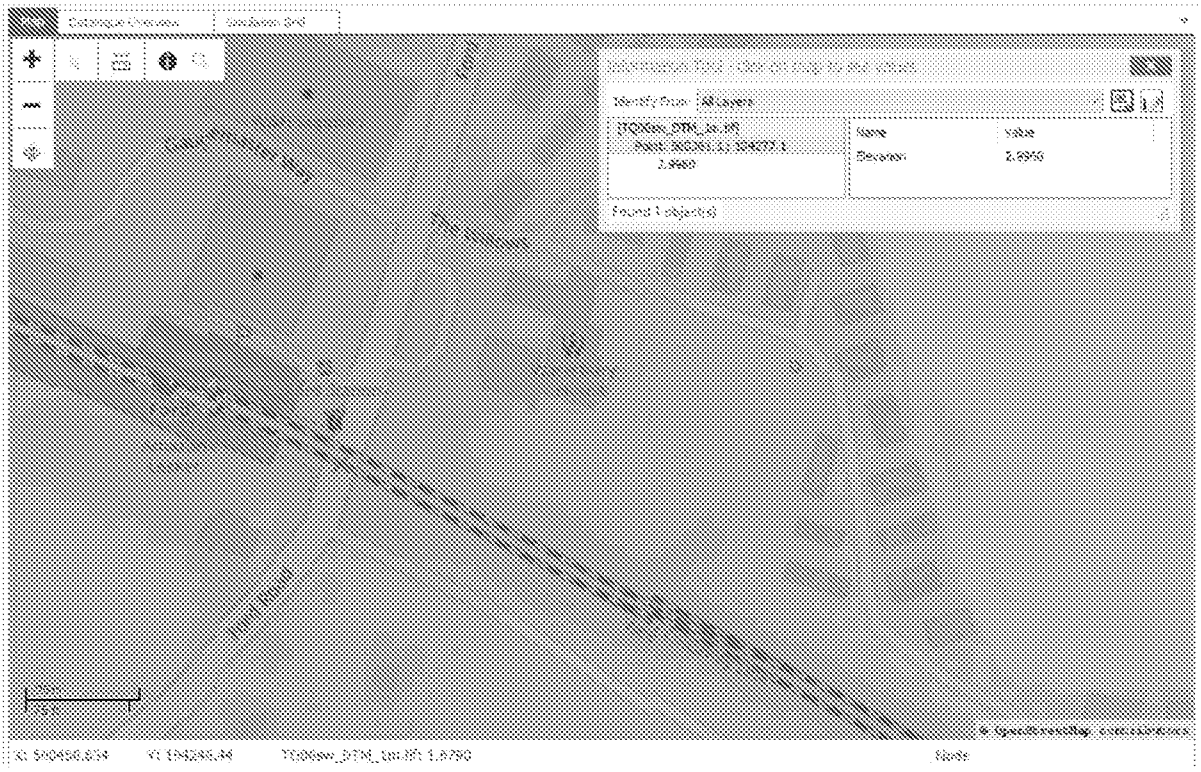


NODE 3 = 4.123

NODE 4 = 4.723



NODE 5 = 2.996

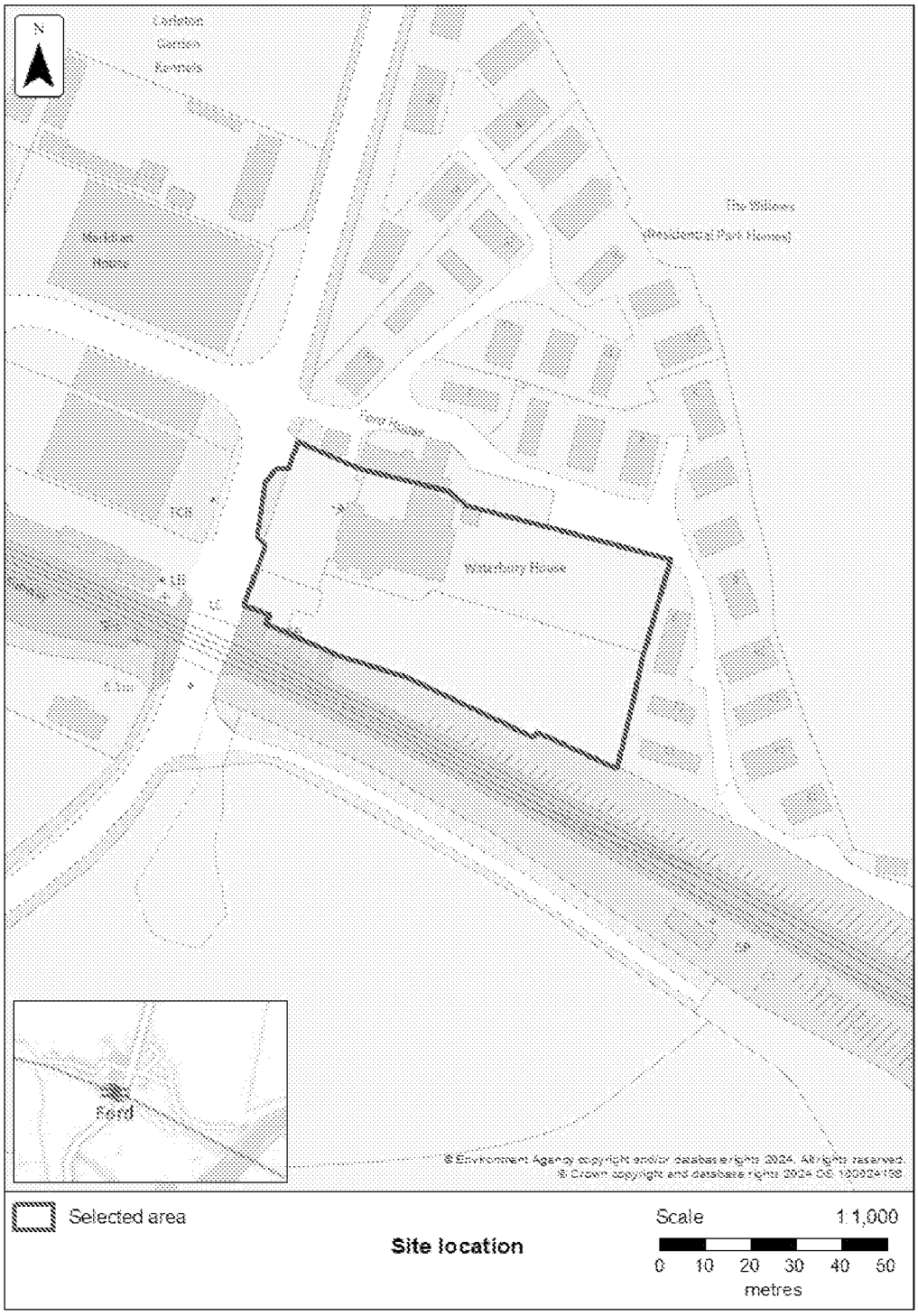


Appendix B: - Environment Agency Flood Data

Flood risk assessment data

Location of site: Waterbury House, 8 Ford Road, Ford, Arundel, BN18 0BH
Document created on: 19 April 2024
This information was previously known as a product 4.
Customer reference number: SSD356017

Map showing the location that flood risk assessment data has been requested for.



How to use this information

You can use this information as part of a flood risk assessment for a planning application. To do this, you should include it in the appendix of your flood risk assessment.

We recommend that you work with a flood risk consultant to get your flood risk assessment.

Included in this document

In this document you'll find:

- how to find information about surface water and other sources of flooding
- information on the models used
- definitions for the terminology used throughout
- flood map for planning (rivers and the sea)
- flood defences and attributes
- information to help you assess if there is a reduced flood risk from rivers and the sea because of defences
- modelled data
- climate change modelled data
- information about strategic flood risk assessments
- information about this data
- information about flood risk activity permits
- help and advice

Information that's unavailable

This document **does not** contain:

- historic flooding

We do not have historic flooding data for this location.

Please note that:

- flooding may have occurred that we do not have records for
- flooding can come from a range of different sources
