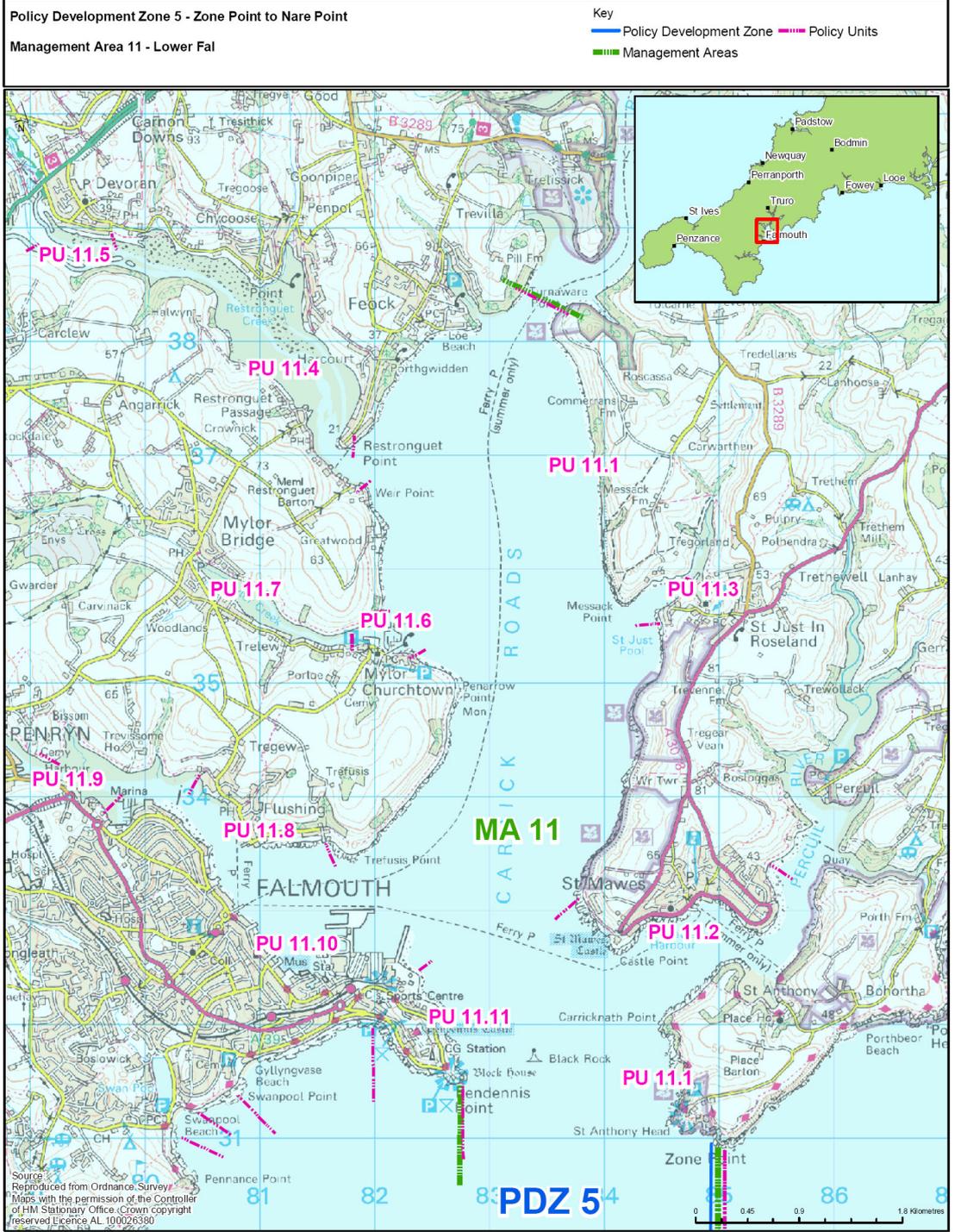


Location reference: Lower Fal
Management Area reference: MA11
Policy Development Zone: PDZ5



Cornwall & Isles of Scilly Shoreline Management Plan Review	

DISCUSSION AND DETAILED POLICY DEVELOPMENT

The preferred plan for the Lower Fal aims to balance the provision of support to the core settlements of Falmouth, Penryn, St Mawes, St Just, Flushing, Restronguet and Mylor (in line with the high-level SMP objectives) with a management approach which does not adversely impact on the undeveloped parts of the lower estuary and importantly takes account of any potential impacts on the Fal & Helford SAC. It is important to note that there is a legal requirement to not adversely affect the integrity of the SAC; through impacts such as the loss of intertidal feeding areas by not allowing the high water mark to move inland due to climate change.

