

Hallam Land Management Limited

NEW BOGNOR REGIS GOLF COURSE

Flood Risk Assessment





Hallam Land Management Limited

NEW BOGNOR REGIS GOLF COURSE

Flood Risk Assessment

REPORT V01 PUBLIC

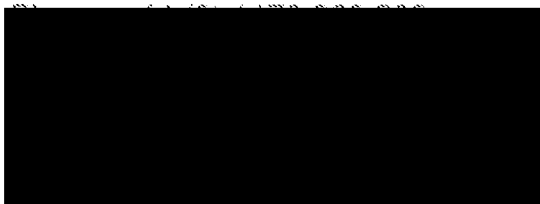
PROJECT NO. 70088068

OUR REF. NO. FRA-V01

DATE: DECEMBER 2021

WSP

3rd Floor, Kings Orchard
1 Queen Street
Bristol
BS2 0HQ





QUALITY CONTROL

Issue/revision	First Issue	Revision 1	Revision 2	Revision 3
Remarks	For Submission			
Date	December 2021			
Prepared by	Aidan Wilks Daly			
Signature	Wilks Daly, Aidan (UKAMW009) Digitally signed by Wilks Daly, Aidan (UKAMW009) DN: c=Wilks Daly, Aidan (UKAMW009), ou=Active, email=Aidan.WilksDaly@wsp.com Reason: I am the author of this document Date: 2021.12.16 15:22:48			
Checked by	Andy Smith			
Signature				
Authorised by	Andy Smith			
Signature	Smith, Andy (UKADS004) Digitally signed by Smith, Andy (UKADS004) DN: c=Smith, Andy (UKADS004), ou=Active, email=Andy.Smith@wsp.com Reason: Authoriser Date: 2021.12.16 15:57:11			
Project number	70088068			
Report number	70088068-FRA-V01			
File reference	70088068- NewBognorGolfCourse- FRA-V01- ForSubmission			



CONTENTS

1.	INTRODUCTION	1
1.1.	BACKGROUND	1
1.2.	LIMITATIONS	1
1.3.	SCOPE OF ASSESSMENT	1
2.	SITE SETTING	2
2.1.	LOCATION	2
2.2.	DEVELOPMENT PROPOSALS	3
2.3.	TOPOGRAPHY	3
2.4.	GEOLOGICAL AND HYDROGEOLOGICAL CONTEXT	4
	Geology	4
	Hydrogeology	4
2.5.	WATERBODIES	4
3.	PLANNING POLICY CONTEXT	5
3.1.	NATIONAL PLANNING POLICY FRAMEWORK 2021	5
3.2.	LOCAL PLANNING POLICY	5
	Local Plan - Adoption Arun Local Plan 2011-2031 (July 2018)	5
	Local Plan – Arun District Council Level 1 and Level 2 Strategic Flood Risk Assessment , November 2016 (SFRA)	6
3.3.	VULNERABILITY CLASSIFICATION	6
	Sequential Test	7
	Exception Test	7
4.	ASSESSMENT OF FLOOD RISK	8
4.1.	OVERVIEW	8
4.2.	HISTORIC FLOODING	8
4.3.	FLOOD DEFENCES	9
4.4.	FLUVIAL & TIDAL FLOOD RISK	9

	ENVIRONMENT AGENCY MAPPING	9
4.5.	HYDRAULIC MODELLING	10
	Consultation	10
	Climate Change	11
	Baseline Hydraulic Modelling	11
	Post Development Hydraulic Modelling	12
	FLUVIAL FLOOD RISK SUMMARY	12
4.6.	SURFACE WATER FLOOD RISK	13
4.7.	GROUND WATER FLOOD RISK	15
4.8.	SEWER FLOOD RISK	16
4.9.	ARTIFICIAL SOURCE FLOOD RISK	16
5.	SURFACE WATER DRAINAGE	17
6.	FLOOD RISK MITIGATION	18
6.2.	PLANNING POLICY	18
7.	CONCLUSIONS	19

TABLES

Table 1 - Flood Vulnerability and Flood Zone Compatibility (PPG Table 3)	7
Table 2 - Flood Risk Overview	8

FIGURES

Figure 1 – Site Location	2
Figure 2 - Site Topography	3
Figure 3 - Environment Agency's Flood Map for Planning	10
Figure 4 - 1 in 100 year plus climate change baseline flood depths (m)	12
Figure 5 - Risk of Surface Water Flooding Map	13



APPENDICES

APPENDIX A FLOOD RISK PACK

APPENDIX B PROPOSED DEVELOPMENT PLANS

APPENDIX C TOPOGRAPHICAL SURVEY



Executive Summary

This Flood Risk Assessment (FRA) has been undertaken to accompany the planning application for the proposed golf course at Ancton, near Bognor Regis. This FRA has been prepared in accordance with the guidelines set out in the National Planning Policy Framework (NPPF) published in July 2021 and the National Planning Practice Guidance along with other relevant local and national guidance.

Item	Overview
Site Location	The Site is located in Ancton, West Sussex, to the south of Grevatt's Lane (A529), with a nearest postcode BN17 5RE, at an approximate National Grid Reference 499033, 101144. The site has an area of approximately 72.4 hectares.
Development Proposals	Construction of a new 18 hole par 4 golf course, a 9 hole par 3 course, practice greens and a driving range; the formation of a new access onto the A259; the construction of a club house with associated golf club facilities; the construction of a maintenance building and external area of hardstanding; the laying out of a car park and new roads and paths.
Environment Agency Flood Zone(s)	The majority of the site, is located in Flood Zone 3, based upon the Environment Agency's Flood Map for Planning, with a small area in the northwest of the site located in Flood Zone 1.
Vulnerability Classification(s)	Water compatible – as the development is outdoor sports and recreation and essential facilities
Fluvial and Tidal Flood Risk	The majority of the proposed development is located in Flood Zone 3 on the Environment Agency's Flood Map for Planning. The Ryebank Rife flows past the north of the site flowing from west to east and the Elmer Ryebank Rife flows past the eastern boundary of the development, flowing from north to south, both of these watercourses are tidally influenced. Hydraulic modelling has been undertaken for the site which demonstrates that the majority of the site is situated outside the 1 in 100 year plus 25% climate change flood extents. The more sensitive parts of the development such as the clubhouse and maintenance buildings will be located outside the floodplain.
Surface Water Flood Risk	The Environment Agency's Flood Risk from Surface Water map demonstrates that the risk of surface water flooding to the proposed development is Low. A drainage strategy has been presented to manage the overall flow of surface water across the site, including the use of SUDS.
Groundwater Flood Risk	Baseline – High, the nearest borehole log records a water strike at 1.8mbgl in a perched aquifer. Post Development – Low, as mitigation measures will be included within the scheme design, these include a positive surface water drainage system and raising the clubhouse and maintenance buildings above ground levels.



