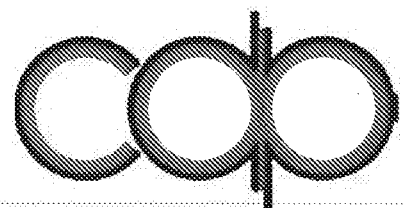




New Road/Brook Lane Rustington, Littlehampton Flood Risk Assessment

On behalf of



Document Control Sheet

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Executive Summary

This Flood Risk Assessment (FRA) has been prepared by Peter Brett Associates LLP (PBA) to support a planning application for the erection of two buildings providing up to 1603 m² of commercial development, plus 156 car parking spaces.

The Environment Agency (EA) Flood Zone map shows the site generally lies within Flood Zone 1 'Low Probability', defined as follows:

Flood Zone 1 'Low Probability' (less than 1 in 1000 (0.1%) annual probability of fluvial or tidal flooding)

The southern and western parts of the site are shown to lie within Flood Zone 2 'Medium Probability' (between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding)

In considering the proposals, the following key aspects have been addressed:

- Vulnerability to flooding from all sources.
- Protection of occupants and users of the new development.
- No increased flood risk to third parties as a result of the development.

The proposed development consists of 'less vulnerable' commercial development. All development is considered appropriate within Flood Zone 1 (ref: National Planning Policy Framework (NPPF) Planning Practice Guidance (PPG) 'Flood Risk and Coastal Change' Table 3).

As it lies generally within Flood Zone 1, the site has no detrimental impact on flood flow routes or floodplain storage capacity, and as the site is already within the area of lowest probability of flooding the Sequential Test has de-facto been passed.

The buildings will be located with ground floors positioned above the EA's Modelled 1 in 1000 year flood level with an appropriate freeboard.

The ground levels on the site will be re-modelled to allow for the raised floor levels and areas of ground lowered to compensate for any losses.

This FRA provides details of the proposed SuDS surface water drainage strategy to demonstrate there will be no significant adverse impact off site. This utilises on-site Sustainable Drainage Systems (SuDS) such as cellular storage and permeable paving, with an outlet control to the adjacent watercourse.

As such, the FRA confirms that the development is safe, it does not increase flood risk and does not detrimentally affect third parties, in accordance with the objectives of the NPPF.

1 Introduction

1.1 Scope of Flood Risk Assessment (FRA)

- 1.1.1 This Flood Risk Assessment (FRA) has been prepared by Peter Brett Associates LLP (PBA), on behalf of our client, CDP, to support a planning application for the erection of two buildings providing up to 1603 m² of commercial development footprint, plus 156 car parking spaces.
- 1.1.2 The FRA focuses on assessing the practical flood risk issues at the site as follows:
- Identification of all the potential sources of flooding at the site (i.e. fluvial, tidal, pluvial, groundwater, surface water);
 - Assessment of the existing flood risk at the site and the potential impact of the proposals;
 - Consideration of the flood risk implications, taking into account the potential allowance for climate change over the lifetime of the development, and the identification of the measures to mitigate flood risk.
- 1.1.3 PBA has many years of experience in, amongst other areas, the assessment of flood risk, hydrology, flood defence and river engineering.

1.2 Policy Context

- 1.2.1 This FRA has been prepared in accordance with the relevant national, regional and local planning policy and statutory authority guidance as follows:
- National policy regarding flood risk as contained within the **National Planning Policy Framework (NPPF)** dated March 2012, issued by Communities and Local Government, and the online **Planning Practice Guidance (PPG)** ('Flood Risk and Coastal Change' section) released in March 2014;
 - West Sussex County Council (WSCC) **Preliminary Flood Risk Assessment (PFRA)**, dated May 2011;
 - Arun District Council (ADC) **Strategic Flood Risk Assessment (SFRA)** dated February 2008;

1.3 Vulnerability and the NPPF Sequential Test

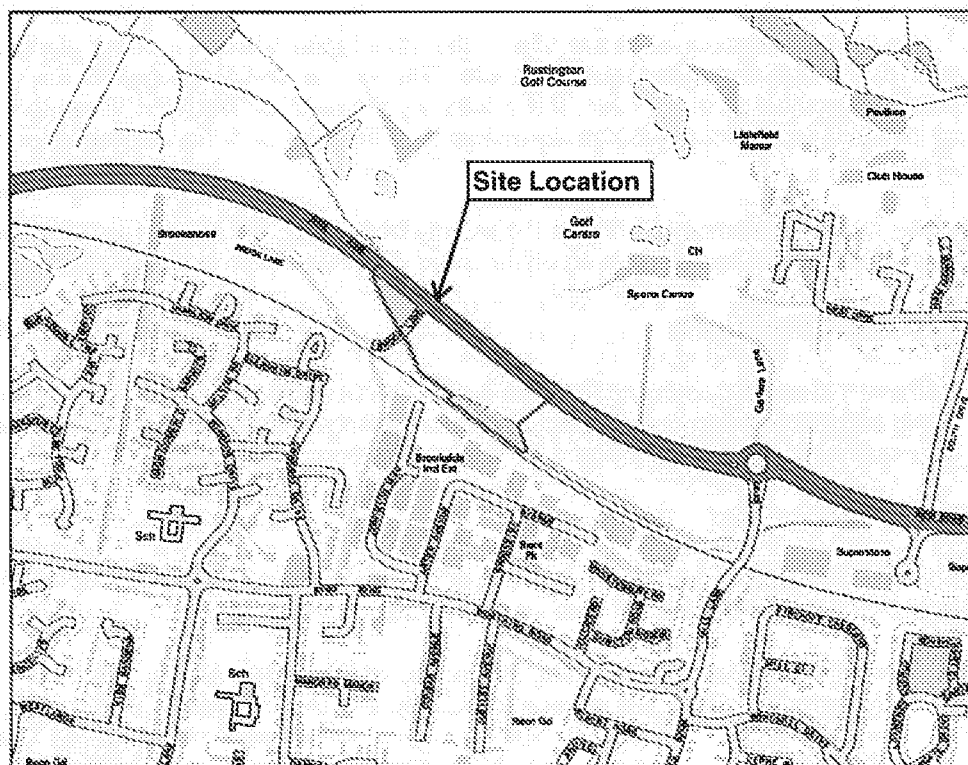
- 1.3.1 The NPPF follows a sequential risk-based approach in determining the suitability of land for development in flood risk areas, with the intention of steering all new development to the lowest flood risk areas.
- 1.3.2 NPPF PPG 'Flood Risk and Coastal Change' Table 2 confirms the '*Flood risk vulnerability classification*' of a site, depending upon the proposed usage. This classification is subsequently applied to PPG Table 3 to determine whether:
- The proposed development is suitable for the flood zone in which it is located, and;
 - Whether an Exception Test is required for the proposed development.
- 1.3.3 The proposed development is classed as 'Less vulnerable' development (*'buildings used for shops & restaurants'*).
- 1.3.4 As set out in NPPF all development is appropriate in Flood Zone 1, and since the buildings are located in the area at lowest probability of flooding it therefore passes the Sequential Test and does not require the application of the Exception Test.

2 Existing Site and Proposals

2.1 Site Description

- 2.1.1 The 3.05 hectare (ha) site is located off Brook Lane, which lies in the northern part of Rustington, Littlehampton, West Sussex; OS grid reference 505,206m E 103447m N, see Figure 2.1 below. The site lies adjacent to the A259 running north of Rustington

Figure 2.1 Site Location



- 2.1.2 The site is approximately 380 metres by 110 metres, with the long axis aligned with the A259, bordering the site to the north.
- 2.1.3 Access to the existing site, from the A259, is provided by Brook Lane
- 2.1.4 The site is currently open land and is effectively 'greenfield' lying in the corridor between the railway line and the A259.

2.2 Proposed Development

- 2.2.1 The proposal is for a planning application for the erection of two buildings providing up to 1603 m² of commercial development footprint, plus 156 car parking spaces. (see Appendix A). All the built development will be located north of the Rustington Stream
- 2.2.2 Access to the site will comprise a 'left in left out' junction with slip roads to the A259 at the existing Brook Lane at the western end of the site. A new roundabout on Brook Lane will lead to a new east west access road and cycleway. The main development will be located north of this new access road up to the A259 embankment. There will be some overflow parking on the southern side of the access road.
- 2.2.3 The development will be located outside the EA's 8m Flood Defence Consent zone on the right bank of the Rustington Stream.

2.3 Topography

- 2.3.1 A topographic survey of the site has been undertaken by Benchmark Land Surveys; see Drawing ref: BM3177/03 in Appendix A. This survey has been updated to OSGPS
- 2.3.2 The survey shows levels ranging from 1.43m AOD along the right bank of the watercourse in the north western corner of the site (bank top is generally 1.70m AOD or higher through the site), to over 5m AOD on the A259 in the north eastern corner. In general, the site ranges from 1.7m AOD to 3.5m AOD

2.4 Watercourses & Existing Flood Defences

- 2.4.1 The nearest watercourse to the site is the Rustington Stream running along the southern boundary of the developed part of the site. This drains land to the east of the site and at this point is classified as 'main river'. It is a tributary of the Black Ditch that flows to the north west of the site (approximately 600m downstream of the site) and this in turn flows into the River Arun.
- 2.4.2 While no flood defence existing in the vicinity of the site, the River Arun (approximately 4km west of the site), has defences on either bank. The River Arun is tidally affected in this reach.

2.5 Ground Conditions

- 2.5.1 A Phase 1 Ground Conditions Assessment has been undertaken for the site (PBA November 2014) and this forms part of the supporting documentation for the planning application. The assessment concluded with regard to ground conditions the following:

2.5.2 BGS Geological Map

The 1:50000 British Geological Survey (BGS) geology map (Sheet 317/332 Chichester and Bognor), indicates the following sequence of strata in the local area:

Superficial – Drift deposits including Raised Beach Deposits, Alluvium and Aeolian Deposits. Alluvium outcrops at the surface across the entire site footprint, with the exception of the far western corner of the site which is shown to be underlain by Raised Beach Deposits (where the alluvium is shown to be absent). The Aeolian Deposits are present at the southern boundary of the site. The Alluvium is described as clays, silts and sands locally organic with gravels. The Raised Beach Deposits are described as sands and gravels. The Aeolian Deposits are described as silts and gravels.

Bedrock – New Pit Chalk Formation (formally designated as being the Middle Chalk Formation) described as principally blocky, white firm to moderately hard chalk with many thin marl beds. The stratum is of Cretaceous Age and is shown to directly underlie the Superficial Deposits within the site area.

