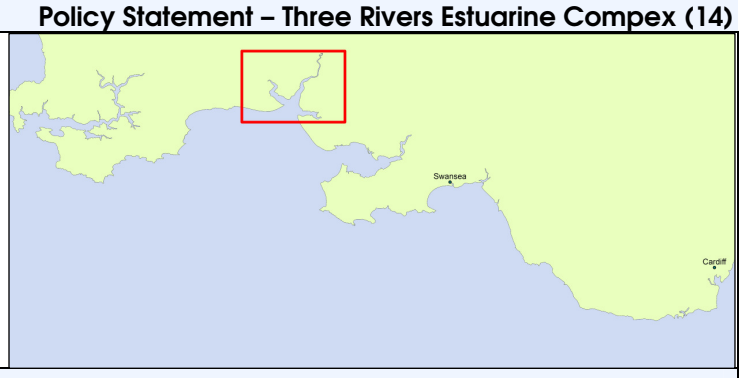
Three Rivers Estuarine Complex (14)



Recommendations:

Long Term Plan

The Three Rivers Estuarine Complex comprises the Gwendraeth, Towy and Taf estuaries which are of international environmental importance for their landforms and habitats. The river channels are narrow and largely constrained by steep and resistant geology. The area is predominantly undeveloped, with a few small key settlements including Kidwelly, Ferryside, Llansteffan, St Clears, Laugharne and Pendine. Otherwise railway infrastructure is one of the main policy drivers, since it runs adjacent to the shore within the Gwendraeth and Towy Estuaries.

The plan is, as far as possible, to enable natural evolution of the estuaries to retaining their geological and environmental interest, whilst continuing to manage the risk of coastal erosion and flooding to residential areas, critical assets and infrastructure, including railway infrastructure, through maintenance and upgrading of existing defences, subject to the future availability of public funding for coastal erosion and flood risk management.

