



Short List Options Report

Langstone Flood & Coastal Erosion Risk Management
Scheme

Eastern Solent Coastal Partnership

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1. Introduction

1.1 This report

AECOM was commissioned by the Eastern Solent Coastal Partnership (ESCP) to undertake an option appraisal study and develop an outline design and business case for a tidal flood risk management scheme at Langstone.

This document is the short list options report for the study. It provides details of the second stage of the option appraisal process in which the long list of options were appraised and reduced to a short list worthy of further more detailed assessment. It also outlines the short list option development, including identification of potential defence alignments and typical option concept sketches.

For information on the first stage of the option appraisal process and on the development of the long list of options, refer to the long list options report.

1.2 Background

1.2.1 Study site

The 1km Langstone frontage is within the jurisdiction of Havant Borough Council (HBC) and located on the mainland, immediately to the north of Hayling Island. At the site a number of residential properties as well as two public houses are located within a few metres of the water's edge. The study location forms part of a wider flood cell which also covers the adjacent Southmoor frontage to the west.



Figure 1-1: Study site

1.2.2 Strategic context

The 2010 North Solent Shoreline Management Plan policy for the frontage is to 'Hold the Line' for the next 100 years with potential for 'Managed Realignment' at Southmoor. The subsequent Portchester to Emsworth Flood and Coastal Erosion Risk Management Strategy (2013, herein referred to as PEMS) which was adopted by HBC

recommends improving the defences at Langstone to a minimum 1:75yr (1.3% AEP) Standard of Protection (SoP) through a phased approach.

In addition to the FCERM context of the Langstone frontage, the key A3023 road to Hayling Island passes through the site. The Langstone Scheme is therefore viewed as an essential element when considering the need to protect access on to and off the island during extreme flood events, with particular reference to the requirement to maintain access for emergency services. The Local Plan review for HBC has also identified the potential for significant housing development on Hayling Island (>1000 properties by 2036) but this is likely dependent on a number of factors including the likelihood of any scheme at Langstone and its ability help ensure safe access and egress onto the island.

1.2.3 Flood risk

PEMS identified that 56 residential properties and 3 non-residential properties are currently at risk of tidal flooding from a 1:200yr return period event. Due to sea level rise, in 100 years' time 81 residential properties and 5 non-residential properties are expected to be at risk from the same return period event. There is a discrepancy between the number of properties identified to be at risk within PEMS and those deemed to be at risk based on the latest EA flood mapping (2017) which suggests that 103 residential properties are at risk from present day from a 1:200 year event. This discrepancy is to be investigated as part of this study and will be reported on when undertaking the economic assessment.

1.2.4 Do Nothing and Do Minimum

As part of the option appraisal processes the Do Nothing (walk away) and Do Minimum (patch and repair reactive maintenance) scenarios have been considered and are included in the short list of options for each ODU.

With regards to the Do Nothing approach, in addition to an increase in flood risk, this approach could also present a number of risks such as increasing risk of public liability injury claims due to unsafe defences, degrading footpaths and associated structures, a loss of rental income and business claims as a result of closures. There are also likely to be indirect impacts on tourism and recreation in the area. These potential 'walk away' outcomes underline the importance of properly planned and robust flood and erosion risk management for the frontage.

1.3 Placemaking opportunities

Placemaking is a multi-faceted approach to the planning, design and management of public spaces. The intention of placemaking is to create public spaces that promote people's health, happiness and wellbeing. The public space at the Langstone frontage, particularly along the pathway between the Royal Oak and The Ship Inn, is highly valued by local residents for its character and footpath access. Whilst it is not a measure to reduce flood risk, placemaking is an important consideration in the development of options at the study site and will be considered throughout the option development and appraisal process.

A range of placemaking opportunities may exist depending on which option is identified as the preferred option. Placemaking may involve large scale landscaping across the frontage, or it may involve alternative small scale methods such as improved signage in the area and education boards. Placemaking opportunities will be identified through the short list option appraisal process and will be incorporated into the preferred option designs during the next stage of the appraisal process.

2. Methodology

2.1 Option Development Units

The frontage has been broken down into four Option Development Units (ODUs) to facilitate the development and appraisal of options. These are presented in Figure 2-1 and are as follows:

- ODU 1: Langstone West, between the east bank of the Langbrook Stream to the edge of the formal defences at the northern end of Langstone Spit
- ODU 2: Sailing club and Langstone Spit, including the spit, sailing club and A3023 revetment
- ODU 3; Langstone east, between the Ship Inn car park and the Old Mill slipway
- ODU 4: Old Mill and Mill pond, between the Old Mill slipway and the slipway to the north east of the Mill pond.

The four ODUs have been divided further to assess options on a local level. Details of these sub-units can be found in the separate ODU chapters 4 to 7.

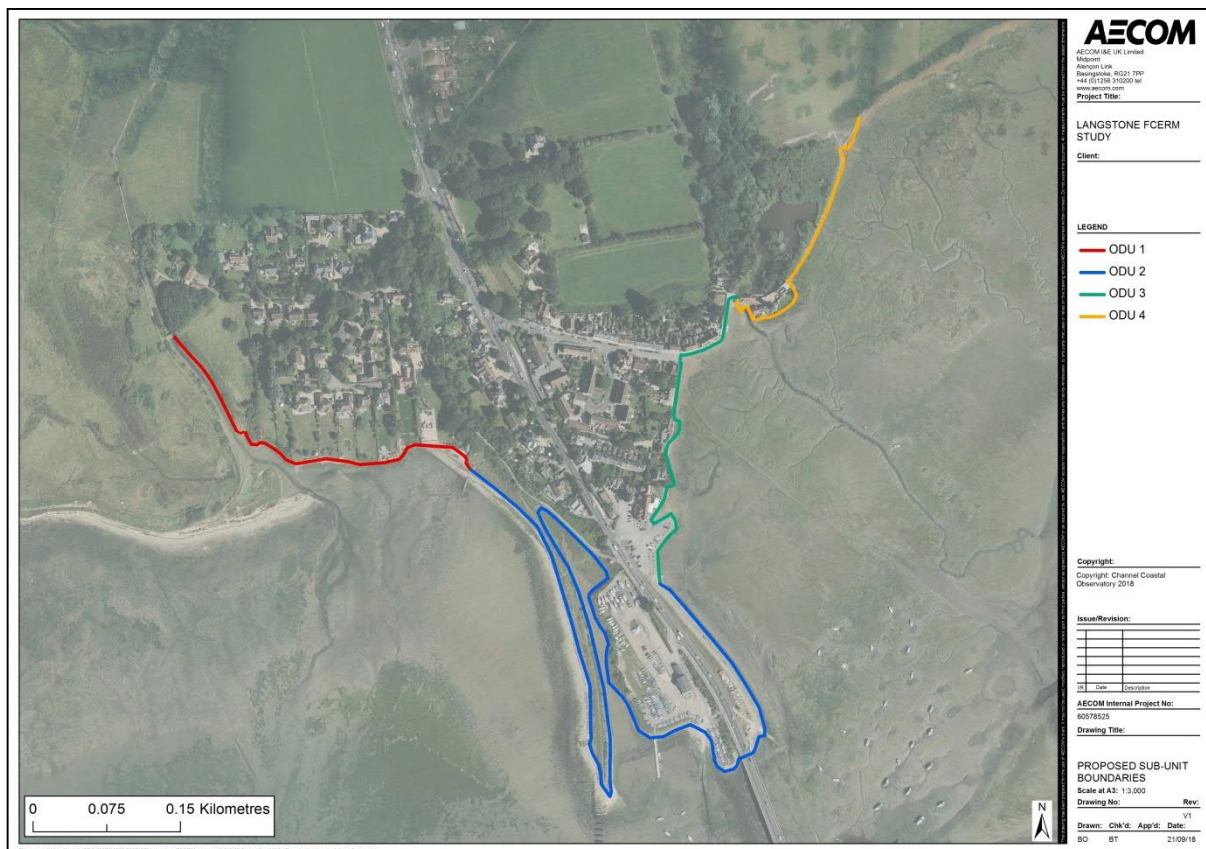


Figure 2-1: Study unit boundaries

2.2 Management options and potential measures

The preferred management option for the frontage that was identified in PEMS is to improve the defences to a 1:75yr standard of protection through a phased approach. As part of the appraisal process this recommendation will be reassessed and the preferred option and standard of protection confirmed. A number of alternatives exist, such as doing nothing, doing minimum and maintaining the defences.

Another alternative that can be considered in FCERM appraisals is sustaining the existing standard of protection to keep pace with sea level rise. However this approach has not been pursued further as an option in this study. This is because the existing standard of protection is very low, with flooding occurring along parts of the frontage on an annual basis. Therefore from an investment perspective a sustain approach is not considered to be a

practical solution. For example, it would not be logical to construct a defence to provide the existing standard (approx. 1:1yr), when in only a few years' time the defence would need to be raised further due to sea level rise. This approach would essentially involve going back and raising defences every few years which over time would be a very costly and illogical approach. It is much more practical to construct a more substantial defence now to protect to a future standard of protection, for example a 75yr standard until year 30, and to repeat this intervention 2-3 times over the course of the next 100 years. This more logical approach would significantly increase the existing standard of protection so it therefore falls under the 'Improve' option discussed above and as recommended by PEMS.

In order to implement the preferred management option a number of different defence measures could be used, either separately, in different locations or in conjunction with one another. Some examples of generic defence measures are maintenance of a seawall with a setback floodwall behind etc. Defence measures may be phased through time to address sea level rise and therefore may not necessarily all require immediate implementation.

2.3 Long to short list appraisal

Stage one of the option development and appraisal process involved developing the long list of measures for each ODU. This process is described in the Long List Report. The long list of measures for each ODU included a wide range of potential approaches, many of which were identified and included simply to ensure that no measures were overlooked. After the long list stage, it was considered unnecessary to appraise all of the long list measures in detail because some were impractical, technically flawed, or environmentally unacceptable. Therefore stage two (this stage) of the appraisal process has involved appraising the different long list measures in a multivariate appraisal to identify the most suitable measures for each ODU. The process and outcome of the multivariate appraisal is outlined in this report.

The multivariate appraisal has been undertaken on an ODU sub-unit basis so that local constraints and opportunities could be considered. Based upon the results of the multivariate appraisal, the short list of measures for each sub-unit has been identified. These sub-unit measures will then be combined into ODU scale options (e.g. maintain or improve) which will be appraised in the next stage of the process against the Flood and Coastal Erosion Risk Management (FCERM) decision rules. Details of frontage wide management approaches can be found in chapter 8.

2.4 Multivariate appraisal

The multivariate appraisal has appraised the long list measures for each ODU sub-unit against the 14 categories below. Different measures were appraised for the various management options; Do Nothing, Do Minimum, Maintain and Improve. The basis of these management options are:

- Do Nothing; with this approach the existing defences would be abandoned in terms of maintenance and repair, and no remedial or additional works would be carried out.
- Do Minimum; would involve reactive repairs or maintenance of the existing defences to ensure health and safety compliance. This approach is small scale, for example, replacing a small number of lost bricks in a masonry structure, and does not allow for capital interventions.
- Maintain; would typically involve the proactive repair and larger scale maintenance of the existing defences, for example a larger scale encasement, concrete spraying or like for like replacement of an existing wall. For the spit in ODU 2 this could include stabilisation works.
- Improve; raising the height of the existing defences or constructing new higher defences to improve the standard of protection provided.

For each category in the multivariate appraisal the measure was scored as red (score of 0), amber (score of 1) or green (score of 2). For each measure the total score across all the categories was then calculated. Based on the total score the measures were then ranked (with 1 being the highest ranking). The top ranking measures were then taken forward to the short list. For the Improve option, a minimum of two, and a maximum of three measures were taken forward to the short list. The Do Nothing, Do Minimum and Maintain options at each location have been taken forward to the shortlist in addition to the improve options.

The scoring categories were as follows:

- Strategy preferred option facilitation
- Residual flood risk

- Erosion risk management
- Ecology impacts
- Heritage impacts
- Landscape impacts
- Technical feasibility
- Stakeholder objectives and consenting
- Community support
- Broader outcomes, aspirations and contributions
- Maintenance requirements
- Design life
- Coastal process impacts
- Relative cost

More detail as to the scoring rules for each of the categories is found in Table 2-1 overleaf. The scoring was undertaken by the project team and was extensively and collaboratively reviewed and ratified in a workshop between ESCP and AECOM staff. This approach, alongside the scoring rules presented in Table 2-1, helped ensure that scoring was as objective and consistent as possible. The scoring was informed by the following:

- Supporting data and assessments; the project team reviewed a wide range of relevant data and completed a number of baseline studies which provided a detailed level of understanding of the frontage and the issues, constraints and opportunities.
- Visual site inspections; several site walkovers were carried out along accessible areas of the frontage. These walkovers aided the project teams' understanding and appreciation of the frontage.
- Stakeholder and community engagement; ESCP led on the engagement and liaison with key stakeholders and the community and the early feedback received formed a key part of the appraisal process.
- A set of heritage, ecology and landscape objectives for the scheme were established collaboratively with ESCP (see Appendix C). These account for key stakeholder input and advice received following the site walkover. The objectives were then considered as part of the multivariate scoring process.

Chapters 4 to 7 present the multivariate scoring for each of the ODU measures and the short list options identified as a result of the scoring process.

Table 2-1: Scoring rules for the multivariate appraisal for each category

Category	Red (score 0)	Amber (score 1)	Green (score 2)
Strategy preferred option facilitation	Measure doesn't support Strategy preferred option (which is to provide an improved SoP)	Measure partially supports the Strategy preferred option but subject to localised changes	Measure fully supports the Strategy preferred option
Residual flood risk	Significant risk of residual flood damage after measure has been implemented, e.g. due to operational requirements of defences (i.e. demountables)	Minor risk of residual flood damage after measure has been implemented	Very minimal risk of residual flood damage after measure has been implemented
Erosion risk management	Measure increases erosion risk or a significant erosion risk remains	Measure partially reduces erosion risk or a minor erosion risk remains	Measure significantly reduces or removes erosion risk
Ecology impacts	Potentially ecologically detrimental	Identified ecological constraints but potential to reduce detrimental environmental effects, or impact is currently unknown	Expected to be negligible or easily avoided / mitigated effects on ecology, or potentially environmentally beneficial
Heritage impacts	Potentially detrimental on heritage features	Identified heritage constraint but potential to reduce detrimental environmental effects	No likely adverse effects on heritage or potentially environmentally beneficial
Landscape	Potentially detrimental on landscape	Identified landscape constraint but	No likely adverse effects on

Category	Red (score 0)	Amber (score 1)	Green (score 2)
impacts		potential to reduce detrimental environmental effects	landscape or potentially environmentally beneficial
Technical feasibility	Measure is technically very challenging or difficult to implement / construct	Measure presents some minor technical challenges to implement / construct	Measure does not have any known minor or significant technical challenges to implement / construct
Stakeholder objectives and consenting	Potential for major objections from statutory consultees or measure unlikely to gain consent	Likely to be support for and against or measure meets requirements of some feedback but not all	Measure helps achieve majority stakeholder needs / addresses main concerns and is likely to receive consent
Community acceptance	Potential for major objections from the community or goes against feedback received	Likely to be support for and against or measure meets requirements of some feedback but not all	Measure helps achieve majority community needs / addresses main concerns
Broader outcomes, aspirations & contributions	Limited potential for broader outcomes, attracting contributions and/or supporting other plans and programmes	Measure could facilitate broader outcomes or secure a contribution, and/or support other plans and programmes	High potential to deliver broader outcomes, secure contributions and/or support other plans and programmes
Maintenance	Measure requires significant level of on-going maintenance	Measure requires some scheduled maintenance	Measure is maintenance free / minimal maintenance requirements
Design life	Measure has a short term design life (e.g. <20years) with further interventions required	Measure has a medium term design life (e.g. 20-50 years)	Measure has a long term design life (50+ years)
Coastal processes	Measure has potential for significant impacts to coastal processes baseline along the frontage	Measure likely to have no significant changes to coastal processes baseline along the frontage	Measure has potential to potentially benefit coastal process baseline along the frontage
Relative cost	Measure likely to be high cost compared to other measures being considered	Measure likely to be average cost compared to other measures being considered	Measure likely to be low cost compared to other measures being considered

Safety, Health and the Environment (SHE) and Construction, Design and Management (CDM) regulations were not considered in the multivariate appraisal because if these aspects were to be included as a separate category there was unlikely to be a variation in the scoring of the category between the various Maintain and Improve measures. SHE and CDM will be considered in more detail during the outline design of the preferred option.

3. Potential scheme alignments

Figure 3-1 to Figure 3-3 in the pages below show potential ideas for scheme alignments at the study site, linking the defences that have been appraised in the different ODUs. Three potential scheme alignments are presented in the figures, each providing a different combination of alignments considered across the ODUs. At this stage no combination of alignments is being ruled out and the purpose of the figures is to demonstrate how the defences in different ODUs could link together. The preferred scheme alignment will be identified at the next stage and it may not necessarily be one of the alignments shown here.

Figure 3-1 shows an alignment around the full frontage, extending from the Langbrook stream in the west to east of the Mill.

Figure 3-2 shows shows an alignment around the main residential parts of the frontage, excluding protection to the Sailing Club and the Spit. The defence also does not include the Mill and the area east of this.

Figure 3-3 shows an alignment around the east side of the Langstone. This involves constructing a defence along the National Cycle Route 2 and excluding the residential properties to the west. This alignment does also not include the Sailing Club, the Mill or the Spit.

The following chapters consider each ODU in more detail, provide an overview of the measure scoring and also present more detailed alignments at the local level.

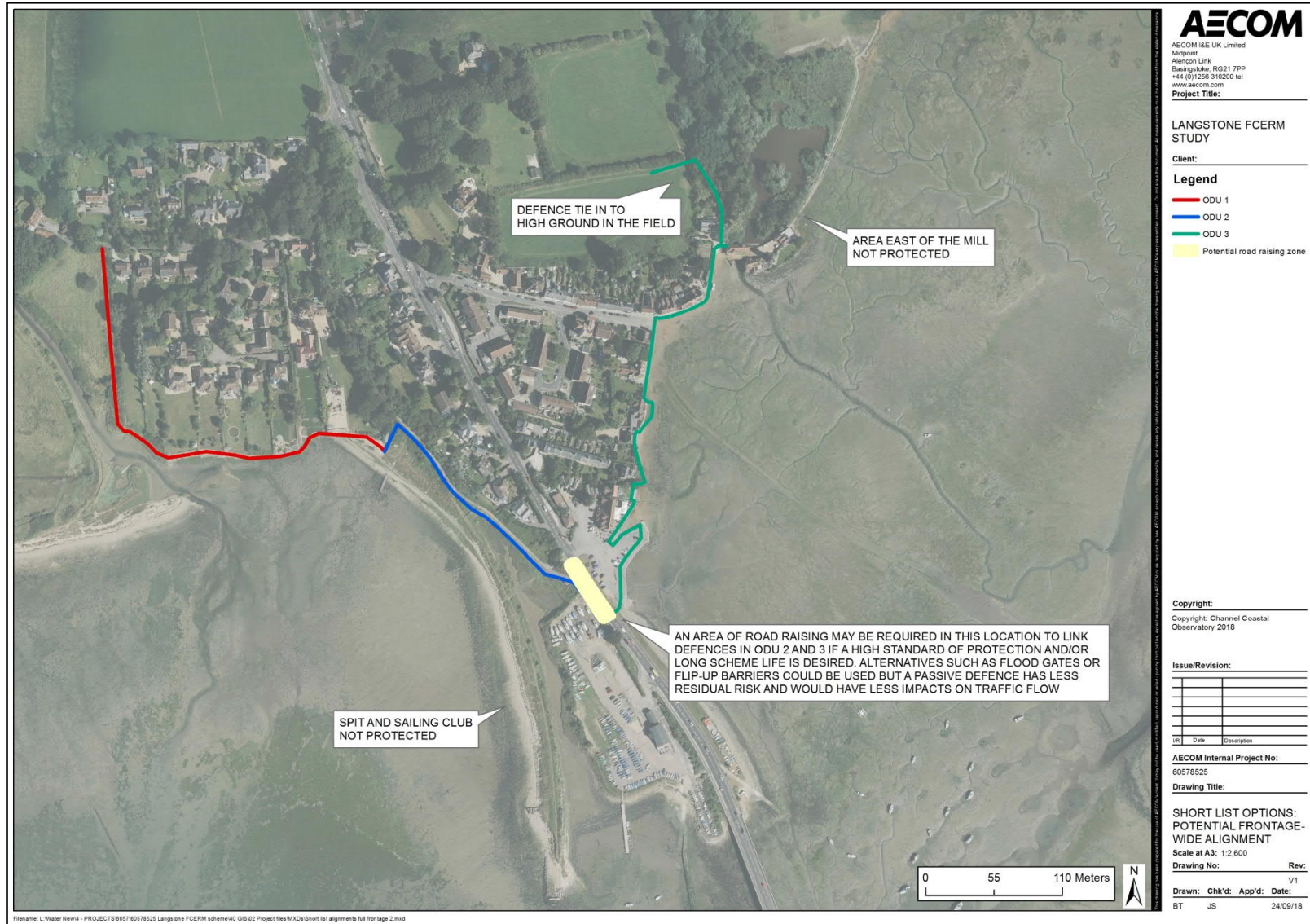




Figure 3-2: Potential alignment 2

4.2 ODU 1 characteristics

Table 4-1: ODU 1 sub-unit characteristics, constraints and opportunities

Sub-unit	Characteristics	Constraints	Opportunities	Photo
ODU 1a Langbrook Stream east bank	<ul style="list-style-type: none"> - Approximately 210m long. - No formal flood defences. - Thickly vegetated river bank - Footbridge to Southmoor site located approximately 60m from the top of the sub-unit. - Higher ground to the north of the sub-unit for potential tie-in locations. 	<ul style="list-style-type: none"> - Character of natural looking riverbank likely to limit the range of structures suitable for this location. - Access is limited along the river bank which could limit the choice of suitable defences in this area and would make a permanent defence structure more viable. - Potential ecology impacts if a defence structure leads to encroachment. - Potential for species (potentially reptiles) along the vegetated river bank - Potential for defence on the river bank to constrain fluvial flows and lead to detriment. - Field behind the river bank is privately owned so consenting could be a constraint if land owner does not support approach 	<ul style="list-style-type: none"> - Lots of space available in field behind the river bank for defences. - Space availability increases the potential for a sympathetic defence design to limit visual impact. - A flood defence in this area could also help to mitigate fluvial flood risk (in addition to tidal). 	
ODU 1b Formal defences protecting west Langstone	<ul style="list-style-type: none"> - Approximately 230m long. - Vertical concrete seawall with concrete apron / encased sheet pile toe. - Defences provide a present day > 1:200 year SoP against wave overtopping, but there is a flow pathway from either side of the defences so the properties behind flood from lower return period events. 	<ul style="list-style-type: none"> - Defences are located immediately to the rear of residential property gardens so the visual aspect of the defences from the landward side is likely to be important. - A frontline defence could lead to encroachment which could have impacts on ecology and difficulty in acquiring consents. - Seawall owned by local residents who may object to any works or claim compensation 	<ul style="list-style-type: none"> - Opportunities to landscape area and deliver place making objectives. For example including a footpath from Langstone to Southmoor alongside a new defence to improve connectivity. - Potential for contributions from residential property owners if a defence is in line with their aspirations. - Opportunities to 'green' new defences 	

4.3 ODU 1 scoring

A summary of the multivariate appraisal scores for ODU 1 is presented in this section. Table 4-2 provides the total score from the multivariate appraisal for each measure considered in the sub-units. Based on these scores the measures taken forward for use in the short list options have been identified. For a detailed breakdown of the scoring against each of the 14 multivariate categories refer to Appendix A.

