

Marine Strategy Framework Directive consultation: UK Initial Assessment and Proposals for Good Environmental Status

Impact Assessment

March 2012



Northern Ireland
Executive

www.northernireland.gov.uk



The Scottish
Government



Llywodraeth Cymru
Welsh Government

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Title: Marine Strategy Framework Directive – targets and indicators for Good Environmental Status IA No: Defra 1405 Lead department or agency: Department for Environment, Food and Rural Affairs Other departments or agencies: Department for Transport, Department for Energy and Climate Change, Natural England, Marine Management Organisation, Centre for Environment, Fisheries and Aquaculture Science, Joint Nature Conservation.	Impact Assessment (IA)	
	Date: 10/10/2011	
	Stage: Consultation	
	Source of intervention: EU	
	Type of measure: Other	
		<ul style="list-style-type: none"> Contact for enquiries: Naomi Matthiessen, 02072385388
Summary: Intervention and Options		RPC: Green

Cost of Preferred (or more likely) Option											
Total Net Present Value	Business Net Present Value	Net cost to business per year (EANCB on 2010 prices)	In scope of One-In, Measure qualifies as One-Out?								
£178m-£336m	£215m-£408m	£2.6m - £49m (i.e. there is a net benefit)	<table border="1"> <tr> <td>No</td> <td>Yes</td> <td>No</td> <td>Out</td> </tr> <tr> <td></td> <td></td> <td></td> <td>In/Out/zero net cost</td> </tr> </table>	No	Yes	No	Out				In/Out/zero net cost
No	Yes	No	Out								
			In/Out/zero net cost								

What is the problem under consideration? Why is government intervention necessary?

The marine environment provides us with a wide range of important ecosystem services such as the provision of food (e.g. fish and shellfish), recreational opportunities (e.g. clean water and beaches for watersports and leisure activities) and regulating services (e.g. helping to regulate our climate). Many of these services tend to be provided free of charge outside traditional markets, and can therefore be over exploited and inefficiently used.

Recent assessments of the UK's seas have shown that parts of our marine environment are in a degraded state due to the impacts of human activities. The need for further action to ensure the marine environment is being used in a sustainable way has already been recognised in the Government's overarching objective of clean, healthy, safe, productive and biologically diverse seas and at a national level action is being taken through the implementation of the UK Marine and Coastal Access Act, the Marine Scotland Act 2010, and similar legislation being developed in Northern Ireland.

However, a number of the activities which impact our marine environment are international in nature (e.g. fishing, shipping), and the pressures which they cause (e.g. litter) can spread across national boundaries. For this reason the measures needed to achieve sustainable use of our seas cannot be taken by the UK on its own, and internationally coordinated targets and indicators are necessary if the UK's objectives for its seas are to be achieved.

What are the policy objectives and the intended effects?

The aim of the Marine Strategy Framework Directive (MSFD) is to achieve Good Environmental Status (GES) in Europe's seas by 2020 through (i) protecting Europe's marine environment, (ii) preventing its deterioration and, (iii) where practical, restoring marine ecosystems that have been degraded through the impact of human activities. However, the Directive also recognises the economic value of our seas and achieving GES is consistent with using the marine environment in a sustainable way. These aims are in line with the UK's existing objective of clean, healthy, safe, productive and biologically diverse seas.

In order to achieve GES, European Member States must carry out the following steps before 2020:

- an assessment of the current status of their marine waters by July 2012;
- development of a set of characteristics of GES, with associated targets and indicators by July 2012;
- implementation of a monitoring programme to measure progress towards GES by July 2012;
- implementation of any management measures which are needed to achieve GES by Dec 2016 (e.g. measures to reduce the impact of fishing on the marine environment or measures to reduce litter on beaches).

This impact assessment looks at the potential impacts of options for UK targets and indicators of GES. These targets and indicators, which must be coordinated with other EU countries, are intended to guide progress towards GES and inform the development of future monitoring programmes and management measures. In order to assess the potential implications of the proposed GES targets and indicators we have considered a range of illustrative management measures which experts and policy makers consider to represent a reasonable indication of the types of action which may be needed to achieve the GES targets. These illustrative measures represent a current best assessment of the type of action which could be needed to achieve the targets but should not be seen as the measures the UK Government and DAs definitely intend to take. The final measures for achieving GES will be subject to a full cost-benefit analysis and impact assessment process during 2014.

What policy options have been considered, including any alternatives to regulation? Please justify preferred option (further details in Evidence Base)

The MSFD has already been transposed in to UK law through the Marine Strategy Regulations 2010 and no additional regulation is proposed in this impact assessment.

This impact assessment sets out a range of proposals for UK targets and indicators of GES. Where scientific uncertainty exists on how to define sustainable use of the marine environment, two options for GES targets have been put forward – this is the case for GES Descriptors 1 (biodiversity), 4 (food webs), 6 (seafloor integrity), 10 (marine litter) and 11 (underwater noise) – for all other Descriptors just one option is considered.

Where two options are put forward, Option 1 is considered to provide a reasonable level of confidence that a target will achieve GES and Option 2 is considered to provide a higher level of confidence that a target will achieve GES. No options have been put forward which are considered to fail to achieve GES other than Option 0 which is the baseline projection for what will happen without MSFD.

The preferred option for each of the GES Descriptors is Option 1, with the exception of D10 (marine litter) where Option 2 has been put forward as the preferred option with respect to litter on coastlines. The preferred option is considered sufficient to achieve GES, whilst minimising costs to business and avoiding the risk of the UK gold-plating the Directive. It is based as far as possible on targets and monitoring that are already required in existing legislation (e.g. the Birds and Habitats Directives) and does not go beyond the requirements of the Directive and subsequent Commission Decision 2010. The likely benefits of the preferred option are considered to greatly outweigh the costs. A more detailed explanation of the approach to options can be found in Section C of the evidence base.

Will the policy be reviewed? Yes If applicable, set review date: Every 6 years (first review in 2018)					
Does implementation go beyond minimum EU requirements?			No		
Are any of these organisations in scope? If Micros not exempted set out reason in Evidence Base. Impacts on small business will be assessed when final measures are implemented in (2014/15). At this stage the measures being considered are illustrative only.	Micro N/A	< 20 N/A	Small N/A	Medium N/A	Large N/A
What is the CO ₂ equivalent change in greenhouse gas emissions? (Million tonnes CO ₂ equivalent)			Traded: N/A		Non-traded: N/A

I have read the Impact Assessment and I am satisfied that, given the available evidence, it represents a reasonable view of the likely costs, benefits and impact of the leading options.

Signed by the responsible SELECT SIGNATORY: _____ Date: _____

Summary: Analysis & Evidence Preferred Option

Description:

FULL ECONOMIC ASSESSMENT

Price Base Year 2010	PV Base Year 2010	Time Period Years 10	Net Benefit (Present Value (PV))		
			Low: £178m	High: £336m	Best Estimate: £207m
COSTS (£m)		Total Transition (Constant Price) Years	Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)	
Low		Optional	Optional	£91m	
High		Optional	Optional	£535m	
Best Estimate				£288m	

Description and scale of key monetised costs by 'main affected groups'

Business: Monetised costs to business have been assessed by looking at the costs of *illustrative* management measures. These are estimated as follows:

- <£3.5m-£17.3m over 10 years to the fishing industry from measures to reduce the impacts of fishing on biodiversity (Descriptors 1, 4 and 6)
- £50m-£252m over 10 years to the fishing industry from measures to achieve Maximum Sustainable Yield in commercial fisheries (Descriptor 3)¹. Apportionment scenarios of 50%, 25% and 10% have been applied.
- £0-£194m over 10 years (partial estimate) to the shipping industry from measures to reduce the risk of introduction of non-indigenous species (Descriptor 2).

The total quantified costs to industry have been estimated to be £54m-£464m over 10 years.

A significant proportion of the monetised costs would fall on the fishing industry. The GES targets proposed in this impact assessment are entirely consistent with the UK's approach to reform of the Common Fisheries Policy (CFP). Achieving the proposed targets for Descriptors 1 (biodiversity), 4 (food webs), 6 (seafloor integrity), and 3 (commercial fish and shellfish) will be dependent on successful implementation of fisheries management measures agreed under the reformed CFP (e.g. use of less destructive fishing gears, limits on landings). However, as the MSFD is a key driver in ensuring that CFP achieves its environmental goals a *proportion* of the costs (and benefits) of these management measures should be attributed to the MSFD. A number of assumptions have been made in assessing what proportion of costs to attribute to MSFD and these are outlined in the key assumptions/sensitivities/risks section below.

The other industry for which potentially significant costs have been monetised is shipping, in relation to illustrative measures to reduce the introduction and spread of non-indigenous species. These costs are only included in the high estimate of the summary table above as it is currently unclear whether any additional management measures would actually need to be taken. A desk study is being undertaken between now and the final impact assessment to allow a more comprehensive assessment of potential costs.

Government: Monetised costs to Government are estimated as follows:

- £24m-£46m over 10 years for additional monitoring for Descriptors 1, 2, 3, 4, 5, 6, 7, 9, 10 and 11².
- £3.5m-8.9m over 10 years for implementing potential management measures to eradicate non-indigenous mammals on key islands for seabirds.
- <£9.2m-£15.7m over 10 years for measures to reduce litter.
- £550K-£893K for reviewing licensing guidance, enforcement in relation to fisheries management measures and setting up a noise registry.

The total quantified costs to Government of implementing the proposed GES targets range from £38m-75m over 10 years.

The quantified costs are summarised in more detail in Table 1 in the Evidence Base (Executive Summary).

¹ Due to overlaps between MSFD and CFP apportionment scenarios of 50%, 25% and 10% costs to MSFD have been applied to come up with these figures. These are explained in more detail in the Key Assumptions/Sensitivities/Risks section. Also, these costs are largely comprised of revenue foregone, due to data availability. A more accurate presentation of these costs would be in terms of GVA or profits affected (further discussions will be required to decide which of the two approaches will be appropriate). Adopting such an approach would imply that the economic costs to the fishing industry associated with these indicative measures are likely to be lower than presented here. This will be revisited if possible in the final Impact Assessment.

² Due to overlaps between the requirements of the MSFD and Birds and Habitats Directives apportionment scenarios of 10-30% costs to MSFD have been applied to come up with this figures.

Other key non-monetised costs by 'main affected groups'

It has not been possible to monetise the costs of all the potential management measures which may be needed to achieve the proposed GES target and these costs are described qualitatively in the IA. The main affected group is likely to be the fishing industry, through potential measures to reduce the impact of fishing practices on particular marine species (e.g. seabirds) and seafloor habitats – this is consistent with the UK's approach to CFP reform.

The cost of the following measures have not been quantified in the IA:

- *Additional illustrative management measures for fisheries (for vulnerable fish, seabed integrity and shellfish).* These include measures to protect threatened or vulnerable fish species (as we are unclear of the specific location of the species and hence the extent to which additional measures would need to be applied), measures to modify fishing gear to make it less damaging to the seabed (loss of Gross Value Added to fishermen is likely to be low but one off changes to fishing gear can be significant if changes are to be made in short time scales) and measures to protect key shellfish life stages (though costs to fishermen are likely to be low as this would only apply to lobsters in specific areas).
- *Illustrative management measures to prevent invasion of non-indigenous mammals on islands with seabird colonies.* These are likely to imply additional costs to vessels visiting the islands (in terms of setting traps and quarantine measures for packages), and potentially decrease revenue for tour operators running visits to those islands if the measures result in inconvenience for tourists (e.g. due to quarantine of packages).
- *Illustrative management measures for mandatory codes of practice for aquaculture to limit introduction of non-indigenous species.* The costs of such measures could be high if new equipment is needed to limit the spread.
- *Litter measures* are likely to impose costs on businesses but the costs are likely to be low as most of the illustrative measures could be implemented on a voluntary basis. Also, it would be important to note that the non-monetised costs are likely to be relatively higher for the preferred option compared to the non-preferred option. This is because the GES targets proposed for Descriptor 10 (marine litter) under the preferred option would require a more significant action to reduce litter than the targets under the non-preferred option.

There are also potential additional costs to Government and Regulators from enforcement of the illustrative management measures. More information will be collected during the consultation process to enable Defra to cost these illustrative measures in more detail.

BENEFITS (£m)	Total Transition		Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
	(Constant Price)	Years		
Low	Optional		Optional	£269m
High	Optional		Optional	£871m
Best Estimate				£495m

Description and scale of key monetised benefits by 'main affected groups'

It has only been possible to monetise a small proportion of the likely benefits of achieving the proposed GES targets, mainly those benefits related to the fishing industry. These include the following:

- £151m-£753m over 10 years to fishermen from increased revenue if fish stocks reach Maximum Sustainable Yield (MSY) level³.
- £118m over 10 years to the fishing industry from reducing litter levels in marine waters (through reduced damage to vessels). The targets for litter proposed under this option would require more significant action to reduce litter levels than the targets under the non-preferred option and therefore the associated benefits are *higher* under this option than under the non-preferred option.

³ Due to overlaps between MSFD and CFP apportionment scenarios of 50%, 25% and 10% benefits to MSFD have been applied to come up with these figures. These are explained in more detail in the Key Assumptions/Sensitivities/Risks section. These benefits are presented comprised of revenues from fishing at MSY. A more accurate presentation of these benefits would be in terms of GVA or profits affected (further discussions will be required to decide which of the two approaches will be appropriate). Adopting such an approach would imply that the economic benefits to the fishing industry associated with these indicative measures are likely to be lower than presented here. Benefits are presented in terms of revenues to ensure comparability with the current presentation of estimates of the costs of indicative measures for Descriptor 3. This will be revisited if possible in the final Impact Assessment

Other key non-monetised benefits by 'main affected groups'

Where it has not been possible to monetise the benefits of achieving the GES targets these are described qualitatively in the impact assessment. The GES targets are likely to lead to cleaner beaches, less litter in the sea, greater mitigation of climate change impacts on bird populations and more varieties of fish stocks (to benefit recreational activities such as sea angling and diving). This would consequently improve cultural and recreational services leading to an increase in the welfare of those individuals that consume these services.

The GES targets will also prevent further deterioration of seafloor habitats that provide key provisioning (e.g. fertilizers, medicine), recreational services (e.g. to divers) and regulating services such as bio-remediation of pollution events (e.g. oil spills, fish farms), carbon sequestration and purification of water through microbial breakdown of pollutants / toxins.

More work will be carried out between now and the final impact assessment to improve the assessment of these un-quantified benefits.

Key assumptions/sensitivities/risks

Discount rate (%)

3.5

Due to the wide breadth of the proposals included in this impact assessment, the significant overlap with other policy areas, and the uncertainty about which management measures might be needed to achieve the proposed targets, it has been necessary to make a significant number of assumptions. These are clearly set out in the Evidence Base, but can be summarised as follows:

- Within baseline scenario it is assumed that existing government policies and commitments related to the marine environment are fully implemented and achieve their desired goals. Particularly significant are commitments to reform of the Common Fisheries Policy, the implementation of the Water Framework Directive, the Habitats and Birds Directives and the Environmental Impact Assessment Directive.
- There are significant overlaps between the MSFD and the Common Fisheries Policy (see above). As the MSFD is a key driver in ensuring CFP achieves its environmental goals it has been assumed that a *proportion* of the costs and benefits of any fisheries management measures needed to achieve the proposed GES targets should be attributed to the MSFD. The following detailed assumptions have been made:
 - For Descriptors 1 (biodiversity), 4 (food webs) and 6 (seafloor integrity) it has been assumed that 100% of the costs of the associated illustrative management measures should be attributed to MSFD because these measures are primarily to protect the wider marine environment rather than to achieve higher levels of commercial fish stocks.
 - For Descriptor 3 (commercial fish), given the overlap between the objectives of the CFP and MSFD it has been particularly challenging to determine how much of the costs of achieving the targets should be attributed to MSFD alone. To tackle the difficulty in apportioning these costs between MSFD and CFP three different scenarios have been considered - 50% of costs attributed to MSFD (£252 over 10 years - high estimate) 25% of costs attributed to MSFD (£126 over 10 years - best estimate) and 10% of costs attributed to MSFD (£50m over 10 years - low estimate).
 - The modelling underpinning yields consistent with MSY assumes that, for each stock considered, recruitment relationships and environmental conditions in future years are consistent with those in previous years. It also assumes that the stocks considered can achieve MSY simultaneously.
 - The same apportionment scenarios (50%, 25% and 10%) have been applied to the estimated monetised benefits of improvements in commercial fish stocks – giving benefit estimates of £753m over 10 years (high estimate), £376m over 10 years (best estimate) and £151m over 10 years (low estimate). For all three scenarios the benefits outweigh the costs by a margin. These scenarios have been included in the summary table above and further explanation is provided in Section D of the evidence base.
- When assessing the benefits from improvement in fish stocks, it has been assumed that the landing price remains the same even when the stock improves. A sensitivity analysis has been carried out on this assumption by looking at the impacts on benefits with a 50% and 20% drop in landing prices. Results from the analysis show that even if there is a significant drop in landing prices following a rise in fish stocks, the value of benefits from improvement in fish stock levels are still significant.
- We assume the benefits from increase in fish stocks accrue within the appraisal period of 10 years. However in reality the benefits of MSY may accrue over a longer time period, and based on feedback from the consultation we will look to model this more accurately. Also, for the initial period the increase in benefits to fishermen will be more in terms of reduction in effort (under the same quota) and then at a later stage benefits will accrue in terms of increase catch levels (from readjustment of the quota based on higher healthy stocks).
- In relation to the monitoring costs associated with the proposed GES targets, there is significant overlap between MSFD and the requirements of the Birds and Habitats Directives. For this reason apportionment scenarios of 10%-30% have been considered.

BUSINESS ASSESSMENT (Option 1)

Direct impact on business (Equivalent Annual) £m:			In scope of OIOO?	Measure qualifies as
Costs: £6.5m-£56m	Benefits: £32m-£105m	Net: £26m-49m	NO	N/A

Summary: Analysis & Evidence Non-preferred Option

Description:

FULL ECONOMIC ASSESSMENT

Price Base Year 2010	PV Base Year 2010	Time Period Years 10	Net Benefit (Present Value (PV))		
			Low: <£88m	High:< £246m	Best Estimate: <£117m

COSTS (£m)	Total Transition (Constant Price) Years	Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low	Optional	Optional	>£91m
High	Optional	Optional	>£535m
Best Estimate			>£288m

Description and scale of key monetised costs by 'main affected groups'

All the monetised costs from the preferred option are applicable for this option and these are likely to be higher because in general the illustrative management measures needed to achieve the GES targets proposed under this option would need to be applied more quickly or more extensively. It has not been possible to quantify the additional costs for this option compared to the preferred option. More information will be collected during the consultation process to inform the assessment of costs for this option.

Other key non-monetised costs by 'main affected groups'

It has not been possible to monetise the costs of all the potential management measures which may be needed to achieve the proposed GES target and these costs are described qualitatively in the IA. The non-monetised costs are the same as described under the preferred option but for Descriptors 1 (biodiversity), 4 (food webs), 6 (sea-floor integrity) these non-monetised costs are likely to be higher under this option because the illustrative measures needed to achieve the proposed GES targets would need to be applied more quickly or more extensively. This would imply higher costs under this option in particular for the fishing industry. There are also likely to be higher non-monetised costs under this option associated with the proposed GES targets for Descriptor 11 (noise). These would fall on the offshore renewable, oil and gas and shipping sectors. For example, there are likely to be additional costs to industry from use of ship quietening technologies (although the net costs may be low as there could be fuel savings from such measures).

For marine litter (Descriptor 10) these non-monetised costs are likely to be *lower* under this option because the proposed GES targets would require less significant action to reduce litter levels than the targets proposed under the preferred option, therefore implying less significant costs.

- More work will be carried out between now and the final impact assessment to inform the assessment of these costs.

BENEFITS (£m)	Total Transition (Constant Price) Years	Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low	Optional	Optional	£179m m
High	Optional	Optional	£782m

Best Estimate				£405m m
<p>Description and scale of key monetised benefits by ‘main affected groups’</p> <p>Under this option it has only been possible to monetise a small proportion of the likely benefits of achieving the proposed GES targets, mainly those benefits related to the fishing industry. These include the following:</p> <ul style="list-style-type: none"> o £151m m-£753m over 10 years to fishermen from increased revenue if fish stocks reach Maximum Sustainable Yield (MSY) level¹. o £29m over 10 years to the fishing industry from reducing litter levels in marine waters (through reduced damage to vessels). The targets for litter proposed under this option would require less significant action to reduce litter levels than the targets under the preferred option and therefore the associated benefits are <i>lower</i> under this option than under the preferred option. <p>The total <i>monetised benefits</i> are lower under this option compared to the preferred option. This is because it has only been able to monetise the benefits in relation to litter (where the benefits are higher under the targets proposed for the preferred option) and fish (where the GES targets, and therefore the associated benefits, are the same under both options). However, if the non-monetised benefits are taken into account it is considered highly likely that the <i>overall benefits</i> of this option will be higher than the preferred option.</p>				

¹ Due to overlaps between MSFD and CFP apportionment scenarios of 50%, 25% and 10% benefits to MSFD have been applied to come up with these figures. These are explained in more detail in the Key Assumptions/Sensitivities/Risks section. These benefits are presented on the basis of revenues from fishing at levels consistent with Maximum Sustainable Yield. A more accurate presentation of these benefits would be in terms of GVA or profits affected (further discussions will be required to decide which of the two approaches will be appropriate). Adopting such an approach would imply that the economic benefits to the fishing industry associated with these indicative measures are likely to be lower than presented here. Benefits are presented in terms of revenues to ensure comparability with the current presentation of estimates of the costs of indicative measures for Descriptor 3. This will be revisited if possible in the final Impact Assessment

Other key non-monetised benefits by ‘main affected groups’

Where it has not been possible to monetise the benefits of achieving the GES targets, these are described qualitatively in the impact assessment. The GES targets are likely to lead to cleaner beaches, less litter in the sea, greater mitigation of climate change impacts on bird populations and more varieties of fish stocks (to benefit recreational activities such as sea angling and diving). This would consequently improve cultural and recreational services leading to an increase in the welfare of those individuals that consume these services.

The GES targets will also prevent further deterioration of seafloor habitats that provide key regulating services such as bio-remediation of pollution events (e.g. oil spills, fish farms), carbon sequestration and purification of water through microbial breakdown of pollutants / toxins. Section E of the evidence base provides a more detailed description of these benefits and an explanation of the relevant ecosystem services.

Compared to the preferred option, the benefits associated with reducing litter levels will be lower because the GES targets for litter under this option would not require such significant action to reduce litter and would therefore lead to a smaller decrease in litter levels (and consequently few benefits). Compared to the preferred option, the benefits associated with preventing deterioration of seafloor habitats and improving bird abundance would be higher because the GES targets under this option would require more extensive management action (implying higher benefits). The recreational benefits from improvement of fish stocks are the same for the preferred and non preferred option as the GES targets are the same under both options.

Key assumptions/sensitivities/risks

Discount rate (%)

3.5

Due to the wide breadth of the proposals included in this impact assessment, the significant overlap with other policy areas, and the uncertainty about which management measures might be needed to achieve the proposed targets, it has been necessary to make a significant number of assumptions. These are clearly set out in the Evidence Base, but can be summarised as follows:

- Within baseline scenario it is assumed that existing government policies and commitments related to the marine environment are fully implemented and achieve their desired goals. Particularly significant are commitments to reform of the Common Fisheries Policy, the implementation of the Water Framework Directive, the Habitats and Birds Directives and the Environmental Impact Assessment Directive.
- There are significant overlaps between the MSFD and the Common Fisheries Policy (see above). As the MSFD is a key driver in ensuring CFP achieves its environmental goals it has been assumed that a *proportion* of the costs and benefits of any fisheries management measures needed to achieve the proposed GES targets should be attributed to the MSFD. The following detailed assumptions have been made:
 - For Descriptors 1 (biodiversity), 4 (food webs) and 6 (seafloor integrity) it has been assumed that 100% of the costs of the associated illustrative management measures should be attributed to MSFD because these measures are primarily to protect the wider marine environment rather than to achieve higher levels of commercial fish stocks.
 - For Descriptor 3 (commercial fish), given the overlap between the objectives of the CFP and MSFD it has been particularly challenging to determine how much of the costs of achieving the targets should be attributed to MSFD alone. To tackle the difficulty in apportioning these costs between MSFD and CFP three different scenarios have been considered - 50% of costs attributed to MSFD (£252 over 10 years - high estimate) 25% of costs attributed to MSFD (£126 over 10 years - best estimate) and 10% of costs attributed to MSFD (£50m over 10 years - low estimate)².
 - The modelling underpinning yields consistent with Maximum Sustainable Yield assumes that, for each stock considered, recruitment relationships and environmental conditions in future years are consistent with those in previous years. It also assumes that the stocks considered can achieve MSY simultaneously.
 - The same apportionment scenarios (50%, 25% and 10%) have been applied to the estimated monetised benefits of improvements in commercial fish stocks – giving benefit estimates of £753m over 10 years (high estimate), £376m over 10 years (best estimate) and £151m over 10 years (low estimate)³. For all three scenarios the benefits outweigh the costs by a margin. These scenarios have been included in the summary table above and further explanation is provided in Section D of the evidence base.
- When assessing the benefits from improvement in fish stocks, it has been assumed that the landing price remains the same even when the stock improves. A sensitivity analysis has been carried out on this assumption by looking at the impacts on benefits with a 50% and 20% drop in landing prices. Results from the analysis show that even if there is a significant drop in landing prices following a rise in fish stocks, the value of benefits from improvement in fish stock levels are still significant.
- In relation to the monitoring costs associated with the proposed GES targets, there is significant overlap between MSFD and the requirements of the Birds and Habitats Directives. For this reason apportionment scenarios of 10%-30% have been considered.

BUSINESS ASSESSMENT (Option 2)

Direct impact on business (Equivalent Annual) £m:			In scope of OIOO?	Measure qualifies as
Costs: >£6.5m-£56m	Benefits: £21m-£94m	Net: £15m-£38m	NO	N/A

² Also, these costs are largely comprised of revenues foregone, due to data availability. A more accurate presentation of these costs would be in terms of GVA or profits affected (further discussions will be required to decide which of the two approaches will be appropriate). Adopting such an approach would imply that the economic costs to the fishing industry associated with these indicative measures are likely to be lower than presented here. This will be revisited if possible in the final Impact Assessment.

³ These benefits are presented comprised of revenues from fishing at MSY. A more accurate presentation of these benefits would be in terms of GVA or profits affected (further discussions will be required to decide which of the two approaches will be appropriate). Adopting such an approach would imply that the economic benefits to the fishing industry associated with these indicative measures are likely to be lower than presented here. Benefits are presented in terms of revenues to ensure comparability with the current presentation of estimates of the costs of indicative measures for Descriptor 3. This will be revisited if possible in the final Impact Assessment

Evidence Base Executive Summary

Section A – Introduction

1. This section sets out the marine policy context and briefly describes the requirements of the Marine Strategy Framework Directive (MSFD), explaining that this impact assessment looks at the potential costs and benefits of proposals for UK targets and indicators for Good Environmental Status (GES). It summarises the approach to assessing costs and benefits taken in this impact assessment.

Section B – Policy rationale and objectives

2. This section sets out the rationale for intervention and also describes the policy objectives of the MSFD in more detail.

Section C – Methodology

3. This section sets out the evidence base for the impact assessment and explains the approach to developing policy options for the GES targets. For each of the GES Descriptors either one or two options for targets have been proposed in addition to the baseline scenario which describes what would happen if the MSFD was not implemented. Two options have been put forward where there is scientific uncertainty on how to define sustainable use of the marine environment. These options represent either a reasonable level of confidence that GES will be achieved (Option 1), or a higher level of confidence that GES will be achieved (Option 2).
4. This section also describes the methodology that has been used for assessing the costs and benefits of the GES targets. The potential costs of the targets have been assessed by considering the costs of implementing a range of illustrative management measures which experts and policy makers believe represent a reasonable indication of the types of action which may be necessary to achieve the GES targets. These measures represent a current best assessment of the type of action which could be needed to achieve the targets, but should not be seen as the measures the UK Government and Devolved Administrations definitely intend to take to achieve GES.
5. The overall benefits of achieving the GES targets have been considered. A comparison of the gap between the expected state of the marine environment in 2020 without MSFD (i.e. the Baseline scenario) and the expected state of the marine environment in 2020 when the GES targets are achieved has been used to provide an estimate of how degraded the marine environment is likely to be in 2020 without the MSFD. An ecosystem services approach has then been used to show how that degradation of the marine environment corresponds to a reduction in human welfare.
6. Wherever possible costs and benefits have been monetised, however, this has not been possible in all cases given the current evidence base and a significant amount of qualitative assessment is included. More work is planned between now and the final impact assessment to support the quantification of costs and benefits.
7. Finally this section describes the development of the baseline scenario and the key assumptions behind it. In general the baseline scenario assumes that existing policy commitments will meet their desired goals. However, in the case of the Common Fisheries Policy (CFP) some more complex assumptions have had to be made due to the fact that the

reform of the CFP and the implementation of the MSFD are very closely connected. These assumptions are set out in more detail below.

Section D – Information on target options and costs

8. The section sets out the proposals for GES targets and indicators for each of the GES Descriptors. The summary text for each Descriptor briefly outlines the thinking behind the target proposals and describes the potential additional management measures and monitoring requirements associated with each of the target proposals. The costs of the illustrative measures and monitoring are summarised in tables at the end of each sub-section. A summary of the conclusions for each Descriptor is set out below.

Descriptors 1 (biodiversity), 4 (food webs) and 6 (seafloor integrity)

9. GES target proposals for these three Descriptors are set out together because of the significant overlap between them. Given the wide range of issues covered by these Descriptors this section is one of the most technically complex of the impact assessment. Targets are proposed for three species groups (marine mammals, birds and fish) and three habitat groups (pelagic habitats, sediment habitats and, rock and biogenic reef habitats).
10. We have high confidence that other countries which are part of the OSPAR Regional Sea Convention⁷ will follow the same broad approach to biodiversity targets being proposed in this impact assessment, but at the time of producing this impact assessment there was relatively little information available about other Member States' proposals. The proposals outlined in this impact assessment may therefore need to be reviewed in the light of further information about approaches being put forward by other OSPAR countries⁸.

Target proposals for species

11. Two options for GES targets are put forward. Existing targets have been used wherever suitable (e.g. from the Habitats Directive, OSPAR) and the proposals have been based as far as possible around existing indicators and monitoring programmes. Targets proposed under Option 1, which is the preferred option, would give a reasonable level of confidence that GES will be achieved, whereas the targets proposed under Option 2 are more precautionary and would give a higher level of confidence that GES will be achieved.
12. Under the baseline scenario there are numerous measures already in place, or planned which are expected to play a significant role in supporting the achievement of the targets proposed under both Options 1 and 2. However, it is not clear at this stage whether these measures alone will be sufficient to achieve the proposed targets and for the purposes of this assessment it has been assumed that some additional management measures may be needed, particularly in relation to reducing the impacts of fisheries and the impacts of non-indigenous mammals on seabirds.
13. A range of illustrative management measures have been considered in the assessment, the costs of which would fall primarily on the fishing industry, but also on small businesses operating vessels to small islands with key seabird colonies, and on Government. Under Option 1, a partial estimate of the total costs to the fishing industry in terms of loss of landings

⁷ The OSPAR Convention is the current legal instrument guiding international cooperation on the protection of the marine environment of the North-East Atlantic. Work under the Convention is managed by the OSPAR Commission, made up of representatives of the Governments of 15 Contracting Parties and the European Commission, representing the European Union.

⁸ It is a requirement of the Directive that Member States must take a coordinated approach to implementation. Member States must ensure their GES targets are coordinated with other Member States in their marine region (for the UK this means other Member States in the North East Atlantic region which is covered by the OSPAR Regional Sea Convention).

is between <£150K–6m over 10 years, with costs to Government of measures to eradicate marine mammals on key island seabird colonies estimated at £3.5-8.9m. Under Option 2 these costs are likely to be higher as the illustrative management measures would need to be applied more extensively.

14. Under both Options 1 and 2 there will also be additional monitoring costs to Government. A broad initial estimate of these costs is between <£4.3m and £7.2m over 10 years. However a significant proportion of these costs are likely to be incurred anyway under the Birds Directive, so are not entirely additional under MSFD. To provide a rough scale of costs scenarios of attributing 10% and 30% of the costs to MSFD have been considered. This implies that additional monitoring costs attributable to MSFD are between <£424k-£2.2m over 10 years.

Target proposals for habitats

15. Two options for GES targets are put forward. For benthic habitats (rock and biogenic reef and sediment habitats) existing targets under the Habitats Directive and Water Framework Directive have been used wherever possible, but new targets have been developed and proposed in relation to predominant sediment habitats, which are not covered by the Habitats Directive. For pelagic habitats, there are no suitable targets in existing legislation and all the proposals for targets are new. Targets proposed under Option 1, which is the preferred option, would give a reasonable level of confidence that GES will be achieved, whereas the targets proposed under Option 2 are more precautionary and would give a higher level of confidence that GES will be achieved.
16. Under the baseline scenario seafloor habitats are expected to remain stable or improve slightly between now and 2020. There are numerous measures already in place, or planned which are expected to play a significant role in supporting the achievement of the targets proposed under both Options 1 and 2. For rock and biogenic reef habitats it has been assumed that measures taken under the Habitats Directive will be sufficient to achieve the proposed targets and for pelagic habitats it has been assumed that the proposed targets will be achieved through measures taken to achieve the proposed targets for Descriptor 3 (commercial fish) and Descriptor 5 (eutrophication). However, for sediment habitats it has been assumed that additional management measures may be needed to achieve the proposed targets under Options 1 and 2, particularly in relation to fisheries.
17. A range of illustrative management measures for sediment habitats have been considered in the assessment, the costs of which would fall primarily on the fishing industry. Under Option 1, an estimate of the costs to the fishing industry is between £3.3m and £11m over 10 years⁹. Under Option 2 these costs are likely to be higher as the illustrative management measures would need to be applied more extensively.
18. Under both Options 1 and 2 there will also be additional monitoring costs to Government. A broad initial estimate of these costs is between £20.7m and £39.2m over 10 years.

Descriptor 2 (non-indigenous species)

19. One option for GES targets is proposed. The targets are new as there are no specific targets for non-indigenous species in existing legislation. They require management measures to reduce the risk from key pathways and vectors of introduction and spread of Non-Indigenous Species (NIS), and the development and implementation of management plans for dealing with key high risk species should they arrive in UK waters. It is currently unclear what approach other Member States are likely to take to these targets and the proposals put forward in this

⁹ To give an idea of scale, UK vessels landed 581 thousand tonnes of sea fish (including shellfish) in 2009, with a value of £674 million.

impact assessment may need to be reviewed if it becomes clear that other Member States are taking a significantly different approach.

20. Under the baseline scenario it is assumed that in 2020 there will still be significant issues presented by invasive non-indigenous species and it is likely that additional management measures will be needed to achieve the GES proposed targets for this Descriptor.
21. A desk based study to assess the key pathways and vectors of introduction of NIS will be carried out between now and the final impact assessment to identify those areas where additional management measures may be necessary. However, for the purposes of this assessment, a range of illustrative management measures have been considered, the costs of which would fall primarily on the shipping industry, ports and marinas, and small vessel owners. The total cost if all the illustrative management measures are implemented is estimated at £1.15bn-£3.31bn over 10 years, or £194m over 10 years if the potentially disproportionately costly measures are excluded from the assessment. However, the need for additional management measures is not yet clear and further work to inform this cost assessment will be carried out based on the results of the proposed desk based risk assessment and further discussion with the relevant industries.
22. There will also be additional monitoring and enforcement costs to Government. A broad initial estimate is that this will be less than £952k over 10 years.

Descriptor 3 (commercial fish and shellfish)

23. One option for GES targets is proposed. The targets are based on the approach taken to stock assessment in the CFP and would require the achievement of stocks within the safe biological limit precautionary thresholds, whilst aiming, in the medium-long term, for the more ambitious stock specific targets for fishing at levels consistent with the Maximum Sustainable Yield. There is currently little detailed information about the approach other Member States are likely to take to setting targets for this Descriptor. However, the International Council for the Exploration of the Sea (ICES) is in the process of developing advice on methodologies for GES targets for commercial fish and the approach proposed in this impact assessment has been put forward by UK scientists in ICES.
24. For the purposes of the baseline scenario it is particularly difficult to distinguish how far the achievement of the proposed targets is additional due to MSFD and how much would be achieved anyway as a result of pressure to improve the environmental outcomes of the CFP. The UK would be pursuing environmental integration as one of its goals for CFP reform irrespective of the MSFD. However, it is unlikely that the wider EU approach to CFP reform would deliver the outcomes the UK is seeking without the added pressure for environmental outcomes provided by MSFD. For this reason for the purposes of this assessment it has been assumed that some of the costs and benefits of achieving the proposed targets are attributable to MSFD. Three different scenarios of apportionment have been considered based on attributing 50%, 25% and 10% of the costs to MSFD. Based on these scenarios, a partial estimate of the additional costs to the fishing industry of achieving the targets proposed under this Descriptor is £252m (high estimate), £126m (best estimate) and £50m (low estimate) over 10 years¹⁰.

¹⁰ Also, these costs are largely comprised of revenues foregone, due to data availability. A more accurate presentation of these costs would be in terms of GVA or profits affected (further discussions will be required to decide which of the two approaches will be appropriate). Adopting such an approach would imply that the economic costs to the fishing industry associated with these indicative measures are likely to be lower than presented here. This will be revisited if possible in the final Impact Assessment.

25. No additional monitoring costs to Government are anticipated in relation to the proposed targets, but there may be additional enforcement costs of between £86k and £431k over 10 years.

Descriptor 5 (eutrophication)

26. One option for GES targets is proposed. The targets are based on existing requirements which the UK is committed to within OSPAR and the Water Framework Directive. They would require nutrient concentrations, and the direct and indirect effects of nutrient enrichment to be at levels which do not lead to an undesirable disturbance to the balance of organisms present in the water or to the quality of the water. There is a high-level of regional coordination on the approach to assessment of eutrophication and it is likely that other countries in OSPAR will follow a similar approach to the one proposed here.

27. Under the baseline scenario it is assumed that measures taken under existing legislation (e.g. the Water Framework Directive and the Urban Waste Water Treatment Directive) will ensure the GES targets proposed for this Descriptor are achieved by 2020. Therefore, it is concluded that there are unlikely to be any additional costs to business associated with these target proposals.

28. An initial assessment of additional monitoring implications suggests that there could be additional costs to Government and regulators of £86k-£861k over 10 years for eutrophication related plankton monitoring.

Descriptor 7 (hydrographical conditions)

29. One option for GES targets is proposed. The target would require developers and regulators to continue to comply with existing legislative requirements through the current marine licensing regime.

30. Under the baseline scenario it is assumed that the existing marine licensing and consents process, in conjunction with the requirements of existing legislation, is likely to be sufficient to ensure that GES for this Descriptor will be achieved.

31. As the proposed target for this option is based on the application of the existing regulatory regime there will be no need for additional management measures and no additional costs to business, assuming there is currently compliance with all the relevant legislation.

32. There will be small additional costs to regulators associated with reviewing the existing licensing regime and updating guidance to developers if necessary (around £20k one off cost for England). There could also be additional monitoring costs to Government and regulators in order to provide a more comprehensive understanding of prevailing environmental conditions and through the development of management and assessment tools to improve our confidence in our GES assessment.

Descriptor 8 (contaminants)

33. One option for GES targets is proposed. The targets are based on existing requirements that the UK is committed to under OSPAR and the Water Framework Directive. They would require concentrations and effects of contaminants in the marine environment to be kept within levels agreed in existing legislation and international commitments. There is a high-level of regional coordination on the approach to assessment for contaminants and it is likely that other countries in OSPAR will follow a similar approach to the one proposed here.

