Marine Litter Issues, Impacts and Actions

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Executive Summary

Marine litter can be defined as “any persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environment. Marine litter consists of items that have been made or used by people and deliberately discarded into the sea or rivers or on beaches; brought indirectly to the sea with rivers, sewage, storm water or winds; accidentally lost, including material lost at sea in bad weather (fishing gear, cargo); or deliberately left by people on beaches and shores” (UNEP, 2005).

Categories are used to classify marine litter, based on source and material, including plastics, glass, metal, timber, paper & cardboard and textiles. The majority consists of synthetic materials such as plastic, and is often highly persistent in the marine environment

Marine litter originates from different sources, circulates through pathways and accumulates in litter sinks. The sources of marine litter are from both land and sea based activities. A number of studies have looked at the differing proportions of litter from each of these and their results estimate that at the global scale the greatest proportion (up to 80% in some cases) is from land based sources, with similar proportions in Scotland.

An analysis of the type and sources of marine litter in Scotland from MCS (2011) revealed 37.5% originated from public, 29.6% non-sourced, 20.5% SRD, 8.9% fishing, 1.7% shipping, 1.6% fly-tipped and 0.2% medical. Plastic continued to be the most dominant type, accounting for 63.3% at the UK level.

Baseline data for Scotland on the types, amounts, sources and trends are limited mostly to coastal surveys of beached marine litter. These have shown in 2010, a total of 53,162 items litter for those Scottish beaches surveyed, with an average of 2382.2 items per km, higher than the UK average (1969 items/km). This represents an increase of 25% since 2009. Limited baseline data exits for benthic and suspended litter

The problems and threats caused directly or indirectly by marine litter are extensive, including environmental, social and economic impacts. Despite this our overall understanding of these issues is limited, particularly the indirect and socio-economic effects.

In addition, marine litter threatens the realisation of a shared vision for ‘*clean, healthy, safe, productive, biologically diverse marine and coastal environments, managed to meet the long term needs of nature and people*’ and may also impact upon Scotland’s Strategic Objectives, most notably the drive to become a *Greener, Wealthier & Fairer, Safer & Stronger* and *Healthier* Scotland.

Marine litter has a substantial impact upon the economy. For several years policy makers and communities have experienced the problem of marine litter on beaches, and waterways with direct and indirect impacts, including a decline in the environmental quality of the coast as well as upon ecosystem services. While economic costing of ecosystem services is considered a relatively new science, it is clear that marine and coastal litter can impact and deteriorate a range of natural functions that provide on-going social and economic benefits.

As part of the study, a workshop was held at the Macaulay Land Use Research. Twenty eight participants were involved from across different sectors and geographical regions of Scotland and the UK. The workshop explored existing reduction, removal and governance issues and

arrangements, and methods to reduce future inputs of marine litter by source (land, coastal and marine). Key areas of discussion which emerged related to chain of responsibility, industry efforts, litter reduction and collection initiatives, litter facilities, harbour and marine issues, riverine inputs, monitoring and data, geographical distribution of marine litter and policy coordination, governance and implementation.

In terms of governance, a vast amount of legislation exists with regards to marine litter. National and regional waste management structures, the actions of industries, and community and personal responsibility are complex issues that cross jurisdictions and scales and therefore have evolved a variety of associated instruments. It is clear that a sufficient mix of regulatory tools exist to inform and implement a Scottish Marine litter Strategy, with instruments from the international, EU and Scottish scales.

There are a plethora of initiatives at the local, regional and national scales both in the UK and Scotland, a number of which are specific to marine litter, others towards general litter management and environmental stewardship. These display a number of key strengths and work at different scales to engage the public in addressing the litter issue. Their coordination within a Strategy and identifying ways in which Scotland can better learn from and coordinate with, the global movement in tackling marine litter, is essential.

In addition to on the ground initiatives, innovation is often cited as a way of tackling environmental management and is essential to achieve goals and wider objectives such as environmental protection, social inclusion and sustainability. Different types of innovation can be used to achieve this including institutional, social, technological and regional innovation supported by emerging tools such as market based instruments. In order to effectively tackle the issue of marine litter, each of these need consideration and assimilation.

These examples and methods of best practice are essential to the development of a Marine Litter Strategy for Scotland, and through best practice process for identifying objectives and management planning a draft vision for a Strategy is recommended:

Vision:

By 2020 marine litter in Scotland is significantly reduced and does not pose a risk to the environment or communities. This is supported by our vision of a zero waste society, where people and businesses act responsibly and reuse, recycle, and recover waste resources

To realise the vision Strategic Directions in the areas of education, reducing inputs, seizing opportunities and economic growth, monitoring and engagement each with a suite of actions, and indicators for achievement, have been developed. Three options for the delivery of a Strategy have been presented across differing levels of implementation and consequently resourcing.

SECTION A

1. INTRODUCTION

1.1 Aims of Scoping Study

This study will contribute to developing a marine litter strategy for Scotland's seas in light of the Marine (Scotland) Act 2010, and the implementation of the EU Marine Strategy Framework Directive (MSFD). The MSFD is one of the largest and most ambitious attempts at implementing the Ecosystem Approach on an international scale. The MSFD mandates the implementation of the ecosystem approach for all 27 EU member states. The Directive obliges each member state to achieve Good Environmental Status (GES) within their Exclusive Economic Zone by 2020 for each of eleven environmental descriptors covering various aspects of environmental health. The management of marine litter falls under the MSFD descriptor 10. Targets for each of these descriptors will be set in 2012 and a program of measures to achieve these targets must be put in place in each member state by 2016.

The aim of this scoping study is to explore the issues, types and sources of marine litter, existing marine legislation and initiatives, goals for a new Marine Litter Strategy and recommendations for options to reduce the total litter load. Such information will be essential to address the costs and impacts on the Scottish economy, its marine regions and local communities as well as meeting policy targets within the EU MSFD.

Existing initiatives tend to be based on approaches from elsewhere in the UK and the increase in interest in the state of Scotland's marine environment has led to a growing recognition that these may not be the most effective solutions for Scotland's coast and seas based on our geography, accessibility and population distribution e.g. organising beach clean ups for local residents may be less effective in very remote and sparsely populated coastal areas.

This research will help meet the Scottish Government's strategic objectives including: Wealthier and Fairer – managing the exploitation of Scotland's coastal and marine area; Safer and Stronger – ensuring that local coastal communities have the opportunity to manage local coasts and seas to improve opportunities and enhance quality of life; Greener – developing new tools to manage and direct exploitation to ensure Scotland's assets are used sustainably.

1.2 Marine Litter Definition

The international definition of marine litter, as defined by the United Nations Environment Program is "any persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environment. Marine litter consists of items that have been made or used by people and deliberately discarded into the sea or rivers or on beaches; brought indirectly to the sea with rivers, sewage, storm water or winds; accidentally lost, including material lost at sea in bad weather (fishing gear, cargo); or deliberately left by people on beaches and shores" (UNEP, 2005).

1.3 Historical and Global Context

The disposal of waste at sea is not a new concept, but the ongoing shift towards more durable materials including synthetics, has resulted in a rapid increase in residence time. The slow decomposition rate of these materials within the marine environment has overall resulted in a litter sink with a net accumulation.

Oceanic currents transport buoyant litter items (often plastics) across territorial boundaries, accumulating around oceanic eddies and sheltered coastlines and because the sources of litter are diffuse, the resulting impacts and removal responsibility currently lie outside the control of any one agency or body.

It should not be assumed, however, that the majority of litter originates from overseas sources; the current lack of baseline data and overall understanding of the sources and interactions litter has with the marine environment and its impacts on society further exacerbates organisational problems aimed at tackling the issue.

1.4 Marine Litter in Scotland

The problem of marine litter also extends to Scotland. As in the global context, marine litter in Scotland comes from a number of different sources; both land and sea and poses a number of problems across the economy, environment and society. These detrimental effects include ingestion and entanglement of wildlife as well as wider ecosystem deterioration, public health issues and impacts on aesthetics and non use values and a wide range of economic impacts across the raft of industries reliant on our coastal and marine environment. In addition, there are legislative requirements and obligations including MSFD compliance, which must be taken into account.

It is difficult to predict future trends and new sources of marine litter, though it is widely recognised that due to the nature of the marine environment in Scotland, current loads will not degrade and reduce and any future inputs will add to that, will an overall net accumulation of litter in our seas and ultimately an increase in the impacts associated with it.

These issues are complex, stem from a number of sources and are complicated by the nature of the marine environment and the geography and demographics of Scotland. Each and every part of our coast and seas is affected by marine litter, often in low levels, but with some areas accumulating higher levels in litter sinks (figure 1-1). Each of these individual factors needs to be taken into consideration and suitable management solutions derived to provide an integrated approach to its overall management.

Figure 1-1 Litter accumulations along the Aberdeenshire coastline

2 REVIEW OF THE TYPES, SOURCES AND DISTRIBUTION OF MARINE LITTER

2.1 Types of marine litter

The majority of marine litter consists of synthetic materials such as plastic, metal, glass and rubber. Internationally 84.1% of the total marine litter found within the coastal area (in 76 countries) could be separated into ten key items including smoking materials, food and beverage containers and other various types of packaging, which by material mainly consist of plastic (Ocean Conservancy, 2008).

2.2 Type by material

Marine litter comprises of various material types, but can be classified into several distinct categories, split by main point source and material (Fanshawe & Everard, 2002; Sheavly & Register, 2007; Cheshire *et al*., 2009; MCS, 2009; Galgani *et al*., 2010):

- General grouped materials
    - Plastics
    - Glass
    - Rubber
    - Metal
    - Timber
    - Paper & cardboard
    - Textiles

2.2.1 Plastics

Plastics cover a wide range of synthetic polymeric materials (such as polypropylene, polyethylene, polyvinyl chloride, polystyrene, nylon, and polycarbonate) (National Research Council, 1994 in OSB, 2008). Plastics can include moulded, soft, foam, fisheries related equipment (nets, ropes, buoys, monofilament line, light sticks), smoking related items (cigarette butts, lighters, and cigar tips), microplastic particles, beverage bottles, bags, food wrappers, bottle caps, and toys (UNEP, 2005b).

Plastics as a result of their buoyancy accumulate on the sea surface and are often washed ashore (Thompson *et al*., 2009). Plastics comprise 50–80% of marine litter; stranded on beaches, floating on the ocean surface and on the seabed (Gregory & Ryan, 1997; Derraik, 2002; Barnes, 2005; Morishige *et al*., 2007; in Barnes *et al*. 2009).

In addition, most polymers are highly persistent in the marine environment, degrading by photo-catalysis when exposed to UV radiation. The lifetime of plastics is estimated between 100-1000 years depending on the properties of the polymer and the environment it is exposed to; with increasing depth, oxygen concentrations and temperatures are low and light is absent, which further increase their lifetime (Galgani *et al*., 2010).

In a local context, beach surveys across the UK suggest that plastic as a proportion of marine litter is slowly increasing, from 55% in 1994 to 64% in 2010. An indication of the extent of plastic in our seas is via the use of ecological indicators: Gannets collect the majority of their

nest material at sea, and recent surveys have found over 90% of the 30,000 gannet nests on Grassholm Island off the coast of Wales contain plastic (MCS, 2009).

2.2.2 Other synthetic materials

Other synthetic materials are similar to plastic in that they are used in a wide range of products, are often cheap to produce and lightweight and thus are common marine litter items. These include glass such as light globes, fluorescent globes and bottles; rubber including tyres, balloons and gloves; and metal including drink cans, aerosol cans, foil wrappers and disposable barbeques. These items can undergo fragmentation over long time periods and often do not completely biodegrade (OSB, 2008).

2.2.3 Semi-degradable

Processed timber such as pallets, crates and particle board, and paper and cardboard items such as cartons, cups and bags, also contribute to marine litter but is found in much smaller quantities than synthetic materials. This maybe due to a shorter residence time in the marine environment as they are relatively quick to bio- and photo-degrade, thus their accumulative impact on the environment, society and economy may be much less (Velander & Mocogni, 1998; UNEP, 2005b; Galgani *et al*., 2010).

2.2.4 Textiles

Textiles also constitute as marine litter including clothing, shoes, and furnishings. The specific impacts of these items are unknown, but are generally considered of lesser importance than other synthetic materials (Velander & Mocogni, 1998; UNEP, 2005b; Galgani *et al*., 2010).

2.3 Type by function

Products are made with specific materials based on their function and durability requirements, thus separating as type by function often enables easier identification of the source. The choice of material and applied usage is also a key factor in their residence time in the marine environment.

- Specific type by source
    - Sewage Related Debris
    - Derelict Fishing Gear
    - Beverage/food packaging
    - Household items
    - Manufacturing and transportation-related wastes
    - Smoking-related wastes

2.3.1 Sewage Related Debris

Sewage related debris (SRD) is discharged to the marine environment directly through domestic outfalls and combined sewer overflows (CSOs) or indirectly via rivers or other water courses. It has been suggested that sewage can amalgamate into mats with the potential to travel large distances depending on prevailing winds, thus outfalls do not need to be in close proximity to the sink to have added to it (Smith, 1993 in Velander & Mocogni, 1998).

SRD includes cotton bud sticks, nappies, tampons, condoms, human waste (faeces) and sanitary products and at the time of the last survey constitutes 20.5% of coastal marine litter in Scotland based on the number of items found (MCS, 2011).

2.3.2 Derelict Fishing Gear

Derelict fishing gear (DFG) refers to nets, lines, bait boxes, floats, creels, and other recreational or commercial fishing equipment that has been lost, abandoned, or discarded in the marine environment. Modern gear is generally made of synthetic materials and metal and can persist for a very long time within the marine environment (Velander & Mocogni, 1998). At the time of survey, DFG makes up 8.9% of coastal marine litter in Scotland (MCS, 2011).

2.3.3 Other

Other groupings by function include:

- Beverage/food packaging such as bottles, cans, lids, food wrappers and containers and disposable cups, plates, straws and utensils
- Household items such as clothing, furniture, appliances, light bulbs and computers
- Manufacturing and transportation-related wastes such as shipping containers and their contents, resin pellets, barrels, drums, shipping pallets, plastic sheeting and strapping bands
- Smoking-related wastes such as cigarette filters, packaging, cigar tips and disposable lighters

2.4 Lifecycle of marine litter

Marine litter originates from different sources, circulates through various pathways and eventually accumulates in litter sinks (figure 2.1). Data can aid in the quantification of these different factors and the transformations that occur through the process (Fanshawe & Everard, 2002). Evaluating this lifecycle of marine litter (spatial, temporal) is an essential part of any remediation and prevention technique and is fundamental prior to implementation, to allow for the identification and quantification of response variables and a review of the effectiveness of any management interventions (Cheshire *et al*., 2009).

Marine litter is in dynamic flux between the land and ocean interface, with several types and states of material (Cheshire *et al*., 2009).Flux rates between different sources and sinks can be measured directly (observation of amounts of material being transported) or indirectly (inferences based on changes in the amounts of litter in each pool over time). This can aid long-term management strategies, with better control of input sources leading to a reduced influx rate and accumulation in the system (Cheshire *et al*., 2009).

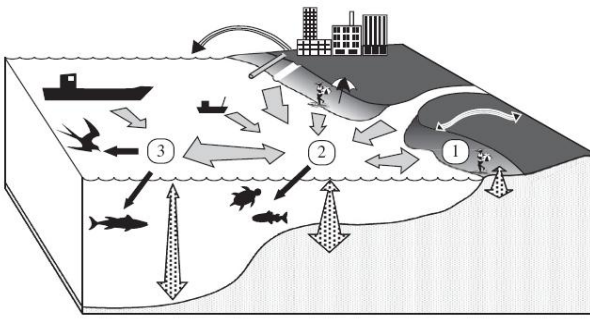

Figure 2-1 The sources, pathways and sinks for marine litter. Sources include wind-blown litter (curved arrows), water-borne litter (grey arrows), vertical movement of litter through the water column (including suspension and seabed – sinks; stippled arrows), and ingestion by marine organisms (black arrows). Sinks include shallow coastal areas (1), continental shelf (2) and open ocean (3); 2 & 3 include litter suspended in the water column. (Taken from Ryan et al., 2009)

2.5 Sources

The sources of marine litter are diffuse including offshore, coastal, riverine and land-based. However the ability to identify a particular source from an individual litter item is difficult, depending on the state of the litter item (weathering) or the possibility of multiple sources. A number of initiatives and studies have looked at the differing proportions of litter from each of these sources and their results show that the greatest proportion is from land based sources. At the global scale it has been reported that up to 80% is derived from land based sources (Faris and Hart, 1994). In the UK approximately 47% was from land based sources, 17% from fishing and shipping and a further 37% is non sourced (MCS, 2011). At the Scotland level source information shows 37.5% was public, 8.9% fishing, 20.5% SRD, 1.7% shipping, 1.6% fly tipped, 0.2% medical and 29.6% non-sourced (figure 2-2). A distinction also exists between accidental and deliberate waste disposal, though with the exception of fly tipping this is often impossible to distinguish.

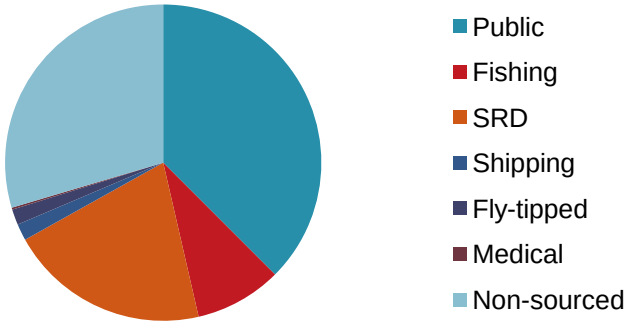

Figure 2-2 Litter by source on Scottish beaches (MCS, 2009)

Sources can be categorised in a number of different ways. This report has used the Marine Conservation Society approach: public; fishing; sewage related debris; shipping; fly tipped; medical and non sourced. Details of each are given below and sub-categorized where necessary.

2.5.1 Public

'Public' is a diffuse source of marine litter, encompassing many sub-source types such as beach users (point source) and riverine and urban runoff (diffuse source). Litter in this category includes food and drink cartons and packaging and smoking related waste.

2.5.1.1 Recreational & leisure usage

Litter sourced from recreational and leisure usage usually involves the inappropriate disposal of litter from the public either accidental or deliberate, of which constitutes a large proportion of beach litter (MCS, 2009).

Beach users and recreational tourists are a key source of litter accounting 37% of all beach litter in 2010 (MCS, 2011). This is despite laws such as the Environmental Protection Act (1990) prohibiting the dropping of litter in a public place which includes beaches (Hall, 2000). For some litter types however, it is difficult to distinguish direct origin (beach or boat user) (Hall, 2000; MCS, 2009).

Recreational boat owners and operators can also discharge waste into the riverine, estuarine, coastal and marine environment. Litter items can include food containers, plastic bottles and recreational fishing gear (Sheavly, 2005; Mouat *et al*., 2010).

2.5.2 Fishing

Marine litter associated with commercial marine fisheries and coastal aquaculture includes nets, ropes, buoys and cages. The release of these items into the marine environment result from the snagging of gear on bottom topographical features, accidental loss, deliberate dumping and the failure to remove these items (Mouat *et al*., 2010).

Litter arising from the fish farming and aquaculture industry, has been under the direct control of individual managers with some fish farmers have admitting to littering however these quantities are seen as relatively small compared to other sources.

Marine, coastal and riverine recreational fishing activities generate small localised areas of marine litter accumulation through the incorrect disposal of fishing lines, tackle and waste items used by anglers (Katsanevakis & Katsarou, 2004). In popular fishing areas high levels of waste can be left.

2.5.3 Sewage related debris

The discharge of untreated sewage due to ineffective waste treatment facilities and combined sewer overflows (storm events), results in an influx of SRD (cotton bud sticks, nappies, condoms, sanitary products) into coastal waters (Hall, 2000; Allsopp *et al*., 2006; Mouat *et al*., 2010).

A study (Hall, 2000) found in comparison to some European countries (e.g. Denmark) the UK has a large percentage (25%) of coastal outfalls that do not have preliminary treatment or screens to remove large items. This does not take in to account recent investment in the network but nonetheless a large number of combined sewer overflows do still exist. SRD represented 20.5% of litter in the MCS Beach watch weekend 2010 (MCS, 2009); nearly

three times higher than the UK average of 7.3%. It is often found to be the most offensive litter type and poses some public health and safety risk.

2.5.4 Shipping and offshore industries

Marine litter can be released into the marine environment by shipping vessels including cargo, bulk carrier, military, surveillance, research, passenger ships and non-commercial vessels, either accidentally (inappropriate storage) or deliberately. The contents of approximately 10,000 cargo containers are lost worldwide each year (Podsada, 2001 in Mouat *et al*., 2010). A recent example of this was the *MSC Napoli* which was beached off the Devon coast after a structural failure; over 100 containers were lost.

The release of marine litter can occur from offshore oil and gas activities, either accidentally or deliberate. Items can include safety equipment (gloves, hardhats) and waste generated from exploration and resource extraction. (Fanshawe & Everard, 2002; Mouat *et al*., 2010)

2.5.5 Fly tipped

Fly-tipping is defined as the '*illegal deposit of waste onto land that has no license to accept it*' (Scottish Flytipping Forum, 2010). The Dumb Dumpers campaign is administered on behalf of the Scottish Flytipping Forum by Keep Scotland Beautiful, and aims to prevent fly-tipping. According to guidance from Scottish Flytipping Forum (2010) although reasons behind fly-tipping are complex, they mainly result from ignorance of the proper management facilities and avoidance of waste management charges and can be linked to antisocial behaviour.

Disposal costs (skips, landfill tax) may discourage the proper disposal of waste, although a study found no empirical evidence that fly-tipping had increased after the introduction of landfill tax apart from some isolated cases (Scottish Executive, 2001). This maybe due to limited baseline data stemming from an absence of standardised recording procedures.

Coastal and terrestrial fly-tipped items are subject to transportation by the wind and rivers distributing them into the marine environment.

2.5.6 Other Sources

There are a variety of other sources most notably land based which contribute to the marine litter problem.

2.5.6.1 Wind blown

Windblown litter is a diffuse source, with many sources of origin and is more of a pathway than a direct source, assisting the distribution of land-based litter to the ocean. Light-weight items such as plastic bags and plastic film (agricultural) are often the most common windblown litter items.

2.5.6.2 Riverine

Litter derived from riverine inputs can have a different relative composition (proportion of litter types) to other marine litter in situ. This is mainly due to a greater influence of SRD and

fly-tipped source items in rivers (Williams & Simmons, 1997). Localised areas (sinks) along beaches near estuaries and river outflows, can therefore are largely different composition of marine litter to other coastal areas. This has implications for litter sampling strategies in that they should address all potential sources rather than limited to recreational and marine sources (Williams et al., 2002).

2.5.6.3 Municipal waste management

Poor waste management practices can be a major source of litter, enabling the transportation of litter into the marine environment through a variety of pathways (wind, riverine). Thus marine litter can originate from landlocked areas and is not necessarily derived in-situ or in close proximity to the sink. In addition, a number of derelict, former waste sites exist on or near the coast, either managed privately or by Local Authorities. An example of this is Nigg Bay, Aberdeen where the coast is eroding and leaching waste out into the coastal environment. Much of the waste at this particular site is landfill material and road materials such as tarmac. These sites cause problems as in many cases those individuals / companies / regional councils responsible for managing the sites are no longer in existence.

2.5.6.4 Industry

Small plastic resin pellets used as the feedstock for plastic production are an example of industrial discharges. The proliferation of these litter items have been recorded in monitoring surveys and usually enter the marine environment through accidental loss during transport and poor disposal techniques (Mouat et al., 2010).

2.5.6.5 Other

Agricultural waste such as silage wrap can enter the marine environment by wind blown and riverine processes. Derelict coastal developments and infrastructure such as piers and derelict vessels also provide a source of marine litter, usually proliferated through wave induced erosion. Marine litter can also originate from military activities such as munitions (Fanshawe & Everard, 2002; Mouat et al., 2010).

2.6 Pathways

Litter suspended in the water column has the ability to circulate between sources and sinks, using pathways (Cheshire et al., 2009). Tidal currents, surface winds and oceanic currents (Fanshawe & Everard, 2002) can influence the distribution, accumulation and end sink of marine litter items depending on their density and longevity.

2.6.1 Oceanic circulation

Ocean and surface winds can influence the drift of litter items suspended in the water column and are instrumental in the distribution of global marine litter. For example, plastic tags and bottles of Canadian origin have been recorded along the coasts of the UK; acting as indicators of large scale oceanic transport systems (Fanshawe & Everard, 2002).

2.6.2 Coastal circulation

The spatial/ temporal distribution and rates of accumulation and fragmentation of beach cast marine litter is also dependant on local coastal geomorphological processes. Research by HR Wallingford (1997) illustrated that the Scottish coastline can be divided into 11 major sediment cells. A sediment cell is defined as “a length of coastline which is relatively self-contained as far as the movement of sand and shingle is concerned and where interruption of such movement should not have a significant effect upon adjacent sediment cells” (HR Wallingford, 1997).

It has been suggested that litter from land-based sources and oceanic sources depending on local currents, could circulate within these cells (Fanshawe & Everard, 2002). Thus these cells could provide logical geographical boundaries or coastal catchments, in which management plans for beach cast and coastal litter could be implemented (MAFF, 1995). This may be preferential to litter management within political boundaries only (Fanshawe & Everard, 2002). Indeed this could also provide boundaries in which flux rates between land-based sources and coastal cell catchments can be quantified with only a slight influence from other marine sources.

2.7 Sinks

Litter sinks in the marine environment include the seafloor across coastal shallow waters and deep sea, as well as suspended in the water column (Fanshawe & Everard, 2002; Galgani et al., 2010).Depending on the relative isolation of a beach, the sink may only be temporary if regular beach cleaning occurs, but can be quickly replenished from offshore deposits (Williams et al., 1993).

2.7.1 Water column

The water column is a temporary sink for marine litter, although this is dependent on coastal currents and the buoyancy of individual litter items. Plastic density varies, with some items denser than seawater. This leads to stratification in the water column of litter of a similar density (floating, mid-water, bottom load). Surveying techniques therefore need to take this distribution of litter into consideration, as most studies to date have only focussed on floating debris (Galgani et al., 2010).

It is also possible to make predictions of the source and future drift of suspended litter, using spatial data on potential sources such as shipping traffic and prevalent currents. This can be useful for assessing the overall impacts on certain ecosystems and infrastructure in the predicted area of deposition (Galgani et al., 2010).

2.7.2 Shallow coastal areas

Shallow coastal areas (<40m depth) can act as litter sinks, due to their inherent geomorphological features and hydrodynamics. Marine litter is generally much greater in shallow coastal areas than the continental shelf and deep seafloor (Katsanevakis, 2008).

The influence of hydrodynamics on coastal bays can contribute to litter accumulation rates as well as land-based source inputs. Sheltered coastlines have greater litter accumulation

rates whereas open coastlines which experience intensive wave action, have lower rates due to wave-induced cleaning of the seabed (Hess et al., 1999; Katsanevakis & Katsarou, 2004; Galgani et al., 2010).

It has been suggested for shallow coastal areas, fishing activities significantly contribute to the density of seabed marine litter; with anchored vessels and the location of ports significantly influencing the distribution and pattern of marine litter on the seabed (Katsanevakis & Katsarou, 2004).

A study by Velander & Mocogni (1998), whilst now outdated due to network improvements, offers an example of the various influences on marine litter in coastal environments. The accumulation of litter on Cramond beach was, at the time of study due to a combination of factors:

- Proximity of sources
    - Proximity to an urban centre (Edinburgh) which increases the likelihood of litter from public (recreational & leisure usage) sources
    - Proximity of sewage outflow pipes (Cramond Island sewage outflow pipe) and villages / towns where raw/poorly treated sewage is discharged, increasing the likelihood of SRD.
    - Proximity to rivers (the mouth of the Almond River) which increases the likelihood of riverine sources of litter and industrial effluent
    - Proximity to ports, fishing and shipping routes for example a large number of commercial and pleasure vessels use the Firth of Forth, which increases the likelihood of litter by accidental or illegal dumping from these vessels
- Local pathways
    - A prevailing current near the sink such as the prevailing current which flows into the Cramond beach causeway resulting in the accumulation of litter
- Position of sink
    - Local hydrodynamics of the area such as intrinsic problems with the flow of estuarine waters and the accumulation of litter in estuaries (Firth of Forth Estuary)

2.7.3 Deep seabed

The majority of macro-debris eventually settles to the seabed, of which plastics, as they are elsewhere, are dominant. Litter aggregation on the seabed is localised, dependant on nearby source inputs and seabed topography (Galgani et al., 2000). The seabed topography of Scottish waters ranges from the continental shelf sea areas (<250m) to the deep ocean regions (>2000m).

The continental shelf is marked by features such as banks and deep channels with a dramatic continental slope of the west coast. The variation in the seabed can be illustrated by Figure 2-3. Local circulation patterns and hydraulic force from rivers can transport plastics away from the coast into deeper waters, accumulating in areas of low circulation and high sediment accumulation, such as coastal canyons (Galgani et al., 1996; Hess et al., 1999; Stefatos et al., 1999; Katsanevakis and Katsarou, 2004). The deep seabed is a stable

habitat, which influences material decomposition rates, thus increasing the residence time of benthic marine litter in the sink.

There is limited data on the abundance and distribution of meso- and micro-litter items on both the continental shelf and deep ocean (Galgani *et al*., 2000).

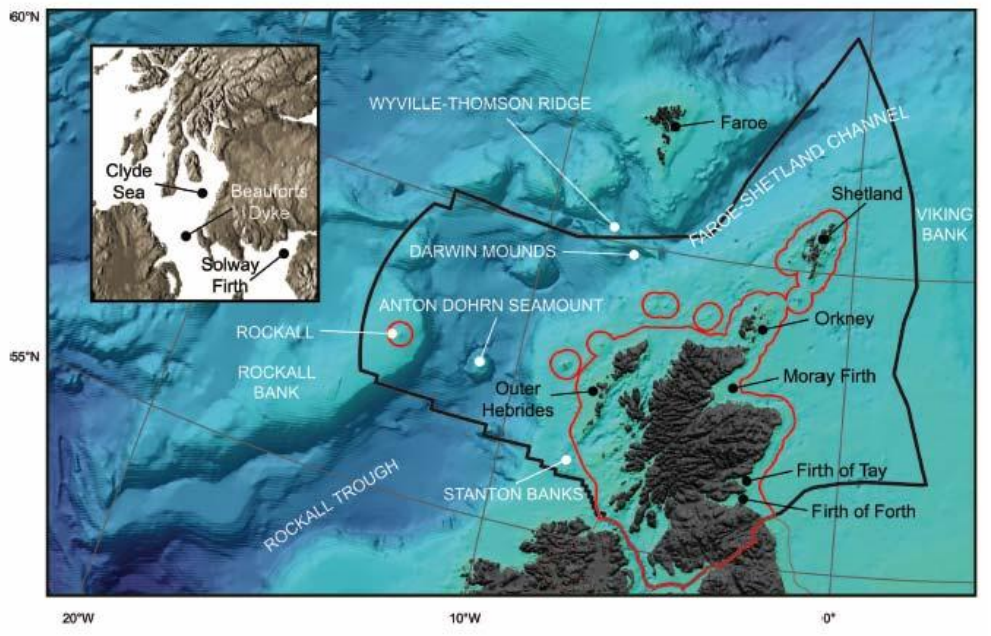

Figure 2-3 Bathymetry, seabed topography and geographical features of the seas around Scotland (taken from Baxter et al., 2008)

3 REVIEW OF THE IMPACTS ASSOCIATED WITH MARINE LITTER

There are numerous problems and threats caused directly or indirectly by marine litter, including environmental, social and economic impacts. These impacts are diverse, usually interconnected thus are harder to mitigate separately. Despite this our overall understanding of these issues is limited in some areas, particularly the indirect and socio-economic effects (Mouat *et al*., 2010). An example of this, are the differing impacts of ghost fishing, resulting in economic losses to commercial and recreational fisheries as well persistent and cumulative environmental impacts (Macfadyen *et al*., 2009).

Marine litter threatens the realisation of a shared vision for 'clean, healthy, safe, productive, biologically diverse marine and coastal environments, managed to meet the long term needs of nature and people'. The general implications for the Scottish economy are also widespread, such as beach cleaning, loss of tourism and the impacts of the fishing industry (damaged gear, lost commercial catches). Most noticeably, marine litter poses a considerable threat to the health and productivity of marine ecosystems. As such, the presence of marine litter in our seas may also impact upon Scotland's Strategic Objectives, most notably the drive to become a Greener, Wealthier & Fairer, Safer & Stronger and Healthier Scotland.

3.1 Environmental Impacts

As a result of the presence of marine litter there are a wide variety of short and long term adverse environmental impacts to individual organisms, species and ecosystems as a whole. Marine litter can damage benthic environments, cause a loss of biodiversity and lead to a reduction in overall ecosystem function (Moore, 2008; Derraik, 2002; Ten Brink, 2009).

The entanglement by and ingestion of, marine litter by organisms, are the most noticeable short-term impacts (Gregory, 2009; Thompson *et al*., 2009). It is estimated that 267 species are affected by marine litter globally of which 86% of all sea turtle species, 44% of seabird species, 43% of marine mammal species are affected (Laist, 1997; U.S. Commission on Ocean Policy, 2004; Allsopp *et al.*, 2006).Plastic litter in particular, is estimated to lead to the mortality either directly or indirectly of one million seabirds, 100,000 marine mammals (including 30,000 seals) and 100,000 turtles globally every year; either through entanglement or ingestion (Wallace, 1985; Laist, 1997; Moore, 2008).

Secondary long-term impacts are usually associated with the fate and interaction of in-situ debris over a long period of time. Ecosystem deterioration can result from a combination of these impacts, such as habitat damage (physical damage, fishing gear), reduced population size (bio-accumulation of toxins, increased competition from invasives, higher mortality rates) and biodiversity loss (Mouat *et al*., 2010).

3.1.1 Ingestion

Ingestion is one of the main impacts on marine wildlife. It is estimated that 177 marine species have ingested litter items which include whole plastic bags, gallon drums and balloons, mistakenly identified as food by mammal, turtle and shark species (Laist, 1997; MCS, 2009). Resin pellets, convenience food packaging and plastic bags are among some of the litter ingested by birds, marine mammals and sea turtles which are particularly

susceptible to floating plastic bags, mistaking them for jellyfish (U.S. Commission on Ocean Policy, 2004).

The ingestion of marine litter is well documented, with extensive literature and numerous international case studies (Gregory 1978, 1991; 2009; Mato *et al.* 2001; Oehlmann *et al.* 2009; Teuten *et al.* 2009; van Franeker *et al,* 2005; Laist, 1997).

The main physical problems, as a result of litter ingestion, being:

- wounds (internal and external);
- blockage of oesophagus and damage to the digestive tract leading to internal infections, satiation, debilitation, drowning, and starvation;
- impaired reproductive capacity;
- reduced predator avoidance;
- impaired feeding capacity and malnutrition

Specifically, ingested plastic resin pellets can absorb and concentrate toxic compounds from surrounding seawater, inside marine mammals, fish and vertebrates, becoming potentially toxic. Organisms are at increased risk of diseases, altered hormone levels and death as a result of ingestion (Derraik, 2002; Gregory, 2009; OSPAR, 2009).