Table 4-2: Summary of multivariate scores for ODU 1

ODU sub-unit	Measure	Ranking	Selection for use in short list?
ODU 1a Langbrook Stream east bank	Do Nothing		
	No Active Intervention	1	✓
	Improve		
	Seawall	3	✗
	Sheet piling and capping beam	3	✗
	Setback floodwall	1	✓
	Land raising	3	✗
	Demountable defences	3	✗
ODU 1b Formal defences protecting west Langstone	Do Nothing		
	No Active Intervention	1	✓
	Do Minimum		
	Patch and repair	1	✓
	Maintain		
	Capital refurbishment	1	✓
	Scheduled maintenance	2	✓
	Improve		
	Crest raising (frontline) + scheduled maintenance of existing structure	1	✓
	Glass crest raising + scheduled maintenance of existing structure	4	✗
	Self-raising floodwall + refurb of existing structure	4	✗
	Demountable defences	4	✗
	Seawall	3	✓
Sheet piling (behind existing defences, in property gardens)	2	✓	
PLP / PLR	4	✗	
Vegetated buffer zones	5	✗	

Note: only two measures taken forward for Improve in ODU1a due to lack of viable alternatives

4.4 ODU 1 scoped out measures

This section provides a commentary on the measures which have been screened out from further consideration based on the results of the multivariate appraisal.

4.4.1 Seawall

- Sub-units appraised / considered in: ODU 1a and ODU 1b

- Sub-units scoped out of: ODU 1a

- Sub-units taken forward: ODU 1b

A seawall was scoped out from further consideration in 1a because it scores poorly on ecology, landscape, stakeholder objectives and relative cost. Given the presence of a wall currently a seawall has been included in the short list of options for Unit 1b. However, a new seawall is likely to have a relatively high cost compared to other measures being considered and may face consent difficulties.

4.4.2 Sheet piling

- Sub-units appraised / considered in: ODU 1a and ODU 1b

- Sub-units scoped out of: ODU 1a

- Sub-units taken forward: ODU 1b

Sheet piling has been scoped out of ODU 1a due to the potential impact on ecology, landscape and poor scores in the categories of stakeholder objectives, community acceptance and relative cost. A potential alignment considered for sheet piling is along the natural looking river bank on the east side of the Langbrook stream. Sheet piling in this location could change the character of the area and this is reflected in the low scores across a number of the multivariate categories.

4.4.3 Land raising

- Sub-units appraised / considered in: ODU 1a

- Sub-units scoped out of: ODU 1a

- Sub-units taken forward: none

Land raising has been scoped out of ODU 1a because it is not considered a viable solution in this area, given the rural character of the field and potential fluvial flood risk in this location. Land raising would involve creating impermeable made ground on top of the existing field which could lead to detrimental landscape issues. In addition, raising the elevation of the field in ODU 1a would reduce the potential flood storage area for the Langbrook stream adjacent to this. This could potentially lead to detrimental impacts to the levels of fluvial flood risk in this location.

4.4.4 Demountable defences

- Sub-units appraised / considered in: ODU 1a and ODU 1b

- Sub-units scoped out of: ODU 1a and ODU 1b

- Sub-units taken forward: none

Demountable defences were considered in both ODU 1 and 1b but were scoped out from further appraisal for various reasons. The main benefits of demountable defences are that they require little space and have limited visual impact on the landscape when they are not deployed. However, they have a number of drawbacks, mainly relating to their deployment which is done manually and requires trained personnel. The residual risk of demountable defences not being deployed correctly or in time can be high. The ground conditions and long lengths required also make this option technically inappropriate. This is reflected in the multivariate scoring for this sub-unit.

In ODU 1a there is ample space to construct a permanent defence and there are not as significant constraints on the landscape impact of defences if an alignment is setback from the frontline. As a result, the demountable defences in this unit are outscored by the permanent defence types (e.g. a setback floodwall or earth embankment) which have less residual risk and are technically feasible approaches.

To support improved flood defence in ODU 1b harder engineering solutions are required, such as formal crest raising (alongside a refurb of the existing defences) or replacing the defences directly.

4.4.5 Glass topped floodwall

- Sub-units appraised / considered in: ODU 1b

- Sub-units scoped out of: ODU 1b

- Sub-units taken forward: none

A glass topped floodwall has been scoped out after scoring poorly in the categories of technical feasibility and relative cost. The foreshore in this location is composed of coarse gravel and concrete debris which could potentially be thrown into the air / against the defences during storm conditions. The suitability of a glass floodwall in this environment is not clear. In terms of cost, the glass approach is likely to be considerably more expensive in this location than frontline crest raising which is reflected in the multivariate scoring.

4.4.6 Self-raising floodwall

- Sub-units appraised / considered in: ODU 1b

- Sub-units scoped out of: ODU 1b

- Sub-units taken forward: none

This measure scores poorly in technical feasibility and relative cost leading to a below average overall score. There is a lack of space in this sub-unit to implement this measure and from a cost perspective this type of defence could be up-to £20k per metre length. This cost greatly exceeds the expected costs for the alternatives in this sub-unit and does not include the additional costs required to refurbish or replace the existing defences to support the self-raising floodwall.

4.4.7 PLP / PLR

- Sub-units appraised / considered in: ODU 1b

- Sub-units scoped out of: ODU 1b

- Sub-units taken forward: none

Property level protection / resilience measures have been scoped out for this sub-unit after scoring poorly across a number of categories. The residual risk of flooding is likely to remain high after implementation of this measure. The risk could remain high for both the properties where PLP / PLR is implemented (due to the residual risk associated with failed deployment or flooding depths greater than the specification standards) and also for properties elsewhere within the study area which could be flooded as a result of flood pathways around the existing buildings. This measure also scored poorly for maintenance where it received a red score due to the high operational requirements and pre-planning required in deploying these defences.

4.4.8 Vegetated buffer zones

- Sub-units appraised / considered in: ODU 1b

- Sub-units scoped out of: ODU 1b

- Sub-units taken forward: none

Vegetated buffer zones do not support the strategy preferred option as they do not provide protection against inundation from still water levels, the key driver of flooding in the area. Vegetated buffer zones could theoretically be used to mitigate against wave overtopping, by helping to trap and absorb flood water behind the overtopped defences. However, in ODU 1b there is insufficient space to implement the buffer zones unless they were situated in the gardens of the residential properties immediately behind the defences. This is not considered to be a technically viable approach that would be supported by the property owners as it would substantially reduce their garden size and sea views.

4.5 Draft short list measures

Table 4-3 below outlines the measures on the draft short list for each sub-unit in ODU 1 to facilitate an option to Improve the SoP.

No Active Intervention, patch and repair and different types of maintenance approach (i.e. capital refurbishment or scheduled maintenance) are also included on the short list for the sub-units within ODU 1. It is necessary to include these measures in the short list for the facilitation of the Do Nothing, Do Minimum and Maintain options. Given the similarities between these approaches for each sub-unit they have not been presented in Table 6-3.

Table 4-3: Draft short list measures to improve the SoP for ODU 1.

ODU sub-unit	Measure	Key reasons for selection
ODU 1a Langbrook Stream east bank	Setback floodwall	Scores highly on ecology, technical feasibility, coastal processes and stakeholder objectives. Measure has a low residual risk and will likely require minimal maintenance and has a long service life.
	Earth embankment	Scores highly in a number of categories, including ecology, technical feasibility, residual risk and stakeholder objectives. Maintenance requirements will also be low and not likely to have an impact on coastal processes.
ODU 1b Formal defences protecting west Langstone	Crest raising (& wall refurb)	Makes best use of existing defences. A technically feasible measure which scores highly in erosion risk, residual risk, maintenance and design life. This approach is also likely to be supported by stakeholders, the community and could have the potential for contributions from local landowners / nearby properties.
	Seawall	This measure scores highly on erosion risk, technical feasibility and residual risk. Likely to have a long design life and low maintenance requirements. Measure scores poorly in ecology but potential to mitigate the impacts by constructing within the footprint of the existing defences if they can be removed.
	Sheet piling	Measure scores highly for erosion risk, technical feasibility and residual risk. Likely to have long service life with minimal maintenance required. Ecology impacts reduced by potentially constructing within the existing embankment behind the defences.









4.5.1 Preliminary assessment of compliance with Habitat Regulations

An essential aspect of the option appraisal process is to identify an option that has a negligible impact on ecology or has easily avoided / mitigated effects or is potentially beneficial. This is needed because under the Habitats Directive legislation the most ecologically advantageous option must be defined and the preferred option, should it not be this, requires justification.

In all of the ODUs, measures to implement Do Nothing, Do Minimum and Maintain are being taken forward to the short list. These approaches are generally expected to have negligible impacts on ecology. Alongside this, there are various Improve measures which are being taken forward to the short list. In some instances the Improve options have potential to lead to negative impacts if not mitigated.

At this stage a robust appraisal of the potential ecological impacts of the Improve measures has not been possible. This is because the Improve measures are still at a high level and specific design and alignment details have not been developed in detail. However, for the purpose of this report and to inform discussions with stakeholders, it has been possible to undertake a preliminary qualitative comparison of the potential ecological impacts of the Improve measures on the short list and to identify the impact this may have on compliance with the Habitats Regulations (Table 4-4). This is based on the multivariate scoring of the ecology category that was undertaken in the long list appraisal (see Appendix C).

Table 4-4: Preliminary indication of ecological impact of short list measures to improve the SoP

ODU sub-unit	Short list measures	Multivariate ecology impact score (red, amber or green)	Measure with high likelihood of Habitats Regulations compliance based on preliminary assessment?
ODU 1a Langbrook Stream east bank	Setback floodwall	 Green	
	Earth embankment	 Green	
ODU 1b Formal defences protecting west	Crest raising (& wall refurb)	 Amber	
	Seawall	 Amber	
	Sheet piling (behind existing)	 Green	

ODU sub-unit	Short list measures	Multivariate ecology impact score (red, amber or green)	Measure with high likelihood of Habitats Regulations compliance based on preliminary assessment?
Langstone	defences through embankment)		

Table 4-4 shows that for each of the sub-units in ODU1, a measure with a negligible ecological impact has been taken forward to the short list. At the next stage, should the alternative measures on the short list with a potential ecological impact be taken forward as the preferred option, then a robust justification will be provided.

4.5.2 Potential alignments

Potential alignments of the various short list measures in the sub-units in ODU 1 are presented in Figure 4-2 below. These figures also include photographs or images of the potential short list measures, from similar sites around the country. The images give an indication of what the defence measures could potentially look like at the site.

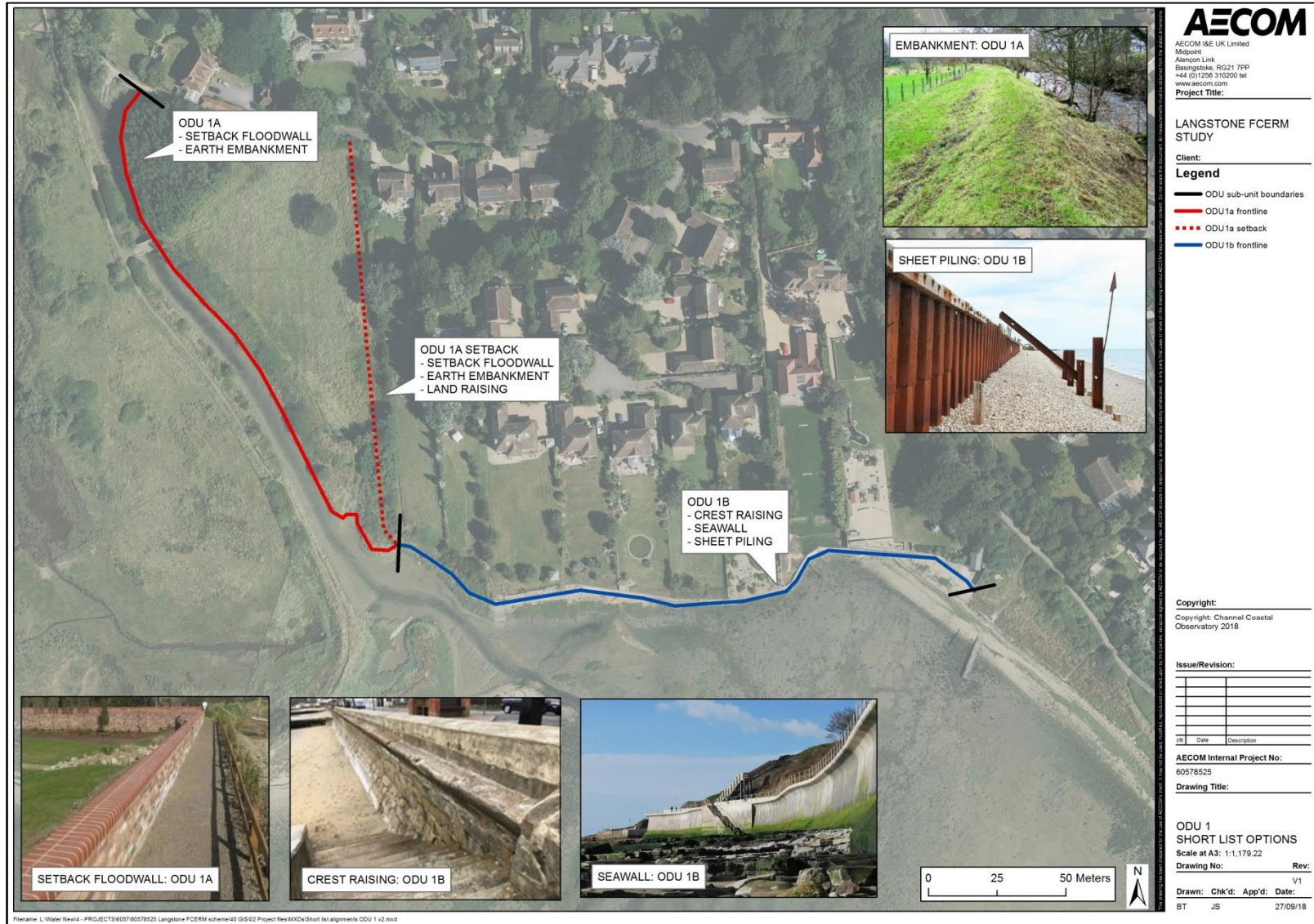


Figure 4-2: Potential alignments and short list measures for sub-units in ODU 1

5. ODU 2 (Sailing club and Langstone Spit)

5.1 ODU 2 sub-units

ODU 2 includes Langstone Spit, the Sailing club and the National Cycle route 2 path. The ODU has been broken down into three sub-units; ODU 2a, ODU 2b and ODU 2c. The extents of these sub-units are shown in Figure 5-1 below. Potential alignments in these areas are shown later on in the report, in section 0.

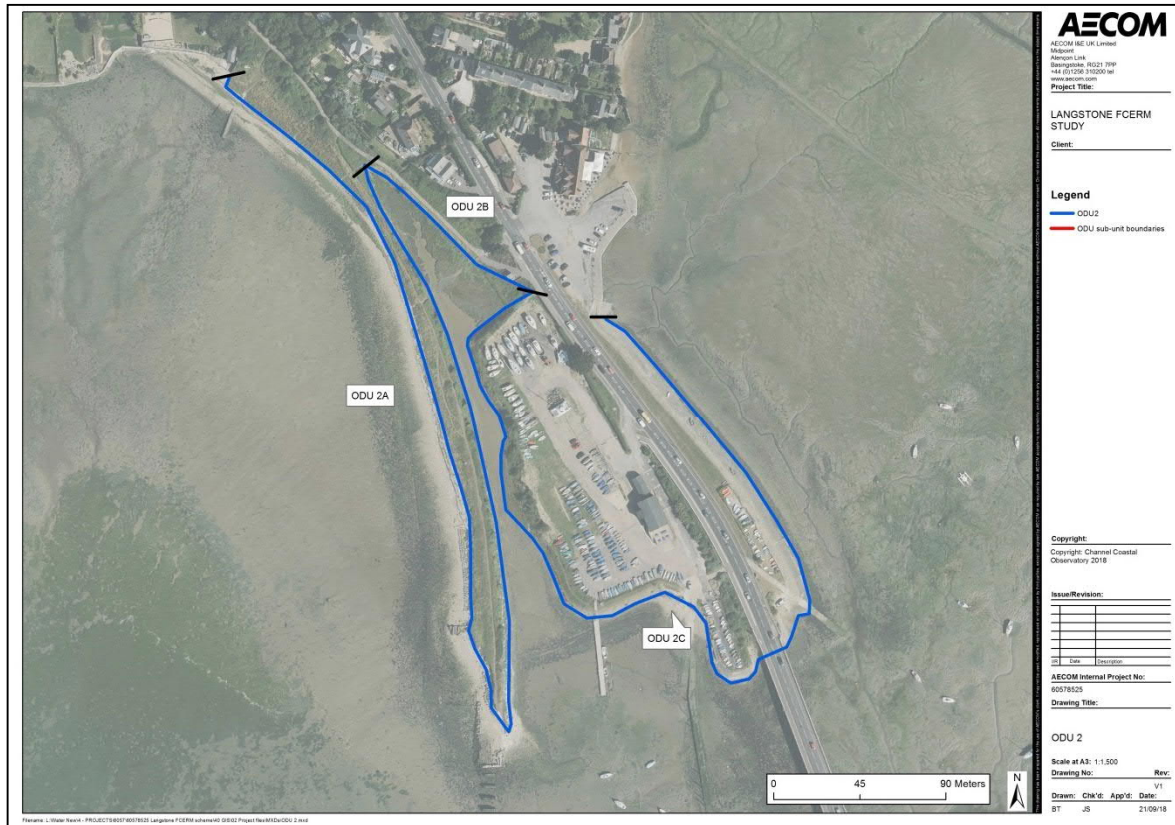





Figure 5-1: ODU 2 sub-units extents

The characteristics of each sub-unit, including the constraints and potential opportunities are presented in Table 5-1 below.

5.2 ODU 2 characteristics

Table 5-1: ODU 2 sub-unit characteristics, constraints and opportunities

Sub-unit	Characteristics	Constraints	Opportunities	Photo
ODU 2a Langstone Spit	<ul style="list-style-type: none"> - Potential defence line approximately 700m long (encompassing both sides of the spit). - Sand/shingle spit, remaining a feature since the Old Hayling railway came out of service. - Base of the spit showing signs of erosion, albeit very slowly. Erosion particularly noticeable at the end of the spit. 	<ul style="list-style-type: none"> - Changes to Langstone Spit could impact coastal processes in the area and consenting may be challenging. - Local community see the spit as a valuable part of the frontage, particularly the difference between its natural character and the built-up region on the west side of the frontage. Therefore, any measures will need to limit any changes to the natural environment along the spit. - If the full length of the spit is protected, there is likely to be a relatively low economic benefit compared to the potential defence cost so the economic case may be poor. 	<ul style="list-style-type: none"> - Maintaining the spit would continue to help reduce wave energy and offer some protection to the sailing club. - The spit is highly valued by the local community. Potential to improve footpath and amenity value of the spit through an erosion protection scheme. - Potential for benches along the spit to make the most of views across Langstone Harbour. 	
ODU 2b National Cycle Route 2	<ul style="list-style-type: none"> - Public footpath between the A3023 opposite the Ship Inn car park to Mill Lane, approx. 350m long. - Footpath runs adjacent to Langstone Spit at the south, and between residential buildings and trees to the north. - Flood defence along the footpath alignment would essentially 'split' the Langstone flood cell in two, providing benefits to either side of the defence depending on the return period of event. 	<ul style="list-style-type: none"> - Access along the footpath and walkways through to the spit would need to be maintained. 	<ul style="list-style-type: none"> - Ample space alongside the footpath to construct a new flood defence - Land levels vary along the footpath so defence level along the path will change. This provides an opportunity to landscape the defence and incorporate aspects such as benches to improve the public realm. This was identified as a key aspiration from the Stakeholder Working Group. 	

<p>ODU 2c Sailing club</p>	<ul style="list-style-type: none"> - Sailing club located behind Langstone Spit - Protected by Hampshire Highways Authority revetment on east and south sides. - No formal defence on west side of the Sailing club adjacent to the spit. - Unit length (on both sides of the Sailing Club) approx. 550m long. 	<ul style="list-style-type: none"> - Likely to be a relatively low economic benefit compared to the potential defence cost around the Sailing club (due to long length required) so economic case for protecting the Sailing club is likely to be poor. - A frontline defence could lead to encroachment which could have impacts on ecology and difficulty in acquiring consents. 	<ul style="list-style-type: none"> - Opportunities to deliver broader outcomes and contributions through protecting the sailing club and also potentially sections of the A3023 road to Hayling. 	
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5.3 ODU 2 scoring

A summary of the multivariate scores for ODU 2 is presented in this section. Table 5-2 provides the total score from the multivariate appraisal for each measure considered in the sub-units. Based on these scores the measures taken forward for use in the short list options have been identified. For a detailed breakdown of the scoring against each of the 14 multivariate categories refer to Appendix A.

Table 5-2: Summary of multivariate scores for ODU 2

ODU sub-unit	Measure	Ranking	Selection for use in short list?
ODU 2a Langstone Spit	Do Nothing		
	No Active Intervention	1	✓
	Do Minimum		
	H&S compliance, clearance of debris	1	✓
	Maintain		
	Stabilisation works / local erosion protection	1	✓
	Beach recycling	2	✗
	Improve		
	Beach nourishment	2	✓
	Rock armour	1	✓
Groynes and beach nourishment	3	✓	
ODU 2b National Cycle Route 2	Do Nothing		
	No Active Intervention	1	✓
	Do Minimum		
	H&S compliance, clearance of debris / vegetation	1	✓
	Maintain		
	Stabilisation of embankment / local erosion protection	1	✓
	Improve		
	Setback floodwall	2	✓
	Demountable defences	3	✗
Earth embankment (raising / formalising existing structure or new)	1	✓	
ODU 2c Sailing Club	Do Nothing		
	No Active Intervention	1	✓
	Do Minimum		
	Patch and repair	1	✓
	Maintain		
	Capital refurbishment	1	✓
	Scheduled maintenance	2	✓
	Improve		
	Setback floodwall	1	✓
	Revetment	2	✓
	Land raising	3	✗
Seawall	4	✗	

Note: only two measures taken forward for Improve in some of the sub-units for this ODU due to lack of viable alternatives

5.4 ODU 2 scoped out measures

This section provides a commentary on the measures which have been screened out from further consideration based on the results of the multivariate appraisal.

