Comhshaol, Oidhreacht agus Rialtas Áitiúil
Environment, Heritage and Local Government


# Guidance Manual on the Economic Analysis Required by the Water Framework Directive

**April, 2009**

# Table of Contents

# A. 1. Introduction

## A.1.1 Background

The EU Water Framework Directive ("WFD") was transposed into national legislation via the European Communities (Water Policy) Regulations (S.I. No. 722 of 2003). The purpose of the Directive is to establish a framework for the protection of inland surface waters, coastal waters and ground waters. Amongst other things, the WFD obliges River Basin Districts to prepare River Basin Management Plans. The preparation of these plans requires two types of economic analysis:

- Where supplementary measures are required to ensure that a water body reaches, or maintains the required level of water quality, the competent authorities must design a cost effective programme of such supplementary measures;
- Where a River Basin District wishes to postpone the achievement of good ware status on a given water body until after the 2015, or wishes to adopt a lower target than "good water quality" for a water body it must demonstrate that reaching the standards normally required by the WFD would be disproportionately costly. The designation of a water body as "heavily modified" also requires a finding that certain actions would be disproportionately costly if they were undertaken.

In 2008 the Water Services National Training Group ("the WSNTG") and the Department of Environment, Heritage and Local Government ("the Department") commissioned Goodbody Economic Consultants to:

- Devise approaches to these two economic analysis tasks;
- Prepare guidance documents describing these approaches; and,
- Deliver training on these approaches.

Under Article 4(3) of the Water Policy Regulations, 2003, the Minister for the Environment, Heritage and Local Government may issue guidance and general policy directions in relation to the implementation of the Regulations. This document constitutes the Minister's guidance and general policy directions on the use of disproportionate cost analysis in the preparation of River Basin Management Plans. While this guidance is not binding, the relevant public authorities shall have regard to it in implementing the river basin management planning process, including the preparation of River Basin Management Plans ("RBMPs").

This guidance document is, therefore, addressed to all of the public authorities, including local authorities and the Environmental Protection Agency, that are involved in the river basin management planning process.

### A.1.2 Layout of the Document

This document is laid out in three sections. The remainder of Section A summarises some key features of the WFD and describes the use of economics in its implementation.

Section B sets out the guidance on the application of cost effectiveness analysis to measures aimed at achieving the objectives of the WFD.

- Section B.1 explains the purpose and scope of cost effectiveness analysis;
- Section B.2 describes the overall approach to cost effectiveness analysis;
- Section B.3 sets out the methodology for defining and estimating costs; and,
- Section B.4 sets out the steps to be taken in completing a cost effectiveness analysis.

Appendix 1 to this document is a table of discount factors for use in calculating the present value of costs. Appendix 2 contains two case studies illustrating the application of the cost effectiveness analysis methodology.

Section C sets out the guidance on carrying disproportionate cost analysis as part of the preparation of river basin management plans.

- Section C.1 sets out the information that is available from the WFD and elsewhere on the meaning of the concept of disproportionate cost;
- Section C.2 sets out the approach that has been devised to establishing that a measure, or set of measures, is disproportionately costly; and,
- Section C.3 describes a systematic, step by step methodology to implement this approach in the preparation of river basin management plans.

Appendix 3 to this document is an illustrative example of the type of Cost Benefit Analysis that may be required as part of a disproportionate cost analysis.

# A. 2. Economic Requirements of the Water Framework Directive

## A.2.1 Introduction

This Section of the guidance document provides an overview of the WFD and identifies the role of economics in its implementation.

## A.2.2 Objectives of the Water Framework Directive

The WFD came into effect on 22nd December 2000 and sets a framework for comprehensive management of water resources in the European Community, within a common approach and with common objectives, principles and basic measures. It addresses inland surface waters, estuarine and coastal waters and groundwater. Member States have to ensure that co-ordinated approach is adopted for the achievement of the objectives of the WFD and for the implementation of programmes of measures for this purpose. The objectives of the WFD are:

- To protect and enhance the status of aquatic ecosystems (and terrestrial ecosystems and wetlands directly dependent on aquatic ecosystems);
- To protect high quality waters where they exist, to prevent any further deterioration of water status and to achieve at least good status (as defined) in surface waters and ground waters by 2015;
- To promote sustainable water use based on long-term protection of available water resources;
- To provide for sufficient supply of good quality surface water and groundwater as need for sustainable, balanced and equitable water use;
- To provide for enhanced protection and improvement of the aquatic environment by reducing / phasing out of discharges, emissions and losses of priority substances;
- To mitigate the effects of flood and droughts;
- To protect territorial and marine waters
- To establish a register of protected areas e.g. areas designated for protection of habitats or species

The status of a water body is defined along a number of dimensions viz. its physical, chemical, biological or ecological behaviour.

## A.2.3 Water Status Levels

The Directive aims to achieve good status or prevent a deterioration in the status of water bodies. Status is defined by reference to:

- Ecological status, or in the case of artificial or heavily modified water bodies, ecological potential; and
- Chemical status.

Ecological status assigns water bodies to one of five ecological classes: High, Good, Moderate, Poor, and Bad.

Four quality elements need to be considered in order to assess a water body's ecological status viz.:

- Biological quality elements
- Physico-chemical conditions;
- Relevant specific synthetic or non-synthetic pollutants; and
- Hydromorphological elements.

Biological quality assessment uses numeric measures of communities of animals and plants. Physico-chemical assessment looks at elements, such as levels of nutrients, which support the biology. The chemical assessment within the ecological classification refers to polluting substances that could adversely affect ecology. The hydromorphological assessment examines water flow and physical habitat.

The overall ecological status of the water body is defined by the lowest level of status achieved across the four quality elements. This means, for example, that if one of the elements is assessed as Poor and all other elements are Good, then the overall ecological status of the water body is Poor.

Chemical status refers to a list of priority hazardous substances for which standards are expected to be adopted in 2008. Good status in respect of chemical elements will be defined by achieving the standards set.

Regulations have been proposed that will give legal status to the criteria and standards to be used for classifying surface waters in accordance with the ecological objectives approach of the Water Framework Directive.[1]

### A.2.4 New Governance Arrangements

The WFD establishes a new administrative structure for the management of water resources. A set of River Basin Districts ("RBD") have been identified, and every water body in the EU has been assigned to one of these River Basins. Where a river basin crosses a national boundary it is administered by an International

[1] Draft European Communities Environmental Objectives (Surface Waters) Regulations 2008.

RBD. The Member States involved are jointly responsible for establishing such an RBD and ensuring that the river basin is managed on a unified basis.

A river basin management plan must be produced for each river basin plan within the territory of a Member State and a joint plan must be produced for IRBDs. In the Irish context, this involves co-ordination of measures with authorities in Northern Ireland in relation to cross-border catchments. Accordingly, a total of 8 RBDs have been established on the whole island of Ireland (i.e. eco-region 17 for rivers and lakes). These 8 RBDs include 1 RBD wholly within Northern Ireland, 4 RBDs wholly within Ireland and 3 IRBDs in relation to river basins shared with Northern Ireland (UK). All of the proposed RBDs are identified in a consultation paper 'Managing Our Shared Waters' which was issued on 18th March 2003 jointly by authorities in Ireland and Northern Ireland.

The competent authorities in each River Basin District must complete their first management plans by the end of 2009. These will cover the period to 2015. A second plan, covering the next six year period up to 2021 must be completed by 2021. The WFD provides for a third plan to be prepared by 2021 to cover the period to 2027.

The competent authorities were required to publish drafts of their 2009 management plans for public consultation by the end of 2008. These management plans will also have to be submitted to the European Commission.

The WFD therefore establishes a comprehensive system for managing water resources, and for reporting on the quality of water resources and the measures being taken to protect and enhance that quality.

### A.2.5 Member State Obligations

The management plans prepared by the competent authorities for each RBD must set out their programme of measures to protect and enhance water quality. This programme must specify both the "basic" and "supplementary" measures that the authorities will be taking over the period to 2015.

Basic measures are the measures that are required to comply with pre existing legislation.[2] The WFD does not introduce any exemptions or derogations from the obligation to carry out these basic measures. RBD authorities are simply required to specify their programme of basic measures for the period of the plan. This will allow easy monitoring of compliance with existing rules by the Commission, and the public.

[2] This legislation includes Council Directives on Integrated Pollution Prevention and Control (96/61EC); Urban Waste Water Treatment (91/271/EEC); and the Protection of Waters against Pollution Caused by Nitrates from Agricultural Sources (91/676/EEC).

"Supplementary measures" are an important new concept introduced by the WFD. The WFD imposed targets for water quality on the competent authorities. In particular, they must bring any water bodies that are currently less than good status, to good status by 2015. In addition, water bodies that are currently at good or high status must be maintained at that quality level. Where the basic measures that must be taken by the competent authorities for a RBD are not sufficient to fulfil this obligation, the authorities must design and set out a set of supplementary measures that will, when combined with the basic measures, reach these quality targets.

The authorities in a RBD are free to choose their own supplementary measures. The WFD only requires that any set of supplementary measures be "cost effective".

Certain derogations from this obligation to achieve water quality targets are possible. These must rely on finding that certain costs are disproportionate. This guidance deals with these derogations, and describes a method to assess whether the costs in question are disproportionate.

However it is important to note that the WFD also recognises that it may simply not be possible to reach the water quality targets that it specifies. The authorities can also therefore either defer achieving good quality on a water body, or set a permanently lower target for a water body, if it would be technically infeasible to reach the WFD quality targets. Technical feasibility includes consideration of operational feasibility. The latter may occur where it takes longer to fix the problem than there is time available or where there is no information on the cause of a problem and a solution cannot be identified.[3]

The term "natural conditions", referred to in this context in the WFD, refers to the conditions which dictate the rate of natural recovery of a water body. It recognises that it may take time for the conditions necessary to support good ecological status to be restored.

The question of whether it is technically feasible to bring a given water body to good status within a given time is a scientific and engineering question. It depends on the effect that the best measures possible in the current state of technology and knowledge would have on the water body in question. Deferring the achievement of good status, or setting a permanently lower target status for a water body on grounds of what is technically feasible does not require economic analysis. Conversely, if measures exist that could be used to reach the WFD quality targets,

[3] This interpretation is supported by the work undertaken as part of the Common Implementation Strategy for the WFD. See CIS DG Environment "Guidance Document on Exemptions to the Environmental Objectives - Draft version 3" 6 November 2008", Section 3.2.4.

then the argument of technical infeasibility cannot be used, regardless of how large the cost of these measures might be.

### A.2.6 Key Economic Aspects of the WFD

The Directive includes numerous references and or provisions in relation to matters involving economic aspects. The most significant provisions are:

- Article 5 requires a Member State to carry out an economic analysis of water use by 2004. This analysis has been completed and published[4];
- Article 9, requires a Member State to have in place by 2010 water-pricing policies which provide adequate incentives to promote efficient use of water resources and which take account of the principle of recovery of the costs of water services;
- Article 11 and Annex III, provide that the programme of measures adopted by a Member State to achieve the relevant environmental objectives must comprise the most cost-effective combination of measures, subject to an overriding obligation to carry out basic measures. In effect the supplementary measures included in the programme must be the most cost effective available;
- Article 4(3) specifies that certain water bodies can be designated as Heavily Modified Water Bodies (HMWBs), and not have to reach good quality. These HMWBs would be areas of water which have been artificially altered to serve some useful purpose such as navigation, recreation, power generation or irrigation. In order to qualify as a HMWB, it has to be shown that it would not be possible to restore the water body to its "natural state" and achieve this useful purpose in some alternative way, without incurring disproportionate costs.
- Article 4(4) allows a Member State to adopt a longer timeframe (i.e. beyond 2015) for achievement of the objective of good status for a water body, in certain circumstances where completing the improvements within the original timescale would be disproportionately expensive; and
- Article 4(5) allows a Member State to adopt less stringent objectives for a specific water body where achievement of full objective would be disproportionately expensive (costly).
- Article 4(7) allows new modifications to a water body that result in it not meeting good status where these modifications serve some useful purpose which cannot be achieved by alternative means without incurring disproportionate cost.

[4] Department of Environment, Heritage and Local Government "Economic Analysis of Water Use in Ireland – Final Report" (2004) Available at: http://www.wfdireland.ie/wfd-charreport.html

## A.2.7 Overall Process of Integrating Economic Analysis

Figure A.1 depicts an overall approach to the integration of economic analysis which fits with the requirements of the Directive. The first issue to be resolved relates to the extent to which Cost Effectiveness Analysis (CEA) must be applied to basic measures. Appendix III indicates that CEA is to be applied to the measures contained in Article 11. As that article refers to both basic and supplementary measures, in principle, CEA must be applied to basic measures. This view must be qualified by two factors:

- Government has already largely initiated these measures: for example, a National Action Programme under the Nitrates Directive is in place; and
- The Community Legislation that underpins the requirements for basic measures usually sets actions that Member States must take, and therefore does not give rise to the possibility of choice of measures.

Where Government has already put in place measures aimed at meeting the requirements of Community legislation, it makes sense that only new or additional i.e. uncommitted basic measures should be subject to CEA.[5] Such uncommitted measures have the potential to arise only where goals rather than actions have been identified in the legislation.

However, it must be recognised that there may not be a need for such additional measures, so that CEA of basic measures may not be required. In terms of Figure A.1, this would mean that the first four steps in the process would become redundant.

CEA must be applied to supplementary strategies so that identification of the 2015 good status or reduced status gap is a requisite first step. This is the gap that remains after all basic measures have been implemented. There is then a need to identify measures or combinations of measures (strategies) to meet that gap. These measures must be both technically feasible and operationally feasible in the sense of capable of implementation by 2015. CEA is then applied to supplementary measures/strategies that are feasible to determine the most cost effective approach. Section B of this report provides advice on the implementation of cost effectiveness analysis.

The final step in the process is to determine that the most cost-effective strategy is not disproportionately expensive. If it is not disproportionately expensive, then implementation can proceed. If it is disproportionately expensive, then achievement of good status can be postponed to 2021 and a similar appraisal

[5] For example, the WFD identifies controls over abstractions of fresh surface water and ground water as a basic measure. CEA is required to choose between alternative measures aimed at achieving such control.

process is then applied. Ultimately, if no affordable strategy can be found to deliver good status by 2027, then adoption of less stringent environmental objectives can be considered.

### A.2.8 Significance of "Disproportionate Cost" in the WFD

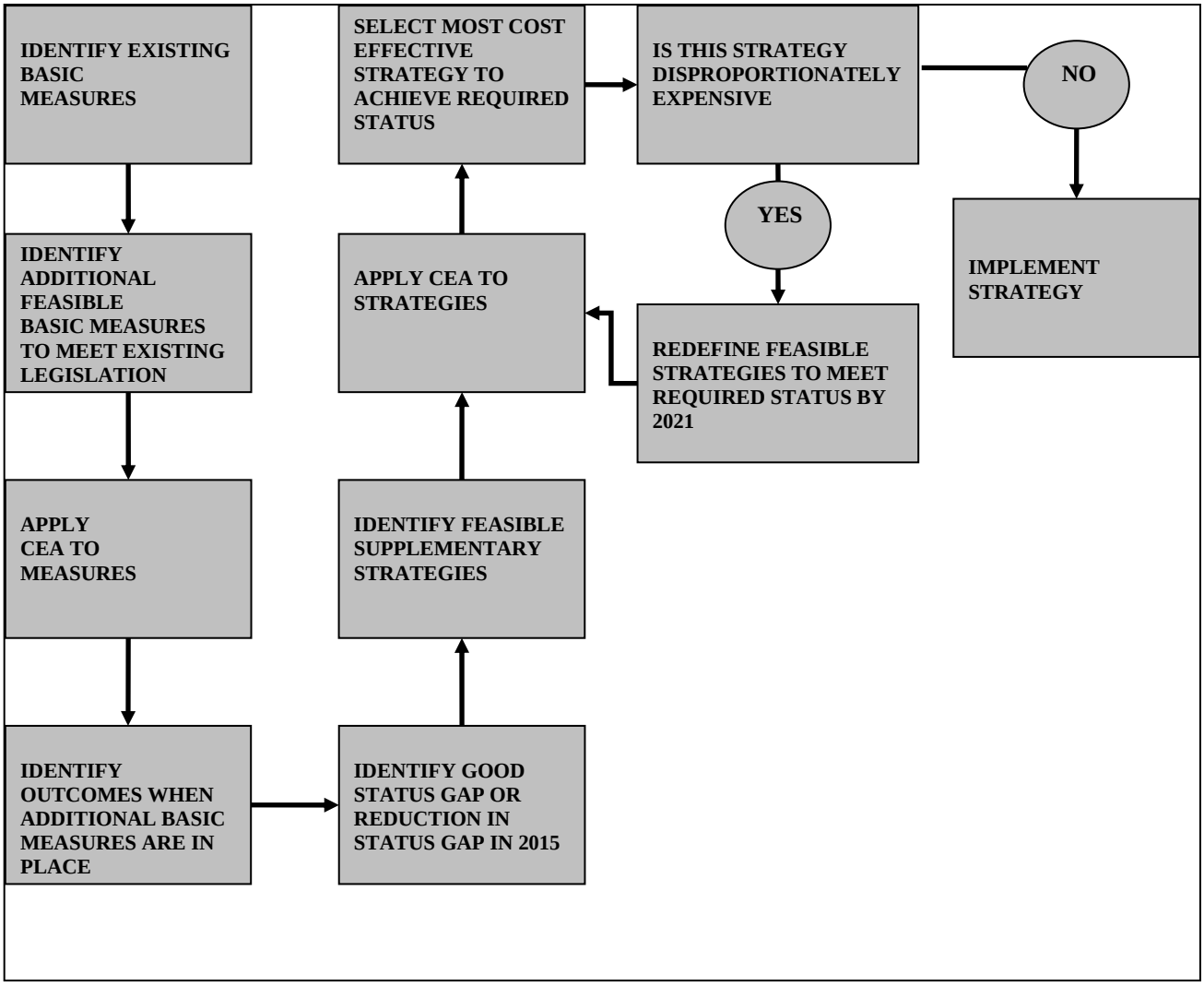
One of the key obligations of the WFD is that of bringing all water bodies in the EU that do not currently enjoy good status to that level of quality by 2015. Where a water body enjoys good or high status must be maintained at that level of water quality. This is a significant obligation on Member States and the competent authorities for each River Basin District.

