Weymouth Level 2 Strategic Flood Risk Assessment

Final Report

June 2023

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Contract

This report describes work commissioned by Oran Balazs, on behalf of Dorset Council, by a email from Chris Osbourne on the 13 December 2021. Dorset Council's representative for the contract was Oran Balazs. Jon Wilson of JBA Consulting carried out this work.

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Purpose

This document has been prepared as a Final Report for Dorset Council. JBA Consulting accepts no responsibility or liability for any use that is made of this document other than by the Client for the purposes for which it was originally commissioned and prepared.

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Acknowledgements

JBA would like to acknowledge the assistance of:

- Dorset Council
- Environment Agency
- Wessex Water

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Executive summary

Introduction and Context

This Level 2 Strategic Flood Risk Assessment (SFRA) document was created with the purpose of providing evidence of understanding of flood risk to support the redevelopment and strategic development of Weymouth Town Centre, Esplanade, and surrounding areas. Seven sites are being assessed as part of the Level 2 SFRA.

Level 2 SFRA Outputs

The Level 2 assessment includes a detailed assessment of the Weymouth Town Centre, Esplanade, and surrounding areas sites. This includes:

- An assessment of all sources of flooding including fluvial flooding, tidal flooding, surface water flooding, surface water flooding combined with a fluvial dominant event, surface water flooding combined with a tidal dominant event, and the potential increase in all these flood risks due to climate change, plus groundwater flooding.
- Reporting on current conditions of flood defence infrastructure, where applicable.
- An assessment of existing flood warning and emergency planning procedures, including an assessment of safe access and egress during an extreme event.
- Advice and recommendations on the likely applicability of sustainable drainage systems for managing surface water runoff.
- Advice on whether the site is likely to pass the second part of the Exception Test with regards to flood risk and on the requirements for a site-specific FRA.

Summary of Key Messages

- The majority of the sites assessed lie mostly or entirely within the Environment Agency's (EA's) Flood Zone 3, with the Commercial Road and Custom House Quay areas of sites WEY2 and WEY4, and part of WEY8 (Lodmoor) being within Flood Zone 3b. Site WEY7 (Westwey Road) lies outside of Flood Zone 3 but is partially within Flood Zone 2. Site WEY5 lies outside of Flood Zone 2. However, access and egress routes to this site lie within Flood Zone 3. The Exception Test will need to be passed for Essential Infrastructure within Zones 3a and 3b, More Vulnerable development within Zone 3a and High Vulnerable development within Zone 2. The EA's Flood Zones are based on undefended outlines and do not take account of flood defences in the area.
- Whilst much of the area within the sites is within Flood Zones 2 and 3, these areas also benefit from flood defences. However, the design standard of protection afforded by these is variable, ranging from one to 200 years. These defences, where assessed, are in variable condition. It is proposed to raise all harbour walls to 3.74m AOD between 2020 and 2030 as set out in the Weymouth Harbour & Esplanade Flood and Coastal Risk Management Strategy (September 2020).
- Weymouth is highly susceptible to climate change and modelling suggests that the proposed future flood defences will be overtopped with significant flooding affecting all sites during a 3.3% AEP tidal event in the future with Upper End climate change uplifts applied. In a 3.3% fluvial event in the future with the Central climate change uplift applied, all sites except WEY7 and most of WEY5 have significant flooding.

- Residual risk from structures and/or defences was considered at the sites. All sites are in close proximity to defences and will be at risk in the event of overtopping or breaching. Breach modelling has been undertaken to inform this assessment. These risks would need to be considered further as part of site-specific FRAs.
- Despite proposed future defences, all sites have considerable fluvial and tidal flooding issues and will require careful consideration. There are likely to be opportunities for phased development such as Less Vulnerable uses in the short term.
- All sites are at risk from surface water flooding. Surface water tends to follow topographic flow routes, for example along minor watercourses/ dry ditches or occurs in isolated pockets of ponding where there are topographic depressions. Surface water modelling applying Upper End (+40% for the 3.3% AEP event and +45% for the 1% and 0.1% AEP events) climate change scenarios were considered in the assessment. All sites appear highly sensitive to increased runoff as a result of climate change. Site-specific FRAs should confirm the impact of climate change using latest guidance.
- For all sites, especially WEY2, WEY4, WEY5 and WEY6, there is the potential for safe access and egress to be impacted by tidal, fluvial or surface water flooding. Consideration should be made for these sites as to how safe access and egress can be provided during flood events, both to people and emergency vehicles. Also, consideration should be given to whether the risk forms a flow path or bisects the site where access from one side to another may be compromised.

Recommendations

Considering the Exception Test for the proposed sites in Weymouth

The majority of the sites assessed lie mostly or entirely within the Environment Agency's (EA's) Flood Zone 3, with the Commercial Road and Custom House Quay areas of sites WEY2 and WEY4, and part of WEY8 (Lodmoor) being within Flood Zone 3b. Site WEY7 (Westwey Road) lies outside of Flood Zone 3 but is partially within Flood Zone 2. Site WEY5 lies outside of Flood Zone 2, however its access and egress routes lie within Flood Zone 3. The EA's Flood Zones are based on undefended outlines and do not take account of flood defences in the area.

To pass the Exception Test, it must be shown that the development will provide wider sustainability benefits that outweigh the risk and that the development will be safe throughout its lifetime without increasing risk elsewhere. The former is a planning-related consideration and the Level 2 SFRA helps to answer the latter part of the Test.

In principle, it is possible for the majority of sites to pass the flood risk element of the Exception Test by:

- Siting development within the settlement away from the highest areas of risk into Flood Zone 1 where Flood Zone 1 is present within sites.
- Considering safe access/ egress in the event of a flood (from all parts of the site, if say the site is severed by a flood flow path).
- Adequately considering residual risk from defences breaching or overtopping, for example through a flood warning and evacuation plan.
- Designing buildings with habitable floor levels above the design flood event, including an allowance for freeboard and/or providing safe refuge for residents to shelter during an extreme event above the 0.1% AEP flood level including climate change.

- Using areas in Flood Zone 2 for the least vulnerable parts of the development in accordance with Table 2 in the NPPF. Highly vulnerable development (for example police and ambulance stations, basement dwellings and caravans and mobile homes) should not be permitted in Flood Zone 3 and no development at all should be permitted in Flood Zone 3b (aside from essential infrastructure, such as a bridge crossing the lowest points of a site and water compatible development).
- Implementing site-level mitigations such as raising land on parts of the site and lowering in others to bring developable areas above the design flood event. Any raising of land must not contribute to a loss of floodplain storage or increase the risk to areas away from the site.
- Testing flood mitigation measures if these are to be implemented, to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).
- Considering space for green infrastructure in the areas of highest flood risk.

Some sites are at greater risk and will require careful consideration and mitigation to pass the flood risk element of the Exception Test.

Consideration should be given to the surface water risk where this is high, with regards to the Exception Test. For example, a site may pass the test based on fluvial or tidal flood risk alone, but greater risk may come from surface water.

If the settlement site is split in future into smaller land parcels for development at a later stage, and some of those parcels are in areas of flood risk, the Exception Test may need to be re-applied by the Developer at the planning application stage.

Strategic-level interventions which reduce the risk to the wider Weymouth area may also enable sites to be brought forward.

Production of a Local Adaptation and Resilience plan for Weymouth would help to identify the need to safeguard land/habitats/infrastructure and development for roll back or relocation as well as the provision to safeguard land for Flood risk management infrastructure.

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Abbreviations and Glossary of Terms

Term	Definition
1D model	One-dimensional hydraulic model
2D model	Two-dimensional hydraulic model
AEP	Annual Exceedance Probability
1% AEP event	A flood event which has a 1% chance of occurring in any given year. A 1% AEP event is equivalent to a 1 in 100-year event.
AStGWf	Areas Susceptible to Groundwater flooding
Brownfield	Previously developed land that is not currently in use.
CC	Climate Change - Long term variations in global temperature and weather patterns caused by natural and human actions.
CIA	Cumulative Impact Assessment
DC	Dorset Council
DTM	Digital Terrain Model
EA	Environment Agency
ESTRY	1D hydraulic modelling software
Exception Test	Set out in the NPPF, the Exception Test is used to demonstrate that flood risk to people and property will be managed appropriately, where alternative sites at a lower flood risk are not available. The Exception Test is applied following the Sequential Test.
FCERM	Flood and Coastal Erosion Risk Management
Flood Map for Planning	The Environment Agency Flood Map for Planning (Rivers and Sea) is an online mapping portal which shows the Flood Zones in England. The Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences and do not account for the possible impacts of climate change.
Flood Risk Area	An area determined as having a significant risk of flooding in accordance with guidance published by Defra and WAG (Welsh Assembly Government).
FWA	Flood Warning Area
Fluvial Flooding	Flooding resulting from water levels exceeding the bank level of a River.
FRA	Flood Risk Assessment - A site-specific assessment of all forms of flood risk to the site and the impact of development of the site to flood risk in the area.
FZ	Flood Zone
GIS	Geographical Information Systems
Greenfield	Undeveloped parcel of land
Ha	Hectare
InfoWorks ICM	1D/2D hydraulic modelling software used for integrated modelling (modelling of sewer networks, tidal & river levels and direct runoff from rainfall (surface water flooding).
JBA	Jeremy Benn Associates

L1/ L2	Level 1/ Level 2 (SFRA)
LIDAR	Light Detection and Ranging
LLFA	Lead Local Flood Authority - Local Authority responsible for taking the lead on local flood risk management.
LFRMS	Local Flood Risk Management Strategy
Main Watercourse	Main rivers are designated by the Environment Agency and are usually larger rivers and streams. It consults with other risk management authorities and the public before making these decisions. The Environment Agency carries out maintenance, improvement or construction work on Main Rivers to manage flood risk and their powers to carry out flood defence work apply to main rivers only.
m AOD	metres Above Ordnance Datum
NPPF	National Planning Policy Framework
NVZ	Nitrate Vulnerable Zone
Ordinary Watercourse	All watercourses that are not designated Main River. Local Authorities or, where they exist, IDBs have similar permissive powers as the Environment Agency in relation to flood defence work. However, the riparian owner has the responsibility for maintenance.
PPG	Planning Practice Guidance
Pluvial flooding	Flooding as a result of high intensity rainfall when water is ponding or flowing over the ground surface (surface runoff) before it enters the underground drainage network or watercourse or cannot enter it because the network is full to capacity.
RAG	Red-Amber-Green
Risk	In flood risk management, risk is defined as a product of the probability or likelihood of a flood occurring, and the consequence of the flood.
RMA	Risk Management Authority
RoFSW	Risk of Flooding from Surface Water (formerly known as the Updated Flood Map for Surface Water (uFMfSW))
Sequential Test	Set out in the NPPF, the Sequential Test is a method used to steer new development to areas with the lowest probability of flooding.
SF	Spatial Framework document – draft working group document
SFRA	Strategic Flood Risk Assessment
SGA	Strategic Growth Area
SPD	Supplementary Planning Document
SPZ	(Groundwater) Source Protection Zone
Stakeholder	A person or organisation affected by the problem or solution or interested in the problem or solution. They can be individuals or organisations, includes the public and communities.

