ADUR & WORTHING
PLANNING SERVICES

PLAN	AWDM/0910/13
DATE VALID	- 7 AUG 2013

Norfolk House, Shoreham-by-Sea

Flood Risk Assessment Report

October 2011
Final

Issue No 1
42437

Project Title:	Norfolk House, Shoreham-by-Sea
Report Title:	Flood Risk Assessment
Project No:	42437
Report Ref:	
Status:	Final
Client Contact Name:	Richard Gillam
Client Company Name:	
Issued By:	Dixon Hurst Kemp Ltd Britannia House 336 Kingsway, house East Sussex BN3 4 LW Tel (01273) 421444 Fax (01273 420008 Email: hove@dhk.co.uk Website: www.dhk.co.uk

Document Production / Approval Record

Issue No: 1	Name	Signature	Date	Position
Prepared by	Jethro Sifflet		27/10/2011	Senior Civil Engineer
Checked & Approved by	Trevor Hayward		27/10/2011	Associate

Document Revision Record

Issue No	Date	Details of Revisions
1	27th October 2011	First Issue
2		

COPYRIGHT

© This Report is the copyright of Dixon Hurst Kemp Ltd. Any unauthorised reproduction or usage by any person other than the addressee is strictly prohibited.

CONTENTS

Section **Page No**

1. EXECUTIVE SUMMARY 1

2. INTRODUCTION 2

2.1. Scope of the report 2
2.2. Regulatory Guidance 2

3. SITE LOCATION & DESCRIPTION 3

3.1. Location 3
3.2. Description 3
3.3. Topography 3
3.4. Existing Surface Water Drainage 4

4. GEOLOGY, HYDROGEOLOGY AND HYDROLOGY 4

4.1. Geology 4
4.2. Hydrogeology 4
4.3. Hydrology 4
4.4. Existing Flood Defences 5

5. PROPOSED DEVELOPMENT 6

6. DRAINAGE STRATEGY 7

6.1. Surface Water 7
6.2. Foul Water 8

7. DRAINAGE DESIGN 8

7.1. Pre & Post Development Peak Rate of Runoff 8
7.2. Foul Water 9

8. ASSESSMENT OF FLOOD RISK 9

8.1. Introduction 9
8.2. Assessment of Flood Risk 10
8.3. Flood Zone 11
8.4. Site Specific Flood Risk Assessment 11
8.5. Potential Sources of Flooding 11
8.6. Tidal and Fluvial Flooding 12
Tidal Flooding 12
Fluvial Flooding 13
8.7. Flooding from Groundwater 13
8.8. Flooding from Sewers 13
8.9. Flooding from Reservoirs, Canals and Other Artificial Sources 13

CONTENTS

Section		Page No
8.10.	Surface Water	14
9.	**MITIGATION MEASURES TO ALLEVIATE/REDUCE FLOOD RISK**	**14**
9.1.	Floor Levels	14
9.2.	Dry Access and Safe Refuge	14
9.3.	Emergency Planning	15
9.4.	Impact of Site Displaced Water	16
9.5.	Proposed Flood Defences	16
9.6.	Proposed Storm Water Runoff and SUDs	17
9.7.	Flood Impact on Existing and Proposed Drainage	17
10.	**SEQUENTIAL TEST**	**18**
11.	**EXCEPTION TEST**	**18**
11.1.	Part A – Wider Sustainability	18
11.2.	Part B – Brownfield Land	18
11.3.	Part C – Safety	19
12.	**RESIDUAL RISK**	**19**

Appendix A- Client Suppied Data

1. EXECUTIVE SUMMARY

The Environment Agency has determined that the site has a 1 in 200 year or greater annual probability of flooding from the sea (0.5%) in any year. On this basis the site is classified under PPS25 as being within a Zone 3a High Probability.

In line with PPS 25 the EA has stipulated that the flood level during a 1 in 200 year surge tide event has been calculated as being 5.27m AOD, based on revised figures issued by the Environment Agency for climate and sea level changes up to year 2115.

The EA define a surge tide flood event as being a 3 tidal phase event, ie 3 low tides and 3 high tides, in a 36 hour period.

The Worthing Borough Council and Adur District Council Strategic Flood Risk Assessment `SFRA` Level 1 & 2, highlight the risk of breach and overtopping of the flood defences by 2115 and classified the hazard as medium to high risk. However the policy of the Environment Agency in the Shoreline Management Plan (SMP) is to `hold the line' maintaining the coastal defences until 2115.

The site has been designed to cater for these flood levels ensuring that the proposed new residential/commercial accommodation areas on the site are situated above the maximum anticipated flood level.

The ground floor areas of the development will be below the anticipated flood level, but are intended to be constructed to be flood resilient, thus enabling the ground floor to be swiftly cleaned up following a flood event, minimising the disruption to the business within the site.

The introduction of a residential/commercial use into a Zone 3a site would require a dry access to be provided to and from the site, in order to address the EA's concerns regarding placing an additional burden on the emergency services. Due to the level of flooding anticipated during a tidal flood event, a dry access will only be available within the 6hour periods of no flooding. However safe refuge will be from the first floor upward for the duration of the flood event.

No additional burden on the emergency services Is posed through the introduction of the development into this flood risk zone at this location.

