

# The physical characteristics and features of the Forth-Tay marine planning region and their importance for seascape characterisation

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## Executive Summary

- Seascape Characterisation can be defined as the “process of identifying and describing variation in the character of the seascape, and using this information to assist in managing change in the seascape.” Policy on Seascape is the responsibility of Scottish Natural Heritage within Scotland. A series of reports and national guidance have been produced. Guidance has also been produced by UK administrations. Approaches to Seascape Characterisation have diverged considerably between Scotland and the rest of the UK. The main differences are: what components are included; whether the focus is on the coast or further offshore; and whether areas below the waterline are considered.
- Seascape Characterisation, Seascape Assessment and Seascape Visual Impact are recent terms which have developed from the discipline of landscape architecture. Two related terms, ‘Coastal Character Assessment’ and ‘Marine Character Areas’ have also begun to be used.
- 33 seascape units have been defined from national perspective around Scotland’s coasts (2005). Seascape Characterisation has also been undertaken at local and regional scales as a first step in conducting environmental impact assessments, and providing strategic assessments of the capacity for aquaculture and offshore wind development. Consideration of natural features and characteristics varies and could arguably be stronger. There remain gaps in regional and local coverage.
- Seascape is a consideration within Marine Planning. It is highlighted both within the UK Marine Policy Statement (2011) and Scotland’s National Marine Plan (2015). Regional marine planning has begun to consider seascape characterisation as baseline information to support decision-making. Two Marine Planning Partnerships, Shetland and Clyde, have commissioned regional seascape characterisations. This report aims to provide a summary of understanding, and considerations which might support future seascape characterisation for the Forth and Tay marine region
- Some broad classifications are offered for the Forth-Tay marine region, based on geological, sedimentological, geomorphological, ecological and physical infrastructure characteristics. These should be considered in future seascape characterisation for the region.
- Future approaches to Seascape Characterisation should consider a variety of issues so that they can be effectively deployed in regional marine planning. These include the purpose, content, scale and spatial extent of seascape characterisations; deeper consideration of biophysical components and natural features; targeted involvement of a broader set of stakeholders and knowledge holders; and opportunities for greater consistency and coordination for the various ways in which seascape characterisation is deployed.

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## 1. Introduction

The purpose of this report is to provide a summary of understanding, and considerations which might support future seascape characterisation for Scotland's Forth and Tay marine region. Two particular aspects considered in this study are: (1) how should physical features and characteristics (cf Appendix A) be considered in defining seascape character and seascape units; and (2) what role visualisation might play in supporting this process (cf Appendix B).

The study is based on interviews with professional practitioners in the UK; reviews of published seascape character assessments; and a workshop in February 2016 jointly hosted by the Tay Estuary Forum and Universities of St Andrews, Dundee and Abertay, involving representatives from local and national government authorities, marine sectors and academia.



*Fig 1: Forth-Tay Scottish Marine Region (source NMPi)*

### 1.1. Terms and Definitions<sup>1</sup>

**Seascape Characterisation** can be defined as the “process of identifying and describing variation in the character of the seascape, and using this information to assist in managing change in the seascape.”

**Seascape Assessment: Sensitivity/Capacity**, can be defined as “The ability of a seascape to respond to and accommodate change. It reflects seascape character, the nature of change and the way both are perceived and experienced.”

**Seascape Visual Impact Assessment** describes an “established methodology which is used to assess the impacts of a development or other land use change on visual amenity”. This approach is often used in Environmental Impact Assessment for offshore developments.

These terms stem from the discipline and professional practice of Landscape Architecture. Many definitions have evolved from the term ‘landscape’. The terms ‘Seascape Unit’, ‘Marine Character Area’ and ‘Coastal Character Unit’ have subtly different meanings, and are used in different parts of the UK.

The word seascape is used in diverse ways beyond these contexts. Two examples: ‘seascape’ is a relatively well known term in art and painting, and ‘seascape ecology’ is a field which researches the patterns that can be found in marine ecosystems.

The focus of this study is Seascape Characterisation.