Sewer Flood Risk	There are no recorded incidents of sewer flooding in the vicinity of the site.
Artificial Flood Risk	The site is outside of the maximum flood extents in the event of a reservoir failure and there are no canals or other artificial waterbodies in the vicinity of the site.
Sequential & Exception Test	Site specific hydraulic modelling shows that the sit buildings are situated outside of the floodplain, i.e. equivalent to Flood Zone 1. The proposed use is water compatible as such the Scheme is sequentially acceptable for use on this site. Water Compatible development is permitted without the need for an exception test.



1. INTRODUCTION

1.1. BACKGROUND

- 1.1.1. WSP UK Ltd (WSP) has been appointed by Hallam Land Management Limited (HLM) to prepare a Flood Risk Assessment (FRA) to support the application for redevelopment of a Bognor Regis golf course into residential housing.
- 1.1.2. The objective of the study is to demonstrate that the site can be developed safely, without exposing the development to an unacceptable degree of flood risk or increasing the flood risk to third parties. The objectives are to:
- » Confirm the sources of flooding which may affect the site;
 - » Provide an appraisal of the availability and adequacy of existing information; and
 - » Undertake an appraisal of the flood risk posed to the site and potential impact of the development on flood risk elsewhere.

1.2. LIMITATIONS

- 1.2.1. WSP has prepared this report in accordance with the instructions of their client, HLM, for their sole and specific use relating solely to the above site. Any person who uses any information contained herein does so at their own risk and shall hold WSP harmless in any event.
- 1.2.2. Whilst this report was prepared using the reasonable skill and care ordinarily exercised by engineers practicing under similar circumstances and reasonable checks have been made on data sources and the accuracy of the data, WSP accepts no liability in relation to the report should any data, information or condition be incorrect or have been concealed, withheld, misrepresented, or otherwise not fully disclosed to WSP.

1.3. SCOPE OF ASSESSMENT

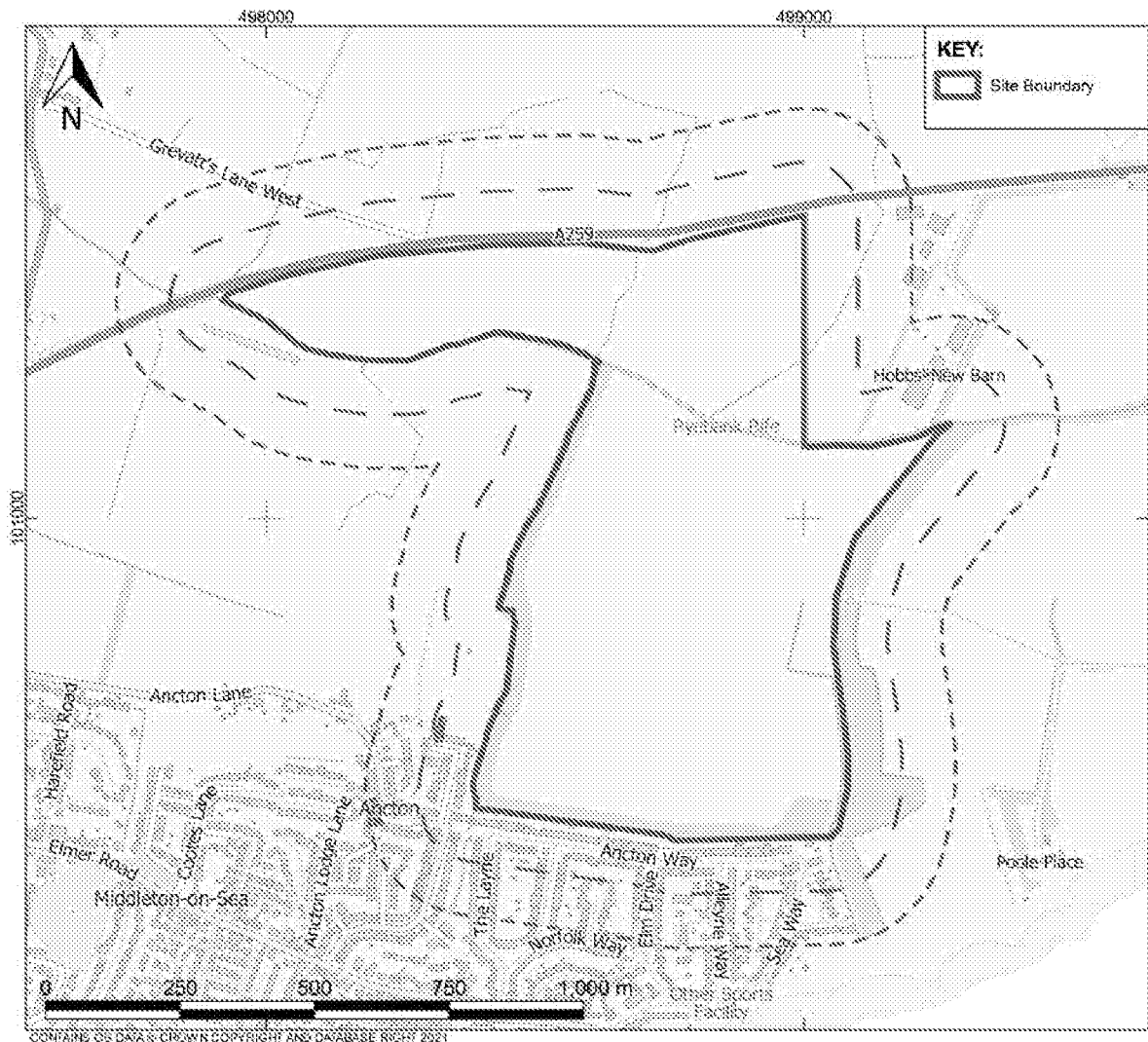
- 1.3.1. The assessment has been undertaken in accordance with the overarching national requirements for Flood Risk Assessments for proposed developments including, but not limited to, the following:
- » National Planning Policy Framework (NPPF) (July 2021); and
 - » Flood Risk Assessments: Climate Change Allowances 2021.

