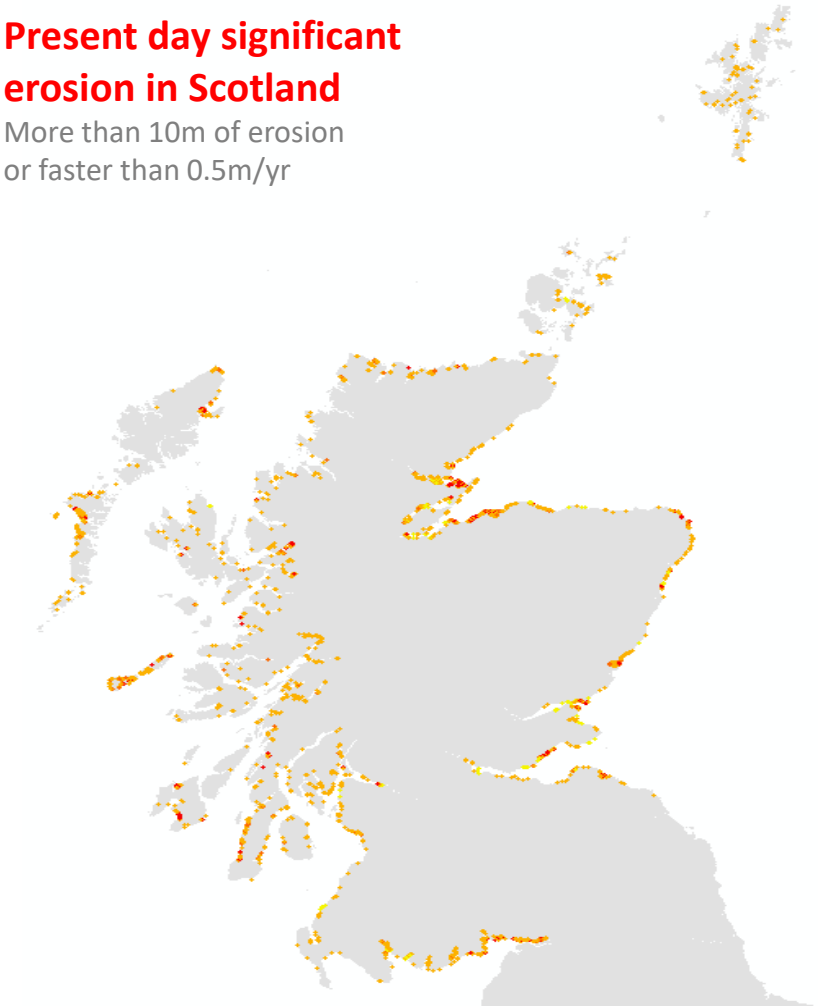
21st Century Coastal Adaptation - Can Scotland Deliver?

Present day significant erosion in Scotland

More than 10m of erosion
or faster than 0.5m/yr



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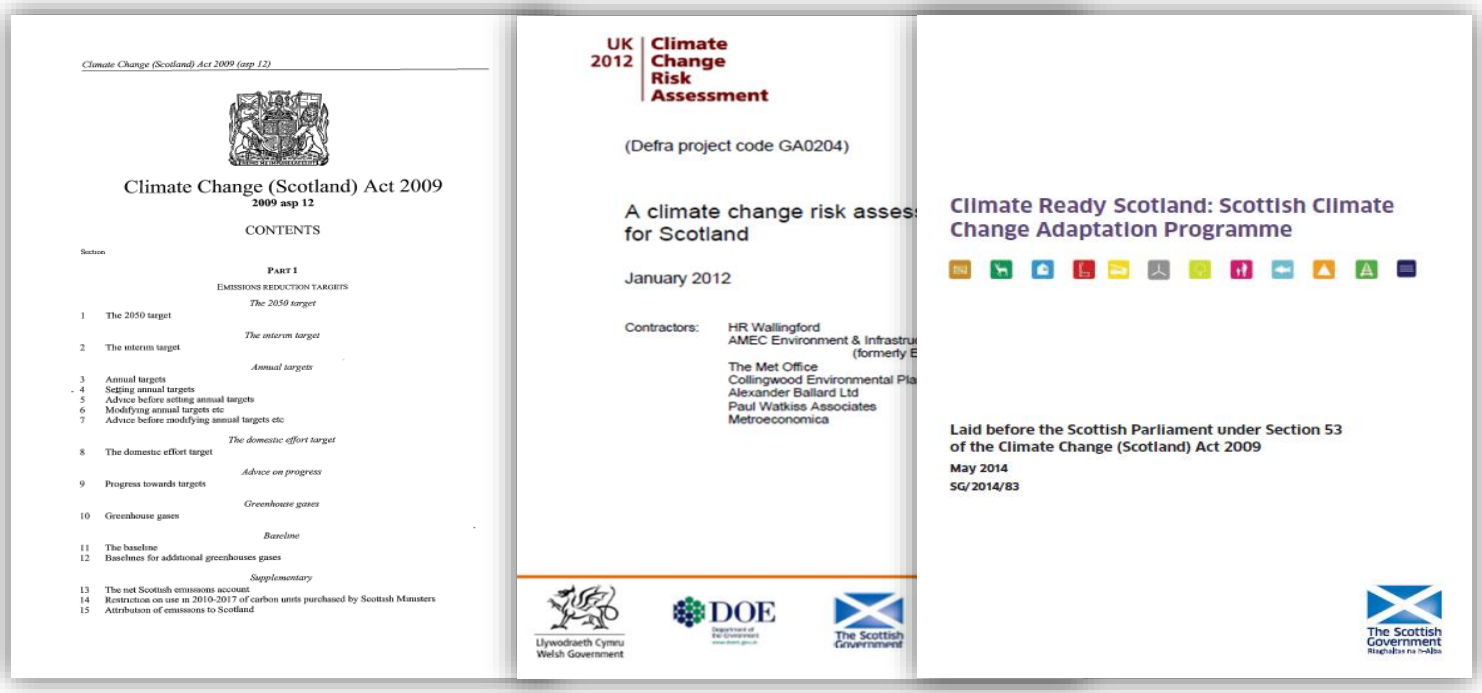
(University of Glasgow[1], SG / SNH [2] , SEPA[3], HES[4])

Climate Change Act (2009)

Places a duty on Scottish Government to address the risks in UK CCRA via the Climate Change Adaptation Programme

"Clear leadership …. and clear duties!"