There are various accounts of marine debris ingestion by a variety of seabirds over the last 50 years (Laist, 1997; Gregory, 2009). It is estimated at least 111 of the world's 312 species of seabird are known to have accidentally eaten plastic (Laist, 1997; Allsopp *et al*., 2006). Surface and plankton feeders (albatrosses, shearwaters, petrels, gulls, auklets and puffins), are the most susceptible seabirds to litter ingestion, due to their feeding patterns. Plastic pellets and pieces are often mistaken by seabirds for food such as fish eggs and plankton, and are thus fed to chicks (Day *et al*., 1985).

Since 1979, research on the stomach contents of dead fulmars in the North Sea has been undertaken (Van Franeker *et al.*, 2008; OSPAR, 2010). An Ecological Quality Objective (EcoQo) to quantify plastic in seabird stomachs, has been developed from this research by OSPAR and is used to identify the extent of floating litter at sea (OSPAR, 2010) and has become a model for the implementation of the Marine Strategy Framework Directive.

Specifically the EcoQo states “There should be less than 10% of Northern Fulmars (Fulmarus glacialis) having 0.1 gram or more plastic in the stomach in samples of 50-100 beach washed fulmars from each of 5 different regions of the North Sea over a period of at least 5 years” (Van Franeker *et al*., 2008; OSPAR, 2010).

During the period 2003-2006 over 1000 beached fulmars were examined, with 45-60% having more than 0.1g of plastic in their stomachs (figure 3-1). The Scottish Islands were comparatively uncontaminated, with fulmar stomachs containing only a third of marine debris encountered by fulmars in the Channel area. However despite this, 50% of beach-washed fulmars on the Scottish Islands still breached the EcoQo level (Van Franeker *et al*., 2008).

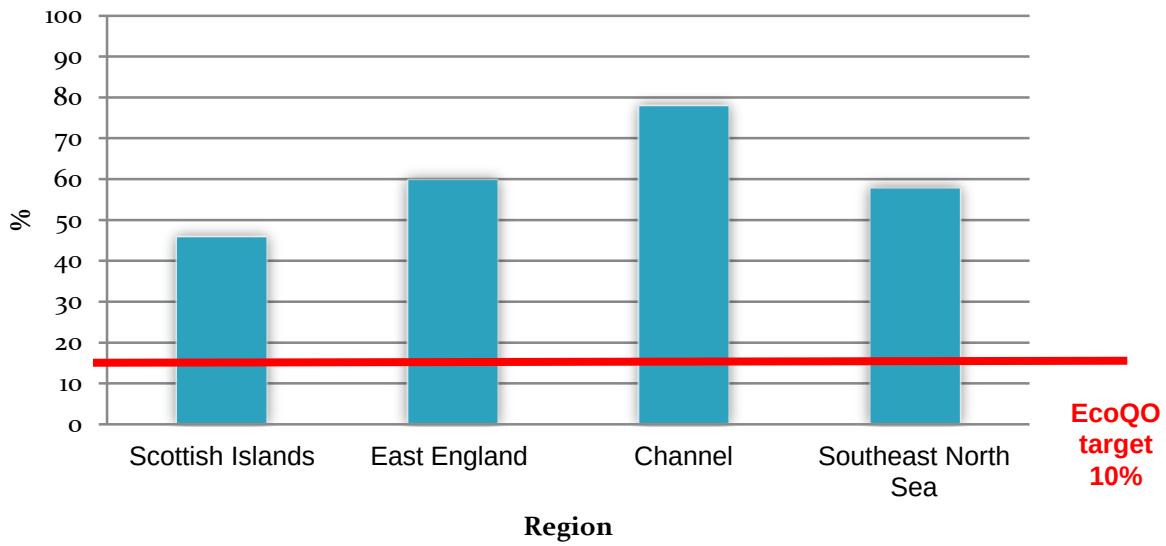

Figure 3-1 The EcoQO performance of Fulmars from study areas around the North Sea over the 5 year period 2002 - 2006: the percentage of beached Fulmars having more than 0.1g plastic in the stomach (adapted from OSPAR, 2010)

Specific marine litter items such as plastic bags suspended in the water column can resemble prey and thus have a greater probability of ingestion and impact (Bugoni *et al.*, 2001; Balazs, 1985; Tomas *et al*., 2002). This can often impact upon turtle species, which are becoming increasingly common in UK waters (Figure 3-3). For example the stomach contents of a Leatherback turtle (*Dermochelys coriacea*) found in Galloway, contained seven different types of plastic bag (MCS, 2009).

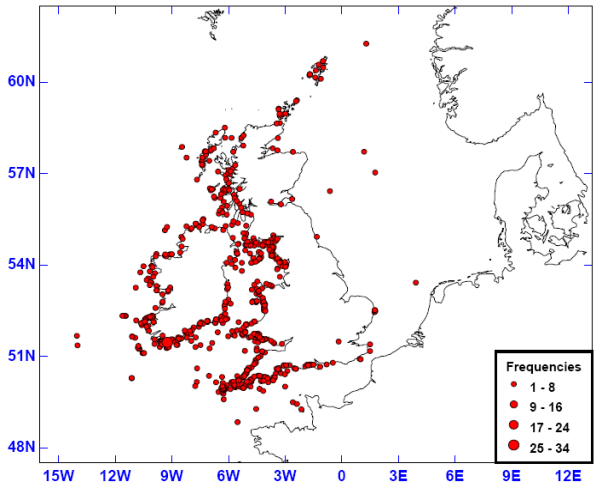

Figure 3-2 Distribution (sightings & strandings) of turtle species in UK coastal waters 1999-2009 (Taken from Penrose & Gander, 2010)

Ingestion has been reported to have caused the death or injury of Cuvier's Beaked whale, Minke whale and grey seals in UK waters. Many such species are BAP species or protected Nature Conservation (Scotland) Act 2004 and the Habitats and Species Directives for example.

The impacts of marine litter on lower trophic levels influence population size and prey availability having greater implications for higher trophic levels and the stability of the food web. For example small plastic pieces can enter the food web through their ingestion by filter feeders, deposit feeders and detritivores, possibly leading to bio-accumulation in their predators and higher trophic levels (Thompson *et al*., 2004; Browne *et al.,* 2008). However relatively little data is available on the specific impacts on lower trophic levels and further research is needed.

3.1.2 Entanglement

Entanglement by items such as fishing nets and line, lures, light sticks, crab/lobster/fish traps, plastic bags, strapping bands and four/six pack yokes pose a significant risk to marine organisms (MCS, 2009; Ten Brink, 2009). These items are responsible for an estimated 62% of all entanglements and can reduce movement, cause injury and in some cases death from starvation, drowning or suffocation (MCS, 2009; Ocean Conservancy, 2009).

An estimated 136 species of marine vertebrate and eight invertebrate species have been reported entangled in marine litter including six turtle species, 11 cetacean species, 19 pinniped species, 51 seabird species and 34 fish species (Laist, 1997; Ten Brink, 2009).

The main physical problems, as a result of litter entanglement, being (Derraik 2002; Gregory 2009; Mouat *et al*., 2010):

- wounds (external) which can cause infection, ulceration and death;
- asphyxiation (fish- require motion for respiration);
- reduced fitness due to increased energy costs of travel;
- impaired reproductive capacity;
- reduced predator avoidance due to impaired mobility;
- impaired feeding capacity and malnutrition;
- restricted growth and reduced circulation to limbs

It is estimated up to 100,000 marine mammals per year die as a result of entanglement in lost fishing gear and other marine debris (Moore, 2008; Wallace, 1985). Although the risk of death caused by entanglement is greater than ingestion, quantifying mortality rates is difficult as a large proportion of casualties are consumed by predators or sink to the seafloor, with only beached animals recorded (Laist & Liffmann, 2000; Derraik, 2002; MCS, 2009).

Entanglement along with other ecological impacts of marine litter can hinder conservation efforts, accounting for a high proportion of mortality rates in endangered species.

3.1.3 Ghost fishing

Until the 1950's rope and cordage were made from natural fibres (Indian, Manila hemp and cotton), which quickly disintegrated in-situ when discarded and lost; posing only a short-term risk to marine organisms (Gregory, 2009). Natural fibres have since been replaced by synthetic materials due to their durability and cost effectiveness. As a result they pose a greater long-term risk when discarded creating a phenomena known as 'ghost fishing'.

Ghost fishing occurs when discarded or lost fishing gear (nets, ropes, traps) continue to catch and kill fish and marine animals in-situ, particularly if the nets are intact (MCS, 2009; UNEP, 2009). This can cause a loss to commercial catches and impact protected species populations (UNEP, 2009).

Net losses have been shown to be generally less than 1 %; the overall length of net lost annually is 209 km for European fisheries. An exception to this is the deepwater fisheries for Monkfish in the North east Atlantic where it has been shown over 25,000 nets are lost each year with an overall length of 1254 km (Brown and Macfayden, 2007).

The efficiency of ghost fishing is dependant on the type fishing gear and local environmental conditions; most notably the degree of exposure and wave conditions and the bottom substrate, with rocky areas tangling nets within a much shorter time frame than muddy or sandy sediments. The nets themselves are likely to remain intact in the environment for some time due to their synthetic construction, yet it has been shown in an European wide study (FANTARED) the catching capacity of the nets is often limited to a few weeks due to deterioration in net structure and the weighting and closing of the nets by their initial catches (Pawson, 2003).

Since ghost fishing is inherently indiscriminate, a diverse range of species are affected, including seabirds, seals, cetaceans and commercially important fish species (Macfadyen *et al*., 2009). As with general entanglement there is increasing concern of the overall impact on vulnerable or endangered species (Allsopp *et al*., 2006; Sheavly &Register, 2007). It is estimated that 130,000 cetaceans are killed globally each year by ghost fishing (Ten Brink, 2009).

Commercial fisheries are affected by reduced recruitment and reduction in reproductive potential, caused by the capture of immature fish by ghost fishing (Williams *et al*., 2005; Macfadyen *et al*., 2009), although this impact is thought to be small compared to direct catches. The Committee on the Effectiveness of International and National Measures to Prevent and Reduce Marine Debris and Its Impacts (2008) estimate that ghost fishing accounts for < 5% of commercial EU landings for gillnet and tangle net fisheries and <1.5% of commercial monkfish landings (Brown *et al*., 2005). In the case of smaller stocks however, ghost fishing may be cause for concern, especially for those of conservation concern.

3.1.4 Secondary pollutants

The increased fragmentation of in-situ plastic litter items, can lead to the production of micro-plastics and chemicals (Thompson *et al*., 2009). Micro-plastics also enter the oceans, from commercial activities (cleansing and air blasting) where they are used as ‘scrubbers’ (Derraik 2002; Thompson et al 2009).

Micro-plastics and associated chemicals are transferred to the aquatic food web and up trophic levels, from their ingestion by marine species such as mussels and pose a significant threat to a wider range of organisms due to their size (Thompson *et al.*, 2004; Barnes et al 2009).

In addition, micro-plastics concentrate organic pollutants such as PCBs, DDE and nonylphenols (Barnes *et al*., 2009; Moore, 2008). This enables these pollutants to enter

living organisms and food webs (Committee on the Effectiveness of International and National Measures to Prevent and Reduce Marine Debris and Its Impacts et al 2008; DEFRA 2011).

The full biological effects of associated pollutants are currently unknown (Thompson *et al*., 2009). Indeed the overall uptake of micro-plastics and full environmental implications are unknown but their abundance has increased and will continue to, due to their longevity in the marine environment (Thompson *et al*., 2009; Thompson et al 2004).

3.1.5 Introduced species

The proliferation of marine litter particularly plastics provide additional opportunities for the dispersal of non-native, potentially invasive species (Lewis et al., 2005; Gregory 2009). The type and size of debris can influence colonisation patterns and biota (Moret-Ferguson et al., 2010).

It is estimated marine litter has doubled or tripled dispersal opportunities for marine organisms (Allsopp *et al.*, 2006). Although dispersal routes are passive, dependent upon ocean currents, they contribute to increased frequency of travel and allow non-native species to adapt to local climatic conditions due to the slow rate of travel. Thus they can be more effective a vector than ship hulls and ballast water (Moore, 2008).

The most common biota attached to marine litter are barnacles, bryozoans and polychaete worms (Allsopp *et al.*, 2006). The increasing northward distribution of a number of species for example the large barnacle (*Perforatus perforatus*) and the Australasian barnacle (*Austrominius modestus*), has been attributed to marine litter as a vector (Rees & Southward, 2008; Moore, 2008). Climate is often a limiting factor with many introduced and potentially invasive species; however their range may extend northwards towards Scotland with a warming climate (Hiscock *et al*., 2004).

Invasive non-native species have been shown to out compete native species and inadvertently cause biodiversity loss, changes to trophic and habitat structure and ecosystem functions (Derraik 2002; Donnan 2009). Due to these devastating environmental effects, invasive species are recognised as one the greatest threats to global biodiversity (Barnes and Milner 2005). The economic impact of such species can be substantial.

3.1.6 Benthic Habitats

Physical damage to benthic habitats can include abrasion, scouring, breaking and smothering (Sheavly & Register, 2007). The smothering of benthic organisms on the seafloor is due to reduced oxygen in sediments caused by litter, which prevents gas exchange between overlying waters. This can lead to changes in the composition of biota on the seafloor (Derraik, 2002). A great deal of marine litter is likely to accumulate on the seafloor, yet despite this the long-term threat to benthic organisms and habitats is relatively unknown.

3.1.7 Ecosystem deterioration

The long-term impacts of marine litter through combined pressures such as entanglement, ingestion, damage to benthic environments and loss of biodiversity, on ecosystem deterioration are relatively uncertain (Hyrenbach and Kennish, 2008). Despite a lack of research into the impact of marine litter on ecosystem services, it is highly likely that litter reduces the resilience of ecosystems, and hence the quality of ecosystem services they provide.

The pressures of marine litter add to other anthropological stressors in the marine environment, such as over-fishing, coastal development, ocean acidification and pollution events (Derraik, 2002).This amalgamation of environmental stressors may combine to cause ecosystem deterioration (either in the short or long term) and reduce ecosystem resilience to withstand large perturbations in the environment, such as climate change (ICC, 2009).

3.2 Social Impacts

Marine litter causes social impacts such as direct short-term public health issues (injuries, entanglement and navigational hazards) and indirect, long-term impacts on quality of life (recreational opportunities, loss of aesthetic value and loss of non-use value). There is limited data on the overall influence marine litter has on society, and further research is needed (Cheshire *et al*., 2009; Mouat *et al*., 2010).

3.2.1 Public Health Issues

Marine litter can pose significant risks to human health and is considered a public health issue, both as beached litter or circulating in coastal waters (Fanshawe & Everard, 2002; Sheavly & Register, 2007). Beached marine litter such as broken glass, medical waste, fishing line, and discarded syringes can harm beach users as well as the risks associated with the leaching of poisonous chemicals (Rees & Pond, 1994; Sheavly & Register, 2007; Thompson *et al*., 2009). In the UK, between 1988 and 1991, 4% of injuries by needles reported to the Public Health Laboratory Service in the Southwest of England were sustained on the beach (Phillip, 1993; Fanshawe & Everard, 2002).

Sewage related debris is particularly harmful and is considered a potential biohazard and may act as a vector for viruses and bacteria (Rees & Pond, 1994). More indirect effects come in the form of wider social impacts, influencing UK coastal tourism and the local economy as a result.

Establishing the frequency and overall extent of incidents, is difficult as most incidents are unrecorded (Laist & Liffmann, 2000; Sheavly, 2005).

3.2.2 Sewage Related Debris

One of the main sources of SRD is from combined sewage overflows and constitutes sanitary products such as nappies, baby wipes, condoms, tampon applicators and needles (Sheavly & Register, 2007). Over one and a half billion sanitary items are deposited in UK toilets per year (Defra, 2005b). In 2003, Scottish Water reported 340 million items in Scotland flushed a year at a cost of £16 million (Scottish Water 2003).

SRD may present serious water quality concerns as with the presence of these items there is increased risk of bacterial (e.g. E. coli) and viral contamination of surrounding coastal waters. Indeed consumption of or contact with contaminated water can pose a risk of contracting hepatitis, cholera, typhoid, diarrhoea, bacillary dysentery and skin rashes (Defra, 2005b; Williams *et al*., 2005). These problems have resulted in expensive closures of beaches in the US.

3.2.3 Human entanglement

Entanglement can also pose a serious threat to recreational users, particularly for swimmers, snorkelers and SCUBA divers who can become entangled in submerged or floating debris, such as fishing nets and ropes. According to the British Sub-Aqua Club, approximately one or two entanglement incidents occur each year in the UK and are potentially life-threatening, usually involving monofilament netting (Fanshawe & Everard, 2002; Mouat *et al*., 2010).

3.2.4 Navigational hazards: Non-military

Marine litter poses navigational hazards to all kinds of vessels (submarines, passenger ferries, fishing vessels) and can result in serious consequences, including loss of life (Allsopp *et al*., 2006; Chivers & Drew 2005; Macfadyen *et al*., 2009). However evidence of incidents endangering vessels' safety is usually anecdotal with the majority of incidents unreported, thus the overall impact and risk is difficult to evaluate.

The main risks to navigation from marine litter (particularly during poor weather conditions) include:

- fouling and entanglement of a vessel's propeller in derelict fishing gear: reducing stability and the ability to manoeuvre;
- blockage of water intakes by plastic bags;
- subsurface debris can foul anchors and equipment deployed from trawlers and research vessels;
- collisions can damage a vessel's propeller shaft seal;
- recovery procedures which require divers increases risk of personal injury (Sheavly & Register, 2007; Macfadyen *et al*., 2009; Mouat *et al*., 2010).

3.2.5 Navigational hazards: Military

In addition to normal navigational hazards by pleasure craft and commercial enterprise, the same risks also apply to military activities which are active in the marine, submarine and inter-littoral zones. Marine litter can disturb the physical environment, affecting the ability to detect certain phenomena many of which are important to the UK's defence capability. These include surface and submarine navigation and geo-acoustics (Fanshawe & Everard, 2002).

3.2.6 Threats to fishermen

Threats to fishermen can include the snagging of fishing gear on marine litter, increasing the risk of capsize, and in some circumstances resulting in loss of life. Objects caught in nets

and brought aboard can also contain toxic substances or disposed of munitions (Edwards, 1995; Olin *et al.,* 1995).

Remediation and preventative measures include the deployment of surveillance aircraft to identify the location of lost objects; the notification to mariners of the location of floating or sunken containers, cargo or debris; the emergency towing of floating containers; and the transfer of cargo from a stricken vessel, all of which are dependent on the availability of financial resources (Fanshawe & Everard, 2002).

3.2.7 Agriculture

The transfer of litter between the land and sea can also be reversed where beached marine litter is windblown back ashore, affecting coastal communities. This has been shown to damage to property and equipment including stock fencing where the litter accumulation prevents wind movement through the fencing and will ultimately flatten effected fencing. Other impacts include harm to livestock through ingestion and entanglement and the resulting economic impact to the land owner/farmer.

In the Shetland Islands, 96% of crofters reported marine litter on their land, including plastic, rope, strapping bands and nets (Mouat, 2010).

3.2.8 Coastal industries

Marine litter has been shown to impact upon industry such as coastal power stations via blockages in intake pipes (Fanshawe & Everard, 2002). Thus screening is required along with automated clearance mechanisms and manual labour to clear blockages. Regular clearances are necessary thus contributing to overall running costs.

3.2.9 Flood defence

Litter clearance is also necessary for coastal defences. Drains and weirs need to be cleared and protected in order to efficiently divert waters away from vulnerable flood zones (Fanshawe & Everard, 2002). The high cost of cleaning and potential damage as a result of defence failures, heightens the overall impact marine litter has on society.

3.2.10 Recreational activities

The marine and coastal zones offer the opportunity for many social and recreational activities such as swimming, diving, boating, and recreational fishing. The accumulation of marine litter can act as a strong but subjective deterrent from these activities (Ballance *et al.*, 2000; Sheavly & Register 2005).

Ballance *et al.*, (2000) and ENCAMS (2005) showed the majority of beach users rank cleanliness as a priority in their choice of destination, with 97% avoiding beaches with more than 10 large litter items per metre. Other recreational users such as divers are deterred by the accumulation of marine litter due to the loss of visual amenity and greater health and safety risks (Sheavly & Register, 2007; Cheshire *et al*., 2009). More research is required to determine the overall affects marine litter has on recreational use.

Studies for Scotland have shown that 99% of Scottish beach visitors rated litter free sand as the most important thing they wanted to see at beaches they visited. (Dow, 2004) and another focussed on Scottish Community Councils who responded to a survey highlighting that the greatest perceived problem to the beaches in their area was marine and coastal litter. Erosion and sewage pollution were also seen as problems (Clean Coast Scotland, 2002).

3.2.11 Aesthetic and non-use value

Marine litter can devalue the visual amenity of the coastal and marine landscape, influencing the tourism sector; recreational activities; the inspirational quality of the marine environment, which is frequently the focus of many of the creative arts; and ultimately the local economy and quality of life for coastal communities (Cheshire *et al*., 2009; Naturvårdsverket 2009).

The mere knowledge that an ecosystem exists and is maintained is of value in itself. Marine litter deprecates the following non-use values (existence, bequest and altruistic):

- the knowledge of the existence of a desirable coastal and marine environment;
- the ability to bequest unimpaired resources to future generations;
- the altruistic benefits of preservation for other users;
- the inherent belief that a litter-free marine environment is intrinsically desirable

(Committee on the Effectiveness of International and National Measures to Prevent and Reduce Marine Debris and Its Impacts *et al*., 2008).

3.3 Economic Impact of Marine Litter

3.3.1 Overview

Marine litter has a substantial direct and indirect impact upon the Scottish and UK economy. For several years policy makers and communities have experienced the problem of marine litter on beaches, waterways, bays and ports and the subsequent impacts on a range of economic activities. Marine litter is a serious non-point source pollution problem that is pervasive, and impacts users of the marine in several ways. Of these, the direct impacts are the most obvious, from local authorities responsible for clean-up activities, the loss of tourism expenditure or shifts in tourism activity, and the loss of vessel activity as a result of propeller fouling or bringing up litter in fishing nets. Indirect impacts can also be substantial and occur from a decline in the environmental quality of the coast that can cause losses in amenity and resulting losses in property values, opportunity costs and civic pride. Despite the uncertainties, marine litter also impacts upon ecosystem services. While economic costing of ecosystem services is considered a relatively new science, it is clear that marine and coastal litter can impact and deteriorate a range of natural functions that provide on-going social and economic benefits.

The full economic cost of the impact of marine litter on the environment is complex because some impacts are more readily evaluated than others. For example costs for cleaning operations or lost fishing revenue from entanglement are captured in traditional economic calculations but the economic implications of degraded ecosystem services are difficult to value (Mouat *et al.* 2010).

3.3.2 Total Economic Value

The concept of **total economic value** (TEV) (figure 3-3) is one of several approaches used in exploring the evaluation of the environment and is being used in research programs such as the UK National Ecosystem Assessment and the Crown Estate guidelines on valuing the marine environment (Saunders et al 2010). Ecosystem goods and services contribute to human wellbeing in several ways and individuals and communities place a value on these resources depending on their values and the social context. What the TEV framework does is explore the impacts on overall 'wellbeing' and classifies different types of economic value, including monetisation where possible. **Direct use** valuation is the most common approach and where most of the effort of valuation occurs. It classifies usage according to direct interaction with the ecosystem. It is split into **consumptive** uses such as fishing or extractive activities and **non-consumptive** uses that use ecosystems to confer benefits without extracting resources e.g. recreation and tourism. **Indirect use** refers to economic benefits derived from an ecosystem but do not relate to spatial interaction. This could be the broader societal benefits from nutrient cycling or waste management, or from socio-economic activities such as education, science, or culture. Option values refer to the potential for future uses of an ecosystem, or viewed as another way, an insurance policy for future societal activities. Non-use values are centred on societal interest in the 'existence' of natural systems and benefits that does not correlate with direct or indirect use of a resource. While important, they are difficult to quantify in direct monetary terms but can be captured by other approaches such as contingent valuation methods. Non-use values raise important ethical questions about sustainability and inter and intra generational equity concerning ecosystems. The Crown Estate (Saunders et al 2010) notes that while TEV is a tool to aid in decision-making, it does not aim to provide all of the answers about the valuation of ecosystem services - monetary valuation is not feasible for every type of resource or service.

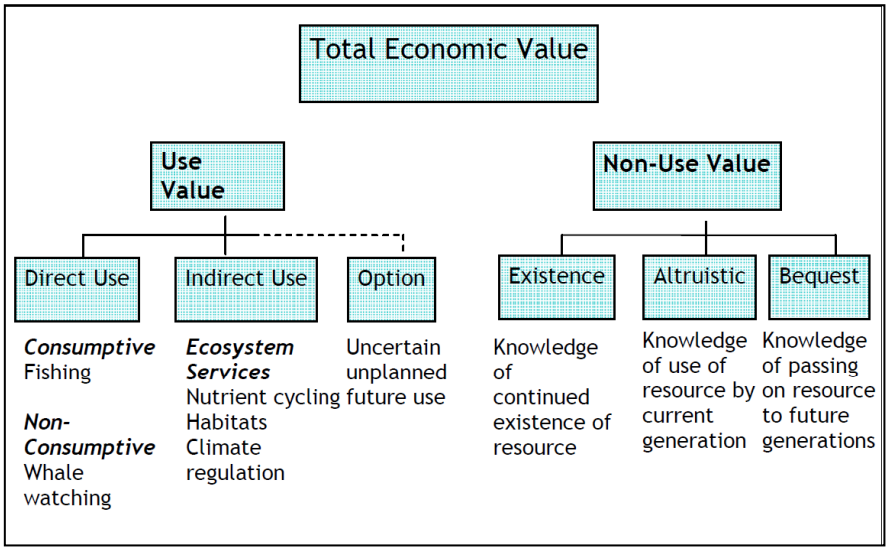

Figure 3-3 Total Economic Value Framework

3.3.3 The value of UK and Scottish Maritime Industries

For the UK as a whole the marine environment is economically important, supporting a diverse range of activities including marine resource extraction, tourism and commercial

shipping. The value of the UK maritime economy was valued by the Crown Estate in 2008 at £46 billion pounds (Pugh 2008). In 2005-06 direct marine related activities comprised 4.2% of UK GDP and approximately 890,000 jobs. The total of the direct and indirect contribution to GDP was approximately 6.2-6.9%. At the Scottish scale, the seas continue this trend of an important and valuable economic and social commodity. The 'Sustainable Seas for All' consultation (Scottish Government 2008) identified that the Scottish maritime economy contributed a minimum of £ 2.2 billion per annum supporting approximately 50 000 jobs (not including oil and gas extraction). Key sectors include oil and gas activities incidental to extraction (£1.12 billion per annum); fisheries, aquaculture and processing (£1.1 billion); ship and boat building (£300 million); and marine transport (£101 million). Recent assessments have been made for emerging sectors such as marine and coastal tourism and recreational fishing. Scottish Government (2010) identified that marine wildlife tourism has a net economic impact of £15 million, with 633 additional FTE jobs and coastal wildlife tourism has a net economic impact of £24 million with 995 additional FTE jobs. Sea angling was valued by the Scottish Government (2009) at £70 million per annum and supporting 3148 full time job equivalents. Marine litter has the capacity to affect all of the above sectors by impacting direct and indirect activity.

As noted in Ten Brink (2009) the costs associated with marine litter are often borne by parties different from those causing the problem. The result is that there is insufficient liability to the entities responsible for the marine litter problem, and a lack of incentives to reduce littering practice. Expressed differently - the polluter, whether it is industries or individuals, does not pay. This is compounded by lack of enforcement mechanisms and actions. Adding to this complexity is the fact that marine litter comes from a diverse array of sources - from land and sea, from individuals, communities, and industries across a variety of spatial scales. The resolution of these problems requires considerable policy innovation and the use of a portfolio of traditional command and control instruments, market based instruments and education and awareness raising initiatives. Indeed, the marine litter problem can be construed within the frame of a 'wicked problem' as defined by Jentoft (2008) where no clear technical solution can be found to a problem that crosses scales and interests. Addressing the problem of marine litter therefore requires investment in long term social change and policy innovation across jurisdictions.

3.3.4 Towards Understanding the Total Economic Impact on Marine Litter

Data on the economic impacts of marine litter in Scotland is sparse. Ten Brink et al (2009) reiterated that the understanding of the economic significance of marine litter remains relatively limited and this is particularly relevant at the Scottish scale. From Figure 3-4 below, the approximate economic cost of the marine litter problem in Scotland is **£16.8 million per annum**. However, this figure is underestimated – the economic costs are likely to be much higher as many sectors do not have data on impacts, and there is no research on the economic impacts of indirect, option, and non-use values (Figure 3-3). There is a need to further improve data collection across a range of sectors to gauge the direct and indirect economic costs.

Total Economic Value	Economic Impact of Litter	Turnover	Scale	Source
Direct use of the ecosystem				
Consumptive uses				
Fisheries	£ 10 280 000 p.a.	£ 443 million (2008)	Scotland	Mout *et al* 2010; Scottish Sea Fisheries Statistics 2009
Aquaculture	£ 133 562 p.a.	£ 367 million (2008)	Scotland	Mout *et al* 2010
Oil and gas	No data	£ 28.6 billion (2006)	UK	Pugh 2008
Agriculture	£841 / croft / pa	£2.28 billion (2008)	Shetland	Mout *et al* 2010, Scottish Economic Statistics 2008
Recreational Angling	No data	£69.67 million (2009)	Scotland	Scottish Government 2009
Non Consumptive				
Ports and Harbours	£1 385 386 p.a.	£8.1 billion (2008)	UK / Scotland	Mout *et al* 2010, Ports.org.uk, Pugh (2008)
Marinas	Emerging data	£113 million (2007)	UK	BMF (2007)
Tourism (Scottish total)	No data	£ 5.8 billion (2008)	Scotland	Deloitte 2008.
Marine and Coastal Wildlife Tourism	No data.	£92 million (2010)	Scotland	Scottish Government 2010
Recreational Sailing	No data	£101 million (2010)	Scotland	Scottish Enterprise 2010
Local authorities	£3 004 895		Scotland	Hall (2000) & Moat *et al* (2010)
Renewables	No data	32 million (2008)	UK	Pugh (2008)
Emergency services	£1 882 540 p.a.		UK	Moat et al (2010)
Indirect Use				
Volunteering	£112 906		Scotland	Mout et al 2010
Visual amenity	No data			
Ecosystem services	No data			

Figure 3-4 Impact of marine litter on maritime sectors

The implications for the Scottish economy are highly significant, from the cost of cleaning beaches, loss of tourism revenue, and the economic cost of direct impacts of damaged gear or lost commercial catches in fisheries. The most recent research on the economic impacts of marine litter was conducted by KIMO (Moat *et al* 2010) at the scale of the NE Atlantic, with a breakdown of the data to the UK scale and in some instances the Scottish scale. The KIMO method used a sector-based approach to investigate the increased costs and potential loss of revenue associated with marine litter for key industries. This report draws upon many of the KIMO figures to adapt to the Scottish scale.

Using the total economic value framework and the figures from the literature, a picture emerges of the considerable impacts of the litter problem. In the category of direct and consumptive use, fisheries sustained considerable economic impacts of £10 million pounds per annum in Scotland (Mout *et al* 2010). Aquaculture had considerably less impacts from litter at £133 562 per annum. Data on impacts upon other extractive sectors such as oil and gas, Scottish agriculture and recreational angling was non-existent. Mouat *et al* (2010) identified costs of £841 per croft per annum in the Shetlands and a total cost to agriculture in the Shetlands of £217 000 per annum. Further research on impacts across small scale and large scale agriculture Scotland is required to assess the true costs of marine litter.

A wide range of industries operate that utilise marine space and provide a variety of services. Marine litter imposes, at a minimum, a £6 million per annum economic impact on non-consumptive users. This is particularly problematic for local authorities who are responsible for cleaning litter off beaches for visitors and residents. From the KIMO study, an average figure of €145 586 per UK municipality was obtained; converting this to UK currency

and multiplying across the 24 coastal authorities in Scotland results in clean-up costs of over £3 000 000 per annum. While the costs per municipality are inherently variable, this gives an indicative figure of the extent of the problem.

For the tourism industry, recreational sailing and the emerging renewables industry there is a lack of data on the impacts caused by marine litter. In the case of tourism, a critically important industry for coastal regions, marine litter may cause deterioration in the quality of the location, the experience of the visitor and may change the preference of location. The study by Ballance *et al* (2000) found that 85% of tourists and residents would not visit a beach with more than 2 debris items per metre and 97% would not go to a beach with 10 or more large items of litter per metre. This could lead to a shift in the geography of tourism, and impact the 'brand' of tourism industries. For example, the Scottish Government has recognised the importance of developing the wildlife and ecotourism sector (Scottish Government 2010). Marine litter can compromise the 'clean and green' image that is important for the sector and for tourism in general. The level of litter to deter tourists from visiting certain areas is a subjective issue depending on personal preference, the activity and litter levels in surrounding regions. As highlighted in Balance *et al* (2000) and Mout *et al* (2010) there is a pressing need to advance research on the perceptions and interactions between tourists and coastal litter and at what level litter will shift tourism away from a particular site.

In terms of indirect use, the picture on impacts is unclear. The challenge is to identify the range of services implied by indirect use than calculate the benefits and estimate the costs. Volunteering is one area that could be considered an indirect use of a coastal system as volunteers and groups offer services based on respect and for local environmental amenity. Data is emerging for the impacts of marine litter on volunteering. Mout *et al* (2010) conducted a survey that calculated that in recent Marine Conservation Society and Keep Scotland Beautiful beach cleaning campaigns, 8809 volunteers contributed £112 906 to removing beach litter. While one interpretation of this impact is a 'cost' to volunteer time, it could also be considered a positive impact to improving social capital and coastal awareness. Visual amenity is another indirect impact of marine litter and could affect property prices in coastal areas as well as impact tourism and a range of non-use values such as publicity and civic pride. Aesthetic costs occur when the presence of marine litter in an area affects the public's perception about the quality of the surrounding marine environment, water quality and amenities. This negative perception potentially impacts the value of local property and the quality of life of residents.

3.3.5 Ecosystem impacts

Emerging research in the UK is exploring the value of ecosystem goods and services but the impact of marine litter upon these values is at this point in time unclear. This report concurs with Ten Brink *et al* (2009) and Moat *et al* (2010) that we do not have a complete picture of the magnitude of impacts associated with the incidence of marine litter, particularly in relation to the impacts upon ecosystem services and resilience. Resilience is an important concept that relates to the ability of natural systems to maintain structure and function in the face of environmental change. Marine litter is an additional pressure in a stressed marine and coastal environment that is facing cumulative pressures from climate change, pollution, development and extraction of biological resources.

As described above through the TEV framework, the coastal systems provide many valuable services and these can be packaged in different ways as 'benefits'. However uncertainty often exists due to the variability of ecosystem functioning at different scales and the links between ecosystem functions, services and flows of benefits. Generally speaking, ecosystem services such supporting, provisioning, regulating or cultural services offer a benefit if there is a direct or indirect human gain – some of which can be quantified by economic transactions or qualitative assessments (Figure 3-5).

While there is limited data on the impact of marine litter on ecosystem processes (Figure 3-5) it is clear from this study that there are significant impacts upon ecosystem services and benefits for society. While our understanding of impacts is improving in regards to direct economic activities, when it comes to a broader array of ecological services such as waste assimilation or pollution control, our understanding is limited in terms of the process itself and the economic impact. While a total economic figure may be elusive at this time, it is clear that litter will negatively affect a range of primary processes, final ecosystem services and the resulting goods and benefits for people.

