

Common Procedure for the Identification of the Eutrophication Status of the OSPAR Maritime Area

UK National Report

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1 Introduction

This report presents the outcome of the second application of the Comprehensive Procedure assessment to OSPAR maritime waters in the jurisdiction of the United Kingdom. The purpose was to assess the status of waters, on the basis of a harmonised set of assessment criteria to provide an *initial* classification and, using further supporting evidence, to produce a *final* classification, as either Non Problem Area or Problem Area with respect to eutrophication. Where there was uncertainty a further assessment category of Potential Problem Area has been assigned.

The first application of the Common Procedure in 2002 applied the agreed Screening Procedure to define obvious Non Problem Areas and focused attention and resources on those areas to which the Comprehensive Procedure was subsequently applied. In line with the spirit of the agreement (but not formal requirement) the UK carried out a further *screening review* in the light of known changes and our developing understanding of overall ecological status to conclude on the areas to which the Comprehensive Procedure would be applied.

A thorough review was undertaken of the thresholds applied for each of the Harmonised Assessment Criteria, taking account of regional differences where this was required, lessons learned from the first application and national developments in the field of eutrophication assessment, including work with respect to European Directives. Where it is scientifically justified, we have used similar thresholds across the wide variety of water types in the UK area for simplicity and transparency.

The UK assessment follows the Comprehensive Procedure Guidance as closely as possible but in the light of the characteristics of UK waters, we have deployed methods that are considered to be more rigorous and improve the quality of the assessment. This is made clear in the report.

It is important to ensure that the methodology has been applied well and that the conclusions are based on robust and reliable evidence. To ensure that this is the case the area based assessments have been subject to an open peer review process. Three international experts, led by Prof Paul Tett (Napier University), were commissioned to undertake the review, which concluded with a public workshop challenging all aspects of the work. The key findings of the review have been incorporated into this report either as changes to overall classification where this was based on evidence or changes affecting the robustness and level of confidence in the classification. The evaluators suggested some improvements to the Comprehensive

Procedure assessment approach which will be submitted separately to OSPAR for consideration (the issues are summarised later in this report) and also proposed changes towards greater consistency of approach across the UK which will be taken up by the national authorities. Findings from the evaluators report will be submitted to OSPAR EUC, for information.

We have not included a specific chapter on the implementation of the integrated set of EcoQOs for eutrophication. The UK believes that the overall assessment provided by the application of Comprehensive Procedure provides the relevant information with respect to ecosystem health and is the most appropriate assessment to target the development of any measures which might be needed.

The first application of the Comprehensive Procedure resulted in identification of most of the UK maritime area as Non Problem Area status with 12 estuaries/embayments identified as Problem Areas and 4 estuaries/embayments as Potential Problem Areas. There were 5 Non Problem Areas downstream of catchments with a size of population and/or level of agricultural activity that were of continuing interest and required monitoring to assure their continuing NPA status. These areas are highlighted in the assessment (Table). The overall UK eutrophication monitoring programme was modified providing additional surveillance in particular areas of concern.

The results of this second application of the Comprehensive Procedure, which broadly confirm those of the first application, can be found in Chapter 7 and in summary form in Table 6, on page 59.

The detailed results within the maritime jurisdiction of the UK are presented in a series of separate area reports, which are available electronically from the following link:

www.cefas.co.uk/ospardocs.

2 Description of assessed areas

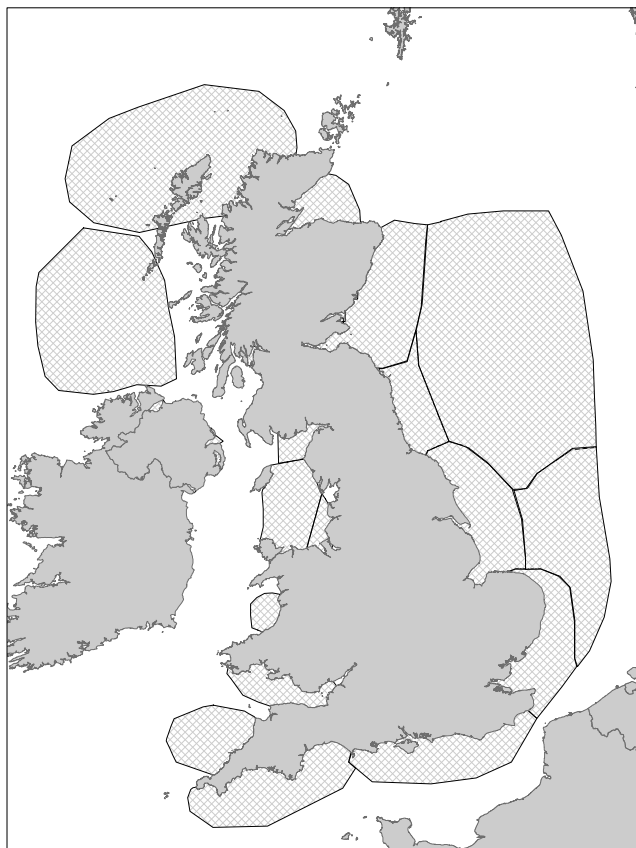


Figure 1: Areas submitted to the 2008 Screening Review

A *screening review* was undertaken to provide assurance that areas previously identified as obvious Non Problem Areas (NPA) through application of the Screening Procedure in 2002 were still NPAs; taking account of any known changes in pressures and through a simple evaluation based on a comprehensive, quality assured database of winter nutrient concentrations (Section 9.1, Annexes). The areas submitted to the screening review are shown in Figure 1. The review confirmed the previous assessment and further identified that waters in the North Sea to the east of Scotland could also be excluded from the Comprehensive Procedure Assessment due to nutrient concentrations being near background and no identified risks of significance.

The areas identified for assessment included specific estuaries and embayments (transitional waters – TW), areas of coastal water with significant freshwater input and offshore areas, either well mixed or seasonally stratified. Sub-division of these wider sea areas is on the basis of a good understanding of ecological type. Boundaries are also set on the basis of national jurisdiction e.g. the median line in the North Sea and Channel. The UK assessment areas are shown in Figure 2.

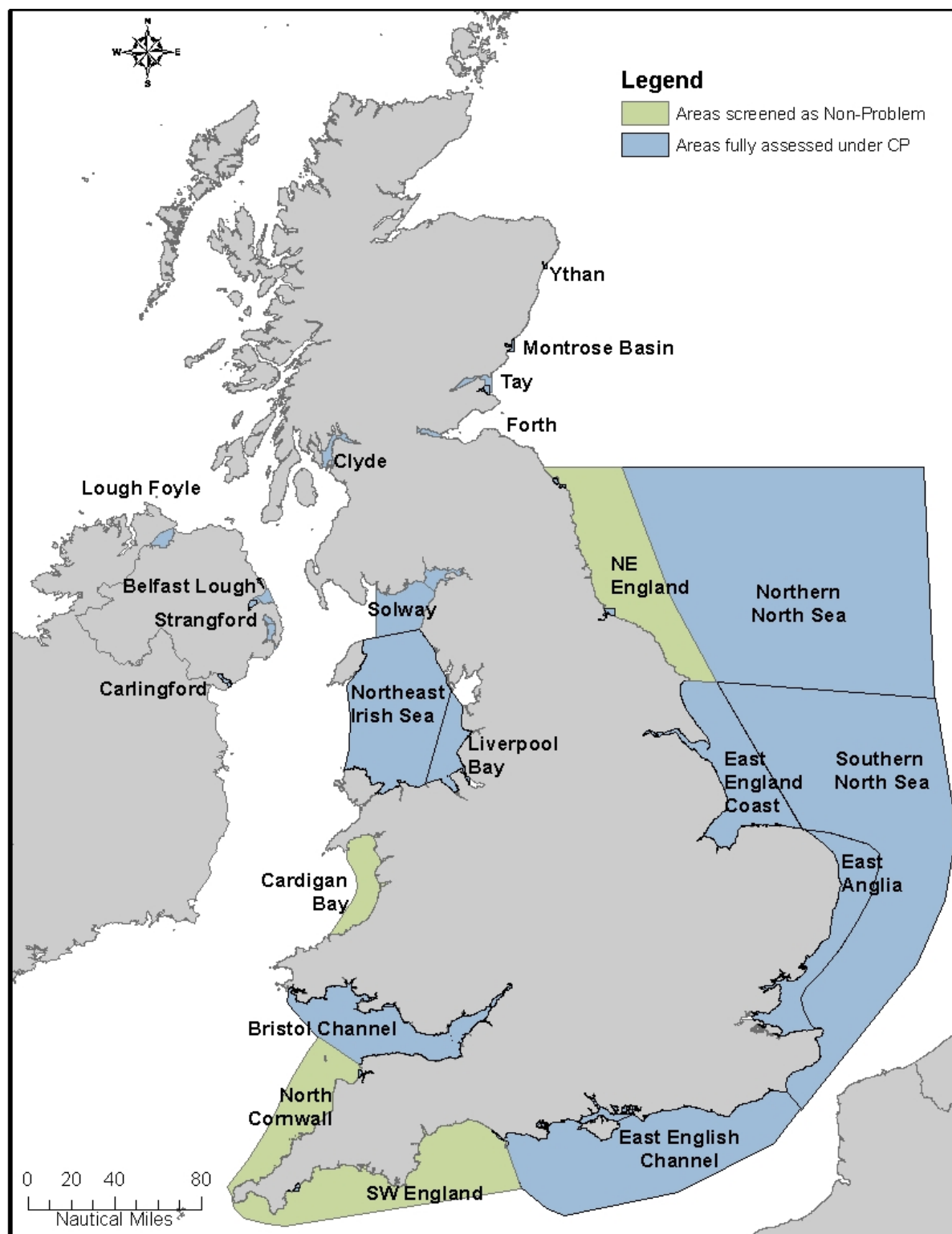


Figure 2: Outcome of the 2008 Screening Review; areas with nutrient concentrations at background levels were designated as Non-Problem (green) and assessed no further. Remaining areas (blue) were submitted to full assessment under the Comprehensive Procedure (CP).

Where we have identified some large sea areas for assessment and to ensure that any problems are not overlooked (reflecting that many such problems are closely associated with nutrient enriched freshwater inputs), we have carried out the assessment of waters within each area on the basis of salinity gradients, which result from the mixing of freshwater and seawater. These are presented in terms of three salinity regimes, but each assessment area will have a dominant salinity regime that is the basis for overall assessment. The salinity regimes are:

- Estuarine: All areas – salinity range 0 – <30.0
- Coastal: Irish Sea – salinity range 30 – 34.0
 North Sea – salinity range 30 – 34.5
- Offshore: Irish Sea – salinity range > 34.0
 North Sea – salinity range >34.5

Some of the UK estuaries/embayments have also received prior assessment of eutrophication status for the purposes of the EC Urban Waste Water Treatment (UWWT) Directive and Nitrates Directive (ND). Where these assessments have resulted in designation as a Sensitive Area (eutrophic) or Polluted Water (eutrophic) then they are deemed, subject to confirmation, to be either OSPAR Problem Areas or OSPAR Potential Problem Areas.

3 Methods and data

The UK assessment follows the Comprehensive Procedure Guidance as closely as possible, but in the light of the characteristics of UK waters and national development of methods that will be used for the Water Framework Directive classification, we have deployed methods that are now considered to be more rigorous and improve the quality of the assessment. The developments are for chlorophyll, phytoplankton indicators, macrophytes (including macroalgae) and oxygen (see Section 4.1).

3.1 Criteria for the OSPAR Comprehensive Procedure assessment

The UK application of the assessment criteria and a detailed description of the assessment parameters for the categories is summarised in Table 1 (page 11).

Category I: Degree of Nutrient Enrichment. Each of the Harmonised Assessment Criteria for **Category I** has been applied according to the CP Guidance. Riverine Input and Direct Discharge (RID) information is utilised for areas that are adjacent to the coast. Nutrient concentration information focuses on winter dissolved inorganic nitrogen ($\text{DIN} = \text{NO}_2 + \text{NO}_3 + \text{NH}_4$) as the primary criterion and is used in each assessment area/salinity regime, normalised to the relevant salinity. We have not used winter dissolved inorganic phosphorus as a primary criterion, unless assessment of the winter DIN/DIP (DIP = dissolved inorganic phosphorous) ratio suggests phosphorus limitation. We have not found such cases.

Category II: Direct Effects of Nutrient Enrichment. Harmonised Assessment Criteria have been subject to detailed national scrutiny (also in association with work-streams to implement the Water Framework Directive) and the following specific approaches for this CP Assessment have been developed. Chlorophyll is assessed using the 90th percentile for the March to September growing season, which will inevitably include high spring-bloom chlorophyll values and this is why the 90th percentile (rather than the 95th percentile, for example) was set. We have also reported the mean and maximum levels for comparison. We do not think it sensible to assess against maximum levels, as they are difficult to sample, even where we have deployed continuous observing equipment. Instead of a set of individual ‘phytoplankton indicator species’ we have deployed an index, which includes measures of *Phaeocystis* spp. and any phytoplankton taxa with abundance over a defined threshold. This is to provide a better assessment of disturbance of the phytoplankton as a result of nutrient enrichment. Areas where macrophytes are significant have been assessed using a specific index including the area covered and biomass of opportunistic macroalgal taxa. This national

development is being considered for adoption by the Intercalibration Process for the Water Framework Directive.