- we can only supply flood risk data relating to floodng from rivers or the sea

You can contact your Lead Local Flood Authority or Internal Drainage Board to see if they have other relevant local flood information. Please note that some areas do not have an Internal Drainage Board.

Surface water and other sources of flooding

Use the long term flood risk service to find out about the risk of flooding from:

- surface water
- ordinary watercourses
- reservoirs

For information about sewer flooding, contact the relevant water company for the area.

About the models used

Model name: Lower Tidal River Arun Strategy (LTRAS)
Scenario(s): Defended fluvial, Undefended fluvial, Defended tidal, Undefended tidal
Date: 2010

This model contains the most relevant data for your area of interest.

Terminology used

Annual exceedance probability (AEP)

This refers to the probability of a flood event occurring in any year. The probability is expressed as a percentage. For example, a large flood which is calculated to have a 1% chance of occuring in any one year, is described as 1% AEP.

Metres above ordnance datum (mAOD)

All flood levels are given in metres above ordnance datum which is defined as the mean sea level at Newlyn, Cornwall.

Flood map for planning (rivers and the sea)

Your selected location is in flood zone 3.

Flood zone 3 shows the area at risk of flooding for an undefended flood event with a:

- 0.5% or greater probability of occurring in any year for flooding from the sea
- 1% or greater probability of occurring in any year for fluvial (river) flooding

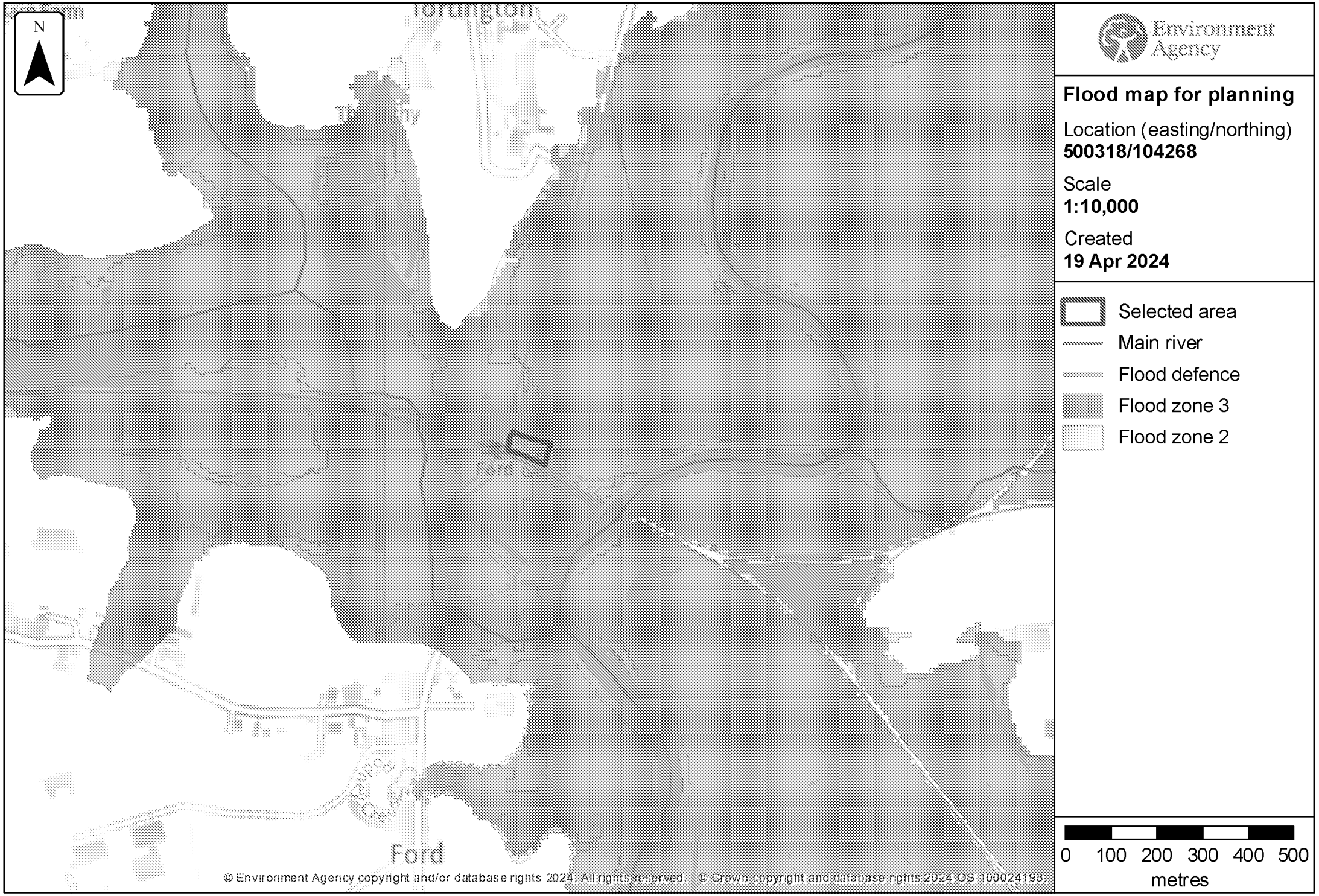
Flood zone 2 shows the area at risk of flooding for an undefended flood event with:

