

Setting GEP and MEP targets in Navigable Water Bodies using the 'Alternative Approach'

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Section 1: Introduction

The EU Water Framework Directive recognises that certain human uses depend on the physical modification of water bodies and provision is made to amend ecological targets accordingly. Instead of 'good ecological status' (GES), the ecological target for heavily modified water bodies (HMWB) and artificial water bodies (AWB) is 'good ecological potential' (GEP). According to the Directive, GEP is to be derived from maximum ecological potential (MEP) - the maximum ecological quality that could be achieved without adversely affecting the specified use of the water body.

Discussions at EU level have identified that, for the first round river basin management plans (RBMP) at least, there may be insufficient information available to enable the setting of GEP targets using the procedure envisaged in the Directive. A so-called 'alternative approach' to identifying GEP based on an assessment of potential mitigation measures has therefore been agreed by EU Member States.

An important principle underpinning this alternative approach is the need to 'do the best you can for ecology given the use' (of the water body). As both ecological characteristics and hydromorphological processes vary considerably between estuaries, the identification of appropriate mitigation measures is necessarily a site-specific exercise. It thus makes sense to ensure that relevant stakeholders are properly involved in the identification and evaluation of potential mitigation measures.

In this spirit, SNIFFER asked the ports sector to participate in the preparation of a guidance document designed to assist in the process of identifying GEP-MEP targets for transitional and coastal (TraC) water bodies used for commercial navigation. An important part of this project was a stakeholder workshop involving port industry representatives, port and navigation regulators, the WFD competent authorities and relevant conservation agencies. The outputs of this workshop, which was held in February 2007, have contributed in large part to the preparation of this guidance document.

Section 2: Workshop Scope and Key Findings

A water body may be designated as a HMWB because of the hydromorphological effects of port or navigation infrastructure and/or those associated with ongoing activities, for example:

- reclamation
- structures (eg. breakwaters, training walls, quay walls, bank stabilisation)
- dredging
- disposal of dredged material

Vessel movement may also contribute to deterioration or failure to achieve good status (eg. due to boat wash/bank erosion or bed disturbance). However, it is important to note that boat wash is unlikely to be an issue in large estuaries other than with certain types of vessel (eg. high speed ferries) and that bed disturbance is similarly unlikely to be significant in dredged navigation channels and berths.

The workshop also discussed the following potential pressures associated with TraC navigation uses, but concluded that these need not be taken forward to the next step of identifying and assessing mitigation measures for the reasons shown:

- impoundments (no significant port or commercial navigation-related impoundments were identified in TraC waters in England or Wales)

- channel straightening (in TraC waters, such works in fact comprise some combination of dredging and/or bank stabilisation and/or reclamation - all of which are already included in the above list)
- maintenance of port infrastructure (with the exception of maintenance dredging and disposal which are addressed separately, no examples of maintenance works being of sufficient scale to affect water status were identified)

Workshop participants discussed a wide range of potential mitigation measures for the five agreed pressure types and drew broad, generic conclusions about their potential applicability (technical feasibility, effectiveness at delivering ecological improvements, cost-effectiveness, etc.). **These discussions underlined the vital importance of considering both pressure (ie. the cause and effect relationship) and the applicability of potential measures at a site-specific level.** They also concluded that, insofar as potential mitigation measures are concerned, the effects of reclamation and other structures are broadly similar: henceforth reclamation and structures are therefore treated as a single category.

Section 3: Using Mitigation Measures to set GEP Targets

3.1 Guiding principles

As indicated above, the 'alternative approach' uses mitigation measures to define GEP and MEP targets.

The workshop highlighted a number of important factors which need to be borne in mind when applying this approach to determine GEP and MEP. These are summarised below:

- When identifying mitigation targets for HMWBs in the first round RBMPs, the focus should be on addressing clearly significant adverse impacts. In this regard, the acknowledged lack of data available to inform the setting of GEP in many TraC water bodies reinforces the need for *careful differentiation between 'real' and 'perceived' issues.*
- In most TraC water bodies, port infrastructure/navigation activities will be one of a number of hydromorphological pressures. In making decisions about the current hydromorphological status of water bodies and hence the possible need for prevention or mitigation measures, the competent authority will also have to take into account other pressures such as flood defences, recreational use, commercial fisheries, aggregate extraction, etc. The competent authority will similarly have to consider whether a pressure is actually causing an impact and which physical modifications are threatening the achievement of WFD objectives. In other words, *the contributory hydromorphological pressures will need to be properly identified before decisions are taken on the need for/apportionment of measures.*
- The significance of impacts may differ substantially between ports/water bodies: a *site-specific assessment* of the technical (and economic) appropriateness of *individual measures will therefore be necessary.*
- *Many potential adverse impacts, notably those associated with ongoing navigation activities, are already mitigated.* It is important to recognise that (in the first river basin planning cycle at least) it is unlikely to be practical to try to 'fine tune' mitigation measures which are already in place unless the environmental benefits of so-doing are clear and substantial.
- There are likely to be *potentially important differences between* the delivery of measures to mitigate the effects of *ongoing activities* (such as dredging and disposal or vessel movement) *and* those required to deal with *so-called*

'legacy issues' (ie. where there is existing port or navigation infrastructure). This is discussed further in the box below.

Existing modifications

Existing modifications include structures such as breakwaters and training walls; reclaimed areas; and, in some cases, historic dredged channels (ie. channels which are no longer used or maintained). Such modifications are assumed to have been constructed in accordance with the consents and permission issued at the time, and any mitigation or compensation works which were required as conditions of these consents should have been completed. The development is thus 'finished' and there is currently no obvious legal route through which the original developer could be required to further modify the structure, reclamation, etc. Indeed, in some cases, the original developer may no longer be in existence.

The CIS hydromorphology guidance documents recognise such cases as 'legacy' issues. In simple terms, this means that although the modification may affect the ability of the water body to achieve its WFD objectives, there is no obvious 'owner' for the solution to the problem. So, whilst it might be possible to identify practicable mitigation or restoration measures for these hydromorphological pressures, it is not always clear who would be responsible for their delivery.

Ongoing hydromorphological modifications

The situation is somewhat different, however, when the hydromorphological modification is 'current'. In such instances (eg. maintenance dredging and disposal or vessel movement), the modification in question is an outcome of an ongoing activity that is, in turn, managed by a port or navigation authority. Where it is deemed that effects of such an activity have implications for water status (ie. for achieving good ecological potential), it may be possible to identify mitigation measures which could be implemented as part of the management process.

- Where more than one sector could contribute measures to achieving GEP, *the most cost-effective combination of measures will need to be identified*; subsequent work may be required to determine whether such a combination is likely to be disproportionately costly.
- There is *currently only a tenuous link between possible mitigation measures and the relevant classification schemes for assessing ecological status*. For example, there is no spatial component to the benthos classification. This means that this classification element is insensitive to the changes in habitat area or extent that may result from the implementation of certain mitigation measures. Again, this suggests that the first round RBMPs should give priority to identify 'essential' mitigation measures needed to deal with 'real' (ie. clearly substantiated) problems
- Article 4(7) of the WFD will apply where a proposed new hydromorphological modification is likely to affect water status. Whilst the toolbox of potential measures presented in Tables 1 and 2 (see Section 3.2 below) may well be of relevance in informing the choice of prevention or mitigation measures associated with such new modifications, it should be noted that additional measures might also need to be considered.

Against this background, the procedure described in Section 3.4 below is designed to allow a site-specific assessment to be made by those with the necessary knowledge and experience (typically the port or harbour authority) in a consistent, transparent and auditable way. **This procedure should be used to help set GEP-MEP targets only in situations where port infrastructure or navigation-related activities have been shown to represent a significant pressure in the water body, and where the mitigation measures currently in place are clearly inadequate.**

3.2 Identification of potential impacts

Prior to the workshop, information on pressures, impacts and mitigation measures for the navigation sector in TraC waters was collated from the following sources:

