

# UK Technical Advisory Group on the Water Framework Directive

## Guidance on Morphological Alterations And the Pressures and Impacts Analyses (Final Working Paper)

**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.**

<b>Working Paper Version:</b>	TAG2003WP7c (01) Draft guidance on morphological pressures (P2.v3-26.01.04).doc	<b>Status:</b>	Working Draft (edited for release)
<b>WFD Requirement:</b>	Article 5 report; risk & impacts assessment characterisation; morphology	<b>UKTAG Review:</b>	5 June 2003 TAG thresholds review 25/11/03

### 1.0 Aims and scope of this guidance

1.1 The aim of this document is to provide guidance on:

- (a) Pressures likely to cause alterations to the morphological conditions of surface waters;
- (b) Morphological data required for carrying out risk assessments for Article 5 analyses; and
- (c) Morphological pressure thresholds above which water bodies are considered to be at risk of failing the environmental objectives of the Water Framework Directive (WFD).

1.2 Whilst the Directive refers to 'hydromorphological elements' comprising both hydrological and morphological attributes, the scope of this document is restricted to morphology and, for rivers, 'continuity'. This guidance does not cover:

- (a) Situations where water body morphology has been changed for the purposes of habitat restoration, although it should be noted that such works should not be permitted if they lead to a reduction in ecological status; and
- (b) Hydrological issues.

### 2.0 Hydromorphology and the Water Framework Directive

2.1 The WFD describes hydromorphological elements as 'supporting the biological elements'. Each of the four surface water categories – rivers, lakes, transitional waters and coastal waters – are ascribed specific hydromorphological quality elements (Annex V).

2.2 Unlike the biological elements (e.g. for fresh waters: phytoplankton, macrophytes and phytobenthos, benthic invertebrates and fish) hydromorphological elements contribute to status classification only for water bodies at high ecological status (Annex V, 1.2). At good and at moderate ecological status, hydromorphological conditions are not defined but are to be 'consistent with the achievement of the values specified for the biological quality elements'. The morphological quality elements listed in Annex V are given in Table 1.

**Table 1:** List of morphological attributes for each of the four surface water categories in the WFD

<p><b>Rivers</b></p> <ul style="list-style-type: none"> <li>• River depth and width variation</li> <li>• Structure and substrate of the river bed</li> <li>• Structure of the riparian zone</li> </ul> <p><b>Lakes</b></p> <ul style="list-style-type: none"> <li>• Lake depth variation</li> <li>• Quantity, structure &amp; substrate of the lake bed</li> <li>• Structure of the lake shore</li> </ul>	<p><b>Transitional waters</b></p> <ul style="list-style-type: none"> <li>• Depth variation</li> <li>• Quantity, structure and substrate of the bed</li> <li>• Structure of the intertidal zone</li> </ul> <p><b>Coastal waters</b></p> <ul style="list-style-type: none"> <li>• Depth variation</li> <li>• Structure and substrate of the coastal bed</li> <li>• Structure of the intertidal zone</li> </ul>
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- 2.3 The requirement to consider connectivity between water bodies and the surrounding land will be covered by separate guidance. However, ‘river continuity’, whilst not one of the morphological attributes listed in the table, is listed in the Directive as a quality element and is therefore dealt with as part of this guidance document.
- 2.4 Surface water morphology is important not only for defining water bodies at high status, or for investigating possible reasons for water bodies that fail to reach good ecological status, it also has an important role to play in characterising and setting in place appropriate monitoring of ‘heavily modified’ and ‘artificial’ water bodies.
- 2.5 The principles set out in this guidance document are principally focused on two of the tasks described in Article 5 of the WFD: the characterisation of river basin districts; and a review of the impact of human activity on the status of surface waters.

This exercise is described in detail in Annex II of the Directive, with the aim of assessing ‘the likelihood that surface water bodies within the river basin district will fail to meet [their] environmental quality objectives....’ (Annex II, 1.5). To assist in this process of risk assessment, Annex II (1.4) lists potentially ‘significant anthropogenic pressures’, including ‘significant morphological alterations to water bodies’.

### 3.0 Definition of terminology used in this guidance

#### 3.1 Relevant environmental objectives

- Protecting, enhancing and restoring all natural surface water bodies with the aim of achieving good ecological status and surface water chemical status by 22<sup>nd</sup> December 2015;
- Protecting and enhancing all artificial surface water bodies with the aim of achieving good ecological potential and good surface water chemical status by 22<sup>nd</sup> December 2015;
- Protecting and enhancing the status of wetlands directly depending on aquatic ecosystems;
- Preventing deterioration of water bodies from one status class to another; and
- Achieving compliance with any water-related standards and objectives for Protected Areas by 22<sup>nd</sup> December 2015, unless another deadline is specified in the Community legislation establishing the Protected Area

#### 3.2 Pressure

*The proximate cause of any human-induced alterations to the morphological conditions needed to support the biological quality elements.*

### 3.2.1 Significant pressure

3.2.1.1 A pressure that on its own or in combination with other pressures and in the absence of suitable measures, including existing controls, is liable to cause a failure to achieve one or more of the Directive's environmental objectives.

3.2.1.2 In particular, significant pressures on surface water morphology include (a) any activity that causes a deterioration from high status [hydro]morphology to a lower status class, and (b) any activity that leads to [hydro]morphological conditions that prevent the achievement of good ecological status, or cause a decline in ecological status from one class to a lower one.

3.2.1.3 The term 'pressure' (and other terms such as 'impact' and 'activity') are often used to mean different things. For the purpose of this guidance, the 'DPSIR' model has been adopted, where:

**D = Driver                      P = Pressure                      S = State                      I = Impact                      R = Response**

An example of the DPSIR model relevant to morphological pressures is:

**Driver:** Fishery habitat management  
**Pressure:** River substrate manipulation  
**State:** Altered flow regime, deep pools where none previously occurred; changed chemistry  
**Impact:** Changes to taxonomic composition and productivity of aquatic biota  
**Response:** Initiating a programme of substrate reinstatement

### 3.2.2 Drivers likely to affect the morphology of surface waters

Drivers ('sectors' of human activity) with the potential for causing morphological change in surface waters are listed in Table 2. This document does not attempt to link the drivers in Table 2 with specific pressures listed in Tables 3-6, as each driver can be associated with more than one pressure, and each pressure can result from more than one driver.

**Table 2:** Drivers with the potential for causing pressures on surface water morphology

• Agriculture
• Coastal defence/protection
• Flood defence
• Forestry
• Freshwater fisheries (including habitat management)
• Infrastructure (e.g. construction and use of roads, railways, airports, bridges, ports, harbours)
• Marine fisheries and aquaculture
• Mining, quarrying and mineral extraction
• Navigation
• Other industry
• Past activity, present purpose undefined (e.g. mill lades)
• Power generation (incl. HEP, off-shore wind farms, tidal stream generation)
• Recreation
• Urban development
• Water supply and treatment

### 3.2.3 Pressures on the morphology of surface waters

3.2.3.1 Put simply, pressures on morphology are human activities that have adverse consequences on the features or processes of water bodies, rather than the artificial structures that are often used in association with the activities. For example, pressures on river morphology include 'impounding' and 'bank reinforcement', the former using structures such as sluices, weirs or dams, the latter using materials such as wood, sheet piling or concrete.