The peer reviewers and our scientists have concerns that the mix of parameters and their formulation in Category II, confuse two aspects of the assessment of eutrophication status and can lead to an incorrect classification in the initial assessment. This issue is considered below (section 6.2.2)

Category III Harmonised Assessment Criteria follow such guidance as exists. We have compared dissolved oxygen concentrations against established thresholds and made best use of any evidence of fish kills and the available widely distributed data on changes to benthic invertebrates. We have not used information about organic carbon/organic matter – there are few depositional areas in UK waters where this would be relevant, though it may be relevant in some restricted circulation areas such as small estuaries and lochs, but is not a parameter routinely included in our monitoring programmes.

Category IV Harmonised Assessment Criterion has been supplemented (in coastal and estuarine regions) with information about the frequency of toxin producing algae (TPA) in water samples, assessed against thresholds established for food safety. These data have been collated as of interest but due to the lack of a clear scientific case linking nutrient enrichment with either the presence or proliferation of TPA, or their presence in bivalve mollusc tissue, we have given these parameters no weighting in our assessment. There is evidence from the Atlantic coasts of the UK that the presence and proliferation of TPA and/or incidence of toxicity in bivalve mollusc tissue result from factors other than nutrient enrichment. This will be the subject of further investigation.

Harmonisation: In developing the approaches and thresholds to be applied on a regional basis the UK has, as far as possible, harmonized with UK national programmes set up to implement the Water Framework Directive which follow the recommendations for assessment levels agreed by the North East Atlantic Geographical Inter-calibration Group. The UK has also noted that some Contracting Parties bordering the North and Irish seas use thresholds, of a similar order for nitrogen and chlorophyll, giving confidence that assessments of similar offshore and coastal waters are being carried out on a comparable basis.

Table 1: Assessment parameters and description of thresholds for the 2008 OSPAR Comprehensive procedure.

Assessment Parameters	Description
Category I. Degree of nutrient enrichment (causative factors);	
1. Riverine inputs and direct discharges (area specific)	Annual inputs for each year assessed (displayed as bar chart) for direct receiving area. Analyse for trend over longest time series available. An increasing trend scores +.
2. Nutrient concentrations (area specific) Elevated level(s) of winter DIN and/or DIP	The winter period defined as November – February inclusive. Thresholds for nutrients based on reference freshwater end point (42 μM, S = 0) and marine reference concentration (10 μM, S = 35). Thresholds can be normalised to any specific salinity. For example, North Sea Winter DIN thresholds – relative to salinity/area¹. Estuary – normalised to salinity of 25. Ref value = 20 μM; + 50% = threshold of 30 μM Coastal – normalised to salinity 32. Ref value = 13 μM; + 50 % = threshold of 20 μM Offshore² – normalised to salinity 34.5 Ref value = 10 μM; + 50 % = threshold of 15 μM P is assessed as part of the N/P ratio (see assessment parameter 3, below). Winter DIP alone will not be presented unless P limitation indicated because of its complex behaviour in estuaries and areas with fine sediment. Notes ¹ <i>Threshold values are presented for two nominal ranges of salinity. Assessments can be based on any point along the reference dilution line</i> ² <i>For Irish Sea – more appropriate to use >34 for offshore waters</i>
3. N/P ratio (area specific) Elevated winter N/P ratio (Redfield N/P = 16)	Significant deviation (>50%) from Redfield ratio based on annual winter average nutrient concentrations¹ N:P 24:1 (Additional information may be supplied for N:Si 2:1) Notes ¹Ratios are calculated for each sample and averaged over the assessment area. (SE can be associated with the ratio).
Category II. Direct effects of nutrient enrichment;	

Assessment Parameters	Description
1. Chlorophyll concentration (area specific) Elevated percentile,	90 th percentile for period March – September (reflects WFD European Intercalibration approach). Thresholds Estuarine – 15 µg l⁻¹ Coastal – 15 µg l⁻¹ Offshore – 10 µg l⁻¹ Mean and maximum concentrations are also reported as supporting evidence.
2. Phytoplankton indicators (area specific) Elevated levels of phytoplankton species (and increased duration of blooms)	Phytoplankton assessment using new phytoplankton index approach based on: Total cell count – assessment of occurrences over 10 ⁷ <i>Phaeocystis</i> cell count – occurrences over 10 ⁶ Any single taxa – occurrences over 10 ⁶ Chlorophyll concentrations – occurrences exceeding 10 µg l ⁻¹ Threshold set on all exceedance counts being less than 25% of all sampling times over 5 years. Description of index This index is designed to assess if the presence, abundance and frequency of occurrence of elevated counts of algal species correspond to undisturbed conditions. The tool is composed of four attributes, one which is a measure of the frequency that elevated biomass [chl] exceeds a reference threshold and three of which focus on counts of algae that may result in the decline of ecosystem health or result in an undesirable disturbance. The classification tool works by recording the number of events, defined by sampling occasions when the sum of the four attributes exceeds these predefined thresholds over the period of the monitoring programme. Each attribute is calculated from the number of times that the sub-metric exceeds the threshold as a proportion of the total number of sampling times and calculated as a six year mean. Final classification score is based on the mean of all four attributes (as a %). The UK believes that this index, which is being developed for Water Framework Directive classification, gives a better assessment of phytoplankton species than just looking at individual species.

Assessment Parameters	Description
	The index is described in detail in: Marine Pollution Bulletin 55 (2007) 91–103
3. Macrophytes including macroalgae (are specific)	Shift from long-lived to short-lived opportunistic species (e.g. <i>Ulva</i>) Thresholds recommended for macroalgal biomass and area coverage based on those developed under the WFD.

Category III. Indirect effects of nutrient enrichment (during growing season);	
1. Oxygen deficiency Decreased levels ($< 4 \text{ mg l}^{-1}$) and lowered % oxygen saturation	The assessment levels that are used are concentrations measured below 4 mg l^{-1} to judge whether oxygen is scored as an undesired oxygen deficiency level for each area - Assessment will be for period of summer/autumn (May – September) 5%ile thresholds.

2. Zoobenthos and fish • Kills (in relation to oxygen deficiency and/or toxic algae) • Long term area-specific changes in zoobenthos biomass and species composition	Incidence of fish kills or documented changes in zoobenthos will be presented to assess level of disturbance related to eutrophication.
3. Organic Carbon/Organic Matter	Not applied in UK waters unless sedimentation area identified and data available.

Category IV. Other possible effects of nutrient enrichment.	
1. Incidence of DSP/PSP mussel infection events	Incidence of toxicity in bivalve mollusc tissue e.g. DSP or PSP mussel infection events. Frequency of occurrences in excess of FSA limits. Additional assessment based on analysis of Toxin Producing Algae (TPA) in water samples. Frequency of TPA occurrence should be below the FSA limits.

3.2 Inventory of available data

Data used in this assessment are provided by the UK National Marine Monitoring Programme (NMMP), which implements the OSPAR Co-ordinated Environmental Monitoring Programme for Eutrophication, together with data collected for other assessments of eutrophication status. The majority of UK marine waters were classified under the 2002 application of the Comprehensive Procedure as Non-Problem Areas which limits the NMMP data collection to winter nutrient concentrations. However, the 2002 application of the CP identified areas of particular continuing interest that required ongoing monitoring, including the **East England, East Anglia, Liverpool Bay, Solent and the Clyde**, and these have been sampled for all relevant harmonised assessment criteria, and in several cases have undergone intense surveillance using *in-situ* sampling equipment (SmartBuoys) or specifically commissioned surveys by the Environment Agency. The Cefas SmartBuoy sites are shown in Figure 3.



Figure 3: Cefas SmartBuoy locations in the southern North Sea (Gabbard and Warp) and Liverpool Bay

Further monitoring and research have been carried out in support of European Directives and through national/international research programmes to provide a rich and well distributed set of relevant data (Figure 4)

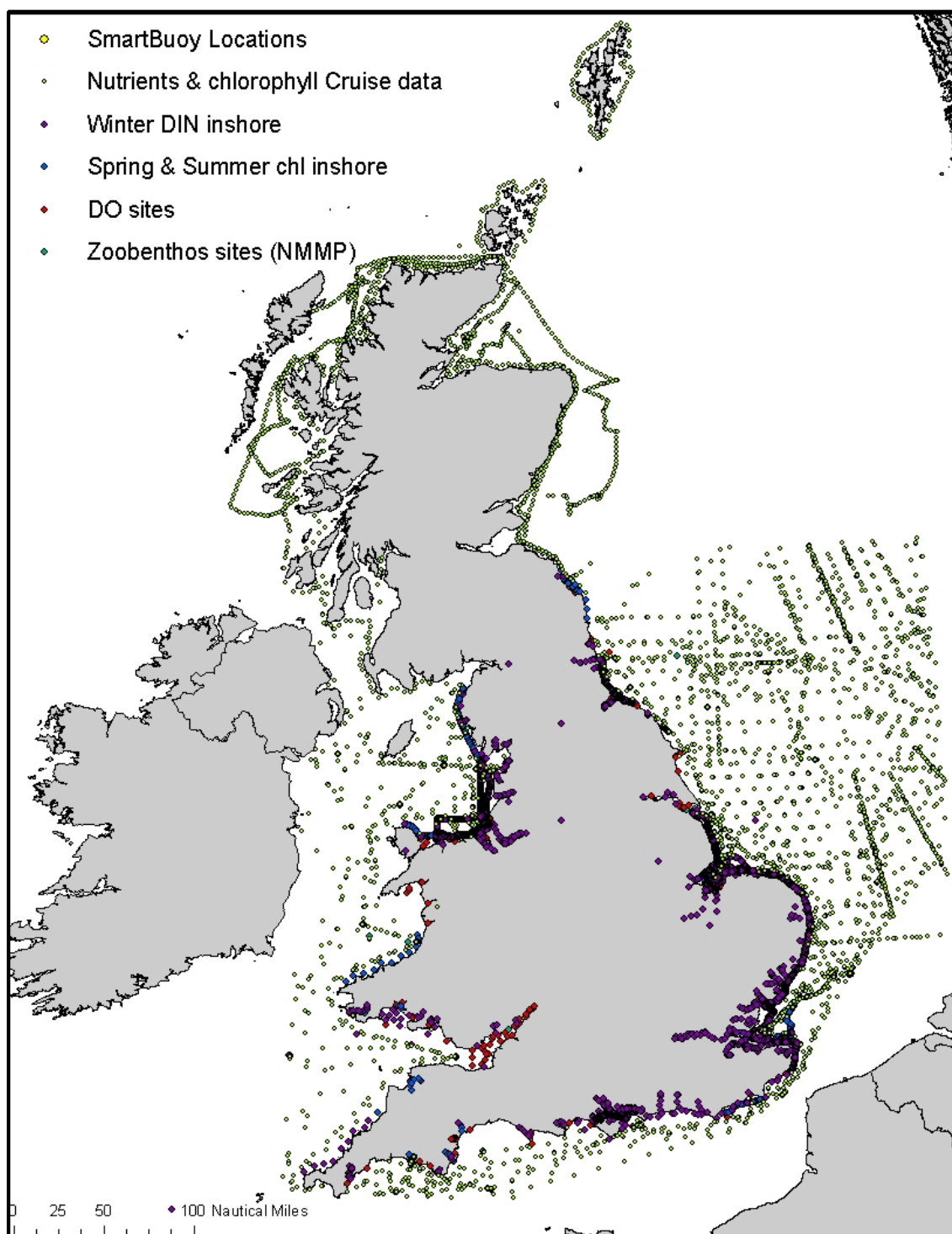


Figure 4: Sampling sites; sites were matched to OSPAR areas for assessments.

Time Period for Data Collection

Monitoring information for the period 2001 – 2005 has been used for most of the areas assessed. There are some areas where, for some parameters, adequate (in quantity or quality) data were not available and this has caused us to assign a lower confidence to the parameter

assessment. Time series information exists for several parameters extending well beyond the assessment period. These data have been included in assessment of trends.

Adequacy of the Data and Confidence in the Assessment

The data sets are generally ‘fit for purpose’ providing adequate spatial coverage and temporal resolution to carry out a good assessment. However, there are variations in data coverage between areas, reflecting the level of perceived risk and the practicalities of monitoring, and between the different parameters where, for example, there are more data available for winter nutrient concentrations and chlorophyll than for phytoplankton species. The adequacy of the data is reflected in the confidence with which we are able to reach conclusions about the status of each area. Included in the classification table (Table , page23) is an assessment of our confidence for each of the three aspects of eutrophication classification – nutrient enrichment, accelerated growth and undesirable disturbance – and our overall confidence in the area classification.

We have made best use of all available data that meet strict quality assurance criteria to carry out the area-based assessments. The data sets are summarised in Appendix I and are itemised in detail in each area assessment report.

4 Eutrophication assessment

4.1 Outline of assessment process

The assessment process follows the 3 steps of the Comprehensive Procedure Guidance.