2.5.3 BGS Borehole Records

The BGS' web-hosted 'Onshore borehole records' database contains records of 9 boreholes within 250m of the site boundary.

The borehole records show that the area is underlain with topsoil of typically around 0.3m thickness. Five of the boreholes, TQ00SE52, 53, 55, 57 & 58 prove soft to very soft Alluvium to depths of between 2.5m and 5.7m below ground level (bgl). The alluvium is directly underlain by Chalk proven to borehole termination depths of between 5.5 mbgl and 14.7 mbgl.

Boreholes TQ00SE54 & 59 proved soft to firm "Brickearth" considered to be associated with the Aeolian Deposits to 1.5 mbgl, underlain by the New Pit Chalk Formation.

The nearby BGS borehole records appear to confirm the anticipated published geology in the area surrounding the site of Alluvium or Aeolian Deposits overlying the New Pit Chalk Formation.

Groundwater strikes recorded by the BGS logs indicate that there are two groundwater bodies. A shallower perched groundwater body was encountered within the granular Alluvium at depth between 1.0 mbgl and 1.8 mbgl, assumed to be flowing towards the west. A deeper groundwater body within the Chalk strata was encountered between 2.1 mbgl to 4.5 mbgl, assumed to be flowing towards the south or southwest.

2.5.4 Third Party Reports

The Card Geotechnics Investigation (2007) comprised the excavation of 15 trial pits on a site immediately to the east of the proposed development. The following sequence of strata were identified:

- Topsoil recorded as Made Ground across the site between 0.4m and 0.8m thickness.
- The topsoil was reportedly underlain by "Brickearth" at thicknesses of between 0.4m and 1.7m across the majority of the site with the exception of the far southeast corner, described as being *soft to firm yellow/orange brown slightly sandy clay*.
- The topsoil in the southeast corner is directly underlain by Alluvium between 0.9m and 1.2m in thickness, described as being *soft black silty clay containing plant debris*.
- In Trial Pit TP6 the "Brickearth" is underlain by a 2.4m thickness Raised Beach Deposits, being described as *medium dense yellow/orange fine to coarse sand*.
- The New Pit Chalk Formation underlies the entire site at depth. The top of the strata was encountered at depths between 1.0 mbgl and 3.8 mbgl. The chalk is recorded as 'Decomposed Chalk', described as small angular blocks of Chalk set within a matrix of deeply weathered Chalk. The Chalk is described as moderately weak to moderately strong, friable and rubbly Chalk with closely spaced open joints. Generally the Chalk was encountered closest to the surface in the west of the site (typically less than 1 mbgl), and at depths greater the 2 mbgl in parts of the north and northeast of the site.
- Groundwater was encountered within the Chalk Formation only at depths of between 1.8 mbgl and 4.5 mbgl, typically at greater depth towards north of the site and is assumed to flow in a southerly direction.
- 15 No. soil samples were tested for contamination. The results of the contamination testing did not reveal any potential contaminants that exceeded their respective guideline values at the time of the investigation.
- CBR tests were carried out on soil samples from trial pits TP6, TP8 and TP10, which indicated CBR values of between 0.89% to 3.20%.

2.5.5 Summary of Expected On-Site Geology

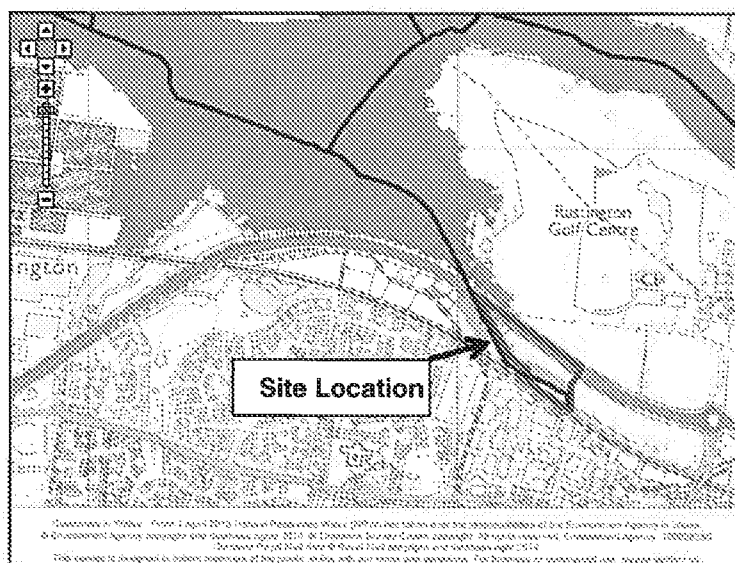
On the basis of the information reviewed as part of the Desk Study it is likely that some parts of the site are underlain by Alluvium, especially along the southern site boundary along the course of Rustington Stream. Remaining parts of the site, away from the southern boundary are likely to be underlain by Aeolian Deposits and possibly by Raised Beach Deposits overlying the New Pit Chalk Formation.

3 Flood Risk

3.1 EA Flood Zone Map

- 3.1.1 The first phase in identifying whether a site is potentially at risk of flooding is to consult the EA's Flood Zone maps. This provides an initial indication of the extent of the Flood Zones, which is refined by the use of a more detailed site-specific level survey and modelled flood levels (if available).

Figure 3.1 EA Flood Map

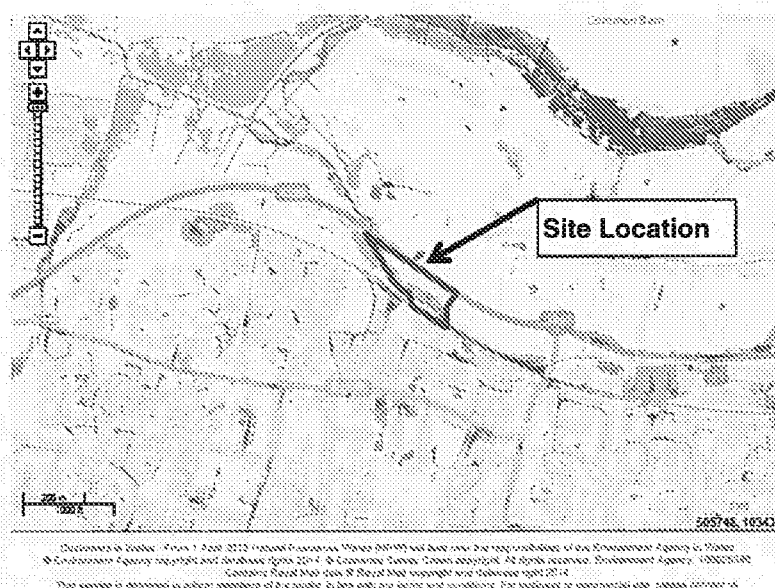


- 3.1.2 The Flood Zone map indicates that the site generally lies within Flood Zone 1 'Low Probability' (no shading – less than 1 in 1000 (0.1%) annual probability of fluvial or sea flooding). Parts of the southern and western areas of the site are shown to be within Flood Zone 2 (light blue shading - between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding)
- 3.1.3 The EA 'Product 4' response dated 11th November 2014 (see Appendix B) also confirms that the site lies within these flood zones.

3.2 EA Surface Water Flood Map

- 3.2.1 The EA 'Surface Water Flood Risk Map' shows where areas could be potentially susceptible to surface water flooding in an extreme rainfall event. It should be noted that these are generated using a relatively coarse methodology whereby rainfall inflows are routed over a ground surface model. As such, the analysis does not take account of any below-ground drainage infrastructure, but does provide a guide to potentially vulnerable areas based on the general topography of an area.
- 3.2.2 This map indicates that the southern and western areas of the site are potentially at risk from surface water flooding with a similar extent to Flood Zone 2 (see Figure 3.2).

Figure 3.2 EA Likelihood of Surface Water Flooding Map

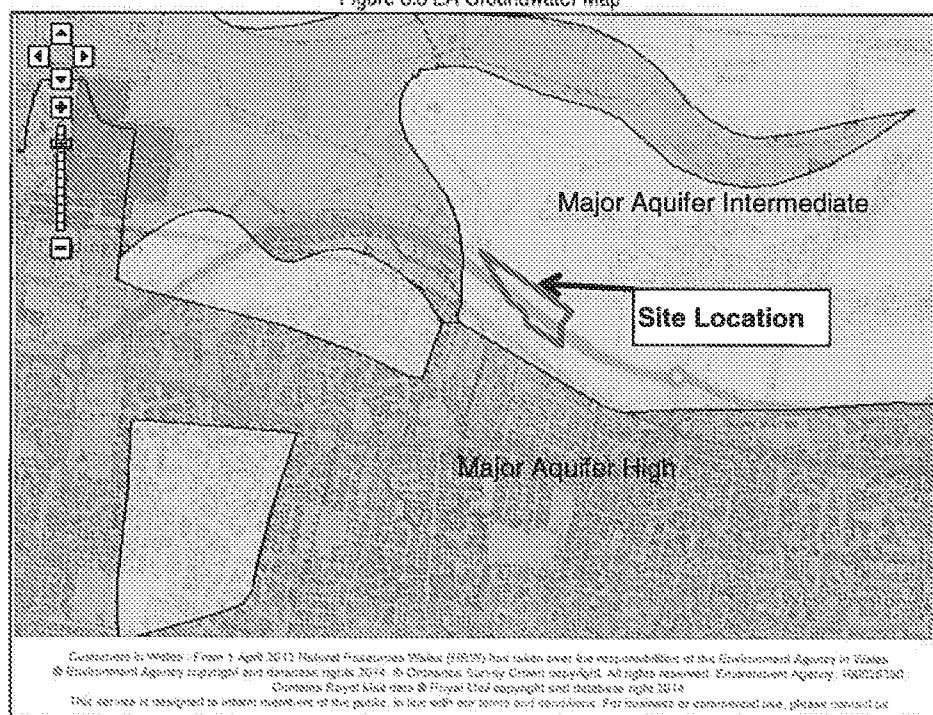


- 3.2.3 The likelihood of flooding from surface water flooding within the site (excluding the watercourse) is generally 'Low' (shaded light blue - less than 1 in 100 (1%) but greater than or equal to 1 in 1,000 (0.1%) chance in any given year.) with small areas partly within 'Medium' (shaded blue - less than 1 in 30 (3.3%) but greater than or equal to 1 in 100 (1%) chance in any given year).
- 3.2.4 However, the majority of the site remains unshaded and therefore within the 'Very Low' likelihood of surface water flooding area (less than 1 in 1,000 (0.1%) probability in any given year).