This, of course, requires a number of different policy options to be employed at different locations. From a high level view-point, it can be seen that across the whole Management Area (and indeed across the entire estuary system) there will be a trend toward a reduction in intertidal area due to sea level rise. Wherever the landward movement of MHWs is constrained by the rising topography or defences, reduction in intertidal area may occur. It is likely that a net overall reduction in intertidal area may occur toward the latter part of the SMP timeframe when considering sea level rise in isolation. However the picture is actually much more complex than this – erosion, accretion, sedimentation, changes in the tidal prism, increases in rainfall and fluvial flow will also affect the current pattern of intertidal exposure.

An overall net reduction of intertidal area is indicated where the position of mean low water moves out from the centre channel towards the banks. Where the high water position is constrained, intertidal area is reduced. Where it can move, intertidal area tends to be maintained.

However importantly, this is only one aspect of geomorphic evolution due to climate change. Another very important factor which will also dictate future geomorphology of the estuary is sedimentation (both erosion and accretion). Sea level rise will lead to increased volumes of water entering the estuary system during the flood tide and this may well increase tidal flow velocities, therefore increasing erosion within the channels and on the flats. It could however promote accretion in some areas. This will result in changed patterns of deposition, possibly depositing more material in the lower estuary and scouring channels in the upper estuary. However increasing rainfall due to climate change will increase fluvial flows coming into the estuary - and subsequently will increase the sediment load carried with them from further inland. Increased deposition due to higher fluvial flows could therefore increase sedimentation in any of the estuary channels to an extent that intertidal exposure is actually increased. Of course increased fluvial flows could also result in periodic erosion of the upper channels as well.

Ultimately the conclusion to be drawn is that the estuary is a finely balanced system and any one of these factors may become the dominant factor under a number of different climate change scenarios. For instance if sea level rise is slower than currently predicted but increasing rainfall exceeds current expectations, increased sedimentation throughout the estuary may more than balance the effects of sea level rise, leading to increased intertidal area exposure. In support of this scenario is the conclusion (presented in Appendix C) that disequilibrium has been noted for the estuary length/tidal wave length, indicating that the estuary is relatively deep throughout the

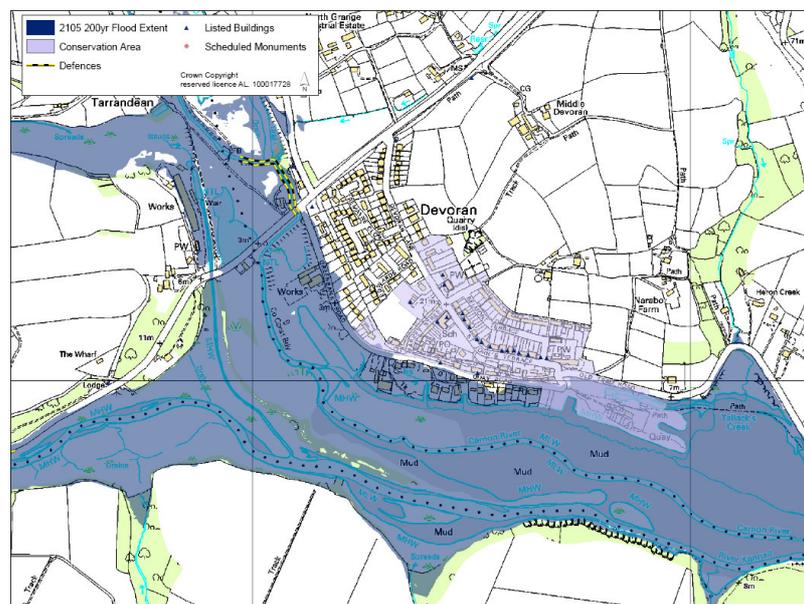
Carrick Roads and that there is potential for large amounts of accretion throughout the SMP2 study area. Anecdotal evidence supports this view in certain areas of the estuary, for instance at Town Quay (Truro) regular dredging of the channel and banks is undertaken in order to keep the quay area navigable for watercraft. At St Just-in-Roseland on-going siltation of the St Just Creek and its banks is reported.

The main issue for the SMP is that it is fairly simple to simulate changes in MLWS and MHS position within the estuary based on current channel morphology. It is however extremely difficult (and beyond the scope of the SMP), to simulate changes in the erosional and accretional patterns due to both increases in tidal prism and increased fluvial flow and sediment availability, based on future predictions of climate change. A very detailed numerical modelling exercise may be able to provide some indication of likely changes but in reality there are so many variables that even this could never be more than vaguely indicative for time periods beyond 20 years or so.

Of course working on a worst case scenario that losses will occur in at least part of the estuary, the SMP needs to think about mitigation of those losses. At least some of this intertidal reduction in the current channels can be offset by identifying those areas suitable for either a managed realignment of existing defences or banks or an accepted regular tidal inundation where low levels in the immediate hinterland would naturally allow this to happen.

