



Stage four: identification and evaluation of measures

This stage explains the ways in which mitigation and improvement measures are identified and selected.

Introduction

If it is established that an activity is likely to affect water status at water body level (that is, by causing deterioration or preventing the achievement of the WFD objective), or that an opportunity may exist to contribute to improving status at water body level, potential measures to achieve either of these must be investigated.

Measures comprise actions that can be taken to change the nature of a dredging or disposal activity, to remove or reduce the environmental impact to an acceptable level or to exploit opportunities for environmental improvement. Measures may be required to:

- i. **mitigate** the impacts of dredging and disposal on the specified WFD parameter(s) such as quality elements, specific pollutants, priority substances, or protected area characteristics. They will prevent deterioration or ensure that the water body can reach its WFD objective; or
- ii. **restore or enhance** (and thus improve) the ecological or chemical status of certain facing parameters in a water body.

Measures comprise dredging- or disposal-related actions that can:

- remove or reduce the effect on status to an acceptable level; or
- exploit opportunities for environmental improvements.

There are a range of measures that carbitigate the impacts of the dredging or disposal activity, or improve (that is, enhance or restor) one or more WFD parameters. Any individual measure may be used alone or as part of a combestion of measures.

This stage is divided in the wo parts:

The first part, stee 1—7, focuses on the identification and initial evaluation of potentially-relevant measures. These are measures that:

- are notalready in place; and
- echnically feasible; and
- make an effective contribution to "closing the gap";

are not obviously disproportionately costly.

The second part, steps 8–14, applies only where necessary (and permissible under the WFD). It helps you to evaluate each measure in terms of cost and benefit. Cost calculations require consideration both of the costs of the measure and of its effectiveness in contributing to the achievement of the relevant WFD objective.

The outcomes of an evaluation of measures will be:

- i. a list of selected measures that are technically feasible and not disproportionately costly and that will be applied to the activity; and/or
- ii. a list of measures that will not be required, for example because they:
 - a. are already in place to the maximum extent possible; or
 - b. are not technically feasible; or
 - c. do not make a meaningful contribution to WFD objectives (they do not adequately address the problem); and /or
 - d. are disproportionately costly.

Clearing the waters – Stage four: identification and evaluation of measures

Mitigation measures

It is important to note there is a hierarchy of potential mitigation measures.

- 1. Take measures to **avoid** the impact.
- 2. If this is not possible or practicable, you may take measures to **reduce** the extent or significance of the effect.
- 3. If this is not achievable, you may take measures to **deal with** the consequences of the impact.

The measures highlighted in Tables 8 and 9 are arranged in this order. Tables 8 and 9 also recognise that monitoring or experimental measures may be required to reduce uncertainty before more practical measures can be taken.

Mitigation measures can help to avoid an impact, reduce its severity, or deal with its consequences.

A wide range of measures can potentially deal with the various biological, physico-chemical or hydromorphological effects of dredging or disposal. Most of these measures can apply irrespective of whether or not the water body in question is designated as a heavily modified (HMWB) or artificial (AWB).

Dredging and disposal operations can also potentially affect water column chemistry, for example as a result of the interaction of suspended sediment and any adsorbed contaminants with the water column. Some

mitigation measures taken to affect chemical water status are the same as those taken to affect biological or hydromorphological status.

You may already be implementing some measures to reduce the impacts of your activities. This methodology enables you to identify and evaluate existing measures, recognising they may be exher inappropriate or insufficient (you have a trived at this point because you need to mitigate an impact).

Heavily-modified water bodies artificial water bodies

In designated heavily-modified (HMWB) and artificial (AWB) water bodies, the G-called "alternative approach" to setting a good ecological potential objective for each water body included considering the potential impacts of dredging or disposal, and identified those measures already in place. This exercise Shfirmed that many HMWBs are already "atSEP" where navigation-related activities such as dredging and disposal are concerned. In such water obdies, while there may be other reasons why the water body is failing to meet its GEP target, no further consideration of measures to deal with hydromorphological effects of maintenance dredging and disposal should be required. Where a water body was identified as being at moderate ecological potential or below for navigation-related activities, measures should have been identified but may not

yet bein place (as of December 2009). It is therefore possible that the application of this draft guidance framework will identify the same measure(s) as being necessary.