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<sup>1</sup> Landscape Institute and Institute of Environmental Management & Assessment (2013), Guidelines for Landscape and Visual Impact Assessment, Third Edition, London: Routledge

## 2. Marine and Coastal Policy Context

### The relationship between seascape characterisation and marine planning

Provisions have been made in law to constitute a Marine Planning Partnership for the Forth and Tay Scottish marine region which will be responsible for developing a regional marine plan. At the present time there is no indication of when this will occur.<sup>2</sup> However, Scotland's National Marine Plan (2015), policy section 4.31, states that "regional marine plans should consider identifying the landscape character types and protected landscapes within the marine region..." It may therefore be expected that coastal or seascape characterisation for this Forth-Tay marine region will one day be conducted. Indeed two partnerships (Clyde and Shetland) from the 11 marine planning regions have already made progress on this topic. However, this document makes no claims about the relative importance of conducting seascape characterisation.

### 2.1 Scottish Coastal Fora

The [Tay Estuary Forum](#) (founded in 1997) and [Forth Estuary Forum](#) (founded in 1993) are voluntary, non-statutory Local Coastal Partnerships who bring together a wide range of people and organisations who 'work, live and play' on the estuaries, including regulatory and management organisations. Both Fora have annual conferences and newsletters to communicate latest initiatives and relevant news to a wide range of interested parties. They offer multiple services which aim to support 'the wise and sustainable use' of the coast and estuaries. Examples of outputs include the first voluntary, multi-stakeholder integrated marine strategy for each estuary (Forth 1999) and Tay (2009). Examples of services include reviews of sectoral interactions on each estuary, commissioned by Marine Scotland. A range of other projects and activities have been co-ordinated by coastal fora.<sup>3,4</sup>

### 2.2 Seascape Policy in Scotland

In Scotland, Scottish Natural Heritage is the government adviser on the natural heritage, which includes coastal landscapes / seascapes. Most of the information and policy-related work is done by Coastal & Marine Ecosystems and People & Places units. Four major reports/ national guidance have been commissioned on this topic, and a number of assessments have been conducted at more local scales (see also 2.5):

2005: a report<sup>5</sup> was produced at a strategic national scale to identify 33 seascape units around the Scottish coastline. See [page 46](#) of that report for the relevant map. The assessment focussed on capacity for offshore development. Also 13 'Coastal Character Types' were defined for Scotland, e.g. 'Type 5: Developed Inner Firths'.

2006, 2008: a report and guidance<sup>6</sup> focussed on identifying capacity for aquaculture development. The report developed and tested a methodology for seascape sensitivity/capacity assessment, drawing on case studies for the North Argyll and Outer Solway coasts. Guidance was developed from the report to provide strategic framework for Scottish Aquaculture. Further related reports have explored the above approaches at a local scale<sup>7</sup> for Lochs Linnhe, Etive and Creran (2005), Loch Fyne (2007) the Sound of Mull (2008) Outer Hebrides (2011) and Orkney (2011).

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<sup>2</sup> Regional Marine Planning Partnerships have been constituted for Clyde region and Shetland region in March 2016.

<sup>3</sup> Booth, L.M; Duck, R.W: (2010) A Decade of Delivering Sustainable Coastal Zone Management: The Tay Estuary Forum, a Voluntary Local Coastal Partnership in Scotland. Presented at Littoral, 2010. London. <http://dx.doi.org/10.1051/litt/201104006>

<sup>4</sup> Forth Estuary Forum (2014) [Marine Planning Partnerships: Possible Governance and Structures for the Forth and Tay Scottish Marine Region](#). July 2014.

<sup>5</sup> Scott, K. E., C. Anderson, H. Dunsford, J. F. Benson, and R. Macfarlane (2005). An assessment of the sensitivity and capacity of the Scottish seascape in relation to offshore wind farms. Scottish Natural Heritage Commissioned Report No.103 (ROAME No. F03AA06). SNH.

<sup>6</sup> Grant, A. (2006). Landscape/seascape carrying capacity for aquaculture. Scottish Natural Heritage Commissioned Report No. 215 (ROAME No. F04NC12). SNH; Scottish National Heritage (2008). Guidance on Landscape/Seascape Capacity for Aquaculture. Natural Heritage. SNH.