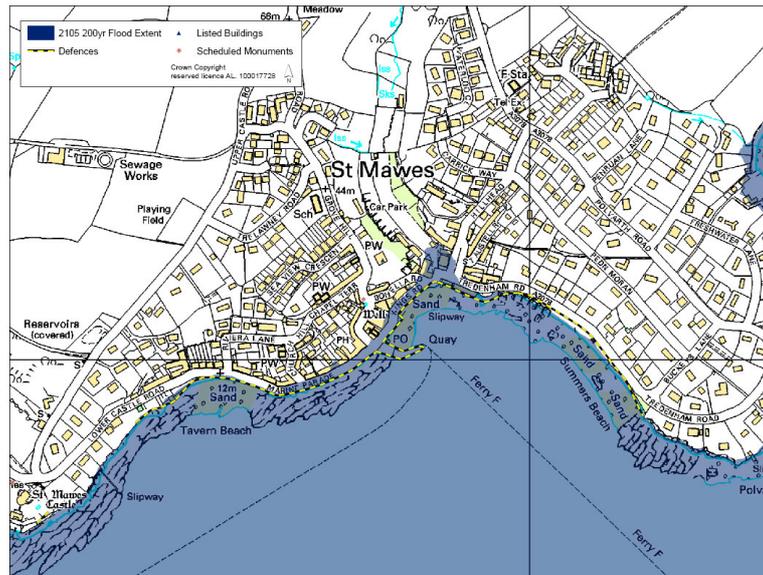
To meet the wider objectives of the Fal and Helford SAC, No Active Intervention along the undefended estuary banks should be satisfactory. This would not preclude the privately funded maintenance of privately owned quays along the main estuary and its tributaries. As indicated above, where the topography dictates, some squeeze between the MLW and MHW positions would be expected resulting in some potential loss of intertidal area, however the accretion potential within the lower estuary system may offset this. The majority of the open Carrick Roads system actually has very little intertidal area – most of the intertidal area is contained within the Restronguet Creek and upper reaches of the Percuil River system (virtually all above Percuil).

It is anticipated that under NAI any loss of intertidal area would be due to natural processes. This may occur at any location where natural topography and geology prevents the inland migration of the shoreline. Some opportunity for realignment to create intertidal habitat may occur around the right hand bank at Devoran (see inset map).



At **St Mawes**, holding the line along the Council maintained defended sections would limit flood risk along Tredanham Road and Marine Parade and allow private maintenance of the harbour breakwater and walls. Although sea level rise will increase pressure on the frontage, its sheltered nature and limited exposure to wave energy means that technically holding the line should be sustainable at least in the medium term. The predominantly rocky nature of the frontage means that the erosion risk is minimal.

The possible alternative to HTL would be managed realignment but there is little room to do so without considerable damage and losses within the St Mawes Conservation Area. The limited pressure on the frontage would not appear to warrant public expenditure on MR strategy studies and costly set back of defences when existing defences could be maintained. NAI is not deemed suitable along the currently defended frontage as this would effectively mean abandonment of the frontline structures which would oppose several of the high level SMP objectives.



Holding the existing defended frontage line at **St Just-in-Roseland** (including maintenance of the frontage - subject to availability of funding) to ensure continued operation of the commercial and leisure boating facilities and to provide protection to historic assets is the preferred plan. The steep sided nature of the inlet dictates that sea level rise in itself does not indicate that the present shoreline position is unsustainable. Localised management of the Bar and adjacent frontage sections would not have impacts on coastal processes along adjacent estuary sections. This approach would be effectively to continue the With Present Management scenario. Implications for the Fal & Helford SAC are considered to be very limited under this management approach – indeed it is likely that the presence of the Bar plays a role in maintaining the sediment levels directly to the south-east of it and therefore is an important part of the current natural system which has been designated.