3.3 Groundwater

- 3.3.1 The EA 'Groundwater Map' shows areas that may be at risk due to groundwater. Figure 3.3 below shows the site to be within a 'Major Aquifer Intermediate' zone but adjacent to the 'Major Aquifer High' zone.

Figure 3.3 EA Groundwater Map



3.4 EA Historic Flood Data

- 3.4.1 The EA confirmed in their Product 4 data that they have no records of the site being affect by previous flood events. The EAs response is shown in Appendix B.

3.5 West Sussex County Council (WSCC) Preliminary Flood Risk Assessment (PFRA)

- 3.5.1 WSCC is defined as a 'Lead Local Flood Authority' ('LLFA') under the Flood and Water Management Act 2010. The first step of the Flood Risk Regulations is for LLFAs to produce a PFRA, providing a high level overview of flood risk from all sources within a local area, including consideration of surface water, groundwater, ordinary watercourses and canals.
- 3.5.2 The PFRA prepared in May 2011 by West Sussex County Council contains a Flood Map for Surface Water as Figure 5.1 (see Appendix C). However, due to the very large scale of the map it is not possible to determine the impact on the site.

3.6 Arun District Council (ADC) Strategic Flood Risk Assessment (SFRA)

The ADC SFRA was released in February 2008 to provide flood risk information:

- so that an evidence based and risk based sequential approach can be adopted when making planning decisions, in line with PPS25;
- that is strategic, in that it covers a wide spatial area and looks at flood risk today and in the future;
- that supports sustainability appraisals of the local development frameworks; and
- that identifies what further investigations may be required in flood risk assessments for specific development proposals.

3.6.1 With regard to development in Flood Zone 1, the SFRA states that:

'A substantial proportion of the Borough is situated within Zone 1 Low Probability and the NPPF does not restrict the nature of development that takes place within this zone. Notwithstanding this, it is important to recognise that all development within the Borough may potentially impact upon the existing flooding regime, and for this reason, a Drainage Impact Assessment will be required for development within Zone 1 Low Probability'.

The provision of the outline surface water drainage strategy described in Section 4 as part of this FRA effectively constitutes the required Drainage Impact Assessment.

3.6.2 The SFRA maps also show the site to be at risk of 1 in 100 year fluvial flooding, from the River Arun, when climate change is taken into account to the year 2056. However, the site is shown to be unaffected by the 1 in 200 year plus climate change tidal extent to the year 2106.

3.6.3 The SFRA also confirms that the site is within a 'Groundwater Emergence Zone' and is at a high risk of ground water flood risk

3.6.4 The SFRA confirms that have been no records of flood events on the site.

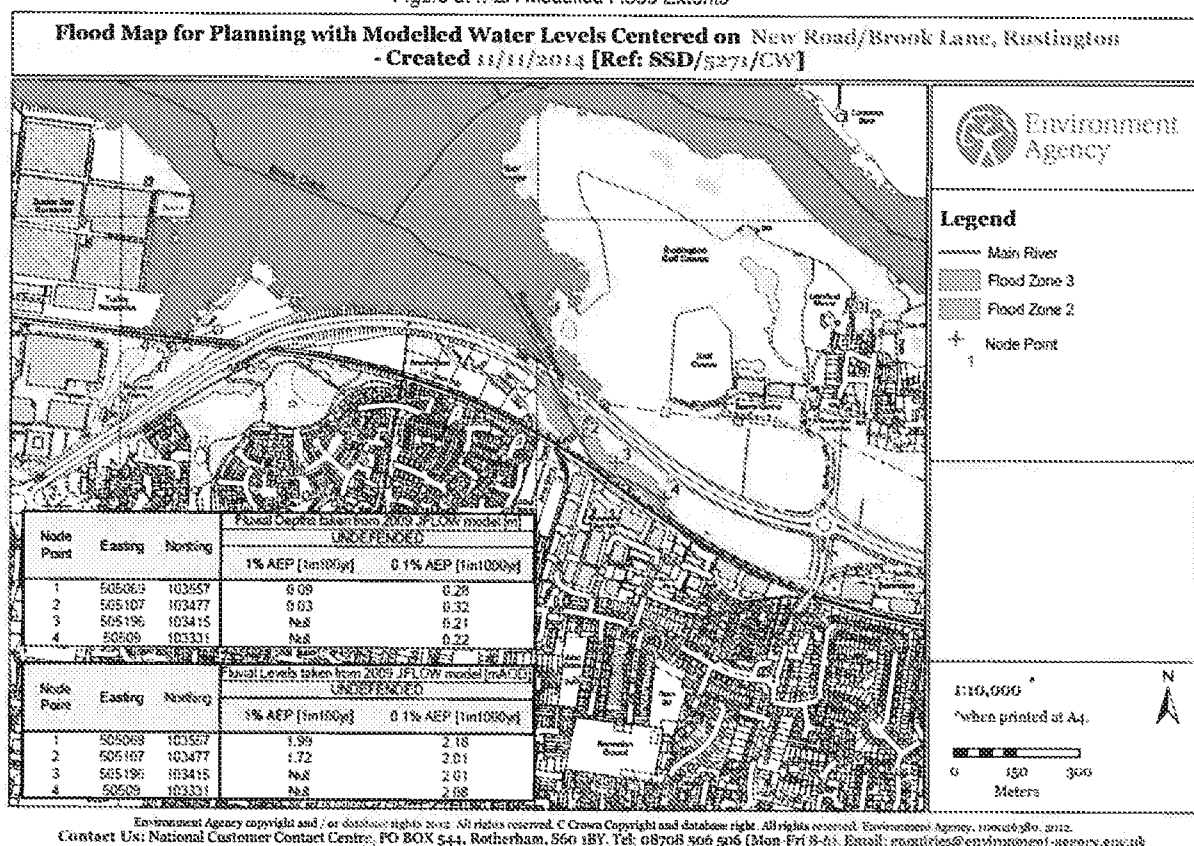
3.6.5 The site is shown to be at a medium to high risk of flooding from the land.

3.6.6 SFRA figures Map C1-F, Map C1-T, Map G1 and Map H, Map L demonstrating the above can be found in Appendix C

3.7 EA Modelled Flood Level Data

3.7.1 The EA has provided flood data from their 2009 JFLOW model as part of their detailed 'Product 4' flood data for the site included in Appendix B. This is considered the best available information with regard to modelled flood levels in the area.

Figure 3.4: EA Modelled Flood Extents



3.7.2 Figure 3.4 shows that the site lies outside the modelled current 1 in 100 (1%) annual probability flood event (dark blue), but the site, in part, is impacted by the 1 in 1000 annual probability event (light blue).

3.7.3 The EA has provided corresponding modelled flood levels at the site from this 'J-Flow' modelling. The highest levels in the area of development (south of Brook Lane) are set out in Table 3.1.

Table 3.1: EA Modelled Flood Levels

Flood Event (Annual Probability)	Flood Level at site (m AOD)
1 in 100 (1%)	1.72 (Point 2)
1 in 1000 (0.1%)	2.08 (Point 4)

3.7.4 The flood levels provided by the EA have been utilised to create more accurate flood extents based on the topographic survey. The 1 in 100 and 1 in 1000 year event extents can be found on PBA 32447/4001/001 in Appendix D. The proposed development has also been shown on this plan.

3.7.5 The plans shows that while parts of the access road and car park are shown to be within Flood Zone 2 'Medium Probability' (between 1 in 100 (1%) and 1 in 1000 (0.1%) annual probability of river flooding) the proposed buildings are shown to be in Flood Zone 1.

- 3.7.6 The EA subsequently sent through available climate change flood level following a request by PBA. These were extracted from the Lower Tidal River Arun Study (LTRAS) carried out in 2010. While undefended climate change flood levels were provided for the year 2115 the EA specifically noted that these levels were not appropriate for use on this site and that the 1 in 1000 year flood level previously provided should be used. This correspondence can also be found within Appendix B.

3.8 Climate Change

- 3.8.1 In considering flood risk to the site, it is necessary to fully consider the potential impacts of climate change for the lifetime of the development within the mitigation measures.
- 3.8.2 The EA's '*Climate Change Allowance for Planners*' guidance (which supports the NPPF) provides contingency allowances for potential sea level rise in Table 1, and for potential increases in peak river flow and rainfall intensity in Table 2 (it is noted that these allowances are consistent with the figures provided previously in the Technical Guidance to the NPPF and, prior to this, in PPS25).
- 3.8.3 The potential for increased flood probability as the result of possible climate change has been addressed through the use of the 1 in 1000 year flood level in the absence of appropriate climate change flood levels to set the ground floor levels. This is in line with the EA recommendation for this site. Suitable climate change allowances in accordance with the NPPF Technical Guidance will be considered of when detailed design the surface water drainage for the site is undertaken.

4 Mitigation Measures

4.1 Proposed Floor Levels

- 4.1.1 Standard requirements for ground floor levels of new development are set out in BS8533:2011 'Assessing and managing flood risk in new development – Code of practice'. This recommends floor levels are set a minimum of 300mm above the modelled 1 in 100 annual probability plus an allowance for climate change flood level.
- 4.1.2 The Environment Agency Product 4 data shows the highest 1 in 1000 year flood level (south of Brook Lane) to be 2.08m AOD adjacent to the site. In the absence of climate change flood levels, this 1 in 1000 year flood levels will be used as a 'proxy' to establish a suitable finished floor level for the units (as recommended by the EA within the Product 4 provision dated 19th November 2014). The finished floor levels will be set at a minimum of 2.4m AOD which is over 300mm above the 1 in 1000 year flood level. This is also 680mm above the 1 in 100 year modelled flood level provided.
- 4.1.3 This target floor level is above the lowest existing ground level within the footprint of the buildings and therefore will require some land raising under and adjacent to the buildings.
- 4.1.4 As the proposals are for 'less vulnerable' commercial use, which are generally assumed to have a shorter life than residential (typically 50-60 years), this freeboard is considered appropriate mitigation to address the flood risk to the site, given the uncertainties associated with the overall hydraulic model and also the uncertainties over the impact of climate change on fluvial flows and sea level rise.
- 4.1.5 Based on the present 1 in 100 year modelled flood level of 1.72m AOD, none of the developed part, (i.e. the buildings, servicing areas, main access road and parking) of the site floods as the flood extent for this event is contained within the 8m strip adjacent to the right bank of the Rustington Stream.