Note that the **GEP classification only considered hydromorphological impacts**, and therefore chemical and physico-chemical elements still needed to be assessed in the same way as for water bodies that are not A/HMWBs. Therefore a water body might be at good ecological potential where navigation-related modifications are concerned but may not reach GEP overall for other reasons, for example flood defence-related hydromorphology, nutrients or temperature.

Protected areas

Impacts on protected areas are most likely to be associated with one or more of the types of impact discussed above. The type of measures in Tables 8 to 9 should therefore also be appropriate for the majority. However, it is worth noting that, in the case of predicted significant effects on a Natura 2000 site, the management and application of such measures may need to be dealt with as part of a parallel process in accordance with the Habitats Directive and its implementing regulations (or related initiatives such as the Maintenance Dredging Protocol).

Process for identification of and initial evaluation of potential measures

If you have reached this stage of this guidance framework it is assumed either:

- the dredging or disposal activity has been assessed and confirmed as being likely to have a nontemporary effect on status at water body level (that is, an effect on the status of one or more WFD parameters or on relevant protected area characteristics); and/or
- an opportunity (or need) to restore or enhance one or more WFD parameters through management of the dredging of disposal activity has been identified.

During this stage you will need to refer to Tables 8 to 9 to identify measures that may mitigate the effects of the activity and/or deliver the required improvement. These tables help you to identify which measures are potentially relevant. At this identification stage, take no account of whether or not a measure is already in place, its likely cost, etc. This is the purpose of the evaluation stage.

The first task is to identify mitigation measures appropriate to the particular effect. Evaluation of cost, etc. comes later.

In identifying appropriate measures, it is essential that you are aware of the scale and duration of any predicted impacts and the extent to which the water body objective is or will be compromised. In other words, you need to understand the extent of the "gap between the current or predicted status and the objective for the particular WFD parameter water body level.

In assessing potential measures, its vital to understand the extent of the "say" between the current (or predicted) status of the water body and the relevant WFD targets.

In practice, this will typically involve a brief assessment of the extent to which the impacts will be reduced or the improvement achieved if one measure or a combination of measures is employed.

Steps set out the initial process to determine whether each identified measure or combination of measures:

is or is not already in place;

- is or is not technically feasible;
- does or does not make an effective contribution to "closing the gap"; and/or
- is or is not obviously disproportionately costly.

The initial identification and evaluation of potential measures involves highlighting all potentially applicable measures and then considering whether each is:

- already in place;
- likely to be technically feasible;
- likely to be effective in closing the "gap"; and/or
- likely to be disproportionately costly.

Where measures are identified that could be disproportionately costly, but where this conclusion is not obvious or could be challenged, the methodology described in Steps 8 to 14: Further evaluation of costs and benefits may need to be applied. Further guidance on both establishing technical feasibility and on determining possible disproportionate cost is contained in WFD common implementation strategies.

There are two possible entry routes to this

- Table 8 (a. posal mitigation) anu, prement measures). Identify a. it measures.

 Let that, at this stage, no consideration should be given to whether the measure is already in place, its likely cost, etc.

 Record the identified measures in the knowld column of Tables 6 and 7 as appropriate, it is likely cost, etc.

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Action: Refer to Table 8 (dredging mitigation) and/or

Note that, at this stage, no consideration should be given to whether the macro

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Step 2: identify measures that are already in place

For each of the measures listed in Tables 6 and/or 7, identify those measures that are:

- already in place to their maximum effect; and
- will continue to be applied unless a better option is identified.

Record measures which meet this criterion. **These** measures will not be considered further.

Action: Place a cross in column 3 against each measure that is already in place to its maximum effect and will continue to be applied.

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Step 3: consider whether measures are technically feasible

For each remaining measure (or each combination of measures), consider whether it is likely to be technically feasible taking into account the sitespecific characteristics.

Action: If the measure is technically feasible, tick column 4(iv) on Tables 6 or 7 as appropriate and keep a note of the reasoning in case regulators request it. If the measure is not considered to be technically feasible or may not be technically feasible, record the main reason(s) for this in column 4(i) on Tables 6 or 7 and tick one of the sub-columns 4(i) or 4(ii).

Where a measure is clearly technically infeasible the measure will not be considered further.

For the remaining measures proceed to step 4.

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Step 4: indicate the likely effectiveness of measures

For each measure (or combination of measures) make an initial estimation of the likely contribution it could make to "closing the gap". This requires consideration of:

- the expected effectiveness in mitigating or reducing the predicted effect on the identified parameters; and/or
- the extent of anticipated improvement in water body status.