- between a 0.1% and 0.5% probability of occurring in any year for flooding from the sea
- between a 0.1% and 1% probability of occurring in any year for fluvial (river) flooding

It's important to remember that the flood zones on this map:

- refer to the land at risk of flooding and do not refer to individual properties
- refer to the probability of river and sea flooding, ignoring the presence of defences
- do not take into account potential impacts of climate change

The flood zones are not currently being updated. The last update was in November 2023. Some of the flood zones may have changed, however all source data is included in the models below.



ARUN DISTRICT COUNCIL F/21/24/PL

Flood defences and attributes

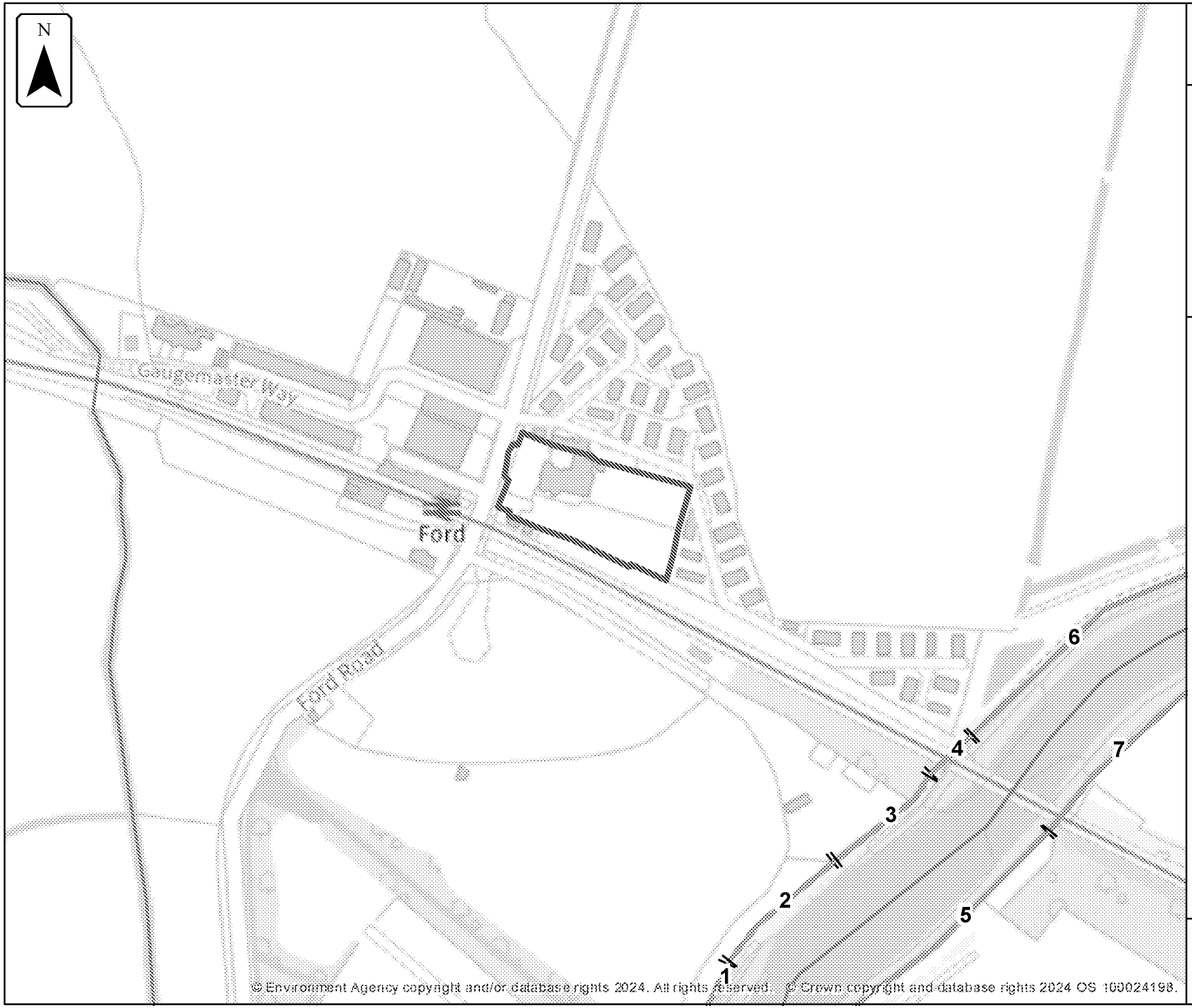
The flood defences map shows the location of the flood defences present.

The flood defences data table shows the type of defences, their condition and the standard of protection. It shows the height above sea level of the top of the flood defence (crest level). The height is In mAOD which is the metres above the mean sea level at Newlyn, Cornwall.

It's important to remember that flood defence data may not be updated on a regular basis. The information here is based on the best available data.

Use this information:

- to help you assess if there is a reduced flood risk for this location because of defences
- with any information in the modelled data section to find out the impact of defences on flood risk



Environment Agency

Flood defences

Location (easting/northing)
500318/104268

Scale
1:2,500

Created
19 Apr 2024

Selected area
Main river
Flood defence

0 25 50 75 100
metres

ARUN DISTRICT COUNCIL F/21/24/PL

Flood defences data

Label	Asset ID	Asset Type	Standard of protection (years)	Current condition	Downstream actual crest level (mAOD)	Upstream actual crest level (mAOD)	Effective crest level (mAOD)
1	156345	Embankment	200		4.07	4.01	
2	156346	Embankment	200		4.01	4.26	
3	156347	Embankment	200		4.26	3.97	
4	137619	Embankment	50		3.97	3.17	
5	125809	Embankment	200		4.12	4.0	3.91
6	137620	Embankment	200		4.08	3.82	
7	137417	Embankment	200		3.71	3.88	

Any blank cells show where a particular value has not been recorded for an asset.