<sup>7</sup> Grant, A. (2007) Landscape/Seascape Capacity for Aquaculture: Loch Fyne; Grant, A., and C. Anderson (2008). Landscape/Seascape Capacity for Aquaculture and Coastal Infrastructure: Sound Of Mull. A report commissioned by Argyll and Bute Council as part of the SSMEI Sound of Mull project; ASH Design & Assessment (2011). Landscape/seascape capacity for aquaculture: Outer Hebrides pilot study. Scottish Natural Heritage

2012: SNH guidance<sup>8</sup> was produced on assessing the impacts of offshore renewables on coastal landscape and seascape. This includes guidance on the standards for 'Visual Impact Assessments' which should be included in Environmental Statements.<sup>9</sup>

2016: SNH guidance<sup>10</sup> document has been circulated for consultation. This builds upon and summarises existing assessment methodologies. It opts for 'Coastal Character Assessment' as the preferred terminology and provides guidance aimed at local authorities, SNH, and consultants undertaking characterisation, including for development purposes and the goal of supporting marine planning.

### 2.3 Seascape Guidance in the rest of the UK: Comparison

In the other UK nations, Seascape policy is the responsibility of Natural Resources Wales (formerly CCW), Natural England, the Department of Environment Northern Ireland, and the Marine Management Organisation. Globally, the first national guidance on seascape characterisation was produced with CCW in Wales in 2001<sup>11</sup>. More recent guidance in England has proposed a set of five 'principles' for Seascape Characterisation.<sup>12</sup>

The approach to Seascape Characterisation has diverged considerably between Scotland and the rest of the UK. One key difference is that other nations have chosen to extend the concept further offshore, and below the waterline to define 'marine character areas.' Meanwhile the Scottish approach emphasises the coast, and the strong inter-linkages between the land and sea in the Scottish context, especially on the West coast.

Under the Scottish model, the approach is based on landscape character assessment with a focus on the coast. "Underwater landscape" is deemed to be the consideration of marine archaeologists and marine ecologists. This could be said to be consistent with the notion that '-scape' refers the visual character of an area, and is therefore not meaningful below the waterline, because this is not a space that is commonly 'seen' (notwithstanding Diving). In this sense, seascape can be considered an extension of the Landscape Characterisation approach.

Whilst under the rest of the UK model, Seascape Characterisation has begun to be considered further offshore, defining character areas out to 12nm or further, including what lies under the water such as ecology and heritage, as it is deemed that these have an influence on character. Furthermore, Seascape Characterisation is used here to provide a wider spatial framework for assessing societies' cultural associations and connectivity with the sea. This could be said to go well beyond standard approaches to Landscape Characterisation.

### 2.4 Relationships to Landscape Character Assessment and other Initiatives

Landscape Character Assessment (LCA) has been conducted since 1994 covering 29 regional studies in Scotland at a local authority level and 1:50 000. The consideration of 'Coastal' Character Types and Areas in LCAs was reviewed in 2002 and it was concluded that "most LCAs only consider whether the coast is rocky or 'hard', forming cliffs, or whether it is soft, forming sandy beaches, often with dunes and other depositional features<sup>5</sup>." This is the manner in which the Tayside Landscape Character Assessment (1999) considers coastal areas. 77 different coastal types are identified across all Scottish LCAs, but there is a lack of consistency in terminology. Nevertheless, some LCAs may provide a useful starting point for conducting Seascape Characterisation. For example, the Shetland LCA (1994) only considers views from land to land and defines a narrow strip characterised as 'coastal edge' with seemingly little relation to the sea; whereas the Skye and

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Commissioned Report No.460; Horner & MacLennan (2011). Orkney landscape capacity for aquaculture: Scapa Flow and Wide Firth. Scottish Natural Heritage Commissioned Report No.466

<sup>8</sup> SNH (2012). Offshore Renewables – guidance on assessing the impact on coastal landscape and seascape. March 2012. SNH.

<sup>9</sup> This report drew on earlier 2005 guidance produced by the DTI in collaboration with SNH, CCW and the Countryside Agency

<sup>10</sup> Carol Anderson Landscape Associates 2016. Guidance on Coastal Character Assessment – Consultation Draft. Feb 2016. For SNH.

<sup>11</sup> Hill, M., Briggs, J., Minto, P., Bagnall, D., Foley, K. & Williams, A. (2001). Guide to Best Practice in Seascape Assessment. Bangor: Countryside Council for Wales, Brady Shipman Martin, University College of Dublin, Maritime Institute Ireland.

<sup>12</sup> Natural England (2012). An Approach to Seascape Character Assessment. Report NECR105. Peterborough: Natural England.

