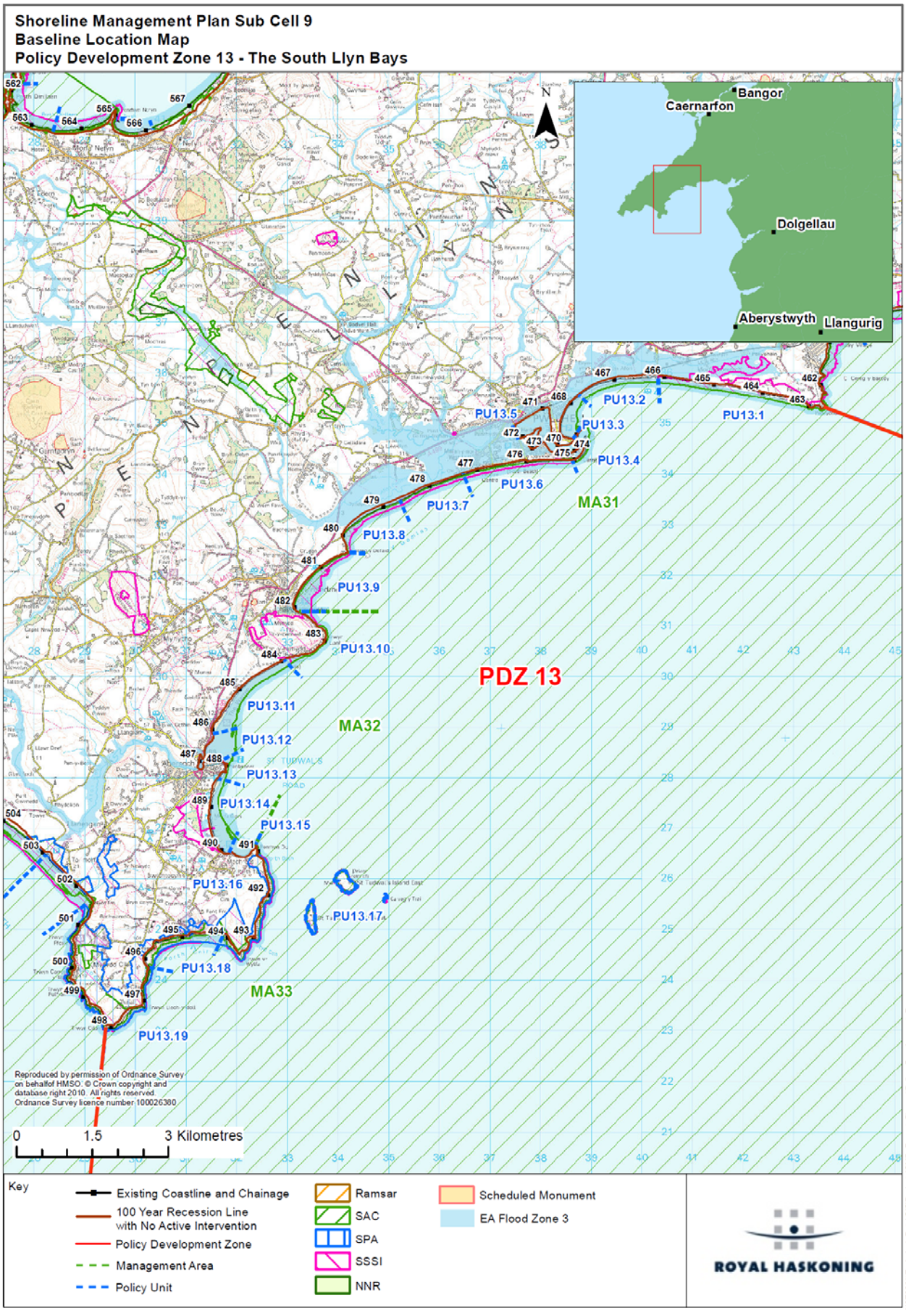
PDZ 13. THE SOUTH LLYN BAYS:

Abersoch

Pen y Chain to Trwyn Cilan

CONTENTS


Shoreline Management Plan Sub Cell 9
Baseline Location Map
Policy Development Zone 13 - The South Llyn Bays
Bangor
Caernarfon
Dolgellau
Aberystwyth
Llangurig
PDZ 13
MA31
MA32
MA33
PU13.1
PU13.2
PU13.3
PU13.4
PU13.5
PU13.6
PU13.7
PU13.8
PU13.9
PU13.10
PU13.11
PU13.12
PU13.13
PU13.14
PU13.15
PU13.16
PU13.17
PU13.18
PU13.19
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0 1.5 3 Kilometres
Key
Existing Coastline and Chainage
100 Year Recession Line with No Active Intervention
Policy Development Zone
Management Area
Policy Unit
Ramsar
SAC
SPA
SSSI
NNR
Scheduled Monument
EA Flood Zone 3
ROYAL HASKONING

Definitions of Scenarios Considered in Policy Development

This section defines the various scenarios that are used throughout the discussion of the Policy Development Zone.

Sea Level Rise
It is recognised that there is a continuing uncertainty with respect to Sea Level Rise (SLR). Taking different SLR scenarios may affect the scale of impact or the timing of some changes, either in terms of sustainable management or in terms of impacts. In the discussion below of the baseline and alternative management scenarios, the Defra guidance on SLR has been generally been used. Where, in any specific area, the impact of SLR is felt to be significant and may change the context of management this discussion is held within a separate box, relevant to that section of text.

Management scenarios;

Unconstrained Scenario
Under this scenario, the behaviour of the coast is considered as if there were no man made defences, effectively if they were suddenly not there. Although recognised to be a totally theoretical scenario it does provide a better understanding of how we are influencing the coastal behaviour and therefore the stresses and broader scale impact that are introduced. This assists in assessing first how the coast might wish to change, but also in defining the limits of interaction which the SMP should be considering.

Baseline Scenarios

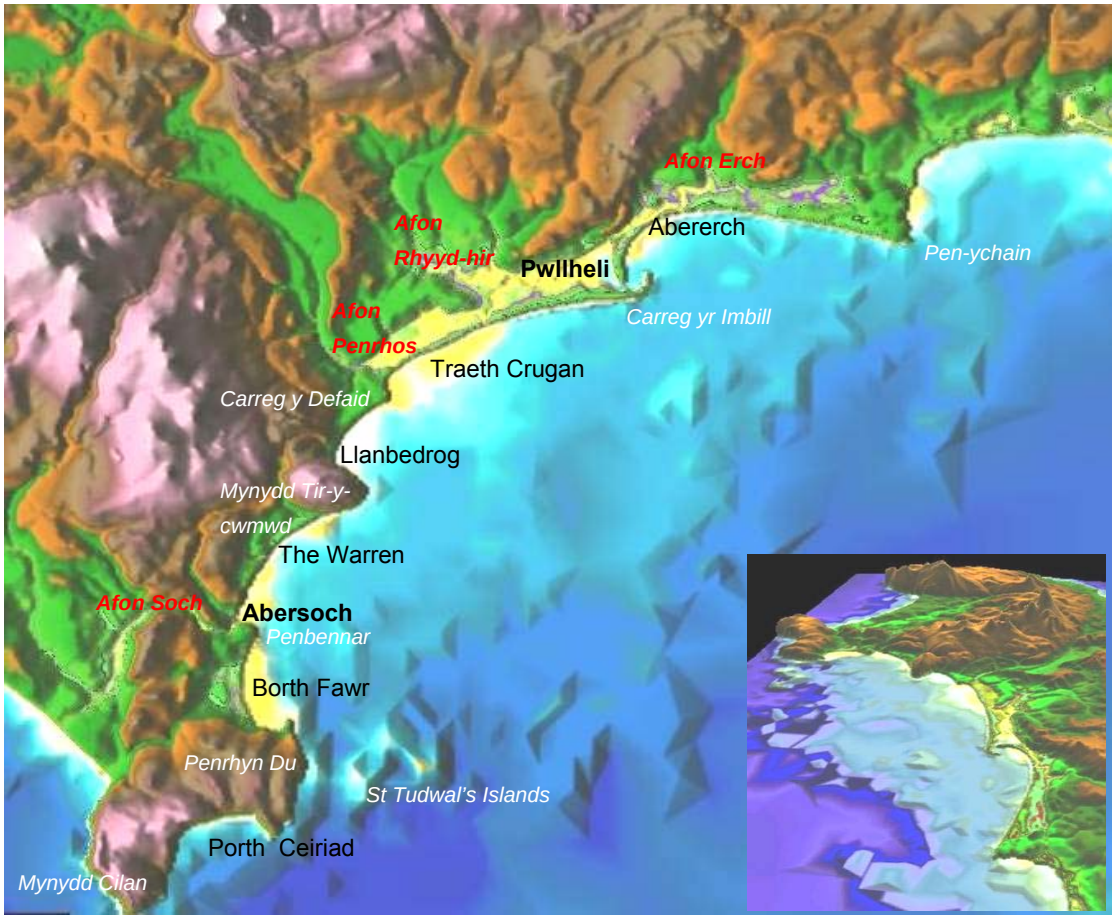
- ***No Active Intervention (NAI) – Scenario 1****, where* there would be no further work to maintain or replace defences. At the end of their residual life, structures would fail. There would be no raising of defences to improve standards of protection.
- ***With Present Management (WPM)– Scenario* 2**. This scenario applies the policies set in the SMP1 or, where relevant, takes updated or clarified policies, if subsequent work has been undertaken e.g. studies or strategies. In many locations, the approach to management defined by SMP1 only covers a 50 year period. Where this is so, the intent of how the coast is being managed has been assumed to apply into the future. It should be noted that WPM does not necessarily imply a Hold The Line approach throughout the zone, in many areas present management may be for a No Active Intervention approach or one of Managed Realignment.

The aim of the No Active Intervention is to identify what is at risk if defences were not maintained. In a similar way, With Present Management aims to examine how the coast may develop, identifying where there are benefits in this management approach or where there may be issues arising in the future.

At the end of this sub-section a brief summary and comparison of the economic risk for each of the baseline scenarios is provided, based on the MDSF analysis undertaken during the SMP (including other study findings where relevant). The baseline scenarios are also assessed in terms of how they address the overall objectives for the Zone. This comparison between the baseline scenarios sets the scene for discussing possible alternative management scenarios which better address all the issues. This discussion is provided in the subsequent sub-section.

1 Local Description

The zone extends over some 35km of coast from the hard headland of Pen-ychain in the east through to the Mynydd Cilan headland in the west. The zone covers a section of coast characterised by strong headland control points, with sweeping curved bays between. Within the zone are the important coastal towns of Pwllheli and Abersoch. The main coastal road runs generally some distance back from the shoreline but does run across the coastal flood plain of the main rivers. The railway line from Porthmadog runs through to Pwllheli and comes close to the shoreline at Abererch. The whole area is very important for coastal tourism with significant holiday villages, important watersports centres and golf courses at Pwllheli and Abersoch. The Harbour at Pwllheli has been developed as a major recreational sailing centre and is the most north westerly of the string of harbours around Cardigan Bay. The area is an important hub of economic activity in its own right but is strongly linked to the main hub of the Porthmadog area, sustaining economic activity in this area of Wales.



The whole zone is covered by the Marine SAC, with much of the coastline designated SSSI for its coastal ecology and geological value. The southern cliffs together with St Tudwal's Islands are designated SPA. The area to the west of Pwllheli is also designated as an Historic Landscape Area and the area to the west of Llanbedrog is also designated as an Area of Outstanding Natural Beauty.

The zone is described in more detail, in terms of each bay; starting from the east.

Pen-ychain to Carreg yr Imbill. To the eastern end of the bay is higher ground, running back from the Pen-ychain headland. There is an important holiday village situated on this higher ground, mainly to the eastern side of the headland (PDZ12). The main coast road and railway line are similarly set well back from the shoreline. The Afon Du flows

down through the holiday village and then along a low lying valley to the back of higher ground at the shoreline. The level of the backshore decreases as one moves west along the bay, such that, some 2.5 km from Pen-ychain, the backshore area, separating the shoreline from the valley behind, is principally a single dune ridge. This is locally protected by revetment.

This narrow ridge continues through to the eastern area of Pwllheli. Central to this lower section of coast is the holiday centre (Abererch Sands) and caravan park, this holiday development sits on a slightly raised area of land behind the dune ridge. The main village of Abererch is set to the back of the main low lying area behind the dunes, straddling the valley of the Afon Erch where it widens to join the valley of the Afon Du. The railway cuts across the valley of the Afon Du, to run close behind the dune backshore at Abererch Holiday village and runs even closer to the dune ridge to the west. Where the Afon Erch joins the Afon Du, this creates a wide flood plain behind the shoreline. The main road runs through this flood plain. The section of coast to the east of Abererch through to Pen-ychain is designated SSSI.

The western section of the bay curves more sharply to the south behind the headland of Carreg yr Imbill, sweeping round to the entrance to the Harbour. There is a width of dune in this western area (Glan-y-Don), backed by an earth bank, which separates the harbour from the coast and this area has been developed as an important industrial estate, as well as containing the main support services to the recreational moorings of the harbour.

The harbour is accessed through a broad reveted entrance channel which then opens out to the main harbour area developed around the mouth of the Afon Erch and combined valleys of the Afon Rhyd-hir and the Afon Penrhos. The Cob, across the valley of the Afon Rhyd-hir and the Afon Penrhos, protects the valley running through the centre of Pwllheli from tidal inundation.

The older part of Pwllheli is developed on high ground to the northern side of the Afon Rhyd-hir valley. The main road running along the northern side of the valley, in effect, defines the division between this older core part of the town and the newer development, extending down into the area of the valley. This lower area contains a significant number of properties, the bus station and shops, and has been developed as an important element of revitalising the economy of the town. To the southern side of the valley is mainly residential development, although the council offices and a school are within the valley area. The valley splits further upstream, with the Rhyd-hir running to the north and the Penrhos running parallel to the coast, through the Pwllheli Golf Course, behind the shoreline ridge of Traeth Crugan. The main road runs across the Rhyd-hir valley, across the ridge separating the two rivers and then across the low lying flood plain of the Afon Penrhos.

The southern side of the harbour entrance channel is the more working area of the harbour, with fishing quays, the Life Boat Station and the main harbour offices. There are also a significant number of residential properties making up the Morfa Garreg housing estate. A small holiday park has been developed on the southern spit at the harbour entrance. This spit is connected to the hard rock outcrop of Carreg yr Imbill, which forms the western control feature of Pwllheli Bay.

Pwllheli South Beach and Traeth Crugan run between Carreg yr Imbill and the outcropping headland of Carreg y Defaid. At the eastern end of this frontage, seaward

of the working harbour area, is relatively natural dune with a steep shingle sand beach. The main sewage treatment works for Pwllheli is situated within the dunes.

Further west is the main recreational beach area to Pwllheli. The dunes are managed with walkways and fencing running down from the improved promenade and seafront road. Behind the road, the frontage has been developed along the relatively wide coastal ridge, with residential and holiday property built along the ridge and property extending down the southern slope of the main river valley to the town. The dunes have become more established and have built up and over the old sea wall on the seaward side of the promenade. To the western end of Pwllheli South Beach, the promenade turns in land and the area reverts to a wider strip of natural dune. There are properties behind this area of dune and to the western end of this section is the Pwllheli Golf Club House.

The Golf course has been developed across the quite shallow valley of the Afon Penrhos, nearly back to the main coastal road out of Pwllheli. At the shoreline the dune frontage has reduced to a single dune ridge that has been progressively defended by sections of rock revetment since the 1970s. This defence, which protects against breach of the dunes and flooding into the Penrhos valley, also protects some isolated properties immediately at the back of the dune ridge; this includes the grade II listed Tan-y-bwlch cottage. The defence now effectively links through to the main revetment to Traeth Crugan at the western end of the frontage, with only limited areas of natural dune. During consultation, the concern was expressed by the Penrhos community that a breach to these dunes would result in flooding to the main road where it crosses the Penrhos valley.

The foreshore of this frontage comprises areas of exposed boulder clay and with several raised sections of harder glacial boulders. The most notable of these raised areas are towards Pwllheli South Beach and to the eastern end of the slightly more embayed Traeth Crugan. The foreshore and intertidal area is designated SSSI and of particular note are the nationally rare intertidal communities, inhabiting the sandy/muddy gravel and clay areas of the lower foreshore, and the amphipod species living in the shingle shore of the eastern half of the frontage..

The Carreg y Defaid headland at the end of the bay is a steep faced rock headland that is eroding slowly on its eastern face.

Llanbedrog Bay runs between Carreg y Defaid and the more massive headland of Mynydd Tir-y-cwmwd. The bay is backed by a low clay cliff, with generally open land behind. Only at the western end are there properties and these tend to be set back some distance from the backshore slope. There is a slipway and outfall at the western end that provide some protection to the cliff. There is a grade II listed building constructed on the rock cliff face of the western headland, situated just above normal tidal level.

The foreshore generally comprises sand and shingle, becoming more muddy over the lower intertidal area. This foreshore is designated SSSI with nationally rare intertidal communities, inhabiting the sandy/muddy gravel and clay areas of the lower foreshore.

The Mynydd Tir-y-cwmwd headland is a very steep rock feature of the shoreline, and the whole headland is designated as an SSSI.

The Warren through to Abersoch. This bay comprises a wide sandy foreshore, widening further at the south-western end, in the lee of the Penbennar headland at Abersoch. The eastern half of the bay has a relatively steep clay and dune cliff upon which is the large Warren Holiday Village. This development extends along 1.6km of shoreline. The centre of the holiday village is set back some 150m from the crest of the coastal slope, but the area between the centre and the shoreline is occupied by chalets and caravans.

