UK Technical Advisory Group on the Water Framework Directive

Guidance on Typology for Coastal & Transitional Waters of the UK and Republic of Ireland

(Final)

This Guidance Paper is a working draft defined by the UKTAG. It documents the principles to be adopted by agencies responsible for implementing the Water Framework Directive (WFD) in the UK. This method will evolve as it is tested, with this working draft amended accordingly.

Working Paper Version:	(Finalv12) 14/4/04	**Status:**	Public Working Draft (P2) Updated for results (V10 -12)
WFD Requirement:	Article 5; Annex 2 Characterisation: Typology Marine, Transitional, Coastal	**UKTAG Review:**	28 October 2003

1. Purpose of this Paper

1.1 The paper sets out UKTAG's guidance on **Coastal & Transitional Waters typology** as required under Article 5 of the Directive. It identifies the methodology adopted in the UK and the Republic of Ireland and the results for the UK.

2. THE DIRECTIVE'S REQUIREMENTS

As part of the characterisation process for typing waters in each River Basin District, Article 5 and Annex II of the Water Framework Directive require Member States to undertake an analysis of its characteristics according to the technical specification outlined in Annex 2.

2.2 Member States must complete the process of characterisation by 22nd December 2004, and report the results to the Commission by 22 March 2005. The initial definition and testing of the typology method for rivers, lakes, and transitional and coastal waters is therefore urgent priority tasks in the implementation of the Directive.

2.3 This paper also relates the UK typology to the relevant common "Eurotypes" for coastal waters

3. BACKGROUND & RELATIONSHIP TO OTHER UK TAG GUIDANCE DOCUMENTS

3.1 This guidance is related to and should be read in association with, other guidance documents produced to support the typology of surface waters across the UK, specifically the following:

- Task 2.a (ii) *Guidance on Typology for Rivers for the England Wales and Scotland*
- Task 2.a (iii) *Guidance on Typology for Lakes for the UK*

3.2 This methodology was developed and tested in consultation with member states of the UK and the Republic of Ireland and EU CIS Working Group 2.4 (COAST).

4. Content Of This Guidance Paper

- Approach to typology method for transitional and coastal waters in the UK and Republic of Ireland (Section 5)
- Application of typology method, supported by tables and maps (Section 6) for:
    - Coastal waters in the UK and Republic of Ireland
    - Transitional waters in the UK and Republic of Ireland
    - Translation to European typology
- Future requirements for method development and testing (Section 7)

5. Approach to Typology for the UK and the Republic of Ireland

5.1 Section 1.2 of Annex 2 of the WFD requires Member States to differentiate relevant surface water bodies according to type using either "System A" or "System B.

5.2 The UK adopted System B in coastal and transitional waters and closely followed the guidance document produced by the EU CIS Working Group 2.4 (COAST) in deriving its final typology. The guidance document describes how both the obligatory and optional factors within System B could be used. The proposed typology was applied separately to transitional waters and coastal waters.

5.3 The obligatory factors for both coastal and transitional waters incorporated are:

- **latitude and longitude:** defined by which ecoregion a member state lies. The UK lies within the Atlantic and North Sea ecoregions. No further discrimination was used.
- **salinity:**
    - All UK coastal waters are euhaline, i.e. > 30 ppt, so no further discrimination using this factor was necessary.
    - Transitional waters have been defined as either polyhaline or mesohaline or just predominately polyhaline. It was not considered necessary to subdivide transitional waters further (in line with the CIS 2.4 guidance that Member States may aggregate descriptors within ranges if there is no biological difference).
- **tidal range:** differentiated using the agreed definitions in the CIS 2.4 guidance i.e. micro-tidal < 1m, meso-tidal 1-5 m, and macro-tidal > 5m.

5.4 Optional factors to be used in defining types included for:

- **Transitional waters**: mixing characteristics, mean substratum composition and extent of intertidal area
- **Coastal waters:** the biologically relevant optional factor is wave exposure

5.5 Therefore, the physical factors used to differentiate types included: four common factors for Coastal and transitional waters and two additional factors for Transitional Waters, as described below in Table 5.1 below.