Record the outcome of this initial evaluation in Tables 6 and/or 7.

Action: Consider whether each measure (or combination of measures) will make a meaningful contribution to "closing the gap" and record the answer as tick (yes) or a cross (no) in column 5 of Tables 6 and/or 7. If uncertain place a question max (?) in column 5 of the relevant table. If "no", keep a record of why this decision was reached.

contribution to closing the gap, the measure will not be considered further. For the emaining

Where a measure will not make a measingful measures proceed to step 5.

Step 5: initial consideration of cost and benefit

For each remaining measure (or combination of measures) make an initial assessment of whether implementing it will obviously be disproportionately costly. In the context of this assessment it means that all parties agree, without further assessment, that the benefits of implementing the measure would not justify the cost.

Action: Consider whether the measure costs outweigh the benefits and record yes (by a tick) or no (by a cross) in column 6 of Tables 6 and/or 7. If uncertain place a question mark (?) in column 5 of the relevant table. If "yes", keep a record of why this decision was reached.

Where a measure will be obviously disproportionately costly the measure will not be considered further. For the remaining measures proceed to step 6.

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e detailed assessment

in whether the required provement will be achieved, in its defense of the three are no stable miligation or that miligation will not prevent alto or failure to achieve the WFO objective an stop here.

Step 7: further assessment of effectiveness (if required)

Assessing the contribution to "closing the gap"

Where there is uncertainty as to the likely effectiveness of the measure(s), you should repeat steps 4 to 6 of the approach to assessment. Reassess the activity assuming that the mitigation or improvement measure is in place.

- If the measure is clearly not disproportionately costly, it should be implemented and the user should proceed to Understanding implications for decision-making.
- In other cases, it may be necessary to establis whether the measure will be disproportionately

Further evaluation of costs and benefits

Cost Benefit Analysis (CBA) is a process for identifying whether the costs of a measure(s) are proportionate to the benefits which would be realised if the measure were implemented.

If there is uncertainty as to whether the measure(s) is disproportionately costly, you should work through steps 8 to 14 on assessing cost and benefits. The level of detail required will vary according to the specific characteristics of the activity and the nature and potential significance of its impacts. The amount of effort required to complete a CBA should be proportionate to the scale of this likely effect and the benefits that would result from the implementation of the measure(s) in question.

The level of detail required for a cost and benefit analysis should be the minimum necessary to establish whether the benefits that would derive from the measure(s) in question justify the

Step 8: record activity and associated costs

In the first instance, you need to define the baseline dredging and/or disposal scenario and associated costs over the period of the timeney/decision. Quantify these costs as far as practicable.

Action: complete columns 1 and 2 of Table 12.

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Step 9: confirm measures to be assessed

To begin to assess whether costs are disproportionate, you need to highlight the potential implications of the identified measure(s) and the potential for the measures to affect the cost of the dredging or disposal activity.

Action: Using Table 13, confirm which measure is to be assessed or describe the combination of measures required. Briefly explain their practical implications for the dredging or disposal activity. Explain why such implications might lead to a change in costs.

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Step 10: quantify costs of measures

Wherever possible, quantify the total cost increases or reductions associated with the measure(s).

Actions Complete column 3 of Table 12 indicating the anticipated changes in costs with the measure(s) pages Estimate costs in monetary terms wherever possible. Alternatively, provide quantitative or qualitative information, if there is more than one obscible measure or combination of measures, complete one table for each.

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Step 11: identify wider implications of measures

Identify any other impacts of applying the measure(s), for example any consequences for the operator's wider business or any costs to society in general. Include any savings or reductions in costs as well as increased costs or other negative consequences. We acknowledge the potential subjectivity of this exercise, however you should attempt to quantify likely implications wherever practicable.

Action: Tick any boxes in Table 14 that describe an anticipated effect of the measure(s). Provide a brief supporting explanation, stating clearly the potential wider implications, indicating who will bear the cost/feel the consequences, and whether the effects are local or national.

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Step 12: identify the benefits of implementing the measure(s)

You need to compare any additional costs of measure(s) with the expected WFD benefit or "value" of the environmental improvement which would result from it. It is assumed that such benefits would be foregone if the measure(s) proves disproportionately costly and therefore not implemented. Again, some of the benefits will be subjective, but you should attempt to quantify likely benefits wherever practicable.