4.2 Flood Storage and Compensation

- 4.2.1 Any new development located in the vicinity of a watercourse should be constructed such that it does not reduce the available fluvial floodplain storage over a site which could potentially cause an increase in flood levels on-site or elsewhere.
- 4.2.2 The overall approach for the development is to raise the buildings to the level set out in 4.1.2 above (i.e. 2.4m AOD) to ensure that the buildings are safe and permit the remainder of the site, including the access road to flood in extreme events. To tie the buildings into the adjacent ground and allow unobstructed access for users, some ground re-modelling will be required adjacent to the two buildings and this land will be raised above the reference flood level. To compensate for this minor loss in flood plain storage, areas within the car parking that are currently above the 1 in 1000 year flood extent will be lowered to between the 1 in 100 and 1 in 1000 year flood levels.
- 4.2.3 The EA data for the present day 1 in 1000 annual probability floodplain has been used for this assessment as a 'proxy' for the 1 in 100 year with an allowance for climate change. The extent of the pre and post scheme flooding is shown on PBA drawing 32447/4001/001 in Appendix B. No ground below a level of 1.70m AOD will be altered to ensure the existing floodplain storage is retained and any changes to the flood storage are restricted to the storage arising from the impact of climate change.

4.3 Surface Water and SuDS

- 4.3.1 The NPPF recognises that flood risk and other environmental damage can be managed by minimising changes in the volume and rate of surface runoff from development sites, and

recommends that priority is given to the use of Sustainable Drainage Systems (SuDS) in new development, this being complementary to the control of development within the floodplain.

4.3.2 The Building Regulations Requirement H3 stipulates that rainwater from roofs and paved areas is carried away from the surface to discharge to one of the following, listed in order of priority:

- a) an adequate soakaway or some other adequate infiltration system,
- b) a watercourse, or where that is not practicable,
- c) a sewer.

4.3.3 The ADC SFRA emphasises the use of SuDS where feasible.

4.4 Existing Drainage Arrangements

4.4.1 The site is undeveloped, and therefore extreme event run-off from the site flows overland into the Rustington Stream following the topography after the capacity of the existing ground and vegetation to absorb rainfall is exhausted. The Phase 1 Ground Conditions Desk Study suggests that the infiltration capacity of the ground is limited.

4.4.2 There is no known drainage infrastructure on the site.

4.5 Consideration of Infiltration Drainage

4.5.1 Based on the aforementioned Building Regulations H3 hierarchy, the preferred method for disposal of surface water from the new development is via infiltration drainage.

4.5.2 However, the Phase 1 Ground Condition Assessment (PBA 2014) concludes the following with regard to infiltration drainage: 'It is probable that the underlying New Pit Chalk Formation is fully saturated and that the ground conditions underlying the site will therefore be unsuitable for infiltration drainage', and therefore the surface water drainage strategy has been developed based on the worst case assumption that infiltration is not a viable technique.

4.5.3 At the detailed design stage, when further intrusive ground investigation will be undertaken this approach will be reviewed.

4.6 Consideration of Discharge to Sewer

4.6.1 Where infiltration drainage or discharge to watercourse is not appropriate, the final preference in the Building Regulations H3 Hierarchy is discharge to a surface water sewer.

4.6.2 There are no public surface water sewers in the area and therefore discharge to surface water sewer is not considered the most appropriate form of disposal of surface water.

4.7 Consideration of Discharge to Watercourse

4.7.1 Where infiltration is not appropriate, the next preference in the Building Regulations H3 Hierarchy is discharge to a watercourse.

4.7.2 A main river watercourses runs through the site and therefore discharge of surface water to watercourse is the most feasible option.

4.8 Outline Surface Water Drainage Strategy

4.8.1 A surface water drainage strategy has been developed for the development based on the 1 in 100 annual probability plus 30% allowance for climate change storm event.

- 4.8.2 The detailed surface water drainage design will be developed at the detailed design stage with consideration of the above, but for the purposes of the FRA an outline strategy has been developed to demonstrate it is feasible for the site to meet NPPF requirements in relation to a SuDS based system for drainage of the site.
- 4.8.3 As infiltration is not considered appropriate based on current evidence, the overall strategy is to attenuate the run-off in below ground storage before discharge into the Rustington Stream via a control structure to limit the discharge.
- 4.8.4 The 'greenfield run-off from the site is estimated (using the ICP SuDS Method) to be:

Table 4.1: Greenfield Run-off Rates

Return Period (Years)	Peak Run Off (l/s/ha)
1	1.6
30	4.3
100	6.0

- 4.8.5 As part of the overall strategy of reducing peak run-off from the developed site and improving water quality, permeable block paving or granular surfacing will be used where ever possible for trafficked areas, draining into the sub-base below. Block paving is anticipated to be used for the main parking areas and circulation routes and in the service accesses and areas subject to satisfactory structural performance of the paving system when used by turning HGVs.
- 4.8.6 The surfacing details of the main access road and cycleway will be confirmed at detailed design stage however are likely to be in 'blacktop' type material.
- 4.8.7 It is anticipated that the drainage will be spilt into three systems: covering the buildings, the parking and circulation and the main access road. In detail the drainage strategy is proposed to consist of:
- Roofwater from the two buildings and the run-off from the garden area for Building B will be discharged into cellular storage located below the service area for Building A and the garden area for the proposed public house (Building B). These will have controlled outlets set at 5 l/s and drain directly to the Rustington Stream. This water will have a low contamination risk as it is not draining an area where vehicles park.
 - The Service Yard for Building A will drain to separately from the building into the main access road drainage system to the south;
 - The eastern half of the main access road and cycle path will drain using conventional 'deep trap' gullies to a piped system that will drain to a ditch/swale located on the southern side of the main access road and the area of overflow parking.
 - The western part of the access road, cycle path and overflow parking will drain directly into a ditch/swale located to the south of the overflow parking, possibly via trapped gullies. The ditch will discharge to the Rustington Stream via a outlet control structure and an oil interceptor.

- e) The central area of parking and circulation will drain via permeable paving into sub-base storage with a controlled outlet at the low point into the ditch/swale on the south side of the access road and overflow parking.

The control devices are anticipated to be 'vortex' type controls to optimise the efficiency of the attenuation storage and reduce the risk of blockage. The total discharge for the 1 in 100 year event from the site is proposed to be limited to 15 l/s via three outfalls, broadly in line with the greenfield run-off for the site.

4.8.8 At detailed design stage, the approach will be to contain all rainfall events up to the 1 in 30 year event within the drainage systems (which will be allowed to surcharge) and for events above this a limited amount of surface flooding will be allowed in non-critical areas of parking and landscaping. This approach is in line with the guidelines set out in Designing for Exceedance (CIRIA Report C635).

4.8.9 The surface water drainage strategy is detailed on the PBA drawing 32447/4001/002 (see Appendix D).

5 Residual Risk

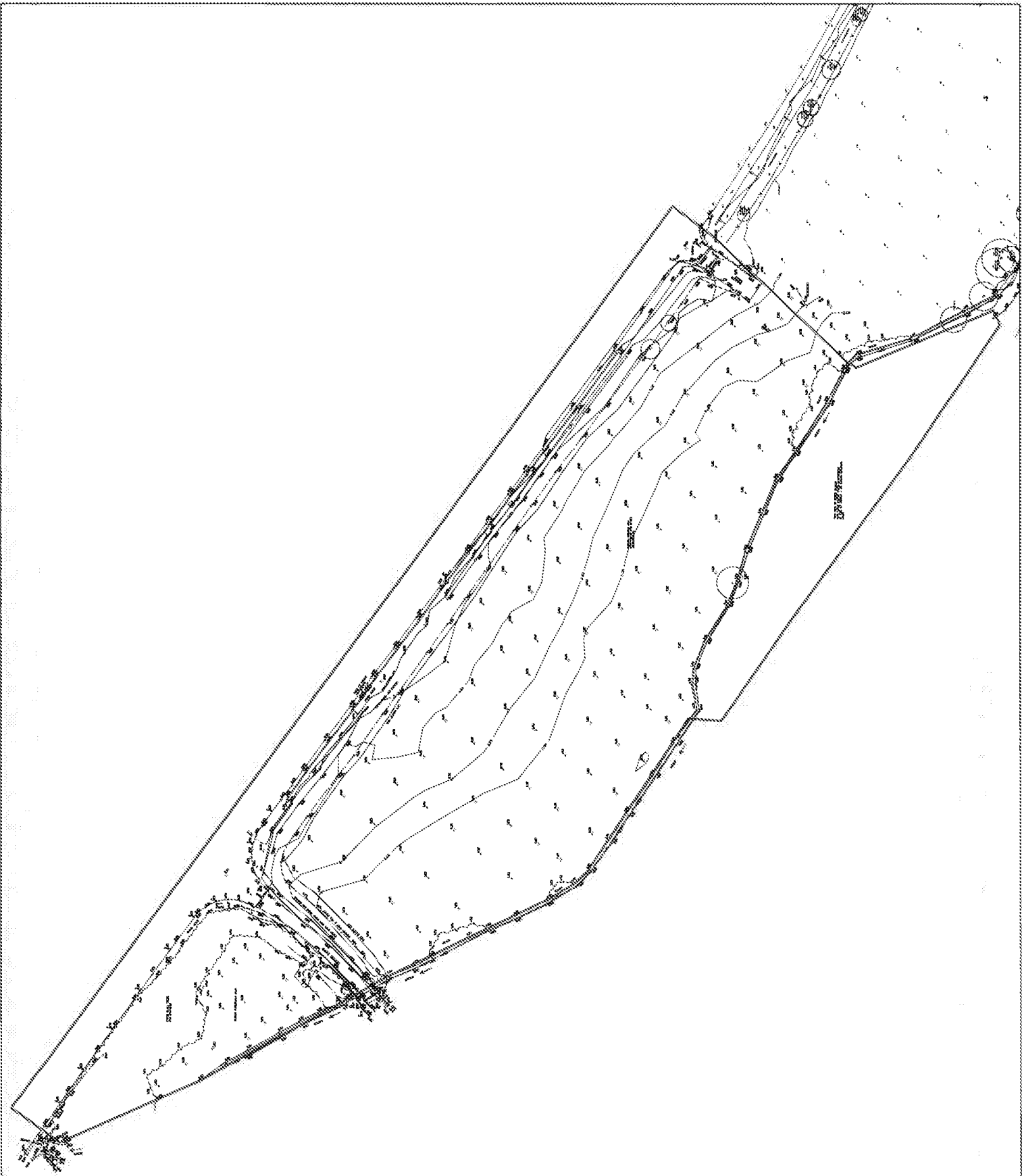
- 5.1.1 It is difficult to completely guard against flooding since extreme events greater than the design standard event are always possible, however, it is practicable to minimise the risk by allowing a substantial freeboard (safety margin) and by using suitable construction and management techniques.
- 5.1.2 The site lies generally within Flood Zone 1 'Low Probability' (less than 1 in 1000 annual probability of river or sea flooding). As such, the flood risk from these sources is considered to be very low. Parts of the southern and western areas of the site are shown to be within Flood Zone 2
- 5.1.3 Finished floor levels will be set over 300mm above the 1 in 1000 year flood level provided by the EA.
- 5.1.4 Overall ground levels will be altered to ensure the existing flood plain storage is maintained.
- 5.1.5 The development will incorporate a surface water drainage strategy designed to the 1 in 100 annual probability plus 30% allowance for climate change storm event and providing on-site below ground attenuation measures with controlled discharges to the adjacent Rustington Stream.
- 5.1.6 The redevelopment of the site will include appropriate landscaping and ground profiles to redirect overland flow routes away from buildings during an extreme rainfall event.
- 5.1.7 As such, the residual risk is considered acceptable for the lifetime of the development.
- 5.1.8 This FRA has been prepared in accordance with the NPPF and Local Planning Policy. Any recommendations regarding floor levels are based on the relevant British Standards (BS8533), the standing advice provided by the EA or based on common practice.
- 5.1.9 However, it should be noted that the insurance market applies its own tests to properties in terms of determining premiums and the insurability of properties for flood risk. Those undertaking development in areas which may be at risk of flooding are advised to contact their insurers or the Association of British Insurers (ABI) to seek further guidance prior to commencing development.
- 5.1.10 PBA do not warrant that the advice in this report will guarantee the availability of flood insurance either now or in the future.