Lochalsh LCA (1996) has a broader range of character types such as 'Fjords', 'Narrows' and 'Islands' which have a genuine maritime character.

A range of other plans, policies and regulations are relevant in considering seascape and landscape. Two relevant initiatives in the Forth-Tay study region are: the [Tay Landscape Partnership](#), focussing on issues such as access, leisure, interpretation and cultural heritage in the upper part of the Tay; and the [Inner Forth Landscape Initiative](#), focussing on conserving, enhancing and celebrating the landscape of the upper Forth Estuary. Both initiatives have a focus on community engagement. A landscape character assessment of the upper Tay was produced in 2012<sup>13</sup>

## 2.5 Regional Character Assessments for Scottish Marine Regions, and Environmental Impact Assessments

As of February 2016, approximately 15 seascape characterisations have been conducted at a variety of scales in UK waters since 2002, using varying terminology and methodology. Two Seascape Character Assessments have been conducted at the regional scale in Scotland for the Clyde<sup>14</sup> Estuary region (2008 and 2013). Two further character assessments are currently under development (as of February 2016) for Shetland and 'Pentland and Orkney Waters/Caithness' regions.

The consideration of natural features and characteristics in these assessments has been varied. Taking three examples, at similar scales to the Forth-Tay region:

1. Clyde<sup>14</sup> (2013) focuses on topography (particularly the physical shape of the landforms), geology and climate.
2. Shetland<sup>16</sup> (in preparation 2016) considers bathymetry, geology and coastal processes.
3. The Pembrokeshire Seascape Characterisation<sup>15</sup> (2013) makes the most extensive consideration of natural processes and features, including geology, coastal form, coastal processes and biodiversity. In contradistinction, this approach is less strong in its consideration of experiential aspects.

Seascape is also commonly chapter title in offshore Environmental Statements, Environmental Impact Assessments and Strategic Environmental Assessments. To give one example, the Forth and Tay Offshore Windfarm Developer Group (formed from companies Repsol, Mainstream and Sea Green) prepared a 'regional seascape character assessment' in 2011, which covered the coastline within a 50km radius from wind farm development areas, near Inch Cape within the Forth Tay marine region. This identified 10 regional character areas which fall within Forth-Tay, for example 'SA4 St Andrews Fife Ness.'

To summarise, seascape characterisation has been conducted at a variety of scales, with a variety of methodologies and for a variety of purposes. What can be said about the proliferation of approaches to seascape characterisation?

On one hand, there are lessons to be drawn from the experience of Landscape Character Assessment during the 1990s where a lack of consistency in approach has proven to be problematic in the long term leading to lack of comparability. The lack of integration between characterisation in LCAs, SCAs around the UK, and Characterisation as used in Environmental Assessment, presents a somewhat confusing picture.

On the other hand, given the variation in geographical contexts, it may be considered that approaches around Scotland will vary to reflect these differences. Furthermore, as the purpose of seascape characterisation also varies, so the scales of approach and forms of assessment used, might vary to fit the task. Altogether, it seems timely for further debate about the appropriate balance between standardisation and flexibility.

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<sup>13</sup> Land Use Consultants (LUC), and STAR Group (2012) Landscape Character Assessment of the Tay Landscape Partnership Area. A report for the Tay Landscape Partnership.

<sup>14</sup> Grant, A. (2008) Landscape/Seascape Assessment: Firth of Clyde SSMEI; Grant, A., C. Anderson, and F. Lee (2013) Seascape/Landscape Assessment of The Firth of Clyde. A report commissioned by the Firth of Clyde Forum.

<sup>15</sup> Pembrokeshire Coast National Park Authority 2013. Seascape Character Assessment.

## 2.6 Seascape and Marine Planning

With the development of the Marine (Scotland) Act 2010 and Marine and Coastal Access Act (2009), Seascape has become a topic of consideration within marine planning. The UK Marine Policy Statement (2011) agreed by the UK administrations, contains a section on Seascapes 2.6.5, and a High level Marine Objective that “People appreciate the diversity of the marine environment, its *seascapes*, its natural and cultural heritage and its resources and act responsibly”. Within Scotland, Landscape/Seascape is covered in sections 4.26-4.31 of the National Marine Plan (2015) and General Policy 7 states that “Marine planners and decision makers should ensure that development and use of the marine environment take seascape, landscape and visual impacts into account”. Approaches to seascape characterisation in marine planning should conform to these policies, but given the resource intensity of the marine planning process, this presents a challenge.



