

THE UNIVERSITY OF HULL

**Impediments to Estuarine Management and Rehabilitation: Case Study
of the Humber Estuary**

**being a Thesis submitted for the Degree of MSc by Research
in the University of Hull**

by

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Abstract

Estuaries are sites of high variability and high productivity but support major urban areas - 22 of the largest 32 cities found in the world can be found on estuaries. These features have degraded estuaries and so there is the need for a holistic management framework. However, there are many impediments that can occur to achieving successful and sustainable estuarine management and rehabilitation. These can occur due to the variety of users and needs that arise within the estuarine environment. This current research interrogates the management and rehabilitation of the estuarine environment, as an economic and ecological resource. It focuses on the connectivity of the system with regards to the catchment area, land use and drainage, as well as, the impacts of activities such as dredging, and fishing on a commercial and recreational level. The research aims to highlight the various users, and how their activities affect the ecosystem and one another. The final aim is produce effective methods and potential proposals, to ensure prolonged activity and sustainable ecosystem function for future generations.

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1. Introduction

The estuarine environment is a highly productive and beneficial ecosystem to both marine and freshwater organisms and humans. Historically, estuaries have been home to new settlements due to access to both the sea and inland ports (Martinez, 2007). Ross (1995) noted that 22 of the largest 32 cities in the world can be found on estuaries. Estuaries have high social importance due to this ease of access to the sea and inland ports, as well as the leisure and recreational activities that they can provide (van der Meulen et al., 2004; Martinez et al., 2007). They are some of the most intensively exploited natural systems globally (Halpern et al., 2008). This has resulted in the need to protect and maintain the estuarine habitat in order to preserve ecosystem services and human uses of the biome (a biome being a naturally occurring fauna and flora, which occupies major habitats; for example, estuaries and tundras). The reason for this includes the decline of health seen with in the systems, resulting in estuaries being one of the most threatened and degraded ecosystems (Jackson et al., 2001; National Ocean Service, 2012). The need to protect the estuarine environment can be done in many ways, through rehabilitation and effective management. However, there are many ways in which these techniques can be hindered.

1.1. What is the estuarine habitat?

Estuaries have been defined as bodies of coastal water that are semi enclosed and have a connection to the ocean (Pritchard, 1967). Estuaries usually occur at the confluence of rivers and the open ocean, leading to brackish water being present in estuaries. The brackish waters found in estuaries are a mix of saline and freshwater. This means that seawaters is diluted with water from rivers and land drainage. This leads to the presence of brackish waters, creating a unique environment for flora and fauna. This definition is based mainly on temperate regions based in the northern hemisphere (Potter et al., 2010). It has been argued that the definition should be extended to include estuaries that become isolated and hyper saline due to the formation of sand bars (Day, 1990).

1.1.1. Basic ecology and hydrology

Estuaries are a harsh habitat in which organisms have to survive, due to seasonal and daily fluctuations and changes experienced in the environment. They are highly productive systems, with many organisms relying on them for nutrients, nursery habitats, and points of rest along migration routes (Elliott and McLusky, 2002; Sardiña and Cazorla, 2005; Platell et al., 2006; Chuwen et al., 2009). Water within the estuary is in a constant state of flux with water of different salinities constantly entering and exiting the system through tidal occurrences (saline water) and river basin drainage (freshwater). Furthermore, within estuaries there is the potential for two different types of currents to occur (Wolanski and Elliott, 2015):

- **Estuarine Current** is when dense salty water flows into the estuary. This causes the estuarine current to drop and sink, when tidal changes occur (Wolanski and Elliott, 2015).
- **Anti-Estuarine Current** is when less dense fresh water, from a river basin, flows into an estuary. These currents tend to be stronger near the surface. They are affected by solar radiation, resulting in these currents being more likely to be warmer than estuarine currents (Wolanski and Elliott, 2015).

One of the main factors affecting the hydrology and ecology of estuaries is the daily tidal patterns that are experienced. Most estuaries will have two high tides and two low tides per day; an exception to the rule is the Gulf of Mexico, which only experiences one high and low tide day (National Geographic Society, 2015). The extent to which tides affect the estuary depends greatly on the shape of the coastline and topography of the ocean floor, geographical location, local winds, and any restrictions that the flow of the tide may experience. For example, the effect of a tide on a large, wide inlet might diminish as there is a large area in which the water can move. However, when tides affect a narrow inlet the influence seems to be amplified with increased wave action occurring in more shallow estuaries (Wolanski and Elliott, 2015).

In addition to tidal changes, great variability can also be seen due to seasonal changes, and daily changes (Levington, 1995). For example, during the rainy or wet seasons there may be reduced salinity. This is due to the greater influx of freshwater from land and river drainage, as a result of increased rainfall. However, during the summer or dry

season there is increased salinity due to increased evaporation and a decrease in the influx of freshwater from rainfall and land drainage (National Geographic Society, 2015).

Estuaries may also be protected from the full force of climatic and tidal events, through natural barriers, such as coral reefs, barrier islands, sand and mud, and fingers of land (NOAA, 2015). Furthermore, the characteristics of individual estuaries depend greatly on local climate, tidal patterns, currents, and freshwater inputs. Broadly estuaries are classified by two characteristics: how freshwater and salt water mix with in them and their geology (National Ocean Service, 2007). However, there are cases where freshwater estuaries are present, for example the Great Lakes in the United States of America. These freshwater estuaries are found where there is an expansive body of freshwater, which is diluted by land drainage and rivers or streams (National Ocean Service, 2012).

Due to the reasons stated above, every estuary is different in terms of the ecology and hydrology (Perillo, 1995). This would lead to the need for specific action plans, in terms of rehabilitation and management, for individual estuaries as the requirements of humans differ, based on geography. In addition to this due to the human activities present, as result of the needs of the estuary, there will be different pressures present.

1.1.2. Ecosystem services

Ecosystem services can be defined as the benefits that nature can provide, through natural processes, to economies, household, and businesses (Boyd and Banzhaf, 2007). This conveys how important ecosystems are to society and that their value, in many ways, may not immediately be identifiable, due to the input of human capital (Daily et al., 1997). The Millennium Ecosystem Assessment classified ecosystem services into four categories (Millennium Ecosystem Assessment, 2005):

- I. **Supporting Services:** Necessary for the production of other ecosystem services. Not limited to primary production, photosynthesis, soil formation, and water and nutrient cycling
- II. **Provisioning Services:** Production of food, genetic resources, natural medicines, biochemicals, ornaments, and pharmaceuticals, obtained from the ecosystem.

- III. **Regulating Services:** Benefits gained from the natural processes that occur within the ecosystem; for example, climate regulation, air quality regulation, water purification, erosion regulation, and pollination, to name a few.
- IV. **Cultural Services:** The benefits that society gain, from the ecosystem, through spiritual enrichment, recreation, cognitive development and wellbeing, and aesthetic experiences.

Due to their highly variable and productive nature estuaries are able to provide a great deal of ecosystem services. For example, estuaries are thought to have contributed \$800 to \$9000 per acre, through aggregate provision, fish production, recreational opportunities, water treatment and storm protection (Anderson and Rockel 1991). Estuaries have seen a deterioration of around 50% in ecosystem health, due to the intense use witnessed, as a result of human activities (Barbier et al., 2011). This decline has led to the decrease in productivity in three major sectors; the number of sustainable fisheries has declined by 33%, detoxification and filtering provided by suspension feeders by 63%, and nursery habitats such as sea grass beds and oyster bed, by 63% (Barbier et al., 2011). The loss of habitats witnessed in the estuarine environment, is thought to have contributed decreased protection from extreme weather and storms, increased flooding, declining water quality due to a lack of suspension feeders, and an increase in biological invasions, compromising the integrity of the ecosystem (Braatz et al., 2007; Koch et al., 2009).

1.1.3. Impacts of humans

Due to the transitional nature of estuaries (area between salt and freshwater; area between sea and land), anthropogenic activities and impacts can be numerous (McLusky and Elliott, 2004). One of the greatest threats, presented to estuaries, is the large-scale change witnessed as a result of activities such as dredging, draining, damming, and filling. Lesser-discussed effects can be seen from non-native or invasive species introduction, the presence of pollutants, and eliciting of harmful chemicals and toxins, previously stored in benthos layers.

Human impacts can be classified into seven significant areas, according to French (2002). These significant areas are:

- Building development and land-claim;
- Navigation, aggregation extraction and dredging;
- Fisheries;
- Water quality;
- Sports and recreation;
- Agriculture;
- Energy generation and barrage construction.

1.1.3.1. Building Development and Land-Claim

There are several reasons why building development and land-claim pose considerable threat to estuaries. Pressure for the development of residential and leisure areas, ports and harbours, industrial plants and power generation is greater within areas adjacent to coastal areas (French, 2002). The demands placed in land can be met in various ways:

1. Redevelopment of sites previously used
2. Development of greenfield sites
3. Claiming intertidal areas to make new land for development.

Land-claim is likely to lead to gains for industry and agriculture and a loss to the natural habitat, wildlife and fisheries found in estuaries (McLusky and Elliott, 2004). A lack of understanding in the past about where land law ends and sea law starts, is thought to have led to the damage of various habitats and ecosystems. This resulted in many natural processes being interfered with, ending with the subsequent requirement to protect the environment from unsuitable developments from occurring within the affected areas (French, 2002). The problems encountered are further exaggerated by the interference of multiple authorities.

1.1.3.2. Navigation, Aggregation Extraction, and Dredging

The construction of new facilities, to accommodate the increase in leisure boating, poses greater threats to the environment compared to those that are currently present within estuaries. Dredging and land-claim that takes place due to the construction of new facilities may lead to many impacts, including additional infrastructure, housing and servicing (French, 2002).

Dredging often occurs in estuaries containing port and harbour complexes. This is due to the need to increase the depth of the estuaries as the size of tankers, container ships and ferries increase in size. The larger berths become the deeper the estuary into which they enter needs to be. There are two types of dredging: -

- **Maintenance dredging:** when the channel depth is maintained to a specific depth (French, 2002; Cefas, 2010). The process involves the removal of sediments, such as mud, gravel and sand. The aim is to allow channels to remain navigable. The process tends to be cyclic or consists of a regime of repeat dredges (Cefas, 2010).
- **Capital dredging:** when materials and sediments are removed in order to allow for greater depth of the channel (French, 2002)

Dredging has the ability to alter the flow and currents witnessed in estuaries due to a change in the topography (bottom profile) of the channel. It is likely that the tidal profile of the estuary will become steeper due to the increased depth witnessed in the channel (Pye and French, 1993; French, 2002). In addition to changing the flow and tidal regimes of the estuary, dredging will cause the re-suspension of sediment, leading to greater turbidity, and any pollutants that may be present in the sediment. The latter point would be particularly true for capital dredging (French, 2002; McLusky and Elliott, 2004). If the sediment extracted is relatively pollutant free, it can be repurposed in a variety of ways. These range from habitat recreation, rebuilding of beaches, and coastal defence in the form of offshore bars (French, 2002).

1.1.3.3. Fisheries and Aquaculture

Estuaries are mainly used for shellfish production, via fisheries, to complement the catch of natural stock (McLusky and Elliott, 2004). Furthermore, vertebrate species are also included in fisheries and aquaculture. Some species, such as salmon, eels, and sea trout tend to be the most popular species to be commercially exploited. Other vertebrate species benefit from less exploitation due to being commercially undesirable or due to the population found in estuary being a nursery stock (McLusky and Elliott, 2004).

There are major concerns for the presence of aquaculture, and fishing in general. This is due to the impacts that they can have on the estuarine environment. For example, fishing and aquaculture can lead to the removal of non-target and target species, as

well as potentially damaging the benthos. This damage to the stocks and benthos could have a wider impact on bird populations and other fish that rely on such species (Blaber et al., 2000). There are many effects that fisheries and aquaculture have on the estuarine ecosystem. The main effects range from effects on fish that are not target species (often through by catch), local species extinctions (often caused by over fishing of the target species), disruption to nursery function (for example, the removal of mudflats in shrimp fishing has led to a decline in juvenile dab and plaice, that rely on mudflats), water quality effects (re-suspension of particles through the use of trawling, increasing the turbidity), habitat destruction and modification via the creation of infrastructure and land-claim, such as flood defence and ports, effect of trophic level interactions (removing species that others rely on, could lead to a reduction in other species). For example, removing sand eels could lead to a reduction in seabird and crustacean population as they rely on sand eels as a source of prey) and increased population vulnerability (removal of juvenile stock and spawning stock via open water and bottom feeding fish stocks being over fished) (McLusky and Elliott, 2004).

1.1.3.4. Water Quality

Water quality is affected by many different components within the estuarine environment. These include industrial outputs and land contamination, water abstraction, increased turbidity due to activities and agricultural runoff. The concept of sustainable development conflicts with use for industrial discharges (French, 2002). Industrial waste, however, is treated before being returned to the estuary, greatly reducing the contaminants found within the effluent (McLusky and Elliott, 2004). Due to the United Kingdom's industrial past, many estuaries contain high amounts of heavy metals imbedded within the sediment of estuaries. If the sediment is disturbed, these heavy metals can then be released into the water, affecting water quality. Sediment could be disturbed through the construction of coastal defences (French, 2002). Heavy metals have various effects on the estuarine habitat depending on salinity, temperature and concentration of heavy metals (McLusky and Elliott, 2004). In addition to this, heavy metals have the ability to bio-accumulate through the trophic levels. Some annelids have the ability to detoxify heavy metals, however these heavy metals then permeate through the trophic levels, via predation, increasing in concentration due to bio-magnification. Industries have strict control when releasing

water back into an estuary but saltmarshes do not and as such pollutants can enter into the estuary via leeching (French, 2002).

1.1.3.5. Sports and Recreation

It is thought that the leisure industry poses one of the biggest threats to estuaries. This is due to the increased demand for leisure facilities and the presence of greater amounts of leisure time (French, 2002). This results in the need for the estuary and the surrounding habitats to be managed in order to allow other users coexistence and to protect the site for the future. Some estuaries experience greater human impacts from leisure and recreation than others. For example, a tidal estuary, appeals more to bird watchers than beach goers. Due to this, it is likely that large scale development is not likely to occur in order to preserve more natural surrounding and reduce disruption to bird life witnessed (French, 2002).

1.1.3.6. Agriculture

Agriculture is one of the main reasons for land-claim to occur (French, 2002). In addition to this, marshes provide diverse pastures for grazing. The European Commission implemented a policy, which sets aside land for managed realignment schemes. These managed realignment schemes allow for the systematic flooding of the land at high tide. Farmers are compensated for allowing such land to be reclaimed by tidal estuaries, being rehabilitated back to intertidal habitat via natural processes (French, 2002; Elliott et al., 2015). In addition to this, nutrient leaching may occur. This, much like pollutant leeching, has the potential to do harm to the estuary. The presence of excess nutrients could lead to eutrophication (limiting factors in photosynthesis such as carbon dioxide, sunlight and nutrient fertilisers, increasing in availability, giving rise to excess plant growth) and algal blooms (French, 2002; Chislock et al., 2013).

1.1.3.7. Energy Generation and Barrage Construction.

Estuaries tend to be the site of many forms of energy generation. This is due to the sheltered locations and abundant supply of cooling water provided by estuaries, and their surrounding habitats. This makes estuaries highly important to humans as we rely on energy generation for many applications, vital to human well-being (French, 2002; McLusky and Elliott, 2004). There are many environmental effects linked to the presence of power generation station that are sited on estuaries (McLusky and Elliott, 2004). One of the main issues that arises when looking at power station is the

abstraction and discharge of large amount of water. When taking in large amounts of water, material can be taken in. This is known as impingement. Any material that is larger than 1 cm² will remain on the initial rotating screens with in the power station, whilst anything smaller will continue into the power plant cooling system (McLusky and Elliott, 2004). Fish, mobile and large invertebrates (crabs and lobsters for example) and litter tend to be included in this material, along with seaweed, octopus and squid appearing nearer the outer estuary (McLusky and Elliott, 2004). The smaller material can include larvae and silt, which then leads to bio-fouling, within the cooling systems. This due to the presence of sessile (slow moving or anchored) fauna, such as mussel spat, saddle oysters and barnacles, and bacterial films. These organisms are then removed using biocides, anti-corrosion and anti-biofouling agents. Finally, when the water is discharged from the power station, the water tends to be released at a higher temperature than the surrounding waters, causing a thermal plume. This change in temperature can cause a change in reproductive cycles and acclimation of native species, and allow for the migration of non-native species into the estuary (McLusky and Elliott, 2004).

Renewable energy has become of great interest in regards to climate change and carbon emissions. However due to the sheltered nature of estuaries, wave power would be ineffective, whilst tidal barrage development poses the greatest threat (French, 2002). There are many harmful effects that can be expected from the development of tidal barrages. In the short term (hours to weeks), there is the potential reduction in the size of fish populations due to the noise and boat traffic increase during the construction phase of the development. This would be due to interference with swim bladder function and possible collisions with outboard motors. It is likely that this would be seen mainly during the months of June, July, August and September when fish migration occurs in salmonids, who seek high energy (fast flowing) freshwater systems (upper reaches of river systems) (FishBase, 2014). Noise travels great distances, from the point source and has the potential to further effect birds, fish and mammals, by inducing stress (Nedwell et al., 2003; Madsen et al., 2006; Parsons Brinckerhoff, 2008; Wade et al., 2010). Barrage development will also change the hydro-morphology of the estuary due to changes in current and topography, due to the obstruction caused by the barrage.

Mid-term (weeks to months) effects depend on the highly variable nature of the weather. There will be a reduction on flow changing the estuary from a high natural dispersal area due to the obstruction caused by the barrage. This reduction in flow will allow sediment to settle on the benthos, resulting in a less turbid environment and causing a change in the benthos community (Gill, 2005). Furthermore, due to the hyper-nutrient nature of estuaries and the high natural dispersal rate of water and nutrients, and obstruction could lead to eutrophication. This is because the basin of the barrage would act as a nutrient sink. This may then lead to increased algal blooms as phytoplankton will benefit greatly from the reduction in turbidity and increased nutrients present in the system (Lanston et al., 2010). This is a major impact as this chain of events has the potential to change the environment into a hypoxic (lack of oxygen) state.

In the long term (months to years), organisms would be expected to adapt, as many studies would confirm and as seen in La Rance, Brittany, where the estuary supports a tidal-power barrage (Kirby and Reitière, 2009). However, due to the obstruction caused by the barrage, catadromous (migrate from freshwater to the seawater in order to spawn;) and anadromous (migrate from seawater to freshwater in order to spawn; for example,) species will be unable to reach their respective breeding grounds. Catadromous species include eels migrate from river to the sea of Sargasso in order to spawn, whilst anadromous species cover salmon, which migrate from the sea, upstream, to fast moving waters in order to spawn. This has been shown to reduce the population size or lead to the extinction of the estuary specific population (Larinier, 2001; Hooper and Austin, 2013). This would reduce population viability due to a reduction in year class strength and genetic diversity.

1.6. Laws

There are many laws that operate within the estuarine system. These laws have the potential to impede management and rehabilitation. This is due to the vast amounts of users and operators within the estuary and the laws and conventions that the United Kingdom implements (Techera, 2012). This results in the need to find ways to reduce impediments to allow for more effective management and rehabilitation.

1.7. Summary

In conclusion, there are many issues that affect the estuarine habitat. In addition to this, due to their highly productive nature, estuaries need to be effectively managed and rehabilitated. This need to protect estuaries is vital due to the ecosystem services provided. Investigating impediments that effect the management and rehabilitation of estuaries is important in order to ensure the longevity of estuaries.

1.8. Aims, Objectives and Hypothesis

This study aims to determine the impediments to estuarine and coastal rehabilitation and sustainable management and the means of overcoming these.

There are the following objectives:

- Define methods of rehabilitation, restoration and remediation, using examples;
- Consider the roles of eco-hydrology and eco-engineering in these methods;
- Use the 10 tenets to rigorously address the pros and cons of the methods;
- Focus on the governance and socio-economic aspects of rehabilitation;
- Use of the DAPSI(W)R(M) model to assess possible break in legislation and areas in which legislation regarding drivers can be fortified;
- Consider how the estuarine environment can be protected and improved by legislation (for example the European Water Framework Directive);
- Look at how human activity can be mitigated and compensated for;
- Can management and rehabilitation be integrated to form a holistic approach and reduce user conflict.

The following hypotheses will be addressed during this study:

- Management is not successful for the rehabilitation of estuarine and coastal areas;
- There are no human activities that will harm the marine and estuarine environment;
- Mitigation and compensatory methods for the marine and estuarine environment are ineffective and poor;

- Human needs exceed that of the biological environment;
- The sustainability of human needs, from the estuarine environment, are not linked to biodiversity and the functioning of ecosystems;
- Is it possible to create a holistic approach to management and rehabilitation in order to reduce user conflicts?

2. Estuarine Governance

Estuarine governance accounts for the way in which the estuarine environment is controlled, through actions which are often influenced by the government and the policies and actions that the government implements (Collins English Dictionary, 2006). Good governance is achieved when decisions made by the government represent the constituents that they represent (Annan, 1999). The relationships present between international laws and community based management, with regards to the estuarine environment, needs to be considered with regards to estuarine governance (Techera, 2012). This balance needs to be found in order to realise the needs of all users and stakeholders involved in estuarine management and rehabilitation. This means that societal problems, biological diversity, and economic development, needs to be considered (Chand, 2007). This requires governmental actors and institutions, organisation and market parties influencing the policies that are proposed, through negotiations. This process allows for control within the estuarine environment (Techera, 2012).

2.1. Management

Management allows for the co-existence of humans with nature. Only by taking a holistic approach can effective management be achieved (French, 2002). This means accounting for all aspects of the estuary; bio-socio-economic uses and threats, hydro-morphology and dynamics, chemistry, and bio-chemistry to name a few (McLusky and Elliott, 2004). A holistic approach needs to be adopted. This is due to the degradation that has occurred in European waters, as a result of increased activities and a lack of communication between economic players and administrators (European Commission, 2015)

As seen in the past the most effective and successful management schemes have been simple in terms of their administration and control (French, 2002). In cases where there are multiple user groups, non-government organisations (NGOs), and environmental groups, there is bound to be mis-communication. This is thought to be the result of conflicting interests and ways of achieving good management, and frustration. Frustration occurs when all tools are available to manage the environment effectively but being unable to due to factions pulling in different directions (French,

2002). It is difficult for much progress to be made, or to operate a successful estuarine strategy, if constant acknowledgement of different groups and their goals and governing interest take precedent.

2.2. Making of Laws and Regulation

The law-making process can be a long and arduous process with many hearings of the proposal, along with amendments and rejections of the proposed legislation. In addition to this any legislation that is passed, whether it be on the international or national level, needs to be seen as desirable. Without this conflicts can be encountered between the regulatory standards and the regulatory bodies, when aiming to achieve compliance (Yeung, 2004). Finally legislation can come from a variety of sources and pass through the legislative process (Boyes and Elliott, 2014). The majority of laws and regulations used to govern the estuaries of the United Kingdom are based on the legislation and regulation applied by the European Union.

2.2.1. European Union

The European Union consists of 28 Member States, with a population of around 500 million citizens (European Parliament ^a, 2016; Figure 1). The representatives for each country are elected to the European Parliament every five years. These representatives act on the views expressed by the country which they represent (European Parliament ^a, 2016). There are three institutions in the European Union, which are involved in the legislative process. These are the Commission, The Council and European Parliament (Chemical Hazards Communication Society, 2006; Figure 2). The Council is the legislative body that demonstrates Ordinary Legislative Procedure, in conjunction with the European Parliament; this is the standard legislative procedure, used for making decisions, and was previously known as co-decision. This results in the elected members of the European Parliament being required to approve European Union legislation, together with the European Council (Chemical Hazards Communication Society, 2006; European Union, 2016). It also co-ordinates policy of Member States.



Figure 1: Map of the European Union. Retrieved from: EdMaps (2016). Historical Maps of Europe: European Union 2014. Found at: <http://endtimestruth.com/wp-content/uploads/2014/03/European-Union-map-2013-from-europaeu-e1393721006447.jpg>.

Last accessed: 16th March 2016.

The Commission is the administrative side of the European Union. The Commission consists of members approved by the European Parliament and then appointed by the Member States (Chemical Hazards Communication Society, 2006). The Commission is the executive arm of the European Union. It is required to answer questions raised by Members of the European Parliament, in addition to providing reports to the European Parliament about the progress on European Union activities, and a yearly report on the implementation of the budget (European Parliament^a, 2016).