To the west of the Holiday Village is an area of undeveloped heavily vegetated dune and coastal slope. The coastal road runs to the back of this slope. The undeveloped area ends at the local rock outcrop at the start of Abersoch. There are properties constructed on the rock outcrop and the road runs across the headland and down to the valley of the Afon Soch.

There are in fact two watercourses that make up this valley, separated by a ridge of high ground. The northerly stream, which has a small reservoir higher up its steeply rising valley, runs through a tidal sluice under the main coastal road at the back of the small estuary area. The larger Afon Soch, which is also sluiced under the road, flows through a steep-sided a narrow gorge from its large catchment area behind Hells Mouth (PDZ14).

The estuary of these two rivers is confined by the rock headland at the western end of the Warren and by the rock headland of Penbennar. The entrance to the small muddy estuary area is further constrained by the development of a sandy spit extending across the entrance from the north. This spit has been partly developed, with a sailing centre and Inshore Rescue Boat Station.

On the southern side of the estuary is a small spit that develops into the estuary and is developed along the toe of the rock cliff. This spit is also used for water sports storage and there are properties running back up the rock cliff behind. The main road follows around the back of the estuary, then divides, with roads running back to the main centre of Abersoch and a road running up and along the southern cliff to provide access to properties around the Penbennar headland. The main course of the Afon Soch tends to run along the toe of the Penbennar headland, but this can cut a more direct path to the sea under high fluvial flows.

Borth Fawr. This bay orientated in a north/south direction, facing out to the east, is formed as a classic curved crenulate shape between the headlands of Penbennar and Penrhyn Du. The southern end of the bay has the wider intertidal area, narrowing at the northern end. At the northern end the beach ramps quite steeply to the clay dune covered coastal slope running into the headland of

Penbennar. This coastal slope reduces in height so that, across the centre of the bay, the backshore is merely a low protected dune ridge with low lying land behind.

The coastal slope to the north is quite heavily developed with beach huts and facilities supporting traditional beach use and watersports. Over the central section of the bay is the Abersoch Links golf course and the designated SSSI, Cors Llyferin. There is also a main sewage works to the back of the low lying area. There are properties and slipway at the southern end of the bay in the lee of the headland. A road runs up and partly out towards the headland of Penrhyn Du, where there is the old lifeboat house and slipway.

Porth Ceiriad Headland and Bay. To the south of Penrhyn Du there is a section of high rock cliff extending some 2.5km around the south facing bay of Porth Ceiriad. Offshore of the section of shoreline are the islands of St Tudwal's Island East and St Tudwal's Island West. There is a light house situated on the west island and the site of the old Augustinian Priory on the east Island. The two islands and the cliffs and land to the crest of the cliff of the mainland are designated both as SSSI and as SPA.

There are no properties close to the cliffs of the mainland and Porth Ceiriad comprises a sand beach, with a steeply rising relatively unstable coastal slope facing out to the south southwest across Cardigan Bay. The western side of the bay is formed by the hard rock Mynydd Cilan headland. The bay and slope are in the ownership of the National Trust and there is a small car park to the western side of the bay.

2 Coastal Processes

The offshore wave climate is dominated by energy from the southwest, although still exposed to a range of directions from south southeast through to that dominant southwesterly direction. As waves approach the shoreline, their direction is modified by refraction as waves move across the shoaling nearshore platform and more obviously at the shoreline, by the hard headlands. This allows sediment to build against the downdrift control points and by the diffraction of wave energy in the lee of the more prominent headlands. These processes create the sweeping bay shapes seen within the zone. Modelling of sediment drift along the frontage is very sensitive to even slight variation in the overall wave climate. Modelling of the area has shown that a shift in net wave energy of as little as 5 degrees can change predictions of drift from that of no drift to rates in excess of 30,000 m^3 a year.

Crenulate Bays of Abersoch and Borth Fawr. 1981

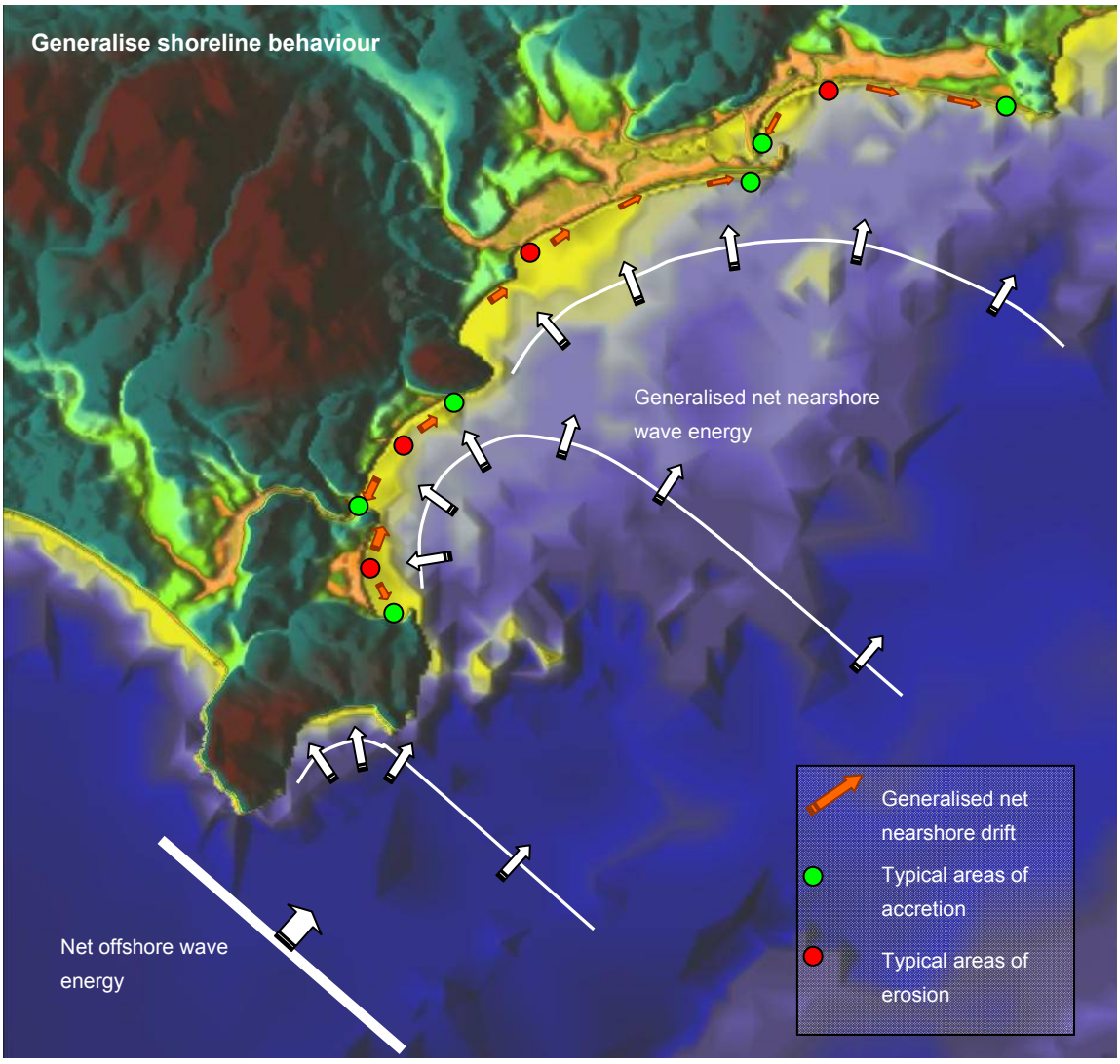
Actual change in wave direction; on a storm by storm basis, between years or in change in wave climate on a decadal time scale, can equally have a marked affect on sediment movement; on areas of erosion or areas of apparent stability and areas of accretion. This affect is seen particularly in the centre of bays, where specific events or periods of different wave conditions can lead to change in behaviour of the coast. This is seen from historic records in areas such as Borth Fawr, where there can be periods of accretion and then sudden change to periods reinforcing the long term trend of erosion. Similar variation has been noted; in areas such as The Warren, Traeth Crugan and Abererch, in the centre of the longer frontages, where there is generally recognised to be areas of drift separation. These areas of vulnerability change in focus along the lengths of the coast as the coast responds to specific wave conditions.

Variation in alignment at the eastern end of Traeth Crugan 1945 (inset photograph from SMP1)

Furthermore, this sensitivity to wave direction, along what is a relatively low drift coastline, means that the shape of the bays can be very sensitive to local variation in the nearshore bed levels or to modification of the main headlands. The former is evident in areas such as the Traeth Crugan/ Pwllheli South Beach frontage where the areas of higher sea bed have allowed the central Golf Course frontage to be held slightly forward of the more

uniform curve of the bay, in effect dividing the longer frontage. It can also be seen, to a lesser degree between Abererch and Pen-ychain, where the slightly higher, and presumably harder sea bed, holds the line of the coast marginally forward and has allowed some accumulation of sediment as an area of intermittent fore dune development. The more obvious case of change in the influence of one of the key headlands is seen to the north of Pwllheli Harbour, where the formalisation of the harbour entrance and the construction of the harbour entrance structures has help establish a generally stable area of dune in front of Glan y Don.

The essential processes have been be summarised on the following diagram but, as may be appreciated from the above discussion, these generalised concepts of behaviour are subject to variation.



Despite this generalisation certain points may be highlighted that are borne out by more detailed studies and monitoring.

- The typical pattern of bay behaviour; of erosion at the headlands and accretion to the centre of the bay, does not hold for this area. The process, if anything, is reversed, with the tendency for sediment to be moved from the centre of the bay and accretion to occur against the down drift headlands and into the lee of the more prominent headlands.
- In the case of Borth Fawr, this process has been seen over the longer term with intermittent periods of erosion to the centre of the bay but with periods of recovery. This is a feature of the bay's position or orientation, with a strong onshore energy direction.
- The entrance to the Soch estuary is rarely subject to periods of severe erosion but it can occur. The general trend however is for this to be a sediment sink.
- Along the Warren, the position where erosion occurs, varies with wave direction. However, sediment does move in either direction along the central section and areas of erosion can subsequently accrete or become stable, despite a long term trend of slow erosion.
- Llanbedrog is quite stable, Carreg y Defaid is a barrier to sediment moving from the bay and there is only weak longshore drift to Traeth Crugan.
- The orientation of the eastern side of Carreg y Defaid is such that the headland only provides limited shelter to the western end of Traeth Crugan. As such, the drift along the Traeth Crugan frontage tends to be towards the east. This western end is an area of erosion and is only maintained by the higher foreshore.
- The areas of higher sea bed to the eastern end of Traeth Crugan do tend to support sediment accumulation in the centre of the bay but this can be variable, and the dunes are vulnerable to erosion.
- South Beach has tended to be an area benefiting from sediment transported from the west. Particularly to the eastern end there has historically been accretion in this area.
- Abererch tends to be an area of sediment parting, with sediment moving to the east and to the west. There can be periods of accretion.
- Glan y Don has tended to erode but is relatively stable.
- The beach to Pen ychain similarly is an area where the beach and dunes are stable but can erode under severe wave attack.

In addition to the general pattern of sediment movement certain features of the coast are significant.

- At Borth Fawr, Traeth Crugan/ South Beach and along the central section of the Pen-ychain bay at Abererch, these areas may be seen to be, in effect, barrier beach systems. Their development seen from early mapping also highlights this fact. Prior to the enclosures of the 18th and 19th centuries there is evidence that Carreg Imbill was, in effect an island linked by a low shingle ridge or spit. South Beach developed as a barrier of sediment infilling between the area of the golf course and the rock outcrop. Borth Fawr, may be seen as being an area of marsh, in front of which developed a dune ridge. These bays are effectively stretching that barrier as they have formed their curved shape. They are very dependent on sediment supply from the nearshore to maintain the distending barrier ridge.
- In the case of the Warren and Llanbedrog, the bays are backed by coastal slopes. The beaches act as a wedge at the base of the slope and with less tendency to distend may be seen as inherently more stable.

The overall pattern of development of the coast is to roll back. This has been an on-going process and one that will increase with sea level rise. As this happens, there

would be the capacity for the barrier beaches to maintain their shape and integrity, so long as there is adequate sediment supply to allow this to happen and adequate width to allow space for the new coastline to develop. Despite there being apparently only quite a thin veneer of sediment at Borth Fawr, the general ability for the frontage to recover from erosion would suggest that there is a reasonable nearshore supply of sediment to this bay. There is also seen as being a good sediment supply within the nearshore area to allow the Warren and Abersoch bays to develop.

At Traeth Crugan and along the western end of South Beach, there is greater concern that nearshore sediment is less prevalent. The reveting of much of the frontage has constrained the shore's ability to retain sediment as a barrier and fixing the back face of the dune system has stopped the ability of the backshore to develop in land.

There is a similar issue now developing at Abererch, where there may be the potential for supply from the nearshore area but limited width within which to allow the backshore ridge to develop.

The impact and influence of the various water courses along the frontage has been significantly curtailed by the enclosure of nearly all the valleys.

POTENTIAL BASELINE EROSION RATES

In assessing erosion and recession in the future, allowance has been made for sea level rise and this is discussed in Appendix C. This is also discussed briefly in following the table.

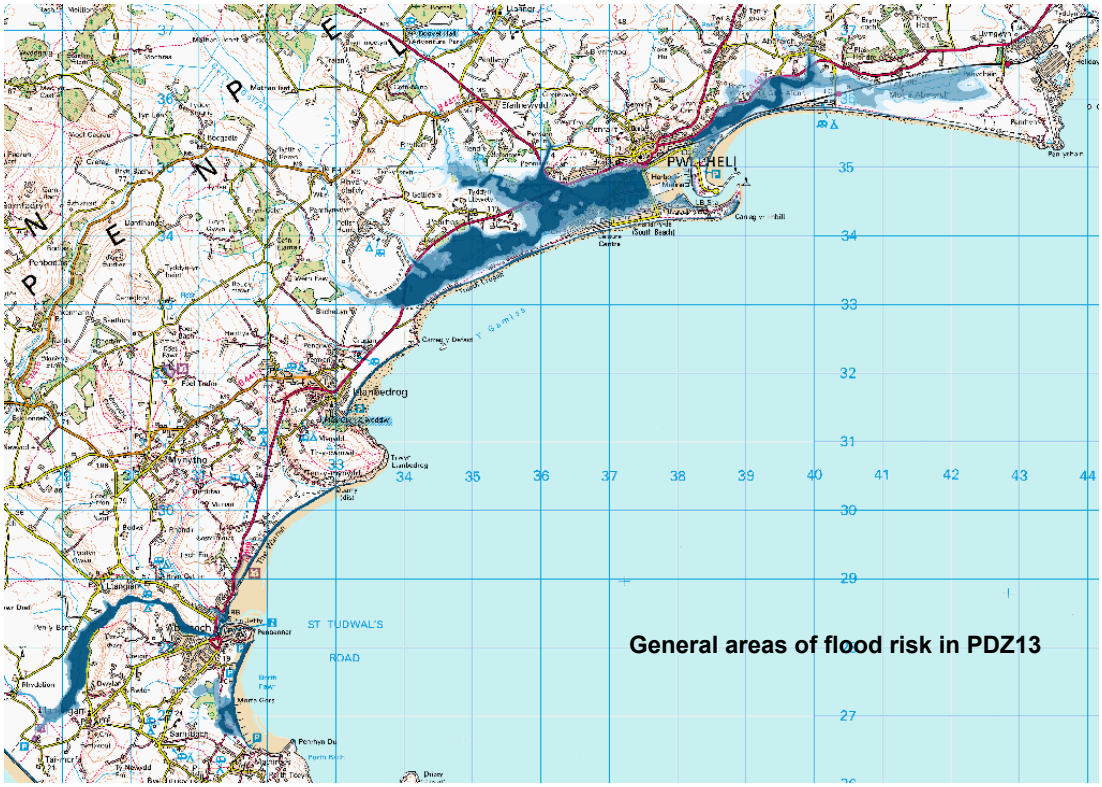
Along the whole frontage, with the exception of the intermittent areas of hard rock, sea level rise (SLR) will be a significant factor in future development of the shoreline, very slow erosion of the main hard headlands will still control the overall shape of the coast and they would be largely unaffected. Where there are softer cliffs or shorelines suffering erosion, the rate of erosion is likely to increase with SLR. This might be by a factor of 1.7 to 2.5 times the existing base erosion rate over the 100 years. Where there are more stable features, such as fully developed beaches or barrier beaches there would be a natural roll back of the beach potentially in the order of 10m to 40m, depending on the nature of beach and the coast behind. Potential cliff instability is only a significant issue between the Warren and Abersoch, where erosion of the toe of the coastal slope may, in the long term impact on the road and at Porth Ceiriad, where there is underlying slippage in the boulder clay slope.