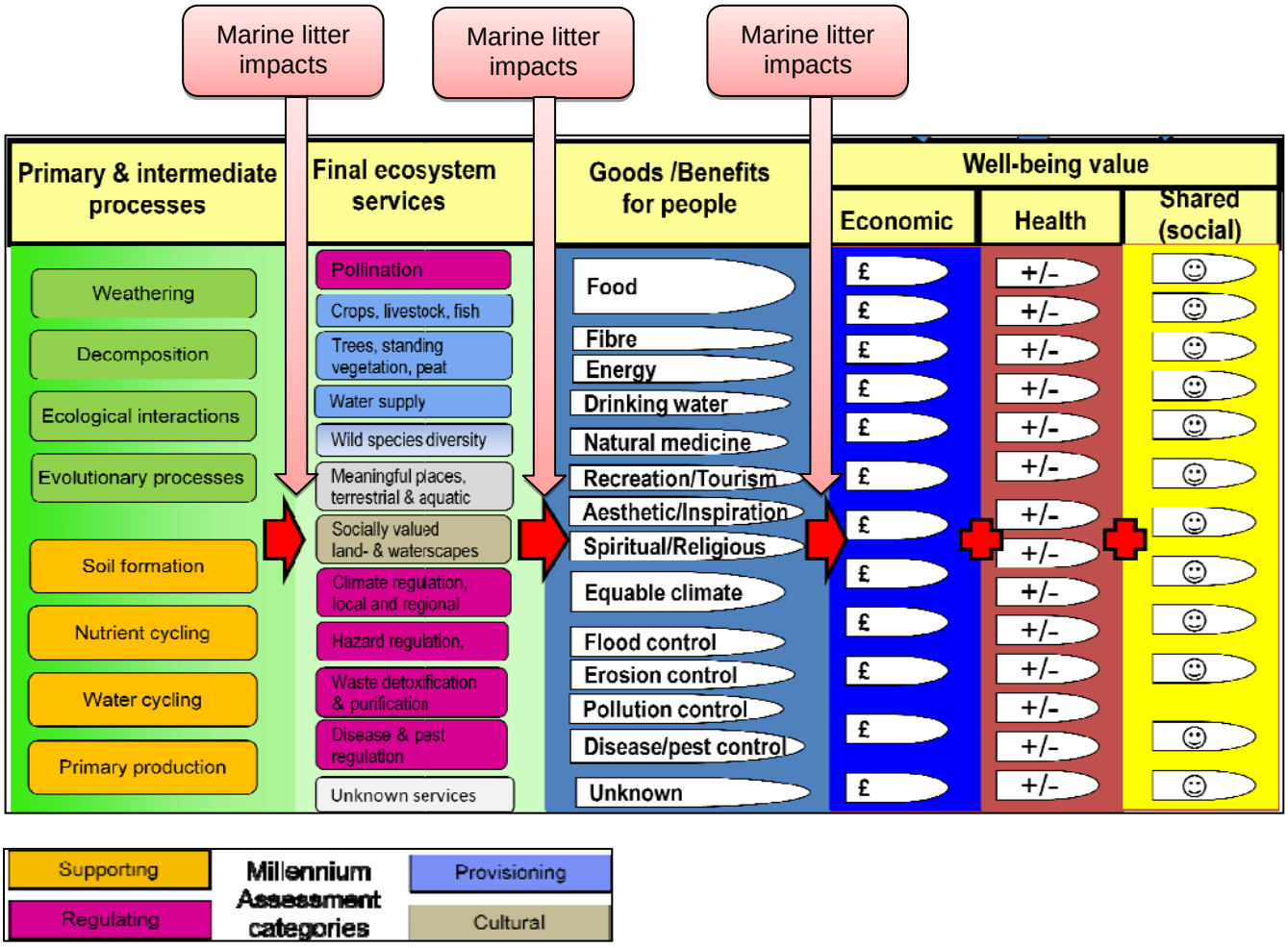

Figure 3-5 The interaction of litter with ecosystem services and benefits. Adapted from NE (2010)

It is clear that marine litter undermines a range of ecosystems processes and benefits and that there are clear gaps in the evidence base in capturing the impacts upon total economic value (Figure 3-6). Under the direct use domain, gaps remain across individual sectors such as oil and gas, agriculture, angling, and parts of the tourism and recreational industries. Further research is needed to gauge the preferences of visitors towards areas that are impacted by litter and the extent of the shifting of tourism activity. Indirect uses including ecosystem service benefits, option values and non-use 'existence' values that relate to cultural wellbeing can be quantified, but this is a relatively new field of research and no data is currently available at the Scottish scale. This paper endorses further evidence gathering to assess the impacts of marine litter across all areas of total economic value to inform a future strategy.

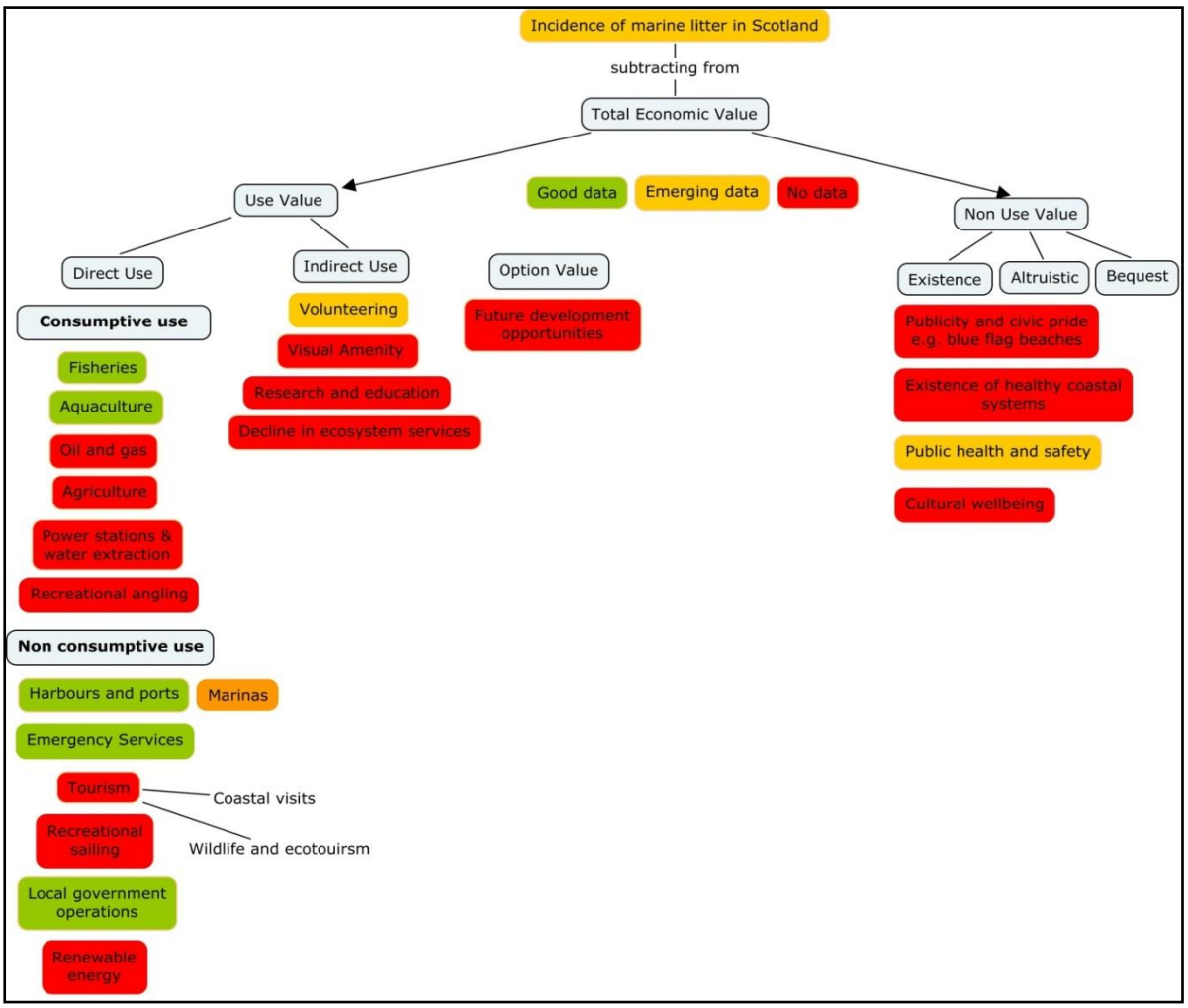

Figure 3-6 Status of data for assessing the impacts of marine litter on total economic value

4 CURRENT STATUS AND REMEDIATION INITIATIVES

Baseline data for Scotland are limited mostly to coastal surveys of beached marine litter. For Scotland the key datasets available are via the Marine Conservation Society (MCS) Beachwatch programme, Keep Scotland Beautiful and KIMO's Fishing for Litter.

4.1 Coastal litter

In 2010, a total of 53,162 items of litter were collected on selected Scottish beaches, covering a length of 22.3 km. The Scottish average of 2382 items per km was higher than the UK average (1969 items/km) of the same year (Figure 4-1). Since 1996, there has been an overall decrease in litter density (Figure 4-2), but there has been a steady rise since 2000 (MCS, 2009).

An analysis of the type and sources of litter from MCS (2011) revealed 37.5% of all Scottish litter originated from the 'public', 29.6% non-sourced, 20.5% from SRD, 8.9% from fishing, 1.7% from shipping, 1.6% fly-tipped and 0.2% medical. This does identify those sources requiring most attention but it should be noted that litter items can be very difficult to source either due to the impact of weathering or their generic nature.

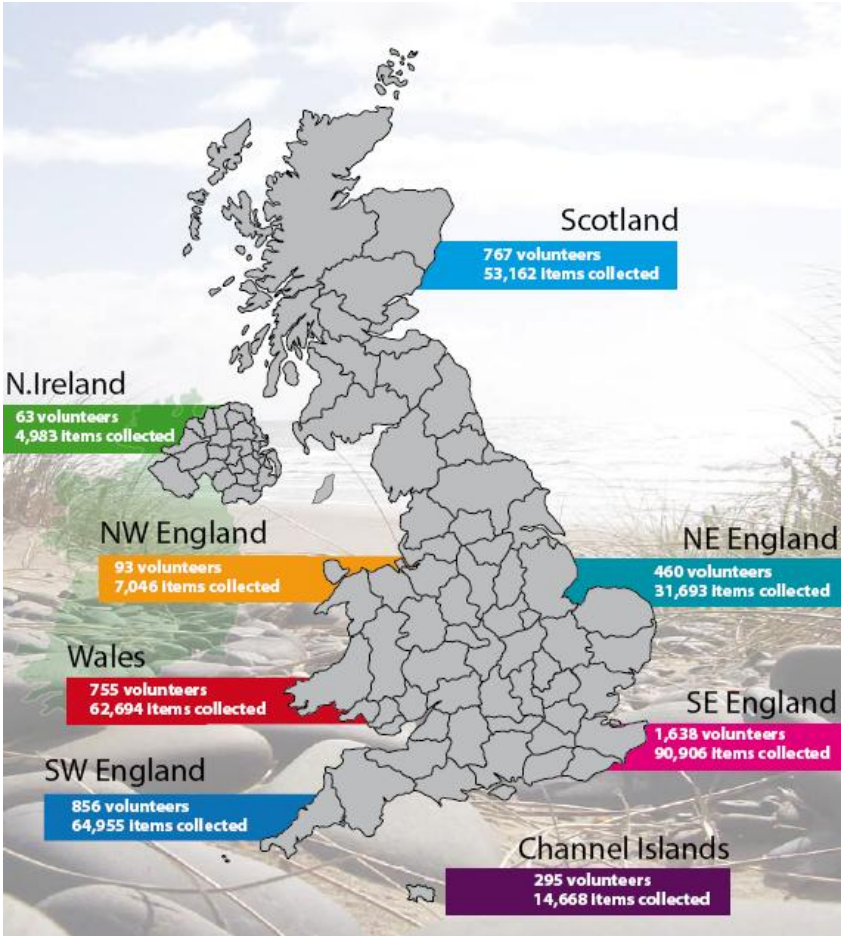

Figure 4-1 Average number of litter items per km in 2008 (MCS, 2011)

Sewage related debris (SRD) accounted for 20.5% of coastal litter (487.8 items/km)during the 2010 survey; significantly higher than the 7.3% UK average. East Bay Helensburgh beach was disproportionably affected by SRD, and has skewed the Scottish average. By removing the results from this beach, SRD constitutes 12% of all litter found on Scottish beaches, still nearly double the UK average.

To work towards resolving this issue Scottish Water have recently completed an extensive network upgrade in Helensburgh, which aims to reduce the frequency of CSO use and consequently the levels of SRD. This work was completed prior to the 2010 survey.

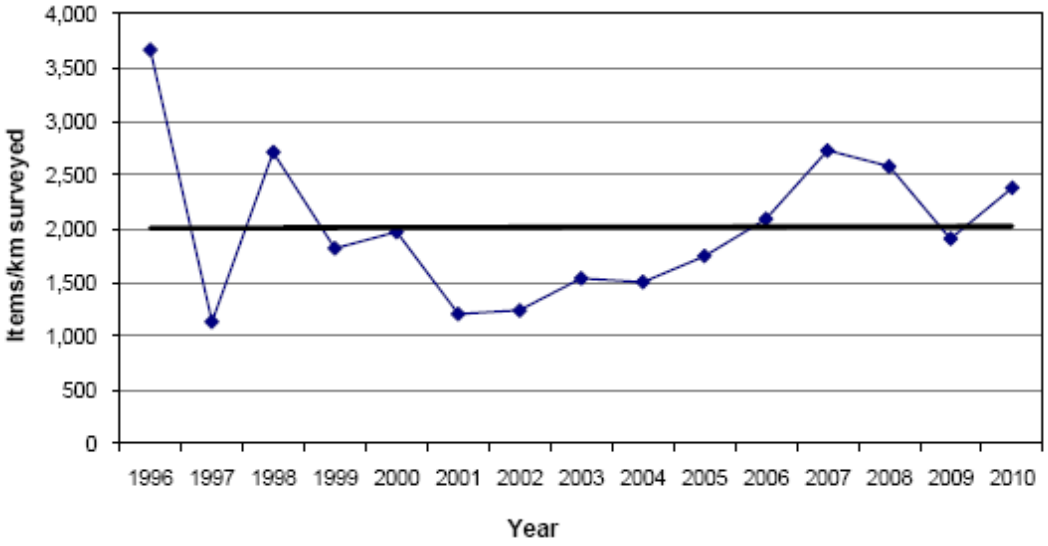

Figure 4-2 Mean items/km in Scotland, Beachwatch surveys 1996-2010(Taken from MCS, 2011)

At the UK level plastic continued to be the most dominant type of marine litter, accounting for 63.5% of all litter which is proportionally the highest to date. The most common items representing 41% of all the plastic recorded, were plastic pieces <2.5 cm, plastic pieces > 2.5 cm, wrappers (crisp, sweet, lolly, sandwich), rope (including cord & string) and lids. In addition, many items in the sewage related debris category are comprised of plastic parts; therefore the overall percentage of plastics could be over 75%.

Other litter types include polystyrene (9%), paper (3.7%), metal (6%), glass (3.7%), sanitary products (7.3%), animal faeces (0.4%), and medical (0.3%) of which may pose potential biohazard risks (MCS, 2011).

4.2 Regional Seas

The Defra report, Charting Progress (Defra, 2005a) recently updated as Charting Progress 2 (Defra, 2011a) assessed Beachwatch data to provide an indicator on one of a number of key human impacts on the marine environment. For the purpose of Charting Progress, UK waters are separated into eight regional seas (Figure 4-3).

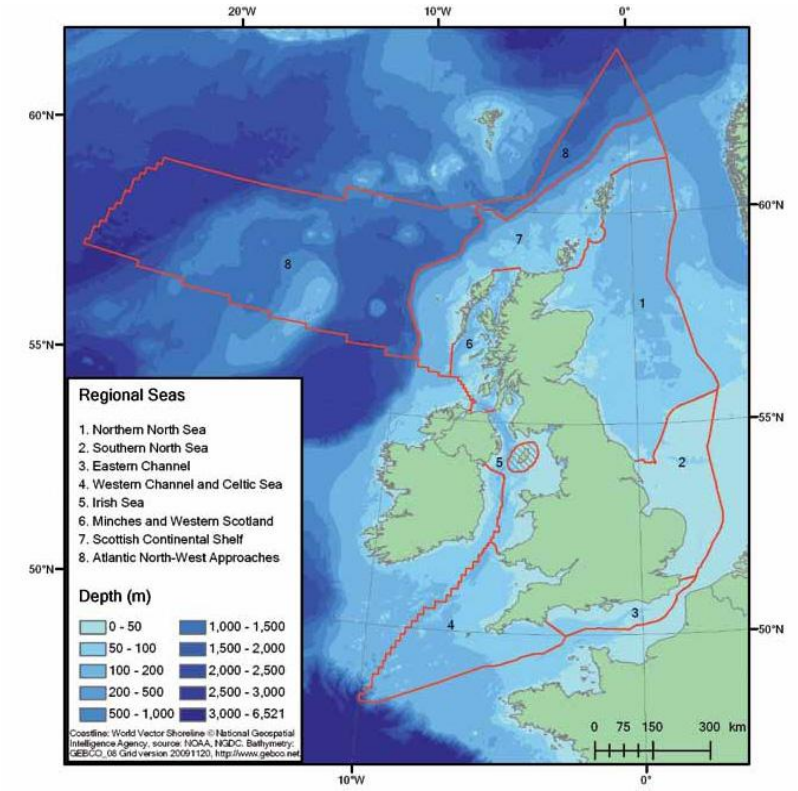

Figure 4-3 Charting Progress 2 Regional Sea boundaries (Defra, 2011a)

Two regions are particularly relevant to Scotland; Region 6 and 7. Region 8 although relevant did not have sufficient data.

Region 1 (Northern North Sea) includes the east coast of Scotland, but extends past the Scottish border to include the English coastline and Region 5 (Irish Sea) includes the west coast of Scotland, and also includes the coastlines of Wales and Ireland. Thus regional summaries for these coastlines will be unrepresentative of Scotland only. Both regions however have been summarised as having an aesthetic and economic problem as a result of beach litter, and that more research is required to assess the overall ecological impact (Defra, 2011b).

In 2009, only three beaches (totalling 2.7 km) were surveyed in region 6, therefore conclusions drawn for this data could be unrepresentative of the region.

Public debris was found to be the main source of litter, contributing 53.5% of litter; proportionally higher than the other regions (figure4-4) (MCS, 2009). Comparatively region 6 also had the second highest proportion of shipping related litter (3.3%). Only four items (0.2%) of medical waste were recorded and four items were fly-tipped (0.2%) possibly reflecting the small population sizes in the region. Additional uncertainties for this region include the large proportion of litter that could not be sourced (24.5%) (MCS, 2009).

In 2009, two beaches (totalling 0.1 km) were surveyed in region 7, and the high litter density is a result of this small sample size (MCS, 2009). Conclusions drawn from this data could be unrepresentative of the region. Fishing debris was found to be the main source of litter, contributing 34.8% of litter; proportionally higher than the other regions. Comparatively

region 7 also had the highest proportion of shipping related litter (6.6%) and the lowest proportion of SRD (0.7%). No medical waste was recorded and only 2 items were fly-tipped (0.2%) (MCS, 2009).

These results may reflect the substantial influence fisheries and shipping have in this region, and the comparatively low population densities (and consequently the low levels of SRD, public sourced litter and fly tipping). Additional uncertainties for this region include the large proportion of litter that could not be sourced (33.5%).

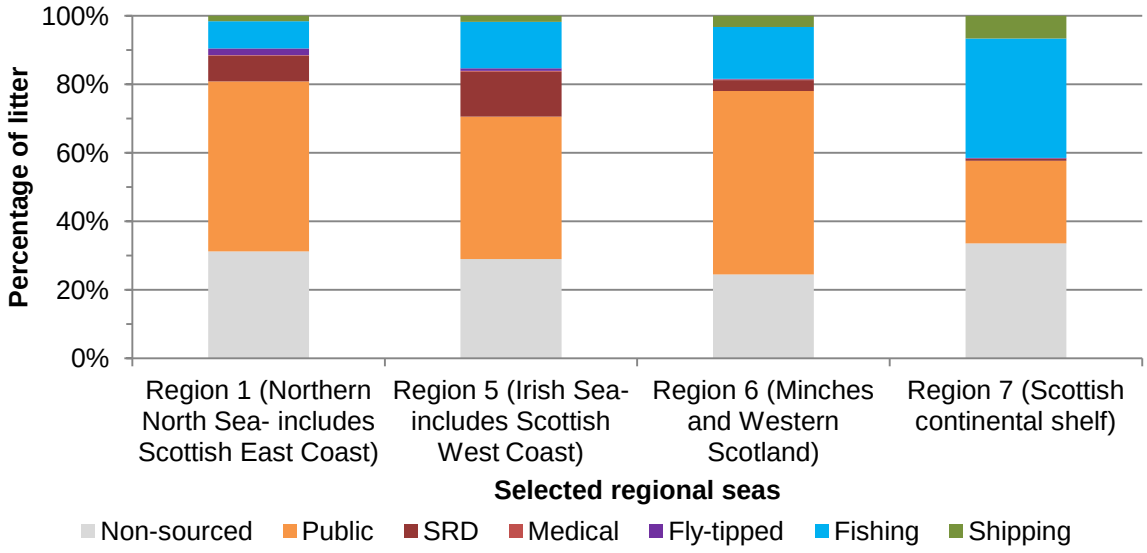

Figure 4-4 Sources of litter in selected regional seas, relating to Scotland (adapted MCS, 2009)

4.3 Benthic and suspended litter

Limited baseline data exits for benthic and suspended litter; KIMO's (Kommunenes Internasjonale Miljøorganisasjon) Fishing for Litter project provides the majority of this information.

KIMO provides fishing boats with bags to collect marine sourced litter.When full, these bags are deposited on the quayside for collection and subsequent disposal. The first phase of the project ran from 2005-2008 and the second phase will run from 2008-2011(KIMO, 2008). As of the second project phase, 162 vessels and 17 harbours are actively participating in the scheme.

From data on total tonnage landed in harbours by various fishers, there is a slight increase in total tonnage (size not weight) of litter collected from 2005-2008. This is most likely attributed to the greater uptake by fishers and increased frequency of surveying rather than increases in the abundance of litter. There are also no significant differences between tonnage (averages) on the east and west coasts. However in the 2007-2008 season Ullapool landed 8.56 tonnage of marine litter, much greater than other harbours in the same period (Figure 4-5).

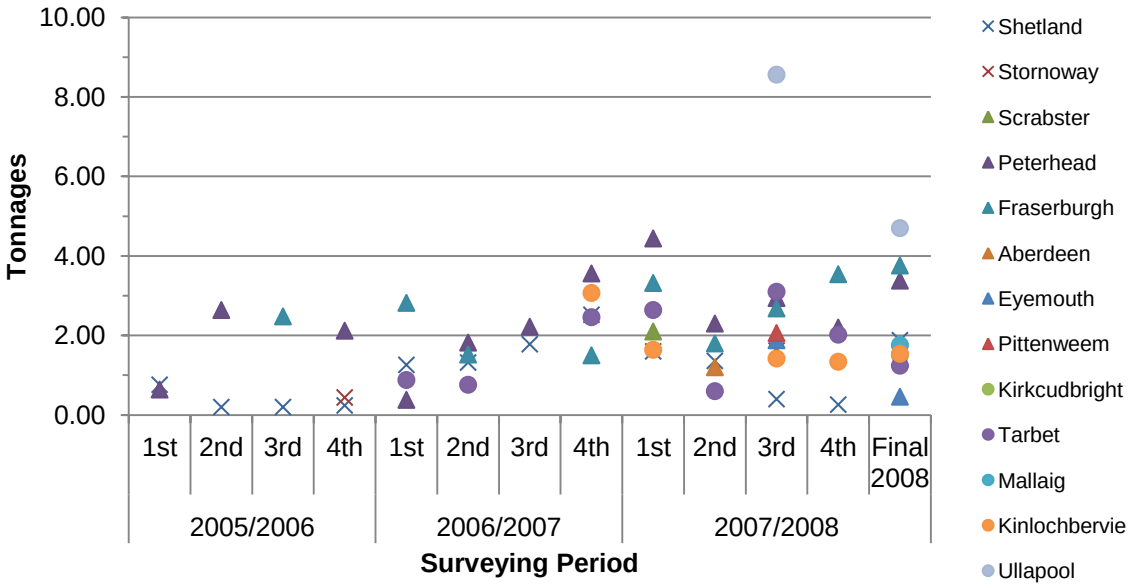

Figure 4-5 Tonnage of marine litter landed at Scottish harbours during the period 2005-2008, (adapted from KIMO, 2008)

The overall conclusions of the fishing for litter scheme correspond with Beachwatch data and the EcoQO studies of plastics and fulmars; plastics and polystyrene are the predominant types of marine litter found in and around the coastal waters of Scotland (KIMO, 2008; MCS, 2009; OSPAR, 2010).

Indeed these two types of litter contributed to 74% of the total litter landed at six harbours during the surveying period (KIMO, 2008). Specific types of litter such as plastic bottles, buoys and gloves were considerably more common than other types in some harbours; however the causes behind these occurrences are unknown.

4.4 Summary of major surveys and initiatives

4.4.1 *UK*

MCS Adopt-a-Beach and MCS Beachwatch are initiatives organised by the Marine Conservation Society, whereby local individuals, groups and communities clean their coastal environment. The MCS Beachwatch project is in its 18th year with thousands of volunteers taking part every year. The annual MCS Beachwatch Big Weekend event takes place on the 3rd weekend of September every year and the data collected are used for the annual MCS Beachwatch report and contributes to the International Coastal Cleanup data.Adopt-a-Beach involves groups monitoring 4 times a year. The data collected by volunteers are used to provide an insight in to marine litter on UK and regional level beaches.

The Bag It & Bin It initiative is co-ordinated by Water UK on behalf of all water companies and authorities in the UK. It aims to improve SRD issues by public campaigns and publicity materials. Regional campaigns have also been initiated to monitor the effectiveness of this approach (Fanshawe & Everard, 2002).

The Marine Litter Research Programme, organised by the Tidy Britain Group was launched in 1973. The primary aim of which, is to generate statistics on the major sources of marine litter, using standardised methodologies and analytical techniques over varying spatial and temporal scales. Major trends in source, type, quantify and rates of accumulation of plastics in UK coastal and oceanic waters were calculated.

Surfers Against Sewage is a not-for profit environmental pressure group focused on the protection of the UK's oceans, waves and beaches, via campaigning, volunteering, conservation, education and scientific research. The group was formed by surfers to help tackle the issue of sewage discharges across the UK.

Various beach award schemes operate across the UK; Blue Flag in all nations, Quality Coast Award in England, Green Coast Award in Wales and Northern Ireland and the Seaside Award in Scotland, Wales and Northern Ireland. All awards represent a high standard for the coastal environment and beach amenities, which beach managers and local authorities work towards. They have been instrumental in raising public awareness on environmental issues such as litter, dog refuse and bathing water quality. Blue Flag Award beaches are aimed at resort beaches, which must meet "guideline" EC Bathing Waters Directive standards and also have adequate facilities for litter and dog refuse as well as basic amenities (public toilets, telephones, parking, and disabled facilities).Seaside Award beaches need to meet the "mandatory" EC Bathing Waters Directive standard only. The Green Coast Award is aimed at rural beaches achieving Guideline water quality. All other awards need to meet at least the Mandatory EC Bathing Waters Directive standard.

The Marine Pollution Control Unit (MCPU) organised by the Maritime and Coastguard Agency assists the co-ordinating of shoreline clean up after large pollution events. MPCU also follows up on reports on illegal dumping of garbage at sea, with the view of initiating prosecutions under the Merchant Shipping (prevention of Oil Pollution) Regulations 1996 and the Merchant Shipping (prevention of Pollution by Garbage) Regulations 1998.

Seasearch organised by MCS, catalogues coastal habitats and anthropogenic impacts including litter in the UK. The MCS and PADI published a guide to underwater clean ups in 1999, encouraging recreational divers to survey and remove sub-tidal litter, however data from these has proved insufficient for further analysis here.

The Green Blue interacts with the boating public on the topic of litter. In their work with DEFRA it was the topic of greatest concern, with 75% being 'very concerned' about it. In addition, their findings showed it was the topic that most people reported taking action with 62% saying they did something to reduce litter and waste 'all the time' since their interaction with The Green Blue.

4.4.2 Scotland

Scotland's Zero Waste Plan sets out the Scottish Government's vision for a zero waste society. This vision describes a Scotland where all waste is seen as a resource; waste is minimised; valuable resources are not disposed of in landfills, and most waste is sorted, leaving only limited amounts to be treated. To achieve this vision the Plan sets out a raft of new measures. Achieving zero waste will also contribute to Scotland's climate change and renewable energy targets.

Keep Scotland Beautiful is an independent charity which undertakes assessments and monitoring of beaches applying for the Blue Flag and Seaside Awards in Scotland. KSB also runs the National Spring Clean campaign (March-May every year); a coordinated campaign for voluntary clean ups and litter picks. Areas covered include coastal paths and beaches as well as terrestrial sites. During April 2010 152 beach litter picks (out of a total of 1406) were registered as part of National Spring Clean, involving 9,797 volunteers. No monitoring takes place by volunteers, although they are encouraged to record the brands of litter found. These clean ups, along with the MCS Beachwatch and Adopt-A-Beach clean ups are not captured anywhere financially, but the volunteer hours and rates would be substantial.

The Think Before You Flush campaign finished in 2002 and was replaced with a branded Bag it and Bin it – don't flush it campaign in 2003. This was funded by Scottish Government, Clean Coast Scotland and Scottish Water.

The GRAB TRUST-Beaches and Marine Litter 

Beaches and Marine Litter Project ran by the GRAB Trust, aims to raise awareness of the impacts of marine litter and to work with schools and community groups to try and tackle the problem.

As well as organising beach clean events, the Trust provide advice and support to community groups wishing to run their own clean ups, often as a way of fundraising for the group, via money paid by the Trust dependent on the length of beach cleaned and whether there were any black spots.

A range of marine litter education workshops and activities in local schools (Primary and Secondary) and with youth groups are undertaken. The education activities are varied and are suitable for pre-five groups through to 16 year olds. They can explore a range of issues including impact, harm, responsible behaviour, identifying and quantifying litter, looking at how long litter items last in the environment as well as quizzes and art activities. The activities are planned to encourage children to be active in their learning and to have fun exploring issues whilst being in line with the Curriculum for Excellence.

The GRAB Trust attend and organise events throughout the year to raise awareness of the impacts of beach and marine litter through visual displays and printed information and to speak to people face to face to encourage them to get involved in beach cleaning and in Reducing, Reusing and Recycling.

By running the Argyll and Bute Beach Forum people are brought together who have a shared passion and commitment to trying to tackle the beach and marine litter problem and is a way of keeping interested groups and individuals in touch with issues and events in the area, via regular bulletins and newsletters.

Forth Estuary Forum's Coastal Litter Campaign

The Forth Estuary Forum's Coastal Litter Campaign encouraged communities and organisations to initiate and carry out co-ordinated clean-up events in association with the Marine Conservation Society's Adopt a Beach campaign. Varying methods were employed to raise awareness of the types, sources and impacts of marine litter using existing initiatives including the Bag It and Bin It campaign, Blue Flag, and the MCS Adopt-a-Beach campaign. An important aspect of the Coastal Litter Campaign was the ability to monitor and evaluate the changing trends for marine litter in the Forth and allow for the development of individual programmes of action to tackle the litter at source. A team of dedicated volunteers used a scientifically standardised technique to assess trends in the deposition of fresh marine litter each month. The campaign found that the majority of the litter came form land based sources and therefore was the focus of their campaigns.

The high level of interest in the Coastal Litter Campaign and the subsequent positive comments they received, help to demonstrate the potential success and impact of such initiatives.

4.4.3 England and Wales

In England and Wales, including representation from Scotland, the National Aquatic Litter Group (NALG), a consortium of partners including the EA, SEPA and EHS (NI) conducted an assessment of the aesthetic state of bathing water beaches, using a standardised monitoring and assessment protocol (Defra, 2005b). Over the period 2000-2002 all designated bathing waters in England and Wales were surveyed annually and beaches were classified from A (very good) to D (poor). Parameters including SRD, general litter, oil dog excrement, harmful debris and large accumulations of litter were recorded (Defra, 2005b). In 2010 the group was disbanded due to funding issues, though much of the work is still available from the EA.

In 2000, 77% of coastal bathing waters beaches were graded A or B (very good or good) in beach aesthetic surveys and in 2002 this rose to 82%. During the same period the number of grade D beaches fell from 10% to 5%. The long-term improvement in the aesthetic state of these beaches cannot be assessed from these results however, due to the short-term nature of the monitoring (Defra, 2005b).

The General Quality Assessment (GQA) scheme, organised by the Environment Agency (originally National Rivers Authority) aims to provide an objective classification scheme against which to measure water quality (Fanshawe & Everard, 2002). Within the marine environment these include sanitary chemistry (Dissolved Oxygen and Ammonia), Nutrients, Biological Quality, Heavy Metals in Sediments and Aesthetic Quality (with a litter component).

4.4.4 Northern Ireland

Northern Ireland holds a dataset on coastal litter by the Northern Ireland Environment Agency (NIEA). The NIEA has carried out surveys since 1999, on identified beaches throughout the bathing season (1st Jun- 15th Sep) (NIEA, 2011). The surveys use a rapid scan technique, which counts and categorises the litter whilst being collected (ibid). So far the quantities of litter collected have been stable, at 8,198 items annually; 42% was packaging and 39% was plastic (NIEA, 2011).

As well as the coastal surveys, the NIEA and Agri-Food Biosciences Institute (AFBI) completed a litter survey of the seafloor of the Irish Sea (NIEA, 2011). The surveys were conducted by fisheries trawlers and found 60% of all litter was plastic.

The Northern Ireland Estuarine and Coastal Waters Classification, adopted from the ADRIS classification scheme and organised by the Environment & Heritage Service (EHS NI) measures the quality of estuaries and coastal waters including an aesthetics component (Fanshawe & Everard, 2002).

The Lough Foyle Research Vessel: Irish Sea Study Trawls undertaken by DANI Agricultural and Environmental Sciences Division, carried out population assessment of demersal, benthic fish and shellfish stocks (Fanshawe & Everard, 2002). As part of a sub-sampling process marine litter was identified in catches, of which high levels of all types were recorded.

4.4.5 International

There are various international campaigns such as Arc Manche (France), Coastwatch Europe, International Coastal Clean Up Initiative (US), Marine Litter Monitoring Project (OSPAR), SPCC Beach Pollution Index (Australia) and research by KIMO.

The potential for Scotland to implement similar monitoring schemes is promising, due to the transferability of these methodologies and assessments to local coastal and marine waters. Linking to these existing initiatives would however, allow for Scotland to better coordinate with the global movement and allow for the use of developed resources and uniformed methodologies.