5.4.1 Beach recycling

- **Sub-units appraised / considered in: ODU 2a**

- **Sub-units scoped out of: ODU 2a**

- **Sub-units taken forward: none**

Beach recycling has been scoped out from further appraisal because it has a poor overall score generated by low scores in the categories of ecology, technical feasibility, residual risk and option life. The residual risk associated with this approach is of particular concern because there is the potential for increased erosion risk in areas along the spit where the recycling sediment is sourced from. The alternative measure for maintenance in this sub-unit (local erosion protection) is considered to be superior because it allows for a targeted local approach without the side effect of potentially increasing the risk of failure elsewhere along the spit. In addition, local erosion protection measures are likely to have a longer lifespan than beach recycling, with recycling likely needing to be undertaken on a frequent basis.

5.4.2 Demountable defences

- **Sub-units appraised / considered in: ODU 2b**

- **Sub-units scoped out of: ODU 2b**

- **Sub-units taken forward: none**

This measure was considered in ODU 2b (National Cycle Route 2) but was scoped out from further appraisal for various reasons. The main benefits of demountable defences are that they require little space and have limited visual impact on the landscape when they are not deployed. However, they have a number of drawbacks, mainly relating to their deployment which is done manually and requires trained personnel. The high maintenance and operational burden over such long lengths renders this option technically and logistically very problematic. The residual risk of demountable defences not being deployed correctly or in time also remains high. Along the National Cycle Route 2 path, the landscape impact of a defence is not considered as significant as elsewhere along the frontage (i.e. in ODU 3) and there is ample space adjacent to the footpath for the construction of a permanent set back defence. As a result, demountable defences score poorly in residual flood risk and operational maintenance which contributes to a lower overall score compared to the alternatives (setback floodwall or earth embankment).

5.4.3 Land raising

- **Sub-units appraised / considered in: ODU 2c**

- **Sub-units scoped out of: ODU 2c**

- **Sub-units taken forward: none**

This measure is a potential approach at the Sailing Club to reduce the flood risk to this area. It could involve raising the entire sailing club land level or just parts of it to reduce the inundation of the area. Undertaken in isolation without new formal defences this measure will also not stop the erosion risk to the area. This approach is considered to be high cost and the overall score is surpassed by that of other more feasible measures.

5.4.4 Seawall

- **Sub-units appraised / considered in: ODU 2c**

- **Sub-units scoped out of: ODU 2c**

- **Sub-units taken forward: none**

A seawall at the Sailing Club has been scoped out for various reasons. It scores poorly in ecology, stakeholder objectives and cost, but also has lower scores than the alternatives in technical feasibility and community acceptance. The logic behind these scores is that there is already a revetment in place around much of the Sailing Club and from a technical, construction and visual standpoint it would make more sense to extend this existing structure rather than replace it with a seawall. In replacing the existing structure the construction of a seawall could also lead to further encroachment or damage to ecology and the community and stakeholders are potentially going to be less supportive of a widespread change in this area when other measures exist which require less extensive change.

5.5 Draft short list measures

Table 6-3 below outlines the measures on the draft short list for each sub-unit in ODU 2 to facilitate an Improve SoP option.

No Active Intervention, patch and repair and different types of maintenance approach (i.e. capital refurbishment, stabilisation works or scheduled maintenance) are also included on the short list for the relevant sub-units in ODU 2. It is necessary to include these measures in the short list for the facilitation of the Do Nothing, Do Minimum and Maintain options. Given the similarities and commonality between these approaches for each sub-unit they have not been presented in Table 6-3.








Table 5-3: Draft short list measures for ODU 2

ODU sub-unit	Measure	Key reasons for selection
ODU 2a Langstone Spit	Beach nourishment	A technically feasible measure which is likely to be supported by the community. Preferable to beach recycling as it would add material to the area and less likely to leave areas exposed to erosion. However, potentially a very costly approach and likely that it would need to be repeated regularly.
	Rock armour	Can be used to reduce erosion locally and also over a wider area. Technically feasible approach with likely a long design life and little maintenance required due to sheltered nature of the frontage.
	Groynes and beach nourishment	Technically feasible approach although sediment modelling would be required to determine effectiveness of groynes. Low maintenance of the groynes and long service life if constructed with concrete / rocks. Groynes would need to be accompanied by beach nourishment to initially fill up the groyne bays and this would likely need to be repeated depending on how material is retained by the groynes. However, potentially a very costly approach.
ODU 2b National Cycle Route 2	Setback floodwall	Scores highly in ecology, residual risk and design life. Likely to be supported by stakeholders and the community.
	Earth embankment	Technically feasible measure which makes use of the existing landscape and space availability. Likely to be supported by stakeholders and the community. Also scores highly in ecology and design life.
ODU 2c Sailing Club	Setback floodwall (& scheduled maintenance / refurbishment of frontline revetment)	This approach also likely to have limited impact on heritage and landscape in this particular area. Technically feasible and likely to be supported by the stakeholders and community. Potential for contributions. Making use of the existing structure to provide erosion protection. Timing requirement for setback wall is dependent on rates of sea level rise.
	Refurbish & heighten existing revetment and extend it where required	In keeping with the existing defence around the area although an extension of this could have ecology impacts due to encroachment. Scores strongly in erosion, residual risk, maintenance and design life. Timing requirement for raising the structure is dependent on rates of sea level rise.

5.5.1 Preliminary assessment of compliance with Habitat Regulations

As per the approach in ODU 1, it has been possible to undertake a preliminary qualitative comparison of the potential ecological impacts of the Improve measures on the short list and to identify the impact this may have on compliance with the Habitats Regulations (Table 5-4). This assessment has been based on the multivariate findings and consideration of the ecology objectives (Appendix C).

Table 5-4: Preliminary indication of ecological impact of short list measures to improve the SoP

ODU sub-unit	Short list measures	Multivariate ecology impact score (red, amber or green)	Measure with high likelihood of Habitats Regulations compliance based on preliminary assessment?
ODU 2a Langstone Spit	Beach nourishment	 Red	
	Rock armour	 Red	
	Groynes and beach nourishment	 Red	
ODU 2b National Cycle Route 2 path	Setback floodwall	 Green	✓
	Earth embankment	 Green	✓
ODU 2c Sailing Club	Setback floodwall (& maintenance / refurb of existing revetment)	 Amber	
	Revetment	 Red	

For sub-units 2a and 2c none of the Improve measures on the short list have a green score in the ecology category. Therefore without significant mitigation none of these Improve options are believed to have a high likelihood of being compliant with the Habitats Regulations Assessment. Mitigation will be explored at the next stages of the appraisal but if it cannot be undertaken successfully, as a fall back alternative, the short list for ODUs 2a and 2c also includes other measures for the Do Nothing, Do Minimum and Maintain options; some of which are likely to have negligible ecological impacts (for example, no active intervention or patch and repair). These measures are more likely to be compliant with the Habitat Regulations.

5.5.2 Potential alignments and cross sections

Potential alignments of the various short list measures for each ODU sub-unit are presented in Figure 5-2 below. These figures also include photographs of the potential short list measures, from similar sites around the country. The photographs give an indication of what the defence measures could potentially look like.

As shown in Figure 5-2, ODU 2b has the option of an extended alignment along the length of the National Cycle Route 2 path. This alignment provides an opportunity to compartmentalise the flood cell and could reduce the overall cost of defences in the study area. For example, if a defence was considered to be viable in ODU 3, but not in ODU 1, then an alignment along the National Cycle Route 2 path could be used to prevent outflanking of new primary defences in ODU 3. The length of this extended alignment is heavily covered by trees on either side of the existing footpath which a new defence could impact. It is therefore recommended that an Arboricultural survey is undertaken should this alignment be taken forward.

For ODU 2 sub-unit 2b an indicative cross section has been produced for the earth embankment measure, adjacent to the National Cycle Route 2 path. This cross section is found in Appendix B, alongside cross section drawings for measures in ODU 3. The cross section is for informational purposes only and should not be used for design or construction.

The cross sections in Appendix B include a 0.3m freeboard allowance. This has been applied to account for uncertainty in water levels and also for any potential wave action against the defences. At this preliminary stage no calculations have been undertaken to determine the optimal freeboard allowance at the site and the 0.3m value has been adopted because it is typical in the coastal zone. Later on in the project during the outline design of the preferred option a calculation will be undertaken to determine the freeboard allowance for the defences based on the latest guidance.

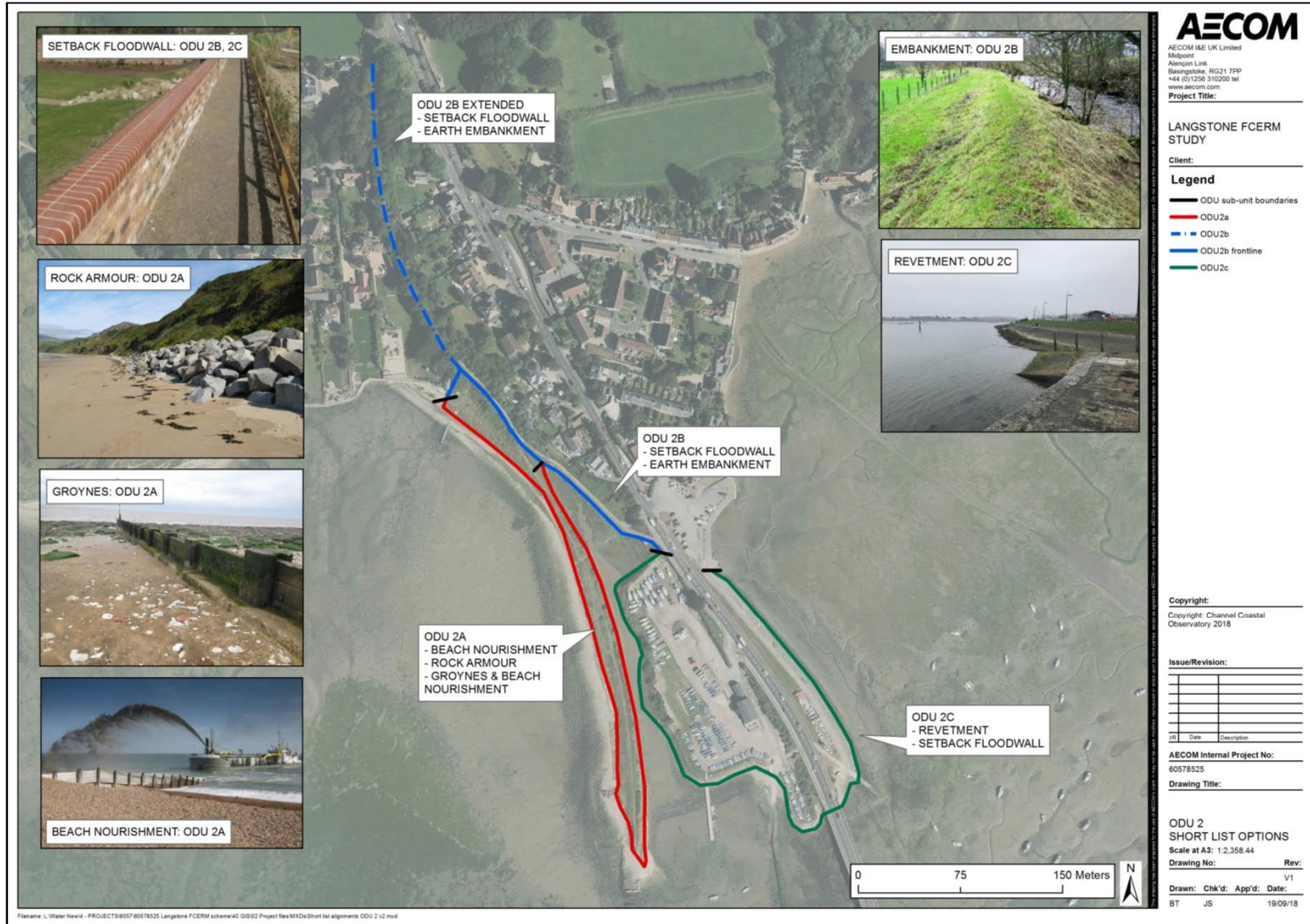


Figure 5-2: Potential alignments and short list measures for sub-units in ODU 2

6. ODU 3 (Langstone East)

6.1 ODU 3 sub-units

ODU 3 covers the east side of Langstone between the Ship Inn car park and the Old Mill. The defences along this frontage are varied and there are a number of unique constraints at the local level so therefore this ODU has been broken down into 12 sub-units to facilitate option development. The extents of these sub-units are shown in Figure 6-1 below. Potential alignments in these areas are shown later on in the report, in section 6.5.2.









Figure 6-1: ODU 3 sub-units extents




The characteristics of each sub-unit, including the constraints and potential opportunities are presented in Table 6-1 below.




6.2 ODU 3 characteristics

Table 6-1: ODU 3 sub-unit characteristics, constraints and opportunities

Sub-unit	Characteristics	Constraints	Opportunities	Photo
ODU 3a Slipway (south of Ship Inn car park)	<ul style="list-style-type: none"> - Slipway located between the Ship Inn car park and the Hampshire Highways Authority revetment protecting the A3023. Slipway approx. 10m wide. - Slipway is thought to be used frequently. - Provides access to the foreshore which is a key component of the frontage for the community (68% of initial community response considered access to water as important). 	<ul style="list-style-type: none"> - Defence will need to consider access and ensure continued slipway function. - A frontline defence could lead to encroachment which could have impacts on ecology and difficulties in acquiring consents. 	<ul style="list-style-type: none"> - Opportunities to improve the landscape of the area and improve placemaking, e.g. such as benches and signage in the area. 	
ODU 3b Ship Inn car park	<ul style="list-style-type: none"> - Car park fronted by public walkway between the slipway and Ship Inn. - Defence length of approx. 100m - Generally the car park is of poor landscape quality with potential for enhancements. - Vertical masonry retaining wall in front of the walkway acts as a formal defence against flooding and erosion. 	<ul style="list-style-type: none"> - A frontline defence could lead to encroachment which could have impacts on ecology and difficulties in acquiring consents. - The area provides a viewpoint across Chichester Harbour and therefore any new defences will need to consider this. 	<ul style="list-style-type: none"> - Ample space to construct a new defence, either across the car park, setback from the frontline or around the back of the car park - Area of poor landscape quality and a new defence provides an opportunity to improve place making and the public realm e.g. such as turning a defence into a seating area etc. 	
ODU 3c Slipway (north of Ship Inn car park)	<ul style="list-style-type: none"> - Slipway located between the Ship Inn car park and the Ship Inn. - Slipway approx. 5m wide. - The usage frequency of the slipway is unknown, although potential for this to be used for emergency access to the foreshore at low tide - Provides access to the foreshore which is a key component of the frontage for the community. 	<ul style="list-style-type: none"> - Defence will need to consider access and ensure continued slipway function. - A frontline defence could lead to encroachment which could have impacts on ecology and difficulties in acquiring consents. - The slipway is adjacent to the Ship Inn courtyard / outside seating area and therefore any defence will need to consider the views from this vantage point. 	<ul style="list-style-type: none"> - Opportunities to improve the landscape of the area and improve placemaking, e.g. such as benches and signage in the area. 	

Sub-unit	Characteristics	Constraints	Opportunities	Photo
ODU 3d Ship Inn	<ul style="list-style-type: none"> - Vertical concrete blockwork wall forming a parapet wall approx. 0.6m high to Ship Inn courtyard / outside seating area, approx. 40m long. - Seating area has views across Chichester Harbour. - Access steps to the foreshore located at the north eastern end of the vertical wall. 	<ul style="list-style-type: none"> - Defence forms the boundary to the Ship Inn courtyard / outside seating area and currently is of a height which permits views across Chichester Harbour. Any new defence will need to consider retaining this. - A frontline defence could lead to encroachment which could have impacts on ecology and difficulties in acquiring consents. 	<ul style="list-style-type: none"> - Opportunities to deliver broader outcomes / attract potential contributions from the Ship Inn if a defence design is supported. - Opportunities to use innovative defence designs, such as glass floodwalls or flip-up floodwalls and develop a scheme that could be considered best practice in the future and utilised in similar areas around the UK. 	
ODU 3e Fenced area adjacent to Ship Inn	<ul style="list-style-type: none"> - Concrete apron with garden fencing approx. 12m long. - Property has clear views across Chichester Harbour and access to the foreshore. - Concrete apron in front of the fencing is used as part of the walkway between the Royal Oak and Ship Inn public houses. 	<ul style="list-style-type: none"> - Views from the residential property across Chichester Harbour are likely to be important and limit the defence type which could be used in this location. - A frontline defence could lead to encroachment which could have impacts on ecology and difficulties in acquiring consents. 	<ul style="list-style-type: none"> - The concrete apron is currently used as a part of the walkway along the frontage. A new defence in this area provides an opportunity to create a formal footpath and improve the public realm. - Opportunities to potentially use innovative defences, such as flip-up floodwalls. 	
ODU 3f Coastal footpath	<ul style="list-style-type: none"> - Vertical brick wall with footpath on top, setback garden walls form an informal (de-facto) secondary defence. ODU 3f approx. 50m long - Footpath along the frontage between the Royal Oak and the Ship Inn public houses. - Gap in setback garden walls provide potential flow pathway through the defences - Informal (de-facto) garden walls can't be relied on as a formal flood defence in their current condition. 	<ul style="list-style-type: none"> - A frontline defence could lead to encroachment which could have impacts on ecology and difficulties in acquiring consents. - Footpath is narrow and incorporating a defence either setback or along the frontline is likely to lead to further space restrictions and could prevent disability access. - Increase to footpath elevation could lead to members of the public being able to view into property gardens behind. 	<ul style="list-style-type: none"> - Opportunities for place making and to potentially improve the public realm and access in the area (i.e. use of a boardwalk). - Opportunities to potentially use innovative defences if space constraints allow. 	

Sub-unit	Characteristics	Constraints	Opportunities	Photo
<p>ODU 3g Private Green / Grassed area in front of heritage buildings</p>	<ul style="list-style-type: none"> - Vertical brick wall with footpath on top, various setback walls forming informal (de-facto) secondary defence. ODU 3g approx. 30m long. - Grassed area between the footpath and the frontline defence, providing more space for potential defence measure. - Informal (de-facto) defences cannot be relied on as a formal flood defence in their current condition. 	<ul style="list-style-type: none"> - Listed heritage buildings located immediately behind the defences. Any new defences will need to be sympathetic towards these features - Services located beneath the footpath in this location. - A frontline defence could lead to encroachment which could have impacts on ecology and difficulties in acquiring consents. 	<ul style="list-style-type: none"> - There is more space for a defence in this particular sub-unit, compared to adjacent units, increasing the potential for innovative solutions. - Opportunities to improve the public realm in this area. - Landowner is thought to be very supportive of FCERM scheme and therefore a potential opportunity for broader outcomes / contributions. 	
<p>ODU 3h Coastal footpath</p>	<ul style="list-style-type: none"> - Vertical brick wall with footpath on top, various setback walls forming informal (de-facto) secondary defence. ODU 3h approx. 45m long. - Continuation of the footpath running from ODU 3f and 3g between the Royal Oak and the Ship Inn. - Informal (de-facto) defences cannot be relied on as a formal flood defence in their current condition. 	<ul style="list-style-type: none"> - A frontline defence could lead to encroachment which could have impacts on ecology and difficulties in acquiring consents. - Footpath is narrow and incorporating a defence either setback or along the frontline is likely to lead to further space restrictions and could prevent disability access. - Increase to footpath elevation could lead to members of the public being able to view into property gardens behind. - Services located beneath the footpath in this location. 	<ul style="list-style-type: none"> - Opportunities for place making and to potentially improve the public realm and access in the area (i.e. use of a boardwalk). - Opportunities to potentially use innovative defences if space constraints allow. 	
<p>ODU 3i Coastal footpath immediately in front of residential building</p>	<ul style="list-style-type: none"> - Vertical brick wall with footpath on top, residential building wall forms informal (de-facto) secondary defence immediately at the back of the path, approx. 10m long. - Continuation of footpath running between the Royal Oak and Ship Inn. - Informal (de-facto) defences cannot be relied on as a formal flood defence in their current condition. 	<ul style="list-style-type: none"> - Significant space restrictions along this length of defence. - The technical feasibility of using the residential building walls as a formal flood defence is not known at this stage and would need to be investigated with the property owner if this approach was taken forward. - A frontline defence could lead to encroachment which could have impacts on ecology and difficulties in acquiring consents. - Services located beneath the footpath in this location. 	<ul style="list-style-type: none"> - Opportunities for place making and to potentially improve the public realm and access in the area (i.e. use of a boardwalk). 	

Sub-unit	Characteristics	Constraints	Opportunities	Photo
ODU 3j Slipway at Langstone High Street	<ul style="list-style-type: none"> - Slipway located at the end of Langstone High Street, next to the Royal Oak public house. - Slipway approx. 10m wide. - Provides access to the foreshore which is a key component of the frontage for the community. 	<ul style="list-style-type: none"> - Defence will need to consider access and ensure continued slipway function. - A frontline defence could lead to encroachment which could have impacts on ecology and difficulties in acquiring consents. - The slipway is adjacent to the Royal Oak and therefore any defence will need to consider the views from this key asset in the area. 	<ul style="list-style-type: none"> - Opportunities to improve the landscape of the area and improve placemaking, e.g. such as benches and signage in the area. 	
ODU 3k Royal Oak and footpath	<ul style="list-style-type: none"> - Vertical stone wall with various setback walls forming informal (de-facto) setback defences. - ODU 3k is the section of the frontage immediately in-front of the Royal Oak public house and around the other frontline properties adjacent to this. This sub-unit has a defence length of approx. 100m. - Footpath in front of the Royal Oak is typically wider than other areas of the study area. 	<ul style="list-style-type: none"> - A large number of buried services for domestic beneath the footpath in front of the Royal Oak. - A frontline defence could lead to encroachment which could have impacts on ecology and difficulties in acquiring consents. - Increases to footpath elevation would restrict views and access to the Royal Oak. 	<ul style="list-style-type: none"> - Good opportunities to use innovative defence designs, such as flip-up floodwalls in this location. - Opportunities to achieve broader outcomes and improve placemaking and the public realm in this location, potentially helping to leverage contributions from local stakeholders. 	
ODU 3l Potential tie-in location to high ground	<ul style="list-style-type: none"> - A potential new defence alignment to tie-in to high ground to the north. - No existing formal defences on this alignment, although it is understood that the residential property owner at the northern end of sub-unit ODU 3k has informal private defences to protect their property. 	<ul style="list-style-type: none"> - Potential issues with land ownership if defence alignment is on privately owned land. - Space constraints in some areas, for example, immediately to the east of the residential property at the northern end of sub-unit ODU 3k. 	<ul style="list-style-type: none"> - Opportunity to tie-in to higher ground to the north. This would mean that a potentially costly frontline defence in ODU 4 would not be required. This is also likely to be supported by the Mill owner in ODU 4 who does not want an FCERM scheme close to his property. 	

