



## **Flood and Coastal Defence Project Appraisal Guidance**

### **FCDPAG3 Economic Appraisal**

**Supplementary Note to Operating Authorities  
July 2004**

#### **REVISIONS TO ECONOMIC APPRAISAL ON:**

- **REFLECTING SOCIO-ECONOMIC EQUITY  
IN APPRAISAL**
- **APPRAISAL OF HUMAN RELATED INTANGIBLE  
IMPACTS OF FLOODING**

**Web site:**

<http://www.defra.gov.uk/environ/fcd/pubs/pagn/fcdpag3/default.htm>

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**July 2004**

## **Flood and Coastal Defence Appraisal Guidance FDCPAG3 'Economic Appraisal Supplementary Note to Operating Authorities - July 2004**

### **1. INTRODUCTION**

HM Treasury published new guidance in 2003 on *Appraisal and Evaluation in Central Government* – the “Green Book”. This is referred to as Treasury Green Book (2003) in this document. Since publication of the Treasury Green Book and Defra’s *Supplementary Note to Operating Authorities – March 2003*, further research has led to both new guidance, and clarification of existing guidance relating to FCDPAG3 “Economic Appraisal”.

This supplementary note therefore presents new advice to operating authorities on the following:

- Section 2 - Reflecting Socio-Economic Equity in Flood and Coastal Defence Appraisals;
- Section 3 - Appraisal of Human Related Intangible Impacts in Appraisal.

Please also note that the new Government Strategy for flood and coastal erosion risk management will be presented for public consultation soon. It is intended that any implications of this strategy will be considered fully in future revisions of the project appraisal guidance series.

### **2. REFLECTING SOCIO-ECONOMIC EQUITY GUIDANCE IN FLOOD AND COASTAL DEFENCE APPRAISALS**

#### **2.1 BACKGROUND**

This interim supplementary note provides advice to operating authorities on the incorporation of social equity considerations in flood and coastal defence appraisals through the use of *Distributional Impacts (DI)*. Proposals might have differential impacts in individuals, amongst other aspects, according to their income. For Flood and Coastal Defence Schemes DI considers the distribution of the costs or benefits of interventions across different income groups and social class. It is current economic policy as outlined by Annex 5 of Treasury Green Book (2003) to assess DI where it is considered *necessary and practical*.

#### **2.2 APPLICATION AND USE IN APPRAISAL**

If a decision is made to assess DI, appraisers should be aware of the principle of diminishing marginal utility<sup>1</sup> of additional consumption whereby the impact of a policy, programme or project on an individual’s well-being will vary according to his or her income; the rational being that an extra pound will give more benefit to a person who has lower income than to someone who has higher income. In other words, as income rises, the marginal value of income reduces.

So, a loss of £1000 to someone on a lower income matters more than the same loss to someone on higher income. Based on Treasury Green Book (2003), earners in the lowest and highest income band, value £1 as the equivalent of £2.45, and 45p, respectively.

For flood and coastal defence strategies and schemes, DI analysis can be applied to the evaluated costs of avoided damage to residential property. The subsequent costs arising from the analysis may then be treated in the conventional manner, following FCDPAG3.

The Treasury Green Book (2003) recommends that distributional impacts should be applied where it is *necessary and practical* to do so. Determining if it is *necessary and practical* to

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<sup>1</sup> Marginal Utility refers to the extra satisfaction derived from an extra £1 of consumption.

apply distributional impact assessment and how to apply it, depends on a number of circumstances including:

- **Likely robustness of any calculation of distributional impacts**. Whether a community at flood risk can be identified with reliable data and categorised according to their prosperity or social class.
- **The type of project being assessed**. Whether the assessment will contribute to an appraisal that demonstrates equity and fairness to people.
- **Scale of the impact associated with a particular project or proposal**. Whether the time and effort in undertaking the assessment is proportional to the scale of the overall appraisal, either at a strategic or scheme level.

In addition, appraisers should consider whether they feel that, in not undertaking the assessment, a strategy or scheme will still have an adverse differential impact on a particular group. Where appraisers decide not to adjust explicitly for distributional impacts (see Section 2.4, below), it is advisable to provide a justification for this decision, which the Operating Authorities and Defra would find satisfactory.