Action: Use the conclusions and information from the assessment and identification of measures processes and evaluation of measures along with any other relevant information (for example that collected as part of a montie licence application), to answer the questions in Table 15.

Step 13: review outcomes of steps 8 to 12

To help decide whether each measure (or combination of measures) is disproportionately costly, an overview of the outcomes of steps 8 to 12 is required. The regulator should conduct this review in consultation with us and others as appropriate.

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In other cases, however, the decision may be less straightforward and additional information may need to be collected. If this is the case (and as discussed above) it may be necessary to move to a more detailed assessment. An appropriate level of effort will need to be determined based on:

Identification and evaluation of measures tables

Table 6: Record of mitigation measures

WFD parameter likely to be impacted	Identified Are measures	Initial evaluation						
	mitigation		Technical viability				Is the measure	
	measure	maximum effect? (tick if yes)	(i) Discussion of technical feasibility		(iii) Moasure may be (echnically infeasible	(iv) Measure is clearly technically feasible	make a meaningful contribution towards closing the gap?	obviously disproportionate costly?
				10°				
				14.				

Table 7: Record of improvement measures

WFD parameter that needs to be improved improvement measure	Identified Are measures	Initial evaluation						
	improvement	already in place to	locinical viability				Will the measure	Is the measure
		(i) Discussion of technical feasibility	(ii) Measure is clearly technically infeasible	may be	is clearly technically feasible	meaningful dis	obviously disproportionate costly?	
		40						
	×	0,						

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Table 8: Mitigation measures for dredging-related impacts

Nodify position of channel.	Examples of measure* Realign channel; create new channel.	What measure aim a schieve
7 1		Reduce or avoid dryaging requirement.
nange vessei management	<u> </u>	
vo ations	Passage planning; speed limits; modify hull design.	Reduce or a cold dredging requirement.
ractices.	Cantual timina afina and dia any and Daira tidal mains	Dadusana a vidadus deina varioren ant
_	Control timing of impounding pumps. Raise tidal weirs.	Reduce or avoid dredging requirement.
asins, inland waterways, etc to		O.
educe suspended sediment inputs.	Construct training walls constrain or direct flow	A vege a natural so diment transmort thus ye dues ay sucid
Manipulate flow.	Construct training walls; constrain or direct flow.	ncrease natural sediment transport thus reduce or avoid dredging requirement.
educe amount of dredging.	Reduce area dredged; reduce depth of dredging.	Reduce or avoid dredging requirement.
Nodify dredging technique.	Change dredger type; change production rate.	Reduce impacts of dredging.
Nodify dredging equipment.	Modify draghead; add visor; constraints on overflow	Reduce impacts of dredging.
lse supplementary equipment.	Silt curtain; aerator.	Prevent dispersion of (contaminated) sediment;
		improve DO levels.
	Adapt dredging programme; seasonal or that constraints on activity.	Reduce impacts of dredging on biological receptors.
	Trickle feeding; inter-tidal placement, water column recharge;	Offset dredging impact by replenishing lost sediment.
	sediment bypassing.	
	Wave protection; structures prevent slumping; soft	Deal with consequences: reduce or avoid (further) erosion or
	engineering solutions; geotextiles; vegetation.	slumping.
70	Bubbler.	Offset dredging impact: re-oxygenate water column.
	Shellfish, fish transferation; seeding; habitat or species translocation.	Offset dredging impact: re-establish characteristic biota.
Nonitoring.	EA WFD monitoring programme.	Reduce uncertainty.
25 - 1 - 27	Maritage (Constant of Name Parties of	Reduce uncertainty.
Adapted from Haskoning 2008, ABPmer 2004, p	OCEA.	

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Table 9: Mitigation measures for disposal-related impacts