6.3 ODU 3 scoring

A summary of the multivariate scores for ODU 3 is presented in the sections below. Table 6-2 provides the total scores from the multivariate appraisal for each measure considered in the sub-units. Based on these scores the measures taken forward for use in the short list options have been identified. For a detailed breakdown of the scoring against each of the 14 multivariate categories refer to Appendix A.

Table 6-2: Summary of multivariate scores for ODU 3

ODU sub-unit	Measure	Ranking	Selection for use in short list?
ODU 3a Slipway (south of Ship Inn car park)	Do Nothing		
	No Active Intervention	1	✓
	Do Minimum		
	Patch and repair	1	✓
	Maintain		
	Capital refurbishment	2	✓
	Scheduled maintenance	1	✓
	Improve		
	Flip-up floodwall	1	✓
	Demountable defences	2	✓
	Flood gate	1	✓
	Temporary defences	3	✗
ODU 3b Ship Inn car park	Do Nothing		
	No Active Intervention	1	✓
	Do Minimum		
	Patch and repair	1	✓
	Maintain		
	Capital refurbishment	2	✓
	Scheduled maintenance	1	✓
	Improve		
	Setback floodwall	2	✓
	Crest raising (frontline) + scheduled maintenance	5	✗
	Glass topped setback floodwall / glasswall	2	✓
	Self-raising floodwall (setback) + refurb of wall	4	✗
	Flip-up floodwall (setback or across the Car Park)	1	✓
	Demountable defences	3	✗
	Seawall	5	✗
Sheet piling	5	✗	
Land raising	3	✗	
Road raising	2	✓	
Temporary defences	3	✗	
ODU 3c Slipway (north of Ship Inn car park)	Do Nothing		
	No Active Intervention	1	✓
	Do Minimum		
	Patch and repair	1	✓
Maintain			

ODU sub-unit	Measure	Ranking	Selection for use in short list?
	Capital refurbishment	2	✓
	Scheduled maintenance	1	✓
	Improve		
	Flip-up floodwall	1	✓
	Demountable defences	2	✓
	Flood gate	1	✓
	Temporary defences	3	✗
	Seawall (frontline across slipway)	2	✓
ODU 3d Ship Inn	Do Nothing		
	No Active Intervention	1	✓
	Do Minimum		
	Patch and repair	1	✓
	Maintain		
	Capital refurbishment	2	✓
	Scheduled maintenance	1	✓
	Improve		
	Setback floodwall	3	✗
	Crest raising (frontline) + scheduled maintenance	4	✗
	Glass topped floodwall / glasswall	1	✓
	Self-raising floodwall + refurb of wall	5	✗
	Flip-up floodwall (setback)	2	✓
	Demountable defences	2	✓
	Seawall	6	✗
Sheet piling	6	✗	
PLP / PLR	4	✗	
Temporary defences	3	✗	
ODU 3e Fenced area adjacent to Ship Inn	Do Nothing		
	No Active Intervention	1	✓
	Do Minimum		
	Patch and repair	1	✓
	Maintain		
	Capital refurbishment (of sloped concrete)	2	✓
	Scheduled maintenance (of sloped concrete)	1	✓
	Improve		
	Glass topped setback floodwall + floodgate	2	✓
	Flip-up floodwall (setback)	2	✓
	Demountable defences	1	✓
	Seawall + floodgate	6	✗
	Sheet piling + floodgate	5	✗
Embankment	3	✗	
PLP / PLR	4	✗	
Temporary defences	4	✗	

ODU sub-unit	Measure	Ranking	Selection for use in short list?
ODU 3f Coastal footpath	Do Nothing		
	No Active Intervention	1	✓
	Do Minimum		
	Patch and repair	1	✓
	Maintain		
	Capital refurbishment	2	✓
	Scheduled maintenance	1	✓
	Improve		
	Setback floodwall – back of path	6	✗
	Crest raising + refurb of wall	7	✗
	Glass crest raising + refurb of wall	7	✗
	Setback floodwall + advance the line walkway	NA*	✗
	Setback floodwall + boardwalk	2	✓
	Self-raising floodwall + refurb existing wall	5	✗
	Flip-up floodwall (on footpath)	4	✗
	Demountable defences	3	✗
	Reinforce / replace de-facto defences (garden wall)	1	✓
	Seawall	7	✗
	Sheet piling	6	✗
	PLP / PLR	5	✗
Temporary defences	4	✗	
Vegetated buffer zones	6	✗	
ODU 3g Private Green / Grassed area in front of heritage buildings	Do Nothing		
	No Active Intervention	1	✓
	Do Minimum		
	Patch and repair	1	✓
	Maintain		
	Capital refurbishment	2	✓
	Scheduled maintenance	1	✓
	Improve		
	Setback floodwall	5	✗
	Crest raising + refurb wall	5	✗
	Glass crest raising + refurb wall	3	✓
	Setback floodwall + boardwalk	1	✓
	Self-raising floodwall + refurb wall	3	✓
	Flip-up floodwall	2	✓
	Demountable defences	3	✓
Seawall	7	✗	
Sheet piling	7	✗	
PLP / PLR	6	✗	
Vegetated buffer zones	6	✗	
Temporary defences	4	✗	

ODU sub-unit	Measure	Ranking	Selection for use in short list?
ODU 3h Coastal footpath	Do Nothing		
	No Active Intervention	1	✓
	Do Minimum		
	Patch and repair	1	✓
	Maintain		
	Capital refurbishment	2	✓
	Scheduled maintenance	1	✓
	Improve		
	Setback floodwall – back of path	6	✗
	Crest raising + refurb of wall	7	✗
	Glass crest raising + refurb of wall	7	✗
	Setback floodwall + advance the line walkway	NA*	✗
	Setback floodwall + boardwalk	2	✓
	Self-raising floodwall + replace wall	6	✗
	Flip-up floodwall (on footpath)	4	✗
	Demountable defences	3	✗
	Reinforce / replace de-facto defences	1	✓
	Seawall	7	✗
	Sheet piling	6	✗
	PLP / PLR	5	✗
Temporary defences	4	✗	
Vegetated buffer zones	6	✗	
ODU 3i Coastal footpath immediately in front of residential building	Do Nothing		
	No Active Intervention	1	✓
	Do Minimum		
	Patch and repair	1	✓
	Maintain		
	Capital refurbishment	2	✓
	Scheduled maintenance	1	✓
	Improve		
	Crest raising + refurb wall	7	✗
	Glass crest raising + refurb wall	7	✗
	Setback floodwall + advance the line walkway	NA*	✗
	Setback floodwall + boardwalk	2	✓
	Self-raising floodwall + replace wall	6	✗
	Flip-up floodwall (on footpath)	4	✗
	Demountable defences	3	✓
	Flood proof building	1	✓
	Seawall	7	✗
Sheet piling	6	✗	
PLP / PLR	5	✗	
Temporary defences	4	✗	
Vegetated buffer zones	6	✗	

ODU sub-unit	Measure	Ranking	Selection for use in short list?
ODU 3j Slipway at Langstone High Street	Do Nothing		
	No Active Intervention	1	✓
	Do Minimum		
	Patch and repair	1	✓
	Maintain		
	Capital refurbishment	2	✓
	Scheduled maintenance	1	✓
	Improve		
	Flip-up floodwall	1	✓
	Demountable defences	2	✓
	Flood gate	1	✓
	Temporary defences	3	✗
ODU 3k Royal Oak and footpath	Do Nothing		
	No Active Intervention	1	✓
	Do Minimum		
	Patch and repair	1	✓
	Maintain		
	Capital refurbishment	2	✓
	Scheduled maintenance	1	✓
	Improve		
	Setback floodwall	7	✗
	Crest raising + refurb wall	6	✗
	Glass crest raising + refurb wall	2	✓
	Setback floodwall + advance the line walkway	NA*	✗
	Setback floodwall + boardwalk	3	✗
	Self-raising floodwall + replace wall	6	✗
	Flip-up floodwall (on footpath)	2	✓
	Demountable defences	3	✗
	Reinforce / replace de-facto defences (e.g. the garden walls) and flood proof building walls (e.g. the Royal Oak)	1	✓
Seawall	7	✗	
Sheet piling	6	✗	
PLP / PLR	5	✗	
Temporary defences	4	✗	
Vegetated buffer zones	6	✗	
ODU 3l Potential tie-in location to high ground	Do Nothing		
	No Active Intervention	1	✓
	Improve		
	Setback floodwall	2	✓
	Earth embankment (tie-in section only)	1	✓

*Measure ruled out through ecologically unacceptable impacts.

Note: in ODU sub-units 3f and 3h only two measures taken forward for Improve due to a lack of technically feasible alternatives in these areas.

6.4 Scoped out measures

This section provides a commentary and justification for the measures which have been scoped out of the sub-units in ODU 3.

6.4.1 Crest raising & refurb of existing walls (where required)

- **Sub-units appraised / considered in:** ODU 3b, ODU 3d, ODU 3f, ODU 3g, ODU 3h, ODU 3i and ODU 3k
- **Sub-units scoped out of:** all of the above
- **Sub-units taken forward:** none

Crest raising along the frontline of the existing defences has been scoped out of all sub-units which it was appraised in. This is because this measure generally scores poorly in a number of the categories with significant detrimental impacts expected to occur which leads to a low overall score. This measure is most likely to impact the local landscape and heritage, and is unlikely to be supported by stakeholders or the local community due to the perceived loss of connection and access to the foreshore that would occur by constructing a physical barrier on the edge of the public footpath.

In some areas, notably ODU 3f and 3h, there are also significant space constraints along the footpath which make this measure technically unfeasible. The existing path width varies and is typically between 0.8-1.2m. Crest raising via the construction of a frontline parapet wall or similar is likely to reduce the width of the footpath by between 0.3-0.5m and therefore this measure is unlikely to leave enough space for individuals to safely walk along the footpath.

6.4.2 Setback floodwall

- **Sub-units appraised / considered in:** ODU 3b, ODU 3d, ODU 3f, ODU 3g, ODU 3h, ODU 3k and ODU 3l
- **Sub-units scoped out of:** ODU 3d, ODU 3f, ODU 3g, ODU 3h and ODU 3k
- **Sub-units taken forward:** ODU 3b and ODU 3l

A setback floodwall has been scoped out of the vast majority of sub-units which it was appraised in. It generally scores poorly across a number of categories such as heritage impacts, community support and stakeholder consenting which leads to a low overall score. In ODU3d (the Ship Inn) this measure is unlikely to be supported by the Ship Inn owners and community in general as it would act as a permanent physical barrier and would need to pass through the outside courtyard / seating area which is considered to be an important feature of what attracts people to the area.

Elsewhere at ODUs 3f and 3h, similar to the frontline crest raising measure discussed above, a setback floodwall would reduce the footpath width considerably and would mean that individuals are unlikely to have sufficient space to walk along the footpath safely. At ODU 3g there is potentially more space to optimise a setback alignment at this location (compared to the footpath either side of this sub-unit) but any formal defence located in the grassed area in front of the listed buildings is likely to visually obstruct these buildings, particularly the views from the lower floor windows.

In ODU 3k in front of the Royal Oak a setback floodwall has been ruled out because it is very unlikely that this measure would be visually or environmentally acceptable. A solid setback structure would obstruct views and potentially impact the heritage setting and landscape of the area.

6.4.3 Glass topped floodwalls / crest raising

- **Sub-units appraised / considered in:** ODU 3b, ODU 3d, ODU 3e, ODU 3f, ODU 3g, ODU 3h, ODU 3i and ODU 3k
- **Sub-units scoped out of:** ODU 3f, ODU 3h and ODU 3i
- **Sub-units taken forward:** ODU 3b, ODU 3d, ODU 3e, ODU 3g and ODU 3k

Glass topped floodwalls / crest raising are similar to traditional floodwalls / crest raising except they provide less disturbance to views from behind the defence which would provide the public in the area better views of the foreshore and harbour (compared to a traditional defence). This measure has been scoped out of three of the sub-units in which it was considered in across this ODU (ODU 3f, 3h and 3i).

In the units which it has been scoped out of this measure generally scores poorly in heritage impacts and landscape. In addition to this, any kind of crest raising / floodwall in units ODU 3f, 3h and 3i, irrespective of whether glass is used, are all technically unfeasible due to the space constraints (see above sections 6.4.1 and 6.4.2) and would likely not be supported by stakeholders or the community due to loss of footpath access and foreshore accessibility.

6.4.4 Setback floodwall and advance the line walkway

- **Sub-units appraised / considered in: ODU 3f, ODU 3h, ODU 3i and ODU 3k**

- **Sub-units scoped out of: all of the above**

- **Sub-units taken forward: none**

This measure involves constructing a floodwall and advancing the line of the existing defences to provide additional footpath width. This is likely to have significant detrimental impacts on ecology that cannot be mitigated within the scope of this study which is considered to be a 'showstopper' from an environmental perspective. This measure has therefore been scoped out from further appraisal in all the sub-units which it was considered.

6.4.5 Setback floodwall and boardwalk

- **Sub-units appraised / considered in: ODU 3f, ODU 3g, ODU 3h, ODU 3i and ODU 3k**

- **Sub-units scoped out of: ODU 3k**

- **Sub-units taken forward: ODU 3f, ODU 3g, ODU 3h and ODU 3i**

This measure has been scoped out of ODU 3k because in this particular sub-unit in front of the Royal Oak there are potentially better solutions. This is different to units ODU 3f-3i where the narrow footpath limits the range of potential measures with the boardwalk being one of the few approaches whereby footpath access can be maintained in these areas.

In ODU 3k the views from the Royal Oak across the harbour are also considered to be especially important, for both the local business and the community. Therefore, any solid setback structure in front of the Royal Oak is likely to be visually unacceptable as it would obstruct views and also affect the heritage setting of the area. Given the range of potential measures that are suitable for this sub-unit any shadowing of the foreshore caused by a boardwalk is also likely to be viewed as avoidable and not necessary.

6.4.6 Self-raising floodwall & refurb of existing wall

- **Sub-units appraised / considered in: ODU 3b, ODU 3d, ODU 3f, ODU 3g, ODU 3h, ODU 3i, ODU 3k**

- **Sub-units scoped out of: ODU 3b, ODU 3d, ODU 3f, ODU 3h, ODU 3i and ODU 3k**

- **Sub-units taken forward: ODU 3g**

This measure generally scores poorly in technical feasibility and relative cost leading to a below average overall score.

In sub-units ODU 3b and 3d, a self-raising has the potential to lead to public health and safety issues. For example in ODU 3b a self-raising wall could also lead to property damage if, for example, cars are incorrectly parked and the flood wall rises. In ODU 3d a similar issue could occur as a self-raising wall would need to be located in the existing Ship Inn courtyard / seating area. This has the potential to lead to public health and safety issues if, for example, the floodwall were to raise with members of the public in the immediate vicinity.

In the remaining ODUs which it has been scoped out of there are space constraints and/or buried underground services which make this approach difficult to implement from a technical standpoint. Due to these constraints the cost is expected to also be large, with costs per metre length of defence quoted up to £20k in these areas.

6.4.7 Flip-up floodwalls

- Sub-units appraised / considered in: ODU 3a to ODU 3k
- Sub-units scoped out of: ODU 3f, ODU 3h and ODU 3i
- Sub-units taken forward: ODU 3a, ODU 3b, ODU 3c, ODU 3d, ODU 3e, ODU 3g, ODU 3j and ODU 3k

This measure has been scoped out of sub-units ODU 3f, 3h and 3i largely because there is insufficient space along the footpath for both the placing and deployment of the defences and therefore this approach scores poorly in technical feasibility for these areas. In addition to this due to the space constraints only a low standard of protection could be provided here (as the width of path essentially determines the maximum height of the floodwall) and therefore this measure in these areas may not align with the overall standard of protection being pursued by a scheme along the full length of the frontage.

6.4.8 Demountable defences

- Sub-units appraised / considered in: ODU 3a to ODU 3k
- Sub-units scoped out of: ODU 3b, ODU 3f, ODU 3h, ODU 3k
- Sub-units taken forward: ODU 3a, ODU 3c, ODU 3d, ODU 3e, ODU 3g, ODU 3i, and ODU 3j

This measure typically has a higher than average score but in ODUs 3b, 3f and ODU 3h it is surpassed by other more feasible measures and has therefore been scoped out. Categories which this measure scores poorly on are residual flood risk and maintenance due to the risk of the defences not being deployed and the operational requirements to deploy the defences. The deployment of the defences is of particular concern along the sub-units which it has been scoped out from because the areas could be far from potential storage sites and the defence alignments spread over a relatively long length of the frontage.

In ODU 3k this measure is not considered to be technically feasible and the residual risk of failure could be high. There are potential issues associated with storing approximately 100m of demountable flood barriers on site and given the length of the demountables required in the sub-unit, the risk of failing to deploy the defences on time, or without any errors is considered to be too great to be overlooked.

6.4.9 Seawall

- Sub-units appraised / considered in: ODU 3b, ODU 3c, ODU 3d, ODU 3e, ODU 3f, ODU 3g, ODU 3h, ODU 3i and ODU 3k
- Sub-units scoped out of: ODU 3b, ODU 3d to 3k
- Sub-units taken forward: ODU 3c

A seawall was scored poorly across the vast majority of the sub-units with a red classification for the ecology, heritage, landscape, stakeholder, community and cost categories. This produces an overall score far below the average score for the units and consequently this measure was scoped out. The key drivers for poor scores in these categories were that this measure could fundamentally change the character of the area, potentially encroach into environmental designations, lead to a loss of access and would be costly compared to other more feasible measures.

It has been included in ODU 3c as it could be used to reclaim an area of land between the Ship Inn car park and the Ship Inn, providing a placemaking opportunity for the frontage. At this stage there is uncertainty as to the usage of the slipway and the potential environmental implications that this measure may have at this location but this will be investigated during subsequent appraisal work.

6.4.10 Sheet piling

- Sub-units appraised / considered in: ODU 3b, ODU 3d, ODU 3e, ODU 3f, ODU 3g, ODU 3h, ODU 3i and ODU 3k
- Sub-units scoped out of: all of the above
- Sub-units taken forward: none

Similar to the seawall measure discussed above, a sheet pile was scored poorly across the sub-units for a number of categories, including ecology, heritage, landscape, community and cost. A sheet pile in any of the

locations considered is likely to have a similar impact to a seawall in that it could change the character of the area, potentially lead to encroachment (although to a lesser extent than a seawall), a loss of access and would be costly. For these reasons this measure was scoped out of further appraisal.

6.4.11 PLP / PLR

- **Sub-units appraised / considered in:** ODU 3d, ODU 3e, ODU 3f, ODU 3g, ODU 3h, ODU 3i and ODU 3k
- **Sub-units scoped out of:** all of the above
- **Sub-units taken forward:** none

Property level protection / resilience measures have been scoped out of each of the units it was considered in after scoring poorly across a number of categories. The residual risk of flooding is likely to remain high after implementation of this measure. The risk could remain high for both the properties where PLP / PLR is implemented (due to the residual risk associated with failed deployment or flooding depths greater than the specification standards) and also for properties elsewhere within the study area which could be flooded as a result of flood pathways around the existing buildings. This measure also scored poorly for maintenance where it received a red score due to the high operational requirements and pre-planning required in deploying these defences.

6.4.12 Temporary defences

- **Sub-units appraised / considered in:** ODU 3a to ODU 3k
- **Sub-units scoped out of:** all of the above
- **Sub-units taken forward:** none

Temporary defences have been scoped out from further consideration across all the sub-units mainly because other measures are more suitable and provide a more robust, reliable defence against flooding. This is reflected in the maintenance category for the temporary defences where it received a red score due to the high operational requirements and pre-planning required in deploying these defences. In addition to this, the typical service life of temporary defences is <20 years which is low compared to the other measures considered in the sub-units.

6.4.13 Vegetated buffer zones

- **Sub-units appraised / considered in:** ODU 3f, ODU 3g, ODU 3h, ODU 3i and ODU 3k
- **Sub-units scoped out of:** all of the above
- **Sub-units taken forward:** none

Vegetated buffer zones do not support the strategy preferred option as they do not provide protection against inundation from still water levels, the key driver of flooding in the area. This approach may be useful in areas where wave energy needs to be dissipated to reduce overtopping risk but across ODU 3 it is not considered an approach to be taken forward. The scoring of this measure reflects this.

6.4.14 Embankment

- **Sub-units appraised / considered in:** ODU 3e and ODU 3i
- **Sub-units scoped out of:** ODU 3e
- **Sub-units taken forward:** ODU 3i

An embankment is not considered to be technically feasible in ODU 3e given the space constraints in the area and would also likely have detrimental impacts to the landscape. The local community and residential property owner would also likely not be in support of this approach and therefore this measure has been scoped out.

6.4.15 Land raising

- **Sub-units appraised / considered in:** ODU 3b
- **Sub-units scoped out of:** ODU 3b

- Sub-units taken forward: none

In unit 3b land raising has a higher than average score but is surpassed by other more feasible measures and has therefore been scoped out. The measure scores poorly on are relative cost and there is also potential for stakeholders to oppose this measure if it were to be widespread land raising of the entire car park.

6.5 Draft short list measures

Table 6-3 below outlines the measures on the draft short list for each sub-unit in ODU 3 to facilitate an Improve SoP option.

No Active Intervention, patch and repair and different types of maintenance approach (i.e. capital refurbishment or scheduled maintenance) are also included on the short list for each of the sub-units within ODU 3. The implementation of these measures across the different sub-units would be broadly similar and it is necessary to include them in the short list for the facilitation of the Do Nothing, Do Minimum and Maintain options. Given the similarities and commonality between these approaches for each sub-unit they have not been presented in Table 6-3.