As described above, limited derogations from this obligation are possible:

- Attaining good status can be postponed until after 2015, if reaching this water quality level by 2015 would be disproportionately costly;
- A water body can be brought to a lower level of quality than good status, and maintained at that level, if bringing it to good status would be disproportionately costly;
- A water body that has been artificially modified to serve some practical purpose can be designated as a HMWB, and so exempted from the requirement to be brought to good status. To qualify for this designation it must be shown that it would be disproportionately costly to restore the water body in question to its original state and provide alternative means to fulfil the practical purpose currently fulfilled by the water body;
- New modifications to water bodies that create new HMWBs can be authorised. To allow a new HMWB it must be shown that achieving the practical purpose of the new HMWB could not be fulfilled by some alternative means without incurring disproportionate costs.

All of these derogations depend on the concept of disproportionate cost. In Section C this guidance document sets out the approach to be adopted in determining whether the costs of a measure set of measures are in fact disproportionate. Extending this methodology to HMWB designation is then described.

## Figure A.1: Economic Analysis



## B. 1. Cost Effectiveness Analysis

### B.1.1 Introduction

This Section of the Guidance identifies the measures to which cost-effectiveness analysis (CEA) should be applied.

### B.1.2 Setting a Target Status Date

The objective, in the first instance, should be to achieve Good status by 2015. Where this is not possible on either feasibility or disproportionate costs grounds, a revised Target Status Date of 2021 should be considered. Again, if this is not possible, a revised Target Status Date of 2027 should be set.

### B.1.3 Establishing the Good Status Gap and Need for Supplementary Measures

The first step in the process is to consider whether supplementary measures are required to achieve Good Status by the Target Status Date. This will require the description of a Reference Scenario. This scenario depicts the water quality status that will be achieved by the Target Status Date when current trends in pressures and the effect of current policies, including basic measures already committed, are taken into account.

Where the predicted Reference Status is less than Good Status a Good Status Gap is present. Additional basic measures and or supplementary measures are those currently uncommitted measures that would be needed to close this Good Status Gap.

### B.1.4 Maintaining Good Status

The above process depicts the situation where the water body is currently below Good Status. However, some water bodies may be assessed as being already at or above Good Status. The Directive requires that the status of these water bodies should not deteriorate. This again requires a prediction of the Reference Status of the water body by 2015, if all basic measures have been implemented. If that predicted Reference Status is less than the current status, then there is a Reduced Status Gap additional basic and or supplementary measures are required.

### B.1.5 Focusing on Additional Uncommitted Measures

Where Government has already put in place basic measures aimed at meeting the requirements of Community legislation, these should not be subjected to Cost Effectiveness Analysis. The only basin measures that should be included in Cost

Effectiveness Analysis are any additional, uncommitted basic measures. Supplementary measures are uncommitted measures to be applied in addition to basic measures with the aim of achieving the objectives of the Directive. These supplementary measures should be selected on the basis of Cost Effectiveness Analysis.

### B.1.6 Focusing on Feasible Supplementary Measures

Additional uncommitted measures must be both technically feasible and operationally feasible in the sense of capable of implementation by the Target Status Date. CEA is then to be applied to measures/strategies that are feasible to determine the most cost effective approach.

### B.1.7 Undertaking CEA at the Appropriate Geographic Unit of Analysis

The first step in the identification of feasible measures will be an assessment of the appropriate geographic unit of analysis. Where water bodies are interconnected, and where the pressures identified for one water body are leading to good status gaps in other water bodies, then the level of analysis should be the aggregate of these water bodies or the river basin as a whole.

### B.1.8 Applying CEA to Measures aimed at each of the Quality Elements

In practice, river basin planners will aim to address pressures that impact negatively on four of the five elements viz.

- Physico-chemical conditions;
- Relevant specific synthetic or non-synthetic pollutants;
- Hydromorphological elements; and
- Chemical status elements.

Achieving good status in respect of biological quality elements will normally be an outcome of good status achievement for the other four quality elements.

As good status must be achieved across all elements, this means that CEA must be applied to alternative measures to achieve good status for each of the four quality elements identified above.

### B.1.9 Identifying Candidate Measures

Annex VI Part B of the Directive provides a sample list of supplementary measures that may be considered. It is important to note that these measures include administrative and legal standards and controls, economic and fiscal instruments, and management measures as well as capital works. Care should be

taken to consider low cost measures from this list, as well as more expensive capital projects.

### B.1.10 Sifting and Screening of Measures

If there is only one feasible measure available for achieving good status in respect of a quality element, then CEA need not be applied, as a choice between measures does not arise.

Alternatively, there may be on occasion a large number of measures available to address a specific quality element. In order to reduce the workload, river basin planners may:

- Identify and exclude measures that are dominated by others, in sense of being obviously less cost effective, and or
- Screen measures by excluding some measures from further analysis.

In arriving at a reduced number of measures to be evaluated, planners should take care to include very different measures for analysis, so as to ensure that trade-offs between costs and effectiveness are highlighted by the process. In this context, screening of measures could take the form of taking one measure to represent a family of similar measures.

Where sifting and screening of measures takes place, it is important to document the decisions made and, in particular, why measures have been excluded from further analysis.

### B.1.11 Making Use of Generic Cost Effectiveness Analyses

As the same pressures may be identified for a number of River Basins, it may make sense to consider the cost effectiveness of measures for some pressures in an abstract manner, or alternatively, to transfer CEA analyses from one River Basin to another. This generic approach could both save time and reduce costs. This approach is acceptable provided that the CEA is rigorously applied at the generic level and the relevance of the measures and the CEA for the water body in question is confirmed.

### B.1.12 Including Supplementary National Level Measures

Inclusion of national level measures in a management plan presents issues as such measures have to be subject of a policy decision and or legislation at central government level. There is currently a structural problem with regard to the incorporation of such measures at the river basin planning level, in that full planning at the river basin level requires national policy context.

The need for such measures will become evident from the river basin planning process itself and there will be a need to assess the requirement for such measures based on the analyses of all river basins. This can be done at two stages. If generic CEAs are carried out, then national level measures can be identified at this stage. If these measures are agreed in principle, then they can be included subsequently in the river basin level CEAs of measures and confirmed through that process. Alternatively, if they are not considered at the generic level, then they will need to be considered at river basin level. Some greater co-ordination of the approach to this issue across river basins will then be required.

### B.1.13 Developing Strategies

This Guidance envisages that CEA will be applied to measures aimed at achieving good status in relation to each quality element. However, some measures may impact on more than one quality element. In this context, there may be a need to evaluate combinations of measures or strategies. [6] Similarly, no one measure may achieve good status on its own, so that there may be a need to consider packages of measures or strategies.

In this context, the better options arising at the measure level should then be combined to develop strategies. These strategies would then be subject to a CEA that recognises any synergies between them e.g. that morphological measures to improve ecological status may also improve chemical status. [7]

In developing strategies, consideration should be given to:

- Including measures in a package to address the four quality elements identified above;
- Including complementary measures in a package; complementary measures are those where the inclusion of one measure increases the effectiveness or reduces the cost of another measure;
- Avoiding substitutable measures in a package, where measures are aimed at the same quality element; substitutable measures are those where the inclusion of one measure reduces the benefits or increases the costs of another measure.

Where options for analysis comprise alternative packages of measures, these packages should be formed so as to present substantially different approaches to meeting the project's objectives. For example, there might be a point discharge

[6] It is also recognised that an individual measure or measures may be sufficient to achieve good status.
[7] It is recognised that in practice, there may be a limited number of feasible measures and strategies.

strategy that would be compared to a diffuse discharge strategy. This would illustrate relative effectiveness leading to a combined preferred strategy that combines elements of both.

## B.2. Structure of the Cost Effectiveness Analysis

### B.2.1 Introduction

This Section of the Report sets out the overall structure of the CEA. Cost effectiveness analysis is a technique aimed at identifying the most cost effective method of achieving a set target. There is, thus, a need to define the output precisely, establish how the achievement of that output will be quantified and set out a cost effectiveness analysis decision criterion, which may be used to assess the relative merits of alternative measures.

### B.2.2 Defining Outputs

The output of measures/strategies is measured by the extent to which status is improved from the Reference Status. Thus, a measure should be regarded as contributing to effectiveness, only when good status is achieved. Improvements in water quality that fall short of good status should not be regarded as effective in the sense of achieving an output.

As was indicated in Section A.3, status is defined via a five-fold hierarchy from bad to poor to moderate to good to high. Only movements from a level below good status to a level of good status or above should be regarded as effective. This means that improvements in status that fall short of good status should not be accorded any weight in the decision-making process and the focus should be on considering fully effective measures.

### B.2.3 Measuring Outputs

A numeric scoring system should be used to encapsulate incremental changes, with one incremental unit being awarded for a one step move in status and two for a two step move, and so on. So for example, the outputs arising from a sample of different transitions between water status levels is as follows:

**Table B.1: Output and Water Status Transitions**

| Water Status Transition | Incremental Units |
|---|---|
| Bad to Good | 3 |
| Poor to Good | 2 |
| Moderate to Good | 1 |
| Moderate to High | 2 |

### B.2.4 Assessing the Timing and Duration of Outputs

Some measures may achieve good status earlier than others. Although feasible effective measures are those that can be both implemented and achieve the desired outputs by the target year (2015, in the context of the first river basin plan), the impacts of these measures may extend over a much longer period. Similarly, the impact of a measure may attenuate, so that the improvement in status does not persist. In order to ensure that such analyses are implemented in a consistent fashion and take full accounts the impacts wherever they occur, they should be evaluated over a 30-year period to take account of the long life of capital projects. A shorter evaluation period may be adopted where capital measures are not involved. In such cases, the effective lifetime of the most long lasting measure should be adopted as the evaluation period.

**Non Water Outputs**

In addition to raising the status of water bodies, measures may also contribute some non-water positive or negative impacts. A key question to be answered is the degree to which these other impacts should be included in the measure of effectiveness. Non water impacts would appear to emanate from two sources.

Firstly, the improvement in status of a water body could give rise to positive economic benefits in terms of, say, tourism. Such effects do not need to be considered in the CEA as the latter is aimed at achieving good status, and only measures that achieve that status are considered. Thus, in respect of a given water body, the non-water benefits arising from good status are identical, no matter what measures are applied.

Secondly, non-water benefits could arise from the nature of the measure itself. For example, measures to control the rate of afforestation could impact on carbon sinks and increase Ireland's contribution to global warming. Rather than develop a methodology that attempts to encompass these effects, it is proposed to adopt achievement of good status as the indicator of effectiveness, rank measures on this basis and then consider the scale of measure-specific non water impacts and whether the cost-effectiveness ranking would be altered by including such impacts.

## B.2.5 Discounting of Outputs

Some measures may achieve outputs sooner than others, and the CEA should, other things being equal, favour those measures. Table 4.2 depicts a hypothetical situation where the water body is at moderate status and two alternative measures are being assessed to achieve good status by 2021. [8]

The first measure achieves good status by 2016, and thus has 24 years over which it is providing output in terms of meeting good status requirements. The second measure achieves good status in 2020 and has only 20 years of output.

A discounted factor is applied to each output for each year and a sum of discounted status increment years is calculated. Thus output or effectiveness is measured as

$$\text{Output} = \sum^{n} \frac{\text{Status Increment Years}_n}{(1+R)^n}$$

Where R is the Rate of Discount.

In the example of Table 4.2, output is measured at 12.53 for the first measure and 9.55 for second, reflecting the fact that good status is achieved earlier for the first measure.

The discount factor applied is 4 per cent, which is the factor mandated by the Department of Finance. A table of discount factors is presented in Appendix 1.

## B.2.6 Using a Present Value Year of 2010

As river basin management plans are to be completed by end 2009, some measures contained within the plan may be commenced in 2010. The year 2010 should be used as the present value year, i.e. the year to which all outputs are discounted. As an evaluation period of 30 years is proposed, this means that measures should be assessed for each year from 2010 to 2039, as in the example given.

[8] It is assumed that there are no feasible measures that would achieve good status by 2015

**Table B.2: Example of Discounting Procedure**

| Year | Measure 1 | | Measure 2 | |
|---|---|---|---|---|
| | Status Increments | Discounted Status Increments | Status Increments | Discounted Status Increments |
| 2010 | 0 | 0 | 0 | 0 |
| 2011 | 0 | 0 | 0 | 0 |
| 2012 | 0 | 0 | 0 | 0 |
| 2013 | 0 | 0 | 0 | 0 |
| 2014 | 0 | 0 | 0 | 0 |
| 2015 | 0 | 0 | 0 | 0 |
| 2016 | 1 | 0.79 | 0 | 0 |
| 2017 | 1 | 0.76 | 0 | 0 |
| 2018 | 1 | 0.73 | 0 | 0 |
| 2019 | 1 | 0.70 | 0 | 0 |
| 2020 | 1 | 0.68 | 1 | 0.68 |
| 2021 | 1 | 0.65 | 1 | 0.65 |
| 2022 | 1 | 0.62 | 1 | 0.62 |
| 2023 | 1 | 0.60 | 1 | 0.60 |
| 2024 | 1 | 0.58 | 1 | 0.58 |
| 2025 | 1 | 0.56 | 1 | 0.56 |
| 2026 | 1 | 0.53 | 1 | 0.53 |
| 2027 | 1 | 0.51 | 1 | 0.51 |
| 2028 | 1 | 0.49 | 1 | 0.49 |
| 2029 | 1 | 0.47 | 1 | 0.47 |
| 2030 | 1 | 0.46 | 1 | 0.46 |
| 2031 | 1 | 0.44 | 1 | 0.44 |
| 2032 | 1 | 0.42 | 1 | 0.42 |
| 2033 | 1 | 0.41 | 1 | 0.41 |
| 2034 | 1 | 0.39 | 1 | 0.39 |
| 2035 | 1 | 0.38 | 1 | 0.38 |
| 2036 | 1 | 0.36 | 1 | 0.36 |
| 2037 | 1 | 0.35 | 1 | 0.35 |
| 2038 | 1 | 0.33 | 1 | 0.33 |
| 2039 | 1 | 0.32 | 1 | 0.32 |
| Sum of Discounted Status Increments | | 12.53 | | 9.55 |

## B.2.7 Estimating the Cost Effectiveness Decision Criterion

To estimate cost effectiveness, the outputs of a measure or strategy must be compared to the costs. The proposed measure for this is the output achieved per €1m spent on the measure or strategy in question.

Costs should therefore be discounted in a similar manner to yield a Present Value of Costs

$$\text{Present Value of Costs (PVC)} = \sum^{n} \frac{C_n}{(1+R)^n}$$

The cost effectiveness of the measure is thus calculated as:

$$\text{Output per €1m spent on measure} = \frac{\text{Output}}{\text{PVC}} * 1\text{m}$$

The measure or strategy with the highest output per €1m of spending is to be preferred. The next section discusses the estimation of costs, while Appendix 2 provides a two worked examples of CEA for a hypothetical water body.

## B.2.8 Dealing with Uncertainty

Assessing the cost effectiveness of measures or strategies requires estimates of costs and outputs. There may be a degree of uncertainty about both of these estimates. The method of choosing the most cost effective measure or strategy described here, is based on selecting the method which has the best ratio of output to cost relative to the other methods available. Therefore the results of the exercise will remain valid in a range of situations where the actual costs and outputs of the measures in question prove to be different to the estimates used in the assessment. This feature of the method contributes to the robustness of the results that it gives.

In addition, this method of assessing cost effectiveness should produce valid results even when the effects of a measure are not exactly the same as those estimated. There may be uncertainty as to the exact effect of a measure on water quality, and the actual effect may be different from that estimated during the cost effectiveness analysis. However, over a wide range of outcomes, predictions that the measure will, say, improve water quality from moderate to good, will remain valid. Even where a measure does not reach the output anticipated this may simply amount to a delay in achieving good status. This would have a relatively small effect on the output measures used in this approach to measuring cost effectiveness. Provided that the cost effectiveness analysis would not lead to the

choice of a different measure if the output varied by a number of units, then the method is robust with respect to this risk.

This method of assessing cost effectiveness may be vulnerable to uncertainty in predicting the costs of measures or strategies. To the extent that unforeseen circumstances would affect the costs of all possible measures, they should not affect the relative ranking of measures produced by this method. To this extent, the method is robust with respect to certain sources of uncertainty about costs.

However, it is possible that the method may identify the wrong measure as being the most cost effective. This will arise if the costs of the measure in question turn out to be higher than estimate by a significant margin, while the rejected measures would have had actual costs closer to their estimated costs. This risk can be addressed by applying sensitivity analysis to the cost estimates. This technique for addressing forecasting risks investigates whether the result of the cost effectiveness analysis would be different if the costs of the measure in question were higher than the estimates used in the cost effectiveness analysis. There are two main approaches to carrying out this type of sensitivity analysis:

- Add a percentage "contingency" amount to the estimated costs of the measure, and verify that this does not affect the outcome of the cost effectiveness analysis; or,
- Analyse the cost estimate, identify areas where the costs could be higher than anticipated and prepare an alternative "worst case" estimate of the costs of the measures. Verify that using this "worst case" estimate would not change the result of the cost effectiveness analysis.

### B.2.9 Reviewing for Measure-specific Impacts and Non-Monetisable Costs

The above methodology assumes that all measure costs are known as well as the value of measure specific impacts. With regard to the costs of measures, it is imperative that all Exchequer costs and resource costs are measured. However, environmental costs may not be measurable. Similarly, the value of measure-specific impacts may not be easily gauged. Where these unknowns are present, the analyst should consider whether the scale of these non-monetisable effects is likely to be such as to alter the relative cost effectiveness of measures.

### B.2.10 Auditing the Process

The CEA process should be recorded in detail, with each step being recorded even where it does not impinge on the final outcome. For example, where measures are screened out, the reason for doing so should be set out; where no measure is possible for technical or operational reasons, the rationale should be made clear.

## B.3. Defining and Estimating Costs

### B.3.1 Introduction

This Section of the Guidance discusses the definition and measurement of costs.