3.2.3.2 Specific pressures are listed for:

- Rivers (Table 3)
- Lakes (Table 4)
- Transitional waters (Table 5)
- Coastal waters (Table 6).

**Table 3:** Specific pressures on the morphology of rivers

Specific pressures	Description
River substrate manipulation	Removal of silt and/or substrate from a river channel – includes dredging for navigation, for creating on-line ponds and for fisheries enhancement e.g. pool creation; addition of gravel for spawning areas
Bed and bank reinforcement	Strengthening of river beds for various purposes (e.g. ford construction, erosion control); flood protection using flood walls, embankments; bank protection using gabion baskets, boulders, sheet piling, wood, willow spiling, geotextiles, etc.
River resectioning	Reprofiling of bank-face, changes to gradient of channel bed, introduction of artificial substrate
River straightening	Engineering to produce ditch-like channels
River realignment	Removal of meanders: increase in channel gradient, flow velocity, flood capacity
River channelisation	Straightening, widening, and deepening of channel
Culverting	Complete enclosure of river channel, often impassable to fish
Flow manipulation	Placement of boulders, deflectors, etc. for redirecting pattern of water flow
Impounding	Backing-up of water through the construction of dams, weirs, sluices, fords, etc.
Construction	Building instream structures for a range of purposes – structures include outfalls, jetties, piers, boat slipways, flood relief channels, flood storage areas, bridge supports
Intensive use	Grazing, removal of riparian vegetation, management of riparian vegetation, poaching, erosion from boat traffic
Removal of natural barriers	Removal of waterfalls and other instream natural barriers, usually to permit upstream fish migration
Modifications to sediment regime	Poor catchment land management leading to increases in sediment and water run-off
Floodplain modification	Construction of flood banks limiting channel and floodplain interactions

**Table 4:** Specific pressures on the morphology of lakes

Specific pressures	Description
Bank construction and reinforcement	Flood or erosion protection using flood walls, embankments; bank protection using gabion baskets, boulders, sheet piling, wood, willow spiling, geotextiles, etc.

Channelisation of inflows and outlets	Straightening, widening, and deepening of channel at approach to river mouths and outlets
Impounding	Backing-up of water through the construction of dams, weirs, sluices, fords, etc.; artificial water level regime
Lowering/drainage	Lowering by cutting outlet, often for land claim
Construction	Building structures for a range of purposes – structures include outfalls, jetties, piers, boat slipways, bridge supports
Intensive use	Grazing, removal of riparian vegetation, management of riparian vegetation, poaching, erosion from boat traffic
Intensive macrophyte management	Removal or excessive growth of macrophyte beds in littoral/sublittoral areas.
Modifications to sediment regime	Poor land management leading to increases in sediment and water run-off

**Table 5:** Specific pressures on the morphology of transitional waters

Specific pressures	Description
Land claim	Enclosure of intertidal or subtidal areas within impermeable banks followed by infilling for use by agriculture, housing, port, industry, waste disposal or other use.
Bank reinforcement	Flood protection, erosion control or other bank elevation or strengthening using flood walls or embankments; bank protection using gabion baskets or blankets, boulders, sheet piling, wood, geotextiles, etc.; road embankments
Tidal river resectioning	In upper estuaries, where channel remains river-like, reprofiling of bank-face, changes to gradient of channel bed, introduction of artificial substrate
Channel dredging	Removal or displacement of substratum by dredging or related techniques to create a new channel, to maintain navigation or flood conveyance, or for aggregate extraction
Deposition of material	Deposit of dredged sediments or other material onto intertidal or subtidal bed for purposes of disposal or beach nourishment or beach feeding
Tidal river channelisation/realignment/straightening	In upper estuaries, where channel remains river-like, straightening, widening, and deepening of channel, removal of meanders to increase channel gradient, flow velocity, flood capacity
Flow manipulation	Placement of boulders, deflectors, training walls, etc. for redirecting pattern of water flow
Impounding	Backing-up of water through the construction of barrages, weirs, sluices, fords, etc.
Construction	Building intertidal and subtidal structures for a range of purposes – structures include outfalls, jetties, piers, sea-locks, boat slipways, bridge supports, causeways
Intensive use	Grazing on saltmarsh, poaching, reed-bed management, erosion from boat traffic
Manipulation of sediment transport	Placement of piers, groynes and breakwaters for controlling sediment distribution.
Modifications to sediment regime	Poor land management leading to increases in sediment and water run-off
Fishing	Damage to benthic habitats by the use of bottom fishing gear e.g. scallop dredging, suction and hydraulic dredging, benthic trawling

**Table 6:** Specific pressures on coastal water morphology

Specific pressures	Description
Land claim	Enclosure of intertidal or subtidal areas within impermeable banks followed by infilling for use by agriculture, housing, port and harbour, industry, waste disposal or other use.
Shoreline reinforcement	Flood protection, erosion control or other shoreline elevation, stabilisation or strengthening using flood walls or embankments;

	shoreline protection using gabion baskets or blankets, boulders, sheet piling, wood, geotextiles, boulders etc.; road embankments
Dredging	Removal or displacement of substratum by dredging. To maintain navigation channel depths at ports and harbours, or for acquisition of capital material i.e. aggregate extraction.
Deposition of dredged material/Spoil dumping	Deposit of dredged sediments onto intertidal or subtidal bed for purposes of disposal or beach nourishment or beach feeding
Manipulation of sediment transport	Placement of piers, groynes and breakwaters for controlling sediment distribution.
Construction	Building intertidal and subtidal structures for a range of purposes – structures include outfalls, jetties, piers, oil and gas pipelines, sea-locks, boat slipways, bridge supports, barrages, causeways, wind farms and tidal energy devices.
Fishing	Damage to benthic habitats by the use of bottom fishing gear e.g. scallop dredging, suction and hydraulic dredging, benthic trawling.

#### 4.0 Datasets and data sources

4.1 Annex 1 to this document contains a set of tables to assist those carrying out risk assessments. These identify datasets and data sources relevant to assessing the morphological features of:

- Rivers (refer Table A1.A in Annex 1)
- Lakes (refer Table A1.B in Annex 1)
- Transitional waters (refer Table A1.C in Annex 1); and
- Coastal waters (refer Table A1.D in Annex 1).

