SOUTH WESTERN RIVER BASIN DISTRICT

MARINE MORPHOLOGY
Progress Update in support of the SWMI Report

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RATIONALE FOR THE STUDY

The fundamental objective of the Water Framework Directive (WFD) aims at maintaining 'high status' of waters where it exists, preventing any deterioration in the existing status of waters and achieving at least 'good status' by 2015.

Annex V of the Directive describes the quality elements that must be used for the classification of ecological status/potential for all surface water categories. The Directive sub-divides these quality elements into the following 3 groups:

1. biological elements
2. hydro-morphological elements supporting the biological elements
3. chemical and physio-chemical elements supporting the biological elements

Table 1 below further defines the hydro-morphological quality elements as per Annex V of the Directive.

Table 1: WFD Hydro-morphological quality elements

Annex V 1.1.3 Transitional Waters	**Annex V 1.1.4 Coastal Waters**
Tidal Regime	Tidal Regime
- FW Flow	- Direction of dominant currents
- Wave Exposure	- Wave exposure
Morphological Conditions	Morphological Conditions
- Depth Variation	- Depth variation
- Quantity, structure and substrate of seabed	- Structure and substrate of the coastal bed
- Structure of intertidal zone	- Structure of the intertidal zone

The Marine Morphology POMS Study aims to provide a protocol to apply in the further characterisation and risk appraisal for Marine Morphology in transitional and coastal waters (TRaC), the outcomes of which will contribute to the development of a tool for the assessment and management of marine morphology in these water bodies. This study involves all TRaC water bodies within the Republic of Ireland, but is being undertaken in parallel to the NS Share project to ensure compatibility of methodologies between Northern Ireland and the Republic of Ireland.

Transitional waters (estuaries) are waters near river mouths which are saline but influenced by fresh water flows. Coastal water, for the purpose of the WFD, are surface waters in the area between the coast and one nautical mile (1852 metres) from the coast.

The Water Framework Directive defines TRaC waters as follows:

Transitional Waters: *bodies of surface water in the vicinity of river mouths which are partly saline in character as a result of their proximity to coastal waters but which are substantially influenced by freshwater* (Article 2, section 6).

Coastal Water: *surface water on the landward side of a line, every point of which is at a distance of one nautical mile on the seaward side from the nearest point of the baseline from which the breadth of territorial waters is measured, extending where appropriate up to the outer limit of transitional waters*. (Article 2, section 7).
The Marine Morphology study involves a total of 309 water bodies; 113 coastal water bodies (4 of which border with NI) and 196 transitional water bodies (2 of which border with NI) within the Republic of Ireland.

The values of the WFD hydromorphological quality elements (Table 1) must be taken into account when assigning water bodies to the high ecological status class (HES) and

maximum ecological potential (MEP) class. Therefore this study will concentrate on the quality elements for high and good (for the purpose of deterioration) status only.

For HES, the values for the hydromorphological quality elements correspond "*totally or nearly totally to undisturbed conditions*" (Annex V Tables 1.2.1 – 1.2.4). For other status levels or potential classes, the hydromorphological elements are required to have '*conditions consistent with the achievement of the values specified for the biological quality elements*' i.e. if the biological quality element values relevant to good, moderate, poor or bad status/potential are achieved, then by definition the condition of the hydromorphological quality elements must be consistent with that evaluation. This will be determined via monitoring of biological quality elements and [in the case of Good Ecological Status/Good Ecological Potential] the physio-chemical quality elements.

An initial risk assessment was undertaken for the Article 5 Characterisation Report. This included the identification and assessment of a number of morphological pressures (refer to Table 2). Following initial assessment of these morphological pressures, the following key data gaps were identified to be addressed:

- Lack of quantitative data regarding pressures
- Examination of the impacts of morphology pressures
- Lack of compliance datasets for protected areas other than Bathing Waters

This Characterisation Report, completed in 2005, identified morphology modification as one of the most significant pressures on the water environment.

Table 2: Morphology pressures considered for the initial risk assessment undertaken for the Article 5 Characterisation Report.

Pressure	Transitional Waters	Coastal Waters
Dredging		✔
Dredging & Channelisation	✔	
Disposal of Dredge Spoil	✔	✔
Coastal Defence, Flood Protection and Embankment	✔	✔
Impoundment (tidal barrage)	✔	
Built Structures: (Port / Harbours)	✔	✔
Built Structures: (Urbanisation)		✔
Built Structures: (Industrial / Power Station Intakes)	✔	✔
Intensive Land Use	✔	

For the Article 5 report, each marine water body was assigned a risk category based on the proportion of the water body altered by human activities. This assessment concluded that 36% of transitional water bodies, and 19% of coastal water bodies in the Republic of Ireland were *'at risk'* or *'probably at risk'* of failing to meet the WFD objective of Good Status due to physical alteration.