### B.3.2 Defining Costs

The costs to be assessed in the CEA should be economic costs. Economic costs go beyond public sector financial costs in that they assess the costs to society as a whole, rather than simply the financial cost to the Exchequer.

Measures may thus give rise to a number of categories of costs:

- Public Implementation Costs: these are costs for the public sector arising from implementation of the measure. These costs may be initial, recurring or both. They include the costs of infrastructure, management initiatives, legislation and control measures. Where the measure imposes additional taxes or charges, these should be netted off the public implementation costs.
- Industry Implementation Costs: These are compliance costs imposed on industry.[9] Again they may be initial or recurring or both. They include the costs of additional treatment and restraints on production
- Consumer Implementation Costs: These are costs arising from implementation of measures that are imposed directly on consumers of water or water related activities. They include additional taxes, access charges and the reduction in consumer welfare from restraints on access to water-based recreation.[10]
- External Costs: these are costs for society at large that arise because of implementation of the measure by the public sector or industry. These are most likely to arise where infrastructure development gives rise to external environmental costs such as air pollution or visual intrusion.

It should be noted that in respect of both public and industry implementation costs, it is important to consider costs that arise indirectly, where these are important. For example, a restraint imposed on ground water abstraction may give rise to costs associated with the supply of water from more distant water bodies.

[9] "Industry" is used throughout the report to refer to all private sector productive activities, including agriculture and services.

[10] In most cases, some or all of the costs imposed on industry will be passed on to consumers. In order to avoid double counting, these costs should be ignored and the costs should be reckoned as if they were fully met by industry. As a result, consumer implementation costs refer only to those costs directly imposed on consumers.

Similarly, a reduction in marine dredging activities may have an impact on port economics.

### B.3.3 Deciding the Level of Detail of Cost Estimates

In order to assess the cost-effectiveness of measures, they must be described in sufficient detail to enable costs to be measured. It is a matter of judgment as to the degree to which measures should be designed. However, by analogy with capital projects, it is suggested that a feasibility design and cost be established. This design and cost estimate is indicative and falls considerably short of detailed design and costing.

### B.3.4 Treating Initial and Recurring Costs

The costs of a measure will typically comprise initial and recurring costs. There is a need to combine these costs to arrive at an estimate of the overall cost of the measure. As recurring costs occur some time in the future, a simple aggregation of cost will not suffice.

The discounting process which was described in Section B.2.7 should be used. This process allocates costs to the year in which they occur and discounts them to a present value year.

### B.3.5 Prices

All costs should be estimated at constant prices. That is, general inflationary effects should be excluded. As cost analyses will be completed in 2009, it is recommended that costs be measured at constant 2009 prices.

### B.3.6 Quantification of Costs

In principle, public and private sector implementation costs and taxes and charges imposed on consumers are readily amenable to quantification. Quantification is more difficult or impossible in relation to consumer welfare impacts or external costs, because a set of robust values for these impacts is not available. It is recommended that the measurement of cost-effectiveness should proceed on the basis of costs that are readily quantifiable and significant non-quantifiable cost impacts should be noted for consideration in the appraisal process.

**Treatment of Taxes and Subsidies**

Where a measure requires inputs that are taxed, then the true cost of the measure is overstated. This is because while such taxes are a cost to the entities implementing the measure, they represent a benefit to other taxpayers through State expenditures or transfers. Thus, tax costs are not economic costs and should be excluded. Similarly, if some input costs are subsidised, the true costs are understated, as more resources are used up than would be indicated by the subsidised prices.

The implication is that costs should be measure net of taxation but gross of subsidies. A practical step in addressing this issue would be to exclude VAT on construction and other inputs and where impacts on agricultural production are being measured, to estimate such impacts at agricultural prices gross of subsidies.

## B.4. Summary of Steps in the CEA

| Step Number | Description | Comment |
|---|---|---|
| | **Overall** | |
| 1. | Determine the current status of the water bodies in the catchment | |
| 2. | Predict the 2015 status assuming based on the Reference Scenario | Take account of the impact of pressures up to 2015 and those measures and actions that are already committed by Government under existing legislation |
| 3. | Identify water bodies that have either a good status gap or a reduced status gap by 2015, | Reduced status gap is where the status is good or above in 2008 but falls by 2015 |
| 4. | Determine the geographic unit of analysis | Where the pressures identified for one water body are leading to good status gaps in other water bodies, then the level of analysis should be the aggregate of these water bodies or the river basin as a whole. |
| | **For Each Status Deficient Water Body** | |
| 5. | Determine whether additional measures are available to help close gap by 2015 | Include technical and operationally feasible measures only |
| 6. | Sift and screen measures as appropriate | Where a large number of measures are available, reduce their number to reflect the principal alternative approaches available |
| 7. | Develop alternative measures and or strategies capable of closing the gap | Make sure the alternatives to be considered represent substantially different approaches |

| | | |
|---|---|---|
| 8. | Measure outputs of alternative measures or strategies | Make sure to discount and aggregate the outputs |
| 9. | Measure costs of alternative measures or strategies | Include all relevant public implementation, industry, consumer and external costs. Include initial and recurring costs. Make sure to discount and aggregate the costs |
| 10. | Calculate cost-effectiveness ratio for all alternative measures or strategies and rank them | |
| 11. | Choose most cost-effective measure or strategy | In doing so, consider whether non water outputs and non-monetisable costs are large enough to alter the ranking of measures based on the cost-effectiveness ratio. |
| 12. | Determine whether the most cost effective measures is disproportionately expensive | Refer to Guidance on Disproportionate Cost Analysis |
| 13. | If not disproportionately expensive, include measure or strategy in river basin plan | If measure disproportionate set status target for 2021 and start the CEA with this target date |

## C.1. Disproportionate Cost Analysis

### C.1.1 Introduction

The term Disproportionate Cost is not defined in the WFD. In addition, it is not a recognised term in economics. However certain authoritative guidance exists as to the intended meaning of the term. This Section of the guidance document outlines this material. It begins by examining the extent to which the Directive itself provides guidance on the approach to be adopted. The contribution of work under the EU Commission's Common Implementation Strategy is then outlined. The conclusions of a workshop organised by the Commission in April 2008 are summarised. Goodbody Economic Consultants reviewed the economic literature on the valuation of benefits as part of its work. The results of this work are available in a separate document[11]. However the main conclusions of that work are set out below.

This Section concludes by outlining the proposed approach for defining and using the concept of disproportionate cost.

### C.1.2 Guidance Provided by the Directive

The WFD does not define, or even elaborate on, the term Disproportionate Cost. As is described in Section A.2.4 above, the term is used in Article 4 of the Directive to describe conditions that must be met if certain limited derogations from the requirements of the Directive are to apply.

The recitals to the Directive give some guidance as to how the term may be interpreted.

Recital 30 describes the basis on which derogations can be given, and states that "In order to ensure a full and consistent application of this Directive any extensions of timescale should be made on the basis of **appropriate, evident and transparent criteria** (Goodbody emphasis) and be justified by the Member States in the river basin management plans."

Recital 31 states that "In cases where a body of water is so affected by human activity or its natural condition is such that it may be unfeasible or unreasonably expensive to achieve good status, less stringent environmental objectives may be set on the basis of **appropriate, evident and transparent criteria** (Goodbody emphasis)"

[11] Goodbody Economic Consultants *Review of Water Resource Benefit Values* August 2008. Available from Department of Environment, Heritage and Local Government.

These Recitals do not give specific guidance on the form that a disproportionate cost analysis should take. However, they do suggest the importance of establishing objective criteria and methods for finding that costs are disproportionate in advance of any actual use of the concept, and of setting out the basis of individual findings that costs are disproportionate in river basin management plans.

### C.1.3 European Guidance

The European Commission has established a Common Implementation Strategy for the Water Framework Directive. Within the context of this Strategy, the Wateco Working Group has produced a guidance document entitled "Economics and the Environment – the Implementation Challenge of the Water Framework Directive"[12]. DG Environment of the European Commission is currently preparing a further guidance document[13]. Drafts of this Commission Guidance have been circulated for comment.

#### C.1.3.1 WATECO Guidance

The Wateco Guidance extends to all of the economic aspects of the Directive identified in Section A.2.4 above. The Guidance is not mandatory but rather reflects an informal consensus agreed by participating Member States. The Wateco Guidance provides some pointers as to how economic analysis should be integrated into the river basin management planning process. In particular, it advises that:

- Economic analysis is only an aid to decision-making and as such must be integrated with other (technical) analyses;
- In assessing cost-effectiveness, the dynamic impact of measures should be considered because some measures require time to take full effect;
- Cost effectiveness of measures should be performed at the geographic scale at which the environmental issues take place;
- Cost effectiveness analysis should be applied to both basic and supplementary measures;
- Disproportionality should involve assessment of benefits and costs of a measure;

The Wateco Guidance does not specify how to judge whether or not costs are disproportionate. It notes that making the case for derogation on the grounds of disproportionate cost will be resource intensive, and recommends that it be done

[12] The Common Implementation Strategy for the Water Framework Directive. Guidance Document No.1. Economics and the Environment – the Implementation Challenge of the Water Framework Directive. 2003.
[13] See Note 4

with input from technical experts. It is also recommended that key stakeholders and the public be consulted if such a derogation is being sought.

The Wateco Guidance contains a number of real world examples of possible measures, and discusses how an assessment might be made of whether their cost was disproportionate or not. It does not suggest a definition of Disproportionate or propose a method for making this judgement. However a number of interesting observations or suggestions are made. In summary these are:

- Disproportionality should not begin at the point where measured costs simply exceed quantifiable benefits;
- The assessment of costs and benefits will have to include qualitative costs and benefits as well as quantitative;
- The margin by which costs exceed benefits should be appreciable and have a high level of confidence; and,
- In the context of disproportionality the decision maker may also want to take into consideration the ability to pay of those affected by the measures.

These statements need to be interpreted carefully. The Wateco Guidance is, correctly, very insistent that many of the benefits of high water quality may be difficult to quantify, or may not be expressible in money terms. These Guidelines emphasise to the need to identify and take into account these qualitative benefits. The Wateco Guidelines seem to be suggesting that a practical way to deal with this issue would be to deem the costs of a measure to be disproportionate only when the costs exceed the **quantifiable** benefits by a significant margin. This prevents the rejection of useful measures, which would actually represent value for money, because some of their benefits could not be quantified. In principle, if all of the benefits of a measure could be identified and valued, and the costs of the measures exceeded these benefits, then implementing the measure would reduce total welfare.

The examples or potential "real life" measures presented in the Wateco Guidance are principally qualitative. The Wateco Guidance states that this type of qualitative analysis may be all that is required, at least in the early stages of assessing possible disproportionality.

The Wateco Guidance also makes a useful suggestion that the level of detail in an argument that costs are disproportional may vary depending on the type of derogation sought. The Wateco Guidance suggests that if a permanent derogation is being sought on the basis of disproportionate cost, i.e.

- Setting a lower permanent target for water quality under Article 4(5);
- Designating a water body as a HMWB under Article 4(3); or,
- Justifying modifications to a water body under Article 4(7).

Then a detailed assessment must be carried out which will include quantifying market costs and benefits, and describing non-market costs and benefits in qualitative terms.

Where a temporary derogation is being sought i.e. a postponement of the achievement of good status under Article 4(4) then simple financial criteria may be enough to justify a finding of disproportionate cost. This Guidance for the application of DCA in Ireland adopts this "two tier" approach.

#### C.1.3.2Draft Commission Guidance

Subsequent to the Wateco Guidance discussed in Section C.1.3.1 further work was done on the use of economics in implementing the WFD under the auspices of the Common Implementation Strategy. The Commission is drafting a guidance manual to capture the results of all of this work. A draft of this guidance has been circulated for comment[14]. Key points for the issue of DCA are:

- The indications on the concept of disproportionate cost from the Wateco guidance are repeated in this draft guidance from the European Commission. (See in particular Section 3.2.5 of the document);
- This draft Commission guidance describes the concept of technical infeasibility in Section 3.2.4. This is incorporated in Sections C.1 and C.2 of this document;
- This draft Commission guidance emphasises the importance of doing as much as possible to improve or maintain water quality even if an exemption from the full requirements of the WFD is applicable. (See in particular Section 3.2.5.1); and,
- Section 3.2.5.3 of the draft Commission guidance gives important indications on the concept of affordability as used in the WFD. It makes it clear that the possibility of using alternative financing mechanisms must be considered before it can be concluded that a set of measures is not affordable. In addition it notes that although it is widely accepted that an affordability argument can be used to delay the achievement of good status, that Member States are divided on whether an affordability argument can justify a permanent derogation from the requirement of the WFD.

### C.1.4 Workshop on Disproportionate Costs

In April, 2008 a workshop on Disproportionate Costs was held in Copenhagen under the Common Implementation Strategy Framework. The purpose of the

[14] DG Environment, "Common Implementation Strategy for the Water Framework Directive (2000/60/EC), Guidance Document on Exemptions to the Environmental Objectives, Draft Version 3, 6 November 2008".

Workshop was to examine the different approaches to DCA across Member States. Different approaches to DCA were evident with the following methodologies in use: cost benefit, cost effectiveness, distribution of costs, social and sectoral impacts, and affordability. There is thus no consensus on the approach to be adopted.

### C.1.5 Benefit Valuation

A key element in assessing disproportionate cost will be to measure the benefits that can arise from improving water quality. A finding that the costs of improving water quality are disproportionate must in some way relate to the benefits of that improvement.

Goodbody Economic Consultants have identified and assessed the material that is available on the valuation of improvements in water quality. The results of this work are available in a separate document.[15] The main findings of this work were as follows:

- There are only a small number of Irish studies that put monetary values on water resource benefits. These focus on valuing water-based leisure activities. In contrast, a large body of research studies have been undertaken abroad. These have been incorporated into a number of databases of which the four largest are the Environmental Valuation Reference Inventory (EVRI), Envalue, Ecosystem Services Database (ESD) and Review of Externality Data (RED). The databases cover benefits arising from a range of water bodies, although they provide better coverage of valuation of the benefits of inland rather than coastal waters.

- These databases are largely funded and maintained by governments. They are aimed at providing data for policy makers; governments generally have not mandated their use in the appraisal of water resource improvement initiatives. As well as these databases, the UK's Environment Agency has collated UK studies on benefit valuation and has issued guidance on the use of such values in the appraisal of water resource improvement initiatives.

- The application of benefit values to proposed measures under the WFD is hindered by the incomplete coverage of such studies, the fact that many of them were conducted outside Europe, and their failure to focus on incremental changes to water quality.

- The benefit values mandated in the UK are the most appropriate as they refer to the benefits of incremental changes in water quality status. However, these

[15] Goodbody Economic Consultants *Review of Water Resource Benefit Values* August 2008

benefit values are, in some instances, the result of relatively few studies. There is also some evidence that the benefit values are low in relation to the few Irish estimates that have been made. Finally, the incremental changes in status that underpin the guidance do not map directly onto water status levels, as defined in the WFD.

- In general terms, it is clear that the use of benefit values in disproportionate cost analysis requires careful consideration on a case by case basis. In that context mandating a set of values for use in the WFD disproportionate cost analysis is premature.

On this basis of these findings it is recommended that when benefit values are required for a disproportionate cost analysis that those in use in the UK should be considered, subject to the test of the transferability of such values. However, sensitivity tests should be used to test the robustness of the analysis to alternative values.

## C.2 Proposed Approach to Disproportionate Costs

### C.2.1 Introduction

This Section of the guidance document outlines the approach that has been developed to establishing that the costs of a set of measures is disproportionate, as a basis for seeking derogation from the water quality requirements of the WFD. The following Section sets out a step by step methodology for applying this approach, and explains how to use this approach in making HMWB designations.

This Section first summarises the key background factors identified in this guidance document that have informed the design of this methodology. It goes on to describe the main steps in the proposed methodology.

### C.2.2 Key Background Factors

This approach is based on a number of key features of the WFD, the guidance that is available on the meaning of disproportionate cost and the current state of knowledge on the economic value of measures that improve water quality. These are described in the earlier sections of this guidance. The key points are:

- The WFD quality targets do not have to be met if it is not technically feasible to do so. Demonstrating that it is not technically feasible to meet water quality targets is a task for engineering and scientific analysis, rather than economic analysis;
- A lower "standard of proof" will be required to postpone the achievement of good status to a point after 2015, as opposed to setting a permanently lower quality target than good status;
- If it is decided to bring a water body to a lower level of quality than good status, a very strong case will have to be made that the cost of achieving good status would be disproportionate;
- The decision that the costs of achieving good status are disproportionate will, in the final analysis, have to be a policy decision. However such a policy decision will have to be backed up with a complete, objective description of the relevant economic factors;
- Possible economic factors informing a decision to adopt a permanently lower quality target than good status include:
    - The cost of achieving good status exceeds the benefits, even taking account of the benefits that are hard to value in monetary terms;
    - The cost and benefits of the measures in question would fall on different populations in a disproportionate way, i.e. inequitably; or
    - The costs of the measures would not be affordable.