#### 5.0 Risk assessment

5.1 The remit of the drafting group preparing this guidance comprises the following task specific to the risk assessment exercise:

*‘To identify consistent thresholds in relation to (i) the magnitude of a pressure; and (ii) observed or predicted changes in the morphological conditions for helping to decide if water bodies, or groups of water bodies, should be identified as being at risk of failing to achieve the Directive’s environmental objectives.’*

5.2 Guidance is provided specifically for:

- Rivers (Section 5.5)
- Lakes (Section 5.6)
- Transitional and Coastal Waters (Section 5.8)

5.3 For each surface water category, the following are provided:

- (a) A risk assessment table identifying:
- Specific pressures
  - Severity of pressure
  - Measures attributes
  - Morphological criteria for high/good status boundary
  - Morphological criteria for good/moderate boundary
  - Morphological criteria for identification of provisional HMWB
  - Relevant datasets

- (b) For rivers and lakes – a screening level risk threshold method is also provided to support initial characterisation in 2004
- (c) For rivers, lakes and transitional waters – a map-based screening level risk threshold approach is also defined.

#### **5.4 Assumptions/Limitations to the proposed approach**

##### ***Data availability***

- 5.4.1 There is currently only limited data available within the UK on the extent of morphological alterations to rivers, lakes, transitional and coastal waters. The most detailed level information is available from monitoring information. The majority of quality assured monitoring data is for rivers. This only covers a small proportion of the UK river network, and the density of coverage varies across the UK.
- 5.4.2 Techniques for describing and assessing surface water morphology are not well developed except for rivers where River Habitat Survey (RHS) is now a standard procedure. In addition, the relationships between specific morphological features and their associated biota are often poorly understood. This means that determining the effect that a specific pressure on morphology will have on 'biological elements' inevitably relies to a large extent on expert judgement.
- 5.4.3 The member agencies of UKTAG also intend to use the knowledge of their local experts to help identify significant morphological alterations. The assessment framework will guide how this often quite detailed local knowledge will be applied.

##### ***Risk assessment tables***

- 5.4.4 The assessment framework provides sets of rules and threshold criteria for use in interpreting available data and knowledge on morphological alterations to surface water bodies. For rivers and lakes, these rules and threshold criteria have been used to develop a screening approach. The screening approach has been used in Scotland, where more detailed data is often absent. The screening approach uses Ordnance Survey 1:50,000 scale mapped data or, where available, aerial photography. For the screening approach, the threshold criteria have been set deliberately high to take account of the difference between what may be indicated by national map-based data sets and the reality on the ground. The intention is to ensure that alterations identified through the screening process are highly likely to cause a water body to fail to achieve good status.
- 5.4.5 It is important to note that some alterations that do not exceed the thresholds may present a risk to the achievement of good status. It has not been possible with existing data to identify all alterations that may pose a risk to the achievement of good status. Further data will be collected and the initial results reviewed later in the planning cycle.
- 5.4.6 The risk assessment tables attempt to provide a comprehensive treatment of pressures and their impacts for each surface water category. For any one water body, the range of pressures encountered will be far smaller. Where water body morphology is affected by several pressures, interactions between them should be considered.

For example, manipulating flow regimes by placing boulders in rivers may exacerbate the erosive effect of increased sediment transport caused by poor land-management. In Tables 7-10 each pressure is assigned a level of severity ('minor', 'intermediate', or 'major'). These are intended only as general guidance. As the severity of pressures will vary across the range of water body types site-specific assessment is essential.

5.4.7 The extent to which pressures interact or reinforce each other also depends on scale and timing. Some pressures on rivers and lakes, for instance, operate at the scale of entire catchments (e.g. the effects of conifer afforestation on run-off patterns) whereas the effects of others (e.g. short lengths of river bank protection) are spatially restricted. In some cases pressures are seasonally limited (e.g. the management of aquatic vegetation in lakes) whereas others (e.g. the presence of piers or jetties) are permanent.

5.4.8 Each risk assessment should include an estimate of confidence, although mathematical measures of confidence in assessing risks to water body morphology cannot be made. Factors such as the age of data, the reliability and suitability of particular methods, and the coverage of survey sites within a water body can all affect the level of confidence in any given risk assessment. Variability in the response of different water body types to morphological change, and the uncertainty in the links between morphological features and biota will also limit certainty in risk assessment.

## 5.5 Risk assessment approaches to Rivers

5.5.1 The following sections provide guidance on three approaches to the assessment of the risks from morphological alterations to river water bodies. The approach followed will depend on the nature and extent of existing data.

- Where River Habitat Survey Data is available, the criteria described in section 5.5.2 will be used to assess the risk of a river water body failing to achieve good status;
- Where RHS data are not available, the criteria set out in Table 7 will be used when making judgements on whether a river water body is at risk of failing to achieve good status;
- Where a simple screening approach is necessary because there are limited data on morphological alterations, a map-based approach (see Table 8) may be used. The criteria for this approach are derived from those set out in Table 7.

### 5.5.2 Risk Assessment approach using RHS data

5.5.2.1 The revised version of Habitat Modification Score (HMS) used in RHS 2003 should be applied as follows:

HMS Score	Status
0-2	high status (morphologically)
3-8	likely to have morphological conditions consistent with good ecological status
> 8	likely to have morphological conditions that would lead to a failure to achieve good ecological status
> 21	likely to be identified as a provisional Heavily Modified Water Body

- (a) Where RHS data are available at a frequency of at least one site every 2 km RHS data alone should be used where appropriate.
- (b) RHS data at lower spatial frequencies along the length of a river reach (water body) may be used to characterise the water body, but the confidence in the risk assessment will be lower.
- (c) Use RHS data in conjunction with other sources of information (e.g. maps, local knowledge) both to increase confidence in the risk assessment and to assess other pressures that RHS does not cover adequately.
- (d) Table 7 should be consulted as an adjunct to RHS (e.g. for pressures that RHS does not cover).

