PDZ:5	Zone Point to Nare Point (including the Fal estuary)	Management Area 11 Management Area 12 Management Area 13 Management Area 14

Zone Point to Nare Point

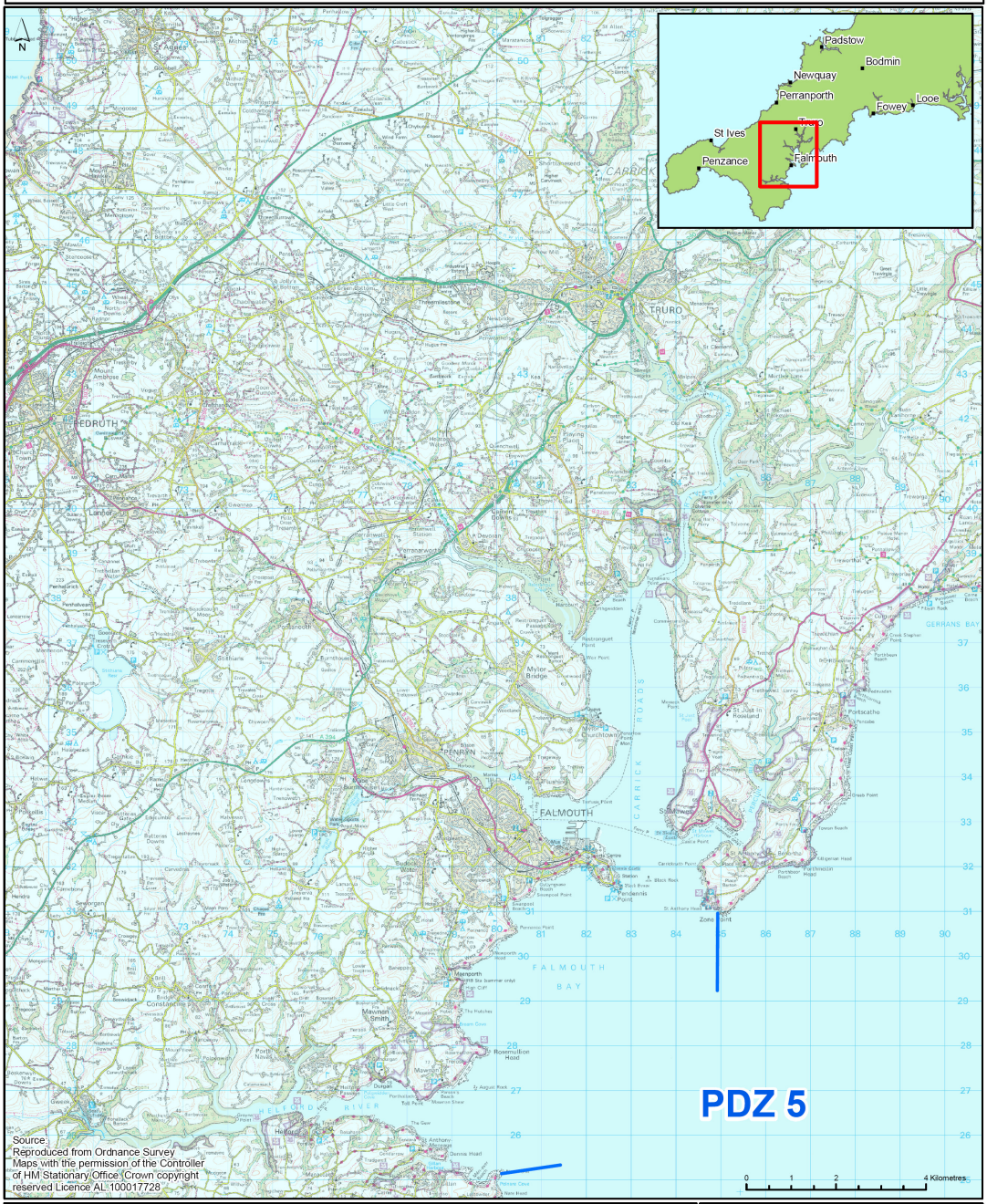
The Fal estuary is a large, deep estuary (formed through flooding of a river valley) with a lot of activity associated with the docks at Falmouth and the numerous sailing clubs found throughout the area. The normal tidal limit of this extensive estuarine water body extends inland some way to the city of Truro and a number of significant tributary creeks at Tresillian, Calenick, Ruan Lanihorne and Cowlands.