- CIS Guidance No 4 Identification and Designation of Artificial and Heavily Modified Water Bodies (Working Group 2.2, 2003) (Pressures categorisation)
- UKTAG Guidance on Morphological Alterations and the Pressures and Impacts Analyses. Final Working Paper, 2003 (Pressures categorisation)
- Good practice guidelines for ports & harbours operating in or near marine SACs (ABP Research, 2000) (Mitigation Measures)
- CIS Hydromorphology Project: Good practice in managing the ecological impacts of hydropower schemes; flood protection works; and works designed to facilitate navigation under the Water Framework Directive and associated case studies (Impacts and Mitigation Measures)
- TraC Scoping Study (Brooke, 2004) (Mitigation Measures)
- CRP Project 2c Costs Database (Entec, 2006) (Mitigation Measures)
- EU Vth Framework Project TRAPIST (Impacts)
- EU Vth Framework Project ECOPORTS Solutions Database (Mitigation Measures)
- EU NWE Interreg IIIb Project NEW Delta Theme 5 Cause- Effect Methodology (ABPmer (in prep) (Impacts)
- Green Blue Website Database (Mitigation Measures)

Annex 1 to this document summarises some of the main impacts thus identified, including both primary impacts (e.g. reduction in flow velocity) and secondary impacts (e.g. changes to water quality as a result of changes in flow; changes to habitats as a result of increased or reduced sediment deposition; etc). It also describes associated, potentially appropriate mitigation measures.

3.3 A toolbox of potential measures

Based on the outcomes of the workshop, and in order to support the process of identifying prevention and mitigation measures relevant to the commercial navigation sector, two tables illustrating potential measures have been prepared. These potential measures include pressure reduction measures, impact reduction measures (both in relation to direct and secondary impacts), and indirect/offsite measures (offsetting measures). In seeking to identify both generic approaches and detailed examples of specific measures, Tables 1 and 2 thus describe the full range of potentially effective measures for preventing or mitigating the impact(s) identified (ie. conceivably practical measures that might deliver some benefit and are hence relevant to setting MEP).

As indicated earlier, **port and harbour activities are already subject to a stringent licensing procedure and, as such, many measures may already be in place (to the extent that it is practical to do so)**. Further, additional measures may already be implemented as part of current good practice initiatives.

3.4 Adverse effects on use and/or on the wider environment

The potential applicability (or relevance) of any measure at a given site will be determined by a number of factors, all of which must be considered before a measure is confirmed. Two main categories of 'determining factors' need to be taken into account in establishing whether particular measures might have an adverse effect on use or on the wider environment, are:

- statutory duties and regulatory responsibilities of the port, harbour or conservancy authority
- site specific natural/physical conditions (also related practical considerations).

3.4.1 Statutory duties and regulatory responsibilities

Ports and navigation are governed by a variety of national and international legislative instruments and ensuring safety of navigation is an issue of paramount importance therein. In addition to the public right of navigation ('right of innocent passage') enshrined in the UN Convention on the Law of the Sea (UNCLOS), the International Convention for the Safety of Life at Sea (SOLAS) specifies minimum standards *inter alia* for the operation of ships compatible with their safety.

The local acts under which most UK port, harbour and conservancy authorities operate typically place a specific duty upon the authority to ensure safety of navigation. The Port Marine Safety Code in turn introduces a national standard for every aspect of marine safety, applying to all authorities to the extent that they have duties and powers relating to marine safety, and requiring them to apply the principles of risk assessment and safety management. In this respect, most ports already apply the ALARP principle (as low as reasonably practicable) which lies at the heart of the British Health and Safety system: indeed, 'reasonably practicable' is a key concept in the general duties of the Health and Safety at Work, etc. Act. 1974.

Several of the measures described in the tables, if applied inappropriately, could adversely impact on navigational safety and hence on use. As such, a careful assessment will be required to ensure that any measure is appropriate (ie. fit-for-purpose). The following examples illustrate this situation:

- whilst vessel traffic management is already practiced in most ports, specific measures to minimise underkeel clearance or to introduce fluid mud navigation are only likely to be appropriate in a very limited number of circumstances
- measures such as introducing speed limits can affect vessel manoeuvrability and hence safety
- any proposal to reduce the extent of dredging would require detailed assessment in order to avoid compromising navigational safety.

3.4.2 Site specific natural/physical conditions and associated practical considerations

Some of the measures listed in the tables will only work effectively in specific natural or physical conditions (ie. it is not a case of 'one size fits all'). Notwithstanding the safety issues discussed above, fluid mud navigation for example will clearly be limited to sites where the bed of the estuary has an adequate depth of an appropriate material. Measures designed to limit the resuspension of sediment may be neither appropriate nor necessary in a highly turbid estuary. Opportunities for habitat enhancement may be limited if the existing habitat in the vicinity is already of high value.