5 RELEVANT LEGISLATION AND COASTAL MANAGEMENT POLICIES

5.1 Current legislation

There is a variety of International, European and regional law ranging from Customary International law, Treaties, Conventions and Declarations that are applicable to tackling the problem of marine litter. In some cases these are specific to the issue and in others integral to the wider principles of sustainability including the UK commitment to the Sustainable Development Convention and Agenda 21, Rio Earth Summit, 1992 and the United Kingdom's Darwin Initiative (HMSO, 1992).

5.1.1 International legislation

United Nations Convention on Oceans and the Law of the Sea (UNCLOS)

Part XII of the Convention (Articles 192-237) outlines basic obligations to prevent, reduce and control pollution from land-based sources, sea-bed activities subject to national jurisdiction, activities in the Area, dumping, vessels and from the atmosphere, within the context of the marine environment.

In November 2005, Marine Litter was specifically addressed in the UN General Assembly Resolution A/RES/60/30- Oceans and the Law of the sea. It sought to encourage States to develop partnerships with industry and society, by raising awareness of the issues and noted a general lack of data. It also urged States to integrate marine litter within national coastal management and waste strategies, including economic incentives.

International Convention for the Prevention of Marine Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78) Annex V

The MARPOL Convention is an international agreement to prevent pollution of the marine environment by ships. Under MARPOL the general obligations are;

- Parties to ensure that ships flying their flag do not discharge wastes into the sea
- Provision of port reception facilities

Annexes I (Oil) and II (Chemicals) are compulsory, with Annex V relating to garbage being voluntary. Annex V regulates the types and quantities of garbage that ships may discharge at sea; with ‘Garbage’ including food, domestic and operational waste (excluding fresh fish) (IMO, 2002). Garbage being defined as “all kinds of victual, domestic and operational waste including fresh fish and parts thereof, generated during the normal operation of the ship and liable tobe disposed of” and ships as a “vessel of any type whatsoever operating in the marine environment, including hydrofoil boats, air cushion vehicles, submersibles, floating craft and fixed or floating platforms”, therefore covering fishing vessels and pleasure craft.

The obligations for ratified coastal states include the provision of adequate reception facilities in all ports and the notification of IMO of said facilities.

Under MARPOL Special Areas of sea are designated for oceanographic and ecological conditions which require the adoption of additional mandatory garbage pollution measures. Within these areas certain obligations exist for ships:

- Disposal PROHIBITED EVERYWHERE:
    - All plastics, including ropes, fishing nets
    - All other garbage, including paper, rags, glass and metal
    - Mixtures of garbage and other wastes with different discharge requirements
- Disposal PROHIBITED WITHIN 12 MILES FROM LAND:
    - Food wastes

Outside of the Special Areas obligations are less controlling in that:

- Disposal PROHIBITED EVERYWHERE:
    - All plastics, including ropes, fishing nets
    - Mixtures of garbage and other wastes with different disposal or discharge requirements
- Disposal PROHIBITED WITHIN 25 MILES FROM LAND:
    - Floating dunnage (protective material used for packaging)
- Disposal PROHIBITED WITHIN 12 MILES FROM LAND:
    - Food wastes and other garbage, including paper,rags, glass metal, bottles, crockery, etc.
    - Disposal is permitted outside 3 miles from land if ground to 25mm.

The North Sea has been designated as a Special Area for garbage since 1991.

In March 2010, 140 states ratified MARPOL Annex V, with regulations covering approximately 97.5% of global shipping tonnage (IMO, 2010). Annex V is also being reviewed by the International Maritime Organisation (IMO) to assess and improve its effectiveness.

London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 and 1996 Protocol relating thereto

The London Convention aims to promote the effective management of all sources of marine pollution, by preventing the dumping of wastes at sea. Certain items are strictly prohibited whereas others require special permission and are subject to strict control. Annex I inhibits signatories from dumping plastics and other non-biodegradable materials from ships at sea and other man-made structures.

The London Protocol (1996) prohibits the dumping of all sources of pollution, with some exceptions. States can currently Party to either the London Convention (1972) or the Protocol (1996), however it is expected the Protocol will permanently succeed the Convention (Mouat *et al*., 2010).

Under this convention dumping is defined as the ‘deliberate disposal at sea of wastes and other matter from vessels, aircraft and other structures, including the vessels themselves’. The term dumping does not extend to pipeline discharges from land or operational discharges from vessels or offshore installations.

Basel Convention on the Transboundary Movements of Hazardous Wastes and their Disposal 1994

The Convention aims to protect human health and the environment against the adverse effects resulting from the generation, management, transboundary movements and disposal of hazardous and other wastes.

The Parties to the Basel Convention recommend that States must take the necessary measures to ensure that the management of hazardous wastes, including their transboundary movement and disposal is consistent with the protection of human health and environment. The Convention defines "environmentally sound management" of wastes as taking all practicable steps to ensure that wastes are managed in a way which will protect human health and the environment against the adverse effects which may result from such wastes.

Other applicable international legislation

Other applicable law relating to the marine environment and marine litter includes Agenda 21: The United Nations Programme of Action from Rio and Johannesburg Plan of Implementation, the Convention on Biological Diversity (1992), with the Jakarta Mandate on the Conservation and Sustainable Use of Marine and Coastal Biological Diversity (1995).

5.1.2 EU legislation

There are a number of EU directives which address the sustainable use of the marine environment, ship based pollution and waste in general; all of which to a certain extent are relevant to the problem of marine litter.

EU Marine Strategy Framework Directive (2008/56/EC)

The Marine Strategy Framework Directive (MSFD) is an integrated policy for the protection of the marine environment, which aims to address multiple threats such as climate change, over fishing, biodiversity loss, eutrophication, introduction of alien species and pollution from land and ocean sources.

Member States are required to develop strategies in order to achieve and maintain good environmental status by 2020, having to meet a strict implementation timetable. Good environmental status is defined: ‘the environmental status of marine waters where these provide ecologically diverse and dynamic oceans and seas which are clean, healthy and productive within their intrinsic conditions, and the use of the marine environment is at a level that is sustainable, thus safeguarding the potential for uses and activities by current and future generations’.

The MSFD also specifically identifies marine litter (descriptor 10) as one of 11 qualitative descriptors for determining good environmental status, stating this, the ‘properties and quantities of marine litter do not cause harm to the coastal and marine environment’. Competent monitoring authorities will have to start monitoring litter to comply with the directive and protocols for monitoring beach and offshore litter are being developed for them to follow.

EU Directive on Port Reception Facilities for Ship-generated Waste and Cargo Residues (2000/59/EC)

This directive aims to improve the availability and use of port reception facilities, in order to reduce the illegal discharge of waste from ships and cargo residues. Member states must monitor compliance with the directive and submit regular progress reports to the EC on the status of the Directive's implementation.

The Directive applies to:

- all ships, including fishing vessels and recreational craft, apart from warships;
- all Member State ports.

Member States must ensure port reception facilities are provided to meet the needs of the vessels. These facilities must be tailored to the size of the port and to the categories of ship calling there.

A waste reception plan must be drawn up in each port and approved and assessed by the Member State it relates to.

Unless exempted, all ships are required to deliver their ship-generated waste before leaving a port, unless the vessel has adequate storage capacity. Ships which do not deliver their waste without providing valid reasons for exemption are not allowed to leave the port until such delivery has taken place.

Individual ports must establish cost recovery systems to encourage the delivery of waste on land and discourage dumping at sea. All ships calling at a Member State port will pay a proportion of this cost whether or not they use the facilities.

The data for disposals is collected centrally by the MCA.

EU Bathing Water Directive (76/160/EEC and 2006/7/EC)

This directive requires the visual inspection of bathing waters for pollution (tarry residues, glass, plastic, rubber or any other waste) and implementation of management measures when such pollution is found.

The revision of the Bathing Waters Directive (transposed through the Bathing Waters (Scotland) Regulations 2008) has brought some changes which all bathing waters must adhere to by 2015. The revision increases the water quality standards which need to be met. Four new classifications are introduced – excellent, good, sufficient, and poor, based on concentrations of bacteria (Intestinal enterococci and Escherichia coli) found in the water. The good standard is broadly equivalent to the existing guideline standard. All bathing waters must be of at least sufficient standard, and that appropriate measures are taken to increase the numbers of bathing waters classified as excellent or good by 2015. Other changes to the directive include the requirement to identify risks to compliance; alterations to the sampling times and methods; and whilst the criteria relating to the classification of bathing waters are currently bacteriological, the revision states other parameters must also

be considered in a bathing water's management. Amongst these considerations is the presence of litter pollution.

EC Urban Waste Water Treatment Directive (91/271/EEC and 98/15/EC)

The objective of this Directive is to protect the environment from the adverse effects of urban waste water discharges and discharges from certain industrial sectors and concerns the collection, treatment and discharge of:

- Domestic waste water
- Mixture of waste water
- Waste water from certain industrial sectors

This directive is particularly relevant for SRD, and recommends minimum screening requirements for both waste water treatment works and sewerage systems.

EU Waste Framework Directive 2006/12/EEC (to be replaced by 2008/98/EC with effect from 12 December 2010)

This directive requires ports to develop waste management plans and provide reception facilities for waste.

Other applicable EU legislation

Also of relevance are the EU Environmental Liability Directive (2004/35/EC) and the EU Directive on Packaging and Packaging waste (2004/12/EC)

5.1.3 National legislation

Merchant Shipping (Port Waste Reception Facilities) Regulations 2003

The Port Reception Facilities for Ship Generated Waste and Cargo Residues Directive was transposed in the UK by the Merchant Shipping (Port Waste Reception Facilities) Regulations 2003 to prevent waste produced on board ships from getting into the sea.

The major requirements of the Regulations are:

a) Ships must notify the harbour authority of the waste they will discharge, including information on types and quantities.
b) Ships must deliver their waste to port reception facilities before leaving the port or terminal
c) Ships must pay a mandatory charge to significantly contribute to the cost of port reception facilities for ship generated waste, whether they use them or not.
d) Recreational craft authorised to carry up to 12 passengers and fishing vessels must deliver their waste to port reception facilities but are exempted from the requirement to notify before entry into port and the requirement to pay a mandatory charge.

Environmental Protection Act (1990)

The Environmental Protection Act, 1990 makes 'Duty' Bodies (local authorities, government departments, statutory undertakers, schools, universities) responsible for keeping their land and beaches clear of litter and refuse.

The Code of Practice on Litter and Refuse (Scotland) 2006 has been produced under section 89 (7) of the Environmental Protection Act 1990 (EPA). The code provides guidance on duties including responsibilities. It states that Duty Bodies (mainly Local Authorities but also includes some land owners) are responsible for keeping beaches clear of litter as far as practicably possible. The Code of Practice is based on the following two principles:

- Areas which are habitually more heavily trafficked should have accumulations of litter cleared away more quickly than less heavily trafficked areas; and
- Larger accumulations of litter and refuse should be cleared more quickly than smaller accumulations.

Based on levels of use and time it sets standards of acceptable levels of cleanliness. It is not based on the frequency of cleaning, rather the maintenance of an area's cleanliness. Scotland's beaches are categorised into one of four zones;

- Amenity Beach (Blue Flag beaches and those adjoining designated bathing waters)
- Recreational Beach (managed beach, award winning beach or beach adjoining other SEPA sampled waters)
- Sensitive Conservation Area (SSSIs, SPA's, SAC's and nature reserves)
- Other Beach (any other beach)

The Code is based on four grades of cleanliness;

- Grade A: no litter or refuse;
- Grade B: predominantly free of litter and refuse, other than a few small items;
- Grade C: widespread distribution of litter and refuse with minor accumulations;
- Grade D: heavily littered with significant accumulations.

If the level of cleanliness falls below a Grade B, the Code sets a response time in which the Duty Body must restore the land to its given standard depending on the time of year and the zone in which that beach falls (Figure 5-1). For example if a recreational beach should deteriorate to a Grade C or D in July it should be returned to a Grade B within one week.

Grade/Cleanliness Standard

	A	B	C	D	
Amenity Beach			48 hrs		1st Jun -15th Sept
		←			→
			4 wks		16th Sept- 31st May
Recreational Beach			1 wk		1st Jun- 15th Sept
		←			→
			4 wks		16th Sept-31st May
Sensitive Conservation Area					Monthly hand picking of litter
		←			→
Other Beach					As Necessary
		←			→

Figure 5-1 Timescale to return beaches to appropriate grade, based on beach type and time of year (KSB, 2009)

In 2010, a survey carried out by KSB revealed that 15% of beaches fell below the legal Grade B standard as outlined in the COP. 10% achieved Grade C while 5% only met the Grade D standard.

The EPA gives rights to take action if the timescales and levels of cleanliness are not adhered to. If, after putting a complaint in writing to the Duty Body, action is not taken, a member of the public can take legal action to get a Litter Abatement Order whereby the duty body must clean up the area. There is a charge to apply for an Order and it can be time consuming but it has been successfully used in the past.

Marine (Scotland) Act 2010

The Act is a major legislative reform that will guide marine planning and development. The management of litter, while not directly specified under the Act, may fall under the scope of marine planning. Marine planning will be critical for influencing the spatial extent and license regime for many maritime activities, including activities that have not been regulated in the past such as marine leisure and tourism.

Climate Change (Scotland) Act 2009

Whilst not directly related to marine litter, the recent climate change legislation includes provisions for improved waste management by giving Ministers the power to enact and enforce waste management plans, packaging changes, deposit schemes and carrier bag charges.

6 KNOWLEDGE GAPS

6.1 Micro plastics

Marine plastics have been shown to act as a vehicle for absorbing, transporting or releasing contaminants including PCB's, and a number of studies have shown this can be transferred to species through ingestion (in some cases selective ingestion). Thus the ingested micro plastics may prove a significant source for primary producers and input into and along the food chain, including to humans. The biological consequences of this are as yet, unclear.

The proliferation of marine litter particularly plastics provide additional opportunities for the dispersal of non-native, potentially invasive species. The type and size of debris can influence colonisation patterns and biota; however, uncertainties exist with regard to the potential extent of this issue with a warming climate and the resulting economic implications for Scotland and its maritime industries.

6.2 Monitoring

Beach cleans and the resulting monitoring tend to mostly occur on more popular, often urban or semi-urban beaches and as such the information available on the issues, types, levels, trends and impacts of marine litter are skewed because of this. To overcome this, a comprehensive picture of marine litter on Scotland's coasts including in rural and remote areas, is required to fully understand where the greatest issues lie, and regional differences and thus where resources are best aimed.

Information on the amounts and types of litter in the water column and on the sea bed is limited, due to the relatively limited monitoring studies focussed here. Based on estimations, however, there is a much greater amount here than on the coasts, yet efforts currently are more focussed on coastal cleaning than offshore. This is predominantly due to access and cost issues but also because it is much easier to feel affinity with an environment you are familiar with i.e. your local beach than the relatively unknown deep sea. This could be used as an advantage in any media campaigns as viewers become accustomed and desensitised by familiar images; the use of images out with their familiarity may act as more of a shock tactic.

Improved knowledge of litter sinks in terms of their location and size may allow for the predictions of the proximity of the source and local pathways including the future drift of suspended litter. This may be more suited to identification at the local scale, as frequently these sites are already known to local practitioners and field staff.

A comprehensive monitoring programme is required which is easily comparable spatially, both within Scotland and the UK but also at the EU level and temporally. This is fundamental for getting a clear idea of the scope of the issue but also for the evaluation of any management actions and legislation, in terms of their effectiveness. This should not, however, halt or preclude and current actions as the monitoring data from initiatives such as Beachwatch, KIMO's Fishing for Litter and the International Bottom Trawl Surveys (IBTS), do to some extent show the scale of the problem and have identified key areas for focus based on amounts from a particular litter source such as land based sources.

The use of geospatial technologies and remote sensing could be better explored to make the most of limited resources for monitoring and assessment as well as data management and sharing.

6.3 Economic Impacts

Limited conclusive studies to date have been produced, either in the UK or internationally, on the full economic impacts of marine litter, including the potential cost of ghost fishing to the commercial fisheries industry. This may be a priority for any Strategy as cost implications on individuals and sectors are likely to work as strong deterrents for future inputs and as a driver for action on existing litter. In addition, it is necessary in objective setting to understand the cost (economic) of any action against the costs (in all senses) of taking no action, and which on that basis is the right course of action.

6.4 Social Impacts

Knowledge gaps exist regarding the social impacts of marine litter including the implications for ecosystem services (regulatory, provisioning, supporting and cultural). Despite a lack of research into the impact of marine litter on ecosystem services, it is highly likely that litter reduces the resilience of ecosystems, and hence the quality of ecosystem services they provide. Additional gap exist in the root cause of litter (marine and terrestrial); particularly in surveys that explore the social and behavioural aspects of society and marine litter generation and what forms of communication, media, governance and infrastructure are necessary to be effective not only in informing people of the impacts but to a sufficient level to change their behaviour.

Studies are required to evaluate the effectiveness of measures to prevent and reduce marine litter and to provide useful guidance to managers and decision makers for litter mitigation.

These gaps in knowledge hinder the ability to prioritize mitigation efforts and to assess the effectiveness of implementation measures. Where possible these gaps should be filled by joining forces with existing research programmes

7 WORKSHOP OUTPUT

7.1 Workshop Overview

The Marine Litter workshop was held at the Macaulay Land Use Research Institute on Friday 18th February. Twenty eight participants were involved from across different sectors and geographical regions of Scotland as well as a representative of the British Plastics Federation, who have a UK wide remit.

The workshop was run in two halves. The morning session explored existing reduction, removal and governance issues and arrangements, and the afternoon's looked at how to reduce future inputs of marine litter by source (land, coastal and marine). The participants were split into three groups and rotated around each of the topics. Key points emerging from facilitated discussion were recorded on flipchart paper, with responses on view to subsequent groups.

Raw data from this exercise is collated in Appendix 1. Here we present a summary of the discussions arranged by the themes that emerged for each question.

7.2 Workshop Themes

7.2.1 Chain of responsibility

One of the key points raised related to the chain of responsibility for marine litter – indeed we should be reducing the overall scale of litter rather than collecting it. While the manufacturers of products might not be directly responsible for the act of littering, their product design and use is related to the impact that their release into the marine environment (including nano particles from broken down plastics). Indeed consumers may not themselves be litterers either and some responsibility will lie with ineffective waste management (e.g. uncovered landfills). Consumers often pay for litter cleanup through local taxation, raising the question of the extent to which the Scottish Government's view that the "polluter pays" principle should apply. Ways forward included setting up packaging partnerships with retail to help reduce the problem; possibly linking up to marine industries and businesses need to reduce the opportunity for customers to litter.

Local authority budget cuts mean that funding for community services such as clean ups and beach litter enforcement is likely to become more difficult despite a responsibility under the Environmental Protection Act to clean beaches. It was suggested that a devolvement of land fill tax to Scotland may help, particularly given that landfill is becoming more expensive and less accessible.

The Crown Estate might, as a major landowner, be encouraged to establish coastal monitoring but has no official responsibility to do so. At the moment the public pays through taxes, but the actual costs to local government were not available to us at the workshop, and the environmental costs and impacts are also sometimes unclear. Research to establish the costs and benefits of litter reduction approaches would allow cost savings to be made, perhaps releasing LA funds for other public services.

7.2.2 Industry efforts

Industry reports that there has been a recent reduction in use of plastic bags (1 billion fewer/year). It was also emphasised that biodegradable bags *do not* biodegrade in a cold marine environment. Encouraging re-use (e.g. deposit/return) has often been too costly to implement (e.g. BARRS one of few companies left who still do this), however if such an approach could be expanded across sectors it might prove more effective. Alternatives to plastics are hard to identify but product development and reduced packaging needs to be encouraged or legislated for. Improvement options include using wood or cardboard sticks for cotton buds and possibly even fungi based or popcorn packaging materials. The pros and cons of plastic versus paper bags continue to be debated. Product development including truly degradable plastics is one option, but surely a reduction in packaging, the use of alternatives (e.g. use of fungus in USA for packaging), use of recyclable materials, improved labelling of biodegradable plastics and the minimisation of the production of single use items would all help.

Retailers should be encouraged to stock products which are less harmful to the marine environment, particularly in the case of coastal businesses: if litter is bought there then provide facilities for disposal. More engagement is needed along the lines of “love where you live” (MacDonald’s, Wrigley’s funding etc). The plastics industry sees representational interest: they do not ‘own’ the waste but it affects the industry’s reputation.

7.2.3 Litter reduction and collection initiatives

It appears that there are many initiatives relating to litter reduction in Scotland. Campaigns and behaviour change tools are raising social awareness of the issues, but littering is often still socially acceptable and convenient. These awareness raising campaigns and behaviour change tools include efforts by Scottish Water such as “Bag it and Bin it” relating to household waste and good practise guidance for fat disposal which can be found by searching Scottish Water’s website. It was noted that such initiatives *need* to be kept in the media otherwise littering behaviour returns to pre-campaign levels. However such awareness campaigns have been ongoing for many years in some cases, and compliance with campaigns is not mandatory. There was widespread agreement that appropriate behaviours could be more widely advertised and other methods could be developed, including improved labelling of goods.

Recreation groups were noted as potential participants in marine litter reduction efforts including providing underwater litter surveys, the RYA’s Green Blue education initiative for sailors and sailing clubs. Eco Schools has a compulsory unit on litter which might usefully be expanded to include marine litter and its impacts and as with other awareness raising campaigns, make better use of emotive images. An example of this might be the Local Coastal Partnership Litter DVD for marine litter as part of 5-14 yrs curriculum.

Public attitudes towards litter need to change, in line with the long running ‘Keep Britain Tidy’ campaign. While fines may work where enforcement is possible, improved use of information to contribute to seasonal campaigns, better coordination of Bag it and Bin it and links to other initiatives and sectors would help. Using shocking images (such as injuries caused to animals by plastic can connectors) and increasing awareness of marine litter issues in broader litter campaigns

Targeting of campaigns at specific beach user types and at specific beaches and making more use of LA beach managers (Fife is currently the only 'active' one) would be also effective. Lifeguards are often used for this purpose on busier beaches. Incentives for LA's to manage their beaches include Seaside awards and Blue flags which require them to write beach litter plans, including the provision of facilities and awareness raising (e.g. using MCS beachwatch statistics in April) and Internet campaigns.

Opportunities to make waste a resource should be explored by Zero Waste Scotland including giving waste a value (e.g. money for returned plastic bottles or supermarket loyalty points for returning containers?) which would help in changing attitudes towards litter. Use of other media could also be improved including more advertising in the cinema or on the internet, and use of shocking images of wildlife impacts (KIMO have an excellent selection).

Other issues common across current approaches are lack of geographical coordination, a dependence on voluntary engagement, untargeted campaigns that only refer to generic solutions and the short lifespan of many initiatives resulting in a decline in motivation and remedial action over time. A variety of bodies lie behind such work including Local Authorities, the Marine Stewardship Council (MSC) and the Group for Recycling in Argyll and Bute (GRAB) Trust. The GRAB Trust currently receives funding from SNH, landfill tax and the Crown Estate to carry out awareness raising in schools and beach cleaning activities.

7.2.4 Litter facilities e.g. type and availability of bins

Public litter facilities need to be appropriate, for example lids on coastal bins to prevent seagulls from emptying them. Other options include simple recycling at these bins (common elsewhere e.g. Australia) and use clear simple signage on busier beaches, while on more remote coastline encourage take home only (removal of bins has resulted in a reduction in beach litter on Aberdeenshire beaches), an approach backed up by research by Forestry Commission and National Trust.

Similar issues apply at a different scale in harbours where the (lack of) infrastructure, education, legislation, litter charges, waste management systems and communications between ports all need to be considered. Vessels are required to report on levels of waste (to the harbour authority) but this currently only applies to boats over 500 tonnes – could this be lowered? There was a feeling Scotland is behind in terms of infrastructure for marinas and ports (e.g. recycling, pump-outs, oil etc) (even though it is a statutory to have the appropriate facilities) but this might be improved if covered by mooring fees. In all cases, the available facilities need to match the messages.

7.2.5 Harbour and marine issues

Harbour litter disposal facilities (including KIMO's 'Fishing for Litter') are limited to 17 ports across Scotland and some have port waste plans providing removal of shipping waste (often to landfill) with a mandatory charge for all but fishing boats. Aberdeen harbour and Forth Harbour boards have boats to collect port litter enabling them to remove litter brought from upstream and in by the tide. If new technologies such as recycled plastic booms currently being tested for litter recovery in Southern France are effective, then there is the possibility of expanding its use across Europe.

International Convention for the Prevention of Pollution from Ships (MARPOL) for offloading waste needs further implementation and more enforcement, there being issues with ships transporting litter between harbours and reporting at landfall. Responsible fishing practices are encouraged by training (which should be provided prior to going to sea) through "Seafish" and there were suggestions that this might be linked in future to the leasing of fishing nets to encourage good net management as well as return and repair facilities.

Prosecutions under MARPOL are rare. Part of the regulation covers the fitting of new ships with waste management systems including the sorting of recyclables, while older boats are not required to retrofit these systems. Environmental standards (ISO) for fishfarms are incorporated in environmental management agreements and it was suggested that such an approach could be applied in other sectors.

Containers used on boats should be stamped/marked to enable the source to be identified and the item returned, with the responsibility on companies to take back packaging

There are examples of environmental accreditation for fish farms that include the need for them to help to funding for cleanups. The Responsible Fishing Scheme (SeaFish) could include producer responsibility for nets in the fishing industry, including the introduction of waste/return schemes for when purchasing gear (e.g. nets). Fishing nets are often mended on the quayside leaving large amounts of material which should be cleared up before it enters the water, requiring the provision of facilities to allow this.

7.2.6 Riverine water inputs

Litter entering the sea from riverine sources is also of concern and regulation requires marine waters to be of Good Ecological Status (GES) to 3km from the shore. Scottish Water is investing in this to achieve GES by 2015, including screening at shellfish and bathing water sites and WFD compliant river grills (on outside bends of rivers to trap litter). Linked to this is the need for improved management of Combined Sewerage Overflows (CSOs) including mesh sizes and reducing inputs from household and other drainage as campaigned for by Surfers Against Sewage who raise awareness of the fact that "you'll see me again". CSO capacity in some cases is inadequate and spills are not restricted to storm events.

7.2.7 Private and NGO initiatives and lobbying

The Strategy needs to recognise that big companies often have the resources, and arguably the responsibility for driving marine litter related issues. For example the "Love where you Live" campaign launched in England and Wales in 2010with £200k of private funding, W.R.A.P. which is working to reduce waste and packaging and some key retailers are signed up to targets to reduce packaging and increase recycling. NGOs can also play a significant role in lobbying, awareness raising and volunteering.

7.2.8 Monitoring and data

Coastal litter monitoring is carried out in several different ways, the most well known being that which has been done alongside Beachwatch litter collections for the past 18 years. They conform to OSPAR guidelines but apply mainly to urban beaches. Although limited in

geographical scope their guidelines are used by other groups. There will always be calls for more funding, staff time and better promotion, however a priority might be to manage and use existing regional figures (collected using comparable methods) and feed these back to MCS. There are OSPAR photo guidelines for different litter types, and helping to develop an EU wide approach would facilitate the use of standardised data. MCS data includes source, amounts, types, changes, and how to reduce it and should be actively used by the SG in this Strategy development to plan for marine litter reduction.

Examples from Scotland include Da Vor Redd Up which is an annual spring clean of Shetland's beaches and roadsides which is organised by the Shetland Amenity Trust, is now in its 21st year and is the largest community initiative of its kind in the UK. Each year up to 40% of the population gather about 50 tonnes of rubbish, but there is little data collection.

Scotland's National Spring Clean now happens over two months and provides data on the number of bags collected. More commercial sponsoring is needed for publicity and equipment (Wrigley's Gum has provided funding for permanent kits for individual groups). Information on the number of volunteers, number of events, location of events, organiser details, dates, times and the number of bags of rubbish (including recyclables when collected separately) are available on request. Some local Coastal Partnerships run cleans for team building, but data collection is piecemeal. Island tourist beaches are often cleaned by their communities, community cleans in Argyll and Bute (GRAB Trust) make use of landfill tax funding while in other areas Local Authorities clean amenity beaches (Aberdeen City clean c. 60 tons/yr).

SEPA trawls for litter during routine survey work and data will be reported on a national database. The data collected by SEPA is in a format suitable for submission to ICES and will be combined with data from other UK marine monitoring organisations including Marine Scotland Science. Overall, monitoring not adequate and the SG will need to set up a programme for GES and MSFD compliance that links to voluntary OSPAR work. The Clean Safe seas Evidence Group of the UK Marine Monitoring and Assessment Strategy (UKMMAS) has responsibility for ensuring UK marine monitoring Authorities collect litter data to provide information for the MSFD descriptor for Litter. Marine Scotland Science, MCS and SEPA are members of this group. Both SEPA and MSS are collecting litter data from routine trawling. SEPA is also collecting some beach litter data but resources are limited.

Broader points raised include questioning how much we need to expand monitoring efforts beyond existing processes, or make better use of what we have. There is also a need to consider more rural, inaccessible areas in Scotland which may collect litter, without having contributed to it – where are litter sinks and how can we reduce inputs to them? This would address the skewing of resources to bathing waters and more urban sites. Another interesting note relates to access to all of the data by universities who might be able to develop new conclusions from it, or suggest better recording methods. Finally, is there data that is recorded but not used or simple incentives to gather other fishing data?

7.2.9 Geographical distribution of marine litter

Maritime litter distribution is dependent on the source (hard to locate), currents and level of maritime activity. It shifts between regions (e.g. LAs) and littoral cells which serve to trap marine litter in discrete areas along Scotland's coast. Further out to sea shipping containers

may be lost overboard, however this is an EU / UK issue. This included a Cornish example of pellet pollution from shipping freight containers lost overboard and the mention of "Operation Cleansweep" and a Voluntary Code of Practice for container shipping.

7.2.10 Policy coordination, governance and implementation

The Marine Litter Strategy offers an excellent opportunity to review of legislative options in Scotland and to arrange a less scatter-gun approach to the issue and needs to consider monitoring requirements, GES, funding and how to coordinate and use marine litter data. This will involve consideration of scale, including coordination between local and national scales and different local authority levels of engagement. Management will need to be location specific (rural beaches, busier beaches etc.), and the establishment of regional partnerships / ICZM to tackle litter management should be promoted. Local responses to acute littering issues might be addressed through the Scottish Outdoor Access Code by Local Outdoor Access Forums since littering does not constitute 'responsible access'.

The maritime industries are required by the Ports Directive to keep a 'rubbish log' but these, like other marine measures are very difficult to police and the incentive to cast overboard is high. It was suggested that every boat should be charged a fee across the board, but that a combined carrot and stick approach would be most effective. Very high requirement for evidence to prosecute

Enforcement issues also arise on land where penalties are rarely applied, which may reflect a deficiency in the legislation itself (e.g. Local Government Act 2003, Environment Protection Act). Fly-tipping is an issue that might be reduced by increasing the likelihood of being prosecuted, perhaps by improving community involvement and their communication links with local police. Scottish Law requires a high burden of proof so surveillance and enforcement is still important. Courts could be encouraged to use community service orders to enable a rapid process from crime to clean-up. Enforcement of litter schemes should be easier on high use beaches using targeted fixed penalties and peer pressure – the locals are the enforcers. Outright bans on activities are rare, although some Local Authorities have banned balloon races and it was felt that this should be applied universally.

Other policy tools that should be linked to the Marine Litter Act include the Climate Change Act (through efficiency gains) and trading standards legislation. Clear guidelines from the plastics industry relating to what is biodegradable etc. should be made available and should be used to address labelling issues in partnership with the SG/UK Government.

SOLAS / IMO / UK / Merchant Shipping Act and Marine Conservation Act, recent review Annex 5 of MARPOL and its extension to fishing vessels, the Marine Act feeding into secondary legislation including OSPAR constitute a range of related policy tools.

Sharing good practice between Scottish regions, sectoral approaches and overseas experience should be an ongoing process, building on existing networks of expertise. Any Marine Litter Strategy should encourage this.

SECTION B STRATEGY DEVELOPMENT

8 EVALUATION OF MARINE LITTER LEGISLATION AND ALIGNMENT WITHIN A SCOTTISH MARINE LITTER STRATEGY

A vast amount of legislation exists with regards to marine litter. National and regional waste management structures, the actions of industries, and community and personal responsibility are complex issues that cross jurisdictions and scales and therefore have evolved a variety of associated instruments. There is a disconnect between land and sea, with most management and policy arrangements in Scotland focusing on the terrestrial dimension, a key pressure on the quality of coastal and marine systems in terms of marine litter and pollution. However, as identified, litter is also derived from the marine dimension. As a result, there has been the emergence of a regime for addressing and attempting to improve litter management from a range of maritime industries, and legislative requirements under the Marine Strategy Framework Directive to control and reduce the problem. From Figure 8-1 below it is clear that there is a sufficient mix of regulatory tools that can be used to inform and implement a Scottish Marine litter Strategy. The table identifies the key instruments from the international, EU and Scottish scales, with notes on alignment to a potential strategy.