Modelled data

This section provides details of different scenarios we have modelled and includes the following (where available):

- outline maps showing the area at risk from flooding in different modelled scenarios
- modelled node point map(s) showing the points used to get the data to model the scenarios and table(s) providing details of the flood risk for different return periods
- map(s) showing the approximate water levels for the return period with the largest flood extent for a scenario and table(s) of sample points providing details of the flood risk for different return periods

Climate change

The climate change data included in the models may not include the latest flood risk assessment climate change allowances. Where the new allowances are not available you will need to consider this data and factor in the new allowances to demonstrate the development will be safe from flooding.

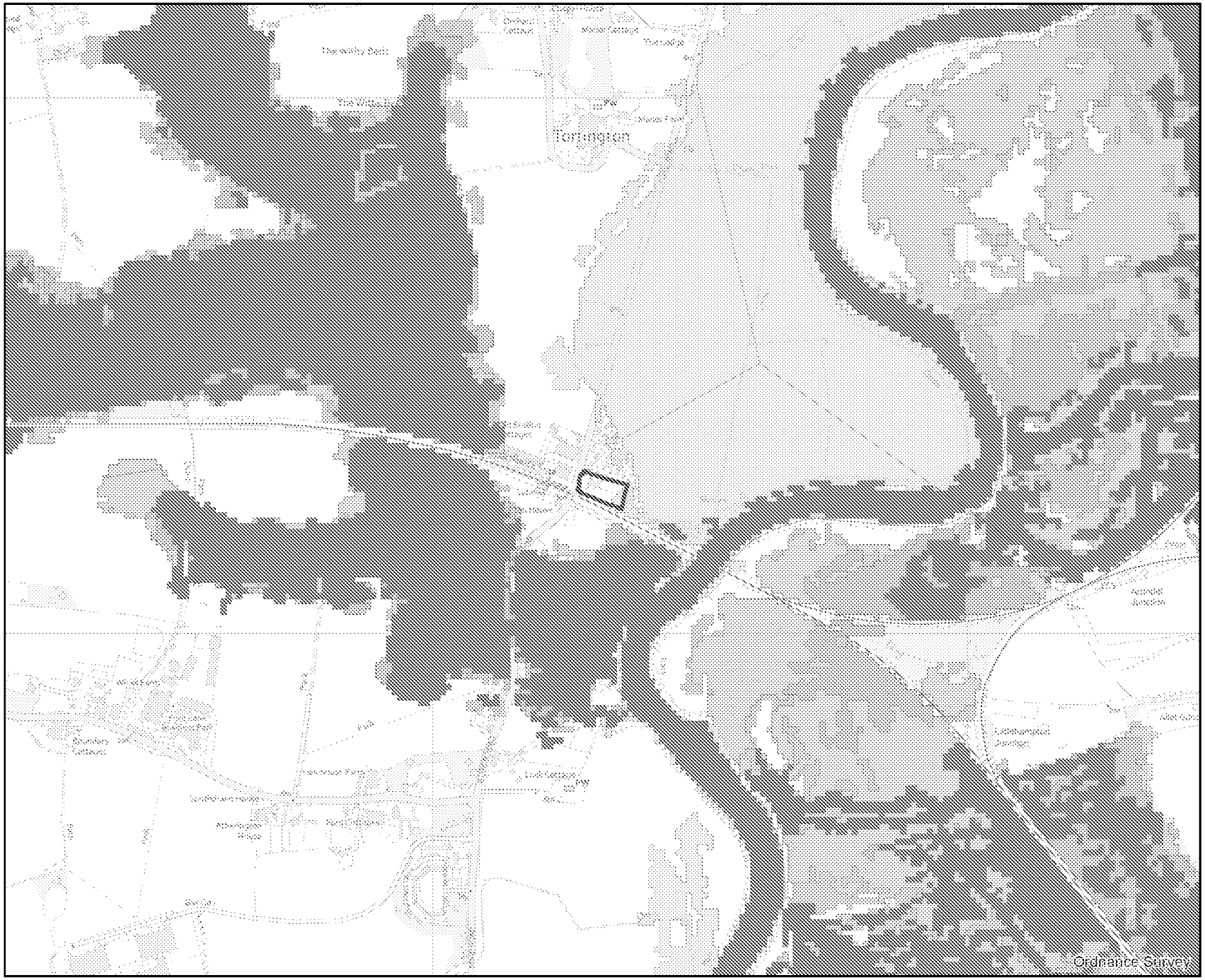
The Environment Agency will incorporate the new allowances into future modelling studies. For now, it's your responsibility to demonstrate that new developments will be safe in flood risk terms for their lifetime.

Modelled scenarios

The following scenarios are included:

- Defended modelled tidal: risk of flooding from the sea where there are flood defences
- No defences exist modelled tidal: risk of flooding from the sea where there are no flood defences
- Defended modelled fluvial: risk of flooding from rivers where there are flood defences
- No defences exist modelled fluvial: risk of flooding from rivers where there are no flood defences

Modelled Flood Outlines (Defended Fluvial). Centred BN18 0BH. Created 19/04/2024.