Finally, the European Parliament elected once every five years by the 500 million citizens of the European Union. The European Parliament has three purposes:

- Shares Ordinary Legislative Procedure with the European Council;
- Influences the allocation of the European budget, due to the shared budget authority with the European Council ;
- Approves the candidates for the European Commission and has democratic supervision over it. The European Parliament supervises all institutions within the European Union (Chemical Hazards Communication Society, 2006).

European Union law can be divided into two types of legislation: treaties are the basis on which all European Union actions are centred (primary legislation), whilst regulations, decisions and directives are classed as secondary legislation and are formed on the ideals expressed in primary legislation (European Union, 2016).

The Ordinary Legislative Procedure begins when a report for a proposal is prepared by the European Commission. This is done at the request of countries or other European Union institutions (European Union, 2015; Figure 2, 2016). This then leads to the proposal being presented by the European Commission, to the Council, European Parliament, and National Parliaments (European Parliament ^a, 2016; European Parliament ^c, 2016; Figure 2).

In the first reading, the European Parliament President, refers the proposal to a committee. This parliamentary committee then assigns a rapporteur, who becomes responsible for writing a draft report (European Parliament ^a, 2016; European Parliament ^c, 2016; Figure 2). Included in the draft report are any amendments to the proposal. The committee then vote on the proposal and any amendments. The legislative proposal is then discussed and voted on by the European Parliament. The result of this discussion and vote becomes parliament stance on the proposal. The proposal is accepted at this stage, either without changes or with the suggested amendments. The proposal is then passed to the European Council, along either the European Parliaments position (European Parliament ^a, 2016; European Parliament ^c, 2016; European Union, 2015; Figure 2). The President of European Parliament has the power to reject proposal, however, this is rare (European Parliament ^c, 2016; Figure 2).

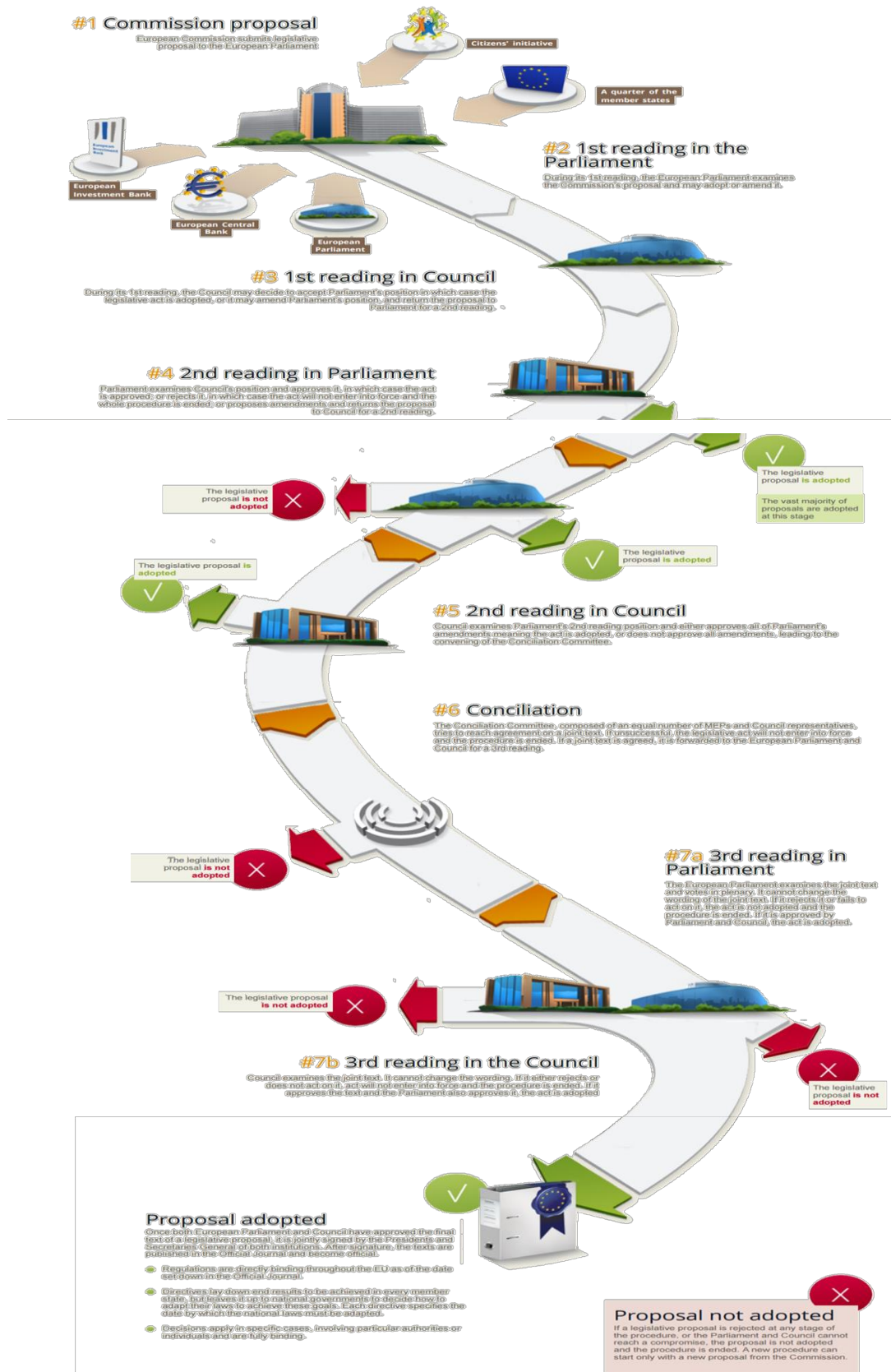


Figure 2: The stages included in the ordinary process of making legislation and regulation in the European Union.

Retrieved from: European Parliament (2016). Ordinary legislative procedure. Found at:

http://www.europarl.europa.eu/external/appendix/legislativeprocedure/europarl_ordinarylegislativeprocedure_howitworks_en.pdf. Last accessed 15th March 2016.

Prior to the first reading of the proposal in with the European Council, the European Council runs preparatory work, alongside the European Parliament during their first reading of the proposal. The European Council can conduct their first reading of the proposal, once the European Parliament has finished the process of their first reading, and their position on the proposal is known (European Parliament ^a, 2016; European Parliament ^c, 2016; Figure 2). During this first reading the European Council can either adopt the legislative act, by accepting the European Parliament's position, or make changes to the European Parliament's position. If the latter happens then the proposal is amended and sent to the European Parliament for a second reading (European Parliament ^c, 2016; Figure 2).

During the second reading of the proposal, the European Parliament has three months to review the European Council's stance on the proposal (European Parliament ^a, 2016; Figure 2). The Council's position goes the committee responsible for the proposal first. This committee then prepares further recommendations for the second reading in parliament (European Parliament ^a, 2016; European Parliament ^c, 2016; Figure 2). The recommendations and limited amendments of the proposal are then voted on by the European Parliament. There are four possible outcomes for the proposal at this stage:

1. The European Council's position in the proposal is accepted by the European Parliament, and is adopted.
2. The amendments recommended by the European Council in the first reading are adopted, if the European Parliament do not come to a decision within the time limit.
3. The European Parliament rejects the Council's first reading position. This means the proposal is not implemented and the process comes to an end
4. The European Parliament proposes amendments to the Council's first reading stance, forwarding the proposal to a second reading within the European Council (European Parliament ^a, 2016; European Parliament ^c, 2016; European Union, 2015; Figure 2).

The second reading in the European Council consists of a three month period, in which the Council reviews and examines the European Parliament's stance after the second reading of the proposal. The Council is also informed of the Commission's opinion on the Parliament's second reading amendments (European Parliament ^c, 2016; Figure 2).

The Council either approves or disapproves of the Parliament's position. If the former occurs the proposal is adopted; however, if the latter occurs, the President of the Parliament and the Council convene a meeting of the Conciliation Council (European Parliament ^a, 2016; European Parliament ^c, 2016; European Union, 2015; Figure 2).

The Conciliation Committee needs to convene within six weeks of Council's refusal to take the same position as Parliament. The Conciliation Council consists of an equal amount of members from both the Council and Parliament (European Parliament ^a, 2016; European Parliament ^c, 2016; Figure 2). The Conciliation Committee has six weeks to draw up a joint proposal based on the second reading stance of both the Council and Parliament (European Parliament ^c, 2016). If a joint proposal cannot be produced, then the proposal fails and the proposal is dropped. If a joint proposal can be decided, it is passed back to the Council and Parliament for a third reading.

The third and final reading takes place simultaneously. The two legislative bodies have six weeks to decide if they wish to adopt the proposal. The proposal cannot be altered in any way. In Parliament a plenary occurs, followed by a vote on the proposal (European Parliament ^a, 2016; European Parliament ^c, 2016; Figure 2). If both bodies approve the proposal, then the legislation is adopted. However, if both or one of the bodies rejects, or does not respond in time, the procedure will end and the proposal dropped. The only way the proposal can be restarted is if the Commission submits a new proposal (European Parliament ^a, 2016; European Parliament ^c, 2016; European Union, 2015; Figure 2).

2.2.1.1. The Lisbon Treaty

The Lisbon Treaty came into effect in 2009, bringing with it new powers within law-making in the European Parliament. This change put the European Parliament on a par with the European Council of Ministers in terms of how the European Union's budget is spent and deciding what the Union does (European Parliament ^a, 2016; European Parliament ^b, 2016; Figure 3). Furthermore, the treaty gave Members of the European Parliament (MEPs) more influence on the leader of the European Union, whilst also changing the way the European Parliament works with other European Institutions. This allows the citizens of the European Union to have greater say in terms of the

direction in which the European Union is heading (European Parliament ^a, 2016; European Parliament ^b, 2016).

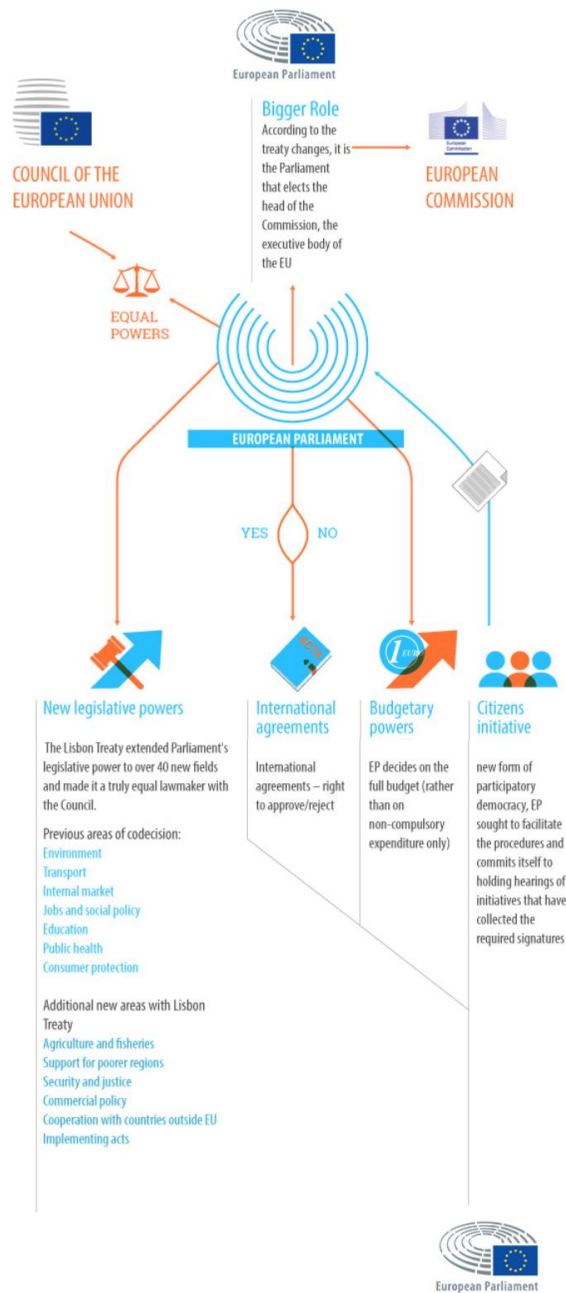


Figure 3: New powers that have surfaced since the introduction of the Lisbon Treaty. Retrieved from European Parliament (2016). EP after the Lisbon Treaty: Bigger role in shaping Europe. Found at: <http://www.europarl.europa.eu/aboutparliament/en/20150201PVL00008/The-Lisbon-Treaty>. Last accessed: 16th March 2016.

2.2.2. Laws and Regulation

There are many laws and regulation present within the European Union that are in place to aid the conservation and management of the estuarine and marine environment. Figure 4 highlights the boundaries for European legislation and regulation regarding the marine and estuarine habitat.



Figure 4: Geographical map of European Union legislation and regulations. Taken from Boyes et al. (2016)

2.2.2.1. The Marine Strategy Framework Directive

The Marine Strategy Framework Directive (MSFD) allows Member States, of the European Union, to take the required action to achieve or maintain good ecological status (GES), in the marine environment by 2020. Marine strategies shall be developed and implemented in order to achieve two aims:

- Protect and preserve the marine environment, prevent its deterioration or, where possible, restore marine environments that have been adversely effected.
- Prevent and reduce the inputs in marine ecosystems, to ensure no significant impacts on marine biodiversity, human health, and legitimate sea users, or risks to these areas.

The MSFD applies an ecosystem approach to the management of human activities, ensuring that the collective pressure of such activities is kept within levels compatible with the achievement of GES. The MSFD also ensures that the ecosystems capacity to respond to these pressures is not compromised, while enabling the sustainable use of marine goods and services for present and future users. In addition to this, the MSFD aims to bridge the gaps and increase the coherence between different current policies and plans to integrate environmental concerns, which may impact the marine environment.

The MSFD is to be applied to all marine waters of the European Union, for example, the Mediterranean, the Baltic Sea, the Black Sea, the North East Atlantic, and waters surrounding the Azores, Canary Islands and Madeira. The directive shall take account of the trans-boundary effects on the marine and estuarine environment of third states in the sub region or region. The MSFD is not applicable to activities whose sole purpose is national security and defence. However, Member States should endeavour to ensure that such activities comply with the marine strategy framework directive, as far as possible and practical.

2.2.2.2. The Water Framework Directive

The Water Framework Directive (WFD) was first implemented in December 2000, after the first wave of water legislation that was introduced throughout the 1980's. The directive is used to represent a new framework for governing water policies. WFD is purely defined in terms of ecological status, which has led to conflict with historical uses of water ways and water bodies, in Member States. The directive states criteria which, which needs to be met:

- Demands undisturbed fish migration; for example, in the case of weirs and dams the installation of fish ladders;

- Demand for adequate residual flow according to ecological criteria;
- Demand for surge restrictions to reduce uncharacteristic high or low water levels further downstream;
- The water body must not deteriorate further.

The water framework directive covers all surface water bodies including, estuarine, coastal (out to 1 nm) and ground water bodies. These water bodies are covered, regardless of use, by the directive. In addition to this, the WFD provides an inclusive approach looking at the catchment area, flood plains, and water bodies as one cohesive unit. Furthermore, the directive covers the interactions between surface and ground water.

2.2.2.3. The Birds and Habitats Directive

The Birds and Habitat Directives have had to evolve over the years since they were first implemented in 1979 and 1992 respectively. This is due to the changes seen within the European Union. In order for the two directives to be inclusive of all habitats, as the European Union has expanded, so the directives have been changed to take account of new types of habitats and new species of native birds (European Commission ^b, 2016). The Birds and habitats Directives form the cornerstone of the European Union's policy on nature conservation, along with Natura 2000 (European Commission ^a, 2016; European Commission ^b, 2016; European Commission ^c, 2016; Natura 2000, 2007).

The Habitats Directive aims to cover the conservation of a variety of endemic, threatened and rare habitats and species. There are 200 characteristic and rare habitats that are targeted for conservation, in their own right (European Commission ^b, 2016). In total there are currently 200 habitat types and 1000 species listed in the annexes of the Habitat Directive. There are three different annexes that cover these species and habitats:

- **Annex II Species:** These are core areas of around 900 species' habitat. They are titled as Sites of Community Importance (SCIs), and are accounted for in the Natura 2000 Network. The area is managed in regards to the needs of the species (European Commission ^b, 2016).
- **Annex IV Species:** There are over 400 species and habitats included in this annex, many of which are also covered by **Annex II**. This includes a strict

protection regime, which must be applied to the entirety of the species natural range within the European Union (European Commission ^b, 2016)

- **Annex V Species:** Exploitation and removal of species, from their habitat, must ensure that there is an acceptable breeding population, in order to maintain a good conservation status. There are over 90 species included in this annex and the management of the species population is decided by the member state (European Commission ^b, 2016).

The European Union published a guide on the correct implementation of the Habitat Directive in order to help Member States achieve the directives provisions (European Commission ^b, 2016). Articles 6, 12, 16, and 17 in the Habitats Directive require Member States to report on the conservation status of certain habitats and species. This is to allow compensatory measures to be taken, where negative impacts occur on Natura 2000 sites due to ongoing projects (European Commission ^b, 2016). Finally, The Habitats Directive calls for the presence of the Habitats Committee, to support the European Commission in the implementation of the directive (European Commission ^b, 2016).

The Birds Directive aims to protect all 500 species that are native to the European Union (European Commission ^a, 2016). The Birds Directive is one of the oldest pieces of legislation in the European Union. It was adopted in 1979, when Member States became concerned with the decline of native bird species. Co-operation has become key for protecting these species as they often migrate over borders and boundaries. Many human activities such as transport networks and urban sprawl have led to the fragmentation and reduction in habitat for these species. In addition to this, forestry, the use of pesticides, fisheries and intensive agriculture has reduce the availability of prey and other food supplies, further weaken bird populations (European Commission ^a, 2016). The main threat to wild bird populations is the loss or degradation of their habitats. This has led the emphasis of this directive being place on habitat protection, for endangered and migratory species. This has led to the creation of a network of Special Protected Areas (SPAs) for these species. SPAs have been included in the Natura 2000 ecological network since 1994 (European Commission ^a, 2016). There are five annexes that for the directive and aim to protect wild birds and their habitats:

- **Annex 1:** There are 194 particularly threatened species and sub-species in the European Union. This has resulted in Member States being required to designate Special Protected Areas (SPAs) to these species in order to aid survival of these species and other migratory birds (European Commission ^a, 2016).
- **Annex 2:** 82 species of birds, in the European Union, can be actively hunted. However, there are restrictions as to when hunting may occur. These no hunting season tend to be when the birds are at their most vulnerable life stages: for example, when reproducing and raising their offspring, and when they are returning from wintering grounds, to nesting areas (European Commission ^a, 2016).
- **Annex 3:** Any threatening practices towards birds are banned (trade, capture, or deliberate killing of birds). Some of these activities can occur with the permissions from the member state, providing the activity happens with in the restrictions set out by the European Commission and the Birds Directive (this only applies to 26 species) (European Commission ^a, 2016).
- **Annex 4:** The Birds Directive provides sustainable management of hunting of species. This being said the large scale hunting and non-selective killing of birds must be outlawed by Member States (European Commission ^a, 2016).
- **Annex 5:** Promote research into the use, management and protection of all species covered by the Birds Directive.

Guideline to hunting practice, sustainable management of populations, and the key concepts of the directive are provided by the European Commission. The European Union aims to eradicate the illegal trade, trapping, and killing of birds, in addition to launching its first sustainable hunting initiative in 2001 (European Commission ^a, 2016). As seen with the Habitats Directive, Member States are required to submit reports, commenting in the trends and status of bird populations. Implementation of the Birds directive is overseen by the ORNIS committee that assists the European Commission (European Commission ^a, 2016).

2.2.2.4. Natura 2000

Natura complements the Birds and Habitats Directives (Natura 2000, 2007). It covers almost 6% of European Union's marine territory and over 18% of its land area (European Commission ^c, 2016). It is the world's largest group of co-ordinated projects of protected areas, offering havens for the most threatened and valuable species and habitats found in Europe (European Commission ^c, 2016). Natura 2000 provides resting and breeding sites for these threaten and rare species, while some habitats are protected outright (European Commission ^c, 2016; Natura 2000, 2007). Natura 2000 aims to protect the long-term survival of these threatened and valuable species and habitats that are listed under the Birds and Habitats Directives. The network does not prohibit all human activity in the Special Areas of Conservation (SACs) and Special Protected Areas (SPAs); most of the land involved in the network is privately owned. Natura 2000 emphasises the need for people to work with nature, rather than against it, in order to aid conservation and sustainable use of the network; Member States need to ensure the areas are managed sustainably, in terms of ecological and economical gains (European Commission ^c, 2016).

2.2.2.5. Flood Risk Management Directive

The Flood Risk Management Directive was implemented on the 26th November 2006 after being proposed to the European Commission in mid-January 2006 (European Commission ^b, 2016). The directive aims to provide management plans in order to reduce and effectively manage flood risks posed to the environment, human health, economic activity and cultural heritage. The directive aimed to have management plans for all European Union waters in place by 2015, after preliminary assessments to identifying coastal zones and river basins prone to flooding and then mapping the flood risks, by 2011 and 2013 respectively (European Commission ^b, 2016).

The directive was undertaken in conjunction with the Water Framework Directive, mainly through co-ordination of river basin management plans and flood risk plans and the implementation of these plans through public participation; all flood risk maps, plans, and assessments were made public (European Commission ^b, 2016).

The directive required member states to work with each other in cases where the river basin was shared, whilst ensuring that when working independently that the plans

would not affect neighbouring countries by increasing their flood risk(European Commission^b, 2016).

2.2.2.6. Maritime Spatial Planning Directive.

The Maritime Spatial Planning (MSP) Directive was first implemented in September 2014, after being adopted in July of the same year. It was the first directive, which requires countries to establish transparent planning at sea systems and co-operate with neighbouring countries to ensure the transparency, by law (European Commission, 2015). The MSP Directive is now required to be transposed into national legislation of all European Union countries and for these countries to appoint competent officers by 2016 (European Commission, 2013). Full implementation of MSP must be achieved in the waters of Member States by 2021. MSP focuses mainly on four major objectives that are linked to the legal bases: fisheries, environment, energy, and marine transport. Management and planning details, for implementation, must be decided by Member States as this is not specified with the Maritime Spatial Planning Directive.

The need for maritime planning has arisen due the increased traffic from users, such as shipping and fishing, and the need for these users to share space with users that previously were not present in that space; for example, marine protected areas and marine renewable energy (European Commission, 2015). In addition to this, the ocean has great potential for growth and innovation, whilst being a driver for the European economy. Finally, the maritime spatial planning directive has the potential to secure the future of important fishing grounds. This is because it allows the fisherman to have a voice in terms of the development of European waters. The directive also has the ability to help increase the development of aquaculture by identifying suitable areas for farms, providing more certainty to investors and helping the sector gain required access to European waters (European Commission, 2015).

There are many benefits that accompany the implementation of the Maritime Spatial Planning Directive. For example, one for the main benefits is a reduction in conflict between maritime users. The Maritime Spatial Planning Directive accomplishes this through the early detection of potential synergies and conflicts (European Commission, 2013). Moreover, Maritime Spatial Planning Directive, aims to improve management of human activities on the environment, helping to reduce the negative impacts of

humans in European waters (European Commission, 2015). In addition to this, the directive aims to foster investment by increasing certainty, with regard to economic activities, and transparency as to locations and length of the activity. The transparency and certainty helps to strengthen the investment opportunities and creates new prospects, by reducing the risk associated with the development of new ventures (European Commission, 2015). Furthermore, the Maritime Spatial Planning Directive aims to integration of land-sea interaction, as they are closely inter-related. Many terrestrial activities have an impact on the marine habitat, and vice versa. For example, the waves created by increased boat traffic has the potential to increase coastal erosion (European Commission, 2015). Finally, the directive aims to improve trans-boundary co-operation. This is due to the fluid nature of activities and ecosystems that occur within the marine and estuarine environment. Co-operation is required for the development of trans-national activities; for example, installation of submarine pipelines and cables, use of shipping lanes, and establishment of power grids (European Commission, 2015). Trans-boundary communication increases, would allow for the increase in marine environmental protection. This would be achieved through the creation of a coherent network of protected areas, which may straddle boundaries (European Commission, 2013).