No issues arise from the proposed development which could be deemed to have a detrimental effect on the adjacent sites, such as displaced flood volume or additional surface water runoff from the site.

In line with PPS25 the Sequential and Exception Tests have been applied to the development, and the proposed development in our opinion meets the requirements of these conditions.

On this basis the flood risks determined for the development are considered to be able to be addressed in full through the proposed design and levels, or managed through the Emergency Plan in consultation with the local emergency planning organisation and

emergency services

2. INTRODUCTION

Dixon Hurst Kemp Ltd have been commissioned by Richard Gillam to undertake a site specific Flood Risk Assessment (FRA) for the proposed redevelopment of 79 Norfolk House, High Street, Shoreham- by- Sea, West Sussex.

This Flood Risk Assessment is in support of a revised planning application for a mixed use Residential/Commercial development proposed by Mr. Richard Gillam. The site already benefits from a Flood Risk Assessment which formed part of the supporting documentation for an approved Planning Application No.ADC/252/09 for the construction of a 72 room hotel granted by the Adur District Council.

The aim of this report is to ensure that implementation of the proposed development does not increase flood risk at the site or elsewhere, and that the corresponding surface water run-off design strategy avoids, reduces and delays the discharge of rainfall to public sewers and watercourses in accordance with Planning Policy Statement 25 (PPS25).

2.1. Scope of the report

The scope of this report is to report on the findings of an assessment of flood risk for the proposed development in accordance with Planning Policy Statement 25 (PPS25) and to demonstrate the drainage strategy for the proposed development i.e. how surface and foul water will be collected and disposed of. The objectives of this report are as follows:

- To identify and quantify flood risk to and from the site
- To outline possible approaches to mitigating flood risk on site
- To outline the drainage strategy for the site

2.2. Regulatory Guidance

Planning Policy Statement 25 'Development and Flood Risk' was introduced by the Government in December 2006. It sets out the Government's policy with respect to these issues and has to be taken into account by all relevant statutory bodies from regional to local authority planning departments. The aim is to ensure that flood risk is taken into account at all stages of the planning process in order to avoid inappropriate development in areas that are at risk of flooding.

A risk based approach is utilised whereby sustainable development is delivered by a combination of appraisal, management and reduction of a perceived flood risk. In addition a partnership approach is encouraged to allow effective working with the Environment Agency and other operating authorities to utilise available information and expertise so that plans are effective and applications can be delivered expeditiously.

3. SITE LOCATION & DESCRIPTION

3.1. Location

The development site is located on the southern side of the High Street, Shoreham-by-Sea, West Sussex, BN43 6RE. The approximate National Grid Reference for the centre of the site is 521347,105010. See the site location plan in Figure 1 below.

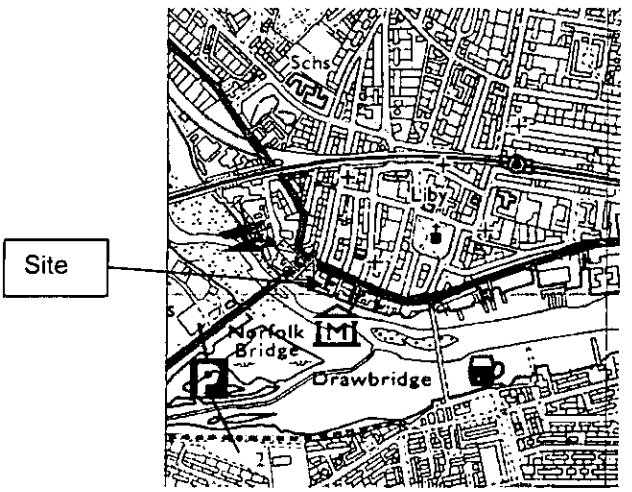

Figure 1 – Site Location Plan

3.2. Description

The site is a Brownfield site and is situated to the rear of 63-77 High Street within Shoreham-by-Sea. The site is currently occupied by a single three storey high office building named Norflok House which houses the Department of Works and Pension (DSS) office, 8No.garages and associated private access road, car parking areas and walkways.

The site is an irregular shaped parcel of land with dimensions of approximately 58m and 29m along its length and width respectively. The site has a red line boundary area of 1700m^2 (0.17ha) and is bounded by A259 High Street to the north, the River Adur to the south, the Bridge Inn to the West and a concrete slipway and Riverside House to the east.

A quay retaining wall with ground anchors positioned within the site forms the boundary line with the River Adur. The sheet pile retaining wall is topped with a concrete beam, and has a final level of approximately 4.0m AOD.

3.3. Topography

The Topographic survey indicates the levels across the site generally falling from north to south from the High Street at 5.15m AOD to the River Adur at 4.00m AOD over 49 metres (i.e. at a gradient of approximately 1:45).

Norfolk House has a finished ground floor level of 4.21m AOD and the 8No garages have varying floor levels from 4.06-4.54m AOD. See Appendix A.

3.4. Existing Surface Water Drainage

The existing site is regarded as totally impermeable, based on the extent of hard paved surfaces and buildings, as shown on the survey plan in the Appendix.

The site's impermeable area is approximately 1700m^2, which results in an existing surface water runoff from the whole site in the order of 25.3 l/s, based on a rainfall intensity of 50mm/hr. This approximate runoff generally equates to the surface water runoff for a 1 in 2 year return storm even.