Location (Policy Unit)		Preferred SMP2 policy and proposed approach to implementing the Plan		
		0-20 years	20-50 years	50-100 years
14.1	Tywyn Point to Banc-y-Lord	The policy is to enable natural evolution of this largely undeveloped area of marshland through **no active intervention**, in order to retain the high conservation value of the area. Potential increased risk of flooding to RAF Pembrey Sands Air Weapons Range which is considered further in PU 13.1.		
14.2	Banc-y-Lord to Commissioner's Bridge	The policy is to **hold the line**, in order to continue to manage the risk of flooding and erosion to Pembrey Motor Sports Centre, Pembrey village, A484 road and railway infrastructure by maintaining and upgrading the existing set back defence (earth embankment along the inshore edge of the inter-tidal area), subject to the future availability of public funding for coastal erosion and flood risk management.		
14.3	Kidwelly (Commissioner's Bridge to Kidwelly Quay)	The policy is to enable natural evolution of the estuary to continue through a policy of **no active intervention**, to retain the conservation value of the area. The risk of coastal erosion and flooding to railway infrastructure would continue to be monitored, and if risk increases, privately funded defences could be constructed along a set-back line, subject to obtaining the necessary consents, licences and approvals.		
14.4	Gwendraeth Fach Eastern Bank (Kidwelly Quay to NTL at A484 bridge)	In order to manage the risk of coastal erosion and flooding to Kidwelly village the existing defences would be maintained, and upgraded if necessary, subject to the future availability of public funding for coastal erosion and flood risk management, through a policy of **hold the line**. It is assumed that local road bridges across the river are maintained, in order to maintain the integrity of the Kidwelly community.		
14.5	Gwendraeth Fach Western Bank (NTL at A484 bridge to railway bridge)	The policy is to allow natural estuary evolution to continue through **no active intervention**, to retain the conservation value of the area. Due to the steeply rising land and the nature of the tidal river along this frontage, there are few assets at risk from flooding or erosion within the western part of Kidwelly, although Kidwelly castle is sited along the banks of the river. This policy assumed that local road bridges across the river are maintained, in order to maintain the integrity of the Kidwelly community.		
14.6	Kidwelly railway bridge (western bank) to Carmarthen Bay Holiday Centre	The long term aim is to monitor and manage the risk of erosion to the railway line and associated infrastructure, under a policy of **no active intervention** along this currently undefended frontage. If the risk of coastal erosion and flooding to railway infrastructure increases it may be necessary to construct, maintain and upgrade privately funded defences along this frontage to manage the risk to the strategically important railway line. These defences would be subject to obtaining the necessary consents, licences and approvals.		
14.7	Carmarthen Bay Holiday Centre	The long term policy is to allow the shoreline to develop naturally along this frontage through **no active intervention**. Maintenance of existing defences would cease and they would be allowed to deteriorate and fail, such that natural processes would resume. This would not, however, preclude the right of landowners to privately maintain or upgrade existing defences subject to obtaining necessary consents, licences and approvals. Continued provision of defences along existing alignments would become increasingly difficult to sustain in the long term, as sea level rises and the estuary responds to climate change. The future risk of coastal erosion and flooding to railway infrastructure will be monitored. If the risk of coastal erosion and flooding to railway infrastructure increases it may be necessary to construct, maintain and upgrade privately funded defences along this frontage to manage the risk to the strategically important railway line. These defences would be subject to obtaining the necessary consents, licences and approvals.		
14.8	Carmarthen Bay Holiday Centre to south of Ferryside	In order to manage the risk of coastal erosion and flooding to the railway line, the long term policy is to **hold the line** through maintenance and upgrading of the existing defences and construction of new (privately funded) defences as required, subject to obtaining necessary consents, licences and approvals. Railway defences would have little impact on natural coastal processes due to the lack of sediment along this frontage and the resistant geology upon which the railway was built, which would naturally restrict future shoreline change.		
14.9	Ferryside	The policy is to **hold the line**, in order to manage coastal erosion and flood risk to Ferryside village and the railway line, through maintaining and upgrading existing defences as required and subject to the future availability of public funding for coastal erosion and flood risk management and private funding for railway defences.		
14.10	River Towy Eastern Bank (North of Ferryside to Aalton river bend)	The policy is to continue managing the risk of coastal erosion and flooding to railway infrastructure through a policy of **hold the line**, by maintaining and upgrading existing defences and providing new defences if required, subject to obtaining the necessary consents, licences and approvals. Not all of this frontage is currently defended, Continuing monitoring is required in order to determine the performance and condition of existing defences and to determine whether new defences are required.		
14.11	River Towy Western Bank (Aalton river	The policy is to allow natural estuary evolution by **no active intervention**. This would not, however, preclude the right of landowners to privately maintain or upgrade existing defences at		

	bend to North of Llansteffan)	Ferry Point and the Towy Boat Club, subject to obtaining necessary consents, licences and approvals.	
14.12	**Llansteffan**	The policy is to continue to **hold the line** in order to manage the risk of coastal erosion and flooding to Llansteffan village through maintaining and if required upgrading the existing set back earth embankment, whilst allowing the dunes and intertidal area to function as naturally as possible, subject to obtaining the necessary consents, licences and approvals and the future availability of public funding for coastal erosion and flood risk management.	
14.13	**South of Llansteffan to Wharley Point**	There are limited socio-economic assets at risk along this frontage and therefore the policy is to allow natural estuary evolution through **no active intervention**. This would not, however, preclude the right of landowners to privately maintain or upgrade existing defences at St Anthony's Well subject to obtaining necessary consents, licences and approvals. Continued provision of defences along the existing alignment are unlikely to have adverse impacts on the function of the estuary as a whole, but would become increasingly difficult to sustain in the long term, as sea level rises and the estuary responds to climate change.	
14.14	**Wharley Point to Black Scar**	The long term policy is to allow the estuary to evolve and retreat naturally through **no active intervention**, in order to retain the landscape and environmental interest in this undeveloped shoreline.	
14.15	**River Taf Eastern Bank (Black Scar to St Clears)**	The long term policy is to allow the estuary to evolve and retreat naturally through **no active intervention**, in order to retain the landscape and environmental interest in this largely undeveloped shoreline. There is a potential site along this frontage where managed realignment could be undertaken to create an area of compensatory intertidal habitat, however this is subject to further detailed investigations.	
14.16	**St Clears**	In order to continue managing flood and erosion risk to the southern part of St Clears, the long term policy is to **hold the line** through maintaining and improving existing defences, subject to the future availability of public funding. This would not, however, preclude the right of landowners to privately maintain or upgrade existing defences, subject to obtaining necessary consents, licences and approvals.	
14.17	**River Taf Western Bank (St Clears to Laugharne)**	The policy is to allow the estuary to evolve and retreat naturally through **no active intervention**, in order to retain the landscape and environmental interest in this undeveloped shoreline.	
14.18	**Laugharne**	The policy is **managed realignment** in order to allow natural coastal evolution, whilst continuing to manage flood and erosion risk to Laugharne village. Flood risk management improvements have recently been undertaken including individual flood protection and flood warnings to 43 properties, but there remains a risk of coastal flooding (and erosion) to Laugharne village since a surge barrier was not constructed, as the local community were primarily concerned with the associated aesthetic impact on the village.	
14.19	**South of Laugharne to Ginst Point**	In the short term, the policy is to continue to **hold the line** and manage the risk of flooding through maintaining the existing defences, whilst realignment opportunities are investigated.	The medium and long term policy is to construct a set back defence through **managed realignment**, and then **hold this set back line** by maintaining and upgrading this defence, as required to create a large area of compensatory intertidal habitat on this area of the land, which was reclaimed from the sea during the Medieval period, and is currently susceptible to flood and erosion risk. This policy is subject to further detailed investigation, consultation and the future availability of public funds for the creation of compensatory intertidal habitat and coastal erosion and flood risk management.