Location	NAI Base Rate (m/yr)	Notes	100yr. Erosion range (m)
Pen-ychain	0.05	Hard rock outcrop.	5 to 10
Morfa Abererch	0.05	Erosion to softer slope , roll back of dunes	30 to 40
Abererch	0.3	Held forward by defences, potential for breach	60 to 100
Glan y Don	0.05	Relatively stable dune, potential to roll back	25 to 30
South Beach	0.05	Relatively stable dune, potential to roll back	10 to 40
Traeth Crugan	0.3	Eroding ridge held forward by defences potential breach	60 to 90
Llanbedrog	0.1	Stable coastal slope	20 to 35
The Warren	0.05 to 0.1	Variable local erosion	20 to 35
Borth Fawr	0.2	Barrier dune	50 to 70

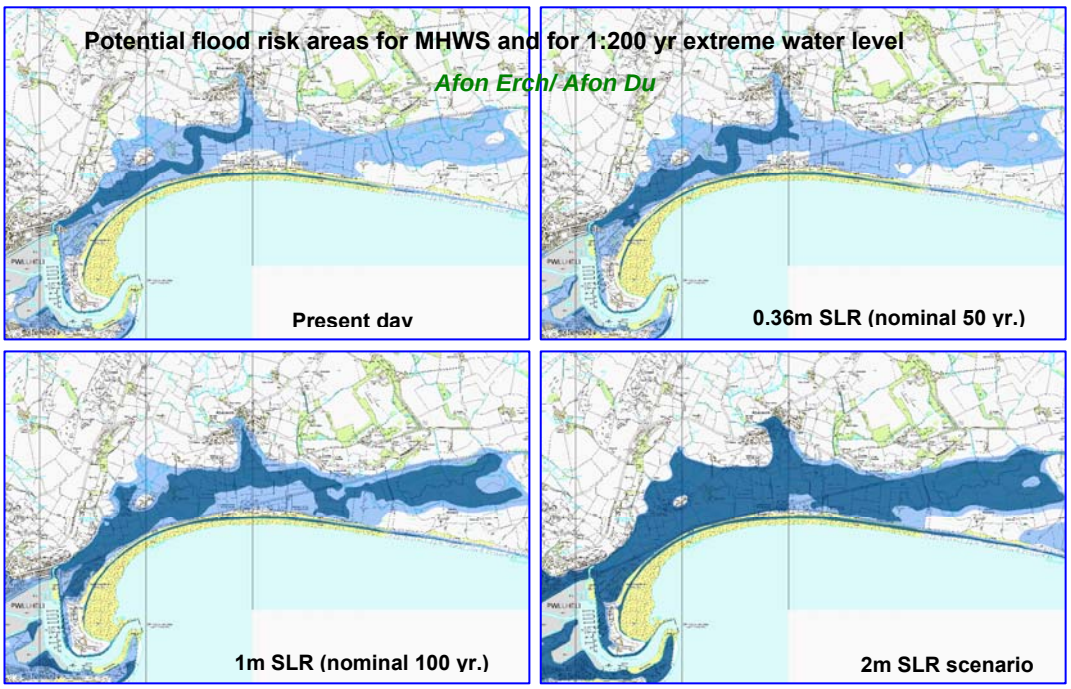
Base rates have been assessed from monitoring and historical data. The range of potential erosion is assessed in terms of variation from the base rate and sensitivity in potential sea level rise. Further detail on erosion rates together with erosion maps are provided in Appendix C.

FLOODING

The key areas of flood risk are at Pwllheli and the valley of the Erch and at Abersoch. These areas are highlighted in the following diagram and discussed in more detail below. Clearly, sea level rise will have a significant impact on the degree and extent of flood risk.



Afon Erch and Afon Du. The following sequence of figures highlight the present day flood risk from MHWS and for the 1:200 year extreme water level and for different sea level rise scenarios.



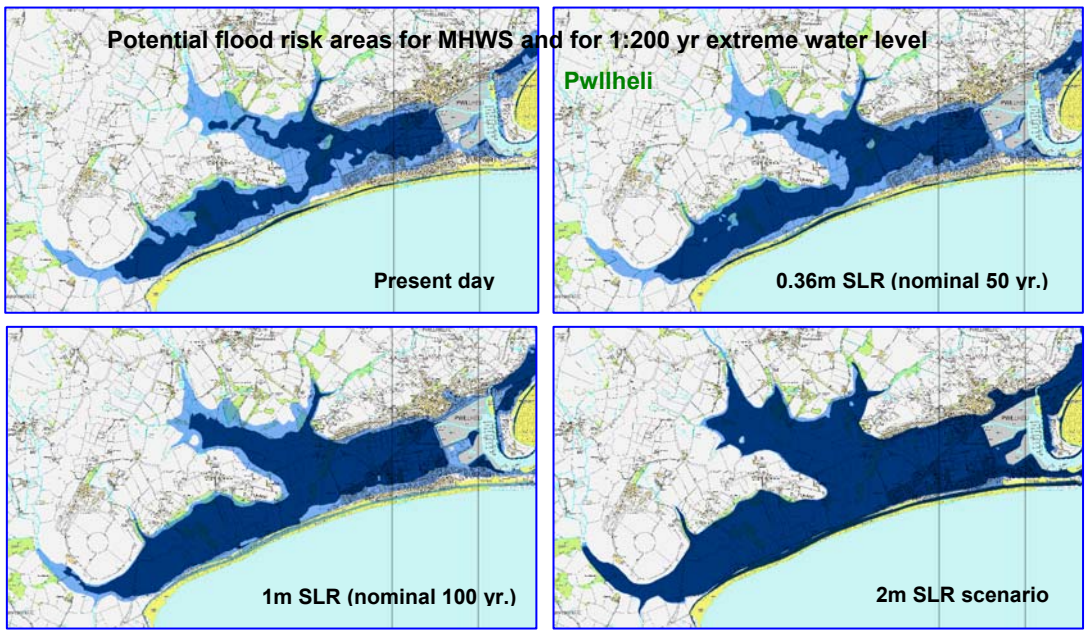
Under present day conditions, flooding under normal tide levels would be confined to the main channel of the Afon Erch. The larger potential flood risk area under extreme water level extends up much of the low lying valley of the Afon Du. Sluice gates at the corner of Pwllheli Harbour act to defend the area against sea flooding. The defence of the area is critically dependent on the shoreline ridge. The railway is at potential risk, as are local areas of the road, however much of Abererch would only be affected by more extreme flood conditions above that of the 1:200 year event. The valley can be tidally locked and is at risk from fluvial flooding.

Under sea level rise of 0.36m, there would be out of bank flooding of the main river. There is slightly greater risk of flooding to the main village and tidal locking of river flows is likely to increase. Under a 1m sea level rise scenario, the larger valley would be at risk of flood under normal tidal conditions and this might impact on both the road and railway line. The extent of more extreme water level flooding does not significantly increase but would now take in the area of the Holiday village and would result in deeper flooding of the valley and slightly increased risk to the main village.

Impact of different Sea Level Rise Scenarios

Under a 2m SLR scenario, flood risk would increase substantially. Much of the main valley would be at risk of flood under normal tidal conditions, as would areas of the main village. The more general extent of flooding would not significantly increase, reflecting the shape of the natural coastal flood plain which has been enclosed by the barrier dune system.

Pwllheli. The following sequence of figures highlights the present day flood risk from MHWS and for the 1:200 year extreme water level and for different sea level rise scenarios.



There is a relatively similar pattern of flood risk to that in the Abererch area, in that it is not so much the overall extent of the flood risk area that changes with sea level rise but rather the depth and frequency of flood risk within that area. This again reflects the pre-enclosure shape of the old coastal flood plain. It is also of note that the older part of Pwllheli, shown on early maps, is above normal tidal flood levels.

Under present day conditions the central section of the main valley of the Afon Penrhos and Rhyd-hir is below MHWS. This normal tidal extent extends well up the Afon Penrhos into the low lying areas of the golf course and the heavily drained land around Penrhos Village. Even under present conditions the main road, where it crosses the Rhyd-hir valley is at risk from normal tidal flooding. There would also be flood risk to the road where it crosses the western side of the Penrhos valley. The newer redeveloped area of the northern part of the town is at risk from flooding on MHWS, this includes the bus station and the ambulance station. On the southern side of the valley, the council office would be at similar risk as would the school and property around the junction of the Cardiff Road and Fford Galncymerau. A large proportion of the property on the slope down from the South Beach promenade would be at risk on more extreme water levels.

In the area of the harbour, the Morfa'r Garreg housing estate is at risk on extreme events.

There is some increase in area at risk from normal tidal flooding with 0.36m sea level rise. However the areas with more extreme flooding increase only marginally.

Clearly, tidal locking of the valley is already a significant issue and the slight increase in sea level might be quite critical to this. Under the 1m sea level rise there is again a significant increase in area at risk from tidal flooding. Areas of the road presently at risk due to MHWS, would now be subject to flooding in excess of 1m only normal tides.

Impact of different Sea Level Rise Scenarios

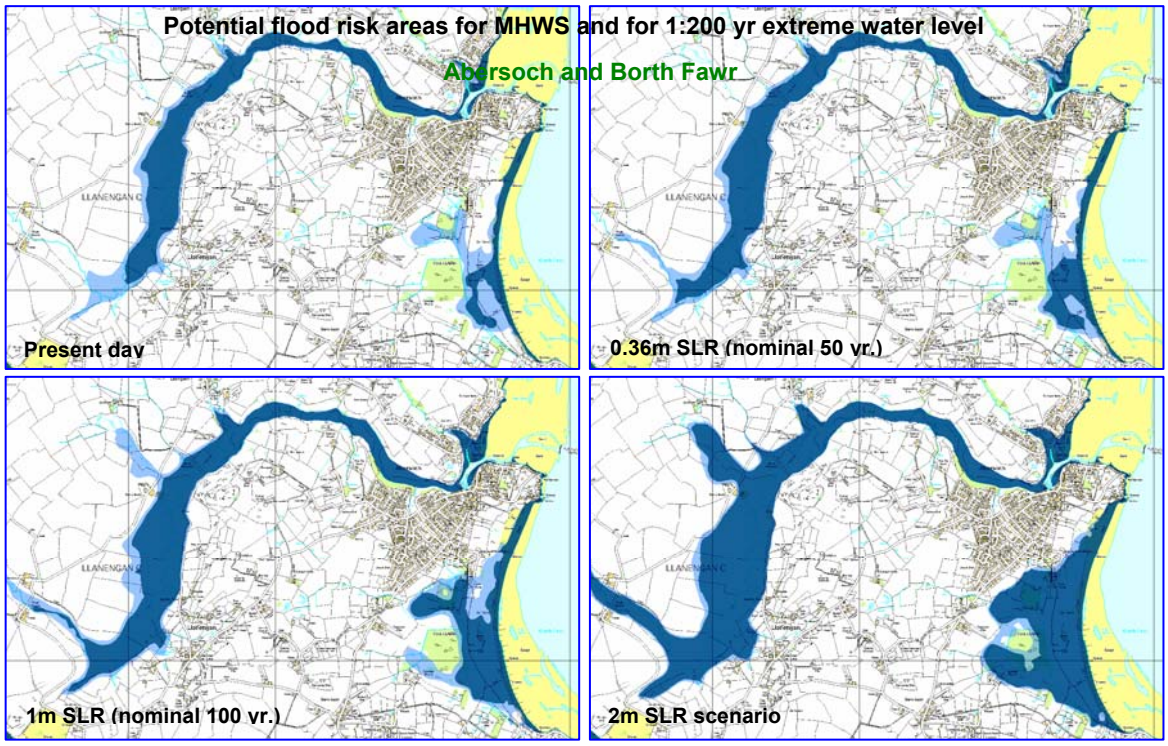
Under a 2m SLR scenario, normal tidal flooding would cover an area slightly greater than might occur under a 1:200 year extreme event. All but the most seaward properties on the southern sea front would be at risk under MHWS. All properties south of the main road would be under similar flood risk. There would be significant tidal locking of fluvial flows.

Defence against flooding is provided the presence of the Cob and by the dune ridge along South Beach and Traeth Crugan. In considering future management of the area these sections of the shoreline need to be considered together.

Abersoch and Borth Fawr. In this area there is a more marked difference in flood area extent with the more extreme sea level rise scenarios in specific areas. Around the mouth of the Afon Soch there is already potential flood risk even on normal tides to the spit at the mouth of the estuary and on the southern spit. The current use of these areas for water sports facilities tends to recognise this risk. There is also a more extreme risk to the road to the back of the estuary. Not surprisingly, given the steep sides of the Soch Gorge, the flood risk area through this narrow valley is well defined and limited to the floor of the valley. However, it should be noted that the whole length of the Gorge is below MHWS at present and this level of risk extends beyond the Gorge into the low lying land below Llanengan, in the area behind Hells Mouth. As such, the potential tidal prism of this valley would be quite significant and if not defended, would generate significant flows through the relatively narrow estuary entrance at the coast.

The main affect of sea level rise, specifically when considering a 1m sea level rise, is a further significant area at risk upstream of the gorge. This would principally impact upon farmland rather than property.

The following sequence of figures highlights the present day flood risk from MHWS and for the 1:200 year extreme water level and for different sea level rise scenarios.



Further south at Borth Fawr, under present day conditions, while there is a relatively small area of normal tidal risk to the area behind the shoreline dunes, the area at risk from more extreme water levels would impact on the Golf Course. Much of the Cors Llyferin SSSI would be above even extreme water levels.

With sea level rise of 1m the area of normal tidal flood risk would increase sharply, with extreme water levels extending over much of the Golf links, including the Club House and put some properties at risk behind the Club House. There would be significant incursion into the SSSI.

Impact of different Sea Level Rise Scenarios

Under a 2m SLR scenario, normal tidal flooding would extend inland to cover the whole of the old coastal flood plain. Part of the SSSI would remain above normal or extreme water levels. The extreme water level flooding would not be significantly greater than that of normal tidal flooding.

EXISTING DEFENCES

There are local defences along the Abererch frontage, these comprise dune management and rock revetment. The Afon Erch valley provides defence at the sluice in the corner of the harbour. There are defences around the whole circumference of the harbour, at the harbour mouth and to the spit running down from Carreg Imbill.

Along Pwllheli South Beach there is a sea wall to the promenade that is now largely submerged under the managed dunes. There has in the past been recharge of the beach to the west of the sea wall, making use of sediment won from dredging the harbour. Further west, defence has been progressively extended from in front of the Golf Club House and from the eastern Traeth Crugan end. In effect, the natural dune system has been defended with rock revetment over the last thirty years.

There are very local defences to Llanbedrog around the slipway at the western end. To the west of Mynydd Tir y cwmwd, significant lengths of the Warren have been reveted. In some areas, these defences have been substantially re-covered as areas of the frontage have subsequently accreted.

At Abersoch, there is a wall to the north of the estuary, built in the 1950s, which is now well buried by sand. The road around the back of the estuary is in effect a defence with sluices defending against tidal incursion up the valleys. The cliff line of Penbennar is protected in short lengths and this piecemeal approach to defence extends around to the northern area of Borth Fawr.

There is a rock revetment at the northern end of the low lying land behind Borth Fawr and there is a sea wall and groyne system along the central section of this frontage.

Unconstrained Scenario

The natural behaviour of the bay between Carreg Imbill and Pen ychain is to roll back. In the absence of defences this is what would occur. It seems quite probable that a breach would occur and that the area of the Afon Erch and Afon Du would form a new tidal inlet. This may then become a new entrance to the Afon Erch. In the absence of the harbour entrance structures, together with the opening up of the river valley through Pwlhelli, which would substantially increase the tidal prism, this would have a significant change in the area of the channel. The entrance is likely to widen, there could be increased sediment moved into the entrance and there would be increased erosion along Glan y Don as the shape of this frontage changes.

Along South Beach there would be a tendency for the shoreline to roll back. The limited sediment in the area of Traeth Crugan is likely to result in this section breaching through to the Afon Penrhos valley behind. It seems quite probable that this entrance would develop as the main entrance to the river. The low lying land is likely to accrete and form saltmarsh and there is a possibility that the route through to the central valley of Pwllheli may partially close.

At Llanbedrog and along the Warren, the coast would erode back slowly. This is likely to maintain the necessary width in the backshore area for beaches to be retained and the coast would respond much as at present, just set back slightly.

At Abersoch, in the absence of defences or control of tidal flow up the Afon Soch, the tidal prism of the estuary is likely to increase. This would result in more pressure on the northern spit at the estuary mouth as the entrance channel attempts to widen. The existing estuary area may well accrete as more sand is flushed into the estuary. The influence of the river and estuary flow on the foreshore would also increase. The exact impact this might have is uncertain but there is the potential for increased nearshore banks and from this to be positive in relation to retaining sediment in the Abersoch area.

At Borth Fawr the whole bay would tend to roll back. The ability of the beach to recover after periods of erosion suggest that there is the potential for a more developed dune system to be created set back behind the line of existing defences. It seems probable, however, that there would be increased flooding to the low lying land and that the existing culverted stream would open more as a small estuary mouth.

At Porth Ceiriad, there would be gradual erosion of the cliff and roll back of the natural beach. This erosion is likely to give rise to increased instability in the coastal slope.

KEY INTERACTION WITH DEFENCES

From the above assessment, it may be seen that there are several places where the existing defences are or are beginning to have a significant influence on coastal behaviour. Obviously, one key area is the flood risk management of the valley running through the centre of Pwllheli. The Cob and sluice act to constrain the tidal flow into the valley, this limits the tidal prism and, in conjunction with the navigation control structures at the entrance, fixes the control of the dune frontage to Glan y Don. While this restricts the ability of this frontage to respond naturally and for a more natural active dune system to develop, the present management does control the frontage so that there is a reasonably active system which works as a front defence to the raised banks behind.

The other area where defences are constraining a more natural system response is at Abersoch, where the defence, principally of the Afon Soch valley, is preventing the natural interaction between the estuary and the shoreline. The response of the shore to a change in management is uncertain.