A positive drainage system is evident on site from inspection of the site survey, with gullies and manholes annotated. It is assumed that based on the site's proximity to the River Adur that the storm water runoff from the site discharges to this watercourse. The discharge to the river is assumed to be un-attenuated.

4. GEOLOGY, HYDROGEOLOGY AND HYDROLOGY

4.1. Geology

British geological survey (BGS) map reference (Sheet 318, 1:50,000) for the area indicate that the site is underlain by head deposit (Clay with flints).

4.2. Hydrogeology

The Environment Agency Groundwater Vulnerability Map indicates that the site is not located within the extent of Aquifer Protection Zone. There is no information to date on any recorded Environment Agency licensed groundwater abstraction points within close proximately of the site.

4.3. Hydrology

The nearest hydrological feature to the site is the River Adur. The Environment Agency has divided the River Adur CFMP area into five hydrological sub-catchments that can be studied in more detail. These sub-catchments are the Adur East Branch, Adur West Branch, Lower Adur, Ferring Rife and Teville Stream.

The site is located in the tidal reach of the Lower Adur sub-catchment. The River Adur runs along the site southern boundary and outfall into the English Channel approximately 1500m southeast of the site. There are flood defence embankments on both sides of the River Adur along the whole of the section of the river influenced by tide. The protective harbour arm at Shoreham reduces the severity of surge tides travelling up the river.

The Environment Agency and SFRA flood maps confirm that the development site lies within Flood Zone 3 as defined by PPS25 which means that the site has a high risk of being flooded from tidal or coastal sources. This zone comprises of land assessed as having a 1 in 100 year or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year ignoring the presence of flood defences Figure 2 below.

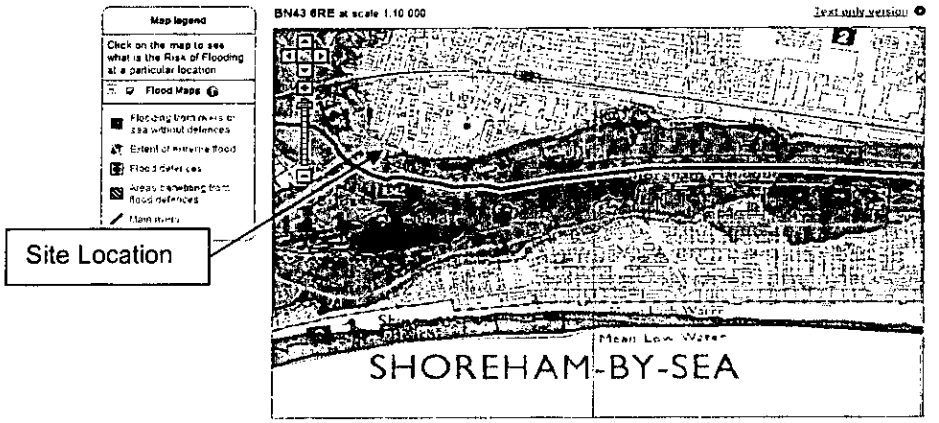

Figure 2 Environment Agency Flood Maps

(Reproduced from Environment Agency digital map data
© Crown copyright 2011All rights reserved.

4.4. Existing Flood Defences

The site benefits from the presence of coastal defences which reduces flood risk. The Worthing Borough Council and Adur District Council 'SFRA' Level 1 & 2, confirm the defences form part of the Shoreline Management Plan (SMP) to maintain the coastline for the next 100 years. The SMP covers the coastline area between Beachy Head to Selsey Bill.

Coastal defences are in the main part constructed to offer protection from the 0.5% annual probability of exceedance event (1 in 200 year event). The type of tidal defence along the Adur estuary varies. The standard of protection along the River Adur ranges from 0.2% annual probability event (1 in 500 year chance of flooding) with some areas having a considerably lower standard for the remainder of the defences.

The site is also defended from flooding by a sheet pile retaining quay wall with ground anchors constructed on the site's western boundary with the River Adur.

The Environment Agency has recommended that a structural assessment of the existing river wall (flood defence) be undertaken to determine the structural integrity of the wall and its remaining life expectancy. The wall will be required to provide flood defence to cater for a life span of 100 years and will need to be maintained and improved over time

to mitigate the effects of climate change,

The Environment Agency and the Local Authority have scheduled a meeting for the 31st October 2011, to discuss flood defences in the Shoreham area through the Adur Tidal Wall Project. The outcome of this meeting could benefit the site by an upgrade of its defences through capital funding or developer contributions.

5. PROPOSED DEVELOPMENT

The proposed development is based on the conceptual master plan by Jane Duncan Architects as shown in Appendix A in support of a revised Planning Application. The proposed development will consist of 9 residential units, 2000 sq.m commercial building space and associated site wide infrastructure.

The development proposal is to convert the existing Northfolk House building into 8 semidetached houses, construct a new detached residential building to the east of Northfolk House and replace the existing garages with a one storey high commercial building. The eastern slipway is outside the site's curtiledge and thus will be unaffected by the proposed scheme.