2.2.3. Governing Bodies

The European Union has seen a large-scale increase in the number of European environmental agencies in recent years (Craig, 2012; Lee, 2014). For many regions, the role of agencies lie mainly in the regulatory purpose. They often determine activities and regulatory standards that can take place in a specified area. Due to this agencies enforce the regulations (Lee, 2014). The power and role of many European Union agencies varies a great deal, with some having power close to that of regulatory power (Shapiro, 2012). This being said, they do not have decision making power, rather provide expertise in the institutions of the European Union (Lee, 2014).

The European Environmental Agency (EEA) is mainly a reporting and information gathering body (Regulation No. 401/2009/EC). The main role is to provide reliable, comparable and objective information at the European level (Lee, 2014). The EEA produces a report every four years on the 'state of the environment' as well as numerous reports on a variety of issues. The EEA does not have a legislative role, so

cannot set standards or issue permits, and as such other agencies are likely to be of more benefit to environmental lawyers (Lee, 2014).

Further agencies include the European Chemicals Agency (ECHA) and the European Food Safety Authority (EFSA). Agencies, such as these, provide technical expertise that contributes to the final Commission on important decisions (Lee, 2014). Both EFSA and ECHA interpret complex legislation. For instance, EFSA issues guidance on how to implement risk assessment for the authorisation of genetically modified organisms (GM crops), whilst ECHA provides advice on how to execute socio-economic analysis for the restriction or authorisation of chemicals (Lee, 2014). The Commission reserves the right to pass legislation, however, the environmental agencies are highly influential in any decision that are made, regarding environmental legislation and regulation.

2.3. England

The supreme legislative body witnessed in the United Kingdom, British overseas territories and British Crown dependencies, is the Parliament of the United Kingdom of Great Britain and Northern Island. The British sovereignty resides over the two houses (the House of Lords and the House of Commons), that makes up the bicameral structure of parliament, through the opening and dissolving of the parliamentary term (Parliament ^c, 2015). In addition to this the crown is required to formally accept a bill before it can be implemented (Parliament, 2015; Figure 4). Parliament is a democracy, meaning that people, whom represent the best interests of the nation, are voted into a position of power within the House of Commons. There are 650 Members of Parliament that can be found in the House of Commons (Parliament ^d, 2015). The House of Lords consists of 300 members; 240 members are elected, whilst 60 members are appointed (Parliament ^b, 2015).

There are several stages involved in passing legislation through Parliament. Once a proposal has been backed and taken forward by ministers, it is debated. Once approved by cabinet committees the proposal is rewritten as a bill by the minister whom first suggested the proposal (Parliament ^a, 2015). Bills are then presented to Parliament at the opening of the parliamentary session by the Monarchy. At this point the bill is discussed and scrutinised, after being introduced. For a bill to become law it must be approved by both Houses and the Monarchy (Parliament ^a, 2015; Parliament ^b,

2015; Parliament ^c, 2015; Parliament ^d, 2015). The movement of the bill through both Houses is relatively similar. Any environmental law can start in either house.

The first stage of the bill being passed through Parliament, is when the bill's title introduced to the chamber, with the bill then made available to all Members of Parliament. This is known as the first reading (Parliament ^a, 2015; Figure 4).

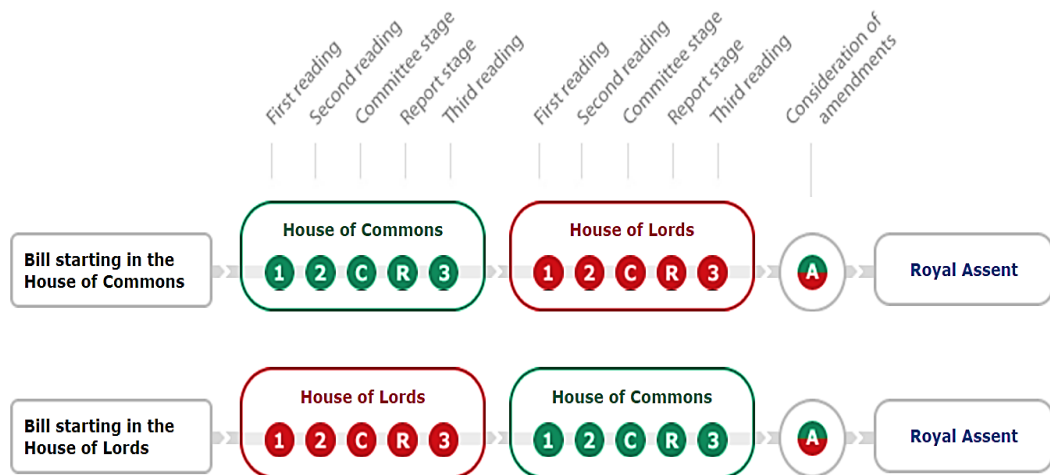


Figure 5: The legislative process witnessed in the United Kingdom. There are two possible pathways; one starts in the House of Lords, whilst the second starts in the House of Commons., Both Pathways lead to Royal Assessment, which is where the legislation is given royal approval to be implemented. Retrieve from: <http://www.parliament.uk/about/how/laws/passage-bill/>. Last accessed: 31st May 2016

The second reading takes place when the main principles of the bill are discussed. In the House of Lords, a vote is not required for the bill to move to the next stage. However, in the House of Commons a vote may ensue at the end of this stage, particularly if the bill is thought to be controversial (Parliament ^a, 2015; Parliament ^d, 2015; Figure 5).

The third stage involves committees of Members of Parliament or peers, who analyse the bill. At this point, the bill has amendments suggested and voted on. The bill is then changed accordingly. The entirety of the House of Lords is likely to take part in this stage, whilst the House of Commons committees often only include around 20 Members of Parliament (Parliament ^a, 2015; Parliament ^b, 2015; Parliament ^d, 2015; Figure 5).

The report stage involves the bill being presented to the chamber, with all amendments. The bill is reviewed by all members of the chamber, and further recommendations can be made at this stage by members who were not involved in the committee (Parliament ^a, 2015; Parliament ^d, 2015; Figure 5).

The third reading involves a Member of Parliament debate followed by a vote on the bill. This is the bill in its final form before being sent to the next House. In the House of Lords, amendments can still occur at this stage (Parliament ^a, 2015; Parliament ^b, 2015; Figure 5).

Once the bill has been passed through both Houses, and has been amended and approved by both Houses, it is then sent for formal approval from the Monarchy. This stage is known as Royal Assent. The Monarchy makes the decision with advice from ministers. Once the bill is approved by the Monarchy, it becomes law, and is described as an Act of Parliament (Parliament ^a, 2015; Parliament ^b; Parliament ^c; Parliament ^d, 2015; Figure 5).

There are many environmental laws that are used to manage the estuarine habitat and surrounding habitat. These laws are often influenced by European and International legislation and conventions (Boyes and Elliott, 2014).

2.3.1. Laws and Regulation

There are many laws and regulations that govern the estuarine environment and surrounding habitats.

2.3.1.1. Environmental Protection Act, 1990

The Environmental Protection Act (1990), aims to implement a system of integrated pollution control for the disposal of waste to water, air and land (DEFRA ^c, 2011). It can be divided into three parts, as describe by the act. Part I of the Environmental Protection Act aims to define what the environmental consists of, as well as the pollution to the environment and processed that have to ability to cause harm, and harm. It further states that the enforcing authorities as the Environment Agency and local authorities, in England and Wales (United Kingdom Parliament ^a, 2015). Part II aims to improve waste disposal rules and regulation. Finally, Part III aims to cover clean air and statutory nuisances (DEFRA ^c, 2011).

2.3.1.2. Water Industry Act 1991

The Water Industry Act (1991) aims to consolidate enactments, prior to this date, in regards to waste-water services and water supply. The act is in eight sections.

- **Part I:** Highlights the duties of the Director General of Water Services, and their appointment
- **Part II:** Looks at the private sector water companies and their duties and appointment. This part also refers, to the private sectors obligations to maintain the United Kingdom's water supply system.
- **Part III:** States the duties of water companies, with regard to water supply in England and Wales.
- **Part IV:** Concerns sewage and the obligations of the water companies in regards to sewage.
- **Part V:** Concerns operating system, and system cost and financial requirements.
- **Part VI:** Allows the specific powers to the water companies, in order to discharge their duties.
- **Part VII:** Refers to the information released to interested parties
- **Part VIII:** Concerns miscellaneous details. For example, limiting the right to take legal action against water companies in relation to sewage transgressions (United Kingdom Parliament ^c, 2015).

2.3.1.3. Water Resources Act, 1991

The Water Resources Act (1991) regulates water pollution and quality, flood defence, and water resources. The Water Resources Act was one part of four different acts, which aimed to consolidate the 20 acts that were present at the time (United Kingdom Parliament ^d, 2015).

- **Part I:** Highlights and outlines the role of the Environment Agency in ensuring water quality and quantity. It also aims to highlight offences regarding discharge contents, possible ways to defend offences and water.
- **Part II:** This part states the duties of the Environment Agency. The Environment Agency, as far as possible, needs to maintain, secure and provide appropriate management for any apparatus, other works, or reservoirs that are controlled and operated by private water companies.

- **Part III:** Refers to the legal framework used to ensure that environmental quality standards are met. The quality of the water bodies is classified by a system, outlined by the Secretary of State for Environmental, Food and Rural Affairs.
- **Part IV:** Refers to flood defence, which the Environment Agency has general supervision of. This often includes conducting surveys of the environment and obligations to provide flood defence functions. The latter is done through the use of committees, which are authorised to improve, construct or maintain drainage system (Kingdom Parliament ^d, 2015).

2.3.1.4. Environment Act, 1995

The Environment Act (1995) gave rise to the formation of the Environment Agency (England and Wales' environmental governing body) and the Scottish Environment Protection Agency (Scotland's environmental governing body) (DEFRA ^b, 2011; United Kingdom Parliament ^b, 2015). There are five parts to the Environment Act:

- **Part I:** Highlights the roles of the Environment Agency and the Scottish Environmental Protection Agency
- **Part II:** Refers to abandoned mines and contaminated land.
- **Part III:** Refers to the National Parks and the ways in which they are managed by the respective agency and local authorities.
- **Part IV:** Refers to air quality.
- **Part V:** Refers to the supplemental, general and miscellaneous provisions. For example, hedgerows, fisheries, drainage and mineral planning permissions to name a few (DEFRA ^b, 2011; United Kingdom Parliament ^b, 2015).

2.3.1.5. Pollution Prevention and Control Act, 1999

The Pollution Protection and Control Act aims to allow the Secretary of State to provide new pollution control systems, through the power of making new regulations (DEFRA, 2011). These new pollution control systems need to meet requirements set out by the Integrated Pollution Prevent and Control Directive (European Council Directive 96/61/EC) and for other pollution prevention and control measures. The Environmental Protection Act (1990) has provisions for regulation of more simple polluting processes, that may occur due to the activities of local authorities, through the Local Air Pollution Control Act and as well as integrated pollution control (DEFRA^e,

2011). The Environmental Protection Act (1990) is amended, through this Act, in order to allow Integrated Pollution Prevention and Control to occur, as stipulated by the European Council Directive 96/61 (DEFRA^e, 2011).

2.3.1.6. Clean Neighbourhoods and Environment Act, 2005

The Clean Neighbourhoods and Environment Act (2005) is the result of a 2002 review of the previously set out legislative framework used to provide and maintain safe and clean local environmental. The review was carried out by the Department of Environment, Food and Rural Affairs (Legislation Services^a, 2016). The review found that legislation was not working as effectively as possible to ensure clean and safe local environments. The Clean Neighbourhoods and Environment Act consists of 10 measures, which were proposed and then amended during the consultation process.

- I. **Crime and Disorder:** The laws pertaining to crime and disorder reduction partnerships were amended, requiring them to account for anti-social behaviour and other negative behavioural towards the local environment, as well as making allowances to gate minor highways that attract anti-social behaviour.
- II. **Vehicles:** This measure relates to nuisance parking and reviews and amends laws and legislation relating to illegally parked and abandoned cars
- III. **Litter and Refuse:** The amends the duties and power of local government in relation refuse and litter, as well as extending legal transgression of litter dropping.
- IV. **Graffiti and Other Defacement:** Amends the legislation, in regards to fly-posting, illegal advertising displays and graffiti.
- V. **Waste:** Waste is broken up into three chapters. Chapter 1 makes provisions in regards to carriers of waste and the particular kinds of waste they transport. Chapter two concentrates on fly-tipping (the illegal disposal of waste) and local authorities duties and powers to dispose and collect the waste. Chapter three covers waste generation, as a result of construction sites.
- VI. **Dogs:** There are two chapters relation to dogs within the act. The first chapter allows local authorities to create infractions relating to the control of dogs. These powers are set to provide a an easier route compared to the previous byelaws used by local authorities. The measure replaces the Dogs (Fouling of

Land) Act (1996), and allows local authorities to bypass the Secretary of State when applying new offences. The second chapter relates to stray dogs and removes most of the statutory responsibilities of the police, in regards to them.

- VII. **Noise:** This relates to noise nuisance and the various problems relating to it. Local authorities were given powers to deal with intruder alarms, while the night-time noise nuisance powers were extended to cover licensed premises as well as domestic. This measure also allows authorities to try different means to deal with nuisance noise prior to issuing an abatement notice.
- VIII. **Architecture and the Built Environment:** This measure sets out a general function for the statutory Commission for Architecture and the Built Environment.
- IX. **Miscellaneous:** Contains supplementary and miscellaneous notes.
- X. **Miscellaneous:** Contains supplementary and miscellaneous notes.

2.3.1.7. Natural Environment and Rural Communities Act, 2006

The Natural Environment and Rural Communities Act (2006) was mainly intended to be used to implement the Rural Strategy, proposed by the Government, in 2014. It addresses a wider range of natural and environmental issues, as well (DEFRA, 2011). Natural England was established as an independent body. Natural England became responsible for enhancing, conserving and managing the natural environment for years to come, within England. In addition to this, Natural England will work closely with organisations, such as English Heritage, the Environment Agency and the Forestry Agency, which operate within the natural environment, The Act also establishes the Commission for Rural Communities. The Commission aims to be an independent watchdog, expert advisor and advocate for Natural England (DEFRA^d, 2011). The aim is for the Commission to provide information, monitoring and advice to the government and others on policies and issue affecting the need of rural areas. The Act can be broken into 10 parts.

- I. **Natural England and the Commission for Rural Communities:** The creation of Natural England and the Commission for Rural Communities lead to the dissolution of English Nature and the Countryside Agency. Natural England and the Commission for Rural Communities are two independent non-departmental public bodies. The part of the Act allows for the transfer of rights, property and

liability, as a result of the disbanding of the Countryside Agency and English Nature. It also allows for future transfers between Natural England, The Commission for Rural Communities and a Minister of the Crown, in order to assure efficient management of the property, liabilities and rights.

- II. **Nature Conservation in the UK:** This relates the Joint Nature Conservation Committee and its reconstitution as a nationwide organisation. It also makes changes to the Committee's responsibility.
- III. **Wildlife:** This part of the Act makes allowances with respect to pesticides that harm wildlife, protection of invasive non-native species and of birds, and biodiversity. It also makes provisions for the enforcement of powers in relation to wildlife, as well as time limits for certain wildlife offence proceedings.
- IV. **Spites of Specific Scientific Interest:** This part of the Act aims to account for the ambiguities and openings, which have been highlighted for sites of specific scientific interest (SSSIs). Specifically, it creates offence with regard to any damaged cause to a site of specific scientific interest, by any operator, without acceptable reasons. There is also a further, related offence, which covers the reckless or intentional destruction of a site of specific scientific interest's fauna, flora, geography or physiographical features without sound justifications. Finally, provisions are made for Natural England's failure to provide notice to all those involved in the area, when notifying or de-notifying a site of specific scientific interest. It allows for Natural England to install signs and notices regarding the site of specific scientific interest. It also makes it illegal to recklessly or intentionally, damage, deface, destroy or cover these notices without reasonable excuse.
- V. **National Parks and Broads:** This part relates to the clarification of the factors taken into account when aiming to designate an area as a National Park. In addition to this it aims to amend the constitutions of National Park authorities and their functions, as well as those of the Broads Authority. Finally, it allows for the Broad Authority and National Park authorities to receive emergency funding, should they require it.
- VI. **Rights of Way:** The Act regulates the rights of way of mechanically propelled vehicles, as well as non-mechanically propelled vehicles (for example, pedal

cycles). The Act allow for the creation of new rights of way, when there is evidence of use, by non-mechanically propelled vehicles, for a period of 20 years. This route is then recorded on the definitive map and statement (document that highlight all local bridle ways, footpaths, byways open to all traffic and restricted byways). Any mechanically propelled vehicle route, which is not recorded on the definitive map and statement, may be terminated. There are however certain exceptions; for example, private land owners, who require mechanically propelled vehicle to accessed their land, may be provided with private rights of way. Finally, the Act allows for National Park authorities to create traffic regulation orders, which include the regulation of traffic on recorder footpaths, byways, bridleways and unsealed carriageways, within National Parks.

VII. **Inland Waterways:** It is important to note the function of the Inland Waterways Advisory Council has not changed, though the name has. The Act severs all ties with British Waterways, becoming an independent body, which is supported by DEFRA. This independent body was given wider, new parameters enabling greater advisory functions. The Act enables the Council to provide advice to navigation authorities, the Government and other interested parties about inland waterways.

VIII. **Flexible Administration Arrangements:** The Act allows for agreements to be made between designated bodies and the Secretary of State, in relation to different functions carried out by those bodies (DEFRA^d, 2011). In addition to this, designated bodies have the power to allocate their functions to other designated bodies, which have to ability to carry out the function. Furthermore, activities currently carried out by the Rural Development service will instead be carried out by Natural England. Moreover, the Act enables the ability to create boards in order to help with the development and promotion of agriculture and its related industries, whilst also giving rise to the abolishment of existing levy bodies within DEFRA's remit; for example, the Meat and Livestock Commission and the British Potato Council. Finally, the Act aims to give financial assistance for any purpose relating to DEFRA and its activities. The Secretary of State gives this financial assistance.

- IX. **Miscellaneous:** Many Acts refer to areas of natural beauty. The Act clarifies the criteria which may be taken under consideration when deciding on such areas. In addition to this, byelaws powers regarding drainage and flood defence were amended, allowing local authorities to take environmental matters into account when looking at flood defence and drainage. Final, the Act allows for the dissolution of ineffective statutory committees.
- X. **Final Provisions:** Final provisions are supplied in relation to commencement and extent, and transitional arrangements. It also introduces two schedules which a) contain consequential and minor amendments and b) appeals.

2.3.1.8. Climate Change Act, 2008

The Act aims to establish a framework in order for the United Kingdom to achieve its long-term aims of reducing greenhouse emissions. In addition to this it aims to take steps regarding the impact of climate change, and adapting to the impacts witnessed as a result of climate change. The Act can essentially be broken down into six parts (Legislative Services^b, 2016).

- I. **Setting Emission Reduction Targets in Statute and Carbon Budgeting:** Establishes a pathway that is economically credible in regards to emission reduction by 2050 and beyond. This is achieved through mid and long term objectives. The Act also introduces carbon budgeting, which will set targets and last a period of five years. The target must be established for three cycles of the five-year period. The ranges for carbon budgeting are to be set by the Secretary of State, accounting for net carbon emissions in the United Kingdom each year of the budget.
- II. **A New Reporting Framework:** Annual reporting will become a systematic requirement of the Government, in order to highlight greenhouse emission. The Committee on Climate Change has a specific role in annual progress reports, with the requirement of the Government to respond to this report in front of Parliament.
- III. **Creation of an Independent Advisory Body:** This allows for the formation of the Committee on Climate Change, whom will advise the Government and produce plans on how to reduce emission over time and other matters that affect or relate to climate change, when requested. The Committee on Climate

Change will advise the best way to achieve targets by the end of the budgetary periods and 2050 (Legislative Services ^b, 2016).

- IV. Trading Scheme Powers:** This allows for the introduction of new domestic trading scheme, in order to reduce emissions, through secondary legislation. This aims to increase options, provided through policy, with which the Government can then use to aim to achieve mid and long term goals present within the Act.
- V. Adaptation:** The risks and impacts of climate change for the United Kingdom requires a procedure, which is set out in the Act. This section further requires the Government to have an adaptation programme when considering matters to which the Government is accountable, these programmes must be sustainable, or lend a hand in sustainable development. The Act also requires the Committee on Climate Change to receive reports, action plans, risk analysis and progress reporting and advisory functions, from other bodies (Legislative Services ^b, 2016).
- VI. Policy Measures to Reduce Emissions:** The Act aims to support reductions in emissions through specific policy measures. These include:
- Improvement of the operation of renewable transport fuels obligations
 - Introduce single use carrier bag charges
 - Incentives for local authorities to increase recycling and reduce land fill waste
 - Changes to the Certified Emissions Reduction Scheme
 - The reporting of emissions by companies
 - Annual reports to be produced regarding contribution and efficiency of building to sustainability (Legislative Services ^b, 2016).

2.3.1.9. Marine and Coastal Access Act, 2009

This Act aims to provide a legal mechanism in order to help ensure biologically diverse oceans that are safe, clean productive and healthy (Joint Nature Conservation Committee, 2013; Royal Society for the Protection of Bird, 2010). The Act consists of eight vital elements:

- I. **Marine Management Organisation:** Operates on behalf of the Government as a marine planning authority. The Marine Management Organisation enforces marine legislation and carries out marine licencing in English territorial waters and United Kingdom offshore waters (Joint Nature Conservation Committee, 2013). The Marine Management Organisation is the centre of marine expertise and aims to provide holistic approach to the distribution of data and information, by replacing existing independent organisations.
- II. **Strategic Marine Planning System:** Reach agreed and clarified marine priorities and objectives for future users, and to ensure that current and future users and decision makers are utilising the sea in the most efficient and sustainable way possible, protecting marine resources. The Government and administrations will work together to produce a joint Marine Policy Statement, which will outline short term and long terms objectives for sustainable use of the marine environment. Marine planning will produce a series of plan for specific areas, which will highlight spatial uses, needs and conflicts seen in these areas.
- III. **Streamlining Marine Licensing System:** Become more consistent and transparent across all sectors that operate within the marine environment. The system will be simplified, providing a level playing field for all users and a single licence for all authorised activities
- IV. **Marine Nature Conservation:** The Acts allows for the creation of Marine Conservation Zones (The Royal Society for the Protection of Birds, 2010; Joint Nature Conservation Committee, 2013). This will allow for conservation in certain areas, in order to reduce or stop the degradation of habitats and biodiversity. It is hoped that Marine Conservation Zones will encourage recovery, support healthy ecosystem function and provide legal framework with which to apply international marine conservation pledges; for example, the Marine Strategy Framework Directive and the Convention on Biological Diversity.
- V. **Fisheries Management and Marine Enforcement:** Covers the modernisation of inshore fisheries management via the formation of the Inshore Fisheries and Conservation Authorities that will serve as a replacement for existing Sea

Fishery Committees. The aim is to conserve the marine ecosystem whilst ensuring a sustainable and profitable fishery. The Marine Management Organisation will be responsible for the regulation of a majority of the activities as well as enforcing legislation and conservation measures.

- VI. **Migratory and Freshwater Fisheries:** The Environment Agency will act as the competent body in this part of the Act. They will introduce new licensing and authorisation systems for fishing activities and have the power to make byelaws that respond to unforeseen threats that could damage fish stocks. In addition to this, there is the potential for an introduction of new authorisation schemes that will allow the movement of live fish, in regards to better protection of local and national biodiversity (Joint Nature Conservation Committee, 2013).
- VII. **Coastal Access:** The aim is to connect the entire coastline of England and Wales, through the use of an effectively managed and well signed route. This would also include areas such as beaches, dunes, and cliffs, where applicable to do so.
- VIII. **Coastal and Estuarine Management:** Creation of a holistic policy and set of byelaws is required to reduce the conflicts between users witnessed in the environment. In addition to this, the promotion of sustainable use via an Integrated Coastal Zone Management scheme is vital.

2.3.1.10. Flood and Water Management Act, 2010

This Act provides comprehensive management of flood risk for homes, people and businesses. It also helps to safe guard against unaffordable rises, for community groups, in water drainage charges, as well as protecting water companies from consumers (DEFRA, 2013). This Act aims to account for extreme weather, which is predicted to occur more frequently due to climate change, and the flood risk associated with it. The Act calls for the co-operation of all flood risk management authorities, with each other, whilst providing power to the Environment Agency and local flood authorities to request the required information regarding their flood risk management functions. In addition to this, the Act provides a framework, which is overreaching and simple, that allows different bodies ad organisation to collaborate with each other, developing a mutual understanding of suitable management for surface water flooding problems. The Act also requires local flood authorities to create

and maintain register of structures that are likely to flood. Furthermore, the Act necessitates flood and coastal erosion risk management authorities to try and contribute to sustainable development when applying their functions to flood and coastal erosion risk management. Finally, the Act amends the 1975 Reservoirs Act and presents new measures for safety around reservoirs. These new measure are based on risk rather than size (DEFRA, 2013).