Annex II of the Directive requires that further characterisation shall, where relevant, be carried out for those bodies identified as being at risk of failing the environmental quality objectives in order to optimise the design of both the monitoring programmes and the programme of measures.

OBJECTIVES

The principle aim of the Marine Morphology Study is to provide a protocol to apply in the further characterisation and risk appraisal for marine morphology in coastal and transitional (TRaC) waters. The objectives of the study are as follows:

- Establish the relationship between morphology characteristics and biological status;
- Identify what level of morphological pressure is "sustainable" within a water body;
- Establish which morphological indicators should be included in coastal and transitional monitoring programmes;
- Identify water bodies where morphology restoration measures are required (links to the Heavily Modified Water Body (HMWB) designation process);
- Identify the available buffer (or capacity) of water bodies to prioritise action levels;
- Prioritise morphology pressures;
- Develop a decision support tool for regulators to assess the potential impact of future developments on individual water bodies.

APPROACH / METHODOLOGY

The Marine Morphology Study is being progressed under the following tasks:

1. Literature Review
2. Data Review / Data Gaps
3. Review of Monitoring Systems
4. Improve Definition of Pressures and Receptors
5. Assess Ecological Impacts of Pressures
6. Develop Assessment Tool
7. Prepare Final Report on National Methodology

The following paragraphs provide more information on what work is required for each of these separate tasks

Task 1: Literature Review

A Literature Review is required to:

- investigate and report on relevant approaches being developed;
- identify current research underway into the relationship between morphology and ecology;
- identify the availability and applicability of any literature and guidance for the development of an appropriate assessment methodology.

Task 2: Data Review / Data Gaps

The initial risk assessment for the Article 5 Characterisation identified major gaps in quantitative information for morphology. To address these gaps the data review will:

- research both national and local datasets;
- include an assessment of the reliability of the data currently available;
- include studies currently underway or due to be commissioned during the life of this project, and
- summarise the data to be requested for inclusion in this work.

Task 3: Review of Monitoring Systems

Following a review of existing morphological monitoring data and systems the requirements for additional monitoring of morphological attributes will be summarised.

Task 4: Improve Definition of Pressures and Receptors

Following the Literature (Task 1) and Data (Task 2) Reviews, the definition of the pressures identified by the Article 5 initial characterisation will be improved.

The initial characterisation was primarily based on the location of pressures. Information on the 'intensity' of pressures (e.g. frequency of dredging) was not reviewed in detail. This is important as the effects of a pressure and the resultant change in environmental factors (morphological attributes) are site specific and where possible should not be generalised.

To aid the development of the Programme of Measures this task will also identify activity and development trends where possible e.g. investment in development of Ports, dredging plans foreshore license / planning application approvals.

Task 5: Assess Ecological Impacts of Pressures

The morphological attributes of TRaC water bodies that can potentially be altered by the pressures identified will be determined.

After improving the definition of the pressures on TRaC waters and linking them with the morphological attributes likely to be altered, the ecological impacts of these pressures can be assessed. Some elements of this task will be met via the literature review (Task 1) which will focus on similar studies and information sources used in such studies. This will involve the use of quantitative and qualitative information to estimate the intolerance and recoverability of a receptor after exposure to a change in an external factor i.e. its sensitivity to a change in morphological attributes.

Task 6: Develop Assessment Tool

The development of this tool will cover most elements of the tasks defined above and gather them in a 'data store' that will act as a structured Decision Support Tool. This 'tool' is intended to help regulators determine whether morphological alterations could threaten the aim of achieving WFD objectives, or result in a deterioration in ecological status (from high to good status).

Compilation of this tool will involve the development of a database holding all attribute data and information collected. This information will then be geo-referenced and displayed spatially using Geographical Information System software. The decision support aspect of the tool will help establish the 'sustainable' level of morphological pressures.

A review of best practice measures and available reports will be undertaken, and collated for use with the tool.

Task 7: Prepare Final Report on National Methodology

A report outlining the work undertaken to develop the methodology will be prepared. This report will include recommendations for the design of the monitoring programme and programmes of measures arising from this work.

PROGRESS TO DATE

A Steering Group was set up to facilitate the completion of the marine morphology study within the Republic of Ireland. Steering Group members consist of representatives from the Department of the Communication, Marine and Natural Resources, the Marine Institute, the Environmental Protection Agency, the National Parks and Wildlife Services, Cork County Council, and a representative of the Northern Ireland marine morphology task team. To ensure a harmonised approach to marine morphology throughout Ireland, work undertaken to date has been consistent with that being carried out in Northern Ireland.

Task 1: Literature Review

The Literature Review was completed for approval in June 2006 and identified:

- the key organisational bodies for implementation of the WFD in Ireland, including those specifically related to marine morphology;
- the current approaches to marine morphology being developed; and
- the research underway that may prove relevant to the completion of the Marine Morphology task.

