SHOREHAM HARBOUR REGENERATION

SHOREHAM HARBOUR FLOOD RISK MANAGEMENT GUIDE

SUPPLEMENTARY PLANNING DOCUMENT

DRAFT FOR CONSULTATION SEPTEMBER 2014

Contents

1. Introduction

A Supplementary Planning Document (SPD) provides greater detail to policies in a development plan. If relevant to a planning application being determined, an SPD is a material consideration that must be taken into account when determining the application.

This document is the Shoreham Harbour Draft Flood Risk Management Guide ('the Guide') Supplementary Planning Document (SPD). This document and its accompanying Technical Report have been prepared by JBA Consulting and Baca Architects on behalf of the Shoreham Harbour Regeneration Partnership comprising Adur District Council (ADC), Brighton & Hove City Council (BHCC), West Sussex County Council (WSCC) and Shoreham Port Authority (SPA) (working closely with key stakeholders including the Environment Agency (EA)). It will sit alongside and support the Shoreham Harbour Joint Area Action Plan (JAAP) which is currently being produced to identify a set of locally supported and sustainable proposals for Shoreham Harbour over a 15-20 year plan period. This SPD and accompanying Technical Report will not form part of the JAAP, but the Guide will be a critical element of the evidence base supporting it. It will also support and sit alongside the Adur Local Plan and the Brighton & Hove City Plan when these are adopted.

This Draft Flood Risk Management Guide sets out guidance for decision-makers, landowners and developers about suitable flood defences and flood mitigation measures for proposed development sites identified in the JAAP. Flooding can cause damage to property, disrupt economic and social activities and in extreme cases can lead to injury and death. Parts of the Shoreham Harbour Regeneration area are currently vulnerable to flooding. The need to ensure adequate flood protection is therefore a key consideration of the Partnership. This Guide is a key document identifying the requirements for adequate flood risk protection in the JAAP area.

In addition to addressing existing flood risk constraints, many waterfront redevelopment sites identified in the JAAP for residential, employment and other uses will require a higher standard of flood protection than currently exists. The Guide will aid developers of these sites to demonstrate, through the planning process, that new development will be safe for its lifetime; that flood risk has not been increased elsewhere as a result of the development; and that wherever possible, flood risk overall has been reduced.

It has been developed to ensure a consistent approach to flood defence infrastructure delivery in the area, taking into account other local flood risk strategies and plans being delivered

Figure 01 - Shoreham Harbour moorings, Southwick (source: Baca Architects)

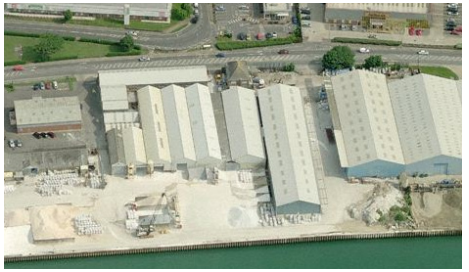


Figure 02 - Industrial uses along Western Harbour Arm (source: Bing Maps)

by other organisations[1]. It also provides a guide to delivering integrated flood defences and mitigation measures to create not only distinctive, high quality structures but also a high quality public realm environment. Flood defences are, by their very nature, barriers that can physically divide and segregate one area from another. Important urban design goals for Shoreham Harbour are to promote permeability and linkages through and across sites, to ensure that new development is of a high design quality, to enhance the waterfront and to improve the relationship with the river.

A Technical Report supporting this Guide provides a full appreciation of the approach and process taken to identifying recommended flood defence and mitigation measures identified within this guide. The Technical Report provides cost information for flood defence options, concept drawings of suitable flood defences and a Preliminary Environmental Assessment.

1.1 Consultation

This is a draft consultation version of the SPD and it is being published for a 4 week period of public consultation. The views and considerations of interested parties are sought during this period. It is envisaged that it will be adopted by Adur District Council and Brighton & Hove City Council following a review of the consultation feedback.

Consultation of this document has been informed by the Statements of Community Involvement for Adur District Council and Brighton & Hove City Council.

A Consultation Statement has been produced to accompany this SPD which sets out in more detail consultation activities, who is being consulted as well as detailing consultation activity to date. This document will be updated after the consultation period has ended and will act as a record of consultation responses made during the period as well as noting any amendments required.

Figure 03 - Flooding in Shoreham 2013 (source ITV)

Figure 04 - Flooding in Shoreham 2013 (source ITV)

1. These include the Shoreham Adur Tidal Walls Scheme (EA) and the Brighton Marina to River Adur Strategy (BHCC, 2014).

2. Background & Context

2.1 Background

The Shoreham Harbour regeneration area, as identified in the JAAP, is located between the western end of Hove seafront and the Adur Estuary at Shoreham-by-Sea. The harbour stretches for five kilometres of waterfront, bounded by the A259, the West Coastway railway line and the coastal communities of Shoreham-by-Sea, Kingston-by-Sea, Southwick, Fishersgate, South Portslade and Hove. The harbour straddles the local authority boundaries of Adur District Council (within West Sussex County) to the west and the City of Brighton & Hove to the east.

The JAAP area has been broken down into seven distinct character areas as follows:

- South Quayside
- Aldrington Basin
- North Quayside/South Portslade
- Portslade/Southwick Beaches
- Southwick Waterfront/ Fishersgate
- Harbour Mouth
- Western Harbour Arm

There are four key development opportunity areas that have been identified as being critical to the realisation of the long-term strategy for the harbour and are located within the character areas as shown in Figure 05. These strategic sites are:

- Strategic Site 1 (SS1):
- Aldrington Basin
- Strategic Site 2 (SS2):
- South Portslade
- Strategic Site 3 (SS3):
- Southwick Waterfront
- Strategic Site 4 (SS4):
- Western Harbour Arm

Strategic Sites 1, 2 and 4 are all areas where new residential-led mixed-use development is proposed[2]. Strategic Site 3 is identified for non-residential development[3].

2.2 The Strategic Sites

SS1 - Aldrington Basin has been identified for new employment and residential uses. However the Brighton & Hove Strategic Flood Risk Assessment (SFRA, 2012) identifies that most of the Aldrington Basin lies within Flood Zones 2 and 3a with areas lying within Flood Zone 3b.

The Brighton Marina to River Adur Strategy[4] sets out plans to improve the standard of protection to the lock gates and surrounding area in Southwick. It is anticipated that the existing lock gates and the adjacent area will be raised and an additional lock gate added to defend against a future (2015) 1 in 200-year flood event. This will provide protection to property and proposed development within the locked section of the Port (including Strategic Site 1 Aldrington Basin and Strategic Site 3 Southwick Waterfront).

SS2 - South Portslade has also been identified for new employment and residential development. Whilst the South Portslade strategic site is situated outside of the area at risk of tidal and fluvial flooding, the Brighton & Hove SFRA (2012) identifies some parts of the area as being at risk from surface water flooding in both the 1 in 30 and 1 in 200 year events.

SS3 - Southwick Waterfront has been identified for a mix of uses including new leisure, marina and community facilities as well as new employment development. The Adur & Worthing

2. Development Briefs for these sites have been produced and adopted by the Councils. Please refer to the Western Harbour Arm Development Brief (2013) and the South Portslade Industrial Estate and Aldrington Basin Development Brief (2013).

3. For more information, please refer to the Shoreham Harbour Joint Area Action Plan

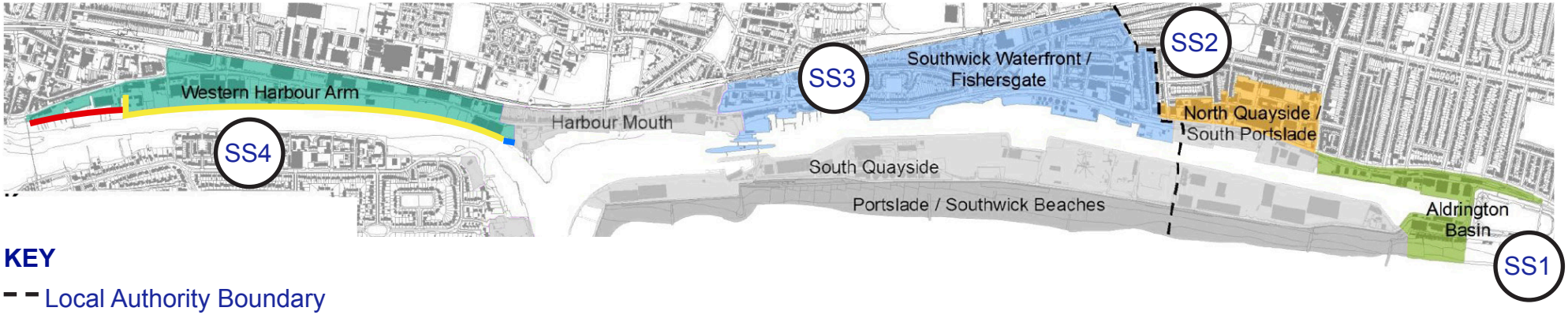


Figure 05 - Joint Area Action Plan - Character Areas and strategic sites (contains Ordnance Survey data © Crown copyright and database right 2014)

Councils SFRA, (2012), identifies parts of the site as fluvial Flood Zone 2 and 3a. The site also suffers from some small risk of tidal flooding. It is anticipated that improvements identified in the Brighton Marina to River Adur Strategy will provide adequate flood defence protection for the site, taking into account the type of development proposed.

These sites are discussed further in sections 10 through to and 13, which identify flood resilience and flood resistant measures that would be required of development in these locations.

SS4 Western Harbour Arm has been identified for comprehensive redevelopment with the aim to create an exemplar sustainable, residential-led, mixed-use area. A priority is to deliver a high-quality cycle and pedestrian route along the waterfront to create better linkages with Shoreham town centre and surrounding areas and to create a positive inter-relationship with the river environment. Future plans should also enhance the area's natural biodiversity by incorporating multi-functional green space.

The Adur and Worthing Councils' SFRA (2012) identifies a number of sites in this area as tidal Flood Zone 2, 3a and Non-functional Flood Zone 3b. This latter category recognises that some sites have the same risk of flooding as Flood Zone 3b but do not have a significant storage or conveyance potential which materially impacts flood risk elsewhere. Some sites also fall within fluvial Flood Zones 2, 3a and 3b. The site is also at risk from surface water flooding. The majority of the existing defences consist of steel sheet piling in a continuous line, bordering the river[5].

4. Brighton Marina to River Adur Flood and Coastal Erosion Risk Management Strategy Review (Adur & Worthing Councils and Brighton & Hove City Council, 2014).

5. The 'Adur River - Left Bank Quay Wall Survey 2014' (Shoreham Port Authority, 2014) was undertaken to assess the condition of these piles and indicates varying lifespans of the piles in this location.