Table 6-3: Draft short list measures for improve SoP option in ODU 3

ODU sub-unit	Measure	Key reasons for selection
ODU 3a Slipway (south of Ship Inn car park)	Flip-up floodwall	Technically feasible approach which would allow slipway access when not deployed. Setback at the top of the slipway so no ecology impacts. Likely to be supported by stakeholders and the community.
	Demountable defences	Relatively low cost measure compared to alternatives. Setback so no ecology impacts.
	Flood gate	Technically feasible, limited ecology impact and likely to be supported by stakeholders and the community.
ODU 3b Ship Inn car park	Setback floodwall	Scores highly in ecology as it is setback so no impact. Low residual risk of flooding and long option life and likely to be supported by stakeholders.
	Glass topped setback floodwall / glasswall	Low residual risk of flooding and long option life. No ecology impacts and likely to be supported by stakeholders.
	Flip-up floodwall	Setback alignment or across the car park, likely to be supported by community and stakeholders also scoring highly in technical feasibility. Condition of the existing frontline defences makes setback approaches more affordable in this location.
	Road raising	A measure which could be used to link defences in ODU 2 and ODU 3 if a high standard of protection and/or a long scheme life is desired. Would not replace the other short list measures in this unit but supplement them and be used to link defences to those on the west side of the frontage. Main benefit of this approach is that it is a permanent passive defence which would not interrupt traffic flows and emergency access during flooding (as a flood gate across the road would).
ODU 3c Slipway (north of Ship Inn car park)	Flip-up floodwall	Technically feasible approach which would allow slipway access when not deployed. Setback at the top of the slipway so no ecology impacts. Likely to be supported by stakeholders and the community.
	Demountable defences	Relatively low cost measure compared to alternatives. Setback so no ecology impacts.
	Flood gate	Technically feasible, limited ecology impact and likely to be supported by stakeholders and the community.
	Seawall (across slipway)	Technically feasible, likely to have community support and potential for broader outcomes and placemaking opportunities. The existing use of the slipway will need to be investigated during the next stage to determine if this measure can be selected as the preferred approach.
ODU 3d Ship Inn	Glass topped floodwall / glasswall	Less of an impact on views from the Ship Inn compared to other measures in this sub-unit. Low residual risk and potential for broader outcomes / contributions.
	Flip-up floodwall (setback)	Scores highly in ecology and stakeholder objectives. A viable alternative to a frontline scheme.
	Demountable defences	A low cost approach and scores highly in ecology and technical feasibility.

ODU sub-unit	Measure	Key reasons for selection
ODU 3e Fenced area adjacent to Ship Inn	Glass topped setback floodwall + floodgate	Scores highly in ecology, technical feasibility and design life. Likely to be supported by stakeholders.
	Flip-up floodwall	Less of a landscape impact compared to alternatives. Also scores highly in ecology and stakeholder consenting.
	Demountable defences	Relatively low cost compared to alternatives. Also scores highly in ecology and landscape.
ODU 3f Coastal footpath	Setback floodwall + boardwalk	Use of boardwalk improves access / footpath and therefore likely to be supported by community. Also scores highly in broader outcomes, technical feasibility and has a low residual risk. Generally a lack of feasible alternatives in this ODU sub-unit.
	Reinforce / replace de-facto defences (garden wall)	Little change to the frontage so likely to be supported by stakeholders and community. Also scores highly in ecology, landscape and heritage. Potential technical difficulties in reinforcing the existing de-facto defences and therefore may need to replace them on their existing alignments (which is technically feasible).
ODU 3g Private Green / Grassed area in front of heritage buildings	Glass crest raising + refurb wall	Technical feasible approach with a low residual risk and long design life.
	Setback floodwall + boardwalk	Use of boardwalk improves access / footpath and therefore likely to be supported by community. Also scores highly in broader outcomes, technical feasibility and has a low residual risk.
	Self-raising floodwall + refurb wall	Adequate space in this sub-unit makes this a technically feasible approach. Wall is not visible when not deployed so little impact on heritage and landscape. Likely to be supported by stakeholders and the community.
	Flip-up floodwall	Scores highly in ecology, heritage and landscape. Likely to be supported by stakeholders and the community.
	Demountable defences	Relatively low cost approach compared to alternatives. Scores highly in ecology and landscape.
ODU 3h Coastal footpath	Setback floodwall + boardwalk	Use of boardwalk improves access / footpath and therefore likely to be supported by community. Also scores highly in broader outcomes, technical feasibility and has a low residual risk. Generally a lack of feasible alternatives in this ODU sub-unit.
	Reinforce / replace de-facto defences (garden wall)	Little change to the frontage so this measure is likely to be supported by stakeholders and community. Also scores highly in ecology, landscape and heritage.
ODU 3i Coastal footpath immediately in front of residential building	Setback floodwall + boardwalk	Use of boardwalk improves access / footpath and therefore likely to be supported by community. Also scores highly in broader outcomes, technical feasibility and has a low residual risk.
	Demountable defences	Relatively low cost measure compared to alternatives. Setback so no ecology impacts.
	Flood proof building	Little change to the frontage so this measure is likely to be supported by stakeholders and community. Also scores highly in ecology, landscape and heritage.
ODU 3j Slipway at Langstone High Street	Flip-up floodwall	Technically feasible approach which would allow slipway access when not deployed. Setback at the top of the slipway so no ecology impacts. Likely to be supported by stakeholders and the community.
	Demountable defences	Relatively low cost measure compared to alternatives. Setback so no ecology impacts.
	Flood gate	Technically feasible, limited ecology impact and likely to be supported by stakeholders and the community.
ODU 3k Royal Oak and footpath	Glass crest raising	Sufficient space for this to be implemented and footpath access would be maintained. Low residual risk once constructed and provides a permanent defence to the area.

ODU sub-unit	Measure	Key reasons for selection
	Flip-up floodwall (on footpath)	Scores highly in ecology, heritage and landscape. Likely to be supported by stakeholders and the community.
	Reinforce / replace de-facto defences and flood proof building	Little change to the frontage so this measure is likely to be supported by stakeholders and community. Also scores highly in ecology, landscape and heritage.
ODU 3l Potential tie-in location to high ground	Setback floodwall	Scores highly on ecology, technical feasibility and stakeholder objectives. Measure has a low residual risk and has a long service life.
	Earth embankment (tie-in section only)	Scores highly in a number of categories, including ecology, residual risk and stakeholder objectives. Likely to have a long service life.

6.5.1 Preliminary assessment of compliance with Habitat Regulations

As per the approach in ODUs 1 and 2, it has been possible to undertake a preliminary qualitative comparison of the potential ecological impacts of the Improve measures on the short list and to identify the impact this may have on compliance with the Habitats Regulations (Table 6-4). This assessment has been based on the multivariate findings and consideration of the ecology objectives (Appendix C).

Table 6-4: Preliminary indication of ecological impact of short list measures to improve SoP.

ODU sub-unit	Short list measures	Multivariate ecology impact score (red, amber or green)	Measure with high likelihood of Habitats Regulations compliance based on preliminary assessment?
ODU 3a Slipway (south of Ship Inn car park)	Flip-up floodwall	 Green	✓
	Demountable defences	 Green	✓
	Flood gate	 Green	✓
ODU 3b Ship Inn car park	Setback floodwall	 Green	✓
	Glass topped setback floodwall / glasswall	 Green	✓
	Flip-up floodwall	 Green	✓
	Road raising	 Green	✓
ODU 3c Slipway (north of Ship Inn car park)	Flip-up floodwall	 Green	✓
	Demountable defences	 Green	✓
	Flood gate	 Green	✓
	Seawall (across slipway)	 Red	
ODU 3d Ship Inn	Glass topped floodwall / glasswall	 Amber	
	Flip-up floodwall (setback)	 Green	✓
	Demountable defences	 Green	✓
ODU 3e Fenced area adjacent to Ship Inn	Glass topped setback floodwall + floodgate	 Green	✓
	Flip-up floodwall (setback)	 Green	✓
	Demountable defences	 Green	✓
ODU 3f Coastal footpath	Setback floodwall + boardwalk	 Amber	
	Reinforce / replace de-facto defences (garden wall)	 Green	✓
ODU 3g Picnic area in front of	Glass crest raising + refurb wall	 Amber	

ODU sub-unit	Short list measures	Multivariate ecology impact score (red, amber or green)	Measure with high likelihood of Habitats Regulations compliance based on preliminary assessment?
heritage buildings	Setback floodwall + boardwalk	 Amber	
	Self-raising floodwall + refurb wall	 Amber	
	Flip-up floodwall	 Green	✓
	Demountable defences	 Green	✓
ODU 3h Coastal footpath	Setback floodwall + boardwalk	 Amber	
	Reinforce / replace de-facto defences (garden wall)	 Green	✓
ODU 3i Coastal footpath immediately in front of residential building	Setback floodwall + boardwalk	 Amber	
	Demountable defences	 Green	✓
	Flood proof building	 Green	✓
ODU 3j Slipway at Langstone High Street	Flip-up floodwall	 Green	✓
	Demountable defences	 Green	✓
	Flood gate	 Green	✓
ODU 3k Royal Oak and footpath	Glass crest raising	 Amber	
	Flip-up floodwall (on footpath)	 Green	✓
	Reinforce / replace de-facto defences and flood proof building	 Green	✓
ODU 3l Potential tie-in location to high ground	Setback floodwall	 Green	✓
	Earth embankment (tie-in section only)	 Green	✓

Table 6-4 shows that for each of the sub-units in ODU 3, a measure with a negligible ecological impact has been taken forward to the short list. At the next stage, should the alternative measures on the short list with a potential ecological impact be taken forward as the preferred option, then a robust justification will be provided.

6.5.2 Potential alignments and cross sections

Potential alignments of the various short list measures in each ODU 3 sub-unit are presented in Figure 6-2 and Figure 6-3 below. These figures also include images and photographs of the potential short list measures, from similar sites around the country. The photographs give an indication of what the defence measures could potentially look like.

A number of indicative cross sections have been produced for various setback flood wall / crest raising options along the coastal footpath in ODU sub-units 3f and 3h. These cross sections are found in Appendix B. The cross sections demonstrate the technical and spatial difficulties in constructing a setback wall and crest raising along the footpath, a key reason why the setback wall and crest raising were scoped out from further appraisal. Included in the cross sections is a representation of the setback floodwall and boardwalk concept which has been taken through to the shortlist in a number of the ODU sub-units. As demonstrated, the creation of the boardwalk would lead to a significantly wider footpath and presents opportunities to improve place making.

The cross sections in Appendix B are for informational purposes only and should not be used for design or construction.

Potential requirement for road raising

To the south of ODU 3a the A3023 road which runs adjacent to this sub-unit is generally higher than the Ship Inn car park and provides an opportunity to tie-in any defences to higher ground and to provide a linkage in the defence alignments between ODU 2 and ODU 3.

Based on an inspection of the LiDAR data, the elevation of the middle of the road in the area behind the car park is between 3.4-3.6m AOD. The pavement on the west side of the road is approximately 3.8m in places.

Depending on the standard of protection that is desired from the scheme, the existing road level may be sufficient to prevent outflanking and to link the defences in ODUs 2 and 3. However, if the scheme is intended to protect to higher standards of protection and/or have a longer term design life then it may be necessary to raise the road level in ODU 3b to prevent flood water running down the road and outflanking the defences. This measure has therefore been kept in the short list for ODU 3b as it would provide a passive flood defence and negate the need to close off the road and prevent emergency access to Hayling Island with a flood gate.

7. ODU 4 (Mill and Mill Pond)

7.1 ODU 4 sub-units

ODU 4 extends from the Mill to the eastern end of the study frontage. The defences in this unit primarily consist of a vertical brickwork retaining wall. This ODU has been broken down into 2 sub-units to facilitate option development. The extents of these sub-units are shown in Figure 7-1 below. Potential alignments in these areas are shown later on in the report, in section 0.





Figure 7-1: ODU 4 sub-units extents

The characteristics of each sub-unit, including the constraints and potential opportunities are presented in Figure 7-1 below.

7.2 ODU 4 characteristics

Table 7-1: ODU 4 sub-unit characteristics, constraints and opportunities

Sub-unit	Characteristics	Constraints	Opportunities	Photo
ODU 4a Mill	<ul style="list-style-type: none"> - The Mill is a listed building and is valued by the local community, adding to the character of the area. - There is a brickwork wall protecting the Mill from erosion and wave damage along the seaward face of the property. - However, there is no defence structure at the western side of the property (approx. 8m open area) due to vehicle access, therefore the property is at risk of flooding from outflanking. 	<ul style="list-style-type: none"> - The Mill property owner is largely against any kind of development which will impact the character of the area or the views of/from their property. - A frontline defence around the Mill could lead to encroachment which could have impacts on ecology and difficulty in acquiring consents. - Access to and from the Mill would need to be considered in any defence alignment. - Protection of the Mill is likely to require a relatively long length of defence for limited economic benefits, therefore, the economic case is likely to be poor. 	<ul style="list-style-type: none"> - Opportunity to protect the listed building from flood risk, which is likely to increase in the future due to sea level rise. 	
ODU 4b Footpath	<ul style="list-style-type: none"> - Footpath to the east of the Mill, in front of the Mill Pond, extending to the concrete slipway at its eastern end. - Vertical brickwork retaining wall along the full length of the footpath (approx. 200m long). Sluice gate to Mill Pond located approx. half way along the defence. - Areas of saltmarsh in front of the defence - Wall has not been maintained for a number of years. 	<ul style="list-style-type: none"> - Defences either at the back of the footpath or the front are likely to disturb the views of either the Mill Pond or the foreshore respectively. - A frontline defence along the footpath could lead to encroachment which could have impacts on ecology and difficulty in acquiring consents. 	<ul style="list-style-type: none"> - Opportunities to improve the footpath, access and landscaping, for example, to include more benches along the footpath. - There is generally more space for a defence along this unit than in other ODUs (e.g. ODU 3). 	

7.3 ODU 4 scoring

A summary of the multivariate scores for ODU 4 is presented in the sections below. Table 7-2 provides the total scores from the multivariate appraisal for each measure considered in the sub-units. Based on these scores the measures taken forward for use in the short list options have been identified. For a detailed breakdown of the scoring against each of the 14 multivariate categories refer to Appendix A.

Table 7-2: Summary of multivariate scores for ODU 4

ODU sub-unit	Measure	Ranking	Selection for use in short list?
ODU 4a Mill	Do Nothing		
	No Active Intervention	1	✓
	Do Minimum		
	Patch and repair	1	✓
	Maintain		
	Capital refurbishment	2	✓
	Scheduled maintenance	1	✓
	Improve		
	Demountable defences	2	✓
	Setback floodwall (setback around the back of the Mill property along the footpath)	1	✓
	PLP / PLR (in addition to a formal defence elsewhere, either setback or in ODU 3).	2	✓
ODU 4b Footpath	Do Nothing		
	No Active Intervention	1	✓
	Do Minimum		
	Patch and repair	1	✓
	Maintain		
	Capital refurbishment	2	✓
	Scheduled maintenance	1	✓
	Improve		
	Setback floodwall	2	✓
	Crest raising (frontline) + scheduled maintenance	3	✓
	Glass topped floodwall / glass wall	4	✗
	Self-raising floodwall + replace wall	5	✗
	Flip-up floodwall	4	✗
	Setback floodwall + advance the line walkway	NA*	✗
	Setback floodwall + boardwalk	1	✓
	Demountable defences	4	✗
	Seawall	6	✗
Sheet piling	5	✗	
Footpath raising	4	✗	
Temporary defences	4	✗	

*Measure ruled out through ecologically unacceptable impacts

Note: only two measures taken forward in ODU 4a due to lack of viable alternatives in this sub-unit

7.4 Scoped out measures

This section provides a commentary and justification for the measures which have been scoped out of the sub-units in ODU 4.

7.4.1 Sheet piling

- Sub-units appraised / considered in: ODU 4b

- Sub-units scoped out of: ODU 4b

- Sub-units taken forward: none

Sheet piling was scored poorly in ODU 4b with a red classification for the ecology, heritage, landscape, stakeholder, community and cost categories. This produces an overall score far below the average score for the unit and consequently this measure was scoped out. The key drivers for poor scores in these categories were that this measure could fundamentally change the character of the area, potentially encroach into environmental designations, lead to a loss of access and would be costly compared to other more feasible measures.

7.4.2 Glass topped floodwalls / crest raising

- Sub-units appraised / considered in: ODU 4b

- Sub-units scoped out of: ODU 4b

- Sub-units taken forward: none

In this unit the glass topped floodwall has an average overall score, but is surpassed by other more feasible measures and has therefore been scoped out. The landscape and visual benefits of a glass topped floodwall compared to a traditional RC concrete / masonry clad setback floodwall are likely to be limited in this area given that there is sufficient space at the back of the footpath for a setback structure. Thus, the views of the foreshore and across the harbour would not be disturbed using a traditional structure and use of glass in this area is therefore not required. As a result, the glass structure does not score anymore strongly in the multivariate categories compared to the traditional setback floodwall. However the glass structure is likely to have a significantly higher cost and therefore the overall score is lower than the measures recommended for the short list.

7.4.3 Self-raising floodwall & refurb of existing wall

- Sub-units appraised / considered in: ODU 4b

- Sub-units scoped out of: ODU 4b

- Sub-units taken forward: none

This measure generally scores poorly in relative cost leading to a below average overall score. As a result, less costly and technically challenging measures are recommended instead in this sub-unit.

7.4.4 Flip-up floodwall

- Sub-units appraised / considered in: ODU 4b

- Sub-units scoped out of: ODU 4b

- Sub-units taken forward: none

This measure has an average overall score, but is surpassed by other more feasible measures and has therefore been scoped out. The measure scores poorly on maintenance due to the length of the defence that would be required and consequently the significant resources that would be required to deploy the defences. Given the length of the defence required in this sub-unit, a passive structure which does not require operation is preferred.

7.4.5 Setback floodwall and advance the line walkway

- Sub-units appraised / considered in: ODU 4b

- Sub-units scoped out of: ODU 4b

- Sub-units taken forward: none

This measure involves constructing a floodwall and advancing the line of the existing defences to provide additional footpath width. This is likely to have significant detrimental impacts on ecology that cannot be mitigated within the scope of this study which is considered to be a 'showstopper' from an environmental perspective. This measure has therefore been scoped out from further appraisal in all the sub-units which it was considered.

7.4.6 Demountable defences

- Sub-units appraised / considered in: ODU 4b

- Sub-units scoped out of: ODU 4b

- Sub-units taken forward: none

This measure has an average overall score, but is surpassed by other more feasible measures and has therefore been scoped out. The measure scores poorly on maintenance due to the length of the defence that would be required and consequently the significant resources that would be required to deploy the defences. Given the length of the defence required in this sub-unit, a passive structure which does not require operation is preferred.

7.4.7 Seawall

- Sub-units appraised / considered in: ODU 4b

- Sub-units scoped out of: ODU 4b

- Sub-units taken forward: none

A seawall was scored poorly across this sub-unit with a red classification for the ecology, heritage, landscape, stakeholder, community and cost categories. This produces an overall score far below the average score for the unit and consequently this measure was scoped out. The key drivers for poor scores in these categories were that this measure could fundamentally change the character of the area, potentially encroach into environmental designations, lead to a loss of access and would be costly compared to other more feasible measures.

7.4.8 Footpath raising

- Sub-units appraised / considered in: ODU 4b

- Sub-units scoped out of: ODU 4b

- Sub-units taken forward: none

Footpath raising scores poorly on cost as this approach is likely to be expensive compared to other measures considered in this unit. This is due to uncertainty in the structural composition of the existing footpath, which is likely to require reinforcement in order to support additional height. In addition, increasing the height of the path could reduce the perceived connection and access to the foreshore which is an important aspect to retain for the local community. These factors are reflected in the scoring of this measure which has an average overall score. This measure is surpassed by other more feasible alternatives and it is recommended that this measure is scoped out from further consideration.

7.4.9 Temporary defences

- Sub-units appraised / considered in: ODU 4b

- Sub-units scoped out of: ODU 4b

- Sub-units taken forward: none

Temporary defences have been scoped out from further consideration across this sub-unit mainly because other measures are more suitable and provide a more robust, reliable defence against flooding. This is reflected in the maintenance category for the temporary defences where it received a red score due to the high operational

requirements and pre-planning required in deploying these defences. In addition to this, the typical service life of temporary defences is <20 years which is low compared to the other measures considered in the sub-units.

7.5 Draft short list measures

Table 7-3 below outlines the measures on the draft short list for each sub-unit in ODU 4 to facilitate an Improve option.

No Active Intervention, patch and repair and different types of maintenance approach (i.e. capital refurbishment or scheduled maintenance) are also included on the short list for each of the sub-units within ODU 4. The implementation of these measures across the different sub-units would be broadly similar and it is necessary to include them in the short list for the facilitation of the Do Nothing, Do Minimum and Maintain options. Given the similarities between these approaches for each sub-unit they have not been presented in Table 7-3.

Table 7-3: Draft short list measures for ODU 4

ODU sub-unit	Measure	Key reasons for shortlist selection
ODU 4a Mill	Demountable defences	Relatively low cost measure compared to alternatives. Setback so no ecology impacts.
	Setback floodwall	Measure carried forward mainly due to lack of feasible alternatives in the area. Setback alignment so limited ecological impact and low residual risk after construction.
	PLP / PLR	For the Mill buildings. Low ecology and landscape impacts. Relatively low cost. This measure would need to be combined with a formal defence elsewhere to ensure that flood waters cannot pass through the Mill area and flood other parts of the frontage. For example, could be combined with a defence in ODU 3l or sheet piling / demountables behind the Mill.
ODU 4b Footpath	Setback floodwall	Scores highly in ecology as it is setback so no impact. Low residual risk of flooding and long option life and likely to be supported by stakeholders.
	Crest raising & scheduled maintenance	Scores highly in erosion risk, technical feasibility and a low residual risk.
	Setback floodwall & boardwalk	Use of boardwalk improves access / footpath and therefore likely to be supported by community. Also scores highly in broader outcomes, technical feasibility and has a low residual risk.

7.5.1 Preliminary assessment of compliance with Habitat Regulations

As per the approach in the other ODUs, it has been possible to undertake a preliminary qualitative comparison of the potential ecological impacts of the Improve measures on the short list and to identify the impact this may have on compliance with the Habitats Regulations (Table 7-4). This assessment has been based on the multivariate findings and consideration of the ecology objectives (Appendix C).

Table 7-4: Preliminary indication of ecological impact of short list measures







ODU sub-unit	Short list measures	Multivariate ecology impact score (red, amber or green)	Measure with high likelihood of Habitats Regulations compliance based on preliminary assessment?
ODU 4a Mill	Demountable defences	 Green	✓
	Setback floodwall	 Green	✓
	PLP / PLR	 Green	✓
ODU 4b Footpath	Setback floodwall	 Green	✓
	Crest raising & scheduled maintenance	 Amber	
	Setback floodwall & boardwalk	 Amber	

Table 7-4 shows that for each of the sub-units in ODU 4, a measure with a negligible ecological impact has been taken forward to the short list. At the next stage, should the alternative measures on the short list with a potential ecological impact be taken forward as the preferred option, then a robust justification will be provided.