Table 5.1 Factors used to differentiate types for transitional and coastal waters

Mixing Characteristics	)	)
Salinity	)	)
Mean Tidal Range	)	)
Wave Exposure	)	)
Depth	)	
Substratum	)	

5.6 Other factors noted as part of the process but not used for separating type classes included: Longitude & latitude, Current velocity, Residence time, etc

5.7 The typology approach was tested and identified that the full range of physical types in UK and Republic of Ireland waters had not been described. Therefore the following modifications to the typology approach was agreed:

- the differentiation between macrotidal and mesotidal waters was adopted as it did produce an ecologically relevant split (a mandatory component in the Directive)
- Transitional Lagoons had not been identified as a specific type.
- Macrotidal water were split between bigger estuaries (e.g. Severn, Thames, Humber) from the rest. While their biology may be similar, they are considered quite different in other ways (e.g. intertidal areas, turbidity).
- Additional types were required to describe for coastal waters – embayments, sea lochs and coastal lagoons.

5.8 The biological validation process highlighted that

- biogeographical variation within each type across the UK;
- diverse mosaic of different habitats within any given estuary or seaway crossed the specific types.

Therefore in future iterations of the characterisation process, further work will be required to reference habitat conditions across the types. (Note: presently classification tools are under development to assist this process.)

5.9 The types identified in the UK were compared with the ten common coastal types identified for the North East Atlantic ecoregion. This enabled identification whether UK types were represented at European level, so supports intercalibration of data. Refer Section 6.7 for results.

6. Results of Application of Typology Methodology to UK and Republic of Ireland

6.1 Six types were associated with Transitional Waters (described in Table 6.1 below) located in the two UK ecoregions (as described in Table 6.2).

Table 6.1 Predominant typology characteristics of main transitional water types

Transitional Water Type	Name	Mixing Characteristics	Salinity	Mean Tidal Range	Exposure	Depth	Substratum	Example
TW1		Partly mixed/ stratified	Mesohaline or Polyhaline Estuaries	Macrotidal	Sheltered	Intertidal/ shallow sub-tidal estauries	Sand and mud	Parrett Estuary
TW2		Partly mixed/ stratified	Mesohaline or Polyhaline Estuaries	Strongly mesotidal	Sheltered	Intertidal/ shallow sub-tidal estauries	Sand and mud	Tees Estuary Dart Estuary
TW3		Fully mixed	Predominantly polyhaline estuaries	Macrotidal	Sheltered	Extensive intertidal areas		Humber , Thames, Severn & Solway Estuaries
TW4		Fully mixed	Polyhaline or Euhaline Estuaries	Mesotidal	Sheltered	Extensive intertidal areas	Sand or mud	Southampton Water Plymouth Sound
TW5	Transitional Sea Lochs		Polyhaline	Mesotidal	Sheltered			Gare Loch Loch Eil Loch Linnhe Loch Etive
TW6	Transitional lagoons	Partly mixed/ stratified	Oligohaline - polyhaline	N/A	Sheltered	Shallow	Predominately mud	

Table 6.2 Ecoregions in which transitional water types located

Transitional Water Type	Ecoregions	Additional description
TW 1	Ecoregion 1 (North Sea) Ecoregion 4 (Atlantic)	
TW2	Ecoregion 1 (North Sea) Ecoregion 4 (Atlantic)	
TW3	Ecoregion 1 (North Sea) Ecoregion 4 (Atlantic)	
TW4	Ecoregion 1 (North Sea) Ecoregion 4 (Atlantic)	
TW5 Transitional Sea Lochs	Ecoregion 1 (North Sea) Ecoregion 4 (Atlantic)	
TW6 Transitional Lagoons	Small waterbodies in coastal locations >0.5km^2 scattered throughout the UK and ROI.	• typified by very shallow waters with no single channel to the open sea. • Waters supplied direct from the sea during high tides and through seepage. • Salinity regimes significantly affected by freshwater inputs from diffuse sources or small streams. This causes a reduction in salinity such that oligohaline – polyhaline conditions prevail.