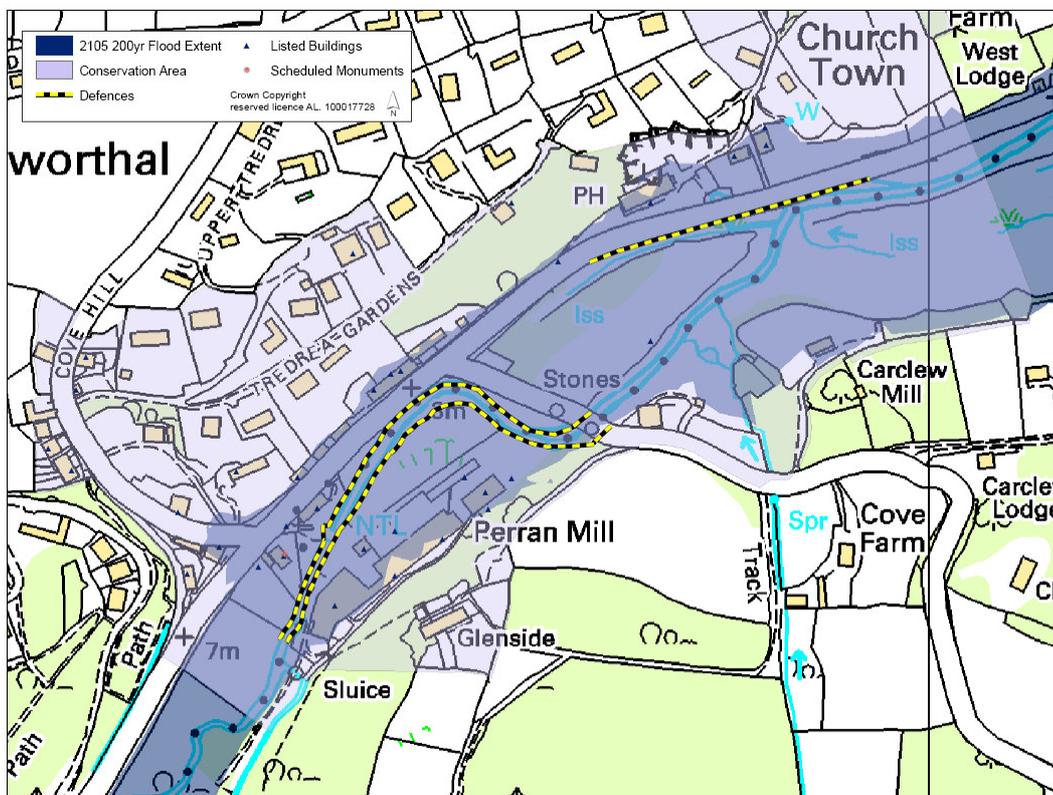


At **Restronguet** some increasing flood risk is expected to develop in line with sea level rise. Existing defences would not prevent flooding from extreme events but may limit the impact. Although NAI is preferred at Restronguet, in line with the rest of the Restronguet Creek, this should not preclude the localised maintenance and upkeep of the low masonry walls and slipway structures which enable the

community to sustain the leisure craft access which has such important socio-economic benefits. This would result in some extremely localised and small scale constraint of the shoreline and intertidal zone. A fully-supported hold the line approach would be very unlikely to be forthcoming under future funding streams and local adaptation of the frontage will be able to occur gradually under the NAI approach, without requirement for full managed realignment strategy, given the limited assets at increasing risk.

Future flood risks at **Devoran** appear to mostly affect Greenbank Road and Quay Road along with 20+ residential properties and commercial assets. The preferred plan would be to develop and introduce a process of managed realignment on both banks of the Creek – on the Devoran village side (left bank) MR would assist in managing the flood risks, while on the right bank MR could provide some additional flood storage capacity and potentially contribute to compensatory intertidal habitat targets. More detailed assessment of future risk will be required by any scheme. As well as structural responses this, should also consider appropriate future flood warning services and improvements to the resilience of estuary-side community. Community adaptation should be supported by the Land Use Planning system and considered as part of any Community Strategy.

Perranarworthal and a number of listed buildings within its Conservation Area (including the Perran Foundry complex) are indicated by the mapping to be increasingly at risk during a 1:200 year tidal flood event (see inset map, below showing extent of risk in 2105). Whilst there is a current planning permission for development at Perran Foundry, no works have been carried out and the SMP has assumed that this is not being progressed.