A review of the impacts of the preferred SMP2 policies on coastal evolution and behaviour is provided in Appendix E: Policy Development and Appraisal, Section E1.3.

Policy sensitivities and key uncertainties (further detail is included in Appendix K)

All policy units – there is significant uncertainty with regard to how the estuaries will evolve in the future, particularly in response to future climate change and sea level rise and potential changes in the alignment/ extent of low water channels and offshore sand banks. Monitoring of the future response of the estuaries is therefore highly recommended.

Policy units 14.1, 14.5, 14.11 14.13, 14.14 and 14.17 – these units are considered to be of low sensitivity and therefore unlikely to change.

Policy units 14.2, 14.3, 14.6, 14.7, 14.8, 14.9 and 14.10 – these units are sensitive to the future plans, and availability of funding, for the Swansea – Llanelli – Carmarthen – Pembroke Dock railway line and associated infrastructure.

Policy unit 14.4 – there is a risk along this frontage, subject to the availability of public funding, that a hold the line policy will not maintain the existing standard of protection in line with sea level rise. This would lead to an increased risk of overtopping and flooding, whilst continuing to manage the risk of erosion.

Policy units 14.9 and 14.12 – future management of these frontages will depend upon the future availability of public funding for coastal erosion and flood risk management.

Policy units 14.9 and 14.12 – the feasibility of implementing this policy will depend on future estuary and dune evolution, which are in turn sensitive to changes in sea level, storminess and the alignment of low water channels.

Policy unit 14.15 – there are limited assets at risk along this frontage including link roads, sewage works and archaeological assets which could be affected by tidal flooding. The risks to these should be monitored. If the risks are found to significantly increase relocation, adaptation measures or new localised set back defences should be considered, due to the environment and landscape value of this area. This frontage also includes a potential site for the creation of compensatory intertidal habitat through managed realignment of existing defences.

Policy unit 14.19 – the medium and long term policy is subject to further detailed studies to investigate the viability of alternative managed realignment and compensatory intertidal habitat creation options, which will include assessment of potential impacts on the wider estuary system and managing the risk of flooding to various assets at East and West Marsh (south of Laugharne), Qinetiq's Pendine test facility and Pendine village.

Changes from present management / SMP1 policy[1]

The majority of policies remain unchanged from either the present management or SMP1 policy. The key differences are:

Policy units 14.4, 14.5, 14.10, 14.11, 14.15, 14.16 and 14.7 – the SMP1 did not extend so far upstream any of the estuaries and therefore these policy units are not covered.