6.2 Nine types associated with Coastal Waters were identified in the Typology report. Of these only eight actually occur in UK waters. Three additional geographical features were identified which crossed the Coastal Waters types:

- **Embayments**
  - semi-enclosed basins that are connected to transitional waters but are predominantly euhaline.
  - seasonally affected by fresh waters but not "substantially". This results in the ecology being dominated by marine habitats.
  - Embayments are significant bodies >10 km^2 which are very sheltered and dominated by sediments predominantly sand and mud.
  - Embayments are shallow sometimes with extensive areas of intertidal. Examples include Budle Bay, outer Wash and the Hampshire Harbours. Embayments have been allocated to the appropriate sheltered coastal water types, CW7, CW8 or CW9.
- **Sea Lochs** (including European sea lochs, sea loughs, fjords and fjards), noting that they:
  - are usually post-glacial features incised in coastal landscapes by glacial action and to which the sea now has access
  - are sometimes but not always stratified by the addition of freshwater from local catchments and where stratification is found, it varies strongly in relation to local rainfall.
  - have been allocated either to transitional water type TW4 or coastal water types CW11 and CW12.
- **Coastal Lagoons**

6.3 Table 6.3 identifies the predominant typology characteristics for coastal waters, whilst Table 6.4 defines location according to ecoregion and additional descriptions.

6.4 Figures 6.1 (a-c) provides the distribution of these types across Scotland, England and Wales respectively.

Table 6.3 Predominant typology characteristics of coastal water types

Type	Name	Salinity	Mean Tidal Range	Exposure	Example
CW1		Euhaline	Macrotidal	Exposed	South Wales North coast Cornwall, Devon
CW2		Euhaline	Mesotidal	Exposed	North West Scotland West coast of Ireland Cardigan Bay
CW3		Euhaline	Microtidal	Exposed	North coast Northern Ireland Islay to Mull of Kintyre
CW4		Euhaline	Macrotidal	Moderately Exposed	North West England Kent and Sussex coast
CW5		Euhaline	Mesotidal	Moderately Exposed	Northumberland coast North Channel Scotland
CW6		Euhaline	Microtidal	Moderately Exposed	Sound of Jura

Type	Name	Salinity	Mean Tidal Range	Exposure	Example
CW7		Euhaline	Macrotidal	Sheltered	Bridgwater Bay Outer Wash (Embayment)
CW8		Euhaline	Mesotidal	Sheltered	Firth of Forth Firth of Clyde Hampshire Harbours (Embayment)
CW9		Euhaline	Microtidal	Sheltered	None (N/A in UK)
CW10	Coastal lagoon	Euhaline	N/A	Sheltered	
CW11	Sea Lochs (Shallow)	Euhaline	Mesotidal	Sheltered	Busta Voe Loch Ryan Loch Indaal Loch Skipport
CW12	Sea Lochs (Deep)	Euhaline	Mesotidal	Sheltered	Loch Long Loch Torridon Firth of Clyde Loch Fyne Loch Nevis

Table 6.4 Ecoregions in which main coastal water types are located.

Coastal Water Type	Ecoregions	Additional description
CW1	Ecoregion 4 (Atlantic)	restricted to the coastal and offshore waters of Cornwall, Devon and Somerset in SW England, the south coast of Wales and the north west coast of Anglesey.
CW2	Ecoregion 1 (North Sea) Ecoregion 4 (Atlantic)	widespread in the west coast of Scotland and Ireland, the north-east coast of Scotland and the south west English channel coast
CW3	Ecoregion 4 (Atlantic)	occurs only on the north coast of Northern Ireland and in waters between Islay and the Mull of Kintyre in Scotland.
CW4	Ecoregion 1 (North Sea) Ecoregion 4 (Atlantic)	occurs on the north-west coast of England, the East Anglian and Kent and Sussex coast.
CW5	Ecoregion 1 (North Sea) Ecoregion 4 (Atlantic)	widespread around the coasts of the UK and the RoI
CW6	Ecoregion 4 (Atlantic)	occurs only in Scotland in waters between Islay and the Mull of Kintyre and on the east coast of the RoI
CW7	Ecoregion 4 (Atlantic)	occurs only in small areas of North and South Wales and the Bristol Channel
CW8	Ecoregion 1 (North Sea) Ecoregion 4 (Atlantic)	occurs mainly in small areas of Scottish and Irish coastal waters
CW10 Coastal lagoon	Small waterbodies in coastal locations >0.5 km^2 scattered throughout the UK and ROI	• typified by very shallow waters with no single channel to the open sea. • Waters supplied direct from the sea during high tides and through seepage. • Sediments will be sand and mud.
CW11 Sea Lochs (Shallow)		• All sea lochs tend to be sheltered compared with adjacent coastal waters and are often narrow in relation to their length. • Currents cannot be typified by single value because of large range of depths and widths within sea lochs. The currents are often strongly three-dimensional, with significant vertical density driven circulation ventilating the deeper parts of the systems.
CW12 Sea Lochs (Deep)		

