Suffolk Marine Pioneer: Scenarios Assessments Report

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Introduction

The Suffolk Marine Pioneer was established by Defra to test the application of a natural capital approach in practice. In doing so, the Pioneer's purpose is to inform the implementation and iteration of the Government's 25 Year Environment Plan. The Pioneer is delivering this objective by examining how the implementation of natural capital thinking applies locally – on the basis that any intervention to improve the state of the environment will affect people living, working and recreating in that environment.

The University of Hull, in collaboration with the University of Aberdeen, were commissioned to run two participatory mapping workshops (Burdon et al., 2019a, b). The workshops were co-developed with the Suffolk Marine Pioneer Project and aimed to: expand the role of participatory mapping and scenario-based deliberation for the enhancement of natural capital; initiate discussions with local stakeholders on the enhancement of natural capital assets for the Deben Estuary; and strengthen the relationships and knowledge exchange with stakeholders via the Suffolk Marine Pioneer network.

This report presents the results from the two future scenarios assessments which were undertaken during the second participatory mapping workshop which was held in Ipswich on Tuesday 11 June 2019. The workshop was attended by 19 local stakeholders representing 17 different organisations with an interest in the management of the natural capital within the Deben Estuary, Suffolk.

Scenarios Assessments

Given the increasing development of activities in the marine environment, and the lack of local evidence regarding ecosystem response, future scenarios assessments can be used to investigate whether current policy measures are robust to aid future management decisions. Scenarios assessments provide a valuable tool to enable new ways of thinking and to model changes in society. However, for scenarios to be a useful tool, they must all be plausible and credible, thus requiring local knowledge gained through stakeholder engagement (Burdon et al., 2018). Here two scenarios were developed with the Suffolk Marine Pioneer Manager to assess the delivery of benefits under a hypothetical futures scenario against the current delivery of benefits by the Deben Estuary (i.e. 'Business as Usual'). The scenarios were developed on the basis of potential changes to coasts from changing climatic conditions, a genuine risk for the east coast of the UK. However, it is important to clarify that the scenarios were both hypothetical and were developed as a *learning tool*, allowing stakeholders to explore ecosystem changes in a structured format.

0. The 'Business as Usual' scenario reflects the current delivery of benefits by the natural features of the Deben Estuary and assumes that all natural features, modified/managed features and built features remain the same, with any current management initiatives remaining in place.

The two hypothetical scenarios assessed by the stakeholders were:

1. Scenario 1 - a 'Change in Feature Type', from a saltmarsh dominated habitat to an intertidal mud habitat, as a result of sea level rise.
2. Scenario 2 – 'Flood Mitigation' in the form of managed realignment within the Deben Estuary catchment, resulting in a change from arable/pasture land to saltmarsh.

Scenario 1: Change in Feature Type

Background: Scenario 1 is site-specific and focusses on an area in the middle Deben Estuary around Waldringfield (Figure 1). With current estimates of sea level rise (approx. 2 mm per year) it is likely that if no intervention is made, areas of saltmarsh which are currently eroding within the Deben Estuary may be lost within the next few decades. For the purpose of this scenario, it is assumed that 82 ha of saltmarsh may be lost from the western bank of the Deben Estuary, resulting in an increase in intertidal mud from 57 ha to 139 ha (Figure 1).

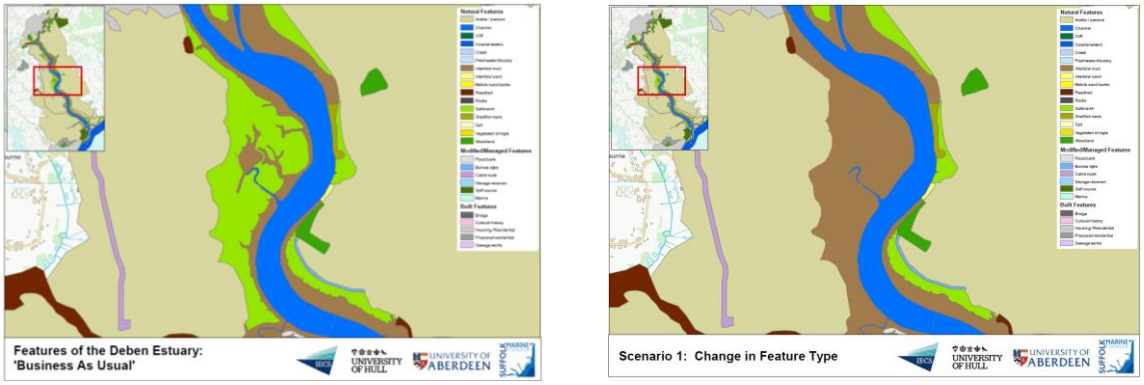

Figure 1: Maps of 'Business as Usual' (left) and 'Change in Feature Type' scenario (right).