The development proposes no habitable rooms at ground floor level in line with the original planning application. The main entrance to the building is from the ground floor and serves as an 'undercroft' private car park to the individual residential property. The existing ground floor levels 4.21m AOD of the Norfolk House building will be maintained and the proposed finish floor levels for the development proposal are as follows:

Table 1: Proposed Finish Floor Levels

Floor Reference	Residential Units	Commercial Building
Ground Floor	4.21m AOD	4.23m AOD
First Floor	7.26m AOD	7.28m AOD
Second Floor	10.30m AOD	-
Third Floor	13.62m AOD	-

The new development will comprise of an approximate impermeable developed area of 1580 m^2 (0.158 ha) including car-parking areas, walkways and hard landscaped areas out of a red line boundary area of 1700m^2 (0.170ha). This will result in an overall reduction in impermeable surface area of 7% (from 100% to 93%) at the site. The Table 2 below summarises details of the post-development impermeable areas.

Table 2: Impermeable Areas of the Site Post-Development

Impermeable Areas	Area	Impermeable Area (%)
Roof	800.0 m^2	47%
Hard-standings/access road	780.0 m^2	46%
Soft Landscape	120.0 m^2	0%
Total	**1700 m^2**	**93%**

6. DRAINAGE STRATEGY

The drainage design strategy proposed is for a separate foul and surface water drainage network to service the whole of the site in line with the existing system.

6.1. Surface Water

The conceptual drainage strategy for the proposed development is based on the principals of a conventional drainage system and may incorporate methods of source control (i.e. attenuation tank and or a Brown Roof) to convey and attenuate surface water runoff flows throughout the development.

The EA confirmed that they would not require SUDs as part of the development, principally as the site is within a flood zone and envisaged high ground water table within the site and siltation of any SUDs scheme installed following a flood event.

The drainage system will be designed in accordance with the latest British Standards and Building Regulations, and SUDS Manual CIRIA C697. Climate change will be accounted for by a 30% increase in rainfall intensity.

It is likely that the drainage design will be conditioned within the planning approval and hence subject to review and subsequent approval by the Local Planning Authority and in some instances by the Environment Agency.

The runoff from the site, as currently envisaged, is to be discharged to the River Adur, utilising existing discharge points within the existing boundary retaining wall or via new discharge points in the existing/new boundary retaining wall. These outlets are proposed to have flap valves to prevent the ingress of water in the storm water system during periods of very high water levels or flood levels.

Any new discharge points into the River Adur would require the consent of the EA.

6.2. Foul Water

Generally it is intended that all foul water generated by the development will be disposed off site through a gravity sewer network into the Southern Water public sewer via an existing manhole located at the front entrance of the site.

7. DRAINAGE DESIGN

The following catchments hydraulic characteristics have been used in determining the drainage design for the site and the relevant catchments characteristics maps for the site have been included below.

Table 7: Catchment Hydraulic Characteristics

Characteristics	Values
Region	7
M5-60	19.0 mm
ratio (r)	0.35
Soil	1
SPR	0.2
SAAR	750 mm
UCWI	115.0
Runoff Coefficient	0.75 - 0.85

7.1. Pre & Post Development Peak Rate of Runoff

The site pre-development and post-development peak rates of runoff have been calculated for a 1, 30 & 100 year event using the IoH124 Report and the Wallingford Procedure. The peak runoff was calculated for a range of storm duration up to and including a 6 hour storm and a 30% allowance on rainfall intensities due to climate change in accordance with PPS25.

Table 3: Pre & Post Development Peak Rate of Runoff

Return Period	*Pre-Development Area (1700 m^2)*	*Post-Developed Area (1550.0 m^2)*
1 Year	14.2l/s	12.5l/s
2 Year	24.0 l/s	21.0 l/s
30 Year	35.0 l/s	31.0 l/s
100 Year	46.0 l/s	40.0 l/s

The proposed development will result in a reduction in the impermeable surface area and as a result surface water runoff generated by the development will be reduced. Therefore the storm water runoff generated by the development will not increase the flood risk to downstream neighbours and property.

7.2. Foul Water

The foul sewer drainage design proposal will be in accordance with Sewers for Adoption 6th Edition. The peak flow rate from the development site of approximately 0.6 l/s has been calculated based on water usage 220l/s/d per person for the proposed development. Calculation methods are in accordance with the criteria set out in Sewers for Adoption 6th Edition.

Table 3: Foul Water Peak Flow Rate

Usage	Floor Area (m2)	Residential		Flows (l/s)
		No. of units	Population	
Residential	-	9	27	0.5
Commercial	2000	-	-	0.1
Total	-	9	1104	0.6

8. ASSESSMENT OF FLOOD RISK

8.1. Introduction

The aim of the study is to undertake a flood risk assessment that meets the requirements of PPS25 and the Environment Agency by identifying the flood risk posed to and from the development from all sources and by scoping flood management measures that could

feasibly be used to ensure that the development is safe in the event of a flood.

This section provides a review on flood risk associated with the development of the site and summarises the flood risk issues at the development. Specifically, it seeks to satisfactorily meet the criteria's of PPS 25.