This review concluded that the most common, and in most cases necessary, approach to assessing and reporting the impact of morphological pressures involves a mixture of qualitative and quantitative assessments.

Although it is clear that many anthropogenic activities which result in morphological pressures impact on ecology, there is limited quantitative data describing the relationships between morphological conditions and ecological health.

At present there are no quantitative environmental standards available to assess the ecological impacts of alterations to the morphology of TRaC waters. Where regulation exists, decisions are principally made on a case by case basis, using a combination of field data and expert judgement.

Task 2: Data Review / Data Gaps

An initial Data Review report was completed for approval in June 2006.

As part of this task a review of existing coastal models (primarily hydrodynamic and water quality) and existing transitional water models (hydrodynamic/water quality/nutrients/ecological) was undertaken to help identify any relevance and potential use / benefit to the Marine Morphology task.

Following the identification of relevant datasets and key organisations, data requests were issued to all River Basin Districts, public institutions, academia and various consultancies.

The main categories of information being collated for this study are ***Pressures*** (anthropogenic activities), ***State*** (morphological conditions), and ***Receptors*** (WFD biological quality elements: phytoplankton, macroalgae, benthic invertebrates and fish (transitional only)).

The data is, where possible, being co-ordinated within a Geographical Information System (GIS) and used to develop the Data Store Tool (Task 6).

Task 3: Review of Monitoring Systems

A summary report of existing monitoring systems and any requirements for additional monitoring is currently being prepared.

Task 4: Improve Definition of Pressures and Receptors

A register of morphological pressures to be assessed has been generated and presented to the Steering Group for comment.

Information and data collated to date is currently being assessed to improve the definition of these pressures.

Task 5: Assess Ecological Impacts of Pressures

Researching the relationship between ecology and morphological characteristics formed part of the literature review. Further research has included liaisons with the UK Technical Advisory Groups (UKTAG) 'TRaC Morphology Technical Panel' and UK-Ireland Marine Task Team in relation to the development of morphological classification and assessment tools.

Seabed habitats and their occupying communities of species are an essential component of the marine ecosystem. To assess the impact of morphological pressures and help identify the correct measures to maintain or improve status, our understanding of ecosystem function must relate seabed habitats to existing environmental conditions (morphological attributes).

The distribution of seabed habitats is defined by the combination of various physical, biological and chemical processes. Morphological attributes that share this role in supporting ecological communities are being identified and will relate closely with the Hydromorphological Quality Elements specified in the WFD (Table 1). Currently, a pragmatic approach is being used to develop a decision-support framework that will help assess the risks to ecological status caused by proposed alterations to TRaC waters. This assumes that a deterioration of an attribute resulting from the human activities (pressures) outlined above will result in a deterioration of the ecosystem it supports.

The initial approach/methodology developed for the RoI was presented to the Programme of Measures Group. Following approval of this approach, it was further developed using input from the Steering Group. A similar approach being developed for the UK is now being considered for application in Ireland, and following various reviews, a morphological impact assessment tool for TRaC waters is proposed for trialing in Northern Ireland in the summer of 2007.

It is recognised that due to the case specific nature of morphological pressures on TRaC water bodies, any tool developed by this task will be undertaken such as to complement existing case specific use of expert judgement and/or case specific impact assessments. Therefore this tool will effectively act as a risk assessment tool; assisting regulators to determine whether proposals which alter morphological features could risk the ecological objectives of the WFD.

Task 6: Develop Assessment Tool

The tool being developed consists of the following two parts:

1. A data-store GIS: this holds and displays the collated data to assist regulators in decision-making. The functionality of this tool can be summarised as follows;
   - The user will assess the information provided by an applicant for a proposed development/activity e.g. foreshore licence or dumping at sea application.
   - The user can then access the GIS tool to view and query its database to inform a decision based on the local environmental conditions and sensitivity of the receptors identified.
2. Morphological Impact Assessment: The data store GIS provides baseline data of which a regulator can interpret using expert judgement to make a decision. This function however, uses assessments of morphological features and pressures to estimate the risks to ecology. The development of this function will require the input of additional data to that available at present. This will be sourced from the monitoring programmes and research projects such as INFOMAR (the Integrated Mapping For the Sustainable Development of Ireland's MARine Resource), a joint venture between the Geological Survey of Ireland and the Marine Institute.

The combination of the above elements will inform the further characterisation of TRaC waters and provide a suitable approach to assist coastal managers and regulators in assessing the potential impact of future developments on individual water bodies.

Task 7: Prepare Final Report on National Methodology

A final report will be produced when the approach and methodology discussed above has be tested and approved for use.

EARLY INDICATIONS OF RESULTS / CONCLUSIONS

Trialling of the methodology for morphological impact assessment will commence soon in Northern Ireland. The results of this trialling exercise will be analysed and presented to the Steering Group and the national Programme of Measures & Standards Co-ordination Group prior to its application in the Republic of Ireland.