SuDS	Sustainable Drainage Systems - Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques.
Surface water flooding	Flooding as a result of surface water runoff as a result of high intensity rainfall when water is ponding or flowing over the ground surface before it enters the underground drainage network or watercourse or cannot enter it because the network is full to capacity, thus causing what is known as pluvial flooding.
Tidal flooding	Flooding resulting from sea levels exceeding the coastal defence and natural ground levels. This includes allowances for storm surge and wave overtopping.
TUFLOW	2D hydraulic modelling software
URBEXT	Urban extent catchment descriptor, describing the level of urbanisation in a catchment.
WW	Wessex Water

1 Introduction

1.1 Purpose of the Strategic Flood Risk Assessment

> ***"Strategic policies should be informed by a strategic flood risk assessment, and should manage flood risk from all sources. They should consider cumulative impacts in, or affecting, local areas susceptible to flooding, and take account of advice from the Environment Agency and other relevant flood risk management authorities, such as lead local flood authorities and internal drainage boards.".***
>
> (National Planning Policy Framework, paragraph 160)

This Level 2 Strategic Flood Risk Assessment (SFRA) document was created with the purpose of informing decisions for securing allocation for regeneration and strategic development of Weymouth town centre, Esplanade and surrounding areas within the Dorset Council Local Plan and the preparation of sustainable policies for the long-term management of flood risk.

1.2 Local Plan

Dorset Council is working to produce a new Local Plan for Dorset, this will replace the current strategic policies of the existing adopted plans for the former council areas including the **West Dorset, Weymouth and Portland adopted local plan** for 2011-2031. The new Local Plan, called the 'Dorset Council Local Plan' will guide how the county will develop in the future and provide policies to guide decisions on development proposals and planning applications over a 17-year period.

1.3 Levels of SFRA

The published guidance on **"How to prepare a strategic flood risk assessment"** advocates a tiered approach to risk assessment and identifies the following two levels of SFRA:

- Level 1: where flooding is not a major issue in relation to potential site allocations and where development pressures are low. The assessment should be of sufficient detail to identify all flood risk areas and to enable application of the Sequential Test.
- Level 2: where it is not possible to allocate all land for development outside flood risk areas or where there may be high numbers of applications in flood risk areas on sites not identified in the local plan. A level 2 SFRA needs to be det be detailed enough to identify which development allocation sites have the least risk of flooding. It should also contain the information needed to apply the exception test and, if relevant, enable a decision to be made on whether development can be made safe without increasing flood risk elsewhere.

This report fulfils the requirements of a Level 2 SFRA for the Weymouth regeneration and strategic development sites.

1.4 SFRA Objectives

The objectives of the Level 2 SFRA are to:

1 Provide individual flood risk analysis for site options using the latest available flood risk data, thereby assisting the Council in applying the Exception Test to their proposed site options in preparation of their Local Plan.

2 Using available data, provide information and comprehensive mapping presenting flood risk from all sources for the site.

3 Where the Exception Test is required, provide recommendations for making the site safe throughout its lifetime.

4 Take into account most recent policy and legislation in the NPPF, PPG and LLFA SuDS guidance.

5 Consider whether the catchment is sensitive to new development in flood risk terms by undertaking a Cumulative Impact Assessment and further review policy and recommendations for these catchments.

1.5 Context of the Level 2 Assessment

Dorset Council is committed to the regeneration and strategic development of Weymouth Town Centre, Esplanade, and surrounding areas. It, however, accepts that these areas are at risk from various sources of flooding, both now and in the future. Areas surrounding the harbour are at risk of fluvial and tidal flooding, areas behind the Esplanade are at risk of wave overtopping in addition to fluvial and tidal flooding. Due to the low lying topography of the town, Weymouth has also experienced flooding from groundwater and surface water sources. Weymouth experienced significant flooding in the 1950s and 1960s and recently in 2014 during repeated coastal storms[1]. The Council understands therefore, that new and upgraded defences, as well as maintenance of existing structure will be necessary to meet its development objectives. To secure allocation within the new Dorset Council Local Plan, the council, in accordance with National Planning Policy, is required to evidence its understanding of flood risk and demonstrate how this might be managed and mitigated via a Level 2 Strategic Flood Risk Assessment (SFRA).

The main objectives of the Level 2 SFRA are stated above in section 1.4, it will also be used:

- To assess flood risk when taking decisions on planning applications;
- By applicants when preparing planning applications;
- To inform related work on the Flood & Coastal Risk Management (FCRM) Scheme for Weymouth; and
- To help inform any future Weymouth Neighbourhood Plan undertaken by others.

1.6 Consultation

1 Weymouth Flood Defence vision document, Weymouth and Portland Borough Council (2015) https://www.dorsetcouncil.gov.uk/documents/35024/280970/Flood+Vision+document.pdf/63e14f0e-b11e-4a1a-a612-438de7ebe2a7

SFRAs should be prepared in consultation with other risk management authorities. The following parties (external to Dorset Council) have been consulted during the preparation of this Level 2 SFRA:

- Environment Agency
- Wessex Water

1.7 How to use this report

Table 1-1: SFRA User Guide

Section	Contents	How to use
1. Introduction	Outlines the purpose and objectives of the Level 2 SFRA.	For general information and context.
2. The Planning Framework and Flood Risk Policy	Includes an overview of the information included within the Dorset Council Level 1 Strategic Flood Risk Assessment (section 2) (August 2022), including information on the implications of recent changes to planning and flood risk policies and legislation, as well as documents relevant to the study.	Users should refer to this section to identify which sections of the Level 1 SFRA to use to research for any relevant policy which may underpin strategic or site-specific assessments.
3. Planning policy for flood risk management	Provides an overview of both national and existing Local Plan policy on flood risk management. This includes the Flood Zones, application of the Sequential Approach and Sequential/Exception Test process. Provides guidance for the Council and Developers on the application of the Sequential and Exception Test at allocation and planning application stages.	Users should use this section to understand and follow the steps required for the Sequential and Exception Tests.
4. Impact of climate change	Outlines the latest climate change guidance published by the Environment Agency and how this was applied to the SFRA. Sets out how developers should apply the guidance to inform site-specific Flood Risk Assessments.	This section should be used to understand the climate change allowances for a range of epochs and conditions, linked to the vulnerability of a development.
5. Level 2 Assessment	Summarises the L2 assessment of the settlement sites and the data used to inform the assessment.	This section should be used in conjunction with site summary tables mapping to understand the data presented. Developers should refer back to this section when understanding requirements for a site-specific FRA.
6. Surface water management and SuDS	Includes an overview of the information included within the Dorset Council Level 1 Strategic Flood Risk Assessment (section 9) (August 2022), including information on specific local standards and guidance for Sustainable Drainage Systems (SuDS) from the Lead Local Flood Authority.	Developers should use this section to identify which sections of the Level 1 SFRA to use to research what national, regional and local SuDS standards are applicable.
7. Flood risk management requirements for developers	Includes an overview of the information included within the Dorset Council Level 1 Strategic Flood Risk Assessment (section 8) (August 2022), including the assessments that must be submitted in FRAs supporting applications for new development.	Developers should use this section to identify which sections of the Level 1 SFRA to use to research requirements for FRAs and flood mitigation requirements for the site as a whole and sub-catchments assessed.

8. Summary of Level 2 assessment and recommendations	Summarises the results and conclusions of the Level 2 assessment and makes recommendations for planning policy and development.	Developers and planners should use this section to provide an overview of the Level 2 assessment.
Appendix A: A.1 Site summary tables A.2 PDF mapping	Detailed assessment of the risk to specific sites identified by Dorset Council and likely actions required to bring the site forward under the Sequential/Exception Tests.	Developers and planners should use this section to provide an overview of the risk to specific sites.

Hyperlinks to external guidance documents/websites are provided in **bold** throughout the SFRA.

1.8 L2 SFRA Study Area

Weymouth is located on the south coast in the county of Dorset. There are two Environment Agency Main Rivers in its vicinity, the River Wey and Preston Brook. The town is located at the mouth of the River Wey where the river meets Weymouth Bay. Within Weymouth, to the south of Westham Bridge the River Wey forms Weymouth harbour; tidal flap valves in Westham Bridge make Radipole Lake, upstream of the bridge, largely non-tidal. Bordering Weymouth to the north east is the marshland of Lodmoor RSPB reserve which is tidally influenced through the discharge culvert of the Preston Brook.

Dorset Council wish to regenerate and strategically develop Weymouth Town Centre, Esplanade, and surrounding areas. To support this, an assessment of potential areas for urban renewal was carried out. This has identified seven sites which require further consideration, as shown in Figure 1-1. The main watercourses in the study area are shown in Figure 1-2.