Figure 8-1 Evaluation of International, EU, UK and Scottish Legislation and Policy

Instrument	Relevance to Marine Litter Management (H-M-L)	Scope	Implementation in Scotland / alignment with Scottish Strategy
International Regulations			
MARPOL Annex V (Garbage)	H	MARPOL regulates the types and quantities of garbage that ships may discharge into the sea. The disposal of plastic anywhere into the sea is prohibited and the discharge of other wastes is restricted in coastal waters and "Special Areas" (e.g. North Sea). Port State control officers can inspect a vessel on grounds of negligence relating to the prevention of pollution by garbage. Annex V provides for: • the prohibition of disposal of plastics into the sea; • the prohibition of disposal of other garbage except in certain circumstances; • restrictions on ships entering Antarctic Treaty waters without sufficient capacity for garbage retention onboard; • inspections to be carried out with regards to garbage management and procedures on ships; • Governments to be required to ensure the provision of facilities at ports and terminals for the reception of garbage; • the imposition of requirements to carry placards relating to the disposal of garbage; • a garbage management plan; and • a garbage record book	March 2010, 140 states have ratified MARPOL Annex V & cover 97.5% of the world's shipping tonnage. **Enforcement** is still a problem; however Garbage Management Plans and Garbage Record Books can assist in investigations by Port authorities. The dumping of all plastic at sea is banned butwith poor enforcement and insignificant fines, it holds very little deterrent for polluters. 2010 review of Annex V by Marine Environment Protection Committee (MEPC) of the IMO has raised a number of amendments. Changes include the updating of definitions; the inclusion of a new requirement specifying that **discharge of all garbage** into the sea is prohibited except as expressly provided otherwise; and expansion of the requirements for placards and garbage management plans. OSPAR QSR 2010 notes **information is too limited** to quantify the contribution of shipping to impacts such as oil spills or litter and to evaluate progress made since 1998. Improved monitoring is a priority. MARPOL is administered in the UK under The Merchant Shipping (Prevention of Pollution by Sewage and Garbage from Ships) Regulations 2008 with enforcement carried out by the MCA. There have been few prosecutions to date under this legislation but several ships have been inspected **and delayed in port.** MCA surveyors also regularly inspect both foreign and UK flag commercial and fishing vessels to ensure compliance with international maritime conventions or domestic Merchant Shipping legislation. The MCA will detain non-compliant vessels when appropriate. Garbage plans and records apply to ships of 400 gross tonnage

Instrument	Relevance to Marine Litter Management (H-M-L)	Scope	Implementation in Scotland / alignment with Scottish Strategy
			&above and/or ships certified to carry 15 persons or more. Practicality of this applying to all ships of any size? **Sectors**: Ships, fishing, recreation
London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matters1972 / 1996 Protocol	M	One of the first global conventions to protect the marine environment - in force since 1975. Its objective is to promote the control of all sources of marine pollution and to take steps to prevent pollution of the sea by dumping of wastes from ships, structures, aircraft and platforms. This is in contrast to MARPOL which governs waste from the day to day operation of shipping. The convention uses 'black' and 'grey' lists. Black list items are prohibited and grey list items require permission and are subject to strict regulation from national authorities. Persistent plastic materials are prohibited from being dumped. The 1996 Protocol modernises the convention and will eventually, replace it. Under the Protocol all dumping is prohibited, except for acceptable wastes on the so-called "reverse list". The "reverse list" is based on a precautionary approach, which implies that all dumping is prohibited unless explicitly permitted. The Protocol entered into force on 24 March 2006 and there are currently 39 Parties to the Protocol.	There are no compliance mechanisms under the London Convention, however, with the entry into force of the London Protocol on 26 March 2006, a set of Compliance Procedures and Mechanisms, pursuant to Article 11, were adopted in November 2007. 39 parties to the London Protocol – lack of international coverage. Traditional drawbacks of international law – enforcement, monitoring and opt out procedures by states. UK has ratified this agreement. The Secretary of State for the Environment is responsible for negotiation, representation and policy formulation in relation to the London Convention and Protocol, and guidelines issued under it. The Food and Environment Protection Act 1985 (FEPA) provides the necessary statutory means to meet the UK's obligations under both the London Convention and is the **relevant Scottish instrument** for the management of pollution from dumping at sea. This will be repealed by provisions in the Marine (Scotland) Act 2010. **Sectors**: Ships, oil & gas, coastal infrastructure; ports, renewable energy.
Convention on the Protection of the Marine Environment of the North East Atlantic 1992 (OSPAR Convention)	H	OSPAR identifies threats to the marine environment and organises programmes and measures to ensure national action to combat them. Work to implement the Convention is taken forward through the adoption of legally binding decisions and recommendations that set out actions to be taken by the Contracting Parties. The UK is one of 16 contracting parties to OSPAR and Defra is the lead co-ordinating department. A variety of government departments, devolved administrations and agencies contribute to OSPAR committees and programs and OSPAR decisions influence UK and Scottish policy and	OSPAR influences a range of UK and Scottish regulations including FEPA, Petroleum Act 1998, and the Marine and Coastal Access Act 2009 and Marine (Scotland) Act 2010. OSPAR should extend its marine litter monitoring on beaches in all Regions and consider including it in its Coordinated Environmental Monitoring Programme. Include monitoring of water column and the seabed. *Despite initiatives to reduce the amount of marine litter in the OSPAR area, overall levels in areas monitored are frequently unacceptable.*

Instrument	Relevance to Marine Litter Management (H-M-L)	Scope	Implementation in Scotland / alignment with Scottish Strategy
		regulatory instruments. OSPAR members implement a range of monitoring programs including the Quality Status Reports and the Co-ordinated Environmental Monitoring Programme (CEMP). Since 1998, OSPAR has monitored levels of beach litter, initially through a pilot project and then through a voluntary monitoring programme	**Sectors**: All maritime sectors generally. Specific to oil and gas, conservation, coastal infrastructure.
European Regulations			
EU Marine Strategy Framework Directive (2008/56/EC)	H	Member States are required to develop strategies in order to achieve and maintain 'good environmental status' by 2020. MSFD identifies **marine litter** (descriptor 10) as one of 11 qualitative descriptors for determining good environmental status. To achieve this, the "properties and quantities of marine litter do not cause harm to the coastal and marine environment". The directive divides the EU waters into marine regions and subregions and Member States should develop programmes and measures, which are designed to achieve or maintain good environmental status by 2020. Key requirements: • An assessment of the current state of UK seas by July 2012 • A detailed description of what Good Environmental Status means for UK waters, and associated targets and indicators by July 2012 • Establishment of a monitoring programme to measure progress towards GES by July 2014 • Establishment of a programme of measures for achieving GES by 2016	While it is too early to assess the effectiveness of the MSFD in the UK, it will be a **central element driving a Scottish marine litter strategy**. The GES descriptors, in particular Descriptor 10, will drive action at a Scottish scale to monitor and improve environmental quality. **A marine litter strategy will be a primary means of coordinating response to the MSFD Descriptor 10.** The Marine Strategy Regulations 2010, in s6.1 highlight that each devolved policy authority must provide the Secretary of State with: (a)proposals for— (i)the establishment of the monitoring programmes for the devolved marine area; (ii)the determination of a programme of measures for the devolved marine area; and (iii) the review or update of such monitoring programmes or programme of measures. (b)information, including information for any review or update, to support— (i)the assessment of marine waters for the devolved marine area; (ii)the determination of the characteristics of good environmental

Instrument	Relevance to Marine Litter Management (H-M-L)	Scope	Implementation in Scotland / alignment with Scottish Strategy
			status for any area within the devolved marine area which is distinct as regards its hydrological, oceanographic and biogeographic features; and (iii) the development of environmental targets and indicators for any area within the devolved marine area which is distinct as regards its hydrological, oceanographic and biogeographic features . **Sectors**: all
EU Directive on Port Reception Facilities for Ship-generated Wasteand Cargo Residues (EC2000/59)	H	This directive aims to improve the availability and use of port reception facilities, in order to reduce the illegal discharge of waste from ships and cargo residues. Ports must set up waste handling plants and make available adequate reception facilities. Every ship is required to deliver ship-generated waste and cargo residues to ports. All ships are to pay a set fee for waste disposal, irrespective of their actual use of the facilities. Member states must ensure proper monitoring of compliance with the directive, by means of spot checks and the exchange of information between ports. Ships that do not deliver waste in one port will be reported to their next port of call for a more detailed inspection. The Port Waste Reception Facilities Regulations entered into force on 16th July 2003. There are three significant changes under the new regulations: • All ships must provide notification before entering into the port or terminal of the waste they will discharge, including information on types and quantities, • All ships must deliver their waste to the port reception facilities before leaving the port, unless they have sufficient	Directive 2000/59/EC is **implemented in the UK** through the Merchant Shipping Act 1995, Merchant Shipping and Fishing Vessels (Port Waste Reception Facilities) Regulations 2003 and the (Amendment) Regulations 2009. These regulations stipulate that Ports and Harbours must provide adequate facilities for waste disposal. The acts raise **significant monitoring and compliance issues** for Scottish and UK authorities. Is current resourcing appropriate for adequate monitoring of reception facilities and compliance with the Directive by Port operators? To what extent does **information exchange** occur between ports within and external to Scotland concerning marine litter? A debate exists over the effectiveness of the fee structure in driving invectives and behaviours. A European Maritime safety Agency review in 2005 highlighted mixed use of reception facilities, and wide interpretation of the fee structure. One reason given for ships failure to discharge their waste to shore has been inadequate provision of waste reception facilities. The incentive for dumping at sea is high and can save on the fees that ports charge for the use of such facilities. This is compounded by a lack of monitoring and enforcement issues. An approach, known as a “no-special-fee” system incorporates the cost of port facilities use in the general harbour dues which all

Instrument	Relevance to Marine Litter Management (H-M-L)	Scope	Implementation in Scotland / alignment with Scottish Strategy
		dedicated storage capacity to store the waste until the next port of call, • All ships must pay a charge to make a significant contribution to the cost of the port reception facilities for ship generated waste, whether they use them or not.	ships pay. This aims to remove incentive for ships choosing to dump at sea. At present legislation only requires a partial inclusion of facility fees in harbour dues with savings still to be made by ships that choose to dump at sea instead.
Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste	H	Directive 2008/98/EC on waste establishes the legislative framework for the handling of waste in the European Union. It defines; "Member States shall take appropriate measures, in cooperation with other Member States, to establish an integrated and adequate network of waste disposal installations and of installations for the recovery of mixed municipal waste collected from private households, including where such collection also covers such waste from other producers, taking into account best available techniques." Specifies an obligation for the Member States to draw up waste management plans. It defines concepts such as waste, recovery and disposal and puts in place the requirements for the management of waste, notably an obligation for an establishment or undertaking carrying out waste management operations to have a permit or to be registered. It also establishes principles such as an obligation to handle waste in a way that does not have a negative impact on the environment or human health and to develop measures and legislation to apply the waste hierarchy in accordance with the polluter-pays principle. The hierarchy stipulates that waste must be managed in order of: 1) prevention 2) reuse 3) recycle 4) energy recovery.	In Scotland, the directive is implemented by a complex range of legislative instruments initiating from The Environment Act 1995 (establishing SEPA as the regulatory body for control of pollution and waste) and the Environmental Protection Act 1990 that establishes in England, Scotland and Wales the structure and authority for waste management and control of emissions into the environment. Subsequently amended by a range of Scottish Waste regulations, the Scottish regulations have evolved over a decade from the initial Waste Management Licensing Regulations 1994 through several Statutory amendments. A current draft of The Waste Management Licensing (Scotland) Regulations 2011 and the Waste (Scotland) Regulations 2011 aims to consolidate all previous legislation and streamline waste licensing and management and incorporate elements of the 2008 Directive. In 2010 the Waste Information (Scotland) Regulations were passed requiring persons having control or management of undertakings to **comply with any request** made to them by SEPA **for information relating to waste** associated with that undertaking. SEPA itself is undergoing a reform process and is proposing to improve, simplify and better integrate the environmental protection and improvement services it provides. Current consultation on 'Better Environmental Regulation' aims to boost efficiency and streamline monitoring and licensing services. The Zero Waste Plan is a cornerstone of implementation of the Directive in Scotland and is detailed below. Any marine litter strategy should be compliant with the Zero Waste Plan (detailed below).

Instrument	Relevance to Marine Litter Management (H-M-L)	Scope	Implementation in Scotland / alignment with Scottish Strategy
EU Directive on Packaging and Packaging waste (Directive 2004/12/EC)	M	The main objective of the Directive on Packaging and Packaging Waste is to prevent packaging waste by encouraging packaging re-use and recycling, while at the same time avoiding distortions in the internal market. The Directive requests that Member States introduce systems for the return and/or collection of used packaging and defines specific targets for packaging waste recovery and recycling.	This Directive aims to harmonise national measures in order to prevent or reduce the impact of packaging and packaging waste on the environment. It contains provisions on the prevention of packaging waste, on the re-use of packaging and on the recovery and recycling of packaging waste. In Scotland the Directive is implemented via the Producers' Responsibility Obligations (Packaging Waste) Regulations that provide the statutory framework by which the UK must meet the minimum recovery and recycling targets. These Regulations place obligations on all UK companies that have a turnover exceeding **£2 million** and that handle more than **50 tonnes** of packaging per annum and are enforced by SEPA. The Regs were amended in 2010 to establish new targets. The amendments have also clarified the position with regards to packaging that is moved offshore to marine installations where any packaging moved to such installations forms part of a producer's obligations and cannot be excluded.
Bathing Water Directive (2006/7/EC)		The main objective of the Bathing Water Directives (76/160/EEC and 2006/7/EC) is to protect public health and the environment from faecal pollution at bathing water sites. Member States are required to identify popular bathing areas and to monitor water quality throughout the bathing season. The revised Directive uses two parameters to assess water quality, Escherichia coli and intestinal enterococci, using a four year data set for each set of results, and sets much tighter standards than the original Directive. There will be four classification categories: Excellent (approximately twice as stringent as the current Guideline standard); Good (similar to the current Guideline); Sufficient (approximately twice as stringent as the current Mandatory standard) and Poor, for waters which do not comply with the Directive's standards. There will be a new requirement for information about water quality and potential sources of pollution at bathing waters to be provided on signs and via the internet. Regular reviews	In March 2006 the revised Directive came into force. This was enacted in the UK by the Bathing Waters (Scotland) Regulations 2008 which came into effect in May 2008. Key features include increased provision of public information, tighter microbiological standards to be met by 2015 and monitoring to be commenced by 2012. All bathing waters must be of at least sufficient standard, and that appropriate measures are taken to increase the numbers of bathing waters classified as excellent or good by 2015. Whilst the criteria relating to the classification of bathing waters are bacteriological, the revision states other parameters must also be considered in a bathing water's management. Amongst these considerations is the presence of litter pollution. Acknowledged that the responsibility for controlling litter on beaches is local authorities and communities. Actions on implementing the BWD integrate with **Water Framework Directive and river basin management planning**

Instrument	Relevance to Marine Litter Management (H-M-L)	Scope	Implementation in Scotland / alignment with Scottish Strategy
		of the list of bathing waters will be carried out and the public will be encouraged to participate in the review.	**and the Water Environment and Water Services (Scotland) Act 2003.** While the WFD relates primarily to the management of aquatic pollutants, environmental objectives and management plans need to be established for each planning district. The Marine Strategy Framework Directive Good Environmental Status indicator 10 will also apply to all Water Framework Directive water bodies for litter.
Scottish Legislation and Initiatives			
Scottish Government Zero Waste Plan	H	The Zero Waste Plan sets the **strategic direction for waste policy in Scotland** and applies the process and approach in the waste management hierarchy. It sets the goals for achieving the strategy with a focus on a **cultural change of waste as a resource.** This vision describes a Scotland where resource use is minimised, valuable resources are not disposed of in landfills, and waste is sorted into streams for reprocessing, leaving only limited amounts of waste to go to residual waste treatment, including energy from waste facilities. A zero waste Scotland will: * be where everyone - individuals, the public and business sectors - appreciates the environmental, social and economic value of resources, and how they can play their part in using resources efficiently; * reduce Scotland's impact on the environment, both locally and globally, by minimising the unnecessary use of primary materials, reusing resources where possible, and recycling and recovering value from materials when they reach the end of their life; * help to achieve the targets set in the Climate Change (Scotland) Act 2009 of reducing Scotland's greenhouse gas emissions by 42% by 2020 and 80% by 2050;	Particular actions in the Zero Waste Plan will have a resonance with a Marine Litter Strategy. The two will be closely linked across particular waste streams, industry innovation, and public education and awareness. The plan will provide the means of reducing the litter from source, including point and non-point means. Actions to be carried forward into a marine strategy include: **Resource Streams:** • The Scottish Government will introduce a long term target of 70% recycling for all waste arising in Scotland by 2025, regardless of its source, based on improved data and supported by sector-specific programmes of work. • The Scottish Government will introduce progressive bans on the types of materials that may be disposed of in landfill, and associated support measures, to ensure that no resources with a value for reuse or recycling are sent to landfill by 2020. **Economic opportunity** • SEPA with the Scottish Government will develop further and implement the Better Waste Regulation Action Programme to support delivery of the Zero Waste Plan • Development of Low Carbon Economic Strategy investing in Environmental and Clean Technologies. • The Scottish Government will continue to support the development of collection and reprocessing capacity for plastics. **Waste Sector** • The Scottish Government, with local planning authorities and

Instrument	Relevance to Marine Litter Management (H-M-L)	Scope	Implementation in Scotland / alignment with Scottish Strategy
		* contribute to sustainable economic growth by seizing the economic and environmental business and job opportunities of a zero waste approach. It sets actions under the topics of resource streams; economic opportunity; resource management sector; and education and awareness. Detail of actions from: http://www.scotland.gov.uk/Publications/2010/06/08092645/0	SEPA, will ensure the land use planning system supports the Zero Waste Plan and the provision of local waste infrastructure. **Awareness** • Zero Waste Scotland will develop and implement, in cooperation with local authorities, a consistent, targeted, coordinated and phased education and awareness programme to encourage participation of the public and businesses to meet zero waste objectives. • Zero Waste Scotland, in cooperation with local authorities, will review the success of measures to influence waste behaviours, including incentives.
Environmental Protection Act 1990		Despite the fact that the EPA act has been considerably amended over the past 20 years, elements of the Act are still in force and provide the baseline for litter management in Scotland. Under Section 87 of the EPA 1990, it is an offence to drop litter in any public place, including beaches. Section 88 allows local authority officers and / or accredited persons to issue a fixed penalty notice for leaving litter. The EPA also places duties on, and gives powers to, the local authority to keep its beaches clear of litter according to the Code of Practice. In 2000, a revised Code of Practice extended the requirements from amenity beaches to all beaches. Duty bodies are advised that they may find it helpful to encourage voluntary groups to assist in cleaning up beaches. The Code of Practice was updated again in 2006. The code now carries a description of aquatic litter, and guidance suggests that between May and September beaches should be subject to a frequent monitoring routine, and cleansed to as practicable a standard as possible.	The Environmental Protection Act 1990 (the Act) imposes under **S89 a duty on local authorities** and certain other landowners and occupiers (the duty bodies) to keep specified land clear of litter and refuse so far as is practicable. **The Code of Practice on Litter and Refuse (Scotland) 2006**, established under S89.7 specifies the duties for authorities and guidance on the cleaning regime. It states that Duty Bodies are responsible for keeping beaches clear of litter as far as practicably possible accumulations. Based on levels of use and time it sets standards of acceptable levels of cleanliness. Scotland's beaches are categorised into one of four zones; • Amenity Beach (Blue Flag beaches and those adjoining designated bathing waters) • Recreational Beach (managed beach, award winning beach or beach adjoining other SEPA sampled waters) • Sensitive Conservation Area (SSSIs, SPAs, SACs and nature reserves) • Other Beach (any other beach) The Code is based on four grades of cleanliness; • Grade A: no litter or refuse;

Instrument	Relevance to Marine Litter Management (H-M-L)	Scope	Implementation in Scotland / alignment with Scottish Strategy
			• Grade B: predominantly free of litter and refuse, other than a few small items; • Grade C: widespread distribution of litter and refuse with minor accumulations; • Grade D: heavily littered with significant accumulations. If the level of cleanliness falls below a Grade B, the Code sets a response time in which the Duty Body must restore the land to its given standard depending on the time of year and the zone in which that beach falls. Under S91 persons aggrieved by litter may take legal action against the person who has the duty to keep the area clean. Under S92 local authorities may also undertake summary proceedings. In 2010 KSB visited 71 beaches and assessed them in line with the EPA and COP. Of those visited 85% achieved a Grade B standard, with 15% falling below the minimum legal cleanliness standard. Of those not achieving the minimum acceptable cleanliness standard 10% achieved a Grade C and 5% a Grade D. A Marine Litter strategy should take into account the obligation of 'duty of care' for beaches as prescribed in the Act. Furthermore the provisions in the Act provide the basis of enforcement activity for coastal litter.
Marine (Scotland) Act 2010		The Marine (Scotland) Act is a major reform that will implement national and regional marine planning and address the requirements of the Marine Strategy Framework Directive. The management of litter, while not directly specified under the Act, may fall under the scope of the marine planning and licensing regime. Marine planning will be critical for influencing the spatial extent and license regime for many maritime activities, including activities that have not been regulated in the past such as marine leisure and tourism. The Act specifies under Part 2 s.3 the duty of Scottish Ministers for sustainable development and protection and enhancement of the health of the Scottish marine area.	Scottish ministers must prepare a national marine plan and may prepare regional marine plans. Part 3 s.5 (4) of the Act provides that for a marine plan Scottish Ministers must set— (i)economic, social and marine ecosystem objectives, (ii)objectives relating to the mitigation of, and adaptation to, climate change, (b)prepare an assessment of the condition of the Scottish marine area or, as the case may be, Scottish marine region at the time of the plan's preparation, (c)prepare a summary of significant pressures and the impact of

Instrument	Relevance to Marine Litter Management (H-M-L)	Scope	Implementation in Scotland / alignment with Scottish Strategy
		Under s.4 there is a duty to ensure Mitigation of and adaptation to climate change in the Scottish marine area and to meet the requirements of the Climate Change (Scotland) Act 2009. Part 3 implements a new marine planning system for Scotland. Although MSP is yet to be implemented in Scottish seas, we see it as providing the overall vision for a marine region, and the policy 'glue' that will coordinate activities underpin integrated and joined up thinking across sectors and issues. The Act provides the framework for the new marine licensing regime for activities carried out in the marine environment, such as deposits in the sea, dredging, marine renewable projects and other construction works. Licensing decisions will be closely linked with the new marine planning arrangements. Marine Scotland will be the first point of contact for all marine licensing applications under FEPA, CPA and section 36 of the Electricity Act 1989 consents, within the Scottish marine area from 0-200 nautical miles (nm) through powers within the Marine (Scotland) Act and the UK Marine and Coastal Access Act. The new **marine licence** will replace a number of existing consenting regimes and their consolidation will draw together into a single licensing decision, consideration of environmental, human health and navigational safety factors as well as the interests of other users of the sea.	human activity on the area or region. The pre-consultation draft national marine plan includes marine litter objectives to be further operationalised in the regional marine plans. At present the draft consultation specifies that the GES Descriptor 10 forms the objective. While this will need to be further specified across marine regions for example across different habitats, industries and regional targets. As a result, relevant authorities will have to take authorisation or enforcement decisions 'in accordance' with the marine plan that **contains litter based objectives**. A Scottish Marine Litter strategy should take into account these requirements and deliver assessments and recommendations at the regional and national scale. Planning can also integrate an appropriate mix of regulatory instruments at a regional scale. With drivers from the Zero Waste Plan, the Climate Change Act, and EU Directives, particularly the MSFD, marine licensing is an important instrument to improve litter management practices across maritime industries and users. For example, licensing or approvals could further the implementation of waste management plans, facilities for recycling or waste, and incentives for marine users and industries to bring back litter to shore. The option of marine licensing for litter management should be looked at in the context of the SEPA regulatory efficiency reforms.
The Climate Change (Scotland) Act 2009		The Climate Change (Scotland) Act 2009 received Royal Assent on August 4, 2009 and is ambitious legislation that articulates the Scottish commitment to reducing greenhouse gases and developing a low carbon economy. Part 1 of the Act, creates the statutory framework for greenhouse gas emissions reductions in Scotland by setting an interim 42 per cent reduction target for 2020, with the power for this to be varied based on expert advice, and an	In regards to a Marine Litter Strategy, the act as several important provisions. S. 44 places a duty on public bodies to contribute and report on actions to the delivery of the emission reductions targets Part 1 of this Act. As a result, public bodies who are involved in marine litter management may report on resource efficiency initiatives that reduce emissions **and** reduce litter loads.

Instrument	Relevance to Marine Litter Management (H-M-L)	Scope	Implementation in Scotland / alignment with Scottish Strategy
		80 per cent reduction target for 2050. Part 2 of the Act contains provisions which will allow the Scottish Ministers to establish a Scottish Committee on Climate Change Part 3 places duties on the Scottish Ministers requiring that they report regularly to the Scottish Parliament on Scotland's emissions and on the progress being made towards meeting the emissions reduction targets Part 4 places climate change duties on Scottish public bodies. This Part also contains powers to enable the Scottish Ministers, by order, to impose further duties on public bodies in relation to climate change. Part 5 includes provisions on climate change including adaptation, forestry, energy efficiency and waste reduction.	The Climate Change (Scotland) Act 2009 gives the Scottish Ministers powers, through regulations, to introduce new obligations for matters relating to waste (Part 5, chapter 5.) The purpose of taking these powers was to reduce the impact that waste management and misuse of resources have on climate change. S.78 details the provision of waste management plans and s.79 specifies that Minister may, by regulation, require persons to report waste management data to SEPA. Improved management and coordination of facilities for recycled waste are required under s.80 and 81. The intent of Ministers to promote and enact regulations to increase recycling (s.82), reduce packaging (s.83), implementing deposit schemes (s.84-87) and introducing carrier bag charges (s.88). While these actions will be implemented via secondary legislation and amendments of existing waste legislation (see above) it will be important to consider these drivers in the context of a Marine Litter Management Strategy.

8.1 Key themes emerging from the evaluation of marine litter legislation

8.1.1 Coverage

Figure 8-1 identifies a number of instruments that apply to the management of marine litter across sources. At a minimum, 3 international conventions, 6 EU Directives, and 21 UK and Scottish legislative and statutory instruments directly influence marine litter management. Not every legislative, statutory or policy instrument was captured analysis as many secondary (minor) instruments relate to implementation. The overall conclusion from the assessment is that a substantial network of regulatory tools exists to address the management problem, and further major legislative reform is considered unnecessary. While it is an accepted requirement to introduce further minor statutory instruments to enable powers or refine regulatory instruments, the key challenge for a Marine Litter Strategy will be to utilise the existing network to ensure effective outcomes. These include meeting a range of policy objectives across the land and the sea interface including OSPAR criteria, GES and Descriptor 10 of the MSFD, GES under the WFD, excellent and good status of bathing waters, the strategic objectives and actions of the Zero Waste Plan, the waste management requirements of the Climate Change Act and meeting the 'sustainable development and protection and enhancement of the health of the Scottish marine area'.

8.1.2 Jurisdiction

A Scottish Marine Litter Strategy should account for jurisdictional influences within the legislation using the principle of subsidiarity, whereby decisions are taken at the lowest possible administrative and political level. In this situation, action would be taken at a higher level only where there are clear benefits or basis. The analysis highlights that many objectives and outcomes can be achieved within Scottish jurisdiction, as management of waste and litter is predominantly a devolved activity. When it comes to the maritime sector most activities relating to marine litter are devolved or executively devolved. However, several legislative instruments and management regimes remain in the area of UK competence, and will require cooperation and integration of policy and management initiatives as well as coordination of the regulating authorities and organisations. For example, while ports are a devolved activity, shipping and oil and gas are regulated in a UK context. Monitoring and enforcement of shipping activity in the context of MARPOL Annex V under The Merchant Shipping (Prevention of Pollution by Sewage and Garbage from Ships) Regulations 2008 is undertaken by the Marine Coastguard Agency and the provision and incentives for ships to deposit waste in Ports requires policy coordination between Scottish and UK authorities. In addition, the effectiveness of the MARPOL and the EU Directive on Port Reception Facilities for Ship Waste relies on information exchange and monitoring between ports in different jurisdictions. OSPAR identified in the 2010 Quality Status Report that too little information exists on the contribution of shipping to marine litter and waste and that further monitoring and performance assessment is required.

8.1.3 Integration

Integration means 'joining the dots across legislation and policy instruments'. When we consider the land and coastal system as an integrated whole, there are several connections to consider when addressing the problem of marine litter. The most obvious is the accumulation of litter from terrestrial and marine sources at the coastal interface, which can

be considered a sink for litter. From this sink (and if it is not captured) marine litter can deteriorate into the unknown and potentially harmful state of micro-plastics and is beyond the authorities ability to remediate. Therefore, when addressing the marine litter problem, a marine litter strategy should be thinking with a systems approach addressing not only the sink (or the symptom) and cleaning up litter, but addressing the sources of litter from terrestrial and marine sectors and making progress against the root causes of the problem. While this appears common-sense, it is questionable that the legislative and policy system is currently suitably integrated to address the marine litter problem. Integration also must be considered across scales from the Scottish to the European, both in terms of the effectiveness of individual instruments such as the Marine (Scotland) Act or the Zero Waste Policy and in terms of how these instruments aggregate upwards and influence initiatives at the UK and EU levels. One area to consider is under the MSFD, States are required to cooperate on a regional sea basis to ensure Good Environmental Status. Therefore raising the problem and further addressing the issue of marine litter in forums such as OSPAR will progress integration at a regional sea scale. Note that OSPAR is proposing amendments to monitoring, stating the members should extend its marine litter monitoring on beaches in all regions and consider including marine litter in the Coordinated Environmental Monitoring Program, with inclusion of monitoring of the water column and the seabed.

The above highlights many instruments that can and should be used to effect upon the problem from the terrestrial, coastal and marine sphere. The proposed Strategy is an opportunity to provide a roadmap and integration of a range of statutory and non-statutory instruments that can be used on the marine litter problem. An important principle when constructing the strategy is to consider duplication of effort under a variety of instruments, and to ensure the most efficient regulatory path is taken to address the problem. In particular we observe the Marine (Scotland) Act 2010 and the Climate Change (Scotland) Act 2009 as key overarching mechanisms to deliver a Marine Litter Strategy, supported by some aspects of the Zero Waste Plan.

8.1.4 Effectiveness

Legislative and regulatory rationalisation may be necessary to reduce marine litter, though due to its nature, time lags will be associated with any new or altered legislation, policy or Strategy before the impact of that is seen. However, this assessment notes that the key issue for progress is raising awareness and changing behaviours in individuals, communities and businesses; promoting a culture change of ‘waste as resource’; developing novel and innovative market based approaches; and implementing a supportive, efficient and effective regulatory system. A Marine Litter Strategy should endeavour to capture and integrate these elements, with the acknowledgement that creating the framework is the first step in the policy cycle, and on its own will do little to reduce the actual problem. In the Marine Litter Workshop held at the Macaulay land Use Research Institute, Aberdeen in February 2011 consistent issues over enforcement, compliance, and culture change were raised by the expert panel across the various domains of regulatory instruments from ports to individual actions. This infers that while the strategy should clearly articulate objectives and actions that relate to monitoring, effectiveness and compliance, it should also address changes in behaviour and the provision of resources to undertake action programs and expand

successful initiatives. Referring to integration above, many of these actions will come under the Zero Waste Plan and duplication should be avoided.

9 EVALUATION OF CURRENT MARINE LITTER INITIATIVES

9.1 Overview

There are a plethora of initiatives which exist at the local, regional and national scales both in the UK and Scotland, a number of which are specific to marine litter, others towards general litter management and environmental stewardship. In this section, evidence gathered during the literature review and stakeholder workshop will be summarised to offer an evaluation of those initiatives with a remit of reducing marine litter which are applicable in the UK or Scotland. This includes a summary table of the current initiatives (Figure 9-1), the lead organisation, their scope and remit, the strengths of the individual initiative and suggestions for improvements. The discussion section further explores the strengths and benefits of the initiatives as well as their limitations, with the overall aim of addressing their coordination within a Strategy and identifying ways in which Scotland can better learn from and coordinate with, the global movement in tackling marine litter.

Initiative	Lead/ Coordinating Organisation	Scale	Scope	Remit	Status and Funding Source	Key Strengths	Potential Improvements
Beach Clean Ups, Surveys and Campaigns							
International Coastal Clean Up	Ocean Conservancy	International	• Remove litter • Identify sources • Change the behaviours that lead to littering	• Removal • Survey • Education	• Charity: • Membership, donations and corporate sponsorship	• 498,818 volunteers • 108 countries • 6430 sites • Global snapshot on a single day • Standardised approach and methodology • Data collected since 1989 • Data are fed in to the Marine Debris Index- the only country by country, item by item accounting of marine litter • Flexibility to schedule the events over September and October to accommodate holidays, bad weather etc • During the year, volunteer coordinators identify sites to be cleaned and recruit sponsors and volunteers for the day of the event (MCS in UK) • Cost effective monitoring as reliant on volunteers	• Expand the focus beyond the USA • Broaden out the data collection methodology beyond 42 items in 5 source groups • Take terrestrial inputs that are not from the immediate coastal area into account in the source groups • Increase the % of global population taking part • Provide feedback to participants after the event, to increase ownership and aid their future participation
Marine Litter Monitoring Project	OSPAR	North East Atlantic	• Sources and trends identified from OSPAR Contracting Parties	• Survey		• Region wide scope • Based on a statistical analysis, using a standardized protocol during the pilot project period (2001–2006) • Approach allows for comparison and overall assessment between reference beaches and countries • Source categories in line with MCS • Cost effective monitoring	• Increase the time span. Project ran from 2000-06 • Expand work beyond beaches only; to offer a wider picture of the total litter load • Undertake further surveys to give full assessment in NE Atlantic
Beachwatch Big Weekend	MCS	UK	• Involves local individuals, groups and communities in caring for their coastal environment	• Survey • Clean	• Charity: • Membership and donations	• Provides monitoring and trend data for marine litter on UK and regional level beaches • Running since 1993 • Has 17 years of data • UK's biggest beach clean and litter survey • Links with the International Coastal Clean Up (with over 90 countries participating)	• Work to increase the geographical spread of cleans beyond the more urban/populated areas • Expand work beyond beaches only; to offer a wider picture of the total litter load

Initiative	Lead/ Coordinating Organisation	Scale	Scope	Remit	Status and Funding Source	Key Strengths	Potential Improvements
						• Data fed back to OSPAR Marine Litter Monitoring Project • Cost effective monitoring • Dedicated website • Education and awareness raising for participants • Reduces the likelihood of participants dropping litter • Extensive national, regional and local media coverage of results each spring	• Work to increase the % of the population taking part • Expand organiser feedback to participants after the event, to increase ownership and aid their future participation
Adopt-a-Beach	MCS	UK	• Involves local individuals, groups and communities in caring for their coastal environment	• Survey • Clean	• Charity: • Membership and donations	• Regular cleaning of adopted beaches (4/yr) • Provides monitoring and trend data for marine litter on UK and regional level beaches • Data spans 13 years • Links with the International Coastal Clean Up (with over 90 countries participating) • Data fed back to OSPAR Marine Litter Monitoring Project • Cost effective monitoring • Education and awareness raising for participants • Reduces the likelihood of participants dropping litter • Dedicated website/pages	• Work to increase the geographical spread of cleans beyond the more urban/populated areas • Expand work beyond beaches only or link to other initiatives; to offer a wider picture of the total litter load • Increase % of the population taking part • Provide feedback to participants after the event, to increase ownership and aid their future participation
Sickness and Sewage	Surfers Against Sewage	UK	• Protection of the coast, via campaigning, volunteering, conservation, education and research, to tackle sewage discharges	• Campaign/ pressure group	• Not-for profit • Membership, donations, merchandise sales, fund-raising events and sponsorship	• Links to water sports governing bodies • Sector specific knowledge • High profile issues • Dedicated website	• Employ a project officer • Increase knowledge exchange work to increase awareness amongst non members • Expand current focus beyond the South coast and England
Seaside Award	KSB	UK	• To recognise the best managed beaches; resort and rural	• Award • Survey	• Charity	• Raises attention to beach quality standards particularly issues with water quality, litter and provision of facilities • The number of Awards has increased	• Explore other awards and opportunities for those beaches that do not meet criteria i.e.