In addition to site-specific conditions, certain practical constraints can limit the applicability of some measures. For example, constraints on the timing of dredging activities can only be introduced if the type of dredger required to carry out the work is available at that time. Further, aspects such as the design of vessels is not usually within the remit of the port or harbour authority (indeed, it is more usual for ports and harbours to be responding to global changes in the design of vessels - for example, the growth in container ships).

Finally, in terms of establishing whether or not certain measures might have an adverse effect on the wider environment, it is worth bearing in mind that water-borne transport is generally regarded as being environmentally preferable to road transport. Thus, if a consequence of constraining dredging/navigation is modal shift (ie. a shift in the transport of the goods in question from water to road), there will be adverse effects on the wider environment (ie. air quality, noise, congestion, safety, quality of life).

The possible wider environmental consequences of measures such as re-oxygenation of the water column or fish/shellfish re-stocking similarly require assessment to ensure that the disbenefits (eg. in terms of carbon footprint of the former or the impact of capturing fish from elsewhere to support re-stocking) do not outweigh the benefits.

3.5 Proposed procedure for setting GEP at water body level

Given the wide variety of factors potentially affecting the applicability of measures in most transitional and coastal water bodies it will therefore be essential to ensure that the relevant port or navigation authority has the opportunity to carry out an appropriate (ie. proportionate)

site-specific assessment to support the setting of GEP and MEP targets. In order to ensure that such decisions are made in a consistent way, a standard procedure has been developed. For the commercial navigation sector, this procedure could potentially be embodied in a Code of Practice (ie. to be used not only to set GEP targets, but also to guide the future investigation and selection of site-specific prevention and mitigation measures and their inclusion in RBMPs where measures are required).

It is proposed that, where port infrastructure or navigation activities are identified by the competent authority (or by the river basin liaison panel) as causing significant adverse impacts, the port or navigation authority would be asked to complete the following screening procedure (Steps 1-4):

Step 1: For all situations

1. Determine whether the identified impact results from a 'legacy' development or from an ongoing activity

From this point on, there are potentially important differences between these two types of pressure. Steps 2 - 4 are therefore described separately in the following Boxes for ongoing activities (Box 1) and for legacy issues (Box 2).

In both cases, it should be noted that whenever a decision is made to *reject* certain measures, supporting information is likely to be required to justify this rejection. Such information will need to be proportionate rather than necessarily extensive: its purpose will simply be to support the decision. The provision of supporting information is essential if the setting of GEP is to be transparent and auditable.

Box 1: Proposed procedure for setting GEP for ongoing activities

Step 2: Identifying MEP for water bodies affected by ongoing activities

2. *Select all* measures from the lists in Table 1 which could potentially be appropriate given the physical characteristics of the water body and the nature of the impact identified (ie. measures which could be effective in terms of preventing deterioration or achieving an environmental improvement)
3. From these measures
 - a. *reject* those measures which would have an adverse effect on use (eg. due to safety of navigation implications), and
 - b. *reject* those measures which would have an adverse effect on the wider environment.
4. Where two or more of the measures then remaining on the list are 'interchangeable' (ie. they would deliver broadly the same outcome or improvement) *reject* the less appropriate and/or less effective and/or most costly measure(s)
5. At this stage, if all the prevention and mitigation measures remaining on the list were to be implemented, this would represent the port and commercial navigation sector's maximum contribution to ensuring that the water body's hydromorphological status is consistent with the local (ie. water body-specific) achievement of MEP

Step 3: Identifying GEP for water bodies affected by ongoing activities

6. For the measures remaining on the list, differentiate between those measures which are already implemented and those which are not
7. For measures which are already implemented, *highlight* those where strengthening of the existing measure would be likely to lead to a clear and substantial additional environmental benefit (ie. those which would make a significant contribution to dealing with the identified impact on water status)
8. For all other measures (ie. those which are not already implemented), *highlight* those where implementation would be likely to lead to a clear and substantial environmental benefit and *reject* those which would make only a marginal contribution to dealing with the identified impact on water status
9. Where two or more of the measures then remaining on the list are 'interchangeable' (ie. they would deliver broadly the same outcome or improvement) *reject* the less appropriate and/or less effective and/or most costly measure(s)
10. At this stage, if all the highlighted measures remaining on the list were to be implemented, this would

represent the port and commercial navigation sector's maximum contribution to ensuring that the water body's hydromorphological status is consistent with the local (ie. water body-specific) achievement of GEP

