

6 Option Risks

Risks associated with the options described in Section 3 have been identified for the planning and design, construction, and operation and maintenance phases of the harbour's life cycle. Mitigation measures for the risks have also been identified for each option, together with the organisation best-placed to manage each risk.

The probability and consequence for each risk has been qualitatively assessed for each option on a scale of nil, low, medium and high. The consequence of each risk has also been identified in terms of whether it impacts on time (e.g. the completion date for construction), cost or quality (e.g. reduced technical quality, adverse environmental impacts, potential injury to the construction staff, harbour users etc).

The result of the risk assessment process is shown in Table 6.1. To assist in interpreting the relative risk profiles of the options, the table has been colour coded, with green representing nil probability or nil consequence, graduating through to red for high probability or high consequence.

As noted in Section 2, the risk of actual sea level rise in the future differing significantly from present predictions is explicitly assessed as an operational risk. The offshore breakwater and maintain and repair options are more susceptible to this risk, suffering a moderate cost consequence. The managed retreat and maintain and repair until failure options have a lower exposure to this risk, experiencing low (minor) time consequences because, should the risk eventuate, it would result in an accelerated programme for removing the harbour structures.

It can be seen that the breakwater option is associated with the highest risk profile, with the other options having similar, moderate to low risk profiles. The major construction, involving application of known engineering principles in a challenging environment, is the primary reason for higher risk profile for the offshore breakwater option. The maintain and repair option, continuing existing practice and therefore with fewer unknowns, is the lowest risk option. The options involving managed retreat (managed retreat and maintain and repair until failure), which include decommissioning activities that have been carried out only in a limited context to date, score between the other options. However, it is notable that the maintain and repair until failure option does have greater flexibility than the other options to accommodate future changes in environment, funding, and public perception.

Table 6.1: Risk assessment

Risk	Risk Manager	Offshore breakwater option			Repair and maintain option			Managed retreat option			Repair and maintain until failure		
		Mitigation Measures	Mitigated Probability	Mitigated Consequence	Mitigation Measures	Mitigated Probability	Mitigated Consequence	Mitigation Measures	Mitigated Probability	Mitigated Consequence	Mitigation Measures	Mitigated Probability	Mitigated Consequence
Planning and Design													
Local community do not accept option	NT	-public involvement in study -clear communication of issues, options, reasons for option selection	L	H (Time, Quality – may prevent option proceeding, impair NT’s image, slow option implement’n significantly)	-public involvement in study -clear communication of issues, options, reasons for option selection	Nil	H (Time, Quality – may prevent option proceeding, impair NT’s image, slow option implement’n significantly)	-public involvement in study -clear communication of issues, options, reasons for option selection	M/H	H (Time, Quality – may prevent option proceeding, impair NT’s image, slow option implement’n significantly)	-public involvement in study -clear communication of issues, options, reasons for option selection	M	H (Time, Quality – may prevent option proceeding, impair NT’s image, slow option implement’n significantly)
Statutory approvals not given	NT	-undertake early and thorough consultation with stakeholders (undertaken for this study) -identify all necessary approvals (process commenced in this study) -early discussion with stat auth. & landowners regarding approvals for selected options(s) (EN, EH, C Agency, C Est, D Cornwall) -address stat auth & landowner concerns in planning & prelim design prior to submission of request for approval -do not proceed with contract documentation until approvals given.	M/H	H (Time, Quality – may prevent option proceeding or slow its implement’n significantly)	-early discussion with stat auth. (C Est, D Cornwall approvals unlikely to be reqd; EN, EH, C Est)	L	M (Time, Quality – may prevent option proceeding or slow its implement’n)	-early discussion with stat auth. (C Est, D Cornwall approvals unlikely to be reqd; EN, EH, C Est)	L	H (Quality, Cost – may prevent option proceeding or slow its implement’n significantly)	-early discussion with stat auth. (C Est, D Cornwall approvals unlikely to be reqd; EN, EH, C Est)	L	M/H (Quality, Cost – may prevent second phase of option (managed retreat) proceeding or slow its implement’n significantly)
Design error	Designer	-use designer with experience in offshore breakwaters -peer review of design	L	M (Time, Cost, Quality)	-‘reality check’ against maintenance and repair history for Mullion harbour and for other similar harbours -monitor structural condition and reassess planned works if necessary	L	M (Time, Cost, Quality)	-‘reality check’ against damage history for Mullion harbour and for other similar harbours -monitor structural condition and reassess timeframe for retreat if necessary	L	L (Time – harbour takes longer than expected to deteriorate)	-‘reality check’ against damage history for Mullion harbour and for other similar harbours -monitor structural condition and reassess timeframe for retreat if necessary	L	L (Time – managed retreat phase starts earlier than anticipated/ harbour takes longer than expected to deteriorate)
Inaccurate costs	Designer	-include contingency to cover for assumptions, unknowns -incorporate cost data from similar projects, where appropriate -use cost consultant (quantity surveyor) to confirm costs at detailed	L	M (Cost)	-include contingency to cover for assumptions, unknowns -incorporate cost data from similar projects, where appropriate	L	M (Cost)	-include contingency to cover for assumptions, unknowns -incorporate cost data from similar projects, where appropriate	L	M (Cost)	-include contingency to cover for assumptions, unknowns -incorporate cost data from similar projects, where appropriate	L	M (Cost)