2. Background & Context

This guide focuses on SS4, the Western Harbour Arm, as it has the greatest flood risk challenges and unlike the other strategic sites it sits outside The Brighton Marina to River Adur Strategy[6] which aims to improve the standard of protection to the east of the lock gates. The Western Harbour Arm is also excluded from the Adur Tidal Walls scheme and will derive no benefit from the Arun to Adur strategy[7]. Consideration of flood risk to the other strategic sites is provided in the guide but it is limited to building design mitigation measures rather than flood defence infrastructure. The proposed protection of this Strategic Site is to ensure closure of the flood cell and to provide comprehensive protection to future development and current infrastructure.[8]

There are three distinctive characters of existing flood defences and frontages in the Western Harbour Arm. Therefore the Western Harbour Arm strategic site has been further subdivided into three areas as set out in Figure 1.2.2 for the purpose of identifying appropriate flood defence solutions. These areas are:

- Adur Ferry Bridge to Riverside Business Centre – revetments provide the defence with hards and slipways allowing for access to the water. A short section of piles can be found at the former Parcelforce site.
- Riverside Business Centre to Kingston Beach – steel sheet pile wall, with concrete coping, provides the defence
- Kingston Beach – blockwork revetment and tetrapod protection provide the defence.

6. Brighton Marina to River Adur Flood and Coastal Erosion Risk Management Strategy Review (Adur & Worthing Councils and Brighton & Hove City Council, 2014).

7. Environment Agency (2010) Rivers Arun to Adur Flood and Erosion Management Strategy

8. Please refer to the Joint Area Action Plan for further details

3. Process

This guide has been developed through a four stage process including assessment, exploring options, consultation with stakeholders and identification of recommended solutions. This process is detailed in the accompanying Technical Report and summarized below:

3.1 Assessment of flood risk

A review of existing documentation and studies was carried out to compare the current and future flood risk with the planned development. Flood risk is described in section 4

3.2 Development and appraisal of options

The appraisal of flood defence options involved the identification of mitigation measures, the short listing of measures using multi-criteria analysis, design integration with the public realm and cost estimation of emerging favoured options.

3.3 Identification of options

A long list of options was determined by considering all possible flood defences for the Western Harbour Arm (WHA). These were then categorised and split into types and defence alignment (see Table 2.1 of the FRMG – Technical report). An options matrix was created to enable consideration of the feasibility of each of the flood defence types and to create a short list of options, based on the following categories:

- applicability
- cost
- maintenance
- adaptability
- design life
- environmental impact
- visual impact

The initial screening process was based on engineering judgement and not a consideration of the architectural opportunities. Materials and finishes are not integral to short listing design concepts. Finishes may change based on planning requirements to integrate flood defences into the overall redevelopment. The integration of flood defence and mitigation measures within the redevelopment is considered further within this Guide.

3.4 Multi Criteria Analysis

Multi Criteria Analysis (MCA), which is primarily a qualitative approach to identify preferences amongst the options proposed, was used to facilitate the options selection process and to enable the relative merits of defence options that had passed the initial screening to be assessed.

MCA had the advantage of simplifying comparative assessment where there were many factors to take into account.[9]

3.5 Stakeholder Consultation

The guidance was presented to key stakeholders to obtain preliminary feedback. This guide has been prepared following this feedback and is now issued for wider public consultation.

Section 4 illustrates the areas at risk of flooding within the strategic development sites.

9. Please refer to Section 2.3 of the Flood Risk Management Guide Technical Report for further details

4. Flood Risk

4.1 Flood Risk

Figure 06 and Figure 08 show the current flood zones. Figure 07 and Figure 09 show the flood depths for a future 1 in 200-year flood event. These maps show that flooding would encroach on the proposed development areas, unless protected by flood defences.

This guide identifies flood defence solutions to defend against a future (2115) 1 in 200-year flood event. The guide also addresses how these defences integrate with, and help facilitate a prospective pedestrian/cycle route across the Western Harbour Arm.

4.2 Design Levels

The predicted flood level along the Western Harbour Arm for a 1 in 200-year event in 2115 is 5.08m Above Ordnance Datum (AOD), based on UK Climate Projections (UKCP) 09. To protect against a breach scenario floor levels for residential use should be set at 5.77m AOD and for commercial use set 4.94m AOD. However the Environment Agency have indicated that finished floor levels do not have to be prescriptive for commercial uses if flood defences and/or land raising are implemented.

Freeboard (illustrated in Figure 10) is used to provide additional allowance for a flood level to accommodate unknown factors that could contribute to flood heights greater than those calculated. An example of this would be wave action. Minimum freeboard allowances of 150mm for hard defences (defences not subject to settlement e.g. walls)

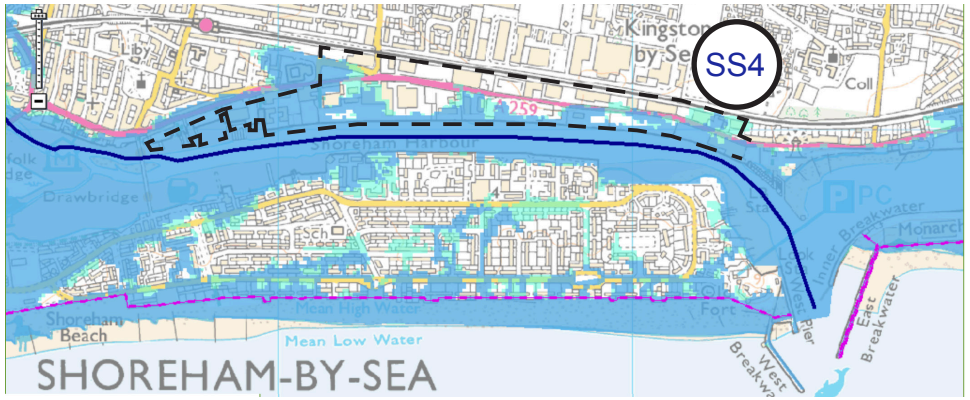
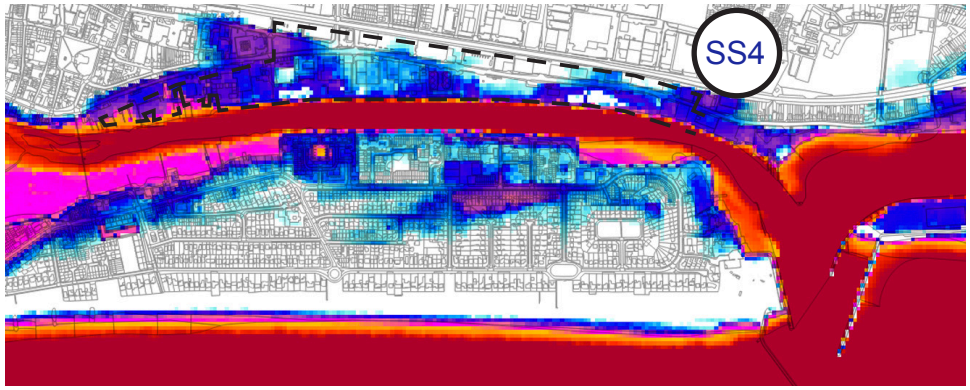


Figure 06 - Current flood map for the WHA (EA, 2014)

Flood Zone 3 - 1 in 200-year
Flood Zone 2 - 1 in 1000-year
Main river



Water Depths Key (m AOD)

7m + 6m 1m 0.3m

Figure 07 - Future (2115) 1 in 200-year flood map indicating water depths along the WHA. Model results provided by the Environment Agency(contains Ordnance Survey data © Crown copyright and database right 2014)

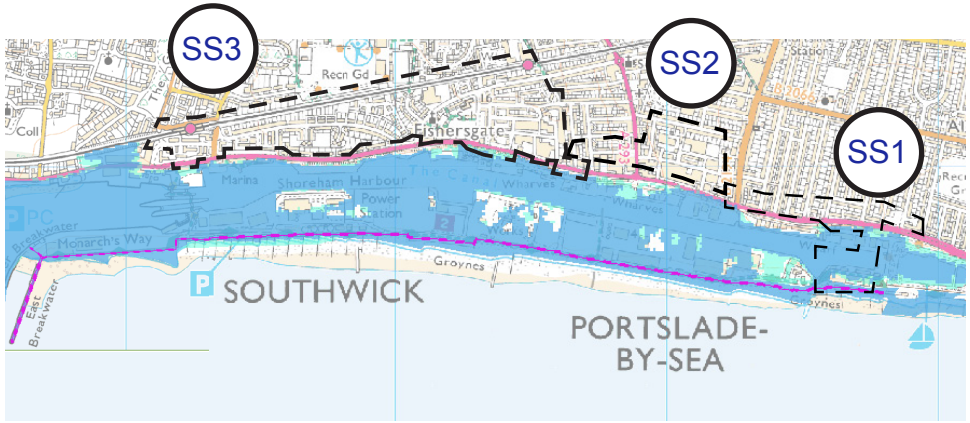
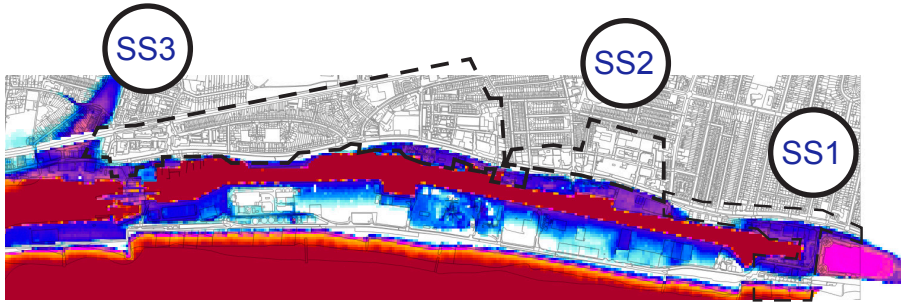


Figure 08 - Current flood map for Southwick waterfront and South Portslade (EA, 2014)

Flood Zone 3 - 1 in 200-year
Flood Zone 2 - 1 in 1000-year
Main river



Water Depths Key (m AOD)
7m +
6m
1m
0.3m

Figure 09 - Future (2115) 1 in 200-year flood map indicating water depths along. Southwick waterfront, South Portslade and Aldrington Basin. Model results provided by the Environment Agency (contains Ordnance Survey data © Crown copyright and database right 2014)

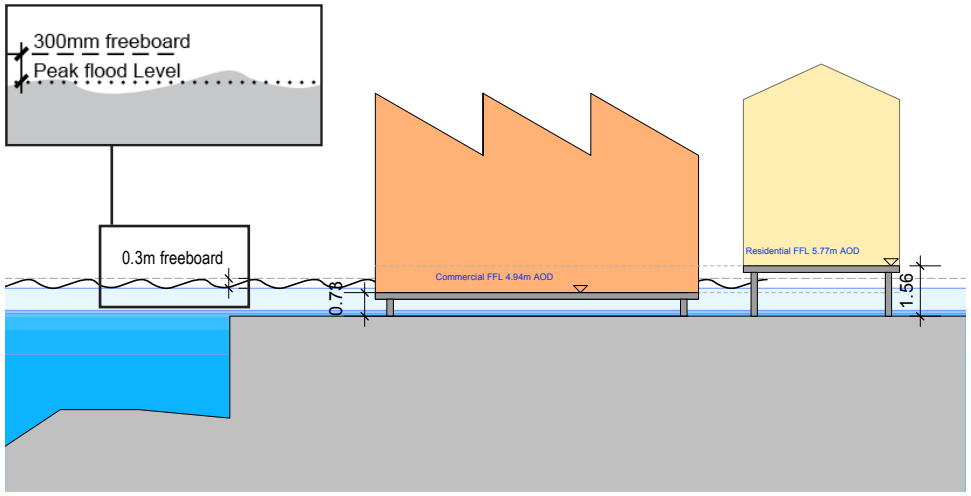


Figure 10 - Floor levels with freeboard (based on JAAP)

RESIDENTIAL - 5.77m AOD

COMMERCIAL - 4.94m AOD

and 300mm for soft defences (defences subject to settlement e.g. embankments) are recommended[10]. Consequently the defence design levels required for new flood defences at the Western Harbour Arm are as follows:

5.25m AOD for hard defences;

5.40m AOD for soft defences.