Step 1 is to select and apply relevant parameters from the table of Harmonised Assessment Criteria to the area being assessed. This requires the collation of appropriate data sets for the area and the application, as required, of the relevant statistical treatment to produce a score to show whether or not the criterion has been exceeded (designated by a + or – for each criterion). The respective thresholds for the parameters in UK waters have been highlighted in Table 1 **Step 2** uses a common format, based on the four categories of assessment criteria, to arrive at an *initial* classification for the area. Examples of how the combination of scores produces the initial classification are given in the Common Procedure guidance (OSPAR 2005-3, Section 5, Table 2).

Step 3 is an appraisal of all relevant information (concerning the harmonised assessment criteria, their respective assessment levels and the supporting environmental factors) to provide a sufficiently sound and transparent account of the reasons for assigning a particular status to an area. This leads to the final classification of the status of the area.

The results of the application of the Comprehensive Procedure to areas within the maritime jurisdiction of the UK are presented in a series of separate area reports, which provide the detailed evidence on which the overall classification is based. These reports are available electronically from the following link: www.cefas.co.uk/ospardocs. Table provides a summary of the outcome of these assessments in the overall classification format described in Annex 5 of the Common Procedure Guidance (OSPAR 2005-3).

4.2 Assessment under the EC Urban Waste Water Treatment Directive (UWWTD) and Nitrates Directive (ND)

Relevant UK estuaries and coastal waters have received prior assessment of eutrophication status for the purposes of the UWWTD and ND. Most estuaries have been assessed and where there is a weight of evidence showing an undesirable disturbance resulting from nutrient enrichment, designation as Sensitive Waters (eutrophic) and/or identification of Polluted Waters (eutrophic) has occurred. These designations are deemed to be either Problem Areas or Potential Problem Areas with respect to eutrophication for the purposes of the Comprehensive Procedure Assessment but have not, for England and Wales, been separately assessed using the OSPAR methodology. To check the comparability of the

different assessments, the OSPAR Comprehensive Procedure has been applied to areas designated as Sensitive Water (eutrophic) and Polluted Waters (eutrophic) in Scotland and Northern Ireland. The methods are found to be broadly comparable resulting in equivalent classification of eutrophication status.

For Northern Ireland we have relied on existing robust assessments to come to a conclusion about status which has already driven management action in several cases. The assessment for some Northern Ireland areas has been updated but, as noted by the peer evaluators, there remains a mis-match with regard to the period for which data is reported and the assessment period for the application of the Comprehensive Procedure.

4.3 Assessment of Transboundary Transport of Nutrients

The OSPAR Comprehensive Procedure points out Contracting Parties should take into account the risk that nutrient inputs may be transferred to adjacent areas where they can cause detrimental environmental effects and Contracting Parties should recognise that they may contribute significantly to problem areas and potential problem areas with regard to eutrophication outside their national jurisdiction. The UK has made the following assessment of this risk and of the associated footnotes in Table 2 of the Comprehensive Procedure.

Footnote 9 in table 2, which refers to those areas with nutrient enrichment but no other effects (i.e scoring +--) states that: "The increased degree of nutrient enrichment in these areas may contribute to eutrophication problems elsewhere"

Areas in the UK with this "+--" score are: the North East Irish Sea, Liverpool Bay, the Bristol Channel, the Solent, the Eastern English Channel, the Clyde Estuary, the Tay Estuary, the Eden Estuary and Carlingford Lough.

The UK has looked at these assessment areas and, on the basis of current knowledge, does not believe that the transport of nutrients (nitrogen and phosphorus) from these areas will give rise to undesirable disturbance in the waters of other Contracting Parties.

This evaluation is based on

- Knowledge of general circulation and flows from the areas concerned
- Transport from coastal to offshore waters within the UK maritime area
- The scores for nutrient enrichment in the waters of other Contracting Parties given in their national assessments
- Reflection on the strength of assessment based on specific assessment parameters employed by other Contracting Parties e.g. Phytoplankton Indicator Species
- Current information from modelling activities

The main findings of the evaluation are summarised in Table 2 below. More information is available in the UK area reports. Furthermore the UK is leading the OSPAR modelling work on transboundary transport which should give further information on this issue, particularly for North Sea areas in the next couple of years. When this modelling exercise is completed, the UK will see if this risk evaluation needs to be revised.

Table 2. Evaluation of Risk of Nutrient Enriched Waters scoring “ + - -“ to Eutrophication Problems Elsewhere

Areas with (+ - -) initial scores	Adjacent area	Adjacent area status	Possible recipient areas further away	Remote Area status	Supporting Information	Evaluation of risk of contribution to eutrophication problems elsewhere
Bristol Channel	Celtic Sea (UK)	Non Problem Area (screened)	Irish Sea (UK and Ireland)	Non Problem Area (screened)	Ireland has no Problem Areas in possible recipient waters. Ireland has confirmed it does not see UK nutrients as a risk to eutrophication status.	Minimal
Liverpool Bay	North East Irish Sea	Non Problem Area	Irish Sea (UK and Ireland)	Non Problem Area (screened)	Ireland has no Problem Areas in possible recipient waters. Ireland has confirmed it does not see UK nutrients as a risk to eutrophication status.	Minimal
NE Irish Sea	Irish Sea	Non Problem Area (screened)	Irish Sea (Ireland)	Non Problem Area (screened)	Ireland has no Problem Areas in possible recipient waters. Ireland has confirmed it does not see UK nutrients as a risk to eutrophication status.	Minimal
Carlingford Lough	Northern Ireland and Ireland Coastal Waters	Non Problem Area (screened)	Irish Sea (UK and Ireland)	Non Problem Area (screened)	Ireland has no Problem Areas in possible recipient waters. Ireland has confirmed it does not see UK nutrients as a risk to eutrophication status.	Minimal
Solent Coastal Water	East English Channel Coastal Water	Non Problem Area (+ - -)	Southern Sea offshore UK Belgium Netherlands	Non Problem Area (- - -) Potential Problem Area (- - -) Problem Area (- +)	No positive scores for nutrient enrichment, lack of harmonisation of chlorophyll thresholds, weak evidence of undesirable disturbance in possible recipient PPAs and PAs. ¹	Minimal
East English Channel Coastal Water	East English Channel Offshore Water	Non Problem Area (- - -)	Southern North Sea offshore UK Belgium	Non Problem Area (- - -) Potential Problem Area (- - -) Problem		

¹ Some countries have still not finalised their assessment thresholds (as at February 2008)

Areas with (+ - -) initial scores	Adjacent area	Adjacent area status	Possible recipient areas further away	Remote Area status	Supporting Information	Evaluation of risk of contribution to eutrophication problems elsewhere
			Netherlands	Area (-+ +)		Minimal
Clyde Estuary	Outer Firth of Clyde	Non Problem Area (- - -)	West of Scotland Coastal Waters	Non Problem Area (screened)	Transport of nutrients in significant amounts to waters of other OSPAR countries unlikely	Minimal
Tay Estuary	East of Scotland Coastal Waters	Non Problem Area (screened)	North Sea offshore (UK, Denmark, Norway)	Non Problem Area	There is no evidence of enhanced nutrients in adjacent coastal waters so impacts on the waters of other OSPAR countries is unlikely ² .	Minimal
Eden Estuary	East of Scotland Coastal Waters	Non Problem Area (screened)	North Sea offshore (UK, Denmark, Norway)	Non Problem Area		Minimal

Footnote 8 in table 2 of the Comprehensive Procedure , which refers to those areas classified as problem areas scoring “-++”, “-+-“ or “--+” which may be caused by transboundary transport of (toxic) algae and/or organic matter arising from adjacent/remote areas. The UK does not have any assessment areas which have these scores, and therefore concludes that transboundary transport of this nature is not responsible for eutrophication problems in UK waters.

² A study of the relative importance of riverine nutrient inputs to the Scottish North Sea Coastal Zone. *Marine Pollution Bulletin*, Volume 26, Issue 11, November 1993, Pages 620-628

Table 3: UK results of the OSPAR Comprehensive Procedure Assessment 2008.

Key to the table

NI Nutrient inputs (riverine and direct discharges total N and total P)
 DI Dissolved nutrients (Winter DIN and/or DIP concentrations)
 NP Increased winter N/P ratio
 Ca Maximum and mean Chlorophyll a concentration
 Ps Region/area specific phytoplankton indicator species

Mp Macrophytes including macroalgae
 O₂ Degree of oxygen deficiency
 Ck Changes/kills in zoobenthos and fish kills
 Oc Organic carbon/organic matter
 At Algal toxins (DSP/PSP mussel infection events)

+ = Increased trends, elevated levels, shifts or changes in the respective assessment parameters
 - = Neither increased trends nor elevated levels nor shifts nor changes in the respective assessment parameters
 ? = Not enough data to perform an assessment or the data available is not fit for the purpose

Area	Category I Degree of nutrient enrichment		Category II Direct effects	Category III and IV Indirect effects/ other possible effects				Initial classifica ⁿ	Appraisal of all relevant information (concerning the harmonised assessment criteria their respective assessment levels and the supporting environmental factors). The level of confidence placed in the evidence used to assess the various categories and the overall conclusion are also given (see section 3.2 for explanation).	Final class ⁿ	Assessment period
Northern North Sea	NI		Ca	-	O ₂	-	At	NPA	- There is strong evidence that the area is not nutrient enriched (high confidence). Although this is based on limited monitoring data the conclusion is confirmed by taking account of > 30 years of ICES data and a published climatology report (UKCIP02, 2002). - There is evidence that there is no accelerated growth (medium confidence). The chlorophyll 90th percentiles were <10 µg l⁻¹ in all years and the modified green test is also passed. The conclusion is confirmed by taking account of ICES data and the climatology report. - The available evidence does not suggest that there is any undesirable disturbance (low confidence). The final classification of the area is a Non Problem Area (high confidence), based on the lack of nutrient enrichment, the absence of accelerated growth and evidence that there is no undesirable disturbance to the biology or water quality.	NPA	Nutrients (1999-2006) Biomass (1999-2004)
	DI	-	Ps		Ck	-					
	NP	-	Mp		Oc						

Area	Category I Degree of nutrient enrichment		Category II Direct effects		Category III and IV Indirect effects/ other possible effects			Initial classifica ⁿ	Appraisal of all relevant information (concerning the harmonised assessment criteria their respective assessment levels and the supporting environmental factors). The level of confidence placed in the evidence used to assess the various categories and the overall conclusion are also given (see section 3.2 for explanation).	Final class ⁿ	Assessment period
Southern North Sea	NI		Ca	-	O ₂	-	At	NPA	- There is no nutrient enrichment (high confidence) based upon extensive measurements from SmartBuoy time-series and spatial data. - There is evidence of no accelerated growth (medium confidence). High intensity sampling has shown that since 2002 chlorophyll 90th percentiles in waters of >34.5 salinity were below the threshold. - The evidence available suggests that there is no undesirable disturbance (medium confidence). Measurements show DO was consistently > 4 mg l⁻¹, there was no detectable disturbance in the zoobenthos community and there was an absence of fish kills. The final classification of the Southern North Sea is as a Non-Problem Area (high confidence). The results show that there was no nutrient enrichment, accelerated growth or undesirable disturbance	NPA	Nutrients (1999-2006) Biomass (1999-2006)
	DI	-	Ps		Ck	-					
	NP	-	Mp		Oc						

Area	Category I Degree of nutrient enrichment		Category II Direct effects		Category III and IV Indirect effects/ other possible effects				Initial classifica ⁿ	Appraisal of all relevant information (concerning the harmonised assessment criteria their respective assessment levels and the supporting environmental factors). The level of confidence placed in the evidence used to assess the various categories and the overall conclusion are also given (see section 3.2 for explanation).	Final class ⁿ	Assessment period
Eastern English Coast (area of particular continuing interest)	NI	-	Ca	+	O ₂	-	At	-	PA	Following the 2002 application of the Comprehensive Procedure this area was subject to enhanced monitoring and surveillance. - There is nutrient enrichment (high confidence) with winter DIN exceeding the threshold. - There is evidence of accelerated growth (low confidence). The chlorophyll 90th percentiles exceeded the threshold in the 3 years with sufficient data. However, the means were below the threshold in all years, except 2004. - There is evidence of no undesirable disturbance (high confidence). The phytoplankton indicator was below the threshold and there was no excessive opportunistic macroalgae growth. DO was consistently > 4 mg l⁻¹. The zoobenthos showed no evidence for change, there were no reported fish kills and no toxicity in bivalve mollusc tissue. The final classification of the area is a Non Problem Area (high confidence) based on evidence that in spite of nutrient enrichment and accelerated growth, there high confidence that there is no evidence of undesirable disturbance, and that PA status is not justified..	NPA	Nutrients (1999-2006) Biomass (1999-2004)
	DI	+	Ps	-	Ck	-						
	NP	+	Mp	-	Oc							