## C.2.3 Outline of Proposed Approach

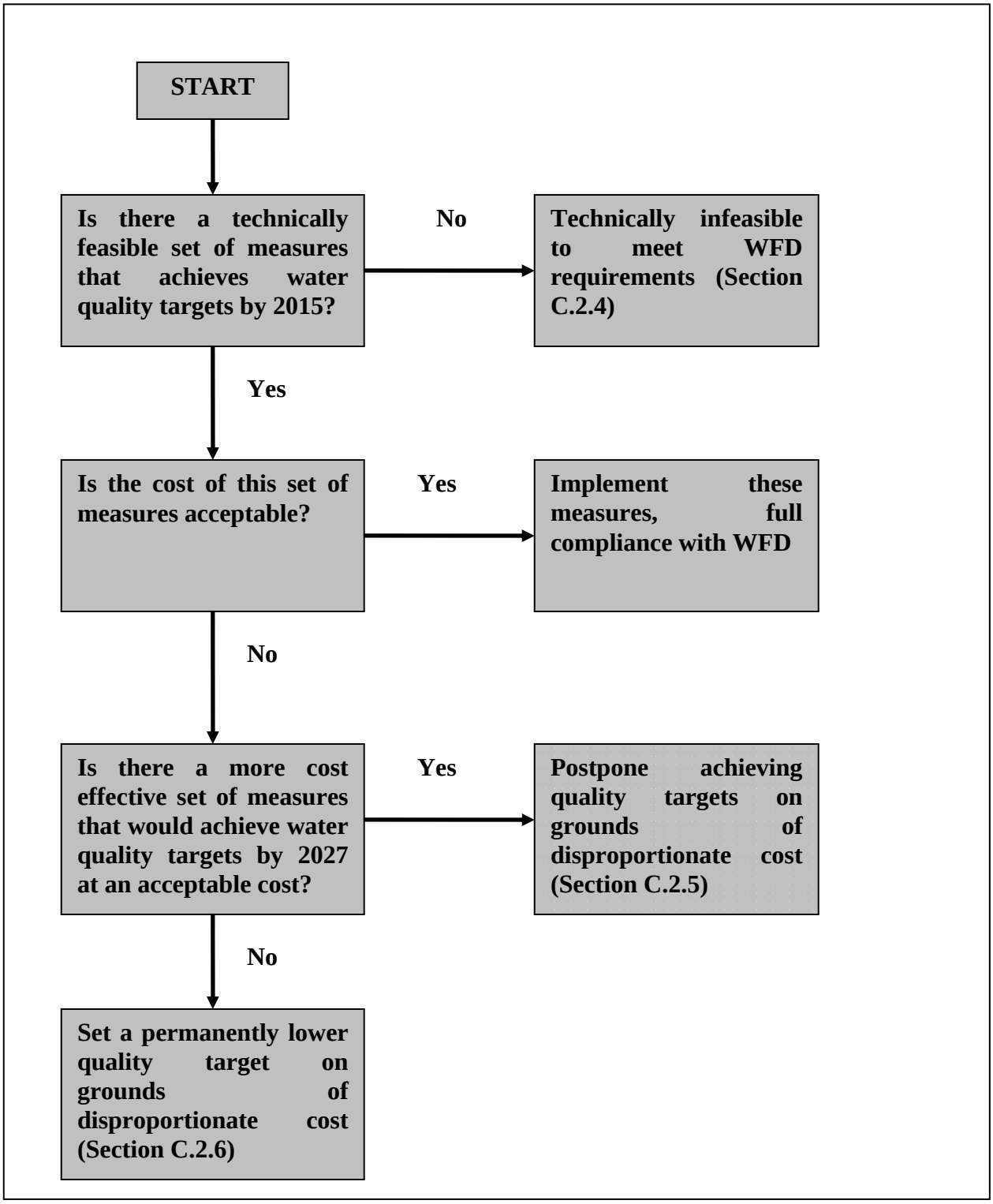
Based on the above guidance and findings, a pragmatic approach to the use of DCA has been developed. This approach is intended to be practical for use in preparing River Basin Management Plans. The key elements of this approach are:

- Where it is simply not technically feasible to reach WFD quality standards by 2015, postpone on this basis. Note this in the 2009 river basin management plan, providing the relevant technical and engineering information. The plan should outline all of the measures that can and will be taken, and indicate how close water quality will be brought to WFD quality standards without incurring disproportionate cost[16];
- Where a set of measures exist that would achieve good status by 2015, but these are disproportionately expensive when compared with measures that would achieve good status after 2015, postponement of good status may be justified. As before all measures that can be taken without incurring disproportionate cost should be included in the 2009 river basin management plan. As is explained below, this argument can be based on the cost effectiveness work already carried out;
- In all other cases, if a set of measures exists that would meet WFD water quality requirements by 2015, but this is disproportionately expensive, it will be necessary to demonstrate that the set of measures is disproportionately costly in itself;
- There are a number of ways of showing that a set of measures[17] is disproportionately costly in itself, and so justifying a permanently lower quality target for a water body. In order of preference these are:
    - That the cost of the measure or strategy exceeds any possible valuation of the benefits of increasing water quality to good status;
    - That the distribution of costs and benefits arising from moving to good quality would be disproportionate; or,
    - That the cost of the measure or strategy on a particular body or group would not be affordable.

These summary steps, and the thinking behind them, are described in more detail below. A step by step approach to implementing this approach is set out in the next Section of this guidance document. The diagram in set out in Figure C.1 summarises these steps.

[16] The draft Commission guidance referenced in note 4 suggests that the term "best available technique" as defined in the IPPC Directive may provide a guide to the concept of technical feasibility.
[17] Following the terminology established in the Cost Effectiveness Analysis Guidance a strategy is a combination of measures which brings a given water body, or bodies, to good status.

## Figure C.1: Outline Approach to Disproportionate Cost Analysis



### C.2.4 Postponing Based on Technical Feasibility

The WFD clearly provides that there is no obligation to meet its requirements for water quality by 2015 if it is not technically feasible to do so. Showing that it is not technically feasible to achieve a target level of water quality would be based on technical and engineering information, and would have no economic element.

If there is no technically feasible set of measures that will achieve the WFD quality requirements by 2015, three possibilities arise:

- A set of measures can be identified that would achieve the quality targets after 2015, and it is desired to put this in place;
- It is not technically feasible, in the current state of technology, to meet WFD quality requirement for the water body in question at any time;
- A set of measures can be identified that would achieve WFD quality targets post-2015, but these are considered to be too costly.

In all of these cases postponement on grounds of technical feasibility should be sought.

To consider each of these "sub cases" in turn:

1. If there is a set of supplementary measures that can be put in place now that will achieve good status after 2015, and if the cost of these measures is not disproportionate, then this set of measures should be included in the programme of measures in the management plan. The plan should point out that the achievement of good status for this water body is being postponed until after 2015 on the grounds of technical feasibility.

2. In the current state of technology it may not be possible to identify supplementary measures that would ever achieve good status. In this situation the river basin management plan should include all of the technically feasible measures that are available to bring water quality as close as possible to the WFD quality standards by 2015. The plan can note that the WFD quality standards are not being met by 2015 on grounds of technical feasibility.

3. In the third situation, it is not technically possible to meet the WFD quality standards by 2015, but a disproportionately costly set of measures exists that would achieve the WFD quality target after 2015. The river basin management plan for the period to 2015 should include all of the technically feasible measures that are available to bring water quality as close as possible to the quality standards of the WFD. The plan can note that the quality standards of the WFD will not be met by 2015 on grounds

of technical feasibility. If it is clear that the quality standards of the WFD will never be fully met, as the necessary measures will always be disproportionately expensive, the river basin management plan could note that a permanently lower quality target is being set for the water bodies in question on grounds of disproportionate cost. This could be justified using the method set out below. However, it could be more appropriate to revisit the possibility of reaching full WFD quality standards when the next river basin management plan is being prepared. Technology may improve, or costs may decrease, so it may not be necessary top rule out ever reaching WFD quality standards at this stage.

As described above, such a decision to postpone the achievement of WFD quality targets on feasibility grounds would not affect the obligation to prepare a River Basin Management Plan containing all basic measures, or to take all feasible supplementary measures that would bring the water body as close as possible to the WFD quality targets.

### C.2.5 Postponing Based on Grounds of Disproportionate Cost

Another situation that could arise is as follows:

- A given water body requires supplementary measures to bring it to good status by 2015, or to maintain its current good or high status;
- A set of supplementary measures exists that could meet the WFD quality targets by 2015, but the cost of these is considered to be too high; and,
- An alternative set of supplementary measures can be identified which would achieve the quality targets after 2015, but at an acceptable cost; and,
- The lower cost measures that would achieve the necessary quality level after 2015 score have a higher cost effectiveness score[18] than the measures that would take effect by 2015.

In this situation, the lower cost measures should be included in the programme of measures in the 2009 river basin management plan. The plan should specify that the achievement of good water status on this water body is being postponed on grounds of disproportionate cost.

This finding of disproportionate cost can be justified on the basis of the cost effectiveness scores calculated for the two programmes of measures in question. These results are telling us that the extra cost of the set of measures that achieves

[18] See Note 2 for reference to this separate guidance on measuring cost effectiveness

good status by 2015 is not matched by a net extra output in terms of improved water status. This additional cost of the set of measures that achieves good status by 2015 must be considered disproportionate, since it does not produce net extra benefits.

### C.2.6 Lower Water Quality Target on Grounds of Disproportionate Cost

In any other situation where a exemption from the WFD quality targets is considered, it will have to be shown that achieving these quality targets involves disproportionate cost, and that a permanent, lower, target for water quality must be set. This will involve showing that the cost of the most cost effective set of measures that would achieve the relevant quality standard, is disproportionate in itself. This will require one of:

- Demonstrating that the cost of the measure or strategy exceeds any possible valuation of the benefits of increasing water quality to good status;
- Demonstrating that the distribution of costs and benefits arising from moving to good quality would be disproportionate; or,
- Showing that the cost of the measure or strategy on a particular body or group would not be affordable.

### C.2.7 Conclusion

The approach to disproportionate cost analysis set out in C.2.3 to C.2.6 above covers all situations where the water quality standards in the WFD are not being met. This is made clearer in the decision tree representing the approach in Figure C.1

## C.3. Steps in a Disproportionate Cost Analysis

### C.3.1 Introduction

This Section sets out a detailed step by step approach to applying the concept of disproportionate cost when preparing River Basin Management Plans.

As is explained in Section C.2, there are a limited number of possible responses where basic measures will not be enough to ensure that a water body meets the quality requirements of the WFD. These are:

- Include a set of supplementary measures in the river basin management plan that will secure the water quality required by the WFD;
- Demonstrate that there are no possible supplementary measures that would secure the water quality required by the WFD, and so postpone meeting these quality targets on grounds of technical infeasibility;
- Postpone achieving the water quality required by the WFD until after 2015, using cost effectiveness information to show that it would be disproportionately costly to achieve these quality standards before 2015 as opposed to after 2015; or,
- Set a permanently lower water quality target for the water body in question on the grounds that it would be disproportionately costly to meet the quality requirements of the WFD.

In the last of these situations, there are three potential methods for demonstrating that it would be disproportionately costs to meet the quality targets of the WFD, and that a lower quality target should be set for the water body in question. These are:

- Demonstrate that the cost of the measure or strategy exceeds any possible valuation of the benefits of increasing water quality to good status;
- Demonstrate that the distribution of costs and benefits arising from moving to good quality would be disproportionate; or,
- Show that the cost of the measure or strategy on a particular body or group would not be affordable.

The remainder of this Section describes each of the possible methods of obtaining derogation from the water quality requirements of the WFD in turn: i.e. showing that it is not feasible to reach good status; postponing the achievement of good status beyond 2015 on disproportionate cost grounds and adopting a permanently lower quality target on disproportionate cost grounds. It goes on to indicate how these techniques can be adapted to the case of HMWBs.

### C.3.2 Feasibility Grounds for not Reaching Good Status

The issue of disproportionate cost analysis only arises where supplementary measures are needed to reach the quality targets of the WFD; a set of such supplementary measures exists that would achieve this by 2015; and, the cost of these measures is too high.

If no such set of supplementary measures exists, then the achievement of quality targets should be postponed on the grounds of technical feasibility. The river basin management plan should set out the technical and engineering facts that make it clear that, in the current state of technology, it is not technically possible to achieve the relevant quality target by 2015.

As discussed above, if certain measures should be put in place now on the basis that they will either:

- meet the relevant quality targets at an acceptable cost at some time after 2015, if they are put in place now; or,
- they will improve the quality of the water body at an acceptable cost without necessarily reaching the targets set in the WFD;

then the management plan should record this, and these measures should be included in the programme of measures. Otherwise the question of the appropriate measures should be revisited when preparing the 2015 management plan. This reconsideration of measures can take account of any improvements in technology in the intervening period.

### C.3.3 Justifying Postponement based on CEA output

Following the process outlined in Section C.2, it will be possible to use DCA to support a postponement of the achievement of good status where:

- A set of supplementary measures exists which would achieve the quality targets of the WFD by 2015;
- The cost of the set measures that achieve good status by 2015 is too high;
- A more cost effective set of measures exists which would achieve good status after 2015, but before 2027.

A Cost Effectiveness Analysis ("CEA") will have been carried out, and the strategy that would achieve good status by 2015 will have a lower measure of cost effectiveness than the preferred strategy. This result from the CEA supports a decision to postpone the achievement of good status based on disproportionate costs. Box C.1 below shows an example of the type of his type of situation.

In this situation, the results of the CEA are showing that the measures to achieve good status by 2015 cost more than the set of measures that achieve good status later, even when the cost of the two sets of measures are adjusted for the later achievement of good status under one of the sets of measures. The extra cost of the set of measures that achieve good status by 2015 is not matched by a net extra output in terms of improved water status. The cost of the set of measures that achieve good status by 2015 must be considered disproportionate, since they cost more than an alternative set of measures without delivering any net extra impact.

This approach should cover any situation where it is desirable to postpone the achievement of good status.

For example, it will cover a situation where cost savings can be realised by opting for a cheaper strategy to achieve good water status which takes longer to take effect than a more expensive alternative that would achieve good status by 2015.

This approach will also allow postponement of good status to be justified where some foreseeable change in circumstances makes it worthwhile to do so. For example in order to achieve good status for a given water body, it might be necessary to scale back the activities of certain livestock farmers. This will impose a cost on these farmers, which would be taken into account when carrying the CEA of this strategy. However it could be the case that postponing these actions to improve water quality would reduce their impact on farmers, if outside factors such as changes in the CAP or other agriculture polices would mean that the activity in question would be scaled back in the future anyway.

In this case there are in fact two strategies under consideration: take the measures that restrict livestock activities now; or, wait and take the measures later when they will have less impact on farmers. Since taking the measures later results in a lower cost to farmers, this strategy will have a lower cost, and should score higher in the CEA provided that it does not delay achievement of good status by too long a time. On this basis it will be possible to postpone this measure so as to minimise its impact on the farming community, and to support this postponement of the achievement of good status on grounds of disproportionate cost.

### Box C.1: Postponing Good Status Based on the Results of CEA

Dredging has occurred in the Fake River, leading to channelisation. This has altered river flow and spawning grounds, with adverse effects on fish life. Supplementary measures to address this pressure are needed to bring the status of the river from Moderate up to Good. Two possible strategies (sets of supplementary measures) have been identified:

- Assisted recovery – enhancement scheme; and
- Large scale restoration scheme.

Assisted recovery would achieve good status by 2017, two years after the deadline imposed by the Water Framework Directive. Large scale restoration involves re-meandering of the river and raising bed levels in addition to the actions under assisted recovery. Good status would be achieved by 2014.

For the purposes of CEA both of these strategies have an output of one status unit per year. Assisted recovery will produce one unit of output per year from 2017. Large scale restoration will produce one unit of output per year from 2014. This output is discounted and summed over the period to 2039, with the following results:

| Strategy | Output in Discounted Increment Years |
|---|---|
| Assisted recovery | 11.74 |
| Large scale restoration | 14.21 |

The costs of each are quantified. These costs and the resulting cost effectiveness measures are summarised below:

| Strategy | Output in Discounted Increment Years | Discounted Costs (€m) | Effectiveness Ratio (units of output per €m) |
|---|---|---|---|
| Assisted recovery | 11.74 | 2.646 | 4.4 |
| Large scale restoration | 14.21 | 6.926 | 2.0 |

Large Scale Restoration is the only strategy that achieves good status by 2015. However, as this strategy is significantly less cost effective than Assisted Recovery, it would be disproportionately costly to opt for it. The Assisted Recovery strategies, which will achieve good status by 2017, should be adopted. This postponement of the achievement of good status is justified on grounds of disproportionate cost. The greater cost effectiveness of Assisted Recovery compared with the strategy that would achieve good status by 2015 is used to demonstrate this disproportionate cost.

## C.3.4 Setting a Lower Water Quality Target

If it is not possible to postpone the achievement of the WFD water quality targets beyond 2015 on the basis of cost effectiveness as described above, it will be necessary to justify a permanently lower status for that water body. This can only be done by showing that it would be disproportionately costly to bring this water body to good status. In principle, there are a number of ways to do this:

- Comparing the costs and benefits of the most cost effective set of measures that would achieve good status (See Section C.3.5);
- Identifying a disproportionate impact on a particular group of the most cost effective set of measures that would reach good status (See Section C.3.6); or
- Demonstrating that the set of measures that would achieve good status is not affordable (See Section C.3.7).

There is a clear order of preference between these three methods for DCA. The first method, comparing costs and benefits, will be the most robust, and the remaining methods will be progressively less robust. Where a DCA is being carried out to support a lower quality target for a water body the most robust method possible from this list should be used. It should be emphasised that setting a lower objective for water quality should be regarded as an unusual step to be taken in exceptional circumstances. This type of DCA analysis should only have to be carried out in a small number of cases, if at all. Each of these three approaches is described in more detail in the subsections below:

## C.3.5 Lower Objectives: Cost Greater than Benefit

### *Introduction*

Derogation on the grounds of disproportionate cost will always be essentially a policy decision. However, this policy decision must be backed up with robust

financial and economic analysis if the decision is to be accepted by the public and other stakeholders.

It will not be possible to value all of the benefits of achieving good water status, so the decision cannot be based on a simple comparison of the value of costs and the value of benefits. In particular, it is clear that the decision to set a lower objective cannot be based on the costs of achieving good status being greater than the benefits that can be valued in money terms. (See Section C.1.3 above for more discussion of this issue.) A finding that the costs of achieving good status are disproportionate and that a lower target for water quality should be set, must be based on a comparison of the costs of the strategy that would achieve good status with the fullest possible description and quantification of the benefits of good water status. This comparison must show that the costs of achieving good status would clearly exceed any possible value of the benefits of achieving good status.

There are a number of steps in carrying out this analysis:

- Analyse the results of the CEA already carried out;
- Define the relevant "Do Nothing" scenario; and,
- Identify the potential benefits of achieving WFD quality targets for the water body in question;

The issues that arise in each of these steps are discussed below. An example of a cost benefit carried out in line with this approach is attached as Appendix 3.

***Analyse the Results of CEA***

The costs of the set of measures in question will have been identified in the cost effectiveness analysis already carried out. These costs will comprise:

- Public implementation costs, i.e. any costs incurred by the local authority or other public body in implementing the strategy in question;
- Industry implementation costs, i.e. any costs imposed on farming, services and manufacturing industries;
- Consumer implementation costs, i.e. cost imposed on consumers such as increased flood risks; and,
- Externalities cost to society as a whole from the strategy, such as environmental costs of some actions.