Flood Risk Management Act (2009)


Climate Change (Scotland) Act 2009
2009 asp 12

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UK 2012 Climate Change Risk Assessment

(Defra project code GA0204)

A climate change risk asses for Scotland

January 2012

Contractors: HR Wallingford
AMEC Environment & Infrastru (formerly E
The Met Office
Collingwood Environmental Pla
Alexander Ballard Ltd
Paul Watkiss Associates
Metroeconomica

Llywodraeth Cymru Welsh Government

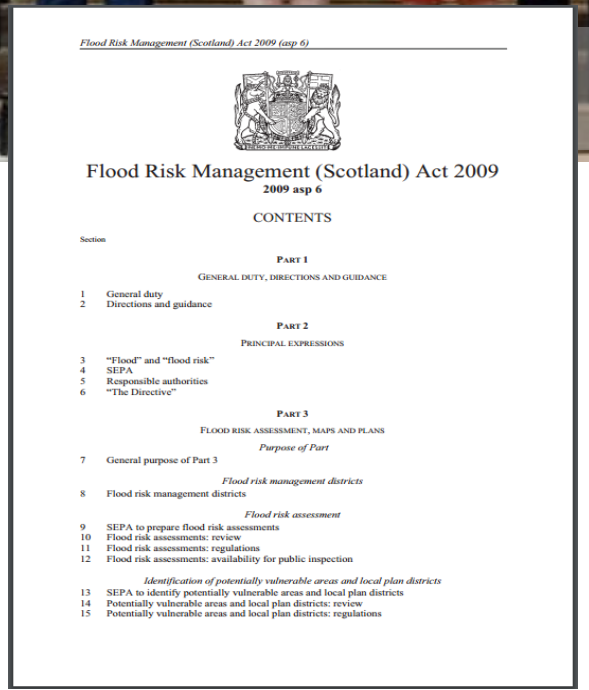
DOE

The Scottish Government

Climate Ready Scotland: Scottish Climate Change Adaptation Programme

Laid before the Scottish Parliament under Section 53 of the Climate Change (Scotland) Act 2009
May 2014
SG/2014/83

The Scottish Government Riaghaltas na h-Alba


Flood Risk Management (Scotland) Act 2009 (asp 6)

Flood Risk Management (Scotland) Act 2009
2009 asp 6

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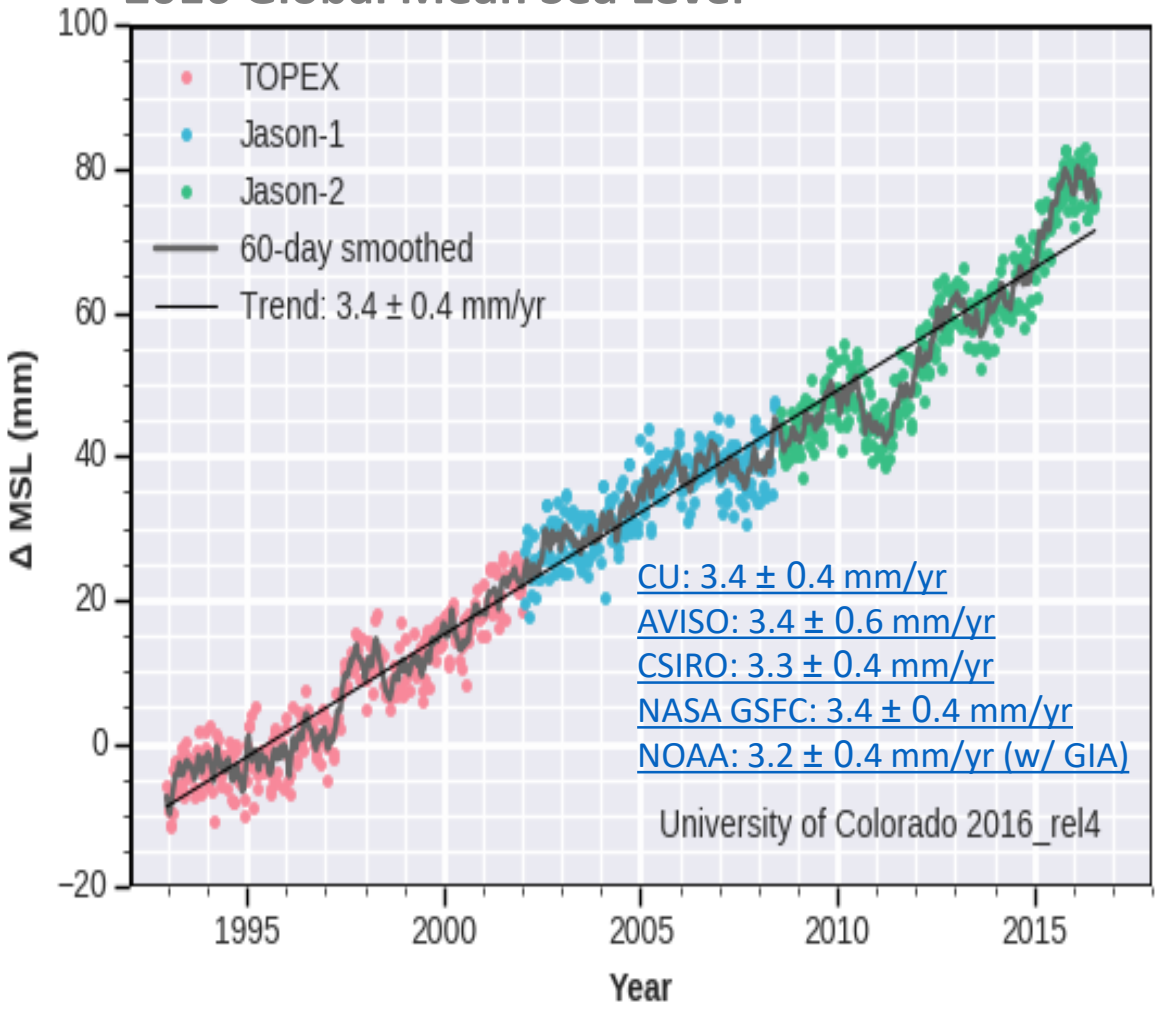
What do we anticipate?

- **That rising sea levels, increased coastal erosion and erosion-enhanced flooding will progressively impact Scotland's soft coastlines, its assets and communities.** *Science uncertainties gap.*
- **Magnitude of future coastal change cannot be accommodated within the present littoral.** *Acceptance gap 1.*
- **Strategies that fix the shoreline (rather than allow shifts) are increasingly unsustainable.** *Acceptance gap 2.*
- **Need to know the extents and rates of erosion, past, present and future, along with risk assessment of the coastal assets and communities impacted (economic, natural, cultural heritage, social disadvantage).** *Knowledge gap.*
- **Need for policy and strategic levers to cope with "slow-burn" pressures: slow short term impact but rapid medium term pick-up.** *Policy implementation gap.*
- **Need to put in place Adaptive Policies and Measures to deliver a sustainable coast.** *Policy gap.*

Key drivers of coastal erosion and flooding in Scotland

Is sea level an issue?