Methodology: The relative contribution of saltmarsh and intertidal mud features in delivering a range of intermediate ecosystem services and benefits (as defined by Turner et al., 2015) is illustrated in Figure 2. The circles represent low, moderate and high contribution moving outwards from the centre.

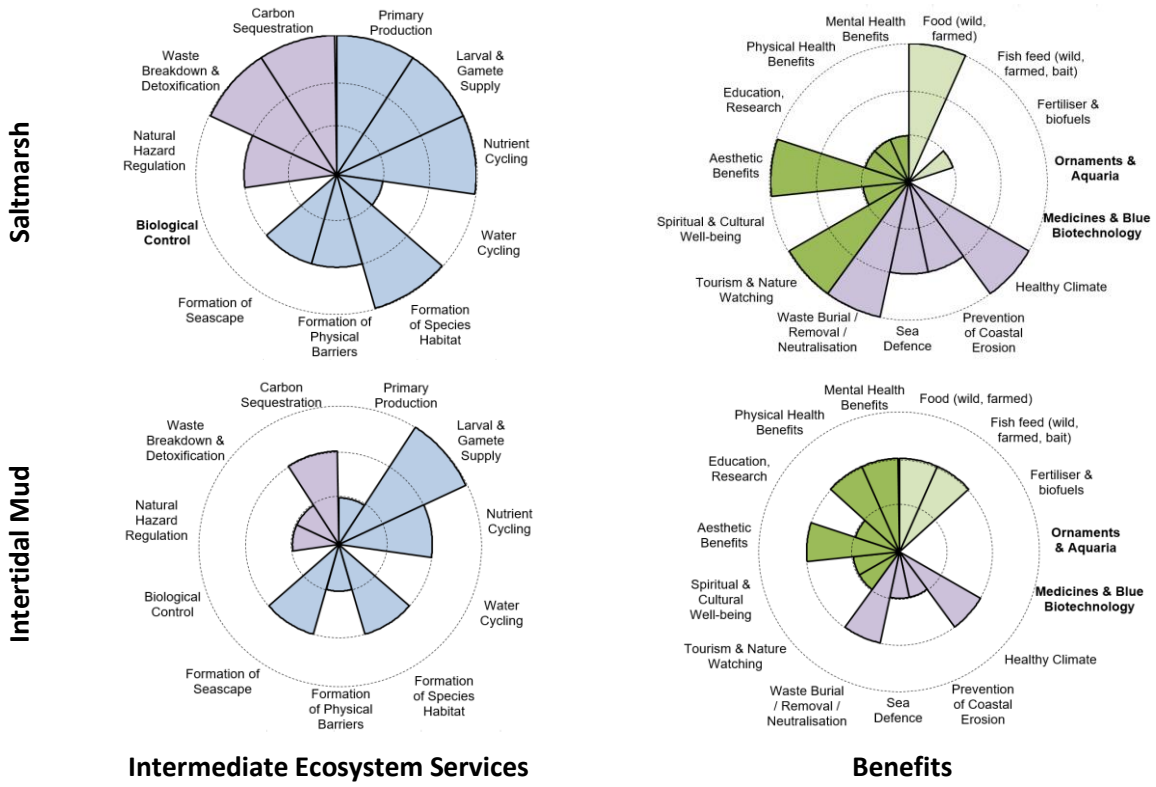

Figure 2: Relative importance of saltmarsh and intertidal mud in providing a range of intermediate ecosystem services and benefits (after Potts et al., 2014).

Stakeholders used these relationships to support their trade-off discussions. The assessment included: a change in benefits under the future scenario; a description of why this change may occur; the confidence in their decision; and a description of which stakeholders may be affected. The same assessment was undertaken with three separate tables of 5/6 stakeholders. The change in benefit provision was assessed using a 5-point Likert scale (-2 = large decrease; -1 = small decrease; 0 = no change; +1 = small increase; +2 = large increase; ? = unknown) (after Defra, 2007; Smyth et al., 2015).