### 3. Seascape Areas/Units and Natural Features in the Forth-Tay Region

As part of the national assessment in 2005, two seascape character units were identified relative to the Forth-Tay region, including 'coasts with open views', 'outer firths', and 'inner firths'. Whilst much useful information about the character and sensitivity of seascapes is provided, the report does not constitute a meaningful level of information for the purposes of Regional Marine Plans. Further work is required.

During the workshop for this research, fifteen separate attempts were made by coastal professionals to map natural characteristics and features which could help define seascape units for the Forth-Tay region. Respondents generally found the task challenging, and the process of drawing boundaries in marine space was debatable- lines on a map were considered, to some extent, artificial. Delegates wished to see more innovation on how fuzzy boundaries could be defined, which better represent the seasonal and cyclical dynamics in the marine environment. However, taking the combined work of all fifteen attempts, a number of factors may be drawn upon to identify and map initial divisions of the region:

- A major geological boundary trends across the region. In the northern part of the region, rocks principally of the Lower Devonian dominate, including andesitic lavas and volcanic conglomerates, along with sedimentary sequences of conglomerates, sandstones and shales of the 'Old Red Sandstone', as exposed in the cliffs between Arbroath and Lang Craig in Angus. In the southern part of the region, Carboniferous sedimentary rocks dominate, including sandstones, mudstones and siltstones as exposed along the shore platforms between St Andrews and Fife Ness. This may be considered a geological aspect of characterisation.
  - The Holocene aeolian deposits of Tentsmuir and Buddon Ness are characterised as relict features of long term geomorphological processes.
- Considering the area below the waterline, offshore seabed sediment types provide for a twofold general classification in this region:
  - Sandy features generally dominate the mouth of the Tay Estuary and in St Andrews Bay, whilst the seabed is more muddy in the mouth of the Forth.
- Two major estuarine systems, the Tay and the Forth, characterise the region. The coastal areas offshore have distinguishing features with a rippled seabed offshore to the North and flat muddy bed with bare rocky patches to the middle and South. This may be considered a geomorphological/sedimentological aspect of characterisation.
  - Within this, the estuaries can be divided into upper (freshwater influence), mid estuary, and firth (mouths of estuaries);
  - Coastal areas can be further divided according to geomorphological features such as Montrose Basin, Lunan Bay, the Eden Estuary, St Andrews Bay and Largo Bay;
  - At a more detailed scale, coastal landforms can be identified including cliffs, raised shorelines, sand dunes, mudflats and reed beds. In many of these cases, both the biological and geomorphological components are of relevance.
- The area was also divided according to human physical infrastructure, related to coastal and maritime uses: urban (industry, city settlement, transport infrastructure including roads, bridges and ports) and rural (with related uses of conservation, recreation and tourism):
  - For offshore areas, urban/rural typology highlighted physical infrastructure around the upper Forth, the various bridges that cross the Forth and offshore of Edinburgh and Dundee, including the Tay Bridges.

Sound knowledge of such natural features and characteristics could influence definition of seascape units; for example an obvious cartographic or 'perceptual' change occurs at Fife Ness, whereas the geological change in character occurs further north along the Fife coastline. The incorporation of such knowledge into seascape characterisation is related to wider debates about the relative roles of expert and lay knowledge<sup>16</sup>.

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<sup>16</sup> McGlashan, D. J., and E. Williams 2003. Stakeholder Involvement in Coastal Decision-making Processes. *Local Environment* 8(1).

#### 4. Considerations and Recommendations for Seascape Characterisation

Future approaches to Seascape Characterisation should consider a variety of issues so that they can be effectively deployed throughout the Scottish Marine Planning regions and across the UK as a whole. The following considerations particularly apply from the perspective of regional marine planning in Scotland:

##### 1. PURPOSE and CONTENT

- PURPOSE. Consideration of sensitivity to change and capacity for development has been a consistently strong feature of Scottish approaches to Seascape. Sensitivity and Capacity Assessments require definition of character areas and types in the first phase of work. Work on Seascape characterisation has been done at a national scale, but more work is needed to provide a comprehensive approach at a regional scale.