Environment Agency

N

Legend

- Site Boundary
- 5% AEP (Defended Fluvial)
- 1% AEP (Defended Fluvial)
- 1% AEP +CC (Defended Fluvial)
- 0.1% AEP (Defended Fluvial)

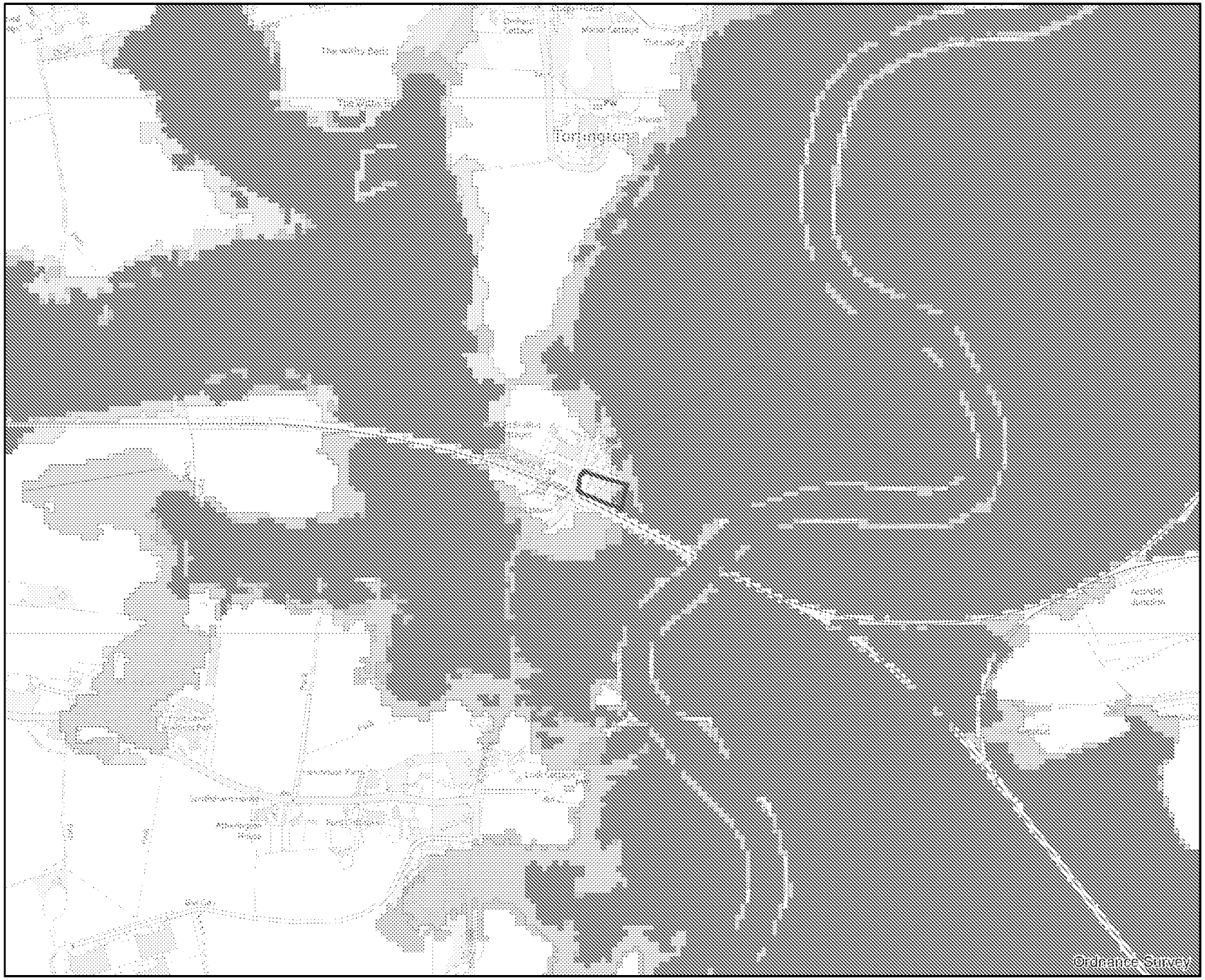
Annual Exceedance Probability (AEP) The probability of a flood of a particular magnitude, or greater occurring in any given year.

Scale: 1:10,000

0 0.225 0.45
Kilometers

ARUN DISTRICT COUNCIL F/21/24/PL

Modelled Flood Outlines (Undefended Fluvial). Centred BN18 0BH. Created 19/04/2024.



Environment Agency

N

Legend

- Site Boundary
- 5% AEP (Undefended Fluvial)
- 1% AEP (Undefended Fluvial)
- 1% AEP +CC (Undefended Fluvial)
- 0.1% AEP (Undefended Fluvial)

Annual Exceedance Probability (AEP) The probability of a flood of a particular magnitude, or greater occurring in any given year.

Scale: 1:10,000

0 0.225 0.45
Kilometers

ARUN DISTRICT COUNCIL F/21/24/PL

Modelled Flood Outlines (Defended Tidal). Centred BN18 0BH. Created 19/04/2024.

Environment Agency

N

Legend

- Site Boundary
- 0.5% AEP (Defended Tidal)
- 0.5% AEP (2110) (Defended Tidal)
- 0.1% AEP (Defended Tidal)