7.5.2 Potential alignments

Potential alignments of the various short list measures in each ODU sub-unit are presented in Figure 7-2 below. These figures also include images and photographs of the potential short list measures, from similar sites around the country. The photographs give an indication of what the defence measures could potentially look like.

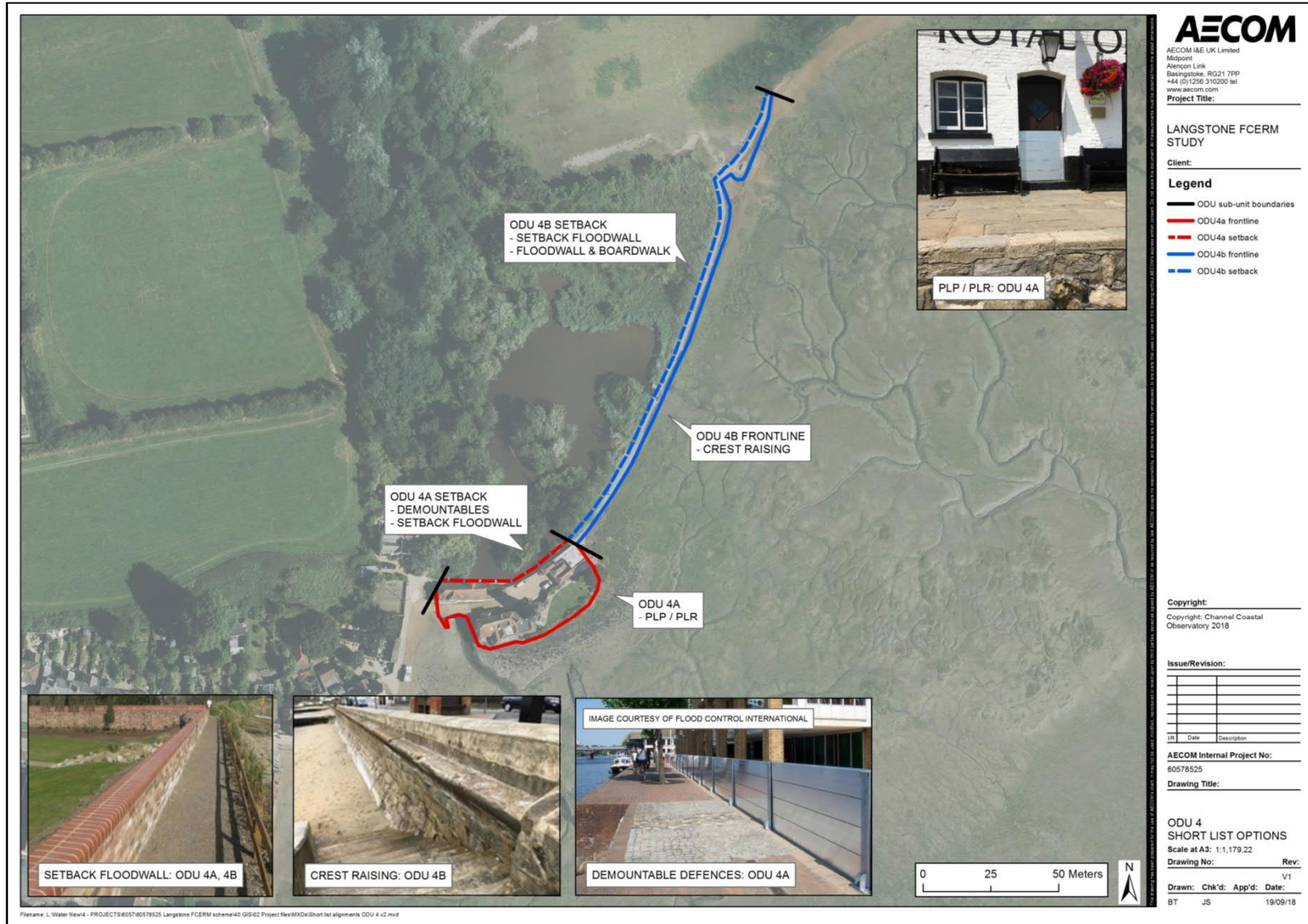


Figure 7-2: Potential alignments and short list measures for ODU 4 sub-units

8. Frontage wide approaches

8.1 Road raising

Road raising is an approach which could be used along the A3023 (Langstone Road) to essentially split the Langstone flood cell in two. This is an approach which could be used alongside a primary defence in another location to prevent 'backdoor' flooding and outflanking of the new primary defence.

An example of where this approach may be useful is if a business case for a defence in ODU 3 was developed, but there was not a viable case to construct defences elsewhere in the study area. In this specific example the A3023 could be raised to prevent flood water flowing from ODUs 1 and 2 and outflanking the new defences in ODU 3.

Road raising of the A3023 could potentially have other benefits, such as providing an increased level of protection to the roadway itself. The road serves as the main transport link to Hayling Island and flooding to this road could significantly impact the access and egress to the Island. Safe access and egress at all times is essential, particularly for emergency services.

The drawbacks of road raising are that it would likely be an expensive approach and could cause widespread disruption during the construction phase. There is however a potential for broader outcomes and to attract contributions from the highways authority should this approach to be taken forward.

During the next stage of the appraisal process the short list options for each ODU outlined in this report will be appraised in detail and a preferred option will be selected. If a business case for improved defences in each unit can be developed then the defences will not only provide an increased standard of protection to the properties in Langstone, but will also protect the roadway itself. If this is the case then depending on the SoP provided then road raising along the A3023 may not be required in the Langstone study area.

Primary defences along the Langstone frontage are the preferred outcome of this study and therefore it is not the intention to appraise road raising in any more detail in this report. However, at this stage road raising can also not be ruled out from further consideration so that in the event that defences along the whole Langstone frontage cannot be justified, then road raising could be used to prevent outflanking and protect access on/ off Hayling Island during extreme flood events.

8.2 Tidal flood barrier

A potential measure to reduce the tidal flood risk across the whole study site would be the construction of a tidal flood barrier. This measure was suggested during early consultation with the community and was therefore considered in the long list of potential measures. There are a number of locations where a tidal barrier could be located, such as at the entrances to Langstone and Chichester Harbours.

Tidal barriers are not commonly used for flood defence in the UK, due to their very high cost. However, a number of recent flood risk management studies – e.g. Boston, Ipswich and Bridgwater – have identified a tidal flood barrier as the optimum solution. The prime attraction of a barrier is its ability to provide a single strategic solution to flood risk by cutting off ingress of flood waters which would otherwise propagate upstream on a river or estuary.

Research has been undertaken to assist with assessing the potential costs (both capital and whole life), as well as other factors which may influence the choice and feasibility of a barrier solution. A key conclusion is that the single most important parameter for determining barrier cost and feasibility is the width of a barrier. Other factors, such as configuration / gate type, are less important for costing and there are a number of different technical solutions to achieve the required objectives for any particular barrier project.

A tidal barrier solution would need to form a defence to the full height of the tidal defence level to prevent outflanking. In addition to the moveable structures required across the 'wet' channel it is necessary to assess the need for embankments or other structures to tie-in the barrier to high ground. Because Langstone and Chichester harbours are connected at their north ends, a barrier would be required in each harbour to be able to effectively control water levels in both harbours and at Langstone. For the purpose of this appraisal it has been assumed

that the most suitable location for a barrier would be across the entrances to the harbours, as this would require the minimum width of barrier and is likely to keep costs as low as possible. The estimated width of Langstone Harbour entrance is 300m and Chichester Harbour entrance is in excess 1.1km wide.

From the information available in the research a high level cash cost estimate of barriers of this width has been made. For a barrier around 300m wide at Langstone Harbour, the likely costs could be in the region of £500m to £1bn. For a significantly larger structure at Chichester harbour, the costs are likely to be to the scale of billions of pounds.

The cost of the two tidal barriers required to mitigate the tidal flood risk at Langstone makes this approach unfeasible at this time and the level of study to fully examine such an option is beyond the scope of this study. In addition to this, there are likely to be access and navigation issues, significant environmental impacts, a residual fluvial flood risk, geomorphology impacts and security issues associated with a tidal barrier solution. For this reason this approach has been scoped out from further consideration for this study.

8.3 Tidal lagoon

A potential measure which could be used to reduce flood risk would be to construct a ring of impermeable offshore breakwaters around the frontage. This would create a sheltered lagoon which would protect from tidal surge and waves. A water level control system could be included in the structure via a series of gates to allow the water levels in the lagoon to rise and fall under normal tidal conditions; however, the gates would be closed during periods of increased risk to protect the frontage from flooding.

There are a number of constraints associated with this measure, most notably a very high cost which is likely to significantly exceed the benefits by at least an order of magnitude. This makes this approach unfeasible from a funding perspective and is unlikely to be supported by key stakeholders when other less costly approaches are feasible.

Another significant constraint is the environmental impact of such a structure. Construction of an offshore structure in the harbours would be in environmentally designated SPA, SSSI, SAC and Ramsar areas and the approach would likely fail in gaining consenting from key stakeholders, such as Natural England and the Marine Management Organisation (MMO). In addition the area is an Area of Outstanding Natural Beauty and an offshore structure is likely to significantly change the character of the foreshore and frontage.

8.4 Property level protection / resilience

Property level protection / resilience measures have been considered for a number of the ODU sub-units across the frontage. However, it has been scoped out for all of the units with the exception of ODU 4a (the Mill) (see sections 0 and 6.4). The key reason for scoping this measure out is that a large number of properties in the study area are already using PLP / PLR measures and it would not be technically feasible to improve the level of protection that existing the PLP / PLR provides. This is because PLP is only considered a suitable approach up to flood depths of approximately 0.6m and the existing PLP protection generally protects to this level. In addition to this, flood depths are likely to exceed 0.6m more frequently in the future (due to sea level rise) and therefore it is not considered to be a suitable long term approach as a frontage wide measure.

9. Next steps

The next steps of the option appraisal process include:

- Develop further the short list option details and design concepts;
- Consider in more detail Safety, Health and Environment (SHE) and Construction, Design and Management (CDM) regulations as part of the short list options
- Undertake the economic damages and benefits assessment in line with the Multi-Coloured Manual guidance as well as GVA and economic footprint study;
- Develop costs for the short list options, including capital construction costs and maintenance costs;
- Undertake a more comprehensive environmental appraisal of the short list options, refer to Appendix C for the environmental objectives which have been agreed with the project team; and
- Appraise the short list options in line with Flood and Coastal Erosion Risk Management (FCERM) appraisal guidance

10. Appendix A: Multivariate scoring

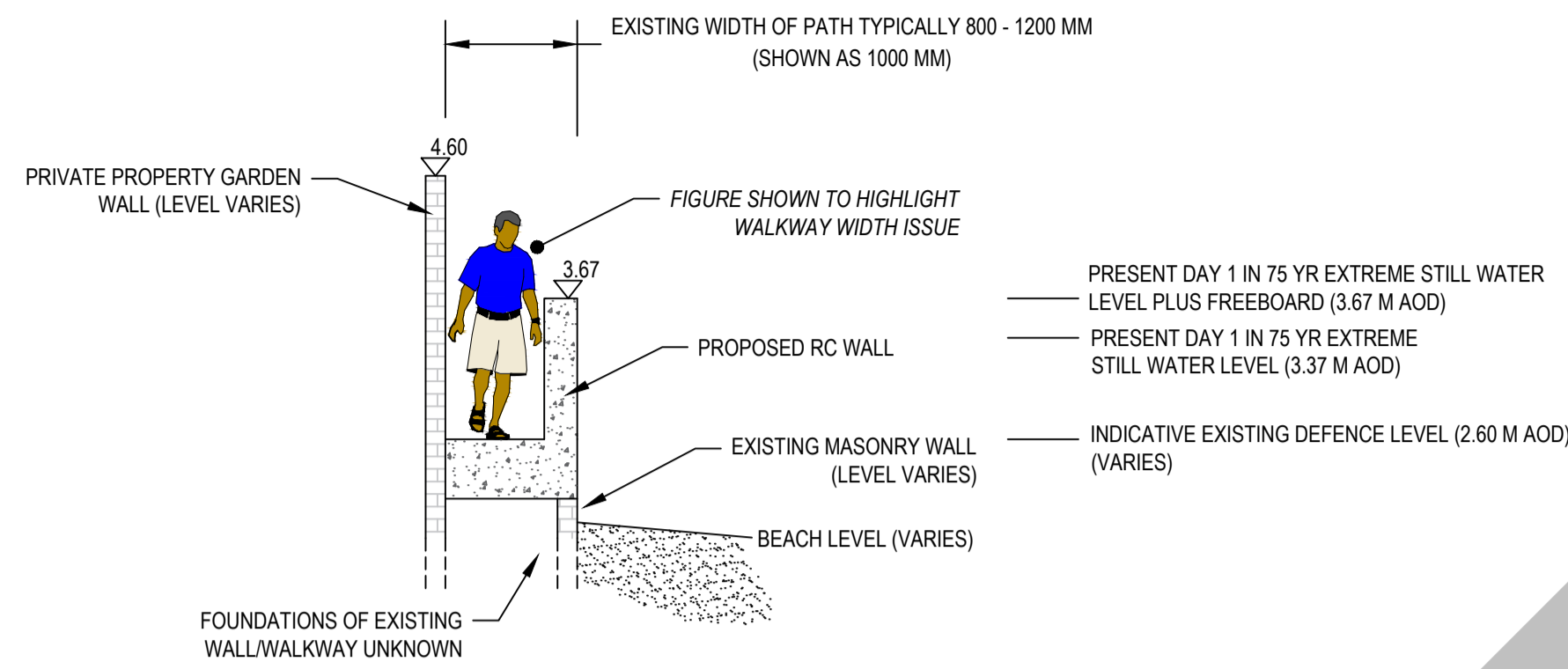
ODU	Option	Policy	Erosion	Ecology	Heritage	Landscape	Tech	Risk	Stakeholder	Community	Broad/cont	Maint	Life	Coast Proc	Relative cost	Shortlist
1a east bank of stream	Do Nothing															
	No Active Intervention	🔴	🔴	🟢	🟡	🔴	🟢	🔴	🔴	🔴	🔴	🟢	🔴	🟡	🟢	✓ 10.00
	Improve															
	Seawall	🟢	🟢	🔴	🟡	🔴	🟢	🟢	🔴	🔴	🟡	🟢	🟢	🟡	🔴	✗ 15.00
	Sheet piling and capping beam	🟢	🟢	🔴	🟡	🔴	🟢	🟢	🔴	🔴	🟡	🟢	🟢	🟡	🔴	✗ 15.00
	Setback floodwall	🟢	🟡	🟢	🟡	🟡	🟢	🟢	🟢	🟡	🟡	🟢	🟢	🟢	🟡	✓ 22.00
	Land raising	🟢	🟡	🟡	🟡	🔴	🟡	🟢	🟡	🟡	🟡	🟢	🟡	🟡	🔴	✗ 15.00
	Demountable defences	🟢	🟡	🟢	🟡	🟡	🔴	🔴	🟡	🟡	🟡	🟢	🟡	🟢	🟢	✗ 15.00
Earth embankment (setback)	🟢	🟡	🟢	🟡	🟡	🟢	🟢	🟢	🟡	🟡	🟢	🟡	🟢	🟡	✓ 21.00	
1b hard defences	Do Nothing															
	No Active Intervention	🔴	🔴	🟢	🟡	🟡	🟢	🔴	🔴	🔴	🔴	🟢	🔴	🟡	🟢	✓ 11.00
	Do Minimum															
	Patch and repair	🟡	🟡	🟢	🟡	🟡	🟢	🔴	🔴	🟡	🔴	🔴	🔴	🟡	🟢	✓ 12.00
	Maintain															
	Capital refurbishment	🟡	🟢	🟡	🟡	🟢	🟢	🟡	🟡	🟢	🟢	🟢	🟢	🟡	🟡	✓ 21.00
	Scheduled maintenance	🟡	🟢	🟡	🟡	🟢	🟢	🟡	🟡	🟢	🟢	🟢	🟡	🟡	🟢	✓ 20.00
	Improve															
	Crest raising (frontline) + refurb	🟢	🟢	🟡	🟡	🟡	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟡	🟡	✓ 23.00
	Glass topped crest raising + scheduled maintenance	🟢	🟡	🟡	🟡	🟡	🔴	🟢	🟢	🟡	🟡	🟡	🟡	🟡	🔴	✗ 15.00
	Self raising floodwall (frontline) + refurb of wall	🟢	🟡	🟡	🟡	🟡	🔴	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🔴	✗ 15.00
	Demountable defences	🟢	🟡	🟢	🟡	🟡	🟡	🔴	🟡	🟡	🟡	🟡	🟡	🟡	🟢	✗ 15.00
	Seawall	🟢	🟢	🟡	🔴	🟡	🟢	🟢	🔴	🟡	🟡	🟡	🟢	🟡	🔴	✓ 17.00
Sheet piling (potentially behind the defences)	🟢	🟢	🟢	🔴	🟡	🟢	🟢	🔴	🟡	🟡	🟡	🟢	🟡	🔴	✓ 18.00	
PLP / PRL	🟢	🟡	🟢	🟡	🟡	🟡	🔴	🟡	🟡	🟡	🔴	🔴	🟡	🟢	✗ 15.00	
Vegetated buffer zones	🔴	🟡	🟡	🟡	🟡	🟡	🟡	🔴	🟡	🔴	🟡	🟡	🟡	🟢	✗ 14.00	

ODU	Option	Policy	Erosion	Ecology	Heritage	Landscape	Tech	Risk	Stakeholder	Community	Broad/cont	Maint	Life	Coast Proc	Relative cost	Shortlist
2a Langstone Spit	Do Nothing															
	No Active Intervention	🔴	🔴	🟢	🟡	🟡	🟢	🔴	🔴	🔴	🔴	🟢	🔴	🟡	🟢	✓ 11.00
	Do Minimum															
	H&S compliance, clearance of debris	🔴	🔴	🟢	🟡	🟡	🟢	🔴	🔴	🔴	🔴	🔴	🔴	🟡	🟢	✓ 9.00
	Maintain															
	Stabilisation works / local erosion protection	🟡	🟡	🟡	🟡	🟡	🟢	🔴	🟡	🟡	🟡	🟡	🟡	🟡	🟡	✓ 14.00
	Beach recycling	🟡	🟡	🔴	🔴	🟡	🔴	🔴	🟡	🟡	🟡	🟡	🟡	🔴	🟡	✗ 9.00
	Improve															
	Beach nourishment	🟡	🟡	🔴	🟡	🟡	🟢	🟡	🔴	🔴	🟢	🟡	🟡	🔴	🔴	✓ 11.00
Rock Armour	🟡	🟢	🔴	🔴	🔴	🟢	🟡	🟡	🟢	🟡	🟢	🟢	🟡	🟡	✓ 16.00	
Groynes with beach nourishment	🟡	🟡	🔴	🔴	🔴	🟢	🟡	🔴	🟡	🟡	🟢	🟡	🔴	🔴	✓ 10.00	
2b Solent Way footpath	Do Nothing															
	No Active Intervention	🔴	🔴	🟢	🟡	🟡	🟢	🔴	🔴	🔴	🔴	🟢	🔴	🟡	🟢	✓ 11.00
	Do Minimum															
	H&S compliance, clearance of debris / vegetation - continued ad-hoc	🔴	🟡	🟢	🟡	🟡	🟢	🔴	🔴	🟡	🔴	🔴	🔴	🟡	🟢	✓ 11.00
	Maintain															
	Stabilisation of embankment / local erosion protection	🟡	🟡	🟡	🟡	🟡	🟢	🔴	🟡	🟡	🟡	🟡	🟡	🟡	🟡	✓ 15.00
	Improve															
	Setback floodwall	🟢	🟡	🟢	🔴	🟡	🟡	🟢	🟢	🟢	🟡	🟡	🟡	🟡	🟡	✓ 19.00
Demountable defences	🟢	🟡	🟢	🟡	🟡	🔴	🔴	🟢	🟡	🟡	🔴	🟡	🟡	🟡	✗ 15.00	
Earth embankment (raising/formalising or new structure)	🟢	🟡	🟢	🟡	🟡	🟢	🟢	🟢	🟢	🟡	🟡	🟡	🟡	🟡	✓ 21.00	
2c Sailing club	Do Nothing															
	No Active Intervention	🔴	🔴	🟢	🟡	🟡	🟢	🔴	🔴	🔴	🔴	🟢	🔴	🟡	🟢	✓ 11.00
	Do Minimum															
	Patch and repair	🟡	🟡	🟢	🟡	🟡	🟢	🔴	🔴	🟡	🔴	🔴	🔴	🟡	🟢	✓ 12.00
	Maintain															
	Capital refurbishment	🟡	🟢	🟡	🟡	🟡	🟢	🟡	🟡	🟢	🟢	🟢	🟡	🟡	🟡	✓ 19.00
	Scheduled maintenance	🟡	🟢	🟡	🟡	🟡	🟢	🔴	🟡	🟡	🟢	🟡	🟡	🟡	🟡	✓ 17.00
	Improve															
	Setback floodwall + scheduled maintenance / refurb of existing struc	🟢	🟢	🟡	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟡	🟢	🟡	🟡	✓ 24.00
Revetment	🟢	🟢	🔴	🟢	🟢	🟢	🟢	🟢	🟡	🟢	🟢	🟢	🟡	🔴	✓ 22.00	
Land raising	🟢	🟡	🟢	🟢	🟢	🟢	🟢	🟡	🟡	🟢	🟡	🟡	🟡	🔴	✗ 20.00	
Seawall	🟢	🟢	🔴	🟢	🟢	🟡	🟢	🔴	🟡	🟡	🟡	🟢	🟡	🔴	✗ 18.00	