However, less consideration has been given to Seascape as an approach which potentially integrates a wide range of cultural and social data which might support decision-making for marine planning. In this latter approach, Seascape represents another ‘layer’ of evidence or understanding (as exemplified by the SNH *Talking about our place* toolkit, or the range of cultural associations with the sea highlighted in the draft Shetland CCA<sup>17</sup>).

- CONTENT: The Seascape Wheel (Fig 2) (adapted from the Landscape Wheel) represents a clear way of portraying the range of components which should be considered in seascape characterisation.

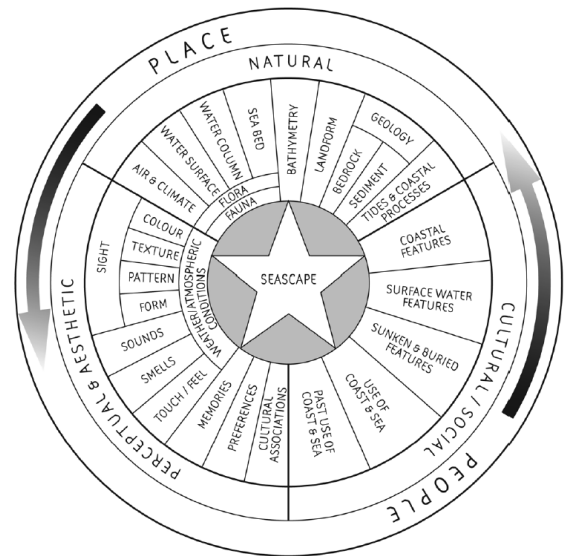


Fig 2 Source: Natural England/LUC

##### 2. BIOPHYSICAL COMPONENTS and NATURAL FEATURES

- Treatment of marine natural processes and features in Scottish SCA has so far been mixed. Consideration of natural components could therefore be improved. However, aesthetic and experiential aspects remain basic and essential to what constitutes seascape.

- ##### 3. EXPERTISE AND PARTICIPATION.
- Landscape architects uniquely have technical training in visual assessment. The role of landscape architect, geographer or similar generalist is important in bringing together character assessments, without which an assessment would lack coherence. However, marine geomorphologists, geologists or ecologists should be brought into the character assessment process more often to provide deeper understanding of the marine aspects. Appendix A provides some reflections on how visualisation technology could support wider stakeholder engagement, both including and beyond these expert knowledge sources.

##### 4. SCALE and EXTENT:

- SCALE: The working cartographic or hydrographic scale is not consistently defined in Seascape Characterisations. Workshop respondents unanimously felt that some clarity and consistency would be helpful to: (1) relate seascape characterisation to work done on landscape character, as well as (2) provide a meaningful hierarchy for the work done on seascape character throughout Scotland.
  - Current guidance on Landscape Character Assessment identifies three scales of approach: Regional or national context at 1:250 000; a Local (authority) context at 1:50 000 or 1:25 000;

<sup>17</sup> NAFC Marine Centre, University of Highlands and Islands (2015). Shetland Coastal Character Assessment. Pilot.

and at a local or 'nested' scale at 1:10 000. However, these are based upon terrestrial notions of scale.

- Draft guidance (2016) on Coastal Character Assessment in Scotland proposes Regional characterisation at 1:100 000 and Local characterisation at 1:50 000
  - Admiralty hydrographic charts have an extensive series at 1: 200 000 around Scottish coasts, whilst more local charts are available from 1:75 000 down to 1:25 000.
  - EXTENT: there is continued debate on whether seascape should have more of a 'coastal' or 'maritime' focus, and on a related point, whether seascape characterisation should extend below the waterline. The current Scottish guidance favours a coastal approach. It would be timely for a broad range of stakeholders to review the positive and negative implications of this approach for regional marine planning (c/f section 2.5).
5. CONSISTENCY and COORDINATION Approaches to defining Marine and Coastal Character Types are diverse and inconsistent between regions. Some variation in terminology between regions should be expected given global natural variability of marine features. However, stronger consistency between national and regional assessments could provide greater clarity.
  6. BUREAUCRACY and COMPLEXITY In order for Seascape Characterisation to play a more effective role within marine planning, there is a need to strongly signpost related policy frameworks such as (1) Local Development Plans/Frameworks and (2) Marine Policies in national and regional plans. Characterisations should also aim to invoke the hierarchy of National and International Guidance on Seascape which helps establish the goals and refine the scope of assessments.
  7. OBJECTIVITY AND ANALYSIS. Visibility mapping offers a technical approach to defining the landward and seaward limits of visibility. Although based on a number of assumptions, this seems to offer a more objective and less contentious aspect of assessment. Experiential and aesthetic aspects of seascape are more challenging to capture, but a systematic approach helps provide some transparency and rigour, and stakeholder or public engagement could provide more data about the spectrum of values and interpretations.
  8. POLITICS AND VALUES. Notwithstanding everything that has been said about the technical process of seascape characterisation within this report, seascape remains an emotive topic- especially the aspect of scenic views. As such, proposals to develop technical tools should be mindful of alternative options to: avoid conflict; accept conflict and encourage debate; or build accommodations between different parties- neutral bodies such as coastal fora can play a role here.