Step 4: Identifying potential measures for inclusion in the first (2009) river basin management plan

11. For the highlighted measures (ie. those identified as potentially contributing to the achievement of GEP)
 - a. *reject* those which would be disproportionately costly
 - b. *reject* those which would require a new delivery mechanism unless an appropriate mechanism seems likely to be in place by 2012 (ie. the deadline by which measures need to be operational)
 - c. *reject* those which would be technically infeasible given the prevailing site specific conditions
 - d. *consider rejecting* those where there remains significant uncertainty as to the cause and/or extent of the problem and where the potential consequences of doing nothing are not critical
12. At this stage, the remaining measures might be considered alongside measures derived by/for other sectors for inclusion in the first round river basin management plan (ie. to contribute towards achieving the 2015 target)

This procedure is also represented in the flowchart in Figure 1 [**to be prepared**].

The outcome of Step 2 of the proposed screening procedure for navigation-related activities essentially provides the list of measures that the commercial navigation sector might contribute to MEP. The outcome of Step 3 then provides the list of measures that the commercial navigation sector might contribute to GEP. However, at both these Steps it is important to remember that similar measures might be undertaken by another sector, and the most cost-effective combination of measures can only be determined after the range of possibilities has been assessed (by the competent authority and/or the liaison panel), *inter alia* taking into account distributional considerations.

Finally, Step 4 identifies the possible need for exemptions (ie. extended deadlines or less-stringent targets) on the basis of disproportionate cost or technical feasibility. These tests, which are part of the WFD's objective setting provisions, are used to prioritise the implementation of measures over successive planning cycles, thus ensuring that the pace of improvement is feasible and proportionate.

Box 2: Proposed procedure for setting GEP for legacy issues

Step 2: Identifying MEP for water bodies affected by legacy issues

2. *Select all* measures from the lists in Table 2 which could potentially be appropriate given the physical characteristics of the water body and the nature of the impact identified (ie. measures which could be potentially effective in terms of preventing further deterioration or achieving an environmental improvement)
3. From these measures
 - a. *reject* those measures which would have an adverse effect on use, and
 - b. *reject* those measures which would have an adverse effect on the wider environment.
4. Where two or more of the measures then remaining on the list are 'interchangeable' (ie. they would deliver broadly the same outcome or improvement) *reject* the less appropriate and/or less effective and/or most costly measure(s)
5. At this stage, if all the prevention and mitigation measures remaining on the list were to be implemented, this would represent an important contribution to ensuring that the water body's hydromorphological status is consistent with the local (ie. water body-specific) achievement of MEP

Step 3: Identifying GEP for water bodies affected by legacy issues

6. For the measures remaining on the list, *highlight* those where implementation would be likely to lead to a clear and substantial environmental benefit and *reject* those which would make only a marginal contribution to dealing with the identified impact on water status
7. Where two or more of the measures then remaining on the list are 'interchangeable' (ie. they would

deliver broadly the same outcome or improvement) *reject* the less appropriate and/or less effective and/or most costly measure(s)

8. At this stage, if all the highlighted measures remaining on the list were to be implemented, this would represent an important contribution to ensuring that the water body's hydromorphological status is consistent with the local (ie. water body-specific) achievement of GEP

Step 4: Identifying potential measures for inclusion in the first (2009) river basin management plan

9. For the highlighted measures (ie. those identified as potentially contributing to the achievement of GEP)
 - a. *reject* those which would be disproportionately costly
 - b. *reject* those which would require a new delivery mechanism unless an appropriate mechanism seems likely to be in place by 2012 (ie. the deadline by which measures need to be operational)
 - c. *reject* those which would be technically infeasible given the prevailing site specific conditions
10. At this stage, the remaining measures might be considered alongside measures derived by/for other sectors for inclusion in the first round river basin management plan

This process is also represented in the flowchart in Figure 2 [**to be prepared**].