Policy units14.7, 14.18 and 14.19 – the recommended policies represent a change from present management where the frontages are defended. These changes may be due to funding availability (14.7), future sustainability of defences (14.18) and habitat creation (14.19).

[1] The SMP1 documents should be referred to for more details as unit boundaries do not always align with SMP2 policy units and the policies refer to different time periods.

Three Rivers Estuarine Complex (14) (this is a summary of impacts, for full details see **Appendix G SEA Report**)	
Issue	**Appraisal**
Receptor: Property, population and human health Key residential settlements along this frontage include Pembrey, Kidwelly, Ferryside, Llansteffan, St Clears, Laugharne and Pendine. However, there are also a number of smaller villages and isolated properties. The shores of the estuaries are typically undefended, with existing defences adjacent to developed areas and where the railway runs adjacent to the shore.	
Will SMP policy maintain coastal settlements and manage the impact of coastal flood and erosion?	+ The risk of coastal erosion and flooding to key communities, such as Pembrey, Kidwelly, Ferryside, Llansteffan, St Clears and Laugharne will be managed by maintaining and upgrading existing defences, subject to the future availability of public funding for coastal erosion and flood risk management. The risk of flooding to various assets at East and West Marsh (south of Laugharne), Qinetiq's Pendine test facility and Pendine village will be considered when developing alternative options for managed realignment/ compensatory intertidal habitat creation. – Undefended properties and assets within Kidwelly, St Clears and Laugharne could be at increased risk of coastal erosion and flooding. Other isolated properties may also be at increased risk subject to future rates of coastal erosion and sea level rise.
Will SMP policy directly increase the actual or potential coastal erosion or flood risk to communities?	+ The risk of coastal erosion and flooding to key communities will be managed through maintenance/ upgrading of existing defences. Otherwise, undefended frontages will be allowed to continue evolving naturally unless this presents an increased risk to assets such as the railway line. – At Carmarthen Bay Holiday Park, the existing defences would be allowed to fail, and there would be increased flood and erosion risk to the caravan park and associated infrastructure. The recommended policy for the East and West Marsh (south of Laugharne) is to hold the line in the short term with managed realignment in the medium/ long term. This could increase flood risk to isolated properties and various other assets dependent on the extent of the realignment scheme.
Is SMP policy sufficiently flexible to take account of dynamic coastal change?	+ In undeveloped parts of the estuary, the policy is no active intervention to allow dynamic coastal change. Whilst defences will be maintained/ upgraded adjacent to developed areas and where the railway runs adjacent to the shore, these are typically where there is resistant rising geology, and therefore limited natural coastal change would be expected if the coast was undefended.
Could there be a detrimental impact on the fabric of coastal communities?	+ Along most of this shoreline, there will be limited impact on coastal communities since the risk of coastal erosion or flooding will be managed by existing defences, or the communities are located sufficiently far inland/ high ground so as to be unaffected. – The loss of defences at Carmarthen Bay Holiday Park would result in loss of holiday chalets, caravans and associated infrastructure, – There may be wider impacts at Kidwelly and Laugharne, in addition to increased flood and erosion risk to parts of the community, such as inability to obtain property insurance, property value depreciation and loss of future investment.
Receptor: Land use, infrastructure and material assets The Three Rivers Estuarine Complex is typically undeveloped. The main non-residential asset is the railway line which runs along the coast on the north bank of the Gwendraeth Estuary and the eastern bank of the Towy Estuary. There are also a number of strategically important routes including the A484 highway. Carmarthen Bay Holiday Centre is situated on an outcrop seaward of the railway in the Gwendraeth Estuary, and Laugharne is a popular tourist destination. On the reclaimed land south of Laugharne is a large ragworm farm. There are also a number of sewage works associated adjacent to, or near to, the river.	
Will SMP policy maintain key industrial, commercial and economic assets and manage the impact of coastal flooding and erosion?	+ The risk of coastal erosion and flooding to many key assets will be managed through maintenance/ upgrading of existing defences. There may be an increased risk of flooding to agricultural land, the ragworm farm and various other farm properties and assets at East and West Marsh (south of Laugharne), including Qinetiq's Pendine test facility and Pendine village, dependent upon the extent and detail of the proposed managed realignment scheme which is subject to further detailed studies. – There will be potential loss of assets at Kidwelly and Laugharne.
Will the SMP policy ensure critical services and infrastructure remain operational, for as long as required?	– Several of the sewage works will be at increased risk from flooding and erosion, and therefore adaptation/ resilience/ protection measures may need to be implemented, or the assets may need to be relocated. Risk is dependent upon location and estuary response to sea level rise, although the sewage works immediately south of St Clears appears to be at greatest risk due to its location. – Critical infrastructure and assets within Laugharne and Kidwelly may be at increased risk from flooding and erosion, dependent on their location. However the risk to these assets will be similar to the risk to the properties they support. + Risk to the railway would be managed to ensure that services remain