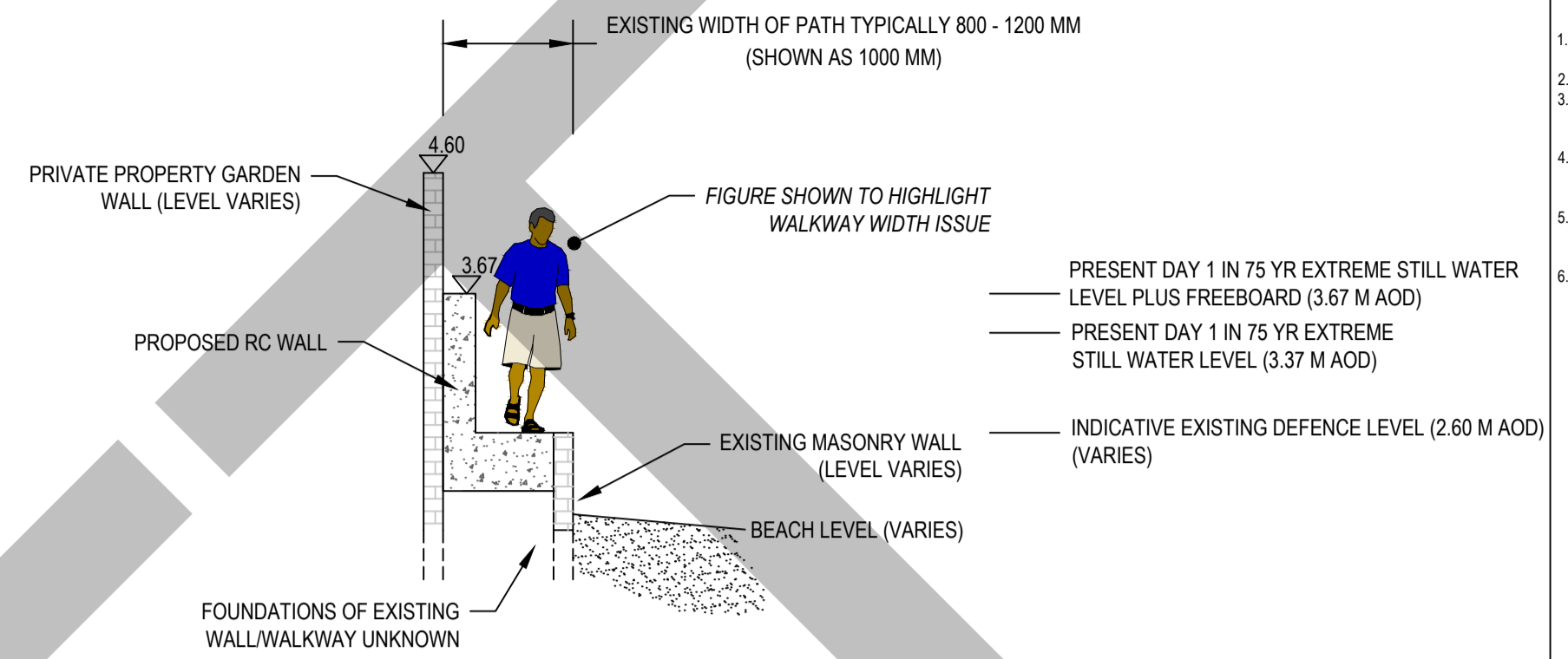
ODU	Option	Policy	Erosion	Ecology	Heritage	Landscape	Tech	Risk	Stakeholder	Community	Broad/cont	Maint	Life	Coast Proc	Relative cost	Shortlist	
3a (slipway)	Do Nothing																
	No Active Intervention	🔴	🔴	🟢	🟡	🟡	🟢	🔴	🔴	🔴	🔴	🟢	🔴	🟡	🟢	✓ 11.00	
	Do Minimum																
	Patch and repair	🟡	🟡	🟢	🟡	🟡	🟢	🔴	🔴	🟡	🔴	🔴	🔴	🟡	🟢	✓ 12.00	
	Maintain																
	Capital refurbishment	🟡	🟢	🟡	🟡	🟡	🟢	🔴	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	✓ 15.00
	Scheduled maintenance	🟡	🟢	🟡	🟡	🟡	🟢	🔴	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	✓ 16.00
	Improve																
	Flip-up floodwall (setback)	🟢	🟡	🟢	🟡	🟡	🟢	🟡	🟡	🟢	🟢	🟡	🟡	🟡	🟡	🟡	✓ 19.00
	Demountable defences	🟢	🟡	🟢	🟡	🟡	🟢	🔴	🟢	🟢	🟡	🟡	🟡	🟡	🟡	🟡	✓ 18.00
Flood gate	🟢	🟡	🟢	🟡	🟡	🟢	🟡	🟡	🟢	🟢	🟡	🟡	🟡	🟡	🟡	✓ 19.00	
Temporary defences	🟢	🟡	🟢	🟡	🟡	🟢	🔴	🟡	🟡	🟡	🟡	🔴	🔴	🟡	🟡	✗ 17.00	
3b (car park)	Do Nothing																
	No Active Intervention	🔴	🔴	🟢	🟡	🟡	🟢	🔴	🔴	🔴	🔴	🟢	🔴	🟡	🟢	✓ 11.00	
	Do Minimum																
	Patch and repair	🟡	🟡	🟢	🟡	🟡	🟢	🔴	🔴	🟡	🔴	🔴	🔴	🟡	🟢	✓ 12.00	
	Maintain																
	Capital refurbishment	🟡	🟢	🟡	🟡	🟡	🟢	🔴	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	✓ 15.00
	Scheduled maintenance	🟡	🟢	🟡	🟡	🟡	🟢	🔴	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	✓ 16.00
	Improve																
	Setback floodwall	🟢	🟡	🟢	🔴	🔴	🟢	🟢	🟢	🟢	🟡	🟡	🟡	🟡	🟡	🟡	✓ 18.00
	Crest raising (frontline) + scheduled maintenance	🟢	🟢	🟡	🔴	🔴	🟡	🟢	🟢	🔴	🔴	🟡	🟡	🟡	🟡	🟡	✗ 14.00
	Glass topped setback floodwall / glasswall	🟢	🟡	🟢	🟡	🔴	🟢	🟢	🟢	🟢	🟡	🟡	🟡	🟡	🟡	🟡	✓ 18.00
	Self raising floodwall + refurb of wall	🟢	🟢	🟡	🟡	🟡	🔴	🟡	🟡	🟢	🟡	🟡	🟡	🟡	🟡	🟡	✗ 15.00
	Flip-up floodwall (setback or across the car park)	🟢	🟡	🟢	🟡	🟡	🟢	🟡	🟡	🟢	🟢	🟡	🟡	🟡	🟡	🟡	✓ 19.00
	Demountable defences	🟢	🟡	🟢	🟡	🟡	🟢	🔴	🟢	🟢	🟡	🟡	🟡	🟡	🟡	🟡	✗ 17.00
Seawall	🟢	🟢	🔴	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🟡	🟢	🟡	🟡	🟡	✗ 14.00	
Sheet piling	🟢	🟢	🔴	🔴	🔴	🟡	🟢	🟢	🟡	🔴	🟡	🟢	🟡	🟡	🟡	✗ 14.00	
Land raising	🟢	🟡	🟢	🟡	🟡	🟢	🟢	🟢	🟡	🟡	🟡	🟡	🟡	🟡	🟡	✗ 17.00	
Road raising	🟢	🟡	🟢	🟡	🟡	🟢	🟢	🟢	🟡	🟡	🟡	🟡	🟡	🟡	🟡	✓ 18.00	
Temporary defences	🟢	🟡	🟢	🟡	🟡	🟢	🔴	🟡	🟡	🟡	🟡	🔴	🔴	🟡	🟡	✗ 17.00	
3c (slipway)	Do Nothing																
	No Active Intervention	🔴	🔴	🟢	🟡	🟡	🟢	🔴	🔴	🔴	🔴	🟢	🔴	🟡	🟢	✓ 11.00	
	Do Minimum																
	Patch and repair	🟡	🟡	🟢	🟡	🟡	🟢	🔴	🔴	🟡	🔴	🔴	🔴	🟡	🟢	✓ 12.00	
	Maintain																
	Capital refurbishment	🟡	🟢	🟡	🟡	🟡	🟢	🔴	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	✓ 15.00
	Scheduled maintenance	🟡	🟢	🟡	🟡	🟡	🟢	🔴	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	✓ 16.00
	Improve																
	Flip-up floodwall (setback)	🟢	🟡	🟢	🟡	🟡	🟢	🟡	🟡	🟢	🟢	🟡	🟡	🟡	🟡	🟡	✓ 19.00
	Demountable defences	🟢	🟡	🟢	🟡	🟡	🟢	🔴	🟢	🟢	🟡	🟡	🟡	🟡	🟡	🟡	✓ 18.00
Flood gate	🟢	🟡	🟢	🟡	🟡	🟢	🟡	🟡	🟢	🟢	🟡	🟡	🟡	🟡	🟡	✓ 19.00	
Temporary defences	🟢	🟡	🟢	🟡	🟡	🟢	🔴	🟡	🟡	🟡	🟡	🔴	🔴	🟡	🟡	✗ 17.00	
Seawall (across slipway)	🟢	🟢	🔴	🔴	🔴	🟡	🟢	🟢	🔴	🔴	🟡	🟢	🟡	🟡	🟡	✓ 18.00	
3d (Ship Inn)	Do Nothing																
	No Active Intervention	🔴	🔴	🟢	🟡	🟡	🟢	🔴	🔴	🔴	🔴	🟢	🔴	🟡	🟢	✓ 11.00	
	Do Minimum																
	Patch and repair	🟡	🟡	🟢	🟡	🟡	🟢	🔴	🔴	🟡	🔴	🔴	🔴	🟡	🟢	✓ 12.00	
	Maintain																
	Capital refurbishment	🟡	🟢	🟡	🟡	🟡	🟢	🔴	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	✓ 15.00
	Scheduled maintenance	🟡	🟢	🟡	🟡	🟡	🟢	🔴	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	✓ 16.00
	Improve																
	Setback floodwall	🟢	🟡	🟢	🔴	🔴	🟡	🔴	🟢	🟢	🔴	🟡	🟡	🟡	🟡	🟡	✗ 16.00
	Crest raising (frontline) + replace wall	🟢	🟢	🟡	🔴	🔴	🟡	🟢	🟢	🟡	🔴	🟡	🟡	🟡	🟡	🟡	✗ 15.00
	Glass crest raising (frontline) + replace wall	🟢	🟢	🟡	🟡	🟡	🟡	🟢	🟢	🟡	🟡	🟡	🟡	🟡	🟡	🟡	✓ 18.00
	Self raising floodwall + replace wall	🟢	🟢	🟡	🟡	🟡	🔴	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	✗ 14.00
	Flip-up floodwall (setback)	🟢	🟡	🟢	🟡	🟡	🟢	🟡	🟡	🟢	🟢	🟡	🟡	🟡	🟡	🟡	✓ 17.00
	Demountable defences	🟢	🟡	🟢	🟡	🟡	🟢	🔴	🟢	🟢	🟡	🟡	🟡	🟡	🟡	🟡	✓ 17.00
Seawall	🟢	🟢	🔴	🔴	🔴	🟡	🟢	🟢	🔴	🔴	🟡	🟢	🟡	🟡	🟡	✗ 13.00	
Sheet piling	🟢	🟢	🔴	🔴	🔴	🔴	🟢	🟢	🔴	🔴	🟡	🟢	🟡	🟡	🟡	✗ 13.00	
PLP / PLR	🟢	🟡	🟢	🟡	🟡	🟡	🔴	🟡	🟡	🟡	🔴	🔴	🟡	🟡	🟡	✗ 15.00	

ODU	Option	Policy	Erosion	Ecology	Heritage	Landscape	Tech	Risk	Stakeholder	Community	Broad/cont	Maint	Life	Coast Proc	Relative cost	Shortlist
3k Royal Oak and footpath	Setback floodwall	🟢	🟡	🟢	🔴	🔴	🔴	🟢	🔴	🔴	🟡	🟡	🟢	🟡	🔴	❌ 12.00
	Crest raising + refurb wall	🟢	🟢	🟡	🔴	🔴	🟡	🟢	🔴	🔴	🟡	🟡	🟢	🟡	🟡	❌ 14.00
	Glass crest raising + refurb wall	🟢	🟢	🟡	🟡	🟡	🟢	🟢	🟡	🟡	🟡	🟡	🟢	🟡	🟡	✅ 19.00
	Setback floodwall + advance the line walkway	🟢	🟢	🟡	🟡	🔴	🟢	🟢	🔴	🟢	🟢	🟡	🟢	🟡	🔴	❌ 17.00
	Setback floodwall + boardwalk	🟢	🟢	🟡	🔴	🔴	🟡	🟢	🟡	🟡	🟡	🟢	🟢	🟡	🟡	❌ 17.00
	Self raising floodwall + replace wall	🟢	🟢	🟡	🟡	🟡	🔴	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	❌ 14.00
	Flip-up floodwall (on footpath)	🟢	🟡	🟢	🟢	🟢	🟡	🟡	🟢	🟡	🟡	🟡	🟡	🟡	🟡	✅ 19.00
	Demountable defences	🟢	🟡	🟢	🟡	🟢	🔴	🔴	🟢	🟢	🟡	🟡	🟡	🟡	🟡	❌ 17.00
	Reinforce / replace de-facto defences and flood proof building walls	🟢	🟡	🟢	🟢	🟢	🟡	🟢	🟢	🟢	🟡	🟡	🟡	🟡	🟡	✅ 22.00
	Seawall	🟢	🟢	🔴	🔴	🔴	🟡	🟢	🟢	🔴	🔴	🟡	🟢	🟢	🟡	❌ 13.00
	Sheet piling	🟢	🟢	🔴	🔴	🔴	🟡	🟢	🟢	🟡	🔴	🟡	🟢	🟢	🟡	❌ 14.00
	PLP / PLR	🟢	🟡	🟢	🟡	🟢	🟡	🔴	🟡	🟡	🔴	🔴	🟡	🟡	🟡	❌ 15.00
	Temporary defences	🟢	🟡	🟢	🟢	🟢	🟡	🔴	🟡	🟡	🟡	🟡	🔴	🔴	🟡	❌ 16.00
Vegetated buffer zones	🔴	🟡	🟡	🟡	🟡	🔴	🟡	🔴	🟡	🟡	🟢	🟡	🟡	🟡	❌ 14.00	
3m Tie-in	Do Nothing															
	No Active Intervention	🔴	🔴	🟢	🟡	🟡	🟢	🔴	🔴	🔴	🔴	🟢	🔴	🟡	🟢	✅ 11.00
	Improve															
	Setback floodwall	🟢	🟡	🟢	🔴	🔴	🟢	🟢	🟢	🟡	🟡	🟡	🟢	🟡	🟡	✅ 18.00
Earth embankment (tie-in section only)	🟢	🔴	🟢	🔴	🔴	🔴	🟢	🟢	🟢	🟢	🔴	🟢	🔴	🟡	✅ 21.00	

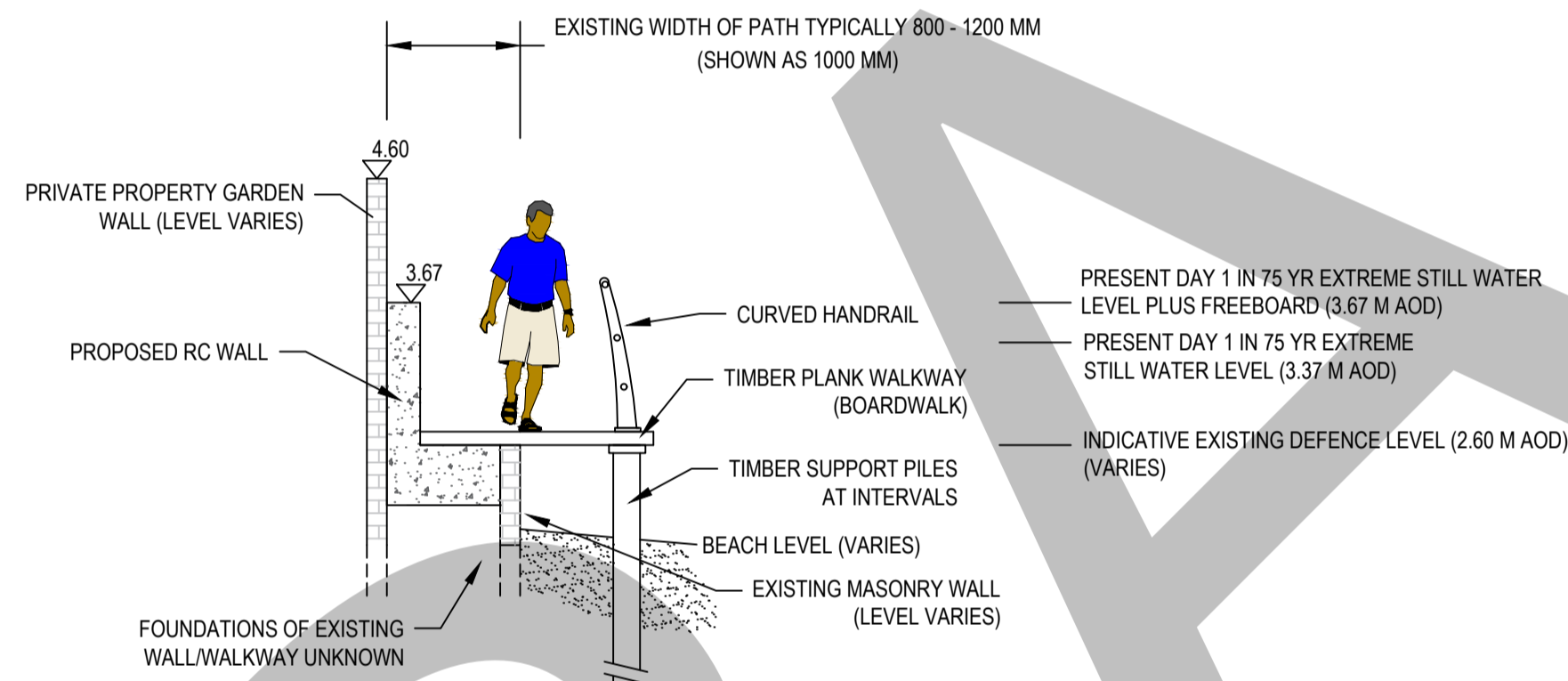
11. Appendix B: Indicative cross sections



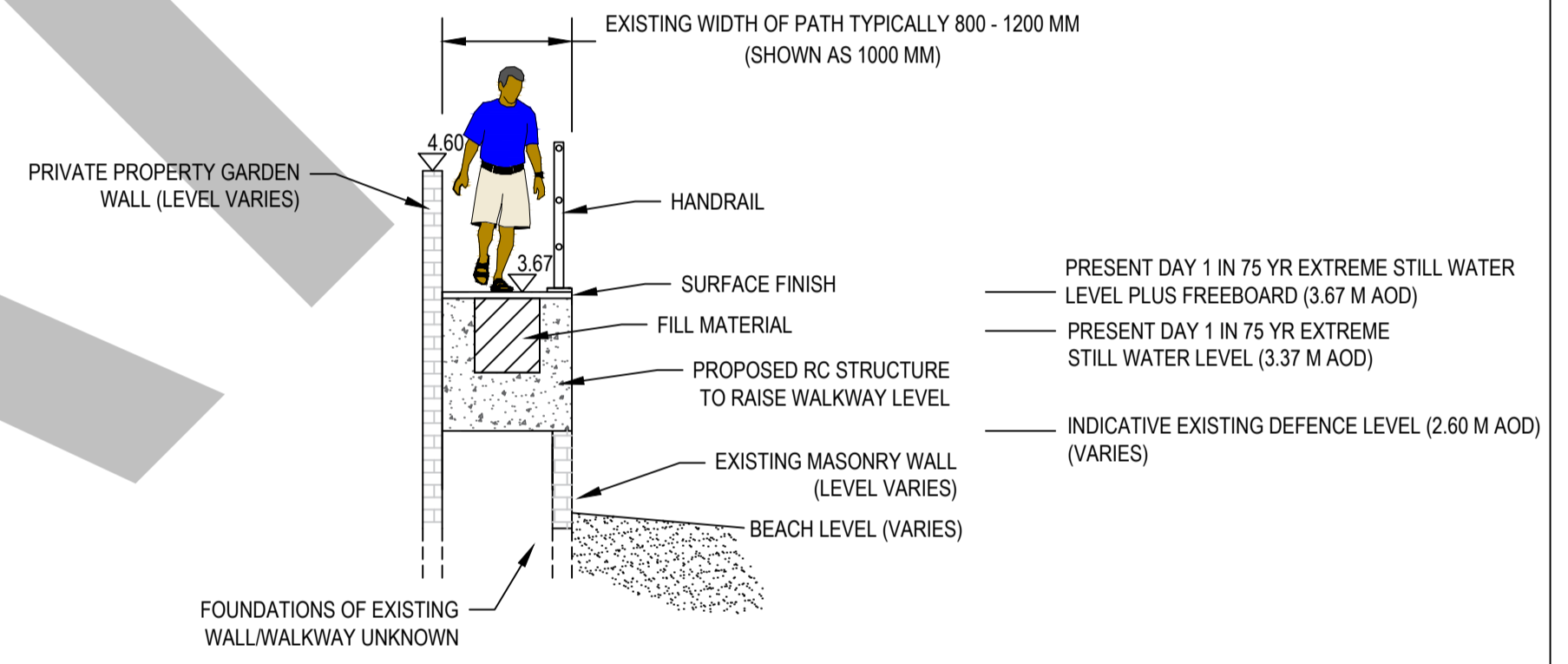
**CROSS SECTION A - PROPOSED WALKWAY OPTION 1
FLOOD WALL ON OUTSIDE OF WALKWAY (1:50)**



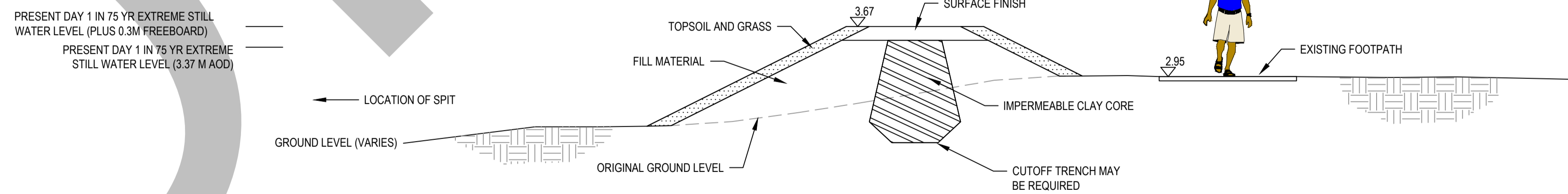
**CROSS SECTION A - PROPOSED WALKWAY OPTION 2
FLOOD WALL ON INSIDE OF WALKWAY (1:50)**



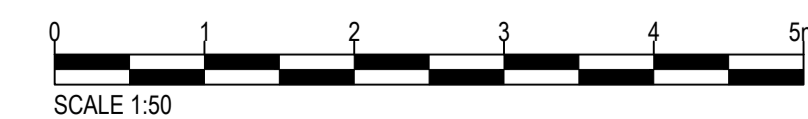
**CROSS SECTION A - PROPOSED WALKWAY OPTION 3
FLOOD WALL ON INSIDE OF WALKWAY & INCREASE
WALKWAY WIDTH (1:50)**



**CROSS SECTION A - PROPOSED WALKWAY OPTION 4
RAISE HEIGHT OF WHOLE WALKWAY (1:50)**



**CROSS SECTION B - PROPOSED FLOOD EMBANKMENT OPTION
(1:50)**



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 - OPTION APPRAISAL DESIGN BASED ON LIMITED GROUND INVESTIGATIONS AND CONDITION INSPECTIONS. FURTHER ASSESSMENTS TO BE UNDERTAKEN AT DETAILED DESIGN STAGE AS REQUIRED.
 - LEVEL OF EXISTING WALKWAY (CROSS SECTION A) TAKEN FROM TOPOGRAPHIC SURVEY. LEVEL OF EXISTING FOOTPATH (CROSS SECTION B) TAKEN FROM LIDAR SURVEY.
 - OPTION APPRAISAL DESIGN INTENDED FOR SPATIAL COMPARISON OF OPTIONS RATHER THAN ASSESSING TECHNICAL FEASIBILITY.