Figures 6.1(a-c) Distribution of Transitional and Coastal Water Types

Legend	CW1	Exposed, Macro-tidal	Dark Blue
	CW2	Exposed, Meso-tidal	Blue
	CW3	Exposed, Micro-tidal	Light Blue
	CW4	Moderately exposed, Macro-tidal	Dark Green
	CW5	Moderately exposed, Meso-tidal	Bright Green
	CW6	Moderately exposed, Micro-tidal	Light Green
	CW7	Sheltered, Macro-tidal	Red
	CW8	Sheltered, Meso-tidal	Orange
	TW1		Dark Brown
	TW2		Brown
	TW3		Yellow
	TW4		Light Yellow

Figure 6.1(a) Scotland

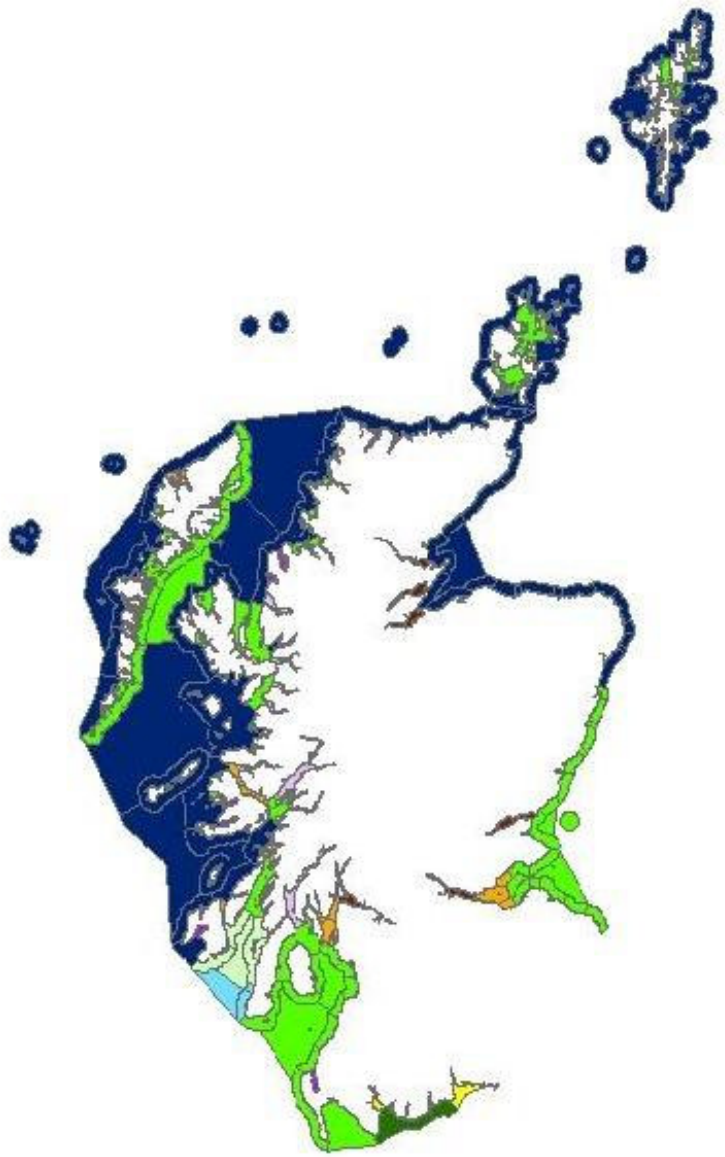
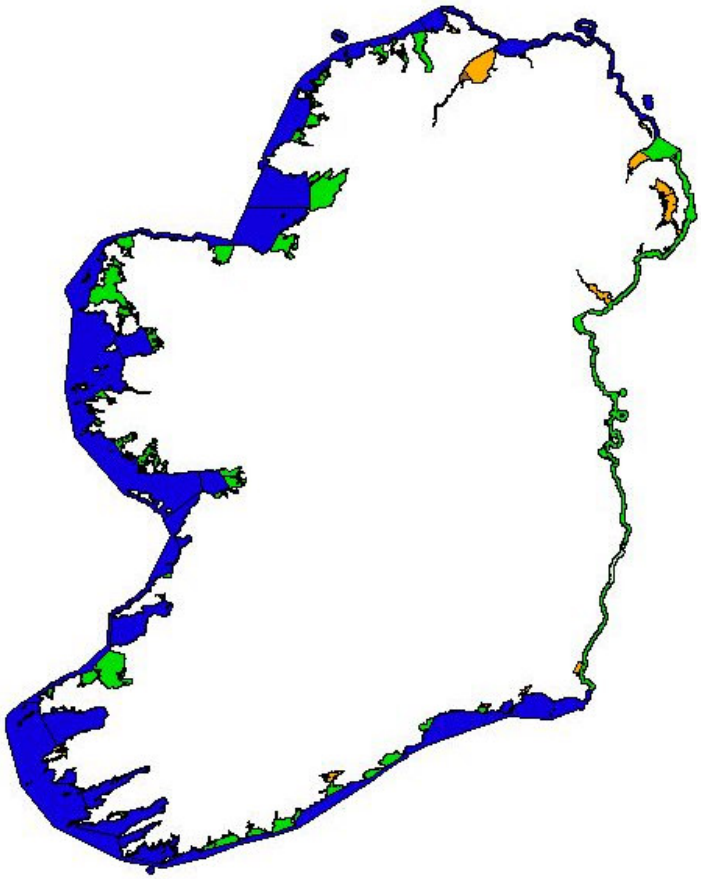
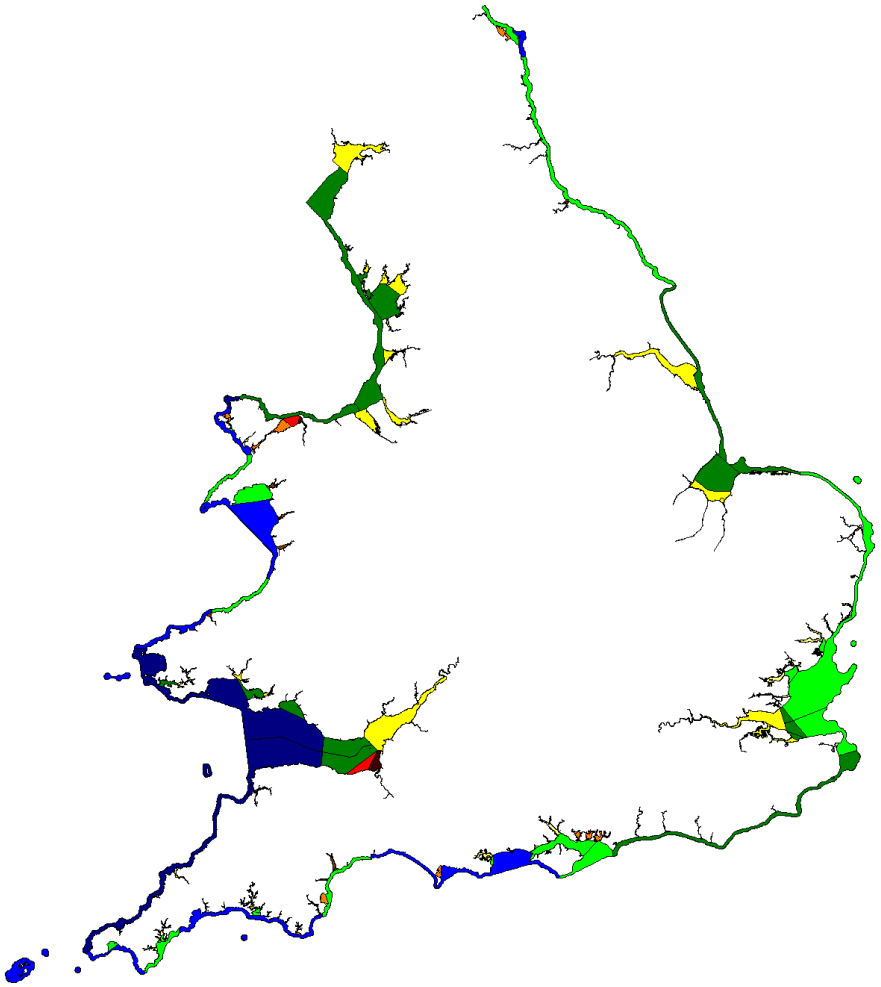