Area	Category I Degree of nutrient enrichment		Category II Direct effects		Category III and IV Indirect effects/ other possible effects				Initial classifica ⁿ	Appraisal of all relevant information (concerning the harmonised assessment criteria their respective assessment levels and the supporting environmental factors). The level of confidence placed in the evidence used to assess the various categories and the overall conclusion are also given (see section 3.2 for explanation).	Final class ⁿ	Assessment period
East Anglia (area of particular continuing interest)	NI	-	Ca	+	O ₂	-	At	-	PA	Following the 2002 application of the Comprehensive Procedure this area was subject to enhanced monitoring and surveillance. - The area is nutrient enriched (high confidence) with winter DIN exceeding the threshold in most years. - The area is assessed as showing signs of accelerated growth (medium confidence). Chlorophyll 90th percentiles exceeded the threshold in 30 – 34.5 salinity, but were below threshold in salinity >34.5. - The area exhibits strong evidence of no undesirable disturbance (high confidence). The phytoplankton indicator and opportunistic macroalgal growth levels were below their thresholds. DO was consistently > 4 mg l⁻¹. The zoobenthos showed no evidence for change and there were no reported fish kills. There were no incidents of toxicity in bivalve mollusc tissue. The final classification is of a Non Problem Area (medium confidence), because in spite of nutrient enrichment and accelerated growth, there is high confidence that there is no evidence of undesirable disturbance, and that PA status is not justified..	NPA	Nutrients (1999-2006) Biomass (1999-2006)
	DI	+	Ps	-	Ck	-						
	NP	+	Mp	-	Oc							

Area	Category I Degree of nutrient enrichment		Category II Direct effects	Category III and IV Indirect effects/ other possible effects				Initial classifica ⁿ	Appraisal of all relevant information (concerning the harmonised assessment criteria their respective assessment levels and the supporting environmental factors). The level of confidence placed in the evidence used to assess the various categories and the overall conclusion are also given (see section 3.2 for explanation).	Final class ⁿ	Assessment period
Northeast Irish Sea	NI		Ca	-	O ₂	-	At	-	- The area is assessed as showing evidence of nutrient enrichment, (low confidence). Winter DIN exceeded the threshold in 3 out of 5 years but N/P ratios did not. - The area is assessed as showing evidence of no accelerated growth (high confidence) as chlorophyll 90th percentiles were consistently <15 µg l⁻¹. - The area is assessed as showing evidence of no undesirable disturbance (high confidence). Phytoplankton indices did not exceed thresholds. DO was consistently >4 mg l⁻¹. There were no recorded fish kills and zoobenthos data provide evidence of no change in community structure. There were no incidents of toxicity in bivalve mollusc tissue. The final classification is of the northeast Irish Sea as a Non-Problem Area (high confidence), based on evidence that in spite of nutrient enrichment, there was no evidence of accelerated growth or undesirable disturbance.	NPA	Nutrients (1999-2005) Biomass (1999-2006)
	DI	+	Ps	-	Ck	-					
	NP	-	Mp	-	Oc						

Area	Category I Degree of nutrient enrichment		Category II Direct effects		Category III and IV Indirect effects/ other possible effects				Initial classifica ⁿ	Appraisal of all relevant information (concerning the harmonised assessment criteria their respective assessment levels and the supporting environmental factors). The level of confidence placed in the evidence used to assess the various categories and the overall conclusion are also given (see section 3.2 for explanation).	Final class ⁿ	Assessment period
Liverpool Bay (area of particular continuing interest)	NI	-	Ca	-	O ₂	-	At	-	NPA	Following the 2002 application of the Comprehensive Procedure this area was subject to enhanced monitoring and surveillance. - This area is assessed as showing evidence of nutrient enrichment (high confidence). Winter DIN exceeded the threshold, although DIN/DIP ratios did not. - The area is assessed as showing evidence of no accelerated growth (medium confidence). The chlorophyll 90th percentiles were >15 µg l⁻¹ in 2004, but <15 µg l⁻¹ in more recent years. - There is evidence of no undesirable disturbance (high confidence). The phytoplankton indicator was below the threshold and N:Si would not favour flagellate growth. There are no macroalgae blooms above the threshold. DO was consistently >4 mg l⁻¹. The zoobenthos showed no evidence for change and there were no reported fish kills. There were no incidents of toxicity in bivalve mollusc tissue. The final classification is of a Non Problem Area (high confidence), based on evidence that in spite of nutrient enrichment there was good evidence that there was no accelerated growth or undesirable disturbance.	NPA	Nutrients (1999-2006) Biomass (1999-2005)
	DI	+	Ps	-	Ck	-						
	NP	-	Mp	-	Oc							

Area	Category I Degree of nutrient enrichment		Category II Direct effects		Category III and IV Indirect effects/ other possible effects				Initial classifica ⁿ	Appraisal of all relevant information (concerning the harmonised assessment criteria their respective assessment levels and the supporting environmental factors). The level of confidence placed in the evidence used to assess the various categories and the overall conclusion are also given (see section 3.2 for explanation).	Final class ⁿ	Assessment period
	Nutrient	Enrichment	Parameter	Effect	Parameter	Effect	Parameter	Effect				
Bristol Channel	NI	-	Ca	-	O ₂	-	At	-	NPA	- The area is assessed as nutrient enriched (medium confidence). Winter DIN and DIN/DIP ratios exceeded the threshold in the 3 years with sufficient data. - The area is assessed as showing evidence of no accelerated growth (high confidence), with chlorophyll 90th percentiles below the threshold. - Bristol Channel is assessed (high confidence) as showing evidence of no undesirable disturbance. The phytoplankton indicator and opportunistic macroalgal growth levels were below their thresholds. DO was consistently > 4 mg l⁻¹. The zoobenthos showed no evidence for change and there were no reported fish kills. There were no incidents of toxicity in bivalve mollusc tissue. The final classification of the Bristol Channel is of a Non-Problem Area (high confidence), based on evidence that in spite of nutrient enrichment, there is strong evidence that there was no accelerated growth or undesirable disturbance	NPA	Nutrients (1999-2004) Biomass (1999-2004)
	DI	+	Ps	-	Ck	-						
	NP	+	Mp	-	Oc							

Area	Category I Degree of nutrient enrichment		Category II Direct effects		Category III and IV Indirect effects/ other possible effects			Initial classifica ⁿ	Appraisal of all relevant information (concerning the harmonised assessment criteria their respective assessment levels and the supporting environmental factors). The level of confidence placed in the evidence used to assess the various categories and the overall conclusion are also given (see section 3.2 for explanation).	Final class ⁿ	Assessment period
Eastern English Channel	NI		Ca	-	O ₂	-	At	-	- This area is assessed as showing evidence of nutrient enrichment, (medium confidence). Winter DIN exceeded the thresholds in waters 30 – 34.5 salinity, but in only one year in >34.5 salinity. - The area is assessed as showing no evidence of accelerated growth (low confidence). Chlorophyll 90th percentiles were below thresholds, except in 2002 in 30 – 34.5 salinity. Chlorophyll means were below thresholds. - There is evidence of no undesirable disturbance (medium confidence). Phytoplankton indices did not exceed the threshold and there were no excessive opportunistic macroalgal blooms. DO was consistently >4 mg l⁻¹. There have been no recorded fish kills and zoobenthos data did not indicate long-term change. There were no incidents of toxicity in bivalve mollusc tissue. The final classification is of the east English Channel as a Non-Problem Area (medium confidence), based on evidence that in spite of nutrient enrichment, there was no accelerated growth or undesirable disturbance.	NPA	Nutrients (1999-2006) Biomass (1999-2003)
	DI	+	Ps	-	Ck	-					
	NP	+	Mp	-	Oc						

Area	Category I Degree of nutrient enrichment		Category II Direct effects		Category III and IV Indirect effects/ other possible effects				Initial classifica ⁿ	Appraisal of all relevant information (concerning the harmonised assessment criteria their respective assessment levels and the supporting environmental factors). The level of confidence placed in the evidence used to assess the various categories and the overall conclusion are also given (see section 3.2 for explanation).	Final class ⁿ	Assessment period
Solent (area of particular continuing interest)	NI		Ca	-	O ₂	-	At	-	NPA	Following the 2002 application of the Comprehensive Procedure this area was subject to enhanced monitoring and surveillance. • The area is assessed as nutrient enriched (high confidence), with winter DIN in waters <34.5 salinity exceeding the threshold. • The area assessment is of no accelerated growth (medium confidence). Chlorophyll 90 th percentiles did not exceed the thresholds in 5 out of 6 years. • The area is assessed as showing no undesirable disturbance (medium confidence). Phytoplankton indices remained below thresholds. DO was consistently >4mg l ⁻¹ . There were no fish kills and no toxicity in bivalve mollusc tissue. In conclusion, the Solent has the final classification of a Non-Problem Area (medium confidence), based on evidence that in spite of nutrient enrichment, there was no accelerated growth or undesirable disturbance.	NPA	Nutrients (1999-2005) Biomass (1999-2004)
	DI	+	Ps	-	Ck	-						
	NP	+	Mp	-	Oc							

Area	Category I Degree of nutrient enrichment		Category II Direct effects		Category III and IV Indirect effects/ other possible effects			Initial class ⁿ	Appraisal of all relevant information (concerning the harmonised assessment parameters, their respective assessment levels and the supporting environmental factors). The level of confidence placed in the evidence used to assess the various categories and the overall conclusion are also given (see section 3.2 for explanation).	Final class ⁿ	Assessment period
Solway	NI	-	Ca	-	O ₂	-	At	NPA	- There are sufficient nutrient data to demonstrate that there is no evidence of nutrient enrichment (high confidence). - There are limited data showing that chlorophyll concentrations did not exceed assessment criteria on surveys between 2001 and 2005, giving low confidence in the conclusion that there is no evidence of accelerated growth. - There is low confidence in the lack of evidence of undesirable disturbance, due to the limited data. The phytoplankton data were qualitative rather than quantitative so the new assessment criterion could not be used. However, the waters are well oxygenated and there was evidence of no fish or zoobenthos kills. The final assessment of the Solway is as a Non-Problem Area (medium confidence), based on strong evidence of no nutrient enrichment and some evidence that there was no accelerated growth or undesirable disturbance.	NPA	2001 – 2005
	DI	-	Ps	?	Ck	-					
	NP	-	Mp	-	Oc						

Area	Category I Degree of nutrient enrichment		Category II Direct effects		Category III and IV Indirect effects/ other possible effects				Initial class ⁿ	Appraisal of all relevant information (concerning the harmonised assessment parameters, their respective assessment levels and the supporting environmental factors). The level of confidence placed in the evidence used to assess the various categories and the overall conclusion are also given (see section 3.2 for explanation).	Final class ⁿ	Assessment period
	NI	-	Ca	-	O ₂	-	At					
Clyde estuary (area of particular continuing interest)	DI	+	Ps	?	Ck	-			PPA	- There is evidence of nutrient enrichment (high confidence), as winter DIN exceeded the assessment threshold. However, the N/P ratio did not exceed the threshold. - There are sufficient chlorophyll data to give high confidence that there is no evidence of accelerated growth. - There is low confidence in the evidence of undesirable disturbance due to very limited phytoplankton data, however the existing data suggest that the criterion would not be exceeded. The low dissolved oxygen concentrations at the head of the estuary during summer are related to inputs of urban wastewater rather than eutrophication. There is evidence to show that measures taken to reduce these discharges have led to an increase in diversity and abundance of zoobenthos in the estuary. There was evidence of no fish or zoobenthos kills since 1990. The final assessment of the Clyde estuary is as a Non-Problem Area (medium confidence), based on evidence that in spite of nutrient enrichment, there is strong evidence that there was no accelerated growth and evidence to show there was no undesirable disturbance.	NPA	2001- 2005
	NP	-	Mp	-	Oc	-						

Area	Category I Degree of nutrient enrichment		Category II Direct effects		Category III and IV Indirect effects/ other possible effects				Initial class ⁿ	Appraisal of all relevant information (concerning the harmonised assessment parameters, their respective assessment levels and the supporting environmental factors). The level of confidence placed in the evidence used to assess the various categories and the overall conclusion are also given (see section 3.2 for explanation).	Final class ⁿ	Assessment period
	NI	-	Ca	-	O ₂	-	At	-				
Inner Firth of Clyde	DI	-	Ps	-	Ck	-			NPA	- There is no evidence of nutrient inputs increasing. There are sufficient winter nutrient data to give high confidence that there is no evidence of nutrient enrichment. - There are sufficient summer chlorophyll data to give high confidence that there is no evidence of accelerated growth. - The lack of suitable phytoplankton data gives low confidence in the conclusion of no undesirable disturbance. There is no evidence of alteration of the phytoplankton community. Macrophyte growth is below the assessment criterion. The waters are well oxygenated and there was evidence of no zoobenthos or fish kills. This is not a commercial shellfish area, so there have been no mussel infection events. The final assessment of the Inner Firth of Clyde is as a Non-Problem Area (high confidence), based on strong evidence of no nutrient enrichment or accelerated growth and evidence of no undesirable disturbance	NPA	2001-2005
	NP	-	Mp	-	Oc	-						