2.3.1.11. Marine Navigation Act, 2013

The Act amends previous legislation relating to harbour and port authorities, pilotage, manning of ships and lighthouse authorities. It also extends the port police's powers (Parliament, 2013). The Act aims to commence plans to diminish the burdens placed on the shipping industry and ports and harbours. It also aims to ensure that the vessels operating in waters around the United Kingdom and in harbours have better safety. Furthermore, the Act aims to include provisions governing the management of harbours, pilotage, and the duties and powers applicable to the General Lighthouse Authority, port constables, and harbour and port authorities (Parliament, 2013)

2.3.1.12. Water Act, 2014

This Act introduces changes to legislation, whilst also amending the Water Industry Act (1991) (Legislative Service, 2014). The Act is broken down into six parts including:

- I. **Water Industry:** This part of the Act looks at the required licensing of water suppliers and sewage licenses, whilst also looking at the duties of those whom undertake sewage work. In addition to this, the part of the Act mentioned above also looks at how the water industry is regulated and companies' duties to supply water and sewage services. Finally, this part of the Act looks at providing the Secretary of State with the power to put in place regulations, which would allow undertakers to halt the provision of any retail service to future and current non-household customers (Legislative Services, 2014)
- II. **Water Resources:** This part looks at water resources and has provisions for withdrawal of compensation for undertakers, progress on water abstraction reform, Environment Agency maps highlighting water works, and river map in England.
- III. **Environmental Regulation:** This part focuses on environmental permitting and consolidation of the requirements relating to impoundment and water

abstraction licenses, fish passage approval and consent regarding flood defences. This part of the Act set out a single set of regulations that cover the aforementioned activities as well as encompassing the existing pollution prevention and control permits; enabling operators to require a single permit as opposed to multiple.

IV. **Flood Insurance:** This part of the Act details the framework arrangements which aim to deal with availability and affordability of insurance for homes, in areas where there is a higher risk of flooding (Legislation Services, 2014). The framework comprises of:

- The ability to create a levy-funded reinsurance pool for households (Flood Re).
- Reserve powers in order to regulate the insurance industry, requiring insurance companies to share higher flood risk properties (Flood Insurance Obligation).

The Flood Insurance Obligation powers are required in case the Flood Re is unworkable or does not deliver the policies aims laid out by the Government, if open market pricing on the open market proves to be unacceptable.

The final two parts relate to miscellaneous parts of the Act, as well as general and final amendments and provisions (Legislative Services, 2014).

2.3.1.13. Energy Act, 2016

The Energy Act (2016) covers the Gas and Oil Authority and their functions. In addition to this, it also makes provisions about the use of upstream petroleum infrastructure and the abandonment of offshore installation, upstream petroleum infrastructure and submarine pipelines. Furthermore, it extends the first part of the Petroleum Act (1998), to include Northern Ireland, and makes requirements about disclosure of information for the purpose of international agreements (Legislative Services^c, 2016). Finally, the Act covers information about fees in regards to activities relating to pipelines, gas, carbon dioxide and oil, as well as making provisions relating to wind power and connected purposes (Legislative Services^c, 2016).

2.3.2. Governing Bodies and Organisations

There are many organisations that operate within the estuarine and marine environment. Some are non-government organisation and rely on public funding and grants. Others are organisation, which are governmental and receive funding from the government. They also work and provide reports to other government agencies and organisations. These organisations include:

- Department of Environment, Food and Rural Affairs
- The Environment Agency
- The British Ornithology Trust
- Associated British Ports
- The Royal Society for the Protection of Birds
- Angler's Trust
- Local Wildlife Trusts
- Heritage Trust
- Marine Managent Organisation
- Rivers Trust
- Centre for Environment, Fisheries and Aquaculture Science
- The Institute of Environmental Sciences
- Marine Conservation Society
- Chartered Institution of Water and Environmental Management
- United Utilities
- Institute of Estuarine and Coastal Studies
- Joint Nature Conservation Committee
- British Waterways

2.4. Sustainability of Laws and Regulation

In order to maintain laws and regulation, two models may be used on conjunction with each other to assess the sustainability of a set of laws and regulations, these two models are DAPSI(W)R(M) model, which is based on the pressure-state-response model proposed by the Organisation for Economic Co-Operation and Development, and the Ten Tenets (Agu, 2006; Elliott, 2013). The DAPSI(W)R(M) model predicts the effects of an action on the environment, both ecologically and economically, allowing for it to further predict courses of action to mitigation and compensation for any damage the activity may have (Caerio et al., 2004). The Ten Tenets cover any problems

that may arise as a result of the implementation of specific laws and regulation (Elliott, 2013).

2.4.1. The Ten Tenets

The Ten Tenets are used to assess the sustainability, socially, economically and environmentally, of an activity within the environment (Elliott, 2013). This is achieved by identifying all regulation and legislation, which surrounds human activity in the ecosystem, with socio-economic needs, more often than not, dominating aspects of the approach. There are ten criteria, which needed to be fulfilled if the activity is to be classed as sustainable.

1. **Environmentally and ecologically sustainable:** Maintain the natural system through protective measure. For example, protecting ecosystem services, structure and functioning, and ecological carrying capacity, which has intrinsic benefit to the ecosystem's health (Elliott, 2013). All elements of the ecosystem should be included; for instance, when considering the marine environment, the chemistry of the system needs to be accounted for, as well as the topography and hydrology. This will in turn give rise to ecological sustainability (Gray and Elliott, 2009). Furthermore, environmental compensation and/or mitigation may need to be considered, if an activity is harmful or damaging to the ecosystem (Elliott et al., 2007).
2. **Economically viable:** Success in this day and age often depends largely on investment and funding. There has to be sufficient funding to prevent and/or remove damage and stress caused by humans' activities (Elliott, 2013). It includes the monitoring of potential and actual environmental effects, and economic gains made from the system (Boja and Elliott, 2013).
3. **Technologically feasible:** Technology must be able to mediate or prevent any damage as a direct or indirect consequence of the activity (Elliott, 2013). This includes technology's ability to compensate and mitigate against any changes, within the environment, as a result of activities (Elliott et al., 2007)
4. **Socially accepted or tolerable:** The benefits of on activity need to be presented to society, as well as the impacts. (Elliott, 2013). The need for public health and quality, as well as societal benefits, is covered (Mee et al., 2008). For example, a scheme that has national support may not be supported locally, leading to not in my backyard syndrome may arise without society backing at a local level (Dear, 1992).

5. **Legally permissible:** This accounts for the activity complying to local, national and international laws and regulations (Elliott, 2013). It includes guiding measures and is comprised of legislation and regulations such as: the conservation of biological diversity and ecological integrity, the precautionary principle, and the economical valuation of environmental factors and the polluter pays principle (EDOWA, 2011). Industry is legally committed to the protection of the environment, through the introduction of legislation and regulation, and compliance to such regulation and legislation (Elliott, 2013).
6. **Administratively achievable:** This refers to all the regulatory bodies, ministries, and user groups, required for the successful integration and implantation of legislation and regulation, regarding an activity. This is done through the various bodies communicating with each other and interlinking their ideas on effective management (Elliott, 2013).
7. **Politically expedient:** it is important that environmental controls are not increased, in order to benefit business interests and the economy (Elliott, 2013). Political parties may try to avoid passing certain legislation and regulation, in order to appear more favourable. This makes this tenet highly important, as it may lead to unsustainable activities.
8. **Morally correct (ethically defensible):** Both human and environmental issues much be considered in a holistic manner. Without one legislation and regulation would not lead to a sustainable outcome (Elliott, 2013). This could lead to people considering the law unfavourable and choose to ignore the legislation or regulation, to do what they believe to be morally correct. Reversely, if the environment is ignored then the ecosystem could potentially collapse.
9. **Culturally inclusive:** Culturally traditions will need to be precedence; for example, in Australia there is specific legislations, Aboriginal and Torres Strait Islanders Heritage Act (1984), that protects traditions but may affect management of the marine and estuarine environment (Elliott, 2013; Government of Queensland, 2015)
10. **Effectively communicable:** Must be seen to be doing what is best for all user groups and the environment. This will also allow for better decision making when considering management options (Elliott, 2013).

2.4.2. DAPSI(W)R(M)

The DAPSI(W)R(M) model is a conceptual tool used to create models highlighting the links between the environment and the economic needs and gains from a system (Elliot, 2014). It gives rise to the possibility of integrating conservation measures in regards to the economic environment. It does this by combining the needs of the estuary, and any consequences of action resulting from those need, that humans require. One example of this is fish as a source of food. This results in the societal benefits and ecosystem services needing to be accounted for (Atkins et al., 2011). Furthermore, the model supports and encourages the decision making process that occurs, in regards to management rehabilitation and cause and effect of state changes and other issues, witnessed in the estuarine environment (Agu, 2006).

The model is an extension of the Organisation for Economic Co-Operation and Development's pressure-state-response model, which highlights the interactions between the environment and socio-economic activities (Agu, 2006). The model can be broken down into six stages: drivers, activities, pressures, state changes, impacts (on human welfare), and responses. Drivers relate to the needs of the users of the system, while activities are the human influences that affect the system. The stressors evident in the system are covered under the pressures stage an, while state changes refer to any differences in functioning of the system as a result of human activity. Impacts (on human welfare), relates to the how humans adapt their use of the system. Finally, response, and mitigation, relates to the way in which policy and legislation is used, or changed, in an effort to reduce the impacts of humans on the system or lessen the state changes that may occur (Elliott, 2011; Scharin et al., 2016.). The stages mentioned above give rise to a systematic analysis of the activities that occur within the system.

The magnitude of pressures observed, depends greatly on the human interactions with the system and the scale of the driver. New pressures, drivers, state changes, and activates may occur as a result of a response to an activity in the model. Responding to a driver or activity may, theoretically, improve the situation as well (Caerio et al., 2004).

2.4.3. Securing Compliance

Securing compliance is vital in relation to maintaining environmental laws and regulation and has come to the forefront of research within environmental law and its legislative processes (Tallberg, 2002). It is important that regulators ensure that those

operating in areas follow the legal requirements of legislative and regulatory requirements. In addition to this, it is key that the operators ensure that the activities that they undertake are kept within the boundaries and that they accept responsibility of and action and consequence due to their activities (IEMA, 2005). There are two approaches which can be used when trying to obtain compliance. These are the Enforcement Approach and the Management Approach (Chayes and Chayes, 1995; Downs et al., 1996). The expectations anticipated from the two different approaches vary greatly. This is due to the ideas on the effectiveness of way to secure compliance and the ramifications of non-compliance (Tallberg, 2002).

The application of game theory and collective action theory form the basis on which the Enforcement Approach is based (Dorn and Fulton, 1997). This approach addressing non-compliance by providing an incentive structure. This means that the cost of detection of non-compliance will exceed the benefits. It is thought that the issue of non-compliance can be reduced through a combination of threat of sanctions and penalties, increased detection, and through monitoring (Tallberg, 2002). For various reasons, it is possible that some may not comply to laws and regulations, wilfully; for instance, priorities of users may differ to those of the law or regulation, or users may not agree with some aspects of the law or regulation, but may consider the act of agreement as important. This means, that for co-operation to occur and be beneficial to users, enforcement of the law or regulation must occur to prevent non-compliance (Tallberg, 2002). There are two core components to implementing the Enforcement Approach; monitoring and sanctions (Downs et al., 1996; Underdal, 1998). Sanctions aim to deter non-compliance, whilst monitoring aims to increase transparency and uncover potential renegades (Tallberg, 2002). This is achieved by raising the cost of avoidance. These core elements combined; aim to reduce non-compliance, hence gaining compliance.

When considering the Management Approach, non-compliance arises as a result of capacity limitations and ambiguity within laws and regulation, rather than making a premeditated decision to violate laws and regulations (Tallberg, 2002). When considering how best to overcome non-compliance, the Management Approach suggests that it is best to resolve the issue through a capacity to build, a problem solving strategy of rule interpretation, and transparency, rather than coercive

enforcement (Tallberg, 2002). Sources of non-compliance appear, mainly to be due to limitations within the economy and politics; for example, when governments do not have the ability to ensure public and private sector companies to comply with commitments (Young, 1992; Jacobson and Brown Weiss, 1998). Further political limitations may occur as a result of limited administrative capacity and non-compliance at a sub-national level. Economic issues arise when the state does not have the financial ability to fulfil the international requirements of laws and regulations (Tallberg, 2002). To combat this, the Management Approach suggests an authoritative rule in which dispute settlement is established through clarification, adjudication and interpretation (Tallberg, 2002).

2.5. Summary

In summary there are many potential areas for impediments as a result of legislation and regulation, and agencies, government organisations, users, stakeholders and non-government organisations. For example, each group or organisation, works with their own interests and these interests can influence collaboration between the groups and organisations. This can lead to a conflict of interests and a breakdown in communication, leading to potential impediments for the estuarine environment. Furthermore, the amount of legislation currently in place to manage the estuarine environment could potentially lead to disruption in the management and rehabilitation of estuarine management and rehabilitation, due to potential contradicting stipulations and requirements within the legislation and regulation.

3. Case Study: The Humber Estuary

3.1. Introduction

The Humber Estuary is the second largest coastal plain estuary in the United Kingdom. It is the largest on the east coast and drains over 20% of England's land surface within its catchment- around 24,472 km² (Humber Management Scheme, 2004; Humber Nature Partnership, 2016). Tributaries the Humber includes the rivers Aire, Don, Derwent, Ouse, Wharf, and Trent. It has a large tidal range due to the position of the mouth of the estuary, that flows in to the North Sea (Humber Nature Partnership, 2016). The mean spring tide ranges averages at 5.7 m at Spurn, increasing the further up the estuary (6.9 m at Hessle). Due to these ranges, the Humber can be classified as a macro tidal estuary.

The estuary is 14 km long at its widest point, with an average depth of 6.5 m, and a high turbidity. This high turbidity (high levels of suspended sediment) gives rise the muddy appearance of the estuary; the Estuary is considered healthy despite this brown and murky appearance (Humber Management Scheme, 2004). The sediment deposit is as a result of the erosion from the boulder cliffs and river sediments (Humber Nature Partnership, 2016). It is estimated that every tide carries 1,500 tonnes of sediment with it, with around 1.26 million tonnes present in the estuary (Humber Nature Partnership, 2016). This sediment is highly important in terms of estuary function as well as ecosystem function (nursery habitat for worms and nutrient movement and cycling). The sediment helps to maintain habitats such as mud flats, salt marshes, and sand flats. In addition to this, further key habitats include samphire banks and sub tidal sand beds (Humber Management Scheme, 2004). The Humber estuary is recognised as one of the most valuable estuaries in Europe for wintering birds, and supports nine species of international importance (Humber Nature Partnership, 2016). Due to this, the Humber has been given numerous nature conservation designations under International, European and United Kingdom law.

The Humber estuary plays a significant part in industry and trade, within the local area and nationally- an average of 40,000 ship movements per year, with its wharfs and ports dealing with around 20% of the UK international import trade and 10% of its

export trade (Department for transport, 2014; Humber Nature Partnership, 2016). In addition to this, the Humber estuary supports the largest port complex in the United Kingdom. There are many industries along the Humber- oil refineries, chemical works and power stations to name just a few.

The occurrence of this trade and other industries, has an impact on the Humber Estuary. There are many users, uses, NGO's and environmental agencies that need to be involved in the management of the estuary. However, there are many administrators, due to the many stakeholders and users, and this can lead to problems when trying to manage the estuary. Finally, the presence of conservation designations, wildlife and tourism makes the Humber Estuary and its surrounding highly important to the local economies (Lonsdale et al., 2015). The need for a holistic approach to governance and management, it would seem, is vital to the protection of the habitats present and the economic benefits the Estuary provides, via its many users and uses.

3.1.1. Basic Ecology

The Humber Estuary is a highly important area for wildfowl and ranks within the top five areas in the country. It is also, internationally recognised for the wintering waterfowl populations due to the sheer numbers in which they occur along the estuary (DEFRA ^a, 2011). The upper shore of the Humber Estuary has areas of common reed and saltmarshes (North Lincolnshire Council, 2014). In addition to the saltmarshes and reed beds, there are many freshwater lakes along the estuary that provide habitat to many invertebrates, fish and birds. The habitat aims to mitigate against the drainage of the wetlands around the Humber Estuary (North Lincolnshire Council, 2014). The mud flats found within the Humber Estuary's catchment area provide habitat form numerous invertebrates (Middleton, 2008)

3.1.2. Ecosystem services and human impacts

The Humber Estuary has many ecosystem services that benefit humans. For example, the port complex found in the Estuary supports large amounts of trade that support the local and national economy via imports and exports (Environment Agency, 2000). In addition to this, the port complex provides numerous jobs to local people, further supporting the local economy. This being said, the port complex has the ability to cause numerous impacts on the Estuary. For example, dredging in order to widen and

deepen the Estuary, has the potential to resuspend pollutants (heavy metals, for instance) that have been trapped within the muddy deposits due to sedimentation (French, 2002; McLusky and Elliott, 2004). The effect of heavy metals on the ecosystem can be great, as mentioned in Chapter 1, Part 1.1.3.4. In addition, this, there is the chance of increased turbidity due to the possibility of dredging and increased boat traffic. This is due to the benthos being disturbed increasing the particle load seen within the water column (French, 2002). Boat traffic, also has the ability to increase mortality of fish species, due to fish being hit by outboard motors and stress caused by noise disturbance (Nedwell et al., 2003; Madsen et al., 2006; Parsons Brinckerhoff, 2008; Wade et al., 2010; FishBase, 2014). Furthermore, the port complex has the ability to introduce oil pollution into the Estuary. This is due to the oil that is released from the motors. Furthermore, the ballast waters of the boats and tankers that enter the Estuary, have the ability to transport organisms that are not native to the Estuary. This means that there is the potential for ecosystem damage to occur as some of the organisms could impact trophic levels within the Estuary (Cloern et al., 2016).

The Estuary is also home to fishing, both recreational and commercial. This strengthens the local economy through the purchase of rod licences and fish sales. However, overfishing has the potential to occur (Jackson et al., 2011; Cloern et al., 2016). The larger species are often targeted, removing predators and allowing for trophic cascades to occur (when predators are added or, in this case, removed from the food web causing drastic changes to predator-prey relationships further down the web). These cascades can lead to changes in nutrient cycling and ecosystem services, through a reduction in biological complexity. The lack of biological complexity can lead to the Estuary being more sensitive to change and disturbances; for instance, nutrient enrichment (Jackson et al., 2001). Finally, commercial trawling removes benthos dwelling organisms leading to a reduction in benthic diversity and causing changes in the systems topography (Thrush et al., 1998)

Other human impacts include the problems associated with water quality, power generation and its outputs, land use, tourism and littering (Humber Management Scheme, 2004). Many of the impacts witnessed are similar to those describe in 1.1.3.2, 1.1.3.4., 1.1.3.5., and 1.1.3.6..

3.1.3. Protective laws, legislation and management

Due to the Importance of the ecology within and surrounding the Humber Estuary, it has gained many designations, whilst also being protected by European and United Kingdom laws and regulations. The Humber Estuary has been designated: -

- Special Area of Conservation (SAC)
- Special Protection Area (SPA)
- Site of Special Scientific Interest (SSSI)
- Ramsar Site

The Humber Estuary is also protected and managed through: -

- Natura 2000
- Habitats Directive
- Flood Risk Management Directive

In addition to this, activities have been assessed, through the Humber Management Scheme (2004), by the relevant authorities (Table 1). The aim of these assessments was to produce management plans and any other further work required to protect the action listed in Table 1.

Table 1: Table taken from the Humber Management Scheme (2004)

Category	Lead Author	Additional Authors
Fisheries	North Eastern Sea Fisheries Committee .	English Nature, Humber Advisory Group, Institute of Estuarine and Coastal Studies.
Flood Defence and Land Drainage	Environment Agency.	Internal Drainage Board.
Industry, Water and Waste Management	Environment Agency.	
Land Use	English Nature.	Institute of Estuarine and Coastal Studies (high tide roost), Humber Advisory Group (saltmarsh management), Royal Society for the Protection of Birds (high tide roosts and saltmarsh

		management).
Recreation and Tourism	Local Authority	Humber Advisory Group
Science and Education	English Nature	Humber Advisory Group
Shipping and Navigation	Associated British Ports	British Waterways
Ministry of Defence	Ministry of Defence	

3.2.1. Methodology

Numerous methodologies will be used to analyse the qualitative data gathered through the use of questionnaires. Questionnaires provide a wealth of data that, when analysed correctly, can lead to highly informed conclusions. The use of questionnaires and the data they provide, depends greatly on the type of question asked (Oberski, 2014). Questions can be classed as “good” and “bad” questions. Bad questions are questions which do not address the topic and are hence irrelevant. In addition to this, bad questions may address the topic but in a convoluted way, which can result in the answer being less valuable. Reliability is a key aspect of questionnaires as unreliable answers have the potential to skew data sets and lead to a bias (Carroll et al., 2006). This means that question design needs to be good and accurate, and that samples need to be large and representative of the information you wish to find out. The questionnaires were sent out via email, with a link to an online version of the questionnaire included. Respondents were chosen based on use within the estuary, taking into account industries, social groups and environmental groups. This variety of respondents was important in order to reduce bias. The questionnaire was then completed electronically, online through the use of Survey Monkey. The aim was to involve as many industries, government organisations and non-government organisations as possible, with the hope of gaining five to ten responses from a range of users. The aim of this would be to provide a round response to the uses and impediments of the Humber Estuary. The quantitative data are presented as graphs in

order to help analyse the responses. Once this has been completed, some of the qualitative data will be translated into a DAPSI(W)R(M) model highlighting the wants of biologically based groups, economically based groups, and socially based groups. These DAWSI(W)R(M) models will then be combined to highlight processes that overlap within the three over-branching groups. In addition to this, there will be a S.W.O.T. analysis used on order to identify the internal and external analysis of strength and weaknesses (internal) and opportunities and threats (external). This S.W.O.T. analysis will be used to look at the potentially for partnerships within the Estuary and aim to provide a potential pathway to better ensure management and rehabilitation of the Estuary. Finally the Ten Tenets will be used to assess whether the current use levels on the Humber is potentially sustainable and where weaknesses may occur based on the answers received within the questionnaire.

3.2.3. Results and Analysis

The results and analysis for the research carried out can be found below. The data was transcribed and then analysed using various techniques.

3.2.3.1. Questionnaire responses and graphs

The results from the questionnaire highlights the opinions of the respondents in relation to how European legislation and regulation affects an organisation's ideals for

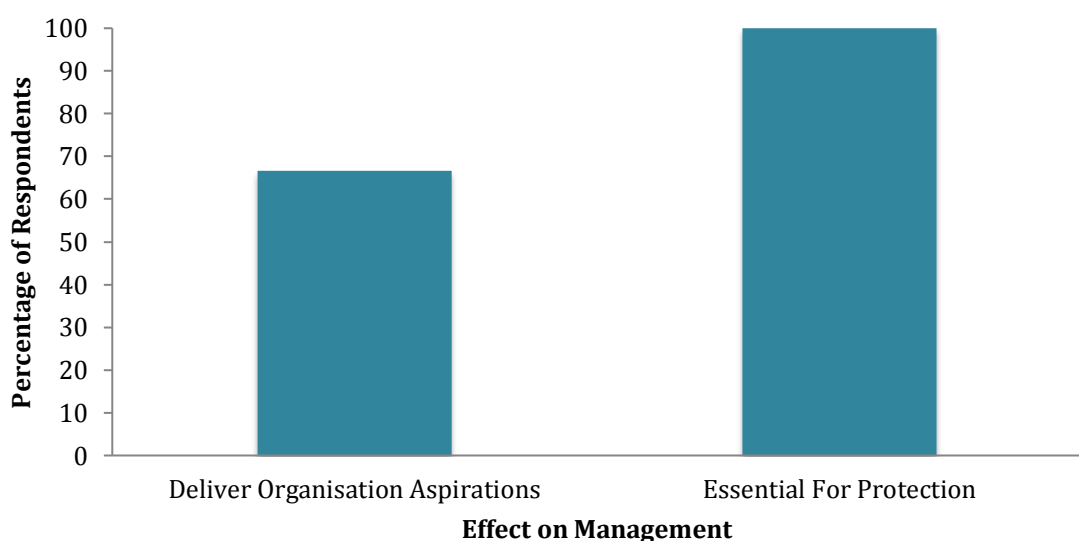


Figure 6: Responses to how European legislation and directives affect the management of the Humber Estuary.

the Humber Estuary. 66% of the respondents agree that the presence of European legislation and regulation allows for the aspirations of their organisation to be realised. All respondents claim that the European regulation and legislation play a pivotal role in the protection of the Humber Estuary. This is due to the clear aims and objectives set out in European legislation and regulation.