### 2.3 EXISTING APPROACHES AND THEIR LIMITATIONS

The cost of flood damage to property in an appraisal, is assessed by applying a number of methods. Several are expressed in the Flood Hazard Research Centre's (FHRC) Multi Colour Manual (MCM(2003)), and specifically in the manual's Table 4.6, which summarises a step-wise approach for assessing the potential damage to residential properties and households.

The MCM(2003) methods refer to depth/damage curves based on property type, age and social class of the dwellings occupants, in order to evaluate the overall damage avoided in a flood risk area.

However, MCM(2003) does not recognise Treasury Green Book (2003) guidance on DI, as outlined earlier. Without applying this adjustment to values of damages avoided, there is a risk of a catchment wide strategy having a socially unfair outcome. For example: an appraisal may identify that a scheme is justified to protect a community that is predominantly of AB social class group. The economic benefits of such a scheme might be strong, and may generate high Benefit Cost Ratio and high priority score. However, this might be at the expense of displacing the priority of a strategy or scheme within a programme that protects a mixed social class community (say C2 & DE social class groups), upstream.

### 2.4 NEW APPROACH CONSIDERING DISTRIBUTIONAL IMPACTS

The following two steps set out how Treasury Green Book (2003) guidance on DI is transposed into flood and coastal defence investment.

#### *Step 1*

Analyse and understand the level of knowledge on the type, age and number of residential property; the mix of social class groups and levels of income within an appraisal area. Take account of DI by following Step 2, if necessary<sup>2</sup> and practical<sup>3</sup>. If it is not necessary and practical, then ignore Step 2 and use standard depth damage curves that focus on property type and age, only, without accounting for social class mix or income level.

#### *Step 2*

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<sup>2</sup> Necessary; in this case, recognising the type of project being assessed; for example, where there is a bias in social class group AB or DE in an area.

<sup>3</sup> Practical; in this case, recognising the robustness of data and the scale of the impact; for example, practical is where good quality data can be obtained without using disproportionate resources.

If proven necessary and practical, and good quality information is obtainable, *Total Weighted Factors* may be used by social class group. See Table 1 and Annex A1 for more information. *Total Weighted Factors* for social class groups C1 and C2 will generally have a negligible effect on the DI assessment. Hence, use of *Total Weighted Factors* is only recommended where AB or DE social class groups are predominant. *Total Weighted Factors* may then be applied to adjust the standard depth-damage curves to obtain damages avoided, taking account of DI.

<i>Total Weighted Factors by social class group</i>			
AB%	C1%	C2%	DE%
<b>0.74</b>	<b>1.12</b>	<b>1.22</b>	<b>1.64</b>

Table 1  
**Total Weighted Factors**

In the interest of transparency both weighted and non-weighted results should be routinely presented. Where results are sensitive to any weighting adjustment, a sensitivity analysis should be provided.

Application of *Total Weighted Factors* has the effect of *converging/reversing* a set of depth-damage curves representing different social class groups who reside in similar property types.

## **2.5 OTHER RELEVANT POINTS**

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#### Coastal Erosion and other 'write-off' situations

Generally, use is made of capital property values for erosion losses and other situations of assumed write off of property (e.g. where flooding is very frequent). In this case residential property values should generally be based on average 'no risk' values for property of the same physical type (i.e. all two bed-roomed detached bungalows or all three bedroom terraced houses). The use of average values should go some way towards an approach that takes account of DI between income groups. For more detailed studies where it is appropriate to use individual residential property valuations then the value of damages should be scaled by the appropriate Total Weighted Factor shown in Table 1. Please note that it is ownership of lost assets that will determine weighting, not occupiers as the owners are those who suffer capital loss (It is usually assumed with coastal erosion and other write-off decisions that there would be time to remove all contents and personal effects).

#### Priority Score System

For the time being, the use of DI in economic appraisal should be considered as separate from the allowance used for deprivation in the Defra FM Priority Score System, and not as a replacement treatment for it. The impact of this and any double counting that might be introduced will be reconsidered in any future review of the prioritisation system.

#### Rented Property and Homogeneous Areas

Where the quality of available information permits, appraisers should take account of DI in homogeneous areas or areas with a high proportion of rented accommodation. For the latter, the income level or class of the owner of the property should be taken into account for building damages and that of the occupier applied to contents damages. The approach in Step 2 is suggested, but again recognising where it is necessary and practical to do so.