34. Under the baseline scenario it is assumed that measures taken under existing legislation will ensure that the GES targets proposed for this Descriptor are broadly achieved by 2020. The only exception to this is in relation to the presence in a few areas of persistent legacy

contaminants in sediments. Measures to remove these contaminated sediments would not be practical and the costs would almost certainly be disproportionate taking into account the risks to the marine environment. The UK does not propose to take these type of measures. Therefore, it is concluded that there are unlikely to be any additional costs to business associated with these target proposals.

35. Existing monitoring programmes under the Water Framework Directive and OSPAR will be used to meet monitoring requirements associated with these target proposals. No additional monitoring costs to Government are anticipated at the current time.

Descriptor 9 (contaminants in seafood)

36. One option for GES targets is proposed. The target is based on existing thresholds for contaminants set out in existing EU legislation or other internationally and nationally agreed standards. Since the target proposed reflect existing agreed standards, it is likely that other Member States will take a similar approach to setting GES targets to the one proposed here.

37. Under the baseline scenario it is assumed that measures taken under existing legislation will continue to manage this pressure and will be sufficient to achieve the GES targets proposed for this Descriptor. Therefore, it is concluded that there are unlikely to be any additional costs to business associated with these target proposals.

38. An initial assessment of additional monitoring implications suggests that there could be additional costs to Government and regulators of £344k-689k over 10 years for additional monitoring in commercial fishing grounds to extend the scope of current Food Standards Agency monitoring schemes¹¹.

Descriptor 10 (marine litter)

39. Two options for GES targets have been put forward. All the proposed targets are new because there are no targets for marine litter in existing legislation, however, they are based on a Ministerial commitment made in the OSPAR 2010 Bergen statement to reduce litter levels by 2020.

40. Under the baseline scenario it is assumed that litter will continue to be a problem, accumulating in coastal areas and in the water column. The GES targets proposed for this Descriptor are unlikely to be achieved through existing legislation and policy commitments.

Target Option 1 – reasonable level of confidence of achieving GES

41. Under this option the proposed target is focussed on litter on coastlines and would require a slowing of the current rate of increase in litter items reaching UK beaches. Targets would not be established for other aspects of marine litter (e.g. litter on the seafloor, micro-particles, or the impacts of litter on marine life) given current uncertainties. Instead they would be monitored as surveillance indicators until that time where sufficient evidence could support the establishment of a target.

42. It is likely that additional management measures will be needed to achieve the GES target proposed under this option. Measures to reduce terrestrial litter (a major source of marine litter) are already being taken under the baseline, but these may need to be tailored to specifically address litter in the marine and coastal environment. Specific measures to reduce marine sources of litter may also be needed e.g. working with the fishing industry to reduce fishing litter. The costs of such measures would fall primarily on Government, with some

¹¹ Some additional monitoring in commercial fishing grounds in the relevant MSFD sub-regions (Greater North Sea and Celtic Seas) is likely to be necessary because current Food Standards Agency monitoring schemes are generally not able to identify the source of the samples being tested in their current monitoring programmes.

additional costs for the fishing industry, coastal businesses and voluntary organisations. Costs are difficult to assess, but a rough estimate of additional costs to Government is £9.2m-£15.7m over 10 years. Further information on costs will be collected during the consultation period.

43. There will also be some additional monitoring costs for Government and regulators associated with this option. An initial estimate suggests that these would amount to somewhere between £473k-£1.1m over 10 years for England and Wales. Further analysis will be carried out over the consultation process to assess costs for Scotland and Northern Ireland. This would bring total costs to Government to £9.7m-£16.8m over 10 years.

Target Option 2 – higher level of confidence of achieving GES

44. Under this option the proposed target for litter levels on coastlines would require an absolute reduction in litter items reaching UK beaches. Specific trend reduction targets would also be put forward for seafloor litter and the impacts of litter on marine life.

45. In order to meet these targets incrementally more of the measures described under Option 1 would be needed, and in some cases further new measures might be necessary. Therefore the costs to Government, industry and the voluntary sector would be higher under this option. The monitoring costs would be the same as under Option 1.

Preferred option

46. The preferred option is a mixture of Options 1 and Option 2. The more ambitious approach of an overall reduction in litter items on the beach (Option 2) is the preferred option on the basis that it is more consistent with existing Government commitments. For litter on the seafloor and the impacts of litter on marine life, the surveillance indicators set out in Option 1 are the preferred approach. This implies that the costs of achieving the proposed targets are higher under the preferred option compared to the non-preferred option.

Descriptor 11 (underwater noise)

47. Two options for GES targets have been put forward. These cover both impulsive sounds (e.g. those caused by seismic surveys and pile driving) and ambient sounds (e.g. those caused by shipping). All the proposed targets are new because there are no targets for underwater noise in existing legislation. There is still considerable uncertainty over the approach that other Member States will be taking to setting GES targets for noise. If it becomes clear that other Member States are adopting a significantly different approach it may be necessary to review these targets to ensure closer regional coordination.

48. Under the baseline scenario activities causing impulsive sounds will increase between now and 2020. However, our current understanding indicates that it is unlikely that there would be any significant adverse effects on marine animal populations, provided appropriate measures continue to be taken through the current licensing regime to manage the potential physical impacts near to individual noise generating activities. For ambient sounds, shipping activity is likely to increase between now and 2020, but existing measures to make ships more efficient should also make them less noisy. It is unclear how this would affect overall ambient sound levels, or what impact ambient noise has on marine animals at a population level.

Impulsive sounds

Target Option 1 – reasonable level of confidence of achieving GES (preferred option)

49. The proposed GES target under this option would require the establishment and maintenance of a 'noise registry' which would record in space and time activities generating noise in order that they can be analysed to determine whether they may potentially compromise the achievement of GES. This approach would reflect the conclusion that estimated future levels of activity do not currently appear to pose a significant threat to marine animal populations.

50. The costs to industry (e.g. renewable, oil and gas) of submitting information to such a registry are estimated to be low. Costs to Government and regulators of managing the registry are estimated to be in the region of £407k over 10 years.

Target Option 2 – Higher level of confidence of achieving GES

51. The proposed GES target under this option would establish a precautionary limit on the proportion of days over a year (averaged across the entire UK hydro-carbon licence block area) where impulsive sounds generated by human activity can exceed a particular threshold. The limit would be set at a level which is broadly in line with current levels of activity. This is based on the view that although current levels of activity are not considered to be affecting populations significantly, there may be sufficient uncertainty to warrant a precautionary approach to any increase on current noise levels.

52. This target would also involve creating a ‘noise registry’, but under this option there would need to be significantly more active management and planning of noise generating activities which could result in restrictions to when and where developments can take place. This would result in significant (and potentially disproportionate) costs for both regulators and industry; e.g. through delayed projects.

Ambient sounds

Target Option 1 – Reasonable level of confidence of achieving GES (preferred option)

53. Under this option a specific target for ambient sound levels would not be established and instead a surveillance indicator would be put forward with the UK determination of GES for noise being used as a generic, qualitative target. There would be no additional costs to industry under this option.

54. Additional monitoring would be necessary to improve our understanding of current ambient sound levels and allow the establishment of a more specific target at a later date. An initial estimate of additional monitoring costs to Government and regulators is in the region of £861k-£1.3m over 10 years.

Target Option 2 – Higher level of confidence of achieving GES

55. The proposed GES target under this option reflects a more precautionary approach, aiming to keep ambient noise at current levels. The intention would be to revise this target once a better understanding of what constitutes GES is reached.

56. The nature and extent of the measures necessary to achieve this target remain somewhat unclear. Measures which have recently been agreed through the IMO to improve the efficiency of new ships will help to reduce noise levels, but it is not clear whether these measures alone would be sufficient to achieve this target and additional international noise reduction measures for shipping may need to be taken through the IMO. This has the potential to become disproportionately costly compared to the risks to the marine environment. Monitoring costs are the same as option 1 (£861k-£1.34m over 10 years).

Section E – Benefits

57. This section describes the approach to assessing the benefits of the GES targets and then sets out the detailed benefits assessment.

58. Benefits have been assessed in relation to those aspects of the marine environment where it was identified that there would be degradation in the absence of MSFD. This included assessing the benefits attributable to the MSFD of increased abundance of fish stocks, reduction of litter, improvements in seafloor habitats, and a reduction in the impacts on seabird species. It has not been possible to monetise all the benefits and a significant element of the assessment is qualitative, particularly in relation to seabirds and seafloor habitats.
59. In relation to increased abundance of fish stocks the benefits¹² to the fishing industry of achieving the proposed GES targets are estimated at £1.5bn over 10 years. However, as described above, it is likely that some of these benefits would be achieved anyway through the reformed CFP under the baseline scenario. For this reason for the purposes of this assessment three different scenarios of apportionment have been considered based on attributing 50%, 25% and 10% of the benefits to MSFD. Based on these scenarios, an estimate of the additional benefits to the fishing industry of achieving the proposed GES targets is £753m (50%), £376m (25%) and £151m (10%). The estimates are calculated on the assumption that all these benefits accrue within the 10 year appraisal period. In reality benefits will accrue over a longer time period and based on feedback from the consultation we will look to model this more accurately. Also, for the initial period the increase in benefits to fishermen will be more in terms of reduction in effort (under the same quota) and then at a later stage benefits will accrue in terms of increase catch levels (from readjustment of the quota based on higher healthy stocks). Further assumptions are provided in Section E of the evidence base. These benefits are the same under both the preferred and non-preferred options as the GES targets for commercial fish are the same in both cases.
60. The benefits from complete removal of litter are estimated to be at least £1.8-£1.9bn over 10 years. However, not all of these benefits are attributable to MSFD, as the proposed targets for litter (under both option 1 and 2) require a reduction in litter levels rather than complete removal. However, these figures clearly indicate that there will be benefits to addressing the problem of increasing litter levels. We have used scenarios to estimate a part of these benefits – benefits from reduction in litter levels causing damage to fishing vessels. These are estimated at £29m over 10 years under Option 1 and £118m over 10 years under Option 2 (preferred option). The other non-monetised benefits are higher under Option 2 than Option 1 because the GES targets proposed under Option 2 would require more significant action to reduce litter than those proposed under Option 1, and therefore the associated benefits under Option 2 will be higher.
61. It has not been possible to monetise the benefits associated with achieving the GES targets for seafloor habitats or bird abundance and these have been described qualitatively in Section E. The benefits would be higher under target Option 2 than Option 1 because the targets proposed under Option 2 would require more significant management measures, and therefore the associated benefits under this option would be higher. Further work will be carried out between now and the final impact assessment to improve the analysis of benefits.

Section F - Conclusion

62. This section provides a brief conclusion.

¹² These benefits are presented comprised of revenues from fishing at MSY. A more accurate presentation of these benefits would be in terms of GVA or profits affected (further discussions will be required to decide which of the two approaches will be appropriate). Adopting such an approach would imply that the economic benefits to the fishing industry associated with these indicative measures are likely to be lower than presented here. Benefits are presented in terms of revenues to ensure comparability with the current presentation of estimates of the costs of indicative measures for Descriptor 3. This will be revisited if possible in the final Impact Assessment.

63. Given the lack of data it has only been possible to quantify part of the costs and benefits of achieving the proposed GES targets. On comparing these quantified costs and the benefits across the GES Descriptors, we arrive at a net present value of £178m-£336m (over 10 years) for the preferred option and net present value of £88m-£246m (over 10 years) for the non-preferred option. These estimates are driven by the assumptions made in the baseline and scenarios that have been used for apportioning the additional costs and benefits between MSFD and CFP.
64. To tackle the difficulty in apportioning the costs and benefits between MSFD and CFP three different scenarios have been considered - 50%, 25% and 10% of costs and benefits solely attributed to MSFD. In relation to the monitoring costs associated with the proposed GES targets, there is significant overlap between MSFD and the requirements of the Birds and Habitats Directives. For this reason apportionment scenarios of 10%-30% have been considered. The apportionment scenarios used in the analysis are purely for indicative purposes and will need to be refined as we become clearer about the outcome of existing policies in the baseline such as the CFP.
65. There are other costs and benefits that it has not been possible to quantify. It is likely that these qualitative benefits and costs will be higher under Option 2 (higher certainty of achieving GES) compared to Option 1 (probable certainty of achieving GES) because the targets proposed under Option 2 imply a more precautionary approach which would require the implementation of more extensive measures to achieve the targets. The consultation process will be used to gather more information on these non-quantified costs and benefits.

Summary of costs

	OPTION 1		OPTION 2
Target	PV costs over 10 years	Qualitative costs	PV costs over 10 years/ Qualitative costs
Descriptors 1, 4 and 6 – Species Marine Mammals, Fish and Birds	Potential costs to business: <£150k-£6m costs over 10 years to the fishing industry for measures to reduce seabird by-catch	Potential costs to business in terms of measures to prevent invasion of non-indigenous mammals on islands with key seabird colonies. Restrictive measures are likely to impact visitor numbers and consequently profits to business. Potential costs to regulators for enforcement of quarantine measures for vessels visiting islands with key seabird colonies. Potential additional costs to the fishing industry of adopting additional bespoke measures to protect particular threatened or vulnerable fish species – these will depend on their range and extent. Potential additional costs to government of enforcing these measures.	For marine mammals and fish the measures and costs are the same as under Option 1. For Birds the measures are the same as for Option 1, but may need to be applied more extensively and more quickly in order to improve the status of more species by 2020. There may also be a need for additional fisheries measures to reduce pressure on particular bird species or colonies (beyond those identified for Descriptor 3). This implies higher costs to the fishing industry under Option2. Costs to Government would be similar to Option 1, but monitoring costs are likely to be slightly higher under Option 2. Option 2 is our non preferred option.
	Potential costs to government: <£3.9m-£11m over 10 years for monitoring and measures to eradicate non-indigenous mammals from islands with key seabird colonies.		
	Total potential costs: <£4m-£17.4m over 10 years Option 1 is our preferred option		
Descriptors 1, 4 and 6 – Habitats Rock & biogenic reef, sediment and pelagic	Potential costs to business: £3.3m-£11m costs over 10 years to the fishing industry for measures to ban mobile demersal gears in a proportion of Marine Protected Areas.	Potential costs to the fishing industry in terms of measures to modify fishing gear to reduce damage to the seabed. Costs are likely to be less than banning gear and there could also be fuel savings to vessel owners, reducing the net costs.	For rock and biogenic reef habitats and pelagic habitats measures and costs are the same as Option 1 For sediment habitats measures are the same as under Option1, but these would probably need to be applied more extensively, implying higher costs to the fishing industry under Option 2. Monitoring costs are same as under option 1.
	Potential costs to government: £20.7m-£39.2m over 10 years for monitoring.		
	Total potential costs: <£24.1m-£50.2m over 10 years		

	Option 1 is our preferred option		Option 2 is our non preferred option.
<p>Descriptors 2 – Non-indigenous species</p>	<p>Potential costs to business: £189m over 10 years for additional management of hull cleansing for large vessels. £185m-£2.25bn over 10 years for additional management of ballast water in large vessels (likely to be disproportionately costly). £764m over 10 years for additional use of biosecure treatment facilities in marinas (likely to be disproportionately costly). £5.4m over 10 years for measure on mandatory guidance for small water exchange. Total costs to business are estimated to be around £194m over 10 years (excluding measures that are likely to be disproportionately costly). However this is a high end cost estimate as it is unclear whether any additional management measures will need to be taken until further work has been carried out to assess high risk pathways of introduction of non-indigenous species.</p>	<p>Potential costs to aquaculture industry and government in terms of measures to develop mandatory codes of practice for aquaculture for limiting the spread of Non Indigenous Species. Cost to industry from this kind of measure is likely to be high if new equipment was needed to limit the spread.</p> <p>Potential costs to business and regulators associated with the development and implementation of species specific plans for key high risk marine invasive species. The costs will vary depending on the management actions identified.</p> <p>Enforcement costs to regulators from adopting all the illustrative measures.</p>	<p>Not applicable as only one option is considered.</p>
	<p>Potential costs to government: £50K (one off) for desk based study to assess high risk pathways of introduction of non indigenous species. £41K (one off) for updating and drafting guidance/mandatory code of</p>		

	practice. £861K over 10 years for monitoring abundance and distribution of non-indigenous species		
	Total potential costs: £911K -£195m over 10 years. This excludes the costs of measures that are likely to be disproportionately costly.		
Descriptors 3 – Fish and shellfish	Potential costs to business: £50m (low estimate), £126m (best estimate) and £252m (high estimate) ¹³ estimated costs to the fishing industry for changes in fishing gear and landing sizes for shellfish in Marine Protected Areas and measures to limit landings of commercial fish. Costs of vessel decommissioning schemes were also considered and were estimated at £112m-£113m over 10 years. However, these costs have been excluded from the cost summary because decommissioning schemes are considered likely to be disproportionately costly and unlikely to be cost effective.	Potential costs to business from using less destructive fishing gear. Provided there is significant period of grace to allow for any change, there should be no replacement costs. However improved selectivity could impact the catch levels of fishermen. Potential costs to regulators and business from protecting the landing of ovigerous lobsters nationally. Since these measures would only effectively extend the scope of existing controls (i.e. applying beyond the IFCA areas) the costs to business and regulators are likely to be low.	Not applicable as only one option is considered.
	Potential costs to government: There are no additional monitoring costs but there are likely to be additional		

¹³ Due to overlaps between MSFD and CFP it has been assumed that only a proportion of the costs of these measures should be attributed to MSFD. Total costs of enforcement are estimated at £17.6m-£23.7m over 10 years, but apportionment scenarios of 10%, 25% and 50% have been applied to calculate the figures above. Also, these costs are largely comprised of revenues foregone, due to data availability. A more accurate presentation of these costs would be in terms of GVA or profits affected (further discussions will be required to decide which of the two approaches will be appropriate). Adopting such an approach would imply that the economic costs to the fishing industry associated with these indicative measures are likely to be lower than presented here. This will be revisited if possible in the final Impact Assessment.

	enforcement costs estimated at £86k (low estimate), £215k (best estimate) and £431k (high estimate) ¹⁴ .		
	Total potential costs: £50m - £252m over 10 years		
Descriptor 5 - Eutrophication	Potential costs to business: No additional costs to business as no measures are anticipated over those that will be taken under existing legislation (e.g. the Water Framework Directive).	No un-quantified costs identified.	Not applicable as only one option is considered.
	Potential costs to government: There are likely to be additional monitoring costs estimated at between 86K and £861K over 10 years.		
	Total potential costs: 86K- 861K over 10 years		
Descriptor 7 – Hydrographical Process	Potential costs to business: There are no potential costs to business	Possibly additional monitoring costs to government to provide comprehensive understanding of prevailing environmental conditions and the further development of assessment tools. Costs to government in terms of updating guidance in Wales, Scotland and Northern Ireland.	Not applicable as only one option is considered.
	Potential costs to government: There will be some costs to government and regulators in terms of updating to guidance. This is estimated to be around £20K (one-off) for England.		
	Total potential costs: Partial estimate of the cost is £20K (covers England		

¹⁴ Due to overlaps between MSFD and CFP it has been assumed that only a proportion of the costs of enforcing these measures should be attributed to MSFD. Total costs of enforcement are estimated at £861k over 10 years, but apportionment scenarios of 10%, 25% and 50% have been applied to calculate the figures above.

	only)		
Descriptor 8 – Contaminants	Potential costs to business: No costs to business as no additional measures are anticipated over those that will be taken under existing legislation (e.g. the Water Framework Directive)	No un-quantified costs identified at this time, although there could be some additional monitoring costs in the future if new substances are added to the WFD or OSPAR list.	Not applicable as only one option is considered.
	Potential costs to government: No additional costs are anticipated at the current time.		
	Total potential costs: No additional costs.		
Descriptor 9 – Contaminants	Potential costs to business: There are no costs to business as not additional measures are anticipated over those that will be taken under existing legislation.	There are likely to be smaller additional monitoring costs for government in Scotland.	Not applicable as only one option is considered.
	Potential costs to government: There are likely to be additional monitoring costs for England and Wales estimated at between £344K and £689K over 10 years.		
	Total potential costs: Estimate of costs are £344K - £689K over 10 years (covers England only)		
Descriptor 10 – marine litter	Potential costs to business: We have not been able to estimate the costs to business and these costs have been described qualitatively.	Costs to business will depend on which measures are ultimately taken forward and how they are implemented. Further analysis will be carried out during the consultation stage to inform the estimates.	Option 2 involves implementing the same measures as Option 1, but these would need to be applied more extensively and hence the costs would be higher.
	Potential costs to government: Costs of increasing beach cleaning		

	<p>estimated at £6.5m-£13m over 10 years¹⁵ Cost of tailoring 'Keeping Britain Tidy' campaign to include messages on marine litter is estimated to be £64.5K to £129K over 10 years¹⁶. Cost of fishing for litter is estimated to be £2.72m over 10 years Costs of additional monitoring for England and Wales are estimated to be £473K-£1.1m over 10 years</p>	<p>Additional monitoring costs in Scotland and Northern Ireland.</p>	<p>Additional monitoring costs to government of £473k-£1.1m over 10 years also apply under this option. Option 2 is our preferred option.</p>
	<p>Total potential costs: Costs are estimated at £9.7m - £16.8m over 10 years. Option 1 is our non preferred option.</p>		
<p>Descriptor 11 – Noise</p>	<p>Potential costs to business: Impulsive sound It has not been possible to quantify the potential costs to business (associated with setting up a noise registry) but a qualitative description of the costs is provided in the adjacent column. Ambient sound No new measures will be required under this option and hence there will be no additional costs to business.</p>	<p>Impulsive sound Costs to business from setting up a noise registry are likely to be small, arising from the need to submit some additional information during the licensing process. Ambient sound No new measures will be required under this option and hence there will be no additional costs to business.</p>	<p>Impulsive sound Costs to business and government of implementing a noise registry would be significantly more under Option 2 because the proposed targets would necessitate more intense management of noisy activities, limiting when and where noisy activities can take place. Ambient sound Any additional measures considered necessary under this option would have to be adopted through the International Maritime Organisation. It is currently unclear whether additional ship quietening measures would be needed</p>
	<p>Potential costs to government: Impulsive sound Costs are likely to be £402K over 10 years, arising from the need to create</p>		

¹⁵ Costs of additional beach cleaning will be incremental to the existing £15m pa costs. To provide a rough indication of costs we have looked at a scenario of 5-10% incremental increase in costs.

¹⁶ Costs have been estimated by assuming a 1-2% increase in the costs of the current 'Keeping Britain Tidy' campaign.

	and administer a noise registry. Ambient sound Additional monitoring will be in the region of £861K-£1.34m over 10 years.		beyond those that are likely to be applied anyway through the recently agreed IMO Energy Efficiency Design Index. If additional measures are needed (e.g. modified propellers) the costs to industry of applying these will vary. For new vessels costs are not likely to be high, but the cost of retrofitting old vessels could be significant. Additional monitoring costs to Government of £861K-£1.34m over 10 years also apply to this option. The total costs to business and government under this option are likely to be significantly higher than Option 1.
	Total Potential costs: Costs are likely to be low for both ambient and impulsive sound. The costs to government of setting up a noise registry and monitoring ambient sound are estimated to be £1.3m-1.7m over 10 years.		
GRAND TOTAL	PREFERRED OPTION (option 1 for all Descriptors, but option 2 for litter)		NON PREFERRED OPTION (option 2 for all Descriptors, but option 1 for litter)
	Potential costs to business: £54m- £463m over 10 years		Potential costs to business: >£54m- £463m over 10 years
	Potential costs to government: £37m- £72m over 10 years		Potential costs to government: >£38m- £72m over 10 years
	Total potential costs: £91m - £535m over 10 years		Total potential costs: >£91m - £535m over 10 years

Summary of benefits

Final ecosystem components and pressures	OPTION 1		OPTION 2	
	PV benefits over 10 years	Qualitative benefits	PV benefits over 10 years	Qualitative benefits
Fish	Benefits to the fishing industry are estimated to be £227m (low estimate),	There is also likely to be an increase in recreational services from improvement	Not applicable as only one target option is considered for commercial fish (Descriptor 3).	Not applicable as only one target option is considered for commercial fish (Descriptor 3).

	£567m (best estimate) and £1.13bn (high estimate) over 10 years ¹⁷ . Benefits were arrived at by looking at increase in catch levels (of 5 key fish stocks) from reaching MSY. The model is a simplistic one and is informed by a number of underlying assumptions ¹⁸ .	in abundance of fish species.		
Litter	Litter in marine waters could affect the profitability of boats by causing significant damage to gears and propellers. Benefits to the fishing industry from reducing the rate of increase ¹⁹ in marine litter are estimated to be £29m over 10 years.	There will be improvements in recreational and cultural benefits from a reduction in the rate of increase in litter levels in beaches. WTP study estimates avoidance of litter and dog mess to be 1.72bn over 10 years. Though these estimates have not been included in the summary benefits (as it refers to complete removal	Litter in marine waters could affect the profitability of boats by causing significant damage to gears and propellers. Benefits from an overall reduction ²⁰ in litter are estimated to be £118m over 10 years.	There will be more improvements in recreational and cultural benefits, and higher benefits to other sectors (aquaculture, harbours and marinas, agriculture) under this option compared to Option 1, because the targets under this option aim for an overall decrease in litter levels (rather than merely slowing the rate of increase).

¹⁷ Due to overlaps between MSFD and CFP it has been assumed that only a proportion of the benefits of improvements to fish stocks should be attributed to MSFD. Total benefits are estimated at £1.5bn over 10 years, but apportionment scenarios of 10%, 25% and 50% have been applied to calculate the figures above. These benefits are presented comprised of revenues from fishing at MSY. A more accurate presentation of these benefits would be in terms of GVA or profits affected (further discussions will be required to decide which of the two approaches will be appropriate). Adopting such an approach would imply that the economic benefits to the fishing industry associated with these indicative measures are likely to be lower than presented here. Benefits are presented in terms of revenues to ensure comparability with the current presentation of estimates of the costs of indicative measures for Descriptor 3. This will be revisited if possible in the final Impact Assessment.

¹⁸ Please refer to section E for further information on the assumption used.

¹⁹ We have estimated benefits from a reduction in rate of increase in litter from 5% to 3%. Please refer to section E for further assumptions used to model the benefits.

²⁰ We have estimated benefits from 5% overall reduction in litter. Please refer to section E for further assumptions used to model the benefits.

		of litter rather than reduction) it helps to illustrate that there will be benefits to reducing future increases in litter. There are also likely to be additional benefits to other sectors (aquaculture, harbours and marinas, and agriculture) which it has not been possible to quantify.		
Seafloor Habitats	It has not been possible to quantify the benefits	Habitats provide key regulating services (such as climate regulation, regulation of water and air quality, hazard protection, regulation of disease and pests), provisioning services (such as food, medicine from seaweed) and recreational services. The proposed GES targets under this option will lead to an improvement in these services but it is not currently possible to quantify this.	It has not been possible to quantify the benefits	The improvements in regulating, provisioning and recreational services are likely to be higher under Option 2 than Option 1 as the targets proposed under this option would require more significant action to protect seafloor habitats than those proposed under Option 1.
Birds	It has not been possible to quantify the benefits	Based on RSPB estimates, we found the cultural and aesthetic benefits ²¹ from seabirds range from £51m - £102m over 10 years. There	It has not been possible to quantify the benefits	The improvement in cultural and recreational benefits is likely to be higher under Option 2 than Option 1 as the targets proposed under this option

²¹ These benefits are calculated based on expenditure by visitors in only 4 seabird reserves. Please refer to section E for further information.

		are likely to be increases in cultural and aesthetic services that result from the implementation of GES targets for birds. It has not been possible to estimate the increase in these benefits but the estimates above show the high benefits that are associated with healthy seabird colonies.		would require more significant action to protect birds than those proposed under Option 1.
GRAND TOTAL	PREFERRED OPTION (option 1 for all Descriptors, but option 2 for litter)	Quantified benefits are estimated to be £269m -£871bn. There are likely to be other benefits that have not been quantified such as: Improvement in recreational and cultural benefits from improvement in fish stocks, habitats, seabird colonies and smaller increases in litter on beaches Improvement in provisioning and regulating services from preventing degradation of habitats	NON PREFERRED OPTION (option 2 for all Descriptors, but option 1 for litter)	Quantified benefits are estimated to be £179m-£-782m. There are likely to be other benefits that have not been quantified (mentioned under the preferred option). These benefits are likely to be higher compared to the preferred option for seabirds and habitats, but lower for litter (as for litter, Option 1 is our less preferred option).
NET PRESENT VALUE	£178m – £336m over 10 years		<£88m – £246m over 10 years	

Section A – Introduction

66. Within Europe marine habitats are continuing to deteriorate and an increasing number of marine species are seriously threatened. The Marine Strategy Framework Directive - 2008/56/EC (MSFD) was developed in response to concerns that although existing legislation protected the sea from some specific impacts, it was sectoral and fragmented. There was also recognition that since some of the activities that impact on the marine environment are managed at a European or international level (e.g. fisheries and shipping), national action on the marine environment needs to be supported by a framework to ensure action is taken across Europe.
67. The MSFD requires Member States to put in place the necessary management measures to achieve Good Environmental Status (GES) in their marine waters by 2020. GES is defined in the Directive²² and described in more detail by 11 high-level Descriptors (see p.39) which set out what Member States must achieve in their marine waters. GES is not intended to refer to a pristine environmental state, but involves protecting the marine environment, preventing its deterioration and restoring it where practical, whilst at the same time providing for sustainable use of the marine environment.
68. The MSFD requires Member States to go through a number of stages before the eventual implementation of management measures to achieve GES. The first stage, to be completed by July 2012, is for Member States to carry out an initial assessment of the current status of their seas and to determine specific characteristics of GES for their marine waters, setting out specific environmental targets and indicators to underpin this (based on the 11 Descriptors of GES given in the Directive). The second stage, to be completed by 2014, is for Member States to put in place monitoring programmes to measure progress towards GES, and the final stage, to be completed by 2016, is the implementation of management measures to achieve GES by 2020.
69. The aims of the Directive are consistent with the UK Government and Devolved Administrations' aim of clean, healthy, safe, productive and biologically diverse seas, as well as with the commitments made in the Natural Environment White Paper to be the first generation "to leave the natural environment...in a better state than we inherited it"²³. Charting Progress 2²⁴, the most recent assessment of the UK's marine environment, recognised that although many aspects of the UK's marine environment are improving (e.g. the impacts of contamination), other aspects (e.g. seafloor habitats, fish populations) are degraded and continue to be subject to unacceptable pressures from human activity. The Government and Devolved Administrations have already committed to taking many measures which will improve the state of the UK's marine environment, most notably through the UK Marine and Coastal Access Act (2009), the Marine (Scotland) Act (2010) and the proposed Northern Ireland Marine Bill. Equally, many existing pieces of EU legislation, such as the Water Framework Directive and the Birds and Habitats Directives are also aimed at improving the state of the UK's marine and coastal environments. These existing measures will all support the achievement of GES under this Directive.

²² MSFD, 2008/56/EC Article 3(5) – Good Environmental Status means 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.

²³ Natural Environment White Paper, p.3 <http://www.official-documents.gov.uk/document/cm80/8082/8082.pdf>

²⁴ <http://chartingprogress.defra.gov.uk/>

70. The MSFD is transposed into UK legislation via the Marine Strategy Regulations (2010)²⁵ and an impact assessment for the transposition of the MSFD has already been completed and is available at <http://www.defra.gov.uk/environment/marine/msfd/>. This current Impact Assessment considers the options for UK targets and indicators of Good Environmental Status and assesses the cost-benefit implications of those options. Further impact assessments will be required at later stages in the implementation process (both for monitoring programmes and management measures), and we will continue to work with experts and stakeholders to maintain an evidence-based approach to implementation.

71. Although the UK is able to define its own set of GES targets and indicators, in reality this is constrained by three key factors:

- The definition of GES and the 11 high-level GES Descriptors are set out in the Directive and must be used by Member States as the basis for their targets and indicators.
- The European Commission has set out specific criteria and indicators for GES in its Decision on Criteria and Methodological Standards on Good Environmental Status of Marine Waters 2010/477/EU²⁶ (hitherto referred to as the Commission Decision 2010). Member States must follow the criteria and indicators in this Decision when developing their national GES targets and indicators.
- The Directive requires Member States within the same region to follow a coordinated approach to implementing the Directive, including the development of GES targets and indicators. For the UK, the region of relevance is the North East Atlantic and the UK has been playing a leading role in the OSPAR Regional Sea Convention²⁷, and bilaterally with key Member States, to try to ensure the UK's proposals for GES targets and indicators are consistent with those of other countries. However, as yet only a few other countries have shared detailed information on their proposed GES targets and indicators. For this reason the proposals put forward in this impact assessment will need to be reviewed before the final impact assessment in the light of further information from other Member States.

72. Taking into account these three factors, the proposals for GES targets and indicators set out in this impact assessment have been developed on the basis of scientific advice provided by the Centre for Environment, Fisheries and Aquaculture Science (Cefas), the Joint Nature Conservation Committee (JNCC) and a large range of experts involved in the UK Marine Monitoring and Assessment Strategy, as well as socio-economic evidence provided by Eftec²⁸. For some of the 11 GES Descriptors there is strong scientific evidence to support particular ecological thresholds as suitable targets for GES. Where this is the case (e.g. for contaminants, eutrophication and fisheries) only one option for GES targets is put forward. However, some of the other GES Descriptors (e.g. biodiversity, noise and litter) are much less well understood and there is less evidence to allow experts to point to specific ecological thresholds which would be suitable targets for GES. In this latter case two options for GES targets and indicators have been put forward (Option 1 and Option 2), both of which are considered to be sufficient to achieve GES. More information on the different options is provided in Section C.

²⁵ <http://www.legislation.gov.uk/ukxi/2010/1627/contents/made>

²⁶ Commission Decision of 1 September 2010 on criteria and methodological standards on good environmental status of marine waters 2010/477/EU <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:232:0014:0024:EN:PDF>

²⁷ OSPAR Convention for the protection of the North East Atlantic.

²⁸ This advice is summarised in the Cefas Report – *Proposed UK Targets for Achieving GES and Cost Benefit Analysis for the MSFD*, hitherto referred to as the *Cefas CBA report 2012*, <http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&ProjectID=16817&FromSearch=Y&Publisher=1&SearchText=ME5405&SortString=ProjectCode&SortOrder=Asc&Paging=10#Description>.

73. As far as we are aware, the options for GES targets and indicators put forward in this impact assessment do not gold-plate the requirements of the Directive:
- The proposals are based as far as possible on targets and monitoring commitments set out in existing legislation (e.g. the Habitats Directive, the Water Framework Directive, the Environmental Impact Assessment Directive);
 - The proposals stick closely to the requirements set out in the Directive and the Commission Decision 2010 and do not cover any elements not included in those documents;
 - As far as we know at this stage, the proposals do not go beyond what is being proposed by other Member States.
74. In this Impact Assessment, the UK-wide costs and benefits of the proposed GES targets and indicators (Options 1 and 2) are compared to the projected baseline scenario (Option 0) for what will happen without MSFD. The baseline scenario is informed by a report produced for Government by ABPmer which describes the potential state of the marine environment in 2020 and 2030 based on current trends and existing policy commitments²⁹. Assessment of the costs of the proposed GES targets and indicators is based on an assessment of a range of illustrative management measures which experts and policy makers consider to represent a reasonable example of the types of additional measures which may be needed to achieve the GES targets. Further work will be carried out between now and 2015 to define the exact range of additional measures that will be implemented and these will be subject to a full impact assessment in due course. The cost assessment also considers the likely additional monitoring costs associated with the proposed GES targets and indicators. These should be seen as broad indicative estimates, with further work being carried out between now and 2014 to refine the monitoring proposals and to establish the most cost effective way of meeting them. Assessment of benefits is based on an assessment of the change in value of ecosystem goods and services between the baseline scenario and the scenario if all the proposed GES targets are achieved.
75. It should be noted at this stage that the Directive accepts that there may be some narrow circumstances where it is not possible to achieve GES and includes a number of legitimate reasons³⁰ why a Member State might, in exceptional circumstances, fail to meet their GES targets. The UK will consider the application of these exceptions if and when the relevant circumstances arise.
76. In addition to these exceptions, Member States do not need to take measures to achieve the GES targets where the costs of taking action relative to the benefits are considered to be disproportionate taking into account the risks to the marine environment, and provided there is no further deterioration³¹. For the purposes of this impact assessment we have tried to indicate where there is a high likelihood that the illustrative measures could be disproportionately costly. Where this is the case the costs of these measures have not been included in the total estimate of costs.
77. This impact assessment does not cover:

²⁹ 'Business as Usual Projections of the Marine Environment: to Inform the Implementation of the Marine Strategy Framework Directive', ABPmer 2012.
<http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&ProjectID=17775&FromSearch=Y&Publisher=1&SearchText=ME5104&SortString=ProjectCode&SortOrder=Asc&Paging=10#Description>.

³⁰ Directive EC/56/2008 – Article 14(1) The exceptions in the Directive include: action or inaction for which the Member State concerned is not responsible; natural causes; force majeure; where meeting targets would go against the over-riding public interest; and natural conditions which do not allow the timely improvement in the status of the marine waters concerned.

³¹ Directive EC/56/2008 – Article 14(4).

- The UK determination of GES – The Directive requires Member States to determine a set of characteristics for GES. The UK interpretation is that these are high-level characteristics which are given practical effect by the more specific GES targets and indicators. For this reason, the impacts of the UK characteristics of GES are effectively covered by the assessment of the impacts of the associated GES targets and indicators and do not need to be considered separately as part of this Impact Assessment. The draft characteristics of GES for each of the 11 Descriptors are included for information in the Descriptor summaries in Section D.
- The UK monitoring programmes for GES – as mentioned above, although this impact assessment gives a broad indicative estimate of the monitoring costs associated with the proposed GES targets and indicators, more work will be carried out between now and 2014 to look at what is already delivered by existing monitoring programmes and to define additional monitoring needs. This will be the subject of a separate impact assessment in due course.
- The UK programmes of measures for achieving GES – as mentioned above, the management measures included in this impact assessment are illustrative examples used to assess the potential costs of achieving the proposed GES targets. Choosing a particular GES target should not be seen as necessarily committing the UK to utilising the measures suggested here. All decisions on which measures are taken will be subject to a separate impact assessment which will fully assess the effectiveness of those measures in achieving GES as well as their socioeconomic implications.

Section B – Policy rationale and objectives

Policy rationale

78. The UK published the National Ecosystem Assessment (NEA) in 2011³², the first analysis of the UK's natural environment in terms of the benefits it provides to society now and in the future. The UK also published Charting Progress 2, a comprehensive report on the state of the UK seas, in July 2010. Both these reports emphasise the significant anthropogenic pressures on the marine environment at present.

79. Marine habitats and species provide a wide range of ecosystem services that provide benefits of significant value to society. These include provisioning, regulating, supporting and cultural services and are illustrated with examples in Fig. 1 below³³.