Results: The combined results from the three tables of stakeholders are presented in Figure 3. For example, the results show that under Scenario 1, the provision of '1. Primary Production' would be a large decrease (-2) from the Business as Usual (0) and that the variance of responses across the tables ranged from -2 to -1; whereas the combined results for Benefit '15. Aesthetic benefits' would show no change under Scenario 1 but that the responses between the tables ranged from +1 to -1.

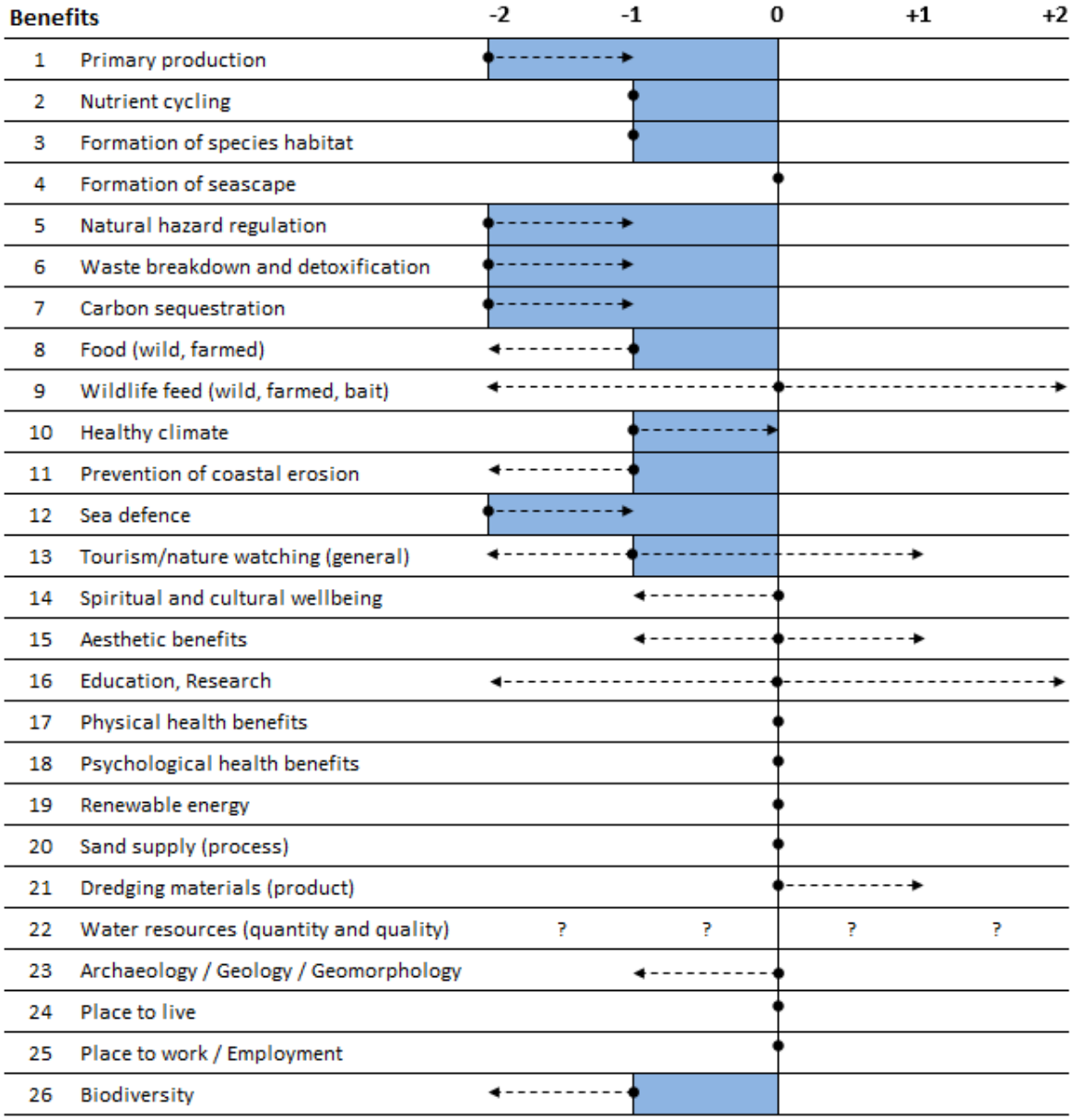

Figure 3: Output from the trade-off assessment for Scenario 1, change in feature type (combined results from 3 tables of 5/6 stakeholders). The blue bars with black dot represent the combined change from the 'Business as Usual' (represented as 0), with the variance of responses across the three tables represented by the dashed line.