The cost effectiveness analysis will also provide a good initial indication of whether the costs of a set of measures are, in fact, disproportionate. The output of the cost effectiveness analysis is an "effectiveness ratio". This number captures:

- How much water quality is improved by the set of measures in question;

- How soon that improvement will be achieved; and,
- The cost of the set of measures.

Other things being equal, if a set of measures is disproportionately costly, this should be reflected in an effectiveness ratio that is lower than that calculated for the measures that are being included in river basin management plans.

### Defining the "Do-Nothing" Scenario

As with any cost-benefit type exercise defining the "do-nothing" scenario is an essential step in this exercise.

This DCA is being carried out because the most cost effective set of measures that can be identified that would achieve the WFD quality targets for a given water body are too expensive to implement. As a result, the water body will not meet the quality standards set by the WFD. However, certain measures will be carried out. In particular, the competent authorities will be obliged to implement all basic measures for this water body. In addition, the competent authorities will be obliged to implement any supplementary measures that have been identified in the CEA process that will bring the body closer to the quality standards of the WFD without incurring disproportionate costs. This course of action, implementing basic measures and a cost effective set of supplementary measures, is the "do-nothing" scenario for the DCA.

The relevant costs for the DCA are the costs over and above this do-nothing scenario, i.e. only the costs of the specific supplementary measures which the competent authorities wishes to avoid implementing. The relevant benefits are the hypothetical benefits of bringing water quality from the state it will reach under the "do nothing" scenario to full compliance with the quality requirements of the WFD.

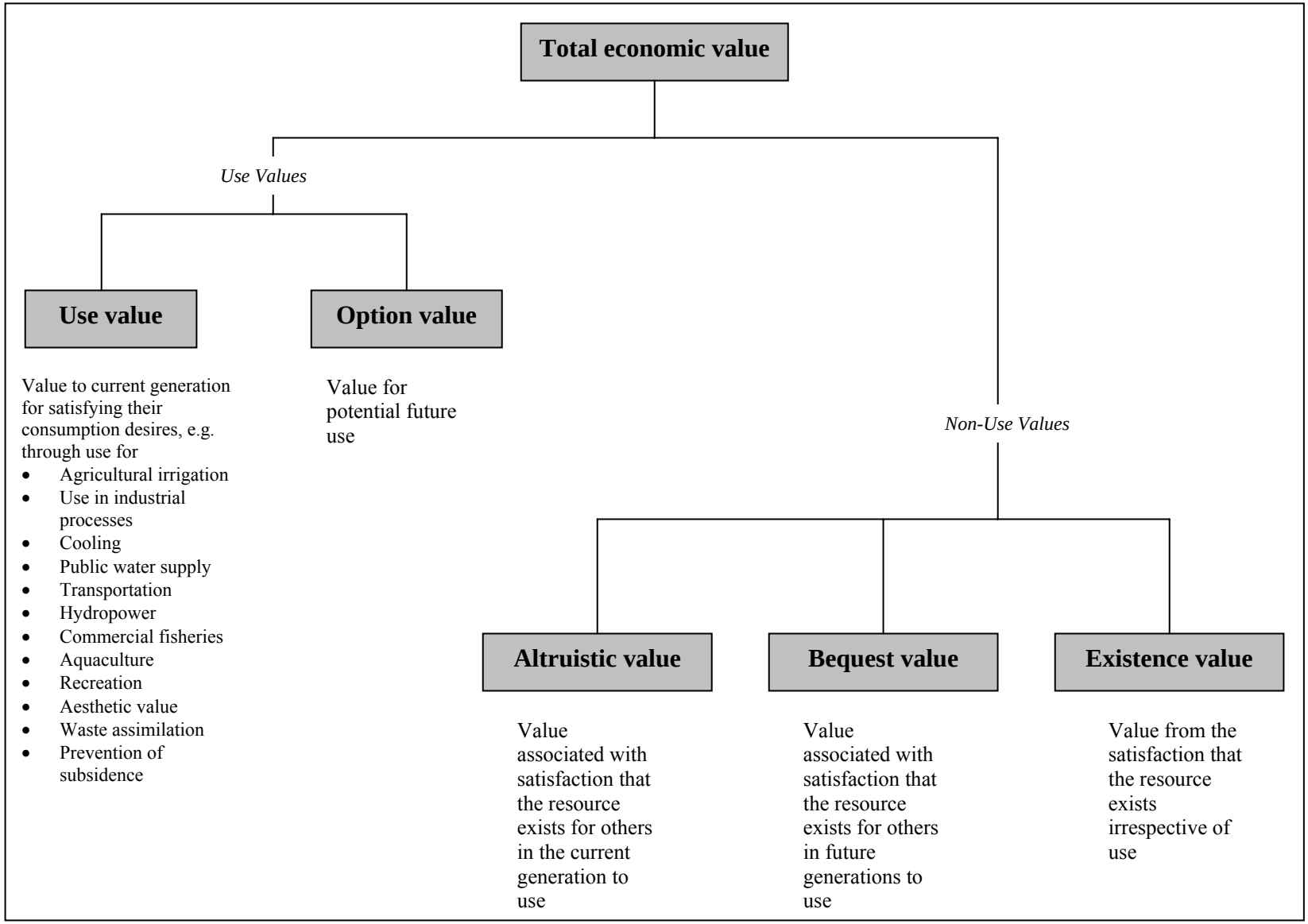
In most cases the WFD will require that a water body is brought to good status. A likely do-nothing scenario is one where a combination of basic measures, and possibly some supplementary measures, will bring a water body to moderate quality. A DCA will be needed to support not bringing the water body to good status. The relevant benefits to be taken into account will be the additional benefits of having the water body at good rather than at moderate status. For example, if the water body can be used for abstraction while it is at moderate status there may be no abstraction benefits from bringing it to good status. Conversely if a move from moderate status allows game fishing as well as coarse fishing there is an amenity benefit. However, it is important to note that this amenity benefit is only the increase in total amenity, not the full amenity value of a water body that allows coarse and game fishing.

### *Potential Benefits of Achieving WFD Quality Targets*

The potential benefits of a set of measures that would achieve good status are discussed in a separate paper on valuing the benefits of water resources[19]. The potential benefits of achieving good status are summarised in Figure C.2 below, reproduced from that paper.

[19] Goodbody Economic Consultants *Review of Water Resource Benefit Values* August 2008

## Figure C.2: Total Economic Value of Water




Source: Entec 2008

In constructing a DCA argument for a lower target than good status the potential for each of these benefits from achieving good water status should be considered. Where achieving good status would give rise to benefits, these should be identified and valued to the extent possible. When it is not possible to place a monetary value on a benefit, the best information available on the scale of the benefit should be identified.

### *Illustration of this Approach to Benefits*

This approach is illustrated in Table C.1 below. This list of potential benefits is not exhaustive, but illustrates the approach that could be taken to assessing the benefits foregone by not bringing a given body of water to good status. This illustration assumes that the water body is at moderate status in the do-nothing scenario, and that, in the absence of a DCA, the WFD would require that the water body be brought to good status:

**Table C.1: Measuring the Benefits of Good Water Status**

| Type of Benefit | Suggested Measurement |
|---|---|
| ***Use Values*** | |
| Agricultural Irrigation | If achievement of good status is necessary for agricultural use:<br>• Volume of water that would be used<br>• Market value of that water at indicative water charge<br>• Margin earned on produce |
| Use in Industrial Process | If good status is needed for a process:<br>• Volume of water that would be used<br>• Market value of that water at indicative water charge<br>• Margin earned from output of industrial process |
| Public Water Supply | If good status is needed to use the water in public supply:<br>• Volume of water that would be made available<br>• Market value of that water at an indicative water charge (net of any additional distribution costs that would be necessary) |
| Commercial Fisheries and Aquaculture | If good status us needed to support commercial fishing or aquaculture:<br>• Margin earned in this new activity |

| | |
|---|---|
| Recreation | Recreation includes informal recreation, angling, boating, canoeing, coastal bathing etc. See Section C.1.5 for references to existing studies on valuing the recreational use of water bodies. For example UK Environment Agency guidance suggests that increasing the quality of a water body used for informal recreation from a level that can support good coarse fishery to one that would support trout fishing generates extra value of £0.09 (in sterling, at 2001 prices) per visit to the water body |
| Aesthetic value | • Number of current and potential future visitors to the water body |
| Heritage, Archaeology and Landscape | • Quantitative measures such as the number of heritage and archaeological sites affected or extent to which landscape will be affected. |
| Biodiversity | The protection of certain species is mandated by existing legislation. However reaching good status on a given water body could increase the number of species present at that location. If this is the case relevant measures are:<br>• Increase in biodiversity as a result of reaching good status;<br>• Number of other habitats for the species in question;<br>• Potential educational and "amenity" benefit of having these species at the site in question |
| ***Option Values*** | A water body might not currently be used for any of the purposes described above, however if circumstances change in the future it might become a valuable resource. This is referred to as an option value. The extent of such an option value should be assessed by measuring the value of the water body if used for these purposes and estimating the likelihood of it being needed for these purposes in the future. |
| ***Altruistic Value,*** | These "non-use" are difficult concepts to measure. |

| | |
|---|---|
| ***Bequest Value, and Existence Value*** | However the altruistic value of knowing that others can use a water body must be a function of the use value to those who do use it. Similarly, the bequest value must be related to the current use value delivered by a water body and the existence value must be related to the option value of potential future use of the water body. Some studies have been carried out which attempt to place money values on these benefits by using surveys to determine that amount of money that people would be "Willing to Pay" for improved quality of a given water body. These represent the best available source of money values for these benefits. |

In summary the benefits that can flow from bringing a water body to good status are:

- Use values such as abstraction and leisure use;
- Option value of potential future use;
- Altruistic Value;
- Bequest Value; and,
- Existence Value.

These should be identified and measured to the extent possible, and compared with costs to justify the finding of disproportionate cost. Indicators that a particular strategy was indeed disproportionately costly would include:

- The costs of the strategy to achieve good status are significantly in excess of the monetisable benefits of achieving good status. As discussed above, since many of the benefits of good water status are not monetisable, simply finding that costs exceed monetisable benefits would not be enough to demonstrate disproportionality; or,
- The benefits of the strategy are significantly less than those obtained from strategies actually included in River Basin Plans, which have a similar cost.

### C.3.6 Lower Objectives: Disproportionate Impact

The benefits of increasing water quality are diffuse. A large number of people will consume water, or use the recreation and leisure possibilities of a water body. The value gained by any one individual will be small compared to the costs of measures to improve water quality.

In some circumstances, a large portion of the cost of a measure to improve water quality will fall on a relatively small group of individuals. This type of impact could be considered disproportionate, and could form the basis of a derogation from the requirement to reach good water status.

A likely circumstance where this type of argument would arise is where the only measure to achieve good status in a water body requires that a source of pollution from industrial activity be brought to an end. The only way to do this may be to close down an industrial activity that currently discharges waste into a water body. This would have a serous impact on the employees and owners of this firm. If the firm is a significant local employer, and the workers displaced have few alternative sources of employment in the area this could be considered a disproportionate impact.

This type of issue is best dealt with by seeking derogation on the grounds on disproportionate impact, rather than assigning a cost to this effect and arguing that the cost of the strategy is too much in excess of the benefits. The practical difficulties that arise in assigning costs to this type of effect are described in Box C.2 below.

**Box C.2: Treatment of Effects on a Local Industry**

Cost Effectiveness Analysis may identify a strategy that would have a significant negative impact on local employment and businesses. For example, the most cost effective way to achieve good status might be to impose stringent IPPC licence conditions on a business that discharges waste into a river. These conditions could have the effect of forcing the business in question to reduce its output, or even to close down its operations. This would lead to job losses, and lost profits. The questions arises of how this should be reflected in the DCA, and how such factors could be used in a DCA to argue for a postponement of the measures in question, or even to argue for not taking such measures.

In terms of economic theory a reduction in wages paid in an area does not represent a loss of total welfare. Formally, the benefit of the wages and salaries paid to those working in a firm have to be set against the effort and loss of welfare from having to work. This is expressed as labour having a "shadow price". In a time of high employment, where workers will have a number of options for employment, this shadow prove will be very close to the wages that must be paid. If the shadow price of labour is high relative to wages, the loss of a given set of jobs in an area will have a very minor impact on total welfare. It is intuitively acceptable that job losses in a given firm will not cause significant reductions in total welfare in a time of high employment. Conversely, if the shadow price of labour is low, in an area of high unemployment where people have few alternative employment opportunities, then job losses can give rise to significant reductions

in total welfare.

Calculating the cost, in terms of economic welfare, of job losses would require estimating the relevant shadow price of labour. The shadow price of labour could vary over time, as economic conditions change, and from place to place, depending on the local labour market. The use of a shadow price for labour in DCA would therefore be impractical. Where a measure is disproportionately costly due to the fact that it will cause job losses, it will not be practical to calculate an economic cost for these job losses to demonstrate that the costs of the measure are disproportionate to its benefits. Instead, it is proposed to demonstrate that the measure is disproportionate based in the second possible ground, that it has a disproportionate negative impact on one group of stakeholders.

It is an important principle of the WFD, and of EU and Irish environmental law and policy, that polluters should pay for the effects of their pollution. A DCA argument based on impact on a particular industry and/or community should only be made if:

- The industry in question is not responsible for the pollution in question; or,
- The costs imposed on the industry and/or community in question as a result of the measures envisaged greatly exceed the value of the damage done by pollution generated by that industry.

Once it has been established that a strategy to achieve good water status will have a significant impact on a given industry, and possibly on a local community that depends on this industry, it will have to be demonstrated that this represents a net negative impact on overall economic welfare. There are a two ways in which this could arise:

- The effect on income distribution is inequitable;
- The effect on a community and the location of economic activity conflicts with spatial and other national policies.

Considering each of these in turn:

### C.3.6.1 Equity Effects of a Disproportionate Impact

If a significant number of the employees affected by closing the industrial activity have below average incomes, and would suffer a reduction in income as a result of the closure, there is a clear equity argument that the measure could be disproportionately costly.

The benefits of achieving good water status will be widely spread through society and will accrue to people of all income levels. If the costs of achieving good water

status fall on those with below average income the strategy is "regressive" i.e. it has the effect of redistributing income from the less well off to the more well off. The strategy will increase income inequality.

In addition, it is very likely to decrease total economic welfare. Assuming a diminishing marginal utility of income, those who lose out as a result of the closure will suffer a greater loss of welfare than the gain in welfare experienced by those who benefit from the measure.

### C.3.6.2 Spatial Policy Effects of a Disproportionate Impact

If the negative impacts of a strategy are confined to a particular geographic community the strategy will have a negative impact on spatial policy. A number of significant national policies are dedicated to preserving and increasing the spread of economic activity and employment opportunities around the country. A measure to improve water quality that closes down a particular economic activity could go against some or all of these policies. Examples of these policies include:

- The National Spatial Strategy;
- The regional aspects of the National Development Plan;
- The RAPID and CLÁR programmes operated by the Department of Community, Rural and Gaeltacht Affairs;
- The EU's LEADER programme to promote sustainable rural communities;
- The network of county development boards; and
- The activities of regional assemblies, regional authorities and local authorities.

To consider some of these in more detail:

The National Spatial Strategy ("NSS") sets out policy priorities for the spatial dimension of growth and development in Ireland over the period to 2020[20]. This Strategy noted that "much of Ireland's recent prosperity has been generated in the Greater Dublin Area….Ireland also needs to build up other places and areas to be similarly strong on a national and international scale – generating benefits closer to where people live."[21] With this in mind the NSS aims to establish a network of nine "Gateway" cities and related Hub towns to act as focal points for a more even spread of economic activity around the country. Improving the regional balance of development in this way is to improve quality of life and the sustainability of Ireland future economic growth.

[20] "National Spatial Strategy for Ireland, 2002-2020 People Places and Potential" available at www.irishspatialstrategy.ie
[21] Ibid. paragraph Section 1.1.(i)

The current National Development Plan ("NDP")[22] has as one of its goals the "integration of regional development within the National Spatial Strategy framework". The range of capital spending envisaged in the Plan is to promote regional development through improvements in infrastructure and targeted investments in NSS Gateways. In addition the NDP aims to preserve and diversify rural communities through such investments as the rollout of rural broadband, the Rural Transport Initiative and non-national roads. Spending under the NDP may be affected by current budgetary considerations, however the plan itself remains an authoritative statement on national policy on certain spatial matters.

If a strategy to achieve good water status were to have a significant negative impact on the economy of a small community this would be in direct opposition to national spatial and regional policy as expressed in the NSS and the NDP. Such a negative impact on national, policy would clearly represent a disproportionate cost of such a strategy, and justify claiming an exemption from the requirements of the WFD on the basis of this disproportionate cost, and not implementing the strategy.

### C.3.7 Lower Objectives: Affordability

There is a clear consensus that affordability issues can support postponing the achievement of WFD quality targets. However, a number of Member States involved in the Common Implementation Strategy do not consider that affordability arguments can be used to justify water quality that is permanently below WFD targets. Because of this, and a number of other factors, affordability may not carry much weight as the basis of a DCA argument for permanently lower water quality in practice. Other difficulties with the use of affordability in practice include:

- The stated position of the Commission that the WFD places an obligation on Member State Governments to fund necessary measures; and,
- The obligation on the competent authorities to consider alternative funding mechanisms for water quality measures.

Any DCA argument based on affordability would have to be based on the relationship between water quality and other national objectives, and national policy on funding these policies. In practice this type of DCA analysis would have to be carried out on a national basis, rather than by individual Local Authorities.

[22] National Development Plan 2007-2013 "Transforming Ireland, a better quality of life for all" January 2007. Available at www.ndp.ie

## C.3.8 Other Uses for DCA

As discussed in Section C.3.1 above a process similar to DCA is required when a river basin district wishes to either designate a water body as a HMWB or seek derogation where man-made changes to a water body will prevent it from reaching good status.