The open coast between Falmouth estuary (Pendennis) and the Helford River faces east into Falmouth Bay. Although short, this coast is quite varied, and includes hard rock headlands, exposed open cliffs with shore platforms and small beaches protecting brackish lagoons at Swanpool and Maenporth.

The Helford estuary is a flooded river valley, the upper reaches of which have formed muddy banks. This estuary is significantly smaller than the Fal and much less developed, with only a few communities at Gweek, Porth Navas, Helford and Gillan.

Policy Development Zone 5 - Zone Point to Nare Point

Key
Policy Development Zone



Cornwall & Isles of Scilly
Shoreline Management Plan Review

CORNWALL COUNCIL
Cornwall and the Isles of Scilly Coastal Advisory Group www.ciscag.org
ROYAL HASKONING

General Description

Built Environment

Significant communities have developed along the immediate Fal estuary frontage particularly at Falmouth and Penryn, with the smaller communities of St Mawes, St Just, Feock, Mylor Churchtown also with fixed residential and commercial, recreation and amenity, roads and flood and coastal defence assets on the frontage. Falmouth Docks is a significant feature of the area both in terms of physical presence and employment, and sets the character of the estuary as a working and active environment in terms of commercial activity, recreation and amenity. Truro is the other significant community on the upper most reach of the estuary on the Truro River. Truro is the County Town of Cornwall with all the fixed assets and infrastructure present that you would associate with a small city; including residential and commercial properties, roads and car parks on the estuary waterfront. There is a tidal gate and other flood defence structures at Truro.

The coast between Falmouth estuary (Pendennis) and the Helford River coast includes the main tourist frontage of Falmouth (from Pendennis Point to Swanpool), with hotels dominating the frontage which is protected by structures against erosion. South of Swanpool there are few structural assets close to the water line or cliff edge.

Discrete fixed assets exist alongside the Helford estuary banks adjacent to the small communities and these assets include roads, quays, slipways, flood walls and some residential and commercial properties. Commercial shell fishing is active in the area.

Heritage

Historic features of interest include; sites dating to both the civil war and the Iron Age at the coast limit of the Helford Estuary (Little Dennis), a listed church dating to the middle ages at St Anthony-in-Meneage, a prehistoric submerged forest at Gillan Creek, the site of an Iron Age castle at Rosemullion Head and of course Pendennis Castle and St Mawes Castles at the mouth of the Fal estuary. Also present is the parkland of Tregothnan and Trelissick beside the estuary, a medieval bridge at Tregony, an historic port at Devoran and historic oyster beds on the Helford estuary. There are WWII and cold war features at Nare Head. In addition a site of the Cornwall and West Devon Mining Landscape World Heritage Site is present (Perran Foundry complex) and there are a large number of Conservation Areas.

Environment and Nature Conservation

Conservation designations in this area are very significant, with the Fal and Helford SAC the major designation. Intertidal mudflats and saltmarsh are found frequently through the upper parts of both the Fal and Helford estuaries and between them make up the most significant area of sheltered, estuarine nature conservation interest within the entire SMP area. In addition to the SAC designation, there are SSSIs at Rosemullion and Swanpool and saline lagoons and lowland mixed deciduous woodland BAP priority habitats.

Recreation and Amenity

Tourism and recreation, particularly in the form of recreational sailing and boating is a key activity of the area. Principal centres for this type of activity are around Restronguet Creek, Mylor Creek, St Just Creek, Penryn, Falmouth and St Mawes. Commercial shell fishing also active.


Mylor Creek

Key Values and Drivers

The key values of the Fal estuary and open coast section are those associated with commercial and residential activity within the context of recreation and tourism, together with the internationally recognised importance of the natural environment.