Initiative	Lead/ Coordinating Organisation	Scale	Scope	Remit	Status and Funding Source	Key Strengths	Potential Improvements
						since the schemes were introduced • The Awards represent a high standard, which beach management authorities now aspire to • Increases public awareness of environmental management issues including litter • Offers reassurance to visitors that the beach meets certain standards	numbers of users/day and not eligible for Awards, often many rural beaches currently cannot apply • Further funding would increase staff and ensure all beaches are meeting standards
Blue Flag Award	KSB (on behalf of the Foundation for Environmental Education)	UK	• Raise environmental awareness and increase good environmental practise amongst tourists, local communities and beach and marina operators	• Award • Survey	• Charity	• Raises attention to beach quality standards particularly issues with water quality, litter and provision of facilities • The number of Awards has increased since the schemes were introduced • The Awards represent a high standard, which beach management authorities now aspire to • Increases public awareness of environmental management issues including litter • Offers reassurance to visitors that the beach meets certain standards	• Explore other awards and opportunities for those beaches that do not meet criteria i.e. numbers of users/day and not eligible for Awards, often many rural beaches currently cannot apply • Further funding would increase staff and ensure all beaches are meeting standards
National Spring Clean	Keep Scotland Beautiful	Scotland	• Annual clean up	• Clean	• Charity. • Initiative is supported by Greggs (bakers) and EAE (marketing specialist)	• Scotland's biggest annual clean up • 83, 668 volunteers took part in 2010 (1.6% of the Scottish population) • 1,041 clean ups • Two month period in which to take part • Fosters community spirit • Incentive for cleaners not to drop litter • Dedicated website • Can join an event or organise your own • Clear information for participants and organisers • Free clean up kits available	• Increase % of the population taking part through wider publicity and advertising in more 'public' media • Provide feedback about the results in an individual's area to participants after the event, to increase ownership and aid their future participation
Coastal Litter Campaign	Forth Estuary Forum	Local-Forth Estuary	• Develop a community awareness-raising programme to reduce marine	• Clean • Education • Prevent at source	• Campaign funded by Fife Environment Trust, BOC Foundation,	• Linked to existing initiatives including the Bag It and Bin It campaign, Blue Flag, and the MCS Adopt-a-Beach campaign • Monitor and evaluate the changing trends for marine litter	• Expand the time span of the project (initially ran for a 3 year duration (2001-2004)) • Increase % of the

Initiative	Lead/ Coordinating Organisation	Scale	Scope	Remit	Status and Funding Source	Key Strengths	Potential Improvements
			litter in the Firth of Forth.		Edinburgh Environment Partnership	• Develop individual programmes of action to tackle the litter at source • Involves local people and schools • Dedicated web pages and reporting	population taking part through wider publicity and advertising in more 'public' media
Da Voar Redd Up **(The Spring Clean Up)**	Shetland Amenity Trust	Shetland	• Annual clean up after the winter storms and before the summer tourist season	• Clean	• Charitable Trust	• 15% of the population takes part, and do so year on year • Running since 1988 • Press releases • Personalised registration cards foster ownership • Clean up packs and litter collection easily organised • Packs are personalised and tailored to the needs of that specific group • Volunteers are written to thank them and given a summary of the clean • Familiar and local slogan 'Dunna Chuck Bruck' and logos used • Flexibility over clean up time and dates • Small financial reward for participating community groups • Organisers are familiar to participants • Local dialect is used to foster ownership	• Increase and improve the recording for monitoring waste types and levels to ascertain trends over time and to help reduce litter at source
Education							
Don't Let Go	MCS	UK	• Stop balloon releases	• Education	• Charity • Membership and donations	• Many local authorities have banned releases on their land • Raises awareness to public, companies and groups of the impacts of releases • Web page allows members of the public to report releases • Offer alternatives to releases	• Increase publicity to include more 'public' media sources
No Butts on the Beach	MCS	UK	• Highlight the increasing numbers of cigarette ends found on beaches	• Education	• Charity • Membership and donations	• Gives information on the impacts of cigarette litter and numbers of butts found during cleans • Offers ways you can reduce your impact	• Increase publicity to include more 'public' media sources

Initiative	Lead/ Coordinating Organisation	Scale	Scope	Remit	Status and Funding Source	Key Strengths	Potential Improvements
Go Plastic Bag Free	MCS	UK	• To reduce plastics bags on beaches via plastic bag free communities	• Education	• Charity: Membership and donations	• A comprehensive information pack (pdf) to make it easy to go plastic bag free has been written and is available online. The pack contains extensive information on the impacts of plastics bags and how to go plastic bag free in your community	• Reduce file size of the online guide (currently c. 20MB) as it may put off readers due to download time. This is true in the smaller rural communities who are more likely to go plastic bag free but where connection speed is often slower
Bag It & Bin It	Water UK	UK	• Prevent SRD • Encourage people to bag and bin disposable products • Target blockages in the network and the costs to water companies and customers	• Education	• Membership group • Funded directly by its members	• Logos are widely seen in public toilets to increase awareness • Involves UK water and wastewater service suppliers across England, Scotland, Wales and Northern Ireland	• Campaign was most proactive at its launch; re-launch with ongoing information materials online and hardcopies • Produce and circulate further promotional materials to increase awareness of the issue and meet the overall aims of the campaign
Think Before You Flush	Scottish Water	Scotland	• Raise public awareness of the issues associated with flushing • sanitary waste	• Education	• Publicly Owned Company	• The campaign incorporated advertising, leaflets, local groups and events, beach cleans and school visits	• Re-launch campaign or work with existing campaigns to raise awareness i.e. Bag it & Bin It
Beaches and Marine Litter	The GRAB Trust	Local-Argyll & Bute	• Raise awareness of the impacts of marine litter	• Education	• Charity	• Trust provide advice and support to community groups • A range of marine litter educationworkshops and activities in local schools • Attend and organise events to speak to people directly • Use a forum to develop a shared ownership and keep people informed • Organise beach clean events	• Secure further funding to expand the remit and geographical scope of the project as part of a coordinated approach to targeting marine litter

Initiative	Lead/ Coordinating Organisation	Scale	Scope	Remit	Status and Funding Source	Key Strengths	Potential Improvements
The Green Blue	British Marine Federation and Royal Yachting Association	UK	• Help water users and businesses reduce their impact on coastal and inland waters	• Education	• Funded by British Marine Federation, Royal Yachting Association, The Crown Estate and SNH	• Provide information to users on environmental impacts of water sports and mitigation measures • Promotes sustainable boating • Encourages the design and production of innovative environmentally friendly products, facilities and processes within the recreational marine industry • Raises awareness and appreciation of coastal and inland water environments	• One staff member to cover Scotland, Wales and Northern Island. Further funding and/or project expansion would allow for further staff members to cover this area and become more of a recognised figure within their local area
Marine Litter Removal							
Fishing for Litter	KIMO	Scottish Waters	• Reduce marine litter by involving a key stakeholder; the fishing industry.	• Removal • Education	• Local Authorities International Environmental Organisation	• Involves key stakeholder • Is one of the few initiatives to tackle litter in the marine environment	• Ensure wide spread coverage across the fishing fleet and gears
Research							
Global Initiative on Marine Litter	UNEP	International	• Establish pilot activities in badly affected regions • Global platform for partnerships, co-operation and co-ordination of activities for marine litter management	• Research	• 95% Voluntary support	• Production of guidelines on source reduction activities and polices	• UK to coordinate with UNEP and relevant Contracting Parties to prepare an Action Plan for North East Atlantic • Scotland to lead this process to better coordinate with the global movement and highlight their position
Marine Debris Programme	NOAA	International	• To support international effort on preventing, and reducing marine litter	• Research • Coordination • Education • Grants • Clean	• Funded via NOAA	• Wide range of initiatives from research and conferences to source specific activities • Links to a number of other initiatives through its Partners	• Expand main focus beyond USA and Pacific region

Figure 9-1 Current Marine Litter Initiatives operating in Scotland, across differing scales

Figure 9-1 identifies a number of marine litter initiatives relevant to the UK and Scotland across varying scales and remits from surveying and monitoring, cleaning, research and education. These have all shown to have a number of key strengths and work well to connect with participants and in engaging local people in environmental issues. Some of the initiatives also offer awards for example Seaside and Blue Flag Awards, which set criteria for participating beaches and is a standard many beach management authorities now aspire to.

9.2 Participation

The initiatives aimed at cleaning, both coastal and marine, generally rely on volunteers (public and fishers)to undertake the work, often (but not in all cases) with paid staff members as campaign coordinators. For the coordinators, the cleans can be time consuming, but they do act as effective monitoring and removal mechanisms and many of the more coordinated cleans (i.e. MCS over one off community events) have both of these key areas within their remit. The Strategy should consider whether such an extensive use of and reliance on, volunteers is the most effective way to tackle the marine litter issue. The use of volunteers for beach cleaning clearly allows for a large data set to be collated and extensive monitoring to be undertaken, with minimal equipment and experience. It is well recognised volunteering is an effective means of drawing attention to the issue at hand and engaging members of the public in environmental management yet it may not be a suitable approach for MSFD compliance for example.

As with the majority of the initiatives included in the summary table, only a small percentage of the population take part in the events. It is not known whether this is due to lack of publicity (or lack of publicity in the right places), because it is not perceived as an issue by the public, or not one that should be tackled by the general public through volunteering. The initiatives with an International focus, such as the Ocean Conservancy's International Coastal Clean Up does indeed have a large geographical coverage (Figure 9-2) but questions need to be raised over the extent of these cleans. This particular initiative does offer a global snap shot of the issue but there may be countries that do not take part or areas within participating countries which have less of a focus and could therefore not be presenting a true picture.

Figure 9-2 Participating (darker blue) and non participating countries (light blue) in the International Coastal Clean Up 2010 (Ocean Conservancy, 2010)

9.3 Distribution of Cleans

The most easily accessible areas for studying, cleaning and removing marine litter are beaches. In addition due the increased visibility of beached litter and the more obvious direct impact on society, greater media and public attention are given to these areas, rather than litter suspended in the water column, circulating in coastal waters and on the sea bed. Therefore comprehensive datasets for these areas are limited. Consequently the Strategy may be best placed to coordinate existing initiatives concentrating on beaches and focus its efforts and resources on the aspects which currently receive less attention.

From a review of the initiatives, it is clear most of those with a cleaning remit focus their efforts towards the popular urban beaches and not so much on those in more remote areas (Figure 9-3), which is pertinent for much of Scotland. This is partly due to population demographics and distribution but also to resourcing; an area akin to Aberdeen has staff members from various organisations to drive and organise clean up events, where as areas such as the Highlands have their resources spread over a much larger area and are unlikely to have this in the more remote and smaller settlements.

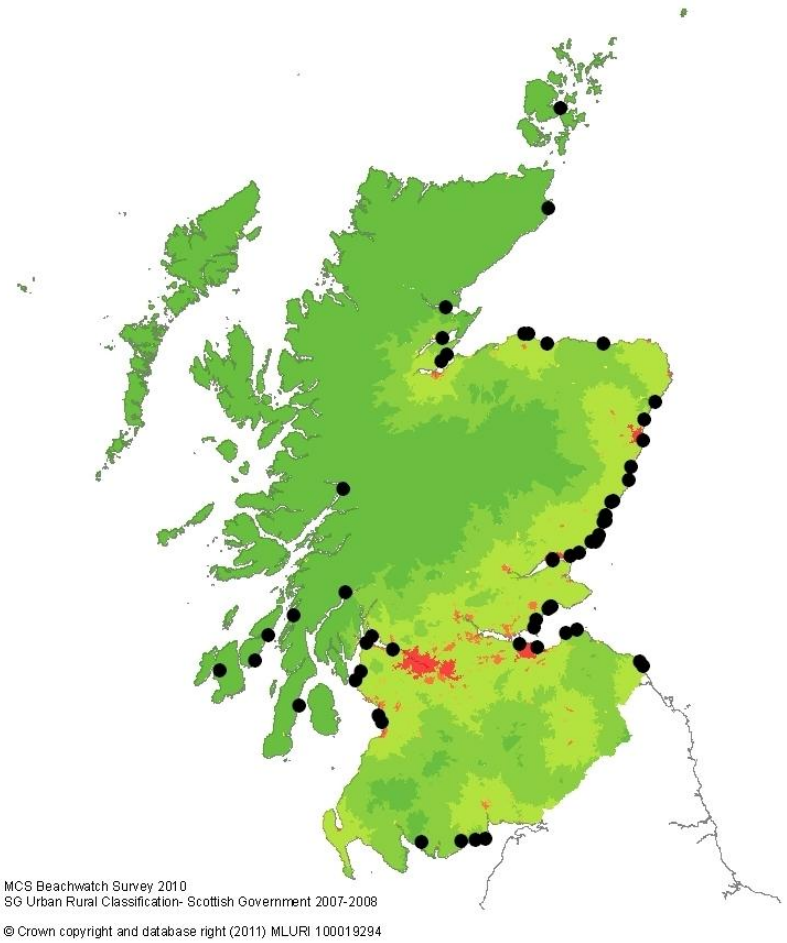

Figure 9-3 Distribution of the MCS Beachwatch 2010 cleans across Scotland (data courtesy of MCS), against population distribution (urban areas, red; small towns, light green; remote, dark green)

9.4 Methodologies

Despite the establishment of beach study sites and the standardised approach by MCS, the spatial and temporal irregularity of surveys and differing methodologies (especially in the case of the community organised events) including different surveyors (volunteers) has in some cases led to sparse datasets spanning short time frames (Barnes *et al*., 2009). Often, this means the results are not comparable and cannot be used to provide a full and comprehensive assessment of an area. Internationally there is considerable variation in the methodology between regions and investigators, usually of voluntary nature. The Strategy may wish to develop and advocate the use of a standardised methodology such as that employed by MCS, to allow for greater compatibility between existing survey methods, the identification of a baseline and any trends and to ensure the efficient use of limited resources.

In addition, there are a number of specific problems and limitations for current beach cleaning and survey techniques and initiatives:

- Surveys typically only provide data on coarse trends due to irregular spatial and temporal frequency of surveys;
    - only selected beaches, often once a year
    - the same beaches are not surveyed every year, making direct site comparisons difficult
- Some area have sparse datasets due to spatial infrequency of surveys;
- Up to 40% of litter items remain un-sourced each year, either because they are too small, weathered, or could have come from multiple sources (Defra, 2005a; MCS, 2009);
- Methodological problems include definitions of public sources;
- Lack of distinction in land sources (riverine, wind blown, outflows, beach users), all of which require different preventative techniques;
- Due to the voluntary nature of the surveys, identification skills of marine litter may vary between volunteers, dependant on their experience and knowledge;
- There is a lack of publicity, in the right places and media and to the appropriate audience;
- Lack of staffing and resourcing (including financial) for the lead or coordinating organisations

One initiative that overcomes a number of the points raised here is the Da Voar Redd Up (The Spring Clean Up), Shetland. It offers a positive example of what can be achieved with regards to participation rates, ownership, publicity and feedback but other existing initiatives would require significant additional resources to allow them to be personalised and tailored to local areas and cultures to the same extent.

Da Voar Redd Up

Da Voar Redd Up is an annual clean up of Shetland's beaches and roadsides after the winter storms to clean the islands for the tourist season, wildlife and the residents. The cleanups are undertaken by local residents on a voluntary basis and, from a population of 26,000, the event attracts around 3,500 volunteers (15% of the population).

Da Voar Redd Up is organised by the Shetland Amenity Trust, a charitable trust who receives its income from the local authority, grants and its own profit making activities. The Redd Up is one of a number of initiatives lead by the Trust.

There are a number of factors that appear to contribute to the success of Da Voar Redd Up:

- The organisers are familiar and respected in their communities
- Language – "Da Voar Redd Up" means The Spring Clean Up. Use of the local dialect encourages a sense of ownership.
- Recognised images – The Dunna Chuck Bruck slogan is widely used. The use of logos around the Island and for the event gives it an identity and continuity year on year.
- Volunteers are encouraged at a school age and often continue into adulthood
- Strong feeling of community spirit and pride
- Incentives - Up to £50 is given to community groups completing clean ups
- Personalised – Previous volunteers are written to before the clean to ascertain if they are taking part this year, provided with the equipment they need and contacted again after the event to thank them for their efforts; all of which is done in a personalised way to give a sense of ownership and involvement
- Flexibility - Volunteers have the opportunity to clean where they like and when. They are provided with the opportunities and resources to help them.

9.5 Knowledge Gaps

As identified in Chapter 6, a number of knowledge gaps exist. To provide a true assessment of the marine litter issue in Scotland, its extent and impacts, these gaps need to be addressed, yet current initiatives may not be best placed to deal with them due to their remit and scope. These include:

- source and environmental impacts of micro plastics;
- bio-transfer and bio-accumulation of pollutants, particularly associated chemicals from plastics;
- impacts of marine litter on lower trophic levels;
- impacts of marine litter on ecosystems and their services
- deep sea accumulation and consequences (Scottish shelf waters and beyond)
- management practices

    - including the disturbance from mechanical beach cleaning and where best to use (or not) these techniques and comparing the risks with accumulating in-situ
- illegal sources
    - some sources suggest that plastic waste is deliberately being shredded into fragments and discarded at sea (Barnes *et al.*, 2009)

9.6 Benthic Litter

To tackle the issue of non beached marine litter, there are few initiatives, of which KIMO's Fishing for Litter is one. For this scheme, harbour and fishers involvement did increase over the 2005-2008 period; totalling 165 vessels (KIMO, 2008). However as Fishing for Litter was not designed to be a monitoring tool (its main focus being awareness raising and removal of litter, with monitoring as an additional output) it does not provide the quality or quantity of data required for a monitoring programme. As such, long-term trends in the distribution and accumulation of benthic/suspended litter are difficult to distinguish.

Specific limitations with this initiative include:

- Limited use of results;
- Significant time and effort involved in engaging with fishing industry;
- Communication problems with fishers;
- Unsuitable provision of equipment- smaller bags for smaller vessels
- Only fished areas are cleaned (KIMO, 2008).

There was an also an observed reduction in the participation of vessels in Stornoway and two main issues were identified as the cause of this (KIMO, 2008). The original bags provided were considered too big for smaller vessels and there were operational difficulties regarding waste disposal between the harbour and the fishers. Bags were replaced for a smaller size, enabling quicker emptying thus preventing decomposition of the contents whilst on board the vessels. Aside from routine litter monitoring trawls by Marine Scotland Science vessels *RV Scotia* and *RV Alba na Mara*, Fishing for Litter is the principal mechanism for monitoring and retrieving benthic litter. The Strategy may wish to expand the resources directed to this and look at ways to incentivise fishers to participate to ensure continued efforts.

9.7 Baseline Data

To establish extensive and reliable baseline data for long-term management strategies, existing methodological problems need to be resolved, coupled with in-situ removal. Baseline data of marine litter in Scotland is currently limited due to a number of factors, including coordination and implementation of schemes and overall financial investment (most work on a voluntary basis). The Strategy needs to overcome these, along with those noted above including the lack of publicity and engagement with the wider public and knowledge gaps in such a way that ensures the efficient use of limited resources. Consideration needs to be given to the extensive reliance on volunteers in helping to tackle the marine litter issue, monitoring and compliance with MSFD objectives.

9.8 Coordination

Each of the initiatives offers something unique and reaches out to varying sectors of society across different geographical areas and scales. As such, there appears to be little benefit in eliminating any of the initiatives highlighted but benefits may exist in their integration and improved coordination, incorporating overarching aims, standardised methodologies and joint publicity and marketing campaigns where this is deemed appropriate and beneficial. The Strategy may wish to consider the introduction of a coordinating body to lead Scotland's approach in tackling marine litter. Furthermore, this would provide a focus within Scotland and single point of contact with a remit to coordinate with and better learn from the global movement.

10 INNOVATIVE AND COST EFFECTIVE STRATEGIES

At the international, national and local level there is a raft of activities to combat marine litter and in many cases litter in general. These may offer examples of best practice and effective strategies for marine litter management.

Innovation can be defined as improving an existing service, product or policy or the successful development and exploitation of new ideas as alternatives; a novel approach. Through development comes increased challenges and opportunities and it is widely recognised innovation is essential to achieve specific goals and wider objectives such as environmental protection, growth, social inclusion and sustainability (e.g. Damanpour and Gopalakrishnan, 1998).There are different types of innovation and in order to effectively tackle the issue of marine litter, each of these need consideration and assimilation.

10.1 Institutional Innovation

Institutional innovation is centred on the creation of neworganisations, or new approaches to the way existing organisations operate, allowing for a change in organisational priorities, and cultural or social changes within that organisation (Damanpour and Gopalakrishnan, 1998). This coordinated approach can lead to improved learning, often standardised approaches and data sharing, and fosters relationship building to effectively meet mutual objectives.

Examples of this can be seen from the summary table in the NOAA Marine Debris Programme which aims to centralize their capability with regard to marine litter reduction both within the agency, its partners, and the public and provide a platform for global partnerships and cooperation for marine litter management. The UNEP Global Initiative on Marine litter aims to help resolve the issue through building knowledge through the Regional Seas programmes and joint initiatives as well as the development of a common approach to monitoring marine litter to address the lack of data and information as an obstacle to improved management.

10.2 Product Innovation

Product innovationis the process through which new or improved products or processes are developed and brought into widespread use. Often these products or processes are grouped together to serve a particular function within society (social innovation). The process of product innovation usually consists of research, development and demonstration through to the operational use of that process or product (OECD, 2005).

The plastics industry is a good example of product innovation, with plastic now being an essential part of modern society. Their continued innovation has enabled plastic to be used in place of other material offering cost savings and material improvement. Given our reliance on plastics and their extent in the coastal and marine environment industry innovation can also be tailored to product development and biodegradable alternatives. In March 2011, 47 plastics industry organisations from around the world signed up to a Joint Declaration for Solutions on Marine Litter (www.marinedebrissolutions.com/declaration).

10.3 Social Innovation

Social innovation refers to new ideas, organisations or strategies that work to address pressing social needs, more effectively than alternatives and create new social relationships or collaborations, with the overall aim of improving either the quality or the quantity of life (Pol and Ville, 2009). Many of the initiatives focussed on enhancing environmental quality such as the KSB National Spring Clean or Love Where You Live campaign, are examples of social innovation, where society is acting to solve a common problem.

New methods of social innovation are relevant in every sector but they are likely to offer most in situations which are intensifying, in fields where existing models and approaches are failing or stagnant, and in situations where new possibilities(such as emerging technologies) are not being adequately exploited to develop innovative solutions to common needs. Social innovation may be overlooked in some situations as unlike technological innovation, there is no obvious gain for any one organisation, however opportunities do exist to ensure its full potential for example through the use of incentives.

10.4 Regional Innovation

Regional innovation encourages the exchange of knowledge, skills, ideas and best practice within a given geographic area (OECD, 2005). Regional innovation systems act as an interface for interaction with other regional, national and international actors to further encourage information sharing. Furthermore relationships are fostered through the geographical proximity, yet innovation encouraged through the diversity of participants, rather than clustering innovation around institutional or industry based groups in the case of technological innovation (Todtling and Trippl, 2005). The regions may be drawn conceptually or organizationally around institutional regimes such as Marine Planning Partnerships or other recognised groups.

The case for regional innovation is especially pertinent for Scotland where such diversity exists from the large urban areas of the Central Belt to the remote and sparsely populated Highlands and Islands. Offering the opportunity to deal with the issues specific to a particular region and its' individual characteristics i.e. degrees of rurality, helps to ensure any management approaches take account of this and thus are more likely to succeed.

10.5 Market Based Instruments

Market based instruments offer a complimentary approach to address the marine litter issue alongside the more traditional, recognised methods of education and legislation, as part of an integrated, comprehensive programme. Market based instruments are economic tools including taxes, charges, fines, penalties, liability and compensation schemes, subsidies and incentives and tradable permit schemes. These tools fully incorporate the polluter pays principle, the user/beneficiary pays principle and the principle of full cost recovery and work to raise revenue (which can be used to further support the work) through fines and charges, act as an incentive to change behaviour, or ensuring market pricing is a reflection of the true cost of the environmental impact.

The use of market based instruments in environmental management is becoming common place, using market forces to help offer a resolution. Globally there is now a great deal of

experience to be gleaned to ensure their effective use and lessen the risk inherent in policy innovation. There are a plethora of market based tools which can be used in this context, and the decision of which to use will be based on a number of considerations including the type and source of litter, its impacts, ensuring an adequate regulatory framework is in place to support their use and the cost effectiveness and likely gains (Figure 10-1).

Marine Litter Types							
	Land Based Sources			Marine Based Sources			
Market Based Instruments	**Plastic**	**Solid Waste**	**Sanitary/ Medical**	**Plastic**	**Solid Waste**	**Sanitary/ Medical**	**Fishing Debris**
Plastic bag tax systems				■			
Charging schemes for waste services	■	■	■				
Landfill tax	■	■	■				
Deposit for drink containers	■	■		■	■		
Port reception fee (general fee approach)				■	■	■	■
Incentives to fishermen for reporting and retrieval of litter				■	■		
Award-based incentives for coastal communities	■	■	■				
Damaged/abandoned fishing gear buy-back							■
Parking fees, waterfrontbusiness charges and other sources of revenue for beach cleaning	■	■					
Fine for fly tipping/illegal disposal	■	■					
Ship garbage records books				■	■	■	■
Fines register				■	■	■	■

Figure 10-1 Marine litter types and example of market based instruments (adapted from Ten Brink *et al*., 2009)

10.6 Barriers to Innovation

Several factors including skills shortages, and lack of understanding may impact upon the development and uptake of new or modified products and processes, and ultimately on innovation. There is a requirement to prioritise which of these to develop further based on their likelihood of success and the risks involved. Often the social and environmental benefits can be overlooked in favour of economic benefits, or because the costs of action is currently more than the economic cost of the current situation but as already shown, the true cost of marine litter is intrinsically difficult to value in economic terms.

10.7 Innovation and Policy

From the literature two schools of thought appear on innovation and environmental policy. Firstly, debate emerges over the effectiveness of policy and its impact on innovation, in that it is suppressed by policy by diverting valuable resources away from blue sky thinking and high risk (but potentially effective) approaches towards regulatory compliance via commonplace end of pipe solutions. In contrast, it is argued the links between environmental policy and innovation are two dimensional. From one point of view, environmental policy (such as stringent packaging standards) may stimulate innovation in the use of alternative materials designed to meet those standards. On the other hand, the possibilities thrown up by innovation can help policy-makers to set progressively stringent standards.

10.8 Existing Approaches

A number of the initiatives have been summarised in the following summary table (Figure 10-2), targeting the key sources of litter including public, SRD, fishing, shipping, fly tipping, and non-sourced. These activities show differing uses of innovation in their approach to marine litter reduction and prevention, including technological and policy innovation as well as social innovations whereby groups are coming together to better address a specific issue as in the example from Korea of a management system to address land based litter from rivers where authorities are coming together to develop cost sharing agreements for clean up operations.

The Strategy may wish to explore expanding these to Scotland where applicable, or drawing on their key strengths and incorporating these in to existing work.

Initiative	Lead/ Coordinating Organisation	Scale	Scope	Remit	Key Strengths
Public					
Coastal Clean Up Programme	South Korea's Ministry for Land, Transport and Maritime Affairs	South Korea	• Clean marine environment • Raise public awareness • Create jobs	• Removal • Education	• Government budget of $9 million • Coordinated approach using 5 methods to meet main aims • Paid staff, often local residents, remove much of the litter (46,151 staff in total) • Removed c. 30,000 tons of litter • Includes local companies and cleans take place in that area, led by the company to highlight the amount of litter from them
Management System to Address Land Based Litter from Rivers	South Korea's Ministry for Land, Transport and Maritime Affairs	Republic of Korea	• Waste management of the Nakdong River	• Removal	• Costs shared with inland local authorities and not borne wholly by those in coastal areas (based on estimated waste from population size) • Shared costs acts as an incentive to those upstream to better manage their waste • Uses the Polluter Pays Principal
Marine Debris 101	NOAA	International	• Web based educational campaign for marine litter prevention and awareness	• Education	• Coordinated campaign targeting all sources • Dedicated website • 140,000 hits/month • Provides fact sheets on impacts of litter as well as what you can do as an individual to prevent it, by target audience • Information for all interests and ages • The site draws together information and campaigns from many organisations in to one easy to use resource • Social networking tools to increase marketing
Clean Marina		Local-Florida	• Voluntary designation program for environmental stewardship	• Education • Award	• Participants receive assistance in implementing Best Management Practices through on-site and distance technical assistance • Mentoring by other *Clean Marinas* • Facilities must implement a set of environmental measures designed to protect waterways. • Easily to recognize facilities engaging in environmentally friendly practices
SRD					
CSO Control Policy	USA-Environmental Protection Agency	USA	• National framework for control of CSOs	• Guidance	• Provides guidance to authorities on how to meet legislative water pollution goals as flexibly and cost-effectively as possible • CSO controls are cost-effective and meet local environmental objectives • Implementing 9 minimum technology-based controls-measures that can reduce the prevalence and impacts of CSOs but are not expected to require significant engineering studies or major construction

Initiative	Lead/ Coordinating Organisation	Scale	Scope	Remit	Key Strengths
					• Communities with CSOs are expected to develop long-term CSO control plans that will provide full compliance • The long term plan incorporates public participation and awareness raising
Bin it-don't block it	Thames Water	Local-Thames region	• Campaign to educate people about sewer abuse	• Education	• Has a clear message-anything other than human waste and toilet paper cannot be flushed, even those marketed as flushable • Use graphic images, celebrities, social media and video sharing sites to put the message across • Provides simple tips for what you can do as an individual
Sewer Network Action Programme	Water UK	UK	• Education campaign for sewer abuse and work with manufacturers	• Education • Industry guidance	• The development of a protocol to determine whether an individual sanitary product is flushable • Work in partnership with the producers and trade organisations to develop the protocol, encourage appropriate labelling of sanitary products and improve consumer education
Shipping					
Hellenic Marine Environment Protection Association	HELMEPA	Greece	• Joint initiative of Greek seafarers and shipowners to voluntarily undertake the responsibility to eliminate ship-generated marine pollution	• Education • Training	• Complementing the education of Greek seafarers with updated information covering a wide spectrum of topics that focus on the prevention of ship-generated marine pollution, safety at sea and security • Raising environmental awareness and cultivating a safety culture within the industry so that proper compliance with International Conventions, laws and regulations is ensured • Run a training programme tailored for each year based on IMO committees and conventions, and vessel inspections, to raise awareness of the areas currently seen as lacking • Education and outreach programme for young people
Marine Awareness Course	ProSea Foundation	North Sea Countries	• International Marine Awareness Courses for students of maritime colleges and professionals	• Education • Training	• Improves the environmental knowledge among maritime students and seafarers • Highlights international legislation as well as creating a better understanding for marine biology • It is expected that better compliance with the rules will be the result • Emphasis on financial sustainability

Initiative	Lead/ Coordinating Organisation	Scale	Scope	Remit	Key Strengths
Fishing					
Marine debris Buyback Programme	Korean Central Government	Republic of Korea	• Fishing gear and other marine litter landed by fishers • Improve marine environment • Aid fish population recovery	• Removal • Education	• Offers a financial incentive for litter landed • Landed litter sent off for correct disposal • Increases awareness of litter impacts amongst stakeholder group • Small sacks suitable for inshore vessels • Ongoing awareness programme • Collected 29,472 tons over 4 year period • Cost effective way to remove benthic litter
Reel In and Recycle	BoatU.S Foundation	USA	• Create a network of recycling facilities for anglers to dispose of used fishing line	• Removal • Education • Data Collection	• Tackles one of the top 10 most dangerous items of marine litter (as ranked according to the International Coastal Clean Up) • Small designated bins located at popular fishing spots • Bins managed and emptied by hosts • Uses Partner organisations to increase marketing potential • Consistent branding • Web based map of bin locations • Collected line is recycled • Online data reporting tool for collected line • Use social networking sites
Nets to Energy	Hawaiian Islands Marine Debris Group	Hawaii	• Use derelict fishing nets to produce electricity	• Removal • Energy Provision	• 603 tons removed since 1996 • Used for combustion in the local waste to energy facility
At-sea Detection of Derelict Fishing Gear	NOAA	North Pacific	• Detection and removal of derelict fishing gear	• Removal	• Combines three distinct disciplines: marine debris, oceanography, and remote sensing technology • Developed an at-sea detection strategy
Encounter Reporting Program	NOAA	North Pacific	• Pilot project to observe and record derelict fishing gear	• Removal • Research	• Partnership working • Reducing the impact of local fisheries, navigation and safety
Fly-Tipped					
Urban	Keep America	USA	• To prevent litter	• Education	• Action across cities to reduce fly tipping and litter

Initiative	Lead/ Coordinating Organisation	Scale	Scope	Remit	Key Strengths
partnerships	Beautiful		and illegal dumping		• Coordinated programme across existing groups and geographical areas
Total Focus Week	Fly-tipping Action Wales	Local-Conwy		• Education	• Involves eight local organisations coming together to clean up fly-tipped hot spots and tackle illegal waste dumping • Involves police, authorities, housing associations, enforcement officers • Raises awareness • Uses strict penalties • Coincides with Wales Sustainability Week
Non-Sourced					
Floating Containment Booms		Global	• Remove litter in situ • Frequently used in waterways to prevent riverine inputs of litter	• Removal	• Removes litter within a pathway • Easy to contain and dispose of the collected litter • Does not rely on volunteers • Easy to install • Can be used in a variety of ways from spans to eddies and natural collection points
Global Programme of Action for the Protection of the Marine Environment from Land-based Activities	UNEP	Global	• Prevent the degradation of the marine environment from land-based activities	• Guidance • Education	• The only global initiative directly addressing the connectivity between terrestrial, freshwater, coastal and marine ecosystems • Source of conceptual and practical guidance to be drawn upon by national and/or regional authorities for devising and implementing action • Seen as the task of Governments, in close partnership with all stakeholders • Recognises the formulation of national and regional programmes of action is a necessity • Links to Regional Seas
Reverse vending		Global	• Provide a platform for recycling	• Removal • Education • Prevention	• Helps tackle one of the most prolific litter items • Puts a value on waste • Extends producer responsibility
Global Initiative on Marine Litter	UNEP	Global	• Global platform for partnerships and co-operation for marine litter management	• Research	• Production of guidelines on source reduction activities and polices • Building knowledge through joint initiatives • Development of a common approach to monitoring marine litter • Addressing the lack of data and information

Initiative	Lead/ Coordinating Organisation	Scale	Scope	Remit	Key Strengths
Marine Debris Programme	NOAA	Global	• To support international effort on preventing, and reducing marine litter	• Research • Coordination • Education • Grants • Clean	• Wide range of initiatives from research and conferences to source specific activities • Links to a number of other initiatives through its Partners • Centralised activity to increase coordination both internally and with partner agencies
Trawl net for floating plastics debris	EUPC	Anticipated European wide	• Retrieve floating plastics waste in river and coastal waters	• Research • Education • Clean	• New trawling net made from plastics and designed to retrieve floating plastics waste in river and coastal waters. • Fishermen can use the trawl and catch between 2 – 8 tonnes of marine debris. • There will be a demonstration in France in May. • It is hoped Trawls will be sponsored and brought into use across Europe.
Waste Free Oceans	The European Union of Plastics Converters (EUPC)	EU	• Reduce marine litter in the EU	• Research • Education • Clean	• Mapping current legislation and policy, and its effectiveness; • Communications and awareness raising for fishermen, port authorities, local authorities waste management companies, the shipping industry and schools; • Communication of best practice in waste management; • Training seminars and workshops for fishermen, port and marina workers, consumers and schools; • Voluntary industry initiatives such as Operation Clean Sweep; • Prevention of marine litter best practices: Law enforcement and removal of marine litter such as 'fishing for litter' exercises.
Plastics 2020 Challenge	UK Plastics Industry	UK	• Engage the public in a debate about the use, reuse and disposal of plastics.	• Education • Awareness • Ideas	• Uses an online open forum where anyone can submit their thoughts and ideas and suggest ways to help the plastics industry reduce, res-use, recycleand recover their products

Figure 10-2 Initiatives targeting the key sources of litter

11 ESTABLISHING OBJECTIVES AND TARGETS FOR A MARINE LITTER STRATEGY

11.1 Overview

In this chapter we will introduce:

- A 'best practice' process for identifying objectives and management planning;
- A draft vision and set of strategic objectives to be linked to specific actions based upon existing initiatives , the litter workshop and policy obligations;
- A series of options for developing and improving policies and cost/benefit summary.

11.2 Establishing an objective setting process for marine litter: A best practice approach

In order to present a coherent framework, we will draw upon previous research for the Scottish Government that highlighted a 'best practice' approach to developing objectives for the national marine plan.[1] We have rescaled this approach to inform the development of a marine litter strategy to inform the process of setting objectives, actions and indicators that inform and guide policy actions.