Figure 1-1: Overview Map of Study Area

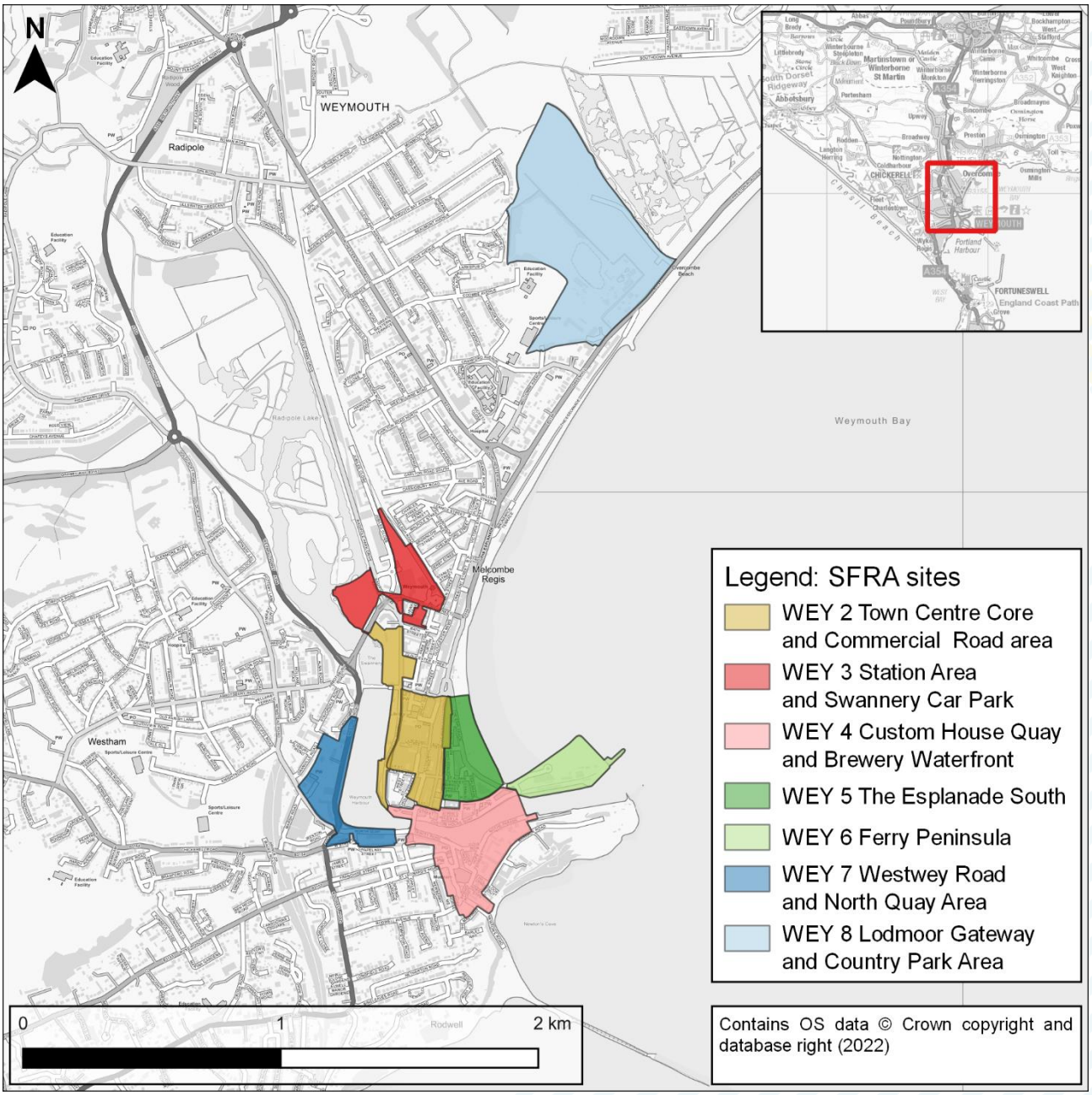
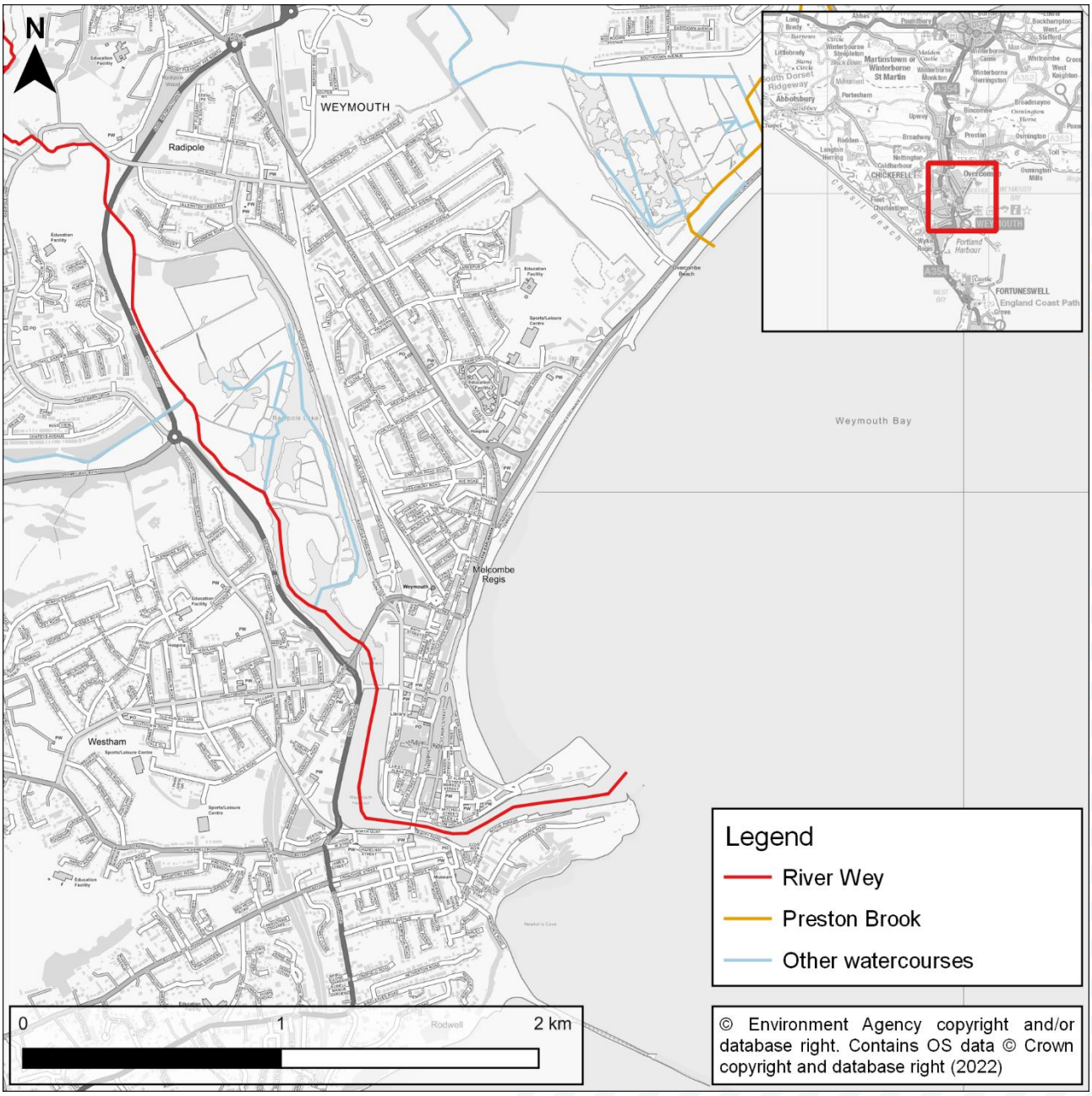


Figure 1-2: Main rivers and other watercourses within Weymouth



2 The Planning Framework and Flood Risk Policy

The Flood Risk Management roles and responsibilities for different organisations and relevant legislation, policy and strategy are detailed within the Dorset Council Level 1 Strategic Flood Risk Assessment (section 2) (August 2022).

This contains detail on:

- Flood risk policy and strategy
- Roles and responsibilities for Flood Risk Management in Dorset
- Relevant legislation
- Relevant Flood Risk Policy and Strategy Documents
- Key legislation for flood and water management
- Key national, regional and local policy documents and strategies

3 Planning Policy for Flood Risk Management

This section summarises national planning policy for development and flood risk.

3.1 National Planning Policy Framework and Guidance

The revised **National Planning Policy Framework (NPPF)** was published in July 2021, replacing the 2019 version. The NPPF sets out Government's planning policies for England. It must be considered in the preparation of local plans and is a material consideration in planning decisions. The NPPF defines Flood Zones, how these should be used to allocate land and flood risk assessment requirements. The NPPF states that:

"Strategic policies should be informed by a strategic flood risk assessment and should manage flood risk from all sources. They should consider cumulative impacts in, or affecting, local areas susceptible to flooding, and take account of advice from the Environment Agency and other relevant flood risk management authorities, such as lead local flood authorities and internal drainage boards"

The **Planning Practice Guidance** (PPG) on flood risk and coastal change sets out how the policy should be implemented. **Diagram 1 in the PPG** sets out how flood risk should be considered in the preparation of plans. It was updated on the 25 August 2022.

3.2 The risk-based approach

The NPPF takes a risk-based approach to development in flood risk areas. Since July 2021 the approach has adjusted the requirement for the Sequential Test (as defined in Para 162 of the NPPF) so that all sources of flood risk are included in the consideration. At the time of preparation of the 2022 SFRA the updated guidance (PPG) has been published, describing a revised approach to the Sequential Test. The requirement for the revised Sequential Test has been addressed by adopting the following approach:

- The test will cease to be based on the use of the Zones describing river and sea flood risk, and instead be based on whether development can be located in the lowest risk areas (high-medium-low) of flood risk both now and in the future (the test applied to all sources of flood risk – whereas previously the test was only performed for present day flood risk for the "Flood Zones" i.e. river and sea flood risk).
- Understanding flood risk to sites based on their vulnerability and incompatibility as opposed to whether development is appropriate
- As there is no available competent risk mapping for other sources of risk that is comparable with that for the sea, rivers and surface water it is not considered appropriate to use such mapping in a strict process that involves comparison of differing levels of flood risk. However, it is important that the potential implications of such risk is assessed in performing the Sequential Test and so reservoir, groundwater and sewer flood risk are addressed during the process of finalising the selection of allocation sites. This process is undertaken in the Level 2 SFRA and involves a more detailed assessment of the implications of reservoir, sewer and groundwater flood risk to establish that more appropriate locations at lower risk are not available. Thus consideration is given to all sources of flood risk using the available data to complete of the Sequential Test so decisions on the selection of preferred sites for allocation address the potential implications of groundwater, reservoir and sewer flooding and where necessary identify sites where consideration should be given to satisfying the requirements of the Exception Test.

3.2.1 Flood Zones – rivers and tidal risk

The definition of the Flood Zones is provided below. The Flood Zones do not take into account defences. This is important for planning long term developments as long-term policy and funding for maintaining flood defences over the lifetime of a development may change over time.

The Flood Zones do not take into account surface water, sewer or groundwater flooding or the impacts of canal or reservoir failure. They do not consider climate change. Hence there could still be a risk of flooding from other sources and that the level of flood risk will change over time during the lifetime of a development.

The Flood Zones are:

- Flood Zone 1: Low risk: less than a 0.1% chance of river and sea flooding in any given year
- Flood Zone 2: Medium risk: between a 1% and 0.1% chance of river flooding in any given year or 0.5% and 0.1% chance of sea flooding in any given year
- Flood Zone 3a: High risk: greater or equal to a 1% chance of river flooding in any given year or greater than a 0.5% chance of sea flooding in any given year. Excludes Flood Zone 3b.
- Flood Zone 3b: Functional Floodplain: land where water has to flow or be stored in times of flood. SFRAs identify this Flood Zone in discussion with the LPA and the Environment Agency. The identification of functional floodplain takes account of local circumstances. Only water compatible and essential infrastructure are permitted in this zone and should be designed to remain operational in times of flood, resulting in no loss of floodplain or blocking of water flow routes. It may be required to consider climate change on the functional floodplain; this would need hydraulic modelling to confirm extents and therefore it is recommended that this is considered in a Flood Risk Assessment and a suitable approach is agreed with the EA.

Further details on the Flood Zones can be found within the Level 1 Strategic Flood Risk Assessment.

3.2.2 Flood risk areas – surface water risk and other sources of flooding

To address the requirement that flood risk from all sources is included in the Sequential Test further sets of flood risk areas for surface water have been prepared. It is not possible to prepare flood risk area maps for reservoir, groundwater or sewer flood risk as the appropriate analyses and data are not available. The existing risk information on reservoirs, sewer flooding and groundwater is used in the sequential approach to consider development at a site in accordance with paragraph 161 of the NPPF (which could in some instances result in alternative sites being considered).

3.2.3 The Sequential Test

Firstly, land at the lowest risk of flooding and from all sources should be considered for development. A test is applied called the 'Sequential Test' to do this. Figure 3-1 summarises the Sequential Test. The LPA will apply the Sequential Test to strategic allocations. For all other developments, developers must supply evidence to the LPA, with a Planning Application, that the development has passed the test.

The LPA should, alongside other Risk Management Authorities and taking account of local circumstances, define a suitable area of search for the consideration of alternative sides in the Sequential Test. The Sequential Test can be undertaken as part of a Local Plan Sustainability Appraisal. Alternatively, it can be demonstrated through a free-standing document, or as part of Strategic Housing Land or Employment Land Availability Assessments.