6 Conclusions

- 6.1.1 This FRA has been prepared by PBA to support a planning application for the erection of two buildings providing up to 1603 m² of commercial development, plus 156 car parking spaces.
- 6.1.2 The site is shown on the EA Flood Zone map as falling generally within Flood Zone 1 'Low Probability' (less than 1 in 1000 (0.1%) annual probability of flooding from rivers or the sea).
- 6.1.3 The proposed 'Less vulnerable' development is appropriate in Flood Zone 1, and since the site is already located in the area at lowest probability of flooding it therefore satisfies the Sequential Test and does not require the Exception Test.
- 6.1.4 The ground floor levels of the two buildings will be positioned with an appropriate freeboard above the EA's modelled 1 in 1000 year flood level on the site
- 6.1.5 The redevelopment of the site will include appropriate changes to the ground levels to ensure there is no overall loss of fluvial flood storage on the site.
- 6.1.6 The development will incorporate a surface water drainage strategy designed to the 1 in 100 annual probability plus 30% allowance for climate change storm event and providing on-site attenuation measures with controlled discharges to the adjacent Rustington Stream via three outfalls. This results in a maximum discharge rate from the proposed site of 15 l/s for the 100 year event.
- 6.1.7 The surface water drainage system will be designed to contain the 1 in 30 year event and allow some surface flooding in non-critical areas for extreme events.
- 6.1.8 The landscaping and ground levels will be designed to redirect overland flow routes away from buildings and critical infrastructure during an extreme rainfall event.
- 6.1.9 The FRA confirms that the development is safe, it does not increase flood risk and does not detrimentally affect third parties, in accordance with the objectives of the NPPF.

Appendix A Topographic Survey and Proposal Drawings

1. Topographic Survey Drawing Ref: BM3177/03 by Benchmark Land Surveys
2. Proposal Drawing by Add Architects:
 - 1117-P-11 - Planning: Site Plan



NOTES:
 1. TRACK AND DOTTED LINE DEPICTED EXTENT OF
 2. SCHEDULED PLANNING APPLICATION.
 3. DASHED AREA DEPICTED EXTENT OF OUTLINE
 4. PLANNING APPLICATION FOR UNIT 8.

ASTORIA MIL. MORGAN ASTORIA TIVIER

REF PLAN. 1:3000A1, 1:10000A3

WEW FROM A-259, TRAVELING EAST

Appendix B EA Data

EA Product 4 Data provided:

- Confirmation letter dated 11th November 2014
- Flood map for Planning
- Surface Water Flood Map
- Email dated 19th November 2014 confirming River Arun climate changes levels unsuitable for use in FRA for site
- Lower Tidal River Arun Modelled Levels and Outlines

Tony Hughes
Caversham Bridge House
Waterman Place
Reading
Berkshire
RG1 8DN

Our ref: SSD/5271/CW
Your ref:

Date: 11/11/2014

Dear Sir

Provision of Product 4 for Land at New Road/Brook Lane, Rustington

Thank you for your request to use Environment Agency data. The information is attached.

If you have requested this information to help inform a development proposal, then you should note the detail in the attached advisory text on the use of Environment Agency Information for Flood Risk Assessments / Flood Consequence Assessments.

Supporting Information

This information is provided subject to the enclosed notice, which you should read.

Modelled Flood Levels

The following flood levels have been taken from the 2009 JFLOW Flood Zones Improvement study. These levels represent undefended fluvial flood risk. Please see attached map for node locations.

Flood Defences

There are no formal raised flood defences in this location.

Flood History

We have no records of this site being affected by previous flood events. However, I would suggest contacting Arun District Council for a more comprehensive flood history check.

If you have any queries or would like to discuss the content of this letter further please don't hesitate to contact me.

Yours faithfully

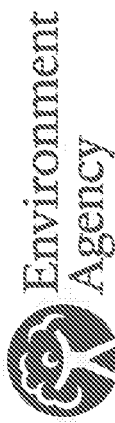
Jon Denman
FCRM Officer
Partnership and Strategic Overview Team – West Sussex



Enc. Detailed FRA/FCA Map, Risk of Flooding from Surface Water map
[Standard Notice]

Flood Map for Planning with Modelled Water Levels Centered on New Road/Brook Lane, Rustington

- Created 11/11/2014 [Ref: SSD/5271/CW]

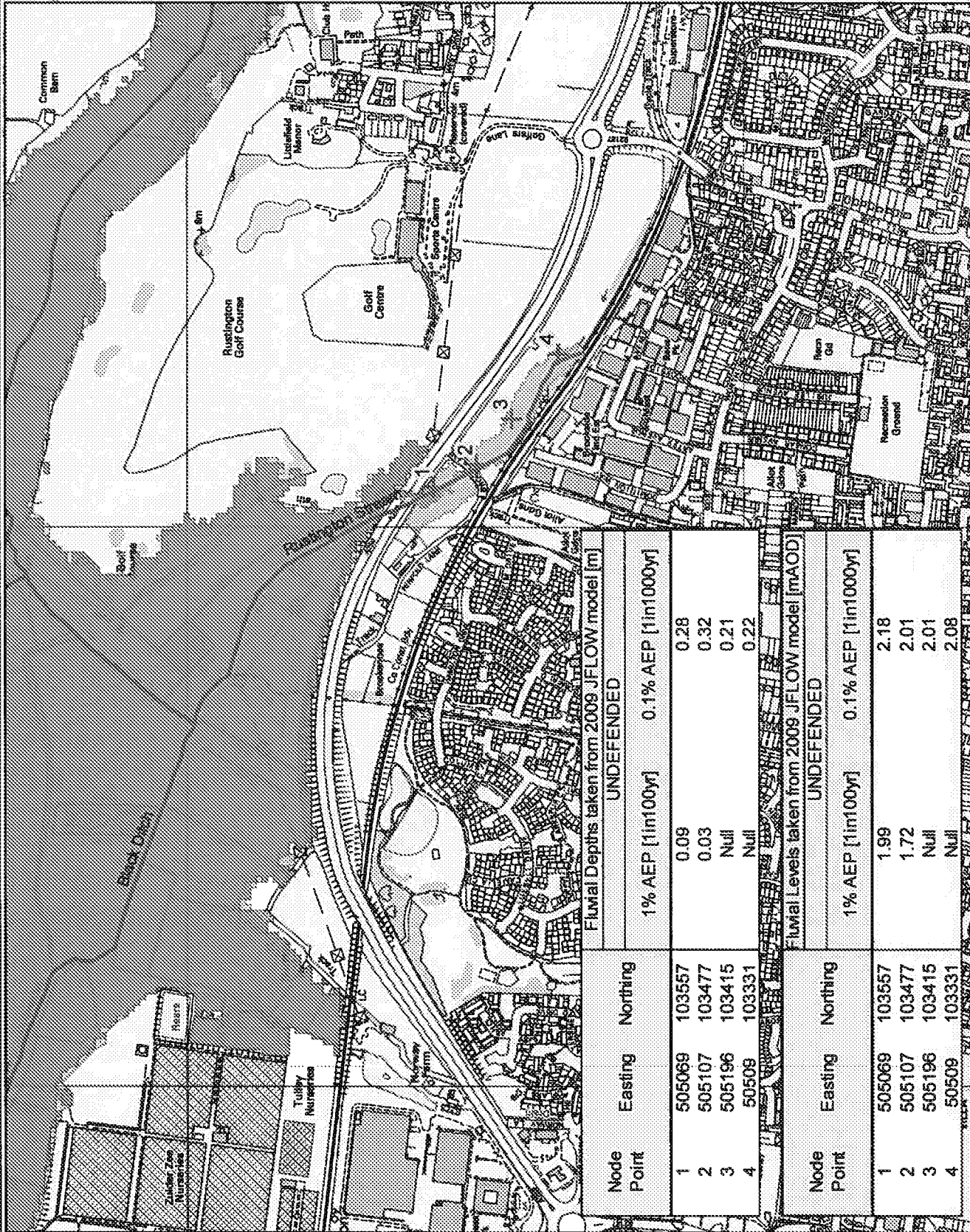


Legend

- Main River
- Flood Zone 3
- Flood Zone 2
- Node Point

1:10,000
*when printed at A4.