2. SITE SETTING

2.1. LOCATION

- 2.1.1. The Site is located to the south of Grevatt's Lane (A259) in Acton, in the Arun District of West Sussex, with a nearest postcode of BN17 5RE, with an approximate National Grid Reference of 499033, 101144. The site has an area of approximately 72.4 hectares.
- 2.1.2. The Site currently consists of undeveloped agricultural land, with a number of trees, hedgerows and drainage ditches. The site is boarded by the A259 to the north, the Elmer Rife to the East, Ancton Way to the South, and agricultural land to the west.
- 2.1.3. The site is currently accessed by vehicles and pedestrians from the A259.
- 2.1.4. The site location plan is shown below in Figure 1.

Figure 1 – Site Location



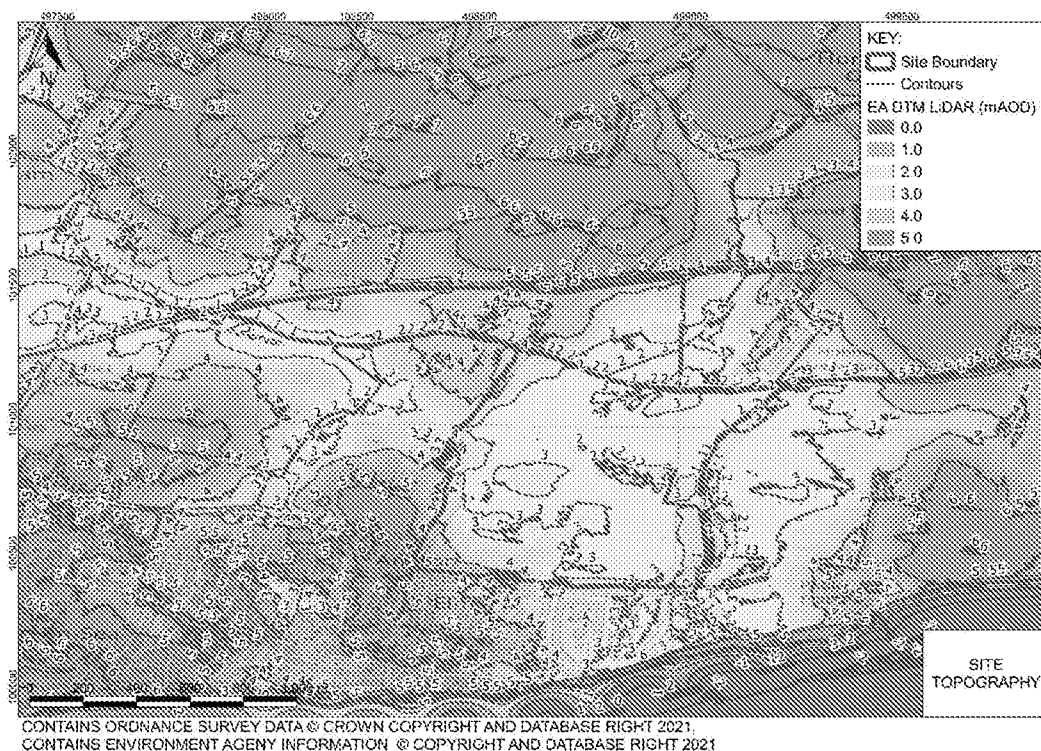
2.2. DEVELOPMENT PROPOSALS

- 2.2.1. The project consists of two proposed developments, the relocation of the existing Bognor Golf Course and the construction of new housing on the existing Bognor Golf course.
- 2.2.2. The re-location is proposed as “*[The] laying out of an 18 hole par 4 golf course, a 9hole par 3, practice greens and a driving range; the formation of a new access onto the A259; the construction of a club house with associated golf club facilities; the construction of a maintenance building and external area of hardstanding; the laying out of a 224 space car park and new roads and paths; new landscape planting, surface water drainage basins and water storage reservoir, and other earthworks and infrastructure*”.
- 2.2.3. The development of new houses is proposed as “*The construction of up to [480] new homes (C3), the formation of a new means of access onto Golf Links Road, the creation of new surface water drainage, new landscaping and habitat creation, ground works and other infrastructure. The retention and re-purposing of the retained club house (F2(b)).*”
- 2.2.4. This assessment is based on the proposed golf course adjacent to the A259 and not the development of new houses on the existing Bognor Golf course, which is the subject of a standalone FRA.

2.3. TOPOGRAPHY

The topography of the site has been assessed using LiDAR from the Environment Agency. As shown in Figure 2, the site is located at a low elevation, with a site slope from west to east, with the low point of the site by the eastern boundary next to the Elmer Rife at 1mAOD. Site specific topographical survey of the site is also available in Appendix C.

Figure 2 - Site Topography



2.4. GEOLOGICAL AND HYDROGEOLOGICAL CONTEXT

Geology

- 2.4.1. The Site is underlain by superficial Quaternary River Terrace Deposits (RTD) , with Raised Marine Deposits (RMD) also present beneath the south. The underlying solid geology comprises the White Chalk Subgroup, specifically the Newhaven Chalk Member.
- 2.4.2. Chalk has been encountered at depths between 2.60 to 11.60 m bgl, as described on available BGS borehole log scans.

Hydrogeology

- 2.4.3. According to the Source Protection Zone map provided by the Environment Agency, the site does not lie within any Source Protection Zones.
- 2.4.4. The RTD and RMD are both designated as Secondary A aquifers, defined by the EA as “permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers”.
- 2.4.5. The White Chalk Subgroup is designated as a Principal aquifer, defined by the EA as “geology of high intergranular and/or fracture permeability, usually providing a high level of water storage and may support water supply/river base flow on a strategic scale”.

2.5. WATERBODIES

- 2.5.1. The Ryebank flows from west to east through the north of the site, separated the northern parcel of the site from the southern parcel of the site. In its reaches past the site is categorised as a main river by the Environment Agency.
- 2.5.2. The Elmer Rife is adjacent to the eastern boundary of the site, with bi-directional flow possible along this rife, either north into the Ryebank Rife, or south into the English Channel. In its reaches past the site the Elmer Rife is categorised as a main river by the Environment Agency.
- 2.5.3. There are also several small field drains crossing the site, which discharge into the Elmer Rife and Ryebank Rife.