Whether any further work is needed to decide if the land is suitable for development will depend on both the vulnerability of the development and the Flood Zone it is proposed for. **Table 2 of the PPG** defines the flood risk vulnerability and flood zone 'incompatibility' of different development types to flooding.

Figure 3-1: The Sequential Test

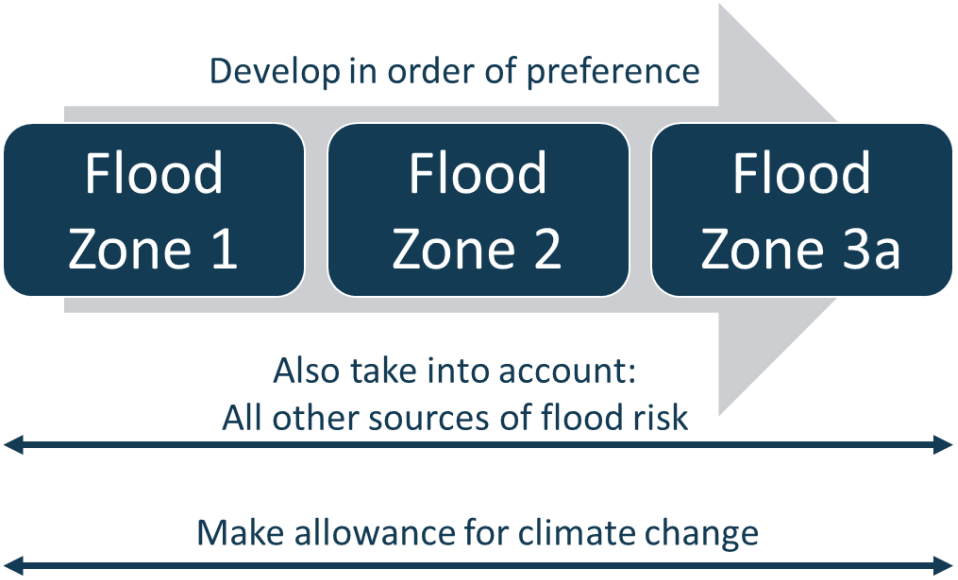
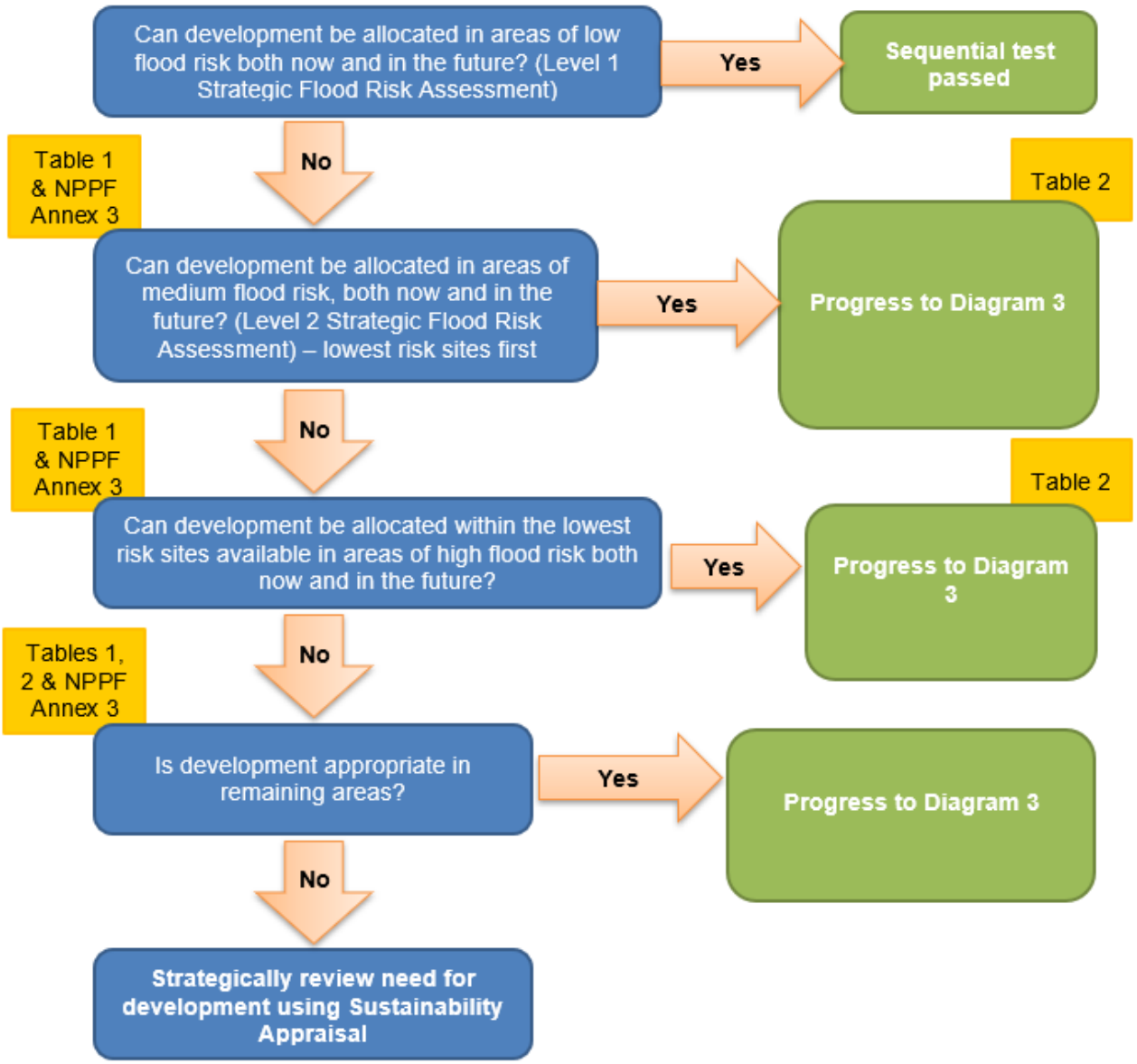


Figure 3-2 illustrates the Sequential and Exception Tests as a process flow diagram (**Diagram 2 of the PPG**) using the information contained in this SFRA to assess potential development sites against the EA's Flood Map for Planning flood zones and development vulnerability compatibilities.

This is a stepwise process, but a challenging one, as a number of the criteria used are qualitative and based on experienced judgement. The process must be documented, and evidence used to support decisions recorded. In addition, the risk of flooding from other sources and the impact of climate change must be considered when considering which sites are suitable to allocate.

Figure 3-2: Application of the Sequential Test for plan preparation



Notes to Figure 3-2: Other sources of flooding also need to be considered.

3.2.4 The Exception Test

The next step in considering flood risk as part of plan making and decision taking following application of The Sequential Test is to determine whether an Exceptions Test assessment is also needed. The requirement to apply the Exception Test is triggered when a greater understanding of the scale and nature of the flood risks is needed.

The Exception Test should only be applied following the application of the Sequential Test. The test is triggered for:

- More vulnerable in Flood Zone 3a
- Essential infrastructure in Flood Zone 3a or 3b
- Highly vulnerable in Flood Zone 2 (this is NOT permitted in Flood Zone 3a or 3b)

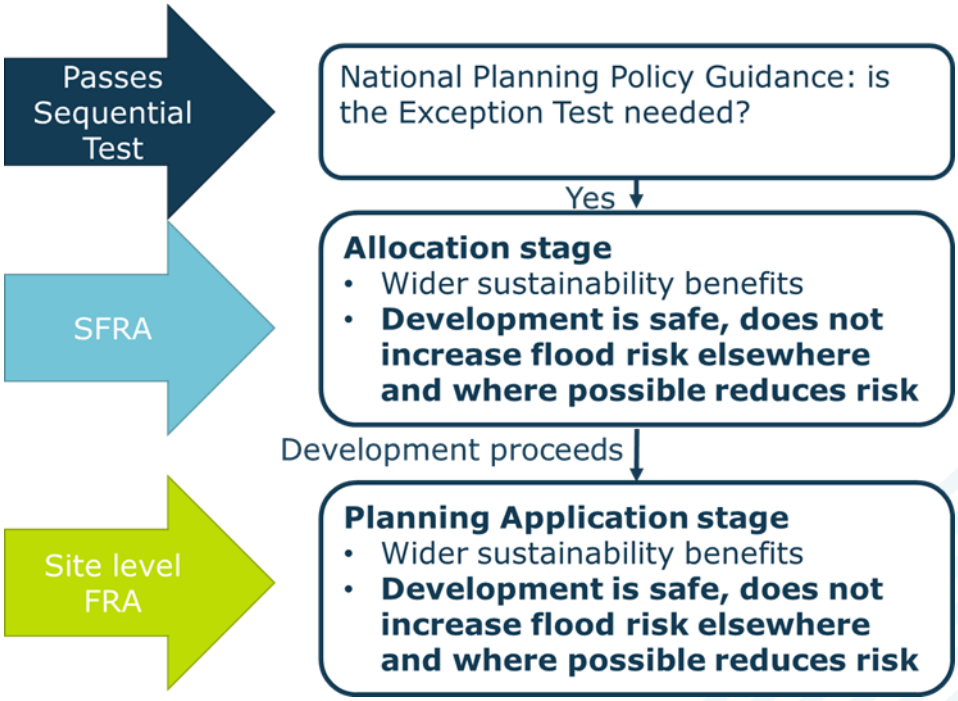
The Council should also consider whether the exception test also needs to be applied for other sources of flood risk, now and in the future.

Figure 3-3 summarises the Exception Test.

For sites allocated within the Local Plan, the Local Planning Authority should use the information in this SFRA to inform the Exception Test. At planning application stage, the Developer must design the site such that it is appropriately flood resistant and resilient in line with the recommendations in National and Local Planning Policy and supporting guidance and those set out in this SFRA. This should demonstrate that the site will still pass the flood risk element of the Exception Test based on the detailed site level analysis.

For developments that have not been allocated in the Local Plan, developers must undertake the Exception Test and present this information to the Local Planning Authority for approval. The Level 2 SFRA can be used to scope the flooding issues that a site-specific FRA should investigate in more detail to inform the Exception Test for windfall sites.

Figure 3-3: The Exception Test



There are two parts to demonstrating a development passes the Exception Test:

Demonstrating that the development would provide wider sustainability benefits to the community that outweigh the flood risk:

Local planning authorities will need to consider what criteria they will use to assess whether this part of the Exception Test has been satisfied and give advice to enable applicants to provide evidence to demonstrate that it has been passed. If the application fails to prove this, the Local Planning Authority should consider whether the use of planning conditions and / or planning obligations could allow it to pass. If this is not possible, this part of the Exception Test has not been passed and planning permission should be refused.

At the stage of allocating development sites, Local Planning Authorities should consider wider sustainability objectives, such as those set out in Local Plan Sustainability Appraisals. These generally consider matters such as biodiversity, green infrastructure, historic

environment, climate change adaptation, flood risk, green energy, pollution, health, transport etc.

The Local Planning Authority should consider the sustainability issues the development will address and how doing so will outweigh the flood risk concerns for the site, e.g. by facilitating wider regeneration of an area, providing community facilities, infrastructure that benefits the wider area etc.