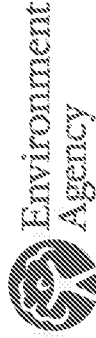
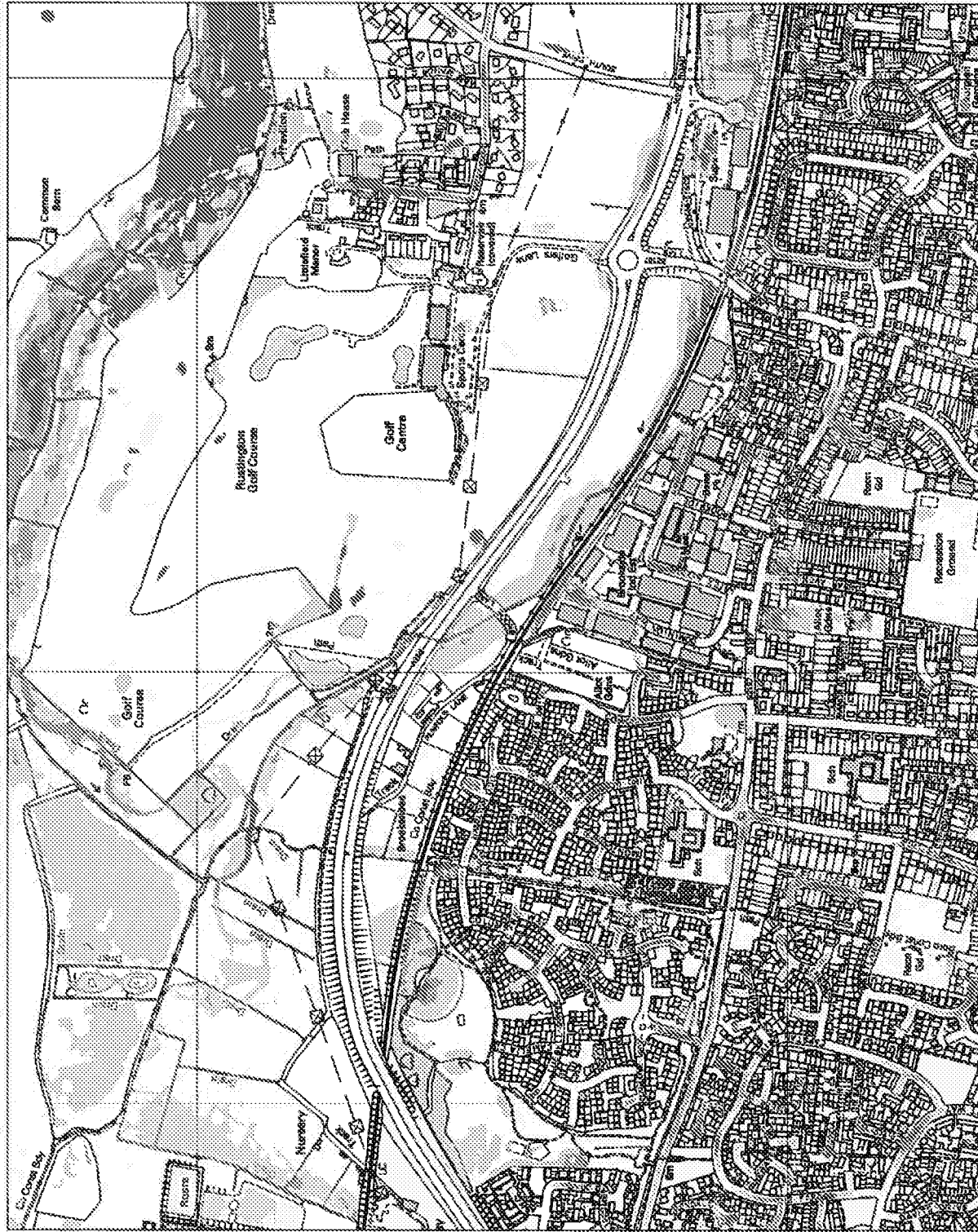
0 150 300
Meters



Node Point	Easting	Northing	Fluvial Depths taken from 2009 JFLOW model [m]	
			1% AEP [1in100yr]	0.1% AEP [1in1000yr]
1	505069	103557	0.09	0.28
2	505107	103477	0.03	0.32
3	505196	103415	Null	0.21
4	50509	103331	Null	0.22

Node Point	Easting	Northing	Fluvial Levels taken from 2009 JFLOW model [mAOD]	
			1% AEP [1in100yr]	0.1% AEP [1in1000yr]
1	505069	103557	1.99	2.18
2	505107	103477	1.72	2.01
3	505196	103415	Null	2.01
4	50509	103331	Null	2.08

Risk of flooding from Surface Water



Scale 1:10,000

N
W E
S

Likelihood of flooding from Surface Water

- High
- Medium
- Low
- Very Low

Likelihood of flooding from Surface Water

- High: Greater than or equal to 1 in 30 (3.3%) chance in any given year
- Medium: Less than 1 in 30 (3.3%) but greater than or equal to 1 in 100 (1%) chance in any given year
- Low: Less than 1 in 100 (1%) but greater than or equal to 1 in 1,000 (0.1%) chance in any given year
- Very Low: Less than 1 in 1,000 (0.1%) chance in any given year

This information is shown on the Risk of Flooding from Surface Water map on our website.

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Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

John Pulsford

From: Denman, Jonathan [redacted]
Sent: 19 November 2014 16:35
To: Tony Hughes
Subject: RE: Our Ref SSD/5271/cw Product 4 Data Request - New Road/Brook Lane, Rustington, Littlehampton
Attachments: P4_Rustington_5271_CW_FloodMap_Levels2.pdf

Hi Tony,

I have attached a plan showing the extents and levels from the 2010 LTRAS modelling. 2070 climate change outputs are not available for the 2D results but 2115 outputs have been included.

Please note that these outputs only account for the tidal/fluvial impact from the Arun. No fluvial inputs have been accounted for the Rustington Stream and so these levels are not suitable for use in a FRA for the site south of the A259. In the absence of a 1in100yr+CC level for the Rustington Stream I would suggest using the 1in1000yr level.

Please let me know if you have any further questions.

Kind Regards
Jon

From: Tony Hughes [mailto:[redacted]]
Sent: 19 November 2014 09:58
To: Denman, Jonathan
Subject: RE: Our Ref SSD/5271/cw Product 4 Data Request - New Road/Brook Lane, Rustington, Littlehampton

Hi Jon

When do you think you will be able to provide the 2070 and 2115 climate change (fluvial and tidal) flood levels and extents, that we discussed last week, from the River Arun study?

Look forward to hearing from you.

Kind regards

Tony

From: Denman, Jonathan [mailto:[redacted]]
Sent: 11 November 2014 12:12
To: Tony Hughes
Cc: SSD Enquiries
Subject: RE: Our Ref SSD/5271/cw Product 4 Data Request - New Road/Brook Lane, Rustington, Littlehampton

Dear Mr Hughes,

Thank you for your email. Please find the requested information attached.

If you have any further questions please don't hesitate to contact me.

Kind Regards
Jon

Jon Denman

Partnership and Strategic Overview - West Sussex
 Environment Agency
 Guildbourne House,
 Chatsworth Road,
 Worthing, West Sussex
 BN11 1LD



Floods happen. Be prepared. Check if you are at risk from flooding and sign up for FREE flood warnings.

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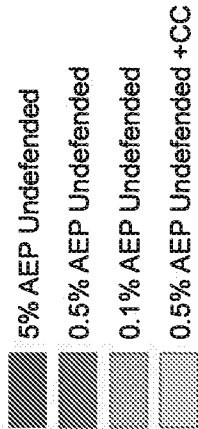
Lower Tidal River Arun Modelled Levels and Outlines Centered on New Road/Brook Lane, Rustington

- Created 19/11/2014 [Ref: SSD/327/CW]



Environment
Agency

Tidal Flood Outlines



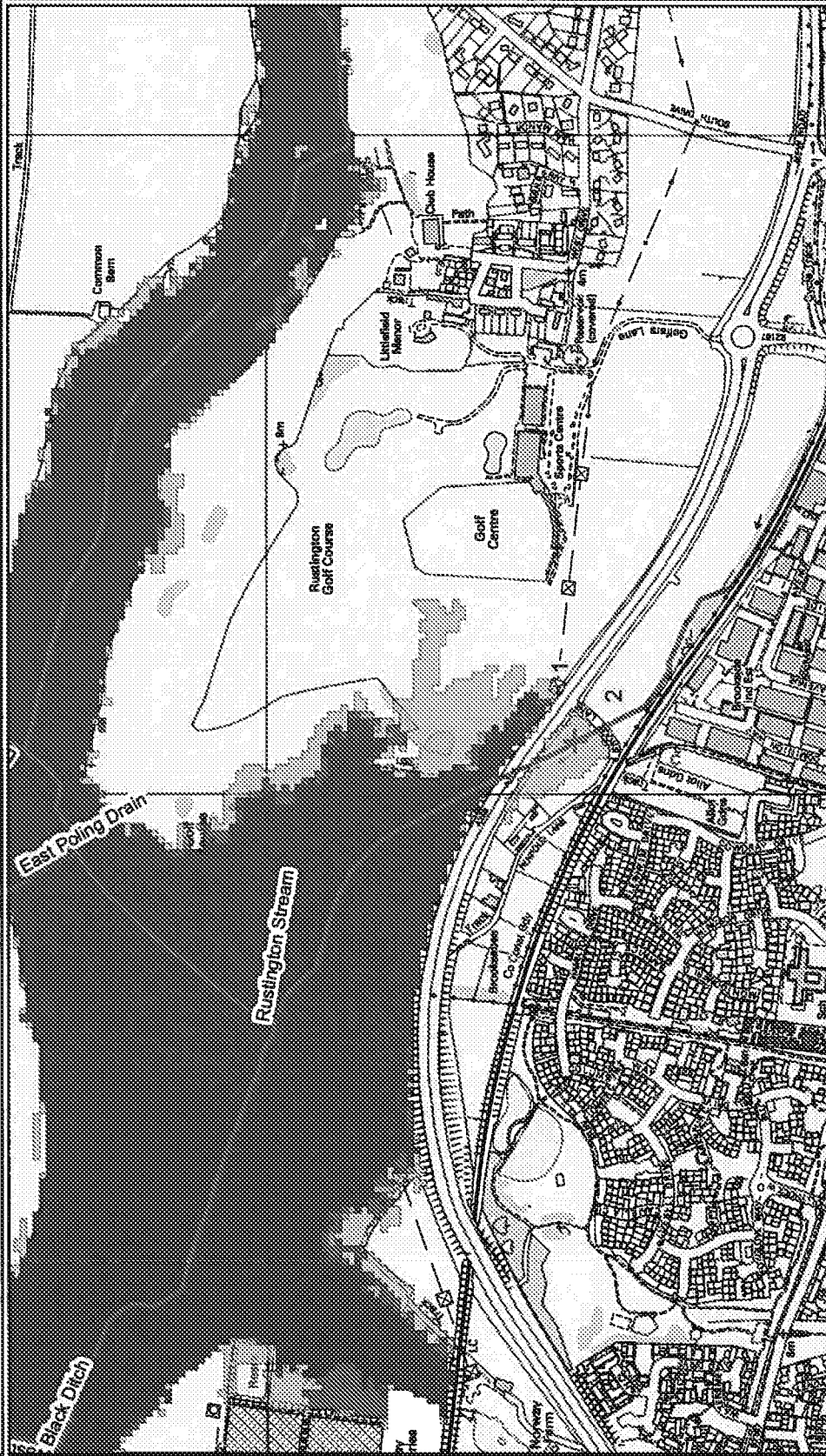
Node Point

Extents and levels do not take account of fluvial inflows for Rustington Stream

Not suitable for use in FRA for site south of A259

1:10,000
*

*when printed at A4.