There are other areas on the open coast where there is significant interaction between defences and the plan shape development of the shoreline. At Morfa Abererch the defence of the railway line has been coming under significant pressure over the last few decades. Continued defence of this area is holding forward the shore in a critical section of the natural shoreline, at that change position in the curve of the bay between the relatively straight coast to the east and the sharply curving section through to the harbour entrance. Future management of this frontage would have to go in one of two directions. Either this frontage is held in a linear manner and, as it becomes outflanked, the length of harder defence has to be extended to either side, or the frontage has to be maintained as a new headland, creating, in effect two sub bays. Either approach would have a significant impact of the whole coastal behaviour.

At Traeth Crugan and the western end of Pwllheli South Beach there has been substantial increase in defence along the frontage. This is stopping the coast from developing naturally and as this defence is maintained and reinforced so the opportunity for retaining sediment along the frontage decreases.

At Borth Fawr, the existing defences are not significantly altering behaviour of the frontage at present but they will in the future as the coast attempts to roll back. This is likely to impact on the foreshore with the potential loss of sediment that might otherwise create the opportunity for natural dune development.

3 Management Scenarios

3.1 No Active Intervention – Baseline Scenario 1

In considering the baseline scenarios and in the subsequent discussion of future management the coast is discussed in six areas:

- Morfa Abererch
- Pwllheli
- Llanbedrog
- The Warren and Abersoch
- Borth Fawr
- Porth Ceiriad

It is recognised that there is interaction between sections and this is referred to in the discussion. However, the sections attempt to draw together areas of coast where there are principal hinterland issues, such as between management of the Harbour area of Pwllheli and that of Traeth Crugan, as well as considering the physical coastal interaction along the shoreline. There are also significant issues in relation to the railway line that extend into management of the shoreline to the east (PDZ12) and indeed further along the coast all the way down to Dyfi Junction (PDZ10). SMP considerations have shown that there are major national issues in this regard and that significant change in approach may be required to maintain the Cambrian Coast railway over its full length. In considering scenarios within this PDZ, these broader scale issues are acknowledged and, with respect to management of the railway, these are noted within the issues.

Morfa Abererch. The key areas of concern are the flood defence to the Afon Erch/ Afon Du valley and the management of defences along the relatively natural dune frontage of the Bay. Under this scenario it is taken that no further defence measures would be taken to manage the erosion and set back of the shoreline. Neither would there be further maintenance of the sluice in the corner of the harbour. However, it is taken that the sluice itself would be operated until such a time as it fell into disuse due to lack of maintenance.

The recent draft report on the geomorphological development of the frontage (Halcrow 2010) indicates that the probable initial failure or breach of the dunes would be to areas adjacent to the current rock defence to the dunes. This seems probable, although a major storm could result in failure of the existing defence. Probably such a failure or breach in the defence or dune would occur in the early part of epoch 2. There would then be a period of readjustment as the beach develops at the main entrance to the valley behind. It is accepted that at present there is only a limited potential for sediment supply from the nearshore area. This is suggested by the recent geomorphological report to indicate that this supply is diminishing. However, it is also noted that the report indicates that there is sediment by pass of Carreg Imbill and there is evidence that the frontage in general has the capacity to recover after a period of erosion. While, therefore it would be agreed that there may be insufficient sediment supply to fully re-establish a competent barrier system, there is the capacity within the system for a new estuary entrance to establish an ebb tide bank system that would tend to hold the natural bay shape forward. There could also be sediment carried into the new estuary mouth creating a flood bank system which would again support the dune barriers to either side. As such, a breach in this part of the bay would not be to the significant detriment of the natural defences along other sections of the frontage. The function of the SAC and SSSI would be maintained and there would be some change but no significant increased erosion to Glan y Don.

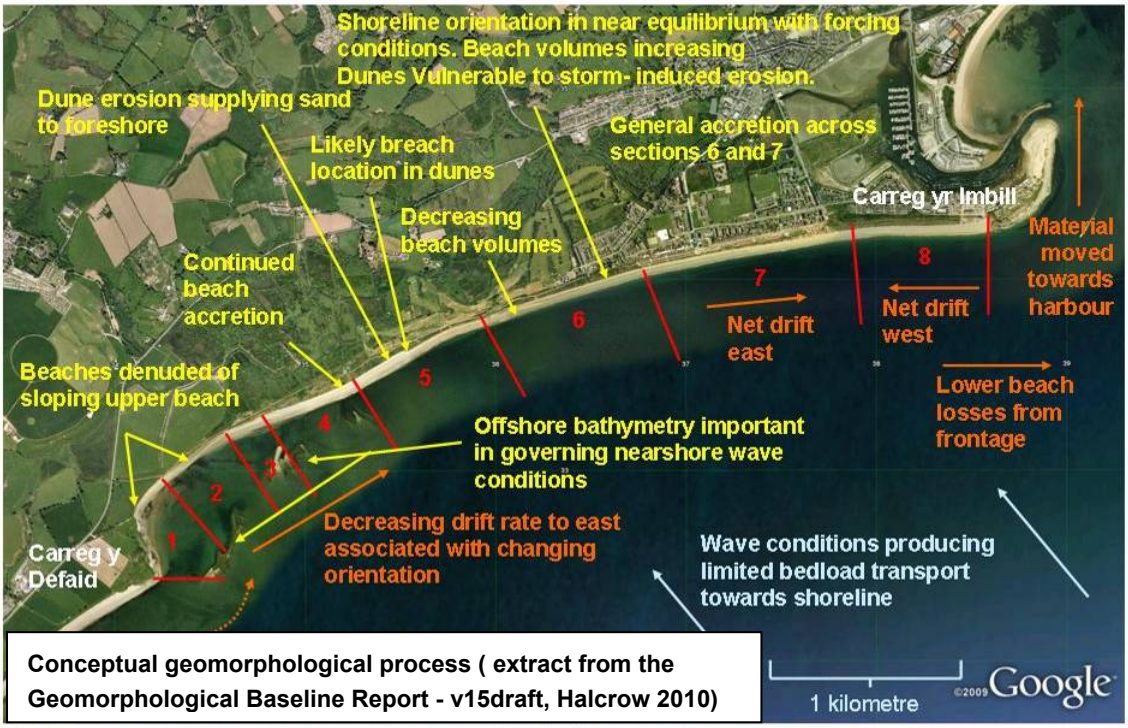
There would be significant loss of the railway line and opening the estuary of the two rivers would significantly increase the flood risk to Abererch and to the agricultural land within the valley. With sea level rise, the flood risk would increase. Particularly, the main road would be at significant risk of flooding and there would be substantial and regular flood damage to Abererch.

The sluice would become redundant and there would be less flushing to the harbour. There would also be increased flood risk to the important industrial estate and this would severely damage the local economy.

Pwllheli. The defence of the core part of the town relies upon maintaining defences at the Cob and maintaining defence from coastal flooding along the Penrhos Valley. There is also significant flood risk, while these defences are maintained from fluvial flooding. There is flood risk in the longer term to the operation of the harbour and navigation to the harbour relies upon control and dredging of the harbour channel.

Over probably the first two epochs, the basic structures to the harbour and the Cob would, even without maintenance, be retained. The critical part of the defence system would be the sluice which without significant maintenance would fail within the second epoch. It is taken that the sluice would still be operated during this time.

The main earlier risk of flooding would be from the Penrhos valley. The defences along Traeth Crugan and along the golf course are adequate at present to resist typical storm events, although the foreshore is eroding. As the defences begin to fail there would be the potential for a major breach. The recent draft geomorphological report suggests that the breach is most likely to occur in the centre of the dunes, based on the assessment of sediment dynamics. It is, however, recognised that a breach could occur through to the



Conceptual geomorphological process (extract from the Geomorphological Baseline Report - v15draft, Halcrow 2010)

lower section behind if the defence failed. As with the Abererch frontage, a significant breach is likely then to form a natural entrance to the Afon Penrhos. Also, as with the system to the east of Pwllheli, the loss of sediment supply along the frontage in general is quite probably not the lack of available sediment in the nearshore system but rather

the lack of width at the foreshore for sediment to be retained. The drift system is known to be variable and under certain conditions, sediment can be fed to the shoreline. Under different conditions that sediment is redistributed along the shore. As such, opening of a new estuary frontage may well result in the opportunity to create an ebb system which may assist in maintaining supply to the east. Where a breach would occur, could be critical to the whole structure and sustainability of South Beach.

Along South Beach there would be a roll back of the shoreline with sea level rise. Under this scenario, without management, the dunes might degrade over time and eventually, in epoch 3, there could be erosional loss to defences.

Overall, this scenario for the whole area creates opportunity for significant gain in nature conservation value as the whole area reverts to a naturally functioning barrier saltmarsh system. However, there would be very substantial losses in terms of infrastructure, flood damage to properties, loss of the golf course, loss of navigation to the harbour and to harbour facilities. There would be substantial increased flood risk both within the town and across the two valleys to the main road. This in the long term would, even during the early part of epoch 2, result in the road being unsuitable as the main through route to the southern part of the **Llŷn Peninsula**. If all this was unmanaged, this scenario would lead to the loss of significant assets which underpin the use and economic value of Pwllheli and to the region.

Llanbedrog. The slow erosion and loss of very local defences around the slipway would occur under this scenario. There would be increased flood risk to the property at the west end of the bay. However, there would not be significant impact on the main village. Allowing natural processes to continue would support the nature conservation values of the area.

The Warren and Abersoch. Under this scenario, there would be continued slow loss to the Holiday Village as defences fall into disrepair. Chalets and caravans would have to be moved back to avoid loss, but if there were no space behind the park this could impact on the viability of the Holiday Centre. This would have a significant impact on the regional economy and on tourism to the area.

At Abersoch, the main change in this area would, as discussed in the unconfined scenario result in opening up the Soch valley to regular tidal inundation. It is uncertain how this would impact on coastal processes. However, while accepting that there would be significant change at the estuary entrance, with potential loss of the Lifeboat Station and existing areas used for water sport facilities, there is the potential that increased influence of the estuary may create a generally more sustainable frontage and use of the area. This may also influence the behaviour of the beach to the east along the Warren. Therefore, while this scenario would result in substantial change and loss of a significant number of properties and use of the area, there is the potential that it may give rise to alternative areas of use within a more natural system.

The flood risk up the Afon Soch would result in areas of agricultural land being inundated by sea water. This would impact on areas currently under drained management. Only in the long term would there be an increased risk to properties. There could be significant benefit in terms of nature conservation and the nature of the potential marsh land this would create could be of significant tourism value, complementing the current water sport focus of tourism that at present under pins the local economy.

There would be erosion risk to property around the Penbennar headland.

Borth Fawr. The no active intervention scenario in this area would allow the roll back of the dune system in the centre of the bay. This may well still provide a significant barrier at the shoreline and enhance use of the beach. An inlet is likely to form behind the dunes and this would impact increasingly of the use of the important Golf Links. It is only in the long term, epoch 3, that flood risk would increase to the extent that the club house was affected.

While the current designated features of the SSSI would be affected, the opening up of the low lying valley associated with the raised land in the centre of this low lying area would create the opportunity for new transitional habitat and the potential development of saline lagoons.

There would be erosional loss of property and facilities at the northern end of the bay and this would impact severely on use of the area. There would also be increased flood risk to properties at the southern end of the bay and potentially in the long term to the sewage works.

Porth Ceiriad, the headland and islands. This scenario is the current management policy for this area. There would be little impact on the islands or to assets around the hard rock mainland. The section of beach and coastal slope would continue to erode and roll back and there could be increased risk of coastal instability. The National Trust car park is not likely to be affected over epochs 1 and 2, but may be subject to loss due to slope instability in the long term. This scenario would support the essential values of the area and would have little detrimental impact on the SPA.

The damages associated with this scenario are set out in table1 and an assessment against general objectives is given in table 2.

3.2 With Present Management – Baseline Scenario 2

Table below Table below sets out the present management policies under SMP1.

SMP 1 No.	Management Unit	Policy	Subsequent Management Approach
Gwynedd			
9.1	Morfa Abererch	R	
9.2	Abererch	HTL	On going sustainability study
9.3	Pwllheli Harbour	A	
9.4	Pwllheli South Beach	DN	
9.5	Traeth Crugan	HTL	
9.6	Llanbedrog	DN	
10.1	Mynydd Tir y Cwmwd	DN	
10.2	The Warren	HTL	
10.3	Abersoch	HTL	
10.4	Borth Fawr	DN	
11.1	Porth Ceiriad	DN	

The following information and policy is abstracted from the North West Wales CFMP Draft Plan.

Preferred policies for Policy Unit 1 – Northern Coastal Rivers

The area is covered by two CFMP policy units, Policy Unit 3 covering the western part of the Llŷn Peninsula and Policy Unit 4 specifically look at the area around Pwllheli.

Policy unit 3 Llŷn Peninsula	This unit covers the **Llŷn Peninsula** from the coastal point from the far western coast to join policy units 2 and 5 on the border of the Snowdonia National Park. The main towns and villages include Aberdaron, Abererch, Abersoch, Chwilog, Criccieth, Llannor and Nefyn.
Problem/risk	**Physical characteristics:** The **Llŷn Peninsula** is drained by a dense network of small rivers and streams flowing and generally north-south direction. The main rivers draining the area are the Afon Soch, Erch, Rhyd-hir and Dwyfach. The peninsula is predominantly rural with scattered settlements and agricultural land of moderate grade 3-4 and poor quality grade 5 land on the east of the peninsula. Most of the peninsula is an ESA with Areas of Outstanding Natural Beauty around the coast. The area is mostly low-lying, except for a few small areas of raised ground on the northern coast. The majority of the rivers in this catchment have moderately gentle slopes and therefore can react relatively slowly to a rainfall event. Soils are mostly impermeable and prone to prolonged waterlogging. Overland flow is likely following rainfall on saturated soils. Water levels rise quickly in some rivers.
	Flood mechanism: Small localised river flooding. Small areas of surface water flooding.
	Receptor: Small villages and settlements scattered across the Peninsula. Landscape designations – ESA and AONB. Environmental Designations – SACs, Ramsars and SSSIs. Historic designations – Listed buildings, Scheduled Monuments, Historical Landscape Areas, Registered Parks and Gardens.
	Future flood risk summary (in 100 years time)
	Climate change is not expected to have a significant affect on the flood risk in all the small villages and settlements across the **Llŷn Peninsula**.
Policy selected	**Policy 2 -** Reduce existing flood risk management actions (accepting that flood risk will increase over time). Note: this policy option involves a strategic increase in flooding in allocated areas, but is not intended to adversely affect the risk to individual properties.

Justification	The current flood risk is low. Only approximately 3% of the total number of properties on the **Llŷn Peninsula** are at risk from a 1% AEP flood event. In the future, the number is only expected to increase to 4%. The number of people currently at risk is approximately 670. To put this into perspective the number shows that 3% of the total population of the policy unit are at risk from the 1% AEP flood event. In the future the number of people at risk remains at 3%. As the flood risk is low, a policy 2 has been selected. This means we intend to continue maintenance of the local flood defences at the current level in the villages and small settlements. However channel maintenance in rural areas will be discontinued as the flood risk is not significant in these areas. The flood depths and extents in the rural areas may increase slightly, however this is unlikely to increase the number of people at risk of flooding from a 1% AEP flood event. In addition, there are no environmental losses expected as a result of implementing a policy 2. The number of people at risk only increases by 1% in the future as a result of climate change. The flood risk remains low. Therefore a policy 4 or 5 is not necessary. Discontinuing the existing flood risk management actions would result in existing flood defences falling into a state of disrepair and would put more people and property at risk of flooding than at present. This would not meet the objectives and therefore policy 1 is unsuitable. Although introducing flood storage area or restoring the Afon Rhyd-hir and its floodplain to a naturally functioning state may have localised benefits in policy unit 4 (Pwllheli), there is no evidence to suggest that carrying out a policy 6 across the whole of the **Llŷn Peninsula** will provide catchment-wide flood risk benefits. Therefore a policy 6 is not suitable.
Catchment-wide opportunities & constraints	Opportunities: To provide flood storage and enhance conservation value and biodiversity by restoring rivers to a naturally functioning state through the removal of Environment Agency owned and maintained structures. Reduce future flood risk by influencing and informing the planning process. Help meet national biodiversity action plan (BAP) targets through flood risk management activities. To improve water level management, meeting the needs of flood risk management as well as enhancing wetland habitats through development of Water Level Management Plans (WLMPs). To improve the sustainability of flood risk management along the coastline and Plans. − Reduce flood risk throughout the CFMP area through initiatives and actions that will enhance the character of the landscape and increase amenity opportunities for recreation, tourism and leisure activities within the National Park and Areas of Outstanding Natural Beauty. − Reduce peak discharge rates in rivers through restoration of watercourses to a good geomorphological river status (i.e. naturally functioning watercourse) in accordance with the Water Framework Directive. − Reduce flood risk through improved flood warning and emergency response. Constraints: Government and international legislation, environmental management policies, plans and strategies for the catchment should be complied with, such as accommodating new housing within the catchment as detailed in the Wales Spatial Plan and compliance with the Habitats Regulations. Some environmentally designated habitats are susceptible to changes

	in flood frequency, flood water chemistry, groundwater levels and drainage system maintenance. Visual impact of flood risk management activities within the AONBs. Presence of protected species with specific water level, water quality and habitat requirements, such as freshwater pearl mussels and water voles. Large number of river catchments operating individually. Historic development and some heritage designation present permanent physical obstructions in floodplains. No degradation of existing fish passage and habitats. Some exposed and subsurface archaeological sites in the floodplain are susceptible to changes in water level, flood frequency and water chemistry. Tourism, leisure and recreation amenities are vital to the economy of the area
Actions	**Strategic influencing** Undertake a study to assess how the policy of reducing actions is most appropriately delivered; Encourage the up take of flood resistance and resilience measures by people at risk from flooding; Influence land management and encourage agri-environment schemes in the **Llŷn Peninsula** area. **Asset management/maintenance** Undertake a System Asset Management Plan; Maintain existing level of maintenance within communities where current flood defences exist; Reduce maintenance of river channels for land drainage benefits in rural areas across the **Llŷn Peninsula** area. **Flood awareness** Provide information about how the communities can help themselves before, during and after a flood.