Area	Category I Degree of nutrient enrichment		Category II Direct effects	Category III and IV Indirect effects/ other possible effects				Initial class ⁿ	Appraisal of all relevant information (concerning the harmonised assessment parameters, their respective assessment levels and the supporting environmental factors). The level of confidence placed in the evidence used to assess the various categories and the overall conclusion are also given (see section 3.2 for explanation).	Final class ⁿ	Assessment period
Forth estuary	NI	-	Ca	-	O ₂	-	At	-	- Winter DIN exceeded the assessment criterion's threshold in 6 years between 1983 and 2005, but anthropogenic nutrient inputs have decreased since 1991. The estuary is assessed as enriched (medium confidence). - Summer chlorophyll data exceeded the assessment criterion once in 1997, but remained below the threshold during 2001 – 2005 assessment period, so there is no evidence of accelerated growth (high confidence). - There were insufficient data to apply the phytoplankton community assessment tool. Low dissolved oxygen concentrations in the turbidity maximum in the upper estuary result from the degradation of resuspended terrigenous organic matter in the water column. There was evidence of no fish kills since the early 1990s. This is not a commercial shellfish area, so there have been no mussel infection events. The conclusion is that there is no undesirable disturbance (medium confidence). The final assessment of the Forth Estuary is as a Non-Problem Area (medium confidence), based on evidence that in spite of nutrient enrichment, there is strong evidence that there was no accelerated growth and evidence to show there was no undesirable disturbance.	NPA	2001-2005
	DI	+	Ps	-	Ck	-					
	NP	-	Mp	-	Oc	-					

Area	Category I Degree of nutrient enrichment		Category II Direct effects		Category III and IV Indirect effects/ other possible effects				Initial class ⁿ	Appraisal of all relevant information (concerning the harmonised assessment parameters, their respective assessment levels and the supporting environmental factors). The level of confidence placed in the evidence used to assess the various categories and the overall conclusion are also given (see section 3.2 for explanation).	Final class ⁿ	Assessment period
	NI	-	Ca	-	O ₂	-	At	-				
Tay estuary	DI	+	Ps	-	Ck	-			NPA	- Winter DIN exceeded the assessment criterion on 2 out of 6 years. The N/P ratio exceeded the threshold in saline waters in 1997, 1999 and 2000, but has not exceeded during the 2001 – 2006 assessment period. Nutrient inputs from wastewater discharges are low and have decreased over the study period. The area is assessed as enriched (medium confidence). - Chlorophyll was measured at 10 fixed stations on axial surveys during the summer (June – August) in 2001 – 2005, inclusive. Chlorophyll exceeded the assessment criterion in 2003 due to localised mid-estuarine peak, but was well below the assessment criterion in all other years. The area is assessed as having no accelerated growth (low confidence). - It was not possible to use the quantitative assessment criterion for phytoplankton; however, qualitative assessment indicated no undesirable disturbance. There were sufficient data to conclude that waters are well oxygenated. There was evidence of no zoobenthos or fish kills. Macroalgae growth was not extensive. Overall there is no evidence of undesirable disturbance (medium confidence). The final assessment of the Tay estuary is a Non-Problem Area (medium confidence), based on evidence that in spite of nutrient enrichment there is no evidence of accelerated growth and undesirable disturbance.	NPA	2001-2005
	NP	+	Mp	-	Oc	-						

Area	Category I Degree of nutrient enrichment		Category II Direct effects		Category III and IV Indirect effects/ other possible effects				Initial class ⁿ	Appraisal of all relevant information (concerning the harmonised assessment parameters, their respective assessment levels and the supporting environmental factors). The level of confidence placed in the evidence used to assess the various categories and the overall conclusion are also given (see section 3.2 for explanation).	Final class ⁿ	Assessment period
Eden estuary	NI	-	Ca	-	O ₂	-	At	-	NPA	- Winter DIN and N/P ratios exceeded their assessment criteria. The estuary is designated as enriched with nutrients (high confidence). - Chlorophyll concentrations were low as phytoplankton growth is limited by the high flushing rate. There is low confidence in the conclusion of no evidence of accelerated growth, as the data are limited. - Estimates of macroalgal cover are limited to 2004 when the assessment criteria were not exceeded. The waters were well oxygenated and there was evidence of no zoobenthos or fish kills. The benthic community did not appear to be modified. This is not a commercial shellfish area, so there have been no mussel infection events. There is evidence of absence of undesirable disturbance (medium confidence). The final assessment of the Eden Estuary is as a Non-Problem Area (medium confidence), because in spite of nutrient enrichment there is some evidence to show there was no accelerated growth and reasonable evidence to show there was no undesirable disturbance.	NPA	2001-2005
	DI	+	Ps	-	Ck	-						
	NP	+	Mp	-	Oc	-						

Area	Category I Degree of nutrient enrichment		Category II Direct effects		Category III and IV Indirect effects/ other possible effects				Initial class ⁿ	Appraisal of all relevant information (concerning the harmonised assessment parameters, their respective assessment levels and the supporting environmental factors). The level of confidence placed in the evidence used to assess the various categories and the overall conclusion are also given (see section 3.2 for explanation).	Final class ⁿ	Assessment period
South Esk estuary (Montrose Basin)	NI	-	Ca	-	O ₂	-	At	-	PA	- Winter DIN and N/P ratios exceeded the assessment criteria. The area is considered to be nutrient enriched (high confidence). - Chlorophyll concentrations were low and there are sufficient data to give medium confidence in the evidence of no accelerated growth. - There was no evidence of modification of the phytoplankton community. Estimates of opportunistic green algal cover in the intertidal area exceeded the assessment criterion. The waters were well oxygenated. There was an abundant and diverse zoobenthos population in the intertidal area and there was evidence of no zoobenthos or fish kills. This is not a commercial shellfish area, so there have been no mussel infection events. There is no evidence of undesirable disturbance (medium confidence). The final assessment of the South Esk estuary (Montrose Basin) is a Potential Problem Area (medium confidence), based on evidence of nutrient enrichment and accelerated growth of opportunistic green algae, although there is no evidence of undesirable disturbance.	PPA	2001-2005
	DI	+	Ps	-	Ck	-						
	NP	+	Mp	+	Oc	-						

Area	Category I Degree of nutrient enrichment		Category II Direct effects		Category III and IV Indirect effects/ other possible effects				Initial class ⁿ	Appraisal of all relevant information (concerning the harmonised assessment parameters, their respective assessment levels and the supporting environmental factors). The level of confidence placed in the evidence used to assess the various categories and the overall conclusion are also given (see section 3.2 for explanation).	Final class ⁿ	Assessment period
	NI	-	Ca	+	O ₂	-	At	-				
Ythan estuary	DI	+	Ps	-	Ck	-			PA	- Nitrogen concentrations in the river Ythan were high, so winter DIN and the N/P ratio exceeded respective thresholds, indicating enrichment (high confidence). - Summer chlorophyll exceeded the assessment criteria (high confidence). - There was no evidence of modification of the phytoplankton community. The Ythan estuary was designated as a Nitrate Vulnerable Zone in 2000 on the basis of extensive growth of macrophytes covering the intertidal area. The waters were well oxygenated and there was evidence of no zoobenthos or fish kills. This is not a commercial shellfish area, so there have been no mussel infection events. The assessment is of no undesirable disturbance (medium confidence). The Comprehensive Procedure assessment indicates that the designation of the Ythan Estuary as a Problem Area purely on the basis of it being a NVZ may be somewhat precautionary, as although there is strong evidence of nutrient enrichment and accelerated growth, there is reasonable evidence of no undesirable disturbance, which, overall would lead to classification as a non problem area or potential problem area.	PA	2001-2005
	NP	+	Mp	+	Oc							

Area	Category I Degree of nutrient enrichment		Category II Direct effects		Category III and IV Indirect effects/ other possible effects			Initial class ⁿ	Appraisal of all relevant information (concerning the harmonised assessment parameters, their respective assessment levels and the supporting environmental factors). The level of confidence placed in the evidence used to assess the various categories and the overall conclusion are also given (see section 3.2 for explanation).	Final class ⁿ	Assessment period
	NI	-	Ca	+	O ₂	-	At				
Inner Belfast Lough	DI	+	Ps	?	Ck	-		PA	The Inner Belfast Lough was designated as a UWWTD ‘sensitive area’ in 2001, and as described in section 4.2, such waters have been automatically designated as Problem Areas or Potential problem Areas under the OSPAR Comprehensive Procedure. The assessment below uses the CP assessment to check this policy. - The Inner Lough is enriched in nutrient concentrations (high confidence), although there is evidence that reductions in nutrient inputs over the last five years have resulted in improvements. - There is still some evidence of accelerated growth on occasions in the chlorophyll and <i>in-situ</i> fluorescence data, (high confidence). - There has been evidence of undesirable disturbance to the balance of organisms (medium confidence). Toxin-producing algae and cysts have been recorded in the 1990s. There are no macroalgae records. DO concentrations are consistently high. There has been a step change improvement in benthic invertebrate faunal population, linked to the reductions in organic carbon as a result of improved effluent treatment and the consequent reduction in nutrients. No fish kills have been recorded. With the current location of WWTW outfalls, this will remain as either a Problem Area, or possibly a Potential Problem Area under the Comprehensive Procedure in the future (high confidence).	PA	Nutrients (1993-2005) Biomass (2002-2006) Phytoplankton spp. (1998-2002)
	NP	-	Mp	?	Oc						

Area	Category I Degree of nutrient enrichment		Category II Direct effects		Category III and IV Indirect effects/ other possible effects			Initial class ⁿ	Appraisal of all relevant information (concerning the harmonised assessment parameters, their respective assessment levels and the supporting environmental factors). The level of confidence placed in the evidence used to assess the various categories and the overall conclusion are also given (see section 3.2 for explanation).	Final class ⁿ	Assessment period
Outer Belfast Lough	NI	-	Ca	-	O ₂	-	At	-	- The Outer Lough is not currently enriched with nutrients (high confidence). - There is no evidence of accelerated algal growth. There is evidence of a reduction in chlorophyll concentrations throughout the Lough from <i>in-situ</i> monitoring over the last 10 years (high confidence). Actual chlorophyll concentrations fall below the threshold value in 2004 – 2006. - There is no evidence of excessive growth of macroalgae. Dissolved oxygen concentrations are consistently >8 mg l⁻¹, i.e. well above the critical threshold. Zoobenthos data did not indicate long-term change. There is no evidence of an undesirable disturbance (high confidence). The final assessment of the Outer Belfast Lough is as a Non-Problem Area (high confidence); based on strong evidence that there was no nutrient enrichment, no accelerated growth and no undesirable disturbance.	NPA	Nutrients (1990-2005) Biomass (1991-2005)
	DI	-	Ps	-	Ck	-					
	NP	-	Mp	-	Oc						

Area	Category I Degree of nutrient enrichment		Category II Direct effects	Category III and IV Indirect effects/ other possible effects			Initial class ⁿ	Appraisal of all relevant information (concerning the harmonised assessment parameters, their respective assessment levels and the supporting environmental factors). The level of confidence placed in the evidence used to assess the various categories and the overall conclusion are also given (see section 3.2 for explanation).	Final class ⁿ	Assessment period
Carlingford Lough	NI	-	Ca	-	O ₂	-	At -	- There is some evidence of nutrient enrichment but over a longer time scale nutrient concentrations are not elevated and inputs are not increasing (medium confidence). - There is no evidence of accelerated growth of algae. Although the water sampling strategy changed in 1998 to winter only, an <i>in-situ</i> buoy has now been installed. - There are no nuisance phytoplankton species and only one toxin producing algae incident over the period. No excessive macroalgal growth. Dissolved oxygen is typically >8 mg l⁻¹ i.e. well above the critical threshold. There are no impacts on fish or zoobenthos communities. There is no evidence of undesirable disturbance (high confidence). The final assessment of Carlingford Lough is as a Non-Problem Area (medium confidence) based on evidence that nutrient enrichment is decreasing, some evidence to show that there is no accelerated growth and strong evidence to show there is no undesirable disturbance.	NPA	Nutrients (1991-2003) Biomass (1991-2001)
	DI	+	Ps	-	Ck	-				
	NP	+	Mp	-	Oc					

Area	Category I Degree of nutrient enrichment		Category II Direct effects		Category III and IV Indirect effects/ other possible effects			Initial class ⁿ	Appraisal of all relevant information (concerning the harmonised assessment parameters, their respective assessment levels and the supporting environmental factors). The level of confidence placed in the evidence used to assess the various categories and the overall conclusion are also given (see section 3.2 for explanation).	Final class ⁿ	Assessment period
Foyle Estuary & Lough	NI	-	Ca	-	O ₂	+	At	-	- There is some evidence of enrichment of nitrogen on occasions and N/P ratios are elevated (high confidence). - There is evidence of accelerated growth in the chlorophyll and fluorescence data from an <i>in-situ</i> buoy (medium confidence). - Phytoplankton nuisance species levels remained low and toxin-producing algae were recorded but did not result in a shellfish toxin event. Dissolved oxygen is consistently above 6mg l⁻¹ throughout both the Lough and the estuary with the occasional dip in DO concentrations in the most upstream of the freshwater sites (medium confidence). There is no undesirable disturbance to the fish or zoobenthos communities. Opportunist macroalgae abundance is low (medium confidence). The final assessment of the Foyle Estuary and Lough is as a Potential Problem Area (medium confidence in <i>in-situ</i> monitoring), based on evidence of nutrient enrichment, accelerated growth and limited evidence of undesirable disturbance in the form of low dissolved oxygen values.	PPA	Nutrients (1990-2006) Biomass (1997-2006)
	DI	+	Ps	?	Ck	-					
	NP	+	Mp	?	Oc						