Figure 7 shows that the Marine Strategy Framework Directive and the Water Framework Directive are believed to be inadequately enforced by 50% of the respondents. Respondents further commented on the Birds, Habitats, Water Framework and Marine Framework Directive have significant issues when trying to translate them into British law. 100% of the respondents feel that, for example, Natura 2000 is one of many mechanisms used to protect designated habitats, that fall under the Habitats Directive. However, the Habitats Regulation 1994 fails to emphasise such designated habitats.

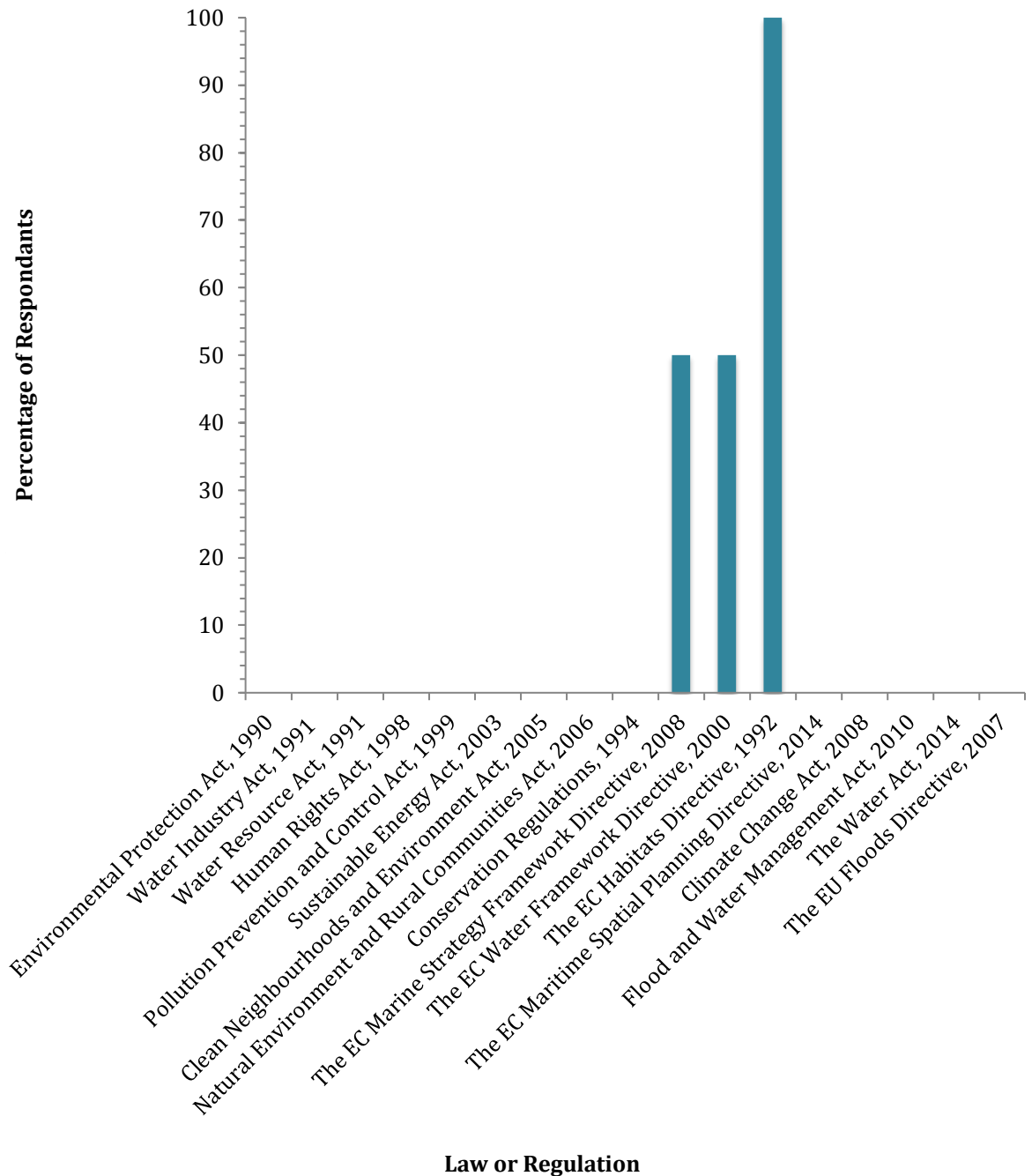
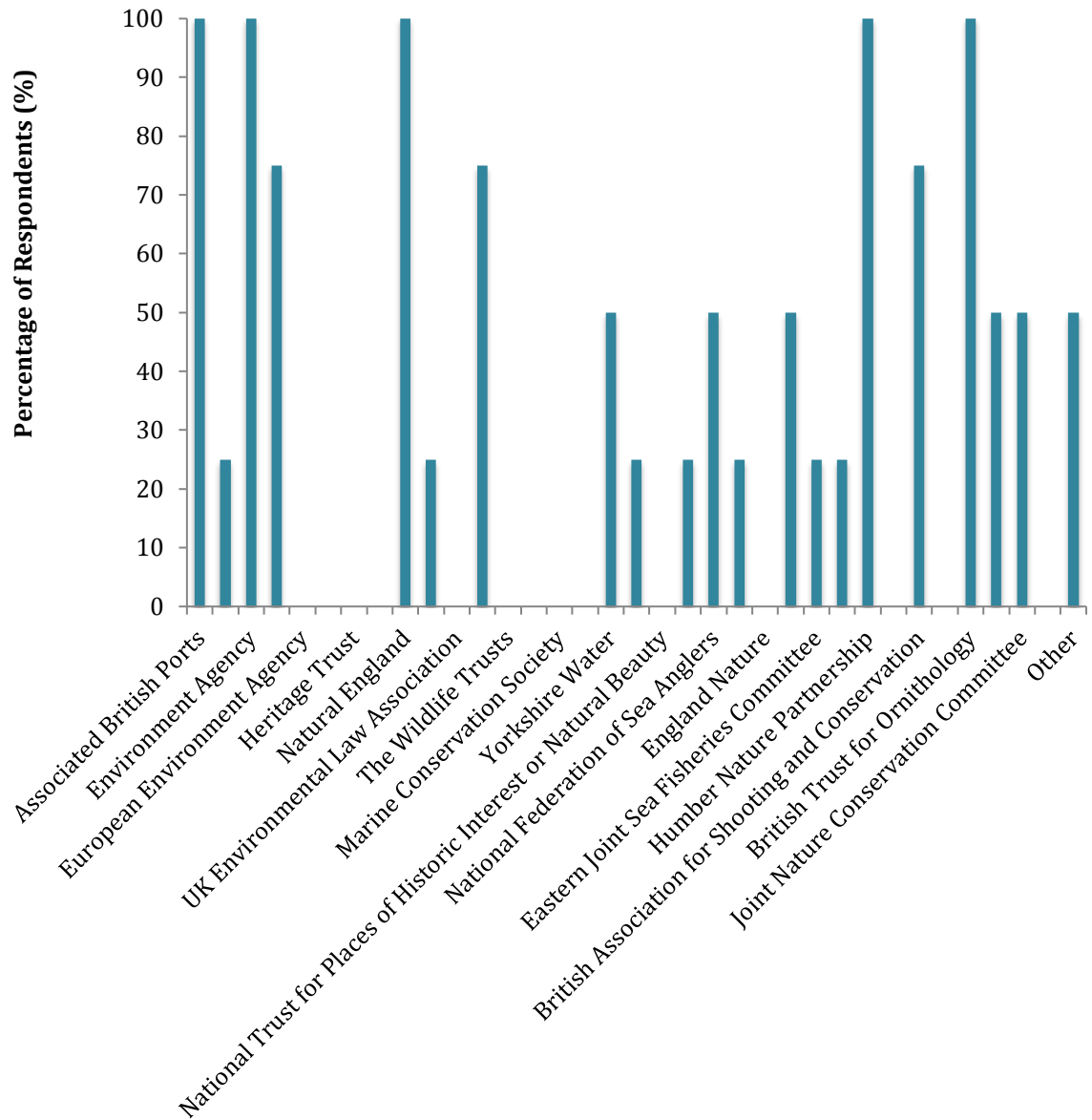


Figure 7: Shows the laws and regulations that agencies, organisations, non-government organisations and industries believe need to be improved in order to better manage and rehabilitate the estuarine environment

currently working with the Associated Ports Authority, Environment Agency, Natural England, the Humber Nature Partnership and the British Trust for Ornithology. The need to work the aforementioned associations, agencies, organisations and non-government organisations is important. For example, working with Associated British Ports is highly important as the Humber Estuary is home to one of the largest port system in the United Kingdom. As mentioned in the introduction to the Estuary, it accounts for a large portion of imports (20%) and exports (10%). This means that any

management scheme should not reduce the movement of ships within the estuary, as this could have wider economic impacts on the local and national economy. As for working with the British Trust for Ornithology, this would be seen as vital due to the Ramsar site classification and other designations previously mentioned. Working with the British Trust for Ornithology, would aim to ensure that the bird populations would continue to thrive. In addition to this, the trust would be able to advise on how activities may affect bird populations and their habitats. As for the Humber Nature Partnership, they work with many users of the Humber Estuary and are likely to be able to provide expertise that would look at impacts from a more holistic point of view. It would be beneficial to work with these three organisations as they provide an extensive overview of the scientific, economic and social importance of the Humber Estuary.



Associations, Agencies, Organisations and Non-Government Organisations

Figure 8: Shows the agencies, organisations, non-government organisations and industries that other wish to work with, or are currently working with.

When asked about the impediments that organisations, users, industries, agencies and non-government organisations encounter, when trying to manage and rehabilitated the estuarine environment (Figure 9). All of respondents agreed that a lack of agreed on management played a role in management and rehabilitation being unsuccessful or hindered (Figure 9). This could be due to the discrepancies seen in the desired

outcomes from the different organisation, users, agencies, industries and non-government organisation. For example, an environmental agency may wish for the port to reduce import and export as the constant movement of ships may disturb wildlife and lead to pollution of the environment. However, the ports may wish to increase import and export rates in order to gain more profit. In this case a compromise would have to be achieved in order to allow for both activities to occur. If an agreed management plan is achieved, it is likely that this will help the organisations involved understand their specific role. In addition to this, half of respondents claimed that budgetary restraints and an increase in workload could also lead to effective management and rehabilitation going not being achieved. Budgetary restraints could have a significantly large impact in management and rehabilitation not being achieved as management and rehabilitation requires funding. Without the required funding, the appropriate approach to management and rehabilitation may not be realised and has the potential to miss key aspects in such activities. The potential of missing key aspects may arise as a result of trying to save money in order for reallocation of funds to other management and rehabilitation aspects. As for increased workload, due to a potential lack of communication or lack of agreed management, industries, organisation, non-government organisations and agencies may prefer to look out for their own interests. Most will operate independently to each other and will only work in collaboration with others if specialist knowledge is required. In addition to this, working in partnership with other industries, organisation, non-government organisations and agencies could lead to task times increasing, leading to greater budgetary expenditure, as opposed to working on a project by themselves; linking to the budgetary constraints.

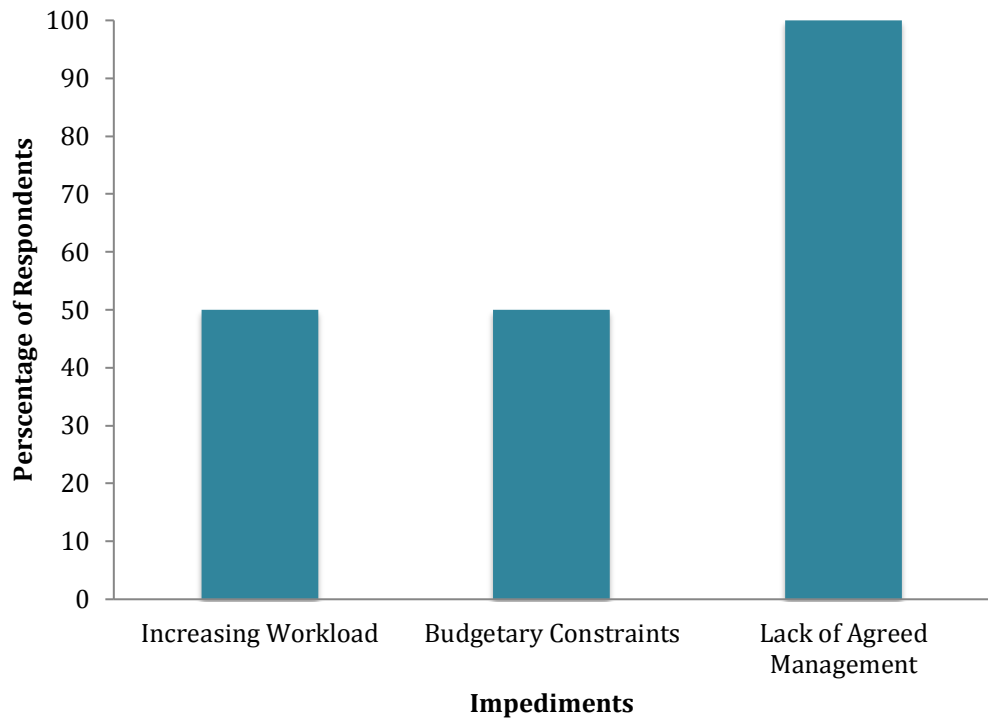


Figure 9: Shows the impediments that agencies, organisations, non-government organisations and industries currently need to contend with in order to management and rehabilitate the estuarine environment.

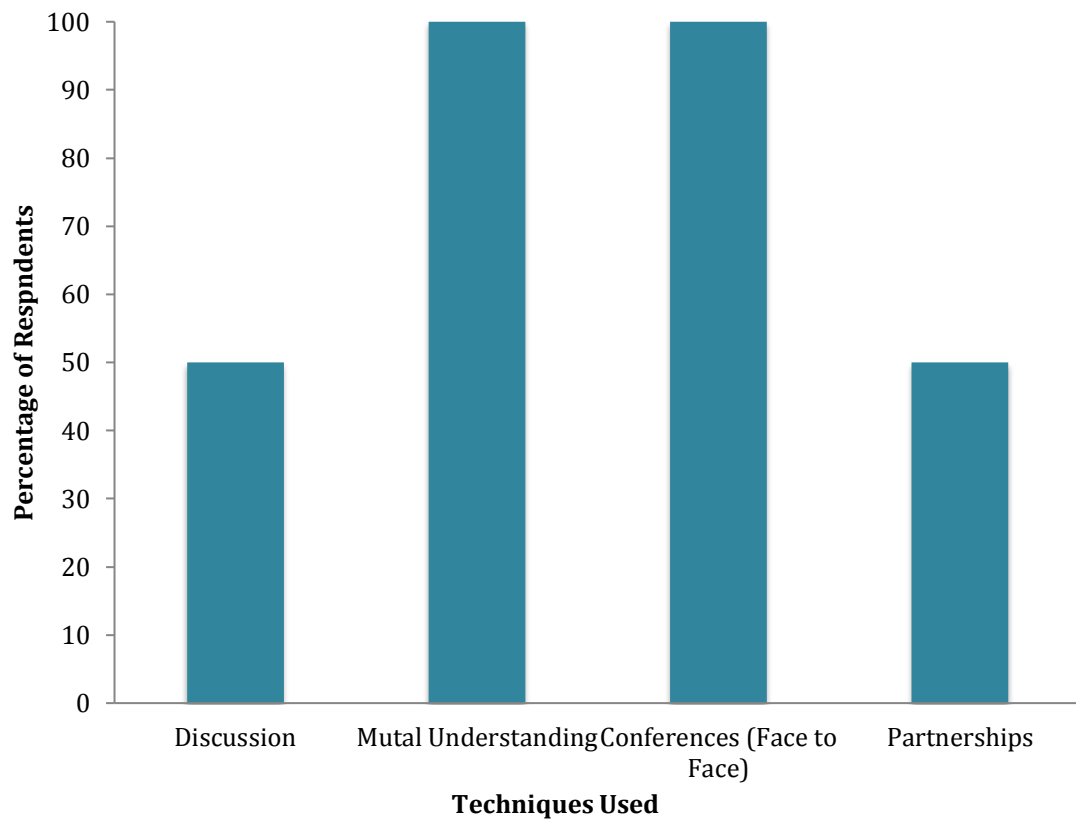


Figure 10: Shows the techniques used by agencies, organisations, non-government organisations and industries in order to overcome multi-user conflicts witnessed within the Humber Estuary.

Finally, when asked about how conflicts of opinion were solved, all of participants found that mutual understanding and conferences are the best way to overcome the problems seen (Figure 9). Gaining a mutual understanding of the aims of others who operate within the Humber Estuary would allow for better management planning and better plans for rehabilitation. In addition to this, half of respondents found that partnerships and discussions with other users were helpful in overcoming multi-user conflicts (Figure 10).

3.2.3.2. Ten Tenets

The Ten Tenets are a list of attributes used to assess the sustainability of actions within the environment (Barnard and Elliott, 2015). The more Tenets that are achieved the more likely it is that an activity will be sustainable. It appears that many of the Tenets are fulfilled currently, with very few impediments affecting the management and rehabilitation of the Humber Estuary (Table 2). As seen in Figure 8, the lack of agreed upon management appears to be due to the large amount of industries, organisation, non-government organisations and agencies operating within the Estuary. This leads to the Tenet covering administrative achievability being unfulfilled. In addition to this, due to the number of groups, it is also very difficult for agreed upon management to be carried out. This is due to the number of individual, independently operating industries, organisation, non-government organisations and agencies. In order to overcome this, as seen in Figure 9, one way to combat might be to create partnerships, such as the Humber Nature Partnership and Humber Local Enterprise Partnership. This will allow for mutual understanding of the aims for the Estuary, from the point of view of the partnership and allow for dialogue between many groups. The partnerships, however, may lead to industries, organisation, non-government organisations or agencies having to compromise on their plans for rehabilitation.

Furthermore, the actions that occur within the Estuary may not be sustainable currently due to a lack of technology to remove or minimise the changes that occur. For example, there is no way to remove noise from the environment. This is an impediment to rehabilitation as noise can affect the swim bladders of certain fish. This could reduce the populations of these species resulting in any protection or rehabilitation being void. In order to accommodate for this effect, mitigation would need to occur to reduce the amount of noise pollution in the Estuary. This could be

done by reducing the amount of boat traffic found within the Estuary, also reducing the amount of oil output from outboard motors and the likelihood of fish being struck by such motors.

Finally, the remainder of the Tenets appear to be met. This is due to public and private acknowledgement of the importance of the Estuary. There are areas which need consolidation, for example, activities being 'effectively communicable'. This can be accomplished through the use of open dialogue, public consultations and education (Table 2; Figure 8; Figure 9).

Table 2: the Ten Tenets applied to the rehabilitation and management of the Humber Estuary, in general.

Tenet	Is this Tenet Met?	Impediments to Management and Rehabilitation	Management/Mitigation/Compensation
Environmentally and Ecologically Sustainable	Yes, for the most part.	<ul style="list-style-type: none"> • Over fishing. • Land reclamation from farmers. 	<ul style="list-style-type: none"> • Designation of sites with environmental and ecological importance. • Payment (compensation) to farmers who loose land due to reclamation. • Enforcement of fishing quotas to ensure stock viability.
Economically Viable	Yes, for the most part.	<ul style="list-style-type: none"> • Lack of funding from local or national government may restrict the type of rehabilitation and management possible. • Lack of public funding to charities. 	<ul style="list-style-type: none"> • Increase awareness of the work done on the Estuary. • Aim to manage effectively within the budget. • Partnerships may gain better funding due to the number of groups within the partnership. • Partnerships will have the same aim as the groups within it, collective budget may be spent on agreed upon management.
Technologically Feasible	No.	<ul style="list-style-type: none"> • There is not an effective way to remove sound from boat traffic • There is effective way to remove oil from the system • Sedimentation will occur and removal of such sediment is harmful 	<ul style="list-style-type: none"> • Limit boat traffic to minimised the noise and oil output from out board motors • Have specified shipping lanes/routes and no boating zones to further minimise noise levels and collision with organisms. • Dedicate land to rehabilitation to ensure the continuation of habitat for annelids and other

			invertebrates found in the sediment of estuary.
Socially Acceptable or Tolerable	Yes.	<ul style="list-style-type: none"> • There are very few impediments as people want to benefit from the Estuary so rehabilitation and management is seen as being favourable. 	<ul style="list-style-type: none"> • Continuation of good management and rehabilitation.
Legally Permissible	Yes.	<ul style="list-style-type: none"> • There are few impediments as it is in everyone's best interest to maintain the Humber Estuary due to its social, ecological and economic benefits. 	<ul style="list-style-type: none"> • Continuation of good management and rehabilitation.
Administratively Achievable	Potentially yes.	<ul style="list-style-type: none"> • A lot of independent organisations and groups with their own opinions and needs from the Estuary. • There is a lack of understanding between such organisations and groups. 	<ul style="list-style-type: none"> • Creation of partnerships make communication easier between groups with similar agendas for the Estuary. • There is a consensus of understanding between partnerships and their aims for the Estuary. • Increase communication between organisations so mutual understanding is reached.
Politically expedient	Yes.	<ul style="list-style-type: none"> • There are few impediments as it is in everyone's best interest to maintain the Humber Estuary due to its social, ecological and economic benefits. 	<ul style="list-style-type: none"> • Continuation of good management and rehabilitation.

Ethically Defensible (Morally Correct)	Yes.	<ul style="list-style-type: none"> • It is ethically correct to maintain the Estuary in a natural way. • It is ethical to return the Estuary to its natural state. 	<ul style="list-style-type: none"> • Land reclamation to allow for natural succession and potentially to rehabilitate through rehabilitation techniques developed by humans. • Protection of specific site that are ecologically important to the Estuary.
Culturally Inclusive	Yes.	<ul style="list-style-type: none"> • Traditional fishing stock may be over exploited 	<ul style="list-style-type: none"> • Enforce fishing quotas • Catch record for commercial vessels and recreational fisherman
Effectively Communicable	Potentially yes.	<ul style="list-style-type: none"> • Lack of communication 	<ul style="list-style-type: none"> • Increase education within the local area about the Humber Estuary • Public consultation so people can ask questions about mitigation, compensation, rehabilitation and management

3.2.3.3. S.W.O.T. analysis in regards to partnerships

The use of the S.W.O.T,analysis is based on the email responses gathered from respondents to the questionnaire. As seen in Figure 9, approximately half of the respondents believe that partnerships and discussions are required for the effective management and rehabilitation of the Estuary. Table 3 highlights how partnerships have the potential to open dialogues between the government organisations, non-government organisations, agencies and users of the Estuary. It shows how the presence of partnerships has the ability to allow multiple members of the partnership to contribute to discussion and for the partnership to come to an agreement and understanding of the groups aims for the Estuary. There are many strengths and opportunities within the S.W.O.T. matrix that highlight the benefits of partnerships. This is due to the ability to open dialogue between the individual groups within the partnership. In addition to this, it allows the groups to from the partnership to establish a single management and rehabilitation plan. This will enable them to work together as a single unit to manage and rehabilitate the Estuary. However, the groups within the partnership still operate independently. This could lead to conflict within the partnership as the individual group may feel as though their values are compromised. There are strength-threats, which would need to be accounted for or worked on. This is due to the small fraction that could arise leading to a weakened partnership. In addition to this, the weakness-opportunities present areas in which partnerships could be improved, whilst the weakness-threats pose the biggest issue towards the partnerships. The weakness-opportunities mainly highlight threat, which may occur within the partnership. This is due to the individuality of each of the groups within the partnership.

Table 3: S.W.O.T. analysis for partnerships. S=Strength, W= Weakness, O=Opportunity, T=Threat. The matrix covers partnerships and the opportunities, strengths, weaknesses and threat that may occur within partnerships.