2016 Global Mean Sea Level



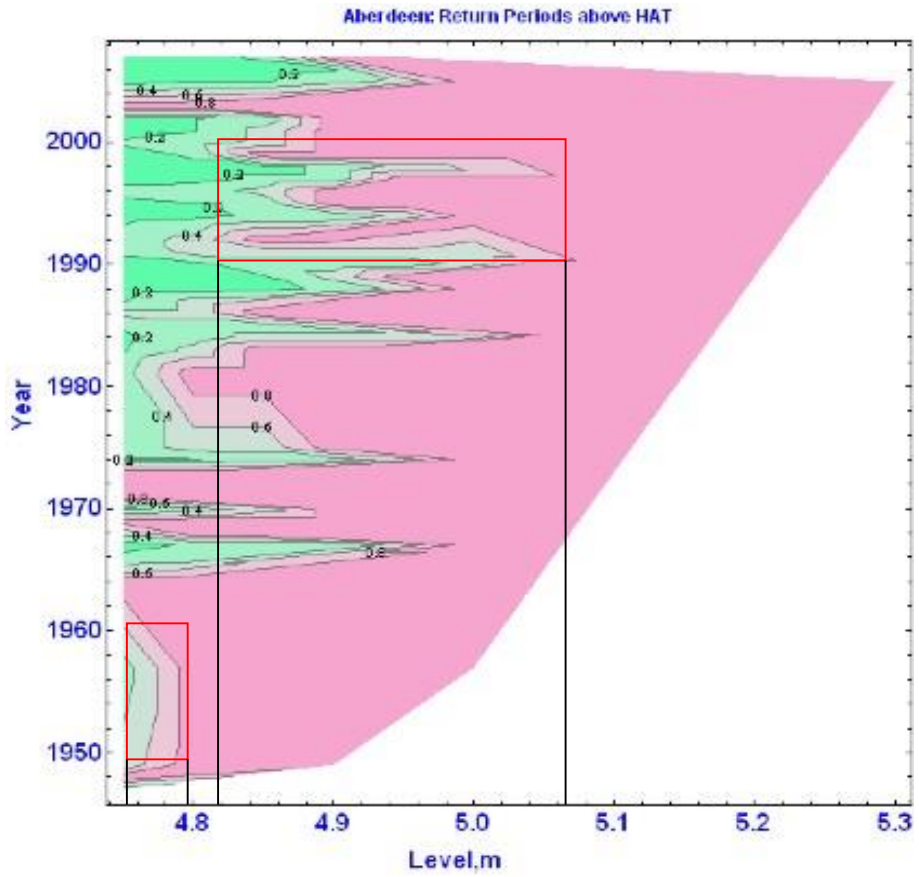
Is sea level an issue in Scotland?

http://sealevel.colorado.edu/content/2016rel4-global-mean-sea-level-time-series-seasonal-signals-removed

Rennie, AF & Hansom, JD (2011) *Geomorphology*

Relative sea level rise is the principal driver underlying increasing coastal flood events

Sniffer (2008)



Tidal records were analysed to establish flood frequency

This increase is not linked to meteorological events, but to underlying increases in mean sea level.

Mean surge levels:
Aberdeen (1946-2007) +1.22mm/yr
Millport (1978-2007) +1.17mm/yr
Stornoway (1976-2007) +2.18mm/yr
Lerwick (1976-2007) -0.36mm/yr

In the 1990s the range of events was this high

In the 1950s the range of events was this high

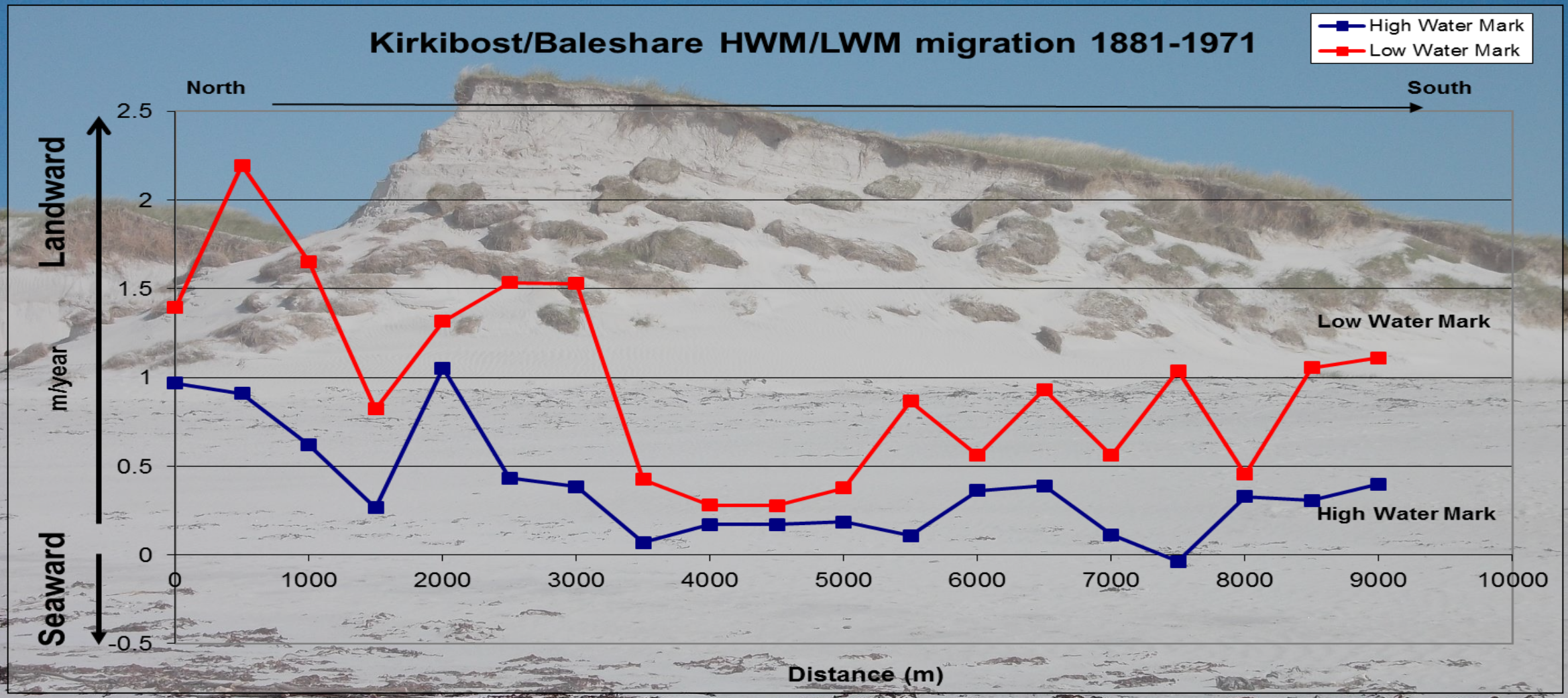
Is storminess (storm waves) an issue?