The outcome of Step 2 of the proposed screening procedure for legacy issues essentially provides the list of measures required to contribute to MEP. The outcome of Step 3 provides the list of measures required to contribute to GEP. As with ongoing activities, it should be noted that similar measures might be undertaken by another sector. These should therefore also be considered, and the most cost-effective combination of measures determined (by the competent authority and/or the liaison panel), *inter alia* taking into account distributional considerations.

Step 4 then identifies the possible need for exemptions (ie. extended deadlines or less-stringent targets) on the basis of disproportionate cost or technical feasibility.

The key difference between the outcomes of the above procedure for legacy issues and the outcomes of the ongoing activities process relates to who has responsibility for delivery of the identified measures. As set out in Section 3.1 above, the measures identified as being required to deal with legacy issues will not necessarily be delivered by the commercial navigation sector: indeed, there may be no obvious delivery mechanism. For all 'legacy issues', the competent authority and/or the river basin district liaison panel will therefore need to agree which such measures are significant at RBD level (ie. those which need to be dealt with in the first round plans) and to make provision for the delivery of appropriate measures accordingly.

Situations in which the commercial navigation sector might have some role in the delivery of measures to deal with legacy issues include:

- 'win-win' solutions (eg. as part of a dredging and disposal strategy where a measure not only provides a solution to a (third party) legacy issue, but is also a more cost-effective option for the responsible authority)
- where a new development is going through the Article 4(7) process and the required mitigation (or offsetting) measures required under that process coincide with the measures required to deal with an identified legacy issue, or
- where a harbour authority already has a particularly strong environmental remit

In all other circumstances, responsibility for delivering the mitigation measures required to deal with legacy issues will need to be resolved by the competent authority and/or river basin liaison panel.

Section 4: Way Forward

It is intended that the procedure described herein will be finalised in the light of any comments received, and then submitted to UKTAG for approval/endorsement. Thereafter, it may be

appropriate to incorporate the procedure into a formal Code of Practice to be agreed between port and harbour authorities and the relevant WFD regulators. Overall compliance with this Code would be taken as delivering the requirements of the WFD in relation to GEP measures.

Table 1: Potential prevention or mitigation measures applying to ongoing port or navigation activities*

| | |
|--|--|
| <p>Maintenance Dredging</p> <p><u>Reduce need for dredging:</u></p> <ul style="list-style-type: none"> ▪ Minimise under-keel clearance ▪ Fluid mud navigation ▪ Flow manipulation or training works <p><u>Dredging strategy:</u></p> <ul style="list-style-type: none"> ▪ Little and often versus infrequent large scale ▪ Phasing of dredging ▪ Better forward planning <p><u>Reduce impact of dredging:</u></p> <ul style="list-style-type: none"> ▪ Dredge smaller area ▪ Dredge to shallower depth ▪ Choice of dredger type ▪ Minimise bucket release/use visor ▪ Silt curtains ▪ No overspill ▪ Manage overspill <p><u>Timing of dredging:</u></p> <ul style="list-style-type: none"> ▪ Seasonal restrictions ▪ Tidal restrictions <p><u>Sediment management:</u></p> <ul style="list-style-type: none"> ▪ Trickle recharge ▪ Sediment bypass ▪ Water column recharge <p><u>Indirect or offsite mitigation:</u></p> <ul style="list-style-type: none"> ▪ Construct training works ▪ Wave screen/protection ▪ Habitat enhancement ▪ Habitat creation ▪ Intertidal placement ▪ Structures to minimise erosion/slumping ▪ Reoxygenation of water column ▪ Fish/shellfish restocking | <p>Dredge Material Disposal</p> <p><u>Disposal site location:</u></p> <ul style="list-style-type: none"> ▪ Avoid sensitive locations ▪ New disposal to land <p><u>Disposal strategy:</u></p> <ul style="list-style-type: none"> ▪ Little and often vs infrequent large scale ▪ Better forward planning <p><u>Manage disturbance:</u></p> <ul style="list-style-type: none"> ▪ Confine disturbance ▪ Dispose over wider area ▪ Disposal method (e.g. trailer down pipe) ▪ Rate of disposal <p><u>Timing of disposal:</u></p> <ul style="list-style-type: none"> ▪ Seasonal restrictions ▪ Tidal restrictions <p><u>Indirect/offsite measures:</u></p> <ul style="list-style-type: none"> ▪ Habitat creation ▪ Habitat enhancement <p>Vessel Movement</p> <p><u>Modify channel</u></p> <ul style="list-style-type: none"> ▪ Deepen dredged channel ▪ Move/realign channel <p><u>Modify vessel design:</u></p> <ul style="list-style-type: none"> ▪ Shallower draft <p><u>Vessel management</u></p> <ul style="list-style-type: none"> ▪ Reduce vessel speed ▪ Traffic management <p><u>Indirect or offsite mitigation:</u></p> <ul style="list-style-type: none"> ▪ Habitat creation ▪ Habitat enhancement ▪ Construct wave protection ▪ Shore protection works |
|--|--|