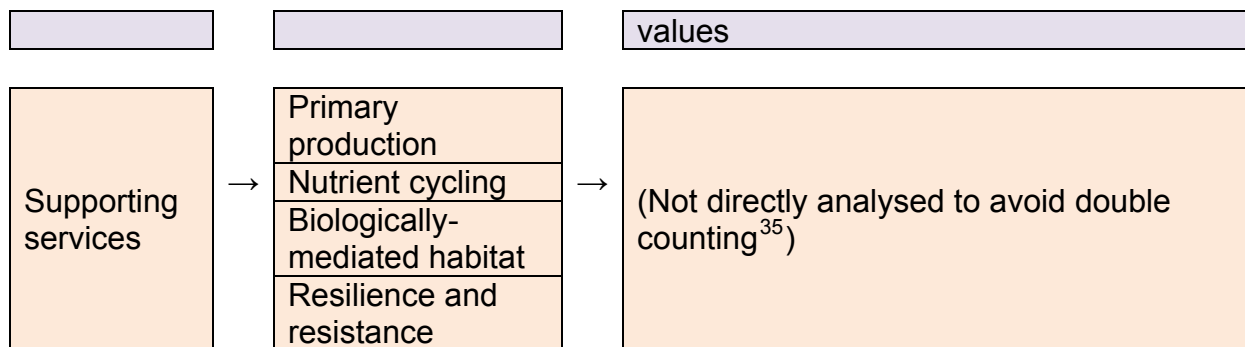
Figure 1 – Summary of ecosystem services

Categories	Relevant Categories	Example of Product or Service
Provisioning services	Food	Fish for human consumption
	Fibre	Fish used in animal feeds
	Biochemicals, pharmaceuticals and natural medicines	Aggregates
		Fish oil
Regulating services	Gas and climate	Carbon sequestration
	Bioremediation of waste	Waste remediation, water purification
	Natural hazard	Protection from natural hazard
Cultural services	Knowledge and education	Scientific knowledge of ecosystem functions, genetic information, and potential for chemical/therapeutics discovery
	Recreation	Recreational sea angling Nature-based recreation Scuba Diving
	Spiritual and religious	Artistic work based on the marine environment
	Cultural and social	Protection of iconic sites or archaeological features
	Aesthetic and inspiration	
	Non-use ³⁴ and option values	Altruistic/Bequest/Existence/Option/Quasi-option

³² <http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx>

³³ This section of the impact assessment sets out some of the services provided by the ecosystem- but this list is not comprehensive.

³⁴ Non-use values are where benefits are derived from the marine environment without directly using it (e.g. from knowledge of their existence and from the potential for their future enjoyment of use).



80. The Marine environment provides a range of ecosystem services which have market values (e.g. the value of fish represented by the price of fish), non-market values (e.g. the value of carbon sequestration of the oceans represented by the price of carbon abated), and values that are not easily expressed in economic terms at all (e.g. cultural value of the sea). Many marine ecosystem services provide “free benefits” to society, which results in their overexploitation (e.g. provision of wild fish species) – this is known as an externality. Additionally, the market price of some marine ecosystem services is an underestimate of the benefits they provide – these represent a market failure.

81. Human activities can cause a range of impacts on the marine environment. These include the loss or degradation of biodiversity, loss of habitats, contamination by hazardous substances and nutrients, and the possible future effects of climate change. All these impacts can have a direct effect on the ability of the marine environment to provide the ecosystem goods and services outlined above.

The Case for Intervention

82. Charting Progress 2 concluded that although many aspects of the UK’s marine environment are improving (e.g. the impacts of contamination), other aspects (e.g. seafloor habitats, fish populations) are degraded and continue to be subject to unacceptable pressures from human activity. The UK Government and Devolved Administrations have recognised the need for intervention in order to provide diverse and dynamic oceans and seas which are clean, healthy, safe and productive, and consistent with sustainable use. Improved systems for managing the marine and coastal environment are already being put in place through the UK Marine and Coastal Access Act 2009, the Marine (Scotland) Act 2010 and the proposed Marine Bill in Northern Ireland.

83. Nevertheless, a number of the human activities which impact on the marine environment are managed at the European and international level (e.g. fisheries and shipping) and other pressures on the marine environment (e.g. litter and non-indigenous species) are trans-boundary in nature and can easily spread across national borders. For these reasons national measures alone will not be sufficient to achieve the UK’s objectives for its seas.

84. In addition as new evidence becomes available about the effects of pressures on the marine environment the UK needs to be able to respond flexibly, in coordination with its maritime neighbours. For instance, the scale of effects of underwater noise on marine animals is not fully understood and a coordinated approach is needed to ensure the cumulative impact of noisy activities is managed at a level which does not cause significant impact on marine species.

³⁵ Supporting services are those that are necessary for the production of all other ecosystem services. The important point to emphasise is that they differ from provisioning, regulating, and cultural services in that their impacts on people are indirect and will therefore not be valued directly but by taking account of the impact on these other ecosystem services that are directly ‘consumed’.

85. The MSFD requires all Member States to take the collaborative action necessary to achieve GES in Europe's seas. It puts in place a coherent common legislative framework for coordinated action across Europe, covering all the human activities that have an impact on the marine environment. A comprehensive set of GES targets and indicators is required in order that the UK, in coordination with other Member States, can assess the impact of human activities on the marine environment and take effective national and international measures to ensure sustainable use of our marine resources.

Policy objectives: An overview of the Directive's requirements

86. MSFD establishes a framework within which Member States shall take the necessary measures to achieve or maintain GES in the marine environment by 2020 at the latest. The aims of the Directive are to:

- 'Protect and preserve the marine environment, prevent its deterioration or, where practicable, restore marine ecosystems in areas where they have been adversely affected;'
- 'Prevent and reduce inputs in the marine environment, with a view to phasing out pollution, so as to ensure that there are no significant impacts on or risks to marine biodiversity, marine ecosystems, human health or legitimate uses of the sea.'³⁶

87. Member States must apply an ecosystem-based approach to the management of human activities. In this context this means ensuring that the collective pressure of human activities is kept within the levels compatible with the achievement of GES.

88. The aims of the Directive are to be delivered through the development of marine strategies covering the following elements:

- An Initial Assessment of marine waters analysing the essential features, characteristics and environmental status of those waters (by July 2012, with subsequent assessments carried out on a six-yearly basis);
- Determination of a set of characteristics for GES, based on the 11 GES Descriptors set out below (by July 2012, reviewed on a six-yearly basis);
- Establishment of comprehensive environmental targets and indicators to guide progress towards achieving GES (by July 2012, reviewed on a six-yearly basis);
- Establishment and implementation of a coordinated monitoring programme for the ongoing assessment of GES (by July 2014, reviewed on a six-yearly basis);
- Development of a programme of measures designed to achieve GES by 2020 (by Dec 2015, reviewed and revised on a six-yearly basis);
- Implementation of the programme of measures described above (by Dec 2016, reviewed on a six-yearly basis).

89. Following the principle of adaptive management, which recognises the fact that our understanding of the marine environment will develop over time, each stage of the marine strategy, including the GES targets and indicators, must be reviewed every six years and revised if necessary³⁷.

90. GES is defined in the Directive and described in more detail by 11 high-level Descriptors of GES which Member States must use as the basis for their GES targets and indicators³⁸. The 11 GES Descriptors are set out in the box below.

³⁶ MSFD 2008/56/EC Article 2

³⁷ As required under Article 17(2) of Directive 2008/56/EC

³⁸ MSFD 2008/56/EC Article 3(5) and Annex 1

MSFD Descriptors of Good Environmental Status

1 - Biological diversity is maintained. The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions (“Descriptor 1” or “D1”).

2 - Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystems (“Descriptor 2” or “D2”).

3 - Populations of all commercially exploited fish and shellfish are within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock (“Descriptor 3” or “D3”).

4 - All elements of the marine food webs, to the extent that they are known, occur at normal abundance and diversity and levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity (“Descriptor 4” or “D4”).

5 - Human-induced eutrophication is minimised, especially adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algae blooms and oxygen deficiency in bottom waters (“Descriptor 5” or “D5”).

6 - Sea floor integrity is at a level that ensures that the structure and functions of the ecosystems are safeguarded and benthic ecosystems, in particular, are not adversely affected (“Descriptor 6” or “D6”).

7 - Permanent alteration of hydrographical conditions does not adversely affect marine ecosystems (“Descriptor 7” or “D7”).

8 - Concentrations of contaminants are at levels not giving rise to pollution effects (“Descriptor 8” or “D8”).

9 - Contaminants in fish and other seafood for human consumption do not exceed levels established by Community legislation or other relevant standards (“Descriptor 9” or “D9”).

10 - Properties and quantities of marine litter do not cause harm to the coastal and marine environment (“Descriptor 10” or “D10”).

11 - Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment (“Descriptor 11” or “D11”).

91. Member States are required to further develop these 11 GES Descriptors by determining a more detailed set of characteristics for GES³⁹. The draft UK characteristics of GES can be found in the individual Descriptor summaries in Section D. In turn, these characteristics must be underpinned by the more specific GES targets and indicators⁴⁰ which will be used to assess progress towards the achievement of GES.

92. As explained in the introduction, this impact assessment focuses on the proposals for GES targets and indicators, as these will directly influence the future choice of management measures, and therefore the costs and benefits of implementing this Directive. The choice of targets and indicators is left to Member States, however Member States must follow the requirements for criteria and indicators set out in the Commission Decision 2010, and must also coordinate their proposed targets with other Member States in their marine region.

³⁹ As required by Article 9 of the MSFD.

⁴⁰ As required by Article 10 of the MSFD.

Section C: Methodology

Evidence Base

93. The proposals for GES targets and indicators and related socio-economic analysis set out in this impact assessment are based on evidence set out in two key reports.
94. The Cefas Cost Benefit Analysis Report 2011 provides the main evidence base for the proposed GES targets and indicators, as well as the evidence to support the economic analysis of the illustrative management measures. This report has been carried out for Government by Cefas, in collaboration with JNCC, Eftec and a wide range of marine experts in the UK Marine Monitoring and Assessment Strategy. The development of the report was overseen by a Steering Group including representatives from Defra and the Devolved Administrations and the Steering Group considers the advice in the report to be robust and transparent. The report is currently being independently peer reviewed and this will be completed prior to the final impact assessment.
95. The ABPmer Business As Usual Scenario Report 2011 (BAU Report)⁴¹ provides the main evidence base for the Baseline Scenario (Option 0). The report was carried out for Government by ABPmer and was overseen by a Steering Group including representatives from Defra, the Devolved Administrations and key Government Agencies and Non-Departmental Public Bodies. A wide range of experts from the UK Marine Monitoring and Assessment Strategy also provided input to the report. The evidence in the BAU report is based on data and information available to consultants at the time the report was drafted and is considered by the Steering Group to represent a robust and transparent assessment. The evidence base provided in this report will be updated over time as more information becomes available – this will then form a living baseline which can be used for future impact assessments⁴². The report will be independently peer reviewed and this will be completed prior to the final impact assessment.

Description of Options

96. Proposed options for GES targets and indicators are set out in Section D. These options are compared to the baseline scenario (Option 0), which represents the scenario if the Government and Devolved Administrations were not to propose targets and indicators for GES, and therefore not to take additional measures to achieve GES by 2020. The baseline scenario is a projected baseline informed by the ABPmer BAU Report which describes the potential state of the marine environment in 2020 and 2030 based on current environmental trends and existing policy drivers and commitments. The baseline scenario and BAU Report are described in more detail in paragraphs 108-121 below.
97. For Descriptor 3 (commercial fish), Descriptor 5 (eutrophication), Descriptor 8 (contaminants) and Descriptor 9 (contaminants in seafood) one option for GES targets and indicators has

⁴¹ 'Business as Usual Projections of the Marine Environment: to Inform the Implementation of the Marine Strategy Framework Directive', ABPmer 2012, hereafter referred to as the ABPmer BAU Report 2011
<http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&ProjectID=17775&FromSearch=Y&Publisher=1&SearchText=ME5104&SortString=ProjectCode&SortOrder=Asc&Paging=10#Description>

⁴² The draft final report was completed in early July 2011 and its assessment of the state of the GES Descriptors (under the baseline scenario) is based on the best evidence available before then. Given the uncertainty regarding the delivery of certain policies and the projection of future human activity, the report had to make several assumptions to arrive at the state assessments. Since then there has been further new evidence, such as recommendations on sites that will be designated as Marine Conservation Zones, and future versions of the report will incorporate such new evidence to update its assessments.

been proposed (in addition to the baseline scenario). For these aspects of GES there is strong scientific evidence to support particular ecological thresholds as suitable targets for GES.

98. For Descriptor 2 (non-indigenous species) and Descriptor 7 (hydrographical conditions), one option for GES targets and indicators has also been proposed (in addition to the baseline scenario). For these Descriptors, the GES target proposals reflect the UK Government and Devolved Administrations' assessment that current policy approaches already provide an appropriate framework for managing the impacts of these pressures.
99. For Descriptor 1 (biodiversity), Descriptor 4 (food webs), Descriptor 6 (sea-floor integrity), Descriptor 10 (litter) and Descriptor 11 (noise), scientific understanding is less well developed and there is much less evidence to allow experts to point to specific ecological thresholds which would be suitable targets for GES. For these Descriptors this impact assessment proposes two options for GES targets and indicators (in addition to the baseline scenario). Option 1 represents a reasonable level of certainty that GES will be achieved and Option 2 represents a higher level of certainty that GES will be achieved:
- Option 1: Reasonable level of confidence of achieving GES - Option 1 looks at the impacts of the UK putting forward GES targets which are considered to give a reasonable level of confidence that GES (as described by the 11 Descriptors) will be achieved. These targets are considered to be equivalent to GES and the risks to the marine environment under this option are considered to be acceptable. This impact assessment puts forward Option 1 as the preferred option for all the above Descriptors except for litter (Descriptor 10).
 - Option 2: Higher level of confidence of achieving GES –Option 2 considers the impacts of the UK putting forward targets which are considered to give a higher level of confidence that GES will be achieved. This would equate to a much more precautionary approach than Option 1, but would potentially set targets at a level that would not be justified by the risks to the marine environment. Litter (Descriptor 10) is the only Descriptor where Option 2 is put forward as the preferred option, on the basis that this option is more closely aligned with existing UK Government and Devolved Administrations policy on litter.

Analytical approach to assessing costs and benefits of GES

100. The costs and benefits of the options for GES targets are compared to the baseline scenario (Option 0). Costs and benefits have been assessed over a timescale of approximately 10 years. The decision to use this timeframe was based on various factors. It provides a sufficiently long period over which environmental benefits may arise and the MSFD measures may be implemented. Assessment of the impacts beyond 10 years becomes more uncertain. For example, businesses have greater scope to adjust their activities in the long-term (for example through purchasing new equipment) and may therefore avoid costs that arise in the short-term. However, the analysis assumes that all the environmental benefits accrue within this time period. In reality benefits are likely to be realised over a longer time horizon. Costs and benefits are calculated over the period using a discount rate⁴³ of 3.5%, based on the Green Book⁴⁴
101. Costs of GES target options relative to the baseline scenario (Option 0) have been assessed by examining a list of illustrative management measures which experts and policy makers believe represent a reasonable indication of the types of action which may be necessary to achieve the GES targets. The illustrative management measures used in this

⁴³ The Discount Rate is used to describe the time preference society attaches to benefits – immediate benefits tend to be valued more highly than future benefits.

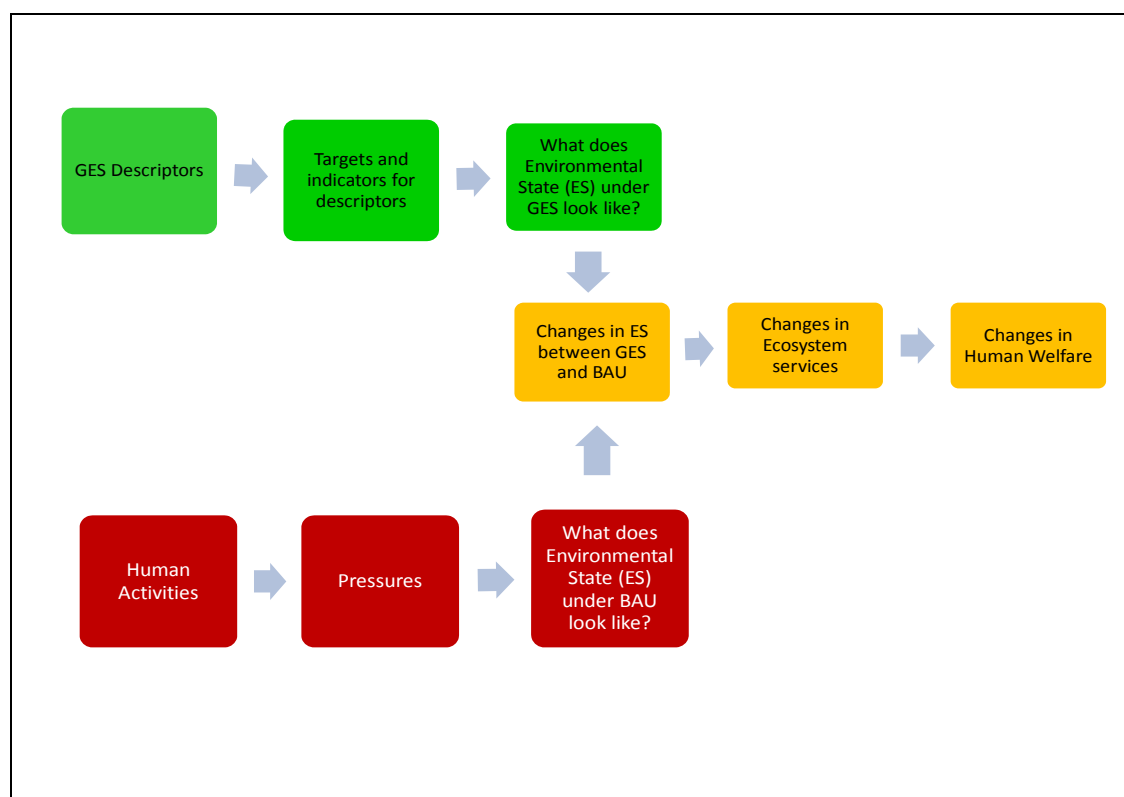
⁴⁴ HM Treasury, The Green Book: http://www.hm-treasury.gov.uk/data_greenbook_index.htm

impact assessment are based on measures included in the Cefas Cost Benefit Analysis Report 2011, as well as some additional measures which have been added by policy makers as the proposals for GES target options became clearer. It must be stressed that these measures represent a current best assessment of the type of action which could be needed to achieve the targets, but should not be seen as the measures the UK Government and Devolved Administrations definitely intend to take to achieve GES. More work is needed between now and 2015 to assess the need for additional action to achieve the proposed GES targets and to consider all possible management measures both in terms of their effectiveness in achieving GES and in terms of their socio-economic implications. This will include an assessment of whether potential additional management measures are disproportionately costly.

102. The cost assessment in this impact assessment also considers the likely additional monitoring costs associated with the proposed GES targets and indicators. These should be seen as broad indicative estimates, with further work being carried out between now and 2014 to refine the monitoring proposals and to establish the most cost effective way of meeting them. Further information is being sought as part of this impact assessment and consultation process to inform the cost assessment.
103. Where appropriate the costs of the illustrative measures associated with different target options have been aggregated to reach a total cost of the target option. However, it has not been possible to cost all the potential measures, some are only estimates or proxies and for others monetary costings are not present. For this reason any aggregated costings for the different target options must be considered within this wider context.
104. Given that the management measures used to carry out the cost assessment are only illustrative, it would not have been proportionate to undertake a full cost-benefit analysis of each individual measure. Therefore a different approach has been taken for assessing the benefits of the GES target options.
105. To assess the benefits of the MSFD the overall benefits of achieving the GES targets have been considered. This can be seen as equivalent to the benefits of avoiding environmental degradation by achieving the GES targets. Comparison of the gap between the expected state of the marine environment in 2020 without MSFD (i.e. the Baseline scenario) and the expected state of the marine environment in 2020 when the GES targets are achieved, has been used to provide an estimate of how degraded the marine environment is likely to be in 2020 without the MSFD. An ecosystem services approach has then been used to show how that degradation of the marine environment corresponds to a reduction in human welfare. Wherever possible the reduction in welfare has been monetised, however, this has not been possible in all cases given the current evidence base and a significant amount of qualitative assessment is included.
106. As stated previously in this impact assessment, for Descriptors 1 (biodiversity), 4 (food webs), 6 (sea-floor integrity), 10 (marine litter) and 11 (noise), two options for GES targets have been identified. Given the lack of quantitative evidence it has been difficult to estimate the quantitative difference in benefits across the two options. However as the targets proposed under Option 2 (higher confidence of achieving GES) for each of the Descriptors are more precautionary, involving the implementation of more extensive management action, it is likely to deliver more significant benefits (orange box in Fig.2 below) compared to Option 1. Due to insufficient understanding of the effectiveness of management measures in achieving GES it has not been possible to quantify the increased benefits of Option 2 compared to Option 1.
107. Further work is planned between now and the final impact assessment to improve the benefits assessment, but work is needed over the longer-term to support a fully quantified

ecosystem services assessment. This approach to assessing benefits is set out in Figure 2 below and the benefits are described in more detail in Section E.

Figure 2 – Summary of the approach to assessing costs of degradation and benefits of achieving GES



Baseline option (Option 0)

108. As described above, the baseline scenario aims to describe what the marine environment would look like in 2020 and 2030 if the MSFD is not implemented; it provides a baseline against which the potential costs and benefits of the options for GES targets and indicators are compared.

109. The baseline scenario for each of the GES Descriptors is described in the individual Descriptor summaries in Section D. By definition the costs and benefits of the baseline scenario are zero since no additional actions will be taken.

The Business As Usual Report – Methodology for developing the baseline:

110. The baseline scenario was heavily informed by the ABPmer Business As Usual Report 2011. This report was constructed by using the Driver, Pressure, State, Impact, Response (DPSIR) model to relate predicted changes in social, political and economic drivers to changes in the level of pressure on the marine environment exerted by human activities, and ultimately to potential impacts on future ecosystem state⁴⁵. Social, political and economic drivers (e.g. changes in political ambitions, population changes, increased incomes) are likely to influence

⁴⁵ European Environment Agency, 2007. Drivers' (D) are the socio-economic and socio-cultural forces driving human activities, which increase or mitigate pressures on the environment. 'Pressures' (P) are the stresses that human activities place on the environment. These pressures result in a change in the 'State' (S) of the marine environment. 'Impacts' (I) are the effects of changes in state that may influence ecosystems, human health, and materials. This approach highlights the number of steps in the causal chain where the chain can be broken by policy action or 'Responses' (R) by society to the impacts.

future trends in activities which affect the marine environment, which in turn are likely to cause changes in the environmental condition of our seas.

111. The BAU report analysis includes an assessment of marine ecosystem services and their links to the GES Descriptors; identification of the key social, political and economic drivers and their influence on achieving GES; identification and prioritisation of key environmental pressures caused by different marine activities and a temporal and spatial analysis of their projected future trends; an assessment of ecosystem sensitivity to these pressures; and finally an assessment of projected future changes in environmental state and ecosystem services.
112. The following categories of marine activities were considered and mapped against the pressures they exert on the marine environment⁴⁶:
- Energy production (e.g. wind turbines)
 - Extraction of non-living resources (e.g. sand and gravel extraction, oil and gas extraction)
 - Extraction of living resources (e.g. fishing)
 - Food production (e.g. aquaculture)
 - Habitat modification (e.g. coastal defence, managed realignment)
 - Military
 - Recreation and tourism
 - Survey and research
 - Transport
 - Waste management – gas (e.g. carbon capture and storage)
 - Waste management – liquid (e.g. sewerage disposal)
 - Waste management – solid (e.g. disposal of fish waste, land-based sources of litter)
113. In the BAU report analysis, pressures were prioritised on the basis of whether they are likely to have significant impacts on the state of the marine environment. In order to do this the ABPmer team, with support from experts in the UK Marine Monitoring and Assessment Strategy, carried out a detailed analysis of the current spatial and temporal extent of the pressures at all stages in the life cycle of an activity. The ABPmer team also carried out an assessment of the existing management measures which are in place to manage these pressures⁴⁷. The rationale for prioritisation was generally as follows: if activities are already managed through measures taken under existing legislation (e.g. the Environmental Impact Assessment Directive or the Water Framework Directive), then these measures should be sufficient to ensure that the pressures from the activities do not significantly affect the UK marine environment, even if activity increases. The results of this analysis are summarised in the ABPmer Business As Usual Report 2012⁴⁸.
114. The assessment then looked at the key social, political and economic drivers behind the prioritised list of pressures and carried out an analysis of the projected temporal and spatial footprint of these pressures in 2020 and 2030 – this is summarised in the APBmer Business As Usual Report 2012, Table 6 (p.54-55). The final step involved using the results of this analysis to assess the potential future state of the marine environment in 2020 and 2030 for each of the 11 GES Descriptors and their implications for ecosystem services.

Key Assumptions in the baseline scenario:

⁴⁶ This activity-pressure assessment was based on some work originally carried out by JNCC and the UK Marine Monitoring and Assessment Strategy, Healthy and Biologically Diverse Seas Evidence Group. This work was adapted for the purposes of this analysis.

⁴⁷ See ABPmer Business As Usual Report 2012, Appendix C: Identification of Drivers and Activities Operating on GES Descriptors (p.114).

⁴⁸ See ABPmer Business As Usual Report 2012, Table 6 (p.54-55) and Appendix D1:Pressure Prioritisation (p.122)

115. In general, for the baseline scenario, it has been assumed that all existing UK legislative commitments and established policies (both national and international) will be met and their goals achieved⁴⁹. For example, it is assumed that the Water Framework Directive will achieve Good Ecological Status and Good Chemical Status in coastal waters. It is recognised that there is uncertainty surrounding the effectiveness of existing management measures and legislative commitments, however, the only assumption that could be reasonably made at this stage is that they will meet their intended objectives.
116. However, the timing of this impact assessment creates particular problems in estimating the impact of Marine Protected Area designation and subsequent management measures, marine planning and reform of the CFP, since these measures are still at an early stage in their development. It is particularly difficult to anticipate the outcome of the public consultations on MCZs in English waters or Devolved Administration plans for MPA designation. It is equally difficult to anticipate the outcomes of the EU CFP reform negotiations.
117. In the circumstances therefore it has been assumed that for MCZ designation in England, there will be a reduction in the impacts of scallop dredging and demersal trawling on benthic habitats and mobile species in the draft candidate sites, but that this will lead to some displacement of activity elsewhere. There will, however, be a small net improvement in the situation as a consequence of some fishermen choosing to scale back on their activity or leave the industry altogether (if their traditional grounds are closed to them). It is clearly critical to the success of the designation process, that any displacement does not result in even greater harm to protected habitats or species outside the MCZ areas – and the modelling rightly assumes this. It is also clear, that even if a sizeable number of the draft English MCZs are ultimately approved, and sites are designated as planned in the Devolved Administrations, this will not in itself be sufficient to deliver GES for the UK's marine habitats and species.
118. Successful reform of the CFP is crucial to the achievement of GES for those elements of the marine ecosystem impacted directly or indirectly by fishing activity. It is critical for Descriptor 1 (biodiversity), Descriptor 3 (commercial fisheries), Descriptor 4 (food webs) and Descriptor 6 (sea-floor integrity). The scope for the UK to take unilateral action to achieve the kinds of fisheries measures potentially necessary to achieve GES for these Descriptors is extremely limited. For these reasons the CFP is seen as the key delivery vehicle for any fisheries management measures necessary to achieve GES and successful reform of the CFP is critical to this.
119. For the purposes of the baseline scenario, however, it is particularly difficult to distinguish between what aspects of CFP reform might be driven by the introduction of the MSFD and what would have happened anyway as a result of pressure to improve the environmental outcomes of the policy. The UK's negotiating position on CFP reform calls for, amongst other things, integration of fisheries with wider environmental goals. The UK has long been pursuing the aim of sustainable, ecosystem-based fisheries management, which reduces the impact of fisheries on the wider marine environment and would be continuing this approach to CFP reform irrespective of MSFD. It could, therefore, be argued that from a purely UK perspective reform of the CFP and the associated measures needed to achieve sustainable fisheries should be included within the baseline scenario. However, it is unlikely that the wider EU approach to CFP reform would deliver the outcomes the UK is seeking without the added pressure for environmental improvement provided by the MSFD. For this reason a proportion of the costs and benefits of achieving the UK's desired outcomes under a reformed CFP should be attributed to the MSFD.

⁴⁹ Existing legislative commitments are summarised in Appendix C of the ABPmer Business AsUsual Report 2012 (p.114)

120. Given the close overlap between MSFD and CFP it has been difficult to quantify how much of these costs and benefits should be included within the baseline scenario and how much should be apportioned to MSFD. For the GES targets proposed for Descriptors 1 (biodiversity), 4 (food webs) and 6 (seafloor integrity) it has been assumed that 100% of the costs and benefits should be attributed to MSFD because these targets are primarily aimed at protecting the wider marine environment rather than achieving higher levels of commercial fish stocks (which is the primary objective of the CFP). For Descriptor 3 (commercial fish), given that the CFP and MSFD have the same objectives in terms of achieving Maximum Sustainable Yield for fish stocks, it has been particularly challenging to determine how much of the costs and benefits of achieving the GES targets should be attributed to MSFD alone. To tackle the difficulty in apportioning these costs and benefits between MSFD and CFP for the purposes of this impact assessment three different scenarios have been considered - 50% of costs attributed to MSFD (high scenario) 25% of costs attributed to MSFD (middle scenario) and 10% of costs attributed to MSFD (low scenario).

121. Similarly, successful implementation of marine planning will be a useful tool in helping to achieve GES for some descriptors. However, although the implementation of marine planning is included within the baseline scenario, it is currently difficult to quantify its impact because it is still in its early stages across all UK administrations. Based on the impact assessment which was carried out for marine planning in England in 2009⁵⁰, it has been assumed that marine planning will support the achievement of GES both through the Sustainability Appraisal process undertaken during the development of marine plans and by providing a framework for decisions on the licensing of marine activities.

⁵⁰ <http://archive.defra.gov.uk/environment/marine/documents/interim2/20110221mps-ia.pdf>

Section D: Information on target options and costs

122. This section sets out the options for GES targets and indicators, the associated illustrative management measures, and an assessment of the costs associated with these. The proposals and costs are set out Descriptor by Descriptor as this was considered to be the simplest way of presenting the information. However, it should be noted that there is some overlap between the different Descriptors and a number of the illustrative management measures will support the achievement of targets under more than one Descriptor. Where this is the case it has been clearly indicated.
123. Proposals for Descriptors 1 (biodiversity), 4 (food webs) and 6 (sea-floor integrity) are set out first and are dealt with together in one sub-section due to the significant degree of overlap between them. The proposals for these Descriptors are the most complex to describe due to their wide coverage. The overall approach to setting GES targets and indicators for these Descriptors is set out first, followed by separate sections describing the proposed targets for species (mammals, fish and birds), and the proposed targets for habitats (pelagic habitats, sediment habitats and rock and biogenic reef habitats). The GES target proposals, illustrative measures, associated costs, and assumptions and risks are set out in 6 summary tables.
124. There are then separate sub-sections setting out proposals for Descriptors 2 (non-indigenous species), 5 (eutrophication), 7 (hydrographical conditions), 8 (contaminants), 9 (contaminants in seafood), 10 (litter) and 11 (noise). For each Descriptor the information is arranged in the following format:
- A background section, which includes the draft UK characteristics of GES;
 - A section describing the baseline scenario (Option 0);
 - A section describing the options for GES targets and indicators and their implications (in the case of Descriptors 10 and 11 there are two options for GES targets, in the case of the other Descriptors there is only one option);
 - A summary table setting out the GES target options, the illustrative measures, the associated costs, and the key assumptions and risks.
125. The cost assessment has been monetised as far as possible, but still contains a number of aspects which it has only been possible to describe qualitatively. This is particularly the case for Descriptors 1, 4 and 6, and Descriptors 10 and 11. Further information to support the cost assessment will be gathered during the consultation process.

Descriptors 1, 4 and 6 – Biodiversity, Food Webs and Seafloor Integrity Background

Descriptor 1: Biological diversity is maintained. The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions.

126. This Descriptor has a very broad scope. To achieve GES a multi-species and multi-habitat approach is needed, together with a robust assessment of the impact of human pressures on these components⁵¹. Most activities in the marine environment affect biodiversity in some way and achieving GES for the other Descriptors will help achieve GES for this Descriptor.
127. The proposed UK characteristics of GES for this Descriptor are as follows:

⁵¹ ICES-JRC Report on Descriptor 1, 2009.

- Biodiversity⁵² loss is halted and where possible restored, with key ecosystems maintained or recovered⁵³.
- The abundance, distribution and condition of species and habitats in UK waters reflects, or is consistent with, prevailing environmental conditions⁵⁴, taking into account sustainable use of the marine environment.
- The extent and natural range of habitats and species is not being significantly reduced (nor likely to be so in the foreseeable future) and the specific structures and functions necessary for their long-term maintenance exist and are likely to exist for the foreseeable future.
- Habitats and species defined as rare or threatened under existing national or international agreements are conserved effectively through appropriate national or regional mechanisms.
- Impacts of human activities do not lead to significant degradation of marine habitats or adversely affect species at the population or key functional group level.

Descriptor 4: All elements of the marine food webs, to the extent that they are known, occur at normal abundance and diversity and levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity.

128. A properly functioning marine food web is crucial to the overall health of the ecosystem. This Descriptor is intended to cover the functional aspects of food webs (particularly energy transfer) and levels of productivity. However, there is not currently enough known about energy transfer between trophic levels⁵⁵ and species interaction to meaningfully cover these within the targets for this Descriptor. In the medium term a pragmatic approach is proposed, which focuses on the abundance, distribution and productivity of key species and trophic groups⁵⁶ within the food web. This means there is significant overlap with Descriptor 1.

129. The proposed UK characteristics of GES for this Descriptor are as follows:

- Populations of key species groups within the food web occur at levels that ensure the long-term sustainability of the marine ecosystem of which they are part with an age and size structure for these and other key species, indicative of sustainable populations e.g. a high proportion of larger, more mature individuals in fish populations.
- The bycatch of non-target species in fisheries is reduced to a level which does not threaten food web structure, taking account of other pressures on the respective populations.

Descriptor 6: Sea floor integrity is at a level that ensures that the structure and functions of the ecosystems are safeguarded and benthic ecosystems, in particular, are not adversely affected.

130. This Descriptor is intended to ensure that human pressures on the seabed do not prevent the ecosystem from retaining its natural diversity, productivity and dynamic ecological processes. The seabed and associated benthic habitats⁵⁷ underpin key elements of the marine

⁵² According to the Convention on Biological Diversity (CBD), biodiversity is defined as “the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems”.

⁵³ This is in line with the updated CBD Target 12 “By 2020 the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained.”

⁵⁴ Prevailing conditions are defined as “in accordance with the intrinsic physiographic and climatic conditions of the different geographic regions”. Prevailing conditions are understood to include climatic changes caused by human induced climate change. Prevailing conditions (including climatic changes) will need to be monitored in order for a full assessment of progress towards GES to be carried out and targets will need to be revised if prevailing conditions change in such a way as to make them no longer relevant or achievable.

⁵⁵ The **trophic level** is the position that an organism occupies in a food chain - what it eats, and what eats it.

⁵⁶ Trophic group refers to a category of organisms within a trophic structure, defined according to their mode of feeding (e.g. primary producers).

⁵⁷ Benthic habitats are those on the seafloor. It is a generic term that refers to both rocky and sedimentary seafloor habitats.

ecosystem and play a key role in detrital decomposition, nutrient cycling and energy flow to higher trophic levels, supporting both primary and secondary production. Human pressures are known to reduce the diversity of benthic habitats. One of the most significant single activities contributing to the pressure on sea-floor habitats is bottom trawl fishing. There is significant overlap with Descriptor 1.

131. The proposed UK characteristics of GES for this Descriptor are as follows:
- The sea-floor habitats (physically and structurally) are both productive and sufficiently extensive at the UK seas level, to carry out natural functionality, including the necessary ecological processes (e.g. cycling carbon and nutrients) and to provide ecological goods and services (e.g. food security and climate regulation) - and are capable of supporting a healthy and sustainable ecosystem for the long term.
 - The seafloor habitats most susceptible to the significant detrimental impacts of human activity are protected to ensure their extent and functioning is maintained.
132. The goals of these Descriptors are in line with existing UK Government commitments e.g. the Natural Environment White Paper 2011 and the England Biodiversity Strategy 2011 goals to halt overall biodiversity loss and support healthy well-functioning ecosystems and establish coherent ecological networks of Marine Protected Areas. They are also in line with similar commitments made by the Devolved Administrations.
133. There are a significant number of measures already in place which will support the achievement of the GES targets proposed for these Descriptors. This impact assessment attempts to assess how far existing measures will achieve proposed targets and what additional measures might be needed.

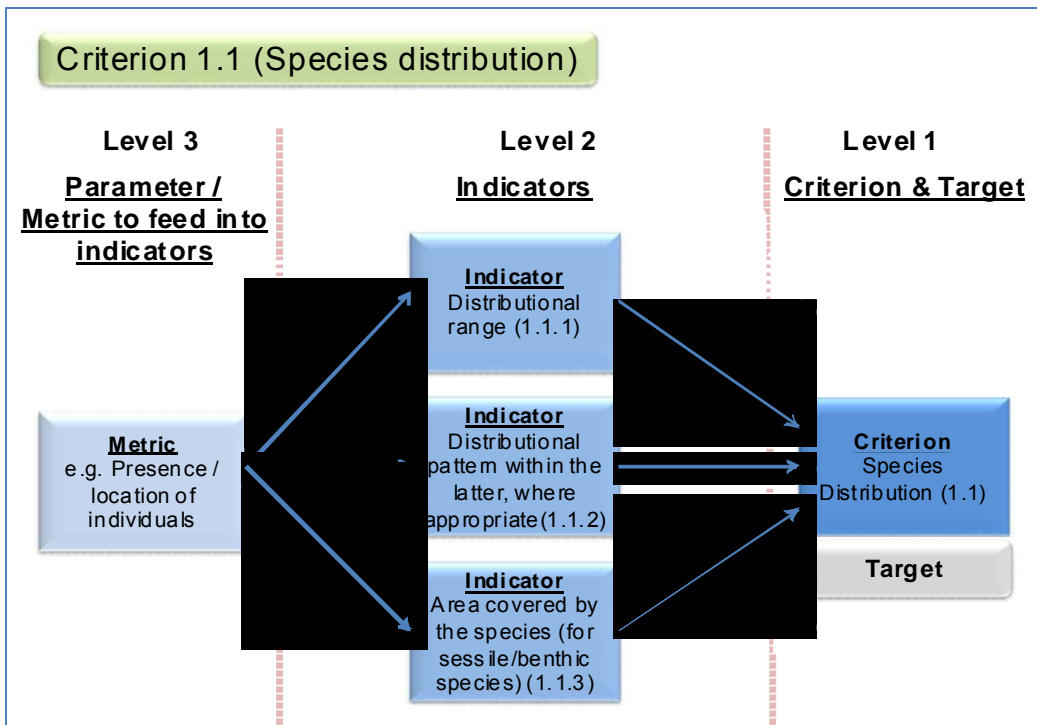
Approach to developing target options for these Descriptors

134. Proposals for GES targets and indicators for these Descriptors are set out in the Cefas CBA Report 2012, and have been developed by experts in the UK Marine Monitoring and Assessment Strategy Healthy and Biologically Diverse Seas Evidence Group (UKMMAS - HBDSEG), facilitated by JNCC⁵⁸. The proposals closely follow the requirements of the Directive and of the Commission Decision 2010 and have been used by policy-makers as the basis for the GES target options included in this impact assessment.
135. The GES targets for these Descriptors were developed on the basis of three species groups (birds, mammals and fish) and three habitat groups (pelagic, rock and biogenic reef and sediment), rather than Descriptor by Descriptor. This reflects the fact that there is significant overlap between the three Descriptors, and tackling the targets according to key groups of species and habitats has allowed experts to use many of the same targets across the Descriptors, minimising duplication. Experts have also proposed a range of more detailed indicators, which underpin the targets and explain how they would be assessed and monitored – these are set out in the Cefas CBA Report 2012⁵⁹ and will be further developed between now and the final impact assessment.

Figure 3, below provides an example of the different levels at which targets and indicators have been developed. Targets are set at the criterion level (level 1) and are underpinned by more detailed indicators (level 2) and monitoring parameters (level 3).