Policy unit 4 Pwllheli	This unit covers the town of Pwllheli on the south coast of the **Llŷn Peninsula**.
Problem/risk	**Physical characteristics:** Mostly urban area. The town is drained by the Afon Rhyd-Hir which flows into the sea at Pwllheli. The impermeable geology comprises lava, mudstones and shales. The topography of the policy unit is relatively flat and low-lying which, with its coastal location, leaves it vulnerable to tidal flooding. The fine sandy beach attracts visitors to the area. **Flood mechanism:** Tide-locking of the outfall on the Afon Rhyd-Hir causes the water in the river to 'back-up' and overtop its banks. Sewer flooding – the highest number of sewer flooding incidents in the CFMP area. Surface water flooding **Receptor:** People and properties in Pwllheli. Main A499 road through the town and local B roads. Listed buildings.
	Future flood risk
	Our modelling indicates an increase in flood damages of approximately 460% as a result of climate change in Pwllheli. The large increase in damages resulting

	from climate change reflects the large number of properties located in Pwllheli. The future impacts to critical infrastructure also increases significantly increasing the level of disruption during a flood event.
	Policy 4 - Take further action to sustain the current level of flood risk into the future (responding to the potential increases in risk from climate change).
Justification and alternative policies considered	Currently floodwaters are shallow, low velocity and short-lived. The present flood risk is low and no immediate action is necessary. Therefore a policy 5 is not required. However, climate change, especially sea level rise, has significant impacts on the flood risk in Pwllheli. These changes affect flooding mechanisms in expected to increase and as inflows increase from more frequent storms, sewer flooding incidents will increase. Flood damages increase from £0.7 million now to £4.1 million in the future from river flooding with tidal influences. The number of people at risk increases from 90 to 320. This is a significant increase. It is therefore necessary to take further action and mitigate the affects of climate change to reduce the future flood risk in the policy unit. For this reason, a policy 4 is selected. This means we intend to improve the channel maintenance, and look to introduce a flood warning service, carrying out local defence works and investigate options for flood attenuation upstream on the Afon Rhyd-hir. A policy 4 will achieve the objectives set to ensure the harm to life caused by flooding does not increase due to future changes. Stopping or reducing the existing flood risk management actions would allow existing flood defences to fall into a state of disrepair and would put people and property in Pwllheli at a greater risk of flooding than at present. There are likely to be more than 940 people at risk if the current flood risk management actions were discontinued or reduced. This is unacceptable and therefore policies 1 and 2 are unsuitable. Given the significant increase of risk in the future from climate change it is essential to mitigate the affects of increased inflows and sea level rise to ensure the harm to life, community disruption, number of properties and flood damages do not increase from the baseline. For this reason policy 3 is unsuitable as it does not mitigate the affects of climate change. As the policy unit is mostly urban, there are no suitable locations to increase the frequency of flooding, therefore a policy 6 is not considered feasible in this policy unit.
Catchment-wide opportunities & constraints	Opportunities: Ensure no increase in run-off from the new developments proposed in the Wales Spatial Plan through development control. Reduce future flood risk by influencing and informing the planning process. To reduce flood risk and improve water quality by promoting and encouraging the appropriate use of SuDS in the proposed urban developments in the Wales Spatial Plan. To improve the sustainability of flood risk management along the coastline and estuaries through influencing the second generation of Shoreline Management Plans. Reduce peak discharge rates in rivers through restoration of watercourses to a good geomorphological river status (i.e. naturally functioning watercourse) in accordance with the Water Framework Directive. Reduce flood risk through improved flood warning and emergency response. Constraints: Government and international legislation, environmental management policies, plans and strategies for the catchment should be complied with, such as accommodating new hosing within the catchment as detailed in the Wales

	Spatial Plan. CFMP objectives must compliment the Cardigan Bay Shoreline Management Plans (SMPs). Historic development and some heritage designation present permanent physical obstructions in floodplains. No degradation of existing fish passage and habitats. Some exposed and subsurface archaeological sites in the floodplain are susceptible to changes in water level, flood frequency and water chemistry. − Tourism, leisure and recreation amenities are vital to the economy of the area.
Actions	**Strategy Plans** Develop a strategy for Pwllheli. This should concentrate on understanding the future fluvial and tidally influenced flood risks. **Strategic influencing** Put in place policies within the Local Development Plans that ensure buildings at risk of flooding are made more resilient; Produce an appropriate study to focus on river restoration and attenuation upstream on the Afon Rhyd-hir. **Flood risk mapping and modelling** Undertake a flood risk mapping study for the fluvial flood risk in Pwllheli; Undertake an appropriate hydrologic and hydraulic modelling study. **Asset management/maintenance** Develop a System Asset Management Plan; Continue maintenance of flood defences and flood risk management assets in Pwllheli; Continue maintenance of the Afon Rhyd-hir and Afon Erch; Continue maintenance of the completed sewage-surface water pumping scheme at Y Maes. **Urban drainage** Develop an integrated urban drainage strategy; Provide development control advice; Promote and support the implementation of Sustainable Drainage Systems (SuDS) in all new developments. **Flood awareness** Provide information about how the communities can help themselves before, during and after a flood. **Flood forecasting and warning** Investigate the potential to introduce a flood warning area; Investigate the potential to install flow/level gauges on the Afon Rhyd-hir. **Flood incident response** Work with the Local Flood Planning Group to develop a Multi Agency Flood Plan; Produce a local community flood plan. **Tidal flooding** Carry out a more detailed study to investigate the future flood risks to Pwllheli as a result of the predicted sea level rise; Encourage the second generation of Shoreline Management Plans to consider the tidal flooding problem in Pwllheli.

The CFMP conclusions may be very simplistically summaries in relation to the interaction with the coastal area as being an intent to sustain Pwllheli as an important economic centre but taking regard to the conclusions of tidal flooding coming from the SMP2, while only looking to manage defence at a local level to other areas of the Llŷn Peninsula. This generally fits in with the policy of SMP1, where the intent is similarly to address and continue to mange the coastal defence to major areas of concern, specifically around Pwllheli and Abererch but to adopt a more local management approach at Abersoch and Porth Fawr, where the policy is for Do Nothing but highlighting concerns over damage with respect to the Golf Course.

SMP1 policy looked forward on over a 50 year period and neither SMP1 nor the CFMP considered in detail the increasing pressure on the coast, nor the risk of direct coastal flooding. It is significant to note that SMP2 identified the potential flood damages arising from coastal flooding to Pwllheli as being of the order of £300 million, whereas the CFMP assessing damages arising from tidally influenced fluvial flooding as being only of the order of £0.7 million at present rising to £4.1 million in the future. Clearly direct tidal flooding to the town is the most significant aspect of risk management to the area.

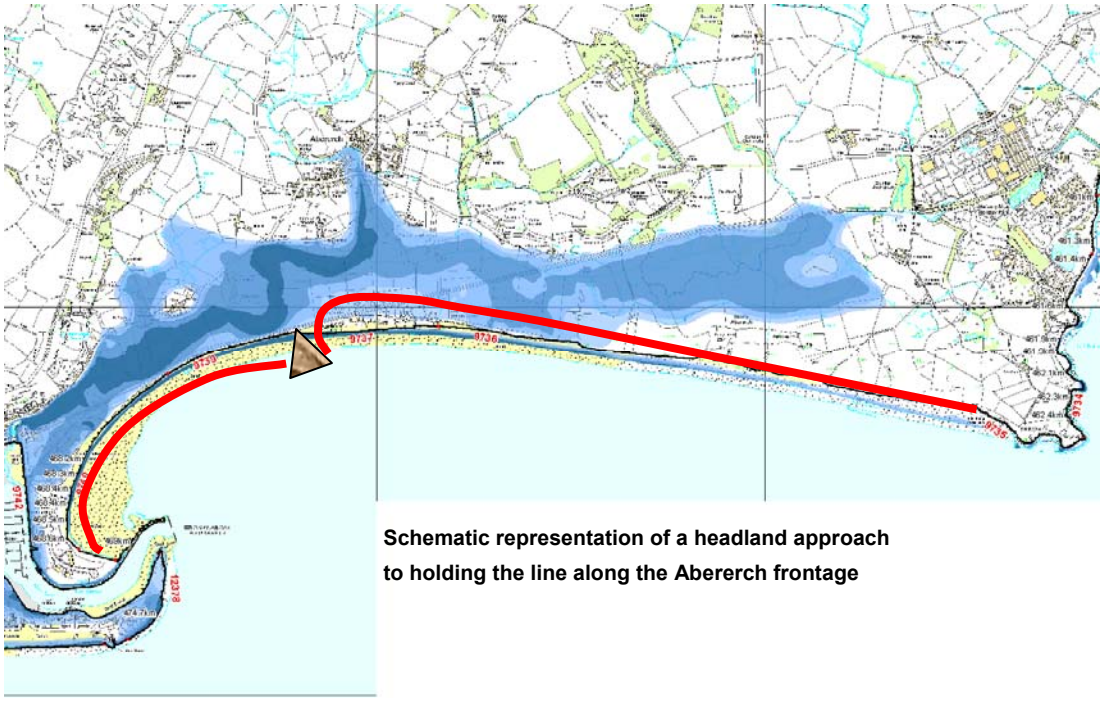
These aspects, particularly the aspect of future sustainability of the above approaches is considered in the following discussion.

Taking the above approaches in terms of their long term intent is taken as defining in general terms the With Present Management scenario, each area of the PDZ is discussed below.

Morfa Abererch. The key area of concern in terms of flood risk management is the railway and the village of Abererch. However, the key issue is the sustainability of managing the coastal frontage. From the previous discussion it is seen that current management practice would result in the need to extend the current defences laterally along the shoreline or to shift to an approach where the vulnerable area of the shoreline is managed as a new headland.

In the first approach there would be a need to gradually reinforce the existing defence and as this becomes outflanked to extend this to avoid the potential for breach elsewhere along the frontage. Typically over the 100 year period of the SMP this would require possibly a rock revetment extending some 3km over this section of the bay. This would constrain any width in the shoreline system to allow onshore sediment retention and would result in increasing erosion of the foreshore. The defences would no longer benefit from dune development and as well as having to increase the toe of the defence there would be a need to continue to raise the defence against sea level rise. This approach is inherently unsustainable.

Taking an approach whereby the area is developed as a new headland would sustain the defence to the west and create the opportunity for dune growth behind the new headland. However, the coast to the east would substantially erode creating a further embayment within a broader bay. This is shown schematically on the following figure. Although very conceptual it may be seen that there would be a need to subsequently address issue of erosion further to the east and under this general approach to management this might typically impose the need for further headlands. There would be potentially significant impact on the environment and on the landscape of the area. There would still be issues in relation to drainage and tidal locking of fluvial flows. As such this is not seen as beneficial to the area and may not be sustainable in the long term, even though the approach at the shoreline could be managed.



Schematic representation of a headland approach to holding the line along the Abererch frontage

The main economic justification for management is protection of the railway line. This would ultimately be a national strategic issue given the importance of this feature. However, as identified in other areas to the east, this requires large scale planning of the future sustainability of this asset.

Pwllheli. In itself management of the Cob and the management of the sluice to the river is seen as being sustainable with respect to the significant loss that might otherwise occur to core assets within Pwllheli. Along side this, maintaining the harbour and the use of the harbour, together with the significant benefit this brings to the sustainability of the regional and national economy. However, even though the flood risk to the town may be sustainable against a rise of 2m in sea level rise; with the need for pumped management of fluvial flows, sustaining this defence system will substantially increase the residual vulnerability of people and assets within the flood risk area. Looking at the very long term management of flood defence there has to be a question as to the long term sustainability of the area.

This is purely from a perspective of management in the area of the harbour. The other pathway for flood risk is from the south and is dependent on maintaining the defence at Traeth Crugan and along the Golf Course area. This defence has needed to be reinforced and extended significantly over the last 30 years and would continue to do so into the future. The frontage is subject to significant erosional pressure and, overtime there is seen as being a general loss of sediment and width for sediment retention along the frontage. Even in the centre of this frontage, where there has been an area of differential accretion, with sea level rise, the beneficial affect of the raised sea bed is likely to diminish. The lack of width at the foreshore created by the defences has resulted in a reduced capacity for sediment to be retained and hence a reduced capacity to feed sediment to the east. To Hold the Line along this frontage by sustaining the current linear defence would require substantial raising and reinforcing of the rock revetment. Given the processes at work this is not seen as leading to a sustainable management of food risk beyond potentially the early part of the second epoch.

The eastern end of this frontage, along South Beach is naturally retained by the presence of Carreg Imbill. Historic evidence indicates that this section is relatively stable. With sea level rise, there would be a tendency for the frontage to erode back. However, even with this increased pressure and given the importance both of the sea front and the potential risk of flooding to the harbour and to the valley of Pwllheli, maintaining a defence in this area would be achievable. Strictly, SMP1 policy for this frontage is for Do Nothing. However, within the text of the SMP this is defined because there was not considered to be a need to undertake works to sustain the defence. As such the With Present Management for the frontage is taken as defining an intent to maintain a defence to the area.

Overall, therefore, because of the difficulty in managing the defence at Traeth Crugan, the policy for Holding the Line in terms of current practice in defence of Pwllheli is not seen as being sustainable in the long term. Alternative approaches are considered in the final section of the PDZ.

Llanbedrog. With Present Management policy for this frontage is Do Nothing and is discussed earlier.

The Warren and Abersoch. The With Present Management policy for these areas is to Hold the Line. This is discussed in SMP 1 far more from a perspective of local management than any attempt to rigidly impose defence over the whole frontage. This is seen as being sustainable over the first and probably the second epochs. However, with sea level rise there will be increased pressure for erosion along the Warren and the intent within SMP1 to allow continued linear defence along this frontage is likely to impact on the quality of the beach. This is seen as being an important issue in management of the use of the area.

While the local defence to the properties around Penbennar are seen as being related to local management of the generally hard rock cliff, there are more significant issues in continuing to manage the area of the small estuary. The use of the spit would be increasingly difficult to maintain with sea level rise. Holding the Line (and the use) of the area would require a need to increase the level of the defences. This in turn may have implications for use and on the quality of the beach. Defence of the road is sustainable and with this so would be the sluices to the valley of the Afon Soch. However, the question then arises as to the benefit of maintaining the sluices. Despite the very low cost involved, maintaining the sluice would increase the potential for tidal locking of fluvial flow and this may give rise to flooding further within the valley. As such there may be little economic benefit.

Borth Fawr. The With Present Management policy is for Do Nothing. This refers principally to the centre section of defences and the implications of this are discussed under baseline scenario 1 (NAI).

Porth Ceiriad, the headland and islands. The policy for this area is similarly the same as for scenario 1.

The damages associated with this scenario are set out in table1 and an assessment against general objectives is given in table 2.

4 Summary Comparison and Assessment of Baseline scenarios.

Table 1. Economic Assessment

The following table provides a brief summary of erosion damages determined by the SMP2 MDSF 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.

ASSESSMENT OF EROSION DAMAGES

Epoch	0 -20 year			20 – 50 years			50 – 100 years			50 – 100 years (2m SLR)		
No Active Intervention	**No. of properties:**		**Value**	**No. of properties:**		**Value**	**No. of properties:**		**Value**	**No. of properties**		**PV Damages**
Location	*Res.*	*Com.*	**x £k**	*Res.*	*Com.*	**x £k**	*Res.*	*Com.*	**x £k**	*Res.*	*Com.*	**(£x1000)**
Pwllheli	0	0	0	0	0	0	2	1	822	4	2	46
Abersoch	0	0	0	1	0	212	2	2	427	4	2	90
Borth Fawr	1	0	212	1	0	212	2	0	425	4	0	310
											Total for PDZ1	
With Present Management	**No. of properties**		**Value**	**No. of properties**		**Value**	**No. of properties**		**Value**	**No. of properties**		**PV Damages**
Location	*Res.*	*Com.*	**x £k**	*Res.*	*Com.*	**x £k**	*Res.*	*Com.*	**x £k**	*Res.*	*Com.*	**(£x1000)**
Pwllheli	0	0	0	0	0	0	2	1	822	2	1	42
Abersoch	0	0	0	0	0	0	0	0	0	0	0	0
Borth Fawr	0	0	0	1	0	212	2	0	425	3	0	98
											Total for PDZ1	

Notes: PVD determined for 1m SLR in 100 yrs.

Other information: MDFS does not identify damages to the holiday chalets at Abererch nor loss of promenade and services at Pwllheli South Beach. Erosion would also impact on the railway line.

The following flood damages have been determined through use of MDSF. These figures are aimed to indicate the level and impact of flood risk rather than being a detailed economic appraisal. In many areas substantial numbers of properties would be liable to flooding on the more frequent events both under NAI and WPM, a nominal write off value has been allowed in the table for properties at frequent risk; this generally excludes values at risk at present on a 1:1 year event, in 50 years time for the 1:10 year event and in 100 year time the 1:50 year event.