5.5.3 Where RHS data is not available, Table 7 should be used as the basis for risk assessment for rivers.





**Table 7: Risk assessment table: pressures and threshold criteria for rivers**

Pressure Code	Specific pressures	Severity of pressure	Measured attribute	Morphological criteria for high/good boundary	Morphological criteria for good/moderate boundary	Morphological criteria for identification of provisional HMWB	Relevant datasets
R1	River substrate manipulation	Intermediate.	Proportion of natural substrate removed Proportion of unnatural/artificial substrate introduced	<5% of river bed manipulated	<15% of bed with artificial substrate (AR in RHS)	>50% of bed with artificial substrate (AR in RHS)	RHS, Fluvial audit, fishery habitat surveys
R2	Bed and bank reinforcement	Intermediate	Proportion of bank length affected	<5% of either bank affected, no critical areas affected.	<15% of either bank affected	>60% of either bank affected	OS maps RHS FDMS (England & Wales only) Local Authorities (Scotland)
R3	River resectioning	Intermediate	1. Proportion of bank length affected 2. Proportion of channel length affected	1. <5% of length affected on either bank 2. <5% channel length affected	1. <15% of length affected on either bank 2. <15% of channel length affected	1. >60% of length affected on either bank 2. >60% of channel length affected	OS maps RHS FDMS (England & Wales only) Local Authorities (Scotland)
R4	River straightening	Major	Proportion of river length affected	<5% of river length affected	<15% of river length affected	1. >50% of river length affected	OS maps RHS FDMS (England & Wales only) Local Authorities (Scotland)
R5	River realignment	Major	Proportion of river length affected	<5% of river length affected	<15% of river length affected	>50% of river length affected	OS maps RHS FDMS (England & Wales only) Local Authorities (Scotland)
R6	River channelisation	Major	Proportion of river length affected	<5% of river length affected	<15% of river length affected	>50% of river length affected	OS maps RHS FDMS (England & Wales only) Local Authorities (Scotland)
R7	Culverting	Major	Presence and passability of culverts	No culverts present	No culverted sections for land gain; no impassable culverted crossings	>30% of length culverted (impassable)	OS maps RHS FDMS (England & Wales only) Local Authorities (Scotland)
R8	Dredging	Major	Length of channel affected	No dredging	<15% of channel length affected, no critical sections affected	>30% of channel length affected	FDMS (England & Wales only) Local Authorities (Scotland) British Waterways
R9	Flow manipulation	Major	Artificially placed structures	No more than one artificially placed structure per km. No intermediate or major structures (RHS manual 2003)	Fewer than three artificially placed structures per km. No major structures (RHS manual 2003)	More than three artificially placed structures (intermediate or major: RHS manual 2003) per km	OS maps RHS FDMS (England & Wales only) Local Authorities (Scotland)
R10	Impounding	Major	Number and effect of impoundments	No impoundments	Main channel free of impoundments; if tributary channels impounded, <10% of water body area affected; no critical areas affected	Major impoundment present on water body	OS maps
R11	Construction	Intermediate.	Presence and nature of structures	No more than one structure per km. No intermediate or major structures (RHS manual 2003)	Fewer than three structures per km	More than three structures (intermediate or major: RHS manual 2003) per km	OS maps RHS Fluvial audit

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Pressure Code	Specific pressures	Severity of pressure	Measured attribute	Morphological criteria for high/good boundary	Morphological criteria for good/moderate boundary	Morphological criteria for identification of provisional HMWB	Relevant datasets
R12	Intensive use	Intermediate.	1. Proportion of river length with non-natural land cover. 2. Proportion of river length without effective buffer zones	1. >90% natural/near-natural buffer zones 2. >95% buffered against harmful land-use	1. >70% natural/near-natural buffer zones 2. >90% buffered against harmful land-use	1. >70% intensive land-use 2. >50% harmful land-use	OS maps Land cover datasets RHS
R13	Floodplain modification	Intermediate	Presence and extent of flood banks	No flood banks	<15% of floodplain active	<5% of floodplain active	OS maps
R14	Removal of natural barriers	Intermediate	Integrity of natural barriers	All natural barriers intact	All natural barriers intact		Environment Agency (England & Wales) Fisheries Boards and Trusts (Scotland)
R15	Modifications to sediment regime	Intermediate	1. Rate of sediment accretion. 2. Proportion of habitat lost due to smothering	1. <10% increase 2. <5% habitat lost	1. <15% increase 2. <10% habitat lost	1. >50% increase 2. >50% habitat lost	FDMS (England & Wales only) CAMS (England & Wales only) Local Authorities

5.5.4.1 Where map-based screening approaches are used, the thresholds set out in Table 8 should be used.

**Table 8:** Screening criteria for identifying significant morphological alterations – Straightening and associated works

<b>Description: Straightening</b>	Map evidence of <b><u>unnaturally straight sections of river</u></b> If in doubt, assessments should be verified using aerial photographs or local knowledge. [Information on statutory land drainage and flood management schemes should also be used]
<b>Sensitivity</b>	<ul style="list-style-type: none"> <li>Exclude sections of rivers with gradients &gt; 0.04 (steep). Such rivers are often naturally straight;</li> <li>Exclude sections of rivers in gorges and other naturally narrow confined valleys. Such rivers are often naturally straight</li> </ul>
<b>Risk thresholds for river water bodies &gt; 4 km long</b>	> 25% straightened = Probably at Significant Risk > 50% straightened or > 5 km straight = At Significant Risk
<b>Risk thresholds for river water bodies &lt; 4 km long</b>	>1 km straightened = Probably at Significant Risk >2 km straightened = at Significant risk
<b>Minor tributaries of a water body (i.e. tributaries with a catchment area &lt; 10 km<sup>2</sup>)</b>	30 % of total length of minor tributaries associated with a water body is straightened = probably at significant risk 60 % of total length of minor tributaries associated with a water body is straightened = at significant risk
<b>Notes</b>	In estimating cumulative lengths in relation to the above thresholds, lengths of less than 1 km should be ignored as map interpretation becomes unreliable for short stretches of river

<b>Description: Embankment</b>	Map evidence of <b><u>embankments likely to affect the structure and condition of the riparian zone or indicate the presence of other morphological alterations</u></b> If in doubt, assessments should be verified using aerial photographs or local knowledge. [Information on statutory land drainage and flood management schemes should also be used]
<b>Sensitivity</b>	<ul style="list-style-type: none"> <li>Exclude sections of rivers with gradients &gt; 0.04 (steep). Embankments are likely to be rare on such rivers</li> <li>Exclude sections of rivers in gorges and other naturally narrow confined valleys. Such rivers are unlikely to be embanked</li> </ul>
<b>Risk thresholds for river water bodies &gt; 4 km long</b>	> 25% of length embanked = Probably at Significant Risk > 50% of length embanked or > 5 km of length embanked = At Significant Risk
<b>Risk thresholds for river water bodies &lt; 4 km long</b>	>1 km of length embanked = Probably at Significant Risk >2 km of length embanked = at Significant risk
<b>Minor tributaries of a water body (i.e. tributaries with a catchment area &lt; 10 km<sup>2</sup>)</b>	30 % of total length of minor tributaries associated with a water body is embanked = probably at significant risk 60 % of total length of minor tributaries associated with a water body is embanked = at significant risk
<b>Notes</b>	In estimating cumulative lengths in relation to the above thresholds, lengths of less than 1 km should be ignored as map interpretation becomes unreliable for short stretches of river

<b>Description</b>	Map evidence of <b><u>intensive land use likely to adversely affect the structure and condition of the riparian zone.</u></b> If in doubt, assessments should be verified using aerial photographs or local knowledge
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<b>Risk Threshold For river water bodies &gt; 4 km long</b>	> 30 % of length with adjacent intensive land-use = Probably at Significant Risk > 60% of length with adjacent intensive land-use or > 6 km length with adjacent intensive land-use = At Significant Risk
<b>Risk Threshold for river water bodies &lt; 5 km long</b>	>1.5 km with adjacent intensive land-use = Probably at Significant Risk >3 km with adjacent intensive land-use = at Significant risk
<b>Minor tributaries of a water body (Catchment area &lt;10km<sup>2</sup>)</b>	30 % of total length of minor tributaries associated with a water body has adjacent intensive land-use = probably at significant risk 60 % of total length of minor tributaries associated with a water body has adjacent intensive land-use = at significant risk
<b>Notes</b>	Map data only provides information on urban and forestry land-uses In estimating cumulative river lengths with adjacent intensive land-use in relation to the above thresholds, lengths of less than 1.5 km should be ignored as map interpretation becomes unreliable for short stretches of river