Three Rivers Estuarine Complex (14)
(this is a summary of impacts, for full details see **Appendix G SEA Report**)

Issue	Appraisal
	operational. This will include construction of defences, if necessary, along currently undefended frontages. It is assumed that the A484 bridges across the Gwendraeth Fawr and Gwendraeth Fach would continue to be maintained in order to retain key transport links. − There is risk to local access roads, including the B4312 running along the west bank of the Towy estuary and a number of other minor roads. However the risk is likely to be minimal due to the resistant nature of the underlying geology.
Will there be an impact on marine operations and activities?	+ There are no significant marine operations along this frontage.
Will SMP policy impact coastal flooding or erosion on agricultural activities?	− Small areas of agricultural land will be at increasing risk of coastal erosion and flooding, particularly in the upper estuaries. However, risk will be dependent on estuary response to sea level rise, and low water channel migration. In many places the risk will also be minimised by the resistant nature of the underlying geology, The risk to agricultural land landward of the railway would continue to be managed where there are existing defences.
Will the SMP policy ensure that MoD (Qinetiq) ranges remain operational?	x The risk of coastal erosion and flooding to the Qinetiq test facility will be taken into account when developing alternative options for managed realignment/ compensatory habitat creation at East and West Marsh (south of Laugharne).
Receptor: Amenity and recreational use The Three Rivers Estuarine Complex is not a significant area for tourism and amenity. However the villages of Kidwelly and Laugharne include some recreational, amenity and tourist facilities. The Carmarthen Bay Holiday Centre is situated on a rock outcrop in the Gwendraeth Estuary.	
Could the SMP policy have an impact on tourism in the area?	− Increased risk of coastal erosion and flooding to some facilities within Kidwelly and Laugharne dependent upon their location and the rate of future sea level rise. − Failure of the defences at the Carmarthen Bay Holiday Park would result in loss of assets, particularly since the park has recently experienced flooding.
Will SMP policy affect coastal access along, or to, the coast?	x There is no coastal access along the majority of the coast.
Receptor: Historic environment There are a range of Scheduled Monuments within the study area, including Kidwelly Castle SM, Llansteffan Castle SM, St Teilo's Church SM, Trefenty Mound and Bailey Castle SM, St Clears Mound and Bailey Castle SM and Laugharne Castle SM. There are also listed buildings associated with Kidwelly, St Ishmael, Ferryside, Llansteffan, Laugharne and St Clears. Local archaeology includes wrecks, peat deposits and military remains. Pembrey Airfield and associated military remains. Nationally important landscape south of Laugharne. These marshes have been drained and reclaimed from the Medieval period, surviving as an exceptional agricultural earthwork landscape from the 17th century.	
Will SMP policy maintain the fabric and setting of key historic listed buildings, cultural heritage assets and conservation areas?	− Risk to archaeological and historic assets in intertidal areas, including wrecks and peat deposits. Scheduled Monuments situated on the upper reaches of the estuaries, including St Teilo's Church and Trefenty Mound and Bailey Castle are at risk from flooding or erosion, although this risk is dependent on sea level rise and future estuary evolution. + The risk of coastal erosion and flooding to listed buildings within Kidwelly, St Ishmael, Ferryside, Llansteffan, Laugharne and St Clears would be managed through maintenance/ upgrading of existing defences. − Risk to historically important landscape south of Laugharne in the medium and long term under a policy of managed realignment, subject to further detailed studies.
Will the SMP provide sustainable protection of archaeological and palaeo-environmental features or ensure adequate time for monitoring, assessment and mitigation measures to be devised in response to ongoing and future erosion.	● Along currently undefended sections there is no intent to provide new defences, as this would not be socio-economically justified and is considered unsustainable, unless existing assets are at risk from coastal erosion/ flooding. In the meantime monitoring should be undertaken to enable alternative mitigation measures to be developed, appraised and implemented, as appropriate. + At East and West Marsh (South of Laugharne), the policy is to hold the line in the short term which would allow time for consideration of monitoring, assessment and mitigation measures.
Receptor: Landscape character and visual amenity There are no specific landscape designations along this frontage. The estuaries are narrow and largely constrained by the steep and resistant geology. Much of the area is undeveloped.	
Will SMP policy maintain a range of key natural, cultural and social features critical to the integrity of the coastal landscape?	● For much of this shoreline there is no proposed change from existing policy, therefore minimal change to the landscape, particularly in the short term. − Allowing defences to fail at the Carmarthen Bay Holiday Centre may adversely affect the visual landscape locally, as they deteriorate and fail. The only requirement to remove the remains of defences would be if they represented a health and safety risk.
Could SMP policy lead to the introduction of features which could be unsympathetic to the character of the landscape?	+ There is generally no intent to introduce defences, unless existing assets are at risk from coastal erosion/ flooding. Any defences constructed to protect the railway would be linear defences adjacent to the railway line itself and thus are not considered to adversely affect the landscape.