Area	Category I Degree of nutrient enrichment		Category II Direct effects		Category III and IV Indirect effects/ other possible effects			Initial class ⁿ	Appraisal of all relevant information (concerning the harmonised assessment parameters, their respective assessment levels and the supporting environmental factors). The level of confidence placed in the evidence used to assess the various categories and the overall conclusion are also given (see section 3.2 for explanation).	Final class ⁿ	Assessment period
Strangford Lough; north	NI	-	Ca	-	O ₂	-	At -	PPA	- Nutrient concentrations are elevated above the threshold, but DIN/DIP ratios are not. This is classified as nutrient enriched (medium confidence). - Chlorophyll is low and only exceeds the threshold on a few occasions. There is no accelerated growth (high confidence). - There are no exceptional occurrences in the phytoplankton data. Species richness of macroalgae is reduced in the north end of the Lough, with an increased abundance of <i>Enteromorpha</i> spp. Dissolved oxygen is predominantly >6 mg l⁻¹. Zoobenthos data show an improvement in the community to good/high ecological status. There is considered to be some evidence of undesirable disturbance given that <i>Enteromorpha</i> spp is taking over the ecological niche of the <i>Zostera</i> spp. beds (medium confidence). The north end of Strangford Lough is exhibiting some signs of disturbance. The final assessment of the Strangford Lough North is as a Potential Problem Area (medium confidence), based on evidence of nutrient enrichment (medium confidence), accelerated growth (medium confidence) and limited evidence of undesirable disturbance (medium confidence) in the form of changing angiosperm/macroalgae dominance.	PPA	Nutrients (1994-2005) Biomass (1990-2005)
	DI	+	Ps	-	Ck	-					
	NP	-	Mp	+	Oc						

Area	Category I Degree of nutrient enrichment		Category II Direct effects		Category III and IV Indirect effects/ other possible effects			Initial class ⁿ	Appraisal of all relevant information (concerning the harmonised assessment parameters, their respective assessment levels and the supporting environmental factors). The level of confidence placed in the evidence used to assess the various categories and the overall conclusion are also given (see section 3.2 for explanation).	Final class ⁿ	Assessment period
	NI		Ca	-	O ₂	-	At -				
Strangford Lough; south	DI	-	Ps	-	Ck	-		NPA	- Nutrient concentrations and DIN/DIP ratios are not elevated, though there are few recent data (medium confidence). - Chlorophyll is low and rarely exceeds the threshold (high confidence). - There was only one, short-lived exceedance in <i>Dinophysis</i> spp. (2004) in the phytoplankton data. This area supports a high diversity of macroalgal species and benthic infaunal quality fluctuates between good and high status. DO is predominantly below the threshold of 6 mg l⁻¹. The zoobenthos community is undisturbed. There have been no recorded incidents of toxicity in bivalve mollusc tissue in the Lough The final assessment of Strangford Lough South is as a Non-Problem Area (high confidence), based on good evidence that nutrient enrichment and accelerated growth do not occur, and strong evidence to show there is no undesirable disturbance.	NPA	Nutrients (1994-2004) Biomass (1990-2005)
	NP	-	Mp	-	Oc						

Area	Category I Degree of nutrient enrichment		Category II Direct effects		Category III and IV Indirect effects/ other possible effects			Initial class ⁿ	Appraisal of all relevant information (concerning the harmonised assessment parameters, their respective assessment levels and the supporting environmental factors). The level of confidence placed in the evidence used to assess the various categories and the overall conclusion are also given (see section 3.2 for explanation).	Final class ⁿ	Assessment period
	NI	-	Ca	-	O ₂	-	At -				
Larne Lough	DI	-	Ps	-	Ck	-		NPA	- Winter nutrient concentrations within the Lough are close to background concentrations for the Irish Sea. DIN/DIP ratios are not elevated (high confidence). - Chlorophyll is consistently < 6 µg l⁻¹ throughout the summer and concentrations cannot be considered to be elevated. However, there are no data since 2002 (medium confidence). - There have been no occurrences of algal scums (e.g. <i>Phaeocystis</i>), nuisance algal blooms or toxicity in bivalve mollusc tissue. Dissolved Oxygen concentrations are consistently > 6 mg l⁻¹. The benthic invertebrate community are now considered consistent with unpolluted or normal conditions. There is no undesirable disturbance (high confidence). The final assessment of Larne Lough is as a Non-Problem Area (high confidence) based on good evidence that nutrient enrichment and accelerated growth do not occur, and strong evidence to show there is no undesirable disturbance	NPA	Nutrients (1993-2003) Biomass (1992-2002)
	NP	-	Mp	?	Oc						

5 Comparisons with European eutrophication related policies

The UK has been active in the development of systems for assessment of sensitive areas (eutrophic) under the Urban Waste Water Treatment Directive and polluted waters (eutrophic) under the Nitrates Directive, including assessment of waters that may become eutrophic. The starting point for all classification schemes is the definition of eutrophication, which has a consistent formulation between the EC Directives and the OSPAR strategy. As a result all classification methods are based on a similar set of criteria. The assessment methodology, however, differs and in the case of the Comprehensive Procedure Assessment may lead to a different outcome. This is described in section 6.2.2, below.

The Comprehensive Procedure Assessment is not carried out in isolation. There has been significant development of assessment methodology in the last few years driven by the need to assess ecological status under the Water Framework Directive, which covers transitional and coastal waters. We have actively sought to ensure that parameter-based assessments for both OSPAR and WFD are based on a common scientific understanding. This has led us to adopt some of the tools developed under the Water Framework Directive implementation strategy (for example for chlorophyll concentration and phytoplankton indicators) for application in the Comprehensive Procedure.

However, the UK has not yet finalised the full classification of waters using the tools developed for the Water Framework Directive. This is work in progress and we are, therefore, unable to compare and contrast this with the Comprehensive Procedure outcomes.

It is clear, subject to a few caveats, that the OSPAR Comprehensive Procedure provides a reliable and scientifically robust classification of areas of the maritime region as Problem Areas and Non-Problem Areas and could usefully contribute to the Initial Assessment that will be required for the implementation of the new European Marine Strategy Directive.

6 Perspectives

6.1 Measures taken to address UK Problem Areas and Potential Problem Areas

6.1.1 Problem Areas and potential Problem Areas designated in 2002

As mentioned in Section 4.2, a number of small estuaries, harbours and loughs, which had already been identified by the UK as either sensitive waters (eutrophic) leading to designation as Sensitive Areas (SA) under the UWWT Directive, or as polluted waters leading to the designation of Nitrate Vulnerable Zones (NVZ) under the Nitrates Directive were automatically designated as OSPAR Problem Areas or Potential Problem Areas in the UK report on the first application of the OSPAR Comprehensive Procedure in 2002. These are listed in the second column of Table 4 below.

Table 4: UK Problem Areas and Potential Problem Areas reported to OSPAR in first application of the Comprehensive Procedure in 2002; sensitive areas (SA) under the UWWT Directive and nitrate vulnerable zones (NVZ) under the Nitrates Directive

Assessment area	OSPAR status in 2002	Reason for OSPAR status
Portsmouth Harbour	PA	SA
Chichester Harbour	PA	SA
Langstone Harbour	PA	SA
Pagham Harbour	PA	SA
Loughor estuary	PPA	SA
Seal Sands (Tees estuary)	PA	SA
Lindisfarne NNR area	PA	NVZ
Holes Bay	PA	SA
Poole Harbour	PPA	SA & NVZ
The Fleet	PPA	NVZ
Truro, Tresillian and Fal estuaries	PA	SA & NVZ
Taw estuary	PA	SA & NVZ
Tawe	PA	SA
Ythan estuary	PA	SA & NVZ
Quoile Pondage (in Strangford Lough Catchment)	PPA	SA
Inner Belfast Lough & tidal Lagan impoundment	PA	SA

6.1.2 Measures taken to reduce the inputs of Nutrients from UK Problem Areas and Potential problem areas

Areas designated as Nitrate Vulnerable Zones under the Nitrates Directive

NVZs were originally designated in 1996 and covered approximately 8% of England's land area. Additional NVZs were designated in 2002 and brought the total coverage to approximately 55% of England.

An Action Programme of measures has been implemented by farmers within these NVZs to reduce losses of nitrate from agricultural land. The Action Programme promotes best practice in the use and storage of fertiliser and manure, and builds on the guidelines set out in the 'Code for Good Agricultural Practice for the Protection of Water';

<http://www.defra.gov.uk/farm/environment/cogap/>.

There are four key aspects to the Action Programme which require farmers to:

- Limit inorganic nitrogen fertiliser application to crop requirements, after allowing fully for residues in the soil and other sources.
- Limit organic manure applications to 170 kg ha⁻¹ of total nitrogen each year averaged over the area of the farm not in grass and 250 kg ha⁻¹ of total nitrogen each year averaged over the area of grass on the farm.
- On sandy or shallow soils not to apply slurry, poultry manures or liquid digested sludge between 1 September and 1 November (grassland or autumn sown crop) or 1 August and 1 November (fields not in grass without autumn sown crop). The storage capacity available for those animal manures which cannot be applied during the autumn closed period must be sufficient to cover these periods unless other environmentally acceptable means of disposal are available.
- Keep adequate farm records, including cropping, livestock numbers and the use of organic manures and nitrogen fertilisers.

Four NVZs were designated in Scotland in 2002, comprising 14% of the land area. They incorporate areas earlier designated, one of which was the Ythan catchment.

In 1999 and 2003 Northern Ireland designated seven small Nitrate Vulnerable Zones (NVZs) due to elevated nitrate levels in groundwaters. In October 2004 a total territory approach to

the implementation of the Directive was adopted in Northern Ireland due to eutrophication of surface waters and the 'Nitrates Action Programme Regulations (Northern Ireland) 2006' (the NAP Regulations) came into operation on 1 January 2007. The introduction of these regulations meets Northern Ireland's legal and environmental obligations and the 'Phosphorus (Use in Agriculture) Regulations (Northern Ireland) 2006', which also became operational on 1 January 2007, support these obligations. These regulations bring into operation measures to improve the use of nutrients on farms and as a result improve water quality throughout Northern Ireland.

Some of the key measures in the NAP Regulations include:

- A closed period for the spreading of organic (15 Oct to 31 Jan) and inorganic fertilisers (15 Sept to 31 Jan);
- A minimum livestock manure storage requirement (26 weeks for pig/poultry and 22 weeks for other livestock);
- A limit on the amount of nitrogen that can be applied to land from livestock manures ($170\text{kg N ha}^{-1}\text{ year}^{-1}$); and
- The inclusion of nitrogen efficiency measures.

In addition to the measures described in action plans, Member States are required to carry out effectiveness monitoring of the action plans. In Northern Ireland, the effectiveness of the programmes is measured by:

- Monitoring surface (~600) and groundwater (~90) stations on a monthly basis for compliance with the 50mg l^{-1}
- Trophic status monitoring of rivers, lakes and transitional/coastal waters, measuring both chemical and biological determinands on a rolling programme.
- Detailed nutrient budgeting of catchments
- Intensive survey at targeted mini-catchments, with known eutrophication problems
- Soil mineral N analysis

The studies outlined above are carried out in conjunction with other government laboratories.

Waters Designated as Sensitive under the Urban Wastewater Treatment Directive

The Urban Waste Water Treatment Directive (UWWTD) sets requirements for the collection, treatment and discharge of urban wastewater and also establishes timetables for the achievement of these standards according to the sensitivity of the waters.

The Directive requires that sewage being discharged to SAs should be subjected to tertiary treatment to standards given in the Directive, within seven years of designation.

The SAs mentioned above were designated in 2002 or earlier. Appraisals of wastewater treatment plants discharging into the SAs and the installation of remedial measures where appropriate are either completed or underway, but a full report on how the various measures have been implemented will not be available until after the seven year deadline has been reached in 2009.

Improvements in the ecology of the waters in Belfast Lough have already been noticed since the installation of nitrogen removal at four wastewater treatment plants discharging into the Lough.

More details on how the UK is working to achieve reductions in nitrogen inputs to the marine environment can be found in the implementation reports for OSPAR Recommendations 88/2, 89/4 and 92/7 which can be found on the OSPAR website.

6.2 Outlook

6.2.1 Expected trends

Using data collected for the OSPAR Riverine Inputs and Direct Discharges survey we have completed statistical trend analysis for four areas. There are no statistically significant trends in the combined riverine and direct input of DIN from four major UK catchments: the Bristol Channel, Liverpool Bay, Humber/Wash and the Thames. The lack of trend may be explained where measures have been taken, under EC Directives, by the long lag time in environmental systems and by the possible confounding effects of environmental change. Experts have indicated that, due to the large existing reservoirs of nitrogen in soils and sediments, it could be decades before measures such as improved agricultural practice with respect to fertilizer and manure use will begin to show measurable improvements in environmental quality. There are circumstances where, in relation to management of point sources, environmental benefits

can be realised quickly; for example, there is local evidence that inputs of phosphorus are lower in recent years compared to previous times, resulting from the introduction of improved urban waste water treatment.

There is a risk that climatic change may affect the eutrophication status of areas of UK waters through either change in physical or biological process driven by warming, or by changing the nutrient input through varying precipitation. Examples of possible change are described below.