## **2.6 FUTURE ADVICE**

It is envisaged that future developments in distributional impacts in appraisal will be covered by future editions of FHRC's Multi Coloured Manual and Defra FCDPAG3 document, taking into consideration comments from those who have applied this method in real situations.

## **2.7 REFERENCES**

Treasury (2003); Appraisal and Evaluation in Central Government (Treasury Green Book)  
HM Treasury.

MCM (2003); The Benefits of Flood and Coastal Defence: Techniques and Data for 2003.  
Flood Hazard Research Centre.

### **3. APPRAISAL OF HUMAN RELATED INTANGIBLE IMPACTS OF FLOODING**

#### **3.1 INTRODUCTION**

To householders, impacts of flooding such as increased stress, health effects and loss of memorabilia can be as important as the direct material damages to their homes and their contents. This guidance covers an interim way forward into treating these effects, having being informed by a joint Defra/Environment Agency research project into economic valuation of these human related intangible impacts of flooding in project appraisals.

This advice can be used for both fluvial, and coastal erosion circumstances (including tidal flooding), although the research was predominantly focussed on fluvial circumstances.

#### **3.2 BACKGROUND TO RESEARCH**

This supplementary guidance is based on evidence from a major research project, which was conducted in two phases following extensive consultation regarding the project specification.

Phase 1 involved developing and validating survey instruments using focus groups, along with pilot surveys to identify health impacts caused by flooding, or the risk of flooding, and provide a method for estimating the value of Willingness to pay to avoid these health impacts.

Phase 2 applied these to an extensive national survey of recently flooded and 'at risk' residents to obtain statistically valid results to: provide the basis for development of this appraisal methodology.

The results of the national survey confirmed that flooding caused physical effects in the short term and psychological effects in the short and longer terms. Psychological effects included memory of the stress from flooding and damage, and the stress of recovering after an event, including that arising from settling claims with insurers and dealing with builders and repairers.

#### **3.3 RESULTS**

The results of the research concluded that the value of avoiding the health impacts of fluvial flooding is of the order of £200 per year per household. This is a weighted average value derived from a very wide range of responses. Even from the relatively large sample used, it was not possible to find any clear relationship between individual valuations and household or flood characteristics. However, researchers have professionally interpreted their results based on the survey data to develop a practical methodology for *general application* to project appraisal.

#### **3.4 INCORPORATION OF INTANGIBLE DAMAGES INTO ECONOMIC APPRAISAL**

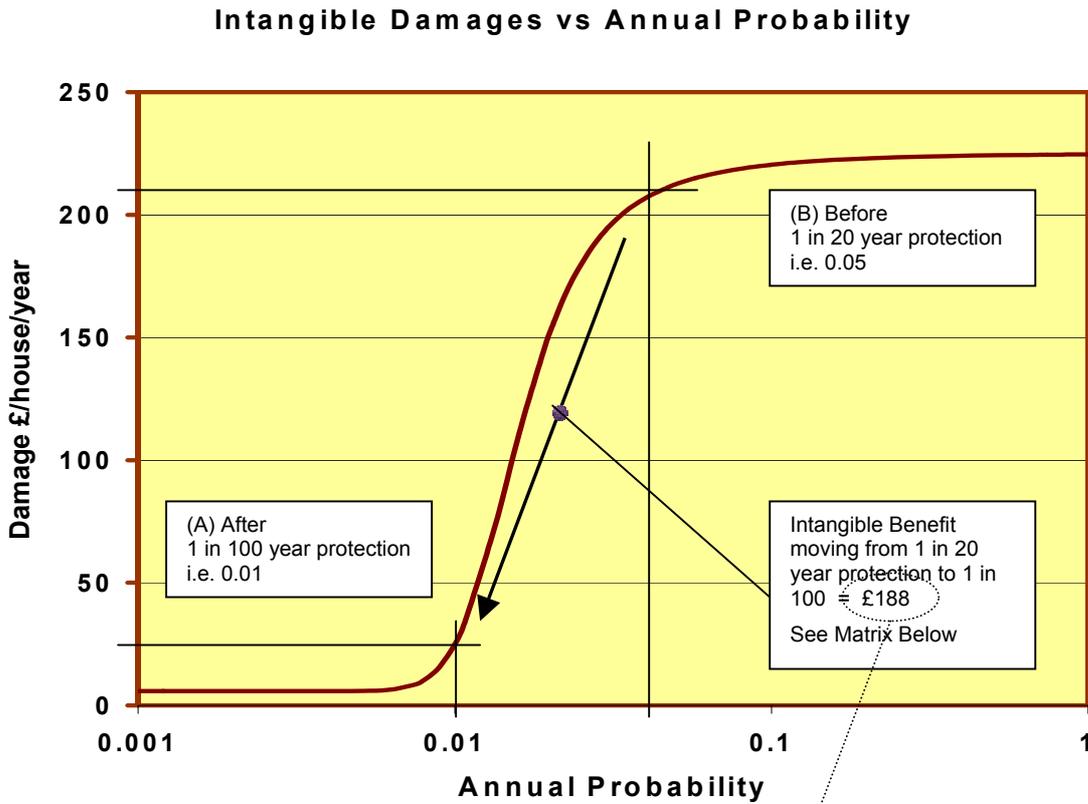
The researchers' interpretation of their results has resulted in a relationship between the value of avoiding impacts and the reduction in likelihood of being flooded. This relationship is highlighted in Figure 1 and Table 2.