3. PLANNING POLICY CONTEXT

3.1. NATIONAL PLANNING POLICY FRAMEWORK 2021

- 3.1.1. The National Planning Policy Framework (NPPF) as updated in July 2021, sets out the Government's national policies for flood risk management in a land use planning context within England.
- 3.1.2. Paragraph 159 of the NPPF states *"Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk (whether existing or future). Where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere."*
- 3.1.3. The guidance further states that local planning authorities should *"ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood-risk assessment."*
- 3.1.4. Allocation and planning of development must therefore be considered against a risk-based search sequence as provided by the guidance.
- 3.1.5. A sequential risk-based approach to determining the suitability of land for development in flood risk areas is central to the policy statement and should take into account the current and future impacts of climate change (Para. 161). This includes the intent to steer the most vulnerable parts of the development to the areas that experience the least, or an acceptable, degree of flood risk.

3.2. LOCAL PLANNING POLICY

Local Plan - Adoption Arun Local Plan 2011-2031 (July 2018)¹

- 3.2.1. Policy W SP1 shows the local plan for general water management and is relevant to flood risk with the policy stating that "The Council will also support development that:

- a. is appropriately located, taking account of flood risk and promotes the incorporation of appropriate mitigation measures into new development, particularly Sustainable Drainage Systems that reduces the creation and flow of surface water and improves water quality."*

Policy W DM2 within Arun's Local plan reaffirms with further details the current approach to flood risk management:

"Development in areas at risk from flooding, identified on the latest Environment Agency flood risk maps and the Council's Strategic Flood Risk Assessment (SFRA) , will only be permitted the following criteria have been satisfied:

- ※ *The sequential test in accordance with the National Planning Policy Guidance has been met.*
- ※ *A site specific Flood Risk Assessment demonstrates that the development will be safe, including access and egress, without increasing flood risk elsewhere and reduce flood risk overall.*

¹ Arun District Council (2018) Adoption Arun Local Plan 2011-2031. Available online: <https://www.arun.gov.uk/download.cfm?doc=docm93jlim4n12844.pdf&ver=12984>

- » *The sustainability benefits to the wider community are clearly identified.*
- » *The scheme identifies adaptation and mitigation measures.*
- » *Appropriate flood warning and evacuation plans are in place; and*
- » *New site drainage systems are designed to take account of events which exceed the normal design standard i.e. consideration of flood flow routing and utilising temporary storage areas.*

Local Plan – Arun District Council Level 1 and Level 2 Strategic Flood Risk Assessment , November 2016 (SFRA)

3.2.2. The combined Level 1 and Level 2 Arun District Council SFRA² reaffirms the need for Sustainable Urban Drainage systems and the sequential approach to flood risk management as set out in the Local Plan. Section 16.2.1 states for future development :

“The Council should consult the Environment Agency’s ‘Flood Risk Standing Advice (FRSA) for Local Planning Authorities’, published in March 2014, when reviewing planning applications for proposed developments at risk of flooding. Planning permission for development affecting watercourses should normally only be granted where:

- » *the natural watercourse system which provides drainage of land is not adversely affected;*
- » *a minimum 8m width access strip is provided adjacent to the top of both banks of any Main River (5m for Ordinary Watercourses) for maintenance purposes and is appropriately landscaped for open space and biodiversity benefits;*
- » *it would not result in the loss of open water features through draining, culverting or enclosure by other means and culverts are opened up where ever possible;*
- » *surface water drainage is delivered by SuDS;*
- » *betterment in the surface water runoff regime is achieved; with any residual risk of flooding, from drainage features either on or off site not placing people and property at unacceptable risk; and*
- » *the application is compliant with the conditions set out by the Lead Local Flood Authority (LLFA).*

At the planning application stage, developers need to undertake more detailed hydrological and hydraulic assessments of the watercourses to verify flood extent, inform development zoning within the site and prove, if required, whether the Sequential and Exception Tests can be satisfied.”

3.3. VULNERABILITY CLASSIFICATION

3.3.1. Under the NPPF the proposed golf course is classified as ‘Water Compatible’ using the flood risk vulnerability classification. Water Compatible development in Flood Zone 3a is permitted in Flood Zone 3a as shown in Table 1, which is an extract of the National Planning Practice Guidance: Flood Risk and Coastal Change (NPPG). The NPPG accompanies the NPPF and provides further context and explanation.

² Arun District Council (2016) Level 1 and Level 2 Strategic Flood Risk Assessment. Available online: <https://www.arun.gov.uk/download.cfm?doc=docm93jilim4n9615.pdf&ver=9488>

Table 1 - Flood Vulnerability and Flood Zone Compatibility (PPG Table 3)

Flood Risk Vulnerability Classification		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Fluvial Flood Zone	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test Required	✓	✓
	Zone 3a	Exception Test Required	✓	✗	Exception Test Required	✓
	Zone 3b	Exception Test Required	✓	✗	✗	✗

Sequential Test

- 3.3.2. The PPG and NPPF Guidance states that Planning Authorities should complete a risk based “Sequential Test” when developing Local Plans, to ascertain areas most suitable, from a flood risk perspective, for future development.
- 3.3.3. The essence of the “Sequential Test” is to “*steer new development to areas with the lowest risk of flooding from any source*” (Paragraph 162 of the NPPF, July 2021).
- 3.3.4. Developments within Flood Zone 2 and Flood Zone 3 require a sequential test if a sequential test has not already been carried out for the development type in question at the proposed site.
- 3.3.5. Site specific hydraulic modelling (see Section 4.5) shows that the site buildings are situated outside of the floodplain, i.e. equivalent to Flood Zone 1. The proposed use is water compatible as such the Scheme is sequentially acceptable for use on this site.

Exception Test

- 3.3.6. Water Compatible development in Flood Zone 3a is permitted in Flood Zone 3a without the need for an exception test.

4. ASSESSMENT OF FLOOD RISK

4.1. OVERVIEW

- 4.1.1. An overview of flood risk for the proposed golf course at Ancton and its surrounds is provided below, based on information obtained from a desk-based review and hydraulic modelling.

Table 2 - Flood Risk Overview

Mechanism	Risk	Comment
Fluvial & Tidal	Low	The majority of the proposed development is located in Flood Zone 3 on the Environment Agency's Flood Map for Planning. The Ryebank Rife flows past the north of the site flowing from west to east and the Elmer Ryebank Rife flows past the eastern boundary of the development, flowing from north to south, both of these watercourses are tidally influenced. Hydraulic modelling has been undertaken for the site which demonstrates that the majority of the site is situated outside the 1 in 100 year plus 25% climate change flood extents. The more sensitive parts of the development such as the clubhouse and maintenance buildings will be located outside the floodplain.
Surface Water	Low	The Environment Agency's Flood Risk from Surface Water map demonstrates that the risk of surface water flooding to the proposed development is Low. A drainage strategy has been presented to manage the overall flow of surface water across the site, including the use of SUDS.
Ground Water	Low	Baseline – High, the nearest borehole log records a water strike at 1.8mbgl in a perched aquifer. Post Development – Low, as mitigation measures will be included within the scheme design, these include a positive surface water drainage system and raising the clubhouse and maintenance buildings above ground levels.
Sewers	Low	There are no recorded incidents of sewer flooding in the vicinity of the site.
Artificial Sources	Negligible	The site is outside of the maximum flood extents in the event of a reservoir failure and there are no canals or other artificial waterbodies in the vicinity of the site.