The key value of the Helford estuary is that of tranquillity, natural beauty, together with the internationally recognised importance of the natural environment and the small communities which have settled to work within the natural environment that the sheltered waters provide. The areas proximity to Falmouth enhances the sense of peace of the area.

- Economic and commercial activity associated with the community of Falmouth and Penryn (including estuarine and coastal shell fisheries)
- Conservation designations, including Fal and Helford SAC of international importance
- Ruan Estuary saltmarshes – importance for bird populations and historic links to the clay mining industry
- Falmouth Docks area
- The natural amenity value of the sheltered estuarine environment, particularly for recreational sailing
- Historical importance of Pendennis

PDZ Management Intent

The overarching management principle for the Fal estuary is therefore to promote shoreline management; prioritising the natural environment values based on their international importance, but also supporting the adaptation and resilience of the communities and developed frontages. This in itself should help to maintain the commercial viability of the areas of Falmouth and Penryn.

The overarching management principle for the Helford estuary is therefore to allow the natural evolution of the estuary, to support its adaptation to sea level rise and protect and enhance its environmental value, whilst managing the risks to the small communities and supporting their adaptation to increases in estuary water levels.

Physical Coastal Processes (further details are provided in Appendix C)

The Fal Estuary is located on the south coast of Cornwall with its mouth positioned within Falmouth Bay. The estuary is classed as a ria and the mouth, which is fixed by the headlands of Pendennis Point and St Anthony Head, is relatively deep with depths of up to 34mCD (Chart Datum) in the main channel. The estuary is branching with a number of tributaries and creeks. The main body of the estuary is referred to as the Carrick Roads. At the northern edge of the Carrick Roads three creeks; the Ruan Creek, and the Tresillian and Truro Rivers flow into the Carrick Roads. Along the western bank of the Carrick Roads three more creeks are present, Restronguet Creek, Mylor Creek and Penryn River. On the eastern side of the Carrick Roads, St Just Creek and the Percuil River converge with the estuary.

The mouth of the estuary is open to swell propagating from the open sea and wave modelling suggests that these waves have limited propagation to the north of the headlands of Trefusis Point and Castle Point (St Mawes) (Halcrow, 1999a).

Sediment within the Carrick Roads is likely to come from marine sources however, the source of this sediment is not described in the literature. There is little evidence of significant levels of accretion and therefore the amount of sediment entering the estuary is likely to be low. The creeks up-estuary of the Carrick Roads has historically accreted rapidly as a result of catchment derived sources such as mine waste.

The coastline outside of the estuary is cliffed and interspersed with a number of sandy beaches. The nature of the coast, along with the prominent headlands forming the estuary mouth, would suggest that little longshore drift occurs along the open coast outside of the estuary.

Grab samples show that the bed sediment throughout the study area is variable, ranging from mud to large shell and stones (HR Wallingford, 1985). Relatively limited data are available concerning the transport of sediment within the estuary.

The estuary is relatively undeveloped overall although some development is present at Falmouth, Feock, Penryn, Restronguet, Devoran, St Mawes, Mylor, Flushing and St Just in the form of coastal defence, quays, harbour walls and docks. The main concentration of development is at Falmouth where a cruise terminal and dock facilities are situated. There are currently plans to extend the cruise terminal through the deepening of the main approach channel and the lengthening of the quay.

Small amounts of historical reclamation are present in Restronguet Creek, Truro River and Mylor Creek (outside of the SMP2 area). The largest amount of reclamation is within Falmouth Docks. However, in the context of the estuary these reclaimed areas do not represent a significant proportion.