## 5.6 Risk assessment approaches to Lakes


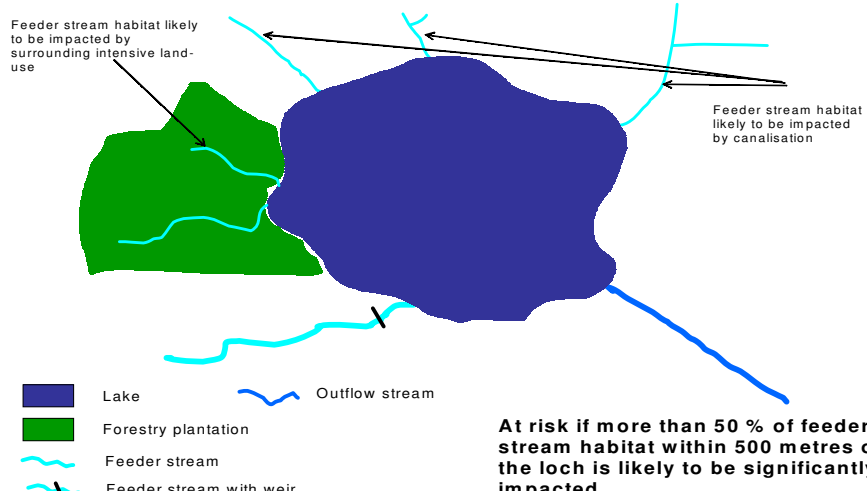
5.6.1 The following sections provide guidance on two approaches to the assessment of the risks from morphological alterations to lake water bodies. The approach followed will depend on the nature and extent of existing data.

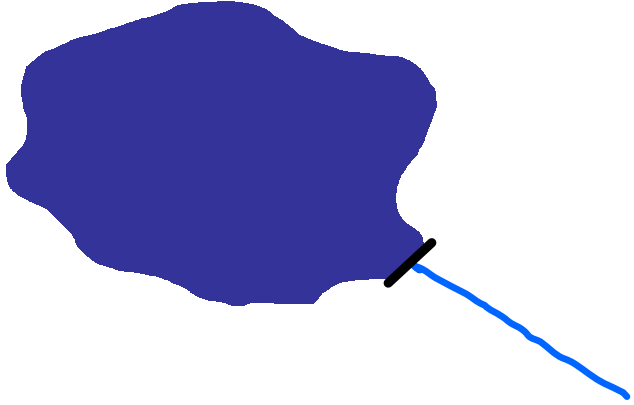
- Table 9 sets out detailed risk threshold criteria;
- Where a simple screening approach is necessary because there are limited data on morphological alterations, a map-based approach (see Table 10) may be used. The criteria for this approach are derived from those set out in Table 9.

**Table 9:** Risk assessment table: pressures and threshold criteria for Lakes

Pressure Code	Specific pressures	Severity of Pressure	Measured Attribute	Morphological criteria for high/good boundary	Morphological criteria for good/moderate boundary	Relevant datasets
L1	Bank construction and reinforcement	Intermediate	1. Proportion of shoreline length affected 2. Proportion of shoreline length affected by hard engineering vs. soft engineering	1. <10% length affected, no critical areas affected 2. <5% length affected by hard engineering	1. <20% length affected 2. <20% length affected by hard engineering	OS datasets (maps)
L2	Channelisation of inflows and outlets	Minor	1. % loss of spawning/nursery habitat 2. Proportion of shoreline length affected	1. <5% habitat lost 2. <5% shoreline length affected	1. <15% habitat lost 2. <15% shoreline length affected	OS datasets (maps)
L3	Impounding	Major	1. Height of impoundment 2. Regulatory capacity of impoundment (sluices, etc). 3. Degree of seasonality of level change. 4. Proportion of littoral exposed at drawdown	1. <Normal water level fluctuation 2. <Normal water level fluctuation 3. Matches seasonality +/- 0.5 month 4. <5% exposed	1. Greater than normal fluctuation by >1 m 2. Increases natural range by >1m 3. Matches seasonality by +/- 1 month 4. <10% exposed	OS datasets (maps) SEPA datasets (from June 2003 onwards) Reservoirs Act site lists(?)
L4	Lowering/drainage	Major	1. Reduction in surface area of lake 2. Reduction in depth 3. Relative changes in littoral/sublittoral/profundal areas	1. <5% reduction 2. <5% reduction 3. <5% change in area	1. <10% reduction 2. <10% reduction 3. <10% change in area	Historical maps and OS datasets Murray and Pullar (1910)
L5	Construction	Minor	1. Scale of structure vs. size of lake 2. Scale of structure vs. proportion of lake habitat lost/affected	1. No structure >5% by area plan view, no critical areas affected 2. No structure causing >5% loss of any one habitat type	1. no structure >15% by area plan view 2. no structure causing >10% loss of any one habitat type	OS datasets (maps) JNCC lake macrophyte database
L6	Intensive use	Intermediate	1. Proportion of lake shore with non-natural land cover 2. Proportion of lake shore without effective buffer zones	1. >90% natural/near-natural buffer zones 2. >95% buffered against harmful land-use	1. >70% natural/near-natural buffer zones 2. >90% buffered against harmful land-use	Land cover datasets (e.g. CS2000, MLURI LCS88, GEH, etc.) GB Lakes Inventory
L7	Intensive macrophyte management	Major	Proportion of available lake area colonised by macrophytes	> 90% colonised by type-specific species	>70% colonised by type-specific species	JNCC lake macrophyte database GB Lakes Inventory
L8	Modifications to sediment regime	Minor	1. Rate of sediment accretion at mouth vs. historical accretion rates 2. Rate of sediment accretion in profundal vs. historical accretion rates 3. Proportion of habitat lost due to smothering	1. <10% increase in accretion 2. <10% increase in accretion 3. <5% habitat lost	1. <20% increase in accretion 2. <20% increase in accretion 3. <10% habitat loss	Palaeolimnology studies (UCL, SEPA, SNH). University Departments (Geography, St Andrews)