Generic measure	Examples of measure*	What measure aims achieve
Alternative disposal option.	Disposal to land; in-situ capping; beneficial use¹; confined	Reduce or avoid impacts of disposal.
	disposal facility; retentive vs. dispersive site.	6
Alternative disposal location.	Disposal site outside water body; retain sediment within system;	Reduce of avoid impacts of disposal on WFD parameters.
	disposal beyond WFD boundary.	
Modify disposal technique.	Bottom dumping; pump to seabed; control amount or rate of	Red Compacts of disposal.
	disposal.	
Use supplementary equipment.	Silt curtain; aerator.	Reduce impacts of disposal: prevent dispersion of
		(contaminated) sediment; improve DO levels.
Modify disposal timing.	Disposal programming; seasonal or tidal constraints on a charty.	Reduce impacts of disposal on biological receptors.
Treatment.	Physical treatment (for example separation of more.	Avoid or reduce impacts of disposal: prevent release of
	contaminated fine sediments); biological or chemical reatment;	contaminants into water column; remove contaminants from
	(for example bioremediation or wet oxidation techniques) ¹ .	sediment prior to final disposal.
Re-stocking.	Shellfish, fish translocation; seeding; habitat pepecies	Offset disposal impact: re-establish characteristic biota.
	translocation.	
Monitoring.	EA WFD monitoring programme.	Reduce uncertainty.
Trial sites.	Monitored (experimental) application.	Reduce uncertainty.

^{*} Adapted from Haskoning 2008, ABPmer 2004, pCEA.

^{*} Adapted from Haskoning 2008, ABPmer 2004, pCEA.

¹ Further information on sediment remediation techniques and alternative disposal options will may be available from the Defra contaminated sediment strategy.

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Table 10: Improvement measures potentially related to dredging initiatives²

Generic measure	Examples of measure*	What measure aims to achieve
Infill.		Restore natural oat symetry.
Habitat restoration.	Beneficial use of dredged material (see above); bank protection (see above).	Restore (suketidal or inter-tidal) habitat.
Habitat creation.	Beneficial use of dredged material (see above); bank protection (see above).	Create (sub-tidal or inter-tidal) habitat.

^{*} Adapted from Haskoning 2008, ABPmer 2004, pCEA.

Table 11: Improvement measures potentially related to disposal activities³

Generic measure	Examples of measure*	What measure aims to achieve
Remove previously-disposed	Dredging; excavation.	Restore natural bathymetry.
material.	6	
Alternative use of dredged material.	Beneficial use of dredged material for habitative ation	Restore or create (sub-tidal) habitat.
	(see above).	

^{*} Adapted from Haskoning 2008, ABPmer 2004, pCEA.

Table 12: Summary of proposed dredging and/or disposal

Dredge/disposal details	Description and cost	Description of dredging with measure(s) included and new total cost
Dredge location.	, C	
Dredge area (m ²).	, O'	
Dredge depth (m).		
Dredge volume (m³).	0	
Dredge methodology.	.6	
Disposal location.	X	
Disposal methodology.		
Dredge/disposal timing.	70.	

² Several of the listed mitigation measures might also provide improvement opportunities.

³ Several of the listed mitigation measures might also provide improvement opportunities.

Dredge/disposal details	Description and cost	Description of dredging with measure(s) included and new total cost
Existing constraints/conditions.		
Existing monitoring requirements.		6 V
Current dredge/disposal cost		K 3
Licence fee (if any).		
Total cost (dredge/disposal cost +		O'
licence fee).		

Table 13: Mitigation or improvement measures to be assessed for costs and benefits

Measure	Practical implications for dredging or disposal activity
	1/1
	S

Table 14: Wider consequences of implementing measure(s)

Potential consequence	Tick if relevant	Who bears cost (or benefits)?	Local or national effect?	Further information (quantified if possible)
Closure of operation.		<i>⊘</i> `		
Unemployment.		×Q)		
Loss of trade.		12		
Significant % change in operating		, 0		
costs.		A .		
Limited ability to pay.	×	O		
Will measure(s) have other, indirect,				
costs?	O ·			
Other implication (please state).	. 5			

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Table 15: Environmental	beneπts of mitid	jation measure(s)

Table 19. Environmental benefits of intigation mea		
Question	Response	
Refer to the selection of mitigation measures		
process and confirm whether implementation of the measure will make a "meaningful and measurable"		
contribution to achieving the relevant WFD		
objective(s).		Ol,
Referring to the current status of the water body and		.0
its WFD objective(s), briefly describe the expected		"M"
environmental improvement; quantify if possible. Indicate over what timescale the improvement		*
should be achieved.	×0.	awn
Indicate the level of confidence in the assessment.	lil.	
Will the required environmental improvement be		
delivered solely and entirely through the implementation of this measure?	100	
If no, what other contributions will be required and	, N°	
what is their relative importance?	20	
Will there be other, indirect, benefits or dis-benefits	W.	
associated with implementing the measure(s) (for	*0	
example angling; recreation; amenity)?		

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