ASSESSMENT OF POTENTIAL FLOOD RISK

	Flood risk tidal 2010			Flood risk tidal 2060			Flood risk tidal 2110			tidal risk 2m SLR		
No Active Intervention	**No. of properties**		**AAD**	**No. of properties**		**AAD**	**No. of properties**		**AAD**	**No. of properties**		**PVD**
Location	<1:10 yr.	>1:10 yr	**x £k**	<1:10 yr.	>1:10 yr	**x £k**	<1:10 yr.	>1:10 yr	**x £k**	<1:10 yr.	>1:10 yr	**(£x1000)**
other	0	2	8.5	0	2	11	2	3	155	6	2	736
Morfa Abererch	0	53	238	38	21	1566	57	18	2811	84	17	5035
Pwllheli	0	791	2759	202	700	19581	864	239	31231	1213	109	318060
The Warren	0	0	0	0	0	0	0	1	0.01	1	1	0.03
Abersoch	0	20	35	0	21	70	21	1	1058	28	1	1202
Borth Fawr	0	2	2	2	2	39	3	2	74	9	4	487
											Total for PDZ13	350690

With Present Management	**No. of properties**		**AAD**	**No. of properties**		**AAD**	**No. of properties**		**AAD**	**No. of properties**		**PVD**
Location	<1:10 yr.	>1:10 yr	**x £k**	<1:10 yr.	>1:10 yr	**x £k**	<1:10 yr.	>1:10 yr	**x £k**	<1:10 yr.	>1:10 yr	**(£x1000)**
other	0	2	2	0	2	11	0	5	3	0	8	141
Morfa Aberech	0	53	28	0	59	35	0	75	97	0	101	1114
Pwllheli	0	791	144	0	902	360	0	1103	484	0	1332	7255
The Warren	0	0	0	0	0	0	0	1	0.01	0	2	0.03
Abersoch	0	20	7	0	21	18	0	22	25	0	29	452
Borth Fawr	0	2	2	0	4	39	2	6	74	9	4	612
											Total for PDZ13	9573

Table 2. General Assessment of Objectives

The following table provides an overall assessment of how the two baseline scenarios impact upon the overall objectives. Specific objectives are set out in more detail within Appendix E. The table aims to provide an initial high level assessment of the two baseline scenarios, highlighting potential issues of conflict. These issues are discussed in the following section, examining alternative management scenarios from which SMP2 policy is then derived.

STAKEHOLDER OBJECTIVE	NAI			WPM		
	Fails	Neutral	Acceptable	Fails	Neutral	Acceptable
Reduce risk to life						
Protect properties from flood and erosion loss						
Identify communities at risk and allow opportunity for adaptation						
Avoid reliance on defence particularly where there is a risk of catastrophic failure						
Highlight areas of long term sustainability issues and where there may need to be relocate						
Maintain connectivity between local communities along the coast						
Maintain Pwllheli as a critical centre						
Maintain recreational use of beaches and bays						
Maintain access to the coast including car parking and facilities						
Maintain access for boat use and associated water sport activities						
Maintain the opportunity for sustainable adaptation of the main Golf Course						
Maintain the opportunity for sustainable adaptation of the main Holiday centres.						
Maintain the economic viability of Porthmadog/Pwllheli economic hub						
Maintain character and integrity of coastal communities						
Maintain the ability for adaptation and opportunity for economic growth of small communities						
Maintain agricultural value of rural community						
Identify risk and reduce risk of loss of heritage features where possible						
Maintain historic landscape						
Prevent disturbance or deterioration to historic sites and their setting						
Maintain or enhance the condition or integrity of the international (SAC, SPA) designated sites and interest features within the context of a dynamic coastal system.						
Maintain or enhance the condition or integrity of the national (SSSI) designated sites and interest features within the context of a dynamic coastal system.						

STAKEHOLDER OBJECTIVE	NAI			WPM		
	Fails	Neutral	Acceptable	Fails	Neutral	Acceptable
Maintain and enhance educational and scientific understanding of geology and geomorphology						
Avoid damage to and enhance the natural landscape.						
Maintain the human landscape and character of communities						
Maintain the critical road network						
Maintain the critical rail network.						

5 Discussion and Detailed Policy Development

The Abererch and Pwllheli frontages pose real challenges for future sustainability in terms of flood and erosion risk management. At Abersoch there are concerns as to the longer term sustainability of use in the area of the Afon Soch Estuary; this and the existing policy at Borth Fawr are of a more local management scale but are still significant in potential impacts on the regional economy. The areas are discussed below in the same order and under the same general headings as presented in the baseline scenarios.

Morfa Abererch. A policy or intent for long term management of the shoreline is at present, not considered sustainable. There are the two main areas of risk, that to the railway line and that of flood risk to the village of Abererch to the back of the flood plain. In addition there is the Holiday village to the slightly raised land behind the dunes, the current use of the valley for agriculture and the important nature conservation values represented by the SSSI and SAC designations. The railway line poses the most immediate risk with the potential of flooding and erosion.

Based on the objectives there is a continuing need to maintain this important national transport route. However, to do so would impose a severe constraint on the sustainable management of the shoreline. At present the risk is being managed and the approach adopted could be sustained potentially over epoch 1. The danger in doing so is that there would be greater expectation that this course of action is extended and there would be a gradual progression towards an approach that results in hardening much of the central section of the bay. It is essential that this is considered along side other issues for maintaining the railway identified in other zones discussed within the SMP. It is suggested that this discussion is needed from both a regional and national perspective.

If it is accepted that there needs to be a change in approach, then the SMP would recommend that management of the dune ridge moves towards a position where the defence could be abandoned. Taking this as a management scenario, it would be envisaged that a breach in the dunes was actively encouraged and managed. The breach would be allowed to develop as the main entrance channel to the Afon Erch and that consideration would be given as how to gain maximum environmental benefit from the new inlet that is created. Potentially, if re-routing the railway line to the back of the flood plain was unacceptable, then consideration would need to be given to establishing the line on some form of trestle bridge over the new estuary.

In opening the coast in this way there is a good potential to create a naturally functioning ebb tidal system which would assist in maintaining sediment feed and control to the adjacent shorelines. This would have to be considered in more detail. The aim through this approach would help to sustain the natural defence to the holiday park and provide a good transition through to the natural dune system towards Pen ychain. The Holiday Park would still be at risk from flooding and would need to adapt accordingly, but it is probable, because of its slightly raised location that this use could be maintained potentially into epoch 3. The shoreline to the west is also likely to benefit from this approach to management and it is seen as being sustainable to maintain defence to the industrial estate and the harbour area of Glan y Don. There would need to be a clearly defined buffer zone of no development within this area to ensure continued width for response of the dune system.

In land, there would be increased flood risk to the main road and to the lower lying areas of Abererch. The intent would be to continue to mange these areas of risk, looking in the future to improve flood defence. This, given the position well back from the active shoreline would be seen as being sustainable in meeting objectives. The flood risk management of the road and the village would need to be developed in further detail.

This is recognised to be a significant change in approach to management and would need to be taken forward in discussion with local people and organisations with an interest in the area. It is also recognised that the change in approach with respect to the railway would be significant. As such, the policy for the area would be for continuing to Hold the Line during epoch 1 and for discussion and development of managed realignment during epoch 2. There would be a continuing need for management and this would require a continuing policy of Managed Realignment through epoch 3 and beyond. The approach to Hold the Line in epoch 1 should be within the context of long term managed realignment.

Pwllheli. At present and over the whole period of the SMP the policy for coastal defence within the harbour and to the Cob would be for holding the line of defence. This is seen as being economically justified and in line with the important social objectives agreed for the SMP. However, this must be viewed from the perspective that the central valley would be at significant residual risk over the next 100 years. It seems probable that with sea level rise there would be a need to raise defence levels generally around the harbour and where possible this should involve gradual adaption of buildings either in terms of flood resilience or in the longer term raising. The Cob would also need to be raised. There would be significant on going risk to the centre of Pwllheli and under increased sea level rise it is probable that defence to the valley would not be sustained. Development within the flood risk area of the valley would need to take this in to account, with the recommended intent that existing use of the valley is abandoned that spatial planning looks to re-establish development outside of the core area of the town.

This approach and establishing a 100 year transition period would be subject to policy and future behaviour of the open coast to the south of the town. Here, maintaining a Hold the Line Policy in the Traeth Crugan area is not seen as being sustainable. While the existing defences to the area could be maintained probably over the first epoch without undue damage to the coastal system and without any substantial need for further strengthening, within epoch 2, it seems probable that this approach would start significantly impacting on management of the whole frontage. The intent defined within the SMP is for managed realignment with the intent of opening a new inlet and encouraging the Afon Penrhos to discharge through this new entrance. Rather than waiting and allowing by default such an opening to develop through natural breaching of the defence, this process should be managed.

There is potential for such a new estuary to create a more sustainable sediment supply to the whole frontage and to help sustain the natural defence to South Beach. This would need to be examined in more detail but the policy for South Beach would be for Hold the Line, while accepting natural roll back and adaptation of the dunes.

In opening the new inlet this would open a potential and significant flood risk to Pwllheli. The intent would be to provide a set back defence between the shoreline and the higher ground around Penrhos Village. Areas of the existing Golf Course may well be affected by this policy, the aim would be to minimise this loss within a set back defence. The flooding of the Penrhos valley would have a significant consequence in regular tidal flooding of the road. This would need to be addressed. In the long term, given that

defence may not be appropriate to the main valley of Pwllheli, consideration would need to be given to re-routing the entire main road further in land.

Llanbedrog. The policy within this area would be for No Active Intervention. This might not preclude local management of the area around the slipway.

The Warren and Abersoch. Holding the Line to the Warren is not seen as presenting significant problems over the short to medium term. However, in the longer term, potentially in 30 to 50 years, this could result in a trend of beach loss. The reason many holidaymakers choose the Warren is the beach location and for the watersport activities. Rigidly holding a linear line of defence would reduce this value of the area. Protection of the whole frontage would in effect reduce the inherent value of the Holiday Village. In epoch 2, therefore the recommended policy would be for Managed Realignment. The approach taken to this would be one of a continuing process of adjustment of defences in a planned manner. There seems scope in taking this approach to move towards controlling and retaining sediment in critical areas of the frontage with a process of allowing the use of the area to roll back. This would need to be developed as an agreement between the private landowners and the planning authority. It is recognised that large scale managed realignment (rollback of holiday pitches) would cause significant issues and this would need to be taken account of through the Planning process.

At Abersoch, again the main concern is in relation to longer term management. Key factors in this would be when sea level rise results in a need to improve defence to the low lying area around the estuary entrance and to the road. Consideration would at that time need to be given to the potential of re-opening the Afon Soch to the tide. There is seen as being potential benefits in a more active estuary system in recycling sediment over the foreshore and in establishing use within the area upon a more sustainable long term system. Consideration would need to be given to potential impacts of flooding further upstream but there is also potential that this could create significant improvement to nature conservation values for the area.

The policy for both the Warren and Abersoch would be to maintaining a Hold the Line Policy in epoch 1 with the intent during epoch 2 to change to a policy of Managed Realignment.

Borth Fawr. Over this section of the coast the intent of SMP 1 was to re-establish a more naturally functioning bay. At present there is only intermittent pressure on the frontage. It is as the defences start to significantly impact on the way in which the bay behaves that the need would be to allow natural development. Therefore, although there has to be a caveat in terms of funding in that alternative funding beyond that of grant in aid would need to be sought, the first epoch policy would be for Hold the Line. This would change over the second epoch to Managed Realignment and subsequently to No Active Intervention.

This approach allows adaption of use. While there would be some impact on the Golf course during epoch 2 when the inlet is allowed to form, there may still be opportunity for adaption to this change. In epoch 3 there would be significantly greater flood risk and the current extent of the golf links would be at risk. The intent within the SMP would be to maintaining the local defence to the north of the bay as part of the management area covering Abersoch. To the south of the bay the policy would allow adaption of properties at risk.

Porth Ceiriad, the headland and islands. The policy for this area would remain as No Active intervention.

6 Management Summary.

The zone is sub-divided into three principal Management Areas and the policy from the above discussion is summarised in the following tables.

MA 31 PWLLHELI AREA: From Pen ychain to Mynydd Tir-cwmwd

Policy Unit		**Policy Plan**			
		2025	**2055**	**2105**	**Comment**
13.1	Pen ychain and western section of the bay	NAI	NAI	NAI	
13.2	Abererch	HTL	MR	MR	Subject to national consideration of railway
13.3	Glan Y Don	HTL	HTL	HTL	Allow buffer zone for natural behaviour of the dunes
13.4	Pwllheli Harbour and entrance	HTL	HTL	HTL	.
13.5	Pwllheli Centre	HTL	HTL	HTL	Spatial planning for potential long term adaptation
13.6	South Beach	HTL	HTL	HTL	Allow and manage development of the dunes.
13.7	Golf Course	HTL	MR	MR	Detailed study to allow transition between Traeth Crugan and South Beach
13.8	Traeth Crugan	HTL	MR	MR	Intent to create new entrance estuary to the Afon Penrhos and to manage new defence to the core of Pwllheli
13.9	Llanbedrog	NAI	NAI	NAI	This would not preclude local management of the slipway area.
Key: HTL - Hold the Line, A - Advance the Line, NAI – No Active Intervention MR – Managed Realignment					

MA32 ABERSOCH AREA: From Mynydd Tir-cwmwd to Penrhyn Du

Policy Unit		**Policy Plan**			
		2025	**2055**	**2105**	**Comment**
13.10	Mynydd Tir cwmwd	NAI	NAI	NAI	
13.11	The Warren	HTL	MR	MR	Progressive management of the retreating shoreline to maintain the beach
13.12	Abersoch	HTL	MR	MR	Consider opening up tidal flooding of the Afon Soch and planning of future use of the entrance
13.13	Penbennar	HTL	HTL	HTL	Local private management of defences
13.14	Borth Fawr Central	HTL	MR	NAI	Opportunity for adaptation
13.15	Machroes	HTL	MR	NAI	This would not preclude local management of the road.
Key: HTL - Hold the Line, A - Advance the Line, NAI – No Active Intervention MR – Managed Realignment					

MA33 PORTH CEIRIAD HEADLAND AND ST TUDWALS ISLAND : From Penrhyn Du to Trwyn Cilan

Policy Unit		Policy Plan			
		2025	2055	2105	Comment
13.16	Machroes headland	NAI	NAI	NAI	
13.17	ST Tudwal's islands	NAI	NAI	NAI	
13.18	Porth Ceiriad	NAI	NAI	NAI	
13.19	Cilan Headland	NAI	NAI	NAI	
Key: HTL - Hold the Line, A - Advance the Line, NAI – No Active Intervention MR – Managed Realignment					

PDZ13
Management Area Statements

MA 31 Pwllheli Area
Pen ychain to Mynydd Tir-cwmwd

MA 32 Abersoch Area
Mynydd Tir-Cwmwd to Penrhyn Du

MA 33 Porth Ceiriad Headland and St Tudwal's Island
Penrhyn Du to Trwyn Cilan

Location reference:	**Pwllheli Area**
Management Area reference:	**M.A. 31**
Policy Development Zone:	PDZ13

* Note: Predicted shoreline mapping is based on a combination of monitoring data, analysis of historical maps and geomorphological assessment with allowance for sea level rise. Due to inherent uncertainties in predicting future change, these predictions are necessarily indicative. For use beyond the purpose of the shoreline management plan, reference should be made to the baseline data.

The following descriptions are provided to assist interpretation of the map shown overleaf.

100 year shoreline position:
The following maps aim to summarise the anticipated position of the shoreline in 100 years under the two scenarios of "With Present Management" and under the "Draft Preferred Policy" being put forward through the Shoreline Management Plan.

- In some areas the preferred policy does not change from that under the existing management approach. In some areas where there are hard defences this can be accurately identified. In other areas there is greater uncertainty. Even so, where the shoreline is likely to be quite clearly defined by a change such as the crest of a cliff the estimated position is shown as a single line.

- Where there is a difference between With Present Management and the Draft Preferred Policy this distinction is made in showing two different lines:

  With Present Management.
  Draft Preferred Policy.