⁵⁸ This advice is included in the Cefas CBA Report 2012, Section 3.

⁵⁹ See Cefas CBA Report 2012, Appendix 10: Appendix 10 - Detailed targets and indicators for each biodiversity Descriptor (p.230).



136. The approach to setting targets for these Descriptors has been coordinated with other Member States across OSPAR. We have high confidence that other OSPAR countries will follow the same broad approach being proposed in this impact assessment, but there is currently little information available about the detailed proposals other Member States are likely to put forward. The proposals outlined here may therefore need to be reviewed in the light of further information about approaches being put forward by other OSPAR countries.

Target options for species (mammals, birds and fish)

137. Experts have proposed GES targets for mammals, fish and birds covering Descriptor 1 (biodiversity) and Descriptor 4 (food webs). These include targets for species distribution, population size and condition, as well as the productivity of key species/trophic groups and the abundance/distribution of key trophic groups. No species targets have been proposed for Descriptor 6 (sea-floor integrity) as the approach to setting targets for this Descriptor focuses on sea-floor habitats (see the section on habitats targets, paragraphs 150-168 below).

138. The approach to setting targets for these different species groups is set out in more detail in the Cefas CBA Report 2012⁶⁰. Existing targets have been used wherever suitable (e.g. from the Habitats Directive, OSPAR) and the proposals have been based as far as possible around existing indicators and monitoring programmes. The baselines proposed for the targets vary for the different species groups. For birds it is proposed that they are set in the past at a time when human pressures were thought to be minimal. For mammals it is also recommended that they are set in the past, either based on best available data, or closely linked to those for existing OSPAR objectives on seals. For fish it is proposed that the baseline is set as the mean value for each species throughout the entire time series of available data. The GES targets are set as a deviation from these baselines, recognising that achieving GES is consistent with sustainable use of the marine environment. Experts have proposed GES target options which they believe are necessary and sufficient to achieve GES for these Descriptors.

Option 0: Baseline scenario

⁶⁰ Cefas CBA Report 2012, pages 117.

139. Charting Progress 2 gives a mixed picture of the current status of marine birds, fish and mammals. The state of demersal fish has improved since the 1980s due to recent reductions in fishing effort, but there are still considered to be problems and there is some way to go before the majority of commercial fish stocks are considered to be at safe levels. The state of cetaceans is thought to be relatively stable, but there are problems in some areas, thought to be due to historic fisheries by-catch. There is a low level of confidence in the assessment due to lack of data. Grey seals are generally not experiencing any problems, but harbour seals have been decreasing in abundance dramatically in some areas and the causes are unknown. The state of most coastal waterbird species is good, but breeding numbers of some seabird species have declined substantially in north and north-west Scotland where the main causes are thought to be climate change and the introduction of non-indigenous species on key island colonies. Fishing has had both positive and negative impacts on seabirds, but evidence is lacking on the extent of these impacts⁶¹. The Business As Usual report concluded that the future status of marine species is difficult to predict given the wide range of pressures on them and our lack of knowledge regarding species interactions⁶².

140. There are numerous measures already in place, or planned under the baseline scenario, which are expected to reduce the key human pressures on these species and support the achievement of the targets proposed under this option. These include: measures required under the Birds and Habitats Directives; management measures for the MPA network; measures to achieve more sustainable fisheries under the CFP; work on monitoring and mitigating marine mammal by-catch in UK waters, and; measures to reduce levels of contaminants. However, it is not clear at this stage whether these measures alone will be sufficient to achieve the proposed GES targets set out under Options 1 and 2 below. For the purposes of this assessment it has been assumed that some additional management measures may be needed (particularly in relation to fisheries and the impacts of non-indigenous mammals on seabirds).

Option 1: Reasonable level of confidence of achieving GES (preferred option)

141. For fish and mammals, there is sufficient scientific evidence to support particular ecological thresholds as suitable targets for GES. Therefore, for fish and mammals only one option for GES targets is proposed and these are the same under Option 1 and Option 2 below.

142. However, for the targets for birds which relate to species distribution, population size and abundance/distribution of key trophic groups, there is insufficient evidence to allow experts to point to one specific ecological threshold which would be a suitable target for GES, and instead scientists have put forward a suitable range for targets based on expert judgement:

- No major shifts or shrinkage in the population distribution of marine birds in 75-90% of species monitored.
- Changes in abundance of marine birds should be within individual target levels in 75-90% of species monitored.

143. Under this option it is proposed that the lower percentage in that range is used as the GES target for birds i.e. indicator thresholds need to be achieved for 75% of the bird species being monitored. Given the significant natural variability in bird distribution and abundance (caused by factors such as changes in climatic conditions, prey distribution etc) it is felt that 75% is an ambitious target, whilst ensuring that it is not overly sensitive to natural variability of these species.

⁶¹ See Charting Progress 2 – <http://chartingprogress.defra.gov.uk/>

⁶² Business As Usual Report, ABPmer 2012, Introduction(ii).

144. Although the management measures included in the baseline scenario are likely to play a significant role in achieving the proposed GES targets under this option, additional measures may be needed to further reduce the key human pressures on these species. Fisheries impacts remain a significant pressure both through by-catch (of birds, fish and mammals) and potentially through competition for prey species. For birds, predation by non-indigenous species on key seabird island colonies is also considered to be a significant pressure. Illustrative examples of the potential additional management measures needed to manage these pressures, and the costs associated with these are set out in Tables 1-3 below. The need for additional measures and the costs and benefits associated with these will become clearer once all the necessary monitoring is in place for these targets.

145. Broad initial estimates of the additional monitoring costs to Government and regulators associated with the GES targets and indicators proposed under this option are also set out in Tables 1-3 below. At this point in time it is difficult to say what proportion of these additional monitoring costs should be attributed to MSFD because monitoring programmes for the Birds and Habitats Directives are so closely interlinked with those that will be required under MSFD. More work will be carried out between now and the final impact assessment to look at the potential monitoring implications in more detail, including consideration of risk-based approaches to monitoring.

Option 2: Higher level of confidence of achieving GES

146. Under this option, most of the targets are the same as those proposed under Option 1. However, under this option we are proposing the higher 90% threshold in relation to targets for birds for species distribution, population size and abundance/distribution of key trophic groups (see paragraph 142 above).

147. Under this option, more individual bird species indicators would need to meet the required thresholds than under option 1 (90% as opposed to 75%). This would provide more confidence that bird populations are not being impacted by human pressures, but given the significant natural variability in bird distribution and abundance it is felt a 90% target would be extremely ambitious and could be overly sensitive to natural variability of these species.

148. As with Option 1, additional measures (beyond those included in the baseline scenario) may be needed to further reduce the key human pressures on these species. However, under this option the potential additional measures for birds may need to be applied more extensively or more quickly in order to improve the status of more species by 2020. Additional specific fisheries measures may also be needed to reduce pressures on particular bird species or colonies (beyond those identified for Descriptor 3).

149. In terms of monitoring, the costs would be similar to Option 1, but are likely to be somewhat higher under Option 2 due to the higher-level of precision and accuracy needed to determine whether 90% of species-specific indicators for birds are achieving their threshold values⁶³.

Table 1 – Targets for Marine Mammals (Descriptors 1 and 4)

	Reasonable Confidence scenario (Option 1 – preferred option)	Higher Confidence scenario (Option 2)
Targets –	In all of the indicators monitored,	Same as Option 1

⁶³ With the 75% target described in Option 1 there is scope for some indicators to be inconclusive and still reach the overall target – this implies that slightly less detailed analysis of the monitoring results could be tolerated, hence lower overall monitoring costs.

Species distribution	there should be no statistically significant ⁶⁴ contraction in the distribution of marine mammals caused by anthropogenic activities ⁶⁵ .	
Targets – Population size	In all of the indicators monitored, there should be no statistically significant decrease in abundance of marine mammals caused by anthropogenic activities ⁶⁶ .	Same as Option 1
Targets – Population condition	There should be no statistically significant decline in seal pup production and bottlenose dolphin calf production; and mortality of marine mammals due to fishing by-catch should be sufficiently low so as not to inhibit population size targets being met ⁶⁷ .	Same as Option 1
Targets – Productivity of key species	There should be no statistically significant decline in seal pup production and bottlenose dolphin calf production caused by anthropogenic activities ⁶⁸ .	Same as Option 1
Targets - Abundance/ distribution of key species/ trophic groups	In all of the indicators monitored, there should be no statistically significant decrease in abundance of marine mammals caused by anthropogenic activities ⁶⁹ .	Same as Option 1
Illustrative measures and costs	Many of the known human pressures on marine mammals, including by-catch and the impacts of contamination and noise, are already dealt with under existing legislation ⁷⁰ .	Measures and costs are the same as under Option 1.

⁶⁴ The way in which statistical significance of an event is determined will vary depending on the target, because some are set on indicators that are based on very different types of data e.g. trends, or proportions etc. However in every case, a statistically significant event is one which would have less than a 5% chance of occurring, if the null hypothesis were true. Given that <5% is a low probability, one could reject the null hypothesis and accept an alternative. In the case of a trend, the null hypothesis would be that a parameter stays the same in each year, but if a value from one or more years is shown to have less than a 5% chance of occurring, one would accept an alternative hypothesis that the value is significantly different statistically from the other values with which it is being compared.

⁶⁵ In 2012 this target will be based on indicators for grey seals and harbour seals distributional range only. Cetacean species indicators are likely to be added in 2018.

⁶⁶ In 2012 this target will be based on indicators for grey seals and harbour seals abundance only. Cetacean species indicators are likely to be added in 2018.

⁶⁷ In 2012 this target will be based on indicators for grey seal and harbour seal pup production and bottlenose dolphin calf production, and by-catch threshold targets for harbour seal, grey seal, harbour porpoise and common dolphin.

⁶⁸ In 2012 this target will be based on indicators for grey seal and harbour seal pup production and bottlenose dolphin calf production only.

⁶⁹ In 2012 this target will be based on indicators for grey seals and harbour seals abundance only. Cetacean species indicators are likely to be added in 2018.

⁷⁰ Relevant legislation includes the Habitats Directive, EU Regulation 812/204 and the Water Framework Directive. There are also relevant existing commitments under ASCOBANS and OSPAR in relation to by-catch, and under OSPAR in relation to contaminants.

	<p>The impact of fishing on marine mammal prey species is not well understood, but it is likely that the targets proposed under Descriptor 3 (commercial fisheries) could also support the achievement of targets for marine mammals. Costs associated with achieving these targets attributed to D3 (further details on p.80, Table 8).</p> <p>The behavioural impacts of underwater noise on marine mammals at a population level are not well understood, but the targets proposed under Descriptor 11 (noise) are also likely to support the achievement of targets for mammals. Costs associated with achieving these targets are attributed to D11 (further details on p.103 and 107, Tables 14 and 15).</p> <p>Monitoring costs A broad initial estimate of additional monitoring costs associated with these targets are as follows: £10kpa for extension of monitoring programmes on seals to ensure MSFD needs are covered⁷¹. £2-5m every 10 years for a census of cetacean populations (At this point in time it is difficult to say what proportion of these additional monitoring costs should be attributed to MSFD because monitoring programmes for the Habitats Directives are so closely interlinked with those that will be required under MSFD⁷²).</p>	
Summary	<p>Potential costs to business – No additional costs likely. Potential costs to government – Costs to Government from monitoring are estimated to be £2.1m – £5.1m⁷³ over 10 years. Due to the difficulties</p>	Costs are the same as under Option 1

⁷¹ Cefas CBA Report 2012, page 243. Additional costs presented here assume that no additional survey work is needed. Costs cover possible extra analysis costs to interpret the data to meet MSFD assessment requirements. Staff costs etc are already covered by the work undertaken for other obligations and are not included here.

⁷² Large scale surveys of marine mammals have been carried out in the past (SCANS/CODA surveys) to meet the requirements of the Habitats Directive, OSPAR and ASCOBANS. The need for future surveys will be driven both by these existing commitments and by the new requirements of MSFD, so the cost of these surveys should at least in part be attributed to MSFD.

⁷³ Cefas CBA Report 2012, p.219

	<p>in attributing these costs between MSFD and the Habitats Directive scenarios of apportioning 10% and 30% of the costs to MSFD have been considered to provide a rough scale of costs. This implies that the costs to MSFD range from between £209K-£ 1.5m over 10 years.</p> <p>Total potential costs – Overall costs are likely to be low with monitoring costs less than £209K-£1.5m over 10 years.</p>	
Key risks and assumptions	<p>The analysis above assumes that the existing policies in the baseline (e.g. Habitats Directive, CFP, action to mitigate marine mammal by-catch) will address the pressure on marine mammals. In relation to monitoring costs it is unclear what proportion of costs should be attributed to MSFD and what proportion to the Habitats Directive. Two scenarios have been considered – with 10% and 30% of the costs being apportioned to MSFD. These are scenarios rather than informed estimates. More work will be carried out between now and the final impact assessment to look at the potential monitoring implications in more detail.</p>	

Table 2 – Targets for Birds (Descriptors 1 and 4)

	Reasonable confidence scenario (Option 1 – preferred option)	Higher Confidence scenario (Option 2)
Targets – Species distribution	No major shifts or shrinkage in the population distribution of marine birds in 75% of species monitored ⁷⁴ .	No major shifts or shrinkage in the population distribution of marine birds in 90% of species monitored ⁷⁵ .
Targets – Population size	Changes in abundance of marine birds should be within individual target levels in 75% of species monitored ⁷⁶ .	Changes in abundance of marine birds should be within individual target levels in 90% of species monitored ⁷⁷ .
Targets – Population condition	Annual breeding success of black-legged kittiwakes should not be significantly different, statistically, from levels expected under prevailing climatic conditions (i.e. sea surface temperature); widespread seabird colony breeding failures should occur rarely (i.e. at <5-15% ⁷⁸ of colonies in no more than three years out of six);	Same as Option 1

⁷⁴ In 2012 this would be based on indicators for breeding seabirds, non-breeding shorebirds and coastal breeding waterbirds. Indicators for seabirds at sea and non-breeding waterbirds are likely to be added in 2018.

⁷⁵ See footnote 70.

⁷⁶ In 2012 this would be based on indicators for all breeding and non-breeding seabird and waterbird functional groups.

⁷⁷ See footnote 72.

⁷⁸ Further work is planned between now and the final impact assessment to define the appropriate % of colonies

	and mortality of marine birds due to fishing bycatch and aquaculture should be sufficiently low to not inhibit population size targets being met.	
Targets – Productivity of key species	Annual breeding success of black-legged kittiwakes should not be significantly different, statistically, from levels expected under prevailing climatic conditions (i.e. sea surface temperature).	Same as Option 1
Targets Abundance/distribution of key species/trophic groups	Changes in abundance of marine birds should be within individual target levels in 75% of species monitored ⁷⁹ .	Changes in abundance of marine birds should be within individual target levels in 90% of species monitored ⁸⁰ .
Illustrative measures and costs	<p>Gear restrictions/modifications to prevent bycatch of birds⁸¹. Seabirds can suffer incidental mortality by becoming snared in fishing nets or hooks. Such by-catch could be reduced by cost-effective mitigation measures in the relevant fisheries. To provide a rough indication of the scale of costs two potential measures have been considered. In longline fisheries (over 10m vessels) measures to prevent or deter birds from coming into contact with fishing gear are estimated to cost <18K⁸² per year. The inshore fleet, use gill nets near sea-cliffs can cause by-catch of seabirds – particularly when they are nesting. Measures to prohibit the deployment of such gear in areas where the birds are particularly vulnerable are estimated at £740k pa⁸³. Based on this assessment, total costs of these</p>	<p>The measures are the same as for Option 1, but they may need to be applied more extensively and more quickly in order to improve the status of more species by 2020.</p> <p>Additional specific fisheries measures to reduce pressures on particular species or colonies may also be necessary (beyond those identified for Descriptor 3).</p> <p>Monitoring costs In terms of monitoring, the costs would be similar to Option 1, but are likely to be somewhat higher under Option 2 due to the more detailed analysis needed to determine whether 90% of species-specific indicators are achieving their threshold values.</p>

⁷⁹ See footnote 70

⁸⁰ See footnote 70

⁸¹ Information on this measure is taken from the Cefas CBA Report 2012.

⁸² This is a very crude estimate. Currently there are 18 fishing vessels over 10m that use long lines. Defra policy experts have estimated that costs of installing devices to scare birds or submerge the lines when they are released in the water would be £1000 per vessel per year. This is an extremely rough estimate and further information on this will be sought during the consultation process (see Annex I).

⁸³ This is a very crude estimate. For the purposes of calculating costs a complete restriction of using gill nets near cliffs has been assumed. Based on consultation with Defra policy experts it was concluded only a small number of small fishing vessels (i.e. vessels under 10m in length) are likely to fish using gill nets near cliffs. On this basis it has been assumed that this measure will lead to a 5% reduction in the value of landings for these vessels, and that there will be no displacement of activities to recover a proportion of the landings lost from such restrictions. The value of landings for under 10m vessels is estimated to be £17.4 for demersal fisheries and £2.2 for pelagic fisheries and 76% of these landings are attributable to UK vessels (MMO report on The UK fishing Industry in 2010).

	<p>measures are estimated to be < £150K – £6m over 10 years. This is an extremely rough estimate and specific questions will be asked as part of the consultation process to inform these costs. There may also be benefits to fishermen from implementing these measures e.g. increased fishing efficiency, reduced loss of bait, less time lost through removing dead birds from nets. There will be no additional enforcement costs to Government over and above those indicated in the illustrative measures for D3.</p> <p>Eradication of invasive, non-indigenous mammals in seabird colonies⁸⁴.</p> <p>Two thirds of the total population of seabirds in the UK breed in offshore islands⁸⁵. In some of these islands predation by non-indigenous mammals (e.g. rats) can have a significant adverse impact on the seabird populations. Costs associated with eradicating non-indigenous mammals depend on the area where the planned eradication will take place and the species to be eradicated. The costs incurred will be due to planning, the purchase of equipment (including bait/poison/drugs), the time involved, and the necessary follow-up such as monitoring the status of the non-indigenous species. Based on eradication costs of £440 per hectare (2009 prices), the costs of eradication measures on the 16 highest priority islands would be £8.7m (2009 prices)⁸⁶. However costs of past eradications suggests that the costs outlined above may be an upper estimate – evidence from Natural England suggests a possibly lower cost per hectare for eradication,</p>	
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⁸⁴ Information on this measure is taken from the Cefas CBA Report 2012.

⁸⁵ Mitchell and Ratcliffe 2007.

⁸⁶ Costs based on the cost per ha of eradicating rats from Canna/Sanday during 2005–2006 (R. Luxmoore pers. comm) and prioritisation of islands as set out in Ratcliff et al 2009 - 'How to prioritize rat management for the benefit of petrels: a case study of the UK, Channel Islands and Isle of Man', For the purposes of this cost estimate islands in the Channel Islands, Isle of Man and Scilly Islands have been excluded as they are not covered by MSFD.

	<p>ranging from £150-£210 per hectare (2004 prices)⁸⁷. So the range of costs for eradication measures on the 16 highest priority islands are estimated at £3.5m -£8.9m (2010 prices)⁸⁸. These would fall on Government, regulators (and possibly voluntary organisations such as the National Trust) and likely to be one off provided there are no re-introductions. More information on costs will be gathered during the consultation process.</p> <p>Measures for preventing invasion of non-indigenous mammals on islands with seabird colonies⁸⁹.</p> <p>Invasive mammals such as rats can stow away in vessels which visit key island seabird colonies and colonise these islands, causing negative impacts on seabird populations. Measures can be put in place to prevent invasion of non-indigenous mammals on these islands (e.g. putting out traps on vessels, quarantine measures for food packages delivered by vessels). The costs would be borne by the owners/ operators of the vessels which visit these islands (e.g. costs of putting traps, keeping records, quarantining packages). There may also be costs to regulators of implementing quarantine regulations or guidelines and monitoring compliance of vessels. Effective quarantine measures may also increase the inconvenience for tourists visiting these islands, decreasing the number of visits⁹⁰ and reducing tour operator revenue. To inform estimates on costs more information will be gathered during the consultation process.</p> <p>Other measures The targets proposed under</p>	
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⁸⁷ Based on correspondence between JNCC and Natural England giving information on an internal review of past eradication costs by Natural England.

⁸⁸ Discounted costs were calculated using the GDP deflator to inflate the 2009 and 2003/2004 prices to 2010 prices.

⁸⁹ Information on this measure is taken from the Cefas CBA Report 2012.

⁹⁰ Opper et al, 2010

	<p>Descriptor 3 (commercial fish) are also likely to support the achievement of targets for birds, although their effectiveness would depend on how the associated measures are implemented⁹¹. Costs associated with achieving these targets are attributed to D3 (further details on p.80, Table 8).</p> <p>Monitoring costs</p> <p>A broad initial estimate of additional monitoring costs are as follows, but at this point in time it is difficult to say what proportion of these additional monitoring costs should be attributed to MSFD because monitoring programmes for the Birds Directives are so closely interlinked with those that will be required under MSFD⁹²:</p> <p>>£100k pa for monitoring aggregations of seabirds and waterbirds at sea.</p> <p><£100k pa for continuation of regular census of breeding seabird colonies.</p> <p><£50k pa for monitoring of winter aggregations of shorebirds.</p> <p>Additional costs for monitoring seabird by-catch (further detail to be provided for final IA).</p>	
Summary	<p>Potential costs to business – There could be costs to business in terms of measures to prevent invasion of non-indigenous mammals on island seabird colonies. Restrictive measures are likely to impact visitor numbers and consequently profits to business. There could also be costs to the fishing industry associated with measures to prevent seabird by-catch – although costs are likely to vary considerably depending on the type of measure and some measures may bring benefits to fishermen. A very crude estimate suggests potential loss of landings to fisherman of between <£150K–£6m over 10 years.</p> <p>Impact on small businesses – Since fishing enterprises tend to be small,</p>	<p>Potential costs to business – Costs are likely to be higher than in Option 1 as the measures are likely to be applied more extensively. Costs may also be incurred early on (rather than being spread out across the years) as the measures would probably need to be applied more rapidly.</p> <p>Potential costs to government – Monitoring costs slightly higher than under Option 1, due to higher level of accuracy required to determine whether 90% of species-specific indicators are achieving their threshold values.</p> <p>Total potential costs – Higher than under Option 1</p>

⁹¹ Some species benefit from discards, but the GES target proposals for birds have been developed such that these positive impacts do not bias the achievement of GES.

⁹² Cefas CBA Report 2012, pages 243

	<p>measures to prevent by catch of birds will have impact on small to medium sized enterprises and all of the estimated <£150K- £6m costs are likely to be on small to medium sized enterprises. Measures to prevent invasion of non-indigenous mammals are also likely to have impacts on small to medium sized enterprises as some of these tourist businesses can be small – medium scale. However, the Impact Assessment is only able to provide a qualitative description of these costs (as mentioned above).</p> <p>Potential costs to government –Costs to government from monitoring are estimated at <£ 2.1m over 10 years. Due to the difficulties in attributing these costs between MSFD and the Birds Directive, scenarios of apportioning 10% and 30% of the costs to MSFD have been considered to provide a rough scale of costs. This implies that the costs to MSFD range from between < £215K - £626K over 10 years. Costs to government and regulator of measures to eradicate non-indigenous mammals on island seabird colonies are estimated at £3.5m -£8.9m. There could also be costs to regulators for enforcement of quarantine measures for vessels visiting island sea-bird colonies.</p> <p>Total potential costs – The total costs are estimated to be <£3.8m-£15.9m over 10 years. Further information to inform the cost assessment will be collected during the consultation process.</p>	
<p>Key risks and assumptions</p>	<p>It has been necessary to make a significant number of assumptions in developing these cost estimates. For measures to reduce by-catch of birds the costs assumptions are based on discussions with Defra policy experts who felt that for both offshore longline vessels and inshore gill-netters the costs of potential measures would be relatively small. However, these assumptions have not been tested and will need to be revised based on information from the fishing industry during the consultation process. The cost assessment of measures to eradication of non-indigenous mammals on island seabird colonies assumes that eradication would be carried out in all 16 islands recommended in Ratcliffe et al (2009) – in reality a smaller number of islands could be targeted for action, hence the costs could be lower.</p> <p>In relation to monitoring costs it is unclear what proportion of costs should be</p>	

	<p>attributed to MSFD and what proportion to the Birds Directive. Two scenarios have been considered – with 10% and 30% of the costs being apportioned to MSFD. These are scenarios rather than informed estimates. More work will be carried out between now and the final impact assessment to look at the potential costs and monitoring implications in more detail.</p>
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Table 3 – Targets for fish (Descriptors 1 and 4)

	Reasonable confidence scenario (Option 1 – preferred option)	Higher Confidence scenario (Option 2)
Targets – Species distribution	The geographic and depth distribution of fish should meet individual indicator targets in a statistically significant proportion of species monitored.	Same as Option 1
Targets – Population size	The population abundance density and population biomass density of fish should meet individual indicator targets in a statistically significant proportion of species monitored.	Same as Option 1
Targets – Ecosystem structure	More than 30% (by weight) of fish in the Greater North Sea and 40% (by weight) of fish in the Celtic Seas exceed a length of 40cm and 50cm respectively.	Same as Option 1
Targets – Proportion of selected species at the top of the top of food webs	A specified proportion (by weight) of fish in any defined marine region should exceed a stipulated length threshold.	Same as Option 1
Illustrative measures and costs	<p>The targets proposed under Descriptor 3 (commercial fish) will play a significant role in supporting the achievement of biodiversity targets for fish. Costs associated with achieving these targets are attributed to D3 (further details on p.80, Table 8).</p> <p>Other measures</p> <p>Additional, bespoke measures may be necessary for threatened or vulnerable species which are not specifically addressed under existing legislation e.g. Atlantic salmon or basking shark. We are already exploring the extent to which bespoke management measures might be appropriate for the conservation of particularly vulnerable fish species like sharks and elasmobranchs (skates and rays). It is not at this point</p>	Same as Option 1

	<p>possible to estimate the costs of any specific measures. However, these might entail seasonal closures to protect spawning or juvenile areas or the introduction of minimum and maximum landing sizes to protect the breeding stock. There could also be enforcement costs to regulators - an estimate of these is included in the enforcement cost estimates provided under D3 (please refer to p.80, Table 8). Further research will be carried out during the consultation process to develop thinking on these potential measures.</p> <p>Monitoring costs There are no additional monitoring costs associated with these targets as they are based on existing groundfish surveys.⁹³</p>	
Summary	<p>Potential costs to business – Costs to business from D3 measures are described on page p.80, Table 8. Costs of adopting additional bespoke measures for particular species will depend on their range and extent. All the costs for the latter will fall on Small to Medium Size Enterprises (SMEs) as fishing enterprises tend to be small.</p> <p>Potential costs to government – There are no additional monitoring costs. There could be additional enforcement costs depending on the nature of any bespoke measures for threatened or vulnerable species.</p> <p>Total potential costs – Costs specific to these targets are currently uncertain. The costs of adopting measures for D3 are described separately.</p>	Costs are the same as Option 1
Key risks and assumptions	<p>There is significant uncertainty about what management measures might be needed to achieve these targets. For the purposes of this cost assessment it has been assumed that achieving the proposed GES targets under Descriptor 3 for Maximum Sustainable Yield in commercial fish stocks would be likely to play a significant role in supporting the achievement of these targets for fish biodiversity. However, it is actually very unclear whether these measures alone would be sufficient, or what additional measures might be needed.</p>	

⁹³ Cefas CBA Report 2012, pages 246

Target options for habitats (rock and biogenic reef, sediment and pelagic habitats)

150. Experts have proposed GES targets for pelagic, sediment and rock and biogenic reef habitats covering Descriptor 1 (biodiversity), Descriptor 4 (food webs) and Descriptor 6 (seafloor integrity). These include targets for habitat distribution, habitat extent and habitat condition, as well as physical damage (to the seabed), and condition of the benthic community. The proposed targets for pelagic habitats also cover the abundance/distribution of key trophic groups.
151. The approach to setting targets for these different habitats is set out in more detail in the Cefas CBA Report 2012⁹⁴. For benthic habitats (rock and biogenic reef and sediment habitats) existing targets under the Habitats Directive and Water Framework Directive have been used wherever possible, but new targets have been developed and proposed in relation to predominant sediment habitats⁹⁵, which are not covered by the Habitats Directive. The proposed baselines for benthic habitats are reference conditions which equate to minimal disturbance from human activity. Targets are set as a deviation from that baseline, recognising that achieving GES is consistent with sustainable use of the marine environment.
152. For pelagic habitats⁹⁶, there are no suitable targets in existing legislation and all the proposals for targets are new. The proposed targets and indicators all focus on plankton, which plays a crucial role in the pelagic food-web and the whole marine ecosystem. Changes in plankton are driven by climate but are also affected by human pressures, particularly eutrophication and fishing. The proposed targets and indicators are designed to identify changes in plankton caused by human pressures.
153. Experts have proposed targets which they believe are necessary and sufficient to achieve GES for these Descriptors. However, for both benthic and pelagic habitats it is recognised that there is a significant lack of evidence and understanding on both current and desired state, and ecologically meaningful GES target thresholds are uncertain. For this reason the options in the impact assessment consider a range of possibilities for implementing the targets proposed in the Cefas CBA Report. Under Option 1 (reasonable level of confidence of achieving GES), only some of the targets proposed by experts are put forward, and additional qualitative targets have been included. Under Option 2 (higher level of confidence of achieving GES) all the targets proposed by experts have been put forward.

Option 0: Baseline scenario

Benthic habitats:

154. The Business As Usual report concludes that the status of benthic habitats is expected to remain stable, or improve slightly between now and 2020. The main sources of pressure on benthic habitats arise from benthic fishing activity, which is predicted to decrease in spatial extent between 2010 and 2020 (and beyond to 2030). Therefore, there is likely to be an overall improvement in benthic habitats, depending on the spatial extent of new conservation measures that exclude demersal fishing activity and depending on the recovery rates of

⁹⁴ Cefas CBA Report 2012, pages 61-117

⁹⁵ These are broadscale, sediment habitats which cover a large % of the UK's seafloor. They are not currently protected by any existing legislation.

⁹⁶ Pelagic habitats refer to the water column. The focus of pelagic habitats is plankton. Plankton is the collective name for the small and microscopic organisms that drift with the waters of the sea; it includes bacteria, microscopic algae (phytoplankton), single-celled protozoans, microscopic animals (zooplankton) such as copepods (which are crustaceans), young fish, and larger animals such as jellyfish.

benthic habitats⁹⁷. However, despite projected improvements, the area of benthic habitats likely to be impacted by fishing pressure remains significant, particularly for certain habitat types⁹⁸. This corresponds with assessments made under Charting Progress 2 which suggest that there are still significant problems for shallow subtidal sediments and shelf subtidal sediments.

155. There are numerous measures already in place, or planned under the business as usual scenario, that are expected to reduce the key human pressures on benthic habitats. These include measures required under the Habitats Directive, management measures for the MPA network, the marine licensing regime, and existing measures to achieve more sustainable fisheries under the CFP. It has been assumed that measures taken under the Habitats Directive will be sufficient to achieve the proposed GES targets for rock and biogenic reef habitats (as these habitats are all protected by that Directive). However, it is not clear at this stage whether these measures alone will be sufficient to achieve the proposed GES targets for sediment habitats set out under Options 1 and 2 below, and for the purposes of this assessment it has been assumed that additional management measures may be needed (particularly in relation to fisheries).

Pelagic habitats:

156. Many changes are likely in the composition and distribution of plankton due to climate change pressures, although the precise nature of these changes is not known and their likely impact on food webs is unclear⁹⁹.

Option 1: Reasonable level of confidence of achieving GES (preferred option)

Benthic Habitats:

157. Under this option the targets proposed in the Cefas CBA Report 2012 are included for all rock and biogenic reef habitats and listed (special)¹⁰⁰ sediment habitats.

158. For predominant sediment habitats the indicators proposed by experts would be monitored, but the proposed quantitative targets would not be implemented at this stage on the basis that ecologically meaningful target thresholds cannot be set at the current time due to lack of evidence. Further monitoring and research would be carried out with the aim of setting robust, quantitative targets for predominant sediment habitats for the next cycle of MSFD in 2018.

159. However, recognising that Charting Progress 2 clearly indicates that some predominant sediment habitats are currently degraded, policy-makers have developed a higher-level, qualitative target which is proposed as an interim measure until more quantitative targets can be agreed. This is as follows:

- Improve the condition of sediment habitats, taking action to reduce impacts where these have been identified as unacceptable.

⁹⁷ Business As Usual Report, ABPmer 2012, Introduction(i).

⁹⁸ The Business As Usual report suggests that in 2020 30% of moderate energy circa littoral rock habitats could be impacted at medium or high intensity by surface abrasion from demersal trawling; around 65% of subtidal mud could be impacted at medium or high intensity by surface abrasion from demersal trawling, and; around 19% of subtidal coarse sediment could be impacted at medium or high intensity by surface abrasion from demersal trawling and around 10% by structural abrasion from fisheries dredging. Business As Usual Report, ABPmer 2012.

⁹⁹ Business As Usual Report, ABPmer 2012, Introduction(ii).

¹⁰⁰ These habitat types are all protected under existing legislation.

160. Although management measures included in the baseline scenario are likely to play a significant role in achieving the proposed GES targets under this option, additional measures may be needed to further reduce the key human pressures on sediment habitats. Fisheries impacts remain the most significant pressure on sediment habitats and where unacceptable impacts are identified it is likely that more significant fisheries management measures will be needed under the reformed CFP or national inshore measures in order to reduce these. Illustrative examples of the potential additional fisheries management measures needed to achieve the proposed targets for sediment habitats under this option are set out in Tables 5 below. The need for additional management measures and the costs and benefits associated with these will become clearer once all the necessary monitoring is in place for these proposed targets and indicators.

161. Broad initial estimates of additional monitoring costs to Government and regulators associated with the GES targets and indicators proposed under this option are set out in Tables 4-5 below. Additional monitoring for rock and biogenic reef habitats and some sediment habitats is likely to be needed in order to meet commitments under the Habitats Directives, but some of this monitoring will be additional due to MSFD. At this point in time it is difficult to say what proportion of the additional monitoring costs should be attributed to MSFD because monitoring programmes for the Habitats Directives are so closely interlinked with those that will be required under MSFD. More work will be carried out between now and the final impact assessment to look at the potential monitoring implications in more detail, including consideration of risk-based approaches to monitoring.

Pelagic habitats:

162. For pelagic habitats the targets proposed in the Cefas CBA Report 2012 would be put forward. As there is insufficient evidence to propose specific ecologically meaningful target thresholds for plankton the proposed targets are qualitative. They would require that the distribution, structure, condition and abundance of the plankton community 'are not significantly influenced by anthropogenic drivers'. Detailed indicators to measure progress towards the achievement of these targets are currently under development. Initial proposals are outlined in the Cefas CBA Report 2012¹⁰¹, but these will be developed further between now and the final impact assessment.

163. It is unclear at this stage whether additional measures would be needed to achieve the proposed targets. The measures proposed under Descriptor 3 (commercial fisheries) should support the achievement of these targets, as should the targets for Descriptor 5 (eutrophication). Provided these targets are achieved it is unlikely that additional measures would be necessary in relation to pelagic habitats.

164. In terms of monitoring an initial estimate of the additional monitoring costs associated with the proposed targets are set out in Table 6 below – these costs would fall primarily on Government and regulators.

Option 2: Higher level of confidence of achieving GES

Benthic habitats:

165. Under this option all the targets for rock and biogenic reef habitats and sediment habitats proposed in the Cefas CBA Report 2012 would be implemented.

¹⁰¹ See Cefas CBA Report 2012, Appendix 10: Appendix 10 - Detailed targets and indicators for each biodiversity Descriptor (p.230).

166. As with Option 1, additional fisheries management measures are likely to be needed under the reformed CFP in order to achieve the proposed targets for sediment habitats under this option. However, under this option the measures are likely to be more extensive, and therefore more costly to the fishing industry, than those proposed under Option 1.

167. In terms of monitoring there is no significant difference between Option 2 and Option 1, although Option 2 may be somewhat more costly due to the level of certainty needed to support quantitative targets for sediment habitats.

Pelagic habitats:

168. For pelagic habitats the proposed targets are the same as Option 1.

Table 4 – Targets for rock and biogenic reef habitats (Descriptors 1 and 6)		
	Reasonable confidence scenario (Option 1 – preferred option)	Higher Confidence scenario (Option 2)
Targets – Criterion 1.4: Habitat distribution	All listed (special) and predominant habitat types - Range and distribution are stable or increasing and not smaller than the baseline value (Favourable Reference Range ¹⁰² for Habitats Directive habitats).	Same as Option 1
Targets – Criterion 1.5: Habitat extent	All listed (special) and predominant habitat types - Area is stable or increasing and not smaller than the baseline value (Favourable Reference Area ¹⁰³ for Habitats Directive habitats).	Same as Option 1
Targets – Criterion 1.6: Habitat condition; Criteria 6.1: Physical damage; Criteria 6.2: Condition of the benthic community	All listed (special) & predominant habitat types - Area of habitat below GES (as defined by condition indicators) must not exceed 5% of the baseline value (Favourable Reference Area for Habitats Directive habitats)	Same as Option 1
Illustrative measures and costs	No additional measures (Habitats Directive will be achieving the target). Monitoring costs An initial estimate of additional monitoring costs is as follows, but it should be noted that some, if not all, of this monitoring is likely to be needed anyway to meet the	Measures and costs are the same as under Option 1

¹⁰² Favourable Reference Range is part of the assessment of Favourable Conservation Status under the Habitats Directive.

¹⁰³ Favourable Reference Area is part of the assessment of Favourable Conservation Status under the Habitats Directive.