Developers will be required to deliver flood defences that meet this standard of protection.

10. Please refer to Appendix A (Design Input Statement) of the Flood Risk Management Guide Technical Report

5. Existing Flood Defences

Figure 11 - Existing flood defences along the strategic sites 1 to 4 (plans using Google Earth Pro)


01

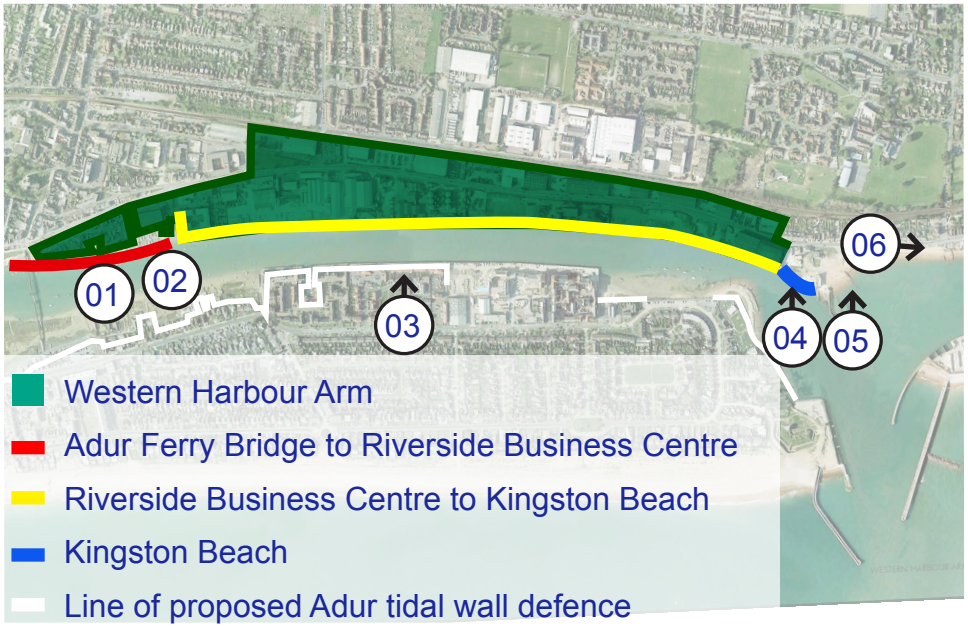

02

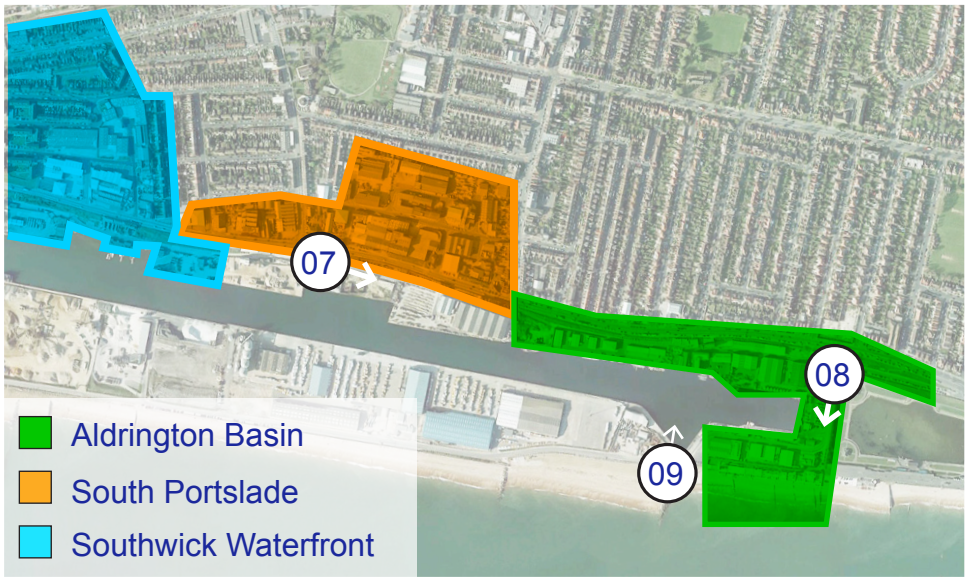

03


07


08


09






04


05


06

Photo references

1. Mud flats
2. Concrete revetment
3. Steel sheet piling
4. Rock revetments and concrete structures
5. Concrete revetments
6. Beach groins
7. Wellington Road, South Portslade
8. Aldrington Basin
9. Aldrington Basin

Figure 11 indicates the four study areas considered through this study. The Western Harbour Arm has been subdivided into three further frontages, Adur Ferry Bridge to Riverside Business Centre, Riverside Business Centre to Kingston Beach and Kingston Beach.

For the Western Harbour Arm, the three frontages are considered in detail with a recommended approach identified for each.

6.1 Flood-risk management options

The following section presents the three frontages of the Western Harbour Arm. The most feasible options for each site are shown as a result of the MCA process. A recommended approach is presented in greater detail.

6.2 Overview of Recommended Options

1. Adur ferry bridge to Riverside Business Centre -

Concrete sea wall

2. Riverside Business Centre to Kingston Beach

Renovated piles with sea wall

3. Kingston Beach

Concrete sea wall with natural rock armour

Figure 12 - Concrete sea wall (source: US Army Corps of Engineers)

Figure 13 - Renovated piles with sea wall. (source: www.creativepultrusions.com) Concrete sea wall (right)

Figure 14 - Concrete sea wall (left) Natural rock armour (right) (© Jonathan Wilkins)

The Sussex Yacht Club is located to the east of the Adur Ferry Bridge and in close proximity to the town centre. The site is protected from flooding by a mix of concrete walls and revetments to a height of 3.4m AOD. This provides a Standard of Protection (SOP) of less than the high annual tide. This defence level is 0.8m lower than adjacent defences and results in a potential breach point through to the A259 and town centre. Raising the defences at the Yacht Club is essential to provide continuity. New defences should connect with existing defences at the footbridge to the west and the proposed development at the Parcelforce site to the east. A consistent public link across the two sites should be delivered. Temporary, demountable defences may need to be considered during phasing of adjacent, undefended land.

The Yacht Club will occupy this site for the foreseeable future. The site may be developed if the yacht club were to relocate. Defences should provide protection to existing uses and the A259 as well as potential future development.

7.1 Issues

- The existing defences are below the level of the current (2014) 1 in 200-year flood level
- The existing land level is lower than the harbour arm to east
- The existing boat yard land use requires access to the water
- If the site floods it is likely to also flood the A259
- Existing views from the road to the water are restricted by buildings and walls
- The site is located within a conservation area and is adjacent to a site of special scientific interest and RSPB reserve
- Currently there is no public access
- The site may be contaminated

7.2 Opportunities

- Prime town centre location providing a key area at the beginning / end of the waterside promenade
- Benefits from waterside views

The following options were considered for this zone, following the MCA process. (see FRMG Technical Report)

Figure 15 - Footbridge to Riverside centre, existing defences - (source: Bing Maps)

Figure 16 - Existing condition of defences at the Sussex Yacht Club (source: Baca Architects)

1. New sheet piling

(source: stgeorgeutah.com)

Steel sheet piling placed in front of existing defences to raise the level of protection to the future (2115) 1 in 200-year flood level.

New piling should form a continuous line of defence from the Parcelforce site through to the footbridge. Compensatory habitat may need to be sought. Localised back filling will be required and consequentially site contamination should be taken into consideration.

2. New flood Wall on existing defence line

(source: US Army Corps of Engineers)

The addition of a flood wall on top of the existing defence line could be used to raise the level of protection to the future (2115) 1 in 200-year flood level. The position of the wall could be varied through the development to create articulation along the length of the public promenade.

3. Flood gates

(source: Doors and metal structures Ltd)

Flood gates would be required to protect flooding via the slipways, unless the land levels were raised.

These would need to be installed alongside options for new flood walls, sheet piling and possibly with demountable defences.

4. Concrete revetment and land raising

(source: EA)

A new concrete revetment in front of the existing defence line could raise the standard of protection to the future (2115) 1 in 200-year flood level and maintain a sloped edge to the river. It would require land raising behind. To maintain the existing land footprint the revetment would need to encroach into the river course.

Compensatory habitat may need to be sought. Land contamination may need to be considered.