8.2. Assessment of Flood Risk

Environment Agency guidance on the requirements for undertaking a Flood Risk Assessment (FRA) for planning applications for development in Flood Zones 3 other than 'minor' extensions are as follows:-

- Consideration of whether the site falls within the functional flood plain as defined by the draft Practice Guide to Planning Policy Statement 25 (PPS25), and if so, demonstration that development meets the vulnerability criteria set out in table D1 PPS25.
- Flood alleviation measures already in place, their state of maintenance and their performance.
- Information about all potential sources of flooding that may affect the site –from rivers and the sea, streams, surface water run-off, sewers, groundwater, reservoirs, canals and other artificial sources or any combination of these.
- The impact of flooding on a site including:
  - the likely rate or speed of surface water run-off with which flooding might occur;
  - the order in which various parts of the location or site might flood;
  - the likely duration of flood events
  - the economic, social and environmental consequences of flooding on occupancy of the site
  - information on extent and depth of previous flood events or on flood predictions.
- An assessment of how safe access and exit can be provided for routine and emergency access under both frequent and extreme flood conditions.
- An assessment of how the layout and form of development can be used to reduce or minimise flood risk.
- An assessment of the capacity of any drains or sewers, existing or proposed, on the site during various flood events.
- An assessment of the volume of surface water run-off likely to be generated from the proposed development.
- Proposals for surface water management according to sustainable drainage

principles, with the aim of not increasing, and where practicable, reducing the rate of runoff from the site as a result of the development

- The likely impact of any displaced water on third parties caused by alterations to ground levels or raising flood embankments.
- The potential impact on fluvial or coastal morphology and the likely longer-term stability and sustainability of existing defences.
- Estimates should be made of how climate change could affect the probability and intensity of flood events. The assessment should ensure that the development meets an acceptable standard of flood protection for the design life of the development. The hydrological analysis of flood flows and definition of defence standards needs to include the allowances for increased flows and sea level rise contained in DEFRA's project appraisal guidance for flood defence and in accordance with Appendix B of PPS 25 or the latest information from UKCIP.
- The residual risks to the site after the construction of any necessary defences and the means of managing those.
- Consideration of the proposal relative to any existing Strategic Flood Risk Assessment carried out by the local authority.

8.3. Flood Zone

The Environment Agency Flood Risk Map, in Figure 1, shows the site is located within a Flood Zone 3, high risk of flooding. An area inside the extent of the extreme flood event, with a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea,(>0.5%) in any year without any benefits from the provision of flood defences located on the map.

8.4. Site Specific Flood Risk Assessment

The following site specific Flood Risk Assessment has been carried out in accordance with the policies stated in PPS25 and those on flood risk in the Local Development Framework (LDF). Climate change has been taken into account in the assessment of the design of the surface water drainage network for the proposed development and is based on a 30% increase in rainfall intensities, which is in accordance with Table 5 B2 of PPS25 for a development life span of 100 years.

The FRA identifies the likelihood of the proposed development being affected by various forms of flooding throughout its proposed lifetime and the likelihood of the proposed development increasing flood risk to adjacent properties.

8.5. Potential Sources of Flooding

This section of the report will identify the risks from the different forms of flooding identified in PPS25.The development site is located within a Zone 3, high flood risk and

requires the site to be assessed against all sources of flooding.

8.6. Tidal and Fluvial Flooding

Tidal Flooding

The development site is located in a Flood Zone 3, of high risk of Fluvial, tidal or coastal flooding and is confirmed by the EA Flood Risk Map Figure 1 and the SFRA Map F1-F and F1-T.

The site is situated in the tidal reach where water levels are increased by high river flows coming down the River Adur and high spring tides and surge tides coming up the estuary. Flooding can be caused by a combination of high tides and high river flows, which, on their own, may not cause any difficulties. However, the most significant factor for flooding of the site is a surge tide event.

The EA defines a surge tide flood event as being a 3 tidal phase event, comprising of 3 low tides and 3 high tides covering a 36 hour period. The time period elapsing between high tide and low tide is 6 hours therefore, the site is likely to be inundated by flood water for a maximum period of up to 6 hours, followed by a period of no flooding on site for a minimum period of 6 hours, continuing for a period of 36 hours.

A surge tide is a high tide made worse by a spring tide coinciding with a severe storm, in which the low pressure raises the sea level even higher than a normal spring tide. In addition, if the storm is forcing/driving the water towards a narrowing, along the English Channel towards Dover, the restriction at the narrowing will increase the sea levels further upstream of the narrowing.

In addition, the flood level during a surge tide will be increased by wave heights. The site is protected from the direct effects of wave heights within the English Channel during a surge tide by Shoreham Beach, located South of the site forming the southern bank of the River Adur, thus effectively acting as a break water. Shoreham Beach will remove the potential increase in water flood levels in the order of 300-600 mm due to wave effects in the English Channel.

However, as the predominant wind direction for this site is South Westerly, there is the possibility of smaller waves being generated from the southern bank of the River Adur to the site. The distance over which a wave can be generated by wind is known as a Fetch, and this is restricted to the width of the River Adur approaching the site from a south westerly direction. It is anticipated that this distance during a flood event will be relatively short, and as such the wave heights are anticipated to be low, i.e. max 100mm.

The EA has provided a revised 1 in 200 year predicted flood level of 5.27m AOD for the year 2115 at the site location. The level includes the appropriate allowances for climate change and is based on the revised national estimates on extreme sea levels undertaken as part of the remodelling for the River Adur Tidal Wall Project to upgrade the existing flood defences along the southern bank of the River.