Discussion (stakeholder comments are identified in *italics* throughout):

In general, the stakeholders perceived that there would be an overall decrease in the provision of benefits under futures Scenario 1. With a change in habitat from saltmarsh to intertidal mud, 5 benefits were considered to have a large decrease (-2), 7 benefits were considered to have a small decrease (-1) with the remaining 13 benefits remaining the same (0). There was 1 benefit (Water resources) which the stakeholders were not confident in assessing. Interestingly, the combined analysis showed that the stakeholders perceived there to be no increase in benefits (+1 or +2) provided under future Scenario 1. Overall, it was considered that there would be the greatest decrease (-2) in the following benefits: '1. Primary production' ('*loss of plant species*'); '5. Natural hazard regulation' ('*saltmarsh absorbs more energy*'); '6. Waste breakdown and detoxification' ('*mudflat is less efficient at waste reduction*'); '7. Carbon sequestration' ('*less plants, roots and biomass*') and '12. Sea defence' ('*increased wave heights from removing saltmarsh*').

With respect to the independent outputs across the three stakeholder tables, the assessments show that there was total agreement for the assessment of 9 benefits, a further 12 benefits had a variance of +1 or -1, whilst the remaining 5 benefits had much greater variance in their assessment. Agreement between table outputs were observed for small decreases in the provision of '2. Nutrient cycling' and '3. Formation of species habitat' under Scenario 1, whilst there was agreement between that tables that a number of benefits would not change under Scenario 1 (e.g. '4. Formation of species habitat' and '17. Physical health benefits'). It was interesting that the provision of two benefits (i.e. '9. Wildlife feed' and '16. Education, research') were assessed to have large increases (+2) or large decreases (-2) depending on the stakeholder's opinions at the three different tables. For example, Table 1 felt that there would be a large increase (+2) in '16. Education, research' given the '*interest in how ecology changes*', Table 2 felt that both systems provide the same level (0) of this benefit, whereas Table 3 felt that there would be a large decrease (-2) in this benefit given the '*rarity value of saltmarsh*'.

Under Scenario 1, the stakeholders felt that changes in the provision of the first seven benefits (Benefits 1-7) would have a greater direct impact on the natural system itself, rather than directly affecting individuals or groups of stakeholders. This observation is supported by the literature, given that the first 7 benefits, as identified by the stakeholders at Workshop #1, relate to the intermediate ecosystem services (as defined by Turner et al., 2015), and reflect those ecosystem services which do not have a direct link to societal goods and benefits. Workshop participants identified a range of stakeholders who may be directly impacted by changes in the provision of a number of benefits including schools, universities and researchers ('16. Education, research'), local communities, businesses and land owners ('12. Sea defence') and wildfowlers, birdwatchers and boating enthusiasts ('13. Tourism/nature watching').

Lessons Learned

From a management perspective, the findings from this scenario assessment help to identify which benefits may be impacted, and what direction that impact may take. The next stage from a valuation perspective, would be to further investigate those benefits which may change under this scenario, and to attempt to quantify (and where appropriate value) this incremental change (Defra, 2007). For example, stakeholders perceive that there would be a large decrease (-2) in 'Primary production' and therefore this change could be quantified using either evidence from the literature or from field sampling or laboratory experiments to quantify this change. In addition, the relationship between different stakeholders and the benefit 'Tourism/nature watching' deserves further attention from a management perspective, given that once this benefit is sub-divided between different activity groups then there may be both winners and losers associated with any given future scenario; this highlights some of the complexity that underlies undertaking natural capital assessments at the local scale.