Figure 17 - Footbridge to Riverside centre defence options

7.4 Recommended Approach

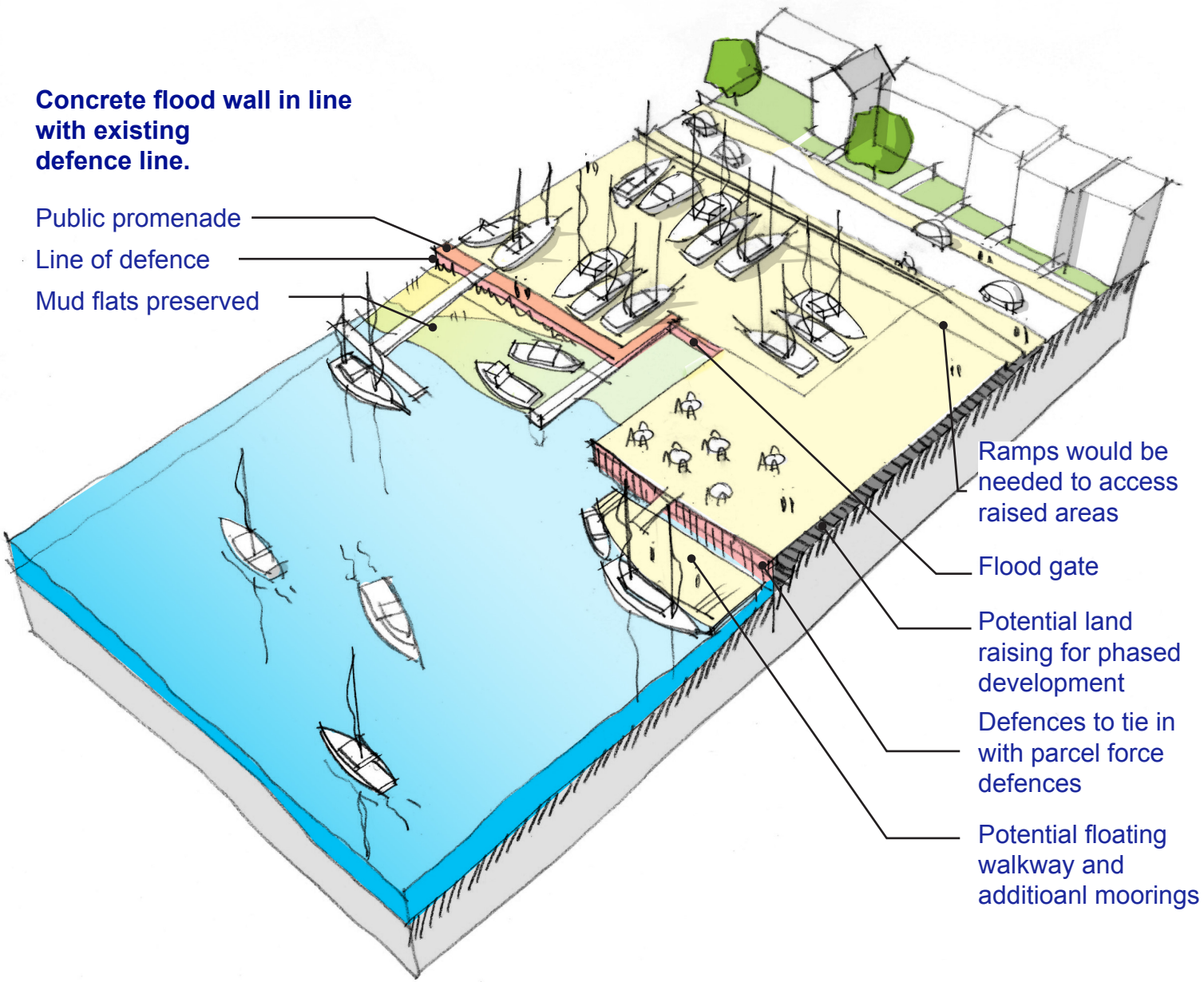


Figure 18 - Illustration of recommended approach

The recommended approach would combine a number of measures, as shown in Figure 18.

The future use of the yacht club site and the extension of the footpath along the edge of the A259 are likely to influence the choice of defences. The Partnership has an aspiration to accommodate a riverside walkway through the site.

If the site is to be redeveloped in part or whole then it may be beneficial to provide continuity of defences in the form of sheet piling to match the adjacent harbour arm. However, if it is not then more cost effective solutions may be considered, including temporary defences and incremental raising of defences.

Given the uncertainty, the 'preferred option' is shown as a mix of land raising and sheet piling to the eastern end and a new concrete flood wall to be installed on top of the existing defences. This wall could be built

to provide protection to the current (2014) 1 in 200-year flood level and raised or replaced in the future. A concrete flood wall is likely to be a relative low cost compared to other defence options presented in Table 3.2 FRMG Technical Report however will result in restricted views to the water.

A new concrete wall on top of the existing defences would result in some loss of usable land to the yacht club, however, there could be an opportunity to add pontoons and floating walkways. Sheet piling may provide an opportunity for direct mooring of boats, however, this is likely to be restricted by the mud banks.

The approach outlined above would enable the defences to tie in with proposed and existing defence lines to the east and west.

There may be an opportunity to integrate some soft landscaping features with the concrete wall but this could require additional maintenance.

The environmental value of the site may require further investigation and compensatory habitat may need to be sought under EA guidance.

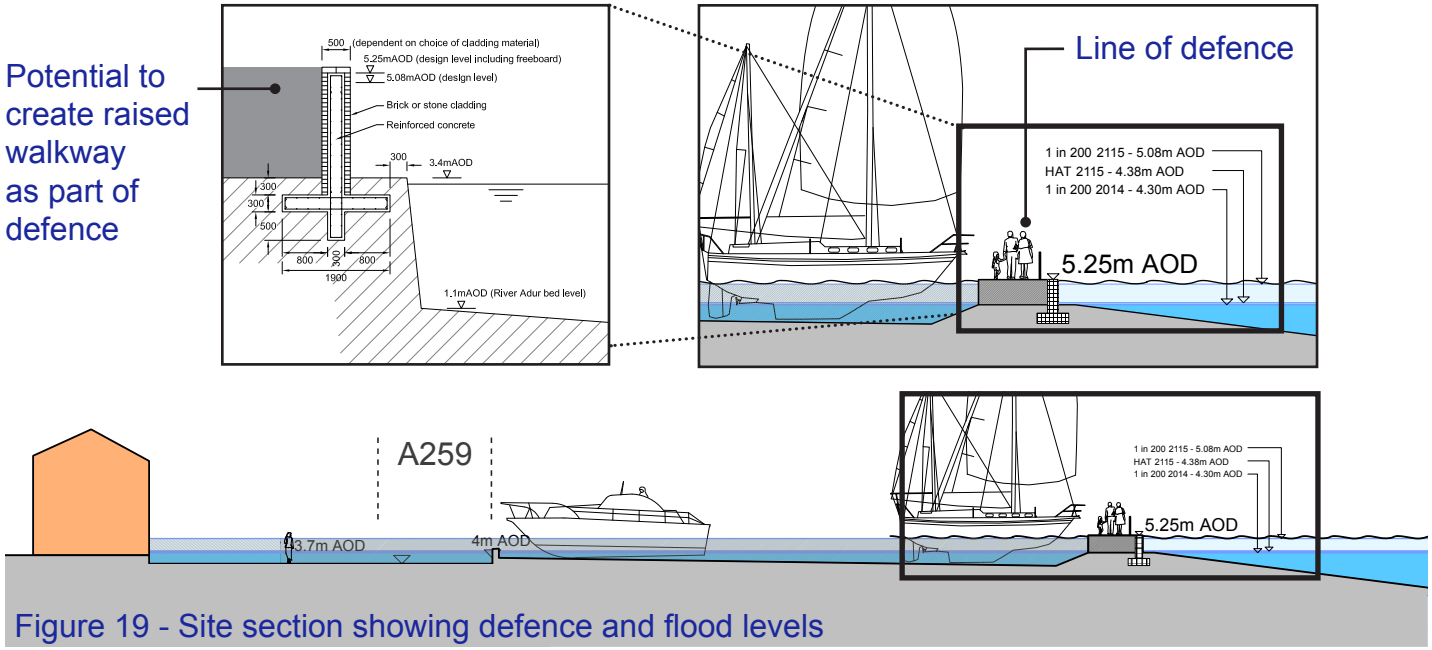


Figure 19 - Site section showing defence and flood levels

Figure 22 - Concrete sea wall (source: US Army Corps of Engineers)

Figure 21 - Elevated and floating walkways in Brisbane

Figure 20 - Hard defences incorporating soft landscaping. (source: herculesmfg.com)

8. Flood Risk Management Options > WHA - Riverside Business Centre to Kingston Beach

The longest stretch of the harbour arm is currently occupied by a mixture of commercial and industrial uses. The area is sandwiched between the A259 to the north and River Adur to the south with access to the water along its length.

The existing defences consist of sheet piling in a consistent, continuous line bordering the river.

Within the JAAP the site is identified for mixed use redevelopment. A supermarket and five storey residential blocks protected by a flood wall has been granted planning consent. Integration of new and proposed defences are essential to provide continuous flood protection and a consistent public realm.

8.1 Issues

- The existing defences are below the level of the current (2014) 1 in 200-year flood level
- The conditions survey “Adur River - Left Bank, Quay Wall Survey 2014“, by Shoreham Port shows the current piling to be in varying states of repair and residual life
- The site is under multiple ownership and phasing constraints should be taken in to consideration
- Current industrial use may result in contamination issues, requiring further consideration
- Planning consent has already been granted on some of the sites, therefore, integration of proposed defences needs to be considered

8.2 Opportunities

- Consistent defence line over a long stretch of the water’s edge
- JAAP requirement for a generous public route along the water’s edge

The following options were considered of this zone following the MCA process. (see FRMG Technical Report)

Figure 23 - WHA Aerial. Source: Contains Google Earth Pro images

Figure 24 - Existing defences (source: JBA)

Figure 25 - Illustrative concept of WHA. (source: WHA Development Brief, 2013)

1. Refurbish existing piling and add flood wall

(source: Baca Architects and US Army Corps of Engineers)

The existing piles are in need of maintenance to prolong their life. Structural surveys will be required to ascertain the condition of defences on an individual basis. The addition of a flood wall could raise the level of defences to the 2115, 1 in 200-year level. The continuous wall alignment may alter through the development to create variety along the length of the public promenade.

2. New sheet piling

(source: stgeorgeutah.com)

Steel sheet piling placed in front of existing defences to raise the level of protection to the future (2115) 1 in 200-year flood level.

New piling should form a continuous line of defence from Kingston beach through to the Adur ferry footbridge. Compensatory habitat may need to be sought. Local back filling will be required and consequentially site contamination should be taken into consideration.

3. Land raising & terracing

(source: The Patriot-News)

Land raising with terracing implemented to raise the level of defence to the future (2115), 1 in 200-year flood level. Terracing could maintain a lower access to the water. Additional retaining structures may be required and should be considered through detailed design. Terracing will require greater land take than other options. Land contamination issues should also be considered.

4. Demountable defences

(source: floodcontrolinternational.com)

Demountable defences could be used to protect sites against flooding during phased development. Defences would be installed temporarily until protection has been provided for the whole stretch of waterfront at risk. Demountable defences can take various forms and further guidance should be sought.