Figure 6.1(b) Ireland



Source (ROI): EPA, Copyright Government of Ireland

Figure 6.1(c) England and Wales



6.5 Of the ten common coastal types that have been identified within the NE Atlantic ecoregion complex under the European typology, four occur in the UK. Of these four, two (NEA 6 and 7) are sea lochs (refer table 6.5 for list)

Table 6.5 Predominant typology characteristics of European coastal water types present in UK

Type	Name	Salinity	Tidal range	Depth	Current velocity	Exposure	Mixing	Residence time
CW – NEA1	Exposed euhaline shallow	Fully saline (>30)	Mesotidal (1-5m)	Shallow (<30m)	Medium (1-3 knots)	Exposed	Fully mixed	Days
CW – NEA2	Sheltered euhaline shallow	Fully saline (>30)	Mesotidal (1-5m)	Shallow (<30m)	Medium (1-3 knots)	Sheltered	Fully mixed	Days
CW – NEA6	Shallow fjordic type	Fully saline (>30)	Mesotidal (1-5m)	Shallow (<30m)	low (<1 knot)	Sheltered	Fully mixed	Days
CW – NEA7	Deep fjordic type	Fully saline (>30)	Mesotidal (1-5m)	Deep (>30m)	low (<1 knot)	Sheltered	Fully mixed	Weeks - Months

6.6 Transitional waters have not been differentiated at the European level for the purposes of intercalibration. Hence all UK transitional water types are grouped.

6.7 Table 6.6 describes the results of this calibration process:

Table 6.6 Cross Reference List of European and UK (RoI) Types for Intercalibration

European Types	Description	UK (RoI) Types
NEA1	Exposed	CW1, CW2, CW3, CW4, CW5, CW6
NEA2	Sheltered	CW7, CW8
NEA6	Shallow Low current Sheltered	CW11
NEA7	Deep Low current Sheltered	CW12
TW		TW1, TW2, TW3, TW4, TW5

7.0 Future Research Requirements - Habitat Reference Conditions

7.1 During the biological validation process to test the proposed typology approach, it became clear that:

- the physical types were not ecologically valid when accounting for the diversity of the invertebrate and macroalgal communities (as tested using JNCC Marine Nature Conservation Review biotope data); and
- it was not possible to represent the diverse array of habitats within an estuary or sea area with one physical type due to the complex mosaic of marine habitats.

7.2 Because typology is the basis of defining reference conditions and an anchor for high status and classification, the consequence of adopting this or any other set of simple physical types is that reference conditions must cover a wide range of habitats within each type.

7.3 Therefore the concept of habitat specific reference conditions has been adopted to support:

- the development of appropriate reference conditions for each quality element. For example - the physical types to which phytoplankton communities relate will be different to those of invertebrates and macroalgae, with invertebrates and macroalgae relating more to substrate and phytoplankton to water column.
- The allocation of a series of appropriate reference conditions to each of the physical types.

Further research and development of type specific reference will be required.