4.2. HISTORIC FLOODING

- 4.2.1. The EA Historic Flood Map (see Appendix A flood risk pack) does not show any historic flood events within the site boundary or the surrounding area.
- 4.2.2. There is no mention of flooding occurring within the site boundary in the combined level 1 and level 2 SFRA².

4.3. FLOOD DEFENCES



- 4.3.1. Coastal flood defences with a 100 year standard of protection are situated along Elmer Beach to the south of the site

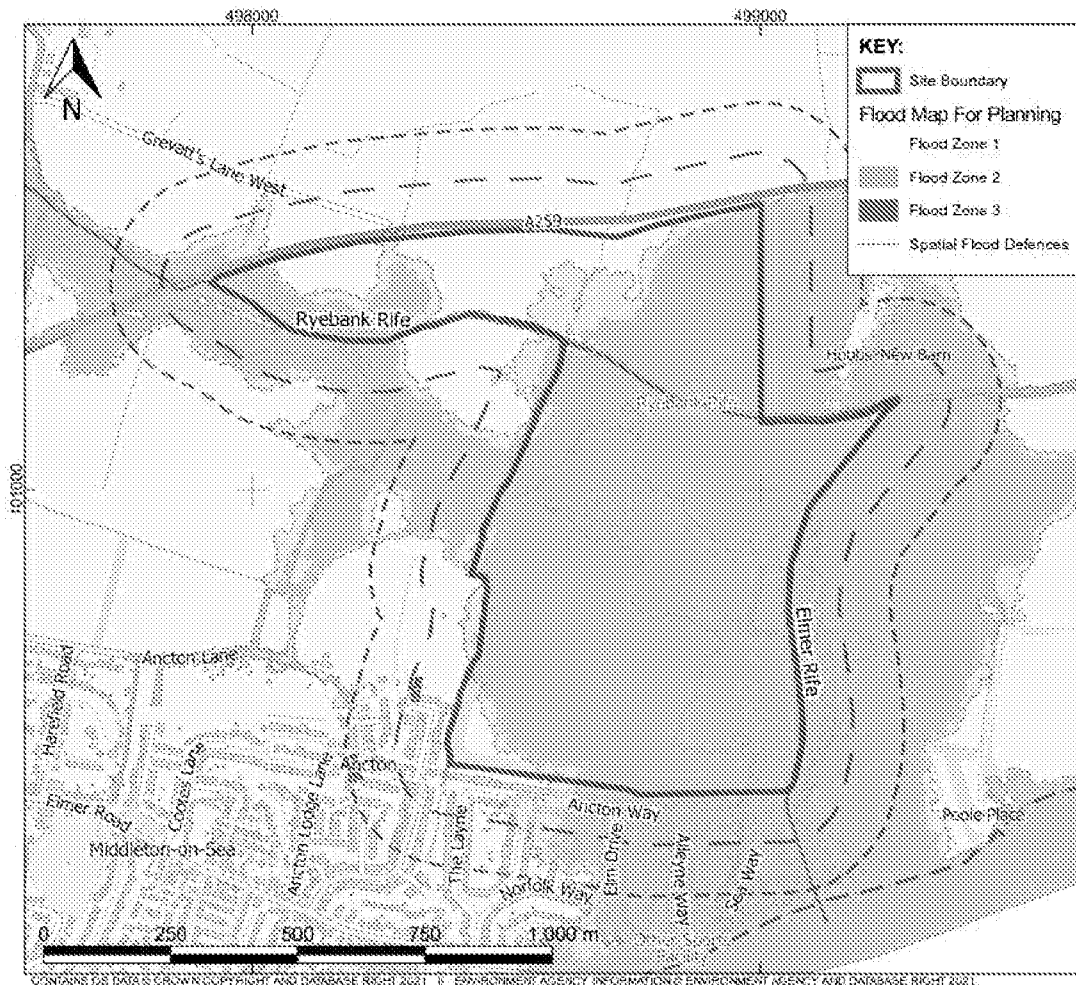
4.4. FLUVIAL & TIDAL FLOOD RISK

- 4.4.1. The watercourses adjacent to the site are tidally influenced and the risk from these sources has been jointly assessed in the hydraulic modelling undertaken, as detailed in section 4.5.

ENVIRONMENT AGENCY MAPPING

- 4.4.2. Figure 3 shows the EA Flood Map for Planning for the site and the surrounding area. The map shows areas that are affected by tidal and/or fluvial flooding and provides a classification of whether there is a High level of risk (Flood Zone 3), Medium level of risk (Flood Zone 2) or a Low level of risk (Flood Zone 1).

Figure 3 - Environment Agency's Flood Map for Planning



4.4.3. The EA Flood map for Planning shows the majority of the site, to be located within Flood Zone 3, which comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%AEP).

4.4.4. Based on this mapping the fluvial flood risk to the proposed development would be classified as high.

4.5. HYDRAULIC MODELLING

Consultation

4.5.1. Prior to undertaking hydraulic modelling consultation was undertaken with the Environment Agency, this included a meeting in January 2020 and subsequent discussions. As part of this the scope and methodology for the completion of the modelling was agreed .

Climate Change

4.5.2. The Environment Agency's Climate Change guidance³ in place at the time of preparation of this report have been used for the assessment of fluvial flood risk within the hydraulic model and mitigation design, this is:

※ 2080s - Central 25%

4.5.3. In addition, sea level rise was factored into the downstream tidal boundary of 1.2m.

4.5.4. This allowance has also been used for the mitigation design, including the on and off site impacts and determining the need for floodplain storage compensation.

Baseline Hydraulic Modelling

4.5.5. Baseline hydraulic modelling has been undertaken to refine the Environment Agency's flood extents for the site. This involved some small updates to the 2015 Aldingbourne direct rainfall ICM model, to make it suitable for the purposes of a site-specific assessment of flood risk.