**Table 10:** Screening Level assessment framework for lakes (map-based)

High risk activity	Description	Sensitivity	Threshold criteria
<p><b>(a) Intensive land use activities present on the lake shore</b></p>	<p>No discernable gap between the water edge and the intensive land-use (using OS 1:50,000 maps and land cover maps. May be validated by aerial photographs if available and time permits.</p>	<p>By lake size – threshold set as a proportion of lake perimeter</p>	<p><b>One or more intensive land-uses appear to impinge on &gt; 40 % of lake shore</b></p>  <p><b>At risk if one or more intensive land use impinges on around 40 % or more of the lake shore zone</b></p>
<p><b>(b) Morphological alterations to feeder streams</b></p>	<p>Feeder stream habitat significantly altered within 500 m of confluence with lake (see river criteria)</p>	<p>No differentiation</p>	<p><b>50 % of feeder stream habitat significantly altered (where feeder streams are very different sizes, give extra weight to larger streams)</b></p>  <p><b>At risk if more than 50 % of feeder stream habitat within 500 metres of the loch is likely to be significantly impacted</b></p>

High risk activity	Description	Sensitivity	Threshold criteria
<p><b>Impounding works on lake outlet</b></p>	<p>Presence of impounding works indicated on OS map</p>	<p>No differentiation</p>	<p><b>Probably at risk if a significant impounding works is identified. Clearly at significant risk if impounding works used for hydro-power generation</b></p>  <p> <span style="display: inline-block; width: 15px; height: 10px; background-color: blue; border: 1px solid black; margin-right: 5px;"></span> Lake  <span style="display: inline-block; width: 15px; height: 5px; background-color: black; border: 1px solid black; margin-right: 5px;"></span> Impounding works         </p> <p><b>Probably at risk if an impounding works is present. Clearly at risk if hydrological information suggests water level changes are likely to be &gt; 1 metre</b></p>

**5.7 Risk assessment approaches to Transitional and Coastal Waters**

5.7.1 The risk assessment approach to transitional and costal waters is undertaken via the assessment of the pressures in accordance with the threshold critiera and datasets in Table 11 and 12 respectively.



**Table 11: Risk assessment table: pressures and threshold criteria for transitional waters**

Pressure code	Specific pressures	Severity of pressure	Measured attribute	Morphological criteria high/good boundary	Morphological criteria good/moderate boundary	Relevant datasets
T1	Land claim	Major	1. Proportion of intertidal area affected 2. Effects on tidal range in rest of estuary	1. <5% affected, no critical areas affected 2. < 5% change in normal tidal range	1. <15% affected, no critical areas affected 2. < 15% change in normal tidal range	SNH coastal geomorphology audits, JNCC Estuaries Inventory, Admiralty Charts and OS maps, aerial photographs.
T2	Bank/shoreline reinforcement	Minor	Proportion of bank/shoreline length affected	<5% bank/shoreline length affected, no critical areas affected	<15% bank/shoreline length affected	SNH Coastal Cells in Scotland, Shoreline Management Plans, Local Coastal Partnership reports.
T3	Tidal river resectioning	Intermediate	1. Proportion of channel length affected 2. Alterations to tidal range	1. <5% of channel length affected 2. Matches normal expected tidal range	1. <5% of channel length affected 2. < 15% change in normal tidal range	FEPA Licensing records, Port and Harbour Authority records
T4	Channel dredging	Intermediate	1. Proportion of channel length affected (tidal rivers) 2. Proportion of water body area affected (estuaries)	1. <5% of channel length affected, no critical sections affected 2. < 5% of water body area affected, no critical areas affected	1. <15% of channel length affected, no critical sections affected 2. < 15% of water body area affected, no critical areas affected	FEPA licensing records, Port and Harbour Authority records
T5	Deposition of dredged material	Minor	1. Proportion of water body area affected through use as spoil grounds 2. Structure of substratum in deposition areas	1. <5% of area affected 2. Substratum changed over <10% of area of water body	1. <15% of area affected 2. Substratum changed over <15% of area of water body	FEPA licensing records, Port and Harbour Authority records, Site Condition Monitoring reports
T6	Tidal river channelisation/realignment/straightening	Major	Proportion of channel length affected	<5% of channel length affected	<15% of channel length affected	FEPA licensing records, Port and Harbour Authority records
T7	Flow manipulation	Intermediate	Naturalness of freshwater inflow and salinity mixing regime	Salinity mixing regime matches expected undisturbed	Salinity mixing regime displays features indicating disturbance of mixing regime	FEPA licensing records, environment agencies' data
T8	Impounding	Major	1. Number and effect of impoundments 2. Proportion of intertidal area lost due to increased water levels upstream	1. Main channel free of impoundments; if tributary channels impounded, <5% of water body area affected; no critical areas affected 2. <5% of intertidal areas lost due to raised water levels upstream of impoundments in tributaries	1. Main channel free of impoundments; if tributary channels impounded, <10% of water body area affected; no critical areas affected 2. <15% of intertidal areas lost due to raised water levels upstream of impoundments in tributaries	FEPA licensing records, JNCC Estuaries Inventory, Admiralty Charts and OS maps, aerial photographs. Local Coastal Partnership reports
T9	Construction	Intermediate (but scale-dependent)	1. Proportion of area directly affected by presence of structures 2. Naturalness of freshwater inflow and salinity mixing regime	1. <5% of area affected by structures (including impoundments) 2. Salinity mixing regime matches expected undisturbed	1. <15% of area affected by structures (including impoundments) 2. Salinity mixing regime displays features indicating disturbance of mixing regime	FEPA licensing records, detailed shoreline assessments and analogous studies, OS maps. SNH Causeways Report.
T10	Intensive use	Minor	Ratio of heavily grazed/ ungrazed or lightly grazed saltmarsh	1. >90% of saltmarsh ungrazed or lightly grazed	1. >70% of saltmarsh ungrazed or lightly grazed	Site Condition Monitoring reports and analogous studies
T11	Modifications to sediment regime	Minor	1. Rate of sediment accretion at mouth vs. historical accretion rates 2. Proportion of habitat lost due to smothering	1. <10% increase in accretion 2. <5% habitat lost	1. <15% increase in accretion 2. <10% habitat lost	Site Condition Monitoring reports, comparisons of aerial photographs, SNH coastal geomorphology audits and site-specific academic studies (e.g Ythan Estuary)
T12	Fishing	Major	Area of subtidal bed affected	<5% of subtidal bed area affected	<15% of subtidal bed area affected	FRS/CEFAS fishing intensity maps, DARD data (?), Site Condition Monitoring reports