Node Point	Easting	Northing	FLUVIAL Depths taken from 2010 INFOWORKS RS model [m]		TIDAL Depths taken from 2010 INFOWORKS RS model [m]	
			UNDEFENDED		UNDEFENDED	
1	505108	103604	1% AEP [1in100yr]	0.1% AEP [1in1000yr]	0.5% AEP [1in200yr]	0.1% AEP [1in200yr]
2	505082	103528	0.24 Null	0.49 Null	0.92 Null	0.49 Null
						0.98 0.26
Node Point	Easting	Northing	FLUVIAL Levels taken from 2010 INFOWORKS RS model [mAOD]		TIDAL Levels taken from 2010 INFOWORKS RS model [mAOD]	
			UNDEFENDED		UNDEFENDED	
1	505108	103604	1% AEP [1in100yr]	0.1% AEP [1in1000yr]	0.5% AEP [1in200yr]	0.1% AEP [1in200yr]
2	505082	103528	2.22 Null	2.47 Null	2.90 4.43	2.51 Null
						3.00 1.96

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Contact: U.S. National Customer Contact Center, PO BOX 544; Rotherham, S60 1BY. Tel: 08708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Appendix C Other Documents

WSCC PFRA Figure 5-1 *'Flood Map for Surface Water'*

ADC SFRA Map C1-F *'Actual River Climate Change Extents (with defences)'*

ADC SFRA Map C1-T *'Actual Sea Climate Change Extents (with defences)'*

ADC SFRA Map G1 *'Indicative Risk of Groundwater'*

ADC SFRA Map H *'Historic Flood Events'*

ADC SFRA Map L *'Areas Prone to Flooding from the Land'*

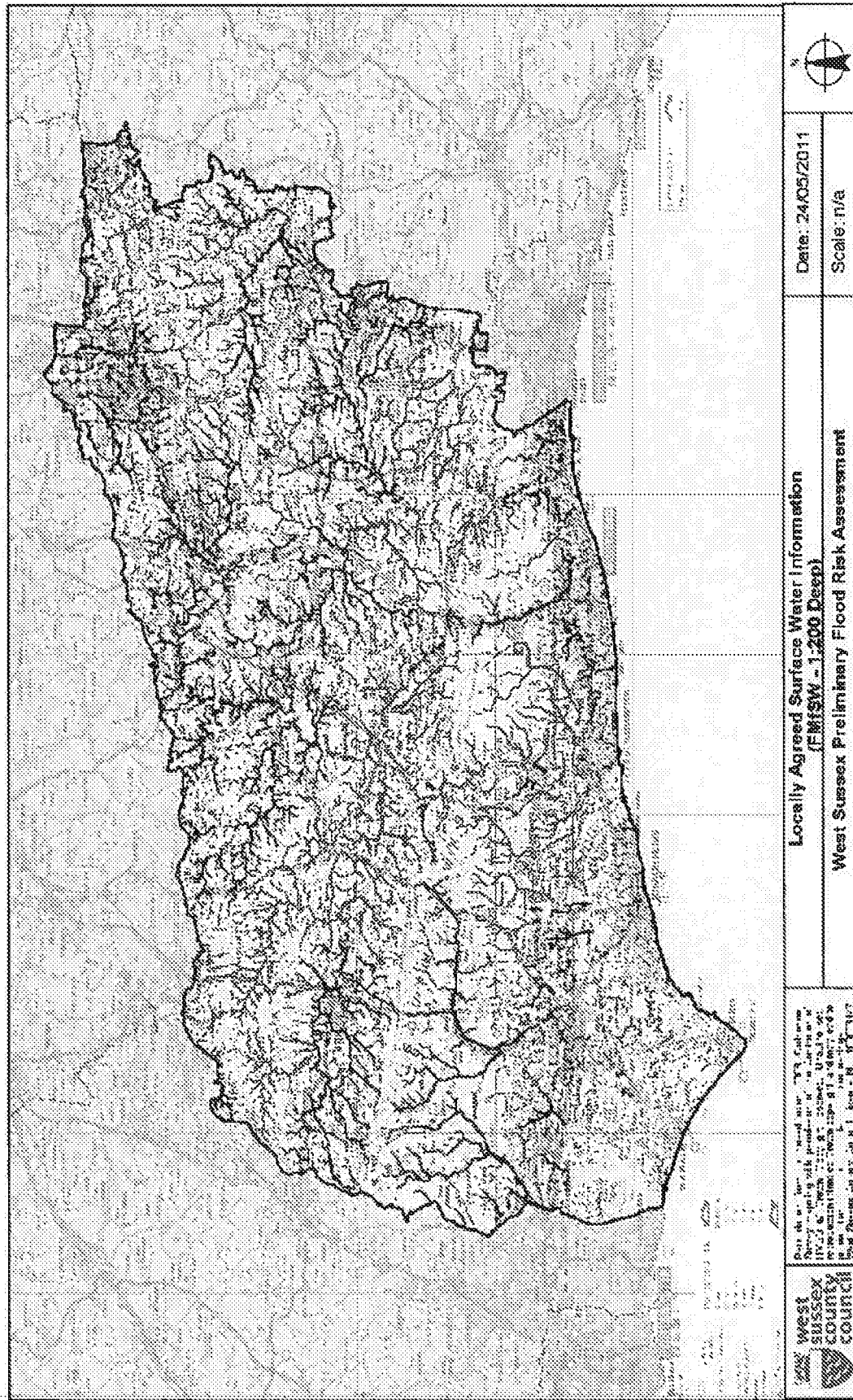


Figure 5.1 Flood Map for Surface Water (FMfSW) deep (>0.3m) flooding model



Notes:

The Arun SFRA is a strategic assessment of flooding. Users of the SFRA should be aware of this when interpreting the information presented. The user is directed to the SFRA reports which outline the uncertainties associated with the studies. Particular attention is drawn to the following:

- Flood extent boundaries are not considered definitive. Land adjacent to these areas may also be at risk.
- Some flooding mechanisms have not been included in the assessment. The coastal risk area is based on advice from LA Engineers and requires further assessment.

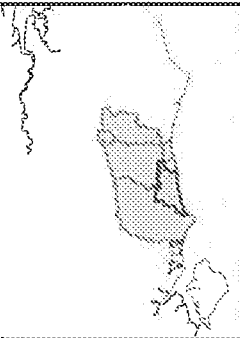
Arun District Council SFRA

Map C1-F - Actual River Climate Change Extents (with defences)



CAPITA SYMONDS

- Legend**
- Arun District Boundary
 - 2050 Climate Change River Flood Extents (1% AEP Defended)
 - 2108 Climate Change River Flood Extents (1% AEP Defended)



Scale at A3: 1:80,000

Date: 31/01/2008

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Map_C1-F ver



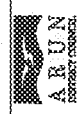
Notes:

The Arun SFRA is a strategic assessment of flooding. Users of the SFRA should be aware of this when interpreting the information presented. The user is directed to the SFRA reports which outline the uncertainties associated with the studies. Particular attention is drawn to the following:

- Flood extent boundaries are not considered definitive. Land adjacent to these areas may also be at risk.
- Some flooding mechanisms have not been included in the assessment. The 'coastal risk area' is based on advice from LA Engineers and requires further assessment.

Arun District Council SFRA

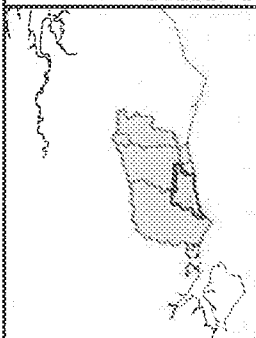
Map C1-T - Actual Sea Climate Change Extents (with defences)



CAPITA SYMONDS

Legend

- Arun District Boundary
- 2056 Climate Change Total Flooding Extents (0.5% AEP, defended)
- 2108 Climate Change Total Flooding Extents (0.5% AEP, defended)
- Coastal Risk Area