Figure 26 - Defensive Options

8.4 Defence Approaches Considered

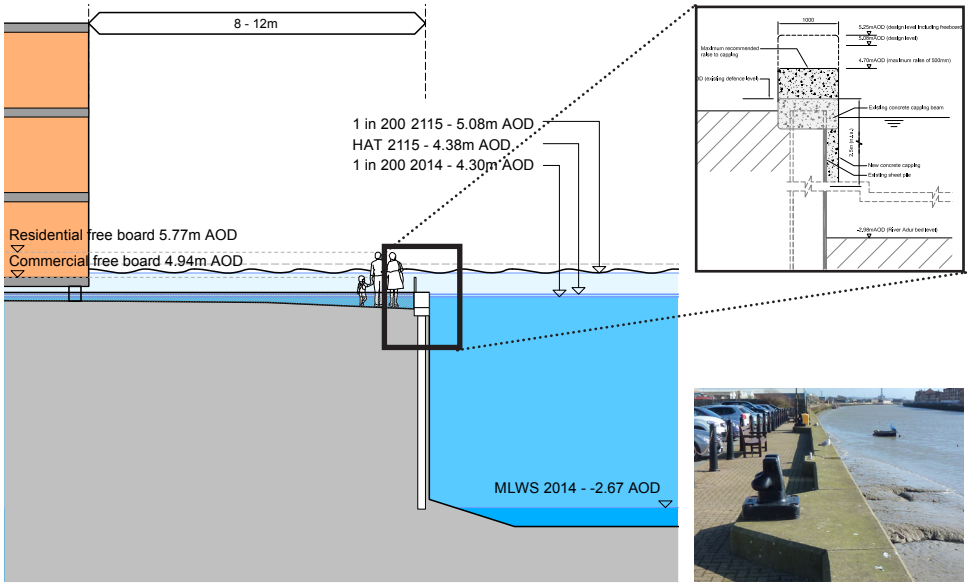


Figure 27 - Refurbish existing piling + extend pile capping by approximately 0.5m

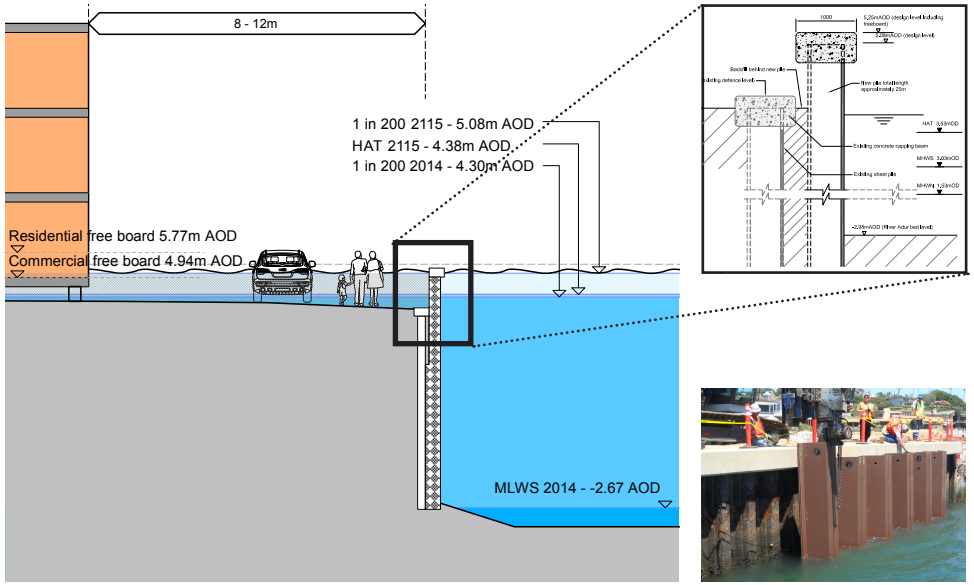


Figure 28 - New sheet piling & concrete capping

Refurbish existing piling and extend pile capping by approximately 0.5m should provide protection to the 1 in 200-year flood level until 2030. Requires the least intervention, causes minimal environmental disruption and represents one of the lower cost options, however does not comply with required defence level. This option is only feasible if alternative flood protection solutions are implemented in the future and maintenance works can extend the pile life to satisfy the 100 year design life required.

New sheet piling and concrete pile capping to extend the defence by approximately 1.1m should provide protection to 1 in 200-year level + freeboard (0.15m) for 2115 levels. Represents one of the more expensive solutions. Compensatory habitat may need to be sought under EA guidance. New piling may be required if a detailed condition survey of existing piling reveals that maintenance will not be suitable to prolong pile life. Residual risk of flooding still exists.

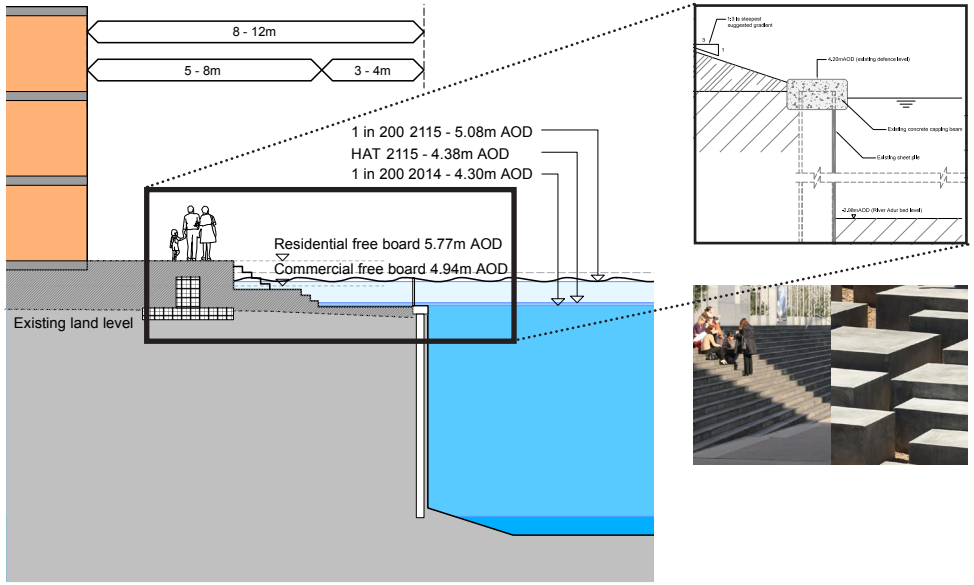


Figure 29 - Land raising and terracing

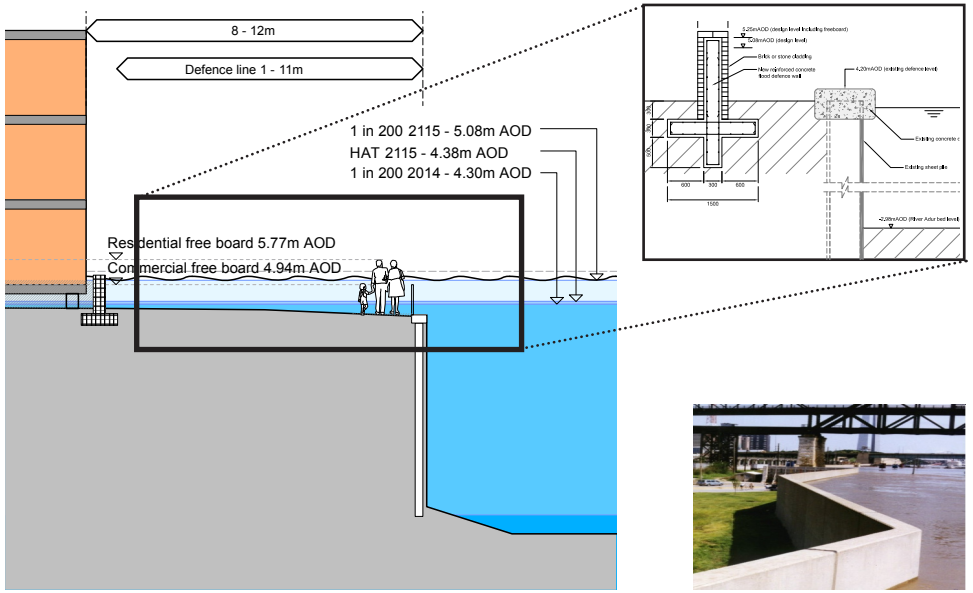


Figure 30 - Flood wall on existing alignment

Land levels raised by approximately 1.5m AOD to 5.7m AOD should provide protection to 1 in 200-year level + freeboard (0.15m) for 2115 levels. Requires high level of intervention. This option is only feasible if maintenance works can extend the pile life to satisfy the 100 year design life required.

Retaining structures will be required to tie-in with other defence types. Further surveys should be undertaken to assess the impacts of contaminated land on the site and the structural integrity of the existing piles. Residual risk of flooding still exists.

Refurbish existing piling and build new flood wall to extend the defence by approximately 1.1m should provide protection to 1 in 200-year level + freeboard (0.15m) for 2115 levels. Works with the existing defences, causes minimal environmental disruption, represents one of the lower cost options (see Table 3.2, FRMG Technical Report) and is in compliance with required defence level. This option is only feasible if maintenance works can extend the pile life to satisfy the 100 year design life required. Residual risk of flooding still exists.

8.6 Recommended Approach

Renovation of existing piles with additional flood wall combined with land raising and terracing.