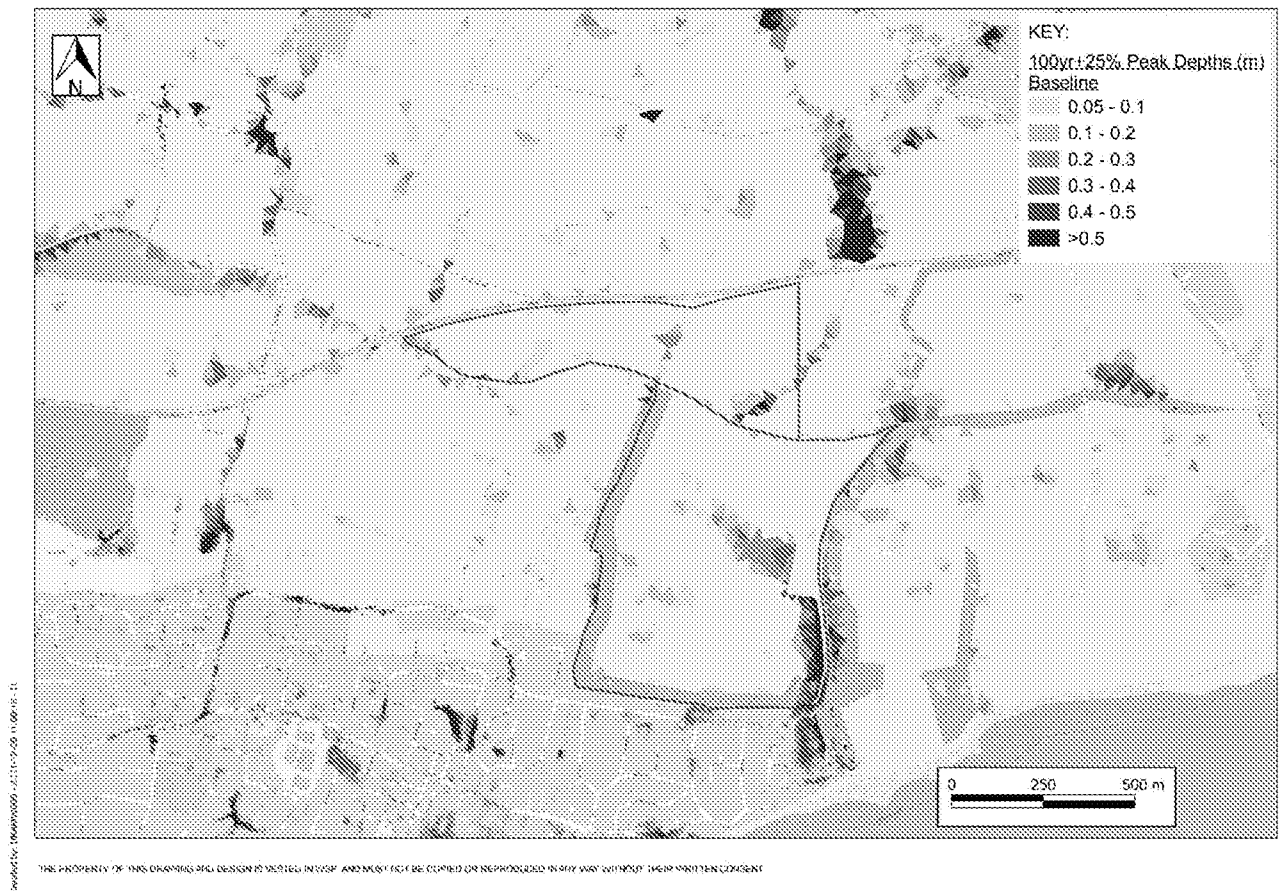
4.5.6. The 2015 Aldingbourne model is a 1D-2D, direct rainfall ICM model, which was commissioned by the Environment Agency for the Aldingbourne Flood Risk Mapping Study. It includes a fluvial and surface water drainage component and allows water to flow from the modelled 1D watercourses into the 2D floodplain. The Scheme specific updates included:

- ※ Utilising the FEH 2013 rainfall model to estimate the hydrology inputs;
- ※ Changes to the runoff parameters for buildings;
- ※ Assigning roughness values to all 1D components;
- ※ improvements to the representation of the watercourse confluences and at structures and manholes;
- ※ Updates to a number of coefficients where required e.g. discharge coefficients;
- ※ Consideration of the infiltration within the modelling; and
- ※ Additional baseflow added to river reaches of 0.01m³/s where instabilities were identified.

The hydraulic model was tested for a range of scenarios, however the main focus was the 1 in 100 year with an allowance for climate change (+25%), as shown in Figure 4.

³ <https://www.gov.uk/guidance/flood-risk-and-coastal-change>

Figure 4 - 1 in 100 year plus climate change baseline flood depths (m)



- 4.5.7. The modelled 1 in 100 year plus climate change (25%) flood depths and extents show that the majority of the site is not at risk of flooding. The most significant area at risk is along the eastern boundary of the site adjacent to the Elmer Rife

Post Development Hydraulic Modelling

- 4.5.8. Post-development hydraulic modelling has not been undertaken as the location of the clubhouse and maintenance buildings are situated in the north of the site outside of the baseline floodplain so it is expected that these elements of the development will not impact the flood regime. The land use parameter plan showing the location of these buildings is shown in Appendix B.
- 4.5.9. The proposed club house is to have a finished floor level of 5.5mAOD, this compares to the existing ground level of 4.0mAOD.
- 4.5.10. Large portions of the site will be regraded to facilitate construction of the golf course, however as a result of the reprofiling there will be no loss of floodplain, with a view to increase floodplain storage if possible.

FLUVIAL FLOOD RISK SUMMARY

- 4.5.11. The Ryebank Rife, categorised as a main river, flows from west to east, through the north of the site and the Elmer Rife (also categorised as a main river) flows bi-directionally (south-north) along the eastern boundary of the site.