Demonstrating that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall:

A Level 2 SFRA is needed to inform the Exception Test undertaken as part of the plan making process. The SFRA should provide evidence around whether the development in an allocation would be safe over its lifetime, whether development would increase flood risk elsewhere and the opportunities to reduce the risks of flooding. At Planning Application stage, a site-specific Flood Risk Assessment will also be needed. Both would need to consider the actual and residual flood risks and how these will be managed over the lifetime of the development.

3.2.5 Making a site safe from flood risk over its lifetime

Local Planning Authorities will need to consider the actual and residual risk of flooding and how this will be managed over the lifetime of the development:

- The actual risk is the risk to the site considering existing flood mitigation measures. The National Planning Policy Guidance refers to the 'design flood' against which the suitability of a proposed development should be assessed and mitigation measures, if any, are designed. The 'design flood' is a flood event of a given annual flood probability, which is generally taken as:
  - river flooding likely to occur with a 1% annual probability (a 1 in 100 chance each year); or
  - tidal flooding with a 0.5% annual probability (1 in 200 chance each year); or
  - surface water flooding likely to occur with a 1% annual probability (a 1 in 100 chance each year),

  plus an appropriate allowance for climate change
- Safe access and egress should be available during the design flood event. Firstly, this should seek to avoid areas of a site at flood risk. If that is not possible then access routes should be located above the design flood event levels. Where that is not possible, access through shallow and slow flowing water that poses a low flood hazard may be acceptable.
- Residual risk is the risk that remains after the effects of flood defences have been taken into account and/ or from a more severe flood event than the design event. The residual risk can be:
  - The effects of an extreme 0.1% annual probability flood event. Where there are defences, this could cause them to overtop, which may lead to failure if this causes them to erode, and/ or
  - Structural failure of any flood defences, such as breaches in embankments or walls.

Flood resistance and resilience measures should be considered to manage any residual flood risk by keeping water out of properties and seeking to reduce the damage it does, should water enter a property. Emergency plans should also account for residual risk, e.g. through the provision of flood warnings and a flood evacuation plan where appropriate.

In line with the NPPF, the impacts of climate change over the lifetime of the development should be taken into account when considering actual and residual flood risk.

3.3 Applying the Sequential Test and Exception Test to individual planning applications

3.3.1 Sequential Test

Dorset Council, with advice from the Environment Agency, are responsible for considering the extent to which Sequential Test considerations have been satisfied.

Developers are required to apply the Sequential Test to all development sites, unless:

- the proposed development is consistent with a strategic allocation made through a local plan and the test has already been carried out by the LPA, or
- the proposed development involves a change of use (except for changes of use to a caravan, camping or chalet site, or to a mobile home or park home site), or
- the proposed development comprises householder development or a small extension i.e. extensions with a footprint of less than 250m^2, or
- the site is in an area at low risk from all sources of flooding, unless the Strategic Flood Risk Assessment, or other information, indicates there may be a risk of flooding in the future.

The SFRA contains information on all sources of flooding and taking into account the impact of climate change. This should be considered when a developer undertakes the Sequential Test, including the consideration of reasonably available sites at lower flood risk.

The council should take account of local circumstances when considering how to define the area of search for the Sequential Test in Weymouth Town Centre Area (taking account of its objectives relating to re-development of key sites and regeneration of this area). Planning practice guidance suggests taking account of local circumstances when defining the area of application of the Sequential Test (within which it is appropriate to identify reasonably available alternatives).

The sources of information on reasonably available sites may include:

- Site allocations in Local Plans
- Site with Planning Permission but not yet built out
- Strategic Housing and Economic Land Availability Assessments (SHELAAs)/ five-year land supply/ annual monitoring reports
- Locally listed sites for sale

It may be that a number of smaller sites or part of a larger site at lower flood risk form a suitable alternative to a development site at high flood risk.

Ownership or landowner agreement in itself is not acceptable as a reason not to consider alternatives.

3.3.2 The Exception Test

If, following application of the Sequential Test it is not possible for the development to be located in areas with a lower probability of flooding the Exception Test must then be applied if required (as set out in Table 2 of the Planning Practice Guidance). Developers are required to apply the Exception Test to all applicable sites (including strategic allocations).

The applicant will need to provide information that the application can pass both parts of the Exception Test:

- Demonstrating that the development would provide wider sustainability benefits to the community that outweigh the flood risk.
- Applicants should refer to wider sustainability objectives in Local Plan Sustainability Appraisals. These generally consider matters such as biodiversity, green infrastructure, historic environment, climate change adaptation, flood risk, green energy, pollution, health, transport etc.
- Applicants should detail the sustainability issues the development will address and how doing it will outweigh the flood risk concerns for the site e.g. by facilitating wider regeneration of an area, providing community facilities, infrastructure that benefits the wider area etc.
- Demonstrating that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.
- The site-specific Flood Risk Assessment (FRA) should demonstrate that the site will be safe, and the people will not be exposed to hazardous flooding from any source. The FRA should consider actual and residual risk and how this will be managed over the lifetime of the development, including:
    - The design of any flood defence infrastructure
    - Access and egress
    - Operation and maintenance
    - Design of the development to manage and reduce flood risk wherever possible
    - Resident awareness
    - Flood warning and evacuation procedures, including whether the developer would increase the pressure on emergency services to rescue people during a flood event; and
    - Any funding arrangements required for implementing measures.

3.3.3 Developer contributions

In some cases, and following the application of the sequential test, it may be necessary for the developer to make a contribution to the improvement of flood defence provision that would benefit both proposed new development and the existing local community. Developer contributions can also be made to maintenance and provision of flood risk management assets, flood warning and the reduction of surface water flooding (i.e. SuDS). The LFRMS Action Plan reinforces that developers may be required to make necessary contributions to the cost of SuDS and flood risk management activities.

DEFRA's Flood and Coastal Risk Management Grant in Aid (FCRMGiA) can be obtained by operating authorities to contribute towards the cost of a range of activities including flood risk management schemes that help reduce the risk of flooding and coastal erosion. Some schemes are only partly funded by FCRMGiA and therefore any shortfall in funds will need to be found from elsewhere when using Resilience Partnership Funding, for example local levy funding, local businesses or other parties benefitting from the scheme.

For new development in locations without existing defences, or where the development is the only beneficiary, the full costs of appropriate risk management measures for the life of the assets proposed must be funded by the developer.

However, the provision of funding by a developer for the cost of the necessary standard of protection from flooding or coastal erosion does not mean the development is appropriate as other policy aims must also be met. Funding from developers should be explored prior

to the granting of planning permission and in partnership with the Council and the Environment Agency.

The appropriate route for the consideration of strategic measures to address flood risk issues is the LFRMS. The LFRMS should describe the priorities with respect to local flood risk management, the measures to be taken, the timing and how they will be funded. It will be preferable to be able to demonstrate that strategic provisions are in accordance with the LFRMS, can be afforded and have an appropriate priority.

The Environment Agency is also committed to working in partnership with developers to reduce flood risk. Where assets are in need of improvement or a scheme can be implemented to reduce flood risk, the Environment Agency request that developers contact them to discuss potential solutions.

Community Infrastructure Levy

The Community Infrastructure Levy (CIL) allows local authorities to raise funds from developers undertaking new building projects in their administrative area. The CIL rate is set locally, within a Charging Schedule. The CIL can be used for a variety of local infrastructure needs arising from new development in the study area including flood defences. The types of infrastructure which can be funded by CIL is set out in the council's West Dorset Regulation 123 list. Further information on CIL can be found on the Councils **website**.

4 Climate Change Guidance

The NPPF sets out that flood risk should be managed over the lifetime of a development, taking climate change into account. This section sets out how the impacts of climate change should be considered. This is further detailed in the Dorset Council Level 1 Strategic Flood Risk Assessment (section 4) (August 2022). This section follows Environment Agency guidance as set out in **Flood risk assessments: climate change allowances** (February 2016, updated May 2022).

4.1 Relevant Allowances for Weymouth

Table 4-1 shows the peak river flow allowances that apply to Weymouth for fluvial flood risk[2]. For large catchments (more than 5km^2) with rural land use, these allowances should be used. The central allowance should be used for all developments except essential infrastructure, for which the higher central allowance should be used. The epoch considered will be dependent on the anticipated lifetime of the development. Residential development can be assumed to have a lifetime of at least 100 years, unless there is specific justification for considering a different period. For example, the time in which flood risk or coastal change is anticipated to affect it, where a development is controlled by a time-limited planning condition. The lifetime of a non-residential development depends on the characteristics of that development but a period of at least 75 years is likely to form a starting point for assessment[3].

The uplifts provided are for the Dorset Management Catchment.

Table 4-1: Peak River Flow Allowances by River Management Catchment

River Management Catchment	Allowance category	Total potential change anticipated for '2020s' (2015 to 39)	Total potential change anticipated for '2050s' (2040 to 2069)	Total potential change anticipated for '2080s' (2070 to 2115)
Dorset	Upper end	37%	58%	103%
	Higher central	25%	35%	63%
	Central	19%	25%	47%

Table 4-2 and Table 4-3 show the peak rainfall intensity allowances[4] that apply when considering surface water flood risk. These should be used for site-scale applications (for example, drainage design), and for surface water flood mapping in small catchments (less than 5km^2) and urbanised drainage catchments. For development with;

- a lifetime beyond 2100: the Upper End allowances for the 2070's epoch should be considered for both the 3.3% and 1% AEPs.

2 https://environment.data.gov.uk/hydrology/climate-change-allowances/river-flow?mgmtcatid=3030

3 https://www.gov.uk/guidance/flood-risk-and-coastal-change#para6

4 https://environment.data.gov.uk/hydrology/climate-change-allowances/rainfall?mgmtcatid=3030

- a lifetime of between 2061 and 2100: the Central allowance for the 2070's epoch should be considered for both the 3.3% and 1% AEPs.
- a lifetime up to 2060: the Central allowance for the 2050's epoch should be considered for both the 3.3% and 1% AEPs.

The uplifts provided are for the Dorset Management Catchment.

Table 4-2: Dorset Management Catchment peak rainfall allowances 3.3% annual exceedance rainfall event

Allowance category	Total potential change anticipated for '2050s'	Total potential change anticipated for '2070s'
Upper end	35%	40%
Central	20%	25%

Table 4-3: Dorset Management Catchment peak rainfall allowances 1% annual exceedance rainfall event

Allowance category	Total potential change anticipated for '2050s'	Total potential change anticipated for '2070s'
Upper end	40%	45%
Central	25%	25%

Table 4-4 shows the sea level allowances for the South West River Basin District[5]. The total sea level rise for each epoch is in brackets. Beyond 2125 the annual 2096 to 2125 increase has been applied to the cumulative rise in sea levels and uplifts were applied to the 2022 sea levels. This results in an increase in level of 1.71m for the Upper End up to 2139. See section 5.3.1 for further details.

Table 4-4: Sea level allowances for the South West River Basin District

Allowance category	2000 to 2035 (mm)	2036 to 2065 (mm)	2066 to 2095 (mm)	2096 to 2125 (mm)	Cumulative rise 2000 to 2125 (metres)
Upper end	7 (245)	11.4 (342)	16 (480)	18.4 (552)	1.62
Higher central	5.8 (203)	8.8 (264)	11.7 (351)	13.1 (393)	1.21

5 https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances#river-basin-district

5 Level 2 Strategic Flood Risk Assessment

This section highlights all the datasets used in the Level 2 SFRA to assess the local plan sites against flood risk.