In both cases the legal "test" required by the Water Framework Directive requires the competent authorities in question to:

- Identify an alternative engineering solution that will deliver the non-water benefits currently provided by the HMWB, or that will be provided by the proposed modifications to a water body; and,
- Demonstrate that this alternative solution would involve disproportionate costs.

Demonstrating that the alternative to a HMWB, or to a proposed new modification to a water body, would involve disproportionate costs should follow a similar process to that described for obtaining permanent derogation from the requirement to reach good status. This process is described in Sections C.3.4 – C.3.7 above.

The most convincing form of DCA would be where the costs of this hypothetical alternative are in excess of the benefits of good water status in the water body in question. The key calculation here is the estimation of the benefits of good status on a given water body, which is discussed in Section C.3.5 above.

If this form of DCA cannot be carried out, disproportionate cost will have to be demonstrated by:

- Establishing that the alternative engineering solution would have a disproportionate negative impact on one group, for example by causing unemployment in a defined community (See Section C.3.6); or,
- Establishing that the alternative engineering solution cannot be financed out of public funds for reasons outside the control of policy makers. As discussed in Section C.3.7 this type of argument would have to be made on a centralised basis.

## Appendix 1: Discount Factors

The Table of Discount Factors is based on a discount rate of 4 per cent.

| Year | Discount Factor |
|---|---|
| 1 | 1.0000 |
| 2 | 0.9615 |
| 3 | 0.9246 |
| 4 | 0.8890 |
| 5 | 0.8548 |
| 6 | 0.8219 |
| 7 | 0.7903 |
| 8 | 0.7599 |
| 9 | 0.7307 |
| 10 | 0.7026 |
| 11 | 0.6756 |
| 12 | 0.6496 |
| 13 | 0.6246 |
| 14 | 0.6006 |
| 15 | 0.5775 |
| 16 | 0.5553 |
| 17 | 0.5339 |
| 18 | 0.5134 |
| 19 | 0.4936 |
| 20 | 0.4746 |
| 21 | 0.4564 |
| 22 | 0.4388 |
| 23 | 0.4220 |
| 24 | 0.4057 |
| 25 | 0.3901 |
| 26 | 0.3751 |
| 27 | 0.3607 |
| 28 | 0.3468 |
| 29 | 0.3335 |
| 30 | 0.3207 |

# Appendix 2: Case Studies

## Case Study A: Fake River - Hydromorphological Pressures

### A1 Background

Fake River contains a ten kilometre stretch with no pollution pressures, but with morphological pressures that impact on the river biology. These morphological pressures consist of overgrazing and channelisation. These pressures are impacting on the ecology of the River, so that measures aimed at addressing morphological pressures are required if good status is to be achieved.

### A2 Identifying the Pressures

There are two pressures. The first is that overgrazing of animals is occurring leading to destruction of the riparian zone and occasional incursion of animals into the river. These are in turn leading to a reduction in water quality and disturbance to spawning grounds. The second pressure is that river dredging has occurred leading to channelisation. This has altered river flow and spawning grounds, with adverse effects on fish life.

### A3 Establishing the Current and Year 2015 Status

Currently, the morphological pressures are such that the ecological status of the River is Moderate. This status will not be raised by 2015 unless additional uncommitted measures are taken.

### A4 Establishing the Good Status Gap

Additional measures are needed to bring the status from Moderate up to Good.

### A5 Identification of Feasible Alternative Measures: Overgrazing

With regard to the overgrazing pressure, planners have identified two options:

- Natural recovery; and
- Assisted recovery.

Natural recovery is often termed “benign neglect” by river morphologists and involves removal of the pressure, and leaving the river alone to recover naturally. Overgrazing has been a problem in the west of Ireland. However it is widely accepted that the process of natural recovery is already occurring in Ireland since farming practices have changed and there is no longer a high intensity of farming

in upland areas i.e. the pressure has been removed. However, this process will take a long time to achieve the desired result.

Assisted recovery is the application of soft engineering enhancement measures to boost the river's recovery potential. Irish experts foresee these measures as being the most relevant to address morphology issues. In the context of Fake River, this takes the form of:

- Bank stabilisation using log tree revetments and willow spiling; and
- Fencing off to allow recovery of riparian zone (preventing livestock).

Recovery of the riparian zone will take 6 years to achieve from the date of the capital works (2011), so that good status would be achieved in 2017, in the period of the second river basin plan.

Natural recovery is not a measure in the context of the WFD. No action is required on the part of Government to achieve this outcome. Either it is happening naturally because of changes in the socio-economic environment, or it is occurring due to past and committed Government initiatives. Natural recovery is in fact the Reference Scenario. It would be different if additional policies to restrict stocking rates were being contemplated.

As a result, there is only one option being considered. If there are no other realistic options, then there is no need to apply cost effectiveness analysis.

However, the issue of disproportionate costs could arise, in that assisted recovery could be deemed to be disproportionately expensive. Assisted recovery costs have been estimated at an initial capital cost of €2m with recurring annual maintenance costs of €7,500.[23]

This might be the case if natural recovery were to occur soon after 2021, say 2023 This would mean that the assisted recovery spend would provide benefits for a limited period of 6 years. A disproportionate cost analysis, which compares a reference scenario (natural recovery) with the assisted recovery scenario, would be needed to make the case.

## A6 Identification of Feasible Alternative Measures: Channelisation

With regard to the channelisation pressure, three measures were again identified:

- Natural recovery;

[23] Note: all the costs in this case study are real costs derived from a number of sources but, principally, the POMS Morphology Report.

- Assisted recovery – enhancement scheme; and
- Large scale restoration scheme.

Natural recovery in this context is the cessation of watercourse maintenance activities. Good status would be achieved within ten years – 2020. It should be noted, that unlike the overgrazing example, natural recovery **is** a measure in the context of the WFD. This is because it requires an additional action on the part of Government viz. cessation of maintenance activities. Thus, "natural recovery" is a misnomer.

Assisted recovery is a lower cost option comprising:

- Recreation of pools;
- Fencing off;
- Narrowing of channels; and
- Substrate Enhancement.

Good status would be achieved within 7 years, i.e. by 2017.

Large scale restoration involves remeandering of the river and raising bed levels in addition to the actions under assisted recovery. Good status would be achieved by 2014.

## A7 Sifting and Screening of Measures

As only three measures have been identified, no sifting or screening is required.

## A8 Developing a Strategy

As all three measures are capable of achieving good status, there is no need to consider combining measures into a strategy.

## A9 Setting a Target Status Date

Only one of the measures – large scale restoration - achieves good status prior to 2015. Therefore, no CEA is required and this measure should be proceeded with, unless it can be shown to be disproportionately expensive. If it is disproportionately expensive, then the CEA analysis of the three options would need to be undertaken in the context of a 2021 target date.

## A10 Defining and Measuring Outputs

As all of the alternative measures are aimed at achieving good status, the output is one incremental unit. This will be achieved at different dates according to the following table.

| Measure | Incremental Output | Year Output is Achieved |
|---|---|---|
| Natural recovery | 1 | 2020 |
| Assisted recovery | 1 | 2017 |
| Large scale restoration | 1 | 2014 |

## A11 Calculation of Outputs

The calculation of the Discounted Sum of the Increment Years is presented in Table A1 and summarised below:

| Measure | Output in Discounted Increment Years |
|---|---|
| Natural recovery | 9.55 |
| Assisted recovery | 11.74 |
| Large scale restoration | 14.21 |

At 14.21 units, the output from the large scale restoration measure is 49 per cent above Natural recovery and 21 per cent above Assisted recovery.

## A12 Defining and Estimating Costs

### Public Implementation Costs

The following are the public implementation costs. These relate to the initial capital costs of works and recurring maintenance costs. Cessation of maintenance activities gives rise to no direct public implementation costs.

| Measure | Initial Costs (€m) | Recurring Costs (€000) |
|---|---|---|
| Natural recovery | 0.0 | 0.0 |
| Assisted recovery | 2.5 | 7,500 |
| Large scale restoration | 6.5 | 15,000 |

### Industry Implementation Costs

As dredging of the river will be discontinued, it may be expected that with the Natural and Assisted recovery Measures, there will be a seasonal loss of productive farming land, as the river will breach its banks in certain places in periods of high rainfall. With regard to large scale restoration, remeandering of the river will give rise to further land take. This will reduce the farmer's consumer surplus as measured by the costs of the land take. This is a once-off capital item.

Three stretches of river to an aggregate of 1,000 metres in length and 50 metres wide will be flooded. This will result in the loss of 5 hectares of land for five months of the year. Assuming a price €25,000 per hectare and assuming a loss of value proportionate to the duration of flooding, this is a once off cost of €0.052m (€25,000 x 5 hectares x 5/12).

With regard to meandering, a further 1,000 metres in length will be affected, with an average width of 150 metres. This amounts to a land loss of 15 hectares at a cost of €0.375m. The once-off industry costs of the measure are therefore as follows:

| Measure | Costs (€m) |
|---|---|
| Natural recovery | 0.052 |
| Assisted recovery | 0.052 |
| Large scale restoration | 0.427 |

**Consumer Implementation Costs**

Prior to dredging of Fake River, periodic flooding occurred. Channelisation was partly prompted by the fact that, in a number of flooding events, some houses had come under threat, although no ingress of water had taken place.

Flood risk modelling revealed that two properties would be affected in a 50 year flood and six properties in the 100 year flood. In the 100 year flood, three properties would be flooded to above floor level, which is a key determinant of damage to property and contents.

The costs incurred by damage at these intervals were calculated using Flood Hazard Research Centre (FHRC) FLAIR data.[24] The FHRC approach calculates the damage inflicted by flooding of different depths and durations and distinguishes between the impact of flooding on the building fabric and on its contents. The costs arising from flood effects on a variety of property types are provided in the FHRC FLAIR report. [25] Using the above damage costs, the expected value of the damage cost for any one year can be estimated, taking account of the probability of a flood occurring and the costs imposed when it does occur. This was estimated at €3,300 per annum.

Intangible benefits such as those impacting on the health of wellbeing of residents are normally taken to be equivalent to the damage costs, so that the annual expected costs of flooding of residences was estimated at €6,600 per annum.

Because the flood heights reached even in the 100 year flood were not sufficient to result in a major ingress of water above floor, dredging was found to be a sufficient response.

[24] FLAIR 1990, Flood Hazard Research Centre, Middlesex Polytechnic 1990.

[25] They are given in January 1990 prices in pounds sterling. These figures were converted revised by converting them into Irish Euro at the 1990 exchange rate and the increasing them according to Irish inflation rates for the intervening period.

It was considered that all of these flood relief benefits (€6,600 per annum) would be lost under the Natural recovery and Assisted recovery measures. These would thus represent a consumer implementation cost.

With regard to Large scale restoration, remeandering of the river would increase the flood plain and reduce the severity of the flooding to some extent. In this case, the expected damage would be reduced by one quarter compared with no protection, so the flood relief benefits lost would be €4,950 (0.75 X €6,600).

For all measures, these costs would start to arise once good status is restored.

The annual consumer costs of the measure are therefore as follows

| Measure | Costs (€m) |
|---|---|
| Natural recovery | 0.007 |
| Assisted recovery | 0.007 |
| Large scale restoration | 0.005 |

**External Costs**

There are no external costs arising.

## A13 Cost Effectiveness

The Table below summarises the cost-effectiveness of the alternative measures. The natural recovery measure has a cost effectiveness ratio of 97.4 units of output per €1m of spending. This is by far the highest cost effectiveness score. Large scale restoration only scores 2 on this scale, while assisted recovery scores 4.4. Tables A.1 to A.3 summarise the calculations.

| Measure | Output in Discounted Increment Years | Discounted Costs (€m) | Effectiveness Ratio (units of output per €m) |
|---|---|---|---|
| Natural recovery | 9.55 | 0.098 | 97.4 |
| Assisted recovery | 11.74 | 2.646 | 4.4 |
| Large scale restoration | 14.21 | 6.926 | 2.0 |

The natural recovery measure is so superior in cost-effectiveness terms that it is likely to hold true across a range of water bodies, especially those outside urban areas. For water bodies with substantial residential or commercial dwellings in their catchments, it is possible that natural recovery would give rise to increased consumer costs in the form of higher risks of flood damage. In this context, large scale restoration might become a more cost–effective option, as remeandering of the river could reduce the flood risk to property.

**Table A1: Measurement of Output**

| Natural Recovery | | Assisted Recovery | | Large Scale Restoration | |
|---|---|---|---|---|---|
| Increment Years | Discounted Increment Years | Increment Years | Discounted Increment Years | Increment Years | Discounted Increment Years |
| | | | | 1 | 0.85 |
| | | | | 1 | 0.82 |
| | | | | 1 | 0.79 |
| | | 1 | 0.76 | 1 | 0.76 |
| | | 1 | 0.73 | 1 | 0.73 |
| | | 1 | 0.70 | 1 | 0.70 |
| 1 | 0.68 | 1 | 0.68 | 1 | 0.68 |
| 1 | 0.65 | 1 | 0.65 | 1 | 0.65 |
| 1 | 0.62 | 1 | 0.62 | 1 | 0.62 |
| 1 | 0.60 | 1 | 0.60 | 1 | 0.60 |
| 1 | 0.58 | 1 | 0.58 | 1 | 0.58 |
| 1 | 0.56 | 1 | 0.56 | 1 | 0.56 |
| 1 | 0.53 | 1 | 0.53 | 1 | 0.53 |
| 1 | 0.51 | 1 | 0.51 | 1 | 0.51 |
| 1 | 0.49 | 1 | 0.49 | 1 | 0.49 |
| 1 | 0.47 | 1 | 0.47 | 1 | 0.47 |
| 1 | 0.46 | 1 | 0.46 | 1 | 0.46 |
| 1 | 0.44 | 1 | 0.44 | 1 | 0.44 |
| 1 | 0.42 | 1 | 0.42 | 1 | 0.42 |
| 1 | 0.41 | 1 | 0.41 | 1 | 0.41 |
| 1 | 0.39 | 1 | 0.39 | 1 | 0.39 |
| 1 | 0.38 | 1 | 0.38 | 1 | 0.38 |
| 1 | 0.36 | 1 | 0.36 | 1 | 0.36 |
| 1 | 0.35 | 1 | 0.35 | 1 | 0.35 |
| 1 | 0.33 | 1 | 0.33 | 1 | 0.33 |
| 1 | 0.32 | 1 | 0.32 | 1 | 0.32 |
| | 9.55 | | 11.74 | | 14.21 |

## Table A2.1: Measurement of Costs: Natural Recovery

| Year | Natural Recovery Costs (€'000) | | | | |
|---|---|---|---|---|---|
| | Public Implementation | Industry | Consumer | Total | Discounted |
| 2010 | 0.0 | | | 0.0 | 0.000 |
| 2011 | 0.0 | | | 0.0 | 0.000 |
| 2012 | 0.0 | | | 0.0 | 0.000 |
| 2013 | 0.0 | | | 0.0 | 0.000 |
| 2014 | 0.0 | | | 0.0 | 0.000 |
| 2015 | 0.0 | | | 0.0 | 0.000 |
| 2016 | 0.0 | | | 0.0 | 0.000 |
| 2017 | 0.0 | | | 0.0 | 0.000 |
| 2018 | 0.0 | | | 0.0 | 0.000 |
| 2019 | 0.0 | | | 0.0 | 0.000 |
| 2020 | 0.0 | 52 | 6.6 | 58.6 | 39.588 |
| 2021 | 0.0 | | 6.6 | 6.6 | 4.287 |
| 2022 | 0.0 | | 6.6 | 6.6 | 4.122 |
| 2023 | 0.0 | | 6.6 | 6.6 | 3.964 |
| 2024 | 0.0 | | 6.6 | 6.6 | 3.811 |
| 2025 | 0.0 | | 6.6 | 6.6 | 3.665 |
| 2026 | 0.0 | | 6.6 | 6.6 | 3.524 |
| 2027 | 0.0 | | 6.6 | 6.6 | 3.388 |
| 2028 | 0.0 | | 6.6 | 6.6 | 3.258 |
| 2029 | 0.0 | | 6.6 | 6.6 | 3.133 |
| 2030 | 0.0 | | 6.6 | 6.6 | 3.012 |
| 2031 | 0.0 | | 6.6 | 6.6 | 2.896 |
| 2032 | 0.0 | | 6.6 | 6.6 | 2.785 |
| 2033 | 0.0 | | 6.6 | 6.6 | 2.678 |
| 2034 | 0.0 | | 6.6 | 6.6 | 2.575 |
| 2035 | 0.0 | | 6.6 | 6.6 | 2.476 |
| 2036 | 0.0 | | 6.6 | 6.6 | 2.381 |
| 2037 | 0.0 | | 6.6 | 6.6 | 2.289 |
| 2038 | 0.0 | | 6.6 | 6.6 | 2.201 |
| 2039 | 0.0 | | 6.6 | 6.6 | 2.116 |
| PVC | | | | | 98 |

## Table A2.2: Measurement of Costs: Assisted Recovery

| Year | Assisted Recovery Costs (€'000) | | | | |
|---|---|---|---|---|---|
| | Public Implementation | Industry | Consumer | Total | Discounted |
| 2010 | 0.0 | | | 0.0 | 0.000 |
| 2011 | 2500.0 | | | 2500.0 | 2403.846 |
| 2012 | 7.5 | | | 7.5 | 6.934 |
| 2013 | 7.5 | | | 7.5 | 6.667 |
| 2014 | 7.5 | | | 7.5 | 6.411 |
| 2015 | 7.5 | | | 7.5 | 6.164 |
| 2016 | 7.5 | | | 7.5 | 5.927 |
| 2017 | 7.5 | 52 | 6.6 | 66.1 | 50.231 |
| 2018 | 7.5 | | 6.6 | 14.1 | 10.303 |
| 2019 | 7.5 | | 6.6 | 14.1 | 9.906 |
| 2020 | 7.5 | | 6.6 | 14.1 | 9.525 |
| 2021 | 7.5 | | 6.6 | 14.1 | 9.159 |
| 2022 | 7.5 | | 6.6 | 14.1 | 8.807 |
| 2023 | 7.5 | | 6.6 | 14.1 | 8.468 |
| 2024 | 7.5 | | 6.6 | 14.1 | 8.142 |
| 2025 | 7.5 | | 6.6 | 14.1 | 7.829 |
| 2026 | 7.5 | | 6.6 | 14.1 | 7.528 |
| 2027 | 7.5 | | 6.6 | 14.1 | 7.239 |
| 2028 | 7.5 | | 6.6 | 14.1 | 6.960 |
| 2029 | 7.5 | | 6.6 | 14.1 | 6.692 |
| 2030 | 7.5 | | 6.6 | 14.1 | 6.435 |
| 2031 | 7.5 | | 6.6 | 14.1 | 6.188 |
| 2032 | 7.5 | | 6.6 | 14.1 | 5.950 |
| 2033 | 7.5 | | 6.6 | 14.1 | 5.721 |
| 2034 | 7.5 | | 6.6 | 14.1 | 5.501 |
| 2035 | 7.5 | | 6.6 | 14.1 | 5.289 |
| 2036 | 7.5 | | 6.6 | 14.1 | 5.086 |
| 2037 | 7.5 | | 6.6 | 14.1 | 4.890 |
| 2038 | 7.5 | | 6.6 | 14.1 | 4.702 |
| 2039 | 7.5 | | 6.6 | 14.1 | 4.521 |
| PVC | | | | | 2641 |