Three Rivers Estuarine Complex (14)

(this is a summary of impacts, for full details see **Appendix G SEA Report**)

Issue	Appraisal
Receptor: Biodiversity, flora and fauna The foreshore and intertidal areas throughout the site are part of the Carmarthen Bay and Estuaries SAC, Special Protection Areas (SPA) & Ramsar Site. There are also a number of SSSIs within the Estuary: Pembrey Coast SSSI, Towy River SSSI, Craig Ddu – Wharley Point Cliffs SSSI, Taf Estuary SSSI and Laugharne – Pendine Burrows SSSI.	
Will SMP policy enable a sustainable approach to habitat management?	+ Proposals include the identification of two potential sites which could be managed to provide compensatory intertidal habitat to offset habitat losses due to coastal squeeze elsewhere along the SMP2 frontage. This therefore a sustainable long term approach to habitat management.
Will SMP policy maintain or enhance any international, national or local sites of natural conservation interest?	+ Managed realignment of defences including at East and West Marsh (south of Laugharne) will locally improve intertidal habitats. ● Natural intertidal narrowing elsewhere may lead to a reduction in intertidal habitat and therefore reduced habitat for wading birds. This will depend upon the rate of future sea level rise.
Will SMP policy <u>accelerate</u> intertidal narrowing (coastal squeeze) and will this affect designated habitats?	– There may be intertidal narrowing, i.e. coastal squeeze, along the defended frontages, although this is partially dependent on channel migration and estuary response to future sea level rise. + Undertaking managed realignment south of Laugharne has the potential to create a large new intertidal habitat.
Will there be a net loss of BAP habitat within the SMP timespan as a result of SMP policy?	+ Extension of intertidal habitat in the short, medium and long term through realignment of the defences at Tywyn Point. + Build up of saltmarsh in the short, medium and long term at Tywyn Point. – Potential loss loss of intertidal sands and mud's including peat exposures (reeds) which could impact the overall morphodynamics of the Estuary at Carmarthen Bay Holiday Centre to south of Ferryside in the short, medium and long term due to the provision of defences resulting in coastal narrowing. – Loss of intertidal habitat on the eastern bank of the River Tywi in the short, medium and long term. + Extension of intertidal habitat on the western bank of the River Tywi in the short, medium and long term.
Receptor: Earth heritage, soils and geology The designated coastline includes Pembrey Coast SSSI, Craig Ddu – Wharley Point Cliffs SSSI, Taf Estuary SSSI and Laugharne-Pendine Burrows SSSI as well as River Tywi SSSI.	
Does SMP policy work with natural processes and enhance or maintain natural features?	● SMP policy is for no active intervention along undeveloped lengths of the shore to enable continuation of natural coastal processes. However, in developed areas and along the railway, the intent to maintain/ upgrade existing defences will restrict natural processes to some extent.
Will SMP policy maintain or enhance the visibility of coastal geological exposures, where designated?	● The designated features are generally in the intertidal zone and therefore seaward of any defences. However, as sea level rises, defences are likely to result in narrowing of intertidal habitats and other features.
Receptor: Water There are numerous coastal, freshwater, transitional (areas of water near river mouths, which are partially saltwater but are influenced by freshwater) and groundwater bodies in the SMP2 area that have the potential to be affected by SMP2 policies.	
Will SMP policy manage the risk of pollution from contaminated sources?	+ There are no known contamination issues along this shoreline.
Will SMP policy adversely affect water bodies in the coastal zone?	+ The Tywi & Cywyn & Gwendraeth water body will experience localised improvement in biological quality elements as MR would allow the development of more naturally functioning saltmarsh at and south of Laugharne (PU14.18, 14.19). This will support WFD objectives. ● Elsewhere, the combination of NAI and HTL is expected to have no significant effect on the Tywi & Cywyn & Gwendraeth and Loughor Outer water bodies. HTL frontages are either landward of intertidal habitat, very short or associated with resistant geology or rising hinterland which would prevent the development of extensive intertidal habitat even if allowed to function naturally. ● The Loughor Outer water body will be unaffected. ● The Carmarthen Carboniferous Coal Measures and Tywi, Taf & Gwendraeths groundwater bodies and numerous river water bodies will be unaffected..