Risk	Risk Manager	Offshore breakwater option			Repair and maintain option			Managed retreat option			Repair and maintain until failure		
		Mitigation Measures	Mitigated Probability	Mitigated Consequence	Mitigation Measures	Mitigated Probability	Mitigated Consequence	Mitigation Measures	Mitigated Probability	Mitigated Consequence	Mitigation Measures	Mitigated Probability	Mitigated Consequence
		design stage -involve contractor in costing process at detailed design stage											
Construction													
Adverse impacts on ecology	Contractor	-consider and address as far as practicable ecological effects during planning & design -identify specific mitigation measures in EIA -include Contractor-led mitigation measures as in contract -implement mitigation measures and use best practice to avoid adverse impacts during construction -monitor ecological impacts during construction, address impacts identified by monitoring where practicable	L	M (Quality, Cost, Time)	-consider and address as far as practicable ecological effects during planning & design -identify specific mitigation measures and include these and Contractor-led mitigation measures in contract -implement mitigation measures and use best practice to avoid adverse impacts during construction	L	M(Quality, Cost, Time)	-consider and address as far as practicable ecological effects during planning & design -identify specific mitigation measures and include these and Contractor-led mitigation measures in contract -implement mitigation measures and use best practice to avoid adverse impacts during construction	L	M(Quality, Cost, Time)	-consider and address as far as practicable ecological effects during planning & design -identify specific mitigation measures and include these and Contractor-led mitigation measures in contract -implement mitigation measures and use best practice to avoid adverse impacts during construction	L	M(Quality, Cost, Time)
Adverse navigation/boat launching impacts including marine accidents	NT/ Contractor	-prior to contract start, advise fishermen/boat users of construction works incl marine plant locations and access routes and programme -liaise with fishermen/boat users during construction and advise of changes to work plans and programme.	L	M (Quality – impair NT’s relationship with local fishermen/boat users, marine accident)	-prior to contract start, advise fishermen/boat users of construction works incl marine plant locations and access routes and programme -liaise with fishermen/boat users during construction and advise of changes to work plans and programme.	L	L (Quality – impair NT’s relationship with local fishermen/boat users, marine accident)	-prior to contract start, advise fishermen/boat users of construction works incl marine plant locations and access routes and programme -liaise with fishermen/boat users during construction and advise of changes to work plans and programme.	L	L (Quality – impair NT’s relationship with local fishermen/boat users, marine accident)	-prior to contract start, advise fishermen/boat users of construction works incl marine plant locations and access routes and programme -liaise with fishermen/boat users during construction and advise of changes to work plans and programme.	L	L (Quality – impair NT’s relationship with local fishermen/boat users, marine accident)
Adverse impacts on tourists/tourist-dependent commerce	NT	-liaise with local community and wider community (via internet) regarding planned works. -prepare information board at Mullion Harbour	L	M (Quality – impair NT’s relationship with local/wider community)	-liaise with local community and wider community (via internet) regarding planned works. -prepare information	L	M (Quality – impair NT’s relationship with local/wider community)	-liaise with local community and wider community (via internet) regarding planned works. -prepare information	L	M (Quality – impair NT’s relationship with local/wider community)	-liaise with local community and wider community (via internet) regarding planned works. -prepare information	L	M (Quality – impair NT’s relationship with local/wider community)