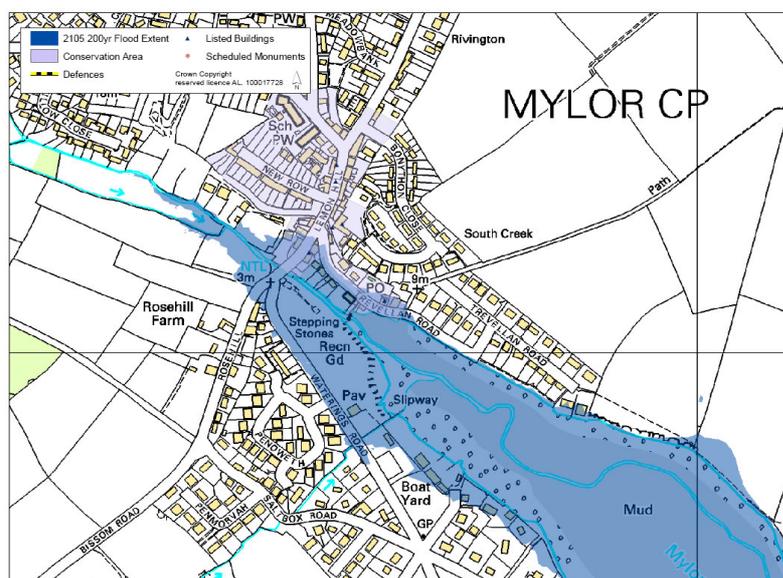


Although the channel is small this far up the Restronguet Creek, flooding across the A39 Truro to Falmouth trunk road, particularly in the vicinity of the Norway Inn, is quite frequent. The A39 effectively constrains the channel on the northern bank but the southern bank may provide some opportunity to allow realignment and some additional channel capacity to be created. This would have the dual benefit of reducing pressure on the northern bank and the A39 at the same time as potentially creating compensatory intertidal habitat. An overall managed realignment strategy at Perranarworthal would probably require maintenance of at least some of the existing structures and retaining walls alongside the A39.

At **Mylor Quay**, holding the existing defence line in the short term would enable the community to sustain the leisure craft access, retail outlets, eateries etc which has such important socio-economic benefits to the local area and linked communities. The flood risk increases into the future, and it is likely to be in the medium to longer term that some realignment (potentially privately funded) of the existing defence line would need be considered. There is very limited intertidal area of any type directly in front of the Mylor Quay defences and as such there is unlikely to be a significant loss of intertidal habitat due to a policy of hold the line in the short term. It may be that subsequent strategies would seek to reinforce a policy of managed realignment and that may be a suitable longer-term objective along this frontage in dealing with low level pressures. Existing quay structures may require some adjustment and there is room and scope for a controlled roll-back of the walled frontage to accommodated rising sea levels. Some aspects of the waterfront development such as floating berths and pontoons would be simple to re-locate and lend themselves to an adaptive MR policy. Land Use Planning, Transport Planning and any village strategy will need to support this policy through consideration of climate change adaptation. This should include improved resistance and resilience measures as well as potentially supporting roll back of property and infrastructure.

Increasing flood risk to local transport routes and a number of residential properties is indicated at **Mylor Bridge** by the assessment of future flood risks (see inset map). These increasing risks should be considered but the preferred method for addressing these would be through improvements to the flood warning services and improved resilience of the transport routes to the more frequent flooding which will occur as the epochs progress.

As this approach to managing the risks is unlikely to require technical intervention, the no active intervention policy is preferred. Managed realignment has been considered but the developed nature of the frontage and the manner in which the roads and properties are clustered does not really provide



scope for any aspect of realignment. It is also considered that the risk levels are unlikely to warrant the type of expenditure that would be necessary for MR. It is accepted that the policy would have a minor impact on the Mylor Bridge Conservation Area and on perhaps two listed buildings but the nature of the risk is low and transient. Land Use Planning, Transport Planning and any village strategy will need to support this policy through consideration of climate change adaptation. This should include improved resistance and resilience measures as well as potentially supporting roll back of property and infrastructure.



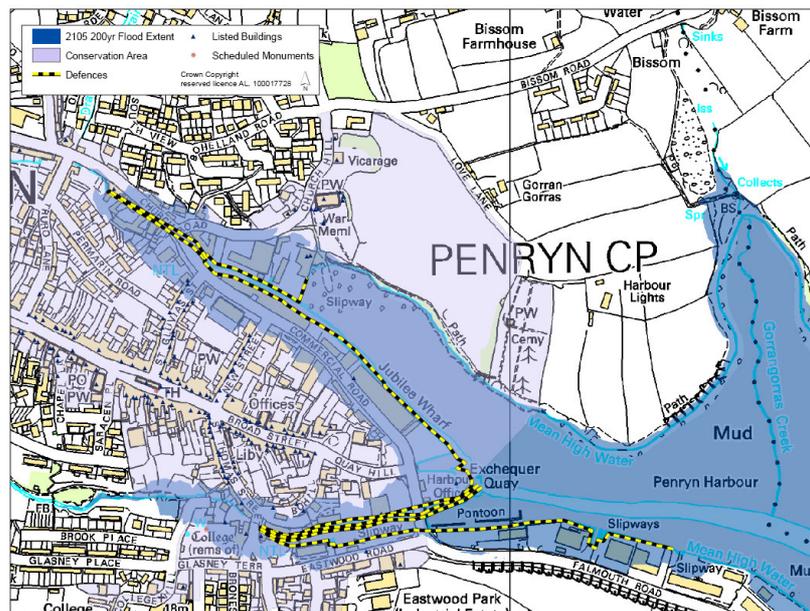
Flushing waterfront

Flushing - Flushing - Frequent flooding already occurs at Flushing, with in excess of 40 residential properties at risk, primarily within the Trefusis and Coventry Road areas. Some investment into improving defences and resilience of the community has occurred, although the defences still only provide a fairly low standard of defence. The preferred approach is to employ HTL in epoch 1, with localised MR as required, but to move toward a more comprehensive managed realignment

approach through epochs 2 and 3. With careful management, the current shoreline position is not seen as unsustainable in the short term. Realignment of the defence line would be necessary in the longer term if sea level rise maintains accelerated increase. Land Use Planning should support the adaptation of Flushing against rising sea levels, including roll back of property to facilitate any future Managed Realignment. This should also be considered in any village strategy.