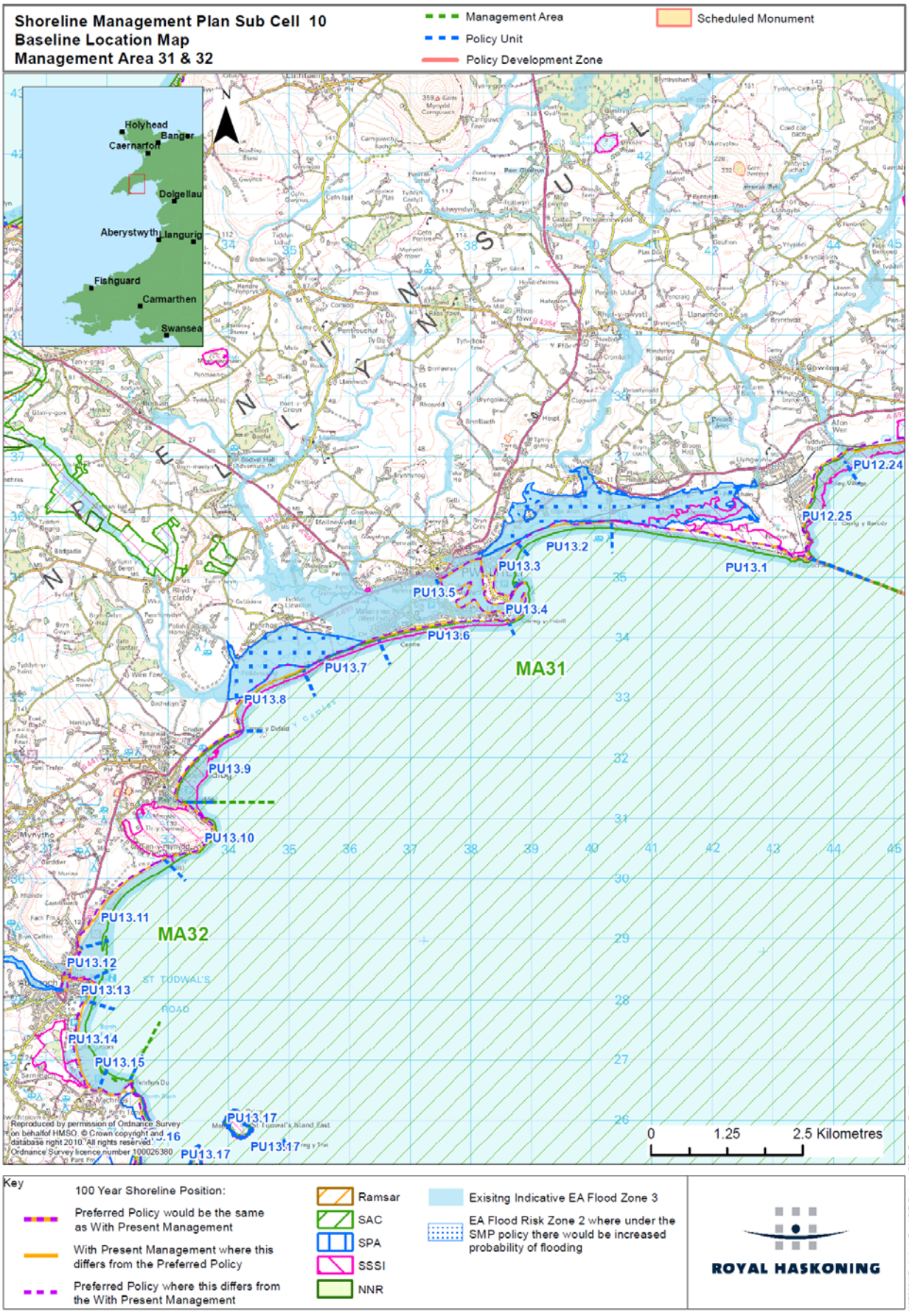
Flood Risk Zones

General Flood Risk Zones. The explanation of these zones is provided on the Environment Agency's web site www.environment-agency.gov.uk. The maps within this Draft SMP document show where SMP policy might influence the management of flood risk.

Indicate areas where the intent of the SMP draft policy is to continue to manage this risk.

Indicate where over the 100 years the policy would allow increased risk of flooding.

The maps should be read in conjunction with the text within the Draft SMP document.


Shoreline Management Plan Sub Cell 10
Baseline Location Map
Management Area 31 & 32
Management Area
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Policy Development Zone
Scheduled Monument
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Bangor
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Dolgellau
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Aberdyfi
Fishguard
Carmarthen
Swansea
MA31
MA32
PU12.24
PU12.25
PU13.1
PU13.2
PU13.3
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PU13.14
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0
1.25
2.5 Kilometres
Reproduced by permission of Ordnance Survey on behalf of HMSO. © Crown copyright and database right 2010. All rights reserved. Ordnance Survey licence number 100026380
Key
100 Year Shoreline Position:
Preferred Policy would be the same as With Present Management
With Present Management where this differs from the Preferred Policy
Preferred Policy where this differs from the With Present Management
Ramsar
SAC
SPA
SSSI
NNR
Exisitng Indicative EA Flood Zone 3
EA Flood Risk Zone 2 where under the SMP policy there would be increased probability of flooding
ROYAL HASKONING

SUMMARY OF PREFERRED PLAN RECOMMENDATIONS AND JUSTIFICATION

INTENT OF THE PLAN:

The plan supports defence to the regionally important town of Pwllheli, with the intent to sustain use of Pwllheli Harbour, the seafront and amenity of the shoreline, as well as maintaining transport routes to the town. However, as identified by the Pwllheli Pilot Study, there is significant pressure on the coast for change and substantial parts of Pwllheli are at risk from potentially severe levels of flooding. To maintain the town and the important values associated with the area, there needs to be significant change into the future.

The main railway line and A497 road to the town comes from the east and runs through the low lying valley of the Afon Erch. This valley is defended by a thin dune ridge. To the back of the flood plain to the river is the community of Abererch. The intent of the plan is to continue to manage the integrity of the dunes during epoch 1. From epoch 2 the aim would be to realign the frontage with the longer term intent to encourage the Afon Erch to breach through directly to the sea. Management of this would need further investigation and would be subject to the ability to realign the railway within the hinterland area. There would need to be further examination of defence to Abererch but with the intent to manage flood risk to the village and the road on a more sustainable set back line of defence. Allowing the river to form a new estuary would help management of the shoreline, without the need to increasingly extend hard defences along the backshore. This would assist in providing defence to the Holiday Park while also maintaining the essential nature conservation value of the frontage, together with the important landscape.

The aim within the plan would be to continue defence to Pwllheli Harbour and to continue to defend the town at the Cob. There would be increased flood risk to areas around the harbour and measures would be needed to increase resilience to properties and commercial buildings. There is the additional flood risk associated with the rivers flowing through the centre of Pwllheli. This is being examined by the Pwllheli Pilot Study but, subject to the conclusions of this work, the intent would be to continue to manage this risk. Associated with this would be the probable need for pumping in the future, re-considering opportunities for increasing flood resilience and planned redesign of the centre of Pwllheli to reduce flood risk.

The Afon Penrhos flows through the town behind the shoreline frontage of Traeth Crugan. Continued defence of this frontage with a linear rock revetment is viewed as being non-sustainable and the intent would be to allow the set back of the dunes and shoreline ridge to allow the Penrhos to flow directly to the sea. This provides the opportunity to manage the whole length in front of the golf course through to South beach more sustainably. The Pwllheli Pilot is also considering ideas for diverting flow from the other main river through Pwllheli (the Afon Rhydhir) and this may reinforce the potentially beneficial impact at the coast. There would then be the need to provide a set back flood defence potentially landscaped within the area of the golf course. The flood issues to the main road would need to be addressed. The coast further to the west, along the Llanbedrog frontage would be allowed to evolve naturally.

KEY ISSUES/RISK AND UNCERTAINTY:

There are uncertainties in terms of timing of impacts and the proposed changes. There is, however, a need for a detailed planned response to change and this is being examined through the Pwllheli Pilot Study. It will be important to relate future behaviour of the coast to

national monitoring of sea level rise and more general climate change and to local monitoring of the shoreline.
The changes proposed by the plan are significant and would need to be developed in detail. Management of the railway line would need to be considered at a regional and national scale in association with other proposed changes elsewhere along the coastline.
Funding for change may not be fully covered by FCERM grant aid and given the important social changes being proposed there would need to be examination of further additional funding sources. There is a strong potential that a collaborative funding approach could be developed such that integrated benefits may be generated. This would need to be examined in detail through community involvement.
Despite the intent to provide continued defence to the town there would remain a high residual risk. This would need to be mitigated by development control and planning, and in the longer term, beyond the period of the SMP, planning may need to look for opportunities for relocation and adaptation to use within the low lying areas of Pwllheli.

ACTIONS:

ACTION	PARTNERS	
Shoreline monitoring	**GC**	**Network Rail**
Adaption planning through the Pwllheli Pilot ▪ Abererch ▪ Pwllheli ▪ Penrhos	**GC** **Communities**	**Highways**
	EA	**Network Rail**
	WAG	**CCW**
Assess implications for realignment of transport routes.	**Network rail**	**Highways**
	WAG	**GC**
Investigate further proposals for re-routing the Afon Erch and Afon Penrhos, with examination for habitat creation and landscape enhancement.	**GC**	**CCW**
	EA	

DELIVERY OF THE PLAN

SUMMARY OF SPECIFIC POLICIES

Policy Unit		Policy Plan			
		2025	2055	2105	Comment
13.1	Pen ychain and western section of the bay	NAI	NAI	NAI	
13.2	Abererch	HTL	MR	MR	Subject to national consideration of railway
13.3	Glan Y Don	HTL	HTL	HTL	Allow buffer zone for natural behaviour of the dunes
13.4	Pwllheli Harbour and entrance	HTL	HTL	HTL	.
13.5	Pwllheli Centre	HTL	HTL	HTL	Spatial planning for potential long term adaptation
13.6	South Beach	HTL	HTL	HTL	Allow and manage development of the dunes.
13.7	Golf Course	HTL	MR	MR	Detailed study to allow transition between Traeth Crugan and South Beach
13.8	Traeth Crugan	HTL	MR	MR	Intent to create new entrance estuary to the Afon Penrhos and to manage new defence to the core of Pwllheli
13.9	Llanbedrog	NAI	NAI	NAI	This would not preclude local management of the slipway area.
Key: HTL - Hold the Line, A - Advance the Line, NAI – No Active Intervention MR – Managed Realignment					

PREFERRED POLICY TO IMPLEMENT PLAN:	
From present day	Maintain existing defences. Develop adaptation planning. Develop funding plan.
Medium term	Maintain defences to Pwllheli. Manage realignment at Abererch and Traeth Crugan.
Long term	Maintain new defence systems.

IMPLICATIONS OF THE PLAN

CHANGES FROM PRESENT MANAGEMENT

There would be significant change in approach at Abererch and at Traeth Crugan, although here this would be in line with the strategy.

ECONOMIC SUMMARY

Economics (£k PV)	by 2025	by 2055	by 2105	Total £k PV
NAI Damages	37,631.0	134,709.7	173,306.1	345,646.8
Preferred Plan Damages	2,264.1	3,269.6	3,614.7	9,148.4
Benefits	35,366.9	131,440.2	169,691.4	336,498.4
Costs	8.5	1,557.1	796.2	2,361.9

The significant changes would mean the need to develop options for additional funding.

FLOOD AND EROSION RISK MANAGMENT

POTENTIAL LOSS

There could be the loss of some 3 properties due to erosion. There would remain a high residual risk of flooding if design standard of defences were exceeded.

BENEFITS OF THE PLAN

The plan provides a longer term sustainable approach to defence, maintaining defence to the core community areas. The plan continues to provide flood defence to over 1000 properties, providing a higher standard of protection to some 800 properties that would otherwise be with the 1:10 year risk zone in the future.

SUMMARY OF STRATEGIC ENVIRONMENTAL ASSESSMENT (INCLUDING HRA)

PDZ 13				
SEA Objective	**Impact of Preferred Policy for each Epoch**			
	1	**2**	**3**	**Mitigation**
Policy Units 13.1 to 13.19				
To support natural processes, maintain and enhance the integrity of internationally designated nature conservation sites. Maintain / achieve favourable condition of their interest features (habitats and species).				Habitat creation
To avoid adverse impacts on, conserve and where practical enhance the designated interest of nationally designated nature conservation sites. Maintain/achieve favourable condition.				Habitat creation
To avoid adverse impacts on, conserve and where practical enhance national and local BAP habitats.				Habitat creation
To support natural processes and maintain geological exposures throughout nationally designated geological sites.				
To conserve and enhance nationally designated landscapes in relation to risks from coastal flooding and erosion and avoid conflict with AONB and National Park Management Plan Objectives.				
To minimise coastal flood and erosion risk to scheduled and other internationally and nationally important cultural heritage assets, sites and their setting.				Excavation and recording
To minimise the impact of policies on marine operations and activities.				
To minimise coastal flood and erosion risk to critical infrastructure and maintain critical services.				
To minimise coastal flood and erosion risk to agricultural land and horticultural activities.				
To minimise coastal flood and erosion risk to people and residential property.				
To minimise coastal flood and erosion risk to key community, recreational and amenity facilities.				
To minimise coastal flood and erosion risk to industrial, commercial, economic and tourism assets and activities.				

This table provides a summary of the SEA (appendix E) and reference should be made to the Appendix for full details of the assessment.

These next two sections provide a headline summary of the findings of the HRA (Appendix G) and the WFA (Appendix H). Reference should be made as appropriate to these Appendices for full details.

HRA SUMMARY

Anticipated Habitat Loss in PDZ 13 as a result of SMP Policy

Designated Site	PU	Habitat Type	Extent of Loss of Habitat (ha)			
			Epoch 1	Epoch 2	Epoch 3	Total
Llŷn Peninsula and the Sarnau SAC	13.6	Intertidal sandflat	0.00	1.19	0.80	2.00
	13.7	Intertidal sandflat	0.00			0.00
	13.8	Intertidal sandflat	0.00			0.00

Pen Llyn a`r Sarnau/ **Llŷn Peninsula** *and the Sarnau SAC:* It is concluded that there would be an **adverse effect on the integrity** of the intertidal habitat (sandflat) within the boundary of the SAC as a result of the SMP2 policies. There will however, be **no adverse effect on the integrity** of the other SAC features.

Clogwyni Pen Llyn/ Seacliffs of Lleyn SAC: **no adverse effect on the integrity of the SAC**.

Mynydd Cilan, Trwyn y Wylfa ac Ynysoedd Sant Tudwal SPA: **no adverse effect on the integrity of the SPA**.

Preventative/mitigation measures: None identified.

Risks/Assumptions: The habitat loss is considered precautionary, and where any works are to be undertaken detailed study would provide an accurate identification of whether habitat would be lost and the extent. Potentially, given the worst case assumptions, further detail of the likely actions and site specific study may conclude no or reduced habitat loss, given the worst case scenario used in this assessment.

SUMMARY CONCLUSION FROM THE WATER FRAMEWORK ASSESSMENT

Water body (and relevant PDZ)	**Environmental Objectives met?**				**WFD Summary Statement required?**	**Achievement of Any South East RBMP Mitigation Measures?**	**Details on how the specific South East RBMP Mitigation Measures have been attained** (dark green = achieved; light green = partly achieved & red = not achieved)
	WFD 1	**WFD2**	**WFD3**	**WFD4**			
Tremadog Bay (Coastal) (PDZ part 12, part 13) (MAN part 26, 27, 28, 29, 30, 31, 32 and part 33)	N/A	✓	✓	✓	**No** - not necessary as delivery of the WFD Environmental Objectives will not be prevented by the SMP policies and in some cases will ensure they are of benefit.	There were no relevant measures to the SMP2 for this water body.	N/A
Erch (Transitional) (PDZ part 13) (MAN part 31)	N/A	✓	✓	✓	**No** - not necessary as delivery of the WFD Environmental Objectives will not be prevented by the SMP policies and in some cases will ensure they are of benefit.	There were no relevant measures to the SMP2 for this water body.	N/A

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Location reference:	**Abersoch Area**
Management Area reference:	**M.A. 32**
Policy Development Zone:	PDZ13

* Note: Predicted shoreline mapping is based on a combination of monitoring data, analysis of historical maps and geomorphological assessment with allowance for sea level rise. Due to inherent uncertainties in predicting future change, these predictions are necessarily indicative. For use beyond the purpose of the shoreline management plan, reference should be made to the baseline data.

The following descriptions are provided to assist interpretation of the map shown overleaf.

100 year shoreline position:
The following maps aim to summarise the anticipated position of the shoreline in 100 years under the two scenarios of "With Present Management" and under the "Draft Preferred Policy" being put forward through the Shoreline Management Plan.

- In some areas the preferred policy does not change from that under the existing management approach. In some areas where there are hard defences this can be accurately identified. In other areas there is greater uncertainty. Even so, where the shoreline is likely to be quite clearly defined by a change such as the crest of a cliff the estimated position is shown as a single line.

- Where there is a difference between With Present Management and the Draft Preferred Policy this distinction is made in showing two different lines:

  With Present Management.
  Draft Preferred Policy.