Risk	Risk Manager	Offshore breakwater option			Repair and maintain option			Managed retreat option			Repair and maintain until failure		
		Mitigation Measures	Mitigated Probability	Mitigated Consequence	Mitigation Measures	Mitigated Probability	Mitigated Consequence	Mitigation Measures	Mitigated Probability	Mitigated Consequence	Mitigation Measures	Mitigated Probability	Mitigated Consequence
		to explain planned works and need for them – it is anticipated that adverse impacts offset by increased public understanding of need for works.			board at Mullion Harbour to explain planned works and need for them – it is anticipated that adverse impacts offset by increased public understanding of need for works.			board at Mullion Harbour to explain planned works and need for them – it is anticipated that adverse impacts offset by increased public understanding of need for works.			board at Mullion Harbour to explain planned works and need for them – it is anticipated that adverse impacts offset by increased public understanding of need for works.		
Poor weather /wave conditions hampers construction	NT	-programme works for non-winter period when weather /wave conditions better -use jack-up marine plant rather than floating plant where practicable to reduce weather downtime.	M	M (Cost, Time)	-programme works for non-winter period when weather /wave conditions better	L	M (Cost, Time)	-programme works for non-winter period when weather /wave conditions better	L	M (Cost, Time)	-programme works for non-winter period when weather /wave conditions better	L	M (Cost, Time)
Unforeseen ground conditions	NT	-undertake comprehensive desk study of available data (undertaken for this study) -engage qualified specialist for ground investigations -undertake ground investigations at breakwater location during planning stage.	L	H (Cost, Time, Quality)	-undertake comprehensive desk study of available data (undertaken for this study)	L	M (Cost, Time, Quality)	-undertake comprehensive desk study of available data (undertaken for this study)	L	M (Cost, Time, Quality)	-undertake comprehensive desk study of available data (undertaken for this study)	L	M (Cost, Time, Quality)
Unforeseen structural conditions (existing harbour structures)	NT	N/A	Nil	Nil	-review history of structure construction, damage and repair (undertaken for this study). -investigate condition of harbour structures (undertaken for this study)	L	M (Time, Cost, Quality)	-review history of structure construction, damage and repair (undertaken for this study). -investigate condition of harbour structures (undertaken for this study)	L	L (Time, Cost)	-review history of structure construction, damage and repair (undertaken for this study). -investigate condition of harbour structures (undertaken for this study)	L	L (Time, Cost)
Injury to work force	Designer/ Contractor	-follow requirements of CDM regulations -programme works for non-winter period when weather /wave conditions better	L	H (Quality)	-follow requirements of CDM regulations -programme works for non-winter period when weather /wave conditions better	L	M (Quality)	-follow requirements of CDM regulations -programme works for non-winter period when weather /wave conditions better	L	H (Quality)	-follow requirements of CDM regulations -programme works for non-winter period when weather /wave conditions better	L	H (Quality)

Risk	Risk Manager	Offshore breakwater option			Repair and maintain option			Managed retreat option			Repair and maintain until failure		
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Damage to existing harbour/ new structures during a storm, directly related to incomplete construction	NT	-programme works for non-winter period when weather /wave conditions better	L	H	-programme works for non-winter period when weather /wave conditions better	L	M (Time, Cost)		Nil	Nil	-programme works for non-winter period when weather /wave conditions better	L	L (Time, Cost)
Operation and Maintenance													
Sea level rise/ storminess significantly greater than standard predictions	NT	-undertake probability-based detailed design to take into account range of predictions for climate change -monitor and review loading conditions regularly (e.g. 5-yearly) in relation to design, identify shortfalls and address as far as practicable	L	M (Cost)	-monitor and review loading conditions regularly (e.g. 5-yearly) in relation to design, identify shortfalls and address as far as practicable	L	M (Cost)	-monitor and review conditions regularly (e.g. 5-yearly) in relation to design, identify shortfalls and address as far as practicable	L	L (Time)	-monitor and review conditions regularly (e.g. 5-yearly) in relation to design, identify shortfalls and address as far as practicable	L	L (Time)
Adverse impacts on ecology	NT	-consider and address as far as practicable ecological effects during planning & design -monitor ecological impacts for first 5-10 of operation, address impacts identified by monitoring where practicable	L	L (Quality)	-consider and address as far as practicable ecological effects during planning & design	L	L (Quality)	-consider and address as far as practicable ecological effects during planning & design	L	L (Quality)	-consider and address as far as practicable ecological effects during planning & design	L	L (Quality)
Adverse navigation/boat launching impacts including marine accidents	NT	-mark offshore breakwater using beacons	L	H (Quality)	-continue to mark harbour as at present	L	M (Quality)	-continue to mark deteriorating harbour as at present -make safe deteriorating harbour	L	M (Quality)	-continue to mark harbour/deteriorating harbour as at present -make safe deteriorating harbour	L	M (Quality)