INDICATIVE OPTION DRAWINGS FOR SHORT LIST	BO	28/08/18	P1
Revision Details	By	Date	Suffix
	Check		

Purpose of issue

FOR INFORMATION

Client

ESCP

Project Title

LANGSTONE FCERM SCHEME

Drawing Title

INDICATIVE OPTION DRAWINGS FOR SHORT LIST

1 IN 75 YEAR SOP

Designed	Drawn	Checked	Approved	Date
BO/GB	BO	-	-	28/08/2018

AECOM Internal Project No.	Subsidiary
60578525	S2
Scale @ A1	Zone
1:50	-

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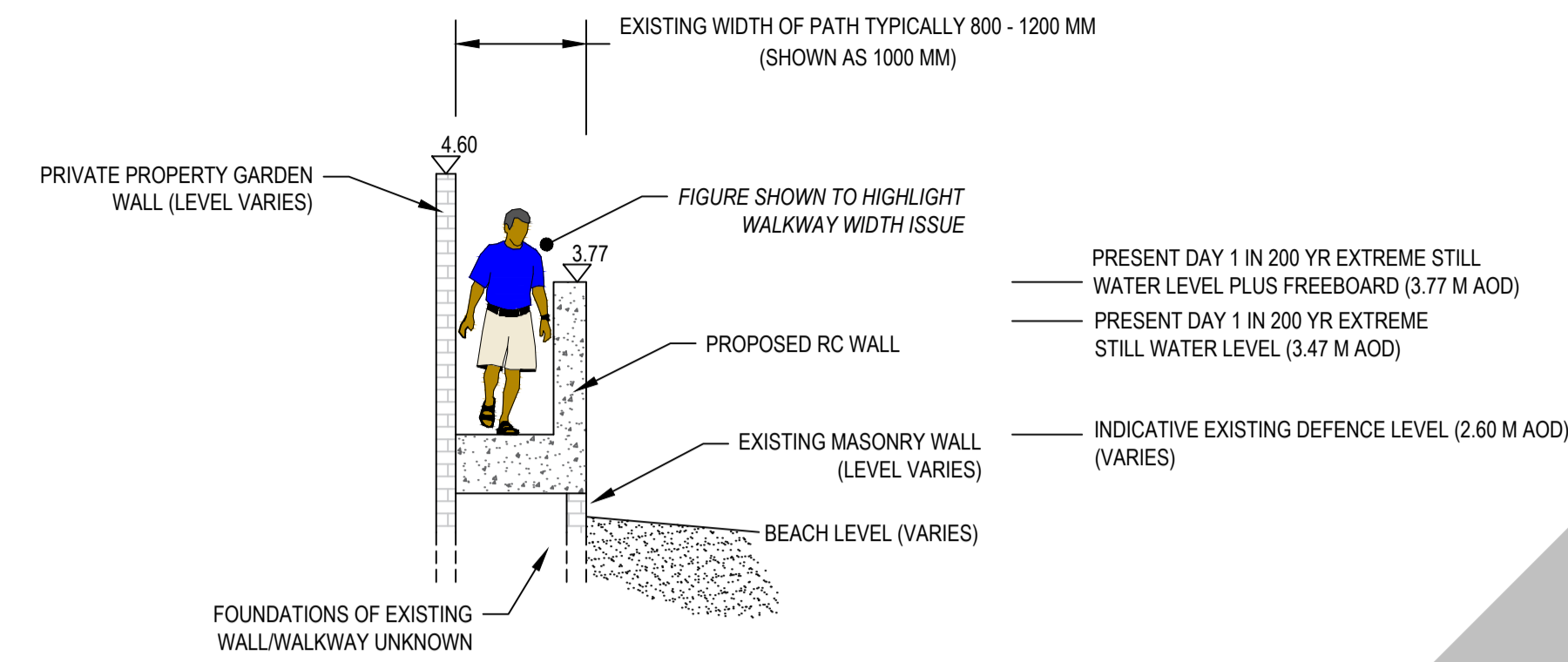
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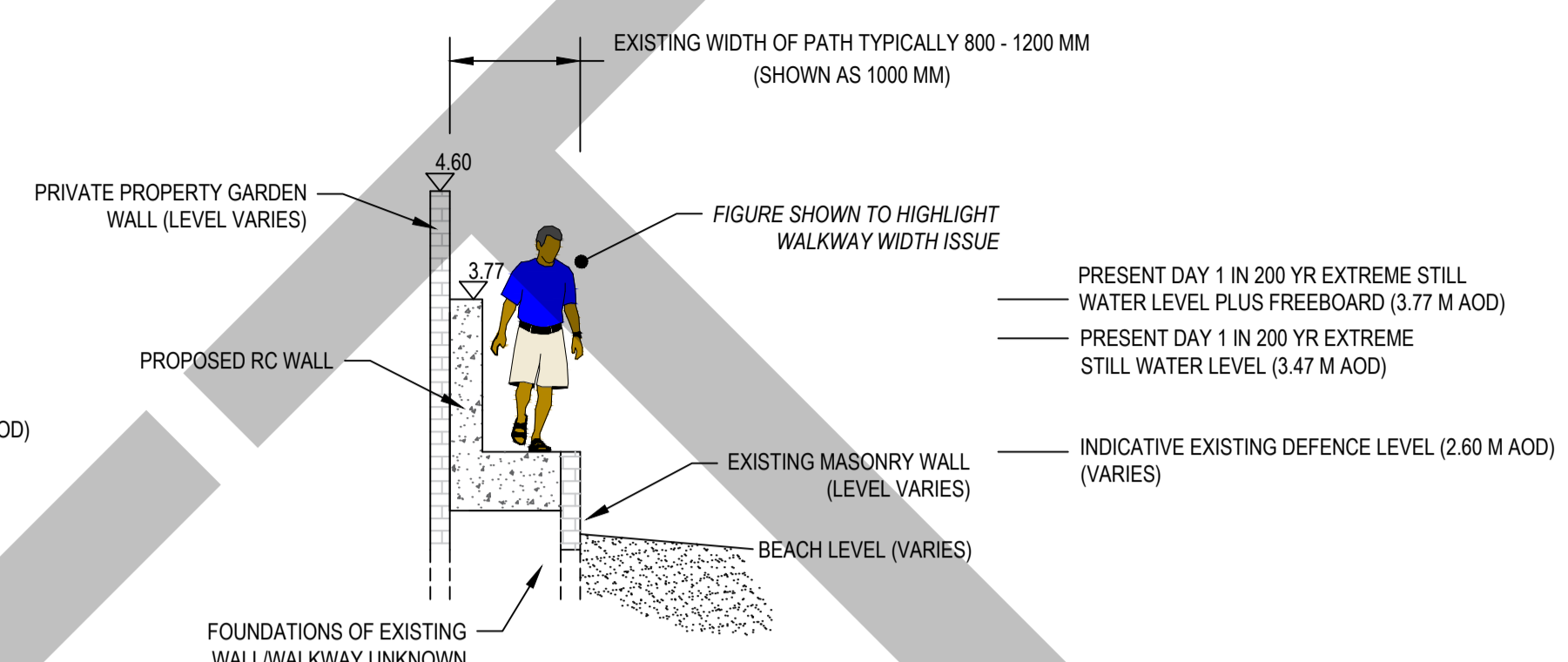
Drawing Number	Rev
LNST-ACM-XX-XX-DR-CE-0001	P1



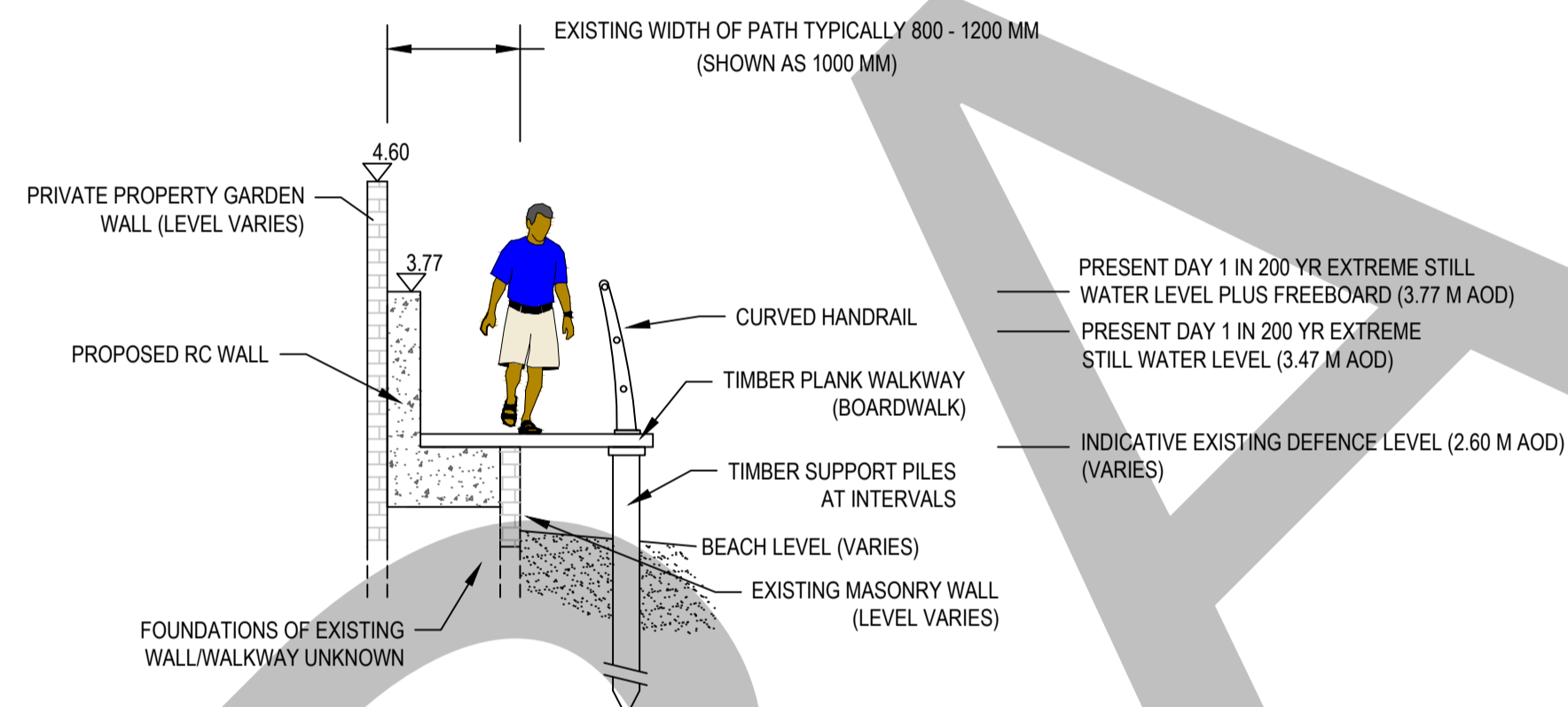
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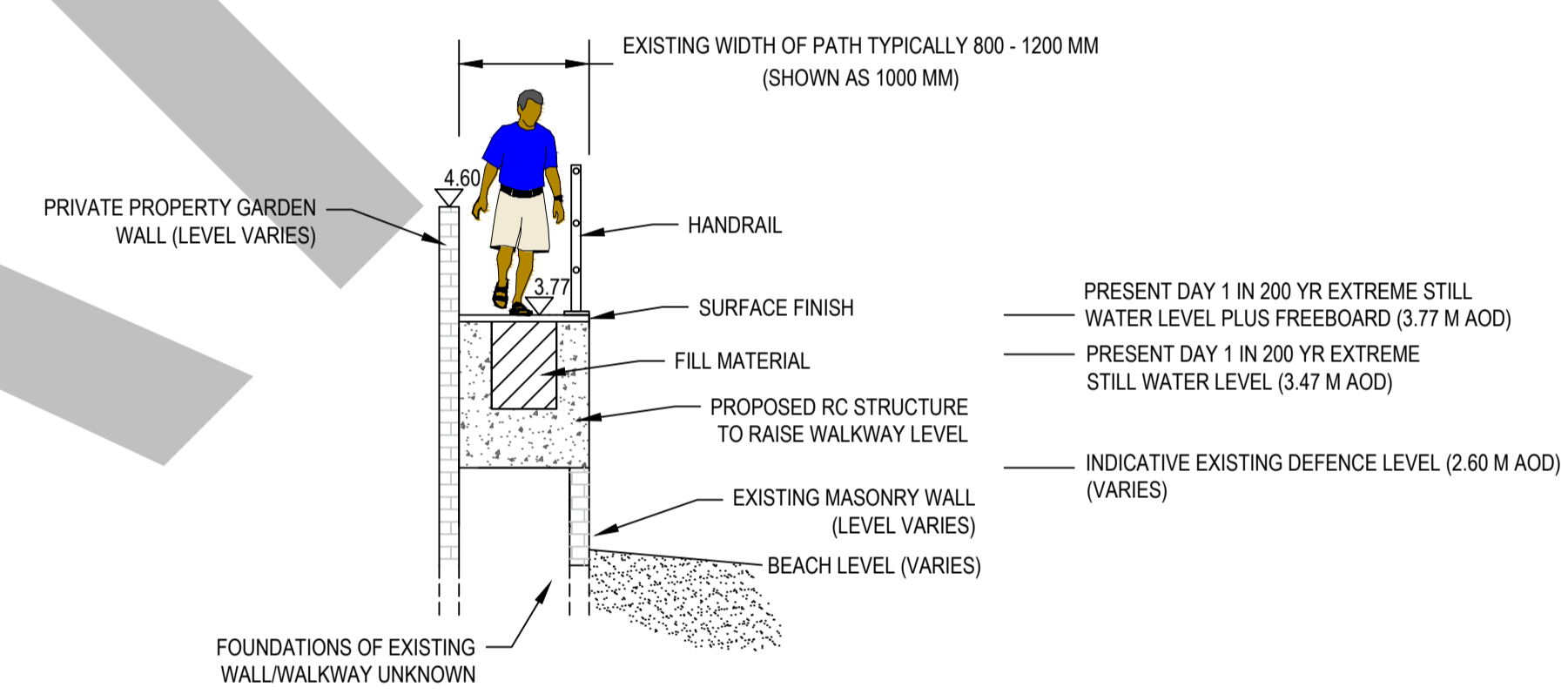
CROSS SECTION A - PROPOSED WALKWAY OPTION 1
FLOOD WALL ON OUTSIDE OF WALKWAY (1:50)



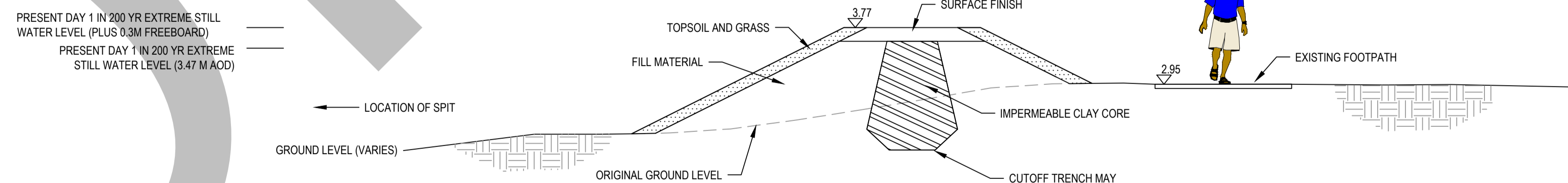
CROSS SECTION A - PROPOSED WALKWAY OPTION 2
FLOOD WALL ON INSIDE OF WALKWAY (1:50)



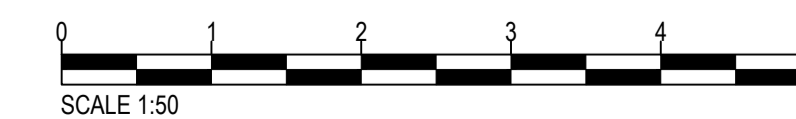
CROSS SECTION A - PROPOSED WALKWAY OPTION 3
FLOOD WALL ON INSIDE OF WALKWAY & INCREASE
WALKWAY WIDTH (1:50)



CROSS SECTION A - PROPOSED WALKWAY OPTION 4
RAISE HEIGHT OF WHOLE WALKWAY (1:50)



CROSS SECTION B - PROPOSED FLOOD EMBANKMENT OPTION
(1:50)



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INDICATIVE OPTION DRAWINGS FOR SHORT LIST	BO	28/08/18	P1
Revision Details	By	Date	Suffix
	Check		

Purpose of issue
FOR INFORMATION

Client
ESCP

Project Title
LANGSTONE FCERM SCHEME

Drawing Title
**INDICATIVE OPTION DRAWINGS FOR SHORT LIST
1 IN 200 YEAR SOP**

Designed BO/GB	Drawn BO	Checked -	Approved -	Date 28/08/2018
AECOM Internal Project No. 60578525			Subsidiary S2	
Scale @ A1 1:50		Zone -		

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Rev
P1

12. Appendix C: Environmental Objectives

Langstone FCERM – Ecology, Landscape and Heritage Objectives

This technical note has been prepared to set out the agreed ecological, landscape and heritage objectives of the Langstone FCERM. Where relevant, this note sets out sub-objectives for each ODU to provide further criteria to consider during the option selection process.

Ecology

The overarching ecological objectives of the Langstone FCERM are:

- Ensure the Conservation Objectives of the European designated sites are not compromised and integrity of the site is not adversely affected; and
- To maintain and where possible enhance and restore biodiversity resulting in an overall biodiversity net gain.

A series of sub-objectives have also been established:

- To be compliant with the habitat regulations; there should be no satisfactory alternative that is economically and technically feasible which is less damaging for habitats;
- Ensure the scheme does not have an adverse effect on SSSI's;
- Where possible including planting, landscaping and other enhancements that will promote biodiversity; and
- Where possible the Option designed will be the 'least damaging' to biodiversity.

Landscape

The overarching landscape objectives of the Langston FCERM are:

- Ensure the scheme preserves and, where possible, seeks to enhance the landscape character of the waterfront;
- Ensure existing trees and vegetation are retained and where this is not possible ensure they are suitably replaced;
- Seek to enhance the existing public open space, wherever possible;
- Maintain existing levels of access to the foreshore; and
- Conserve and where possible enhance the natural beauty and special qualities of the Chichester Harbour AONB.

Heritage

The overarching heritage objectives of the Langston FCERM are:

- Preserve and enhance the character and appearance of the Langstone, Wade Court and Mill Lane Conservation Areas;
- Preserve and where possible enhance the listed and locally listed buildings and their setting;
- Take necessary measures to protect the heritage assets in the area from flooding while preserving their character and appearance including their setting;
- Preserve key views from the conservation areas towards the coast, wetland and harbour but also key views towards the conservation areas;
- Trees and hedges contribute to the rural character of the area and make a positive contribution and they should be retained; and
- Avoiding and minimising impacts on below ground archaeological remains

Unit Specific Objectives

Option Development Unit 1

The following sub-objectives have been set for ODU 1:

- Retain trees and other vegetation as far as possible;
- Preserve and where possible enhance the character and appearance of the Mill Lane Conservation Area including its setting;
- Preserve the open nature of the foreshore area, defined by gardens and fields;
- Preserve the appearance of the Mill Lane Conservation Area as viewed from Langstone Harbour;
- If possible reinforce the historical association of the Mill Lane Conservation Area to Langstone Village; and
- Hedgerows and trees within Mill Lane Conservation Area make a major contribution to the rural character of the area and they should be retained.

Option Development Unit 2

The following sub-objectives have been set for ODU 2:

- Retain trees and other vegetation as far as possible; and
- Any intervention within this unit should respect the character and appearance of the surrounding conservation areas.

Option Development Unit 3

The following sub-objectives have been set for ODU 3:

- Use high quality sympathetic materials to finish the flood defences to ensure they integrate with the environment and don't appear to be a 'bolt-on' to the public realm;
- Respect the individual character of different sections of the waterfront (e.g. Ship Inn to Royal Oak, and Royal Oak to Mill) and seek to strengthen these individual character areas through high quality design and detailing using sympathetic materials;
- Provide a cohesive design strategy that has a co-ordinated approach to detailing of benches and other street furniture;
- Retain barrier free movement between the pedestrian causeway and the foreshore as far as possible, where barriers are essential these should be as subtle and short (in length) as possible and integrate with the public realm;
- Maintain or enhance the public open space at the Ship Inn waterfront and at the existing picnic location between the Ship Inn and the Royal Oak, whilst respecting the existing historic fabric of the waterfront;
- Improve interaction and interpretation along the waterfront to describe the heritage and ecology of the landscape, for example this could be through increasing the number and type of interpretation boards and supplementing this with interactive features such as free-to-use seafront monocular telescopes to identify bird life;
- The special interest of the conservation areas and statutorily listed buildings, including setting, should be preserved and where possible enhanced;
- Preserve and where possible enhance the distinctive character and appearance of the Langstone Conservation Area;
- The unique coastal setting, wetlands and harbour, part of which lies within the conservation area, have national and international significance for their environmental and nature conservation interest. Any intervention within the area should respect this unique setting;
- Views in and out across the harbour are consequently an integral and important element of the character of Langstone. These views should be preserved;
- The relationship of the conservation area with the harbour including the different state of the tide, with large tracts of inter-tidal land being exposed at low water creates a sense of space and is key in the character and appearance of the conservation area. This relationship should be preserved and where possible reinforced;

- Views from Langstone Bridge or Hayling Island towards Langstone are key and should be preserved;
- Trees form an important backdrop and an essential element of the setting of the conservation area and should be retained;
- The surface of the car park could benefit from sympathetic resurfacing;
- Street lighting within the area of historic character and appearance should be retained; and
- There are opportunities for enhancing the seating and generally street furniture around the harbour.

Option Development Unit 4

The following sub-objectives have been set for ODU 4:

- Provide a cohesive design strategy that has a co-ordinated approach to detailing of benches and other street furniture;
- Retain barrier free movement between the pedestrian causeway and the foreshore as far as possible, where barriers are essential these should be as subtle and short (in length) as possible and integrate with the public realm;
- Preserve and enhance the character and appearance of the Wade Court Conservation Area;
- Preserve and where possible enhance the special interest, including setting, of the statutorily listed buildings within the area; and
- Any intervention should respect the setting of the Wade Court and Langstone Conservation Areas.