	<p>requirements of the Habitats Directive¹⁰⁴:</p> <p>£250-500k pa for operational ship based monitoring of deep sea biogenic structures.</p> <p>£80k pa for rotation density assessment programme of rock and biogenic reef.</p>	
Summary	<p>Potential costs to business – None</p> <p>Potential costs to government – costs to Government from monitoring are estimated at £2.8-5m over 10 years. However, it should be noted that a significant proportion of these costs are likely to be incurred anyway under the Habitats Directive, so are not entirely additional under MSFD. To provide a rough scale of costs scenarios of apportioning 10% and 30% of the costs to MSFD have been considered. This implies that the costs to MSFD range from between £284K-£1.5m over 10 years.</p> <p>Total potential costs – Costs are likely to be low. Total monetised costs are estimated at £284K-£1.5m over 10 years.</p>	Costs are the same as Option 1
Key risks and assumptions	<p>The analysis above assumes that the existing policies in the baseline (e.g. Habitats Directive,) will address the pressure on rock and biogenic reef habitats. In relation to monitoring costs it is unclear what proportion of costs should be attributed to MSFD and what proportion to the Habitats Directive. Two scenarios have been considered – with 10% and 30% of the costs being apportioned to MSFD. These are scenarios rather than informed estimates. More work will be carried out between now and the final impact assessment to look at the potential monitoring implications in more detail.</p>	

Table 5 – Targets for sediment habitats (Descriptors 1 and 6)

	Reasonable confidence scenario (Option 1 – preferred option)	Higher Confidence scenario (Option 2)
Targets – Criterion 1.4: Habitat distribution	<p>Predominant habitat types - No target proposed – see qualitative target below for Criterion 1.6</p> <p>All listed (special) habitat types - Range and distribution is stable or increasing and not smaller than the baseline value (Favourable Reference Range for Habitats Directive habitats)</p>	<p>All listed (special) and predominant habitat types - Range and distribution is stable or increasing and not smaller than the baseline value (Favourable Reference Range for Habitats Directive habitats)</p>
Targets –	Predominant habitat types – No target	Predominant habitat types - area of habitat

¹⁰⁴ Cefas CBA Report 2012, pages 243

<p>Criterion 1.5: Habitat extent</p>	<p>proposed – see qualitative target below for Criterion 1.6 All Listed (special) habitat types: Area is stable or increasing and not smaller than the baseline value (Favourable Reference Area for Habitats Directive habitats) WFD extent targets for saltmarsh and seagrass should be used within WFD boundaries as appropriate.</p>	<p>lost, plus area of habitat below GES (as defined by condition indicators) is ≤15%. All Listed (special) habitat types: Area is stable or increasing and not smaller than the baseline value (Favourable Reference Area for Habitats Directive habitats) WFD extent targets for saltmarsh and seagrass should be used within WFD boundaries as appropriate.</p>
<p>Targets – Criterion 1.6: Habitat condition; Criterion 6.1: Physical damage; Criterion 6.2: Condition of the benthic community</p>	<p>Predominant habitat types – Improve the condition of benthic habitats, taking action to reduce impacts where these have been identified as unacceptable. All Listed (special) habitat types: Area of habitat below GES (i.e. unacceptable impact / unsustainable use) as defined by condition indicators must not exceed 5% of baseline value (favourable reference area for Habitats Directive habitats) WFD targets (km² thresholds) for area of unacceptable impact for benthic invertebrates, macroalgae, saltmarsh and seagrass should be used within WFD boundaries as appropriate.</p>	<p>Predominant habitat types - area of habitat lost, plus area of habitat below GES (as defined by condition indicators) is ≤15%. All Listed (special) habitat types: Area of habitat below GES (i.e. unacceptable impact / unsustainable use) as defined by condition indicators must not exceed 5% of baseline value (favourable reference area for HD habitats) WFD targets (km² thresholds) for area of unacceptable impact for benthic invertebrates, macroalgae, saltmarsh and seagrass should be used within WFD boundaries as appropriate.</p>
<p>Illustrative measures and costs</p>	<p>The major pressure on sediment habitats is considered to be bottom trawl fishing. Potential additional management measures which may need to be taken through the CFP or national inshore measures include: Ban on mobile demersal gear (MDGs) in a proportion of Marine Protected Areas. This illustrative management measure considers the costs of banning the use of MDGs over a proportion of the seabed¹⁰⁵. The estimated impacts have a cost range of £0.2m and £-0.72m per annum for vessels over 15 metres. For vessels under 15 metres, the costs are estimated at between £0.19 million and £0.56 million. Total costs could therefore range from approximately £0.39 million to £1.28million loss of</p>	<p>Same measures as for Option 1, but these would probably need to be applied more extensively and would therefore be more costly to the fishing industry than those proposed under Option 1. Monitoring costs Monitoring costs are the same as under Option 1.</p>

	<p>GVA, per year, implying costs over of £3.3m-£11m over 10 years¹⁰⁶</p> <p>Modification of fishing gear most damaging seabed¹⁰⁷</p> <p>This measure involves alterations to mobile demersal gear, rather than banning it as considered above. Both the costs and benefits of this measure would be expected to be lower than those of a ban. Benefits would be lower because disturbance to seabed habitats would still take place. Costs would be lower because the reduction in GVA from the fishing industry would be expected to be smaller, although the one-off costs of changing fishing gears could be significant, particularly if undertaken over shorter timescales than existing cycles of reinvesting in fishing gear. It should be noted that the relatively high cost of fuel is already encouraging a transition to lighter towed gears. For example, Dutch and UK beam trawlers have been experimenting with electronic pulse trawls (which are more fuel-efficient and less damaging to the marine environment). These have been found to reduce fuel costs by between 20% and 40%, discards by 20%, by-catch by 80% and the costs of the crew processing the catch by 50%. The cost of converting a traditional beam trawler to pulse trawling is estimated to be around £300,000. So far three of the UK beam trawl fleet have converted.</p> <p>Use of less destructive fishing gear¹⁰⁸</p> <p>It has been difficult to cost this</p>	
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¹⁰⁶ This analysis is taken from Cefas CBA report 2012. For the purposes of this measure it is assumed that use of mobile demersal gears is banned in all proposed Marine Conservation Zones. In reality decisions about which management measures are necessary to protect MCZs will be based on the individual conservation objectives of the site. The report uses proposed Marine Conservation Zones in non-Scottish UK waters as representative areas of the seabed. Costs have been estimated on the following basis:

- Estimates of the level of fishing effort and value of landings from use of Mobile Demersal Gears in the proposed MCZs.
- Assumption that under a ban, 0-50% of this activity would continue elsewhere in UK waters, and 25-75% would cease to occur altogether (would be lost to the economy). There is very little evidence on the displacement of these activities and hence the report looked at such a wide range to inform the modelling.
- 25% of the effort would be displaced into use of static gears in areas where this was not previously possible due to conflicts between static gear and MDGs.

The impacts are assessed relative to a baseline of the current situation. This may not be realistic given the ongoing process of CFP reform, but is a necessary simplification for this analysis. There may be also be additional costs relating to impacts on the landings of MDG vessels and on the entire fishing industry, which is not captured in the data used for this analysis.

¹⁰⁷ Information on this measure is taken from the Cefas CBA Report 2012, although additional information has been added. Cost estimates are provided by the Dutch industry.

¹⁰⁸ Information on this measure is taken from the Cefas CBA Report 2012.

	<p>measure without a specific description new gear types. Further qualitative description of the costs has been provided under D3 (see p.80, Table 8).</p> <p>Monitoring costs An initial estimate of additional monitoring costs is as follows¹⁰⁹: £2-4m pa for improving information on the seabed (e.g. creating maps of the seabed, increasing data from surveys). £100k pa for extension of monitoring to intertidal habitats to improve information.</p>	
Summary	<p>Potential costs to business – Costs to business from banning MDGs in a proportion of MPAs in terms of loss of GVA is estimated to be £3.3-£11m over 10 years. Modification of gear to reduce damage to the seabed is likely to cost less than banning gear and there could also be fuel savings to vessel owners, reducing the net costs. Further, information will be gathered during the consultation process to inform costs of any such measures. All these costs are likely to fall on small businesses as these fishing enterprises tend to be small.</p> <p>Potential costs to government – Costs to Government for monitoring are estimated to be £18m-£35.3m over 10 years.</p> <p>Total potential costs –Costs are likely to be moderate. The total estimates of the quantifiable costs are £21.4m - £46.3m over 10 years.</p>	<p>Costs are likely to be significantly higher than under Option 1 as the measures will need to be applied more extensively.</p>
Key risks and assumptions	<p>Some significant assumptions have been made in developing cost estimates for the illustrative measure of a ban on MDGs in MPAs, particularly in relation to displacement of fishing activity. The modelling assumes that under a ban, 0-50% of this activity would continue elsewhere in UK waters, and 25-75% would cease to occur (would be lost to the economy). There is very little evidence on the displacement of these activities and hence the Cefas CBA report considers wide range of displacement scenarios to inform the modelling. There are quantitative gaps in the costs assessment of the remaining measures and qualitative information is provided to fill these gaps. For the measure on modification of fishing gear most damaging to the seabed it has been assumed that costs to the fishing industry would be lower than for a ban of MDGs in MPAs because the implied changes in fishing practices are less significant than a ban and could be fitted into</p>	

¹⁰⁹ Cefas CBA Report 2012, pages 243.

	the existing cycle of replacing fishing gear. These costs are also likely to be low due to behaviour changes already happening in the fishing industry brought about by the need to be more fuel efficient.
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Table 6 – Targets for pelagic habitats (Descriptors 1, 4 and 6)

	Reasonable confidence scenario (Option 1 – preferred option)	Higher Confidence scenario (Option 2)
Targets – Criterion 1.4: Habitat distribution	Distribution of plankton community not significantly adversely influenced by anthropogenic drivers.	Same as Option 1
Targets – Criterion 1.6: Habitat condition	Condition of plankton community not significantly adversely influenced by anthropogenic drivers.	Same as Option 1
Targets – Criterion 1.7: Ecosystem structure	Structure of plankton community not significantly adversely influenced by anthropogenic drivers.	Same as Option 1
Targets – Criterion 4.3: Abundance/distribution of key species/trophic groups	Abundance/distribution of plankton community not significantly adversely influenced by anthropogenic drivers.	Same as Option 1
Targets – Criterion 6.2: Condition of the benthic community	Condition of the meroplanktonic (plankton with benthic life phase) community not significantly adversely influenced by anthropogenic drivers.	Same as Option 1.
Illustrative measures and costs	The key anthropogenic pressures on pelagic habitats are considered to be fishing and eutrophication. No additional measures are considered necessary in relation to eutrophication. In relation to fisheries, the targets for Descriptor 3 (commercial fish) will play a role in supporting the achievement of targets for pelagic habitats. Costs associated with these targets are attributed to D3 (further details on p.80, Table 8).	Measures and costs are the same as under Option 1

	<p>Monitoring costs An initial estimate of additional monitoring costs are¹¹⁰: £72k pa for additional inshore zooplankton monitoring. £210k pa for extension of monthly Continuous Plankton Recorder routes to fill gaps in UK waters.</p>	
Summary	<p>Potential costs to business – None – costs of D3 fisheries measures are considered on page p.80, Table 8 Potential costs to government – costs to government from monitoring are estimated at £2.4m over 10 years. Total potential costs – Costs are likely to be low. Total monetised costs are estimated to be £2.4m over 10 years.</p>	Costs are the same as Option 1
Key risks and assumptions	<p>For the purposes of this cost assessment it is assumed that measures proposed to achieve the targets for Descriptor 3 (fisheries) and Descriptor 5 (eutrophication) would be sufficient to achieve the targets proposed for pelagic habitats. The costs of those measures are attributed to D3 and D5 in order to avoid double counting. This assumption is based on scientific understanding of the key human pressures on pelagic habitats, but given the uncertainties in knowledge of pelagic ecosystems it may prove to be inaccurate.</p>	

Descriptor 2 – Non-indigenous Species

Background

169. It is widely accepted that one of the greatest threats to biodiversity across the globe is posed by non-indigenous species (NIS) which become invasive, known under the Convention on Biological Diversity as invasive alien species (IAS). Globalisation and a growth in trade and tourism have greatly increased the human-assisted movement of species over vast distances to new habitats where they may become invasive. It has been estimated that damage caused by terrestrial and marine invasive species worldwide amounts to almost five percent of the world economy¹¹¹. The cost to the British economy alone is estimated to be £1.7 billion per annum¹¹².

170. Invasive NIS may alter ecosystem processes¹¹³, decrease native species abundance and richness via competition, predation, hybridization and indirect effects¹¹⁴, change community structure¹¹⁵ and alter genetic diversity¹¹⁶.

¹¹⁰ Cefas CBA Report 2012, pages 243.

¹¹¹ Defra, (2008) The Invasive Non-Native Species Framework Strategy for Great Britain

¹¹² Williams, F. et al (2010) The Economic Cost of Invasive Non-Native Species on Great Britain. This includes terrestrial, freshwater and marine IAS.

¹¹³ Raizada, P., Raghubanshi, A.S., & Singh, J.S. (2008) Impacts of invasive alien plant species on soil processes: a review.

¹¹⁴ Gaertner *et al.*, (2008) Understanding biodiversity consequences of habitat change, *Journal of Applied Ecology* **45** pp883-893.

¹¹⁵ Hejda *et al* (2009) Impact of invasive plants on the species richness, diversity and composition of invaded communities, *Journal of Ecology*, **97** pp 393-403.

171. There is currently insufficient information to be able to properly assess NIS abundance and distribution in the marine environment. For IAS in particular, a lack of data on their abundance, distribution, introduction routes and ability to survive in new environments has resulted in limited assessment of their impacts. However, invasive NIS are already present in the marine environment and it should be recognised that these generally cannot be eradicated. GES for NIS in UK waters can therefore best be achieved by reducing the risk of new introductions and taking measures to manage newly established invasive NIS where feasible and cost effective.

172. The proposed UK characteristics of GES for this Descriptor are as follows:

- The risk from pathways and vectors which facilitate the introduction and spread of NIS as a result of human activities is significantly reduced, leading to a reduction in the risk of introducing new species some of which may have adverse impacts. Achievement of this will be based on an assessment of high risk areas and known pathways/vectors aiding the spread for such species.

Option 0 - Baseline Scenario

173. The BAU report 2011 concludes that by 2020 there will still be significant issues presented by invasive NIS and that these are unlikely to be resolved by 2030. The main anthropogenic activities that contribute to the introduction of NIS are maritime transport (both commercial and recreational) and aquaculture. Boats and ships may transport NIS either in ballast water or as biofouling (i.e. attaching to hulls, anchor chains and other parts of the vessel). Aquaculture activities can also cause unintended introduction of NIS when transporting species intended for cultivation. Whilst these activities are likely to increase over the next twenty years, there has also been an increase in the number of controls over these activities. In addition, climate change may create conditions which are more suitable for non indigenous species to establish themselves in UK waters¹¹⁷.

Option 1 – Target proposals

174. Due to the lack of information on current abundance, distribution and impacts of IAS, and the very high costs and lack of feasibility associated with widespread management or eradication programmes, the targets proposed for this Descriptor are operational targets, focused on:

- Taking measures to reduce the risk of introduction and spread of NIS (by managing key pathways and vectors more effectively), and;
- Putting in place management plans for dealing with key high risk species should they arrive in UK waters.

175. The proposed targets are based on the advice in the Cefas CBA Report 2012¹¹⁸, but the full range of targets proposed in that report has not been put forward in this impact assessment because several of them were felt to need significant further development work before they could be implemented. An additional operational target has also been developed by policy makers: 'Species specific action plans are developed for key high risk marine non indigenous species by 2020'. This is based on Cefas advice that efforts should focus on reducing the impact of NIS through the implementation of effective management measures, but the target proposed by Cefas has been changed to make it more specific.

¹¹⁶ Ellstrand, N.C., & Schierenbeck, K.A. (2000) Hybridization as a stimulus for the evolution of invasiveness in plants? *National Academy of Sciences USA* **97**, pp 7043-7050.

¹¹⁷ BAU Report 2012, ABPmer.

¹¹⁸ Cefas CBA Report 2012, section 2.1.

176. It is also proposed that the abundance and distribution of NIS in areas which are at a high risk of new introductions (e.g. ports) should be monitored as a surveillance indicator. This will allow assessment of whether measures to reduce the risk of new introductions are succeeding and would give useful information about which pathways and vectors of introduction may need additional management. It would also help to develop a baseline for NIS in high risk areas which could be used to develop a more specific, quantitative target for the next cycle of the Directive in 2018.
177. The proposed targets and indicators are in line with the GB Non Native Species Strategy approach of prevention, early detection and eradication where feasible. This approach is also likely to be compatible with the approach of the EU Invasive Alien Species Strategy which is currently being developed by the Commission and is expected to take the form of a new Directive.
178. Some measures are already in place to manage the key pathways and vectors of introduction of NIS, including controls on aquaculture and shipping. Legislation is also in place to ban the deliberate release of NIS into the wild¹¹⁹. However, additional measures are likely to be necessary to achieve the targets proposed for this Descriptor, but at this stage it is difficult to say what these might be. Most measures to reduce the risk of introductions of NIS need to be implemented at an international scale (e.g. through the International Maritime Organisation). A range of possible illustrative measures are costed in Table 7 below. However, further analysis of the key pathways and vectors of introduction of marine NIS is needed in order to establish which, if any, of these measures is necessary. This analysis will be carried out between now and the final impact assessment.
179. Development of species specific action plans for key species is something which has already been committed to in the GB Non Native Species Strategy and action plans for certain species have already been developed. However, very few marine species have been covered so far and this activity would need to be expanded to cover key marine species between now and 2020, implying additional costs for those developing and implementing the plans. The plans themselves are developed on a case by case basis where they can be shown to add value and the detailed actions they put forward are likely to vary from one species to another and possibly from one geographical location to another.
180. The proposed targets and indicators would also imply additional monitoring costs to government and regulators - primarily related to monitoring the abundance and distribution on NIS in high risk locations (e.g. ports). A review will be carried out between now and the final impact assessment to look at how far it is possible to reduce the costs of additional monitoring by using data on NIS from existing monitoring programmes or adapting existing monitoring to include assessment of NIS (e.g. monitoring which is already carried out in Marine Protected Areas which are in high risk locations).

Table 7 – Targets for non-indigenous species (Descriptor 2)

¹¹⁹ Section 14 of the Wildlife and Countryside Act (1981), The Conservation of Habitats and Species Regulations (2010), and the Offshore Marine Conservation Regulations (2009).

<p>Targets - Abundance and state characterisation of non-indigenous species</p>	<p>Reduction in the risk of introduction and spread of non native species through improved management of the main pathways and vectors.</p> <p>Indicator looking at the abundance and distribution of NIS in areas which are at a high risk of new introductions (with a view to being able to develop a baseline for the rate of establishment of new NIS).</p>
<p>Targets – Environmental impact of invasive non-indigenous species</p>	<p>Species specific action plans are developed for key high risk marine non indigenous species by 2020.</p>
<p>Illustrative measures and costs</p>	<p>Desk based study to assess high risk pathways of introduction One off costs of £50k. This will be ready in time to inform the final impact assessment.</p> <p>On the basis of this study a more robust assessment will be made of the potential management measures which might be needed to reduce the risk from key pathways, but these could include:</p> <p>Additional management of hull cleansing for large vessels¹²⁰ Currently, there are no common guidelines that cover how large vessels are cleaned from biofouling¹²¹. Existing government initiatives to stop the spread of invasive species is targeted mainly to smaller vessels. This measure would entail additional management of hull cleansing for large vessels by adopting guidelines developed through the IMO. The costs of the measure would depend on what the guidelines required. For this impact assessment it is assumed that guidelines could include more extensive record keeping and monitoring, prevention of in-water cleaning, and more regular on-shore cleaning of vessels using bio-secure methods.</p> <p>Costs to business in terms of maintaining record books and monitoring would be minimal as it would only be needed during actual cleaning operations. Costs associated with prevention of in-water cleaning are expected to be relatively low as large vessels do not tend to carry out much in-water cleaning. Costs associated with a requirement for more on-shore cleaning of vessels using bio-secure methods would be more significant and are estimated at £189m over 10 years¹²².</p>

¹²⁰ This measure is based on information in the Cefas CBA Report 2012, but has been significantly amended following discussions with the Maritime and Coastguard Agency, such that it is only applicable to large vessels and guidance is developed via an IMO convention.

¹²¹ Biofouling is the gradual accumulation of waterborne organisms on the surface of structures in the water, such as a ship's hull or mechanical equipment.

¹²² This based on the following assumptions discussed with the Maritime Coastguard Agency:

- That currently drydocking and reapplication of the anti-fouling system occurs every 5 years.
- Costs associated with drydocking are around £10k per day, plus £20k to get the ship in and out, and cleaning would normally take 3 days (based on insurers estimates, but acknowledging this will vary with vessel size).
- Loss of earnings for a ship are £10k per day (recognising that this could be an underestimate).
- That guidelines require vessels to be cleaned on-shore twice every 5 years
- That this applies to the 1,500 over 400gt UK flagged vessels covered by the IMO.

Costs to government associated with a mandatory code of practice would be around £40k+ for drafting legislation (based on cost of staff time, consultation etc)¹²³. There would also be additional costs for enforcement.

Additional management of ballast water in large vessels¹²⁴

There are a number of onboard ballast water treatment systems which eliminate harmful aquatic organisms by introducing chemical biocides or stripping oxygen from the water. Ballast water can then be discharged in compliance with the IMO Ballast Water Discharge Standards.

This measure will be applied to all large vessels that dock outside UK ports. Installation costs would vary from £125K-£1.5m¹²⁵ per ship (one off). Applying this across the UK fleet would imply costs of £185m – £2.25bn to business¹²⁶.

This measure may be disproportionately costly unless the benefits are substantial or the measure is targeted to specific vessels.

Additional use of biosecure treatment facilities in marinas¹²⁷

Small vessels (mostly those that are less than 1500 gross weight tonnes) tend to be treated for biofouling either by scrubbing the hull whilst the vessel is in the water or by removing vessels from the water. Areas where hull cleaning occurs pose an obvious risk of release of non-indigenous species. This measure would require vessels to use biosecure treatment facilities in marinas (such as closed-loop or hard standing washdown facility), which would ensure mobile organisms present in hull biofouling don't simply fall off or swim away from the vessel into the surrounding waters, and that sessile species and algae that are dislodged during scrubbing are not returned to the water.

Costs to marina owners of establishing a treatment facility is at least £45-50K and assuming this is set up across all the 250 UK coastal marinas the cost are estimated to be £11m-£12.5m¹²⁸. Further, the costs to vessel owners of using the service is estimated to be £100 per clean, with costs of £753m when discounted over 10 years¹²⁹. This measure may be disproportionately costly unless the benefits are substantial or the measure is targeted to specific vessels.

Mandatory guidance on small vessel water exchange¹³⁰

¹²³ The figure was arrived at using past cost overhead for MARPOL Annex VI although given the current regulation scrutiny process the figure is likely to be higher.

¹²⁴ This measure is taken from the Cefas CBA Report 2012, but has been further developed following discussions with DfT.

¹²⁵ This figure has been arrived after consultation with Marine Coastguard Agency (MCA).

¹²⁶ This is based on information from the Maritime Coastguard Agency which indicates that there are currently 1,500 over 400gt UK flagged vessels covered by the IMO.

¹²⁷ This measure is taken from the Cefas CBA Report 2012, but has been further developed following discussions with DfT.

¹²⁸ These are very rough estimates based on costs of supplying out of water boatlift cleaning by some private businesses. Although conversations with manufacturers indicated costs could come down if lots of orders were made. There are also likely to be additional cost to ports/marinas of loss of space to berth vessels due to the size of the lift. For the purposes of the analysis it has been assumed following discussion with DfT policy experts that all 250 UK 'coastal marinas' would need to install the treatment facilities, but this may be an over estimate.

¹²⁹ Using figures generated by the RYA/BMF participation study it is estimated that around 375,000 households own a small boat or craft in the UK that could be used in the sea. Most of these boats will be small. Royal Yachting Association figures suggest around 100,000 of these vessels are more capable sailing yachts or power boats with the rest being small RHIBs and day boats (BMF Watersports Participation report 2010). For a small vessel (eg: a yacht, a day fishing boat etc) it's likely that the vessel will be cleaned annually. For racing or charter vessels cleaning tends to be far more frequent as fouling is a significant drag issue – these vessels may be cleaned six plus times a year. Note that some of this cleaning may be done ashore with a pressure hose although it's unusual for such facilities to be bio-secure. On this basis the per year estimate is - [Total number of small boats excluding race boats (375,000-100,000) x cost per clean (£100)] + [race boats only (100,000)x100x6].

¹³⁰ This measure is based on information in the Cefas CBA Report 2012, but has been significantly amended following discussion with DfT so that it refers to grey water exchange rather than ballast water exchange, which isn't so relevant for small vessels.

	<p>Grey water includes water from the galley and showers. This would be applicable to smaller vessels and recreational craft. Costs to develop the guidance are likely to be £1K. Enforcements costs will vary depending on the size of the vessel that the measure applies to. 9FTE staff will be required by the MCA if small vessels needed to be regulated and 3FTE if larger vessels (400gt+) needed to be regulated. The costs per surveyor is likely to be £65Kper annum implying the total costs over 10 years will be £1.8m (large vessels) and £5.4m (smaller vessels)¹³¹. In terms of costs to business, the activity of grey water exchange itself is low cost (some pump costs) but filling forms and documents would be likely to be onerous given rapid cycling of ballast and grey water on small craft depending on weather and use. Pump-out to shore is likely to be of lower cost in marinas since most would pump direct to drains/sanitary facilities.</p> <p>Mandatory codes of practice for aquaculture for limiting spread of NIS (e.g. relating to aquaculture movements)¹³²</p> <p>There is existing legislation that covers aquaculture and the keeping and transport of non native species. However, in UK there is no mandatory existing code of practice for the aquaculture industry on fish movements in order to limit the spread of NIS. Costs to industry of this kind of measure would only be higher than current practices if new equipment was needed to limit spread and minimal if they were only required to keep records (as they are already required to do so under current legislation). There would be some additional time costs to government and regulators in developing guidance.</p> <p>Development of species specific management plans for key high risk species</p> <p>This is likely to entail some additional costs to regulators and stakeholders involved in developing the plans. These costs are expected to be relatively small (the time involved in developing the plans). The actions identified in the plans could also imply additional costs for both stakeholders and regulators - the costs will vary depending on the actions that are identified. As an example, the types of actions recommended in a recent plan for Water Primrose included increased public awareness raising, additional monitoring and eradication in certain locations. Eradication is likely to be the most costly action, for example CCW will again attempt to eradicate the Carpet Seasquirt (<i>Didemnum vexillum</i>) from Holyhead harbour at a cost of £420K over 3 months after an unsuccessful 8 month eradication project¹³³.</p> <p>Monitoring costs</p> <p>Some additional monitoring costs to government and regulators are also expected although these are likely to be less than £100k pa¹³⁴. Further work will be carried out between now and the final impact assessment to estimate these.</p>
Summary	<p>Potential costs to business – Costs of measures will depend on the analysis presented in the proposed desk based risk assessment. If some of the illustrative measures included above need to be implemented then there are likely to be costs to the industry. It is estimated that the costs to industry from all</p>

¹³¹ These figures are estimates provided by officials at the MCA.

¹³² This measure is based on information in the Cefas CBA Report 2012.

¹³³ Rohan Holt and Ashley Cordingley, 'Eradication of the non-native carpet ascidian (sea squirt) *Didemnum vexillum* in Holyhead Harbour: Progress, methods and results to spring 2011.'

¹³⁴ This is based on discussions with policy experts in Defra and advice from the Cefas CBA Report 2012, p.243.

	<p>the illustrative measures listed here would be at least £1.15bn- £3.2bn (partial estimate), or £194m (partial estimate) if the potentially disproportionately costly measures on additional management of ballast water for large vessels and bio-secure treatment facilities for all small vessels are excluded. It will also be important to note that these measures are illustrative and costs are high end. Any measures which are taken forward would not need to be implemented until 2016 which will imply that these will have lower costs than the estimates provided above.</p> <p>Impact on small business – The measures above for mandatory guidance for small vessel water exchange and additional use of biosecure treatment facilities are likely to impact small businesses such as small marinas, yacht charter businesses etc. It has not been possible to cost the impact on small businesses as it is unclear how many marinas are small businesses or how many small vessels are part of small businesses, rather than just being private vessels.</p> <p>Potential costs to government – It will cost Defra £50k to carry out a desk based risk assessment. If the research suggests adopting any of the illustrative measures then the costs are likely to be at least £41K (partial estimate) in terms of drafting legislation and developing guidance. A broad initial estimate of monitoring costs suggests that they would be less than £861k over 10 years. This brings the total quantified costs to government as £952K over 10 years.</p> <p>Total potential costs – Costs could potentially be high. The total cost of all the illustrative management measures set out above is £1.15bn -£3.21bn over 10 years, or £195m over 10 years if the potentially disproportionately costly measures on additional management of ballast water for large vessels and bio-secure treatment facilities for all small vessels are excluded. However, the need for additional management measures is not yet clear and will be informed by the desk based risk assessment. So the costs range between £911K (no additional measures required) and £195m (all the potential additional measures discussed are required).</p>
Key risks and assumptions	<p>The costs are maximum costs which assume all the illustrative measures are adopted. In reality, decisions about the need for additional measures will be based on the proposed desk based risk assessment and further discussion with the relevant industries. The cost analysis for the different measures makes a number of specific assumptions which are set out in the footnotes. Several of the assumptions are based on advice from policy experts in DfT and the MCA and have not been tested. Further information to support these assumptions will be gathered during the consultation process.</p>

Descriptor 3 – Commercially exploited fish and shellfish

Background

181. MSFD requires commercially exploited fish and shellfish to be within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock. This means that commercial species will be exploited sustainably (consistent with the highest sustainable long term yield), species will have adequate reproductive capacity for replacement (able on average to reproduce at least once before being caught) and that stocks will have an age and size distribution that avoids impaired recruitment.

182. A significant number of scientifically assessed finfish stocks are considered to be fished sustainably. However, many remain below the levels expected to provide the highest long term

yield and the majority of demersal stocks have declined in recent years¹³⁵, even though EU catches have steadily declined since 1993 at an average rate of 2% per year. The European Commission is therefore continuing to develop a series of multi-annual management plans to recover depleted stocks, and to manage them sustainably in the longer-term.

183. The CFP¹³⁶ is the principle legal mechanism for managing fish stocks in EU waters, though for some inshore species (predominantly shellfish) national or local management measures exist. The achievement of Maximum Sustainable Yield (MSY)¹³⁷ is therefore dependant on it being possible to take appropriate measures under a reformed CFP. Any appropriate measures would require the approval of the Commission and the other relevant Member States.

184. The proposed UK characteristics of GES for this Descriptor are as follows:

- The level of stock mortality generated by fishing activity (F) is equal to or lower than F_{msy} - the level capable of producing Maximum Sustainable Yield (MSY) for the long-term. Where F_{msy} is not known, the proxy will be the catch/biomass ratio that is consistent with MSY.
- The spawning stock biomass (SSB) is at a level capable of delivering MSY.
- Each fish stock contains a high proportion of mature fish and an appropriate age structure.

185. The UK is an international leader in the field of fish and shellfish stock assessment and is able to draw on extensive data sets, some dating back over 100 years. In more recent times, the EU Data Collection Framework¹³⁸ has standardised data collection requirements across the EU. For this reason, there is sufficient scientific certainty for experts to propose a single set of targets for GES in relation to this descriptor.

Option 0 – baseline scenario

186. For the purposes of the baseline scenario it is particularly difficult to distinguish how far the achievement of the proposed targets is additional due to MSFD and how much would be achieved anyway as a result of pressure to improve the environmental outcomes of the CFP. The UK would be pursuing environmental integration as one of its goals for CFP reform irrespective of the MSFD. It could, therefore, be argued that from the UK's perspective, that all costs and benefits of achieving the targets proposed for this Descriptor should be included within the baseline. However, it is unlikely that the wider EU approach to CFP reform would deliver the outcomes the UK is seeking without the added pressure for environmental outcomes provided by MSFD. For this reason for the purposes of this impact assessment we have assumed that some of the costs and benefits of achieving the proposed targets are attributable to MSFD. Three different scenarios of apportionment have been considered based on attributing 50%, 25% and 10% of the costs to MSFD – these are described in more detail in Table 8 below.

¹³⁵ European Commission (2009) COM(2008) 453 Final communication from the Commission to the European Parliament and to the Council on promoting the adaptation of the European Union fishing fleets to the economic consequences of high fuel prices. Brussels, Belgium. See: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2008:0453:FIN:EN:PDF>

¹³⁶ The Common Fisheries Policy (2002, and due for revision in 2012) is the EU's instrument for the management of fisheries and aquaculture. It is highly centralised with EU Ministers making decisions each year on catch limits on 'quota' stocks and related measures such as the time fishermen can spend at sea. The CFP also provides financial support through the European Fisheries Fund as well as providing the regulatory framework for monitoring, control and enforcement.

¹³⁷ Maximum Sustainable Yield, or MSY, is the largest average catch that can be taken from a particular fish stock for an indefinite period i.e. without threatening its long-term viability.

¹³⁸ Council Regulation (EC) No 199/2008 concerning the establishment of a community framework for the collection, management and use of data in the fisheries sector and support for scientific advice regarding the CFP.

Option 1 – Target Proposals

187. Fish stock management within the CFP currently utilises “safe biological limits” within the Precautionary Approach (PA). These limits are defined in terms of thresholds for the upper level of fishing mortality and lower level of (adult) spawning stock biomass. This prevents high levels of fishing mortality reducing stock size and impeding reproductive potential. Where possible scientific evaluation of each stock’s status relative to its safe biological limits is published annually by the International Council for the Exploration of the Sea (ICES) – based on information provided by Member States’ scientific authorities. ICES also provide an assessment against more ambitious stock specific targets for fishing mortality rates to achieve high levels of average yield.
188. For this Descriptor it is proposed that MSFD targets are based on the achievement of stocks within the safe biological limit precautionary thresholds, whilst aiming, in the medium-long term, for the more ambitious stock specific targets for fishing at levels consistent with the Maximum Sustainable Yield (MSY). Achieving a fishing mortality rate of MSY for all stocks is considered to be equivalent to safe biological limits, while also reducing fishing pressure on the wider ecosystem¹³⁹.
189. The UK Government has accepted the principle of MSY under a number of different commitments including the World Summit on Sustainable Development (WWSN). However, MSY is a single-species target, taking no account of species interactions or the mixed nature of many EU fisheries. Therefore, given the variability inherent in the targets for single species and the difficulty of simultaneously maintaining all stocks in a mixed fishery at MSY, for some stocks MSY may be considered to be a range of exploitation rates which take into account changes in stock dynamics. The proposed targets will not be directly applied to all fish and shellfish stocks exploited in UK waters but instead to a selection of stocks chosen to be representative of all commercial stocks, based on scientific advice.
190. There is currently little detailed information about the approach other Member States are likely to take to setting targets for this Descriptor. However, ICES is in the process of developing advice on methodologies for GES targets for commercial fish and the approach proposed in this impact assessment has been put forward by UK scientists in ICES.
191. Delivering the proposed GES targets for this Descriptor will, with the exception of measures for shellfish and other stocks where there is some scope for national measures, be dependent on the success of fisheries management measures that will be determined and agreed under the reformed CFP. The UK’s approach to CFP reform is entirely consistent with the approach to targets proposed for this Descriptor.
192. For shellfish, as most commercial species are not managed directly through the CFP, we have considered the potential costs of other measures which could be taken on a national or more local basis; e.g. technical conservation¹⁴⁰, limits to landings, use of less destructive gear and the protection of key shellfish life stages.
193. No new monitoring programmes will be required in relation to these targets for finfish stocks, provided the stocks selected as indicators are those already covered by the EU Data Collection Framework. There could however be some additional monitoring and assessment costs in relation to shellfish stocks (e.g. for scallops, crab and lobster). These costs will vary depending on which stocks are included in the assessment of GES.

¹³⁹ More information on the proposed approach can be found in the Cefas CBA Report 2012, Section 2.2

¹⁴⁰ For instance changes to fishing gear and minimum and maximum landing sizes.

Table 8 – Targets for commercial fish and shellfish (Descriptor 3)

Targets – Fishing Mortality	As a first step, all stocks must be exploited at Fpa or lower (short-term objective by 2015). Subsequently, the exploitation rate of each stock is either at FMSY for each stock, or where specified, within the range of possible fishing mortalities consistent with FMSY for each stock (medium- to long-term objective) ¹⁴¹
Targets – Reproductive Capacity of Stock	It is proposed that the target would be that the spawning stock biomass / total biomass/ biomass proxy is above the agreed stock specific threshold. ¹⁴²
Illustrative measures and costs	<p>A range of potential measures are likely to be necessary to achieve the proposed targets. Many of these would need to be taken through the CFP and they are in line with the UK’s position on CFP reform. It has not been possible to identify how far these measures should be seen as additional under MSFD, but MSFD is considered to be one of the key drivers of environmental integration in the reformed CFP. For this reason all potential additional fisheries measures are covered here for the sake of simplicity, even though it is acknowledged that the CFP is the primary delivery mechanism:</p> <p>Technical measures¹⁴³</p> <p>Technical measures are a catch-all term for the whole range of rules governing how and where fishers may fish. Technical measures include minimum/maximum landing sizes, minimum mesh sizes for nets, closed areas and seasons, limits on bycatch, requirements to use more selective fishing gear etc. Costs have been estimated for potential measures on shellfish:</p> <p>Using estimates from a published Special Area of Conservation (SAC) Final IA, the costs of increasing the minimum and maximum landing sizes for crustaceans within all MPAs is estimated to be £11.5m – £17.1m over 10 years and the costs of imposing a cap on the number of pots deployed for crustaceans in all Marine Protected Areas is estimated to be £17.1m - £23.2m over 10 years¹⁴⁴. However, the calculations only use MPAs already designated currently to arrive at estimates and hence do not include MCZs and Scottish MPAs. Additionally there is likely to be overlap with the baseline as the measure is already adopted in some of the MPAs. Additionally, both calculations assumed that the technical measures applied to the whole SAC site. In practice, technical measures may be aimed only</p>

¹⁴¹ For stocks with analytical estimates of fishing mortality targets will be based on the agreed management plan long-term target fishing mortality/exploitation rate or the ICES estimate of F_{MSY} or optimum exploitation rate. For stocks without analytical estimates of fishing mortality the targets will be based on an agreed proxy for exploitation rate derived from the stock age/length structure.

¹⁴² For stocks with analytical estimates of spawning/total biomass, or proxies for them, the base line would be the agreed, stock specific management threshold. Currently ICES uses the threshold $B_{trigger}$ in association with the FMSY target value.

¹⁴³ This measure is based on information in the Cefas CBA Report 2012, but has been further developed with a specific costed example for shellfish.

¹⁴⁴ The figures are based on information contained in the final IAs for 3 SACs (inner Dowsing Race Bank and North Ridge; Lyme Bay and Torbay; and Prawle Point to Plymouth South and Eddystone). Costs for the increases in the minimum landing size and the introduction of minimum landing sizes for crustaceans were estimated to be £0.001-£0.004m. For the introduction of a cap on pots deployed they were estimated to be £0.001m-£0.008m. Minimum and maximum landing sizes would be variable. For the purposes of the IA analysis it was assumed that the measure might affect 25% of landings of crustaceans. Similarly, for the measure on reduction of pots and traps costs of a reduction by 50 percent is estimated. This is assumed to affect 50 percent of the value of landings from potting. These costs were scaled up to arrive at a UK figure by multiplying them by total landings by UK vessels using pots and traps (specifically used for catching crustaceans) and then dividing by the crustacean landings in each site. The figure was then scaled down to MPA sites by using the proportion of MPA designated (5.6% of UK waters). Minimum and maximum landing sizes would be variable. For the purposes of the IA analysis it was assumed that the measure might affect 25% of landings of crustaceans.

at interest features for which they are required.

Fleet capacity control measures¹⁴⁵

The rationale behind fleet capacity control measures is to secure sustainable exploitation of fish stocks. In order to achieve this, the size and power of the fishing fleet has to be better aligned with the available stocks they target (or their effort adjusted accordingly). If the Government were to actively manage this process as they have done on several occasions in the past with decommissioning schemes, the costs would be significant - estimated at £3000-£3500/vessel tonne. So for example, if we assume 20% of the larger vessels¹⁴⁶ were decommissioned the cost to government would be some £113m-114m. Previous experience has however suggested that funded decommissioning of vessels is not a particularly cost effective method of capacity reduction – and there are some alternatives to achieve the desired balance, for example improving existing marketing opportunities. Given the high costs and low potential benefits this measure is likely to be disproportionately costly and hence is unlikely to be considered as part of the programme of measures for MSFD.

Use of less destructive gear¹⁴⁷

A move towards less destructive gear should have a positive impact on the health of many stocks, particularly shellfish, providing greater protection of their respective habitats. There will however be costs for those fishermen who change the type of gear they use e.g. move from beam trawling or scallop dredging to static gear or long lining. However, fishermen normally replace their gear at least every couple of years as a result of natural wear and tear (in some cases more frequently than this), so assuming that there would be a significant period of grace to allow for any change, there should be no additional replacement cost for those who simply improve the selectivity of their gear e.g. by increasing the mesh size or adding a square mesh panel. This could even result in some savings from reduced use of material in larger mesh nets, although a significant proportion of the cost of any new gear would be labour costs. In addition, the improved selectivity could detrimentally alter the catch levels of fishermen (or their species composition). More information on the costs and potential impacts of any measures will be gathered during the consultation process.