Source of flood risk	Data used to inform the assessment	Data supplied by
Historic (all sources)	Historic Flood Map and Recorded Flood Outlines	Environment Agency
	Historic flood incidents/records	Dorset Council
Fluvial (depths, velocities, hazard – present day and climate change)	Weymouth coastal and fluvial model (JBA 2019) – updated 2022	JBA Consulting
Tidal (depths, velocities, hazard – present day and climate change)	Weymouth coastal and fluvial model (JBA 2019) – updated 2022	JBA Consulting
Surface Water (depths, velocities, hazard – present day and climate change)	Weymouth integrated surface water model (JBA 2022)	JBA Consulting
Groundwater	Bedrock geology/superficial deposits dataset JBA's Groundwater Flood Risk Map	Environment Agency JBA Consulting
Reservoir	National Inundation Reservoir Mapping	Environment Agency

5.1 Historic flooding

5.1.1 Data used to inform historic flood risk

Historic flooding was assessed using the Environment Agency's Historic Flood Map and Recorded Flood Outlines, as well as any incidents picked up in the historic flooding register provided by Dorset Council as LLFA.

5.2 Fluvial flood risk

5.2.1 Data used to inform fluvial risk

The Weymouth coastal and fluvial model (JBA 2019) was updated as part of this study. The modelling work included offshore statistics, wave transformation, wave overtopping and flood inundation covering the areas of the River Wey through Weymouth, the town centre and the Lodmoor Nature Reserve.

The model is a 1D-2D ESTRY-TUFLOW model, which was updated with the latest defence information, a new LIDAR Digital Terrain Model (DTM), updated building thresholds, improvements to the representation of sluice gates and outfalls and updated boundary conditions.

Fluvial flows are applied to the model at three locations;

- River Wey approximately 0.8km upstream of Radipole Lane;
- Unnamed watercourse (discharging through Lodmoor Nature Reserve) south of Broadwey, and;
- Preston Brook at Overcombe.

Fluvial flows have been modelled for the 1 in 30-year (3.3% AEP), 1 in 100-year (1% AEP) and 1 in 1,000-year (0.1% AEP) events for the present day and for 2138, taking account of climate change uplifts. The Central climate change uplift has been applied with an increase in peak fluvial flows of 47%. During the climate change simulations the proposed future defences (see 5.13.2) have been included. This model setup represents the planned future defences updated to the specifications outlined within Appendix A and C of the FCRM strategy report.

5.2.2 Assessment of fluvial risk

In Weymouth there is a risk of flooding from the River Wey in many of the sites. There is a small amount of flooding from a 0.1% AEP event in Cousens Quay and Melcombe Regis car parks (site WEY2). With climate change uplifts and future defences, there is very significant flooding in sites WEY2, WEY3, WEY4 and WEY6 in a 3.3% AEP event plus 47% climate change uplift; in a 0.1% AEP event with 47% uplift, sites WEY2, WEY3, WEY 4, WEY6 are nearly completed inundated, sites WEY5 and WEY7 have significant flooding. Flood water enters the sites to the east of the river first from Custom House Quay, with a significant flow north up Commercial Road and then from overtopping of defences to the north of Westham Bridge.

An assessment of fluvial flood risk to the sites is detailed in the site summary tables in Appendix A.1.

5.3 Tidal flood risk

5.3.1 Data used to inform tidal risk

Tidal modelling has been undertaken for this study using the same Weymouth coastal and fluvial model (JBA 2019) that was used for the fluvial modelling (see 5.2.1). Along the coast, wave overtopping discharges were calculated for the 1 in 30-year (3.3% AEP), 1 in 200-year (0.5% AEP) and 1 in 1,000-year (0.1% AEP) events for the present day and for 2138, taking account of climate change uplifts. Within the harbour and Radipole Lake still water levels were calculated. The Upper End climate change uplift has been applied with an increase in water level of 1.71m (based on the predicted rise between 2022s and 2139 (see Table 4-4)) and an increase in wave height of 10%. During the climate change simulations the proposed future defences (see 5.13.2) have been included. This model setup represents the planned future defences updated to the specifications outlined within Appendix A and C of the FCRM strategy report.

5.3.2 Assessment of tidal risk

In Weymouth there is a risk of flooding from the tides to many of the sites. In a 3.3% AEP event, site WEY 2 has significant flooding along Commercial Road and site WEY4 on Custom House Quay. In a 0.5% AEP event, much of the southern section of site WEY4 is flooded, there is also flooding in sites WEY5, WEY6 and WEY8, with a significant increase in WEY2. In a 0.1%AEP event, all the sites are significantly or completely flooded. With climate change and future defences, flooding extents are only slightly less in the 3.3% AEP plus 47% climate change uplift event than in the 0.1% AEP event but with access severely impacted for all sites. Tidal flooding enters many of the sites to the east of the harbour from overtopping of the promenade east of Alexandra Gardens, flowing along Custom House Quay and Commercial Road. In more severe events, water enters at Custom House Quay and Cousens Quay and then directly on both sides of the river.

An assessment of tidal flood risk to the sites is detailed in the site summary tables in Appendix A.1.

5.4 Surface water flood risk

5.4.1 Data used to inform surface water flood risk

A new InfoWorks ICM surface water flood risk model was developed for this study. The study area (including Weymouth, Littlemore and Overcome) has been modelled in 2D using a triangulated irregular mesh (TIN). The sewer network, along with validated inflows were included using the existing Wessex Water sewer model. Radipole Lake, Weymouth Harbour and the coastline were represented with a 1D level boundary. Elsewhere 3-hr duration rainfall events were applied directly to the catchment to generate 2D surface water runoff.

Pluvial events have been modelled for the 1 in 30-year (3.3% AEP), 1 in 100-year (1% AEP) and 1 in 1,000-year (0.1% AEP) events for the present day and for 2138, taking account of climate change uplifts. The Upper End climate change uplift has been applied with an increase in peak rainfall intensity of 40% for the 3.3% AEP event and 45% for the 1% and 0.1% AEP events. During the climate change simulations the proposed future defences (see 5.13.2) have been included. This model setup represents the planned future defences updated to the specifications outlined within Appendix A and C of the FCRM strategy report.

For each event three different downstream boundaries have been simulated to provide an understanding of the cumulative impacts of more than one type of flooding occurring at once. These were:

- No downstream boundary: simulating a free surface water outfall.
- Tidal downstream boundary: for the 3.3% and 1% AEP surface water events a 50% AEP tidal water level has been applied while a 5% AEP tidal water level was applied to the 0.1% AEP surface water event. These were applied to Radipole Lake, Weymouth Harbour and the Coastline based on water levels from the tidal modelling.
- Fluvial downstream boundary: for the 3.3% and 1% AEP surface water events a 50% AEP fluvial water level has been applied while a 5% AEP fluvial water level was applied to the 0.1% AEP surface water event. These were applied to Radipole Lake, Weymouth Harbour and the Coastline based on water levels from the fluvial modelling.

5.4.2 Assessment of surface water flood risk

In Weymouth, there is a risk of surface water flooding along watercourses, roads and topographic low points, where there is ponding in places and areas with significant flows. In the 3.3% AEP event with no downstream boundary, there are significant flows along Spring Road to Brewer's Quay and Cove Row, there is ponding on Westwey Road, Commercial Road and the roads in the vicinity of Custom House Quay. In the 0.1% AEP event, flows are also significant to the north of the river along Commercial Road and Custom House Quay, with significant ponding on many of the roads and in the Melcombe Regis car park, ferry peninsular, bus depot and railway station areas and in site WEY8 (Lodmoor Gateway and Country Park).

An assessment of the surface water flood risk to the sites is provided in the site summary tables in Appendix A.1.

5.5 Data used to inform Depth, Velocity and Hazard to People

The Level 2 assessment seeks to map the probable depth and velocity of flooding as well as the hazard to people during the defended fluvial, tidal and surface water events. The following events have been assessed:

Fluvial:

- 3.3% AEP, 1% AEP and 0.1% AEP depth, velocity and hazard data.
- 3.3% AEP plus climate change, 1% AEP plus climate change and 0.1% AEP plus climate change depth, velocity and hazard data.

Tidal:

- 3.3% AEP, 0.5% AEP and 0.1% AEP depth, velocity and hazard data.
- 3.3% AEP plus climate change, 0.5% AEP plus climate change and 0.1% AEP plus climate change depth, velocity and hazard data.

Surface water:

- 3.3% AEP, 1% AEP and 0.1% AEP depth, velocity and hazard data.
- 3.3% AEP plus climate change, 1% AEP plus climate change and 0.1% AEP plus climate change depth, velocity and hazard data.

Surface water with a tidally dominant downstream boundary:

- 3.3% AEP, 1% AEP and 0.1% AEP depth, velocity and hazard data.
- 3.3% AEP plus climate change, 1% AEP plus climate change and 0.1% AEP plus climate change depth, velocity and hazard data.

Surface water with a fluvially dominant downstream boundary:

- 3.3% AEP, 1% AEP and 0.1% AEP depth, velocity and hazard data.
- 3.3% AEP plus climate change, 1% AEP plus climate change and 0.1% AEP plus climate change depth, velocity and hazard data.

Hazard to people has been calculated using the below formula as suggested in **Defra's FD2321/TR2 "Flood Risk to People"**. The different hazard categories are shown in Table 5-1. Developers should also test the impact of climate change depths, velocities, and hazard on the site, at Flood Risk Assessment stage.

Table 5-1: Defra's flood hazard categories

Flood hazard rating d x (v+0.5)	Degree of flood hazard	Description
<0.75	Low	Caution "Flood zone with shallow flowing water or deep standing water"
0.75 - 1.25	Moderate	Dangerous for some "Danger: Flood zone with deep or fast flowing water"
1.25 - 2.00	Significant	Dangerous for most people "Danger: Flood zone with deep fast flowing water"
>2.00	Extreme	Dangerous for all "Extreme danger: flood zone with deep fast flowing water"

As part of a site-specific FRA, developers may need to undertake more detailed hydrological and hydraulic assessments of the unmodelled watercourses (or modelled watercourses where additional data can be added) to verify flood depth, velocity and hazard based on the relevant 1% AEP plus climate change event as part of a site-specific FRA, using the relevant climate change allowance based on the type of development and its associated vulnerability classification. Not all information is known on every watercourse at the strategic scale.