Wave height (Hs)	Increase rate		Season Period	Source
NE Atlantic	0.022 m/yr		Annual 1960-90	Bacon & Carter, 1991
NE Atlantic	0.027 m/yr		Annual 1960-88	Bouws et al., 1996
NE Atlantic	0.025 m/yr (min)		Annual 1955-94	Gunther et al., 1998
NW Atlantic	0.023 m/yr		Annual 1960-88	Bouws et al., 1996
NW Atlantic	0.024 m/yr		Annual 1976-06	Komar et al., 2010
NW Atlantic	0.032 m/yr		Winter 1976-06	Komar et al., 2010
NW Atlantic (Hurricanes)	0.277 m/yr		Summer 1996-05 33%inc=7.5-10m	Allen & Komar, 2009

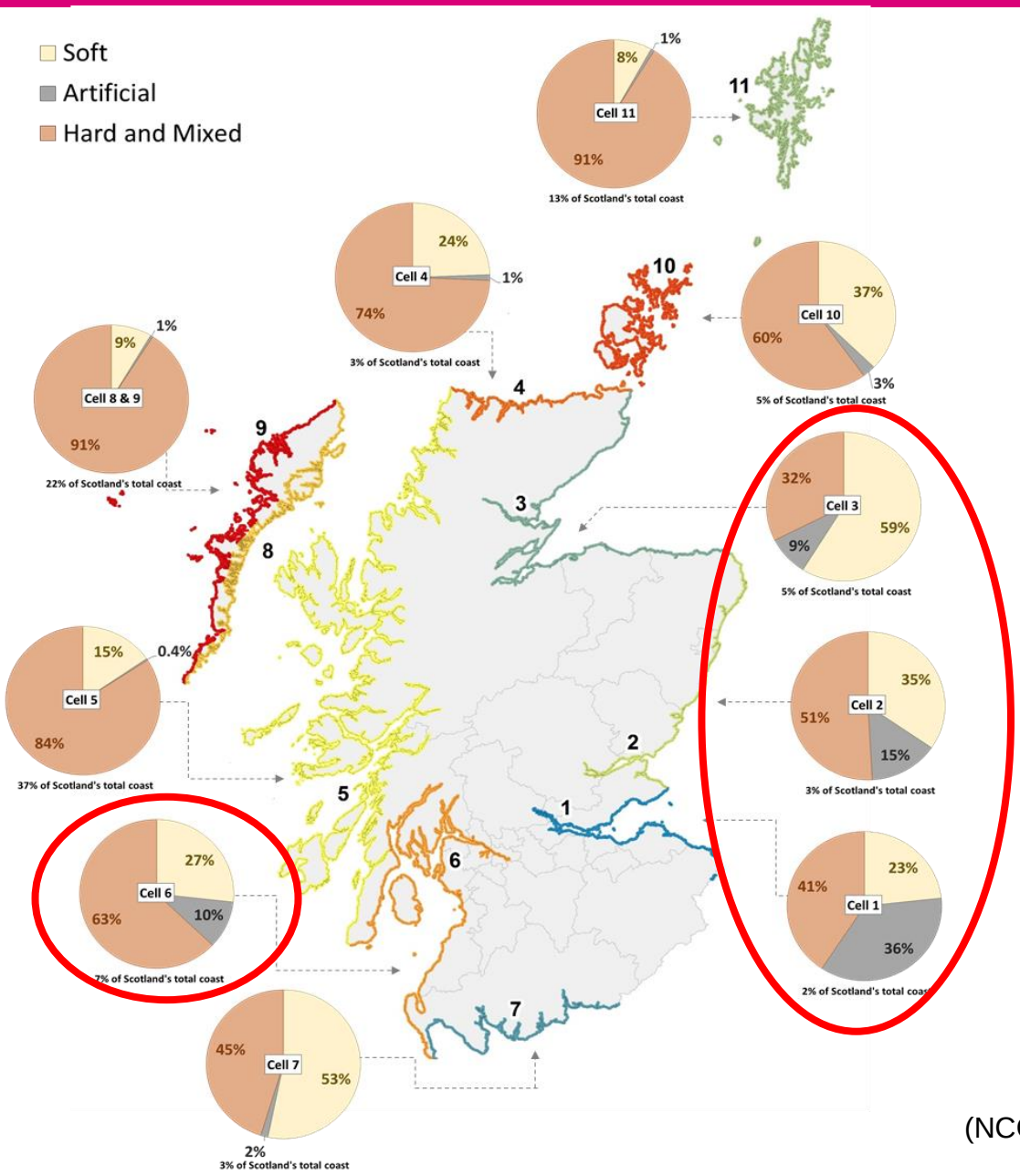
NOTE: Table shows trend in Hs (highest 33% of all waves)
Maximum wave height (Hmax) is higher and mean wave height is lower than Hs.

Is sediment supply an Issue?

Most Scottish beaches display chronic sediment deficits



Spatial footprint of management



(NCCA Results)