Limit on landings¹⁴⁸

Limitations of this sort are an important additional measure which can be applied at national level. Particularly for those shellfish and other stocks which are not covered by the CFP. For fish and shellfish stocks which are covered by the CFP, most species are already subject to catch controls – although these may need to be more stringent to enable the proposed targets to be met. This is in line with the UK approach to CFP Reform. Modelling carried out by Eftec for the Pew Trust contains data on the level of reduction of catch necessary to allow stock recovery. Estimates indicate economic losses to be £469m for recovery over 10 years¹⁴⁹.

¹⁴⁵ This measure is based on information in the Cefas CBA Report 2012, but has been developed further.

¹⁴⁶ The UK fleet consists of some 6477 vessels (2010), of which 5047 are under 10 metres in length, leaving 1430 'larger' vessels. So the gross tonnage (GT) of the 6477 vessels is 207,424 of which the over ten sector accounts for 190,110. The same figures for kW capacity i.e. power are 826,668 and 553,795 respectively.

¹⁴⁷ This measure is based on information in the Cefas CBA Report 2012, but has been developed further.

¹⁴⁸ This measure is based on information in the Cefas CBA Report 2012, Appendix 13.

¹⁴⁹ The work carried out for the Pew Trust involved a modelling and simulation approach in which firstly stock and landings data was used to model stock growth rates, then the estimated parameters were transferred to models of whole commercial groups of fish at the scale of Large Marine Ecosystems (LMEs). These included the North Sea and Celtic-Biscay Shelf, where the majority of UK fishing is carried out. Data constraints made it impossible to model all the different groups, and for both these regions models were constructed for cod-likes, herring-likes, perch-likes and

	<p>However, a number of recent highly respected reports, including one from the World Bank¹⁵⁰, suggest that there is considerable scope for offsetting these costs through a significant increase in future returns from the fisheries concerned. These benefits have been illustrated in section E.</p> <p>Measures to protect key shellfish life stages¹⁵¹</p> <p>This relates primarily to a prohibition on the landing of certain crustaceans when they are ovigerous (carrying or bearing eggs). There are already such measures for crabs nationally and lobsters in some Inshore Fisheries and Conservation Authority (IFCA) areas. Further measures to protect the landing of ovigerous lobsters nationally would increase the long term benefit for all lobster fishermen. However, since we are only effectively extending the scope of the controls (i.e. applying them beyond those IFCA areas) the costs to business and government are likely to be low, but then the marginal increment to benefits in the short term is also likely to be low. The impacts and feasibility of the measure will however be further explored during the consultation process.</p> <p>Monitoring and enforcement costs¹⁵²</p> <p>Some additional monitoring costs are likely in relation to shellfish stocks, although these are anticipated to be relatively small.</p> <p>No additional monitoring costs are anticipated in relation to CFP stocks.</p> <p>Possibility of additional enforcement costs (additional for shellfish, incremental for CFP stocks).</p> <p>The consultation process will be used to gather more information on what the monitoring costs are likely to be.</p> <p>To provide very rough estimate of enforcement costs, estimates in the MMO's business plan have been used. They have projected c£200K increase between 2011 and 2013 and hence we assume the additional costs of CFP reform (and MSFD) will be £100K per annum¹⁵³.</p>
Summary	<p>Potential costs to business – Costs are likely to range from £28.6m to £40.3m over 10 years for changes in fishing gear and landing sizes for shellfish in MPAs. The restrictions on less destructive fishing gear are likely to have cost implications for fishermen who have to switch gears and it might also have implications for their catch levels as well. Limits on landing sizes will have cost implications for fishermen (£469m over 10 years), but are also likely to have substantial benefits in the medium-long term. Measures to protect shellfish life stages are likely to have low incremental costs for business. Given the close interaction between CFP and MSFD there is very little information on how much of these costs will be attributable to MSFD alone. Therefore 3 scenarios of apportionment of costs to</p>

flatfishes, representing 73% of landings values for the North Sea, and 46% for the Celtic-Biscay shelf. The UK took approximately one-third of the value of North Sea landings, and a quarter of Celtic-Biscay landings. Please refer to Annex A for further details of this modelling approach.

Also, these costs are largely comprised of revenues foregone, due to data availability. A more accurate presentation of these costs would be in terms of GVA or profits affected (further discussions will be required to decide which of the two approaches will be appropriate). Adopting such an approach would imply that the economic costs to the fishing industry associated with these indicative measures are likely to be lower than presented here. This will be revisited if possible in the final Impact Assessment

¹⁵⁰ The Sunken Billions: The Economic Justification for Fisheries Reform. The World Bank, 2009: <http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTARD/0,,contentMDK:21930578~pagePK:148956~piPK:216618~theSitePK:336682,00.html>

¹⁵¹ This measure is based on information in the Cefas CBA Report 2012.

¹⁵² Cefas CBA Report 2012, p.246

¹⁵³ This has been simply arrived at by dividing the £200K figure by 2 as the increase is over a two year period (2011-2013).

	<p>MSFD have been considered (50%, 25% and 10%). For these 3 scenarios the costs to MSFD alone are - £252m, £126m and £50m respectively¹⁵⁴ over 10 years. The consultation process will be used to further refine these estimates. Most of these costs will fall on small businesses as fishing enterprises tend to be small and medium scale.</p> <p>Potential costs to government – There are likely to be no significant additional monitoring costs but there may be additional enforcement costs in the region of £861K over 10 years. However, not all the enforcement costs will be attributable to MSFD as some will fall under CFP. Therefore 3 scenarios of apportionment of costs to MSFD have been considered (50%, 25% and 10%). For these 3 scenarios the costs to MSFD alone are £431K, £215K and £86K over 10 years. The consultation process will be used to further refine these estimates.</p> <p>Others – There are also likely to be social and distributional effects and certain fishing communities may be forced to adapt their activities if these measures were implemented.</p> <p>Total potential costs – The costs are likely to be moderate to significant. However, a large proportion of these costs will be attributable to the CFP. As per the scenarios above the costs to MSFD alone have been estimated to be roughly £252m, £126m and £50m¹⁵⁵.</p>
Key risks and assumptions	<p>A number of assumptions have been used to arrive at the estimates of costs and these have been described in detail in the footnotes. However, the key assumption driving the figures is the one related to the apportionment of costs between MSFD and CFP. It was very challenging to estimate what proportion of these costs would be driven by CFP and what proportion would be driven by MSFD. Percentage scenarios of 50%, 25% and 10% of costs attributed to MSFD have been used. These are primarily illustrative, but are based on conclusions of policy experts that the majority of costs should be attributed to CFP as this is considered to be the main driver for the necessary measures.</p>

Descriptor 5 – Eutrophication

Background

194. Eutrophication¹⁵⁶ is one of the major threats to the health of estuarine, coastal and shelf sea ecosystems around the world. Anthropogenic nutrient enrichment mainly from sewage and agricultural sources can result in undesirable disturbances to the balance of organisms in the marine environment, adversely affect water quality, and cause changes to the structure and function of ecosystems.

195. The proposed UK characteristics of GES for this Descriptor are as follows:

- Nutrient concentrations do not lead to an undesirable disturbance to the balance of organisms present in the water or to the quality of the water concerned resulting from accelerated growth of algae; and

¹⁵⁴ These estimates were arrived at by applying the 50%, 25% and 10% apportionment scenarios to the total cost to business which was estimated to be (£495m). Also, these costs are largely comprised of revenues foregone, due to data availability. A more accurate presentation of these costs would be in terms of GVA or profits affected (further discussions will be required to decide which of the two approaches will be appropriate). Adopting such an approach would imply that the economic costs to the fishing industry associated with these indicative measures are likely to be lower than presented here. This will be revisited if possible in the final Impact Assessment.

¹⁵⁵ Please note that the overall figure is close to costs to business as the monitoring costs are relatively small (compared to the costs to business) and hence do affect the overall figures which have been rounded.

¹⁵⁶ Eutrophication is the enrichment of water by nutrients, especially compounds of nitrogen and/or phosphorus, causing an accelerated growth of algae and plant life which produces undesirable disturbance to the balance of organisms present in the water and to the quality of the water concerned.

- The direct effects of nutrient enrichment associated with algal growth do not constitute or contribute to an undesirable disturbance to the balance of organisms present in the water and to the quality of the water concerned ; and
- Indirect effects of nutrient enrichment associated with growth of macroalgae, sea grasses, and reductions of oxygen concentrations do not constitute an undesirable disturbance to the balance of organisms present in the water and to the quality of the water concerned.

196. We have a high confidence in our assessment of eutrophication in UK coastal and offshore areas¹⁵⁷ due to the availability of extensive datasets and the enhanced monitoring employed in regions previously reported as being of concern. For this reason, there is sufficient scientific certainty for experts to propose one option for GES targets and indicators in relation to this Descriptor.

Option 0 – Baseline scenario

197. The projected baseline set out in the BAU report concludes that there are few problem areas in relation to eutrophication at present and that current management measures are considered likely to be sufficient to ensure improvements in remaining areas of concern by 2020¹⁵⁸. Also, it can be argued that due to the very small scale of these problem areas, eutrophication is already minimised in the relevant sub-regions. It is concluded on this basis that the UK will achieve GES for this Descriptor under the baseline scenario.

Option 1 – Target proposals

198. The targets proposed for eutrophication reflect the fact that we expect to achieve GES under the baseline scenario and they are all based on existing OSPAR or Water Framework Directive targets and how these are used to assess eutrophication. They have therefore already been coordinated regionally and we have high confidence that similar targets will be adopted by other Member States¹⁵⁹.

199. It should be noted that the targets proposed here must be considered holistically with the overall eutrophication goal of ensuring no undesirable disturbance (adverse effects) at the scale of the (sub) region resulting from anthropogenic nutrient inputs in mind. This reflects the methodology used to determine eutrophication status under the OSPAR Common Procedure i.e. failure to meet an individual target does not, on its own, necessarily signify eutrophication problems¹⁶⁰.

200. The UK will utilise existing monitoring programmes under the Water Framework Directive and OSPAR to meet monitoring requirements for MSFD. There are likely to be small additional monitoring costs of between £10 and £100k per annum to cover the cost of plankton related eutrophication monitoring¹⁶¹. Any measures which would be required to meet our targets for GES would already be taken under the WFD, the Nitrates Directive and the Urban Waste Water Treatment Directive; therefore our assessment is that there will be no additional cost implications from these targets beyond the additional monitoring costs mentioned above.

¹⁵⁷ OSPAR Comprehensive Procedure for the identification of eutrophication status in 2007 and assessments prepared under relevant EU Directives (including UWWT, Nitrates, and Water Framework Directives).

¹⁵⁸ BAU Report 2011, ABPmer, Introduction(ii)

¹⁵⁹ Further information on the approach to the proposed targets can be found in the Cefas CBA Report 2012, Section 2.3

¹⁶⁰ For example, it might be acceptable to have nutrient levels in the sea which exceed the target in a particular area provided that this does not lead to eutrophication effects such as elevated levels of chlorophyll or other undesirable disturbances.

¹⁶¹ Cefas CBA Report 2012, page 246.

Table 9 – Targets for eutrophication (Descriptor 5)¹⁶²

Commission Criterion	Non Problem Areas 2007/2010	Problem Areas 2007/2010
Targets – Nutrient levels	No increase in the assessed dissolved inorganic nitrogen and phosphorous concentration, resulting from anthropogenic nutrient input using data from periodic surveys.	A downward trend in dissolved inorganic nitrogen and phosphorous concentration, resulting from decreasing anthropogenic nutrient input over a 10 year period.
Targets – Direct effects of nutrient enrichment	No increase in the chlorophyll 90 percentile in the growing season (linked to increasing anthropogenic input) based on periodic surveys. AND If there is evidence of nutrient enrichment and accelerated growth, then: No trend in a eutrophication relevant plankton index that is attributable to increases in nutrient loading, winter nutrient concentrations or trends in nutrient ratios.	A downward trend in the chlorophyll 90 percentile in the growing season over a 10 year period (linked to decreasing anthropogenic input). AND Changes in a eutrophication relevant plankton index that is attributable to decreases in nutrient loading, winter nutrient concentrations or trends in nutrient ratios ¹⁶³ .
Targets – Indirect effects of nutrient enrichment		WFD macroalgae and seagrass tools at good status. Oxygen (concentrations/5 percentile) in bottom waters should remain above area-specific oxygen assessment levels (e.g. 4-6 mg/l). There should be no kills in benthic animal species as a result of oxygen deficiency that are directly related to anthropogenic input of nutrients.
Illustrative measures and costs	No measures are anticipated over those that will be taken under the Water Framework Directive. Therefore there will be no additional costs over the baseline (option 0). Monitoring costs There are likely to be small additional monitoring costs of £10-£100k pa for eutrophication related plankton monitoring – these costs would fall on Government and regulators.	
Summary	Potential costs to business – No additional costs Potential costs to government – There might be small monitoring costs of £86k-	

¹⁶² These targets are assessed holistically to determine whether eutrophication is occurring. Failure with respect to any individual target does not, on its own, necessarily lead to identification of eutrophication problems.

¹⁶³ Further work required as indicator has not been tested in operation

	861k over 10 years. Total potential costs – Low. There might be small monitoring costs £86k-861k over 10 years.
Key risks and assumptions	It has been assumed that any additional measures needed to reduce eutrophication in order to meet these targets would be taken under existing legislation (e.g. the Water Framework Directive and the Urban Waste Water Treatment Directive) and therefore the costs would not be additional to MSFD.

Descriptor 7 – Permanent alteration of hydrographical conditions

Background

201. The MSFD requires that any permanent alteration of prevailing hydrographical conditions resulting from human activities does not have an adverse effect on coastal and marine ecosystems. This Descriptor is, therefore, intended to manage the potential hydrographical impacts (including cumulative and in-combination environmental effects) arising from large scale projects such as offshore windfarms, tidal barrages, tidal farms, offshore airports, and other significant marine infrastructures.
202. Development in the coastal and marine zone can be broadly categorised into urban (e.g. housing), infrastructure (e.g. ports, harbours, navigation channels, windfarms), tourism and leisure (e.g. marinas), and resources (e.g. oil, gas, and aggregate extraction). Developments in these areas can, if poorly managed, alter hydrographical conditions, resulting in significant local scale impacts on both the coastal and marine environments. Some projects, such as large scale tidal barrages, have the potential to have broader scale impacts on hydrographical conditions.
203. Although there is the potential for developments to cause impacts due to changes in hydrographical conditions, impacts arising from marine and coastal development are currently managed through the marine licensing and consents process. All significant developments are assessed, and their potential impacts monitored, in line with the requirements of the Environmental Impact Assessment Directive, the Water Framework Directive, and the Habitats Directive. In addition, Marine Plans, when in place, will provide the framework for the licensing and consents process and will be subject to the Strategic Environmental Assessment Directive.
204. The draft UK characteristics of GES for this Descriptor are as follows:
- The nature and scale of any permanent changes to the prevailing hydrographical conditions (including but not limited to salinity, temperature, pH and hydrodynamics) resulting from anthropogenic activities (individual and cumulative), having taken into account climatic or long-term cyclical processes in the marine environment, do not lead to significant long term impacts on those biological components considered under Descriptors 1, 4 and 6.
205. Two options for targets were proposed by experts in the Cefas CBA report¹⁶⁴ - one of which has been considered in more detail here as Option 1 and is based on existing licensing practices. The second option would require developments above certain thresholds to carry out additional assessment and monitoring of their impacts. As there is high confidence in the robustness of the existing licensing regime in ensuring significant negative impacts on hydrographical conditions are appropriately considered, the second option proposed by Cefas was considered unnecessary and has not been included in this impact assessment.

¹⁶⁴ Cefas CBA Report 2012, section 2.4

Option 0 – Baseline Scenario

206. The existing marine licensing and consents process, in conjunction with the requirements of the Water Framework Directive (in relation to hydromorphological conditions), the EIA Directive, the SEA Directive, and the Habitats Directive (in relation to hydrographical conditions), is likely to be sufficient to ensure that GES for this Descriptor will be achieved. Marine planning will ensure that monitoring for cumulative effects of new activities is interpreted and feeds into future licensing decisions and reviews of marine plans.

Option 1 – Target proposals

207. The proposed target reflects the fact that we expect to achieve GES under the baseline scenario. Under this option the target would require all new developments to continue to comply with the existing regulatory regime and guidance should be followed to ensure that regulatory assessments are undertaken in a way that ensures the appropriate consideration of any potential cumulative and in-combination environmental effects at the most appropriate spatial scales so that GES is not compromised.

208. Under this option there is a need to review the operation of the existing marine licensing regime to ensure it adequately reflects the most up to date understanding of the potential for developments to cause changes to hydrographical conditions, and guidance for developers and licensing authorities may need to be updated to reflect this. Such a review could be carried out by the MMO, Cefas, and DECC between now and the final impact assessment. The cost of this is likely to be small, in the region of £20k. Similar assessments will be needed for the licensing regimes and relevant guidance in Scotland, Wales and Northern Ireland.

209. As the target for this option is based on application of the existing regulatory regime there will be no additional costs to industry assuming there is currently compliance with the EIA Directive and other relevant legislation. Discussions with a number of other Member States and advice generated within OSPAR leads us to believe that they are likely to take a similar approach to the one proposed here.

Table 10 – Targets for hydrographical processes (Descriptor 7)

Targets – Spatial Characteristics of Permanent Alterations	All developments must comply with the existing regulatory regime and guidance should be followed to ensure that regulatory assessments are undertaken in a way that ensures the full consideration of any potential impacts, including cumulative effects at the most appropriate spatial scales to ensure that GES is not compromised.
Targets – Impact of Permanent Hydrographical Changes	
Illustrative measures and costs	There will be small additional costs to regulators associated with reviewing the existing licensing regime and updating guidance to developers if necessary. Costs are likely not to exceed £20K unless significant revisions are needed. Monitoring costs There could be additional costs for Government and regulators in the form of monitoring in order to provide a more comprehensive understanding of prevailing environmental conditions and through the development of management and assessment tools to improve

	our confidence in our GES assessment i.e. the NERC shelf sea model ¹⁶⁵ . Further information on potential costs will be gathered during the consultation process.
Summary	<p>Costs to business – none (assuming full compliance with the EIA Directive and other relevant legislation)</p> <p>Costs to government - there will be some small additional costs for government and regulators in terms of updating the guidance (around £20K for England), and possibly additional monitoring costs to provide comprehensive understanding of prevailing environmental conditions and the further development of assessment tools. Further information on potential costs will be gathered during the consultation process.</p> <p>Total potential costs –The costs are likely to be low. A partial estimate of the costs of updating the guidance is £20K (covers England only). There could be additional monitoring costs which have not been quantified.</p>
Key risks and assumptions	It has been assumed that the existing licensing system will be sufficient to achieve the targets proposed for this Descriptor.

Descriptor 8 – Concentrations of contaminants

Background

210. This Descriptor is intended to ensure the presence of contaminants in the marine environment and their biological effects are kept within acceptable limits so as to ensure that there are no significant impacts on, or risk to, the marine environment. These contaminants include synthetic compounds (e.g. pesticides, antifoulants, pharmaceuticals etc), non-synthetic compounds (e.g. heavy metals, hydrocarbons etc), and other substances considered pollutants, whether solid, liquid or gas.

211. Hazardous substances can enter the marine environment through natural sources and as a result of anthropogenic activities, either as direct inputs or via rivers, estuaries and the atmosphere. Pollution itself is considered to be the introduction of substances which have, or are likely to have, deleterious effects on the marine environment and its uses. This includes effects that result in loss of biodiversity, are hazardous to human health, impair water quality, and reduce our ability to use the sea.

212. The draft UK characteristics of GES for this Descriptor are as follows:

- Concentrations of contaminants in water, sediment, or biota are kept within agreed¹⁶⁶ levels and these concentrations are not increasing; and
- The effects of contaminants on selected biological processes and taxonomic groups, where a cause/effect relationship has been established, are kept within agreed levels.

213. The Descriptor is supported in the UK by a robust legislative framework from international through to national level, and appropriate consenting and monitoring programmes. There is good knowledge of contaminant levels in the marine environment, particularly in coastal and inshore areas, as a result of OSPAR and the Water Framework Directive which require the

¹⁶⁵ Part of the NERC Shelf Sea Biogeochemistry Research Programme which funds further developments in modelling, observational and analytical techniques relating to Ocean Shelf-Edge Physical Exchange. Further developments of such models should help increase our ability to assess cumulative impacts.

¹⁶⁶ Agreed at a national/EU/International level e.g. within domestic legislation, Regional Seas Conventions etc.

monitoring of specific contaminants and compliance with specific concentration limits to prevent pollution. For this reason, there is sufficient scientific certainty for experts to propose one option for GES targets for this Descriptor.

Option 0 – Baseline scenario

214. The BAU report concludes that the effective implementation of the Urban Waste Water Treatment Directive, the Water Framework Directive, the IPPC Directive, the Existing Substances Regulation and REACH are likely to ensure progress towards Good Chemical Status¹⁶⁷ (for priority and priority hazardous substances) and contribute to Good Ecological Status¹⁶⁸ (for other pollutants) for some problem areas up to 2020, with further improvements likely up to 2030 (due to provision for time limited derogations from targets up to 2027)¹⁶⁹. It is concluded on this basis that the UK will broadly achieve GES for this Descriptor under the baseline scenario. However, there are likely to be some areas where the measures taken to control inputs of contaminants under the above Directives will not achieve GES by 2020 due to the presence of very persistent legacy contaminants in sediments where it will not be practical to take remedial measures and where it will be necessary to invoke the derogations for disproportionate cost provided in the Directives.

Option 1 – Target proposals

215. The targets proposed for contaminants reflect the fact that we expect to broadly achieve GES under the baseline scenario and they are based on existing OSPAR or Water Framework Directive targets¹⁷⁰. There is a high-level of regional coordination on the approach to assessment of contaminants and we have high confidence that other countries in OSPAR will follow a similar approach to setting targets.

216. Any measures which would be required to meet the proposed targets for GES would already be taken under the legislation mentioned above. The only exception to this is in relation to the presence in a few areas of persistent legacy contaminants in sediments which will not be dealt with under existing legislation. As mentioned above, measures to remove these contaminated sediments would not be practical and would be highly costly. The UK does not propose implementing these measures on the grounds that they would be disproportionately costly. Therefore, our assessment is that there will be no additional cost implications from measures associated with these targets.

217. The UK will utilise existing monitoring programmes under the Water Framework Directive and OSPAR to meet monitoring requirements for MSFD. Therefore we are confident there will be negligible additional costs in terms of monitoring, although additional monitoring could be required in the future if new substances are added to priority substances lists.

Table 11 – Targets for contaminants (Descriptor 8)

Targets – Concentration of Contaminants	Concentrations of substances identified within relevant legislation and international obligations are below the concentrations at which adverse effects are likely to occur (e.g. are less than Ecological Quality Standards applied within WFD, and Environmental Assessment Criteria applied within
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¹⁶⁷ Achievement of Good Chemical Status is a requirement of the Water Framework Directive.

¹⁶⁸ Achievement of Good Ecological Status is a requirement of the Water Framework Directive.

¹⁶⁹ BAU Report 2012, ABPmer, Introduction(iii)

¹⁷⁰ For further information on the proposed approach to targets see Cefas CBA Report 2012, Section 2.5

	OSPAR).
Targets – Effects of Contaminants	The intensity of biological or ecological effects due to contaminants is below the toxicologically-based standards agreed by OSPAR as appropriate for MSFD purposes in a statistically significant number of samples at relevant monitoring stations. For oil/chemical spills - As a wide range of oils and chemicals may be spilled, targets will be incident-specific and will need to be derived at the time. For spilled chemical compounds relevant assessment criteria (e.g. established Ecological Quality Standards and Environmental Assessment Criteria) will be used to help establish significance of impact and appropriate response.
Illustrative Measures and costs	No additional measures are anticipated. Monitoring costs No additional costs are anticipated at the current time, although there could be some additional monitoring costs in future if new substances are added to the list of WFD or OSPAR contaminants.
Summary	No additional costs
Key risks and assumptions	It has been assumed that any additional measures needed to reduce contaminants in order to meet these targets would be taken under existing legislation (e.g. the Water Framework Directive). The only exception to this is in relation to legacy contaminants which would not be dealt with under the baseline scenario. However, the UK would not take measures to remove contaminated sediments on the grounds that they would be impractical and disproportionately costly. For this reason it has been assumed that no additional management measures will be needed in relation to these targets.

Descriptor 9 – Contaminants in fish and other seafood

Background

218. This Descriptor is intended to ensure contaminants, specifically organic chemicals and trace metals found in fish and shellfish destined for human consumption do not exceed thresholds laid out in Community legislation or other agreements. Biotoxins¹⁷¹ and microbiological contamination are not expressly included under this Descriptor, nor elsewhere in the assessment of GES¹⁷².

219. Contaminants present in fish and other seafood destined for human consumption may arise for a number of reasons, from both anthropogenic sources (e.g. industry, sewage discharges, agriculture, aquaculture, etc) and natural sources (e.g. natural geological factors including geothermal activity).

¹⁷¹ Paralytic, Diarrhetic and Amnesiac Shellfish Poisoning toxins

¹⁷² The ICES Task Group 9 report says "the term "**contaminants**" is interpreted as "hazardous substances present in fish as a result of environmental contamination for which regulatory levels have been set for human consumption or for which the presence in fish is relevant". In this interpretation, hazardous substances are substances (i.e. chemical elements and compounds) or groups of substances that are toxic, persistent and liable to bio-accumulate, and other substances or groups of substances which give rise to an equivalent level of concern. It also says: Although regulatory levels have been set for marine biotoxins, they are not considered as contaminants. Their presence in fish and seafood is not always linked to human activities. Harmful algal bloom events are often due to climatic and hydrographical circumstances although human induced eutrophication from domestic, industrial and agricultural wastes can stimulate harmful algae blooms. Therefore, there is not always a consistent link between the levels of marine biotoxins in fish and seafood and the environmental status of the marine environment. In addition, the threat from marine biotoxins is managed in a different manner to other regulatory levels in seafood, prompting controls on harvesting.

220. The draft UK characteristics of GES for this Descriptor are as follows:
- Concentrations of contaminants in fish and other seafood caught or harvested for human consumption in UK seas do not exceed the relevant maximum levels listed in EU Regulation 1881/2006 (as amended) or other relevant standards and are not increasing¹⁷³.
221. There is sufficient scientific certainty for experts to propose one option for GES targets for this Descriptor.

Option 0 – Baseline scenario

222. The projected baseline set out in the BAU report concludes that effective implementation of existing directives such as Water Framework Directive, the Urban Waste Water Treatment Directive, the Shellfish Waters Directive, the revised Bathing Waters Directive, the IPPC Directive and REACH will continue to manage this pressure to achieve improvements in environmental state by 2020¹⁷⁴. On this basis it is concluded that the UK will achieve GES for this Descriptor under the baseline scenario.

Option 1 – Target proposals

223. The target proposed for contaminants in fish and seafood reflects the fact that we expect to achieve GES under the baseline scenario and it is based on existing thresholds for contaminants set out in existing EU legislation or other internationally and nationally agreed standards. Since the targets proposed reflect existing agreed standards, we have high confidence that other Member States will take a similar approach.

224. It is unlikely that additional measures will be needed beyond those already being put in place to meet existing legislative requirements. Some additional monitoring in commercial fishing grounds in the relevant MSFD sub-regions (Greater North Sea and Celtic Seas) is likely to be necessary because current Food Standards Agency monitoring schemes are generally not able to identify the source of the samples being tested in their current monitoring programmes. Additional monitoring costs are likely to be in the region of £40-80k per annum for England and Wales¹⁷⁵ and some smaller additional monitoring costs for Scotland are also anticipated.

Table 12 – Targets for contaminants in seafood (Descriptor 9)

Targets – Criteria 9.1: Levels, numbers and frequency of contaminants	For contaminants where regulatory levels have been set, there should be a high rate of compliance based on relevant surveys and including samples originating from commercial fishing grounds in the Greater North Sea and the Celtic Seas.
Illustrative measures and costs	No additional measures. Monitoring Costs Additional monitoring costs are likely to be in the region of £40-80k pa for England and Wales for additional samples of commercially exploited species collected on existing surveys, and/or sampling from fish markets and monitoring on sub-samples of shellfish tissue through current biotoxin monitoring programme.
Summary	Potential costs to business – No additional costs

¹⁷³ With the exception of fish liver, for which a high rate of non-compliance is expected.

¹⁷⁴ BAU Report 2012, ABPmer, Introduction(iii)

¹⁷⁵ Cefas CBA Report 2012, p.246

	Potential costs to government – There are likely to be additional monitoring costs for England and Wales of between £344k-£689k over 10 years, and smaller additional monitoring costs for Scotland. Total potential costs – The costs are likely to low – just the additional £344K-£689K monitoring costs described above.
Key assumptions and risks	It has been assumed that any additional measures needed to reduce contamination in order to meet these targets would be taken under existing legislation (e.g. the Water Framework Directive, Urban Waste Water Treatment Directive, revised Bathing Waters Directive) and therefore the costs would not be additional to MSFD.

Descriptor 10 – Marine litter

Background

225. Significant amounts of litter¹⁷⁶ appear in our seas and on our beaches. It is unsightly and can cause harm to marine wildlife through entanglement and ingestion, and through smothering of the seabed. Litter also has economic effects through clean up costs to local communities and lost tourism, and costs to fishermen through lost catch and snagged nets. It can also pose a hazard to seafarers through fouling of ship propellers. Plastics are the main type of litter found both on beaches and offshore, including increasing quantities of microscopic pieces of plastics resulting from degradation of larger plastic products in the sea. These may act as a vector for transferring toxic chemicals to the food chain. There is, therefore, widespread recognition that current and future measures to reduce marine and coastal litter will bring ecological, economic and social benefits.

226. The draft UK characteristics of GES for the Descriptor are as follows:

- The amount of litter, and its degradation products¹⁷⁷, on coastlines and in the marine environment is reducing over time and levels do not pose a significant risk to the coastal or marine environment, either as a result of direct mortality such as through entanglement, or by way of indirect impacts such as reduced fecundity or bioaccumulation of contaminants within food chains.
- A lack of data and understanding with respect to the properties, quantities, sources and impacts of marine litter means making a robust assessment of status either regionally or over time is not possible. A robust baseline and sufficient data to detect trends through time is needed, however acknowledging the need for cost-effective data collection is essential. Whilst our understanding of the quantities and types of beach and seafloor litter is steadily improving, the current programme of monitoring needs further development.
- Due to the high level of uncertainty surrounding the effects of litter on the marine environment experts have been unable to propose specific targets with thresholds equating to GES. It is arguable that proposing targets for litter would be premature until we have a better understanding of the impacts of litter, trends in occurrence, and effectiveness of control measures. However Government policy is to reduce litter and it is for this reason that a range of target proposals have been identified based on the advice provided by experts¹⁷⁸ – these are summarised in the two options below.

Option 0- Baseline Scenario

¹⁷⁶ “Marine litter (marine debris) is any persistent, manufactured or processed solid material discarded, disposed of, abandoned or lost in the marine and coastal environment” Marine Litter – An analytical overview, Regional Seas Programme, UNEP.

¹⁷⁷ Degradation products of litter include small plastic particles and micro plastic particles

¹⁷⁸ Cefas CBA Report 2012, Section 2.7

227. The BAU report concluded that, under the current regulatory regime, litter will continue to be a problem, accumulating in coastal areas and in the water column¹⁷⁹. Charting Progress 2 found that there continues to be “significant amounts of litter in our seas and on our beaches”.¹⁸⁰ The monitoring data are too sparse to allow a meaningful assessment of changes in quantities of litter either regionally or over time.

228. Land-based sources are estimated to make up around 80% of the litter reaching the marine environment¹⁸¹. Measures to reduce land-based sources of litter are already being taken forward as part of the UK Government’s Waste Review¹⁸² and Devolved Administrations waste policy. These include measures to increase recycling, improved product design and measures through the Love Where You Live campaign to reduce littering. All these measures are included as part of the baseline. However, it is assumed that additional measures will also be necessary in order to achieve the targets proposed for this Descriptor.

Option 1- Reasonable level of certainty of achieving GES

229. The target proposed under this option would focus on levels of litter on coastlines. It would require a decreasing trend (where litter levels are shown to be rising or unacceptable) in visible litter items on coastlines within specific categories (e.g. plastics, sanitary items, fishing litter). In effect, this would mean slowing the current rate of increase in litter items reaching our beaches.

230. Given current uncertainties specific targets would not be established for the remaining Commission indicators covering litter on the seafloor, microparticles, and impacts on marine life. Instead surveillance indicators would be put forward with the determination of GES being used as a qualitative target until sufficient information has been collected to allow the establishment of robust, quantitative targets at a later date.

231. In order to meet the proposed target under this option it is likely that some of the measures to reduce terrestrial litter included in the baseline scenario will need to be tailored to specifically address litter in the marine and coastal environment. For example, public behaviour and education programmes under the Love Where You Live campaign could be tailored to include a specific focus on beach litter in coastal areas.

232. There may also be a need to establish specific marine orientated measures such as those focussed on working with the fishing industry to reduce fishing litter, or working with national and local businesses, as well as Non Governmental Organisations, to improve the provision of bins on beaches. The costs of these kinds of measures are difficult to estimate, but some figures are shown in Table 13 below. It is not currently possible to assess exactly what measures will be sufficient to meet the targets proposed under this option, although Defra will have gathered more evidence on this in time for the final impact assessment.

233. There will also be some additional monitoring and information costs for government and regulators associated with the target proposed under this option. A current best estimate is that these would amount to somewhere between £55,000 and £125,000 pa for England and Wales.¹⁸³ Further analysis will be carried out over the consultation process to assess costs for Scotland and Northern Ireland.

¹⁷⁹ BAU Report 2012, ABPmer, Introduction(iii)

¹⁸⁰ Charting Progress 2, Chapter 4, Page 77

¹⁸¹ Faris and Hart, 1994

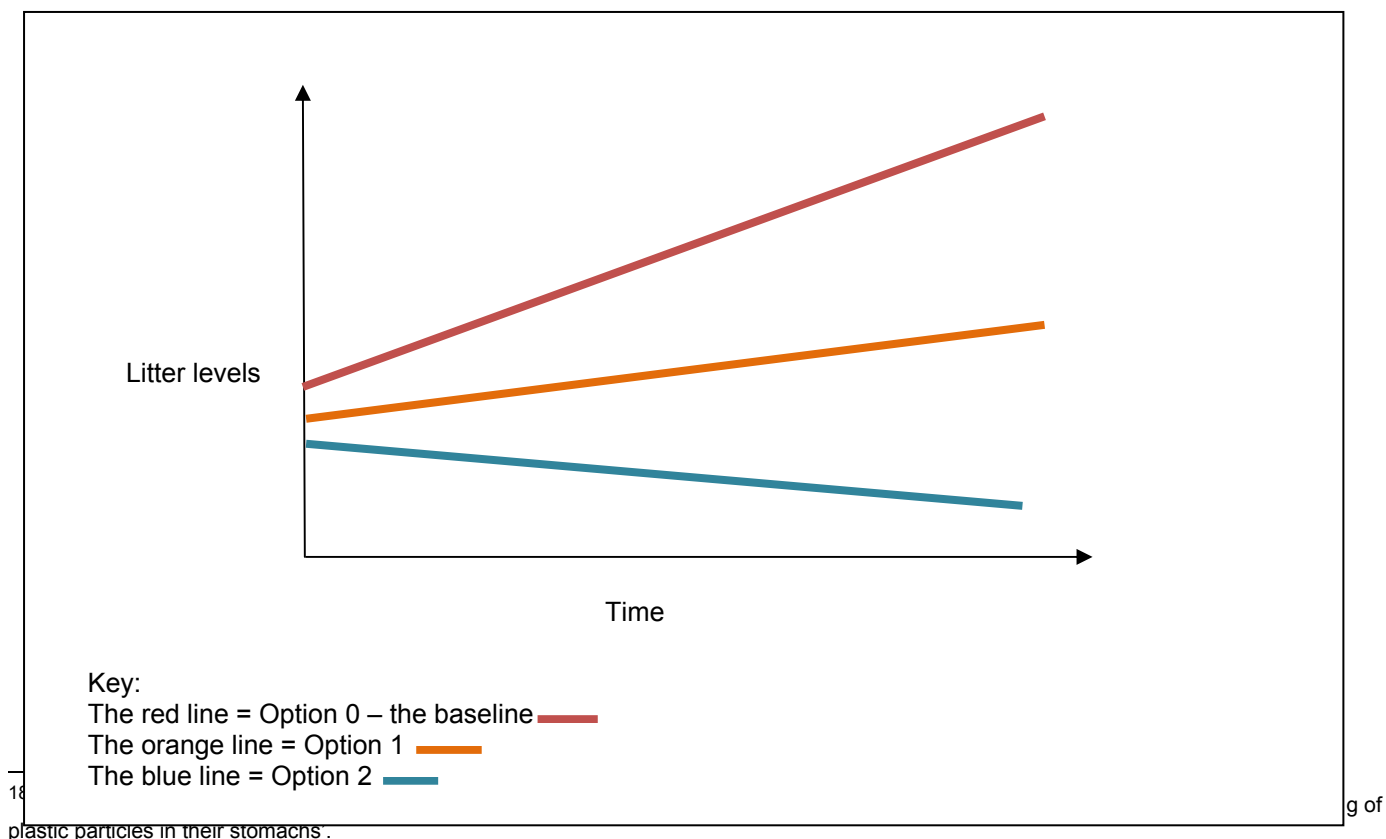
¹⁸² Government Review of Waste Policy in England 2011 - <http://www.defra.gov.uk/publications/files/pb13540-waste-policy-review110614.pdf>

¹⁸³ Cefas CBA Report 2012, p246

Option 2- Higher level of confidence of achieving GES

234. Under this option the proposed target for litter levels on coastlines would require an absolute reduction in visible litter items on coastlines within specific categories (e.g. plastics, sanitary items). Unlike the target proposed under Option 1, this would require litter levels on beaches to decrease, rather than merely slowing the rate of increase.
235. Under this option, a target would be put forward for seafloor litter (rather than just a surveillance indicator), requiring a decreasing trend (where litter levels are shown to be rising or unacceptable) in visible litter items on the seafloor within specific categories (e.g. plastics, fishing litter). A target would also be put forward for the impacts of litter (rather than a surveillance indicator), and would require that trends in the levels of plastic particles in fulmars are moving towards the OSPAR Ecological Quality Objective for levels of plastic found in fulmars stomachs¹⁸⁴.
236. As with Option 1, it is not possible to assess what measures will be sufficient to meet this Option, but it is possible to say that under Option 2 incrementally more of the measures applied currently and described under Option 1 would be needed, and in some cases further new measures might be necessary.
237. The monitoring and information costs associated with this option are the same as under option 1.
238. The illustrative diagram below (Fig.4)¹⁸⁵ sets out the potential effects on coastline litter levels of Option 0, Option 1 and Option2. It is believed that Option 1 may result only in slowing the rate of increase in litter levels, whereas Option 2 would result in an overall reduction.

Figure 4: Effects of proposed target options on levels of litter on coastlines



18 plastic particles in their stomachs .

¹⁸⁵ Not to scale

Preferred Option

239. Since it remains unclear what levels of litter in the marine and coastal environment would actually equate to GES, a mixture of Option 1 and Option 2 is being proposed as our preferred option. The more ambitious option of an absolute reduction in litter levels (Option 2) is the preferred option for litter on coastlines as there is stronger supporting evidence with respect to current trends and the potential effectiveness of management measures. This option is also more consistent with the UK Government and Devolved Administration’s terrestrial litter policy and also reflects a Ministerial commitment made in OSPAR to develop reduction measures and targets, taking into consideration an ambitious target resulting in a reduction in 2020¹⁸⁶. In addition, a significant number of Member States are likely to propose similar targets for coastal litter.