Following on from the above, the recommendations of this report are to:

- **Consider defining seascapes beyond the administrative boundaries of the Scottish Marine Regions, to landward and seaward**
- **Develop a standard but flexible approach to SC which supports the goals of regional marine planning**
- **Review the pros and cons of extending seascape characterisation offshore or below the waterline**
- **Improve consideration of physical characteristics and features**
- **Involve a broader range of knowledge holders in SC**
- **Capitalise on SC as a way to engage the public in marine planning**
- **Integrate SC more into the Marine Planning process**

## Appendix A: Regional Biophysical Context

This appendix provides a working definition of the natural features and characteristics of the Forth-Tay Scottish Marine Region, including the biophysical context. Socio-economic, experiential and aesthetic characteristics of the region are not described here. Nevertheless, workshop participants emphasised that no complete consideration of seascape could ignore these aspects.

The Forth-Tay Scottish Marine Region is one of 11 such regions around the Scottish coast constituted under the Scottish Marine Regions Order 2015. It covers an area from Mean High Water Springs (MHWS) offshore out to 12 nautical miles. It has an area of approx. 4481 km<sup>2</sup> and is bordered by eleven Local Authorities<sup>18</sup> with a combined coastline length of approximately 760 km<sup>19</sup>.

Biophysically, the region consists of the distinctive marine features such as sandbanks and mudflats of Tay and Forth estuaries, respectively; islands and partly submerged rocks including Inch Cape, the Isle of May, Inchcolm, Inchkeith, and the Bass Rock, and distinctive headlands such as Fife Ness. Further offshore, the water depth extends to 70 m but the majority of the area is between 20 and 60 m in depth. The seabed is variously of sand or mud, with cobbly deposits and bare rock in exposed areas. The region has a temperate maritime climate, and water temperature ranges between 14C in summer and 6C in winter, although the water column, particularly in estuaries can be horizontally stratified. In the offshore part of the area, tidal currents trend approximately North to South, parallel to the coastline. In the estuaries there is a steep gradient of characteristics; for example in the upper reaches where there is freshwater input from the rivers flowing from the Tay and Forth catchments, to the outer reaches with salinities of 35 psu. The average tidal ranges in the Forth are 5m (springs) and 2.5m (neaps), whilst in the Tay they are 6m (springs) and 3.5m (neaps).

Around the coast there are rocky cliffs, raised shorelines, sandy beaches, sand dunes, saltmarshes, mudflats, reed beds, rock platforms, estuaries, bays and the sheltered Montrose Basin; as well as developed and engineered coasts for harbours, coastal protection and seafront promenades. The most recent Angus (2016) and Fife (2011) Shoreline Management Plans describe some of the coastal processes operating in parts of the region. Storm waves can affect the coastline when winds blow from the east or south-east across the 500 km fetch from the North Sea, and storm surges can add up to 1.5 m to. Fluxes of material in the coastal zone are constrained by the mixing of water bodies, depth to wave base and headlands caused by both natural and anthropogenic features.