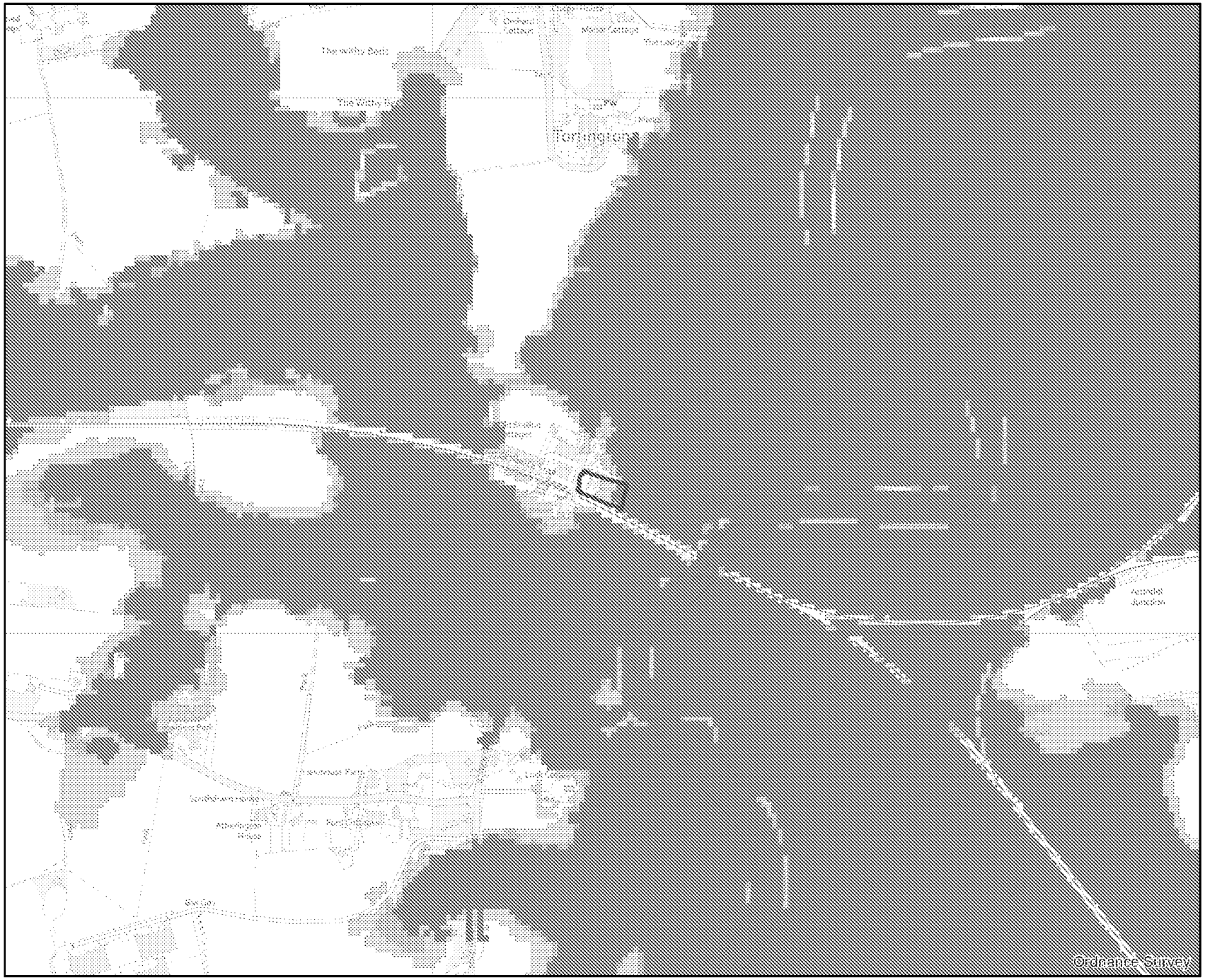
Annual Exceedance Probability (AEP) The probability of a flood of a particular magnitude, or greater occurring in any given year.

Scale: 1:10,000

0 0.225 0.45
Kilometers

ARUN DISTRICT COUNCIL F/21/24/PL

Modelled Flood Outlines (Undefended Tidal). Centred BN18 0BH. Created 19/04/2024.



Environment Agency

N

Legend

- Site Boundary
- 0.5% AEP (Undefended Tidal)
- 0.5% AEP (2110) (Undefended Tidal)
- 0.1% AEP (Undefended Tidal)

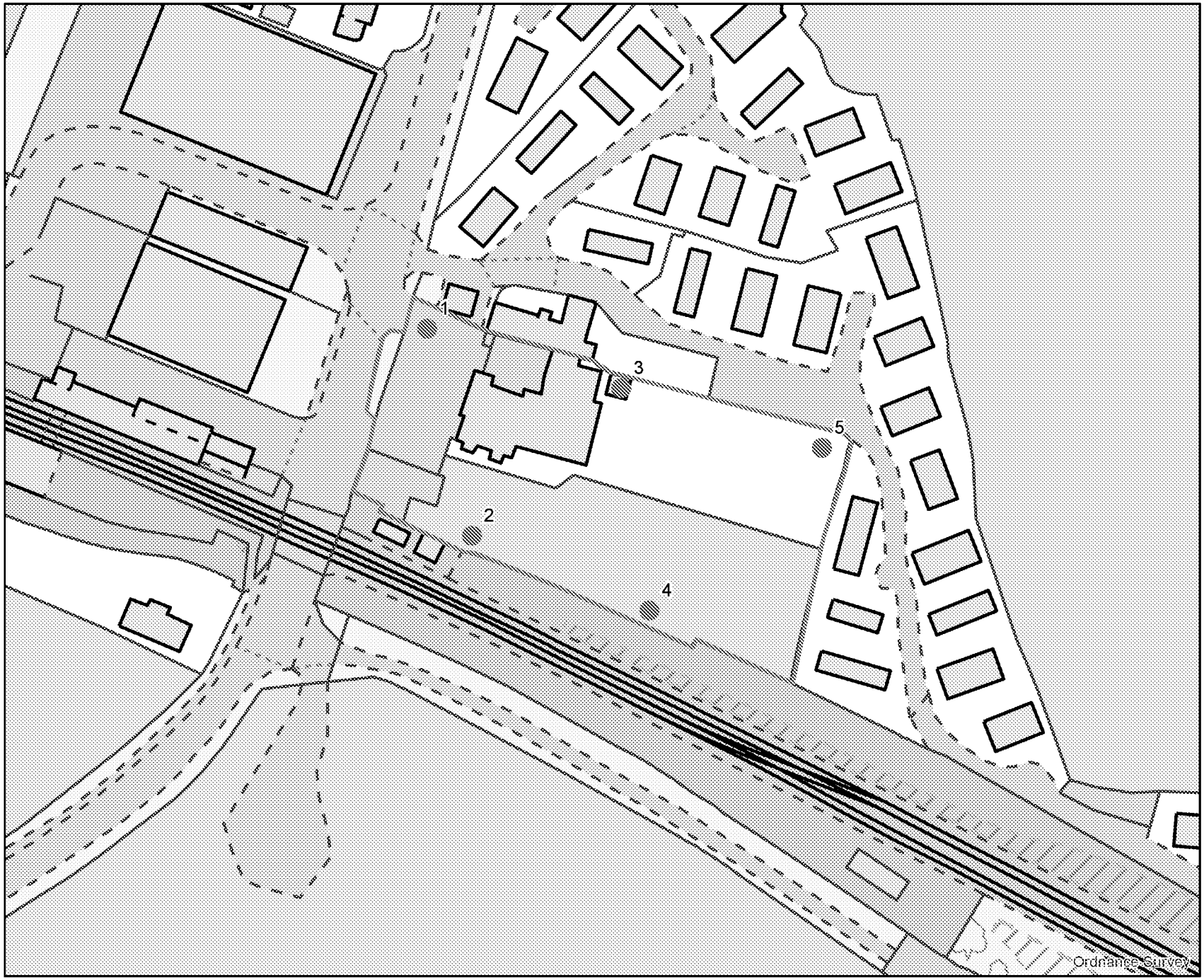
Annual Exceedance Probability (AEP) The probability of a flood of a particular magnitude, or greater occurring in any given year.