The depth of mixing at the continental shelf boundary determines the background concentration of nutrients experienced across the shelf seas around the UK. This is known to respond to storminess which is considered to be increasing due to climatic change and could result in a change in the background nitrogen concentration. Such change is likely to be in a narrow range with limited implication for our current assessments of coastal water eutrophication status.

Taking account of realistic climate change scenarios (UKCIP02 Briefing Report, 2002) we may expect the delivery of nutrients to change in estuarine and coastal areas, with higher loadings in the winter and a reduction during the summer. The direct impact of this change over many decades is difficult to predict and may form the subject of further investigation.

Changes in temperature affect phytoplankton physiology and may result in shifts in species composition of phytoplankton (McQuatters-Gollop, 2007) as well as affecting the duration and strength of thermal stratification of the deeper (> 40 m) shelf seas. There is therefore concern that the growth response of organisms to nutrient enrichment may change and that, for example, deoxygenation of bottom waters in stratified regions may increase. It may be that parts of the seas become more 'susceptible' to the effects of nutrient enrichment, but it is also clear that distinguishing between cause and effect will become more difficult. We can predict such changes using ecosystem models but we are currently building confidence that these predictions form a good basis for management action.

Subject to the qualifications given in the above paragraphs, the expected status of UK assessment areas is summarised in Table 5

Table 5: Expected Eutrophication Status of UK waters examined under the OSPAR Comprehensive Procedure

Country	Assessment area	OSPAR 2002 assessment	OSPAR 2008 assessment	Expected status
England and Wales	Northern North Sea	NPA	NPA	Expected to remain as non-problem areas, subject to significant climatic changes
	Southern North Sea	NPA	NPA	
	Eastern English Coast	NPA	NPA	
	East Anglia	NPA	NPA	
	East English Channel	NPA	NPA	
	Solent	NPA	NPA	
	Bristol Channel	NPA	NPA	
	Liverpool Bay	NPA	NPA	
	Northeast Irish Sea	NPA	NPA	
Scotland	Clyde estuary	NPA	NPA	
	Firth of Clyde	NPA	NPA	
	Forth estuary	NPA	NPA	
	Tay estuary	NPA	NPA	
	Solway	NPA	NPA	
	Eden	NPA	NPA	
Northern Ireland	Carlingford Lough	NPA	NPA	
	Larne Lough	NPA	NPA	
	Strangford Lough South	NPA	NPA	
	Outer Belfast Lough	NPA	NPA	
Estuaries And Harbours In England Wales Scotland And Northern Ireland designated as SAs or NVZs, or “whole territory” Under the UWWT and/or Nitrates Directive.	Lower Fal estuary		[PA] ³	Measures being applied under and/or Nitrate Directives, in conjunction where appropriate with any future measures under the WFD, should lead to progress towards NPA status. However the timeframe is uncertain due to the complexities of the science including the effect of nutrient reserves in soils and sediments (see para 6.2.1)
	Portsmouth & Chichester Harbours	PA	PA	
	Langstone Harbour	PA	PA	
	Pagham Harbour	PA	PA	
	Medina estuary		PA	
	Newtown Harbour		PA	
	Eastern Yar		[PA] ¹	
	Loughor estuary	PPA	PA	
	Hamble estuary		PA	
	Seal Sands (Tees estuary)	PA	PA	
	Lindisfarne NNR area	PA	PA	
	Holes Bay	PA	PA	
	Poole Harbour	PPA	PPA	
	The Fleet	PPA	PPA	
	Truro, Tresillian and Fal estuaries	PA	PA	
	Taw estuary	PA	PA	
	Tawe	PA	PA	
	South Esk estuary (Montrose basin)		PPA ⁴	
	Ythan estuary	PA	PA	
	Inner Belfast Lough & tidal Lagan impoundment	PA	PA	
	Strangford Lough North		PPA	
	Foyle estuary and Lough		PPA	

³ Status of areas in square brackets is provisional and dependent on formal designation under the Nitrates Directives. UK will inform OSPAR when the position is clear.

⁴ the South Esk estuary (Montrose Basin) is not designated as an NVZ, but most of the catchment in which it is situated has been designated as an NVZ. Therefore, this area should benefit from the associated nitrogen reductions.

6.2.2 Improvement of assessments

There are three issues that come out of the peer review of our application of the Comprehensive Procedure and that the UK believes would assist OSPAR to develop/refine the procedure for future applications.

Algal toxicity and eutrophication. The first of these is the use of Category IV concerning Other Possible Effects. Although we have included information about the incidence of DSP/PSP toxicity in bivalve mollusc tissue, and added to this with readily available information about the presence of toxin producing algae, we do not think this information adds anything to the overall classification of eutrophication status and in some cases might provide a wrong classification. There is continuing scientific debate about the link between nutrient enrichment and both the presence of TPA and toxicity in bivalve mollusc tissue. There is evidence that TPA occur in regions where there is no anthropogenic nutrient enrichment, e.g. along the Atlantic coasts of the UK. Until such time as there is clear scientific justification we propose not to use TPA and the presence of toxicity in shellfish as assessment criteria. The UK is commissioning a research project to address this question together with other countries which will report in early 2009.

Adequacy of macrophyte tools. Although we have developed assessment methods for macrophytes, including macroalgae, in shallow coastal and estuarine waters there is scope for improving our quantitative assessment tools. There has been considerable attention given to this area in the work streams supporting the implementation of the Water Framework Directive (Scanlan *et al.*, 2006) and it will be several years before the adequacy of the new tools is confirmed. OSPAR needs to ensure that it contributes to, and benefits from, experience gained in applying this ecological assessment tool.

Lack of clarity in the application of Category II. The most serious of the problems identified, concerns the application of the Category II Harmonised Assessment Criteria where there is a mix of criteria reflecting different aspects of the overall definition of eutrophication. It is clear that the indicators in Category I relate unambiguously to *nutrient enrichment*. It is also clear that the criteria in Category III relate unambiguously to *undesirable disturbance to the balance of organisms or to the quality of the water*. In contrast Category II contains elements that relate to *accelerated growth* (e.g. chlorophyll and macrophyte biomass) and to *undesirable disturbance to the balance of organisms or to the quality of the water* (e.g. phytoplankton indicator species and 'shifts' in the nature of the macroalgae/macrophytes).

Our experience shows that this can lead to a situation where misclassification is possible. The most concrete example is where in the Initial Classification there is a '+' for Category I, a '+' for Category II (relating only to chlorophyll) and a '-' for Category III/IV. The combined scores give a Problem Area Classification. This means that the area is *nutrient enriched* and that there is *accelerated growth* but the final test for eutrophication – *undesirable disturbance to the balance of organisms or to the quality of the water* – has not been met. According to the definition of eutrophication this type of area is a Non-Problem Area (or may be a Potential Problem Area if there are increasing trends related to nutrients and chlorophyll). This anomaly requires a change to the assessment scheme by separating out those criteria relating to undesirable disturbance from Category II.

7 Conclusions on the Eutrophication Status of UK Seas

The results of the latest, more robust, application of the OSPAR Comprehensive Procedure which assesses the eutrophication status of UK seas, generally confirms those of the first application in 2002. The evidence revealed by the monitoring programmes clearly shows, with a good degree of confidence, that the coastal and marine waters around the UK are Non Problem Areas with respect to eutrophication and show no signs of undesirable disturbance. However, the evidence confirms that there are a number of small estuaries, loughs and harbours which are Problem Areas with respect to eutrophication, or are at risk due to factors such as restricted circulation.

The overall classification results for the UK areas subject to the Comprehensive Procedure are listed in Table 6. There are 19 areas classified as Non Problem Areas, 17 areas classified as Problem Areas and 5 areas that are Potential Problem Areas, with respect to eutrophication. The status of these areas has been identified using the Comprehensive Procedure methodology, or the Urban Waste Water Treatment Directive or the Nitrates Directive, where these directives were used in the original assessment of some areas (Table 6).

These areas fall into two categories.

1. Coastal and Offshore marine waters (salinity >30) – which were identified as Non Problem Areas in 2002 and remain Non Problem Areas. We are more confident in the results of the current assessment, especially in the coastal areas identified in 2002 as areas of particular ongoing interest, due to enhanced monitoring and research programmes that were designed to detect any adverse anthropogenic related changes that could threaten the NPA status. These areas are East England, East Anglia, Liverpool Bay and the Solent and the Clyde.
2. Restricted regions including estuaries, loughs and harbours – some of which were identified as Problem Areas or Potential Problem Areas in 2002 (see table 4). Through the ongoing assessment programme related to the implementation of EC Nitrates and Urban Wastewater Treatment Directives a further 5 Problem Areas and 3 Potential Problem Areas have been identified⁵. These are all small water bodies.

The possible impacts of climatic change on the assessment have been considered and while there may be a tendency, in some areas, to increase the risk of nutrient enrichment related

⁵ The status for the Lower Fal Estuary and the Eastern Yar is provisional, and is dependent on formal designation under the Nitrates Directive later in 2008. UK will inform OSPAR when the position is clear.

effects in the seas, further work is required to help develop confidence in such prediction. Currently predicted change would only become significant several decades into the future.

The second application of the Comprehensive Procedure has helped develop our understanding of the eutrophication status of UK waters, and the assessment methods for each of the Harmonised Assessment Criteria from developments in the underpinning science and parallel developments for the purposes of the Water Framework Directive. One of the outcomes is a clear conclusion that several components of the overall assessment process need to be refined, in order to come to a clearer and more robust conclusion reflecting the definition of eutrophication.

Figure 5 is a map of these final classifications and Figure 6a and Figure 6b show the assessment areas for Northern Ireland and Scotland on a smaller scale. Figure 6c presents a small-scale map of the south coast of England in order that the classifications of estuarine areas in this region are visible.

Table 6: Final classification of UK areas

Country	Assessment area	OSPAR 2002	OSPAR 2008
England and Wales – Coastal and offshore areas	Northern North Sea	NPA	NPA
	Southern North Sea	NPA	NPA
	Eastern English Coast	NPA	NPA
	East Anglia	NPA	NPA
	East English Channel	NPA	NPA
	Solent	NPA	NPA
	Bristol Channel	NPA	NPA
	Liverpool Bay	NPA	NPA
	Northeast Irish Sea	NPA	NPA
England and Wales – estuaries	Lower Fal estuary		[PA] ⁶
	Portsmouth & Chichester Harbours	PA	PA
	Langstone Harbour	PA	PA
	Pagham Harbour	PA	PA
	Medina estuary		PA
	Newtown Harbour		PA
	Eastern Yar		[PA] ⁷
	Loughor estuary	PPA	PA
	Hamble estuary		PA
	Seal Sands (Tees estuary)	PA	PA
	Lindisfarne NNR area	PA	PA
	Holes Bay	PA	PA
	Poole Harbour	PPA	PPA
	The Fleet	PPA	PPA
	Truro, Tresillian and Fal estuaries	PA	PA
	Taw estuary	PA	PA
	Tawe	PA	PA
Scotland	Clyde estuary	NPA	NPA
	Firth of Clyde	NPA	NPA
	Forth estuary	NPA	NPA
	Tay estuary	NPA	NPA
	Solway	NPA	NPA
	South Esk estuary (Montrose basin)		PPA
	Ythan estuary	PA	PA
	Eden	NPA	NPA
Northern Ireland	Inner Belfast Lough & tidal Lagan impoundment	PA	PA
	Carlingford Lough	NPA	NPA
	Larne Lough	NPA	NPA
	Strangford Lough North		PPA
	Strangford Lough South	NPA	NPA
	Outer Belfast Lough	NPA	NPA
	Foyle estuary and Lough		PPA