The key factor in calculating intangible health related damages, is evaluating the expected reduction in flood probability. The research shows a direct relationship between human health and stress levels, and flood risk. For practical application in economic appraisal, appraisers need to consider how the level of exposure to household flood risk, varies, with and without the scheme.

The approach recommended depends on the nature of the flood risk area, as follows:

- For areas of uniform risk (such as housing on level ground behind a flood defence, damages are based on common standards of defence for an area.
- For areas of greatly varying risk (sloping ground away from a river), damages are based on individual levels of property flood risk.

Figure 1: Intangible Damages vs. Annual Probability. (Illustrative only)



### 3.5 RISK REDUCTION MATRIX

In order to determine the difference in annual damages before and after an improvement/intervention, the following Matrix can be used.

Table 2: Intangible Benefits Associated With Flood Defence Improvements.

		Standard of Protection After – AFP (RP in years)								
		0.007 (150)	0.008 (125)	0.010 (100)	0.013 (75)	0.020 (50)	0.033 (30)	0.05 (20)	0.1 (10)	
Standard of Protection Before – AFP (RP in Years)	1 (1)	£218	£215	£200	£153	£73	£25	£12	£5	
	0.1 (10)	£214	£210	£195	£148	£68	£21	£8	£0	
	0.05 (20)	£206	£202	£188	£141	£60	£13	£0		
	0.033 (30)	£193	£189	£175	£128	£47	£0			
	0.020 (50)	£145	£142	£127	£80	£0				
	0.013 (75)	£65	£62	£47	£0					
	0.010 (100)	£18	£15	£0						
	0.008 (125)	£4	£0							

AFP - Annual Flood Probability  
RP - Return Period  
Annual Benefits = Damages (before) – Damages (after)

### *Treatment of Matrix for Areas of Uniform Risk*

Identify standards of protection before and after an option is implemented, then use the matrix to evaluate the intangible benefit per household (or residential property). This figure is then applied to the total number of householders that are in the areas of uniform risk to obtain an overall figure for annual intangible benefits for an option.

### *Treatment of Matrix for Areas of Greatly Varying Risk (e.g. sloping ground away from river)*

Identify households that lie within different *band areas* representing a particular existing standard of protection. For example properties up a slope having a 1:50 year return period of protection compared to properties having a 1:20 year return period, down a slope. Then, identify standards of protection that are offered to each *band area* after an option is implemented. For properties within each *band area*, the matrix is used to evaluate the intangible benefit per household (or residential property)

## **3.6 DISTRIBUTIONAL IMPACTS**

Although social grade was found to be a statistically significant variable in the research, it is not a dominant variable. Furthermore, the values in Table 2 already take account of distributional impacts (DI). Thus DI analysis should not be applied to the result arising from the appraisal of intangible impacts.

## **3.7 APPLICATION TO COASTAL EROSION APPRAISALS**

The research project did not attempt to study similar losses in connection with coastal erosion and there are methodological difficulties in attempting such an extension. For example, the available sample of properties at imminent risk at any one time is probably insufficient to produce a statistically valid sample. However it is reasonable to assume that there are intangible impacts on households threatened with imminent loss of their property to coastal erosion, albeit that these may be of a very different nature to that of the constant threat of flooding. As coastal erosion and flood management projects are considered in the same appraisal and prioritisation framework, schemes to combat erosion could be disadvantaged if these potential losses were not recognised.