Characteristic marine and coastal ecosystems, habitats and species may be considered at a variety of scales. Both grey seals and common seals occur in the region; the Isle of May is designated a Special Area of Conservation for the former, whilst the outer Firth of Tay is designated an SAC as an important breeding area for the latter. Dolphins and whales (the latter rarely) also visit the area. Over 150 fish species are found in the region. There are important spawning grounds for herring and plaice. Many other fish species spend parts of their lifecycle in the region. The inshore areas also provide habitats for crabs and lobsters. Salmon and sea trout occur throughout the region, especially in the Tay Estuary. The Tay and Eden Estuaries and the Montrose basin, along with many of the intertidal areas of the Forth Estuary, support national and internationally important populations of wildfowl and wading birds, including pink footed geese, redshanks, knots, dunlins and oystercatchers, for which there are SPA designations. The rocky islands within the Forth also provide breeding grounds for sea birds, including puffins, gannets, fulmars, guillemots and razorbills. Further information about sea areas around Scotland is detailed in the 2011 Atlas represented in Scotland's [National Marine Plan Interactive](#).

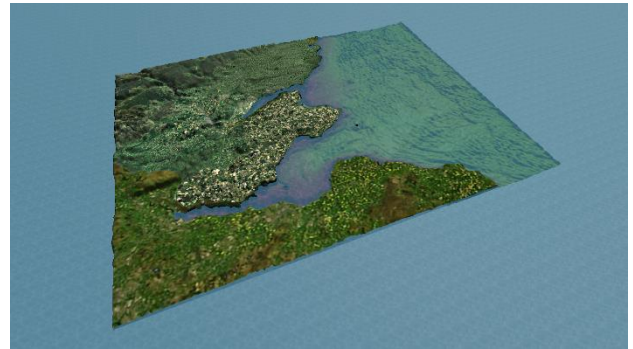
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<sup>18</sup> Angus, Dundee, Perth & Kinross, Fife, Clackmannshire, Stirling, Falkirk, West Lothian, Edinburgh, East Lothian and Scottish Borders.

<sup>19</sup>. As measured at 1:50:000 scale using Mean High Water as the baseline up to the Normal Tidal Limit of estuaries.

## Appendix B: Visualisation

During a workshop in February 2016, coastal professionals were able to explore a visualisation<sup>20</sup> of the Forth-Tay marine region. A range of spatial datasets were compiled into a 3D model, including topography, bathymetry, aerial photography, seabed geology and sediments, and, physical landmarks. Delegates assessed the usability of the visualisation using an interactive viewer.



*Fig 3: Forth-Tay Visualisation*

Visualisation offers a number of advantages,<sup>21</sup> including:

- ability to comprehend huge amounts of data
- perception of distinct and emergent properties of phenomena
- understanding of both large-scale and small-scale features

These capabilities provide potential solutions for dealing with some of the challenges of seascape to support marine planning. Nevertheless, visualisation is not a panacea. The project aimed to review the potential for visualisation to enable seascape characterisation, as well as encourage broader participation<sup>22</sup>. The following findings outline the advantages and challenges of such tools:

1. Visualisation is considered to make a realistic portrayal of the region [High Certainty]
  - a. Vis. moves beyond approaches such as maps and GIS to bring together a wide range of knowledge onshore and offshore in a 3D model which helps understanding of how components relate to one another
  - b. Nevertheless, Viz. is not necessarily photorealistic.
2. Visualisation is considered a positive tool for stakeholder discussion and debate [High Certainty]
  - a. Vis enables exploration of components of seascape at different scales and angles which are otherwise difficult to comprehend. The visualisation then provides a highly flexible tool for discussing these issues in group conversation.
3. Visualisation is considered a useful tool to explore or support marine development [High Certainty]
  - a. Whilst the general impressions of visualisation was positive, opinions about use for seascape characterisation were less conclusive.

Visualisation has challenges to capture significant components seascape.

4. If, as one of the workshop respondents commented, “Seascape is an aesthetic concept which is steered by our life experience and previous engagement with the oceans” Vis. has an inherent weakness of immediately separating the participant from experiencing the seascape through the senses in the real world.

<sup>20</sup> Isaacs, J., D. Blackwood, D. Gilmour, and Falconer R (2013). Real-time Visual Simulation of Urban Sustainability. International Journal of E-Planning Research 2(1). <http://dx.doi.org/DOI: 10.4018/ijep.2013010102>

<sup>21</sup> Ware, C. (2013) Information for Visualisation. 3<sup>rd</sup> Ed

<sup>22</sup> Wang, C., D. Miller, I. Brown, Y. Jiang, and M. Castellazzi (2015). Visualisation techniques to support public interpretation of future climate change and land-use choices: a case study from N-E Scotland. International Journal of Digital Earth: 1-20. <http://dx.doi.org/10.1080/17538947.2015.1111949>