**Table 12: Risk assessment table: pressures and threshold criteria for coastal waters**

Pressure Code	Specific pressures	Severity of pressure	Measured attribute	Morphological criteria for high/good boundary	Morphological criteria for good/moderate boundary	Relevant datasets
C1	Land claim	Minor	1. Proportion of intertidal rock or beach area affected 2. Effects on tidal currents and sediment transport along coastline	1. <5% of area affected, no critical areas affected 2. <5% change in tidal current speed/direction	1. <15% of area affected, no critical areas affected 2. <15% change in tidal current speed/direction	SNH coastal geomorphology audits, JNCC coastal directories, Admiralty Charts and OS maps
C2	Shoreline reinforcement	Minor	Proportion of coastline length affected	<5% coastline length affected, no critical areas affected	<15% coastline length affected, no critical areas affected.	SNH Coastal Cells in Scotland, Shoreline Management Plans, Local Coastal Partnership reports.
C3	Dredging	Intermediate	Area of seabed affected	<5% of seabed area affected, no critical areas affected	<15% of seabed area affected, no critical areas affected	FEPA licensing records, Admiralty Charts.
C4	Deposition of dredged material/spoil dumping	Intermediate	1. Area of seabed affected 2. Structure of substratum	1. <5% of seabed area affected 2. Substratum changed over <5% of area	1. <15% of seabed area affected 2. Substratum changed over <15% of area	FEPA licensing records, Admiralty Charts
C5	Manipulation of sediment transport	Minor	Continuity of sediment transport processes	No substantial interruptions to sediment transport.	Enhanced erosion/ accretion due to interruptions in sediment transport	Detailed shoreline assessments and analogous studies, maps, aerial photographs
C6	Construction	Intermediate	1. Proportion of area directly affected by presence of structures 2. Effects on tidal currents and sediment transport along coastline	1. <5% of area affected by structures 2. <5% change in tidal current speed/direction; no or only minor interruptions to sediment transport	1. <15% of area affected by structures. 2. <15% change in tidal current speed/direction; no substantial interruptions to sediment transport	FEPA licensing records, detailed shoreline assessments and analogous studies, maps
C7	Fishing	Intermediate	Area of seabed affected	<5% of seabed area affected	<15% of seabed area affected	FRS/CEFAS fishing intensity maps, DARD data (?), SNH Site Condition Monitoring reports, University research

**ANNEX 1****Datasets and data sources for morphological assessments of rivers, lakes, transitional waters and coastal waters****Table A1.A Datasets and data sources for rivers**

<b>Data set/source</b>	<b>Geographic spread</b>	<b>Data ownership/ accessibility</b>	<b>Data Quality</b>	<b>Time scale/ periodicity</b>	<b>Utility of data for what is being monitored</b>
River Habitat Survey	UK 20,000 sites	Environment Agency (Warrington)	Good – quality reviewed	Mainly one-off – some repeat survey. From 1994 to present	Habitat and physical characteristics of river reaches (500 m)
Flood Estimation Handbook CD ROM	GB-wide	CEH Wallingford EA owns licence	Good	One-off (1990s)	Physical catchment characteristics (for Qmed estimation). Requires manual extraction but project underway for batch extraction
LEAPs	England and Wales	EA	Good	Mid-1990s one-off	General catchment characteristics and management needs
CFMPs	England and Wales – four pilot catchments	EA	Good	One-off 2002-03	Coarse catchment-scale physical characteristics of river network
FDMS (Flood Defence Management System)	England and Wales (sporadic)	EA	Mixed (quantity and quality)	Data from early 1990s	EA region-based system for managing Flood Defence assets
Flood Defence/Risk data	Scotland (sporadic)	Local Authorities	Mixed (quantity and quality)	Data from early 1990s	Location of flood defence assets for maintenance/management
Maps	GB	Ordnance Survey	Good	mid-1800s to present	Topographic catchment features
Aerial photography	GB	Various – getmapping.com, Cambridge University, EN, CCW, SNH	Good	1940s to present	River channel and floodplain geomorphological features Modifications to rivers (dams, embankments etc)
Fluvial audits	England and Wales – ad-hoc catchment basis	EA	Good	One-off	Detailed catchment-scale geomorphological assessment
Catchment Baseline Assessments	England and Wales – ad-hoc catchment basis	EA	Good	One-off	Coarse-scale catchment-wide geomorphological assessment
LIDAR	GB – variable coverage	EA Twerton Scottish Executive	Average to good	mid-1990s collected on ad-hoc basis	Riparian and floodplain topographic data
IFSAR (Nextmap)	GB – variable coverage	EA Twerton Scottish Executive	Average to good	Late-1990s, 2001/02 collected on ad-hoc basis	Riparian and floodplain topographic data, elevation data
Fisheries habitat data, fisheries enhancements works	Scotland – variable coverage	Scottish Fisheries Coordination Centre (SFCC) Fisheries Research Service (FRS)	Average	1990s onwards	Habitat and physical characteristics of river reaches

**Table A1.B: Datasets and data sources for lakes**

Data set/source	Geographic spread	Data ownership/ accessibility	Data Quality	Time scale/ periodicity	Utility of data for what is being monitored
Murray and Pullar (1910)	Scotland	Available.	>100 years old, but recent in terms of lake change rates	One-off over ~10years	Probably still the best source of data for lake morphology
GB Lakes Inventory (2002)	All 43000 lakes on OS 1:50,000 in GB	EA/SEPA	Mixture of measured and modelled data	One-off, recent..	Most comprehensive dataset available – includes derived data from other sources listed here.
Land Cover datasets	Various available covering GB	CEH, MLURI, DEFRA?	variable	1988 - 2000	Best available for land cover
SEPA datasets (mid 2003 onwards)	Scotland	SEPA	Up to date, WFD specific	2003	Presents locations of all dams, intakes, tunnels etc from power generators, and abstraction/impoundment data from industries other than agriculture
EIA database	All-Scotland	Scottish Executive – in SE library – publicly accessible	Unknown	Annually updated?	Useful for assessment of development pressure in particular areas
Halcrow Water (2001) 'Sedimentation in Storage Reservoirs'. DETR report	GB	DETR	Literature review rather than original dataset	Mainly literature from 1980s to present	May be useful in helping to estimate rates of sedimentation in reservoirs