TIDE AND WATER LEVELS (mODN)

Location	LAT	MLWS	MLWN	MHWN	MHWS	HAT	Neap range	Spring range	Correction CD/ODN
St Anthony	-	-2.30	-	-	2.40	-	-	4.70	-
Falmouth	-	-2.11	-	-	2.49	2.89	-	4.60	-2.91

Extremes(mODN)

Location:	1:1	1:10	1:25	1:50	1:100	1:200	1:500	1:1000
St Anthony	3.04	3.29	3.42	3.49	3.61	3.70	3.82	3.93
Gweek, Helford River	3.04	3.29	3.42	3.49	3.61	3.70	3.82	3.93
Falmouth	3.03	3.30	3.43	3.50	3.63	3.72	3.85	3.96
Penryn	3.03	3.30	3.43	3.50	3.63	3.72	3.85	3.96
Devoran	3.03	3.30	3.43	3.50	3.63	3.72	3.85	3.96
Truro River	3.03	3.30	3.43	3.50	3.63	3.72	3.85	3.96
Tresillian	3.03	3.30	3.43	3.50	3.63	3.72	3.85	3.96

Wave Climate

The wide southerly entrance to the Fal Estuary allows the swell from offshore to propagate into the Carrick Roads. Modelling by Halcrow (1999a) indicates that the bathymetry limits the penetration of this swell and the largest wave heights are found at Trefusis Point (1.5m) and Castle Point (2m). Beyond these headlands offshore wave penetration is limited with the most of the estuary being dominated by locally generated waves of 0.5 to 1.0m (Halcrow, 1999a).

These results broadly agree with modelling of remotely and locally generated waves for the proposed Cruise Terminal Environmental Statement (ES) which indicated that waves from offshore during a 1 in 1 year event do not penetrate significantly into the estuary further than the coast between Trefusis Point and Mylor Creek (HR Wallingford, 2008) and that significant wave heights generally did not exceed 3m within the Carrick Roads. The largest wave heights were observed in the entrance of the estuary and during some scenarios reached a height of 4m. Locally generated waves by winds from 10˚N form the largest waves in the vicinity of Falmouth Docks and in agreement with Halcrow (1999a) which indicated significant wave heights do not exceed 1m at any point in the estuary (HR Wallingford, 2008).

Tidal Flow

Datasets collected throughout the study area (HR Wallingford, 1985, Andrews Hydrographics, 1990 and Totaltide) and modelled data (HR Wallingford, 2008) suggest that in terms of peak velocities the flood tide is stronger than the ebb tide throughout the majority of the Fal Estuary.

In terms of fine sediment transport this does not necessarily imply a net input of fine sediment, other factors such as the duration of the tidal cycle and the length of the slack water period (and hence the amount of time available for fines to settle out of suspension) are also important. Tidal gauge data suggests that in general the ebb tide phase lasts longer than the flood (IECS, 1996 and HR Wallingford, 1985); further tidal analysis would be required to demonstrate the net transport of sediments.

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.

PROCESSES

Control Features:

The solid geology predominantly consists of slates and sandstones of the Porthscatho formation of middle Devonian age (Pirrie *et al*, 2003a). Outcrops of the Porthscatho formation form the cliffs at Trefusis Point and along the eastern side of the estuary. Between Mylor Creek and Trefusis Point the Mylor Slate formation is present.

The Portscatho Formation shows a general NNE-SSW structural trend resulting in the resistant strata forming headlands that are orientated in a SSW direction (Halcrow, 1999a). Analysis of the headlands just outside of the estuary indicates that Pendennis Point and St Anthony's Head can be expected to retreat by 1-2 and 0-1m respectively over the next 100 years along the seaward side (Halcrow, 1999a). As the geological composition of the cliffs outside the estuary is similar to that within the estuary it can be inferred that the cliffs in the estuary are relatively resistant to erosion and hence the solid geology exerts a significant control on the estuary shape.

Existing Defences:

The estuary is relatively undeveloped overall although some development is present at Falmouth, Feock, Penryn, Restronguet, Devoran, St Mawes, Mylor, Flushing and St Just in the form of coastal defence, quays, harbour walls and docks. The main concentration of development is at Falmouth where a cruise terminal and dock facilities are situated.

Processes:

The Fal Estuary is a relatively deep estuary and is orientated along a north to south axis and as such has a small degree of protection from the prevailing south westerly wind direction. The presence of the Lizard Peninsula to the west of the estuary mouth also provides some protection from swells propagating into the estuary from the open ocean. The main body of the estuary (the Carrick Roads) has limited intertidal area although saltmarsh and mudflat is present further up the tributaries.