Community involvement with any management approach is important at Flushing and this would include the design and appearance of any structural approach to MR and the implementation of flood resilience measures for the most vulnerable properties. Improvements to the flood warning system and the provision of community based warnings at Flushing would be beneficial.

At **Penryn** a large number of assets and important local transport links are potentially at risk under a no active intervention scenario (see inset map). Presently there is also significant risk during events in excess of a 1:10 year return period. Extreme water levels at Penryn can be elevated significantly above levels at Falmouth when combined with



strong easterly and south easterly winds. This wind set up has been measured as an additional 300mm at Penryn in comparison to water levels at Falmouth for the equivalent tide. Any development or scheme proposals should take this into account in any assessment of flood risk.

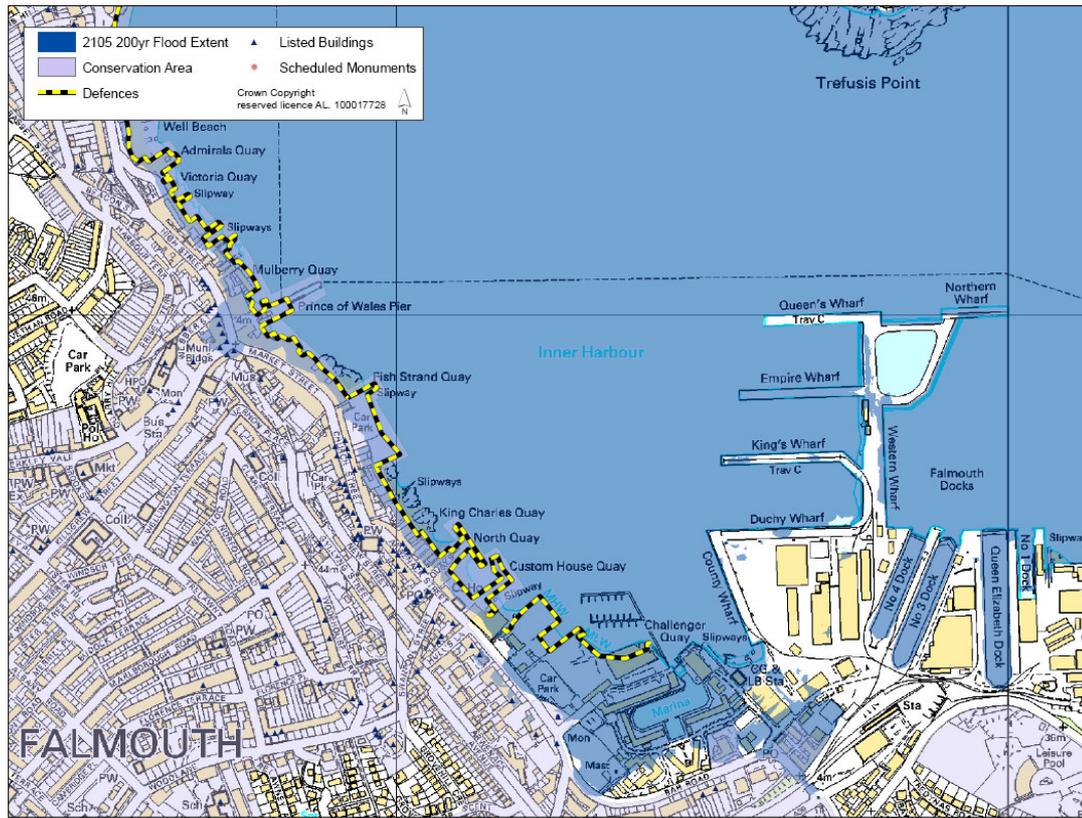
A large number of waterfront properties and the local access road are at currently at risk from tidal flooding. This risk is set to increase with rising sea levels. Currently the northern end of Commercial Road is at risk of flooding from the 10 year return period flood. Historically, development here has been either water compatible uses or uses that require a waterfront location. Land Use Planners should guide non-water compatible uses from out of the future high risk floodplain, and ensure appropriate resilience and resistance measures. Any future redevelopments should look to mitigate for coastal squeeze of the mudflat habitats linked to the downstream Fal and Helford SAC.