Fluvial Flooding

The site is located on the bank of the River Adur and is therefore naturally at risk of fluvial flood events. However the SFRA makes no reference to flooding in the area and the Environment Agency has no record of flood at the site. As a consequence the site is considered at low risk of fluvial flooding. However climate change and changes in weather patterns cannot be ignored as this will impact on the sites risk of fluvial flooding in the future.

The greatest risk to the site acknowledged by the Environment Agency is the risk of tidal flooding. Should the development adequately cater for a tidal flooding event it will be able to withstand future fluvial flooding events.

8.7. Flooding from Groundwater

The relative position of the site to the river and the sea mean that the risk of flooding to the site through ground water is not anticipated, as the ground water table will virtually mirror the river water level, and hence is not regarded as a risk.

The Environment Agency Source Protection Zone maps indicate the site is not located within an Aquifer Protection Zone and lies outside the extent source protection zone. Also Map G1 of the Strategic Flood Risk Assessment for Worthing Borough Council and Adur District Council indicate the area as highly susceptible to ground water flooding. However no ground water flooding incidences have been recorded at the site and immediate surround areas.

The perceived risk of flooding from ground water is considered as medium to low.

8.8. Flooding from Sewers

Southern Water Utiltities are the public sewers service providers for this region. Public sewer records contained in the Appendices confirm that there were no incidents of flooding at the site. However restricted capacity in the foul and surface water public sewer networks may result in surcharging and flooding, but the perceive risk is regarded as low.

Map S of the Strategic Flood Risk Assessment for Worthing Borough Council and Adur District Council also confirms that there are no records of flooding due to surcharging of the sewers.

The perceived risk of flooding from surcharging of the sewers is low.

8.9. Flooding from Reservoirs, Canals and Other Artificial Sources

There are no artificial sources within the vicinity of the site and therefore there is no perceived risk of flooding.

8.10. Surface Water

The proposed drainage system for the site has been designed to cater for a 100 year critical event without causing any significant unplanned flooding.

Flooding to the proposed site from surface water flow, such as overloaded sewers flooding, is regarded as possible, though the risk, depth and extent of flooding is regarded as low based on the proximity of the site to the River Adur and the sea.

Greater risks are posed by the tidal flooding and hence if the development is able to withstand this event then it will be able to cater for the lower risk of surface water flow.

9. MITIGATION MEASURES TO ALLEVIATE/REDUCE FLOOD RISK

Flood risk at the site cannot be alleviated but will be managed through the upgrade of flood defences, by providing an efficient and an adaptable flood warning, evacuation and cleanup system and by incorporating appropriate and sustainable flood resilient design.

9.1. Floor Levels

The ground floor of the residential and commercial buildings have been designed to cater for a minimal amount of service required at this level. The ground floor of the residential buildings will serve as a private 'undercroft' /car park and property entrance to the units. No habitable rooms are proposed at ground floor level of this building, only a plant room, bin store and additional stores will be provided on this floor, as indicated on the Architects drawings, Appendix A. The ground floor of the commercial building will serve as a private 'undercroft' /car park, property entrance and will house a small reception area with a toilet facility.

The ground floor will be at a level of 4.21m AOD and 4.26m AOD respectively and therefore susceptible to the flooding during both Fluvial and Tidal events taking climate change into account. The maximum anticipated depth of flooding will be in the order of 1.06m.

However, it is proposed that the ground floor will be constructed of flood resilient material up to the maximum anticipated depth of flooding to reduce property damage and the layout of the ground floor will be designed to enable residents and commercial tenants to quickly clean up following a flood event enabling normal trading and services to resume.

The first floor level of 7.26m AOD is well above the maximum flood level anticipated. Therefore the first floor and floors above are not affected.

9.2. Dry Access and Safe Refuge

Although the ground floor of the proposed development will be flooded to a maximum depth of about 1.06m, habitable rooms are all provided on upper floor levels which are significantly above the highest predicted flood level of 5.27m AOD, taking wave heights

into account.

The proposed scheme does not provide a dry access to and from the High Street. As a consequence access during a 1 in 200 surge tide flood event will be restricted to low tide phases of the flood event which means residents and the public will be restricted from entering or leaving the development for a maximum of 6 hours. This will not have a detrimental impact as the EA provides a flood warning service which will provide residents with adequate notice of a flood event. This will minimise the risk to residents who may require regular, anticipated or planned medical treatment. Although resident and commercial areas will provide safe refuge, an emergency evacuation plan will be put in place to deal with medical emergencies or fires.

The EA's Flood Zone map indicates the southern side of the High Street as being within a Flood Zone 3. The flood level is predicted as being 5.21m AOD. However, the topographical survey records the footway levels along the southern side of the High Street as being greater than 4.95m AOD (77 High Street) and rising to 5.82m AOD (61 High Street) just north of the eastern extreme of the site. This dry area is just minutes away from the site and could be accessed during the 6 hour window of no flooding.

9.3. Emergency Planning

Further to a recent FRA undertaken by ourselves at Site's within Shoreham by Sea area, we are aware that John Rodway is Adur District Council's Corporate and Public Safety Manager. John is responsible for coordinating the response to an emergency on a local level, which includes flooding within Shoreham By Sea.

We are therefore aware that the authority's response during a flood event would be to advise residents to stay put in their homes, and that only if a fire and flooding incident occurred together would the emergency services be dispatched to evacuate the residents. Evacuation of residents would be to a very basic refuge with a roof and floor but no beds or seats.