Impact colour key	+ Positive	● Neutral	– Negative	x Not applicable

Three Rivers Estuarine Complex (14)

ACTION PLAN

Action	Action Ref	Policy Unit	Action Description (to be approved)	Potential source for funding (subject to approval)	Responsibility (lead partner * (supporting partners)	When by (subject to funding)
1. Studies for Scenario Area	1.1	All	Undertake study to investigate the future evolution of Carmarthen Bay and adjacent estuaries including the Three Rivers estuarine complex to confirm impacts of future climate change on estuary development and the dune systems. This will require the collection of data relating to bathymetric change, wind and wave regime, tidal regime, rainfall, river discharge, sediment sources, transport pathways and sediment fluxes in the long term since there is currently a lack of such data to enable a full understanding of the interactions between physical processes and coastal morphological change.	WAG	Coastal Group (Wales Coastal Monitoring Centre)	0 to 100 years
2. Studies for Policy Units	2.1	14.2, 14.4, 14.8 to 14.10, 14.12 and 14.16	Undertake a scoping assessment to identify when a feasibility study of the upgrading/improvement options to existing defences needs to be carried out and/or identify the criteria/factors that would trigger this feasibility study. The timing of this feasibility study will be influenced by factors such as: existing frequency of flooding, type of receptors at risk, depths and velocity of flooding and residual asset life. Consider alternative further options where it is not possible to justify public investment in coastal erosion and flood risk management.	WAG	CCC (EAW and Network Rail)	0 to 20 years
	2.2	14.7	Engage with and encourage holiday park owner to plan for and adapt to increased risk of coastal erosion and flooding, which may involve consideration of local resistance/ resilience measures.	Private	Private	0 to 20 years
	2.3	14. 15, 14.18 and 14.19	Undertake community engagement, monitoring and detailed studies to investigate the technical, environmental and socio-economic implications of a range of managed realignment schemes along these frontages (including timing of future community change), which need to take full account of potential future climate change and identify potential wider impacts on the estuarine system.	WAG	CCC (EAW)	0 to 5 years
3. Strategy			-			
4. Scheme work			-			
5. Monitoring (data collection)	5.1	All	Undertake beach and coastal defence asset monitoring to inform further studies and future SMP reviews. In particular rates of dune erosion should be monitored. This information should not only be used in future coastal management but also to assist in stakeholder liaison by use of data in public education campaigns.	WAG	CCC (Wales Coastal Monitoring Centre)	0 to 100 years
	5.2	All	Continue with existing beach profile monitoring programme and provide information to Wales Coastal Monitoring Centre for storage and analysis. Use beach profile data to identify the future risk of undermining and overtopping of existing defences,	WAG	Coastal Group (Wales Coastal Monitoring Centre)	0 to 100 years
	5.3	All	Extend monitoring programmes to SMP estuary limits (NTL on Gwendraeth, Aalton river bend on Towy and NTL on Taf.	WAG	Coastal Group/ (Wales Coastal Monitoring Centre)	0 to 20 years
	5.4	All	Undertake periodic defence inspection, including condition assessment and photographs. Confirm defence crest levels.	WAG	CCC (Wales Coastal Monitoring Centre)	0 to 100 years
	5.5	All	Undertake further studies, and associated modelling, to better understand sediment regimes in the SMP area and inform future coastal management.	WAG	Coastal Group	0 to 20 years
	5.6	All	Undertake annual LIDAR survey and vertical aerial photography of the entire estuarine system (undertaken as quickly as possible during a single period of low spring tides) to provide a consistent data set for a particular date (which can be effectively compared to subsequent data sets) to enable efficient monitoring of variations in the alignment of low water channels, sand banks, intertidal muflats and saltmarshes. Link with regular bathymetric surveys, in particular of the offshore areas of Carmarthen Bay and Three Rivers estuarine complex.	WAG	Coastal Group (Wales Coastal Monitoring Centre)	0 to 20 years
	5.7	14.2, 14.3, 14.6 to 14.10	Continued regular monitoring of the risk of coastal erosion and flooding to railway infrastructure, which may require mitigation measures to be developed, assessed and implemented (subject to obtaining necessary consents, licences and approvals). Regular reporting to the CSG including sharing of data/ information.	Network Rail	Network Rail	0 to 20 years
	5.8	All	Monitor risk to the coastal footpath and investigate potential re-routing of the path where appropriate.	WAG	CCC	Ongoing