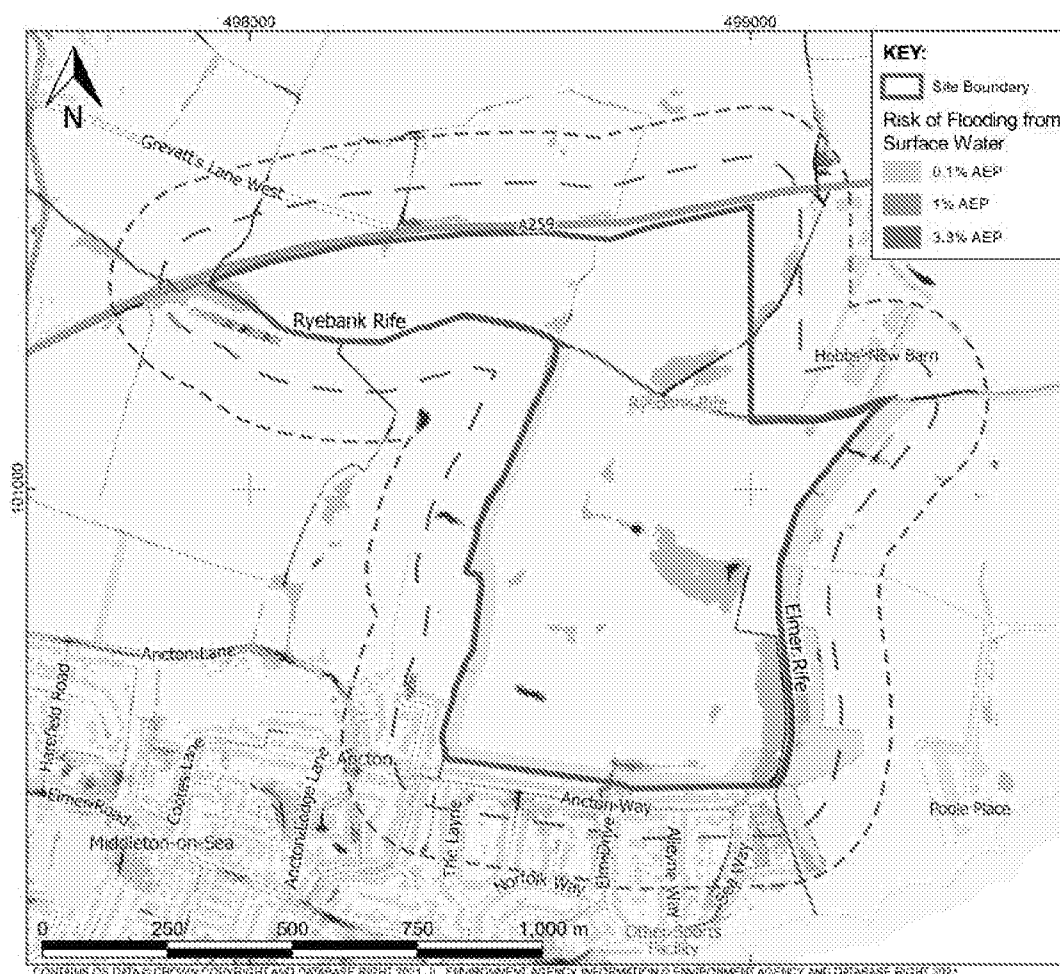
- 4.5.12. The majority of the site is shown to be located within Flood Zone 3 on the Environment Agency's Flood Map for Planning, which comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%AEP).
- 4.5.13. Baseline modelling has been undertaken for the site, the results of which show that the majority of the site is outside of the 1 in 100 year plus climate change flood extents.
- 4.5.14. As a result of the development the majority of the site is to be reprofiled however there will be no loss of floodplain, with a view to increase floodplain storage if possible. This will be modelled at the detailed design stage.
- 4.5.15. The more sensitive parts of the development such as the club house and maintenance buildings will be situated in the north of the site outside of the floodplain and these areas will not impact the flood regime.
- 4.5.16. The maintenance building is to be located to the west of the proposed reservoir reservoir. Topographic levels at the site (see Appendix C) show that levels here fall from west to east and that there is an existing ditch here. Therefore exceedance flows will be shallow and will largely be intercepted by the drain.

Identified Fluvial Flood Risk: Low

4.6. SURFACE WATER FLOOD RISK

- 4.6.1. Flooding from surface water is caused when rainfall cannot soak away because the ground is fully saturated, or drainage systems are full. This form of flooding is usually associated with high intensity rainfall events but can also occur with lower intensity rainfall or melting snow where the ground is saturated, frozen, developed or otherwise has a low permeability. The flood risk relates to both the conveyance of waters to the site by overland flow from areas outside the site and also areas within the site itself, and the ponding of these waters in depressions in the topography.
- 4.6.2. The Environment Agency's Risk of Flooding from Surface Water (Figure 4) indicates that the majority of the site is at very low risk of surface water flooding. Very low means that each year this area has a chance of flooding of less than 0.1%.

Figure 5 - Risk of Surface Water Flooding Map



- 4.6.3. Adjacent to the Ryebank Rife and Elmer Rife there are areas shown to be at low risk of surface water flooding, which means that these areas have an annual probability of flooding of between 1 in 1,000 and 1 in 100 (0.1% AEP to 1.0% AEP). There is also an area at low risk of surface water pooling in the centre of the southern portion of the site. Surface water flood depths are predicted to be between 300mm and 900mm adjacent to the Rifcs, with the depths in the low risk area in the centre of the site predicted to be below 300mm.
- 4.6.4. As a result of the proposed golf course development, the entire of the site is to be reprofiled, which will thereby change the existing surface water flow routes.
- 4.6.5. The hydraulic model (as detailed in Section 4.6) is a direct rainfall model which, therefore, also includes a representation of the surface water pathways onto the site. These pathways are along the Rifcs and ditches which cross the site, as shown in Figure 4 for the 1 in 100 year plus climate change event.
- 4.6.6. As a result of the proposed development, the site will be reprofiled which may result in changes to the onsite flowpaths. However the risk of surface water flooding will be managed through a drainage strategy and this will also ensure that there is no off-site increase in surface water flooding, as detailed in section 5.

4.7. GROUND WATER FLOOD RISK

- 4.7.1. According to the Source Protection Zone map produced by the Environment Agency, the site does not lie within any Source Protection Zones (see Appendix A Flood Map Pack).
- 4.7.2. Appendix F of the Level 1 SFRA, contains an extract of the Environment Agency's Areas Susceptible to Groundwater Flooding (AStGWF) mapping for Bognor Regis. The AStGWF is a strategic-scale map showing groundwater flood areas on a 1km square grid, this data shows the proportion of each 1km grid square, where geological and hydrogeological conditions indicate that groundwater might emerge.
- 4.7.3. The AStGWF mapping indicates that site is located in an area with a high susceptibility to groundwater flooding. High corresponds with >75% of each 1km grid square being susceptible to groundwater emergence.
- 4.7.4. Historical borehole records available from the BGS indicate that groundwater levels within the site vary from 1.8 to 6.0 m bgl.
- 4.7.5. Neither the Level 1 nor Level 2 SFRAs contain details of any groundwater flooding incidents within the vicinity of the site boundary.
- 4.7.6. To mitigate the risk of groundwater flooding the following measures will be implemented:
 - ※ A positive surface water drainage system will be installed;
 - ※ The network of surface water channels across the site will be increased and where required enhanced; and
 - ※ The club house and maintenance buildings will be raised above existing ground levels.
- 4.7.7. The risk that groundwater flooding poses to the development is assessed to be Low.