We have two aims for this work 1) emphasising a transparent, inclusive and integrated approach that supports the development of effective objectives that *work in practice*, and 2) an initial assessment of what the objectives and actions could like to promote further discussion on route to a Scottish Marine Litter Strategy.

Figure 11-1 below highlights the best practice framework. Overall, the system is one that can be used to guide the objective setting and management process. It occurs through a series of consecutive stages that mimic the policy cycle, from pre-planning and engagement to institutional design and to the application in decision making with adaptive feedback loops.

[1] See the report: Marine Scotland 2010. Report on Social and Economic Objectives for a Scottish Marine Plan. Available: http://www.scotland.gov.uk/Publications/2010/03/30180908/7

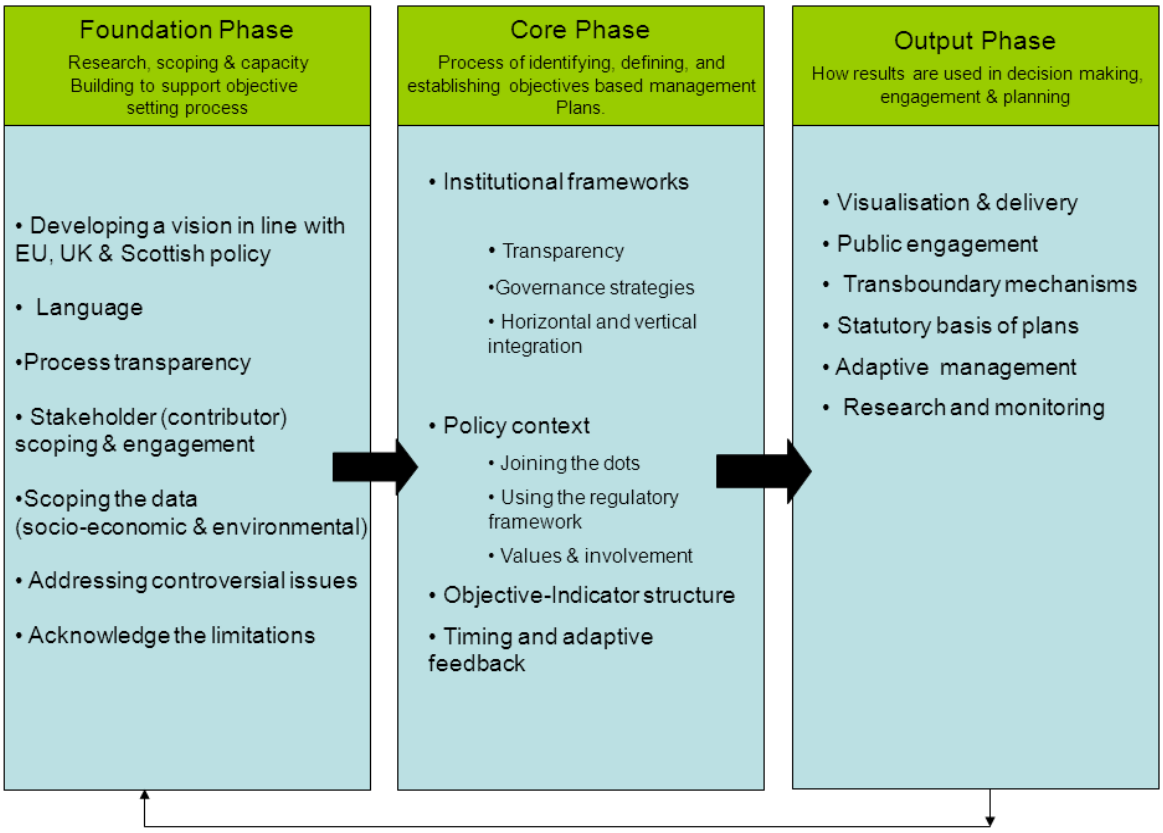

Figure 11-1 The Best Practice Framework for Objective Based Management Systems

The process highlights three key phases:

The Foundation Phase develops the groundwork for establishing an objectives-based management system that brings together research, scoping, and capacity building to support the objective-setting process.

The Core Phase identifies and sets the process of identifying, defining, and establishing objectives indicators and planning structures within an appropriate policy context.

The Output Phase: how the results of the process are used to improve decision-making, stakeholder/contributor engagement, and planning.

11.3 The Foundation phase: research, scoping and capacity building to support the objective setting process

11.3.1 *Setting the vision*

There are currently several inter-related visions for the marine environment and waste management which are relevant to a Scottish Marine Litter Strategy. For example:

- The vision for the Scottish Government is “To focus government services on creating a more successful country with opportunities for all of Scotland to flourish through increasing sustainable economic growth.”

- The Scottish Government marine vision is " clean, healthy, safe, productive and biologically diverse marine and coastal environments managed to meet the long term needs of people and nature"

- The MSFD aims to achieve sustainable management of the seas of Member States by present, and for future, generations.[2] For marine litter the descriptor has been proposed (in draft form) by a DEFRA MGES working group[3] as:

    - Litter and its degradation products currently present in, and entering into, UK waters is reduced over time and does not pose a significant risk to marine life at the population level, either as a result of direct mortality or by way of indirect impacts such as reduced fecundity and bioaccumulation within food chains.
    - Litter currently present in, and entering into, UK waters does not pose a direct or indirect unacceptable risk to human welfare and does not lead to significant detrimental economic impacts for industry and coastal communities.

- The Zero Waste Plan sets the vision of "To achieve a zero waste Scotland, where we make the most efficient use of resources by minimising Scotland's demand on primary resources, and maximising the reuse, recycling and recovery of resources instead of treating them as waste."

- From the UK and Devolved authority High Level Marine Objectives:[4]

    - Marine businesses are acting in a way which respects environmental limits and is socially responsible. This is rewarded in the marketplace.
    - People appreciate the diversity of the marine environment, its seascapes, its natural and cultural heritage and its resources and act responsibly.
    - Marine, land and water management mechanisms are responsive and work effectively together
    - Sound evidence and monitoring underpins effective marine management and policy development.

From the range of 'visions' compiled here, the project team have suggested a vision that mixes the key elements of the GES descriptor and the Zero Waste Plan. The term 'risk' implies a precautionary approach to the management of marine litter, avoiding serious impacts to ecological systems and human welfare before they occur. Further clarification of the vision in a marine litter strategy should quantify and define the concept of risk to avoid misinterpretation of this term. At a minimum this should be in parallel with the indicators used to assess GES in Scottish waters.

[2] Article 1(3) MSFD: "Marine strategies shall apply an ecosystem-based approach to the management of human activities, ensuring that the collective pressure of such activities is kept within levels compatible with the achievement of good environmental status and that the capacity of marine ecosystems to respond to human-induced changes is not compromised, while enabling the sustainable use of marine goods and services by present and future generations".

[3] DEFRA 2010. MSFD GES Workshop. Available: www.defra.gov.uk/environment/marine/documents/.../201010-msfd-report.pdf. **NB.**This document is not finalised and is yet to go out to consultation. The findings are the views of the workshop attendees and not Defra

[4]Cited in: Our seas - a shared resource. High level marine objectives. UK Government and Devolved Administrations. 2009; and in Sustainable Seas for All - a consultation on Scotland's first marine bill

By 2020 marine litter in Scotland is significantly reduced and does not pose a risk to the environment or communities. This is supported by our vision of zero waste society, where people and businesses act responsibly and reuse, recycle and recover waste resources.

11.3.2 Language

It is important to consider the message to be conveyed, and to make sure that the language accurately reflects this message. If the public and key stakeholders receive confused signals this breeds mistrust from the very start. Linguistic foundations must be clear and transparent.

11.3.3 Process transparency

"*There must be confidence in the planning process amongst all of the variousstakeholders. This is very important but also very time-consuming*." – ESSIM Forum, Canada.

Transparency needs to exist at the level of the process itself, as well as in the vision and objectives produced by the process. The selection of the final vision, the engagement of contributors (stakeholders) from individuals to the private sector, and the articulation and evaluation of the objectives and action plan must be transparent and credible. Linked to this concept is that the Scottish Marine Litter strategy must be seen to be pragmatic and action orientated and avoid being labelled as 'just another plan'.

Linked to the concept of transparency is the concept of acknowledgment of limits. We are in a phase of government where public sector programs are competing for scarce and limited resources. There is an increasing pressure to do 'more with less'. While this calls for innovation, networking and capacity building to address the challenges, we strongly endorse that the actions in the proposed litter strategy are supported by appropriate resources and novel funding strategies.

As noted in the legislative review, jurisdictional issues are a complex but realistic issue within the proposed strategy. The analysis highlights that many objectives and outcomes can be achieved within Scottish jurisdiction, as management of waste and litter is predominantly a devolved activity. However, several legislative instruments and management regimes remain in the area of UK competence (e.g. Shipping, EU relations and OSPAR) and will require cooperation and integration of policy and management initiatives between devolved authorities. On issues such as port reception facilities and shipping management, cooperation between ports and agencies in different regions and countries is critical in terms of effective monitoring and enforcement.

11.3.4 Stakeholder engagement

Afford (and be seen to afford) equal opportunity to all members of the public to contribute to the planning process.

The concept of the "stakeholder" is increasingly viewed (by stakeholders) as a 'tick box' exercise in the implementation of policy. The term was coined to reflect individuals or

groups with a particular interest (or stake) in a particular issue, and to engage and encourage them to contribute their views or to hear the views of other stakeholders. We have found that the term over time has lost some of its *capital* as a concept. Therefore the concept and the associated process need an innovative and refreshing start to focus on culture change when it comes to litter management. We suggest the term *contributor* that aims to promote inclusiveness, participation and collaboration. This should be backed by forward thinking and practical actions that can achieve real gains in achieving the GES targets. In addition this is an important aspect of building in the cultural change necessary to drive changes in values and behaviour for seeing waste as a resource (identified in the EU Waste Directive and Zero Waste Plan).

11.3.5 Scoping Data

For marine litter, the availability and cost of obtaining data for mapping out the problem on the coast, water column, and the seabed is a major scientific undertaking. Marine Science Scotland is pursuing monitoring efforts in support of achieving GES and will be expanding monitoring programs. OSPAR is calling for an increase in the scope of beach monitoring and identifying gaps in the data in terms of impacts from maritime industries. In addition, the Zero waste Plan intends to review the success of measures to influence waste behaviours, including incentives, and encourage the development of schemes to drive reductions in waste and improvements in recycling performance.

Data requirements for new objectives and associated indicators are often a challenge to their effectiveness. New data requirements, especially in the economic and social dimensions, and at the appropriate scale, should be identified and resourced by collaboration with research providers.

11.4 Core Phase: The process of identifying, defining and establishing objectives-based management plans

Objectives and management systems must be established through appropriate, accessible and transparent institutional frameworks. Institutional frameworks must reflect needs and core values of government and electorate.

11.4.1 Institutional Framework and Policy context

While the above statement appears fairly obvious, it is important to ensure that any objective system sits within the prevailing policy context. This requires political and parliamentary support, and reflection of the needs of the community. When it comes to marine litter and the zero waste approach, social change is a major element of the process across individual and corporate domains. The recent Scottish Environmental Attitudes and Behaviours Survey (Scottish Government Social Research 2009)[5] shows that societies respond differently to environmental damage and change. According to Professor Jan Webb, *core values*, which are embedded in political, economic and social institutions, lie behind these responses and it

[5] Available from: http://www.scotland.gov.uk/Publications/2009/03/05145056/0

is these that need to be addressed when delivering litter awareness campaigns and fostering a sense of marine and coastal citizenship.

The objectives system should integrate with the prevailing regulatory and policy framework that defines its purpose, structure, and role in decision making.

While the high level strategic action in the marine litter strategy will inform, but not prescribe local level actions, it is important that the strategy meshes with the regulatory framework and is able to be enacted through appropriate instruments. Institutional frameworks establish the governance context for the objective based management system. They establish how decisions are made, how the contributor groups are structured, the role of advice bodies, and the links to central and local government.

Integration means 'joining the dots across legislation and policy instruments' and is endorsed in the UK High Level Marine Principles. There are several connections to consider when addressing the problem of marine litter. The most obvious is the accumulation of litter from terrestrial and marine sources at the coastal interface and the range of legislative instruments available to deal with the issue. While this appears common-sense, it is questionable that the current legislative and policy system is suitably integrated to address the marine litter problem. Integration should be considered in terms of the effectiveness of individual instruments such as the Marine (Scotland) Act or the Zero Waste Policy and in terms of how these instruments aggregate upwards and influence initiatives at the UK and EU levels, e.g. the MSFD and regional cooperation on a regional sea basis to ensure Good Environmental Status.

The proposed Scottish Marine Litter Strategy is an opportunity to provide a roadmap and integration of a range of statutory and non-statutory instruments that can be brought to bear on the marine litter problem. An important principle when constructing the strategy is to consider duplication of effort, and to ensure that the most efficient regulatory path is taken to address the problem. In particular we observe the Marine (Scotland) Act 2010 and the Climate Change (Scotland) Act 2009 as key overarching mechanisms to deliver a Marine Litter Strategy, supported by some aspects of the Zero Waste Plan.

Other factors to consider:

- Centralisation versus a regional model for decision making and coordination;
- Mechanisms to integrate across sectors and communities of interest
- Mechanisms to coordinate across departments and Directorates ensuring regulatory instruments are sufficiently integrated (e.g. WFD and MSFD)
- Coordination down to local government and up to EU
- Adequate community involvement (not just the usual suspects)

11.4.2 Objectives/Indicator structure

The implementation of objectives, actions and indicators is a complex task requiring resources, cooperation, commitment and consensus. The articulation of objectives, actions and indicators is an essential component of system development, and one that takes resources and time. Objectives define a series of 'position statements' or articulated policy goals, are implemented by actions, and performance measured by a suite of indicators and performance measures. Objectives and indicators can be observed to implement four overall functions:

- Linking objectives to management to improve decision-making;
- Reporting and assessment;
- Building consensus and participation; and
- Forming linkages and integrating scientific and policy disciplines.

Objectives, actions and indicators are a package - without succinct and clear objectives, actions to be implemented and targets to assess performance, a strategy can be interpreted in many ways. In practice, the challenge is to drive consensus around the measures, and ensure that decision making and monitoring align with the strategy over time. The process must be politically feasible and pragmatic in order to implement the government's agenda for marine governance. In addition the process should be inspirational, setting ambitious targets and stretch goals that drive innovation, for example ambitious recycling and recovery targets and reduction from source.

We have suggested a framework based on the articulated vision that links a series of strategic directions to a series of actions. The directions and actions are informed by the UK High Level Marine Objectives as agreed by all UK authorities. Under the actions, the performance of the system will be assessed by a series of outcome indicators as specified in the DEFRA workshop on achieving GES. The framework is elaborated in Chapter 12.

11.5 Timelines

The Scottish Marine litter Strategy should mesh with key policy timelines as indicated in the Scottish marine planning process and the Marine Strategy Framework Directive (Figure 11-3). We recommend that 2011 will be an appropriate time to develop and consult on a Marine Litter Strategy, with implementation in 2012 synchronising with key outputs such as the Scottish Marine Plan and the establishment of targets and indicators for the determination of Good Environmental Status for UK waters. This will enable elements of the strategy to be included in the regional marine planning process.

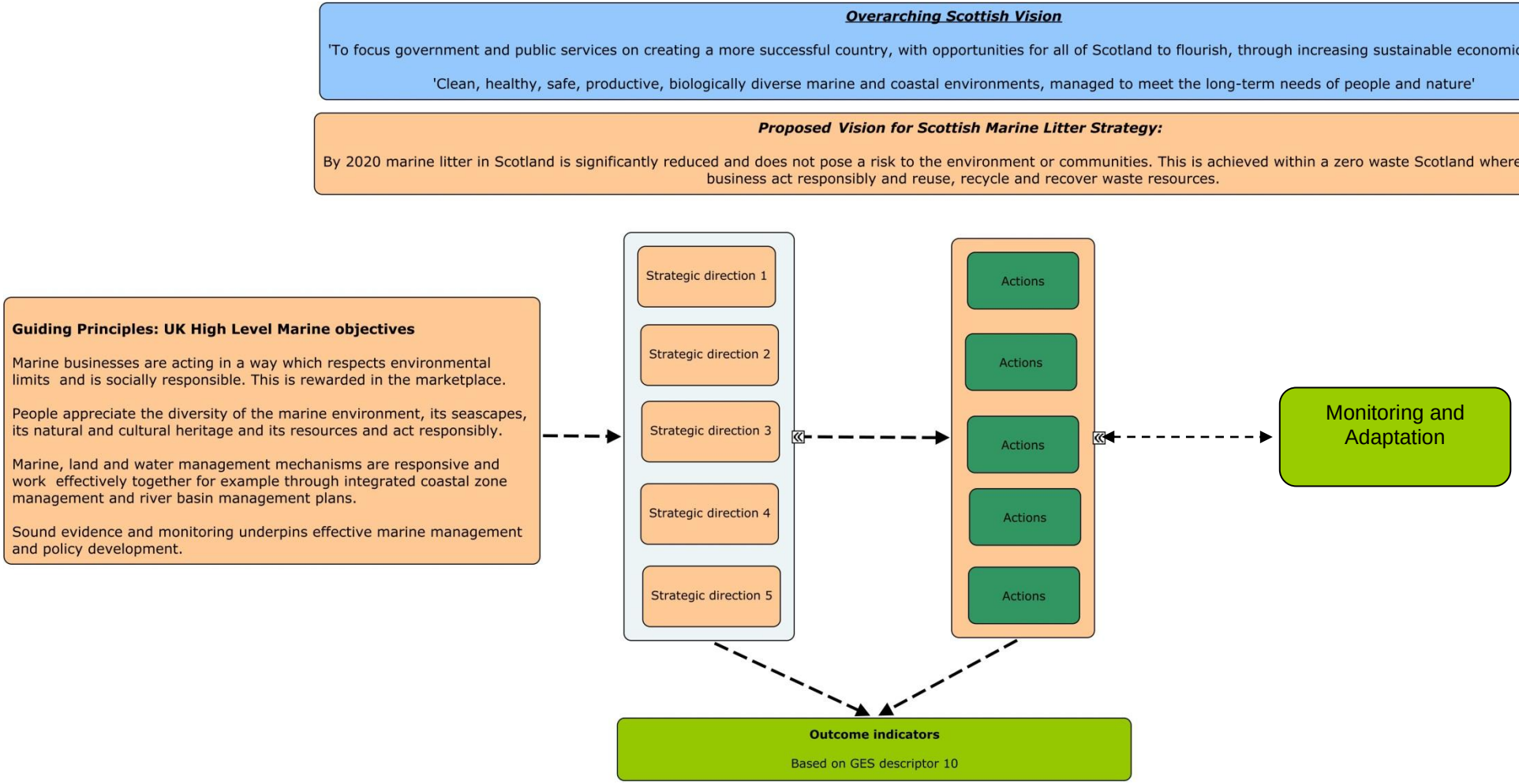

Figure 11-2 Proposed Framework for the Scottish Marine litter Strategy

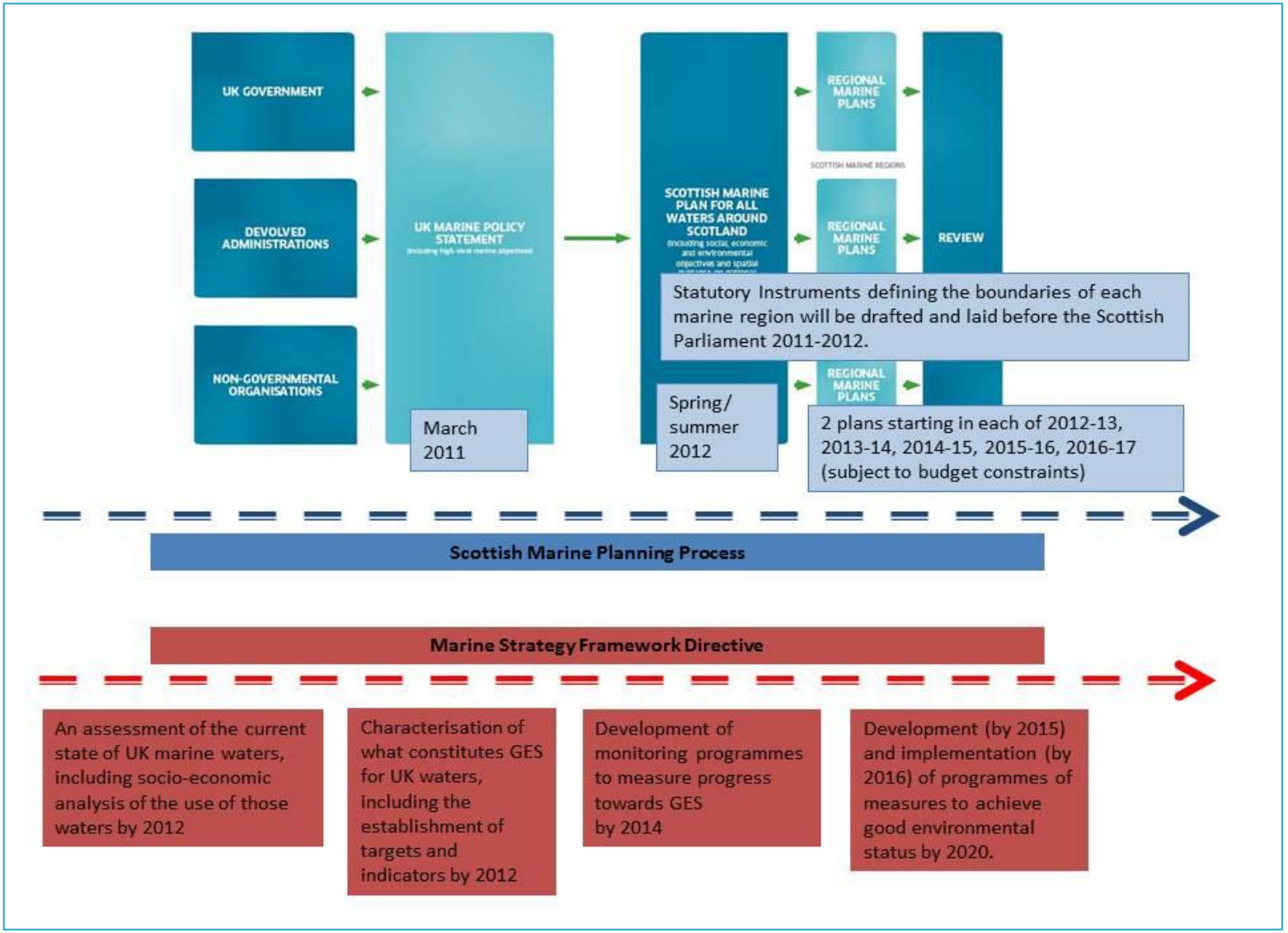

Figure 11-3 Timelines for implementation (Potts, T., 2011)

11.6 Output Phase: How results are used in decision-making, engagement, planning

11.6.1 Visualisation and Public Engagement

The communication of indicator results is a critical phase often neglected in many initiatives. To facilitate their use within decision-making, and to make the results accessible, a strategy of aggregation and/or visualisation is critical. While aggregation refers to mathematically based methods that condense many scores into a few compact indices, visualisation refers to the means of getting the indicator message across to the relevant stakeholders.

There is a demand to be innovative and forward looking when it comes to engaging communities and user interests. The usual way of looking at public/stakeholder/ engagement in the context of the marine environment is to ensure all relevant contributors are identified and have a voice, with a view to fostering a sense of ownership and stewardship over the coastal environment and its resources. This is very important and very necessary. However, there is another aspect to stakeholder/contributor engagement. Often there are interested individuals and groups in the general public who already have a strong sense of ownership and stewardship and who want and need their voices to be heard in this regard. This can be viewed as an asset in that the contributor's commitment and knowledge can be harnessed to help develop and deliver relevant aspects of the proposed plan. It is a matter of getting the balance right between representation and effectiveness.

11.6.2 Transboundary mechanisms

A Scottish Marine Litter Strategy should account for transboundary influences. The legal analysis highlights that many objectives and outcomes can be achieved within Scottish jurisdiction, as management of waste and litter is predominantly a devolved activity. When it comes to the maritime sector several activities relating to marine litter are devolved or executively devolved (such as Ports) where they integrate with the land system. However, several legislative regimes are in the area of UK competence, and will require cooperation. For example, while ports are a devolved activity, shipping and oil and gas are regulated in a UK context. In addition, the legal analysis identifies that a strategy will play an important role in delivering EU MSFD targets and promoting regional cooperation through OSPAR.

11.6.3 Commitment to adaptive management

Adaptive management aims to increase resilience to unforeseeable change in an ecosystem and recognises that the level of scientific uncertainties in social and ecological systems can prevent the making of long-term management decisions. The adaptive management process involves:

- An agreed long-term vision for the future state of the ecosystem;
- The establishment of pragmatic shorter-term operational objectives;
- Progress review supported by scientific monitoring; and
- Information feed-back loops.

As research reduces uncertainty, the process begins again and the operational targets (and long-term vision) may be revised on a regular timetable. The close involvement of all stakeholders is crucial to the success of the adaptive management process.

12 PROPOSED OBJECTIVES FOR A SCOTTISH MARINE LITTER STRATEGY

Vision:
By 2020 marine litter in Scotland is significantly reduced and does not pose a risk to the environment or communities. This is supported by our vision of a zero waste society, where people and businesses act responsibly and reuse, recycle, and recover waste resources

12.1 Strategic Directions and Actions

The Vision for a 'clean and safe' marine and coastal environment is operationalised by several strategic directions. It is important to note that the directions as listed are not in order of priority.

Strategic Direction 1: Improve public awareness of, and behaviour changes around, marine litter.

Actions:

- Assess socially acceptable levels of marine litter and links to economic impact
- Improve education on the full impacts of marine litter in order to stimulate a pro-active approach to its prevention and minimisation
- Encourage a programme of public participation in waste reduction activities to increase public awareness
- Incentivise the reuse of plastic and other containers and their correct disposal through for example deposit schemes and reverse vending and market based instruments
- Incorporate educational material on the sources and effects of litter and ways of reducing the problem at source into the curriculum for excellence
- Ensure mandatory labelling of sanitary products with the correct disposal information: 'Bag It and Bin It – Please Don't Flush It' being clearly visible
- Support an education programme directed towards specific user groups i.e. anglers, boat owners and other recreational groups
- Investigate the application of a range of market instruments to support the reduction of land and sea based sources
- Provide sufficient funding for national and local educational campaigns

Achieving a vision of marine litter in Scotland being significantly reduced and not posing a risk to the environment or communities will depend on everyone playing their part by recognising and taking responsibility for their own actions. Surveys have shown that up to 50% of people litter on a regular basis; this attitude towards the environment has to change. Marine litter is a global issue yet its resolve will only come about through the support and commitment of the people of Scotland and those around the world. To support that, everyone in Scotland needs consistent messages on how to reduce, reuse and recycle, making it clear how each and every one of us can participate as part of daily life.

As advocated by Scotland's Marine Atlas (Baxter *et al*. 2011) individuals, schools, further education establishments and businesses need to understand how their behaviour can

prevent the widespread and often tragic impacts of marine litter through responsible waste practices and resource efficiency, from the products they design, produce and buy, and how they are used and disposed of.

Strategic Direction 2: Reduction of terrestrial and maritime sources of litter entering the marine environment

Actions:

Land Based Sources

- Encouragement of "Food on the Go" code of practice for beach outlets and kiosks, and enforcement where necessary
- A ban on all balloon releases, and their recognition as a form of littering
- Provision of adequate rubbish disposal and recycling facilities for the public, particularly at beaches, supported by publicity on their location
- Expansion of national recycling schemes and infrastructure, especially for kerbside plastics collection and research into refillables
- Play a key role in the UNEP Global Programme of Action for the Protection of the Marine Environment from Land-based Activities initiative
- Local planning and development control must control litter from sites in proximity to the coast

Enforcement

- Properly enforce current legislation for the protection and improvement of the marine environment
- Increase enforcement and impose sufficient fines for litter offences to make them a sufficient deterrent and ensure polluters pay costs that truly reflect the damage they cause
- Better implementation of Environment Protection Act 1990 to ensure the enforcement of anti-littering laws on all land including beaches including the removal of litter from beaches by Local Authorities
- Investigate the application of a range of market instruments to support the reduction of land and sea based sources

Maritime Activities

- A "general prohibition" on all waste discharge from ships to the sea as part of the IMO's revision of Annex V of MARPOL 73/78.
- Establishment of Special Area Status under MARPOL Annex V for all UK waters
- Extend existing Port Waste Reception Facilities to include fishing vessels
- No-special-fee reception facilities and compulsory discharging of marine litter in port for all vessels including fishing boats.
- Encourage the return of trawled or dredged material to Port via the use of the marine licensing system and/or by market mechanisms
- Improve enforcement of ship waste management plans and inspections of Garbage Record Books under the Merchant Shipping (Prevention of Pollution by Garbage and Sewage) Regulations 2008.

- Implementation of a public register of legal notices, offences and fines relating to pollution of the marine environment from shipping.
- An anonymous system to report vessels illegally dumping waste at sea
- Incorporation of environmental responsibilities into the education and training of ship owners, ship operators, crews, port users, fishermen and recreational boat users
- Incorporation of waste management systems into the design of new vessels
- Research should be carried out into recycling and reuse facilities for fishing nets at ports
- The introduction of net markers for UK fishing gear should be implemented
- Incorporate marine litter reduction and management strategies into regional marine plans and marine protected areas under the Marine (Scotland) Act 2010

SRD

- Investigate the causes for high levels of SRD on the Scottish coast
- Improvement by water authorities to combined sewer overflow systems
- Private outfalls to be identified, and adequately screened or treated
- Proper enforcement of CSO discharge consents by the competent authority and strict penalties for failure to comply with discharge consents
- Improve public education to encourage correct use of sewage system

Industry

- Encourage the plastics industry to bring in a code of conduct for the safe handling, packaging and transportation of plastic pellets
- Enforcement of the European Directive on packaging and packaging waste to reduce the environmental impact of packaging by reducing packaging at source, maximising the recovery and recycling of used packaging, and eliminating harmful materials
- Introduce measures to reduce the use of disposable plastic consumer products
- Encourage innovation in packaging and reduction in unnecessary packaging

Marine litter stems from two sources; land based sources and sea based sources and activities, each of which having a number of sub categories/sources within them for example riverine and wind blown inputs. The ability to identify a particular source from an individual litter item is difficult, and often depends on the state of the litter item or the possibility of multiple sources. As such, management needs to work across the land-sea interface as part of an integrated approach to address marine litter and stop it at source (Baxter *et al*., 2011). An example of this is the *UNEP Global Programme of Action for the Protection of the Marine Environment from Land-based Activities* initiative which seeks to prevent the degradation of the marine environment from land-based activities by directly addressing the connectivity between terrestrial, freshwater, coastal and marine ecosystems. This approach needs to be advocated by a Scottish Marine Litter Strategy if it is to be effective in achieving its vision.

Whilst it is difficult to reliably source litter items, a number of initiatives have looked at the differing proportions of litter from each of the sources and their results show that the greatest amount is from activities on land. At the global scale it has frequently been reported that up to 80% is derived from land based sources, however it must be noted that this figure is generally based on beach surveys and thus may be more appropriate to state 80% of beach

litter is from terrestrial sources. At the Scotland level source information (from beach cleans) shows 42.9% public, 7% fishing, 19.3% SRD, 1.8% shipping, 1% fly tipped, 0.2% medical and 27.9% non-sourced. Taking into account the difficulties in sourcing and the potential for error margins, these figures nonetheless do provide an indication of the proportions of litter and their sources and offers an invaluable basis for management. Clearly a large amount of marine litter is from land based sources, but equally given the relatively low number of marine users and scale of activities in the marine environment compared to terrestrial, litter from sea based sources represents a significant proportion and a focus on an 80:20 % split may be misleading.

Due to the diversity of activities and sources, it is clear any management needs to be equally wide in its scope and use a number of tools and instruments, including enforcement, market based instruments and industry action.

Strategic Direction 3: Contribute to a low carbon economy by treating 'waste as a resource' and seizing the economic and environmental opportunities associated with the zero waste plan

Actions:

- Development of a "waste to resource" tool kit targeted at coastal and maritime resource managers, supported by minimum standards for recycled materials
- Provide incentives for Port and harbour reception facilities to drive separate collection and treatment of a range of resources in order to maximise their reuse and recycling value, and generate market supply
- Ensure the Scottish Sustainable Procurement Action Plan identifies and supports opportunities for recycling and reuse of coastal and maritime sources of litter
- Engage proactively with the Low Carbon Economic Strategy for Scotland (March 2011) in particular building opportunities for resource efficiency (energy, water, waste materials) and sustainable business practices across the economy
- Actively seek investment for environmental and clean technologies that facilitate recovery, recycling, and environmental monitoring in coastal and maritime industries
- Investigate the application of a range of market instruments to support waste as resource initiatives such as deposit schemes, plastic bag and product charges, tourist and coastal infrastructure levies, and positive subsidies

The Scottish Government's Zero Waste Plan and the recent Low Carbon Economic Strategy for Scotland set the policy architecture for turning waste into a resource. Preventing unnecessary resource use and transforming waste into a commercial opportunity will require the right mix of incentives and infrastructure to harness economic and environmental opportunities. When pursued, it will enable coastal and maritime sectors to reduce costs, operate more efficiently, and add value to resources with no previous commercial value.

The policy and infrastructure to support this transition is wider than coastal and maritime industries – it will require a whole of economy approach as specified in the recent Low Carbon Economic Strategy for Scotland. However, the coastal and maritime sector will play an important role, and each sector should explore the potential for resource efficiency innovation supported by incentives for action. For example, waste streams will require clear up front sorting practices to reduce contamination for high quality recyclate, and port and harbour facilities may provide a focus for collection, sorting, recovery. There are also potential gains from transformation of waste into energy sources. A Scottish Marine Litter Strategy should align with the broader move towards resource and waste efficiency and recovery. It should focus and implement market based instruments to move coastal and maritime industries and users towards a highly resource efficient and low carbon economy.

Strategic Direction 4: Improvement of monitoring at a Scottish scale

Actions:

- Prioritise an initial evaluation on the current state of research to give a scientific and technical basis for monitoring, knowledge gaps and priority areas for research
- Ensure the implementation of an adaptive management cycle across all Strategic Directions and Actions. This would involve monitoring, identification of main sources, implement reduction and management actions, review success and adapt process as necessary.
- Develop standardised monitoring approaches, to allow comparisons at the National and EU scales
- Clarify organisational responsibility for marine litter monitoring
- Investigate the use of fisheries research vessels to undertake seabed monitoring of marine litter during scientific trawls
- Investigate a monitoring programme for microscopic plastic particles
- Secure sufficient funding for litter monitoring
- Alignment of NGO, Scottish, UK and international monitoring programs and data withUK Marine Monitoring and Assessment Strategy (UKMMAS); MERMAN; ICES and OSPAR.

In order to prevent and reduce marine litter, a comprehensive monitoring programme is essential and as such reliable baseline data should be established. It is therefore necessary to implement regular monitoring strategies across the coastal and marine environment taking account of the full spectrum of litter sinks and pathways. This will help to provide information on the types, quantities and distribution of marine litter; to provide an insight into the associated problems and threats; to assess the effectiveness of pertinent legislation and management policies; to identify sources of marine litter; to explore public health issues related to the inappropriate disposal of waste; and to increase public awareness of the condition of the coastline.