	STRENGTH	WEAKNESS
OPPORTUNITY	<ul style="list-style-type: none"> • Allows multiple users to discuss their plans for the estuary, as part of a group discussion • Allows for greater communication between groups within the partnership • Better understanding of the aims and objectives of the individual groups within the partnership. • Partnerships may have more sway in discussions with other groups as the partnership will have considered a number of viewpoints already 	<ul style="list-style-type: none"> • Some individual groups may feel like they are compromising on their aims and objectives. • Budgets within the partnerships may not be spent as individual groups may like. • All groups within a partnership still work independently
THREAT	<ul style="list-style-type: none"> • Disputes could lead to tension within the partnership and potentially lead to a splintering of the partnership • Individuals groups may feel their individual ideas are better than those of others within the partnership 	<ul style="list-style-type: none"> • Increase in workload for the groups involved in the partnership • Decisions regarding management plans and rehabilitation may take longer to be agreed upon • Pressure from outside parties for quick decisions may not work in the best interest of the partnership

3.2.3.4. DAPSI(W)R(M) Models

The DAPSI(W)R(M) models (Figure 11; Figure 12; Figure 13) highlight the needs of the Estuary for ecologically based groups, economically based groups and any socially based groups. Figure 11 highlights the needs and wants of ecologically based groups in

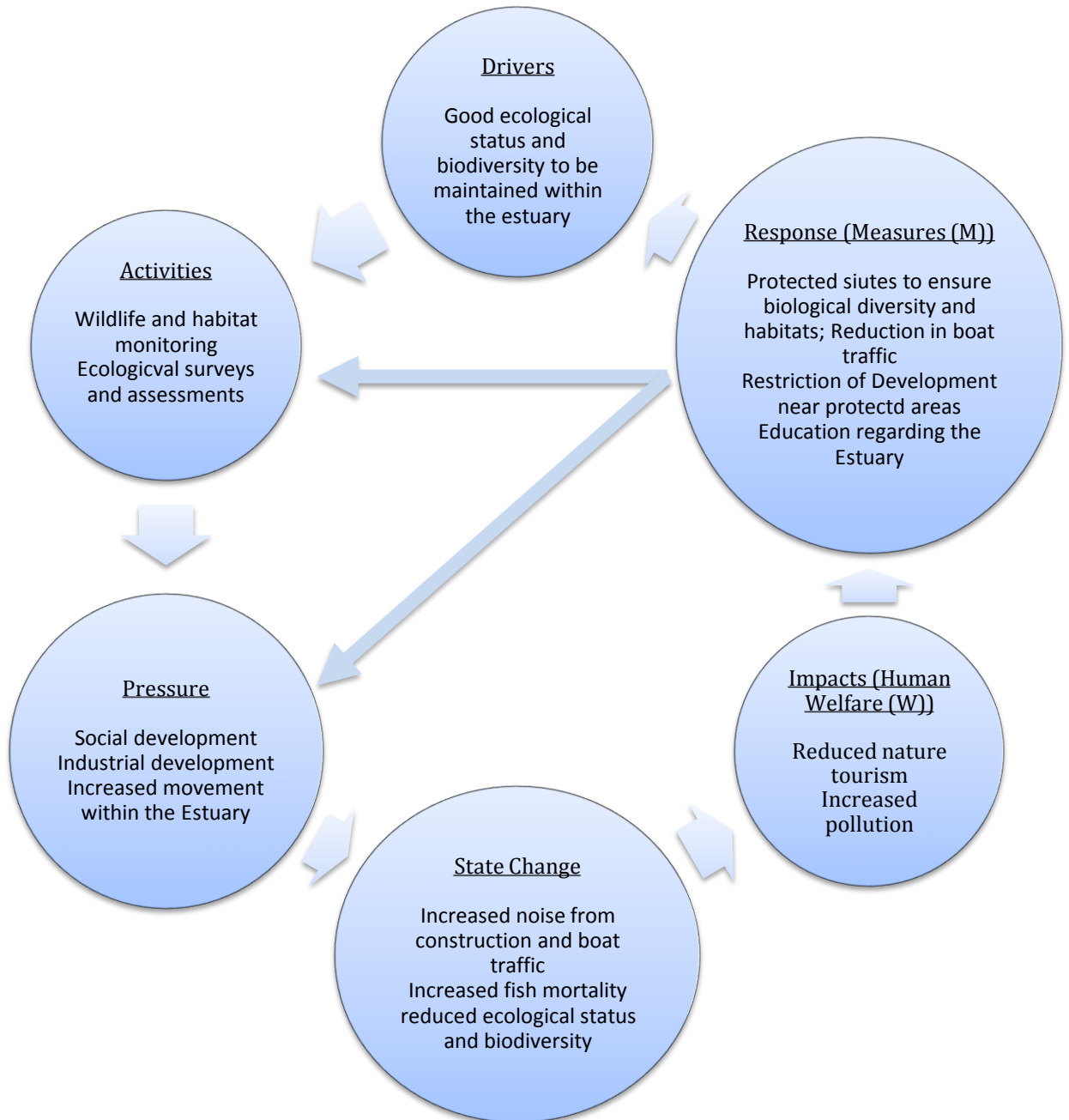


Figure 11: The DAPSI(W)R(M) model for ecologically based groups.

terms of the estuarine environment. The aim of wildlife trusts and the environmental agencies is to help protect the environment and hence the Humber Estuary. The pressures present on the Estuary include navigation for boats and tankers, industrial

works and development as well as social development through tourism and leisure. The response to the degradation of habitat includes many designations, which aim to protect important habitats and species within the Estuary. For example, the Estuary is a SSSI. In addition to this, education will play an important role in protecting the habitat and promoting sustainable use and longevity of the habitats and ecosystems of the Estuary.

There are many gains to be made from the Humber Estuary economically. Figure 12 represents the DAPSI(W)R(M) model for economic activity. For example, in order to

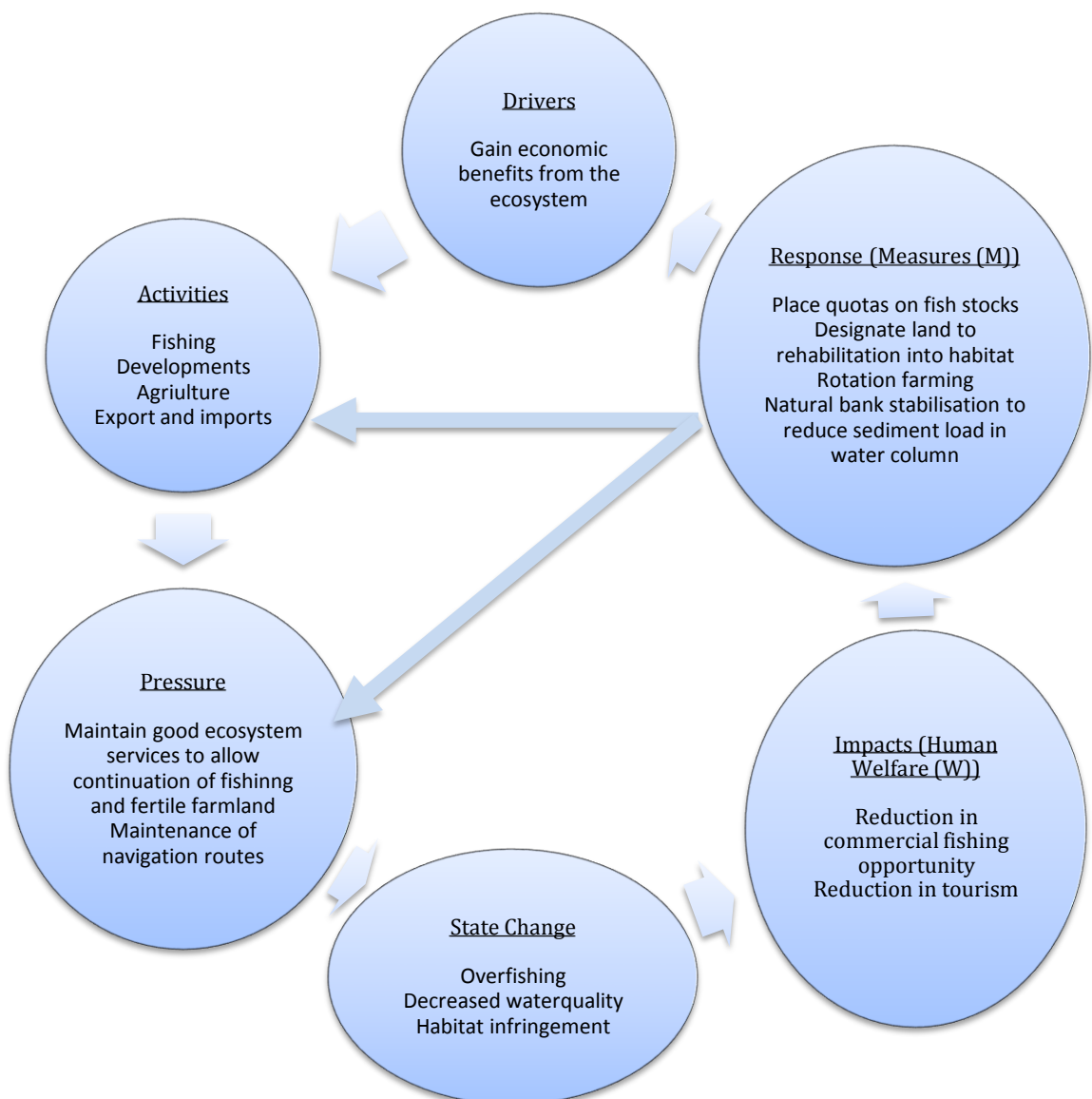


Figure 12: The DAPSI(W)R(M) model for economically based groups.

gain economic support from the Estuary (driver), a large amount of trade can enter the Estuary via import and export trades (activity). However, this leads to the need to

maintain waterways (pressure), often carried out through dredging. Dredging tends to disturb the benthos, leading to a reduction in water quality. This reduction in water quality will appear to make the water seem muddier, reducing the appeal of the water and dissuading people to visit the Humber Estuary (impact). Whilst dredging the Estuary is necessary to allow for easy navigation, the sediment load could be reduced via natural bank reinforcement (plants native varieties of riparian vegetation, allowing roots to stabilise the bank) as well as using mud suckers as opposed to trawl dredges to clear waterways; the mud gathered from the Estuary has the potential to be sold on to be repurposed for other uses. This directly conflicts with the ecological model and social model, as water quality can greatly affect the ecosystem within the estuary (ecological) and the appeal of part taking in recreational use of the Estuary, as very few people would enjoy the sight of a 'muddy' estuary (social) (Figure 11; Figure 13).

The last DAPSI(W)R(M) model presented is that of wants and needs of the Estuary and stakeholders, in regards to societal expectations (Figure 13). Most people would hope to see clean water. However, this is not possible, due to the naturally high dispersal rate and sediment load of the Humber Estuary. This being said, many would still hope for the Estuary to be clean and healthy in order to allow for leisure activities to occur on the estuary. The Estuary provides many societal benefits (3.1.2.). The societal needs are based mainly on recreation and leisure, and the need for the Estuary to be aesthetically pleasing in order to draw attention and tourism to the Estuary.

In addition to this, there are many crosslinks between societal wants and ecological wants, and societal wants and economical wants (Figure 14). For example, in order for bird watching to continue (societal and economic benefit, through tourism), the management, rehabilitation and special designations given to land, where these birds can be found and seen, are important. This will allow for the income to support the local economy to continue into the future. The inter linking seen between these models shows how a sectoral approach to management and rehabilitation cannot be successful. It also highlights how disagreements between groups, which are influenced by different objectives, can impede what would appear to be the most appropriate course of action to ensure the effective use of the Estuary for years to come

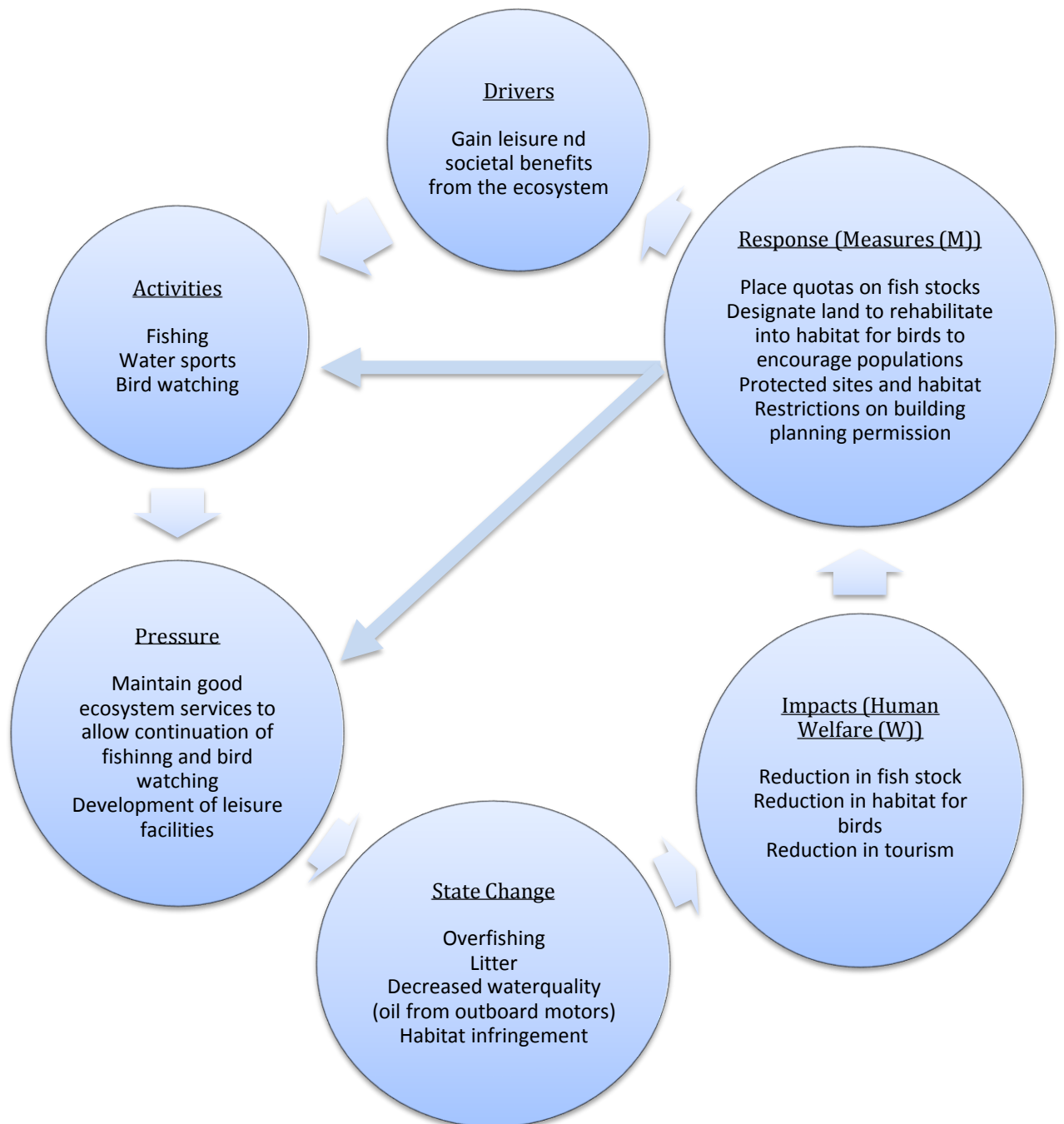


Figure 13: The DAPSI(W)R(M) model for societal based groups.

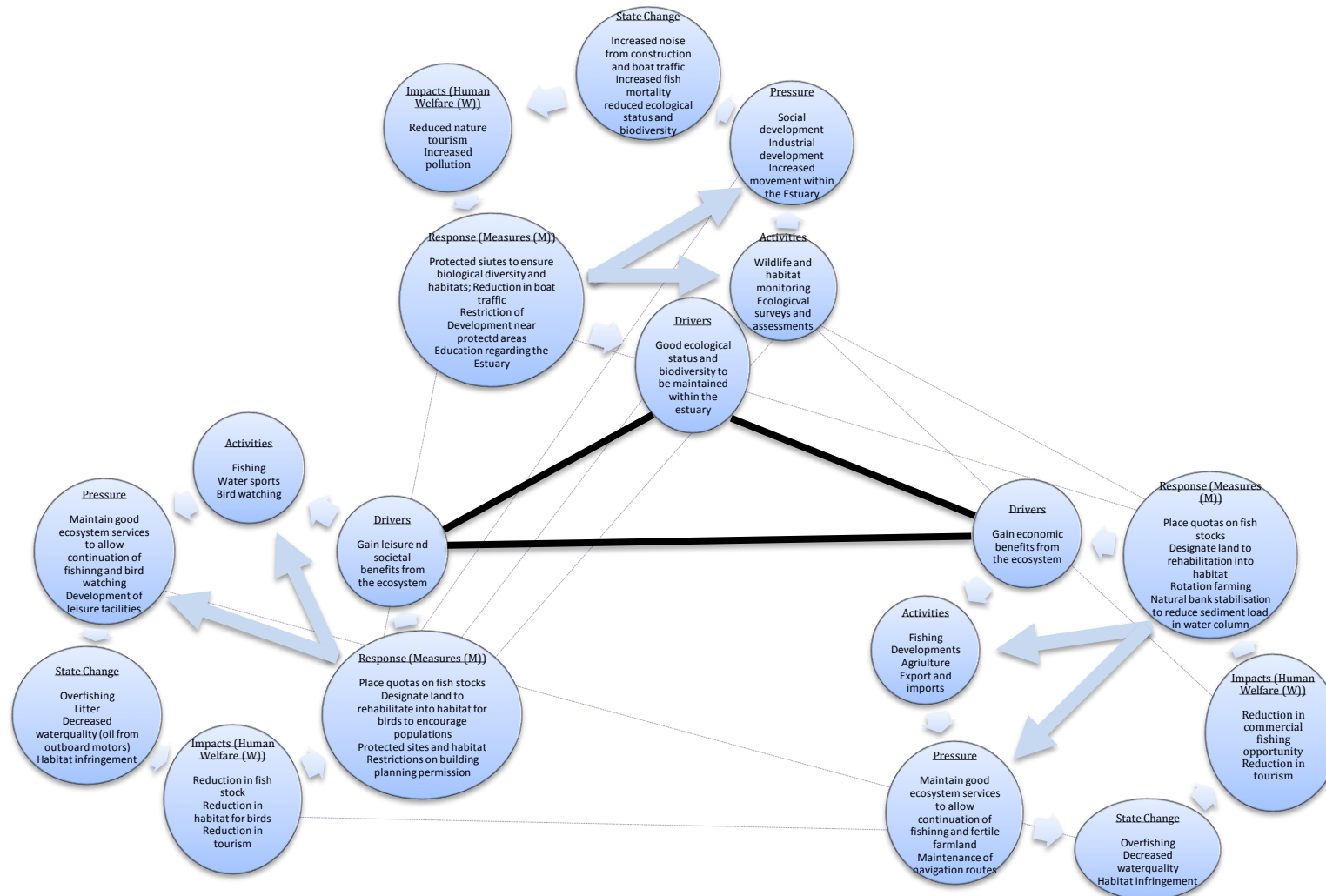


Figure 14: DASI(W)R(M) model of ecological, economical and societal base groups combined. The grey dash lines highlight the connective nature of the three different groups

3.2.3.5. Proposed Management Plan

The results above suggest that the most appropriate management plan would involve the presence of multiple partnerships with a central body to discuss the proposal of each partnership, with regard to the Estuary and the other partnerships present. For example, the central body would consist of an unbiased chairperson, to oversee the discussion that would take place, and then three to four economic, industry, and scientific leaders, who would represent the partnerships. These nine to 12 people would then discuss the wants, needs and aims each partnership aspires to gain, within legislative and regulative power. It is hoped that an agreement would be made between the partnerships at these conferences and meetings, providing an understanding of each partnerships aims, in the hope of reducing conflicts between the partnerships. The partnerships would aim to be representative of the three different types of operating industries, organisation, non-government organisations and agencies found within the Humber Estuary; ecologically based, economically based and socially based. These three, crudely, defined groups would discuss, within the partnerships, what they would like to witness in terms of estuarine management and rehabilitation, whilst also maintaining their identity as an industry, organisation, non-government organisations and agencies. The proposed management plan would involve three stages with the number of people involved at each stage decreasing in order to allow for better communication of plans and wants for the Estuary (Figure 14; Figure 15). Public involvement in the process is important as it would cover the 'effectively communicable' Tenet. This would also allow for the public to raise any concerns they may have (Dear, 1992). The use of a parliamentary approach to management would allow for the input of many in the decision making ensuring that the management plan is in the best interest of all involved. In addition to this, the amendment stages within the proposed scheme would allow for small details, that may have been missed by those whom contributed to the plan, to be added.

Finally, due to the feedback process involved in the proposed model for establishing better management of the Estuary, it is hoped that the management aims of the Estuary will be better understood, reducing the conflicts between industries, agencies, organisations and non-government organisations. This will aid in improving management and rehabilitation as all groups will have a mutual understanding of others needs and wants.