* at water body level, such measures may already be implemented if it is appropriate to do so

Table 2: Potential mitigation measures applying to legacy issues

| | |
|--|--|
| <p>Existing structures/reclamation</p> <p><u>Modify structure/reclamation:</u></p> <ul style="list-style-type: none"> ▪ Remove obsolete structure ▪ Open piled jetties ▪ Culverts in breakwater ▪ Reduce wave reflection ▪ Increase wave absorption ▪ Environmentally friendly materials ▪ Environmentally friendly design ▪ Compensatory dredging <p><u>Flow manipulation</u></p> <ul style="list-style-type: none"> ▪ Structures to normalise flow ▪ Realign frontage | <p>Existing structures/reclamation (cont).</p> <p><u>Sediment management</u></p> <ul style="list-style-type: none"> ▪ Trickle recharge ▪ Water column recharge ▪ Sediment bypass ▪ Beneficial placement <p><u>Indirect or offsite mitigation</u></p> <ul style="list-style-type: none"> ▪ New training works ▪ Compensatory dredge ▪ Provide wave screen ▪ Bank protection ▪ Habitat creation ▪ Habitat enhancement |
|--|--|

Annex 1: Potential Impacts and Possible Mitigation Measures

i) Dredging: Potential Impacts and Possible Mitigation Measures

| Impacts | Generic Mitigation Measures | Specific Examples |
|---|---|---|
| Physical disturbance of bed from mechanical removal of sediment | Reduce extent of disturbance | Dredge smaller area; |
| | Choice of dredging strategy | Little and often versus large, infrequent dredging campaign; greater forward planning |
| | Timing of disturbance | Avoid sensitive seasons |
| Physical disturbance of bed from re-deposition of disturbed sediment | Extent of disturbance | Choice of dredger type, rate of extraction, minimise release from bucket (use of visors), silt curtains, no overspilling, reduced overspilling |
| | Timing of disturbance | Seasonal restrictions; tidal restrictions |
| Increased suspended sediment concentrations in water column | | |
| Changes in flows | Reduce extent of dredging | Dredge smaller area; dredge to shallower depth |
| | Indirect/offsite mitigation (offsetting measures) | Construct training works |
| Changes in wave propagation | Reduce extent of dredging | Dredge smaller area; dredge to shallower depth |
| | Indirect/offsite mitigation (offsetting measures) | Construct wave screens/protection |
| Changes in sediment transport | Reduce extent of dredging | Dredge smaller area; dredge to shallower depth |
| | Beneficial use/sediment management | Trickle recharge, sediment bypass, water column recharge |
| Direct habitat loss/change from dredge | Reduce extent of dredging | Dredge smaller area; |
| | Indirect/offsite mitigation (offsetting measures) | Habitat creation, trickle recharge, sediment bypass, water column recharge; intertidal placement |
| Indirect habitat loss/change from changes to flows/sediment transport | Indirect/offsite mitigation (offsetting measures) | Habitat creation, trickle recharge, sediment bypass, water column recharge; intertidal placement; construction of structures to minimise erosion/prevent slumping etc |
| Reduction in water quality associated with changes in flows | Indirect/offsite mitigation (offsetting measures) | Re-oxygenation of water column |
| Impacts to species from adverse water quality and/or habitat modification | Indirect/offsite mitigation (offsetting measures) | Fish/shellfish restocking |
| All impacts | Reduce need for dredging | Dynamic under-keel clearance Fluid mud navigation Flow manipulation (training works) |
| | Reduce extent of dredging | Dredge smaller area |
| | Indirect/offsite mitigation (offsetting measures) | Habitat creation/enhancement |
| | | |