## Table A2.3. Measurement of Costs: Large Scale Restoration

| Year | Large Scale Restoration Costs (€'000) | | | | |
|---|---|---|---|---|---|
| | Public Implementation | Industry | Consumer | Total | Discounted |
| 2010 | 0.0 | | | 0.0 | 0.000 |
| 2011 | 6500.0 | | | 6500.0 | 6250.000 |
| 2012 | 15.0 | | | 15.0 | 13.868 |
| 2013 | 15.0 | | | 15.0 | 13.335 |
| 2014 | 15.0 | 427 | 4.95 | 447.0 | 382.055 |
| 2015 | 15.0 | | 4.95 | 20.0 | 16.397 |
| 2016 | 15.0 | | 4.95 | 20.0 | 15.767 |
| 2017 | 15.0 | | 4.95 | 20.0 | 15.160 |
| 2018 | 15.0 | | 4.95 | 20.0 | 14.577 |
| 2019 | 15.0 | | 4.95 | 20.0 | 14.017 |
| 2020 | 15.0 | | 4.95 | 20.0 | 13.478 |
| 2021 | 15.0 | | 4.95 | 20.0 | 12.959 |
| 2022 | 15.0 | | 4.95 | 20.0 | 12.461 |
| 2023 | 15.0 | | 4.95 | 20.0 | 11.981 |
| 2024 | 15.0 | | 4.95 | 20.0 | 11.521 |
| 2025 | 15.0 | | 4.95 | 20.0 | 11.078 |
| 2026 | 15.0 | | 4.95 | 20.0 | 10.651 |
| 2027 | 15.0 | | 4.95 | 20.0 | 10.242 |
| 2028 | 15.0 | | 4.95 | 20.0 | 9.848 |
| 2029 | 15.0 | | 4.95 | 20.0 | 9.469 |
| 2030 | 15.0 | | 4.95 | 20.0 | 9.105 |
| 2031 | 15.0 | | 4.95 | 20.0 | 8.755 |
| 2032 | 15.0 | | 4.95 | 20.0 | 8.418 |
| 2033 | 15.0 | | 4.95 | 20.0 | 8.094 |
| 2034 | 15.0 | | 4.95 | 20.0 | 7.783 |
| 2035 | 15.0 | | 4.95 | 20.0 | 7.484 |
| 2036 | 15.0 | | 4.95 | 20.0 | 7.196 |
| 2037 | 15.0 | | 4.95 | 20.0 | 6.919 |
| 2038 | 15.0 | | 4.95 | 20.0 | 6.653 |
| 2039 | 15.0 | | 4.95 | 20.0 | 6.397 |
| PVC | | | | | 6926 |

## Case Study B: Fake River - Point Source Pressures

### B1 Background

Fake River contains a ten kilometre stretch which faces pressure from three point sources of pollution. These point sources are affecting the BOD and nutrient load of the river, and reducing the biological quality of the river. Measures will be required to address this pressure in order to achieve good status for this water body by 2015.

### B2 Identifying the Pressures

There are three point sources which discharge into this water body. They are:

- A municipal waste water treatment plant serving a population equivalent of less than 2,000 ("the small MWWTP");
- A municipal waste water treatment plant serving a population equivalent of between 2,000 and 10,000 ("the medium MWWTP"); and,
- An industrial plant discharging waste water into the river under an Integrated Pollution Prevention Control ("IPPC") licence from the EPA ("the Industrial Discharge").

The assimilative capacity at the point on the river where the small WWTP discharges is such that the river currently shows an excessive BOD load, at this point. Population projections for the community using the small MWWTP indicate that this pressure will persist, and even worsen, by 2015 in the absence of corrective measures. This excessive BOD load is enough to limit water quality to Moderate on this water body.

The assimilative capacity at the point where the medium MWWTP discharges is currently sufficient to ensure that this plant is not causing water quality to fall below Good. However, the future output of the medium MWWTP has been estimated, based on projected population in 2015. By 2012, the medium MWWTP will be causing an excessive nutrient load in the river. This excessive nutrient load will limit water quality to Moderate on this water body from 2012 on.

The industrial plant has adequate capacity to treat its waste water, and the river has adequate assimilative capacity at the point where the waste water is discharged. Despite this, it is causing deterioration in the biological quality of the receiving waters. This deterioration is enough to limit water quality to Moderate on this water body.

## B3 Establishing the Current and Year 2015 Status

If the Fake River is to reach Good status by 2015, all of the water bodies on the river must meet the relevant standards for: biological quality; physico-chemical conditions, pollutants and hydromorphological elements.

As described in Section B2 above, the Fake River currently faces pressure from the small MWWTP and the Industrial Discharge. The effect of these will to keep the river at Moderate rather than Good status. Both of these pressures would have to be addressed to bring the river to Good status.

By 2015, the pressure from the medium MWWTP will have increased to the point where it also would prevent the river from reaching Good status.

## B4 Establishing the Good Status Gap

To reach Good status by 2015 measures are need to address the pressure from all three point sources.

## B5 Identification of Feasible Alternative Measures: Small MWWTP

With regard to the pressure from the small MWWTP, planners have identified two options:

- Upgrading the plant; or,
- Relocating the point at which the plant discharges into the river.

The proposed upgrade to the small MWWTP would increase the extent to which sewage is processed before being discharged into the river. It would increase the level of tertiary treatment from a BOD25 to a BOD10 standard. The upgrade would be completed, and would take full effect, by 2012, at a one off capital cost of €200,000. There would be no additional ongoing costs from this upgrade.

Relocating the discharge point for the small MWWTP would be completed and take full effect by 2014. This work would have a one off cost of €500,000. There would be no additional ongoing costs from this upgrade.

## B6 Identification of Feasible Alternative Measures: Medium MWWTP

With regard to the point pressure from the medium MWWTP, two potential measures were identified:

- Planning and Development controls; or,
- An upgrade to the medium MWWTP.

The medium MWWTP currently has sufficient capacity to deal with the waste water from its catchment area. It does not currently place pressure on water quality that would prevent the Fake River from reaching good status. However, current planning would allow the town served by the medium MWWTP to grow, and it is anticipated that this growth will take place. Once this growth takes place, the MWWTP will no longer be able to treat waste water from the town to a standard where it does not put pressure on water quality in the Fake River. If the relevant area plans were changed to prevent this town from growing any more, this pressure would be removed.

This measure would have no costs for the local authority. However it would impose costs on the private sector. The usefulness of this measure comes from the fact that it prevents developers from building additional residential and commercial property in the medium sized town. This leads to there being fewer residents and businesses in the town by 2015, than would otherwise have been the case. If the revised planning rules have an effect on development, there must be people and firms for whom this medium-sized town was the preferred location for their home or business premises, and the new planning rules must be making them locate in an alternative, "second best" location. The tighter planning controls must, therefore, be imposing some cost on businesses and residents. These costs could take the form of extra construction costs imposed by the "second best" locations, or the premises and homes in these "second best" locations being considered less valuable by the businesses and residents affected. These costs represent an economic cost of this measure, and must be taken into account in assessing cost effectiveness. The process of estimating such costs is discussed below.

The alternative measure that will alleviate pressure from the medium MWWTP is an upgrade of the plant to increase the level of nutrient removal. This upgrade would have a one off capital cost of €300,000 and would be completed by 2012.

## B7 Identification of Feasible Alternative Measures: Industrial Discharge

The only technically feasible solution to remove the pressure from the Industrial Discharge is for the firm in question to invest more in waste water treatment in its plant to increase the quality of the water it discharges into the Fake River. This work would have a one off cost of €1m for the firm in question. The proposed measure is that this investment by the firm should be made a condition of its IPPC licence. This would be implemented by 2012 and would prevent this point source from affecting the quality of the water in the Fake River. As there is only one technically feasible measure to address this pressure and so allow the Fake River to reach good status by 2015, no further cost effectiveness analysis is required for this measure. This measure should be included in the River Basin Management

Plan for the Fake River, and implemented, unless it can be demonstrated that the measure is disproportionately costly.

## B8 Sifting and Screening of Measures

Cost effectiveness analysis is only required for two point source pressures. Only two technically feasible measures have been examined for each point source. No sifting or screening is required.

## B9 Developing a Strategy

For each of the two point sources, there is a choice of two measures, either of which will allow the Fake River to reach good status. None of the measures affects more than one point source. Therefore, there is no need to combine measures into strategies. The Cost Effectiveness Analysis should consist of identifying the most cost effective measure for each of the two point sources of pressure.

## B10 Setting a Target Status Date

For each point source of pressure there is a choice of measures which will deal with the pressure by 2015. It will therefore be possible to pick a pair of measures that will lead to good status for the Fake River by 2015. CEA should be used to pick the most cost effective pair of measures to achieve good status by 2015. These measures should be included in the River Basin management plan and implemented unless they can be shown to be disproportionately expensive.

## B11 Defining and Measuring Outputs

***Small MWWTP***

Both measures for the small MWWTP will allow the Fake River to move from Moderate to Good status (provided the other pressure is dealt with). The output from each measure is, therefore, one incremental unit of status. This will be achieved at different dates according to the following table.

| Measure | Incremental Output | Year Output is Achieved |
|---|---|---|
| Plant Upgrade | 1 | 2012 |
| Relocate the discharge point | 1 | 2014 |

***Medium MWWTP***

Similarly, both measures for the medium MWWTP have an output of one incremental unit of status. For both measures this output will be achieved by 2012.

## B12 Calculation of Outputs

The calculation of the Discounted Sum of the Increment Years is presented in Table B1 and summarised below:

***Small MWWTP***

| Measure | Output in Discounted Increment Years |
|---|---|
| Plant Upgrade | 16.02 |
| Relocate the discharge point | 14.21 |

Plant upgrade has an output some 13 per cent greater than relocating the discharge point, due to earlier results.

***Medium MWWTP***

| Measure | Output in Discounted Increment Years |
|---|---|
| Planning and Development Controls | 16.02 |
| Plant Upgrade | 16.02 |

Both of the technically feasible measures for the medium MWWTP address the pressure, and so allow good status, by 2012. Therefore, they deliver the same output.

## B13 Defining and Estimating Costs

**Public Implementation Costs**

The following are the public implementation costs. These relate to the initial capital costs of works and recurring maintenance costs.

***Small MWWTP***

| Measure | Initial Costs (€'000) | Recurring Costs (€000) |
|---|---|---|
| Plant Upgrade | 200 | 0 |
| Relocate the discharge point | 500 | 0 |

***Medium MWWTP***

| Measure | Initial Costs (€'000) | Recurring Costs (€000) |
|---|---|---|
| Planning and Development Controls | 0 | 0 |
| Plant Upgrade | 300 | 0 |

**Industry Implementation Costs**

None of the measures being considered for the small MWWTP and the medium MWWTP would impose extra costs on industry. The measure that will be implemented for the Industrial Discharge will impose costs on industry. These costs would have to be taken into account if this measure was being compared with another technically feasible measure in a CEA.

**Consumer Implementation Costs**

As discussed above one of the measures being considered for the medium MWWTP, the tightening of planning and development controls, could impose costs on developers.

In principle, the tightening of planning and development controls will prevent developers from building on their first choice of site. Developers will be building on a "second best" site. This will impose extra economic costs on the builder if these second best sites:

- Will impose extra building costs on the developer; or,
- Will lead to the developed property being valued less highly by the eventual user,

These costs will be passed on the eventual user of the buildings, in the form of higher prices or in buildings that are less valuable to the user. In other words, the

imposition of tighter planning controls could lead to an economic cost being imposed on consumers.

However, these costs will not be material if equivalent development land is available elsewhere in the general area. This type of cost will only arise if there is a general shortage of development land in the area.

Placing a value on this cost will be difficult. It will be some proportion of the development value of the lands affected by the tighter planning controls. For this measure, this cost has been estimated as a one off cost of €268,000 arising in 2012 when the new planning controls are introduced. Details of this estimate are set out in Table B3 below.

**External Costs**

There are no external costs arising.

## B14 Cost Effectiveness

The Tables below summarises the cost-effectiveness of the alternative measures. Details of the calculation of Discounted Costs are set out in Table B2 below.

***Small MWWTP***

| Measure | Output in Discounted Increment Years | Discounted Costs (€'000) | Effectiveness Ratio (units of output per €m) |
|---|---|---|---|
| Plant Upgrade | 16.02 | 185 | 86.6 |
| Relocate the Discharge Point | 14.21 | 427 | 33.3 |

The plant upgrade is clearly the most cost effective way to address the pressure on water quality from the small MWWTP. Spending on the plant upgrade is almost three times as cost effective as spending on relocating the discharge point. This arises from the fact that the plant upgrade is cheaper than relocating the discharge point, and delivers the necessary quality improvement sooner.

### *Medium MWWTP*

| Measure | Output in Discounted Increment Years | Discounted Costs (€'000) | Effectiveness Ratio (units of output per €m) |
|---|---|---|---|
| Planning and Development Controls | 16.02 | 248 | 64.6 |
| Plant Upgrade | 16.02 | 277 | 57.8 |

For the medium MWWTP, implementing planning and development controls seems marginally more cost effective than upgrading the plant. Both measures achieve the necessary improvement in quality at the same time, so have the same output in terms of improving water quality. However the cost of the planning and development controls, as estimated for this exercise, is lower than the cost of a plant upgrade. However the cost of the planning and development controls is an economic cost imposed on consumers due to a decrease in the choice of development land available. This cost can only be estimated, and this result is sensitive to the accuracy of the estimate used. If there was a significant risk that the actual cost to consumers of the planning controls would be greater than estimated, the most cost effective strategy might be to opt for the plant upgrade.

## Table B1.1: Measurement of Output, Small MWWTP

| | Upgrade Plant | | Relocate Discharge | |
|---|---|---|---|---|
| Year | Increment Years | Discounted Increment Years | Increment Years | Discounted Increment Years |
| 2010 | 0 | 0.00 | 0 | 0.00 |
| 2011 | 0 | 0.00 | 0 | 0.00 |
| 2012 | 1 | 0.92 | 0 | 0.00 |
| 2013 | 1 | 0.89 | 0 | 0.00 |
| 2014 | 1 | 0.85 | 1 | 0.85 |
| 2015 | 1 | 0.82 | 1 | 0.82 |
| 2016 | 1 | 0.79 | 1 | 0.79 |
| 2017 | 1 | 0.76 | 1 | 0.76 |
| 2018 | 1 | 0.73 | 1 | 0.73 |
| 2019 | 1 | 0.70 | 1 | 0.70 |
| 2020 | 1 | 0.68 | 1 | 0.68 |
| 2021 | 1 | 0.65 | 1 | 0.65 |
| 2022 | 1 | 0.62 | 1 | 0.62 |
| 2023 | 1 | 0.60 | 1 | 0.60 |
| 2024 | 1 | 0.58 | 1 | 0.58 |
| 2025 | 1 | 0.56 | 1 | 0.56 |
| 2026 | 1 | 0.53 | 1 | 0.53 |
| 2027 | 1 | 0.51 | 1 | 0.51 |
| 2028 | 1 | 0.49 | 1 | 0.49 |
| 2029 | 1 | 0.47 | 1 | 0.47 |
| 2030 | 1 | 0.46 | 1 | 0.46 |
| 2031 | 1 | 0.44 | 1 | 0.44 |
| 2032 | 1 | 0.42 | 1 | 0.42 |
| 2033 | 1 | 0.41 | 1 | 0.41 |
| 2034 | 1 | 0.39 | 1 | 0.39 |
| 2035 | 1 | 0.38 | 1 | 0.38 |
| 2036 | 1 | 0.36 | 1 | 0.36 |
| 2037 | 1 | 0.35 | 1 | 0.35 |
| 2038 | 1 | 0.33 | 1 | 0.33 |
| 2039 | 1 | 0.32 | 1 | 0.32 |
| | | **16.02** | | **14.21** |

## Table B1.2: Measurement of Output, Medium MWWTP

| | Planning and Development Controls | | Plant Upgrade | |
|---|---|---|---|---|
| Year | Increment Years | Discounted Increment Years | Increment Years | Discounted Increment Years |
| 2010 | 0 | 0.00 | 0 | 0.00 |
| 2011 | 0 | 0.00 | 0 | 0.00 |
| 2012 | 1 | 0.92 | 1 | 0.92 |
| 2013 | 1 | 0.89 | 1 | 0.89 |
| 2014 | 1 | 0.85 | 1 | 0.85 |
| 2015 | 1 | 0.82 | 1 | 0.82 |
| 2016 | 1 | 0.79 | 1 | 0.79 |
| 2017 | 1 | 0.76 | 1 | 0.76 |
| 2018 | 1 | 0.73 | 1 | 0.73 |
| 2019 | 1 | 0.70 | 1 | 0.70 |
| 2020 | 1 | 0.68 | 1 | 0.68 |
| 2021 | 1 | 0.65 | 1 | 0.65 |
| 2022 | 1 | 0.62 | 1 | 0.62 |
| 2023 | 1 | 0.60 | 1 | 0.60 |
| 2024 | 1 | 0.58 | 1 | 0.58 |
| 2025 | 1 | 0.56 | 1 | 0.56 |
| 2026 | 1 | 0.53 | 1 | 0.53 |
| 2027 | 1 | 0.51 | 1 | 0.51 |
| 2028 | 1 | 0.49 | 1 | 0.49 |
| 2029 | 1 | 0.47 | 1 | 0.47 |
| 2030 | 1 | 0.46 | 1 | 0.46 |
| 2031 | 1 | 0.44 | 1 | 0.44 |
| 2032 | 1 | 0.42 | 1 | 0.42 |
| 2033 | 1 | 0.41 | 1 | 0.41 |
| 2034 | 1 | 0.39 | 1 | 0.39 |
| 2035 | 1 | 0.38 | 1 | 0.38 |
| 2036 | 1 | 0.36 | 1 | 0.36 |
| 2037 | 1 | 0.35 | 1 | 0.35 |
| 2038 | 1 | 0.33 | 1 | 0.33 |
| 2039 | 1 | 0.32 | 1 | 0.32 |
| | | **16.02** | | **16.02** |