Addressing the knowledge gap

NCCA Results

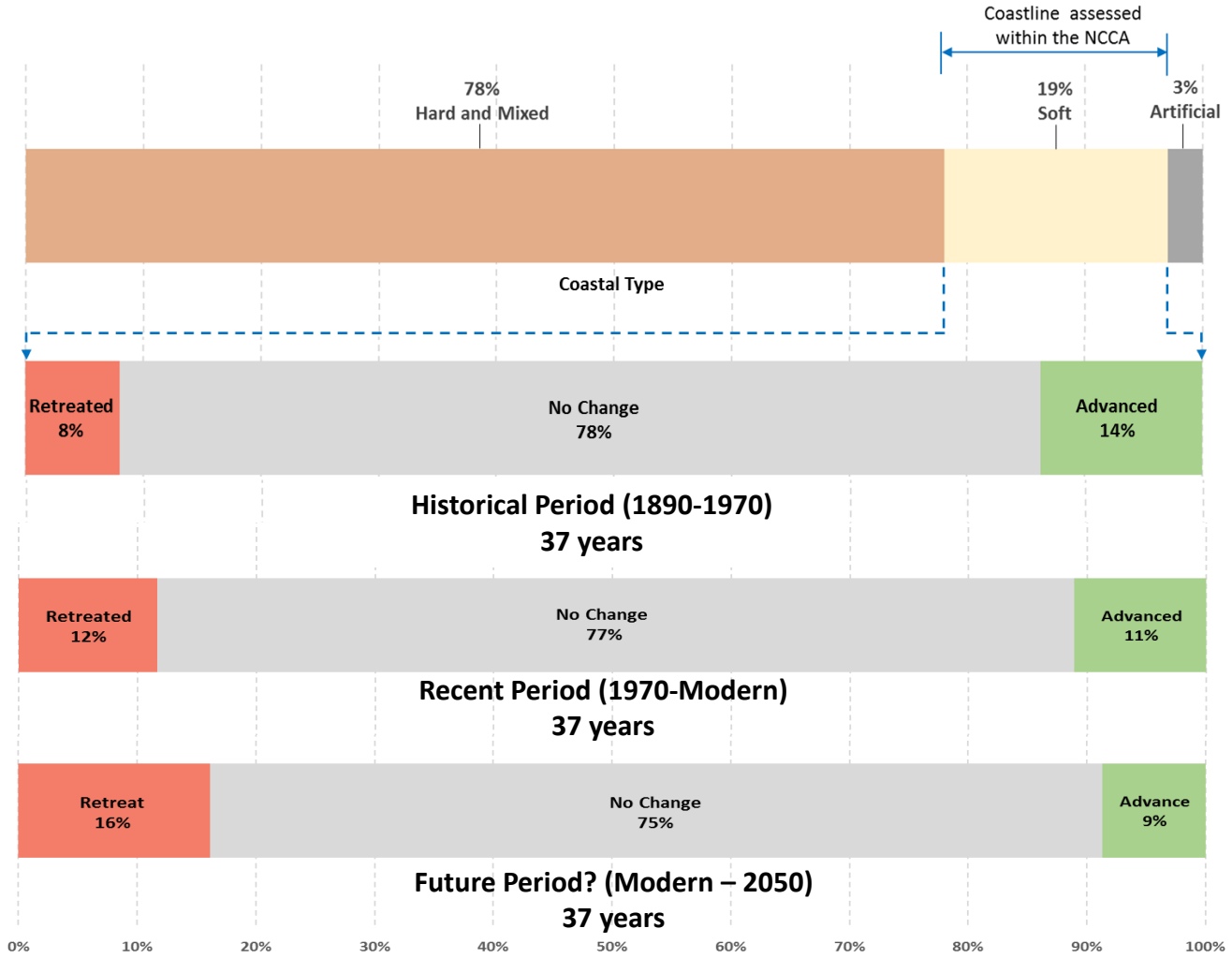
Generally:
75% soft coast dynamic stability
25% directional changes

Before the 1970s:
(normalised for time period)
8% extent of erosion
14% extent of accretion

Since the 1970s:
39% ↑ in extent of erosion
22% ↓ in extent of accretion

+ Doubling of erosion & accretion rates

But:
National picture dilutes more significant changes and patterns.

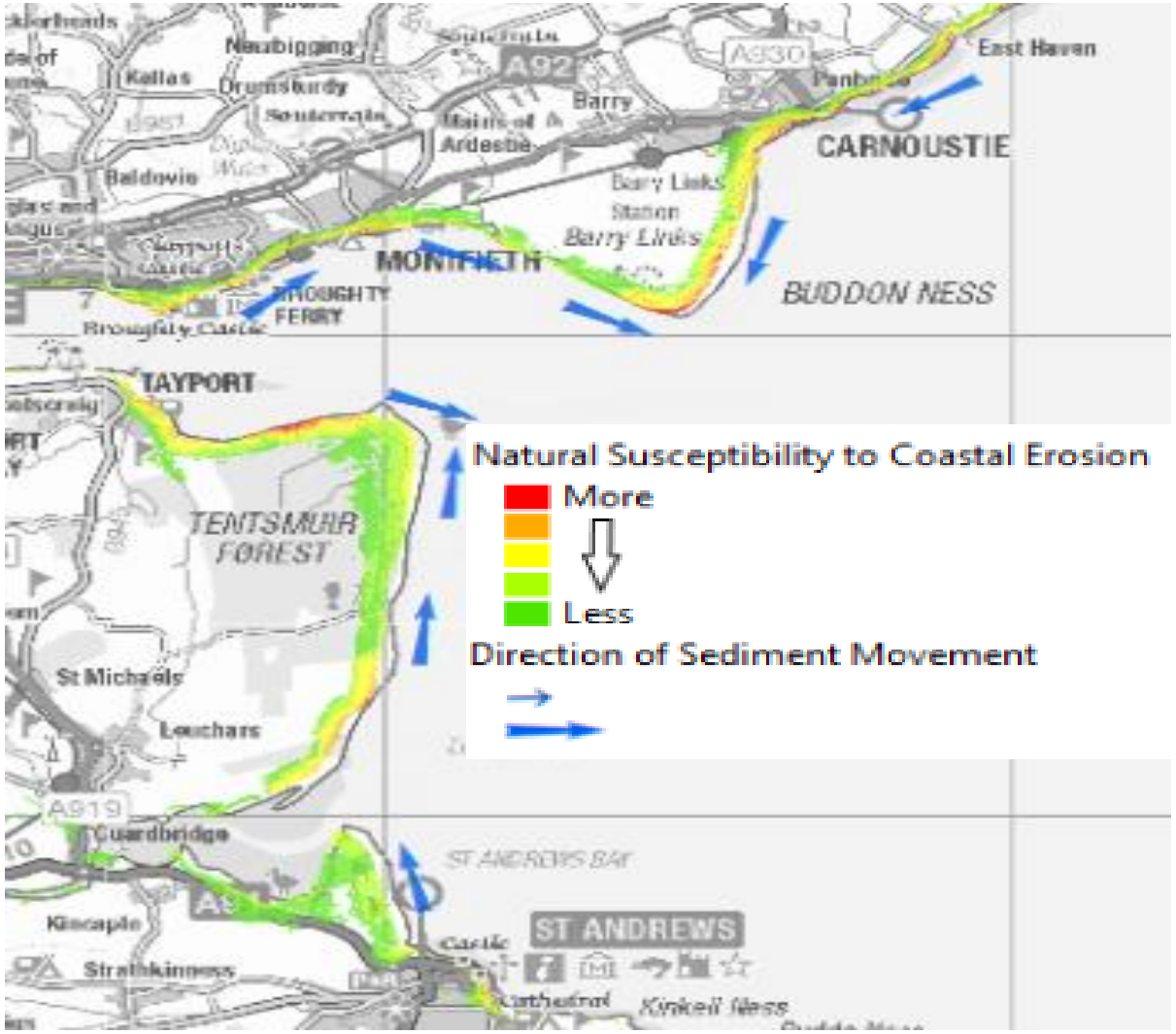


Natural Susceptibility to Coastal Erosion model

- *'coasts inherently susceptible to erosion'*
  - surface altitude,
  - rock head altitude,
  - coastal proximity,
  - wave exposure,
  - sediment supply,
  - coastal defences.