5.6 Duration and onset of flooding

The duration and onset of flooding affecting a site depends on a number of factors:

- The position of the site within a river / surface water catchment, with those at the top of a catchment likely to flood sooner than those lower down. The duration of flooding tends to be longer for areas in lower catchments.
- Tributaries with small catchment areas will respond faster and result in flashier storm hydrographs than those of a larger Main River. However, man-made incidental flood attenuation features in the floodplain will hold water back, such as road embankments. These will affect the speed of water travelling downstream by slowing it down.
- The principal source of flooding: where this is surface water, depending on the intensity and location of the rainfall, flooding could be experienced within 30 minutes of the heavy rainfall event e.g. a thunderstorm. Typically, the duration of flooding for areas at risk of surface water flooding or from flash flooding from small watercourses is short (hours rather than days). The tidal level will also control the duration and onset of flooding as fluvial tidal interactions affect flood levels in Weymouth.
- The preceding weather conditions prior to the flooding: wet weather lasting several weeks will lead to saturated ground. Rivers respond much quicker to rainfall in these conditions. The River Wey is influenced by groundwater levels, when groundwater levels are high this can cause the Wey to respond rapidly to rainfall.
- Whether a site is defended, noting that if the defences were to fail, a site could be affected by very fast flowing and hazardous water within 15 minutes of a breach developing (depending on the size of the breach and the location of the site in relation to the breach), causing danger to life.
- Catchment geology, for example chalk catchments take longer to respond than typical clay catchments.

It is recommended that a site-specific Flood Risk Assessment refines this information, based on more detailed modelling work where necessary.

5.7 Cumulative Impacts

The level 1 SFRA cumulative impact assessment identified the whole of Weymouth as being at high risk of cumulative impact. This is caused by the quantum of development and level of flood risk. However, all sites other than site WEY8 (Lodmoor) are brownfield and are therefore unlikely to increase the cumulative impacts of development within Weymouth. Additionally, these sites are likely to discharge surface water into the harbour or sea and therefore will have limited impact on existing systems.

Should surface water need to be discharged into the existing combined sewer network then further analysis will be required to understand the impact of this on sewer flooding.

All new development should give consideration to the inclusion of Sustainable Drainage Systems (SuDS) within the site design. Details of potential SuDS applicability are provided within the Level 2 Site Summary Tables contained within Appendix A.1.

5.8 River Networks

Main Rivers are represented by the Environment Agency's Statutory Main River layer. Caution should be taken when using this layer to identify culverted watercourses which may appear as straight lines but in reality, are not.

Developers should be aware of the need to identify the route of, and flood risk associated with, culverts. CCTV condition survey may be required to establish the current condition of culverts and hydraulic assessments will be necessary to establish culvert capacity of both culverts on site and those immediately offsite that could pose a risk to the site. The risk of flooding should be established using site survey, including the residual risk of culvert blockage.

5.9 Groundwater

5.9.1 Data used to inform Groundwater risk

In comparison to fluvial, tidal and surface water flooding, current understanding of the risks posed by groundwater flooding is limited and mapping of flood risk from groundwater sources is in its infancy. Groundwater level monitoring records are available for areas on Major Aquifers. However, for lower lying valley areas, which can be susceptible to groundwater flooding caused by a high-water table in mudstones, clays and superficial alluvial deposits, very few records are available. Additionally, there is increased risk of groundwater flooding where long reaches of watercourse are culverted as a result of elevated groundwater levels not being able to naturally pass into watercourses and be conveyed to less susceptible areas.

Mapping of groundwater flood risk has been based a 5m resolution JBA Groundwater Flood Risk Map. The modelling for JBA's mapping involves simulating groundwater levels for a range of return periods (including 75, 100 and 200-years). Groundwater levels are then compared to ground surface levels to determine the head difference in metres. The JBA Groundwater Flood Risk Map categorises the head difference (m) into five feature classes based on the 1% AEP model outputs which are outlined in Table 5-2.

Table 5-2: JBA Groundwater Flood Risk Map categories

Category	Flood depth range during a 1% AEP flood event	Groundwater flood risk
1	Groundwater levels are either at or very near (within 0.025m of) the ground surface	Within this zone there is a risk of groundwater flooding to both surface and subsurface assets. Groundwater may emerge at significant rates and has the capacity to flow overland and/or pond within any topographic low spots.
2	Groundwater levels are between 0.025m and 0.5m below	Within this zone there is a risk of groundwater flooding to both surface and subsurface assets. There is the possibility of groundwater emerging at the surface locally.

	the ground surface	
3	Groundwater levels are between 0.5m and 5m below the ground surface	There is a risk of flooding to subsurface assets but surface manifestation of groundwater is unlikely.
4	Groundwater levels are at least 5m below the ground surface	Flooding from groundwater is not likely.
-	No risk	This zone is deemed as having a negligible risk from groundwater flooding due to the nature of the local geological deposits.

It is important to note that the modelled groundwater levels are not predictions of typical groundwater levels. Rather they are flood levels i.e. groundwater levels that might be expected after a winter recharge season with 1% AEP, so would represent an extreme scenario.

It should be noted that the JBA Groundwater Flood Risk Map is suitable for general broad-scale assessment of the groundwater flood hazard in an area but is not explicitly designed for the assessment of flood hazard at the scale of a single property. In high-risk areas a site-specific risk assessment for groundwater flooding is recommended to fully inform the likelihood of flooding. It should also be noted that the JBA Groundwater Flood Map does not take account of groundwater recharge from the tide and therefore in coastal locations the tidal impact on groundwater levels should also be considered.

5.9.2 Assessment of groundwater risk

The JBA Groundwater Flood Risk Mapping shows the area of Weymouth to the north and east of the River Wey as having no/ negligible risk from groundwater flooding. Along the south bank of the River Wey to the east of Town Bridge, risk varies from Category 2 to Category 3.

However, the River Wey catchment is susceptible to groundwater influence on baseflows.

An assessment of the groundwater flood risk to the sites is provided in the site summary tables in Appendix A.1.

5.10 Reservoirs

5.10.1 Data used to inform reservoir risk

The risk of inundation as a result of reservoir breach or failure has been identified from the **Environment Agency's Long Term Flood Risk Information** website.

5.10.2 Assessment of reservoir risk

No risk of flooding from reservoir breaches has been identified within or around the vicinity of the Weymouth sites.

5.11 Sewer Flooding

5.11.1 Data used to inform sewer flooding

Detailed sewer flooding records were not available for this SFRA. Developers should contact Wessex Water for further information on the risk of sewer flooding to sites.

5.12 Emergency planning

5.12.1 Data used to inform emergency planning

Flood Warning Areas and Flood Alert Areas are detailed in Environment Agency's GIS datasets. Flood Alert Areas inform the EA when there is flooding first in the catchment, irrespective of properties, hence this coverage tends to apply to whole watercourses or stretch of coastline. Flood Warning Areas are derived from the extreme flood outline (0.1% AEP event), focussed on communities, properties and/or infrastructure. Areas covered by this would receive a Flood Warning in advance of flooding.

Modelled depth, velocity and hazard data from the new hydraulic model can be used to understand safe access and egress around each site.

5.12.2 Assessment of Flood Warning

In Weymouth, the River Wey, Weymouth Harbour and the coast are covered by Flood Warning Areas. There are also Flood Alert Areas covering the River Wey area and the coast. To the north of the designated Weymouth sites, the headwaters of the River Wey are included in the "Groundwater flooding in the West of Dorset" Flood Alert area.

5.13 Flood Risk Management Infrastructure

5.13.1 Data used to inform flood risk management infrastructure

Flood defences are represented by Environment Agency's Asset Information Management System (AIMS) Spatial Defences data set. Their current condition and standard of protection are based on those recorded in the tabulated GIS data.

5.13.2 Assessment of flood defences

There are formal flood defences in Weymouth, including walls and natural high ground along Weymouth Harbour and the promenade along back of Weymouth beach. These provide a range of protection based on differing design standards, although they are overtopped in the 1% AEP fluvial event along the River Wey, and along the harbour in all the present day tidal and all the climate change events. An assessment of flood defences is provided in the site summary tables in Appendix A.1.

During the climate change scenarios the model setup represents the planned future defences updated to the specifications outlined within Appendix A and C of the FCRM strategy report, alongside direct correspondence from the client.

The changes and additions to current defences were as follows:

- The raising of the Esplanade by a height of 0.5m. This was achieved by setting a standard elevation value across the defence crest and the associated wave overtopping profiles of 3.65m, 4.05m and 4.40m respectively.
- The addition of a rear 1m defensive raised wall along the length of the Esplanade.
- The upgrading of the defensive wall running adjacent to the B1355 Preston Road to a standard height of 5.4m.
- An increase in the height of the defences within the Harbour and Esplanade regions. This method adds new defences within the two areas, as well

upgrading existing defences to a standard elevation of 3.74m in line with the climate change scenarios.

- The inclusion of a tidal barrier across the entrance to Weymouth Harbour.

The Weymouth FCRM Harbour and Esplanade Adaptive Pathway sets out the changes and additions.

- Harbour sea defence walls: (replacement of seven sections and raising of nine sections, 2020-2030; replacement of nine sections, 2040-2045; either further wall raising or tidal barrier construction, 2060-2070).
- Esplanade sea defence (Greenhill section, 2034-2035; Pavilion to Brunswick section, 2065-2067).

5.14 Residual Risk

The residual flood risk to the site is identified as where potential blockages or overtopping/ breach of defences could result in the inundation of a site, with the sudden release of water with little warning.

Residual risk from breaches to flood defences, whilst rare, needs to be considered in Flood Risk Assessments. Considerations include the location of a breach, when it would occur and for how long, the depth of the breach (toe level), the loadings on the defence and the potential for multiple breaches. There are currently no national standards for breach assessments and there are various ways of assessing breaches using hydraulic modelling. Work is currently being undertaken by the Environment Agency to collate and standardise these methodologies.

Breach modelling shows the flood impact in the event of a failure or overtopping of existing structures or defences. This has been undertaken to inform the risk to sites within this assessment where sites benefit from defences. A breach has been modelled for each of the sites, see Figure 5-1 for the breach modelling locations.

Additionally, if planned improvements to flood defences were not to go ahead over the plan / development lifetime then the residual risk to development would significantly increase. This will need to be managed through site specific Flood Risk Assessments. The recommendations in this SFRA are reliant on defences being completed in time.

Figure 5-1: Breach modelling locations

5.14.1 Assessment of residual risk

There are no canals or reservoirs in the vicinity of the Weymouth sites posing residual risk of failure in the event of a flood. Risk from reservoirs is detailed in section 5.10.

There are flood defences within the Weymouth area which may pose a residual risk in the event of breach/failure. Where sites benefit from defences, breach scenarios have been modelled and considered as part of this assessment (see accompanying site sheets (Appendix A.1 and mapping Appendix A.2).

6 Surface Water Management and SuDS

The Surface Water Management roles and responsibilities for different organisations and relevant legislation, policy and strategy are detailed within the Dorset Council Level 1 Strategic Flood Risk Assessment (section 9) (August 2022).

This contains detail on:

- Role of the LLFA and Local Planning Authority in surface water management
- Sustainable Drainage Systems (SuDS)
- Sources of SuDS guidance
- Other surface water considerations: Groundwater Vulnerability Zones; Groundwater Source Protection Zones; Nitrate Vulnerable Zones

7 Flood risk management requirements for developers

The Flood Risk Management requirements for developers and relevant legislation, policy and strategy are detailed within the Dorset Council Level 1 Strategic Flood Risk Assessment (section 8) (August 2022).