The Carrick Roads have been very stable over the last 200 years (IECS, 1996) which demonstrates the limited amount of sediment deposition occurring in the outer estuary. It has been noted by IECS (1996) that this lack of sediment infill means the Fal has not developed a morpho-dynamic equilibrium when compared to other estuaries in the UK. For example, when compared to estuaries on the east coast of the UK the area of the estuary mouth is an order of magnitude higher than expected given the estuaries tidal prism. This means that velocities are low at the mouth which should lead to deposition reducing the cross sectional area which in turn will eventually bring the mouth into equilibrium (IECS, 1996). A further dis-equilibrium has also been noted for the estuary length/tidal wave length, this indicates 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 although the sediment supply required is unlikely to exist (IECS, 1996).

Unconstrained Scenario:
Although unrealistic, because of the residual impact of defences, this scenario considers how the coast would evolve in the absence of defences.

The intertidal area ratio within the Carrick Roads is low indicating that there is potential for more sediment to be deposited within the estuary, this however depends on a sufficient supply of sediment in the future. The limited deposition within the Carrick Roads suggests that the current supply is limited, meaning that it is unlikely that the estuary will accrete in line with accelerated sea level rise in the future.

IECS (1996) considered the potential response of the estuary to sea level rise. They suggest that the inner creeks and rivers are likely to experience erosion as a result of sea level rise, however there is some space for saltmarsh to migrate as sea levels rise due to the general undeveloped nature of the upper estuary (IECS, 1996).

POTENTIAL BASELINE EROSION RATES

Base rates have been assessed from monitoring and historical data. The range of potential erosion is assessed in terms of variation from the base rate and sensitivity in potential sea level rise.. The base rates provided below are taken as an average based on historical records. The rates are a composite value based on erosion of the toe and recession of the crest of the cliff and reflect the erosion rates following failure of defences.
(Sea Level Rise assumed rates: 0.06m to year 2025; 0.34m to year 2055; 0.96m to year 2105.)

Location	Historic recession rate (lower) (m/100 yr)	Historic recession rate (upper) (m/100 yr)	Projected 100 year erosion rate (lower) (m)	Projected 100 year erosion rate (upper) (m)	Notes
Falmouth	5	10	5	10.9	Wall and gabions, 100 year SoP
Falmouth	25	30	26.6	35.3	Beach with masonry and concrete seawall fronted by rock along road
Maenporth	0	15	11.2	42.3	
Mawnan	0	1	3	8.4	
Helford Passage	0	1	6.7	15.3	Wall between beach and road

BASELINE MANAGEMENT SCENARIOS

PRESENT MANAGEMENT

Present Management is taken as that policy defined by SMP1, modified by subsequent strategies or studies. It should be noted that both in the case of SMP1 and that of many of the strategies undertaken before 2005, the period over which the assessment was carried out tended to be 50 years.

SMP1		
MU	**LOCATION**	**POLICY**
6D-4	St Anthony Head to Castle Drive	Do nothing strategy.
6D-4	St Mawes	Hold the line of existing defences. Monitoring of undefended areas.
6D-4	St Mawes to St Just	Do nothing strategy.
6D-4	St Just	Hold the existing defence line with possible new defences along undefended frontages.
6D-4	St Just to Turnaware Point	Do nothing strategy.
6D-4	Feock to Restronguet Point	Hold the existing defence line and no nothing along undefended frontages Hold the existing defence line
6D-4	Restronguet Weir to Mylor Creek	Do nothing strategy
6D-4	Mylor	Hold the existing defence line
6D-4	Mylor Creek to Flushing	Do nothing
6D-4	Flushing	Hold the existing defence line.
6D-4	Falmouth Harbour	Monitoring of undefended areas. Hold the existing defence line. Do nothing in the short term along undefended length, with cliff stability monitoring.
6D-5	Falmouth Bay	Hold the existing defence line along developed Falmouth frontage. Do nothing short term around Pendennis Point with cliff stability monitoring.
6D-5	Swanpool	Hold the existing defence line along the Swanpool frontage with do nothing along undefended frontage.
6D-5 6D-5	Pennance Point (Swanpool) to Maenporth	Do nothing strategy. Hold the existing defence line.
6D-5	Maenporth	Hold the existing defence line.
6D-5	Maenporth to	Do nothing strategy.