  - **Available on SEPA's website:**
  - **http://map.sepa.org.uk/floodmap/map.htm**

- **For more info see poster**



Flood Risk Management Maps http://map.sepa.org.uk/floodmap/map.htm

Fitton JM, Hansom JD, Rennie AF, 2016. *Ocean and Coastal Management.*

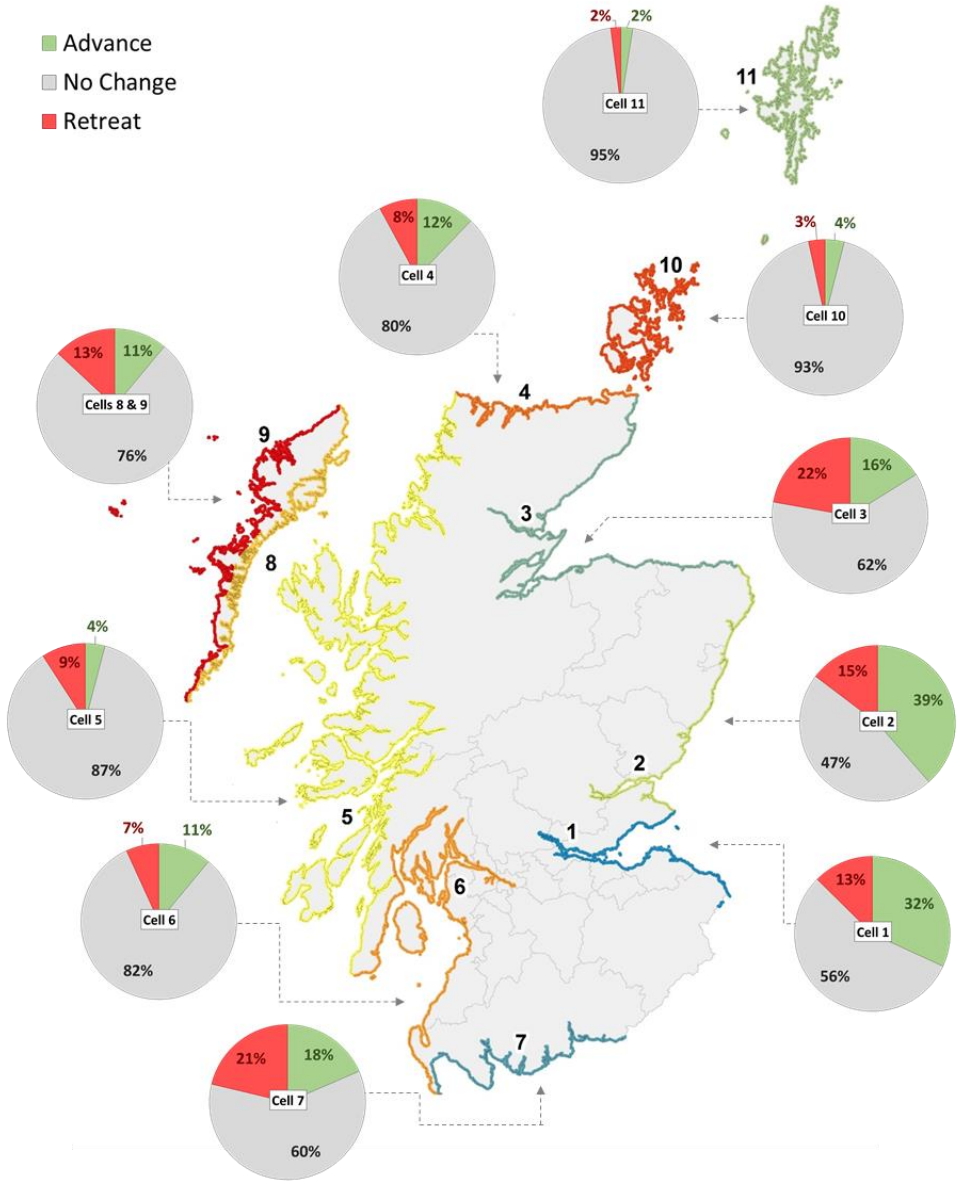
Asset Vulnerability

What lies behind recently eroding areas?

If recent erosion rates continue to 2050:
50 buildings
5.2 km of roads
1.6 km of railway
2.4 km of water pipes
… expected to be eroded

But this assumes…
Spatially limited analysis (red only)
No increase in rate
No change in management
No change due to climate change

Almost certainly under estimated.



Asset Vulnerability: Whole Coast

How many assets close to the coast:

Buffered the coast and intersected the assets.

30,000 buildings
1,500 septic water tanks
1,300 km road
100 km rail

35% are on soft coast which makes up 19% of total coast.

Asset / Receptor	Unit	Within 50m of MHWS					
		All	Coastal Type				Erodable (UPSM40+)
			Hard & Mixed	Soft	Artificial	% in Soft	
Community Services	#	78	48	20	10	26%	45
Non Residential Property	#	9,045	4,393	2,309	2,343	26%	5,101
Residential Prop	#	24,449	9,966	7,194	7,289	29%	15,276
Septic Water Tanks	#	1,656	954	677	25	41%	769
Utilities	#	312	137	80	95	26%	184
Rail	km	104	27	58	18	56%	61
Roads	km	1,336	733	497	107	37%	590
Clean Water Network	km	931	507	304	120	33%	452
Cultural Heritage	ha	1,029	471	438	120	43%	529
Environment	ha	23,430	14,873	8,424	133	36%	8,615
Runway	ha	3	2	0	1	11%	2
Average						35%	

Asset Vulnerability: Whole Coast

How many assets close to the coast

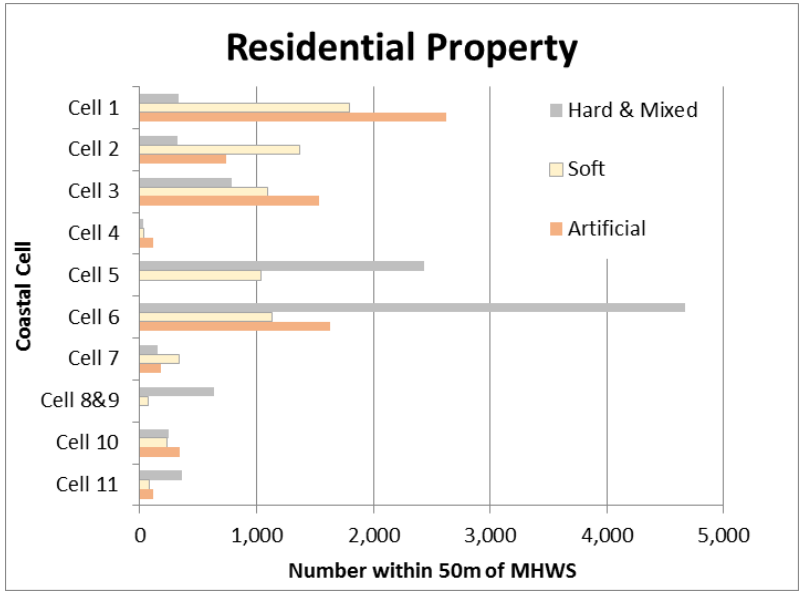
Asset distribution by cell and type.