Scale: 1:10,000

0 0.225 0.45
Kilometers

ARUN DISTRICT COUNCIL F/21/24/PL

FRA Site Boundary & Node Points. Centred BN18 0BH. Created 19/04/2024.



Environment Agency

N

Legend

- Site Nodes
- Site Boundary

Annual Exceedance Probability (AEP) The probability of a flood of a particular magnitude, or greater occurring in any given year.

Scale: 1:1,000

0 0.0225 0.045
Kilometers

ARUN DISTRICT COUNCIL F/21/24/PL

Product 4 Flood Risk Data Requested by: Chris Vose

Site: Waterbury House, 8 Ford Road, Ford, Arundel, BN18 0BH

Table 1: Water Levels: Fluvial Undefended

	NGR		Modelled Flood Levels in Metres AOD Undefended Annual Exceedance Probability			
Node Ref	Eastings	Northings	5%	1%	1% +CC*	0.1%
1	500285	104297	-	-	-	-
2	500294	104259	-	-	-	-
3	500322	104286	-	-	-	-
4	500327	104245	-	-	-	-
5	500359	104275	-	-	3.30	-

Table 2: Water Levels: Fluvial Defended

	NGR		Modelled Flood Levels in Metres AOD Defended Annual Exceedance Probability			
Node Ref	Eastings	Northings	5%	1%	1% +CC*	0.1%
1	500285	104297	-	-	-	-
2	500294	104259	-	-	-	-
3	500322	104286	-	-	-	-
4	500327	104245	-	-	-	-
5	500359	104275	-	-	2.38	-

Table 3: Water Levels: Tidal Undefended

	NGR		Modelled Flood Levels in Metres AOD Undefended Annual Exceedance Probability		
Node Ref	Eastings	Northings	0.5%	0.5% (2110)**	0.1%
1	500285	104297	-	-	-
2	500294	104259	-	-	-
3	500322	104286	-	-	-
4	500327	104245	-	-	-
5	500359	104275	3.02	3.65	3.10

Table 4: Water Levels: Tidal Defended

	NGR		Modelled Flood Levels in Metres AOD Defended Annual Exceedance Probability		
Node Ref	Eastings	Northings	0.5%	0.5% (2110)**	0.1%
1	500285	104297	-	-	-
2	500294	104259	-	-	-
3	500322	104286	-	-	-
4	500327	104245	-	4.09	-
5	500359	104275	-	4.09	2.86

Table 5: Water Depths: Fluvial Undefended

	NGR		Modelled Flood Depths in Metres Undefended Annual Exceedance Probability			
Node Ref	Eastings	Northings	5%	1%	1% +CC*	0.1%
1	500285	104297	-	-	-	-
2	500294	104259	-	-	-	-
3	500322	104286	-	-	-	-
4	500327	104245	-	-	-	-
5	500359	104275	-	-	0.67	-

Table 6: Water Depths: Fluvial Defended

	NGR		Modelled Flood Depths in Metres Defended Annual Exceedance Probability			
Node Ref	Eastings	Northings	5%	1%	1% +CC*	0.1%
1	500285	104297	-	-	-	-
2	500294	104259	-	-	-	-
3	500322	104286	-	-	-	-
4	500327	104245	-	-	-	-
5	500359	104275	-	-	0.19	-

Table 7: Water Depths: Tidal Undefended

	NGR		Modelled Flood Depths in Metres Undefended Annual Exceedance Probability		
Node Ref	Eastings	Northings	0.5%	0.5% (2110)**	0.1%
1	500285	104297	-	-	-
2	500294	104259	-	-	-
3	500322	104286	-	-	-
4	500327	104245	-	-	-
5	500359	104275	0.39	1.01	0.46

Table 8: Water Depths: Tidal Defended

	NGR		Modelled Flood Depths in Metres Defended Annual Exceedance Probability		
Node Ref	Eastings	Northings	0.5%	0.5% (2110)**	0.1%
1	500285	104297	-	-	-
2	500294	104259	-	-	-
3	500322	104286	-	-	-
4	500327	104245	-	0.02	-
5	500359	104275	-	1.45	0.22

All levels taken from: Lower Tidal River Arun Strategy Study, completed by Atkins in 2010.

Produced on: 19/04/2024

*** The flood risk data provided is based on existing EA hydraulic models with an allowance for climate change. Please note the climate change allowances provided are not up to date. These were updated on 17 December 2019.**

You should refer to 'Flood risk assessments: climate change allowances' for the most up to date allowances. You will need to undertake further assessment of future flood risk using different allowances to ensure your assessment of future flood risk is based on best available evidence.

There is no additional information or health warnings for these levels/depths or the model from which they have been produced.

Strategic flood risk assessments

We recommend that you check the relevant local authority's strategic flood risk assessment (SFRA) as part of your work to prepare a site specific flood risk assessment.

This should give you information about:

- the potential impacts of climate change in this catchment
- areas defined as functional floodplain
- flooding from other sources, such as surface water, ground water and reservoirs

About this data

This data has been generated by strategic scale flood models and is not intended for use at the individual property scale. If you're intending to use this data as part of a flood risk assessment, please include an appropriate modelling tolerance as part of your assessment. The Environment Agency regularly updates its modelling. We recommend that you check the data provided is the most recent, before submitting your flood risk assessment.

Flood risk activity permits

Under the Environmental Permitting (England and Wales) Regulations 2016 some developments may require an environmental permit for flood risk activities from the Environment Agency. This includes any permanent or temporary works that are in, over, under, or nearby a designated main river or flood defence structure.