240. With respect to seafloor litter and the impacts of litter on marine life, Option 1 (the establishment of surveillance indicators) is the preferred option. This approach best reflects lack of scientific understanding about the population level effects of marine litter, the difficulties in robustly monitoring these aspects of litter, and the level of uncertainty surrounding the effectiveness of potential management measures. Additionally, due to the highly mobile nature of marine litter, it may not be possible to achieve the targets proposed under Option 2 without the majority of other Member States adopting similarly ambitious approaches. At the current time we have little information about whether other Member States are likely to set targets for seafloor litter or the impacts of litter. Further coordination will be carried out with other Member States within the relevant EU and OSPAR groups between now and mid-2012 and if it becomes clear that other Member States have developed robust target proposals for these aspects of litter it may be appropriate to review the UK position.

241. There is also an additional requirement within the Directive to measure ‘trends in the amount, distribution and, where possible, composition of microparticles (including microplastics)’. Expert opinion at this time has indicated that our understanding of the nature of microparticles in the marine environment and their propensity to cause harm is too underdeveloped to establish a meaningful target at this point in time. Further work will be carried out to improve our understanding of the issue with a view to setting targets in the future should this prove necessary.

Table 13 – Targets for marine litter (Descriptor 10)

	Reasonable confidence scenario (Option 1)	Higher confidence scenario (Option 2)
Targets – Characteristics of Litter in the Marine Environment	Decreasing trend (where litter levels are shown to be rising or unacceptable) in the number of visible litter items within specific categories/types on the coastline from 2010 levels by 2020. Surveillance indicator to monitor the	Overall reduction in the number of visible litter items within specific categories/types on coastlines from 2010 levels by 2020 (preferred option). Decreasing trend (where litter levels are shown to be rising or

¹⁸⁶ The UK Government signed the OSPAR Bergen Statement in 2010 which said: ‘We note that quantities of litter in many areas of the North-East Atlantic are unacceptable, and therefore we will continue to develop reduction measures and targets, taking into consideration an ambitious target resulting in a reduction in 2020.’

	quantities of litter on the seafloor (preferred option).	unacceptable) in the number of visible litter items within specific categories/types on the seafloor from 2010 levels by 2020.
Targets – Impacts of litter on marine life	Surveillance indicator to monitor the amounts of plastic found in the contents of fulmars stomachs (in line with the OSPAR Ecological Quality Objective) (preferred option).	Trends in the amounts of plastic found in the stomachs of northern fulmars are moving towards the levels indicated in the OSPAR Ecological Quality Objective.
Illustrative measures and costs	<p>Increased beach cleaning¹⁸⁷ Costs will be incremental to existing cost of £15m/yr¹⁸⁸. This measure could be achieved through voluntary collaborative activity as part of the Love Where You Live campaign, rather than any extension of standard local authority schemes. This would imply a low incremental increase to existing costs. To provide very rough indication of costs scenario of 5%-10% increase in costs have been considered. This would mean estimated costs would range from £6.5m-£13m over 10 years.</p> <p>Behaviour and education¹⁸⁹ This measure would not establish a new campaign on marine litter but would tailor existing public awareness campaigns (e.g. Love Where You Live) to include specific messages on the coastal and marine environment. The costs are likely to depend on the extent to which the programmes are modified. For instance, the costs would be higher if special efforts were put into delivering specific messages to coastal communities on addressing marine litter than if marine related messages were included in the main national campaign. Currently, the total committed funds for terrestrial Keep Britain Tidy campaigns stands near £750K. Assuming a 1-2% increase in expenditure to account for tailoring key messages to cover</p>	Similar to Option 1 but this option will involve greater effort on measures (e.g. more extensive application of measures, more marine specific measures) therefore there would be a greater % increase in the costs.

¹⁸⁷ This measure is based on information in the Cefas CBA Report 2012, but this has been amended to make it more specific and relevant.

¹⁸⁸ Mouat et al, 2010

¹⁸⁹ This measure is based on information in the Cefas CBA Report 2012, but this has been amended to make it more specific and relevant.

	<p>the marine and coastal environment, additional costs are estimated to be £64.5K-£129K over 10 years. This is an illustrative scenario rather than informed estimate. More information will need to be collected during the consultation process to refine these estimates further.</p> <p>Improved facilities for beach litter deposit and collection ¹⁹⁰</p> <p>This could be achieved in a number of different ways, either by local authorities providing increased facilities, or through more innovative mechanisms such as bin sponsorship schemes by local businesses. Costs would either be to coastal businesses or local authorities and would vary depending on the extent of the measure. Further analysis will be needed during the consultation stage to assess the likely costs of a voluntary scheme ¹⁹¹.</p> <p>Fishing for litter schemes ¹⁹²</p> <p>This management measure aims to improve the fishing industry management practices for the waste they accidentally catch and thus reduce the amount of litter in UK seas by physically removing it. The costs are mainly the costs of provision of bags, skip rental and further waste management. Pilot schemes are in operation but further assessment is needed of their impact and effectiveness, including on overall litter levels. Using estimates from a KIMO study, a UK scheme could cost Government £950,000 for 3 years with proportionally increased coverage and number of boats ¹⁹³.</p>	
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¹⁹⁰ This measure is loosely based on information in the Cefas CBA Report 2012, but this has been significantly amended to make it more relevant and specific.

¹⁹¹ KIMO report (2010) estimate the cost of providing bins on beaches for litter deposit to be £138,522.79 for 27 municipalities and that on average each municipality spend £5,130.47. This should cover maintenance and replacement costs of bins per annum. However a voluntary scheme is likely to cost much less.

¹⁹² This measure is based on information in the Cefas CBA Report 2012.

¹⁹³ The estimate is taken from the Cefas CBA report 2012. It is estimated that a 3 year project of Fishing for Litter Scheme in Scotland would cost approximately £315,450 (Tom Piper, KIMO, personal communication, January 2011). The project aims to maintain coverage in the 17 harbours and to include 300 boats in the scheme. A third of the UK's fishing vessels are registered in Scotland, and the estimate has been increased proportionally to cover the whole of the UK. This does not mean all boats are participants in this scheme. For instance, fishing for litter in Scotland aims to cover 17 harbours and 300 boats, so the UK wide scheme would cover 900 boats (including 300 of Scotland).

	<p>This would imply discounted costs of £2.72m over 10 years. This measure would also create small costs for fishermen in terms of extra time needed to store litter on board and unload it on quayside.</p> <p>Monitoring costs An initial estimate suggests that these could be between £55,000 and £125,000pa for England and Wales¹⁹⁴. Thus the total monitoring costs over 10 years are estimated to be £473K - £1.1m.</p>	
Summary	<p>Potential costs to business – Cost to business will depend on which measures are ultimately taken forward and how they are implemented. Further analysis will be carried out during the consultation stage to inform the assessment of costs.</p> <p>Potential costs to government – The total quantified costs to government from the measures mentioned above are estimated at £9.7m - £16.8m over 10 years. Further information will be collected through the consultation process to refine these estimates</p> <p>Total potential costs – Costs are likely to be low to moderate depending on the design of the measures. We have not been able to quantify the costs to businesses. It is estimated that the costs to government could be between £9.7-£16.8m over 10 years.</p>	<p>Similar to probable scenario but will involve implementing measures more extensively (scenario will involve greater effort on measures therefore a greater % increase in the costs). Monitoring costs are the same as for Option 1.</p>
Key assumptions and risks	<p>Many of the cost estimates for the above measures are based on scenarios rather than informed estimates. This has helped provide a very rough indication of the costs but these will be refined for the final impact assessment. Also, in some cases, taking a voluntary approach for measures such as beach cleaning and increased beach facilities could imply lower costs than simply increasing local authority provision.</p>	

Descriptor 11 – Introduction of energy, including underwater noise

Background

¹⁹⁴ Cefas CBA Report 2012, p.246

242. According to the Commission Decision 2010¹⁹⁵, at this stage this Descriptor is intended to address the impacts of noise on the marine environment and does not currently cover the impacts of any other forms of energy.
243. Anthropogenic inputs of sound can potentially affect marine organisms in a variety of ways. Continuous noise may degrade the sound habitat, masking biologically relevant signals such as echolocation clicks, making it harder or impossible to find a mate, locate food or detect predators. Impulsive sounds can lead to a variety of behavioural reactions such as avoidance of feeding or breeding areas, or may result in physiological effects such as temporary or permanent damage to hearing organs, and at very high levels, even death.
244. There is no evidence at present to suggest that current levels of impulsive or ambient sound in UK waters are having an impact at the population level on cetaceans or other marine animals. There remains, however, significant gaps in our understanding of the current levels of noise in the marine environment, the actual impacts of marine noise on species and populations, and the thresholds at which noise is considered to be having a 'significant' impact on organisms. In addition, underwater noise is not currently monitored or recorded systematically in the UK.
245. The draft UK characteristics of GES for this Descriptor are as follows:
- Human activities potentially introducing loud, low and mid frequency impulsive sounds into the marine environment are managed to the extent that no significant long term adverse effects are incurred at the population level or specifically to vulnerable/threatened species and key functional groups.
 - Continuous low frequency sound inputs do not pose a significant risk to marine life at the population level, or specifically to vulnerable/threatened species and key functional groups e.g. through the masking of biologically significant sounds and behavioural reactions.
246. Due to the high level of uncertainty about the effects of noise on the marine environment it has not been possible for experts to propose specific targets for impulsive sound and ambient sound which they believe to be equivalent to GES. Instead, a range of target proposals have been identified based on the advice provided by experts¹⁹⁶ – these are summarised in the options below (set out separately for impulsive sound and ambient sound).
247. The proposed targets and indicators for noise are new, in the sense that they do not exist under any current national, EU or international obligations. They are designed to enable us to better monitor, understand and manage the impacts of noise.
248. There is still considerable uncertainty over the approach that other Member States will be taking to setting targets for both impulsive and ambient sounds. However, the UK co-chairs the EU Technical Sub-Group on Noise¹⁹⁷, established by the Commission to assist in developing a coordinated approach to this Descriptor, so is well-placed to promote the approaches to target setting proposed in this impact assessment. If it transpires that other Member States are adopting a significantly different approach then it may be necessary to review these targets to ensure closer regional coordination.

¹⁹⁵ Commission Decision of 1 September 2010 on criteria and methodological standards on good environmental status of marine waters (2010/477/EU)

¹⁹⁶ Cefas CBA Report 2012, Section 2.8

¹⁹⁷ This is a group of experts established by, and reporting to, the EU Commission. They have been tasked with discussing and providing advice on marine noise, including approaches to target setting and monitoring methodologies.

Impulsive sounds (Commission Criteria 11.1)

249. The majority of impulsive sounds will come from seismic surveys (e.g. for oil and gas) and pile driving (e.g. for renewable energy installations). The potential physical effects of such sounds on marine life i.e. hearing loss, death etc would occur close to these sources and are recognised and managed in the existing licensing regime; for example, through the use of mammal observers, temporal restrictions on when activities can take place, and “soft starts”¹⁹⁸.
250. For this reason this Descriptor and the associated Commission indicator aim to address the cumulative impacts of noise generating activities on the behaviour of noise sensitive populations i.e. marine mammals, through consideration of noise levels, and their distribution in space and time.
251. Whilst a good scientific understanding exists with regard to the level of noise which can cause physical harm to certain species, there is far less certainty about the levels of noise which are likely to cause negative behavioural impacts and can have an effect at a population level. The difficulty in setting thresholds for behavioural impacts is further compounded by the fact that behavioural change is very context specific. A sound that might have an effect in one context may not have an effect in another context.
252. In order to overcome these uncertainties experts in Cefas and JNCC have made an assessment of current and planned noise levels in UK waters. Based on their expert judgement they have advised that it is unlikely current and future planned levels at least up to 2022 and potentially beyond will have any significant impact on the distribution of noise sensitive species e.g. cetaceans. As a result they have concluded there should be no behavioural impacts at a population level in UK waters based on our current understanding of future planned increases in impulsive sound generating activities.

Option 0- Baseline Scenario

253. The major current source of impulsive underwater sound arises from seismic surveys, and this will likely continue to be the case up to 2020 and most likely beyond. The relative proportion of noise from offshore wind farm construction is likely to increase by 2020, and possibly beyond. Experts have predicted the future distribution of impulsive sound events and although the number of noise generating events is likely to increase (largely as a result of renewable energy expansion), it is not expected that this will be significant at the temporal and spatial scales relevant to this Descriptor. Therefore our current understanding indicates that under the BAU scenario it is unlikely that there would be any significant adverse effects on marine animal populations, provided appropriate measures continue to be taken through the current licensing regime to manage the potential physical impacts near to individual noise generating activities¹⁹⁹.
254. However, under this scenario, there would be no means of recording, assessing or managing the distribution or timing of impulsive noise, increasing the risk that the pattern of activity might pose a threat to the achievement of GES in the future. Not setting any target could also imply that cumulative effects of projects do not need to be considered.

Option 1- Reasonable Level of confidence of achieving GES (preferred option)

¹⁹⁸ A soft start involves slowly building up the strength/intensity of a noise generating activity thus allowing noise sensitive species the opportunity to leave the area prior to physical harm occurring.

¹⁹⁹ This assessment is based on work which was done after the BAU Report 2011 was completed. For this reason the BAU Report conclusions on Descriptor 11 are not considered to be the most up-to-date analysis.

255. Setting a specific target representing GES is difficult, given current uncertainties. The proposed approach under this option would reflect the conclusion that estimated future levels of activity do not currently appear to pose a significant threat to marine animal populations²⁰⁰ and address the need to record, assess, and manage the distribution and timing of impulsive sounds in the future. The aim of the proposed target is to take a proportionate, precautionary approach, allowing continued management, collection and evaluation of better evidence relating to behavioural impacts of noise at a population level.
256. The proposed target establishes a requirement to establish and maintain a 'noise registry' which would record in space and time activities generating noise in order that they can be analysed to determine whether they may potentially compromise the achievement of GES. Such a registry would likely be managed by regulators and require a degree of coordination from regulating authorities around the UK. It would enable a better understanding of potential cumulative and in-combination effects, and allow for some adjustment in the scheduling of activities if it appeared significant adverse impacts may arise. However, any adjustments to the scheduling of activities would need to be very carefully managed and made well in advance given the high potential for significant costs to be incurred by developers e.g. as a result of increased project timescales, missed grid connections etc.
257. It is estimated that the administrative and financial burden of establishing a noise registry would be relatively small for both the regulator and industry (a small additional cost may be incurred by industry where applications are required to provide more detailed information in advance with respect to when and where an activity will take place).
258. In relation to monitoring, beyond the costs associated with the possible creation and administration of a noise registry, there would be no additional monitoring implications under this option.

Option 2- Higher Level of confidence of achieving GES

259. The target proposed under this option reflects a precautionary limit on the proportion of days over a calendar year averaged across the entire UK hydro-carbon licence block area²⁰¹ where impulsive sound (pulses) generated by anthropogenic activity can exceed a particular threshold²⁰². The proportion of pulse days proposed under this option is broadly in line with current levels of activity.²⁰³ This is based on the hypothesis that although current levels of activity are not considered to be affecting populations significantly, there may be sufficient uncertainty to warrant a precautionary approach to any increase on current noise levels.
260. Such a target would also require the establishment of a 'noise registry', a necessity in order to actively manage and plan noise generating activities (e.g. possibly coordinating multiple developers to pile drive over the same period to reduce the overall number of pulse days in a year). This would potentially result in restrictions to when and where developments can take place and be administratively complex, not least because such activities may be delayed by hours, days or more, for example due to technical issues or unfavourable weather conditions. This would then result in potentially significant costs for both the regulator and industry. This

²⁰⁰ Based on the findings of the previously referenced Cefas/JNCC study and further expert judgement.

²⁰¹ Hydrocarbon licensing blocks are existing administrative areas 10 nm N/S and c.5 nm E/W (12 minutes longitude) which cover the whole UK marine area. They offer a practical and consistent delineation of UK waters.

²⁰² The proposed threshold is sound exceeding the energy source level of 183dB re 1 $\mu\text{Pa}^2 \text{ m}^2 \text{ s}$ or the zero to peak source level of 224 dB re 1 $\mu\text{Pa}^2 \text{ m}^2$.

²⁰³ Note that this would not include planned offshore wind installations for Round 3

could prevent or slow the identification of fossil fuel sources and the installation of renewable energy installations, risking failure to meet Government’s domestic and EU commitments on renewable energy and emissions reductions. Given the management implications (including the need for mediation between offshore energy developers and the need to enforce any restrictions) and the potentially restrictive nature of the target on industry, it is very likely that the costs associated with this option would be disproportionate when considering the likely risks to marine animal populations.

261. There may also be some wider and longer term implications of this target. It could result in less inward investment in offshore wind manufacturing and the associated supply chain which in practical terms could translate into a potential loss of hundreds of millions of pounds of investment, and many thousand fewer jobs.
262. Beyond the costs associated with the creation and administration of a noise registry and the assessment of the information contained within it, there would be no additional monitoring costs to government or regulators under this option.
263. Consideration was also given to the establishment of a target based on the principle of Option 2 but where the proportion of “pulse” days would be set broadly in line with the level of activity expected in 2020 under the Business As Usual projections, with an appropriate margin of error to allow for some flexibility²⁰⁴. This would, in effect, establish a lower threshold for GES which reflected projected future activities on the basis that initial analysis and expert judgement had indicated such activity levels would not compromise the overall achievement of GES.
264. This alternative approach has not been put forward at this time as it does not explicitly reflect the point at which GES would be achieved or not, and it is not clear at this time if such targets will be put forward by other Member States. Instead this option will be considered as an alternative if it becomes apparent other Member States are setting quantitative targets along these lines. The cost and benefits of adopting this target would be the same as outlined under Option 1. Work will continue within the EU and nationally to develop our understanding in order to articulate a threshold for GES (and therefore a quantitative target) by 2018.

Table 14 – Targets for impulsive sound (Descriptor 11)

	Reasonable confidence scenario (Option 1 – preferred option)	Higher confidence scenario (Option 2)
Targets – Criteria 11.1: Distribution in time and place of loud, low and mid frequency sounds	To establish an actively managed ‘noise registry’ to record, assess, and manage the distribution and timing of anthropogenic sound sources measured over the frequency band 10 Hz to 10 kHz, exceeding the energy source level 183 dB re 1 µPa ² m ² s; or the zero to peak source level of 224 dB re 1 µPa ² m ² over the entire UK hydrocarbon licence block area.	The mean annual number of pulse-block-days ²⁰⁵ within each UK relevant MSFD Subregion should not exceed [x, y, z]. These numbers will be updated shortly based on work being undertaken by Cefas and JNCC. The assumptions in the IA will remain the same however.
Illustrative	Implementing and managing a noise	Implementing and managing a noise

²⁰⁴ Future projections are based on work carried out by Cefas and JNCC.

²⁰⁵ One pulse-block-day occurs when a sound impulse, measured over the frequency band 10 Hz to 10 kHz, exceeds the energy source level 183 dB re 1 µPa² m² s; or the zero to peak source level of 224 dB re 1 µPa² m² within one UK hydrocarbon licensing block on one day.

<p>measures and Costs</p>	<p>registry - There would be small additional costs to regulators arising from the general administrative burden arising from the establishment and management of such a registry (estimated at £60,000 to establish and run in the first year and dropping to £45,000 per annum after that²⁰⁶). A small additional cost may be incurred by industry arising from the need to submit additional information relating to proposed noise generating activities during the license application process. There may also be a small benefit to industry from utilising the noise registry to plan activities with other developers, thus potentially cutting deployment costs, however this depends on the nature and commercial sensitivity of the information contained in the noise registry.</p> <p>Monitoring costs No new monitoring costs beyond the implementation of the noise registry mentioned above.</p>	<p>registry – Under this option the costs to developers and regulators of implementing and managing the noise registry would be more significant than under Option 1 because it would require more intense management of noisy activities (e.g. more monitoring data would be needed, more modelling and analysis of planned activities would be necessary). In addition, as a result of more stringent thresholds there would be a number of knock on costs:</p> <p>Costs to both regulators and developers of planning activities proactively e.g. coordinating multiple activities on the same day to reduce the overall number of pulse days. Provided planning was carried out well in advance the costs to both industry and regulators might be minimised.</p> <p>Costs to developers where already agreed surveys or construction activities had to be delayed or restricted - these would potentially be very high and likely to be disproportionate when compared with expected benefits for marine life. The cost implications may be lower for future projects that are not yet proposed or planned since there would be an opportunity to plan activities appropriately. Since offshore wind construction is increasing over the next few years there is the potential that this target will necessitate significant temporal restrictions; however without further analysis we cannot be certain at this time.</p> <p>There could also be costs associated with the greater use of noise-reduction technologies by developers. Technologies such as bubble curtains, and pile sleeves can be applied during pile driving activity. However, it is currently very unclear whether such technologies would be</p>
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²⁰⁶ These estimates have been provided by experts in JNCC.

		<p>effective in helping achieve the target proposed under this option. With respect to costs they do add a varied cost to the project depending on duration and size. The cost of installing a bubble curtain, for example, is dependent on several factors: the depth of the sea; the size of the pile driving area and the complexity of the system. An observed cost per project of an “unconfined” bubble curtain has been estimated to be in the region of £35,000 - £138,000, and £69,000 - £138,000 for a “confined” system²⁰⁷. However, these costs increase significantly (along with a reduction in their effectiveness) as water depth increases, therefore the costs are likely to be much higher for future offshore wind developments²⁰⁸.</p> <p>Monitoring costs No new monitoring costs beyond the implementation of the noise registry mentioned above.</p>
Summary	<p>Potential costs to business – Costs to business from managing impulsive sounds will likely be small, arising from the need to submit some additional information during the licensing process.</p> <p>Potential costs to government and regulators - These costs are likely to be £402K over 10 years, arising from the need to create and administer the noise registry.</p> <p>Total potential costs – Costs will be low.</p>	<p>Potential costs to business – Costs of implementing a noise registry would be more significant for business under this option because it would necessitate more intense management of noisy activities.</p> <p>Potential costs to government – The costs of managing a noise registry under this option would be higher than under Option 1 because it would imply more intense management of noisy activity.</p> <p>Total potential costs – Costs will be moderate to high.</p>
Key assumptions and risks	<p>Costs of implementing a noise register are based on an initial estimate made by JNCC. It has been assumed that noise reduction technologies (e.g. bubble curtains) would be effective in reducing noise levels to below the threshold identified in the target for Option 2, but it is currently unclear whether this would be the case.</p>	

Ambient noise (Commission criterion 11.2)

²⁰⁷ Information on costs of this measure is taken from the Cefas CBA Report 2012.

²⁰⁸ Nehls, Betke, Eckelmann and Ros, 2007 highlight a lack of commercial scale examples for the effective use of bubble curtains. They further highlight that their effectiveness drops off in deeper waters which has implications for their use in Round 3 (depths of between 20-60 metres). (<http://www.offshorewind.co.uk/Assets/COWRIE-ENGFinal270907.pdf>)

265. The main source of anthropogenic ambient noise in the marine environment is from shipping activity. As with impulsive sound, what constitutes GES is uncertain given current levels of knowledge but in contrast to impulsive sounds, a management regime for preventing physical harm does not exist and far less is known about current noise levels. The effects of ambient noise on marine life are also largely unknown so again in contrast to impulsive sounds, where it has been possible to use thresholds for physical harm, there are no specific exposure thresholds that can be proposed which can be used as part of a framework to define GES²⁰⁹.

266. Unlike for impulsive sounds where initial research and expert opinion has indicated noise levels can probably increase without having negative impacts at a population level, such evidence does not exist for ambient noise. This level of uncertainty is reflected in the target options proposed below.

267. It should also be noted that the Directive requires appropriate observations to be made of current trends in ambient noise. For this reason regardless of the option chosen monitoring must be put in place to allow an assessment of current ambient noise levels. Cefas are currently developing a proposal for a cost effective monitoring programme to meet the Directive's requirements based on in situ observations (utilising existing platforms) and modelling.

Option 0 – Baseline scenario

268. Ambient noise levels are likely to increase if the volume of shipping in UK waters increases, and no measures are taken to reduce noise levels from ships. However, there is insufficient monitoring data at this time to support any assessment of current ambient noise levels or their impact on marine animal populations.

269. Action already being taken through the IMO to improve efficiency standards in newly built ships will also make them less noisy (more hydrodynamic ships are more efficient and also tend to create less noise). In July 2011 the IMO adopted, by means of an amendment to the MARPOL Convention, an Energy Efficiency Design Index (EEDI) which will establish a mandatory efficiency standard for the design of new ships, with a tightening stringency over time. The EEDI provisions come into force on 1 January 2013, and the first efficiency improvements must be made from 1 January 2015. It is currently unclear how far these measures will reduce noise levels from shipping.

Option 1 - Reasonable Level of confidence of achieving GES (preferred option)

270. Given uncertainties with respect to current levels and impacts of ambient noise a specific target would not be established and instead a surveillance indicator would be put forward with the UK determination of GES for noise being used as a generic, qualitative target. This approach would ensure appropriate monitoring was put in place in order that a more specific target could be established at a later date when sufficient evidence has been collected.

271. Some level of additional monitoring will be needed in order to provide an improved understanding of the current levels and potential impacts of ambient noise in UK waters. This requirement could be met most cost effectively through the adaptation of existing monitoring stations. The costs for this are expected to be between £100-150k per annum²¹⁰ and would fall on Government and regulators. This will be needed regardless of the target established in order to meet the monitoring requirements of the Directive.

²⁰⁹ Tasker et al. 2010

²¹⁰ Cefas CBA Report 2012, p.246

Option 2- Higher Level of confidence of achieving GES

272. The proposed targets under this option would establish a precautionary target aiming for no statistically significant increase in ambient noise levels above natural variation against a baseline determined over 3-4 years of recent data. The intention would be to revise this target once a better understanding of what constitutes GES is reached.

273. The nature and extent of the measures necessary to achieve this target remain somewhat unclear however the IMO measure mentioned above to improve the fuel efficiency of new ships should contribute. The International Fund for Animal Welfare (IFAW) has estimated that 'the noisiest 10% of ships account for between 50% and 90% of noise pollution generated by shipping' and therefore as these vessels are decommissioned through age or as the IMO mandatory efficiency standards are adopted it is hoped that noise levels should at least remain stable. However, it is not possible to categorically state that these measures alone will be sufficient to offset predicted future increases in shipping activity and so there is a possibility that additional measures to apply noise reduction technologies to new and existing vessels may be needed. This has the potential to become prohibitively expensive.

274. In addition this target could not be met by the UK taking unilateral action, given that national measures can only be applied to UK vessels rather than all vessels in UK waters. Adopting any UK based measure would be ineffective in meeting the proposed target (given the international nature of shipping) whilst at the same time putting the UK fleet at a competitive disadvantage. Therefore any additional measures needed to meet this proposed target would have to be progressed and agreed through the IMO and adopted internationally.

Table 15 – Targets for ambient sound (Descriptor 11)

	Reasonable confidence scenario (Option 1 – preferred option)	Higher confidence scenario (Option 2)
Targets – Criteria 11.2: Continuous low frequency sound	Surveillance indicator to monitor trends in the ambient noise level within the 1/3 octave bands 63 and 125 Hz (centre frequency) (re 1µPa RMS; average noise level in these octave bands over a year) measured by observation stations.	Trends in the ambient noise level within the 1/3 octave bands 63 and 125 Hz (centre frequency) (re 1µPa RMS; average noise level in these octave bands over a year) measured by observation stations do not show a statistically significant annual increase above natural variation.
Illustrative measures and Costs	No new measures would be required under this option. Monitoring costs The adaptation of existing monitoring stations would provide a cost effective means of achieving this with the costs expected to be between £100-150k per annum ²¹¹ for government and regulators.	It is currently unclear whether additional measures would be needed to achieve this target over and above action already agreed in the IMO to improve energy efficiency standards in ships. Any additional measures deemed necessary would have to be proposed and adopted through the IMO. Potential additional measures are

²¹¹ Cefas CBA Report 2012, p.246

		<p>set out below: The use of ship quietening technologies²¹² This assumes the need for further ship quietening technologies beyond those that are likely to be applied anyway through the recently agreed IMO Energy Efficiency Design Index. The modification and updating of shipping parts such as propellers and thrusters can help significantly decrease underwater noise. The costs of re-design and manufacture will vary depending on the component, for example modified propellers tend to cost 15-20% more. The cost of re-designing propellers will lie mainly in the adaptation of the machine used to manufacture them and not the increase in material costs. The costs of installing any new technologies will vary. For new vessels the costs are not likely to be high, but the costs of retro-fitting existing vessels could be significant and may be disproportionately costly - for example, the cost of retrofitting a 250,000 dwt oil tanker would be £397,000-£1,853,000 with potential annual fuel savings of £662,000-£1,324,000. Thus, depending on the size of the vessel this would result either in net benefits, or in a reduced net cost. Further information will be gathered during the consultation process to inform costs.</p> <p>Monitoring costs Same as under Option 1</p>
Summary	<p>Potential costs to business – No additional costs. Potential costs to government and regulators – Additional monitoring will be in the region of £861k-£1.3m over 10 years. Total potential costs – Costs will be low.</p>	<p>Potential costs to business – Costs for managing ambient noise will vary depending on the types and costs of installing noise reducing technologies weighed against the benefits arising from associated fuel efficiencies. Costs for new ships are likely to be small but could be significant if retrofitting existing ships is required. However some of these activities are being driven by ongoing agreements on improving energy efficiency within the IMO therefore</p>

²¹² This measure is based on information in the Cefas CBA Report 2012

		<p>there is the potential that these costs would not be attributable to the MSFD. Further information will be collected during the consultation process to inform costs.</p> <p>Potential costs to government – Additional monitoring will be in the region of £861k-£1.3m over 10 years. There could also be enforcement costs associated with any measures which are introduced.</p> <p>Total potential costs – The total costs are likely to be significantly higher than Option 1 if additional measures need to be pushed for within the IMO. This recognises that any action taken by the IMO to reduce noise (driven by the MSFD or otherwise) could have potentially significant costs for the UK government and business.</p>
Key assumptions and risks	Assessment of costs is based on information in the Cefas Cost Benefit Analysis Report 2011.	

Section E: Benefits

Benefits of achieving the GES targets

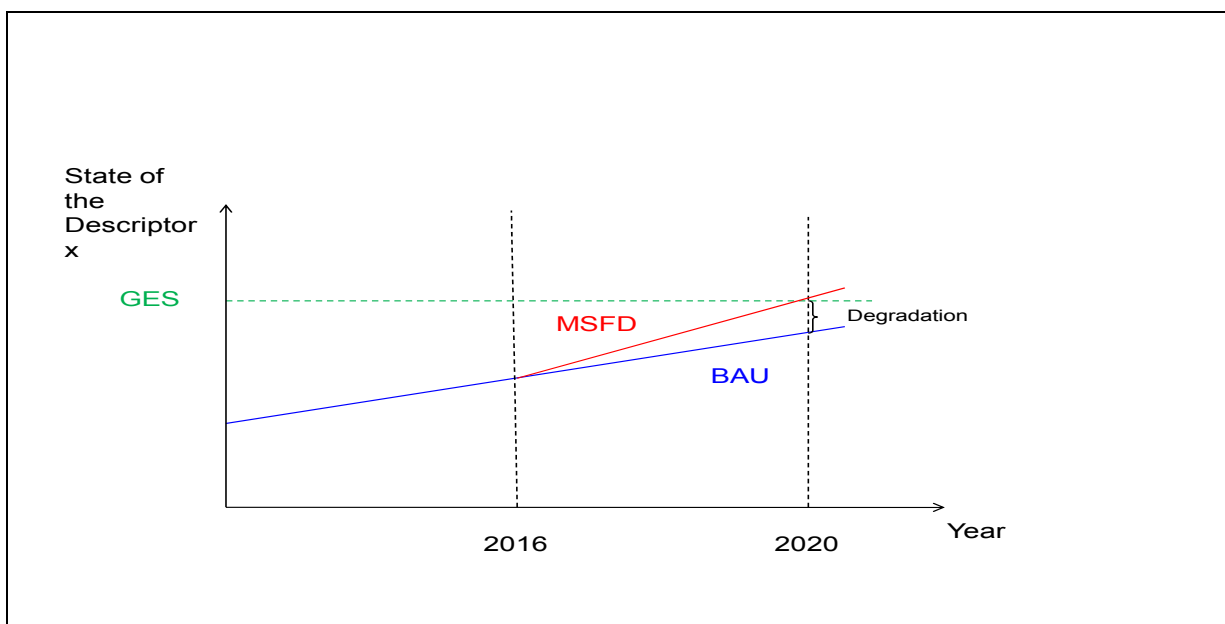
275. The marine environment provides ecosystem goods and services which benefit society. The Millennium Ecosystem Assessment set out a typology of ecosystem services under four broad headings: provisioning, regulating, cultural and supporting services. The diagram below provides examples of some ecosystem services provided by the marine environment.

Categories	Relevant Categories	Example of Product or Service
Provisioning services	Food	Fish for human consumption
	Fibre	Fish used in animal feeds
	Biochemicals, pharmaceuticals and natural medicines	Aggregates Fish oil
Regulating services	Gas and climate	Carbon sequestration
	Bioremediation of waste	Waste remediation, water purification
	Natural hazard	Protection from natural hazard
Cultural services	Knowledge and education	Scientific knowledge of ecosystem functions, genetic information, and potential for chemical/therapeutics discovery
	Recreation	Recreational sea angling Nature-based recreation Scuba Diving
	Recreation Spiritual and religious	Recreational sea angling Nature-based recreation Scuba Diving Artistic work based on the marine environment
	Cultural and social	Protection of iconic sites or archaeological features
	Aesthetic and inspiration	Protection of iconic sites or archaeological features
	Non-use and option values	Altruistic/Bequest/Existence/Option/Quasi-option values
Supporting services	Primary production	(Not directly analysed to avoid double counting ²¹³)
	Nutrient cycling	
	Biologically-mediated habitat	

²¹³ Supporting services are those that are necessary for the production of all other ecosystem services and include habitat provision and nutrient cycling. The important point to emphasise is that they differ from provisioning, regulating, and cultural services in that their impacts on people are indirect and will therefore not be valued directly but by taking account of the impact on these other ecosystem services that are directly 'consumed'.

276. The benefits of implementing the MSFD are assessed by valuing the level of improvement in the marine environment brought about by achieving GES before or by 2020 or, described in another way, by valuing the avoided costs arising from degradation in the marine environment if GES is not achieved within the timeframe. In other words, the benefits of achieving the GES targets can be assessed by valuing the difference in societal welfare when we compare the expected state of the marine environment under the Business As Usual scenario with the expected state when GES targets are achieved before or by 2020. However, in addition, there will also be earlier benefits that arise from the transition to GES before 2020 where this diverges from the BAU scenario.

Figure 6. Illustration of the cost of degradation



277. The blue line shows projected improvements in the state of the marine environment under the Business As Usual scenario. The green line shows the expected environmental state when the GES targets are achieved. The red line shows the trajectory towards achieving GES under MSFD measures. The gap between GES and BAU describes the degradation in the marine environment that will occur in the absence of a situation where GES is achieved through MSFD and the value of this gap, in terms of change in welfare, describes the benefit of achieving the GES targets. The diagram represents the underlying theoretical model behind the assessment of benefits in this impact assessment, however, due to lack of trend data it has not been possible to fully apply this model and only certain elements have been assessed below. Further work will be carried out between now and the final impact assessment, and in future impact assessments, to further develop this approach. Also it would be important to note that for some descriptors BAU and GES are likely to converge over time (as shown in the diagram). This reflects an optimistic BAU scenario where the existing legislative drivers are assumed to deliver improvement in the state of component and pressures in the future. However, for others BAU and GES are likely to diverge over time, reflecting a scenario where the state of the marine environment worsens from under business as usual.

278. In order to value the change in societal welfare (the gap in Fig.6) the ecosystem services framework was used. This framework enables an assessment of the changes in services to the society caused by changes in the state of ecosystem components and pressures in the marine environment. There are a wide range of pressures and components covered by the 11 GES Descriptors, and measuring the change in state across all these elements would be a challenging task. However, for the purposes of valuation the ecosystem services framework requires assessments to be based only on final ecosystem services²¹⁴ – those that directly contribute to human welfare - in order to remove the risk of double counting the benefits. This does not mean that intermediate ecosystem services are less important but that their value in supporting the final services should be captured through the changes in value of the latter. For example, the intermediate ecosystem service of primary production by phytoplankton and macro-algae (ecosystem component) supports the final ecosystem service of food provision in the form of fish and shellfish (ecosystem component) higher up the food chain. This means that the value of food provision also reflects the value of primary production, because without primary production, food will not be available.

279. Similarly, increased levels of litter (pressure) could cause negative impacts on marine mammals (ecosystem component) and could therefore indirectly affect the provision of the aesthetic and cultural services provided by them. At the same time increased levels of litter directly reduce the value of the aesthetic and cultural services received from going to the beach. For the purposes of valuation, only the direct effects of litter have been considered. The indirect effects should be reflected when measuring the value of aesthetic and cultural services from sightings of marine mammals.

280. To identify the changes in the provision of the ecosystem services between the BAU scenario and the achievement of GES targets, the following steps were taken:

- Identification of the ecosystem components that provide these final ecosystem services and the key pressures that impact on them;
- Assessment of whether there is any degradation in the ecosystem components, or significant changes in the impact of the pressures, when comparing the BAU scenario with the achievement of GES.
- These assessments were made based on discussions with economists and policy experts in Defra (step i) and with experts from JNCC and CEFAS (step ii) who have worked on developing the targets and indicators for the descriptors²¹⁵. The table below shows the components and pressures which are considered to relate to final ecosystem services.

Table 15: Final ecosystem services and related ecosystem components and pressures

Final ecosystem service	Relevant ecosystem components or pressures	Further explanation
Provisioning services	Fish and Cephalopods (D1 and D4) Intertidal rocky habitats (D1 and D6) Intertidal sediment habitats (D1 and D6)	Fish and Cephalopods provide food for consumption. Intertidal rocky habitats provide provisioning services such as food, medicine and fertilizer from seaweed. Intertidal sediment habitats also provide e.g. different types of fish, mussels and cockles.

²¹⁴ Final ecosystem services include provisioning services, cultural and recreational services, regulating services. Please refer to the following link for more information on ecosystem services.
<http://uknea.unep-wcmc.org/LinkClick.aspx?fileticket=KSXkgw7AKSY%3d&tabid=82>

²¹⁵ The assessment made by setting up meetings (in August and September) with policy experts within Defra and experts within JNCC and CEFAS

Cultural and Recreational Services	Marine Mammals (D1 and D4) Fish (D1 and D4) Seabirds (D1 and D4) Intertidal sediment habitat (D1 and D6) Intertidal rocky habitat (D1 and D6) Subtidal benthic habitats (D1 and D6) Litter (D10) Organic enrichment (D8) Contamination (D8)	Marine mammals, fish and seabirds provide aesthetic pleasure to divers, tourists, nature lovers and sea anglers. Intertidal rock, intertidal sediment and subtidal benthic habitats also provide aesthetic pleasure to divers. Litter in the sea and beaches is likely to have negative impact on the cultural services that visitors benefit from when they visit these places. Similarly, increase in organic enrichment and contaminants could reduce the aesthetic value of marine waters.
Regulating services	Intertidal sediment habitats (D1 and D6) Intertidal rocky habitats (D1 and D6) Subtidal benthic habitats (D1 and D6) Pelagic habitats (D1 and D6)	These habitats provide key regulating services such as natural hazard protection, climate regulation and detoxification and purification (regulation of water quality and air quality). They also provide key supporting services such as nutrient cycling, ecological interactions. A large part of nutrient cycling is carried out by pelagic habitats and plankton is the foundation of the marine food web. They also play an important role in gas exchange, including regulating the amount of carbon in the atmosphere, and releasing oxygen as a product of photosynthesis.