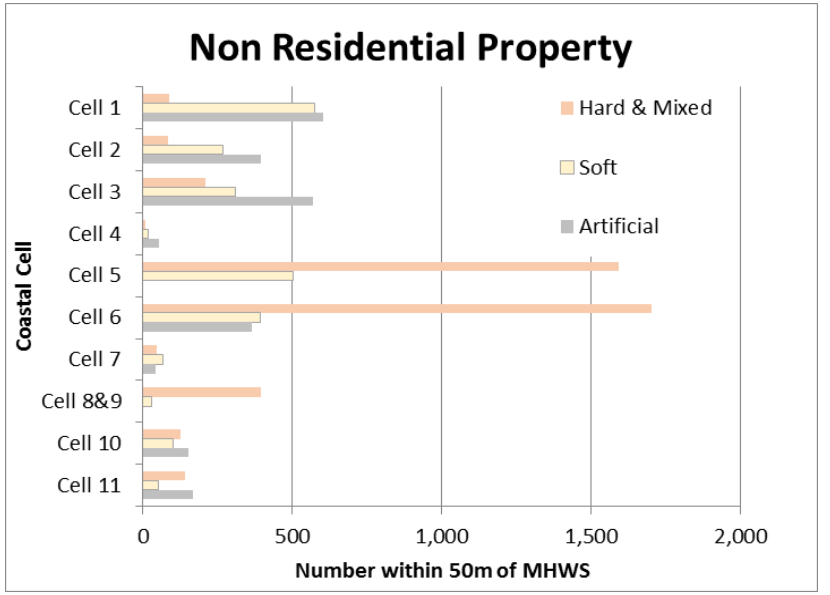
Interpretation:
East coast contains bulk of coastal assets

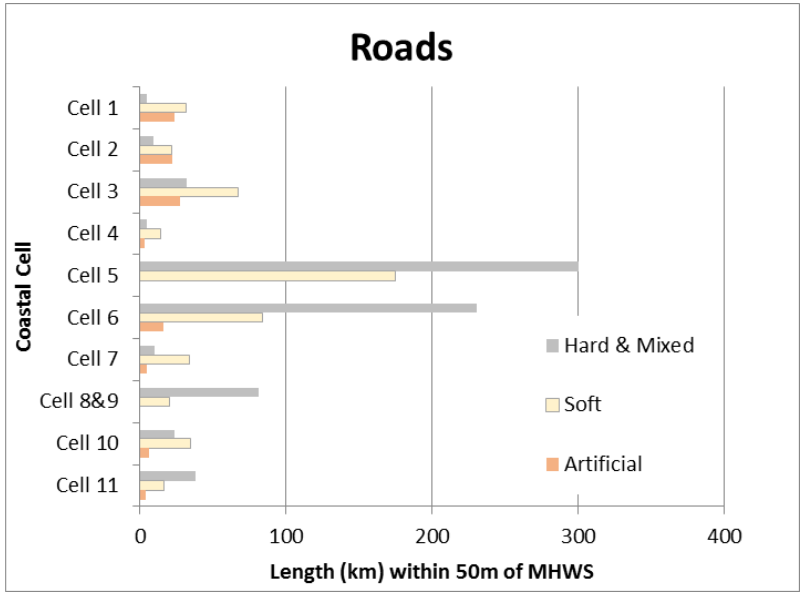
East coast contains bulk of artificial coast 100% of which protects assets.

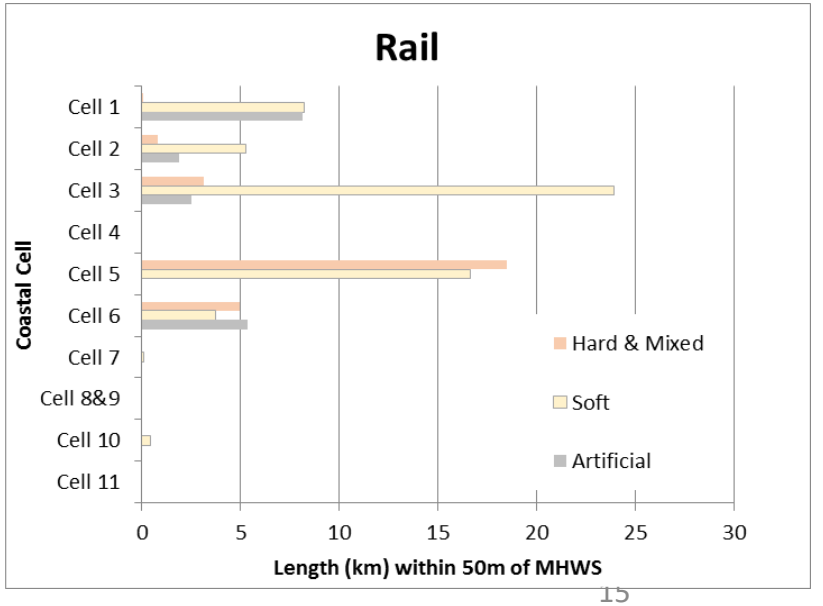
These assets depend on upkeep/renewal of existing protection or insertion of new.

BUT:
No asset type is immune
All cells have erodible assets
Condition of artificial coast is currently variable.