Based on the current advice, that would be given to other residents in this district during a flood event, the proposed floor levels of the development are all sufficient to provide an adequate safe refuge during a flood event.

On this basis, there is deemed to be no general increased burden on the emergency services posed by the development.

The Safety Manager has however recommended that an emergency plan is written, which specifically identifies the following:

- Possible emergency risks, such as a medical emergency or fire during a flood event, and the
- Response to possible emergency risks, ie. by evacuating the person or entire building by:, amphibious vehicle, boat, or helicopter.

Contact with the local Royal National Lifeboat Institution (RNLI) and Jon Simpson of West Sussex Fire & Rescue (WSFR) has been made as part of the previous application.

The RNLI have stated that they have two boats at Shoreham-by-Sea which would be used during a flood event. RNLI confirmed that they have existing capacity to respond to any flood situations taking into account the proposed development similar to those at Shoreham Waterside, ie Norfolk House.

WSFR have two boats (called ribs) based in Storrington and Whittering. These boats would be used during a flood event providing a coordinated response with the RNLI.

Based on the initial comments received from the above consultees it would appear that the proposed residential/commercial development will not place additional burden on the emergency services.

9.4. Impact of Site Displaced Water

The site's existing levels are not proposed to be altered significantly from the levels as recorded on the site's topographical survey.

The proposed building footprints will be the same as the existing Norfolk House office block and associated garages, but soft landscaping will be included in the proposed development.

Based on both of these factors, the actual impact on displaced flood water within the site will be negative, ie there will be less displaced water with the proposed scheme than the existing situation, thus providing a net benefit overall.

9.5. Proposed Flood Defences

The existing flood defences for the site consist of quay retaining walls adjacent to the River Adur. The EA has requested that they are structurally assessed to determine if the proposed development will have any impact on the existing quay wall. Any alterations to the existing defences or new structures will be designed in line with current design standards.

The design and the construction of these structures will be approved by the EA to ensure that they meet the requirements.

The site could benefit from an upgrade of its defences from the Adur Tidal Wall Project this may be determined in a meeting scheduled for the 31st October 2011.

Shoreham's flood defences are currently the subject of the EA's consultation document 'Consulting the Future'. The aim of the document is to identify the most suitable position of the flood defence barrier taking into consideration the users within Shoreham Port and the River Adur.

The Shoreham Port Authority (SPA) are aware of the proposals and consider that a flood barrier positioned beyond Emerald Quay within the River Adur, as identified in the EA's document 'Consulting the Future', would not interfere with the commercial vessels using the Port.

Any flood defences at this location would afford the proposed development additional protection from that currently identified.

However, these plans are still in consultation stage with no funding or designs submitted or approved. As a consequence the possible benefits of any future flood barriers have been ignored for the purposes of the development's FRA

9.6. Proposed Storm Water Runoff and SUDs

The surface water runoff generated by the development will be slightly less than the existing site, because the impermeable area has been reduced by 7%, ie 20.9 l/s based on a rainfall intensity of 50mm/hr.

Therefore the stormwater runoff generated by the development will not increase the flood risk to downstream neighbours and property.

The runoff from the site, as currently envisaged, is to be discharged to the River Adur, utilising existing discharge points within the existing boundary retaining wall or via new discharge points in the existing/new boundary retaining wall. These outlets are proposed to have flap valves to prevent the ingress of water in the storm water system during periods of very high water levels or flood levels.

Any new discharge points to the River Adur would require the consent of the EA.

The use of SUDs on this scheme is regarded as unviable, due to the envisaged high ground water table within the site and siltation of any SUDs scheme installed following a flood event.

The drainage system within the site will be designed so as to conform to the latest British Standards and Building Regulations. It is likely that the drainage design will be conditioned within the planning approval and hence subject to review and subsequent approval by the Local Planning Authority and in some instances by the Environment Agency.

9.7. Flood Impact on Existing and Proposed Drainage

During a flood event the storm drains are likely to become inundated with flood water once the water levels reach the surface gully levels, with the water only receding once the flood levels abate. Additional inflows of storm water into the system from roof areas are likely to egress from the system not via outlets to the River Adur but via other points such as gullies, after finding their own water level equilibrium within the system.

Foul drainage from the site will discharge to the foul sewer within High Street. Similarly the foul sewer within High Street is likely to be inundated with flood water during a flood event, which is likely to result in untreated effluent escaping from the foul sewer network.

Although undesirable this consequence cannot be overcome without considerable expenditure by the sewer authority, Southern Water. The actual health hazard of foul water flooding during such an event is deemed to be relatively low as the dilution rate attributed to the flood water is relatively high, thus minimising the effect when compared

to a foul flooding incident without flood water.

10. SEQUENTIAL TEST

The development is located in a zone 3 of high flood risk and is required in accordance with PPS 25 that a sequential testing must be applied. The Local Planning Authority (LPA) has undertaken a sequential test as part of the SFRA Maps (F1-F&C2-F Fluvial – F1-T&C2-T Tidal).The site benefits from an approved Planning Application ADC/0252/09.