281. On comparing the state of these ecosystem components under the BAU scenario and the achievement of GES it was found that not all the components were likely to face degradation in the absence of MSFD. Similarly, on comparing the impacts of the pressures under BAU and GES it was found that some pressures are already likely to be managed at levels equivalent to GES under the BAU scenario. For example, for contaminants and organic enrichment GES targets are achieved under the BAU scenario, therefore there is no degradation as a result of these pressures. Further details of the assessment of degradation across the different components and pressures is provided in Annex B²¹⁶. Based on this assessment the final list of components and pressures relevant for valuation of benefits was reduced to the following:

- Fish
- Litter
- Subtidal benthic habitats
- Birds

282. The section below provides an assessment of the benefits associated with improvements in the state of these components due to achievement of GES targets, as well as benefits associated with reductions in litter levels. The benefits have been assessed both quantitatively and qualitatively (where there was a lack of substantial evidence).

Benefits – Increase in abundance of fish under GES

²¹⁶ It should be noted that there is a significant level of uncertainty in this assessment. It is based on expert judgement, but for some ecosystem components e.g. marine mammals there is insufficient evidence to make an assessment of degradation.

283. Increased fish stock abundance should lead to an increase in provisioning and recreational services (e.g. from activities such as sea angling and diving).

284. The BAU scenario states that while some stocks are in good condition i.e. around MSY (e.g. North Sea haddock) others are in a depleted state. It is assumed that the CFP would prevent any further significant deterioration in fish stocks, but will not deliver significant progress in achieving objectives such as the recovery of stocks to support MSY across fisheries, or a fully-integrated ecosystem-based management approach to fisheries. This impact assessment proposes GES targets to ensure that key fish stocks reach MSY. In terms of benefits this would imply higher levels of provisioning services (i.e. higher numbers of fish and shellfish for consumption).

285. The table below provides an assessment of benefits from improvement of provisioning services brought about by increased abundance of fish stocks. The analysis is illustrative and only looks at five fish stocks²¹⁷ but it helps to provide a rough indication of the magnitude of benefits arising from improving fish stock abundance generally. The key assumptions underpinning the analysis are as follows:

- The modelling underpinning yields consistent with MSY assumes that, for each stock considered, recruitment relationships and environmental conditions in future years are consistent with those in previous years. It also assumes that the stocks considered can achieve MSY simultaneously²¹⁸.
- Price per tonne does not change when fish stocks reach Maximum Sustainable Yield. This is unlikely as with increase in supply, prices will fall. However, it is difficult to estimate what this fall in price will be. The sensitivity analysis section below looks at scenarios of a 20% and 50% fall in price.
- The analysis is a snapshot, i.e. it describes the loss in revenue from not reaching Maximum Sustainable Yield tomorrow. In reality Maximum Sustainable Yield will be reached over a longer time period for stocks that are not currently at Maximum Sustainable Yield. In some cases in order to restore stocks to MSY levels fishing rates need to be reduced significantly in order to provide the conditions for stocks to rebuild. This is a major one, as it means that catches need to significantly reduce in the short term in order to provide for these high long term yields in the future. This implies that the future benefits are overestimated in the Impact Assessment as it would take longer to get to MSY levels. Also, for the initial period the increase in benefits to fishermen will be more in terms of reduction in effort (under the same quota) and then at a later stage benefits will accrue in terms of increase catch levels (from readjustment of the quota based on higher healthy stocks).
- For some stocks the transition towards MSY will be partly driven by CFP reform (included in the baseline) and hence not all the benefits are attributable to MSFD. Three scenarios have been considered based on attributing 50%, 25% and 10% of the benefits to MSFD rather than CFP.

286. From the table below we see that the likely increase in revenue from improvement in fish stocks (across the five depleted stocks listed below) amounts to £175m in a given year. Discounting the benefits²¹⁹ over 10 years gives a present value of £1.51bn. Based on the

²¹⁷ Due to the scientific uncertainty regarding the fishing mortality and stock levels it was very difficult to calculate the likely loss in revenue of catches for all the stocks that are likely to be in a poor state, therefore the assessment was based on a smaller range of stocks for which evidence is available.

²¹⁸ The UK government has accepted the principle of MSY, however, MSY is a single-species target, taking no account of species interactions or the mixed nature of many EU fisheries. Therefore, given the variability inherent in the targets for single species and the difficulty of simultaneously maintaining all stocks in a mixed fishery at MSY, for some stocks MSY may be considered to be a range of exploitation rates which take into account changes in stock dynamics.

²¹⁹ These benefits are presented comprised of revenues from fishing at MSY. A more accurate presentation of these benefits would be in terms of GVA or profits affected (further discussions will be required to decide which of the two approaches will be appropriate). Adopting such an approach would imply that the economic benefits to the fishing industry associated with these indicative measures are likely to be lower than presented here.

apportionment scenarios described above, the benefits attributable to MSFD would be £753m (50%), £376m (25%) and £151m (10%) respectively. These benefits are the same under the preferred option and the non-preferred option because the targets for commercial fish stocks are the same under both options.

Table 16: Increase in revenue from achievement of MSY220

Type of fish	ICES landings (2010, tonnes)	Yield at Fmsy (tonnes)	Fmsy	Increase in landings (tonnes)	£/tonne	Relative stability	Increase in revenue
IV							
Cod	50615	280,000	0.21	229,385	£2,030	0.32	£151,000,013
Sole	12,600	16,940	0.22	4,340	£8,408	0.04	£1,557,973
Via							
Haddock	3,016	13,345	0.3	10,329	£1,316	0.78	£10,582,851
VIIa							
Cod	464	11,000	0.4	10,536	£2,030	0.43	£9,126,205
Sole	275	1,292	0.16	1,017	£8,408	0.22	£1,897,239
VIIe							
Plaice	1227	2,600	0.19	1,373	£1,114	0.29	£444,811
VIIIf&g							
Plaice	433	1,653	0.19	1,220	£1,114	0.23	£318,534

Notes:

Figures for MSY yield and Fmsy for IV Cod is based on a newer version of the ICES model. The ICES Working Group has not used the new model yet to derive MSY figures and the model is still being refined. Also note that for cod IV we have only used M values that have been observed in the historic data, but that M values at MSY may differ from these observed values, likely in the direction that would lead to lower estimates of MSY (however this is not certain since it would be extrapolating outside the bounds of existing data).

IV-Cod: recruitment dynamics at high stock abundance is uncertain, so the MSY yield value should be treated with caution. Fmax used as basis for Fmsy, so Hockey-stick curve used to obtain a sustainable yield value consistent with Fmsy=0.21.

Via-Haddock: the MSY yield value has been adjusted to reflect human consumption yield only (the MSY analysis in the WGCSE 2010 report shows total removals). Fmsy=0.3 by analogy with North Sea haddock, and Ricker selected as the basis for the MSY yield value as it has a reasonable Fcrash estimate and an Fmsy value of ~0.3.

VIIa-Cod: the 2011 assessment is not used as a basis for short term forecasts because recent mortality values are highly uncertain due to unaccounted mortality. Furthermore, the Ricker curve is selected as the basis for MSY yeild because the WG considered it to be the most biologically plausible. Reading off a Figure is required to obtain the sustainable yield value consistent with the management plan target of 0.4.

VIIe-Plaice: Fmsy is selected by analogy with VIIIf&g plaice. Since the Bev-Holt curve is used as a basis for Fmsy for VIIIf&g plaice, it is also used for VIIe plaice, and therefore reading off a Figure is required to obtain the sustainable yield values consistent with Fmsy=0.19.

IIf&g-Plaice: the 2011 assessment is a trends-only one, so there are no short-term forecasts, and no population estimates (SSB or F) for 2010. SSB and F for 2009 are based on the 2010

Benefits are presented in terms of revenues to ensure comparability with the current presentation of estimates of the costs of indicative measures for Descriptor 3. This will be revisited if possible in the final Impact Assessment.

²²⁰ Source: 2011 ICES advice and WGNSSK 2010 report

assessment (which excludes discards). Catch is from the 2011 ICES advice and includes discards.

The MSY yield is the average yield over an indefinite period, therefore catches will be both lower and (in theory) higher than this value.

£/tonne is based on the average price from Jan to May 2011, taken from Monthly Return Of Sea Fisheries Statistics for England, Wales, Scotland and Northern Ireland, MMO.

287. Although this is a relatively simplistic model, it does give an indication of the magnitude of benefits that could be expected if all the relevant fish stocks and crustaceans were included in the assessment.

288. There are also likely to be increases in recreational services from improvements in the abundance of fish species. The Scottish Government recently commissioned an assessment of sea angling and its contribution to employment and income both in Scotland as a whole and its regions, and estimated the total expenditure on sea angling across the whole of Scotland was £140.86m²²¹ in 2009. Estimates from a report by Drew Associates suggest that the total expenditure by anglers resident in England and Wales was £538m per year based on the average expenditure per day's activity²²². While evidence is available on expenditure the economic impact of recreational sea²²³ angling in different nations of the UK,²²⁴ it is not currently possible to estimate the scale and significance of the value of losses from reduction of recreational benefits due to stocks not reaching MSY levels and further analysis will be done between now and the final impact assessment to inform more detailed analysis.

Sensitivity analysis

289. Some sensitivity analysis was carried out on the assumptions outlined in paragraph 285.

This considered a scenario of a 20% and a 50% fall in price (following a rise in fish stocks) and assessed the impact this would have on the benefits. A 20% reduction in price would imply benefits of £1.13bn over 10 years (£566m for 50% apportionment scenario, £283m for 25% apportionment scenario and £113m for 10% apportionment scenario), while a 50% reduction in price would imply benefits of £571m over 10 years (£285m for 50% apportionment scenario, £143m for 25% apportionment scenario and £57m for 10% apportionment scenario). Both these figures show that in spite of a decline in prices (due to increased supply of fish) the provisioning benefits to society from increased fish stock abundance are likely to be high. The table below shows the benefits for each scenario of apportionment:

²²¹ The study looked at 8 regions in Scotland and estimates indicators such as the study was tasked with estimating such indicators as overall sea angling activity levels, the number of home and visiting anglers;

- the distribution of angler days across shore, private and charter boats; the target species; angler expenditure;
- the economic contribution of sea angling to regional incomes and employment. Given the above objectives and the paucity of secondary data, extensive primary data was collected from sea anglers and other stakeholders. For more details please refer to <http://www.scotland.gov.uk/Publications/2009/07/31154700/4>

Using the GDP deflator to update figures to 2010 and assuming constant expenditure over 10 years provides an indication of benefits (in terms of expenditure) £1.2bn. Also, the report states that sea angling in Scotland supports 3,148 Full Time Job Equivalents (FTEs) and £69.67m annually of Scottish household income in the form of wages, self employment income, rents and profits. If sea angling ceased we could expect a net loss of at least 1,675 FTEs and annual income loss of £37m.

²²² Drew Associates, 2004 (Crabtree et al. 2004). Research into the economic contribution of sea angling, final report to the Department for Environment, Food and Rural Affairs, 71 pp. plus 7 Annexes. Using GDP deflators the 2010 figure would be £626m per year which amounts to £5.3bn over 10 years (assuming expenditure remains constant over the period). Also please note that this excludes sea angling benefits in Northern Ireland.

²²³ On the basis of these studies the total benefits to the UK from expenditure as a result of sea-angling are likely to be at least £6.7bn over 10 years. However, the estimates from the Drew and Scotland study are only updated using GDP deflators and hence do not reflect increases in the number of households or increase in expenditure from more people participating or increase in trips per angler.

²²⁴ For instance, see Drew Associates, 2004 (Crabtree et al. 2004). Research into the economic contribution of sea angling, final report to the Department for Environment, Food and Rural Affairs, 71 pp. plus 7 Annexes, and Scottish Government (2009), Economic Impact of Recreational Sea Angling in Scotland, www.scotland.gov.uk/Publications/2009/07/31154700/4

Table 17: Sensitivity analysis under different apportionment scenarios

% Fall in price following a rise in supply	50% apportionment to MSFD	25% apportionment to MSFD	10% apportionment to MSFD
20%	£566m	£283m	£113m
50%	£285m	£143m	£57m

290. The table demonstrates that there will be a significant decline in benefits attributable to MSFD under a 10% apportionment scenario and a 50% reduction in price.

Benefits – Reduction in litter under GES

291. Marine litter directly and indirectly affects ecosystem services and the benefits we enjoy from the marine environment. As discussed in section D, litter can cause impacts to marine animals through entanglement or ingestion, smothering of seabed, damage propellers of boats, and can be an eyesore for tourists visiting beaches or taking boat trips. This in turn could result in economic costs and losses to coastal communities (tax payers), individuals, fishermen, farmers, ports and marinas and others. Comparison of the BAU scenario with the impact of the proposed GES targets for litter show that there will be benefits from improvement in litter levels both under Option 1 (slowing the current rate of increase in litter) and Option 2 (decrease in litter levels).

292. Both the direct and indirect benefits of reducing litter are discussed further below. However, as mentioned in the introduction, for valuation purposes (and to prevent double counting) only the direct costs of litter have been assessed. Direct and indirect benefits of litter include:

- Benefits from decrease in litter in coastal areas - The BAU scenario states that there is likely to be an increased accumulation of litter in coastal areas. The proposed GES targets for litter would deliver a reduction in litter levels compared to levels predicted in the BAU scenario. This would lead to an increase in the aesthetic, recreational and cultural services experienced by people visiting coastal areas.
- Benefits from decrease in litter items floating in the marine waters - The BAU scenario states that there is likely to be a continuing problem with litter in the water column. This could result in negative impacts on boats and other vessels through damage to propellers. The proposed GES targets for litter could lead to a reduction in the costs of this kind of damage. Similarly there will be benefits to various other marine activities (such as aquaculture) from decreasing trends in litter levels.
- Indirect benefits of decreased litter levels - Under the BAU scenario litter will continue to affect subtidal and intertidal benthic habitats and floating litter items are also likely to affect marine mammals, turtles and fish populations through entanglement and ingestion. The proposed GES targets for litter could lead to a reduction these impacts. These indirect benefits are not valued here as they should be captured in the assessment of degradation for marine mammals, fish and benthic habitats.

Benefits from reduction in litter items on beaches

293. Litter on beaches can negatively affect people’s experiences through reduced recreational opportunities, loss of aesthetic value and loss of non-use values. There are two types of benefit arising from cleaner beaches – use benefits and non-use benefits. Use benefits are benefits that are directly enjoyed by beach users e.g. relaxation, walking. Non use benefits are benefits enjoyed by people who don’t directly use beaches but are keen on maintaining their value so that they can be used by others (altruistic), future generations (bequest), or simply the

benefit derived from knowing clean beaches exist (existence value). As many of the benefits associated with cleaner beaches are not traded in the market alternative valuation techniques have to be used which take into account both use and non-use values e.g. Willingness to Pay techniques²²⁵.

294. A Willingness to Pay study by Susana Mourato et al²²⁶ estimated £2.3bn in benefits to Wales and England from avoidance of dog mess and litter on beaches over 25 years. The study used choice experiment methods to evaluate how much individuals are willing to pay for absence of litter (compared to current levels). Using the average 2002 WTP estimate of £6 (per year per household) these benefits are estimated to be £1.72 billion over 10 years²²⁷ for the whole of UK.

295. Given that the estimates above relate to what people were willing to pay for complete removal of litter from the beaches this is an over-estimate of the benefits of achieving the proposed GES targets for litter (which aim to either reduce the rate of increase in litter (Option 1), or achieve an overall reduction in litter (Option 2))²²⁸. However, this does provide evidence that individuals prefer to have lower litter levels and hence there will be benefits to society from reducing litter levels (Option 2), or preventing future increases in litter (Option 1).

Reduction in impacts from litter on fishing vessels

296. Commercial fisheries could also be affected by marine litter and in some cases the damage caused could be significant enough to affect overall profitability of a vessel. For instance, fishing gear damaged or lost due to marine litter will need to be replaced or repaired, which in turn could result in costs due to loss of time at sea. Reduction in levels of marine litter would reduce the cost of these impacts, resulting in savings to the industry.

297. KIMO International has developed a questionnaire to investigate how marine litter affects fishing vessels in Scotland. Fishermen were asked to provide values based on the direct economic impacts of marine litter on their vessels including the value of dumped catch, the costs of repairs to fishing gear, the cost of fouling incidents and lost earnings as a result of reduced fishing time.

298. Based on these the results of this questionnaire, estimates of the total costs to the UK fishing industry of the impacts of marine litter is between £30.5million to £33.9 million²²⁹ per annum. This is equivalent to 5% reduction (approximately) in the total revenues that are generated by the UK fleet in comparison to 2009 UK vessels landed value. If a 5% increase in

²²⁵ In economics, the willingness to pay (WTP) is the maximum amount a person would be willing to pay, sacrifice or exchange in order to receive a good or to avoid something undesired, such as pollution.

²²⁶ CSERGE Working Paper ECM 03-12, Bathing water directive revisions, what are the benefits to England and Wales (a stated preference study), Susana Mourato, Stavros Georgiou, Ece Ozdemiroglu3, Jodi Newcombe and Alexandra Howarth3

²²⁷ The WTP has been converted to 2010 prices using the GDP deflator and multiplied by the number of households in UK <http://www.communities.gov.uk/housing/housingresearch/housingstatistics/housingstatisticsby/householdestimates/livetables-households/>

²²⁸ This figure is also an overestimate because it includes WTP to avoid dog mess (which is not being tackled under MSFD).

²²⁹ For the purposes of this analysis, the costs of marine litter for UK fisheries is calculated using the average cost of marine litter reported by Scottish vessels. The average cost of marine litter per vessel is split between original survey categories in order to separate out the average cost of fouling incidents per vessel per annum from the rest of the cost categories. Fouling incidents are more likely to be related to marine litter in the water column whilst the rest of the cost categories are more applicable to marine litter that is deposited on the seabed. The total cost of fouling incidents for UK fishing fleet was estimated separately by applying the average cost of fouling incidents for the whole UK active fishing vessel number recorded in 2010. The total cost of fouling incidents is for UK fisheries between £763,111 and £770,282. In estimating the cost of marine litter excluding the cost of fouling incidents for the UK industry, the fisheries that are most likely to be affected by marine litter on the seabed were identified. These fisheries were dredges, nets, seines and demersal trawls. The cost of marine litter excluding the fouling incidents cost was calculated using the average figures per vessel and the number of boats in affected fisheries. Therefore, the total costs excluding fouling incidents are between £29.75million to £33.14 million per annum for UK sea fisheries.

litter levels over future years is assumed²³⁰ then this would result in damage costs to the fishing industry of £344m over 10 years. To model benefits attributable to GES target Option 1 (slowing the current rate of increase in litter) a 2% reduction in the future rate of increase in litter levels is assumed. This would result in benefits (in terms of damage costs avoided) to the fishing industry of £29m over 10 years. For Option 2 (absolute reduction in litter levels), a 5% reduction in future levels of litter is assumed. This would result in benefits (in terms of damage costs avoided) to the fishing industry of 118m over 10 years²³¹.

299. In the records of Marine Accidents and Investigation Branch, 11 injuries were reported caused by floating objects and ropes and nets from 2002 to date. These injuries were serious but not life threatening²³². If we assume that there are 1-2 litter related injury every year then over 15 years the value for prevention of such injuries are likely to be approximately £409K – £817K²³³ over 10 years.

Benefits to other sectors from reductions in litter

300. Other sectors would also derive benefits from the reduction of litter and these have been listed below:

- Aquaculture – KIMO international has estimated that marine litter costs the aquaculture industry in Scotland £135,094 per year on average, due to time spent removing debris from fish farm sites and fouled propellers on work boats. This would mean costs to Scottish aquaculture from marine litter £1.2m over 10 years.
- Harbours and marinas – there are costs associated with having to remove marine litter to ensure that port facilities remain clean, safe and attractive for users. KIMO international has estimated the average cost of marine litter removal of £6,977.82 per harbour per year with total cost for active ports and harbours in 2010 in the UK up to £19m over 10 years.
- Agriculture – there are costs associated with manual removal of marine litter, harm to livestock and vets fees, damage to property and equipment, blocked drainage ditches etc.

Summary

301. The benefits from complete removal of litter are estimated be at least £1.8bn-£1.9bn over 10 years. However, the benefits of achieving GES will be notably lower than these values as the proposed GES targets for litter aim to reduce litter levels rather than remove litter completely. However, these figures clearly indicate that there will be benefits to addressing the problem of increasing litter levels. We have used scenarios to estimate a part of these benefits – benefits from reduction in litter levels causing damage to fishing vessels. These are estimated at £29m over 10 years under Option 1 and £118m over 10 years under Option 2 (preferred option). The other non-monetised benefits (such as improvement in aesthetic and cultural services from beach visits and benefits to other sectors) will be higher under Option 2 than Option 1 because the GES targets proposed under Option 2 would require more significant action to reduce litter than those proposed under Option 1, and therefore the associated benefits under Option 2 will be higher.

²³⁰ We assume increase in litter causes a proportional increase in damage costs to vessels (i.e. a 5% increase in litter results in a 5% increase in damage costs). There is not information on litter trends of marine litter floating in the sea so we used a proxy of litter trends on beaches. The 5% increase was arrived at looking at the average beach litter trends over the last 5 years (Marine Conservation Society Beachwatch report 2010).

²³¹ These estimates need to be interpreted cautiously due to lack of representation of original sample data and the probability of incidence with marine litter across the UK fleet. At this stage, these estimates are based on best available evidence and some broad assumptions (that have been highlighted above).

Benefits - Improvements to seafloor habitats under GES

302. Subtidal benthic habitats, intertidal rocky habitats and intertidal sediment habitats provide key regulating services (such as climate regulation, regulation of water and air quality, hazard protection and regulation of disease and pests), provisioning services (such as food and medicine from seaweed) and recreational services (e.g. to divers).

303. The table below lists the specific regulating services provided by these habitats:

1. Any littoral and infralittoral rock habitat is an effective protection against erosion.
2. All littoral sediment could be considered important in flood control, but it depends on a combination of sediment type, coastal topography and local hydrodynamics.
3. All predominant benthic habitats can be considered as being instrumental in the long term (decadal) bio-remediation of pollution events (e.g. oil spills, fish farms) and the on-going (daily) purification of water through microbial breakdown of pollutants / toxins
4. Sub-littoral and deep sea sediments are a major site of detrital breakdown (purification) and carbon/nutrient recycling.
5. Biogenic reefs are typically built by filter feeding organisms which are instrumental in removing particulate matter from water - hence instrumental in purification.
6. Aquatic plant habitats are instrumental in coastal water purification.
7. Biotic and geochemical processes in all predominant benthic habitats are fundamental to the carbon cycle and so implicated in climate regulation. This is nature's equivalent of 'Carbon Capture and Storage'.
8. Some habitats will be more important than others in climate regulation; the total productivity of the habitat and /or the 'production:biomass ratio' might be used as an indicator of that relative importance.
9. The translocation of benthic organisms (e.g. shellfish) can cause the distribution of diseases and pests that they may carry

304. On comparing the BAU scenario and the achievement of GES targets, it is clear that there is likely to be degradation for subtidal Benthic habitats in the absence of MSFD. It is extremely hard to say what impact this degradation would have in terms of changes to the provision of regulating, provisioning and recreational services - other than to conclude that it would reduce the capacity of these habitats to provide those services. This implies that there will be benefits from improving the state of benthic habitats. The benefits would be higher under target Option 2 than Option 1 because the targets proposed for benthic habitats under Option 2 are more precautionary and would require more significant management measures, and therefore the associated benefits under this option would be higher. Further research will be carried out between now and the final impact assessment to understand the extent to which the delivery of these key regulating services could be affected (and what this would imply in terms of benefits) if GES targets for benthic habitats are not set under MSFD.

Benefits – Improvements in the state of birds under GES

305. Seabirds provide direct cultural and aesthetic services to tourists, as well as providing key supporting services to help maintain vital marine ecosystems. A comparison of the BAU scenario with the achievement of GES targets suggests that there is some degradation in relation to seabirds. In particular, it is considered that the GES targets proposed for birds would result in greater mitigation of climate change impacts on bird populations than would be the case under the BAU scenario.

306. An RSPB study²³⁴ estimates that in 2009, there were more than 142,000 visitors to the four RSPB sites that have the most significant populations of seabirds²³⁵.
307. While evidence exists around expenditure related to seabirds²³⁶, there is limited evidence around the value society places on conserving bird colonies for future generations, or the value people derive from knowing that healthy bird populations exist. Consequently, it has not been possible to assess the improvements in cultural and aesthetic services that would result from the implementation of the proposed GES targets for birds, but the estimates above show the significant benefits that are associated with healthy bird colonies. The benefits would be higher under target Option 2 than Option 1 because the targets proposed for birds under Option 2 are more precautionary and would require more significant management measures, and therefore the associated benefits under this option would be higher. Further analysis will be carried out to improve the assessment of benefits for the proposed target²³⁷.

²³⁴ RSPB, (2010), The Local Value of Seabirds: Estimating spending by visitors to RSPB coastal reserves and associated local economic impact attributable to seabirds, The RSPB, Sandy, UK, accessed online <http://www.rspb.org.uk/Images/seabirds_tcm9-262584.pdf> on 23 June 2011

²³⁵ Estimate was made using the information on the number of visitors in the RSPB Reserves of - Bempton Cliffs, South Stack Cliffs, Mull of Galloway and Rathlin Island. The total expenditure for such visits was estimated to be £5m- £10m. This would imply benefits (in terms of expenditure on the 4 bird reserves) in the range of £51m - £102m over 10 years, assuming expenditure remains constant over the period.

²³⁶ RSPB, (2010), The Local Value of Seabirds: Estimating spending by visitors to RSPB coastal reserves and associated local economic impact attributable to seabirds, The RSPB, Sandy, UK, accessed online <http://www.rspb.org.uk/Images/seabirds_tcm9-262584.pdf> on 23 June 2011

²³⁷ It could be assumed that for areas where the bird population is quite depleted measures to increase abundance would result in higher marginal increase in benefits compared to areas where there are significant abundance of birds.

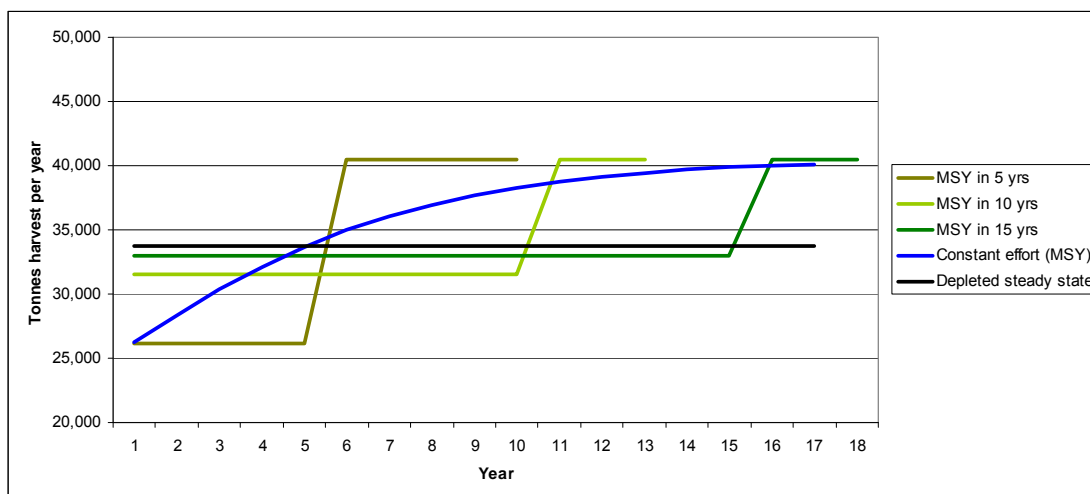
Section F: Conclusion

308. This impact assessment sets out a range of proposals for UK targets and indicators of GES. Where scientific uncertainty exists on how to define sustainable use of the marine environment, two options for GES targets have been put forward. Option 1 is considered to provide a reasonable level of confidence that a target will achieve GES and Option 2 is considered to provide a higher level of confidence that a target will achieve GES. No options have been put forward which are considered to fail to achieve GES other than Option 0 which is the baseline projection for what will happen without MSFD²³⁸.
309. Where two options for GES targets have been put forward, the preferred option is Option 1. The targets proposed under this option are considered to be equivalent to GES and the risks to the marine environment are considered to be acceptable. Whilst Option 2 would provide a higher certainty of achieving GES, and would be likely to deliver higher overall benefits, it would also have higher costs and these are not considered to be justifiable given that there is reasonable confidence that the targets proposed under Option 1 are sufficient to achieve GES. The only exception to this is in relation to the targets for marine litter (Descriptor 10) where the targets proposed under Option 2 have been proposed for coastal litter. This is because this option is more closely aligned with existing UK Government and Devolved Administration policy commitments in relation to reducing litter levels.
310. Given the lack of data it has only been possible to quantify part of the costs and benefits of achieving the proposed GES targets. On comparing these quantified costs and the benefits across the GES Descriptors, we arrive at a net present value of £-£178m – £336m (over 10 years) for the preferred option and net present value of £-£88m -£246m (over 10 years) for the non-preferred option. These estimates are driven by the assumptions made in the baseline and scenarios that have been used for apportioning the additional costs and benefits between MSFD and CFP.
311. To tackle the difficulty in apportioning the costs and benefits between MSFD and CFP three different scenarios have been considered - 50%, 25% and 10% of costs and benefits solely attributed to MSFD. In relation to the monitoring costs associated with the proposed GES targets, there is significant overlap between MSFD and the requirements of the Birds and Habitats Directives. For this reason apportionment scenarios of 10%-30% have been considered. The apportionment scenarios used in the analysis are purely for indicative purposes and will need to be refined as we become clearer about the outcome of existing policies in the baseline such as the CFP.
312. There are other costs and benefits that it has not been possible to quantify. It is likely that these qualitative benefits and costs will be higher under Option 2 (higher confidence of achieving GES) compared to Option 1 (reasonable confidence of achieving GES) because the targets proposed under Option 2 imply a more precautionary approach which would require the implementation of more extensive measures to achieve the targets. The consultation process will be used to gather more information on these non-quantified costs and benefits.

²³⁸ Although for Descriptors 5, 7, 8 and 9 it is concluded that the GES targets will be achieved under the baseline scenario.

ANNEX A: Modelling Information – Limits on Landings

1. Consideration of this issue is difficult due to the uncertainties about appropriate targets for many of the UK's commercial fish and shellfish species. However, some consideration of the relative value of the stocks and landings, and possible implications of CFP measures (e.g. discard ban) is needed. The modelling within the eftec work for the Pew Trust contains data on the level of reduction of catch necessary to allow stock recovery, so this can be used as a proxy for the short-term costs of achieving GES for descriptor 3.
2. The work carried out for the Pew Trust involved a modelling and simulation approach in which we first used stock and landings data to model stock growth rates, then transferred the estimated parameters to models of whole commercial groups of fish at the scale of Large Marine Ecosystems (LMEs). These included the North Sea and Celtic-Biscay Shelf, where the majority of UK fishing is carried out. Data constraints made it impossible to model all the different groups, and for both these regions models were constructed for cod-like, herring-like, perch-like and flatfishes, representing 73% of landings values for the North Sea, and 46% for the Celtic-Biscay shelf. The UK took approximately one-third of the value of North Sea landings, and a quarter of Celtic-Biscay landings.
3. The objective of the Pew modelling was to explore the implications of IUU fishing and the results in that report are not directly useful here. However the model parameters can be used to derive estimates of the temporary reduction in landings and values that would be required to return fisheries to MSY levels. We have looked at achieving MSY within 5, 10 and 15 years, by cutting landings to a constant level over that period. Doing it in 5 years requires larger initial reductions in landings, but of course gives faster return to maximum benefits for the fishery.
- 4.
- 5.



6. **Figure 1** compares three such recovery paths with continuation of the status quo (“depleted steady state”) and the case of cutting effort to a constant level consistent with MSY.

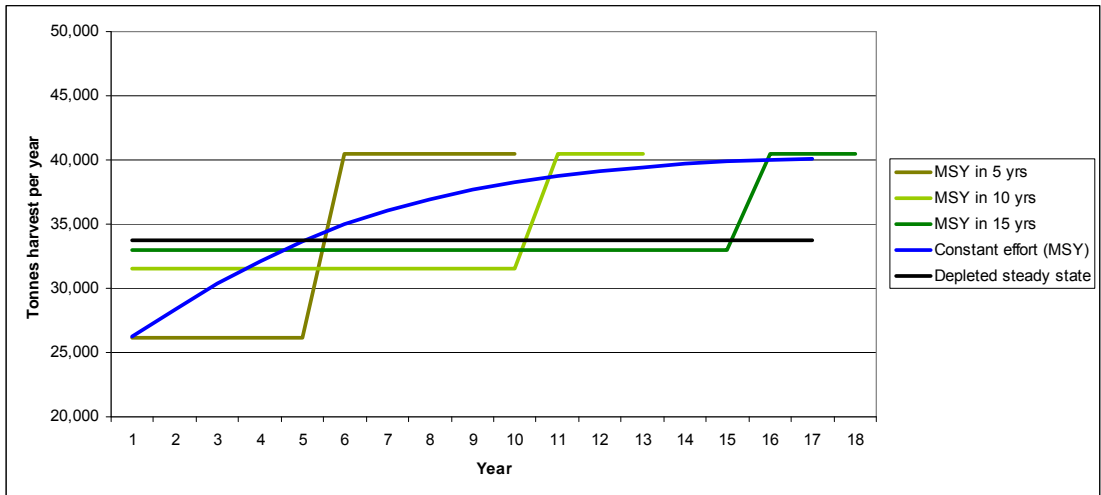


Figure 1: Possible recovery paths for harvests (example of Celtic-Biscay flatfish)

7. The constant MSY effort case is perhaps a more appropriate option, since in the scenarios giving faster return to MSY there is a steeper decline in effort over the period, then an increase at the end when the harvest steps up to MSY levels, and such fluctuations in effort would be difficult to manage. However for exposition of the possible short-term catch losses it is easier to stick with a quota-style of management. The results of running these simple models for the 8 commercial groups are presented below.

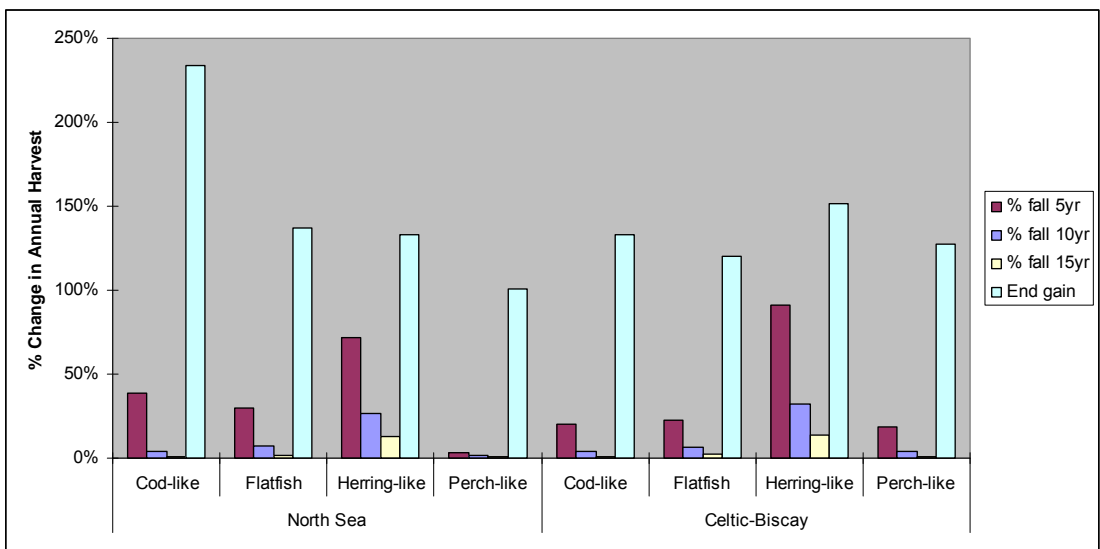


Figure 2: Changes in annual harvest for 3 recovery paths, and the final annual gain.

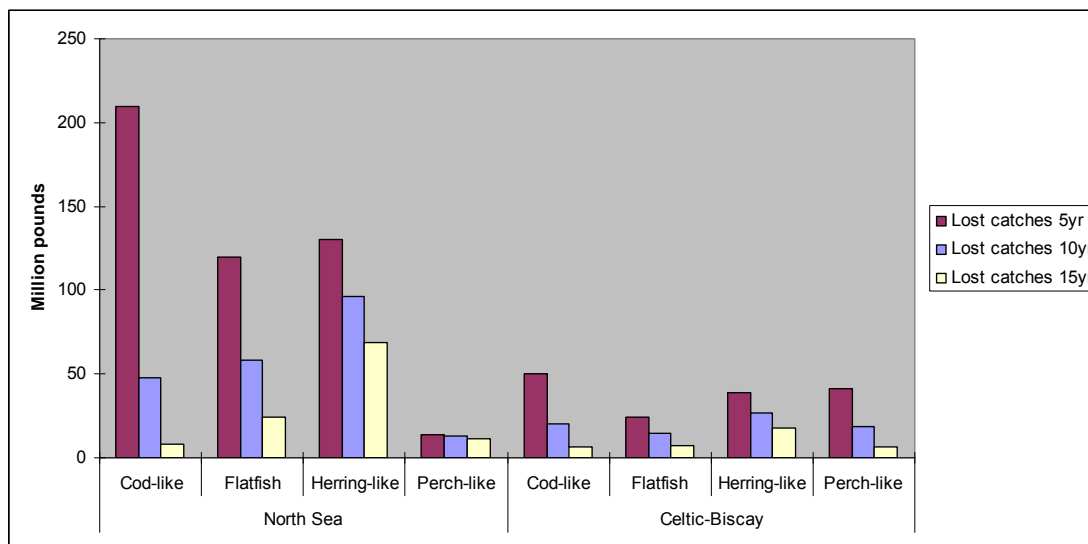


Figure 3: Total value of lost UK catches over 5, 10 and 15 year recovery paths.

8. Figure 2 shows that the short-term harvest reductions required to achieve recovery in 5 years can be quite significant, but for 10 year recovery they are mostly minor, and for 15 year recovery mostly trivial. In all cases, the annual gain once MSY is reached – in principle, achievable in perpetuity – is much greater than the short term loss. Figure 3 shows the short-term losses in economic terms. Adding these across the 8 fishery groups gives a total cost of £628 million for recovery over 5 years, £295 million over 10 years, or £151 million over 15 years. If we assume that similar proportions hold for the stocks we have not modelled (and this is a heroic assumption), this would give corrected totals of £985 million for recovery over 5 years, or about £200 million per year; £469 million for recovery over 10 years, or about £50 million per year; or £237 million for recovery over 15 years, equivalent to £16 million per year. For comparison, the total value of UK landings in the UK and abroad by UK vessels was approximately £719 million in 2010²³⁹. These figures are very approximate, and a number of caveats should be made.

- Results are based on simple models derived from evidence on growth rates for particular stocks, transferred to broad commercial groups, and data on stock status and landing values for these groups.
- The calculations do not take account of any discounting.
- There is no accounting for the costs of fishing: since efforts are lower, these costs would fall and this would partly offset the short-term losses from reduced harvests.
- No account is taken of possible price changes that could modify the results.
- There is no attempt to consider age-structure, but one of the impacts of reduced efforts would be more fish surviving to larger, and more valuable, sizes. Indeed one option for achieving the reductions in harvest/effort could be to introduce larger mesh sizes over the recovery period.
- The calculations assume that it is possible to reduce effort across the whole of the sea areas, which would require cooperation from EU partners.

²³⁹ <http://www.marinemanagement.org.uk/fisheries/statistics/annual2010.htm>

- We have ignored random fluctuations in stock growth rates, which were a feature of the original modelling. Including these would have necessitated a more complex simulation approach, but would not greatly alter the basic conclusions.

ANNEX B: Assessment of degradation across the different ecosystem components and pressures

[See separate document](#)