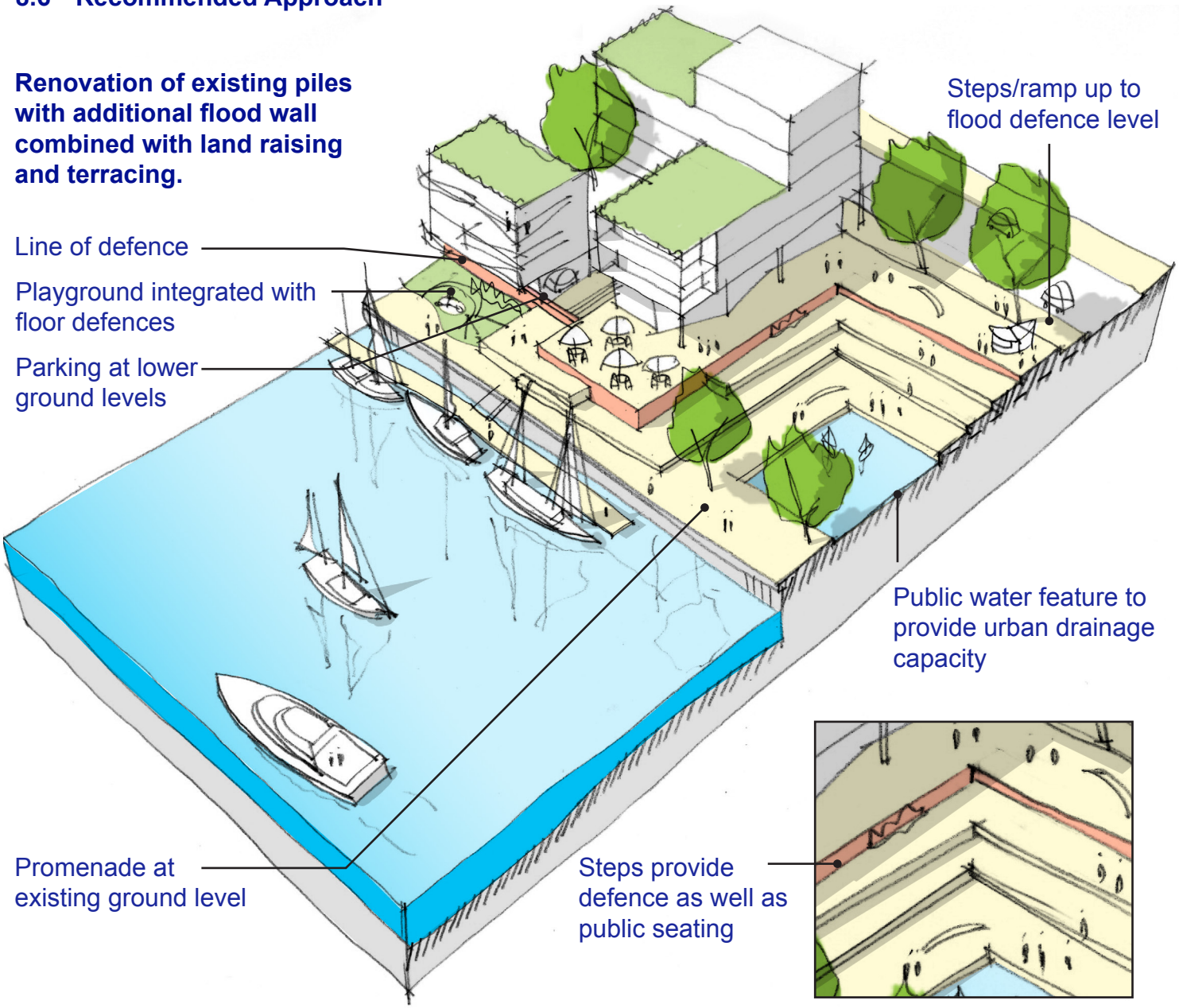


Figure 31 - Illustration of WHA recommended approach

A preferred approach would be to extend the life of the existing piles and add a secondary flood wall with some land raising.

Given the apparent condition of the exiting sheet piling along the harbour arm it is anticipated that the existing pile life could be extended to 100 years. Incremental redevelopment of sites is likely to influence the design of the defences. However a mix of land raising and concrete flood walls could be used to provide protection to the future flood level as well as provide access and views over the water.

The alignment of the flood wall could change along the length of the harbour arm depending on specific site proposals and still be designed to integrate with existing and proposed defences.

The public realm could be designed to allow varying levels of inundation whilst maintaining protection to development and public areas beyond the wall.

This approach was one of the cheaper options considered and would require less intervention to the existing site. Cost associated with maintenance to the existing piles and land contamination issues must be taken into consideration. (See FRMG Technical Report)

The existing line of sheet piling would be retained and there should be no encroachment into the tidal mud flats. However, it may be possible to vary the line of the defences to create articulation of the river edge, subject to consideration of the impact on flood flows and habitat encroachment.

Alignment of flood walls built as part of individual development phasing needs be considered in the context of the wider defence strategy to deliver a continuous, holistic water front defence. Demountable defences could be considered as part of phased redevelopment depending on the predicted flood level at the time.

This approach allows a variety of material finishes to the defence. Landscaped design, such as boardwalks, stone terracing, and planting could be introduced to soften the appearance of the sheet piling. Seating and play areas could also be integrated into the flood defences to maximise their use. A floating pontoon could provide additional mooring opportunities.

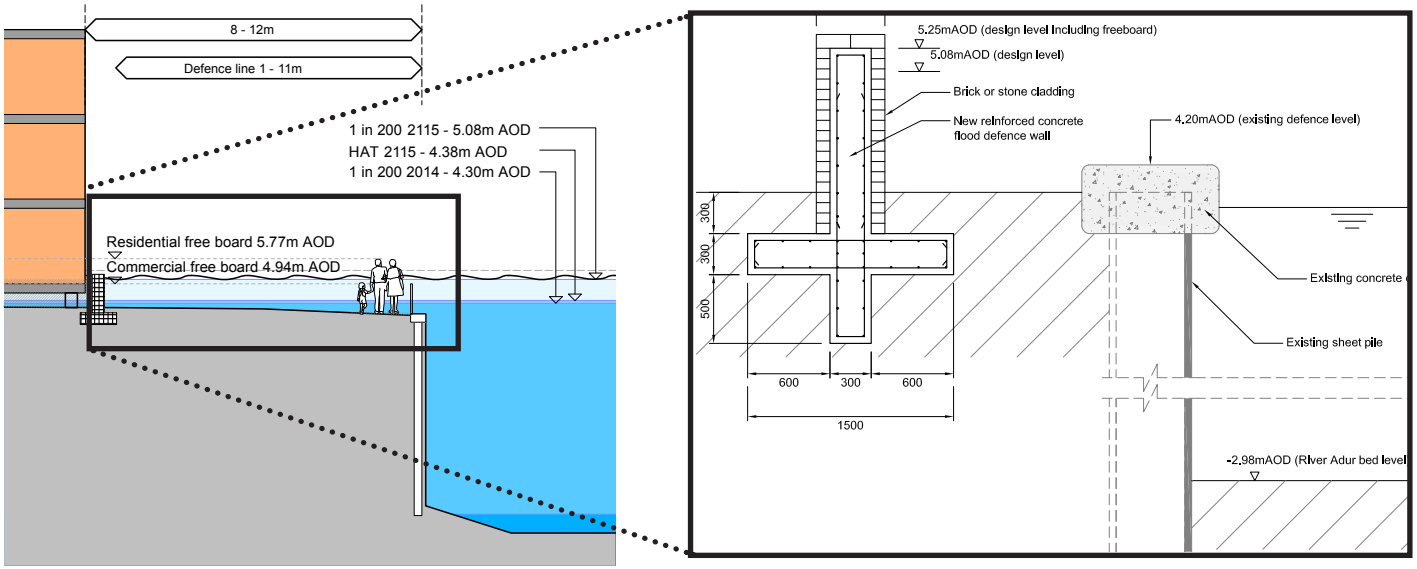


Figure 32 - Site section showing recommended defence and flood levels


Figure 33 - Renovated piles (source: creativepultrusions.com)


Figure 34 - Concrete sea wall (source: US Army Corps of Engineers)


Figure 35 - Terraced seating example, Hafencity (source: Copyright Alex Gaultier)

9. Flood Risk Management Options > WHA - Kingston Beach

Kingston Beach is located at the eastern end of the Western Harbour Arm. The area is currently protected by concrete revetments and artificial concrete armour. The existing defence level is below the current (2014) 1 in 200-year flood level.

The area is exposed to the sea, therefore defences are required to protect against wave action as well as flood levels. Due to the low land levels, continuity with other flood defences is essential to prevent flooding from behind. The area was damaged during the 2013/2014 winter storms.

The area is designated as a Village Green and described as a “community asset” in the JAAP. Shoreham lifeboat station is located on the southern point of the beach and new defences need to maintain access for the lifeboats to the water.

9.1 Issues

- The site is exposed to wave action
- Currently allocated as village green
- Protection from back door flooding required
- Restrictions on development applied due to the proximity to the harbour mouth

9.2 Opportunities

- Key area at the beginning / end of the waterside promenade
- Prominent location for a landmark building
- Sculptural rock/concrete armour to create a feature

The following options were considered of this zone following the MCA process. (see FRMG Technical Report)

Figure 38 - Existing defences - groynes, concrete revetments and sculptural boulders (source: Baca Architects)

Figure 36 - Aerial of Kingston Beach. Source: Google Earth Pro

Figure 37 - Source Bing Maps

Location of RNLI Life boat station

Location of Shoreham rowing club, redeveloped as per JAAP

1. Rock armour revetment with upstand wall

Copyright Jonathan Wilkins

Concrete upstand wall build in place of existing defences to raise the level of protection to the future (2115) 1 in 200-year flood level. Rock armour placed in front of the wall to help break wave energy. The concrete upstand wall should form a continuous line of defence with the defences along the harbour arm.

2. New concrete revetment and flood wall

Source: revetmentsystems.com

Concrete flood wall built in place of existing defences to raise the level of protection to the future (2115) 1 in 200-year flood level. Concrete revetments built in front of the wall to help break wave energy. The concrete flood wall should form a continuous line of defence with the defences along the harbour arm.

Concrete revetments can be plain or sculptural depending on application.

3. Sheet piles and removal of existing concrete revetment

Source: creativepultrusions.com

Steel sheet piling placed to the rear of existing defences to raise the level of protection to the future (2115) 1 in 200-year flood level.

New piling should form a continuous line of defence from Kingston Beach through to the Adur Ferry Bridge. Compensatory habitat may need to be sought. Local back filling may be required and consequentially site contamination should be taken into consideration. Additional rock armour may be placed in front of the new piles to help break wave energy and provide scour protection.