Scenario 2: Flood Mitigation

Background: Scenario 2 reflects the likely future requirement for flood mitigation within the Deben Estuary catchment given the predicted rise in sea level (approx. 2 mm per year). One potential option would be to apply managed realignment within the catchment. This is a hypothetical situation, with no plans to undertake such a mitigation option, but proved a controversial scenario for engagement. Under this scenario, it is proposed that 10% (approx. 504 ha) of arable/pasture land would be breached throughout the catchment resulting in an increase in saltmarsh within the Deben Estuary from 294 ha to 798 ha (Figure 4).

Figure 4: Change in land cover under Business as Usual (left) and Flood Mitigation scenario (right).

Methodology: The relative contribution of arable/pasture land and saltmarsh features in delivering a range of intermediate ecosystem services and benefits (as defined by Turner et al., 2015) is illustrated in Figure 5. Given that Potts et al. (2014) did not include arable/pasture land as a feature in their analysis, then the stakeholders (3 tables of 6/7) generated the fan chart within the workshop based on their local knowledge, and used these relationships to support their trade-off discussions.

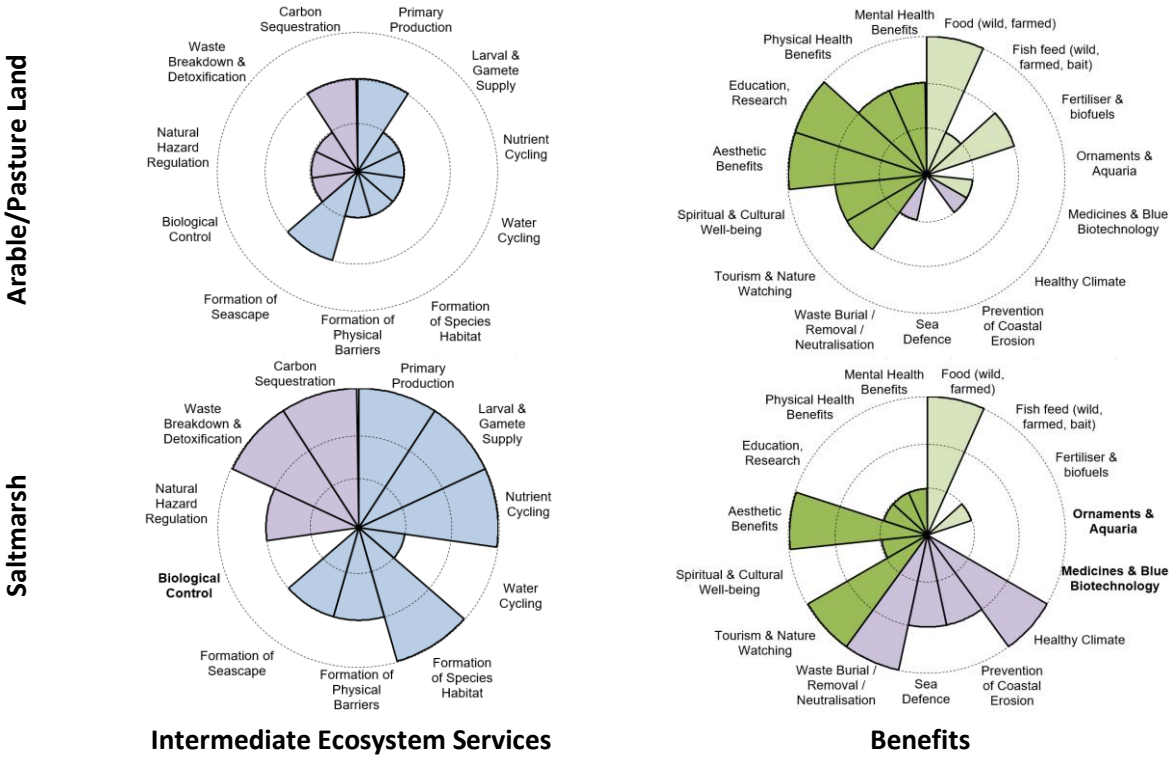

Figure 5: Relative importance of arable / pasture land and saltmarsh in providing a range of intermediate ecosystem services and benefits.

The assessment included: a change in benefits under the future scenario; a description of why this change may occur; the confidence in their decision; and a description of which stakeholders may be affected. The same assessment was undertaken with two separate tables of stakeholders. The change in benefit provision was assessed using a 5-point Likert scale (-2 = large decrease; -1 = small decrease; 0 = no change; +1 = small increase; +2 = large increase; ? = unknown) (Defra, 2007; Smyth et al., 2015).