ii) Dredge Material Disposal – Potential Impacts and Possible Mitigation Measures

| <i>Impacts</i> | Generic Mitigation Measures | Specific Examples |
|--|--|--|
| Smothering of bed from deposition of sediment | Change spatial extent over which material is disturbed of disturbance Spread material over wider area | Dispose of material in a smaller area (more confined disposal); dispose of material over a larger area (less intensive disposal) |
| | Choice of disposal strategy | Little and often versus large campaign; greater forward planning |
| | Timing of disturbance | Avoid sensitive seasons |
| Disturbance of bed from redeposition of resuspended sediment | Extent of disturbance | Choice of disposal method (e.g. pumped discharge back down trailer pipe), rate of disposal, |
| | Timing of disturbance | Seasonal restrictions; tidal restrictions |
| Increased suspended sediment in water column | | |
| Direct habitat loss/change from disposal | Change spatial extent over which material is disposed | Dispose of material in a smaller area (more confined disposal); dispose of material over a larger area (less intensive disposal) |
| | Indirect/offsite mitigation (offsetting measures) | Habitat creation |
| All impacts | Location of disposal sites | Avoid sensitive locations, dispose of to land, dispose beyond 1nm |
| | | |

iii) Vessel Movement – Potential Impacts and Possible Mitigation Measures

| <i>Impacts</i> | Generic Mitigation Measures | Specific Examples |
|---|---|---|
| Physical disturbance of sea bed/direct impacts to habitats | Deepen dredge channel | |
| | Reduce vessel speeds | |
| | Change vessel design (shallower draft) | |
| Increased suspended sediment concentrations/increased sediment deposition | Modify passage planning/access windows | |
| | Indirect/offsite mitigation (offsetting measures) | Habitat creation/enhancement |
| Shipwash | Reduce vessel speeds | |
| | Indirect/offsite mitigation (offsetting measures) | Construct wave protection, shore protection |
| Indirect impacts to habitats | Indirect/offsite mitigation (offsetting measures) | Habitat creation/enhancement |
| | | |

iv) Land Reclamation – Potential Impacts and Possible Mitigation Measures

| <i>Impacts</i> | Generic Mitigation Measures | Specific Examples |
|------------------------------|------------------------------------|--|
| Change in flows | Flow manipulation | Construction of structures to 'normalise' flows |
| Change in sediment transport | Sediment management | Beneficial placement of dredge material, by pass |

| | | |
|---|---|--|
| | | schemes |
| Direct/indirect habitat loss | Indirect/offsite mitigation (offsetting measures) | Habitat creation, enhancement (e.g. trickle recharge, direct intertidal placement) |
| Disruption of habitat connectivity/continuity | Indirect/offsite mitigation (offsetting measures) | Habitat creation, enhancement (e.g. trickle recharge, direct intertidal placement) |
| | | |
| | | |

v) Structures – Potential Impacts and Possible Mitigation Measures

| <i>Impacts</i> | Generic Mitigation Measures | Specific Examples |
|---|---|--|
| Change in flows | Modify structure design | e.g. open piled jetties; culverts in breakwaters |
| | Indirect/offsite mitigation (offsetting measures) | e.g. construct new training works, capital dredge |
| Change in sediment transport | Modify structure design | e.g. open piled jetties; culverts in breakwaters |
| | Sediment management | Trickle recharge, water column recharge, sediment bypass schemes etc |
| Change in wave energy/direction | Modify structure design | Reduce wave reflectance, increase wave absorption |
| | Indirect/offsite mitigation (offsetting measures) | Construct wave screen, provide bank protection |
| Change in water quality from changes in flows | Modify structure design | e.g. open piled jetties; culverts in breakwaters |
| Direct/indirect habitat loss | Modify structure design | Use alternative material types with greater biodiversity value (e.g. timber cladding on sheet pile); use of natural materials and biodiversity friendly design |
| | Indirect/offsite mitigation (offsetting measures) | Habitat creation/enhancement |
| Disruption of habitat connectivity/continuity | Indirect/offsite mitigation (offsetting measures) | Habitat creation/enhancement |
| | | |