This contains detail on:

- General principles for new developments
- Requirements for site-specific Flood Risk Assessments
- Local requirements for mitigation measures
- Resistance and resilience measures
- Reducing flood risk from other sources
- Emergency planning

7.1 Developer contributions

In some cases, and following the application of the Sequential Test, it may be appropriate for the developer to contribute to the improvement of flood defence provision that would benefit both proposed new development and the existing local community. Developer contributions can also be made to maintenance and provision of flood risk management assets, flood warning and the reduction of surface water flooding (i.e. SuDS). The council should only use planning obligations to secure contributions where it is satisfied that the contributions will fund works / measures which are:

- Necessary to make the development acceptable in planning terms;
- Directly related to the development; and
- Fairly and reasonably related in scale and kind to the development (Paragraph 57, NPPF).

8 Summary of Level 2 assessment and recommendations

8.1 Summary of Key Messages

As part of the Level 2 SFRA, seven detailed site summary tables have been produced for the Level 2 sites assessed. With climate change uplifts and future defences, all sites except WEY8 are shown to have significant fluvial flooding. In a 0.1% AEP tidal event, all sites are significantly or completely flooded and in a 3.3% AEP event, sites WEY2 and WEY4 are shown to have significant flooding. In the 3.3% AEP event with no downstream boundary, there are significant surface water flows in site WEY4. In the 0.1% AEP event, there are also significant flows on Commercial Road and significant ponding in many of the sites. The key site issues are summarised in Table 8-1 to Table 8-7 below. The site summary tables and associated mapping are included in Appendix A.1 and Appendix A.2 respectively.

Table 8-1: WEY2 flood risk summary

Site code	WEY2
Current land use	Retail, residential and parking.
Proposed land use	Retail, residential, leisure and parking.
Site area and location	11.9 hectares, Town Centre core and Commercial Road area, Weymouth.
General level of flood risk	**Fluvial dominated**– 7% of the site is flooded during the 0.1% AEP present day event and 84% of site is flooded during the 3.3% AEP event plus climate change. **Surface water (no downstream boundary)** – 13% of the site is flooded during the 3.3% AEP present day event and 22% of the site is flooded during the 3.3% AEP event plus climate change. **Tidal dominated** – 15% of the site is flooded during the 3.3% AEP present day event and 96% of the site is flooded during the 3.3% AEP event plus climate change.
Risk of breach	There is a residual risk flood risk to the site from breached defences. This has been tested for tidal breaches at Commercial Alban (Cousens Quay car park) and at Westham Bridge.
Access and egress issues	There are likely to be significant access and egress issues at this site in particular as a result of the impacts of climate change.

Table 8-2: WEY3 flood risk summary

Site code	WEY3
Current land use	Transport (railway station and bus depot), retail, car park.
Proposed land use	Transport hub, mixed retail, commercial and residential, car park.
Site area and location	6.6 hectares, Station area and Swannery Car Park, Weymouth.
General level of flood risk	**Fluvial dominated** – 22% of the site is flooded during the 0.1% AEP present day event and 54% of site is flooded during the 3.3% AEP event plus climate change. **Surface water (no downstream boundary)** – 21% of the site is flooded during the 0.1% AEP present day event and 26% of the site is flooded during the 0.1% AEP event plus climate change. **Tidal dominated** – 2% of the site is flooded during the 0.1% AEP

	present day event and 83% of the site is flooded during the 3.3% AEP event plus climate change.
Risk of breach	There is a residual risk flood risk to the site from breached defences. This has been tested for a tidal breach at Westham Bridge.
Access and egress issues	There are likely to be significant access and egress issues at this site in particular as a result of the impacts of climate change.

Table 8-3: WEY4 flood risk summary

Site code	WEY4
Current land use	Tourism, leisure, retail, residential.
Proposed land use	Tourism, leisure, retail, residential.
Site area and location	13.2 hectares, Custom House Quay and Brewery Waterfront, Weymouth.
General level of flood risk	**Fluvial dominated** – 1% of the site is flooded during the 0.1% AEP present day event and 54% of site is flooded during the 3.3% AEP event plus climate change. **Surface water (no downstream boundary)** – 26% of the site is flooded during the 3.3% AEP present day event and 34% of the site is flooded during the 3.3% AEP event plus climate change. **Tidal dominated** – 31% of the site is flooded during the 0.5% AEP present day event and 59% of the site is flooded during the 3.3% AEP event plus climate change.
Risk of breach	There is a residual risk flood risk to the site from breached defences. This has been tested for tidal breaches at Town Bridge (downstream) and at Cove Row.
Access and egress issues	There are likely to be significant access and egress issues at this site in particular as a result of the impacts of climate change.

Table 8-4: WEY5 flood risk summary

Site code	WEY5
Current land use	Tourist accommodation, leisure, retail.
Proposed land use	Tourist accommodation, retail, leisure including uses that support outdoor events.
Site area and location	6.5 hectares, The Esplanade (South), Weymouth.
General level of flood risk	**Fluvial dominated** – less than 1% of the site is flooded during the 0.1% AEP present day event and 17% of site is flooded during the 1% AEP event plus climate change. **Surface water (no downstream boundary)** – 13% of the site is flooded during the 1% AEP present day event and 15% of the site is flooded during the 3.3% AEP event plus climate change. **Tidal dominated** – 11% of the site is flooded during the 0.5% AEP present day event and 66% of the site is flooded during the 3.3% AEP event plus climate change.
Risk of breach	There is a residual risk flood risk to the site from breached defences. This has been tested for a tidal breach at the Esplanade

	(south).
Access and egress issues	There are likely to be significant access and egress issues to this site in particular as a result of the impacts of climate change.

Table 8-5: WEY6 flood risk summary

Site code	WEY6
Current land use	Entertainment, parking and disused ferry terminal (brownfield).
Proposed land use	Leisure/tourist-related uses, complementary town centre uses which may include residential, parking.
Site area and location	5.0 hectares, Ferry Peninsula, Weymouth.
General level of flood risk	**Fluvial dominated** – Less than 1% of the site is flooded during the 0.1% AEP present day event and 91% of site is flooded during the 3.3% AEP event plus climate change. **Surface water (no downstream boundary)** – 18% of the site is flooded during the 3.3% AEP present day event and 22% of the site is flooded during the 3.3% AEP event plus climate change. **Tidal dominated** – 19% of the site is flooded during the 0.5% AEP present day event and 98% of the site is flooded during the 3.3% AEP event plus climate change.
Risk of breach	There is a residual risk flood risk to the site from breached defences. This has been tested for a breach at Ferry Peninsula.
Access and egress issues	There are likely to be significant access and egress issues at this site.

Table 8-6: WEY7 flood risk summary

Site code	WEY7
Current land use	Brownfield site, offices and residential.
Proposed land use	Mixed uses which may include residential, hotel, commercial and small-scale retail development.
Site area and location	6.3 hectares, Westwey Road and North Quay area, Weymouth.
General level of flood risk	**Fluvial dominated** – Less than 1% of the site is flooded during the 0.1% AEP present day event and 68% of site is flooded during the 0.1% AEP event plus climate change. **Surface water (no downstream boundary)** – 25% of the site is flooded during the 3.3% AEP present day event and 31% of the site is flooded during the 3.3% AEP event plus climate change. **Tidal dominated** – 12% of the site is flooded during the 0.5% AEP present day event and 72% of the site is flooded during the 3.3% AEP event plus climate change.
Risk of breach	There is a residual risk flood risk to the site from breached defences. This has been tested for a breach at Westwey Road.
Access and egress issues	There are likely to be significant access and egress issues at this site.

Table 8-7: WEY8 flood risk summary

Site code	WEY8
Current land use	Country park, tourism/recreation, car park, recycling centre.
Proposed land use	Country park, tourism, low-key recreation and ancillary uses, recycling centre.
Site area and location	32.6 hectares, Lodmoor Gateway and Country Park, Weymouth.
General level of flood risk	**Fluvial dominated** – Less than 1% of the site is flooded during the 0.1% AEP present day event and less than 1% of site is flooded during the 0.1% AEP event plus climate change. **Surface water (no downstream boundary)** – 18% of the site is flooded during the 3.3% AEP present day event and 23% of the site is flooded during the 3.3% AEP event plus climate change. **Tidal dominated** – 12% of the site is flooded during the 0.5% AEP present day event and 75% of the site is flooded during the 3.3% AEP event plus climate change.
Risk of breach	There is a residual risk flood risk to the site from breached defences. This has been tested for a breach at 'Lodmoor Nature', approximately 300m north east of the site boundary.
Access and egress issues	There are likely to be significant access and egress issues at this site.

8.2 Recommendations

To pass the Exception Test, it must be shown that the development will provide wider sustainability benefits that outweigh the risk and that the development will be safe throughout its lifetime without increasing risk elsewhere. The former is a planning-related consideration and the Level 2 SFRA helps to answer the latter part of the Test.

In principle, it is possible for the majority of sites to pass the flood risk element of the Exception Test by:

- Siting development within the settlement away from the highest areas of risk into Flood Zone 1 where Flood Zone 1 is present within sites.
- Considering safe access/ egress in the event of a flood (from all parts of the site, if say the site is severed by a flood flow path).
- Adequately considering residual risk from defences breaching or overtopping, for example through a flood warning and evacuation plan.
- Designing buildings with habitable floor levels above the design flood event, including an allowance for freeboard and/or providing safe refuge for residents to shelter during an extreme event above the 0.1% AEP flood level including climate change.
- Using areas in Flood Zone 2 for the least vulnerable parts of the development in accordance with Table 2 in the PPG. No development should be permitted in Flood Zone 3b (aside from essential infrastructure, such as a bridge crossing the lowest points of a site).
- Implementing site-level mitigations such as raising land on parts of the site and lowering in others to bring developable areas above the design flood event. Any raising of land must not contribute to a loss of floodplain storage or increase the risk to areas away from the site.

- Testing flood mitigation measures if these are to be implemented, to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another).
- Considering space for green infrastructure in the areas of highest flood risk.

Some sites are at greater risk and will require careful consideration and mitigation to pass the flood risk element of the Exception Test.

Consideration should be given to the surface water risk where this is high, with regards to the Exception Test. For example, a site may pass the test based on fluvial or tidal flood risk alone, but greater risk may come from surface water.

If the settlement site is split in future into smaller land parcels for development, and some of those parcels are in areas of flood risk, the Exception Test may need to be re-applied by the Developer at the planning application stage.

Strategic-level interventions which reduce the risk to the wider Weymouth area may also enable sites to be brought forward.

Production of a Local Adaptation and Resilience plan for Weymouth would help to identify the need to safeguard land/habitats/infrastructure and development for roll back or relocation as well as the provision to safeguard land for Flood risk management infrastructure.

In some cases, and following the application of the Sequential Test, it may be appropriate for the developer to contribute to the improvement of flood defence provision that would benefit both proposed new development and the existing local community. Developer contributions can also be made to maintenance and provision of flood risk management assets, flood warning and the reduction of surface water flooding (i.e. SuDS).

Appendices

A Level 2 Assessment

A.1 Site Summary Tables

A.2 Site summary table mapping

Offices at

Coleshill
Doncaster
Dublin
Edinburgh
Exeter
Haywards Heath
Isle of Man
Limerick
Newcastle upon Tyne
Newport
Peterborough
Saltaire
Skipton
Tadcaster
Thirsk
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