Transport Planners should consider options for improving the resilience of Commercial Road to flooding, which may require localised raising of ground levels over time. The preferred way forward is therefore to manage the risks through a policy of realignment and adaptation of the frontage. A proposed HTL / MR /MR approach will allow time for an initial assessment of how the risks can be accommodated through MR and how this can be delivered over the following epochs.

The preferred policy at **Falmouth** is to continue to hold the line along the entire frontage throughout the three epochs. This would include the defences to the east of the Eastern Breakwater (as far as Middle Point) protecting the sewage works and helicopter landing area. The core values and socio-economic integrity of the port of Falmouth would be protected under this policy. As with Penryn, it is likely that given the complex nature and geometry of the defended shoreline at Falmouth, sea level rise will pressurize different sections of the frontage in different ways.

Therefore under this policy there are likely to be local adjustments to the complex arrangement of wharves, quays, pontoons and walls in response to rising sea levels. Any such responses could be dealt with under a HTL policy as there is not seen to be significant scope spatially for any full scale realignment. Realignment would also result in significant impacts on the historic environment and large numbers of listed buildings and scheduled historic sites which are clustered on and around the harbour and quay areas. Any redevelopment should seek to increase resilience and or resistance to the increasing flood levels.

In reality Falmouth is under less pressure as a frontage than many other settlements within the area. With only limited flood risks anticipated (and generally confined to the wharves and working quay areas around Challenger Quay at the south-eastern end of the frontage – see inset map below) and no exposure to significant wave energy, maintaining the current shoreline defences and structures seems technically and economically sustainable, given the benefits gained from doing so. In environmental terms, there is unlikely to be any significant coastal squeeze affect on habitats, as there is virtually no intertidal zone fronting Falmouth, with just a small area of mud exposed along the North Parade section at low tide.



Pendennis - From Middle Point around Pendennis Point the erosion and flood risk mapping indicates little risk to the historical assets at Pendennis; however the condition of the shore placement gun batteries should be monitored in relation to the ongoing shoreline recession rates. The preferred approach along this frontage is non-interventional. Hold the line is considered to be an inappropriate approach for this frontage and there is no scope or requirement for managed realignment.

The economic assessment for Management Area 11 provides a narrowly positive benefit / cost ratio of 1.06. There is therefore high sensitivity to increasing or decreasing costs (see the Economic Summary Table below and Appendix H) associated with this frontage. It must also be seen within the context of a complex area with a number of long linear defences - this tends to push overall benefits down against the costs of maintaining these linear estuary-side defences. In locations such as Falmouth, there are also very limited assets shown to be at risk, however the economic benefits of maintaining defences for commercial quayside activity is not reflected in the analysis. It is felt overall there is strong economic support for the preferred plan (continued hold the line) at Falmouth, St Mawes and St Just-in-Roseland – alongside general support for an initial hold the line approach at Penryn (followed by medium/long term managed realignment) and a more rapid transition to managed realignment at Flushing.

SUMMARY OF PREFERRED PLAN RECOMMENDATIONS AND JUSTIFICATION PLAN:

Location reference: Lower Fal	
Management Area reference: MA11	
Policy Development Zone: PDZ5	
PREFERRED POLICY TO IMPLEMENT PLAN:	
From present day (0-20 years)	NAI along the undefended estuary banks (not precluding private maintenance of existing historic quays at discrete locations). HTL at ST Mawes. HTL at St Just. NAI at Restronguet. MR at Devoran & Perranarworthal. HTL at Mylor Quay. NAI at Mylor Bridge. HTL (with localised MR) at Flushing. HTL at Penryn. HTL at Falmouth. NAI at Pendennis Point.
Medium term (20-50 years)	NAI along the undefended estuary banks (not precluding private maintenance of existing historic quays at discrete locations). HTL at ST Mawes. HTL at St Just. NAI at Restronguet. MR at Devoran & Perranarworthal. HTL/MR at Mylor Quay. NAI at Mylor Bridge. MR at Flushing. MR at Penryn. HTL at Falmouth. NAI at Pendennis Point.
Long term (50 -100 years)	NAI along the undefended estuary banks (not precluding private maintenance of existing historic quays at discrete locations). HTL at ST Mawes. HTL at St Just. NAI at Restronguet. MR at Devoran & Perranarworthal. MR at Mylor Quay. NAI at Mylor Bridge. MR at Flushing. MR at Penryn. HTL at Falmouth. NAI at Pendennis Point.