Results: The combined results from each assessment are presented in Figure 6. For example, the combined results show that under Scenario 2, the provision of '1. Primary Production' would remain the same, with one table predicting a small increase (+1) and the second predicting a small decrease (-1) in provision; whereas for '15. Aesthetic Benefits', there was agreement between the two tables that there would be a small increase (+1) and therefore no variance and thus no dashed line. One table of stakeholders did not complete this assessment and therefore the outcomes are based on two tables of 6/7 stakeholders.

Figure 6: Output from the trade-off assessment for Scenario 2, flood mitigation (combined results from 2 tables of 6/7 stakeholders). The blue bars and black dot represent the combined change from the 'Business as Usual' (represented as 0), whilst the dashed line represents the variance of responses across the three tables.

Discussion (stakeholder comments are identified in *italics* throughout):

In general, when combining the independent outputs from two tables of 6/7 stakeholders, the stakeholders perceived there to be an increase in the provision of 15 benefits under Scenario 2, a decrease in provision of 4 benefits and no change in the remaining 7 benefits. In particular, the stakeholders identified a large increase (+2) in the provision of '5. Natural hazard regulation' ('*addresses flooding issues, a flood ready landscape*') and '6. Waste breakdown and detoxification' ('*agriculture is a net exporter of waste whereas saltmarsh is a net absorber*') and a large decrease (-2) in the provision of Food ('*agricultural land is more productive*') as a result of reducing arable/pasture land and increasing the amount of saltmarsh. Negative changes were primarily associated with decreased human use of the habitat, for instance in food or fuel production.

Regarding agreement between the two tables, there was total agreement of the scores given to 11 of the benefits identified in Workshop #1, the scores provided for 9 benefits were within 1 point (+ or -) with the remaining 6 benefits having a variance greater than +/-1. In particular, '1. Primary production', '2. Nutrient cycling', '3. Formation of species habitat', '19. Renewable energy', '24. Place to live' and '26. Biodiversity' showed the greatest variance across the two tables of stakeholders. This may illustrate a lack of experience/knowledge when attempting to assess changes in benefits provision from terrestrial and estuarine habitats, or may reflect the challenges associated with applying coastal definitions to a terrestrial context.

Under Scenario 2, the potential impacts on particular stakeholders were more direct. All three tables identified farmers as being one of the key stakeholders to be negatively impacted under the Flood Mitigation scenario. Stakeholders also identified that it was not just the farmer who would be negatively impacted under this scenario, but it would also have a negative impact along the agricultural supply chain which may include food processors, buyers and consumers as well as suppliers of farming machinery etc. A range of stakeholders who may benefit under Scenario 2 were identified, including: locals and tourists who would benefit from improvements in '15. Aesthetic Benefits'; local communities, local authorities and the Environment Agency who may benefit from improvements in '5. Natural hazard regulation', '11. Mitigation of coastal erosion' and '12. Sea Defence'; and local communities, nature conservationists, wildfowlers and wildlife watchers who would all benefit from an increase in '13. Tourism/nature watching'.

The scale of impacts was also noted by a number of stakeholders, for example with respect to '10. Healthy climate'. Although local communities may receive a slight benefit from a healthier climate under this scenario, the impact of a change in land use of 500 ha will be negligible on a global scale.

Lessons Learned

There are a lot of lessons from the scenario assessment which can be used for the future management of the Deben Estuary. By undertaking this assessment, the stakeholders identified a range of benefits which would be impacted under such a Flood Mitigation scenario, and thus illustrated that during trade-off analyses, there will likely be stakeholders who will be winners or losers under any given circumstance. The stakeholders clearly recognised this during the workshop and therefore have already started to understand some of the complexity that underlies management decisions, especially against a backdrop of climate change. Managed realignment is a relatively controversial issue within the Deben Estuary and therefore this Scenario was made abstract so as to not focus on particular geographical locations. However, the stakeholders felt that '*The abstract scenario needs to be more tightly defined*', there was a '*Need for agricultural representation'*, '*Economics was not taken into account during the scenarios exercises*' and there was real '*Difficulty in comparing between terrestrial and marine environments*'. These are all valuable points which should be taken on board should further scenarios assessments be undertaken within the Deben Estuary.

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