The long-term equivalent of £200 per household per year capitalised over 50 years using current Treasury rates is some £5,000. It is therefore proposed that where coastal erosion schemes are designed to significantly postpone (by more than 25 years) imminent loss of property (i.e. the property concerned has more than 80% chance of loss in the next 5 years without the scheme), the damage reduction or benefit per property should be enhanced by this capital value.

## ANNEX A1

### DERIVATION OF TOTAL WEIGHTED FACTORS

The approach for establishing Total Weighted Factors, as described in Step 2 of Section 5 earlier, is shown as follows:

Using information from Treasury (2003), Table 1 shows the factors that represent the marginal utility<sup>1</sup> of five income bands, where the income bands represent those earning at the bottom (0-20%), 2<sup>nd</sup>(21-40%), 3<sup>rd</sup>(41-60%), 4<sup>th</sup>(61-80%) and top (81-100%) slices (or Quintiles) of all income earners.

Quintile	Range (Net)	Range (Gross)	Gross Mean Range Factor (GMRF)
Bottom (lowest Income)	1.9 – 2.0	2.2 – 2.3	2.25
2 <sup>nd</sup>	1.3 – 1.4	1.4 – 1.5	1.45
3 <sup>rd</sup>	0.9 – 1.0	1.0 – 1.1	1.05
4 <sup>th</sup>	0.7 – 0.8	0.7 – 0.8	0.75
Top (highest Income)	0.4 – 0.5	0.4 – 0.5	0.45

Table 1:  
Distributional  
Weighting  
Factors

The Gross Mean Range Factor (GMRF) is calculated as above. The Treasury approach can be extended by application of the weightings to the data<sup>5</sup> obtained on how income is distributed for the five income bands for each social class. Table 2 summarises this data.

Level of income	Social Class Proportion (SCP) / %			
	AB%	C1%	C2%	DE%
Quintile 1 (lowest income)	1.3	11.1	11.4	37.5
Quintile 2	12.3	27.5	33.3	43.6
Quintile 3	15	24.2	29.9	11.8
Quintile 4	18.5	17.6	17.6	3.4
Quintile 5 (Highest Income)	52.9	19.6	7.8	3.7

Table 2  
Distribution of  
Income Within  
Social Class  
Group.

The Weighted Factor (WF) for an income band is derived by multiplying the social class proportions (SCP) in Table 2, by the Gross Mean Range Factors (GMRF) that relates to the same income band, in Table 1. Thus:

$$WF_{ij} = GMRF_j \times SCP_i$$

where i represents the particular social class and j represents the particular income band. The Total Weighted Factor (TWF) for a whole social class group covering all income bands, is derived as follows:

$$TWF_i = \sum_0^j WF_{ij}$$

Total Weighted Factors (TWF) are therefore shown in Table 3

<sup>5</sup> Data source from British General Election Study, 2001; Cross-Section Survey; British Election Study Series (UKDA study number 4619) Sponsor: Economic and Social Research Council Distributed by UK Data Archive, University of Essex, Colchester, 18 March 2003; Archive at: <http://www.data-archive.ac.uk/home/index.asp>

Gross Mean Weighting Factor	Weighted Factors (WF) by Social Class Group			
	AB%	C1%	C2%	DE%
<b>Q1 = 2.25</b>	0.02925	0.24975	0.2565	0.84375
<b>Q2 = 1.45</b>	0.17835	0.39875	0.48285	0.6322
<b>Q3 = 1.05</b>	0.1575	0.2541	0.31395	0.1239
<b>Q4 = 0.75</b>	0.13875	0.132	0.132	0.0255
<b>Q5 = 0.45</b>	0.23805	0.0882	0.0351	0.01665
<b>Total Weighted Factor(TWF)</b>	<b>0.74</b>	<b>1.12</b>	<b>1.22</b>	<b>1.64</b>

Table 3:  
Weighted  
Factors By  
Social Class  
Group.

As an example, this has the effect of converging a set of depth-damage curves representing different social class groups residing in the same property.