Figure 39 - Defensive Options

9.4 Recommended Approach

Rock armour revetment with upstand wall

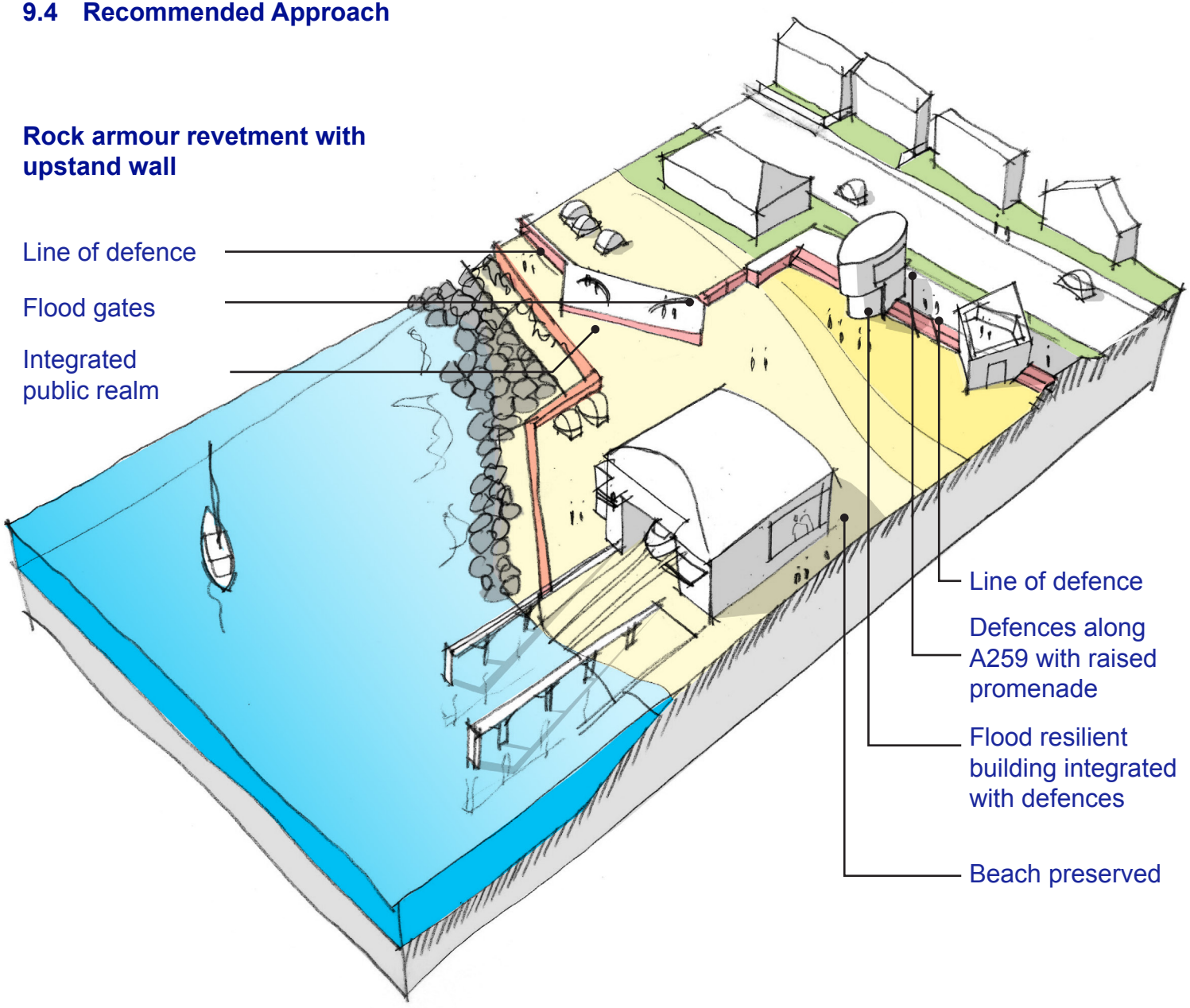


Figure 40 - Illustration of recommended approach

The existing concrete armour should be repaired and upgraded with new rock armour or concrete armour in combination with a new flood wall to the rear of the armour.

The new flood wall should be built to connect with the harbour arm defences to the west to provide a continuous line of defence to the harbour arm and A259. The new flood wall should be built to provide protection to 1 in 200-year level + freeboard (0.15m) for 2115 levels. This would give a wall approximately 1.3m in height. Rock armour should be located to the water side of the wall to provide protection against wave action.

Kingston Beach will be the start/end of the public waterside route to the town centre and ideally the new defences should aim to create an attractive gateway for pedestrians, cyclists and boats. Concrete armour could be designed to provide

a feature to the mouth of the River Adur and is an opportunity for public art (Llanes example)

This approach has a low capital cost compared to sheet piling and has a similar cost to concrete revetment.

The proposed defences are to replace the existing defences and encroachment in to the river mouth is likely to be limited. If encroachment is unavoidable, guidance should be sought from the EA regarding compensatory habitat. Defences should accommodate the existing location and use of the RNLI life boat centre.

Finishes of the defence should act to provide a seamless link between other defences along the harbour arm. A combination of hard and soft finishes could be applied.

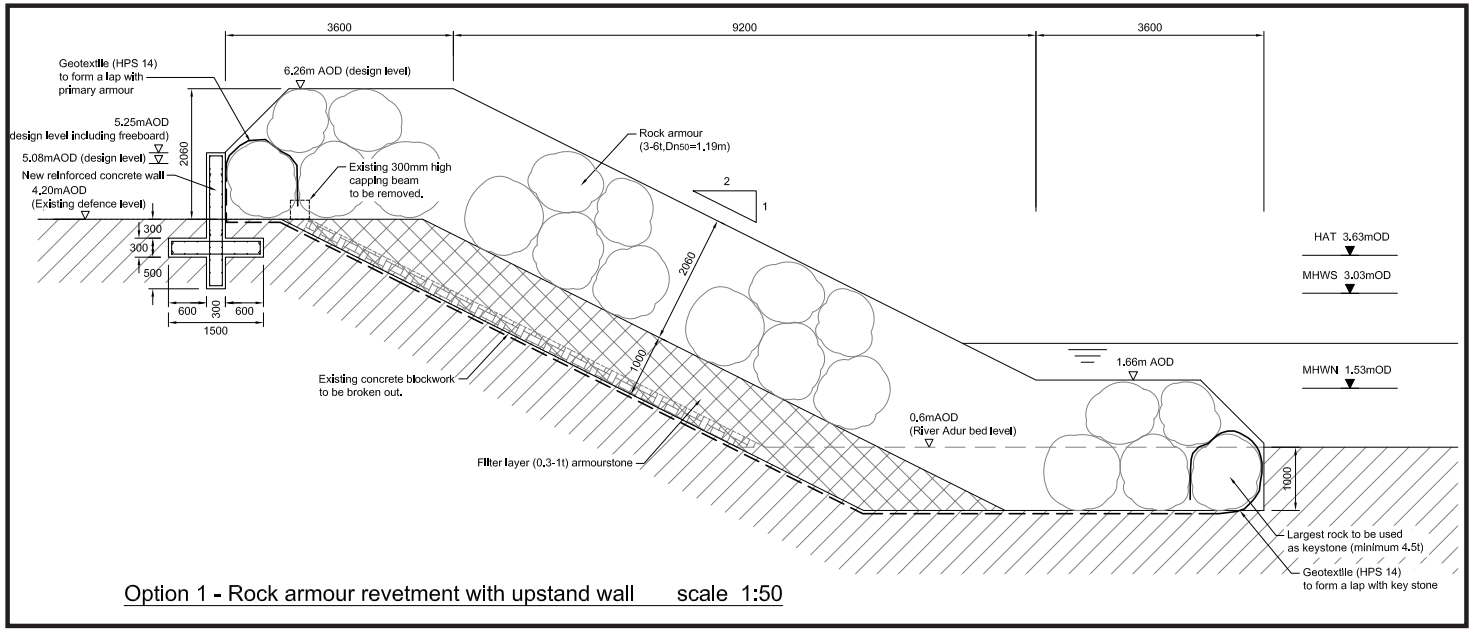


Figure 41 - Site section showing recommended defence and flood levels (source: JBA)

Figure 42 - Concrete wall (source: US Army Corps of Engineers)

Figure 43 - Natural rock armour (© Jonathan Wilkins)

Figure 44 - Rock armour - Llanes Spain (source: Baca)

10. Aldrington Basin

The Brighton Marina to River Adur Strategy sets out plans to improve the standard of protection to the east of the lock gates, to defend the area, encompassing Aldrington Basin, South Portslade and Southwick Waterfront against a future (2015) 1 in 200 flood event.

Therefore, flood risk management guidance for developers in these areas is focused on reducing residual risk and on surface water management.

10.1 Aldrington Basin

Aldrington Basin forms the eastern gateway to the harbour with the main port entrance at the junction of Wharf Road and Kingsway (A259). The basin is situated immediately adjacent to the historic Hove Lagoon and marks the end of the Hove seafront promenade and a transition to the industrial character of Shoreham Port.

This area contains a mixture of employment uses ranging from offices, retail outlets, a restaurant and pub at the Kingsway level through to light industrial, storage and marine-related uses down in the basin itself.

Due to its elevated position, sites along the A259 Kingsway are not at significant risk of flooding. For sites between the A259 Kingsway and the coast, there is a risk of tidal flooding. The Brighton & Hove Strategic Flood Risk Assessment (SFRA, 2012) identifies most of the Aldrington Basin area as Flood Zone 2 and 3a with some small areas of Flood Zone 3b for tidal flooding. The estimated maximum flood depth for this area for the 1:200 year tidal event is 0.50m, with some areas estimated to flood to a depth of only 0.20m.

The risk associated with this form of flooding increases significantly when sea level rise is factored in. In this scenario, maximum estimated flood depths increase to about 1.6m

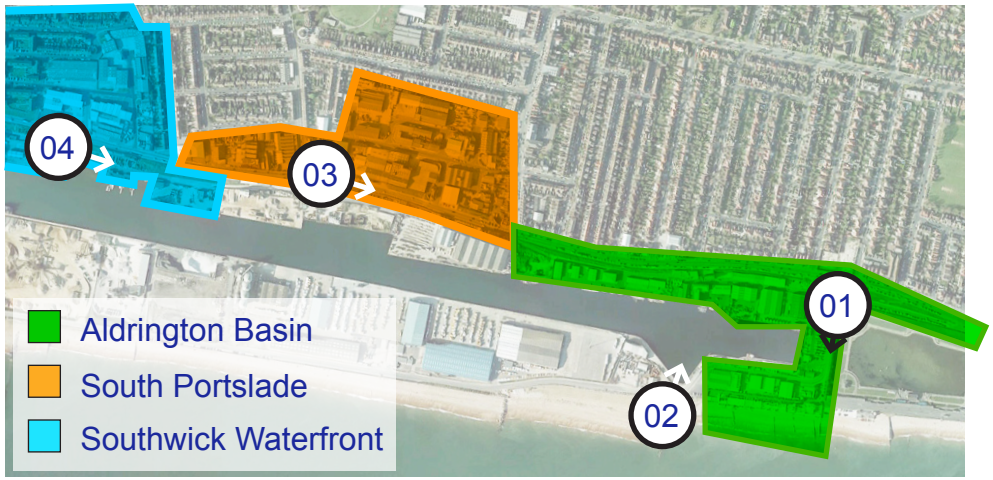


Figure 45 - Map of SSI 1-3 (source: Google Earth Pro)

01. View from Basin Road North (source: Baca Architects)

03. Wellington Road, South Portslade

02. View across Aldrington Basin from Basin Road South

04. Basin Road North, Southwick Waterfront

with increased flood velocities.

10.2 Recommended Approach

Residual flood risk should be dealt with through resilient and resistant design measures as set out in Section 13. Resistant measures are more appropriate where potential flood depths are less than 0.3m. Figure 46 shows a development raised above residual flood levels, Figure 48 shows a flood resistant development in Hamburg which was designed to withstand greater depths of water.

Surface water management should focus on SuDS as set out in Section 14.

Figure 46 - Example of development locally raised above flood levels in Brentford, London (source: Baca Architects)

Figure 47 - Example of raised development in Ypenburg Netherlands (source: Baca Architects)

11. South Portslade

11.1 South Portslade

The South Portslade industrial estate is elevated above the current and future flood extents. Measures need to be taken to ensure that all new development is safe however, traditional building construction should be appropriate and no flood defences should be required in this location. However, sustainable drainage could be considered to help prevent possible surface water flooding.

11.2 Recommended Approach

Residual flood risk should be dealt with through resilient and resistant design measures as set out in Section 13. Resistant measures are more appropriate where potential flood depths are less than 0.3m.

Surface water management should focus on SuDS as set out in Section 14.

Figure 48 - Example of flood resistant property in Hamburg during a flood

Figure 49 - Example of flood resistant property in Hamburg (source: J Lamond)

12.1 Southwick Waterfront

Southwick Waterfront is located to the east of the harbour mouth and north of The Canal, a harbour area in which the water level is controlled by the Southwick Lock Gates.