⁶ Status dependent on formal designation under the nitrates Directive

⁷ Status dependent on formal designation under the nitrates Directive

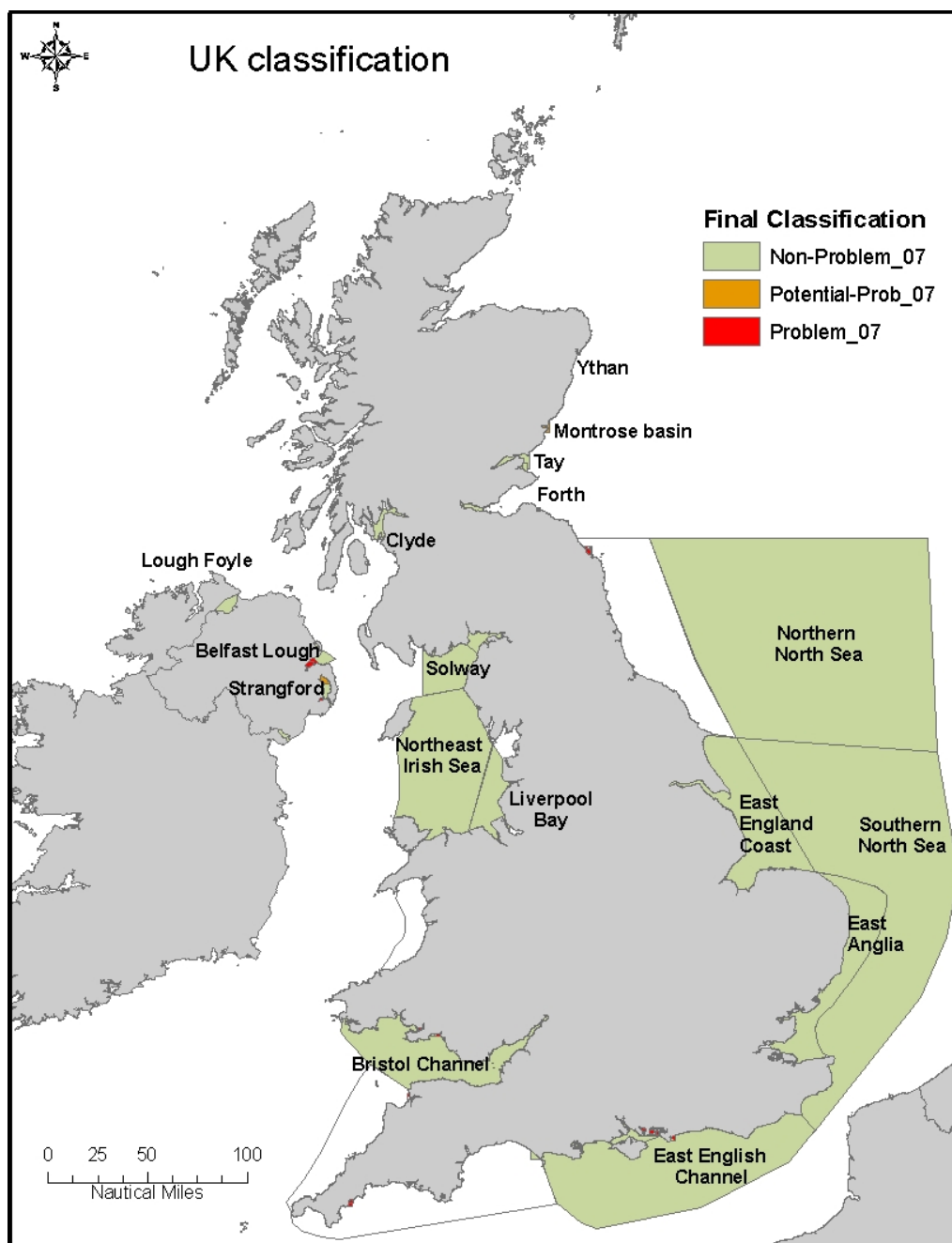


Figure 5: Final classification for UK assessment areas.

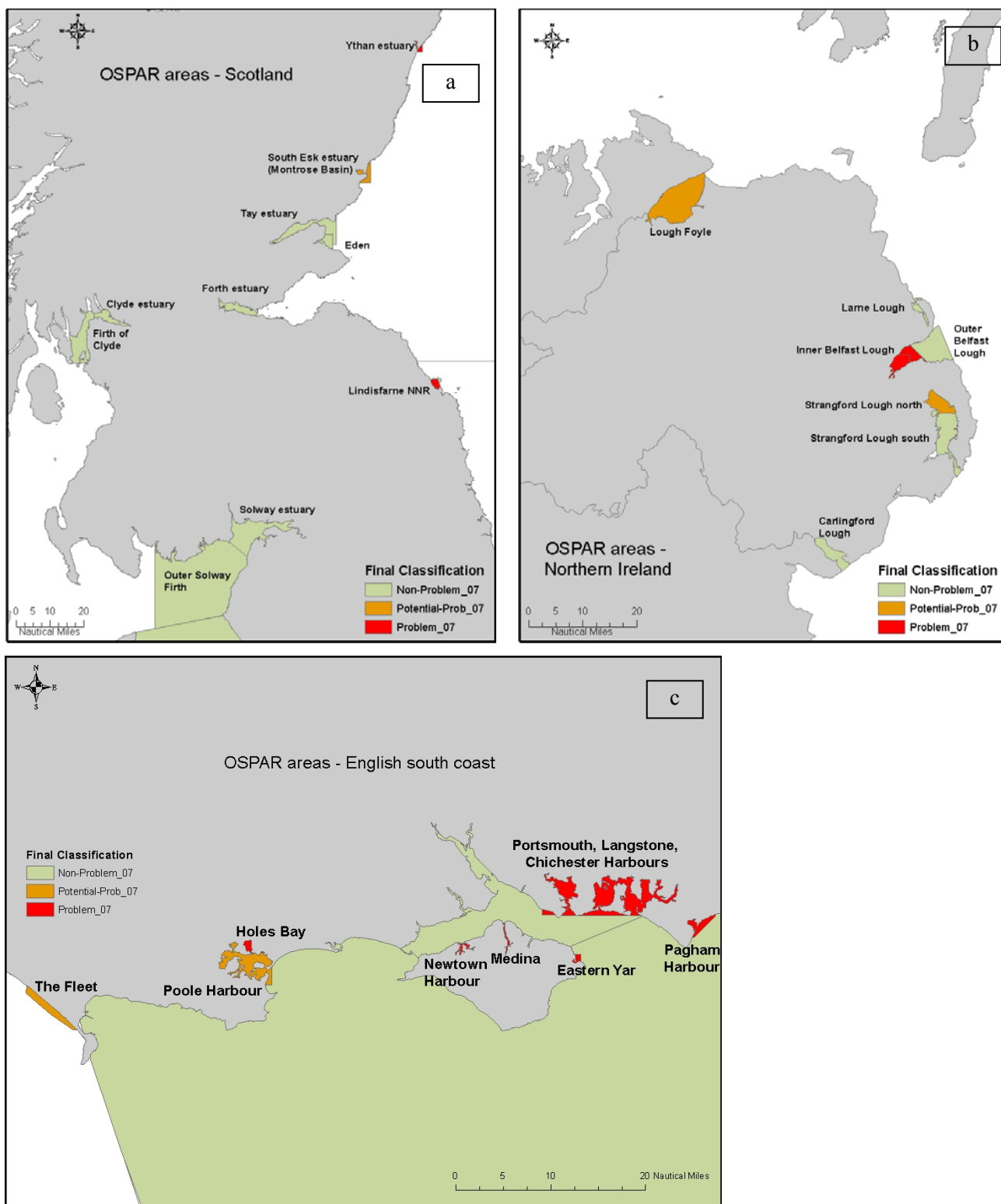


Figure 6: Map extracts of assessment areas in (a) Scotland, (b) Northern Ireland, and (c) English south coast.

8 References

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9 Annexes

9.1 Screening Review

After considering possible changes to the drivers for nitrogen, including any measures taken for national or European purposes, we screened the marine waters around the UK using a simple approach based on winter nutrient concentrations. Winter nitrogen data (dissolved inorganic nitrogen – DIN) from all available surveys were used and where available supplemented by information on TOxN derived from SmartBuoys. SmartBuoys measure total oxidised nitrogen (TOxN), but not ammonium so DIN data are not calculable. However, examination of spatial data (sampled from ship-borne surveys) in an area 150 – 300 km² around each SmartBuoy found that ammonium constituted <6% of DIN in ≥90% of samples; so SmartBuoy TOxN data slightly underestimates spatial DIN data and may be used for screening purposes.

Table 7: Summary results of the 2008 screening procedure for England and Wales.

Data were separated into spatial and temporal.

Assessment area	Mean winter DIN (spatial) & TOxN (SmartBuoy) (µM) for whole assessment period				Full assessment?
	Spatial (NMMP, EA)			SmartBuoy (Cefas)	
	Estuarine	Coastal	Offshore		
Liverpool Bay	55.47	30.06	-	18.47	Yes
Northeast Irish Sea	-	19.64	-	-	Yes
Cardigan Bay	-	11.42	-	-	No
Bristol Channel	56.27	25.97	-	-	Yes
North Cornwall Coast	-	-	8.72	-	No
SW England Coast	-	-	8.53	-	No
East English Channel Coast	160.02	18.63	10.32	-	Yes
Solent	142.20	30.73	17.24	-	Yes
East Anglian Coast	43.95	31.13	19.35	23.99	Yes
Eastern English Coast	93.03	58.60	9.06	-	Yes
NE England Coast	57.94	15.00	8.65	-	No
Northern North Sea	-	-	6.01	-	Yes
Southern North Sea	-	25.42	10.16	7.02	Yes

Data were averaged over the 6-year assessment period. Winter nutrient concentrations exceeding 15µM in coastal and offshore waters were put forward for assessment under the OSPAR comprehensive procedure. The exception was the Northern North Sea area, which did not exceed the DIN threshold but was examined due to interest in relation to the contiguous areas to the east. It has been put forward for a full assessment due to trans-

boundary transport debate. The outcomes of the screening procedure for defining the areas considered to be non-problem are set out in Table 7.

9.2 Thresholds used in the OSPAR comprehensive procedure

9.2.1.1 Phytoplankton

Table 8 is a summary of individual phytoplankton indices' thresholds and the summary equation relating to the occurrences of elevated phytoplankton taxa counts within a whole population. The overall index is composed of counts of the four attributes within the tool. Samples are taken in the growing season between April and September. The GOOD/MODERATE boundary equates to the problem/non problem threshold for OSPAR CP. Phytoplankton data were extracted from the UK phytoplankton database. These data have been compiled for WFD purposes, and are geographically linked to WFD transitional (estuarine; salinity <30) and coastal (salinity 30-34) water bodies.

Table 8: Summary of phytoplankton indices (IE) relating to the occurrences of elevated taxa counts within a whole population

Normative definition	Index	Equation – $\{ \text{SUM [T] + [P] + [S] + [CHL] } / 4 \} * 100$	Phytoplankton assessment	
Phytoplankton abundance	I_E	<i>I_E: sum of the occurrence of any species ($> 10^6$), plus <i>Phaeocystis</i> ($> 10^6$), plus total cell counts ($> 10^7$) and counts of chlorophyll $> 10\mu\text{g/l}$ over a five year period</i>	<25%	Threshold not exceeded
			>25%	Threshold exceeded

9.2.1.2 Macrophytes (macroalgae)

The proposed thresholds for assessment of areas with macroalgal bloom events are set out in Table 9. They have been adapted from Water Framework Directive macroalgal bloom metrics (Scanlan *et al.*, 2007).

Table 9: Thresholds for assessment of macroalgae blooms under the OSPAR CP

Macroalgal biomass	Macroalgal cover	Macroalgae assessment
<500g/sqm	<15%	Threshold not exceeded
>500g/sqm	>15%	Threshold exceeded

9.2.1.3 Dissolved oxygen

Table 10 sets out the standards for dissolved oxygen (DO) levels during the growing season, as proposed for WFD assessment and these have been simplified for OSPAR. Regions are deemed to have exceeded the OSPAR threshold where DO levels is below 4 mg l⁻¹ on more than 5% of sampling occasions during the growing season.

Table 10: Proposed dissolved oxygen standards for naturally ventilated layers (or rapidly exchanged stratified waters) of transitional and coastal waters.

Marine 5%ile	Objectives	DO assessment
≥5.7 mg l ⁻¹	All life-stages of salmonids and transitional fish	Threshold not exceeded
≥4.0 <5.7 mg l ⁻¹	Presence of salmonids and transitional fish	
≥2.4 <4.0 mg l ⁻¹	Most life-stages of non-salmonid adults	Threshold exceeded
≥1.6 <2.4 mg l ⁻¹	Presence of non-salmonids, poor survival of salmonids	
<1.6 mg l ⁻¹	No salmonids present marginal survival of resident species	

9.2.1.4 Zoobenthos/benthic invertebrates and reported fish kills

Sea Fisheries Commissions were contacted for data on incidents of fish kills.

Under the Water Framework Directive benthic metrics, methods and thresholds are being established but this is work in progress and results are not yet available. Monitoring of the benthos has been regularly undertaken by Cefas, though it has not been directly targeted at assessment of eutrophication. Where relevant, results from the UK National Marine Monitoring Programme (NMMP) second report (MEMG Cefas, 2004) and Cefas' Defra-funded research and development study of "The Benthic Ecology of the Western North Sea", have been used in area reports.

9.2.1.5 Toxin levels in bivalve mollusc tissue

For the assessment of bivalve mollusc tissue poisoning events, the procedure set out in the Water Framework Directive characterisation report was used. Table 11 sets out the thresholds for OSPAR exceedance, based on the percentage of bivalve mollusc tissue samples failing to meet FSA standards. As further supporting evidence, TPA concentrations in water samples were also assessed against the same threshold of 10% of samples exceeding the FSA permitted levels.

Table 11: Assessment criteria for Category IV – occurrence of toxicity in bivalve mollusc tissue and presence of toxin producing algae.

Toxin	Maximum permitted levels	TPA species	Shellfish poisoning	Action Level (cells l⁻¹)
PSP	80 µg per 100 g flesh	<i>Alexandrium tamarense</i>	PSP	Present
DSP	Presence in flesh	<i>Dinophysis</i> spp.	DSP	100
ASP	20 µg per g flesh	<i>Prorocentrum lima</i> <i>Pseudonitzschia</i> spp.	DSP ASP	100 150,000
Proportion of failed samples (whichever was most for ASP/PSP/DSP)			Toxicity in bivalve mollusc tissue and TPA assessments	
<10 %			Threshold not exceeded	
>10 %			Threshold exceeded	