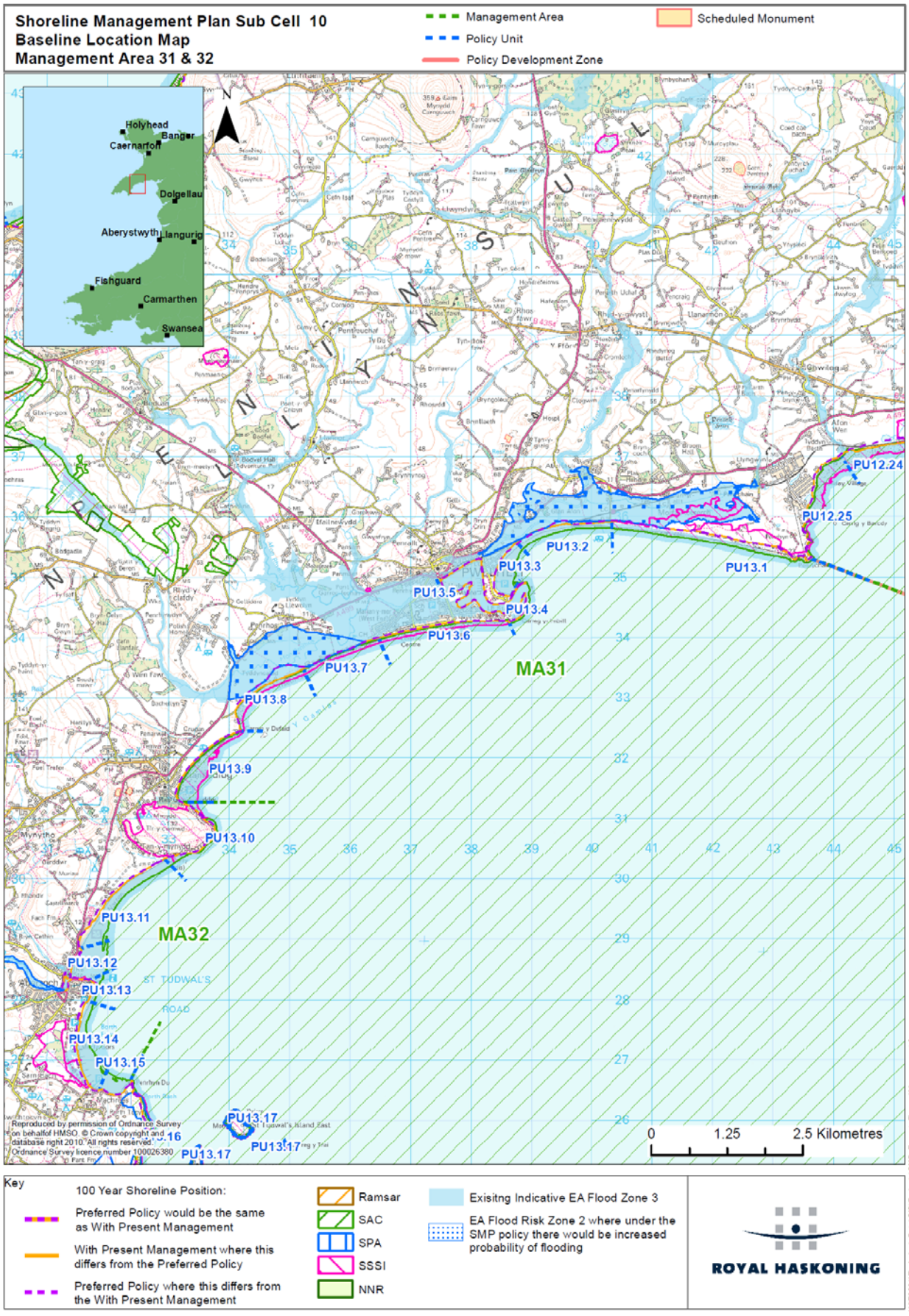
Flood Risk Zones

General Flood Risk Zones. The explanation of these zones is provided on the Environment Agency's web site www.environment-agency.gov.uk. The maps within this Draft SMP document show where SMP policy might influence the management of flood risk.

Indicate areas where the intent of the SMP draft policy is to continue to manage this risk.

Indicate where over the 100 years the policy would allow increased risk of flooding.

The maps should be read in conjunction with the text within the Draft SMP document.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Reproduced by permission of Ordnance Survey on behalf of HMSO. © Crown copyright and database right 2010. All rights reserved. Ordnance Survey licence number 100026380
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ROYAL HASKONING
I:\9T9001\Technical_Data\GIS\Projects\SMP_Report_Figures\Management Areas

SUMMARY OF PREFERRED PLAN RECOMMENDATIONS AND JUSTIFICATION

INTENT OF THE PLAN:

The intent of the plan is to continue to provide defence to much of the core areas of Abersoch and to support local private adaptive management of the shoreline at the Warren and at Penbennar, subject to normal approvals in line with the overall strategic objectives.

At the Warren the approach would be to support a policy of progressive retreat and management of the important amenity beaches. The intent within the plan is to re-examine the need for defence to the Abersoch Valley, with the proposal to allow more natural development of the river. Associated with this change in approach there would be the need for change in flood defence and land use at the entrance to the Soch, with the intent that this would be developed in consultation with the various interest groups in this area. The aim is to sustain Abersoch's important water sport activities in a more sustainable manner.

At Borth Fawr, the intent of the plan continues from the policy set by SMP1 for realignment and development of the natural function of the shoreline. Recognising that there are important assets at risk in this area, however, the initial policy is for Hold the Line to allow adaption to realignment to be undertaken in a more planned manner. A similar approach is taken at Machroes, where future private defence would not be precluded subject to normal approvals in line with the overall strategic objectives.

KEY ISSUES/RISK AND UNCERTAINTY:

There are uncertainties in terms of timing of the proposed changes. There is also a need for a detailed planned response to change. It will be important to relate this to national monitoring of sea level rise and more general climate change and to continued monitoring of the shoreline.

ACTIONS:

ACTION	PARTNERS	
Shoreline monitoring	**GC**	
Adaption planning ▪ Abersoch ▪ Broth Fawr	**GC** **Communities** **EA**	**Highways**
Examine potential realignment to the Afon Soch	**EA**	**GC**
Assess in detail potential impact on historic environment	**CADW**	
Assess opportunities for habitat creation within the Soch Valley and at Borth Fawr	**EA**	**CCW**

DELIVERY OF THE PLAN

SUMMARY OF SPECIFIC POLICIES

Policy Unit		Policy Plan			
		2025	2055	2105	Comment
13.10	Mynydd Tir cwmwd	NAI	NAI	NAI	
13.11	The Warren	HTL	MR	MR	Progressive management of the retreating shoreline to maintain the beach
13.12	Abersoch	HTL	MR	MR	Consider opening up tidal flooding of the Afon Soch and planning of future use of the entrance
13.13	Penbennar	HTL	HTL	HTL	Local private management of defences
13.14	Borth Fawr Central	HTL	MR	NAI	Opportunity for adaptation
13.15	Machroes	HTL	MR	NAI	This would not preclude local management of the road.
Key: HTL - Hold the Line, A - Advance the Line, NAI – No Active Intervention MR – Managed Realignment					

PREFERRED POLICY TO IMPLEMENT PLAN:	
From present day	Maintain existing defences. Develop adaptation planning.
Medium term	Implement realignment.
Long term	Maintain realigned defences.

IMPLICATIONS OF THE PLAN

CHANGES FROM PRESENT MANAGEMENT

The most significant change would be in the approach taken to defence of the Soch Valley. While continuing to defend low lying areas of Abersoch, this would involve change in the alignment of defences. In other areas the approach would be substantially the same as in SMP1.

ECONOMIC SUMMARY

Economics (£k PV)	by 2025	by 2055	by 2105	Total £k PV
NAI Damages	681.2	952.0	3,939.2	5,572.4
Preferred Plan Damages	175.4	469.8	517.9	1,163.1
Benefits	505.8	482.2	3,421.2	4,409.3
Costs	0.0	399.6	85.5	485.1

FLOOD AND EROSION RISK MANAGMENT

POTENTIAL LOSS

There could be the loss of 3 properties due to erosion and properties at Abersoch would still be subject to residual flood risk if the standard of defence were exceeded.

BENEFITS OF THE PLAN

The plan provides a longer term sustainable approach to defence, maintaining defence to the core community areas. Potential some 4 properties would benefit form continues erosion protection. Flood risk would be reduced to some 22 properties.

SUMMARY OF STRATEGIC ENVIRONMENTAL ASSESSMENT (INCLUDING HRA)

PDZ 13				
SEA Objective	**Impact of Preferred Policy for each Epoch**			
	1	**2**	**3**	**Mitigation**
Policy Units 13.1 to 13.19				
To support natural processes, maintain and enhance the integrity of internationally designated nature conservation sites. Maintain / achieve favourable condition of their interest features (habitats and species).				Habitat creation
To avoid adverse impacts on, conserve and where practical enhance the designated interest of nationally designated nature conservation sites. Maintain/achieve favourable condition.				Habitat creation
To avoid adverse impacts on, conserve and where practical enhance national and local BAP habitats.				Habitat creation
To support natural processes and maintain geological exposures throughout nationally designated geological sites.				
To conserve and enhance nationally designated landscapes in relation to risks from coastal flooding and erosion and avoid conflict with AONB and National Park Management Plan Objectives.				
To minimise coastal flood and erosion risk to scheduled and other internationally and nationally important cultural heritage assets, sites and their setting.				Excavation and recording
To minimise the impact of policies on marine operations and activities.				
To minimise coastal flood and erosion risk to critical infrastructure and maintain critical services.				
To minimise coastal flood and erosion risk to agricultural land and horticultural activities.				
To minimise coastal flood and erosion risk to people and residential property.				
To minimise coastal flood and erosion risk to key community, recreational and amenity facilities.				
To minimise coastal flood and erosion risk to industrial, commercial, economic and tourism assets and activities.				

This table provides a summary of the SEA (appendix E) and reference should be made to the Appendix for full details of the assessment.

These next two sections provide a headline summary of the findings of the HRA (Appendix G) and the WFA (Appendix H). Reference should be made as appropriate to these Appendices for full details.

HRA SUMMARY

Anticipated Habitat Loss in PDZ 13 as a result of SMP Policy

Designated Site	PU	Habitat Type	Extent of Loss of Habitat (ha)			
			Epoch 1	Epoch 2	Epoch 3	Total
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	13.7	Intertidal sandflat	0.00			0.00
	13.8	Intertidal sandflat	0.00			0.00

Pen Llyn a`r Sarnau/ **Llŷn Peninsula** *and the Sarnau SAC:* It is concluded that there would be an **adverse effect on the integrity** of the intertidal habitat (sandflat) within the boundary of the SAC as a result of the SMP2 policies. There will however, be **no adverse effect on the integrity** of the other SAC features.

Clogwyni Pen Llyn/ Seacliffs of Lleyn SAC: **no adverse effect on the integrity of the SAC**.

Mynydd Cilan, Trwyn y Wylfa ac Ynysoedd Sant Tudwal SPA: **no adverse effect on the integrity of the SPA**.

Preventative/mitigation measures: None identified.

Risks/Assumptions: The habitat loss is considered precautionary, and where any works are to be undertaken detailed study would provide an accurate identification of whether habitat would be lost and the extent. Potentially, given the worst case assumptions, further detail of the likely actions and site specific study may conclude no or reduced habitat loss, given the worst case scenario used in this assessment.

SUMMARY CONCLUSION FROM THE WATER FRAMEWORK ASSESSMENT

Water body (and relevant PDZ)	**Environmental Objectives met?**				**WFD Summary Statement required?**	**Achievement of Any South East RBMP Mitigation Measures?**	**Details on how the specific South East RBMP Mitigation Measures have been attained** (dark green = achieved; light green = partly achieved & red = not achieved)
	WFD 1	**WFD2**	**WFD3**	**WFD4**			
Tremadog Bay (Coastal) (PDZ part 12, part 13) (MAN part 26, 27, 28, 29, 30, 31, 32 and part 33)	N/A	✓	✓	✓	**No** - not necessary as delivery of the WFD Environmental Objectives will not be prevented by the SMP policies and in some cases will ensure they are of benefit.	There were no relevant measures to the SMP2 for this water body.	N/A

.

Location reference:	**Porth Ceiriad Headland and St Tudwal's Island**
Management Area reference:	**M.A. 33**
Policy Development Zone:	PDZ13

* Note: Predicted shoreline mapping is based on a combination of monitoring data, analysis of historical maps and geomorphological assessment with allowance for sea level rise. Due to inherent uncertainties in predicting future change, these predictions are necessarily indicative. For use beyond the purpose of the shoreline management plan, reference should be made to the baseline data.

The following descriptions are provided to assist interpretation of the map shown overleaf.

100 year shoreline position:
The following maps aim to summarise the anticipated position of the shoreline in 100 years under the two scenarios of "With Present Management" and under the "Draft Preferred Policy" being put forward through the Shoreline Management Plan.

- In some areas the preferred policy does not change from that under the existing management approach. In some areas where there are hard defences this can be accurately identified. In other areas there is greater uncertainty. Even so, where the shoreline is likely to be quite clearly defined by a change such as the crest of a cliff the estimated position is shown as a single line.

- Where there is a difference between With Present Management and the Draft Preferred Policy this distinction is made in showing two different lines:

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Flood Risk Zones

General Flood Risk Zones. The explanation of these zones is provided on the Environment Agency's web site www.environment-agency.gov.uk. The maps within this Draft SMP document show where SMP policy might influence the management of flood risk.

Indicate areas where the intent of the SMP draft policy is to continue to manage this risk.

Indicate where over the 100 years the policy would allow increased risk of flooding.

The maps should be read in conjunction with the text within the Draft SMP document.


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ROYAL HASKONING
I:\9T9001\Technical_Data\GIS\Projects\SMP_Report_Figures\Management Areas

SUMMARY OF PREFERRED PLAN RECOMMENDATIONS AND JUSTIFICATION

INTENT OF THE PLAN:

The aim of the plan throughout this area would be to allow natural evolution of the shoreline. There is likely to be some adaptation planning of the access and car park at Porth Ceiriad.

KEY ISSUES/RISK AND UNCERTAINTY:

There are uncertainties in terms of timing of the response of the coast. There would be a need for a detailed planned response to change. It will be important to relate this to national monitoring of sea level rise and more general climate change..

ACTIONS:

ACTION	PARTNERS
Shoreline monitoring	**GCC**
Adaption planning at Porth Ceiriad	**NT**
Assess in detail potential impact on historic environment	**CADW**

DELIVERY OF THE PLAN

SUMMARY OF SPECIFIC POLICIES

Policy Unit		**Policy Plan**			
		2025	**2055**	**2105**	**Comment**
13.16	Machroes headland	NAI	NAI	NAI	
13.17	ST Tudwal's islands	NAI	NAI	NAI	
13.18	Porth Ceiriad	NAI	NAI	NAI	
13.19	Cilan Headland	NAI	NAI	NAI	
Key: HTL - Hold the Line, A - Advance the Line, NAI – No Active Intervention MR – Managed Realignment					

PREFERRED POLICY TO IMPLEMENT PLAN:	
From present day	Allow natural change to the coast
Medium term	Allow natural change to the coast
Long term	Allow natural change to the coast.

IMPLICATIONS OF THE PLAN

CHANGES FROM PRESENT MANAGEMENT

No significant change from current management.

ECONOMIC SUMMARY

Economics (£k PV)	by 2025	by 2055	by 2105	Total £k PV
NAI Damages	0.0	0.0	0.0	0.0
Preferred Plan Damages	0.0	0.0	0.0	0.0
Benefits	0.0	0.0	0.0	0.0
Costs	0.0	0.0	0.0	0.0

FLOOD AND EROSION RISK MANAGMENT

POTENTIAL LOSS

No properties are identified as being at risk.

BENEFITS OF THE PLAN

The plan provides a longer term sustainable approach to management of the shoreline.

SUMMARY OF STRATEGIC ENVIRONMENTAL ASSESSMENT (INCLUDING HRA)

PDZ 13				
SEA Objective	**Impact of Preferred Policy for each Epoch**			
	1	**2**	**3**	**Mitigation**
Policy Units 13.1 to 13.19				
To support natural processes, maintain and enhance the integrity of internationally designated nature conservation sites. Maintain / achieve favourable condition of their interest features (habitats and species).				Habitat creation
To avoid adverse impacts on, conserve and where practical enhance the designated interest of nationally designated nature conservation sites. Maintain/achieve favourable condition.				Habitat creation
To avoid adverse impacts on, conserve and where practical enhance national and local BAP habitats.				Habitat creation
To support natural processes and maintain geological exposures throughout nationally designated geological sites.				
To conserve and enhance nationally designated landscapes in relation to risks from coastal flooding and erosion and avoid conflict with AONB and National Park Management Plan Objectives.				
To minimise coastal flood and erosion risk to scheduled and other internationally and nationally important cultural heritage assets, sites and their setting.				Excavation and recording
To minimise the impact of policies on marine operations and activities.				
To minimise coastal flood and erosion risk to critical infrastructure and maintain critical services.				
To minimise coastal flood and erosion risk to agricultural land and horticultural activities.				
To minimise coastal flood and erosion risk to people and residential property.				
To minimise coastal flood and erosion risk to key community, recreational and amenity facilities.				
To minimise coastal flood and erosion risk to industrial, commercial, economic and tourism assets and activities.				

This table provides a summary of the SEA (appendix E) and reference should be made to the Appendix for full details of the assessment.

These next two sections provide a headline summary of the findings of the HRA (Appendix G) and the WFA (Appendix H). Reference should be made as appropriate to these Appendices for full details.

HRA SUMMARY

Pen Llyn a`r Sarnau/ **Llŷn Peninsula** *and the Sarnau SAC:* Although it is concluded that there would be an **adverse effect on the integrity** of the intertidal habitat (sandflat) within the boundary of the SAC as a result of the SMP2 policies in adjacent Management Areas, this does not apply to this area. There will be **no adverse effect on the integrity** of the other SAC features.

Clogwyni Pen Llyn/ Seacliffs of Lleyn SAC: **no adverse effect on the integrity of the SAC**.

Mynydd Cilan, Trwyn y Wylfa ac Ynysoedd Sant Tudwal SPA: **no adverse effect on the integrity of the SPA**.

Preventative/mitigation measures: None identified.

SUMMARY CONCLUSION FROM THE WATER FRAMEWORK ASSESSMENT

Water body (and relevant PDZ)	**Environmental Objectives met?**				**WFD Summary Statement required?**	**Achievement of Any South East RBMP Mitigation Measures?**	**Details on how the specific South East RBMP Mitigation Measures have been attained** (dark green = achieved; light green = partly achieved & red = not achieved)
	WFD 1	**WFD2**	**WFD3**	**WFD4**			
Tremadog Bay (Coastal) (PDZ part 12, part 13) (MAN part 26, 27, 28, 29, 30, 31, 32 and part 33)	N/A	✓	✓	✓	**No** - not necessary as delivery of the WFD Environmental Objectives will not be prevented by the SMP policies and in some cases will ensure they are of benefit.	There were no relevant measures to the SMP2 for this water body.	N/A

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