6. Asset management	6.1	All	Ensure that extents of public and privately owned defences are defined and mapped to inform future management decisions.	WAG	Coastal Group (Wales Coastal Monitoring Centre)	0 to 20 years
	6.2	All	Undertake an appraisal of asset inspection and beach profile monitoring data to assess the existing and future risk of undermining and overtopping of existing structures.	WAG	Coastal Group (Wales Coastal Monitoring Centre)	0 to 20 years
7. Communication	7.1	All	Undertake consultation with the local community, key stakeholders and general public during the development of suitable mitigation measures and wherever appropriate to ensure an acceptable approach is developed and adopted.	WAG	CCC	0 to 20 years
	7.2	All	Undertake monitoring and management of Action Plans to ensure SMP policies are put into practice.	WAG	Coastal Group	0 to 100 years
8. Interface with planning and land management	8.1	All	Continue with risk-based improvements to flood risk maps to provide an appraisal of likely future projected sea level rise.	WAG	EAW	0 to 20 years
	8.2	All	Ensure SMP policies and flood and erosion risks are accounted for in the next revisions of land use plans in order to help manage residual risks from coastal erosion and flooding to inform future planning decisions.	WAG	CCC planning	0 to 20 years
9. Emergency response	9.1	All	Development, monitoring and review of emergency response plans to prepare for storm events which are likely to exceed existing defence standards of protection or lead to failure of existing defences (for example following breach or overtopping).	WAG/ Network Rail	CCC/ Network Rail	0 to 20 years
10. Adaptation / resilience			-			
11. Flood forecasting and warning	11.1	All	Continue with risk-based improvements to flood risk maps and inundation modelling to provide improved flood warning service.	WAG	EAW	0 to 20 years
12. Habitat creation and environmental mitigation	12.1	All	Welsh Assembly Government instructed Environment Agency Wales to scope out the scale of potential coastal habitat gains and losses for Wales. The scoping exercise was completed in February 2011 and identified potential options for implementation of a National Habitat Creation Programme for Wales. How this programme is to be delivered and funded has yet to be decided.	WAG	TBC	Ongoing
* Note: It is recommended that the lead partner/s investigate the potential for local partnerships and alternative sources of funding.						