11. EXCEPTION TEST

An Exception Test has been undertaken previously as part of the flood risk Assessment in support of the approved planning application. The Exception Test is based on site's location within a Zone 3a High Probability Flood Risk classification and a Vulnerability Classification of `More Vulnerable` in accordance with Table D2 PPS25.

The Local Planning Authority (LPA) has undertaken a sequential test as part of the SFRA Maps (A1-F&C1-F Fluvial – A1-T&C1-T Tidal).

The section below summaries the results of the exception test carried out.

11.1. Part A – Wider Sustainability

- The proximity of the development to the local transportation infrastructure.
- The demand to reduce development pressure on the green belt.
- Norfolk House is situated within the conservation area, which the council is pushing to be improved due to poor quality buildings along the High Street and the river frontage. The site's main benefits relate to the council's desire, expressed within the Shoreham Renaissance March 2006 Masterplan, to activate the river side with public uses and create public access/ walkway etc.
- The scheme introduces public access and new views of the river, through its relative central position to the High Street and the nearby Pub, creating a water-side activity hub (the restaurant at first floor level and seasonal bar at ground level (seasonal/temporary nature),serving the local community.
- Furthermore the development will enhance employment opportunities, the local economy, local and regional - tourism, etc, assisting as a whole to regenerate the area in line with the aims of the Shoreham Renaissance March 2006 Masterplan, which reflect the aspirations of the Council and the wider community.

11.2. Part B – Brownfield Land

- The proposal involves the redevelopment of Brownfield land.
- The development is in line with Local Planning Authority policies in meeting government targets.

11.3. Part C – Safety

- The Flood Risk Assessment has demonstrated that the development is located in a defended coastal Flood Zone 3a.
- The coastal defences form part of the Shoreline Management Plan (SMP) for the area and have a minimum standard of protection of 1 in 50 years, and there will be no functional Flood Zone 3b.
- The coastal defences will be maintained to 2115 under the SMP and therefore it has been assessed that there will be a low risk of breach or overtopping of the defences.
- The residual has been assessed over the 100 year design life of the proposed building (2115) and is classified as low to medium risk due to overtopping and breaching of the flood defences.
- The Proposed Developed will be part of the Environment Agency Costal Flood Warning Area.
- An emergency and evacuation plan and procedure is recommended to be developed by the development in liaison with the Local Authority and the Emergency Services.
- The application of the exception test demonstrates that the development satisfies all three parts of the test.

12. RESIDUAL RISK

Although the actual flood risk is very low to medium at the site, there remains a residual risk of flooding from a breach of the River Adur defences, especially as land levels to the southern section of the site, particularly along access routes along the river wall, lie up to 1.27m below the peak flood levels.

Flood warning and emergency procedures form an important part in the management of residual risk for the development site and therefore the Flood warning and evacuation strategy for the proposed development outlined below for the local planning authority for approval are as follows:-

An information pack containing information on Flood Risk, Flood Warning and evacuation procedures for residents, staff and general users will be made available. This is a four stage warning system and each stage will trigger a set of procedures for various organisations. The appropriate signage will be placed in communal areas of the building providing warnings on the possibility of flooding, the evacuation procedures and the emergency telephone numbers. Detailed below are the steps recommended for the flood risk evacuation plan;



Flood Watch: Flood Preparation Plans are activated on receipt of the flood warning from the Environment Agency or from other sources (TV, radio, local contacts). Flooding may be possible, and the situation could worsen, so:

- Water levels are monitored by the site manager regularly
- A site manager is posted on site 24 hours a day
- Regular telephone calls are made to the Environment Agency `Flood line` (0845 988 1188) for updates.
- Consider when to start implementing the evacuation plan
- Check pets and livestock
- Reconsider travel plans



Flood Warning: The flood evacuation plan should be implemented when a Flood Warning is received. Flood Warning means flooding is now expected, the evacuation plan should include the following procedures:

- The site manager alerts all residents, staff and users of the warning
- All staff are placed on call so they are available if the situation requires additional staff.
- The site manager issues a flood action plan and pack to all staff so they are aware of what to do.
- The flood situation is assessed every 30 minutes on site by the site manager and with the Environment Agency `Floodline`.
- Evacuation signposts are erected
- Initiate evacuation of the premises
- Follow dry escape route
- Local police are informed a flood warning has been issued
- Site area manager is informed a flood warning has been issued



Severe Flood Warning: The flood evacuation plan should be implemented as a matter of urgency when a Severe Flood Warning is issued. Severe Flood Warning means severe flooding is now expected, and the actions shall include:

- Be prepared to lose power supplies – gas, water, electricity and telephone
- Try to keep calm and reassure others and evacuate the site
- Carry a torch light with you if at night.(Torches are available as part of the Flood Equipment Pack).
- Cooperate with the emergency services and local authorities.
- Turn off gas and electrical appliances immediately.
- Secure building – Lock doors, windows and set alarms



All Clear: is issued when flood watches or warning are no longer in force indicating;

- Flood water levels reducing
- Checks are made to ensure all is safe to return
- Seek advice
- All Clear

As flood warning is a national issue Dixon Hurst Kemp recommends that the developer consults the National Flood Warning Centre and the EA for advice. Recommendations will also be made for the developers to consult the London Emergency Service liaison Panel, the London Resilience team and the London Fire and Emergency Planning Authority on information on current emergency planning.

Appendix A- Client Supplied Data