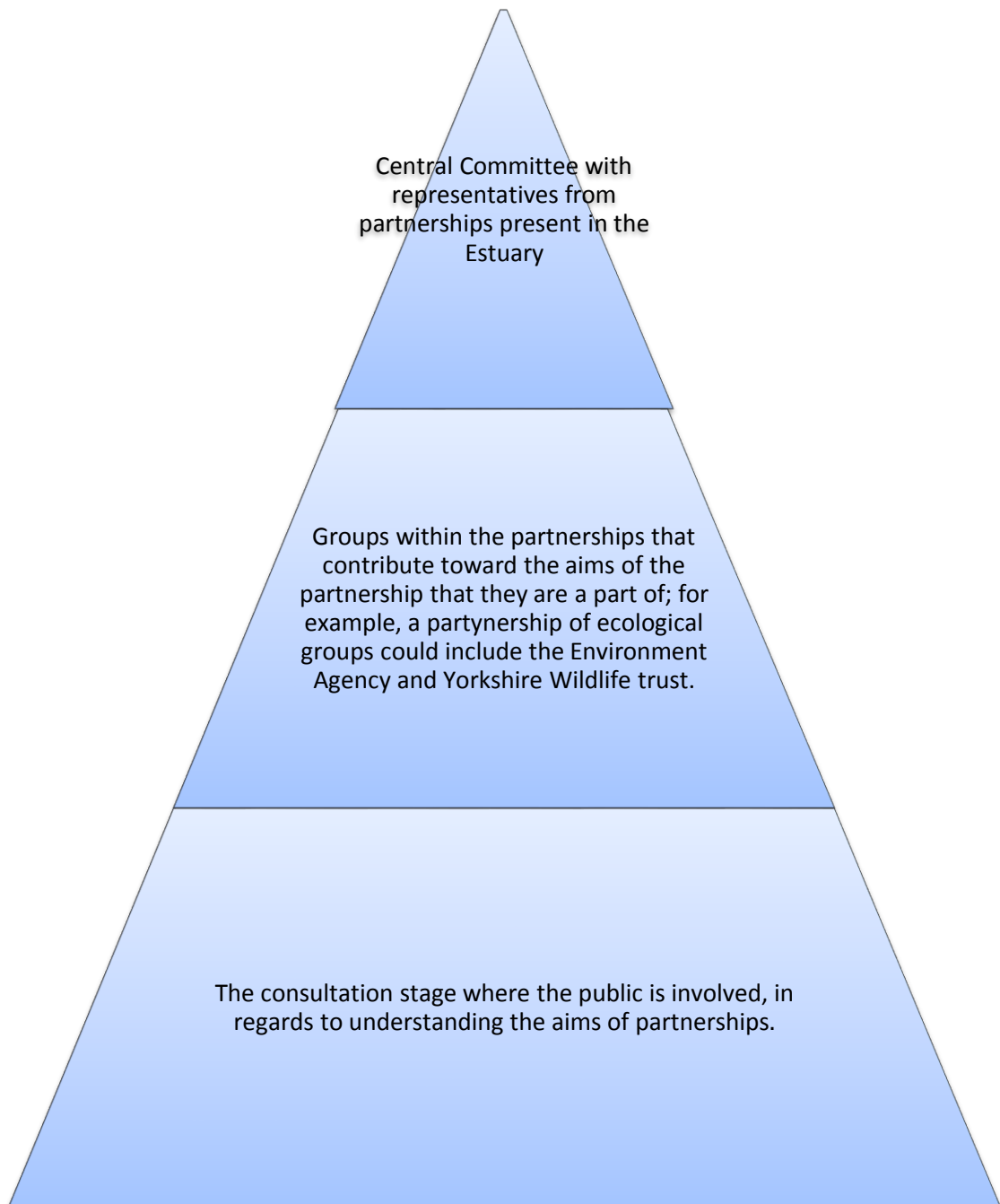


Figure 14: The representation of the number of people involved in the decision making process of the proposed management plan. The higher up the pyramid the fewer people are involved

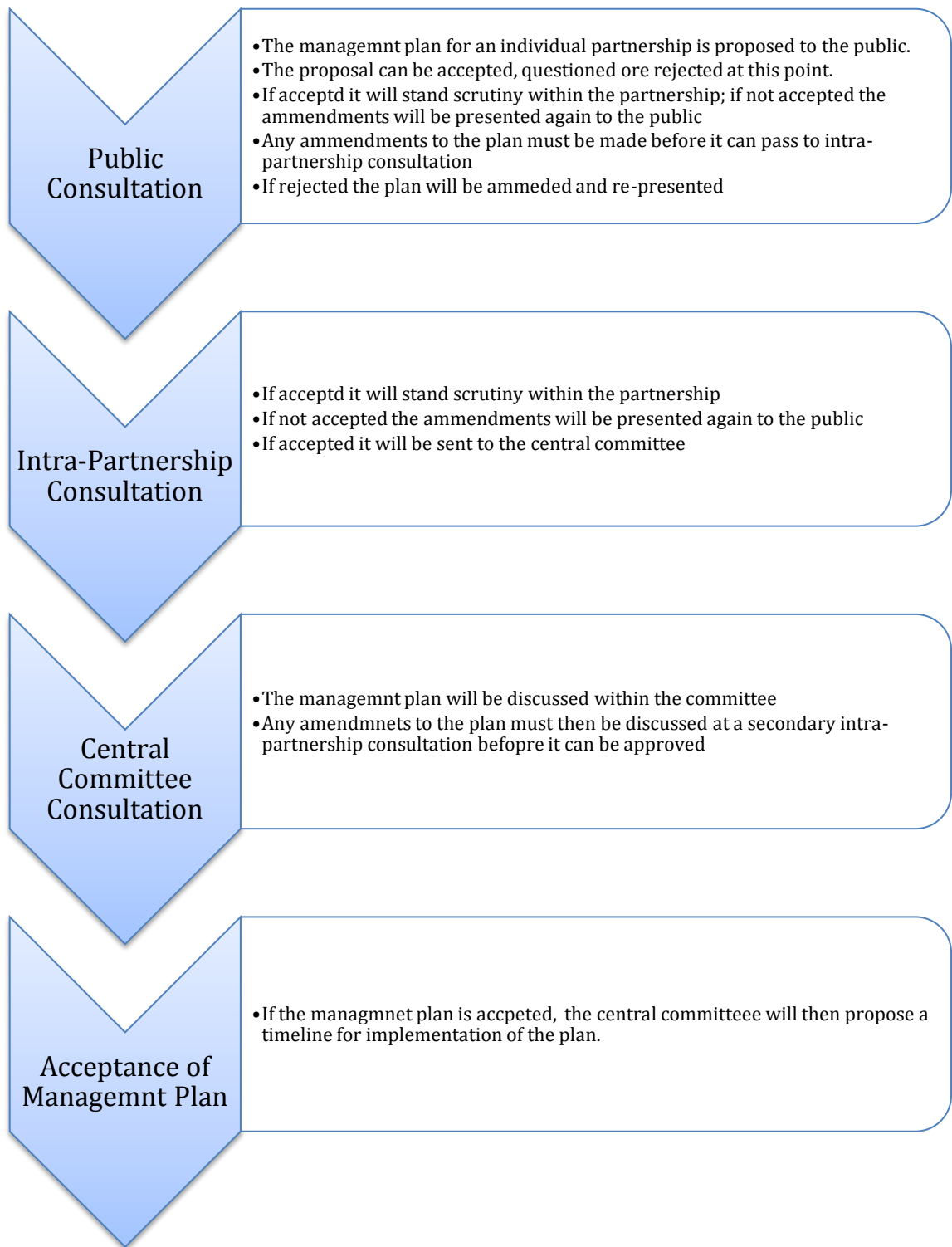


Figure 15: The process by which a management plan would be made in relation to the Estuary and the partnerships involved.

4. Discussion

4.1. Findings

As mentioned by Lonsdale et al. (2015), the best approach for management of the Humber Estuary would be one that encompasses a multidisciplinary approach. This is due to the need to protect the estuary, on an ecological level, in order to maintain the economic and societal benefits gained from the estuary; one approach cannot be successful without the others. This being said, organisations and user groups are independent of each other with their own views. This, currently, would potentially, lead to management and rehabilitation being not administratively possible (Ten Tenets of environmental sustainability), due to the number of users, organisations and industries currently operating in the Humber Estuary. To bridge this gap, the presence of a singular consensus and the creation of partnerships, such as the Humber Nature Partnership and the Humber Local Enterprise Partnership, may be the most effective way to address the discrepancies witnessed between these user groups, organisations and agencies.

Based on the results gathered from the questionnaire, legislation and regulation that is currently in place is thought by the respondent of the questionnaire to be sufficient in managing the Estuary. They provide the backbone through which rehabilitation and management. The Habitats Directive sets out clear and consistent processes, levelling the playing field, for achieving sustainable development. In addition to this, they work alongside and within designated sites, providing further assistance with management and rehabilitation processes. The European Laws and Directives provide a protective institutional framework, giving all parties a coherent framework, which help to deliver society's aspirations and plans for sustainable management and rehabilitation. While European Laws and Directives can sometimes be seen as a hindrance to the group, organisations and users of the system, based on responses, legislation is highly important and needs to be adhered to.

The proposed model has the potential to improve communication at every stage of the management process. However, due to the involvement of so many people, leading to the final stage, there is the potential for agreement of management schemes to take a

longer time to be implemented, if using this model. This poses a problem as the delay in the implementation of management plans can be costly to industry, society and the environment. For example, shipping routes may become more restricted during the consultation reducing export and import change within the Estuary, impacting society as the local economy may experience a period of depreciation. In regards to the environment, if the Estuary's health is degrading, this degradation is likely to continue until the management plan is in place.

In addition to this, when decision take time to come to fruition, funding and budgetary constraints come to the forefront. Budgetary restraints could have a significantly large impact in management and rehabilitation not being achieved as management and rehabilitation requires funding. Without the required funding, the appropriate approach to management and rehabilitation may not be realised and has the potential to miss key aspects in such activities. The potential of missing key aspects may arise as a result of trying to save money in order for reallocation of funds to other management and rehabilitation aspects. As for increased workload, due to a potential lack of communication or lack of agreed management, industries, organisation, non-government organisations and agencies may prefer to look out for their own interests. Most will operate independently to each other and will only work in collaboration with others if specialist knowledge is required. In addition to this, working in partnership with other industries, organisation, non-government organisations and agencies could lead to task times increasing, leading to greater budgetary expenditure, as opposed to working on a project by themselves; linking to the budgetary constraints.

Furthermore, partnerships have the potential to provide a more holistic approach to management and rehabilitation as it has the potential to allow different users of the Humber Estuary, with different backgrounds (biological, ecological, economical and societal), to work together. Partnerships and discussions would allow for groups to discuss their plans for the Humber Estuary, make compromises to accommodate all requests for management plans and rehabilitation. This would reduce the lack of agreed management between the members of the discussion or partnership, which is considered to be one of the main reasons why inadequate management and rehabilitation may occur

Finally, in order to reduce the impediments witnessed within the Humber Estuary, communication needs to be more effective. This can be achieved through the use of partnerships and meeting of the industry leaders with user groups, and organisations. This would allow for individual groups to have their opinions on management and rehabilitation to be heard. From this point a truly holistic management and rehabilitation plan can be achieved. The introduction of partnerships could be introduced through management planning or business planning processes. This in time would potentially lead to a culture of partnerships for a variety of bio-socio-economic activities. These partnerships could potentially be included in legislation in order to assure the co-operation of all users, organisations and industries.

4.2. Critique of Work

While the quality of work appears to be of high quality there are critiques that can be made of the work presented. This is due to the methods used to gather the information. Criticisms and praise of the work include:

- Sample size;
- Responses gained;
- Questionnaires in general;
- The use of Survey Monkey (an online questionnaire site).

4.2.1. Questionnaires

Questionnaires have many strengths and weaknesses in terms of scientific research. Questionnaires have the ability to gather large numbers of respondents at a low cost, particularly when using a distribution method such as Survey Monkey. In addition to this, it makes for ease of contact with correspondents who are situated great distances from person carrying out the research. This means that questionnaires provide an ease of access to a range of people as well as being able to identify specific targeted correspondents (Kirklees Council, 2016). Furthermore, the use of questionnaires results in a standardised collection of responses. This means that questionnaires are likely to be more objective (Milne, 19959). This lends to accurate and relevant information being gathered, if the questions are 'good'.

However, there are numerous weaknesses associated with questionnaires. For example, in order for questionnaires to be effective tools, sample sizes need to be

large and varied within the topic of research. This poses a weakness as, once the questionnaire has been sent, there is little control over who replies to it (Kirklees Council, 2016). This can lead to potential biases, which have the ability to skew the data gathered. In addition to this, questionnaires have to be short, resulting in a potential lack of detail from the respondents (Kirklees Council, 2016). On the other hand, open ended questions have the ability to provide large amounts of data that would need analysis and processing (Milne, 1999).

To conclude, the effectiveness of questionnaires relies heavily on the response of other and an effective questionnaire design. The questionnaire used to gather the data required for this research, was of decent design and covered all the topics that needed to be researched. In addition to this, the correspondents contacted were specifically chosen and have relevant experience regarding the topic. However, relying on responses weakened the validity of the research due to the small sample size used (see 4.2.2.).

4.2.2. Sample Sizes

There are three main approaches of samples used in research. These approaches depend on the size of the sample that needs to be obtained; the statistical approach (250+ participants), the pragmatic approach (30-250 participants), the cumulative approach (5-30 participants). The cumulative approach was used due to the nature of the research and not being able to predict the number of the respondents to the questionnaire. Furthermore, this method is advised for qualitative data collection (Denscombe, 2014). This is a critique of the research presented as the aforementioned techniques is used mainly as an exploratory sample. Furthermore, the respondents to the questionnaire tend to be representatives of ecologically based groups, causing potential biases in the data. These points combined result in the data, potentially, being unrepresentative of the general viewpoints of the groups that operate within the Estuary. This can be overcome by gaining more responses to the questionnaire.

4.2.3. Responses

Some of the responses gained had the potential to be vague and inconclusive. When this occurred, the answer was discarded, if after further consultation with the respondent, the answer was still unclear. In addition to this, some of the questions

were missed, with other receiving only a yes or no response. Furthermore, the lack of responses received led to a potential bias in the data collected (see 4.2.2.). In order to gain more responses, if this type of research is carried out in the future, face to face meetings should be arranged to ensure better co-operation and detail to the questionnaire. In addition to this, the questionnaire should be sent with more time. This is to ensure that all correspondence with the respondents can take place, as well as allowing for respondents to take their time when filling out the questionnaire.

4.2.4. Survey Monkey

Survey Monkey has the advantage of making surveys appear professional and offers an online platform for respondents to fill the questionnaire out on. This is beneficial as it reduces the amount of effort required to receive, fill out and then send back the questionnaire. This, it was hoped, would gather a greater amount of respondents due to its simplicity and ease of use. However, the downside to Survey Monkey was the limitation of questions. The questionnaire originally consisted of 13 questions, however, without being a premium user of Survey Monkey, this was limited to 10 questions. This is a negative of using Survey Monkey as it reduces the accuracy of question and, hence, data gathered. In addition, not as many areas were able to be covered, whilst using Survey Monkey. This has led to potential gaps in the research, leading to a reduction in validity. To overcome this, subscription to the premium package would should be used in future, especially when contacting larger samples due to the basic analysis Survey Monkey provides (see 3.2.1.)

4.2.5. Conclusion of Critique of Research

There are many problems with the research as discussed in 4.2.1.-4.2.4., however, the research does cover the main topics in regards to management and rehabilitation. In addition to this, there are positive design aspects to the research conducted. For example, the questionnaire, for the most part, was clear and allowed for good responses. Finally, the research appears to be replicable.

4.3. Further Application of the Research Presented

The research presented above is only based on one estuary, and whilst ideas can be cross applied, it is worth noting that all estuaries are different to one another due to the variation that is present; for example, different hydro-morphological features,

different species, different eco-hydrology (Wolanski and Elliott, 2015). This being said it is imperative that each estuary is looked at as an individual and that management and rehabilitation plans represent the bio-socio-economic needs of the users, organisations and industries present in the specific estuary.

In addition to this, the outcome of the European Referendum and the impacts of voting to leave the Union are yet to be measured on an environmental stage. The vote to leave may have influenced the responses gathered from the questionnaire, though this is not conclusive due to all responses being attained after the vote. It is thought that the laws and regulations currently in place will have to be amended as a result of the vote to leave the European Union.

There are two possible outcomes from the European Referendum; become a member of the European Economic Area (EEA maintains a relationship with the European Union and includes the European Free Trade Association consisting of four of the three members of the EEA (Buchan, 2012) or completely sever ties with the European Union. Both of the outcomes have the ability to affect the legislation currently in place. For example, if the United Kingdom decides to join the EEA, the United Kingdom would be expected to adopt all European Union legislation (Boyes and Elliott, 2016). However, the United Kingdom would have no say in the legislative process. Various pieces of legislation would be included in the agreement, however, key marine and estuarine legislation would not. These key directives include, the Birds Directive, the Marine Strategy Framework Directive, and Habitat Directive, which are thought to be irrelevant.

The second outcome would result in a restructure of the laws and regulation currently in place (Boyes and Elliott, 2016; Figure 17). The new legislation proposed by the Government would come into effect once withdrawal from the European Union is has occurred (two years after the enactment of the Lisbon Treaty). The international conventions, to which the United Kingdom is a signatory, will still need to be abided by. These include the Bern Convention, The Convention of Biological Diversity and the OSPAR convention (Boyes and Elliott, 2016; Figure 17).

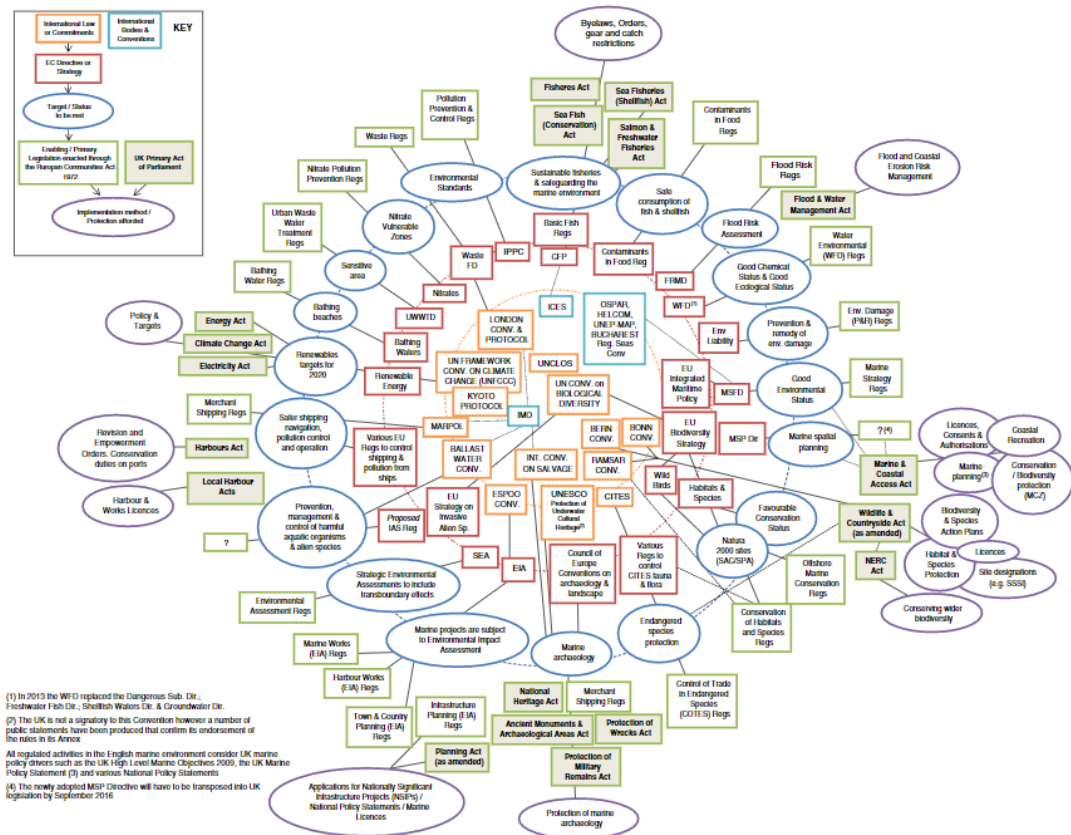


Figure 17: Horrendogram, modified from Boyes and Elliott (2014), highlighting regulations, which were created and implemented as part of the EU (filled green boxes) as opposed to UK Acts of Parliament. Taken from Boyes and Elliott, 2016

The European Referendum has major implications for the management and rehabilitation of the estuarine environment in general. This is because, if the second scenario occurs, legislation could have the potential to become more relaxed, in an attempt to reduce the stringent framework set out by directives, such as the Birds Directive (Boyes and Elliott, 2016). Moreover, this could potentially lead to the merging of certain legislation and regulation in order to reduce the amount of Acts seen (Figure 17). If this is the case further research will need to be carried out to establish how these new Acts will impact the activity found within and bordering the estuarine habitat.

4.4. Final Comments

The research highlights the need for open channels of communication. This is because communication allows for the groups who operate within the Estuary to understand the needs and wants of others in terms of Management and rehabilitation. This understanding is key to ensure that management and rehabilitation techniques being

used individual groups do not contradict the efforts of others. In addition to this, the need for partnerships appears to be vital to management and rehabilitation as a partnership has the ability to manage and rehabilitate larger areas leading to better ecosystem health and service. Moreover, partnerships allow for channels of communication to form, whilst still allowing groups to operate independently.

5. References

- Agu, G. (2006). The DAPSI(W)R Framework Use by the EEA. EEA Integrated Assessment Portal. Found at: http://ia2dec.pbe.eea.europa.eu/knowledge_base/Frameworks/doc101182. Last accessed: 20th February 2015.
- Anderson, R., and Rockel, M. (1991). Economic Valuation of Wetlands. Discussion paper 65. American Petroleum Institute: Washington, D.C.
- Atkins, J., Burdon, D., Elliott, M. and Gregory A.J. (2011). Management of the Marine Environment: Integrating Ecosystem Service and Societal Benefits with the DPSIR Framework in a System Approach. *Marine Pollution Bulletin*: 62, pp. 215-226.
- Barbier, E.B., Hacker, S.D., Kennedy, C., Kock, E.W., Stier, A.C., and Silliman, B.R. (2011). The value of estuarine and coastal ecosystem services. *Ecological Monographs*: 81(2), pp. 169-193.
- Black and Veatch (2007). Tidal Power in the UK. Research Report 3- Review of Severn Barrage Proposals. Report Prepared for the Sustainable Development Commission.
- Boja, A. and Elliott, M. (2013). Marine Monitoring during an Economic Crisis: The Cure is Worse than the Disease. *Marine Pollution Bulletin*: 68, pp. 1-3.
- Boyd, J. and Banzhaf, S. (2007). What are ecosystem services? The need for standardised environmental accounting units. *Ecological Economics if Coastal Disasters- Coastal Disasters Special Section*: 63 (2-3), pp. 616-626.
- Boyes, S.J. and Elliott, M. (2014). Marine Legislation- The Ultimate 'Horrendogram': International Directive and National Implementation. *Marine Pollution Bulletin*: 86 (1-2).
- Boyes, S.J., and Elliott, M. (2016). Brexit: The marine governance horrendogram just got more horrendous! *Marine Pollution Bulletin*; 111 (1-2), pp. 41-44.
- Boyes, S.J., Elliott, M., Murillas-Maza, A., Papadopoulou, N, & Uyarra, MC (2016). Is Existing Legislation Fit-For-Purpose to Achieve Good Environmental Status in European Seas? *Marine Pollution Bulletin* 111, pp. 18-32.
- Braatz, S., Fortuna, S, Broadhead, J., and Leslie, R. (2007). Coastal protection in the aftermath of the Indian Ocean Tsunami. What role for forests and trees? Proceedings of the Regional Technical Workshop, Khao Lak, Thailand, 28–31 August 2006.
- Buchan, D., 2012. Outsiders on the inside Swiss and Norwegian Lessons for the UK. Centre for European Reform. Found at: <http://www.cer.org.uk/publications/archive/policy-brief/2012/outside-inside-swiss-and-norwegian-lessons-uk>. Last accessed: 27th September 2016.

Burrows, R., Walkington, I., Yates, N., Hedges, T., Chen, D., Li, M., Zhou, J., Wolf, J., Proctor, R., Holt, J. and Prandle, D. (2009). Tapping the Tidal Power Potential of the Eastern Irish Sea. Final Report of the Joule Project. Report Number: JIRP106/03.

Caerio, S., Mourao, I., Costa, M.H, Painho, M., Ramos, T.B. and Sousa, S. (2004). Application of the DPSIR Model to the Sado Estuary in a GIS Context- Social and Economic Pressures. 7th AGILE Conference on Geographic Information Science, Heraklion, Greece, 29th April-1st May.

Carroll, R., Ruppert, D., Stefanski, L., and Crainiceanu, C. (2006). Measurement error in nonlinear models: a modern perspective, 105.

Cefas (2010). Development of Approaches, Tools and Guidelines for the Assessment of the Environmental Impact of Navigational Dredging in Estuaries and Coastal Waters. Literature Review of Dredging Activities: Impacts, Monitoring and Mitigation.

Chand, S. (2002). Managing Natural Resources in the Pacific Islands. Found in Resource Management in Asia Pacific Developing Countries. Asia Pacific Press, Abu Dhabi. pp, 97-99.

Chayes, A. and Chayes, A.H. (1995). The New Sovereignty: Compliance with International Regulatory Agreements. Harvard University Press. Cambridge, Massachusetts.

Chemical Hazards Communication Society (2006). The law-making process of the EU. Found at: <http://www.chcs.org.uk/eu-law-making-process.htm>. Last accessed: 6th May 2016.

Chislock, M. F., Doster, E., Zitomer, R. A. & Wilson, A. E. (2013) Eutrophication: Causes, Consequences, and Controls in Aquatic Ecosystems. Nature Education Knowledge 4(4):10.

Chuwen, B.M., Hoeksema, S.D. and Potter, I.C. (2009). The Divergent Environmental Characteristics of Permanently-Open, Seasonally-Open and Normally-Closed Estuaries of South-Western Australia. Estuarine, Coastal and Shelf Science, 85, pp. 12-21.

Cloern, J. E., Abreu, P. C., Carstensen, J., Chauvaud, L., Elmgren, R., Grall, J., Greening, H., Johansson, J. O. R., Kahru, M., Sherwood, E. T., Xu, J. and Yin, K. (2016), Human activities and climate variability drive fast-paced change across the world's estuarine-coastal ecosystems. Global Change Biology, 22, pp. 513–529.

Collins English Dictionary (2003). English Dictionary: Complete and Unabridged (eds. 6th). Harper Collins Publishers. Glasgow, Great Britain.

Council Regulation (EC). No. 401/2009.

Daily, G.C., Alexander, S., Ehrlich, P.R., Goulder, L., Lubchenco, J., Matson, P.A., Mooney, H.A., Postel, S., Schneider, S.H., Tilman, D., and Woodwell, G.M. (1997). Ecosystem Services: Benefits Supplied to Human Societies by Natural Ecosystems. Issues in Ecology: 2.

Day, J.H. (1980). What is an Estuary? South African Journal of Science

Dear, M. (1992). Understanding and Overcoming the NIMBY Syndrome. Journal of the American Planning Association, 58, pp. 288-300.

Denscombe, M. (2014). The Good Research Guide: For Small-Scale Social Research Projects (eds. 5th). Open University Press, pp.44-52.