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Coastal Policies: Coast Protection Act (1949)

- **Formal Coast Protection Schemes are overseen by Scottish Ministers and the Coast Protection Authorities (CPAs), under the Coast Protection Act 1949 (Part I). *Unammended in Scotland, but updated in England and Wales.***
- **Coastal erosion policies lie with Local Authorities, but the responsibility for any action is at the discretion of the landowner *who may or may not decide to act in accordance with Local Authority policy (who have the power to act).***
- **All coastal local authorities are CPAs with 'permissive' (*not mandatory*) powers to undertake certain coast protection works as may appear necessary or *expedient* for the protection of land in their area**: ***expedient: convenient and practical although possibly improper or immoral. "either side can break an agreement if it was expedient to do so"***
- ***No one national organisation has overall responsibility for coastal erosion issues.***
- ***Such a disaggregation of responsibilities hinders the successful implementation of a strategic and nationally coherent response to erosion issues.***

Coastal Policies: Flood Risk Management Act (2009)

- **The Flood Risk Management Act (2009) does not refer to coastal erosion.**
- **Coastal flood risk cannot be appreciated without coastal erosion context, but this is implicit and relies on an interpretation of the Act, not an explicit requirement of it.** *Interpretation: explicit requirements are prioritized ahead of those that are implicit.*
- **"NFRA: take account as far as possible issues such as the position and general geomorphological characteristics of coastal and transitional waters"** *as far as possible.*
- **For each flood risk district, SEPA to prepare maps of artificial structures and natural features, whose removal would significantly increase flood risk (and indicate whether constructed as flood protection scheme under the 2009 or 1961 Act).** *Interpretation: Reads SEPA not required to identify any other structures, limits Act use outwith flood protection schemes and Potentially Vulnerable Areas (PVAs) that are affected by coastal erosion related flooding.*
- ***Explicit** requirements of the 2009 Act obscures the **Implicit** need for consideration of the wider coastal context and hinders integrated aspects of sustainability and broader coastal land use, such as ICZM.*

Coastal Policies:

- **Several national policies in Scotland acknowledge the importance of coastal erosion incorporation into regional plans and local planning decisions along with climate change. Examples include Scottish Planning Policy (SPP), National Planning Framework 3 and the National Marine Plan.**
- **Implementation of these national level strategic policies may prove problematic as they appear to be contradictory in places.** *SNH's working 'with natural processes' may contradict Historic Environment Scotland's 'care and protect role' "Protection" suggests fixing the coast via structures, working with natural processes suggests allowing flexibility and dynamism.*
- **Terrestrial development plans expect new developments to avoid coastal erosion or flooding risk (SPP para 88). Where SMPs exist and erosion is anticipated, the policy approach adopted is clear.** *Where no SMP exists it is unclear the extent to which robust audits of the shoreline are undertaken to inform planning decisions.*
- **In addition, whereas some LAs undertake routine reviews of coastal defences, SPP states that an up-to date audit of green infrastructure should inform planning (SPP para 222).** *It remains unclear how this is being undertaken and the extent to which natural coastal defences are identified, included and by whom.*
- **Only 4 (+2 in development) of 25 LAs have an SMP (9 % (1,232 km). 4 LAs rely on national level policies with no coastal erosion policies of their own and 5 5 have a regional policy.** *4,183 km of coast (22 %) have no apparent policy status reported.*

Coastal Policies:

- **SPP guidance on coastal erosion risk : new development should avoid potentially erosional (and or flood risk) areas and develop plans that take account of these risks: existing developments use SMPs as the main policy tool;** ***where no SMP exists erosion policy and actions are ad hoc.***
- **NPF3 (2014) Scotland's Third National Planning Framework – adaptation strategies are expected on both the developed and undeveloped coast but say little on how this might be achieved.** ***Unwritten assumption that new development might be allowed within existing developed areas that are currently protected, rather than directing new development to risk-free areas.***
- **National Marine Plan (NMP) (and developing Regional Marine Plans?) identify erosion risk areas that new development should avoid, but say little on how this can be achieved.** ***Again, assumption that new development might be allowed within existing developed areas that are currently protected.***
- **All national level strategies, carry direct or oblique reference to the need for authorities to consider adaptation strategies to reduce coastal erosion risk.** ***However, lack of definition about what adaptation means:***
- ***One extreme: adaptation may involve removal of houses, infrastructure, communities to more resilient locations. Other extreme: adaptation might mean raising sea walls or maintaining or extending defences at present levels.***
- **The permissive nature of coastal erosion policies within legislation is noted across the UK (ref DEFRA FECRM).** ***Unclear if this 'optionality' is conducive to developments being built in areas which are known to be erosional, although anecdotal evidence suggests this may be an issue.***

Addressing the policy implementation gap

- **Coastal erosion is a shared problem across government, its public bodies, private sector, and communities** *and its solution needs to be shared across all those actors.*
- **Coastal erosion and coastal flooding are interlinked** *and need to be considered jointly*.
- **The wording in the Coast Protection Act 1949 and the FRM Act 2009 require adjustment,** *particularly in the light of climate change, and a broader need for an integrated approach.*
- **Scottish Government leadership is clear (Climate Change Act, Scottish Climate Change Adaptation Programme as an overarching mechanism),** *but where the strategic ownership lies for delivery throughout the public sector is unclear. One route may be via identified senior "coastal champions" within each organisation.*
- **There is an urgent need for the resources to make adaptation planning happen** *and provisioned to grow into the longer-term as the need increases.*
- **Such an approach may find greater traction if contained within a** *Scottish Coastal Adaptation Plan*.
- **There is a lack of well-developed polices for the large sections of the Scottish coast with no SMP.** *Develop targeted SMPs of key vulnerable areas, rather than the whole coast. Revision of National Flood Risk Assessment and Flood Risk Management Strategies to embrace more coastal erosion provision may provide an alternative* ***statutory*** *mechanism to* ***non-statutory*** *SMPs for sustainable coastal management.*
- **Flood Risk Management Strategies (FRMS) focus on reducing vulnerability on developed coasts and may underestimate important undeveloped coasts vulnerable to flooding.** *Work needed to establish linkages between social disadvantage and coastal erosion and flooding vulnerability, especially across the urban-rural divide.*

Acceptance gap, policy gap

Benbecula, Western Isles, New house (2011) built on reinstated land after land was eroded and original house destroyed on the same site in 2005 storm.

Adaptation is all about fixing the roof while the sun shines

- **Climate change shows a need for coastal erosion and flooding to be considered together: both are set to worsen in the near future.**
- **Magnitude of future coastal change cannot be accommodated within the confines of the present littoral.**
- **Before these trends accelerate we have a window of opportunity now to plan, mitigate and adapt in advance.**
- **We have the policies in place (OK, some need adjustment) but the key is fostering widespread cross sector buy-in for integrated adaptation and mitigation planning at the coast.**
- **Better alignment of terrestrial land-use planning and marine-based planning is needed to deliver a truly sustainable coastal zone.**

On behalf of

Jim Hansom, James Fitton, Ali Rennie & the NCCA Steering Committee

Thanks for listening
Questions ?

www.dynamiccoast.com