This information is fundamental to the development and implementation of effective and efficient management approaches.

Strategic Direction 5: Engagement at the UK, EU, and international scales

Actions:

- Identify a lead agency to progress the fight on marine litter at the Scottish level, and provide a point of focus for coordination on devolved issues and with the global movement
- A marine litter strategy should implement a coordinated approach amongst Scottish government departments, directorates, agencies and NGOs. This would involve resource sharing and prioritising actions amongst different stakeholders. A clear structure for implementation and accountability should be developed within the plan
- Lead the way in minimising marine litter, both in Europe and internationally, by actively raising the issue with other competent authorities
- Continue to participate actively in OSPAR's work on marine litter
- Work with signatory countries to ensure the statutory enforcement of waste reduction measures under the OSPAR and MARPOL Conventions
- Formulate coherent, and well coordinated regional marine litter action plans linked to clear objectives in the national marine plan
- Secure sufficient funding for comprehensive engagement

Marine litter is a problem that cuts across a variety of scales and requires action from the international to local (and individual level). A Scottish Marine Litter Strategy should aim to influence actions within its direct sphere of control and more broadly at the UK, EU and international levels. The analysis highlights that many objectives and outcomes can be achieved within Scottish jurisdiction, as management of waste and litter is predominantly a devolved activity. When it comes to the maritime sector a mix of devolved and reserved activities will need to be addressed and will require cooperation and integration of policy and management, for example, the regulation of shipping and oil and gas and the implementation and effectiveness of the MARPOL and the EU Directive on Port Reception Facilities for Ship Waste. Scotland will be an important participant and should endeavour to take the lead within international initiatives such as OSPAR and cooperation within the MSFD on a regional sea basis to ensure Good Environmental Status. OSPAR is proposing amendments to marine litter monitoring proposing that members should extend marine litter monitoring to beaches in all OSPAR regions and consider including marine litter in the Coordinated Environmental Monitoring Program, with inclusion of monitoring of the water column and the seabed.

12.2 Indicators

The Marine Strategy Framework Directive requires EU Member States to put in place measures to achieve Good Environmental Status (GES) by 2020. By July 2012 the UK is required to determine the characteristics of GES for UK waters and set appropriate targets and indicators for each qualitative descriptor to ensure these will be achieved.

Defra's Marine and Fisheries Directorate held a workshop which brought together marine experts and policy makers to:

- Discuss what GES means for each Descriptor, and as a whole for UK marine waters;
- Develop a consensus around options for developing GES targets and indicators.

It is felt the indicators suggested from this work would provide a benchmark to measure GES achievement at the Scotland and marine regional level.

It is proposed that GES for Marine Litter could be shown to be achieved if:

1) Litter and its degradation products currently present in, and entering into, Scottish waters is reduced over time and does not pose a significant risk to marine life at the population level, either as a result of direct mortality or by way of indirect impacts such as reduced fecundity and bioaccumulation within food chains.
2) Litter currently present in, and entering into, Scottish waters does not pose a direct or indirect unacceptable risk to human welfare and does not lead to significant detrimental economic impacts for industry and coastal[6].

More specifically to ensure SMART targets these could include:

Characteristics of litter in the marine and coastal environment

- [50%] overall reduction in the [volume/weight] of litter on coastlines from 2010 levels by 2020
- [50%] reduction in [volume/weight/number] of plastic/fishing/sanitary litter items and sewage related viruses on coastlines from 2010 levels by 2020
- Trend analysis shows a measurable reduction in the [volume/weight/number] of litter on the seafloor by 2020
- No increase/slow rate of increase of micro-plastics by 2020

Impacts of litter on marine life

- Less than 10% of northern fulmars (*Fulmarus glacialis*) having more than 0.1 g plastic particles in their stomach
- Amount of (species) population with litter 'obstacles/ entanglement' or scarring
- No impact on cetaceans from marine litter at the population level by 2020

[6]**NB** This work is in draft form and are the opinions of the Defra Workshop attendees

12.3 Options for delivery of a Scottish Marine Litter Plan

Option 1: Business as usual

The business as usual scenario stipulates that the existing framework in place for the management of marine litter will remain with no overarching reform process in place. This option assumes a "do nothing" option **does not** exist and Scotland must meet EU targets and obligations such as the MSFD and EU Directive on Waste. This Option assumes that existing work by Government continues in place but is not supplemented by further work. For example the Scottish waste and climate initiatives such as the Zero Waste Plan and the Low Carbon Economic Strategy for Scotland will be operational and addressing marine litter issues, albeit indirectly.

Option 1: Business as usual	**Disadvantages**	**Advantages**
	• Would risk continuation of the current situation, where conflicts and uncertainty about the management of marine litter remain • Risk the MSFD Descriptor 10 will not be achieved • Marine litter management will remain un-coordinated across several policy domains • The profile of marine litter will remain relatively low in the public eye • Marine litter initiatives may not feature prominently in marine planning. • Potential reforms to individual instruments may occur in isolation and remain uncoordinated. • Monitoring and data collection continues across a diverse user landscape and problems with compatibility continue e.g. ICES data.	• Low cost model • Improvements to marine litter will occur indirectly from the variety of initiatives in other sectors such as Zero Waste Plan and the Low Carbon Economic Strategy

12.4 Option 2: Implement the strategy: low cost networked approach

In this option, a Scottish Marine Litter Strategy is prepared, with a focus on coordination, profile raising and networking amongst sectors and stakeholders. All relevant obligations and targets aim to be satisfied and additional coordination implements reforms and adds value. A lead authority is identified, but resources are targeted at providing support for a policy officer to administer the Strategy including the development of a stakeholder group and monitoring of outputs. Key elements of the proposed strategy are resourced through individual sectors – no central funding is available with the exception of supporting the network and its activities.

Option 2: Low cost networked approach	**Disadvantages**	**Advantages**
	• Key proposals that require coordination and leadership may not evolve. For example options for reform measures under SD2 for terrestrial users and maritime industries may lack leadership. • A risk that the profile of the marine litter problem is not raised sufficiently in public and private circles.	• In the current climate of fiscal tightening this option may achieve both the coordination that is necessary for reducing marine litter and promoting reforms but using a model that is relatively low cost. • Obligations under MSFD and GES are addressed. • The strategy links to key areas of development including the Zero Waste Plan and the Low Carbon Economic Strategy

12.5 Option 3: Implement the strategy: high cost and centralised approach

Option 3 relates to the establishment of a centralised policy unit dedicated to the development and implementation of a Scottish Marine Litter Strategy. Resources are available for a dedicated policy officer, stakeholder engagement and the funding of select high profile initiatives the have a direct impact on reducing litter from source and encouraging a waste is resource ethic.

Option 3: Implement the strategy: high cost and centralised approach	**Disadvantages**	**Advantages**
	• A relatively high cost model that is resource intensive • May divert from other policy priorities such as Zero Waste Plan • Will require resources for coordination and delivery • May be difficult to implement in such times of change for marine planning and management in Scotland	• A dedicated team is able to champion and drive the changes indicated in the actions • Committed resources potentially drive match funding from industry and EU. • A high profile public strategy raises the profile of marine litter and begins to shape behaviours • A central unit and office is established to coordinate the initiative and administer the steering group.

NB This work is in draft form and the disadvantages and advantages highlighted in the above tables are not necessarily comprehensive.

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13 APPENDIX 1

13.1 Stakeholder Workshop-Raw Data

	Current situation: Identification and review of *reduction at source* initiatives and approaches (KM)
Awareness raising campaigns and behaviour change tools	– Scottish Water o Awareness campaign o Bag it and Bin it (households) o Fat disposal o Information on SW website
	– Compliance with campaigns is not mandatory o Could be more widely advertised
	– Awareness campaigns have been running for years
	– Labelling could be improved to help raise awareness (**future**)
	– GRAB trust o Awareness raising (schools and beach cleaning) o Funding from SNH, landfill tax and the Crown Estate
	– There are other examples o Not coordinated at the Local Authority level
	– MCS also do this type of work o It depends on volunteer uptake
	– Limited, part time engagement (difficult to keep momentum up beyond an initiative)
	– General litter campaigns (not targeted at marine/coastal)
	– Encourage re-use of bags o Biodegradable bags *don't* biodegrade in cold marine environment o Has been a recent reduction in use of plastic bags (1 billion fewer/year)
	– Some Local Authorities have banned balloon races (a form of littering)
	– Bag it and Bin it campaign: need to keep it in the public eye otherwise littering behaviour returns to pre-campaign levels
Chain of responsibility	– Manufacture (polluter pays?) – consumers (do pay) o System awareness
	– What is the source of litter? Often higher up the chain
	– Scottish Government states that the responsibility for marine litter lies with the producer
Harbour litter facilities (including KIMO) and shipping legislation	– Peterhead, KIMO: fishing for litter o Only 12-16 larger ports involved around Scotland
	– Aberdeen harbour dropped its KIMO skip o However port waste plan does provide removal of shipping waste with a mandatory charge (which goes mainly to landfill) o Fishing boats can also use port waste facilities but no payment required o Port waste plans part of wider international agreements
	– Aberdeen Harbour has a new boat to collect port litter o This will include litter brought from upstream and in by the tide o It may be possible to monitor the volume collected
	– No garbage bags **??**
	– Harbour costs/fees
	– MARPOL regulation relating to offloading waste at every port: needs further implementation and more policing o Issue with boats transporting litter o Economic viability of waste collection o Reporting required but not always provided
	– Harbour cleaning boats: also used on the upper Clyde and by Forth Ports (?) o Why? It's regulation and self interest that drives this

	○ There's lots of supermarket sourced litter: responsibility lies with them? ○ Health and safety is another driver
Engagement with marine industries and fisheries	– Issues of engagement with marine industries ○ Different for fisheries?
	– "Seafish" provides local training focus for "responsible fishing"
	– **FUTURE** Leasing fishing nets (not tried yet)
Regulation - Good Ecological Status to 3km	– Scottish Water: the industry is increasingly regulated ○ Investment is made as early as possible to achieve Good Ecological Status (GES) out to 3 nautical miles by 2015 ○ Screening at shellfish and bathing water sites for GEC (pollution affects this)
Combined Sewerage Overflows	– Pumping stations and combined sewerage overflows (CSO)
	– Address the screening of CSOs including ideal mesh size and working to reduce the inputs to them
Environmental standards (e.g. ISO for Fishfarms)	– Environmental standards for fishfarms? ○ Increasing ISO standards and these are covered in advance by ESAs (**SEA? EIA?)**. ○ Could this approach be applied elsewhere or in other sectors?
Mechanical tools for litter removal/recovery	– ***Future***: recycled plastic booms currently being tested for litter recovery in Southern France ○ Possibility of expanding its use across Europe
	– River grills (on outside bends of rivers to trap litter)
International Convention for the Prevention of Pollution from Ships (MARPOL) and introduction of ship waste management systems	– MARPOL ○ Example from U.S. cruise ship fined $300k, dumping at sea reported by passenger ○ New ships are fitted with waste management systems including the sorting of recyclables ○ Older boats are not required to retrofit these systems (difficult)
Encouraging re-use (e.g. deposit/return)	– Re-use items ○ Encourage through reverse spending (e.g. deposit/return). ○ Can work out to be too costly to implement? ○ E.g. BARRS one of few companies left who still do this (and fund beach cleanups?) ○ Expand and normalise such an approach
	– PB charging
Enforcement and incentives	– Enforcement ○ Fixed penalties for fly-tipping etc. ○ Is the legislation good enough? ○ Can it be policed effectively?
	– Benefits of wider policing
Alternatives to plastics / product development and reduced packaging	– Cotton buds: move to wood/cardboard sticks (with ***Coastal Partnerships?***)
	– Use of popcorn as a packaging material! ○ Fungal packaging being developed!
	– Plastic vs paper bags (pros and cons)
Summary points:	• What is 'reduction at source?' To be clarified in the Marine Strategy • Some industry led initiatives have worked (e.g. reduction in plastic bag usage) – further reduction in packaging is possible • Need to increase the re-use of bottles, fishing gear etc. • Current initiatives are ad-hoc, coordinate and learn from each other. –
	Current situation: identification and review of existing *governance* approaches (TP)
?	– Effectiveness of voluntary schemes?

	– No coordinating role for marine litter issues o Potential for Marine Scotland
?	– Individuals/maritime/industry o Uncoordinated o Reforms o Scale?
?	– Individuals / organisations o Balance of enforcement versus and awareness
?	– Governance is good but behavioural change is needed
Awareness raising campaigns and behaviour change tools	– Social awareness is gathering momentum, it's a social process
	– Linking to the Zero Waste Plan
	– Behavioural
	– Social/cultural psychology of littering: where does the UK / Scotland sit?
	– Social acceptability of littering
	– Recent issue on the radar, people now realise that it is a problem
	– Fly-tipping is convenient
Chain of responsibility	– Packaging partnerships with retail to help reduce the problem
	– Is there a cross-link to marine industry / marine litter sources?
	– Less litter, less littering
	– Non attributable litter raises problems for enforcement (***? 20% from MCS***)
	– Role of business to encourage customers
	– What is the extent of business to consumers **(?)**
	– Easy to get around the system e.g. landfill o Who will pay for that?
	– Landfill is becoming more expensive and less accessible
	– Should we be reducing the overall scale of litter rather than shifting litter?
	– Mass littering through retail activities (e.g. balloon release kits) yet illegal to dump litter
Harbour litter facilities (including KIMO) and shipping legislation	– Harbour Boards / LGAs have bins out but not being used o More innovative infrastructure required
Engagement with marine industries and fisheries	– "Fish for Litter", provide incentives?
Regulation - Good Ecological Status to 3km	– Framework for industrial polluters? o SEPA? o Nanoparticles
	– SEPA role in licencing
Enforcement and incentives	– Strengthen the enforcement regime?
	– How do you regulate everything from individuals to industries at sea? o Very difficult to enforce and prosecute
	– What is the current enforcement regime? o Local authorities, limits from local officers o Maritime industries ▪ 'rubbish log' ▪ Not enforced ▪ Ports Directive ▪ Highly difficult to police
	– It is hard to enforce even in harbour let alone at sea
	– Incentive to drop overboard is high o Every boat should be charged a fee across the board
	– Combine carrot and stick approach
	– Lack of enforcement, who has the power?
	– Difficult to enforce rules on land let alone at sea

	– Despite clear evidence it's hard to regulate or prosecute
	– Enforcement problems at local authority level
	– Very high requirement for evidence to prosecute o Local Government Act 2003 o Environment Protection Act
Alternatives to plastics / product development and reduced packaging	– Statutory targets for recycled content?
Scale, including coordination between local and national scales	– Local Authorities o Edinburgh got tough on enforcing litter (?) o By-laws on Aberdeen beach £40-50 but not enforced
	– Depends on the geography
	– Micro-management to macro-management scale
Litter facilities e.g. type and availability of bins	– What is the effectiveness of recycling activities? o Focus on recycling charges and waste charges o Perceived lack of action and of awareness
Policy coordination, governance and implementation	– Review of legislative options in Scotland
	– Scatter-gun approach
	– Lots of good *examples* but no coordination limits effectiveness
	– Climate change act o Waste provisions? o How to implement?
	– Is there any governance?
	– Is it high up the political agenda? o It is up the media agenda o High up the Scottish (**political?**) agenda particularly through marine strategy framework
Private and NGO initiatives and lobbying	– Big companies are driving this issue o Partly being driven by NGOs
	– There's still an interest in environmental performance by private companies e.g. o "Love where you Live" launched in England and Wales in March (2010 or 2011?) with £200k funding
	– W.R.A.P. is working to reduce waste and packaging
	– Key retailers are signed up to targets to reduce packaging and increase recycling

	Current Situation: Identification and review of existing *removal, cleaning* and *monitoring* operations -EH
Awareness raising campaigns and behaviour change tools	- Wealth of activity by recreation groups o Underwater surveys o RYA Green Blue o Sailing clubs o Responsible fishing scheme by SeaFish for commercial fisheries ▪ Though current funding issues for SeaFish may decrease success
	- Green Blue o Very active currently with education
	- Eco Schools has a compulsory unit on litter o Could this be expanded to include marine litter and its impacts o Using emotive images (eg those form John's ppt) o Needs to link wit curriculum o Local Coastal Partnership Litter DVD for marine litter as part of 5-14

	yrs curriculum link to possible funding from the climate challenge fund
Chain of responsibility	- Crown Estate o Lack of responsibility o Monitoring as the landowner?
	- Water companies are not the source of litter-it is the consumers/users, there is only so much we can do with products not designed for the system i.e. sanitary o Can charges for networks with more issues be increased? o Dilapidated systems in some parts of Scotland o But the same could be said for local authorities, harbours etc o Everyone needs to take responsibility
Harbour litter facilities (including KIMO) and shipping legislation	- KIMO Fishing for Litter o Only in fished areas o Not seen as monitoring-trying to bring about a culture change o Voluntary o Litter not sorted as this would decrease participation
Engagement with marine industries and fisheries	- Training is needed for young fishers before they go to sea
Combined Sewerage Overflows	- Surfers against sewage o Return to sender o Work against sewage overflows
Costs and funding issues	- Local authority budget cuts o Can community services be used for clean ups? o Responsibility under the Environmental Protection Act to clean beaches o Huge budget implications o Lack of enforcement
	- Landfill tax o Polluter pays (or should do) o Fishing for Litter has to pay via KIMO o But some exemptions i.e. dredging for navigation o A devolvement of land fill tax to Scotland may help
Litter facilities e.g. type and availability of bins	- Not just off beaches o Issues with full bins o Too few/lack of bins in busy areas
	- Seaside awards and Blue flags give LA responsibility to write beach litter plans, including the provision of facilities and monitored by KSB
Policy coordination, governance and implementation	- What is the role of Scottish Government in this?
	- Strategy o needs to consider monitoring requirements o funding o and how to coordinate/use that information o needs to take GES into account
Data availability, quality and use	- Is there any access to all of the work/data by universities? o How can we access and capture this information?
	- MSS '*Scotia*' trawls but data not used
	- Incentives for other fisher data?
Monitoring litter	- Beachwatch o very good but beach selection issues; rural v's urban o great for data collection but some people just want to collect rubbish not fill in the forms o easy and logical to participate o * 4/yr
	- OSPAR photo guidelines for different litter types o EU wide approach will allow for standardised data collection

	- Da Vor Redd Up
	  o 40% population participate
	  o Just clean, little in the way of data collection
	  o Clean up kits provided

	- National Spring Clean
	  o Data on the number of bags only
	  o Wriggley's provided funding for permanent kits for individual groups

	- Community beach cleans
	  o More commercial sponsoring is needed for gloves, bags, publicity
	  o Lack of information re numbers of cleans, locations, litter collected-very ad hoc
	  o Clean but no data

	- Local coastal partnership cleans for team building o Unsure if data are collected
	- Island tourist beaches cleaned; community organised

	- Local authorities clean amenity beaches
	  o Amenity beaches well cleaned
	  o Aberdeen City clean c. 60 tons/yr

	- SEPA monitoring data
	  o Not currently shared but perhaps more suitable than KIMO's
	  o SEPA trawls for litter during routine survey work, will be reported to national database

	- Da Vor Redd Up
	  o Beach and roadside clean
	  o High % participation
	  o Community groups get funding depending on how much litter they collect
	  ▪ Benefit from clean area as well as funding
	  o Funding coming to an end due to Disclosure Scotland issues
	  o This will be the first yr with no funding, interesting to see how it effects uptake

	- National Spring Clean now over a 2 month period (previously 1) o General feeling by public that it is LA responsibility

	- Monitoring not adequate
	  o Gov will need to set up a programme for GES and MSFD compliance
	  o And feed in to voluntary OSPAR work

	- Community cleans in Argyll and Bute using landfill tax funding
	  o Not aware of Disclosure issues
	  o Volunteers get checked for free

	- Ad hoc cleans but no data recorded due to time/money issues
	  o Encourage monitoring from community cleans
	  o Will help/could be used to help with source reduction

	- Beachwatch
	  o 18 years of data from monitoring
	  o Contribution to OSPAR guidelines and monitoring
	  o Only organisation to do this but how can it be expanded?
	  o Guidelines and project used by other groups ie LCPs and data for MLIIA
	  o Need more funding and more promotion
	  o Regional figures exist but only produce documents with Scotland level data
	  o Some bias towards more accessible beaches-more public litter, more likely to be cleaned
	  o Lack of data fed back to MCS from LA's
	  o Data issues if methodology is different
	  o Misleading terminology as a crisp packet is not necessarily from a beach user
	  ▪ Wording now changed to 'public'

	- What is the value of our monitoring?
	  o MCS data includes source, amounts, types, changes, and how to reduce it
	  o Data is used by SG and industry to reduce litter
	  o Strategy development shows this is being used
	  o Need regional information to effectively tackle/reduce at source as well as Scottish level; but issues with staff, time and funding
	  o MCS-this could be provided to LA's for their areas
	- Do we expand monitoring beyond a snapshot or use what we have?
	  o We need more monitoring within existing processes but also need to best use what we have
	  o Need to consider more rural, inaccessible areas in Scotland
	  o Need to consider litter sinks-where are they and how to reduce inputs to them
	  o Issues of skewing resources to bathing waters and more urban sites
	  o Issue made more complex as we have relatively low litter levels everywhere and not confined in a few places

Sharing good practice	- How do/should we (LA's, agencies, HEI's, user organisations, industry) exchange information on best practice? o All comes down to funding

	- St Andrews West Sand Partnership
	  o Ecosystem approach
	  o Litter removal by hand to promote strandline biodiversity
	  o Local issues with erosion-mechanical cleaning will likely increase this
	  o Mechanical cleaning only during the Open and the Sandcastle competition
	  o Partnership includes MOD and local people, agencies
	  o EU demonstration site under LIFE funding befits with WFD geomorphological goals
	  o Meets all problems with on management scheme

Top points:	- Enforcement is inadequate/difficult - Geography and regional differences - More encouragement of community groups, currently ad hoc and not joined up - Litter is an accepted part of society

	How to reduce future inputs of marine litter by source: coastal sources (KM)

Awareness raising campaigns and behaviour change tools	– Public change
	  o Fines?
	  o Change views?

	– Accreditation schemes o Zero Waste Scotland to address this: **Courthauld**
	– Improved use of information to contribute to campaigns
	– Better coordination of Bag it and Bin it o Link to other initiatives and sectors
	– Education within communities including: o Ecoschools – schools can choose to participate (public funded initiative)
	– Education of specific beach user types and at specific beaches

	– SEPA
	  o signs on designated beaches
	  o increased policing

	– Beach manager o Provided by every coastal LA, however Fife possibly only one with on the ground presence.

	○ Can this be improved? ○ Lifeguards are used for this purpose elsewhere (busier beaches)
	– Communicate evidence to the public e.g. cigarette butt poster at St Abbs Head
	– Use shocking images such as injuries caused to animals by plastic can connectors ○ Improve packaging
	– Increase awareness of marine litter issues in broader litter campaigns
	– Education regarding litter relating to land, sea, coastal environments ○ Tie in education, government adverts, litter awareness ○ This is seasonal so build up awareness before the beach season, build up awareness when it's needed ○ MCS beachwatch statistics in April: can these be used at the local level?
	– Collect litter and leave in an educational pile indicating 'this is what people left here only yesterday'
	– Use role models e.g. Keep Britain Tidy
	– Internet campaigns?
Chain of responsibility	– Polluter pays? ○ Consumer? Market? Producer?
	– Producer responsible for certain product types (e.g. cotton buds)?
	– Need retailers to stock 'good' products
	– Social responsibility ○ ID by barcodes ○ But who buys is not always who pollutes? ○ How might customer profiles be used? ○ Use to target user responsibility?
	– Businesses on beaches and products used on beaches ○ Work with associated businesses
	– Engage business interest ○ If litter is bought there then provide facilities for disposal
Combined Sewerage Overflows	– CSO (combined sewage overflow) spills occur more frequently than storm events ○ Capacity of the CSO system is not big enough
	– CSOs: raise awareness of the fact that "you'll see me again" ○ Who would fund this, e.g. the Zero Waste Scotland budget?
Engagement with marine industries and fisheries	– Accreditation for fish farms etc. ○ Funding for cleanups (already progress on this)
Mechanical tools for litter removal/recovery	– Physical removal of litter e.g. river grills (need to be WFD compliant)
Encouraging re-use (e.g. deposit/return)	– Improve communication about how to return things for re-use e.g. fish boxes to port/company addresses
Enforcement and incentives	– Cameras on boats ○ To much data and who would monitor it?
	– Fly-tipping ○ Report quickly via local community ○ Councils liaise with the police ○ Increase the likelihood/threat of being caught and get cases to court ○ Increase the priority of such cases in court (awareness raising here)
	– Use community service orders ○ Quick process from crime to clean-up

	○ Could issue these on beaches? (too few staff)
	– There's an increased need for policing overall
	– Enforcement possible on high use beaches ○ Use targeted fixed penalties ○ Use peer pressure: locals are the enforcers
Costs and funding issues	– At the moment the public pays ○ Do we know the costs to local government? (reference to KIMO) ○ And what are the environmental costs (e.g. microplastics)
	– Establish the costs and benefits of litter reduction approaches ○ Might release LA funds for other services ○ Use cost savings and service improvements to appeal to the public
Scale, including coordination between local and national scales	– Different local authority levels of engagement
	– Management needs to be location specific
	– Local variation is important (rural beaches, busier beaches etc)
Litter facilities e.g. type and availability of bins	– Employ appropriate bins on beaches (e.g. lids to prevent seagulls) ○ Separate waste at these bins (common elsewhere e.g. Australia) and use clear simple signage. (**not effective?**)
	– OR, no litter, take home only
	– Rural beaches: use 'litter port' ○ Not for own litter but that picked up, for local involvement e.g. voluntary response at Forvie NNR in partnership with Local Authorities ○ May also have been used on sections of the Fife Coastal path
	– Recycling facilities on beaches ○ Keep it simple e.g. for what's used most on beaches (especially bathing water beaches)
	– Provision of good facilities ○ E.g. large lidded bins (seagulls) because people try to bin litter but facilities poor
	– Or remove bins e.g. this has resulted in a reduction in beach litter on Aberdeenshire beaches ○ Backed up by research by Forestry Commission and National Trust
Dog mess and dog owners	– Dog owners ○ By-laws relating to removal of mess ○ There's a 'Green dog-walkers scheme' in Fife
	How to reduce future inputs of marine litter by source: *Maritime industries* (TP)
?	– Role of IMO, Lloyds (in London)
?	– Limits to voluntary approaches when referring to point sources ○ Role of management / regulations on pollutants (SEPA?)
?	– Oil and gas industry / MARPOL are a UK and EU responsibility ○ Scotland can educate and train where it does not have regulatory responsibility
	– Resourcing is a problem ○ Example of Green Blue to be run by a public agency ○ Versus using a regulatory agency which may be seen as imposed ○ Underscores role of social change
?	– Innovative options for users – an opportunity?
Awareness raising campaigns and behaviour change tools	– Education ○ Notices ○ Basic training format in a format that they can digest e.g. financial aspects ○ SOLAS regulations, inclusion for training for seafarers

	○ Exploring regulations and policy context for mariners
	– Royal Yachting Association: leisure boating ○ Green Blue education and awareness programme
	– Training is critical
	– Mechanisms to drive improved behaviours (e.g. ILL)
Chain of responsibility	– Waste: health and safety e.g. lack of compliance with container design, management, wastes
	– Plastics industry sees representational interest: they do not 'own' the waste but it affects the industry's reputation
	– Merchant shipping to small recreational boats, all are problematic
Harbour litter facilities (including KIMO) and shipping legislation	– Ports and harbours ○ Quality of waste receptacles and infrastructure ○ Training and education ○ EU port based recycling Directive (***?***) ○ Charges and waste management systems ○ Communications between ports ○ Vessels need to report on levels of waste (to MCA)
	– Ports: current reporting only applies to boats over 500t (***?***) ○ Discussion to lower this limit
	– Lack of infrastructure to handle waste (particularly in the south)
	– Expand 'Fishing for Litter', feeling that enough is covered in Scotland (***?***)
	– Crews and harbour staff won't resort litter: is there an opportunity here? Otherwise it's not sorted or recycled
	– Scotland is behind in terms of infrastructure for marinas and ports (e.g. recycling, pump-outs, oil etc) ○ Part of the mooring fee, regardless of use i.e. an incentive to use it ○ Facilities to match options and messages
Engagement with marine industries and fisheries	– Plastic pellets: Cornish example of high incidence of pellet pollution from shipping freight containers lost overboard ○ "Operation Cleansweep" ○ Voluntary Code of Practice ○ Enforcement?
	– Responsible Fishing Scheme (SeaFish) should cover interplay between environment and the consumer
	– Introduce producer responsibility for nets in the fishing industry ○ Introduce waste/return schemes for when purchasing gear (e.g. nets) leading to civil / community responsibility
	– "over the side is out!"
	– Fishing nets ○ Huge amounts and varying in size ○ What guidance is there over their use? ○ Producer / user relationship
Enforcement and incentives	– Environmental Protection Act? Scottish Law requires a high burden of proof
	– Surveillance and enforcement is still important
	– Mooring rights (at risk from prosecution***?***)
	– Port and harbour controls
Scale, including coordination between local and national scales	– Regional partnerships / ICZM to tackle litter management
Policy coordination, governance and implementation	– SOLAS / IMO / UK / Merchant Shipping Act and Marine Conservation Act
	– Recent review Annex 5 of MARPOL
	– What is the legislation for smaller boats?
	– Extension of MARPOL to fishing vessels

	– Marine Act feeding into secondary legislation including OSPAR
	– Marine Act leading to MSFD Des D (***??***)
	– No clear relationship between the Marine Act and litter
Geographical distribution of marine litter	– Maritime litter dependent on geography and source o Hard to pin down source o Proportion is increased where there is increased maritime activity
	– Role of currents versus region (L.A. etc)
	– UNEP reports identify regional differences
Data availability, quality and use	– MCS is a source of regional data
Issues beyond Scotland's direct influence	– Lost shipping containers is an EU / UK issue
	– What are other countries doing in marine litter management?
	– Use and look at other cultural examples
Key points from Tavis' groups:	Organisation's responsibility Business to encourage customers behaviour Behaviour change required Education in schools Psychology Waste as a resource

	How to reduce future inputs of marine litter by source:*Land based sources (EH)*
?	- SRD most offensive items
?	- Landfill is/will reduce as waste disposal option over time
?	- Agricultural plastics-silage wrap, polytunnels, ground cover o Recycling schemes are needed for this, currently burnt in many areas
?	- Landfill design and siteing o Netting areas o Planning for landfills in the coastal zone o Include in schools to raise awareness of the issue
?	- As landfill and packaging costs increase..,… o Value of recycling will increase o Discount on council tax or other incentive of you recycle o Use of a 'stick' may increase dumping o Need more education and recognition that impacts of marine litter are from the whole of Scotland
?	- Mining land fill for high value products
Awareness raising campaigns and behaviour change tools	- Make waste a resource o Recycle, reduce, re use o Give waste a value ▪ i.e. money for returned plastic bottles o need to change attitudes and perception
	- Need ongoing awareness raising of impacts on marine animals o Emotive o Currently people see little link from their balloon release to marine litter
	- Lack of awareness o Need wider litter awareness o Holistic approach o Everyone can make an easy, small (but significant) change-'do a little, change a lot'
	- Education i.e. Bag it and Bin it to increase awareness o Can be very short term, during the campaign only o Get it in schools
	- Use of Mum's net and similar to increase awareness

	- Approx 47% of people admit to dropping litter regularly
	- More advertising and use of shocking images i.e. KIMO ppt o Cinema o Impacts on wildlife o Litter and the local area overlay images
	- 'Bag for Life' level of investment and impact needed for each issue/source
	- Use of virals and social networking sites o Cheap o High number of users
	- Lack of current awareness/understanding o As shown in the BBC blogs on related articles
	- Zero Waste o Placing value/cost on single use products o Voluntary o Incentives; Tesco points for products returned o Germany-deposit on bottles via reverse vending machines ▪ Encourages others to return them as the value is not limited to the user
	- Plastic bag free towns/villages o Join up and expand current initiative
	- Make accommodation providers be more proactive in raising awareness
	- Use of Facebook to name and shame
Chain of responsibility	- Waste oil barrels o Containers should be stamped/marked to enable the source to be identified o May be able to trace currently but who does that and how is it enforced?
	- Engage business to take responsibility o Focus on outlets o More engagement needed i.e. love where you live-Macdonalds, Wriggleys and Pepsi buy in
	- Who is responsible? o UK Gov, SG, Scottish Water, packaging and manufacturers ▪ Scope, but funding needs to be available
	- Packaging o Onus on companies to take back packaging o Some charges, others do not o Responsible disposal o Design out excessive packaging especially in toys etc from China and similar countries o Packaging by weight has decreased but now more smaller parts o Adds to premium products i.e. whisky (bottle, paper, card tube)
Engagement with marine industries and fisheries	- Fish boxes from processors blown away and break up
	- Fishing nets mended on quayside, hundreds of fragments left o Education for fishers/ports o Clean up before it enters the water o Provision/facility in place to prevent
Alternatives to plastics / product development and reduced packaging	- Product development o Degradable
	- Reduce packaging o Alternatives to polystyrene-what can you do with it once used? o E.g. use of fungus in USA for packaging o Key people involved i.e. retailers o Get it back for recycling not just landfill o Electronics retailers i.e. Dixons take away packaging ▪ But a charge for this in some cases
	- Minimise single use items o Put a value on them
Costs and	- Make people aware of the true costs

funding issues	
Litter facilities e.g. type and availability of bins	- Plastic bottles/packaging o Clarification on what can and cannot be recycled (kerbside) o Not standard across Scotland o Recycling centres sometimes full
	- More bins does not necessarily decrease litter o Behavioural patterns o In Argyll and Bute bins ask you to pick up litter as you walk and put in the next bin
Policy coordination, governance and implementation	- Ban single use carrier bags
	- Develop the Strategy at both industry and operational level
	- Agricultural sources i.e. silage wrap o Tackle via SRDP and cross compliance?
	- Marine planning may provide an opportunity to coordinate but there is no direct link to marine litter o May come at regional level
	- Ban sanitary products o Including disposable nappies, move to real nappies o Find alternatives o Costs ££££ for Scottish Water
	- Balloons o Banned in Canada o Can we ban across Scotland o Fine companies who sell 'release kits' o Balloons are not degradable o Paper lantern alternatives have wire and tea lights o Use of trading standards o Guidelines needed form plastics industry-what is biodegradable, marine env, photochemical ▪ Confusing, often misleading for public i.e. biodegradable in 400 yrs in North Sea o Role of SG/UK Gov; what can be used in what situation re biodegradable ▪ Labelling issues o If they were recognised as a source of litter it would help with enforcement o MCS to/will ask for a voluntary ban on releases at LA level ▪ To include fireworks and paper lanterns ▪ Need to target manufacturing here
	- Plastic bag levy
	- Litter now part of the Access code-responsible access
	- One size fits all may not be a solution
Monitoring litter	- Monitoring needed at the regional level to identify sources
Recycling	- Recycling/reprocessing o Some not available in Scotland o Requires investment o Facilities are expensive and have a long pay back time
Top points	- Balloon releases - A lack of advertising and awareness - Packaging o Reduce or find alternatives for - Give waste a value

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