## Table B2.1: Measurement of Costs: Small MWWTP: Plant Upgrade

| Year | Costs (€'000) | | | |
|---|---|---|---|---|
| | Public Implementation | Industry | Total | Discounted |
| 2010 | 0 | 0 | 0 | 0 |
| 2011 | 0 | 0 | 0 | 0 |
| 2012 | 200 | 0 | 200 | 185 |
| 2013 | 0 | 0 | 0 | 0 |
| 2014 | 0 | 0 | 0 | 0 |
| 2015 | 0 | 0 | 0 | 0 |
| 2016 | 0 | 0 | 0 | 0 |
| 2017 | 0 | 0 | 0 | 0 |
| 2018 | 0 | 0 | 0 | 0 |
| 2019 | 0 | 0 | 0 | 0 |
| 2020 | 0 | 0 | 0 | 0 |
| 2021 | 0 | 0 | 0 | 0 |
| 2022 | 0 | 0 | 0 | 0 |
| 2023 | 0 | 0 | 0 | 0 |
| 2024 | 0 | 0 | 0 | 0 |
| 2025 | 0 | 0 | 0 | 0 |
| 2026 | 0 | 0 | 0 | 0 |
| 2027 | 0 | 0 | 0 | 0 |
| 2028 | 0 | 0 | 0 | 0 |
| 2029 | 0 | 0 | 0 | 0 |
| 2030 | 0 | 0 | 0 | 0 |
| 2031 | 0 | 0 | 0 | 0 |
| 2032 | 0 | 0 | 0 | 0 |
| 2033 | 0 | 0 | 0 | 0 |
| 2034 | 0 | 0 | 0 | 0 |
| 2035 | 0 | 0 | 0 | 0 |
| 2036 | 0 | 0 | 0 | 0 |
| 2037 | 0 | 0 | 0 | 0 |
| 2038 | 0 | 0 | 0 | 0 |
| 2039 | 0 | 0 | 0 | 0 |
| Present Value of Costs | | | | 185 |

## Table B2.2: Measurement of Costs: Small MWWTP: Relocate Discharge Point

| Year | Costs (€'000) | | | |
|---|---|---|---|---|
| | Public Implementation | Industry | Total | Discounted |
| 2010 | 0 | 0 | 0 | 0 |
| 2011 | 0 | 0 | 0 | 0 |
| 2012 | 0 | 0 | 0 | 0 |
| 2013 | 0 | 0 | 0 | 0 |
| 2014 | 500 | 0 | 500 | 427 |
| 2015 | 0 | 0 | 0 | 0 |
| 2016 | 0 | 0 | 0 | 0 |
| 2017 | 0 | 0 | 0 | 0 |
| 2018 | 0 | 0 | 0 | 0 |
| 2019 | 0 | 0 | 0 | 0 |
| 2020 | 0 | 0 | 0 | 0 |
| 2021 | 0 | 0 | 0 | 0 |
| 2022 | 0 | 0 | 0 | 0 |
| 2023 | 0 | 0 | 0 | 0 |
| 2024 | 0 | 0 | 0 | 0 |
| 2025 | 0 | 0 | 0 | 0 |
| 2026 | 0 | 0 | 0 | 0 |
| 2027 | 0 | 0 | 0 | 0 |
| 2028 | 0 | 0 | 0 | 0 |
| 2029 | 0 | 0 | 0 | 0 |
| 2030 | 0 | 0 | 0 | 0 |
| 2031 | 0 | 0 | 0 | 0 |
| 2032 | 0 | 0 | 0 | 0 |
| 2033 | 0 | 0 | 0 | 0 |
| 2034 | 0 | 0 | 0 | 0 |
| 2035 | 0 | 0 | 0 | 0 |
| 2036 | 0 | 0 | 0 | 0 |
| 2037 | 0 | 0 | 0 | 0 |
| 2038 | 0 | 0 | 0 | 0 |
| 2039 | 0 | 0 | 0 | 0 |
| Present Value of Costs | | | | 427 |

## Table B2.3: Measurement of Costs: Medium MWWTP: Planning Controls

| Year | Costs (€'000) | | | |
|---|---|---|---|---|
| | Public Implementation | Consumers | Total | Discounted |
| 2010 | 0 | 0 | 0 | 0 |
| 2011 | 0 | 0 | 0 | 0 |
| 2012 | 0 | 268 | 268 | 248 |
| 2013 | 0 | 0 | 0 | 0 |
| 2014 | 0 | 0 | 0 | 0 |
| 2015 | 0 | 0 | 0 | 0 |
| 2016 | 0 | 0 | 0 | 0 |
| 2017 | 0 | 0 | 0 | 0 |
| 2018 | 0 | 0 | 0 | 0 |
| 2019 | 0 | 0 | 0 | 0 |
| 2020 | 0 | 0 | 0 | 0 |
| 2021 | 0 | 0 | 0 | 0 |
| 2022 | 0 | 0 | 0 | 0 |
| 2023 | 0 | 0 | 0 | 0 |
| 2024 | 0 | 0 | 0 | 0 |
| 2025 | 0 | 0 | 0 | 0 |
| 2026 | 0 | 0 | 0 | 0 |
| 2027 | 0 | 0 | 0 | 0 |
| 2028 | 0 | 0 | 0 | 0 |
| 2029 | 0 | 0 | 0 | 0 |
| 2030 | 0 | 0 | 0 | 0 |
| 2031 | 0 | 0 | 0 | 0 |
| 2032 | 0 | 0 | 0 | 0 |
| 2033 | 0 | 0 | 0 | 0 |
| 2034 | 0 | 0 | 0 | 0 |
| 2035 | 0 | 0 | 0 | 0 |
| 2036 | 0 | 0 | 0 | 0 |
| 2037 | 0 | 0 | 0 | 0 |
| 2038 | 0 | 0 | 0 | 0 |
| 2039 | 0 | 0 | 0 | 0 |
| Present Value of Costs | | | | 248 |

## Table B2.4: Measurement of Costs: Medium MWWTP: Plant Upgrade

| Year | Costs (€m) | | | |
|---|---|---|---|---|
| | Public Implementation | Consumers | Total | Discounted |
| 2010 | 0 | 0 | 0 | 0 |
| 2011 | 0 | 0 | 0 | 0 |
| 2012 | 300 | 0 | 0 | 277 |
| 2013 | 0 | 0 | 0 | 0 |
| 2014 | 0 | 0 | 0 | 0 |
| 2015 | 0 | 0 | 0 | 0 |
| 2016 | 0 | 0 | 0 | 0 |
| 2017 | 0 | 0 | 0 | 0 |
| 2018 | 0 | 0 | 0 | 0 |
| 2019 | 0 | 0 | 0 | 0 |
| 2020 | 0 | 0 | 0 | 0 |
| 2021 | 0 | 0 | 0 | 0 |
| 2022 | 0 | 0 | 0 | 0 |
| 2023 | 0 | 0 | 0 | 0 |
| 2024 | 0 | 0 | 0 | 0 |
| 2025 | 0 | 0 | 0 | 0 |
| 2026 | 0 | 0 | 0 | 0 |
| 2027 | 0 | 0 | 0 | 0 |
| 2028 | 0 | 0 | 0 | 0 |
| 2029 | 0 | 0 | 0 | 0 |
| 2030 | 0 | 0 | 0 | 0 |
| 2031 | 0 | 0 | 0 | 0 |
| 2032 | 0 | 0 | 0 | 0 |
| 2033 | 0 | 0 | 0 | 0 |
| 2034 | 0 | 0 | 0 | 0 |
| 2035 | 0 | 0 | 0 | 0 |
| 2036 | 0 | 0 | 0 | 0 |
| 2037 | 0 | 0 | 0 | 0 |
| 2038 | 0 | 0 | 0 | 0 |
| 2039 | 0 | 0 | 0 | 0 |
| Present Value of Costs | | | | 277 |

## Table B3: Estimating the Consumer Costs of Planning and Development Controls

| | |
|---|---|
| Projected Populations Equivalents using the medium MWWTP by 2015 if no controls in place | 12,000 |
| Maximum Capacity of the MWWTP | 10,000 |
| Number of Population Equivalents that the Planning Controls must prevent from using the MWWTP | 2,000 |
| Average Household Size | 3 |
| Number of housing units that must be prevented from being developed | 667 |
| Average plot size in acres for a residential unit in this town (acres) | 0.1 |
| Amount of land to lose development status (acres) | 67 |
| Value of this land per acre when development possible (€) | 200,000 |
| Development Value of land affected by the new Planning Controls (€m) | 13.4 |
| Percentage of this value that is "lost" to the economy due to the change in planning controls, i.e. cannot be replaced by using alternative lands | 2% |
| Cost to consumers of the new planning and development controls (€) | 268,000 |

# Appendix 3: Example of a Cost Benefit Calculation

The approach to DCA described in this Guidance requires the comparison of the costs and benefits of achieving the WFD water quality targets in certain circumstances. This task raises a number of technical issues, and a suggested approach to these is set out in Section C.3.5 of this Guidance. For illustrative purposes this Appendix sets out an example of the form a cost benefit analysis prepared in line with this Guidance might take.

The steps in this process are:

- Assemble relevant background information gathered as part of the CEA process;
- Set parameters for the calculation (discount rates etc.);
- Identify and value costs;
- Identify and, to the extent possible, quantify and value benefits; and,
- Compare costs and benefits to assess whether the measures necessary to reach WFD targets are disproportionately costly.

## A1 Background Information

Fake River contains a ten kilometre stretch with no pollution pressures, but with morphological pressures that impact on the river biology. These morphological pressures arise from channelisation. These pressures would result in the water body being at Moderate status in the absence of supplementary measures.

At the CEA stage the most cost effective supplementary measure to meet WFD targets by 2015 was found to be a large scale restoration scheme. Large scale restoration involves remeandering of the river and raising bed levels in addition to the actions under assisted recovery. Good status would be achieved by 2014.

## A2 Set Parameters

This comparison of costs and benefits should be carried out in line with the Department of Finance Guidelines generally applied in Ireland. As a result:

- An assessment period of 30 years should be used;
- Monetised costs and benefits should be discounted to a present value using a discount rate of 4 per cent;
- All money values should be expressed in current prices, ie no account should be taken of inflation between now and the time when the spending will take place or the benefit will be realised.

## A3 Identify and Value Costs

The costs of this measure would be identified and valued during Cost Effectiveness Analysis. The following costs were identified:

- Public Implementation Costs

These relate to the initial capital costs of works and recurring maintenance costs. Large scale restoration would involve initial capital costs of €6.5m and recurring maintenance costs of €15,000 per annum thereafter.

- Industry Implementation Costs

Large scale restoration will involve remeandering of the river. This will reduce the useful area of farmland around the river. This represents a once off capital cost that falls on the farmer in question.

The costs in terms of land loss are:

  - Three stretches of river verge with an aggregate length 1,000 metres and width of 50 metres will be flooded for five months of the year. This will result in the loss of 5 hectares of land for five months of the year. Assuming a price €25,000 per hectare and assuming a loss of value proportionate to the duration of flooding, this is a once off cost of €0.052m (€25,000 x 20 hectares x 5/12) ; and,
  - A further 1,000 metre stretch of river verge with a width of 150 metres will be permanently under water as a result of meandering. This amounts to a land loss of 15 hectares at a cost of €0.375m

The once-off "industry" costs of the measure are therefore €0.427m. (In this context "industry refers to all productive sectors of the economy including agriculture and services.)

- Consumer Implementation Costs

Restoring the morphology of the river will increase the risk of floods. The expected average cost of the extra flood risk to consumers was calculated as €4,950 as part of the Cost Effectiveness exercise.

- No external costs arise from this measure

These costs are projected forward over a thirty year assessment period and discounted to a present value using a discount rate of 4 per cent. This gives a

present value of the cost of large scale restoration of €6.926m. Details of this calculation are set out in Table A.1 below:

### Table A.1 Measurement of Costs: Large Scale Restoration

| Year | Large Scale Restoration Costs (€'000) | | | | |
|---|---|---|---|---|---|
| | Public Implementation | Industry | Consumer | Total | Discounted |
| 2010 | 0.0 | | | 0.0 | 0.000 |
| 2011 | 6500.0 | | | 6500.0 | 6250.000 |
| 2012 | 15.0 | | | 15.0 | 13.868 |
| 2013 | 15.0 | | | 15.0 | 13.335 |
| 2014 | 15.0 | 427 | 4.95 | 447.0 | 382.055 |
| 2015 | 15.0 | | 4.95 | 20.0 | 16.397 |
| 2016 | 15.0 | | 4.95 | 20.0 | 15.767 |
| 2017 | 15.0 | | 4.95 | 20.0 | 15.160 |
| 2018 | 15.0 | | 4.95 | 20.0 | 14.577 |
| 2019 | 15.0 | | 4.95 | 20.0 | 14.017 |
| 2020 | 15.0 | | 4.95 | 20.0 | 13.478 |
| 2021 | 15.0 | | 4.95 | 20.0 | 12.959 |
| 2022 | 15.0 | | 4.95 | 20.0 | 12.461 |
| 2023 | 15.0 | | 4.95 | 20.0 | 11.981 |
| 2024 | 15.0 | | 4.95 | 20.0 | 11.521 |
| 2025 | 15.0 | | 4.95 | 20.0 | 11.078 |
| 2026 | 15.0 | | 4.95 | 20.0 | 10.651 |
| 2027 | 15.0 | | 4.95 | 20.0 | 10.242 |
| 2028 | 15.0 | | 4.95 | 20.0 | 9.848 |
| 2029 | 15.0 | | 4.95 | 20.0 | 9.469 |
| 2030 | 15.0 | | 4.95 | 20.0 | 9.105 |
| 2031 | 15.0 | | 4.95 | 20.0 | 8.755 |
| 2032 | 15.0 | | 4.95 | 20.0 | 8.418 |
| 2033 | 15.0 | | 4.95 | 20.0 | 8.094 |
| 2034 | 15.0 | | 4.95 | 20.0 | 7.783 |
| 2035 | 15.0 | | 4.95 | 20.0 | 7.484 |
| 2036 | 15.0 | | 4.95 | 20.0 | 7.196 |
| 2037 | 15.0 | | 4.95 | 20.0 | 6.919 |
| 2038 | 15.0 | | 4.95 | 20.0 | 6.653 |
| 2039 | 15.0 | | 4.95 | 20.0 | 6.397 |
| PVC | | | | | 6926 |

## A4 Identify and Value Benefits

1. Identify potential benefits that could apply to this measure based on the standard list in Table 5.1:

| Type of Benefit | *Applicable to large scale restoration of the morphology of the Fake River?* |
|---|---|
| ***Use Values*** **Agricultural Irrigation**<br>**Use in Industrial Process**<br>**Public Water Supply**<br>**Commercial Fisheries and Aquaculture** | Not applicable, no improvement in the usability of the Fake River for these purposes |
| **Recreation** | Fake River may improve as a venue for informal recreation |
| **Aesthetic value** | Fake River may be more aesthetically pleasing |
| **Heritage, Archaeology and Landscape** | Fake River and its banks may be a more valuable part of the landscape |
| **Biodiversity** | May have a positive impact if the restoration creates a new habitat |
| ***Option Values*** | Unlikely to apply, no foreseeable circumstances where Fake River would become a valuable resource for industry, public water supply etc. |
| ***Altruistic Value, Bequest Value, and Existence Value*** | No non-use benefits as Fake River is not currently considered an amenity by residents, so no willingness to pay for these improvements |

2. Where possible place a monetary value on these benefits based on existing studies of the benefits of improving water quality.

   - Recreation Value. Assume that some 100,000 visitors a year use the Fake River as a venue for informal recreation. (In practice this number would have to be estimated based on local knowledge). The UK research referred to in Section C.3 estimates that the value per visitor of improving the quality of a water body was of the order of 9 pence per visit in 2001. On this basis the benefit per visit of improving the status of the Fake River would be no higher than 20c. The annual benefit would be €20,000 (100,000 visitors * 20c). The present value of €20,000 per annum at a discount rate of 4 per cent is €345,000.

3. For benefits that cannot be valued in money terms, quantify them to the extent possible. Otherwise assess the extent of the benefit in a qualitative way:

   - Aesthetic Value: A minor benefit given the scale of the area affected, the low level of recreation use and the current state of the area in question.
   - Heritage, Archaeology and Landscape: No benefit. The proposed measure will not improve access to any heritage or archaeological sites. Landscape improvements covered as "aesthetic value".
   - Biodiversity: Slight benefit. The proposed measure will create an additional natural river habitat, but this type of habitat is not in short supply.

## A5 Compare Costs and Benefits

| Cost of large scale restoration of the Fake River | Benefits |
|---|---|
| €6.9m | • Improved value for informal recreation: €345,000<br>• Minor aesthetic benefits<br>• Additional natural river habitat represents a slight biodiversity benefit |

On this basis the costs of the measure that would be required to achieve the WFD water quality targets are clearly disproportionate.

**Goodbody Economic Consultants**
Ballsbridge Park, Ballsbridge, Dublin 4
• Tel: 353-1-6410482 • Fax: 353-1-6682388
www.goodbody.ie/consultants/ • e-mail – econsultants@goodbody.ie