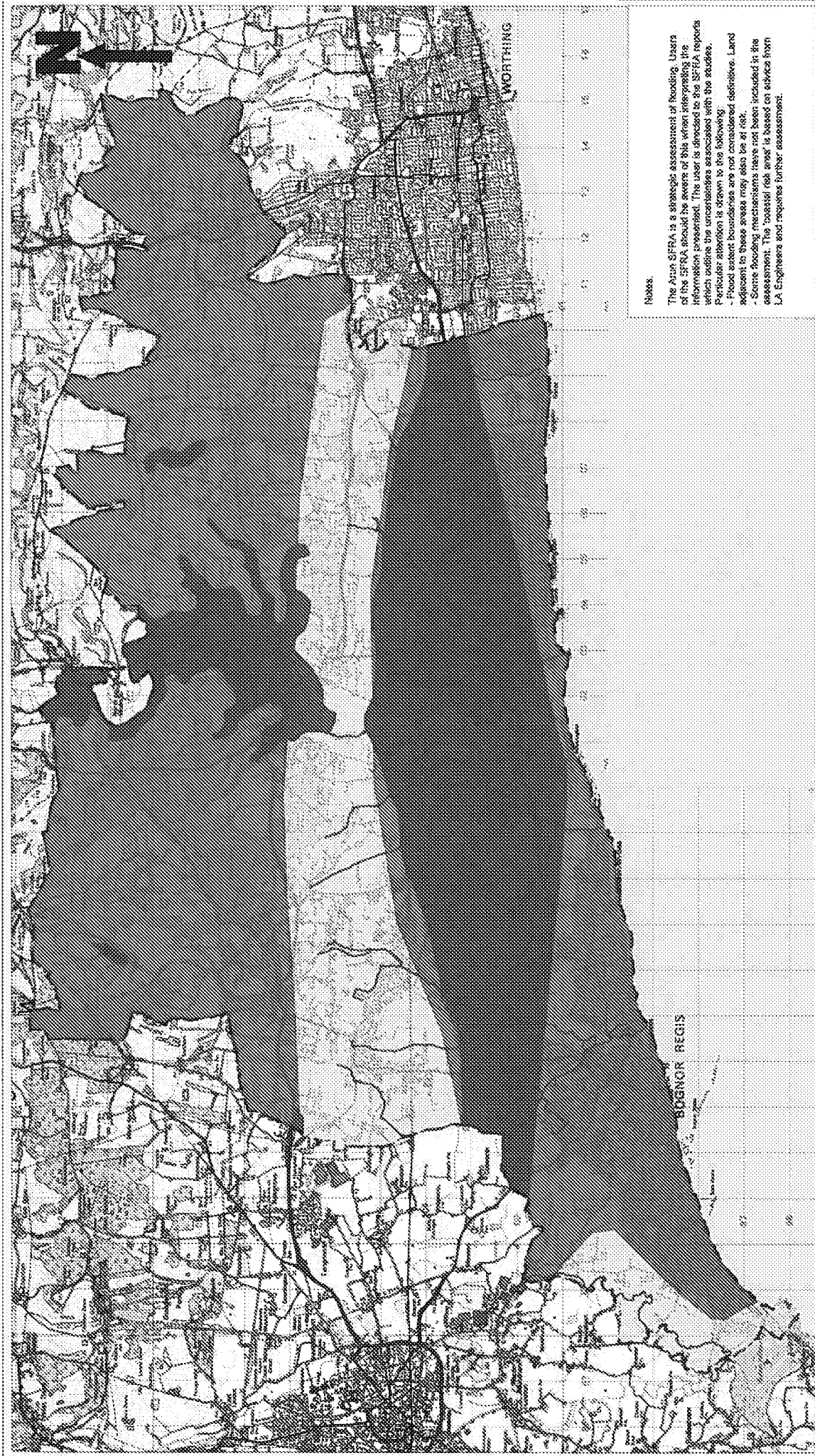
0 2 4
Kilometres

Scale at A3: 1:80,000

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Map... ver



Notes

The Arun SFRA is a strategic assessment of flooding. Users of the SFRA should be aware of this when interpreting the information presented. This user is directed to the SFRA reports which outline the uncertainties associated with the studies. Particular attention is drawn to the following:

- Flood extent boundaries are not considered definitive. Land adjacent to these areas may also be at risk.
- Some flooding mechanisms have not been included in the assessment. The 'coastal risk area' is based on advice from LA Engineers and requires further assessment.

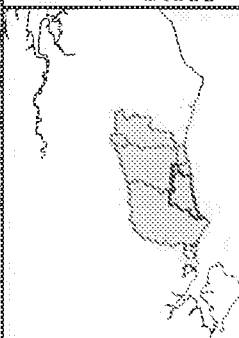
Arun District Council SFRA

Map G1 - Indicative Risk of Groundwater Flooding



CAPITA SYMONDS

- Legend**
- Arun District Boundary
 - Main River
 - Groundwater Emergence Zones
 - Groundwater Flood Risk
 - High
 - Medium



0 2 4
Kilometres

Scale at A3: 1:50,000

Date: 31/01/2008

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Map G1.wor



Notes

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- Flood extent boundaries are not considered definitive. Land adjacent to these areas may also be at risk.
- Some flooding mechanisms have not been included in the assessment. The coastal risk area is based on advice from LA Engineers and requires further assessment.

Arun District Council SFRA

Map H - Historic Flood Events



CAPITA SYMONDS

Legend

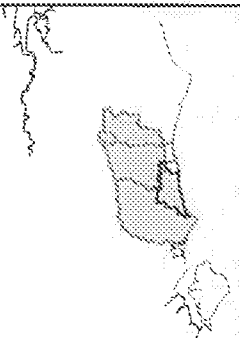
--- Arun District Boundary

Historic Flood Events - Points

- Coastal
- Tidal
- Fluvial
- Surface Water
- Sewer
- Felure
- Unknown

Historic Flood Events - Areas

- Coastal
- Tidal
- Fluvial
- Surface Water
- Unknown



0 2 4
Kilometres

Scale at A3: 1:80,000

Date: 31/01/2008

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Map_H1.doc

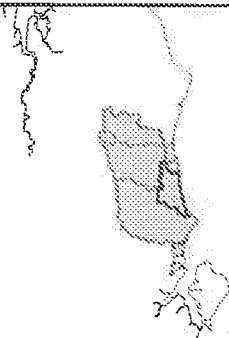


Notes:

The Arun SFRA is a strategic assessment of flooding. Users of the SFRA should be aware of this when interpreting the information presented. The user is directed to the SFRA reports which outline the uncertainties associated with the studies. Particular attention is drawn to the following:

- Flood extent boundaries are not considered definitive. Land adjacent to these areas may also be at risk.
- Some flooding mechanisms have not been included in the assessment. The 'potential risk' area is based on advice from LA Engineers and requires further assessment.

- Legend**
- Arun District Boundary
 - Main River
 - Historic Surface Water Flooding
 - Low to Medium
 - Medium to High
 - Urban
 - Avea
 - Point



Scale at A3: 1:50,000

Date: 31/01/2008

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Map_L_wor

Arun District Council SFRA

Map L - Areas Prone to Flooding from the Land

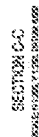
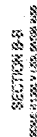
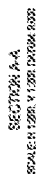


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Appendix D Fluvial Flood Extents and Surface Water Drainage Strategy

PBA drawings (all pre-fixed 32447/4001):

- 001 - Fluvial Flood Extents
- 003 - Sections Sheet 1
- 004 - Sections Sheet 2
- 005 - Surface Water Drainage Strategy



1983:	1 to 10 years prevalence (pct)	1 to 100 years prevalence (pct)
MSD	1	1
1	150	1.5
2	172	2.8
3	165	3.0
4	160	2.6

25

Journal of Management Education 36(8)

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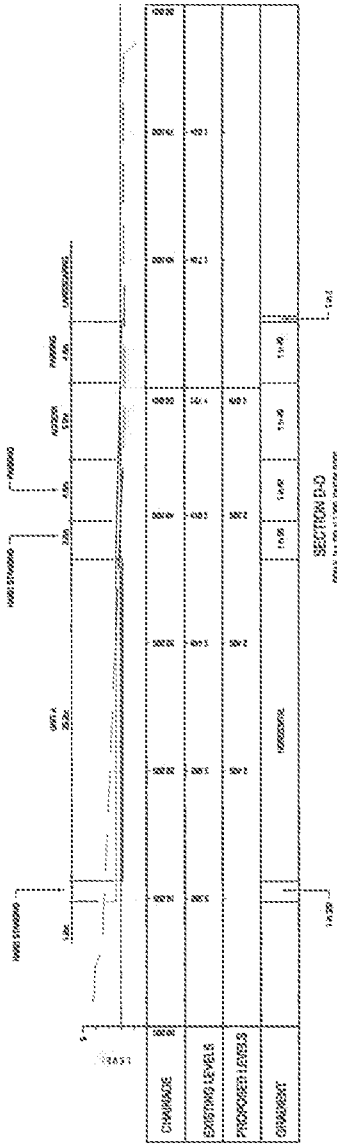
NOVEMBER 2005

NEW ROADBROOK LANE, RUSTINGTON,
LITTLEHAMPTON
1 in 100yr & 1 in 1000yr FLOOD EXTENTS
SECTIONS (SHEET 1 OF 2)

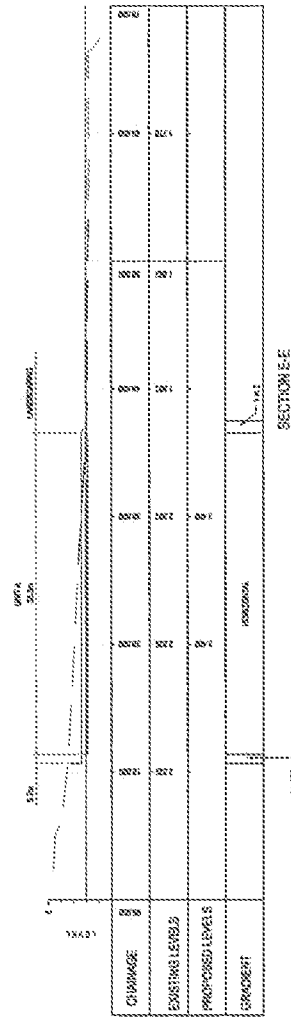
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20011110
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SECTION D-D
SCALE: 1" = 20' (1:20)



SECTION E-E
SCALE: 1" = 20' (1:20)

Station	Existing Level	Proposed Level
1+00	100.00	100.00
1+20	100.00	100.00
1+40	100.00	100.00
1+60	100.00	100.00
1+80	100.00	100.00
2+00	100.00	100.00
2+20	100.00	100.00
2+40	100.00	100.00
2+60	100.00	100.00
2+80	100.00	100.00
3+00	100.00	100.00
3+20	100.00	100.00
3+40	100.00	100.00
3+60	100.00	100.00
3+80	100.00	100.00
4+00	100.00	100.00

SEE

SEE

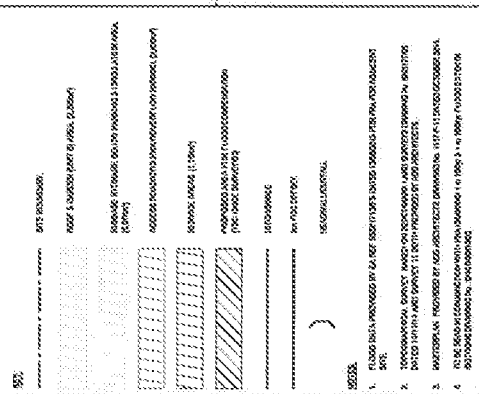
SEE

SEE

1. FLOOD DATA PROVIDED BY U.S. ARMY CORPS OF ENGINEERS FOR THE PROJECT SITE.
2. FLOOD PROTECTION DESIGN BASED ON 100-YEAR FLOOD PROTECTION DESIGN.
3. FLOOD PROTECTION DESIGN BASED ON 100-YEAR FLOOD PROTECTION DESIGN.
4. FLOOD PROTECTION DESIGN BASED ON 100-YEAR FLOOD PROTECTION DESIGN.
5. FLOOD PROTECTION DESIGN BASED ON 100-YEAR FLOOD PROTECTION DESIGN.

FOR INFORMATION	
NEW ROAD/BROOK LANE, RUSTINGTON, LITTLEHAMPTON	
1 in 100yr & 1 in 1000yr FLOOD EXTENTS	
- SECTIONS (SHEET 2 OF 2)	
CDP	
Sheet	
32647/410/1004	
A	



[illegible]

NEW ROAD/BROOK LANE, RUSTINGTON,
LITTLEHAMPTON

SURFACE WATER DRAINAGE STRATEGY



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