	Rosemulllion Head	
6D-5	Rosemullion Head to Toll Point	Do nothing strategy.
6D-5	Toll Point to Durgan	Do nothing strategy.
6D-5	Durgan	Do nothing strategy.
6D-5	Durgan to Helford Passage	Do nothing strategy with possible maintenance of the slipway.
6D-5	Helford Passage	Strategic hold the line of existing defences.
6D-5	Helford Creek	Hold the existing defence line with future intervention along currently undefended frontages to protect properties.
6D-5	Treath to Gillan Creek	Do nothing strategy.
6D-5	Gillan Creek	Strategic hold the line where assets are threatened. Do nothing strategy for remaining lengths.

Economic Assessment

The following table provides a brief summary of damages determined by the SMP2 analysis for the whole PDZ. Further details are provided in Appendix H. Where further, more detailed information is provided by studies, this is highlighted. The table aims to provide an initial high level assessment of potential damages occurring under the two baseline scenarios. The damages for each epoch are current values. These are discounted to give present values in the final column.

ASSESSMENT OF EROSION DAMAGES

Epoch	0 -20 year		20 – 50 years		50 – 100 years		Total	
No Active Intervention *Location*	**Number of properties**	**Present Value x £1000**	**Number of properties**	**Present Value x £1000**	**Number of properties**	**Present Value x £1000**	**Number of properties**	**Present Value Damages (£x1000)**
PDZ5	**2**	**143**	**1**	**70**	**4**	**37**	**7**	**217**
						Total for PDZ		

ASSESSMENT OF POTENTIAL FLOOD RISK

Epoch	Flood risk tidal 2025		Flood risk tidal 2055		Flood risk tidal 2105		Total	
No Active Intervention *Location*	**Number of properties**	**Present Value x £1000**	**Number of properties**	**Present Value x £1000**	**Number of properties**	**Present Value x £1000**	**Number of properties**	**Present Value Damages (£x1000)**
PDZ5	1105	9,749	1309	5,590	1722	2,340	1722	17,679

PDZ 5: Zone Point to Nare Point
Management Area Statements

Management Areas

PDZ 5 has been sub-divided into 4 principal management areas, these being:

MA011 Lower Fal
MA12 Upper Fal
MA13 Pendennis Point to Rosemullion Head
MA14 Helford

Within these areas a summary of policy is provided below. Management Areas statements are provided in the following sheets.

MA11 – Lower Fal

Covering previous SMP1 management units:

6D-4	St Anthony Head to Castle Drive
6D-4	St Mawes
6D-4	St Mawes to St Just
6D-4	St Just
6D-4	St Just to Turnaware Point
6D-4	Feock to Restronguet Point
6D-4	Restronguet Weir to Mylor Creek
6D-4	Mylor
6D-4	Mylor Creek to Flushing
6D-4	Flushing
6D-4	Falmouth Harbour
6D-5	Falmouth Bay

MA12 – Upper Fal

Not covered in previous SMP1 management units

MA13 – Pendennis Point to Rosemullion Head

Covering previous SMP1 management units:

6D-5	Swanpool
6D-5	Pennance Point (Swanpool) to Maenporth
6D-5	Maenporth
6D-5	Maenporth to Rosemulllion Head

MA14 – Helford

Covering previous SMP1 management units:

6D-5	Rosemullion Head to Toll Point
6D-5	Toll Point to Durgan
6D-5	Durgan

6D-5	Durgan to Helford Passage
6D-5	Helford Passage
6D-5	Helford Creek
6D-5	Treath to Gillan Creek
6D-5	Gillan Creek