**Table C: Datasets and data sources for transitional waters**

Data set/source	Geographic spread	Data ownership/ accessibility	Data Quality	Time scale/ periodicity	Utility of data for what is being monitored
JNCC coastal directories	Whole GB coast	Published by JNCC – fully accessible	Peer-reviewed before publication	One-off exercise	General overviews for stretches of coasts or estuaries
JNCC Estuaries Inventory	All major estuaries on GB coast	Published by JNCC – fully accessible	Qualitative	One-off exercise, published in series up to 1994	Useful for qualitative information on historic land claim and other relevant activities up to 1994
FEPA licensing records	All UK coasts	Held by the devolved administrations – in Scotland, Fisheries Research Services on behalf of SEERAD	Good, quality procedures (to be confirmed)	Updated daily/weekly in response to new applications	Very useful, specific information on locations of specific developments. All are marine or coastal developments below Mean High Water Springs
EIA database	All-Scotland	Scottish Executive – in SE library – publicly accessible	Unknown	Annually updated?	Useful for assessment of development pressure in particular areas
Shoreline Management Plans	Statutory, all English and Welsh coastal local authorities. Voluntary in a few local authorities around Scottish Coast	Held by Local Authorities – in public domain	Probably variable but unquantified	Unknown	Useful local data on areas of coastal erosion and flooding, and existing and proposed erosion control and flood management works
SNH coastal geomorphology audits	All major Scottish firths, Western Isles (includes some transitional waters in WI)	Produced by SNH for Scottish major firths. Published by SNH	To SNH-specified standards	One-off exercise	Useful local data on areas of coastal erosion and accretion, and existing and proposed erosion control and flood management works
Local Coastal Partnership reports	Cover large percentage of Scottish coast	Public domain	Probably variable but unquantified	Probably one-off exercises in preparation of partnership strategies	General overviews for stretches of coasts or estuaries. May hold useful local data on existing and proposed erosion control and flood management works
Detailed shoreline assessments and analogous studies	Montrose, Aberdeen, Saltcoats and Western Isles (includes transitional waters)	SNH?	Unknown	Probably one-off exercises	General overviews for stretches of coasts and estuaries
Coastal Habitat Action Management Plans (CHaMPs)	Not applicable to Scotland at present	English Nature, NERC, Environment Agency and DEFRA	Unknown	1999 to 2003	Coastal Habitat Management Plans (CHaMPs) will provide a framework for managing European and Ramsar sites that are located on or adjacent to dynamic coastlines. They offer a long-term strategic view on the balance of habitat losses and gains likely to occur in response to 'coastal squeeze'
Port and Harbour Handbooks	Exist for Orkney and Shetland Islands. Other Ports???	Individual Port Authorities	Unknown	Annually updated?	Very useful, specific information on locations e.g. size of piers, jetties
Admiralty Charts, Historical maps, OS maps	All UK. Historical maps exist for some ports e.g. Aberdeen, Leith	Fully accessible	Good	Variable?	Very useful. Includes information on dredging, spoil dumping locations. Extent of port and other marine constructions also shown. General hydrographic information
Site Condition Monitoring reports	All-Scotland?	SNH	Unknown	One-off exercises?	Information on damage to benthic habitats from fishing activities
Fishing Intensity Maps	All-Scotland	FRS/CEFAS	Good?	One-off exercise?	General overview of fishing intensity around Scotland
University PhD and MSc geomorphological research projects	UK	Various universities	Good	Ongoing	Very useful, specific information on transitional water geomorphological processes. Useful local data
Remote sensing	UK	Environment Agency use CASI for pollution incidents e.g. Southampton Water. Scots Exec LIDAR survey of the Firth of Forth, Moray Firth? NERC Aerial photography Mastermap	Good	Ongoing projects, some one-off exercises	The existing data are available in various 'snippets' across the country rather than on a catchment scale. RS morphological data lacking to date (SEPA Remote Sensing Feasibility Study undertaken to assess the usefulness of RS to assess impacts from morphological modifications) Existing RS can be compared to admiralty charts/historical maps to see if changes to transitional water morphology have taken place

**Table D: Datasets and data sources for coastal waters**

## TAG Work Programme 2003 Task 7.c: Morphological Alterations

Data set/source	Geographic spread	Data ownership/ accessibility	Data Quality	Time scale/ periodicity	Utility of data for what is being monitored
NCC coastal directories	Whole GB coast	Published by JNCC – fully accessible	Peer-reviewed before publication	One-off exercise	General overviews for stretches of coasts or estuaries
EPA licensing records	All UK coasts	Held by the devolved administrations – in Scotland, Fisheries Research Services on behalf of SEERAD	Good, quality procedures (to be confirmed)	Updated daily/weekly in response to new applications	Very useful, specific information on locations of specific developments. All are marine or coastal developments below Mean High Water Springs
IA database	All-Scotland	Scottish Executive – in SE library – publicly accessible	Unknown	Annually updated?	Useful for assessment of development pressure in particular areas
Shoreline Management Plans	Voluntary in a few local authorities around Scottish Coast, Statutory in all English and Welsh local authorities	Held by local authorities – in public domain	Probably variable but unquantified	Unknown	Useful local data on areas of coastal erosion and flooding, and existing and proposed erosion control and flood management works
NH coastal geomorphology audits	All major Scottish firths, Western Isles (includes some transitional waters in WI)	Produced by SNH for Scottish major firths. Published by SNH	To SNH-specified standards	One-off exercise	Useful local data on areas of coastal erosion and accretion, and existing and proposed erosion control and flood management works
Local Coastal Partnership reports	Cover large percentage of Scottish coast	Public domain	Probably variable but unquantified	Probably one-off exercises in preparation of partnership strategies.	General overviews for stretches of coasts or estuaries. May hold useful local data on existing and proposed erosion control and flood management works
NH Coastal Cells in Scotland	All-Scotland	Fully accessible	To SNH-specified standards	One-off exercise	Useful data. Describes the various stretches of coastline which can be treated as independent or semi-dependent cells. Includes a description of the major coastal features and aspects of beach development
Detailed shoreline assessments and analogous studies	Montrose, Aberdeen, Saltcoats and Western Isles (includes transitional waters)	SNH?	Unknown	Probably one-off exercises	General overviews for stretches of coasts and estuaries
Coastal Habitat Action Management Plans (CHaMPs)	Not applicable to Scotland at present	English Nature, NERC, Environment Agency and DEFRA	Unknown	1999 to 2003	Coastal Habitat Management Plans (CHaMPs) will provide a framework for managing European and Ramsar sites that are located on or adjacent to dynamic coastlines. They offer a long-term strategic view on the balance of habitat losses and gains likely to occur in response to 'coastal squeeze'
Port and Harbour Handbooks	Exist for Orkney and Shetland Islands. Other Ports?	Individual Port Authorities	Unknown	Annually updated?	Very useful, specific information on locations e.g. size of piers, jetties
Admiralty Charts, Historical maps, OS maps	All UK. Historical maps exist for some ports e.g. Aberdeen, Leith	Fully accessible	Good	Variable?	Very useful. Includes information on dredging, spoil dumping locations. Extent of port and other marine constructions also shown. General hydrographic information
Site Condition Monitoring reports	All-Scotland?	SNH	Unknown	One-off exercises?	Information on damage to benthic habitats from fishing activities
Fishing Intensity Maps	All-Scotland	FRS/CEFAS	Good?	One-off exercise?	General overview of fishing intensity around Scotland
University PhD and MSc geomorphological research projects	UK	Various universities	Good	Ongoing	Very useful, specific information on coastal processes. Useful local data
Remote sensing	UK	EA use CASI for pollution incidents e.g. Southampton Water. Scots Exec LIDAR survey of the Firth of Forth, Moray Firth? NERC Aerial photography Mastermap	Good	Ongoing projects, some one off exercises	The existing data are available in various 'snippets' across the country rather than on a catchment scale. RS morphological data lacking to date (SEPA Remote Sensing Feasibility Study undertaken to assess the usefulness of RS to assess impacts from morphological modifications) Existing RS can be compared to admiralty charts/historical maps to see if changes to coastal morphology have taken place

NB: In addition to the above data sources LCM2000 (from Countryside Survey 2000) provides an up-to-date, UK-wide coverage of land cover, based on satellite imagery. For Scotland, LCM88, interpreted from aerial photography, provides a detailed land cover map for Scotland. LCM2000 is available under licence from CEH, LCM from MLURI