SUMMARY OF SPECIFIC POLICIES

Policy Unit		SMP1 Policy	SMP2 Policy Plan			Comment
		50 yrs	2025	2055	2105	
11.1	Undefended Estuary banks	<i>Not considered in SMP1</i>	NAI	NAI	NAI	To meet wider objectives of Fal and Helford SAC. NAI should not preclude the privately funded maintenance of privately owned quays along the main estuary and its tributaries.
11.2	St Mawes	Hold the line (along defended sections and at Castle)	HTL	HTL	HTL	Hold the line along Council maintained defended sections which prevent erosion risk along Tredanham Road and Marine Parade.
11.3	St Just-in-Roseland	Hold the line	HTL	HTL	HTL	Holding existing defended frontage line to include maintenance of the frontage (subject to availability of funding) to ensure continued operation of the commercial and leisure boating facilities and to provide protection to historic assets.
11.4	Restronguet Passage	<i>Not considered in SMP1</i>	NAI	NAI	NAI	Although NAI is preferred, this should not preclude the localised maintenance and upkeep of the low masonry walls and slipway structures.

Policy Unit		SMP1 Policy	SMP2 Policy Plan			Comment
		50 yrs	2025	2055	2105	
11.5	Devoran & Perranarworthal	Not considered in SMP1	MR	MR	MR	More detailed assessment of future risk may be required with appropriate future flood warning services considered and improvements made to the resilience of estuary-side community.
11.6	Mylor Quay	Hold the line	HTL	HTL(with localised MR)	MR	it is likely to be in the medium to longer term that some realignment (privately funded) of the existing defence line should be considered.
11.7	Mylor Bridge	Not considered in SMP1	NAI	NAI	NAI	Preferred method for addressing would be through improvements to the flood warning services and improved resilience of the transport routes.
11.8	Flushing	Not fully considered in SMP1	HTL(with localised MR)	MR	MR	With improvements the current shoreline position is not seen as unsustainable though some realignment of the defence line would be necessary in the longer term if sea level rise maintains accelerated increase.
11.9	Penryn	Not considered in SMP1	HTL	MR	MR	Land Use Planners should guide non-water compatible uses from out of the future high risk floodplain, and ensure appropriate resilience and resistance measures.
11.10	Falmouth	Hold the line	HTL	HTL	HTL	The preferred policy at Falmouth is to continue to hold the line along the entire frontage.
11.11	Pendennis Point	Do nothing	NAI	NAI	NAI	From Middle Point around Pendennis Point the erosion risk mapping indicates little risk to the historical assets; however the condition of the shore placement gun batteries should be monitored in relation to the ongoing shoreline recession rates.
Key: HTL - Hold the Line, A - Advance the Line, NAI – No Active Intervention MR – Managed Realignment						

ENVIRONMENTAL ASSESSMENT

Strategic Environmental Assessment (SEA):

In general, the long-term policy plan for the lower Fal (Carrick Roads) is for NAI along the undefended estuary banks with HTL, MR (and to a lesser extent NAI) used selectively at settlements to maintain current standards of defence. Key interest features to benefit from the no active intervention policy include mudflats and Atlantic salt meadows of the Fal & Helford SAC, Carricknath Point to Porthbean Beach SSSI and Lower Fal & Helford Intertidal SSSI. The hold the line defences will also ensure the continued protection of residential and commercial properties and assets associated with lower Fal and the following key features: Harbour facilities at St Mawes; Sailing clubs and gig rowing club at St Mawes; A39 Falmouth - Truro Road at Perranworthal; Feock to Restronguet Point ferry terminal; Harbour Facilities (at Flushing); Falmouth Docks; Pendennis Peninsula Fortifications (SM); and St Mawes Castle (SM).

However, the policy of HTL and MR will impact upon the environment reducing essential natural processes vital for the integrity of geological interests, although it is anticipated that no major impacts will occur to the Fal & Helford SAC for this management area given the boundary of the SAC (at MLW) and the interest features such as the mudflats and saltmarsh.

Habitat Regulations Assessment (HRA):

HTL in Epoch 1 and occasionally later Epochs at St Mawes, St Just-in-Roseland, Devoran, Mylor Quay, Flushing, Penryn, Falmouth, Castle Beach (Falmouth), Swanpool, and Maenporth would occur some distance or outside the Site boundary and would result in highly localised hydrodynamic effects only evident during storm events, which would not extend into or affect the Sites' features.

IMPLICATION WITH RESPECT TO BUILT ENVIRONMENT

Economics Summary		by 2025	by 2055	by 2105	Total £k PV
Property	Potential NAI Damages (£k PV)	5523.4	3366.2	1318.1	10207.8
	Preferred Plan Damages (£k PV)	552.3	673.2	261.1	2039.1
	Benefits of preferred plan (£k PV)	4971.1	2693.0	1057.0	8168.7
	Costs of Implementing plan £k PV	3636	1832	2212	7680
Benefit/Cost ratio of preferred plan					1.06

Notes

Marginal B/C ratio marginal, likely to improve with traffic & other infrastructure asset inclusion