Department of Environment, Food and Rural Affairs ^a (DEFRA ^a) (2011). English Nature Natural Areas - An Introduction: Humber Estuary. Found at: <http://adlib.everysite.co.uk/adlib/defra/content.aspx?id=000IL3890W.16NTBYVUMEY20L>. Last Accessed: 8th June 2016

Department for Environment, Food and Rural Affairs ^b (DEFRA ^b) (2011). Summary: The Environment Act. Found at: <http://adlib.everysite.co.uk/adlib/defra/content.aspx?id=000IL3890W.184SZ24XX5C4OX>. Last accessed: 8th June 2016.

Department for Environment, Food and Rural Affairs ^c (DEFRA ^c) (2011). Summary: The Environmental Protection Act. Found at: <http://adlib.everysite.co.uk/adlib/defra/content.aspx?id=000IL3890W.184SZ3126K04TD>. Last accessed: 7th June 2016.

Department for Environmental, Food and Rural Affairs ^d, (DEFRA^d) (2011). Summary: Natural Environment and Rural Communities Act. Found at: <http://adlib.everysite.co.uk/adlib/defra/content.aspx?id=000HK277ZX.0DQ08KAIOOWDM>. Last accessed: 9th July 2016.

Department for Environmental, Food and Rural Affairs ^e, (DEFRA^e) (2011). Summary: Pollution Prevention and Control Act. Found at: <http://adlib.everysite.co.uk/adlib/defra/content.aspx?id=000IL3890W.184SZKLCC186AA>. Last accessed: 8th June 2016.

Department of Environment, Food and Rural Affairs (DEFRA) (2013). Flood risk management: information for flood risk management authorities, asset owners and local authorities. Found at: <https://www.gov.uk/guidance/flood-risk-management-information-for-flood-risk-management-authorities-asset-owners-and-local-authorities>. Last Accessed: 8th June 2016

Dorn, A.W., and Fulton, A. (1997). Securing Compliance with Disarmament Treaties: Carrots, Sticks, and the Case of North Korea. Global Governance; 3, pp. 17-40.

Downs, G.W., Rocke, D.M. and Barsoom, P.N. (1996). Is The Good News about Compliance Good News About Cooperation? International Organisation; 50, pp. 397-406.

Duriez, O., Saether, S.A., Ens, B.J., Choquet, R., Pradel, R., Lambeck, R.H.D. and Klaassen, M. (2009). Estimating Survival and Movements using Both Live and Dead Recoveries: A Case

Study of Oyster Catcher Confronted with Habitat Change. *Journal of Applied Ecology*, 46, pp. 144-153.

EDOWA (2011). Overview of environmental law in Western Australia – Fact sheet 01. Environmental Defender's Office of Western Australia (Inc.) Perth Western Australia, Australia.

Elliott, M. (2010). Marine Science and Management Means Tackling Exogenic Unmanaged Pressure and Endogenic Managed Pressure – A Numbered Guide. *Marine Pollution Bulletin*: 62, pp. 651-655.

Elliott, M. (2013). The 10-Tenets for Integrated, Successful and Sustainable Marine Management. *Marine Pollution Bulletin*: 74, pp. 1-5.

Elliott, M. (2014). Integrated Marine Science and Management: Wading Through the Morass. *Marine Pollution Bulletin*: 86, pp. 1-4.

Elliott, M., Burdon, D., Hemmingway, K.L. and Apitz, S. (2007). Estuarine, Coastal and Marine Ecosystem Restoration: Confusing Management and Science- A Revision of Concepts, *Estuarine, Coastal and Shelf Science*: 74, pp. 349-366.

Elliott, M., Mander, L., Mazik, K., Simenstad, C., Valesini, F., Whitfield, A., Wolanski, E., (2016). Ecoengineering with Ecohydrology: Successes and Failures in Estuarine Restoration. *Estuarine, Coastal and Shelf Science*: 176, pp. 12-35.

Elliott, M. and McLusky, D.S., 2002. The Need for Definitions in Understanding Estuaries. *Estuarine, Coastal and Shelf Science* 55, pp. 815–827.

Environment Agency (2000). Planning for the Rising Tides: The Humber Estuary Shoreline Management Plan. Found at: <http://www.hull.ac.uk/coastalobs/media/pdf/hesmp.pdf>. Last accessed: 20th August 2016.

European Commission (2013). Proposal for a directive of the European Parliament and council establishing a framework for maritime spatial planning and integrated coastal management. Found at: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2013:0133:FIN:EN:PDF>. Last accessed 30th March 2016.

European Commission (2015). Maritime spatial planning. Found at: http://ec.europa.eu/maritimeaffairs/policy/maritime_spatial_planning/index_en.htm. Last accessed: 30th March 2016.

European Commission ^a (2016). The Birds Directive. Found at: http://ec.europa.eu/environment/nature/legislation/birdsdirective/index_en.htm. Last accessed: 30th March 2016.

European Commission ^b (2016). The EU Floods Directive. Found at: http://ec.europa.eu/environment/water/flood_risk/. Last accessed: 15th April 2016

European Commission ^c (2016). The Habitats Directive. Found at: http://ec.europa.eu/environment/nature/legislation/habitatsdirective/index_en.htm. Last accessed: 30th March 2016.

European Commission ^d (2016). Natura 2000. Found at: http://ec.europa.eu/environment/nature/natura2000/index_en.htm. Last accessed: 30th March 2016.

European Parliament ^a (2016). About Parliament: Legislative powers. Found at: <http://www.europarl.europa.eu/aboutparliament/en/20150201PVL00004/Legislative-powers>. Last access: 15th March 2016.

European Parliament ^b (2016). About Parliament: EP after the Lisbon Treaty. Found at: <http://www.europarl.europa.eu/aboutparliament/en/20150201PVL00008/The-Lisbon-Treaty>. Last accessed: 17th March 2016.

European Parliament ^c (2016). Ordinary legislative procedure. Found at: http://www.europarl.europa.eu/external/appendix/legislativeprocedure/europarl_ordinarylegislativeprocedure_complete_text_en.pdf. Last accessed: 16th March 2016.

European Union (2016). How decisions are made. Found at: http://europa.eu/eu-law/decision-making/procedures/index_en.htm. Last accessed: 24th March 2016.

FishBase (2014). *Salmo salar*. Found at: <http://www.fishbase.org/Summary/SpeciesSummary.php?ID=236&AT=Salmon>. Last accessed: 27th November 2015.

French, P.W. (2002). Coastal and estuarine management. Routledge.

Gill, A.B. (2005). Offshore Renewable Energy: Ecological Implications of Generating Electricity in the Coastal Zone. *Journal of Applied Ecology*, 42, pp. 605-615.

Gray, J.S. and Elliott, M. (2009). *Ecology of Marine Sediments: Science to Management*. Oxford University Press, Oxford. pp. 260.

Government of Queensland (2015). History of Aboriginal and Torres Strait Islander Peoples. Found at: <https://www.qld.gov.au/about/about-queensland/history/aboriginal/>. Last accessed: 5th April 2016.

Halpern, B. S., Walbridge, S., Selkoe, K.A., Kappel, C.V., Micheli, F., D'Agrosa, C., Bruno, J.F., Casey, K.S., Ebert, C., Fox, H.E., Fujita, R., Heinemann, D., Lenihan, H.S., Madin, E.M., Perry, M.T., Selig, E.R., Spalding, M., Steneck, R., and Watson, R. (2008). A global map of human impacts on marine ecosystems. *Science*: 319, pp. 948–952.

Hooper, T. and Austen, M. (2013). Tidal Barrages in the UK: Ecological and Social Impacts, Potential Mitigation, and Tools to Support Barrage Planning. *Renewable and Sustainable Energy Reviews*, 23, pp. 289-298.

Humber Management Scheme (2014). The Humber Management Scheme. Compiled by Manning, C.J. Found at: www.humberems.co.uk. Last accessed 20th August 2016.

Humber Nature Partnership (2016). About the Humber estuary. Found at: <http://www.humburnature.co.uk/estuary/>. Last accessed: 7th January 2016.

Institute of Environmental Management and Assessment (IEMA). (2005). *Managing Compliance with Environmental Law: A Good Practice Guide*. Best Practice Series: 6, pp. 28-30.

Jackson, J.B.C., Kirby, M.X., Berger, W.H., Bjorndal, K.A., Botsford, L.W., Bourque, B.J., Bradbury, R.H., Cooke, R., Erlandson, J., Estes, J.A., Hughes, T.P., Kidwell, S., Lange, C.B., Lenihan, H.S., Pandolfi, J.M., Peterson, C.H., Steneck, R.S., Tegner, M.J. and Warner, R.R. (2001). Historical Overfishing and the Recent Collapse of Coastal Ecosystems. *Science* 293, pp. 629–638.

Jacobson, H.K., and Brown Weiss, E. (1998). Assessing the Record and Designing Strategies to Engage Countries. In *Engaging Countries: Strengthening Compliance with International Environmental Accords*, edited by Edith Brown Weiss and Harold K. Jacobson. MIT Press Cambridge, Massachusetts. pp. 511-54.

Joint Nature Conservation Committee (2010). Marine and Coastal Act 2009. Found at: <http://jncc.defra.gov.uk/page-5230>. Last accessed: 4th September 2016.

Kirby, R. and Reitière, C. (2009). Comparing Environmental Effects of Rance and Severn Barrages. *Maritime Engineering*, 162, pp. 11-26.

Kirklees Council (2016). Research and Consultation Guidelines. Found at: <http://www.kirklees.gov.uk/community/yoursay/questionnaires.pdf>. Last accessed: 30th August 2016

Koch, E. W., Barbier, E.B., Silliman, B.R., Reed, D.J., Perillo, G.M.E., Hacker, S.D., Granek, E.F., Primavera, J.H., Muthiga, N., Polasky, S., Halpern, B.S., Kennedy, C.J., Kappel, C.V., and Wolanski, E. (2009). Non-linearity in ecosystem services: temporal and spatial variability in coastal protection *Frontiers in Ecology and the Environment*: 7(1), pp. 29-37.

Langston, W.J., Pope, N.D., Jonas, P.C.J., Nikitic, C., Field, M.D.R., Dowell, B., Shillabeer, N., Swarbrick, R.H. and Brown, A.R. (2010). Contaminants in the Fine Sediment and Their Effects on the Biota of the Severn Estuary. *Marine Pollution Bulletin*, 61 (1-3), pp. 68-82

Larinier, M. (2001). Environmental Issues, Dams and Fish Migration. *FAO Fisheries Technical Paper*, 419, pp. 45-89.

Lee, M. (2014). EU Environmental Law, Governance and Decision Making. Oxford, United Kingdom and Portland, United States.

Legislative Services (2014). Water Act 2014. Found at:
<http://www.publications.parliament.uk/pa/bills/lbill/2012-2013/0064/en/13064en.htm>.
Last accessed: 16th July 2016.

Legislative Services ^a (2016). Clean Neighbourhood and Environment Act 2005. Found at:
<http://www.legislation.gov.uk/ukpga/2005/16/notes/division/2>. Last Accessed 18th
August 2016.

Legislative Services ^b (2016). Climate Change Act 2008. Found at:
<http://www.legislation.gov.uk/ukpga/2008/27/notes/division/2>. Last Accessed 18th
August 2016.

Legislative Services ^c (2016). Energy Act 2009. Found at:
<http://services.parliament.uk/bills/2015-16/energy.html>. Last Accessed 18th August 2016.

Levinton, J.S. 1995. Marine Biology: Function, Biodiversity, Ecology. New York: Oxford University Press, Oxford.

Madsen, P.T., Wahlberg, M., Tougaard, J., Lucke, K. and Tyack, P. (2006). Wind Turbine Under-Water Noise and Marine Mammals: Implication of Current Knowledge and Data Needs. Marine Ecology Progress Series, 309, pp. 279-295

Martinez, M.L, Intralawan, A.M., Vaquez, G., Perez-Maqueo, O., Sutton, P., and Langrave, R. (2007). The Coast of Our World: Ecological, Economic and Social Importance. Ecological Economics, 63, pp. 254-272.

McLusky, D.S. and Elliott, M. (2004) The Estuarine Ecosystem; ecology, threats and management. Oxford University Press, Oxford.

Mee, L.D., Jefferson, R.L., Laffoley, D.A. and Elliott, M. (2008). How Good is Good? Human Values and Europe's Proposed Marine Strategy Directive, Marine Pollution Bulletin: 56, pp. 187-204.

Millennium Ecosystem Assessment (2005). Ecosystems and human well-being. Found at:
<http://www.millenniumassessment.org/en/index.html>. Last accessed: 14th January 2016.

Milne, J. (1999). Questionnaire: Advantages and Disadvantages. Found at:
http://www.icbl.hw.ac.uk/ltidi/cookbook/info_questionnaires/. Last accessed: 20th August 2016

National Geographic Society (2015). Estuary. Found at:
<http://nationalgeographic.org/encyclopedia/estuary/>. Last accessed: 30th November 2015.

National Ocean and Atmospheric Association (NOAA) (2015). What is an estuary? Found at: <http://oceanservice.noaa.gov/facts/estuary.html>. Last accessed: 13th January 2016.

National Ocean Service (2012). Estuaries: What is an estuary? Found at: http://oceanservice.noaa.gov/education/tutorial_estuaries/est01_what.html. Last accessed: 14th January 2016.

Natura 2000 (2007). Natura 2000 Networking Programme: About. Found at: <http://www.natura.org/about.html>. Last accessed: 27th February 2016.

Nedwell J, Langworthy J, Howell D. (2003) Assessment of Sub-Sea Acoustic Noise and Vibration from Offshore Wind Turbines and its Impact on Marine Wildlife; Initial Measurements of Underwater Noise During Construction of Offshore Wind Farms, and Comparison with Background Noise. Research Commissioned by the Collaborative for Offshore Wind Research into the Environment (COWRIE). Report no. 544 R 0424.

North Lincolnshire Council (2014). Wildlife and the Humber Estuary. Found at: <http://www.northlincs.gov.uk/planning-and-environment/natural-environment/ecology/wildlife-and-the-humber-estuary/>. Last accessed: 14th July 2016

Parliament (2013). Marine Navigation (No. 2). Found at: <http://www.publications.parliament.uk/pa/bills/lbill/2012-2013/0064/en/13064en.htm>. Last accessed: 20th June 2016.

Parliament ^a (2015). About Your Parliament: How Laws Are Made. Found at: <http://www.parliament.uk/education/about-your-parliament/how-laws-are-made/>. Last accessed: 25th May 2016

Parliament ^b (2015). How Parliament Works: History of the House of Lords. Found at: <http://www.parliament.uk/business/lords/lords-history/history-of-the-lords/>. Last accessed: 25th May 2016.

Parliament ^c (2015). How Parliament Works: Parliament and the Crown. Found at: <https://www.parliament.uk/about/how/role/relations-with-other-institutions/parliament-crown/>. Last accessed: 31st May 2016.

Parliament ^d (2015). Parliamentary Business: House of Commons. Found at: <http://www.parliament.uk/business/commons/>. Last accessed: 23rd May, 2016.

Parsons Brinckerhoff (2008). Severn Tidal Power — Scoping Topic Paper. Noise. Report Prepared for the Department for Energy and Climate Change.

Platell, M.E., Orr, P.A. and Potter, I.C. (2006). Inter- and Intraspecific Partitioning of Food Resources by Six Large and Abundant Fish Species in a Seasonally Open Estuary. *Journal of Fish Biology* 69, pp. 243–262.

Perillo, G.M.E. (1995). Geomorphology and Sedimentology of Estuaries. *Developments in Sedimentology*; 53, pp. 18-19.

Potter, I.C., Chuwen, B.M., Hoeksema, S.D. and Elliott, M. (2010). The Concept of an Estuary: A Definition that Incorporates Systems Which Can Become Closed to the Ocean and Hypersaline. *Marine, Coastal and Shelf Science*, 87, pp. 497-500.

Prasetya, G. (2007). Protection from Coastal Erosion. Found in: *Coastal Protection in the Aftermath of the Indian Ocean Tsunami: What Role for Forests and Trees?* Food and Agricultural Organisation of the United Nation, Regional Office for Asia and the Pacific. Proceedings of the Regional Technical Workshop Khao Lak, Thailand, 28–31 August 2006.

Pritchard, D.W. (1967). What Is an Estuary: Physical Viewpoint? In: *Estuaries*. American Association for the Advancement of Science, 83, pp. 3-5.

Pye, K. and French, P.W. (1993). Erosion and Accretion Processes on British Salt Marshes (1-5).

Ross, D.A. 1995. *Introduction to Oceanography*. New York: Harper Collins College Publishers.

The Royal Society for the Protection of Birds (2010). *Marine Protected Areas for the UK*. Found at: <https://www.rspb.org.uk/forprofessionals/policy/marine/legislation/mpa/>. Last accessed: 5th September 2016.

Scharin, H., Ericsson, S., Elliott, M., Turner, R.K., Niiranen, S., Rockström, J., Blenckner, T., Hyytiäinen, K., Ahlvik, L., Heini Ahtiainen, H., Artell, J., Hasselström, L., Söderqvist, T. (2016). Processes for the sustainable stewardship of marine environments. *Ecological Economics*. 128, pp. 55-67.

Sardiña, P. and Cazorla, A.L. (2005). Feeding Interrelationships and Comparative Morphology of Two Young Sciaenids Co-Occurring in South-Western Atlantic Waters. *Hydrobiologia*, 548, pp. 41–49.

Shapiro, M. (2012). Independent Agencies. In Craig, P. and de Burca, G. *The Evolution of EU Law*. Oxford University Press, pp. 111-120.

Tallberg, J. (2002). Paths to Compliance: Enforcement, Management and the European Union. *International Organisation*; 56, pp. 609-643.

Techera, E.J. (2012). *Marine Environmental Governance: From International Law to Local Practice*. Routledge Publishing, England. pp. 1-12.

Thrush S.F., Hewitt J.E., Cummings VJ Cummings, V.J., Dayton, P.K., Cryer, M., Turner, S.J., Funnell, G.A., Budd, R.G., Milburn, C.J., Wilkinson, M.R. (1998). Disturbance of the

Marine Benthic Habitat by Commercial Fishing: impacts at the Scale of the Fishery. *Ecological Applications*, 8, pp. 866–879.

Underdal, A. (1998). Explaining Compliance and Defection: Three Models. *European Journal of International Relations*; 4, pp. 5-30.

United Kingdom Parliament ^a (2015). Legislation: Environmental Protection Act. Found at: <http://www.legislation.gov.uk/ukpga/1990/43/section/1>. Last accessed: 8th June 2016.

United Kingdom Parliament ^b (2015). Legislation: Environment Act 1995. Found at: <http://www.legislation.gov.uk/ukpga/1995/25/contents>. Last accessed: 8th June 2016.

United Kingdom Parliament ^c (2015). Legislation: Water Industry Act 1991. Found at: <http://www.legislation.gov.uk/ukpga/1991/56/contents>. Last accessed: 8th June 2016.

United Kingdom Parliament ^d (2015). Legislation: Water Resources Act 1991. Found at: <http://www.legislation.gov.uk/ukpga/1991/57/contents>. Last accessed: 8th June 2016.

Van der Meulen, F., Bakker, T.W.M. and Houston, J.A. (2004). The Costs of Our Coasts: Examples of Dynamic Dune Management from Western Europe. *Coastal Dunes: Ecology and Conservation*. Springer-Verlag, Berlin, pp. 259-278.

Van Tatenhove J.P.M. (2011). Integrated Marine Governance: Questions of Legitimacy. *Maritime Studies*: 10, pp. 87–113.

Wade, L., Whitehead, H. and Weilgart L. (2010). Conflict of Interest in Research on anthropogenic Noise and Marine Mammals: Does Funding Bias Conclusions? *Marine Policy*, 34, pp. 320-327.

Wolanski, E., and Elliott, M. (2015). *Estuarine Ecohydrology: An Introduction*. Oxford, United Kingdom. pp. 61-72

Wolf, J., Walkington, I., Holt, J. and Burrows, R. (2009). Environmental Impacts of Tidal Power Schemes. *Maritime Engineering*; 162, pp. 165-177.

Yeung, K. (2004). *Securing Compliance: A Principled Approach*. Hart Publishing. Oxford, England. pp. 21-103.

Young, O. (1992). The Effectiveness of International Institutions: Hard Cases and Critical Variables. In *Governance without Government: Order and Change in World Politics*, edited by James N. Rosenau and Ernst-Otto Czempiel, Cambridge University Press. Cambridge, England. pp. 160-194.

6. Appendix: Questionnaire Screen Shots

Impediments To Estuarine Management and Rehabilitation

1.

The aim of this questionnaire is to establish where impediments to estuarine management and rehabilitation lies, in regard to the Humber estuary. The responses gained will help with understanding how and why impediments occur, and will aid in suggestions and management plans that will remove or minimise these problems.

* 1. What organisation are you from? (Please provide your name and your department within the organisation)

2. Do you:

A) Currently undertake estuarine rehabilitation and management measures.

B) Plan to in the future.

(Please give details of any measures in the boxes below)

A)

B)

3. What is your role in estuarine management and rehabilitation, and do you encounter any impediments with regard to your role?

4. How do European Union laws and regulations affect the way you manage the estuarine environment?

5. Are there any particular laws or regulations that require change, or better enforcement, for management to be more effective with regards to the estuarine environment?

Environmental Protection Act, 1990

Water Industry Act, 1991

Water Resource Act, 1991

Human Rights Act, 1998

Pollution Prevention and Control Act, 1999

- Sustainable Energy Act, 2003
- Clean Neighbourhoods and Environment Act, 2005
- Natural Environment and Rural Communities Act, 2006
- Conservation Regulations, 1994
- The EC Marine Strategy Framework Directive, 2008
- The EC Water Framework Directive, 2000
- The EC Habitats Directive, 2011 (Council Directive 92/43/EEC)
- The EC Maritime Spatial Planning Directive, 2014
- Climate Change Act, 2008
- Flood and Water Management Act, 2010
- The Water Act, 2014
- The EU Floods Directive, 2007

Other (please specify):

6. Are there any other user groups with which you currently collaborate with, or should/want to collaborate with to improve estuarine management and rehabilitation?

- Associated British Ports
- Angling Trust
- Environment Agency
- Marine Management Organisation
- European Environment Agency
- International Marine Organisation
- Heritage Trust
- Rivers Trust
- Natural England
- Centre for Environment, Fisheries and Aquaculture Science
- UK Environmental Law Association
- Royal Society for the Protection of Birds
- The Wildlife Trusts
- The Institute of Environmental Sciences
- Marine Conservation Society
- Chartered Institution of Water and Environmental Management
- Yorkshire Water

- United Utilities
- National Trust for Places of Historic Interest or Natural Beauty
- Sea Anglers Matchman Federation
- National Federation of Sea Anglers
- Bass Anglers Sportfishing Society
- England Nature
- North East Sea Fisheries Committee
- Eastern Joint Sea Fisheries Committee
- Waters Edge Project
- Humber Nature Partnership
- National Cycle Network
- British Association for Shooting and Conservation
- Botanical Society of the British Isles
- British Trust for Ornithology
- Institute of Estuarine and Coastal Studies
- Joint Nature Conservation Committee
- British Waterways
- Other (please specify):

7. How do you, as a manager of the environment:

A) Incorporate and resolve multi-user conflicts

B) Embed this into rehabilitation and management plans?

A)

B)

8. Are there any other user groups who the statutory bodies should be engaging with, but for some reason are not currently doing so?

- Associated British Ports
- Angling Trust
- Environment Agency
- Marine Management Organisation
- European Environment Agency
- International Marine Organisation

- European Environment Agency
- International Marine Organisation
- Heritage Trust
- Rivers Trust
- Natural England
- Centre for Environment, Fisheries and Aquaculture Science
- UK Environmental Law Association
- Royal Society for the Protection of Birds
- The Wildlife Trusts
- The Institute of Environmental Sciences
- Marine Conservation Society
- Chartered Institution of Water and Environmental Management
- Yorkshire Water
- United Utilities
- National Trust for Places of Historic Interest or Natural Beauty
- Sea Anglers Matchman Federation
- National Federation of Sea Anglers
- Bass Anglers Sportfishing Society
- England Nature
- North East Sea Fisheries Committee

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- National Cycle Network
- British Association for Shooting and Conservation
- Botanical Society of the British Isles
- British Trust for Ornithology
- Institute of Estuarine and Coastal Studies
- Joint Nature Conservation Committee
- British Waterways
- Other (please specify):

9. Why are these organisations not currently engaged with you, and what are the barriers to getting this group/groups to join discussions?

10. Do you have any suggestions to improve the way estuarine systems are managed and rehabilitated?