The Southwick Waterfront area comprises a mix of residential, community, open space, recreational and employment uses

EA data shows the areas to the south of the A259 are at current flood risk (2014).

Southwick Waterfront has been identified for a mix of uses including new leisure, marina and community facilities as well as new employment development. The site is also a possible location for the Sea Cadets and Nautical Training Corps.

The site lies within in Flood Zone 1, 2 and 3 but flood depths during a 1 in 200-year event have been shown to be relatively low upto 0.4m. The 2115 prediction indicates that flood depths could increase to between 1m and 1.6m. Measures need to be taken to ensure that all new development is safe. Ideally new buildings should be elevated above future flood levels and taking into consideration freeboard. Flood resilient and resistant approaches may be considered in areas where the potential depth of flooding is lower.

12.2 Recommended Approach

Residual flood risk should be dealt with through resilient and resistant design measures as set out in Section 13. Resistant measures are more appropriate where potential flood depths are less than 0.3m.

Surface water management should focus on SuDS as set out in Section 14. Figure 50 shows an example of SuDS integrated within a development.

Figure 50 - Example of sustainable drainage integrated within a new development in Germany (source: J Blanksby)

13. Flood Resistant and Resilient Approaches

Where flood defences are not appropriate, alternative strategies should be implemented to reduce disruption during and following a flood. Property Level Flood protection must be considered with regards to flood depths and recommendations are not appropriate for this document. Flood resistant and resilient measures are described below.

13.1 Flood Resistant (Dry proofing) Buildings

A resistant building prevents water ingress (Figure 51) during a flood event. Flood resistance measures include flood defences, flood barriers, door guards, and back flow drains with the purpose of preventing water from entering the property – hence keeping it dry.

Typically flood resistance measures are only effective for short duration, shallow flooding (below 300mm to 600mm in depth depending on structural assessment. Tests have shown that floodwater may still infiltrate different building constructions designed to resist flooding though the duration of resistance may vary. There are examples of buildings designed to withstand greater depths of flooding, but these require heavy-duty water resisting construction such as tanking, waterproof concrete and steel flood doors.

For most cases it should be assumed that flood resistance measures will only be effective where predicted flood levels are no more than 300mm above the surrounding ground level.

13.2 Flood Resilient (Wet proofing) Buildings

Resilient buildings allow water in (Figure 52) and provide protection through resilient construction and finishes. Multiple building elements require consideration, some items may include:

Floors: Solid flooring to easily

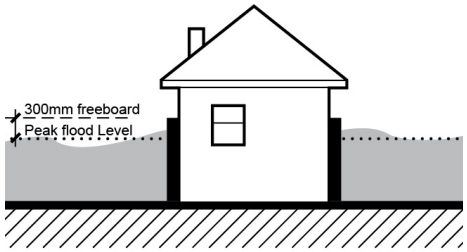


Figure 51 - Concept section of resistant property (© Baca Architects)

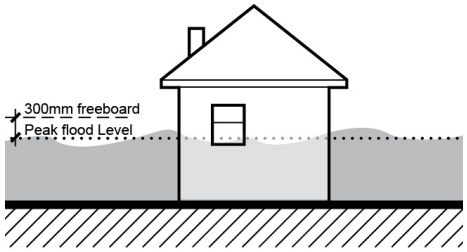


Figure 52 - Concept section of resilient property (© Baca Architects)

Figure 53 - Flood door and glazed screen (source: Baca Architects)

Figure 54 - Raised door with flood guard (source: Baca Architects)

wash down following a flood event.

External walls: Lime plaster to internal surface

Internal partitions: Water resilient and constructed with materials that allow fast drying recovery.

Windows: Should allow water control and safe egress at multiple locations on the building.

Doors: Made from water resilient materials.

Incoming services: All penetrations through the building fabric need to be well sealed and fitted with safety valves.

Drainage: Non-return valves should be fitted to sewage system. All penetrations to the flood proof layer should be sealed.

Electrics: Electric appliances to be located above maximum flood level as best practice. Any fittings below the flood level should be constructed from waterproof materials.

Automated warning systems: Automation is essential to allow the various technologies to work in synergy and provide early warning, emergency contact and automatic safety measures.

Flood emergency kit: Including First aid, documents, radio, etc. to be stored in a sealed package. Pack provided by EA

It is important to note that there is not one approach and that each site needs to be considered in context.

More detail on flood resilient design is available in the following documents:

- 'Improving the flood performance of new buildings: flood resilient construction', CLG
- 'Flood resilient property guide', DEFRA
- RIBA sustainability hub.

Figure 55 - Flood resistant UPVC door (source Aquobex)

Figure 56 - Cable duct seal (source Aquobex)

Figure 57 - Resilient kitchen in Brisbane (source James Davidson)

14. Sustainable Drainage Systems (SuDS)

Integration of appropriate sustainable drainage systems (SuDS) should actively contribute to the quality of urban design across the Shoreham Harbour regeneration area.

SuDS should be applied to all developments as set out in the Harbour Wide Policies within section 3.2 of the JAAP.

Opportunities to design for flood management which also balance the impact of urban drainage on water quality management and amenity should be promoted.

The selection of sustainable drainage approaches should be informed by local site constraints including (but not limited to) topography, geology (soil permeability), and available area, evidencing the primacy of prevention (preventing run-off by reducing impermeable areas), or good housekeeping measures for reducing pollution; and progression through local source controls to larger downstream site and regional controls.

Dealing with water when and where it falls (source control) should be preferred. These are often a cheaper and easier option for many developments and dealing with runoff at source the volume of water and potential amount of contamination is less. Source control components falling within the curtilage of properties or highways areas should be encouraged and can include green roofs, permeable surfaces, rainwater harvesting and water butts. Living Roofs and Walls can vary in type from Roof Gardens, Roof Terraces, Green Roofs and Green Walls. Rainwater harvesting techniques, such as the installation of water butts, can aid in increasing the attenuation of rainfall and contribute to the on-site recycling of water.

An award winning example of a green roof is Rockbourne Mews, Forest Hill, London (Figure 58). Other examples of successful green roof projects can be found in the Mayor of London's 'Living Roofs: Case Studies' document. Wider examples of successful implementation of source control can be found at www.susdrain.org

Where it is demonstrated that site and regional controls are required the layout and design of basins, ponds and infiltration devices including filter trips, soakaways and permeable surfaces which actively provide multiple benefits should be favoured. In particular this will include vegetated or landscaped features which provide amenity value or are shown to positively impact air quality, carbon reduction, recreation, education and other elements of community health and vitality and have monetary or intangible social value. Early consideration of the potential multiple benefits and opportunities will help deliver the best results.

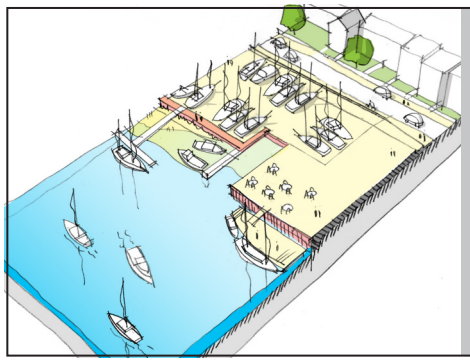
Advice on SuDs is available within the latest Worthing & Adur and Brighton & Hove Strategic Flood Risk Assessments; from the Environment Agency and the Construction Industry Research and Information Association (CIRIA) online SUDS community www.susdrain.org. The latter includes an online resource of guidance and best practice.

Figure 58 - Extensive wildflower and sedum green roof at Rockbourne Mews (source: R Barker, Baca Architects)

15. Integration with Development

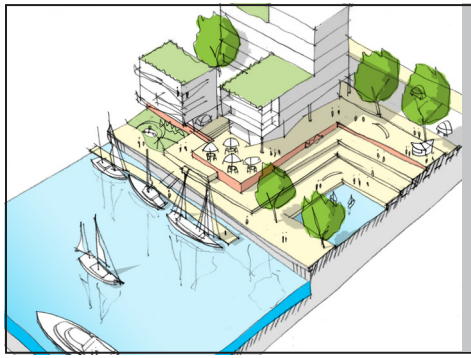
Figure 59 - The drawing below indicates a potential flood defence line and indicative development opportunities.

15. Flood Resistant and Resilient Approaches



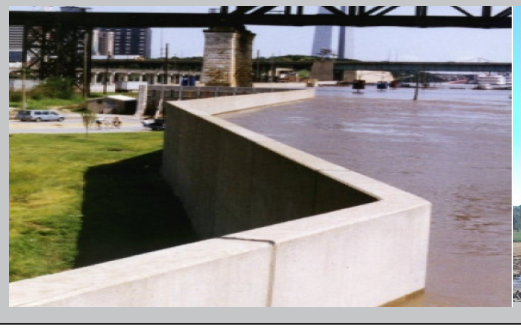
01. FOOTBRIDGE TO RIVER-SIDE CENTRE

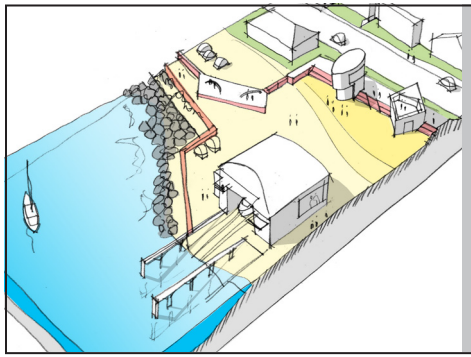
New concrete flood wall and selective land raising



02. RIVERSIDE CENTRE TO KINGSTON BEACH

Renovated piles and new flood wall





03. KINGSTON BEACH

Rock armour and flood wall

16. Acknowledgements

The Flood Risk Management Supplementary Planning Document (SPD) is commissioned by the Shoreham Partnership, consisting of Adur District Council, Brighton & Hove City Council, West Sussex County Council and Shoreham Port Authority. The Guide aims to translate the Partnership's aspirations for a well connected public friendly waterfront into an achievable, high quality flood defence strategy. The Guide will provide landowners and developers with a select pallet of options for flood defence in line with the Partnership's requirements.

The Guide will inform the Shoreham Harbour Partnership's Joint Area Action Plan (JAAP).

The project has been led by JBA consulting in collaboration with Baca Architects.

Project Team

Marc Pinnell and Oliver Francis of JBA Consulting; Robert Barker and Roger Ashman of Baca Architects

Prepared by

Roger Ashman and checked by Robert Barker, Baca Architects

Disclaimer

17. List of Figures

Shoreham Harbour Regeneration
www.shorehamharbour.com
info@shorehamharbour.com

Adur District Council
Portland House
44 Richmond Road
Worthing
West Sussex
BN11 1HS

Brighton & Hove City Council
Hove Town Hall
Norton Road
Hove
East Sussex
BN3 4AH

SHOREHAM HARBOUR REGENERATION

Adur District Council

Brighton & Hove City Council

west sussex county council

shoreham port