Find out more about flood risk activity permits

Help and advice

Contact the Solent and South Downs Environment Agency team at ssdenquiries@environment-agency.gov.uk for:

- more information about getting a product 5, 6, 7 or 8
- general help and advice about the site you're requesting data for

Appendix C: - Desk Top Ground Conditions

ARUN DISTRICT COUNCIL F/21/24/PL

TQ 00 SW/39
0015 0432

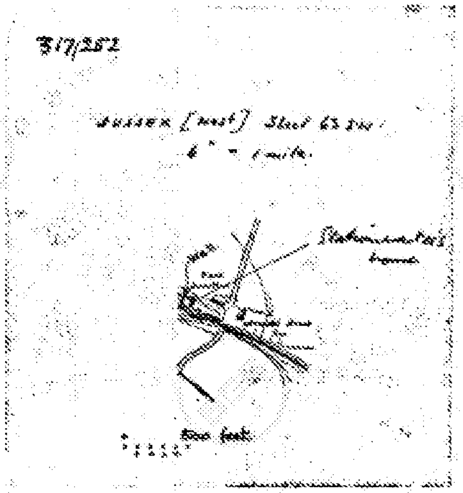
317/252

FORD

Southern Railway Station. Tortington (parish)

Bore 70' Present water level from top of well 13'.
(Southern Railway Water Supplies. Oct 1935.)

6" Sussex 63 SW.



Tracing marked with site of well by Southern Railway.
See correspondence 23/8/41.

Visited. Used to supply station masters house (now pulled down) and station. Disused and no trace at above position, which is now overgrown and is used for storing rails + sleepers. 8.D.4.16. (G.M.) 65.9 Q.R.

Penetrated by:

~~Drift (? Alluvium and Brickearth)~~ (Marine gravels west of Arun...)
Upper Chalk
? Middle Chalk
} 70' (G.M.)

MH
6/75.

DATA Bank

Checked ...

Appendix D: - Greenfield Runoff Rates

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Christian vose
Site name:	8 FORD RD
Site location:	ARUNDEL

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	50.82935° N
Longitude:	0.57679° W
Reference:	252403796
Date:	May 08 2024 12:53

Runoff estimation approach

IH124

Site characteristics

Total site area (ha): 0.1

Methodology

Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	2	2
HOST class:	N/A	N/A
SPR/SPRHOST:	0.3	0.3

Hydrological characteristics

	Default	Edited
SAAR (mm):	742	742
Hydrological region:	7	7
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Growth curve factor 200 years:	3.74	3.74

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited

Q_{BAR} (l/s):	0.2	0.2
1 in 1 year (l/s):	0.17	0.17
1 in 30 years (l/s):	0.45	0.45
1 in 100 year (l/s):	0.62	0.62
1 in 200 years (l/s):	0.73	0.73

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement , which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

Appendix E: - Indicative Attenuation Volumes

Storage Estimate

Return Period (years)	100		OK
Climate Change (%)	50		Cancel
Impermeable Area (ha)	0.100	Update	
Peak Discharge (l/s)	2.000		
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	36.00000	Calc	
Required Storage (m³)	Calc		
from	59		
to	83		
With infiltration (m³)			
from	1		
to	15		

Appendix F: - Personal Flood Plan

Personal flood plan

Checklists to help you prepare for flooding

Before a flood

Actions	Done	Notes
Check what to do before or during a flood		
Sign up for flood warnings		
Check you understand what the warnings mean: • Flood alert • Flood warning • Severe flood warning		
Note your local radio station for travel and weather updates		
Note the phone number for Floodline (0345 988 118)		
Note your local websites and social media for updates		
Check if your insurance covers you for flooding		

Think about how you could stop water entering your home		
Check you know how to turn off your electricity and water		

Move important documents and possessions to a high-up place so that they're safe from flood water. Protect them in a waterproof container. Keep them in a place that is easy to get to in an emergency.

Documents	**Done**	**Notes**
Passport		
Driving licence		
Medical cards		
Insurance documents		
Computers or laptops		
Mobile phones and charges		
Important photos and papers		
Items of sentimental value		

Getting help

Keep a note of who can help you and anyone you can help.

This might be relatives, friends or neighbours. Make a note of what help you might need from them, or what you can do to help them.

Contact details you might need

Insurance	Done	Notes
Home		
Contents		
Vehicle		

Utilities	Done	Notes
Electricity		
Gas		
Water		
Telephone		
Broadband		
Mobile phone		
Media providers		

Finance	Done	Notes
Bank accounts		

Pets	Done	Notes
Kennels		
Carers		
Vets		

Council	Done	Notes
District or unitary		
Town or parish		

Medical	Done	Notes
Doctors		
Hospitals		

Preparing a flood kit

Items you might want to include	Done	Notes
Important documents and contact information		
Warm, waterproof and dry clothing and footwear		

A torch		
Drinking water		
Medicine		
Toys for children		
Baby care items		
Mobile phone or device charger or spare batteries		

Pets and animals

Think about what to do with pets if a flood happens.

Actions	Done	Notes
Where they might go		
Food		
Carriers		
Medicines		

If you are asked to evacuate, many centres will allow you to bring your pet. Put cats or small animals in a carrier or small box.

Immediately before a flood

Actions you can take if you know you are about to be flooded

Actions	Done	Notes
Turn off electricity, water and gas supplies		
Lift curtains over rails above flood water levels		
Use any measures you have to stop water entering your property, such as door guards or air brick covers		
Move important items to safety		
Lift rugs and smaller furniture upstairs or on to tables or worktops if possible		
Get your flood kit together and prepare to move from your home		
Move your pets and vehicles away from flood areas if possible		
Make sure your mobile phone or devices are charged		

When a flood happens

Actions you should take

Actions	Done	Notes

Follow warnings, information and advice issued by authorities		
Do not walk or drive through flood water, as it may conceal hidden dangers		
Do not put yourself or others at risk		
Take your flood kit with you if you are directed to an evacuation centre		
Let your family or friends know you are safe		
Check they are safe too		

After a flood

Actions you can take

Actions	**Done**	**Notes**
Do not return to your home until you are told it is safe to do so		
When returning home, remember that flood water may contain sewage and conceal hidden dangers		
Wear appropriate waterproof or protective clothing when cleaning up		

Contact your insurance company to start the claims process		
If you rent your property, contact your landlord and contents insurance company		
Throw away items damaged by flood water after your property and items have been checked by a loss adjuster		
Throw away items in an appropriate manner		

You may need gas or electricity engineers to check your supply before turning it back on.

Further information

You can find more information from:

- Your local council
- Your local advice centre
- The British Red Cross
- The National Flood Forum

Use this space to make any further notes you think might help you.