Identified Groundwater Flood Risk: Low

4.8. SEWER FLOOD RISK

- 4.8.1. Sewer flooding occurs as a result of a number of influencing factors. It is most likely to occur during storms, when large volumes of rainwater enter the sewers. However, it can also occur when pipes become blocked or damaged.
- 4.8.2. There are no records of sewer flooding at the site in the Around District Council Level 1 or 2 SFRA's or the Arun Strategic Surface Water Management Study.

Identified Sewer Flood Risk: Low

4.9. ARTIFICIAL SOURCE FLOOD RISK

- 4.9.1. The Environment Agency Reservoir Flooding Map (see Appendix A flood map pack) shows that the site is located outside of the maximum extent of flooding in the event of a nearby reservoir failing.

Identified Flood Risk from Reservoirs: Low

Other artificial sources

- 4.9.2. There are no canals or other artificial waterbodies in the vicinity of the site.

5. SURFACE WATER DRAINAGE

- 5.1.1. To mitigate the risk of surface water flooding to the development a comprehensive drainage / SUDS strategy has been developed and is provided as a standalone document. This strategy involves attenuating and harvesting the surface water runoff at source, via ponds and swales, prior to discharging to the Elmer Rife and Ryebank Rife.
- 5.1.2. The water philosophy for the golf course is based around maximising the water collected for re-use from the golf course to minimise the impacts on the wider water environment for instance by minimising that waters which are required for irrigation from surface / groundwater abstraction or from potable water supply. This is to be achieved through rainwater collection / harvesting and water reuse. To achieve this aim rainwaters will be harvested where feasible from the golf course through collection (this is likely to include a network of swales and pipes) followed by and pumping to the reservoir behind the maintenance depot.
- 5.1.3. The surface water runoff to the Ryebank or Elmer Rife will be restricted to greenfield rates for the following scenarios:
- » Should the reservoir become full during a storm event;
 - » The runoff rates exceed the pump rates; or
 - » Runoff occurs from areas which are not part of the rain water harvesting scheme.
- 5.1.4. However, as the golf course will predominantly remain as a greenfield site (excluding car parking, access roads, club house and maintenance depot) the scheme will not result in an increase in runoff rates from these areas. As outlined above the surface water runoff from the new impermeable areas will be collected, treated appropriately (e.g. hydrocarbon interceptor / SuDS) and discharged to the reservoir or discharged at greenfield rates to the Ryebank or Elmer Rife.

6. FLOOD RISK MITIGATION

- 6.1.1. Mitigation measures are embedded within the development to ensure that the development is not exposed to an unacceptable level of flood risk and there is no increase in flood risk elsewhere are:
- ⌘ No loss of floodplain storage;
 - ⌘ The club house and maintenance depot are situated outside the floodplain
 - ⌘ Appropriate maintenance corridors are provided alongside the waterbodies;
 - ⌘ A surface water drainage system will be installed (including rainwater harvesting); and
 - ⌘ The Golf Course will include appropriate measures within the Operational Manual to ensure that players and staff are not placed at risk during flood events.

6.2. PLANNING POLICY

- 6.2.1. The inclusion of these mitigation measures demonstrates that the development meets the planning policy requirements as outlined in policy W DM2 of the ADC local plan:
- ⌘ It identifies adaptation and mitigation measures; and
 - ⌘ It ensures that the development will be safe, including access and egress, without increasing flood risk elsewhere.

7. CONCLUSIONS

- 7.1.1. The risk of flooding to and from the proposed development has been assessed in accordance with the NPPF July 2021.
- 7.1.2. The majority of the development is located in Flood Zone 3, on the Environment Agency's Flood Map for Planning. The Ryebank Rife, categorised as a main river, flows from west to east, through the north of the site and the Elmer Rife (also categorised as a main river) flows bi-directionally (south-north) along the eastern boundary of the site.
- 7.1.3. Hydraulic modelling has been undertaken for the Ryebank and Elmer Rifes combined with the surface water flood risk via a 1D-2D linked ICM hydraulic model. The model has tested the baseline scenario and has shown that the majority of the site is outside of the 1 in 100 year plus 25% climate change flood extents. The more sensitive parts of the development i.e. the clubhouse and maintenance buildings will be located in areas outside of the floodplain.
- 7.1.4. As a result of the development most of the site will be reprofiled to facilitate construction of the golf course, however as a result of the reprofiling there will be no loss of floodplain, with a view to increase floodplain storage if possible.
- 7.1.5. Mitigation measures are embedded within the development to ensure that it is not exposed to an unacceptable level of flood risk and there is no increase in flood risk elsewhere.
- 7.1.6. The post-development scenario includes the following mitigation measures:
 - ✧ No loss of floodplain storage;
 - ✧ The club house and maintenance depot are situated outside the floodplain
 - ✧ Appropriate maintenance corridors are provided alongside the waterbodies;
 - ✧ A surface water drainage system will be installed (including rainwater harvesting); and
 - ✧ The Golf Course will include appropriate measures within the Operational Manual to ensure that players and staff are not placed at risk during flood events
- 7.1.7. The present day risk of flooding from surface water to the site is considered to be low based on mapping from the Environment Agency and the outputs of the 1D-2D linked ICM hydraulic model.
- 7.1.8. To mitigate the risk of surface water flooding to the development a comprehensive drainage / SUDS strategy has been developed, this is a standalone document.
- 7.1.9. The risk of the development flooding from groundwater and artificial sources considered to be low.
- 7.1.10. The majority of the proposed residential development is located in Flood Zone 3. Based on Table 2 of the NPPG, the proposed residential development is classified as being 'Water Compatible'. Table 3 of the NPPG identifies that 'Water Compatible' development can be located in Flood Zone 3, subject to the site passing the sequential test. This site is deemed to be sequentially acceptable.
- 7.1.11. There is no requirement to undertake the exception test.

Appendix A

FLOOD RISK PACK

115/1

Appendix B

PROPOSED DEVELOPMENT PLANS

115/1

Appendix C

TOPOGRAPHICAL SURVEY

115/1



3rd Floor, Kings Orchard
1 Queen Street
Bristol
BS2 0HQ

